EXECUTIVE SUMMARY

of

Block IV – Kalay Mineral Block

Area : 152.5073 Ha.

Santona Village, Sanguem Taluka, South Goa District, Goa

PROJECT PROPONENT

Fomento Resources Private Limited

1st Floor, 102, Kamat Metropolis I

Behind Caculo Mall, St. Inez

Panaji- Goa- 403001

November-2024

EIA Consultant

MINERAL ENGINEERING SERVICES

25/XXV, Club Road, Ballari-583103, Karnataka

email: mes_msraju@yahoo.co.uk

Tel: 08392-267421

1.0 INTRODUCTION

Block IV – Kalay Mineral Block, having an area of 152.5073 Ha is located at Santona Village, Sanguem Taluka, South Goa District, Goa.

The Government of Goa, through Directorate of Mines and Geology (DMG), issued Notice Inviting Tender (NIT) on 30/09/2022 in accordance with the Mineral (Auction) Rules, 2015. As per the said NIT, the auction process for Block IV – Kalay Mineral Block for Iron Ore mineral was conducted. Upon conclusion of the aforesaid auction, DMG, Govt. of Goa, declared Fomento Resources Private Limited as Preferred Bidder for Block IV – Kalay Mineral Block on 22/12/2022. Pursuant to the declaration as Preferred Bidder under Rule 9(9)(iii) of Auction Rules, 2015, DMG was pleased to issue the Letter of Intent (LOI) dated 13/01/2023 for grant of Mining Lease over an area of 179.1826 Ha. Further, vide letter dated 13/03/2023, DMG, Govt. of Goa revised the area of the Block from 179.1826 Ha to 152.5073 Ha., excluding the Eco Sensitive Zone (ESZ) with respect to Bhagwan Mahaveer Wildlife Sanctuary and National Park for the grant of Mining Lease for Block IV - Kalay Mineral Block for Iron Ore Mineral. The executed Mining Lease will be valid for a period of 50 years from the date of registration of Mining Lease Deed.

1.1 PROJECT DESCRIPTION

The proposed project is a fully mechanized opencast Mine extending over an area of 152.5073 Ha consisting of 131.3743 Ha. non-forest land and 21.1330 Ha. of Forest Land.

The project is of a stand-alone type and will involve extraction of Iron Ore. The proposed lease area is having about 16.731 million tonnes of mineral reserves & resources. The mined Iron Ore shall be utilized at the domestic and export markets.

The block area falls under Toposheet No. D43C3, Survey of India and the boundary pillars of the mining lease are given in the below table. The general elevation of ML area varies from 102 m to -0.5 m above MSL. Based on the exploration report provided in the Geological Report by the Directorate of Mines and Geology, Govt. of Goa, the total mineral reserves/resources of Iron Ore as of 01/02/2023 is 16.731 Million Tonnes. The proposed extraction capacity of Iron Ore is 0.75 MTPA.

Boundary co-ordinates of the Mining Lease as per DGPS plan

Mineral Block Boundary Pillar Nos.	Co-ordinates (Datum: WGS84)	
	Latitude (Northing)	Longitude (Easting)
BP-1	15° 17′ 58.2803″	74° 09′ 31.3905″
BP-2	15° 18′ 02.6197″	74° 09′ 29.8008″
BP-3	15° 18′ 08.7974″	74° 08′ 55.2583″
BP-4	15° 17′ 40.1839″	74° 09′ 03.3467″

Mineral Block Boundary Pillar Nos.	Co-ordinates (Datum: WGS84)	
	Latitude (Northing)	Longitude (Easting)
BP-5	15° 17′ 30.9847″	74° 09′ 08.5955″
BP-6	15° 17′ 01.6125″	74° 09′ 13.1548″
BP-7	15° 17′ 12.4794″	74° 09′ 41.2969″
BP-8	15° 17′ 13.0200″	74° 09′ 44.8333″
BP-9	15° 17′ 16.8213″	74° 09′ 43.9885″
BP-10	15° 17′ 19.1419″	74° 09′ 40.8072″
BP-11	15° 17′ 23.3295″	74° 09′ 36.4971″
BP-12	15° 17′ 26.7696″	74° 09′ 33.4331″
BP-13	15° 17′ 30.5546″	74° 09′ 31.2826″
BP-14	15° 17′ 36.0551″	74° 09′ 29.0348″
BP-15	15° 17′ 40.9091″	74° 09′ 28.2686″
BP-16	15° 17′ 44.5813″	74° 09′ 28.2599″
BP-17	15° 17′ 49.1710″	74° 09′ 29.2119″
BP-18	15° 17′ 54.4169″	74° 09′ 30.5870″

Project Details

Land Details & Survey Nos	Mineral Block area: 152.5073 Santona Village: 7/1,8/1,8/2,11/1,15/1,15/2,16/1,23/1,24/1,25/1,25/2,26/1,27/1, 28/3,28/4,28/5,28/6,29/1,38/1,38/3,39/1,40/1,40/2,40/3,40/4,40/5,40/6,40/7,40/8 , 40/9,40/10, 40/11,40/12,40/13,41/1,42/1,43/1, road & nallah.
Geographical Coordinates	Provided in Table above
Survey of India (SOI) Topo-sheet No.	D43C3
Topography of project site	Gradually Sloping from East to West
Reserves & Resources	16.731 million tonnes of Iron Ore
Production Capacity	0.75 Million Tonnes Per Annum (As per Approved Mining Plan)
Life of the Mine	24 Years The mining lease will be valid for 50 years as per MMDR (Amendment) Act, 2015, from the date of Registration of Mining Lease Deed.
Water requirement	300 KLD
Power requirement	1.64 MW/d
Average no. of working days	200 (Actual Mine Handling days excluding monsoon & holidays)
Number of shifts	2
Working hours	14 (Effective working hours)
Man Power Requirement	Direct employment : 127 persons Indirect employment : 200 persons
Environmental Protection Cost	Capital Cost : Rs. 74 Lakhs Recurring Cost : Rs. 45.45 Lakhs/Annum
Project Cost	₹ 3680 lakhs

ENVIRONMENTAL SENSITIVITY

Particulars	Details	Distance and direction
Land Details & Survey Nos.	Survey Nos. 7 (Part), 8 (Part), 11 (Part), 15 (Part), 16 (Part), 23 (Part), 24 (Part), 25 (Part), 26/l (Part), 27 (Part), 28 (Part), 29 (Part), 38 (Part), 38 (Part), 40, 41 (Part), 42, 43 (Part), Nallah and Road, Village Santona, Sanguem Taluka, South Goa District, Goa. Total Area - 152.5073 Ha	
Geographical Coordinates	Provided in Table above	
Survey of India (SOI) Topo-sheet No.	D43C3	
Topography of project site	Gradually Sloping from East to West	

Sanctuary/ National Park / Tiger Reserve/ Elephant / any other Reserve Forest	Bhagwan Mahaveer Wildlife Sanctuary & National Park	1.04 Km (E direction)
Biosphere Reserve	None	-
Habitat for Migratory Birds	Nanda Lake	7 km
Water Bodies	Seasonal Nalla Flows W-E across the Mineral Block. Kalay River runs along Eastern Boundary of the Mineral Block from S-N. Dudhsagar River Sanguem River Panduranga Nala Ugem River Zuari River Mahadayi River Udani River Guloli River Paroda River Nanda lake(Ramsar site) Xeldem lake	Seasonal Nalla – within lease Kalay River - 0.005 km (E direction) 4.0 km (North) 5.66 km (South) 6.55 km (West North West) 5.57 km (South) 3.79 km (South) 4.30 km (North) 8.80 km (North West) 7.20 km (South) 8.6 km (South West) 7.0 km (South West) 8.0 km (South West)
Defence Installation	None	-
Nearest airport	Dabolim Airport	35km (south west)
Nearest Railway Station	Kalay Railway Station Curchorem Railway Station Kulem Railway Station	2.4 km (South East) 5.2 km (South West) 9.9 km (East)
Nearest Highway	State Highway (SH7) State Highway (SH8) State Highway (SH6) National Highway (NH 748) (Old name NH 4A)	1.3 km (west) 4.7 km (South west) 4.8 km (south west) 7.0 km (North)
Seismic Zone	III	as per IS 1893 (Part-I): 2002
Nearest Habitat	Within the lease	Min Buffer of 50mts shall be provided and no drilling and blasting shall be carried out.
Archaeological monuments	--	--
Protected Monuments	Shigao Caves	5.3 km (North North East)
Places of worship	Place of worship -Ambeudak temple	0.3 km (W direction)
Public utilities	None	
Coastal Regulation Zone (CRZ)	Not Applicable	--
Distance from the HFL of the river in m	Kalay River	5 m from eastern Boundary. There is enough elevation difference.

1.2 GRANT OF TOR

ToR was granted by MoEF & CC vide TOR Identification No. TO23B0000GA5122365N dated 08/01/2024.

Condition no. 2.1 of ToR stipulates as under:

> *"……2.1 PP shall submit a certificate from Chief Conservator of Forests regarding involvement of Forest Land in the mining lease area if any. In case forest land is involved i) PP should submit the proof of application made for obtaining forest clearance and ii) a map clearly showing the forest & nonforest area."*

In compliance to the above condition no. 2.1, and subsequent to our communication, Office of the Principal Chief Conservator of Forest, Panaji, Goa, vide its letter No. 6-13-(177)-2024-25-FD/1088 dated 19/06/2024, informed that Block IV - Kalay Mineral Block includes Unclassed Forest area of 18.2210 Ha. and Prospective Private Forest area of 2.901 Ha. within the Mineral Block area of 152.5073 Ha.

In view of the involvement of the forest area within the Mineral Block, the Project Proponent filed an online application on PARIVESH Portal of MoEF&CC for amendment in ToR granted on 08/01/2024. The MoEFCC was pleased to amend the TOR dated 08/01/2024 by addition of following specific conditions as mentioned in the Amended TOR dated 19/11/2024. TOR dated 08/01/2024 and TOR amendment dated 19/11/2024 was used as guidelines to prepare the Environmental Impact Assessment and Environmental Management Plan.

BASELINE DATA MONITORING

Baseline study was carried out during Summer Season i.e. during March to May, 2023.

2.0 MINING METHODOLOGY

The proposal is for obtaining environment clearance is for 0.75 Million tonnes per year with overall overburden ratio of 1: 4. Mining operations will be carried out in accordance with the Approve Mining Plan. Mining operations will be by way of mechanized opencast method, without drilling & blasting, complying with all the statutory requirements using Heavy earth moving machineries like Rippers & Dozers, shovels, dumpers, wheel loaders and tippers. Rippers & Dozers will be used for ripping of hard material and wheel loaders are used for loading and dozers for levelling. Systematic method of mining is proposed by maintaining benches of 6m height and 8 m width in waste rock and ore body with a pit slope of less than 30 degrees from horizontal. The mined Iron Ore shall be utilized at the domestic and export markets. The ore transportation from mine to the jetty will be carried out by tippers with the capacity of 10.5 Tonnes.

2.1 PRODUCTION, RESERVES AND LIFE OF MINE

The total reserves/resources as on 01.02.2023 are 16.731 Million Tonnes, which is considered for defining the Life of the Mine. The life of the mine will be 24 years which may enhance based on the future results of exploration planned during the Mining Plan period. However, the lease is valid till 50 years.

2.2 MANPOWER, WATER & POWER REQUIREMENT

MAN POWER: The Project shall provide direct employment to about 127 people, which includes mine officials, skilled, semi-skilled and unskilled labour and about 200 indirect employment opportunities to the locals. Indirect employment generation in the form of contracts like transportation, plantation, workshops and garages, and allied activities will be generated.

***WATER*:** The Water Requirement of the Project is estimated to be maximum 300 KLD. Out of this, 8 KLD of the water is required for domestic, 10 KLD for green belt, 50KLD for wheel washing, 10 KLD for workshop and the balance 222 KLD for dust suppression. The entire water requirement except that of domestic consumption will be met through Rain water harvested within the mine pits. Efforts will be put for reduction of specific water consumption year on year.

Particulars	Quantity (KLD)	Source
Dust Suppression	222	From Rainwater harvested in the Mine Pit and from registered water vendors through tankers.
Green Belt & Plantation	10	
Wheel washing	50	
Workshop	10	
Domestic Use	8	Through registered water vendors
Total	**300**	

The project proponent has already applied for permission for the withdrawal of groundwater from the Water Resource Department, Goa

POWER REQUIREMENT: Power of 1.64 MW/day will be utilized, which will be sourced from Government Power Grid. A diesel generator having 82.5 KVA capacity will be utilized as a backup in case of power failure.

2.3 RESETTLEMENT & REHABILITATION

There is no proposal for Resettlement and rehabilitation during the entire life of the mine.

3.0 DESCRIPTION OF THE ENVIRONMENT

The Block-IV Kalay Mineral Block is the core zone for the present EIA study. The area encompassing 10 km radius from the boundary of the core zone has been defined as the buffer zone. The core zone and the buffer zone together constitute the study area.

The Baseline Environmental data with respect to Air, Water, Noise and Soil Quality in the study area for the present EIA study is collected for the Summer Season of 2023. Sampling and analysis have been carried out by M/s. Environmental Laboratory (Unit of Mineral Engineering Services), Bangalore, Laboratory accredited by NABL and recognized by CPCB/MoEF&CC.

The following Environmental components have been included in the baseline study for the preparation of EIA report.

• Site Specific Micrometeorological Data (hourly readings from the core zone) on wind speed & direction (wind roses), temperature, and humidity.
• Ambient Air Quality Sampling at 8 Stations on a 24-hourly basis, for 2 days a week for 13 weeks in the summer season for the parameters PM10, PM2.5, and Heavy Metals analysis in Particulates, SO2, NO2, CO, Ozone, Benzene and Benzo(a)pyrene.
• Noise Level Measurements at 8 locations for, Leq day and night, values once in the study period
• Water Quality Sampling by grab sampling once in the study period
1. Surface Waters -6 locations
2. Ground Waters -8 Locations
• Soil Quality Sampling at 7 locations once in the study period for
Textural & Physical Parameters Nutrients (like NPK, etc.) & Micronutrients
• Land Use & Land Cover pattern using LISS IV Mx Data from NRSC
• Biotic Components
• Flora & Fauna –Core & Buffer Zones
• Socio-Economic Profile, based on 2011-Census and Survey 2023:

3.1 TOPOGRAPHY

The topography of the Study area is undulating & hilly with gentle gradient of 10 to 20 degrees towards east. Highest elevation in the study area is 640 m MSL in South East direction. In the core zone the highest level is 102 m MSL towards North East of lease on Dump no. 1 and lowest level is -0.5 m MSL towards North of lease in pit no.3. There is a seasonal nalla flowing across the block from west to east and joins Kalay River flowing towards the eastern side of the block boundary.

3.2 AMBIENT AIR QUALITY

For Ambient air quality, 8 stations have been fixed covering all the directions, the frequency of monitoring is 2 days/ week for 3 months and the parameters covered were as per CPCB NAAQS guidelines.

The statistical analysis of Ambient Air Quality is as follows, the maximum values of SO_2, NO_2, PM_{10} & $PM_{2.5}$ in the core zone station were found to be 15, 16, 55 & 33 $\mu g/m^3$ and in the Buffer zone villages, the maximum values were found to be 15, 18, 57 & 42 $\mu g/m^3$.

All other parameters like CO, O_3, NH_3, Pb, As, Ni, Benzene (C_6H_6) & Benzo(a)Pyrene (BaP), are also sampled and results of the analysis were found to be within the limits of NAAQ's.

3.3 NOISE LEVELS

For noise quality 8 stations including one station in core zone and 7 in buffer zone villages were monitored and Leq during day & night are observed.

The Leq value during day in the core zone is observed as 44.9 dB(A) and in night 38.7 dB(A) and in buffer area it is observed as in day 50.2 dB(A) and in night 35.0 dB(A) monitoring results when compared to Noise Quality Standards are well within limits. The noise levels both in the core zone and buffer zone were found to be within the limits of Noise Quality Standards for Industrial, Commercial and Residential areas.

3.4 WATER QUALITY

Surface water quality monitoring was done by grab sampling once in a season at 5 stations in buffer zone and 1 pit water and 8 ground water samples were collected. IS: 3025, APHA, & IS:1622 standards were used for analysis. The analysis results are compared to IS standards IS:2296, IS:422E & IS:10500:2012.

The results of one location i.e., Zuari river surface water samples show high TDS and Chlorides. This is mainly because of the influence of creek water. The open well samples were found to have pH slightly acidic in nature. This is due to the occurrence of lateritic ore. Whereas other parameters are within permissible limits of respective standards.

3.5 SOIL QUALITY

Soil Quality Monitoring at 6 locations including one from the Mine Block and others from nearby village agricultural fields are collected and analyzed, during the study

period for Physical Parameters and chemical parameters. They are all observed to be within normal soil quality and fit for cultivation.

3.6 LAND ENVIRONMENT

The existing major land use of study area covering 10 km radius are 1.54% of water bodies, 36.34% reserve forests, 11.98 % dense forest, 3.16% of agriculture land, 17.29% of barren/grass land , 20.74% of Vegetation and 4.44% of Settlement area.

During conceptual phase, after the ore is exhausted in the pits, the broken-up land will be backfilled and will be planted and rehabilitated with local species like Cashew, mango, Jamun, Cocum, Terminalia, etc. All the efforts will be taken for maximum survival and growth of the plants. A part of the broken-up area will be developed into water reservoir.

3.7 BIOLOGICAL ENVIRONMENT

The Mineral Block is located at a distance of around 1.04km from the Bhagwan Mahaveer Wildlife Sanctuary from its boundary. The mine management could work in association with the Forest Department for the conservation of wildlife in the buffer zone and also improve the riparian vegetation. The Project Proponent has formulated an Ecological Restoration Plan to rehabilitate the core zone at the end of conceptual period.

FLORA

Seasonal observations have shown a total of 45 species recorded within the core area, including 21 tree species, 11 shrub species, and 13 herb species.

FAUNA

A total of 16 species were observed within the core area, of which 9 species were birds, 3 species of mammals and 4 species of reptiles.

FLORA & FAUNA IN BUFFER AREA

FLORA

Total 198 flora species were reported in buffer zone, of which 89 species of trees, 42 species of shrubs, and 28 species of herbs were recorded in reserve forest and riparian habitats. In addition, 39 flora species were reported by the Biodiversity Board, Goa.

FAUNA

Overall, 262 species were recorded from both primary observation and secondary publications and reports, in the case of fauna there are 22 species of Mammals, 24 species of reptiles, 17 species of Toads & Amphibians, 154 species of Birds, 27 species of butterflies and 18 species of aquatic species were reported from the region.

Total of 48 species of fauna in the study area of 10kms radius falls within the category of the Wildlife Protection Act 1972 under Schedule I

S. No.	Local Name	Scientific name	Family	WPA-Schedule
	Mammal			
1	Common grey mongoose	*Urva edwardsii*	Herpestidae	LC/I
2	Indian porcupine	*Hystrix indica*	Hystricidae	LC/I
3	Malabar gain squirrel	*Ratufa indica*	Sciuridae	VU/I
4	Common leopard*	*Panthera pardus*	Felidae	VU/I
5	Leopard cat*	*Pronailurus bengalensis*	Felidae	LC/I
6	Wronghto's Gaint Mastiff Bat	*Otomops wroughtoni*	Molossidae	LC/I
7	Slender Loris	*Loris lydekkerianus*	Lorisidae	NT/I
8	Tiger	*Panthera tigris*	Felidae	EN/I
9	Mouse Deer	*Moschiola indica*	Tragulidae	LC/I
10	Four Horned Antelope	*Tetracerus quadricornis*	Bovidae	VU/I
11	Gaur or Indian Bison	*Bos gaurus*	Bovidae	VU/I
12	Indian Pangolin*	*Manis crassicaudata*	Manidae	EN/I
13	Sloth bear*	*Melursus ursinus*	Ursidae	VU/I
14	Small Indian civet*	*Viverricula indica*	Viverridae	LC/I
15	Bonnet macaque	*Macaca radiata*	Cercopithecidae	LC/I
16	Wild dog	*Cuon alpines*	Canidae	EN/I
	Birds			
17	White-bellied Sea-Eagle	*Haliaeetus leucogaster*	Accipitridae	LC/I
18	Indian Peafowl	*Pavo cristatus*	Phasianidae	LC/I
19	Shikra	*Accipiter badius*	Accipitridae	LC/I
20	Osprey	*Pandion haliaetus*	Pandionidae	LC/I
21	Chestnut Bittern*	*Ixobrychus cinnamomeus*	Ardeidae	LC/I
22	Cotton Teal	*Nettapus coromandelianus*	Anatidae	LC/I
23	Brahminy Kite	*Haliastur indus*	Accipitridae	LC/I
24	Long-billed Vulture	*Gyps indicus*	Accipitridae	CR/I
25	Crested Serpent Eagle*	*Spilornis cheela*	Accipitridae	LC/I
26	Eurasian Marsh Harrier	*Circus aeruginosus*	Accipitridae	LC/I
27	Crested Goshawk	*Accipiter trivirgatus*	Accipitridae	LC/I
28	Besra Sparrowhawk	*Accipiter virgatus*	Accipitridae	LC/I
29	Black Eagle*	*Ictinaetus malayensis*	Accipitridae	LC/I
30	Crested Tree-swift	*Hemiprocne coronate*	Hemiprocnidae	LC/I
31	Brown Wood Owl	*Strix leptogrammica*	Strigidae	LC/I
32	Common Hill-Myna	*Gracula religiosa*	Sturnidae	LC/I
33	Grey Junglefowl	*Gallus sonneratii*	Phasianidae	LC/I
34	Nilgiri Wood Pigeon	*Columba elphinstonii*	Columbidae	VU/I

35	Small Minivet *	*Pericrocotus cinnamomeus*	Campephagidae	LC/I
36	Forest Eagle-Owl	*Bubo nipalensis*	Strigidae	LC/I
	Reptiles			
37	Indian Rock Python*	*Python molurus molurus*	Pythonidae	NT/I
38	Marsh Crocodile	*Crocodylus palustris*	Crocodylidae	VU/I
39	Indian Falpshell Turtle	*Lissemys punctata*	Trionychidae	VU/I
40	Common Indian Monitor Lizard	*Varanus bengalensis*	Varanidae	NT/I
41	Russell's Viper	*Daboia russelii*	Viperidae	LC/I
42	Cobra	*Naja naja*	Elapidae	LC/I
43	King cobra*	*Ophiophagus hannah*	Elapidae	VU/I
44	Green Forest lizard	*Calotes calotes*	*Agamidae*	LC/I
45	Checkered Keelback	*Fowlea piscator*	*Colubridae*	LC/I
46	Common Kukri Snake*	*Oligodon arnensis*	Colubridae	LC/I
47	Whitaker's Boa*	*Eryx whitakeri*	Boidae	NT/I
48	Common Indian monitor lizard	*Varanus bengalensis*	*Varanidae*	NT/I

The conservation of flora and fauna shall be proposed as suggested in EMP, greenbelt shall be developed all along the boundary, unused areas, inactive dump slopes and along haul road wherever feasible. The proposed Wildlife Conservation Plan will be implemented through the State Forest Department.

The dominant species in the reserved forest were *Anacardium occidentale*, and *Acacia auriculiformis*, which have been promoted significantly on both private and degraded government land. Mango and Coconut orchards are significantly promoted to farmers on agricultural bunds and house backyards. There are no endangered or endemic species of flora or fauna in the core zone.

3.8 SOCIO-ECONOMIC ENVIRONMENT

The mining project will create direct and indirect employment opportunities in the surrounding villages. Apart from direct employment in the mines, indirect employment/business socio-economics will be generated like canteen, and engaging local tippers for transportation of Iron ore.

Due to the Project, employment will be generated in the form of contracts like transportation, plantation, workshops and garages, and allied activities.

The mining activities help in the sustainable development of this area including further development of physical & social infrastructural facilities.

The mining activity provides revenue to the state and center in the form of taxes, royalty etc. The project proponent shall assess the health conditions of the workers as per the DGMS guidelines. Noise, air, and water quality will be maintained well within the permissible limits.

4.0 ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

The Block IV – Kalay Mineral Block is yet to start mining and shall operate taking all precautionary measures to reduce the impact of mining operations on Air, Water, Noise and Soil and ensuring all control measures to comply with the prescribed standards.

4.1 AIR ENVIRONMENT

The impacts on the Air environment are assessed through Aermod Modelling and results show that the cumulative impacts on the surrounding buffer zone villages after the commencement of mining operations will be within the permissible limits.

The following measures will be undertaken to control Air pollution/dust generation during mining activities: -

- Regular water sprinkling on haul roads & loading points will be carried out.
- Development of green belt/plantation around the lease boundary, roads, dumps etc.
- Maintaining the mine haul roads in good condition and implementing a speed limit will ensure the prevention of dust pollution
- Heavy Earth Moving Machinery will have air-conditioned cabins, thus providing a pollution-free atmosphere to the operators.
- Use of Personal Protection Equipment's (PPE) like dust masks, ear plugs etc. by the mine workers.

Ambient Air Quality Monitoring will be conducted on a regular basis to assess the quality of ambient air.

4.2 WATER ENVIRONMENT

The rain water diverted and harvested into mine pits will be utilized for various activities like dust suppression, vehicle washing, gardening etc. Though the ground water shall be encountered in the pit, there shall be no adverse impact due to pit dewatering.

Protective measures such as use of geotextiles to cover dump slopes, garland drainages, trenches, settling tanks, laterite boulder walls application of coco logs will be undertaken to control the water pollution. Thus, there shall be no adverse impacts on surface water. In fact, the local villagers will benefit from the discharge of clean rainwater harvested inside the pit, which will be gainfully utilized for irrigation. The discharge water will

help recharge river water in the downstream and thereby maintaining a flow in the river system.

The impact of Mining operations on Hydrogeology: - hello

Detailed hydrogeological study was conducted within 10km radius from the boundary of Mineral Block considering 15 open dug wells spearing in all directions around the Mineral Block, tapping mostly shallow aquifers to delineate the ground water regime in the study area during summer season 2023. The significant findings of the report are given below:

i. Stage of Ground Water development in Sanguem Taluka is 16.97% and categorised as SAFE in ground water development and management point of view.
ii. Water quality in general is safe and potable in all the sites and is within the maximum permissible limits of the Bureau of Indian Standards (BIS).
iii. Depth to water level varied from less than 2 m bgl to more than 14 m bgl.
iv. The water requirement for the mine is 300 m3/day.
v. Annual average rainfall received in the area is about 4000 mm. Rainwater from the project area will be channelized into the mining pits and settling ponds.
vi. The main iron ore deposit is called as Codli-Kirlapal-Costi deposit. The general succession of the strata observed in the mineral block from top to bottom is Laterite (about 15 – 20 m), Altered Dyke (Intrusive), Ferruginous/Phyllitic/ Limonitic Clay (10 – 15 m), Iron Ore body (20 - 30 m) and Siliceous Manganiferous Clay & Weathered BHQ (forms foot wall).
vii. Laterites are the most important water bearing formation covering over 60 percent of the area. Metavolcanics formation spreads in parts of Sanguem, Quepem and Cancona talukas of South Goa district. The water bearing properties of metabasalt and metagreywacks and the associated rocks of pre Cambrian age are also dependent on fracturing, jointing and foliation present in the rocks.
viii. Two types of aquifer system are observed i.e., Aquifer-I which is shallow phreatic aquifer and Aquifer-II which constitutes the deep fractured aquifer. Aquifer-I comprises of Laterite, Alluvium, weathered meta volcanic and weathered meta sedimentaries, generally occurs in depth ranges of 9-42 m bgl. Aquifer-II comprises of fractured meta-sedimentaries, Granite gneiss and schistose rock. Depth of occurrence of aquifer ranges from 25 to 180 m bgl.

ix. The higher fractured aquifer thickness of 9 to 16 m is observed isolated patches in the central western parts near Sacordem, Kalay.

x. Fractured aquifer thickness indicates that it ranges from 0.10 to 16 m, however aquifer thickness of 2-5 m is observed in many parts of the state.

xi. The discharge of the dug well tested in the lease area is 14.38 m3/ hr. Transmissivity estimated as 16.84 m2/ day for draw down of 20.43 m.

xii. Block IV –Kalay Mineral Block is situated on a Plain region at an elevation of about 18 - 94 m amsl and does not have any surface water bodies. It was observed from the studies carried out on the open wells, that water levels in Phreatic aquifer is mostly shallow where the ground water abstraction structures are located at an elevation of 18 m to 94 amsl. The aquifer at deeper mining level is less potential and made of clayey intercalations and mostly aquicludes. The piezometric surface of deeper semiconfined aquifer shows steady state to rising trend and not showing falling trend. Mining activity will not have any negative impact on ground water regime.

4.3 NOISE ENVIRONMENT

Maximum noise is produced from the operation of earth-moving machinery & movement of dumpers. No drilling and blasting operations are involved. A 7.5 m wide green belt shall be provided surrounding ML to attenuate noise pollution. Regular maintenance of mining equipment, machinery & all vehicles as per the manufactures recommendations to minimize the Noise generation shall be followed.

Following management measures will be adopted to control noise levels:

- The ambient noise levels will be ensured to less than 75 dB(A) during daytime & less than 70 dB(A) during night time by taking all required measures.
- No Drilling and Blasting is involved.
- All the HEMM are provided with air-conditioned, noise-proof cabins
- Providing protective devices like acoustic wool, earplugs and earmuffs to the workmen in noise-prone zones in the mine
- Green belt along the lease boundary and along the haulage roads.

4.4 IMPACT ON LAND ENVIRONMENT

At conceptual period of the mine, total greenbelt/plantation of over an area of 89.97 Ha. will be developed by planting 1500 saplings/ Ha., which will be beneficial to the environment & will also create an aesthetic appeal. Local Species shall be planted with a mixture of fruit bearing trees like Cashew, jackfruit and forestry species.

An area of 44.14 ha will be maintained as a water reservoir. This water will serve to augment the groundwater table of the region. Pit discharge water also be utilized by the local villagers for agricultural purposes.

4.5 IMPACT ON BIOLOGICAL ENVIRONMENT

At the conceptual stage, an area of 89.97 Ha will be rehabilitated by planting 1,34,955 saplings of native fruit-bearing trees like Cashew, Bamboo, Arjuna, Alva, etc. and an area of 44.14 Ha will be converted to water reservoir, which will be beneficial to the society and avifauna. The entire block area at the end of mine life will be restored in such a way that it complements the surrounding areas and nature at large.

4.6 IMPACT ON SOCIO-ECONOMIC ENVIRONMENT

The mining project will create direct and indirect employment opportunities in the surrounding villages. Apart from direct employment in the mines, indirect employment/business opportunities will be generated like canteen, and engaging local tippers for transportation of Iron ore.

Employment will also be generated in the form of contracts like transportation, plantation, workshops and garages, and allied activities.

The mining activities help in the sustainable development of this area including further development of physical & social infrastructural facilities. The mining activity provides revenue to the state and center in the form of taxes, royalties, etc.

The project proponent shall assess the health conditions of the workers as per the DGMS guidelines. Noise, air, and water quality will be maintained well within the permissible limits.

5.0 ADDITIONAL STUDIES

In additional studies, Risk Analysis is followed by a Disaster Management Plan, which will help in identifying the possible risks and promote preparedness to counter any mishap. Risk analysis and disaster management plan have been prepared and incorporated into the EIA Report.

6.0 ENVIRONMENT MANAGEMENT PLAN

A Comprehensive Environment Management Plan including development of Green Belt has been suggested. Identification of all potential environmental impacts of a project is an

essential step of Environmental impact Assessment. These are critically examined, and major impacts are further studied. In the case of mining projects, change in topography and land use, air pollution, water pollution, waste management, biodiversity and socio-infrastructure issues are significant.

The Mine will be operated taking all precautionary measures to reduce the impact of mining operations on Air, Water, Noise and Soil and ensuring all control measures to comply with the prescribed standards. The impact of change of land use will be positive only, as portion of abandoned pit is partly backfilled and afforested and balance portion is left as water reservoir beneficial to local villagers. Development of green belt along the boundary of ML area will ensure a better environment. The budgetary cost towards EMP proposed is Rs 45.45 Lakhs per annum.

6.1 CORPORATE SOCIAL RESPONSIBILITY

A Comprehensive Environment Management Plan including the development of the Green Belt has been suggested. Identification of all potential environmental impacts of a project is an essential step of Environmental Impact Assessment. These are critically examined, and major impacts are further studied. In the case of mining projects, changes in topography and land use, air pollution, water pollution, waste management, biodiversity and socio-infrastructure issues are significant.

The Mine will be operated taking all precautionary measures to reduce the impact of mining operations on Air, Water, Noise and Soil and ensuring all control measures comply with the prescribed standards. The impact of the change in land use will be positive only, as a portion of the abandoned pit is partly backfilled and afforested and the balance portion is left as a water reservoir beneficial to local villagers. The development of a green belt along the boundary of the ML area will ensure a better environment. The budgetary cost towards EMP proposed is Rs. 45.45 Lakhs per annum.

7.0 ENVIRONMENTAL MONITORING PROGRAM

Environmental monitoring is required to know the Quality of Ambient Air, Water and Noise Levels during the operation phase of the proposed project and take required corrective measures, in case of any non-compliance with respect to the norms stipulated by regulatory authorities. The methodologies adopted for environmental monitoring will be in accordance with the CPCB, SPCB and Indian Bureau of Mines requirements.

8.0 EXPLANATION OF HOW ADVERSE EFFECTS ARE MITIGATED

The EIA/EMP Report has established the Base Line Environment of the Project Area and has assessed the anticipated impacts of the Project on the overall ecology & environment. Accordingly, general as well as specific mitigation measures for management of the Key Environmental Parameters have been suggested.

Further, specific measures towards monitoring and implementation of the Environment Management Plan along with details of the funds required towards implementation of the Pollution Control Measures are also included in the Report. By implementing the suggested Environment Management Plan adverse effects of the Project can be mitigated.

9.0 CONCLUSION

Block IV Kalay Mineral Block is a newly auctioned Mineral Block. The Impacts predicted for various Environmental Attributes are on the positive scale. The EMP proposed will have a positive impact on the surrounding environment and the landscape of the area. The local population will benefit from this project by way of employment and CSR activities carried out by the company.

कार्यकारी सारांश

ब्लॉक IV - कालय खनिज ब्लॉक

क्षेत्रफळ : 152.5073 हे.

सांतोना गांव, सांगे तालुका, दक्षिण गोंय जिल्हो, गोंय

प्रकल्प प्रस्तावक

फोमेंतो रिसोर्सेस प्रायव्हेट लिमिटेड

पयलो माळो, 102, कामत मेट्रोपोलिस ।,

काकुलो मॉल फाटल्यान, सांत इनेज

पणजी- गोंय- 403001

नोव्हेंबर - 2024

ईआयए सल्लागार

मिनरल इंजिनीरिंग सर्विसेस

25/XXV, क्लब रोड, बल्लारी-583103, कर्नाटक

ईमेल: mes_msraju@yahoo.co.uk

दूरध्वनी: 08392-267421

1.0 वळख

ब्लॉक IV - कालय खनीज ब्लॉक, जाचो क्षेत्रफळ 152.5073 हेक्टर आसा. गोंयच्या दक्षिण गोंय जिल्ह्यांतल्या सांगे तालुक्याच्या संतोना गांवांत आसा.

गोंय सरकारान खण आनी भूंयशास्त्र संचालनालयाच्या माध्यमांतल्यान 30/09/2022 दिसा वेळावेळार दुरुस्ती केल्ल्या खनिज (लिलाव) नेम, 2015 प्रमाण निविदा आमंत्रण दिवपी नोटीस (एनआयटी) जारी केली (" लिलावाचे नेम"). उल्लेख केल्ल्या एनआयटी प्रमाण लोखण धातुक खनिजा खातीर ब्लॉक IV - कालय खनीज ब्लॉक लिलाव प्रक्रिया केल्ली. वयर सांगिल्लो लिलाव सोंपतकच डी.एम.जी., गोंय सरकारान, फोमेन्टो रिसोर्सीस प्रायव्हेट लिमिटेड कंपनीक 22/12/2022 दिसा ब्लॉक IV - कालय खनीज ब्लॉक प्राधान्य बोलीदार म्हूण जाहीर केलो. लिलाव नेमाच्या नियम 9 (9) (iii) खाला प्राधान्य बोलीदार म्हूण जाहीर केल्ल्या प्रमाण डीएमजीन 179.1826 हॅक्टर क्षेत्रफळार खण भाडें दिवपा खातीर 13/01/2023 दिसाचें हेतू पत्र (एलओआय) जारी करपाक खोशी जाली. फुडें, vide पत्र दिनांक 13/03/2023, डी.एम.जी., गोंय सरकारान भगवान महावीर वन्यजीव अभयारण्य आनी राष्ट्रीय उद्यानाच्या संदर्भांत पर्यावरण संवेदनशील वाठार (ईएसझेड) सोडून ब्लॉकाचो क्षेत्रफळ 179.1826 हॅक्टरांतल्यान 152.5073 हॅक्टर केलो. खण भाडेपट्टी कार्यान्वीत खण भाडें पत्राची नोंदणी केल्ल्या तारखे सावन 50 वर्सां खातीर वैध आसतली.

1.1 प्रकल्पाचें वर्णन

प्रस्तावीत प्रकल्प हो पुरायपणान यंत्रीक उक्ती खण आसा आनी ताचो विस्तार 152.5073 हेक्टर क्षेत्रांत आसून तातूंत 131.3743 हेक्टर रान नाशिल्ली जमीन आनी 21.1330 हेक्टर रान जमनीचो आसपाव आसा.

हो प्रकल्प स्टँड-अलोन प्रकाराचो आसून तातूंत लोखण धातुक काडपाचो आसपाव आसतलो. प्रस्तावीत भाडें वाठारांत सुमार 16.731 दशलक्ष टन खनिज सांठे & संसाधनां आसात. खणून काडिल्ल्या लोखण धातुकाचो वापर देशी आनी निर्यात बाजारांत जातलो.

हें क्षेत्र भारताच्या टोपोशीट क्रमांक D43C3 सर्वेक्षणा खाला येता. खनीज ब्लॉक क्षेत्राची सादारण उंचाय 102 मी. एम.एस.एल. मी. सावन एम.एस.एला. परस -0.5 मी. मेरेन आसा. खण आनी भूंयशास्त्र संचालनालयान, गोंय सरकार, दिल्ल्या भूवैज्ञानिक अहवालांत दिल्ल्या संशोधन अहवालाचेर आदारीत, लोखण धातुकाचो वट्ट खनिज सांठो/संपत्ती ०१/०२/२०२३ 01.02.2023 मेरेन 16.731 दशलक्ष टन आसा. लोखण धातुकाची प्रस्तावीत काडपाची क्षमता ०.७५ एमटीपीए आसा.

डीजीपीएस येवजणे प्रमाण खण भाडेपट्टीचे शिमेचे समन्वय

खनिज ब्लॉक शिमेचो खांब क्र.	कॉ-ऑर्डिनेट्स (Datum: WGS84)	
	अक्षांश (उत्तर)	रेखांश (उदेंत)
BP-1	15° 17′ 58.2803″	74° 09′ 31.3905″
BP-2	15° 18′ 02.6197″	74° 09′ 29.8008″
BP-3	15° 18′ 08.7974″	74° 08′ 55.2583″
BP-4	15° 17′ 40.1839″	74° 09′ 03.3467″
BP-5	15° 17′ 30.9847″	74° 09′ 08.5955″

ब्लॉक IV - कालय खनिज ब्लॉकाचो कार्यकारी सारांश

खनिज ब्लॉक शिमेचो खांब क्र.	कॉ-ऑर्डिनेट्स (Datum: WGS84)	
	अक्षांश (उत्तर)	रेखांश (उदेंत)
BP-6	15° 17′ 01.6125″	74° 09′ 13.1548″
BP-7	15° 17′ 12.4794″	74° 09′ 41.2969″
BP-8	15° 17′ 13.0200″	74° 09′ 44.8333″
BP-9	15° 17′ 16.8213″	74° 09′ 43.9885″
BP-10	15° 17′ 19.1419″	74° 09′ 40.8072″
BP-11	15° 17′ 23.3295″	74° 09′ 36.4971″
BP-12	15° 17′ 26.7696″	74° 09′ 33.4331″
BP-13	15° 17′ 30.5546″	74° 09′ 31.2826″
BP-14	15° 17′ 36.0551″	74° 09′ 29.0348″
BP-15	15° 17′ 40.9091″	74° 09′ 28.2686″
BP-16	15° 17′ 44.5813″	74° 09′ 28.2599″
BP-17	15° 17′ 49.1710″	74° 09′ 29.2119″
BP-18	15° 17′ 54.4169″	74° 09′ 30.5870″

प्रकल्पाचो तपशील

विवरण	तपशील
भूंय तपशील आनी सर्वेक्षण क्रमांक	खनीज ब्लॉज क्षेत्र: 152.5073 Ha सांतोना गांव: सर्वेक्षण क्रमांक 7/1,8/1,8/2,11/1,15/1, 15/2,16/1,23/1,24/1,25/1,25/2,26/1,27/1,28/3,28/4, 28/5,28/6,29/1,38/1,38/3,39/1,40/1,40/2,40/3,40/4, 40/5,40/6,40/7,40/8,40/9,40/10,40/11,40/12,40/13, 41/1,42/1,43/1, रस्तो आनी नाला
भारतीय सर्वेक्षण (एसओआय) टोपो-शीट क्र.	D43C3
प्रकल्प सुवातीची स्थलाकृती	ल्हव ल्हव पूर्व-पश्चिम वटेन देंवपी
सांठवणी आनी संसाधनां	16.731 मिलियन टन लोह खनिजाची
उत्पादन क्षमता	लोह खनिजाचे 0.75 एमटीपीए (मान्य खण आराखड्या प्रमाणें)
खणीचो जिवनकाळ	24 वर्सां एमएमडीआर (दुरुस्ती) अधिनेम, 2015 प्रमाणें, निश्पादीत खण लीज डीडाचे नोंदणीकरण तारखे सावन खण लीज 50 वर्सां खातीर वैध आसतली.
उदकाची आवश्यकताय	300 केएलडी
वीज आवश्यकताय	1.64 MW/d
कामाच्या दिसांचो सरासरी आंकडो	200
शिफ्टांचो आंकडो	2
कामाचीं वरां	14 (प्रभावी कामाचीं वरां)
मनीसबळ आवश्यकताय	प्रत्यक्ष रोजगार : 127 लोक अप्रत्यक्ष रोजगार : 200 लोक
पर्यावरणीय वेवस्थापन खर्च	भांडवली खर्च : रु. 74लाख आवर्ती खर्च : रु. 45.45 लाख/ वर्सा
प्रकल्प खर्च	₹ 3680 लाख

पर्यावरणाची संवेदनशीलताय

विवरण	तपशील	अंतर आनी दिशा
भूंय तपशील आनी सर्वेक्षण क्रमांक	खनीज ब्लॉज क्षेत्र: 152.5073 Ha सांतोना गांव: 7/1,8/1,8/2,11/1,15/1,15/2,16/1,23/1,24/1,25/1,25/2,26/1,27/1,28/3, 28/4,28/5,28/6,29/1,38/1,38/3,39/1,40/1,40/2,40/3,40/4,40/5,40/6,40/7,40/8,40/9, 40/10, 40/11,40/12,40/13, 41/1,42/1, 43/1, रस्तो आनी नाला .	
भौगोलिक निर्देशांक	वयर दिल्ल्या कोश्टकांत दिल्लें आसात	
भारतीय सर्वेक्षण (एसओआय) टोपो-शीट क्र.	D43C3	
प्रकल्प सुवातीची स्थलाकृती	ल्हव ल्हव पूर्व-पश्चिम वटेन देंवपी	
अभयारण्य/ राष्ट्रीय उद्यान/ वाग राखीव/ हत्ती / हेर खंयचेंय राखीव रान	भगवान महावीर वन्यजीव अभयारण्य आनी राष्ट्रीय उद्यान	1.04 कि.मी.
जैवमंडळ राखीव	ना	-
स्थलांतरीत सवण्यांचें स्थान	नंदा तळें	7 कि.मी.
जलसांठो	हंगामी नाला खनिज ब्लॉकांतल्यान डब्ल्यू-ई व्हांवता अस्तंत ते उदेंतेक व्हांवता. कालय न्हंय खनिज ब्लॉकाचे उदेंत शिमेवयल्यान दक्षिणेकडल्यान उत्तरेक व्हांवता. दुधसागर न्हंय सांगे न्हंय पांडुरंगा नाला उगेम न्हंय जुआरी न्हंय महादय न्हंय उदानी न्हंय गुलोली न्हंय पारोडा न्हंय नंदा तळें(रामसर स्थळ) झेल्डेम तळें	हंगामी नाला - खनिज ब्लॉकाभितर. कालय न्हंय - ०.००५ किमी (उदेंत दिका) ४.० किमी (उत्तर) ५.६६ किमी (दक्षिण) ६.५५ किमी (अस्तंत वायव्य) ५.५७ किमी (दक्षिण) ३.७९ किमी (दक्षिण) ४.३० किमी (उत्तर) ८.८० किमी (वायव्य) ७.२० किमी (दक्षिण) ८.६ किमी (दक्षिण अस्तंत) ७.० किमी (दक्षिण अस्तंत) ८.० किमी (दक्षिण अस्तंत)
रक्षा स्थापणूक	ना	-
लागींचें विमानतळ	दाबोली विमानतळ	35 कि.मी. (दक्षिण अस्तंत)
लागींचें रेल्वे स्थानक	कालय रेल्वे स्थानक कुडचडे रेल्वे स्थानक कुळे रेल्वे स्थानक	२.४ किमी (दक्षिण उदेंत) ५.२ किमी (दक्षिण अस्तंत) ९.९ किमी (उदेंत)
लागींचो म्हामार्ग	राज्य म्हामार्ग (एसएच-7) राज्य म्हामार्ग (SH8) राज्य म्हामार्ग (SH6) राष्ट्रीय महामार्ग (एनएच 748) (पोरनें नांव एनएच 4 ए)	१.३ किमी (अस्तंत) ४.७ किमी (दक्षिण अस्तंत) ४.८ किमी (दक्षिण अस्तंत) ७.० किमी (उत्तर)
भूंयकांप संबंदीत झेत्र	III	आयएस 1893 (भाग-I): 2002 प्रमाण
लागींचें प्राकृतीक वास	खनीज लिजा भितर	50mts इतलो किमान बफर दिवचो आनी ड्रिल्लिंग आनी स्फोट करचो न्हय.
पुरातत्व स्मारकां	--	--
संरक्षीत स्मारकां	शिगाव लेणीं	५.३ किमी (उत्तर ईशान्य)

धार्मिक सुवातो	धर्मीक सुवातो – आंबेउदक देवूळ	0.३ किमी (अस्तंत दिका)
भौशीक सुविधा	ना	-
दर्यादेग नियमन क्षेत्र (सीआरझेड)	लागू जायना	-
न्हंयेच्या एचएफएल सावन अंतर	कालय न्हंय	उदेंत शिमेसावन ५ मी. उंचायेचो फरक फावो तो आसता.

1.2 टी.ओ.आर. आनी

MoEF&CC न प्रकल्पा खातीर संदर्भ अटी 08/01/2024 दिसा टीओआर वळख क्रमांक TO23B0000GA5122365N च्या पत्रा वरवीं जारी केल्यो.

ToR अट क्र. 2.1 च्या प्रमाण सकयल दिल्ल्या प्रमाणें थारायलां:

> *"2.1 पीपी खण भाडें वाठारांत रान जमनीचो आस्पाव आसल्यार रानांच्या मुखेल संरक्षका कडल्यान प्रमाणपत्र सादर करतले. रान जमनीचो आसपाव आसल्यार i) पीपीन रान निवळावण मेळोवपा खातीर केल्ल्या अर्जाचे पुरावे सादर करचे आनी ii) रान & बिगर रान वाठार स्पश्टपणान दाखोवपी नकासो सादर करचो."*

वयली अट क्र. 2.1 प्रमाण, आणि आमच्या संपर्काच्या उपरांत, रान मुखेल संरक्षक कार्यालय, पणजी, गोंय, vide आपलें पत्र क्रमांक 6-13-(177)-2024-25-FD/1088 दिनांक 19/06/2024, म्हायती दिली की ब्लॉक IV - कालय खनिज ब्लॉकांत 18.2210 हॅक्टर अवर्गीकृत रान क्षेत्राचो आनी संभाव्य खाजगी रान क्षेत्र 2.901 हॅक्टर, 152.5073 हॅक्टर खनिज ब्लॉक वाठारा भितर आस्पाव जाता.

खनिज ब्लॉका भितर रान वाठाराचो आस्पाव पळोवन प्रकल्प प्रस्तावकान 08/01/2024 दिसा मंजूर केल्ल्या ToR त दुरुस्ती खातीर MoEF&CC च्या PARIVESH पोर्टलाचेर ऑनलायन अर्ज दाखल केलो. 19/11/2024 तारखेच्या दुरुस्ती टीओआरांत उल्लेख केल्ल्या प्रमाण सकयल दिल्ल्यो विशिश्ट अटी जोडून 08/01/2024 दिसा टीओआर दुरुस्त करपाक एमओईएफसीसीक खोस जाली. पर्यावरण परिणाम मुल्यांकन आनी पर्यावरण वेवस्थापन येवजण तयार करपा खातीर 08/01/2024 दिसा टीओआर आनी 19/11/2024 तारखेची टीओआर दुरुस्ती मार्गदर्शक तत्वां म्हणून वापरली.

1.3 बेसलायन डेटा निरिक्षण संमती

बेसलाइन अभ्यास उमाशेच्या हंगामांत म्हळ्यार मार्च ते मे, 2023 ह्या काळांत केल्लो.

2.0 खणकामाची कार्यपद्दत

वर्साक 0.75 दशलक्ष टन (एमटीपीए) उत्पादन क्षमतेक पर्यावरण मंजुरी मेळोवपा खातीर हो प्रस्ताव आसा आनी एकंदर ओव्हरबर्डन प्रमाण 1:4 आसा. खणकामाचीं कामां मान्य खण येवजणे प्रमाण जातली. खणकामाचीं कामां बोरींग & स्फोट करिनासतना यंत्रीक ओपनकास्ट पद्दतीन आसतलीं, रिपर्स आनी डोझर, उत्खनक, डंपर, व्हील लोडर आनी टिपर सारकिल्या जड माती हालोवपी यंत्रणां वापरून सगळ्या कायदेशीर गरजांक पाळो दितले. कठीण खडपां रिप करपा खातीर रिपर & डोझर वापरतले आनी लोडिंग खातीर व्हील लोडर आनी लेव्हलिंग खातीर डोझर वापरतले. कोयराच्या खडपांत ६मी उंच आनी ८ मी. रुंद

आनी आडव्यासावन ३० अंशांपरस उणो खड्ड्याचो उण्या खड्ड्याची उतार आशिल्लीं बेंच सांबाळून खणकामाची पद्धतशीर पद्धत सुचयल्या मांडल्या. रन ऑफ मायन (रोम) लोखण धातुक देशी तिख्या उद्देगांक आनी निर्यात बाजारपेठे खातीर विकतले. खणींतल्यान जेटी मेरेन धातुकाची येरादारी 10.5 टन क्षमताय आशिल्ल्या टिपरां वरवीं जातली.

2.1 खण उत्पादन, सांठे आनी जिवीत

डी.एम.जी.,गोंय सरकारान दिल्ल्या भूवैज्ञानीक अहवाला प्रमाण अदमास खनीज सांठे आनी संसाधनां 01.02.2023 मेरेन 16.731दशलक्ष टन लोखण धातू आसा. खणीचें अदमाशी जिवीत 24 वर्सां आनी फुडल्या संशोधनाचेर आदारीत वाडटलें. पूण खण लीज कार्यान्वीत खण लीज करार नोंदणी केल्ले तारखे सावन 50 वर्सां खातीर वैध आसा.

2.2 मनीसबळ, उदक आनी विजेची गरज

मनीस बळ: ह्या प्रकल्पांत सुमार 127 व्यक्तींक थेट रोजगार दितले, खण अधिकारी (वेवस्थापक, देखरेख करपी), कुशळ मजूर, अर्दकुशळ कामगार आनी आनी अकुशळ कामगार आनी थळाव्या लोकांक सुमार 200 अप्रत्यक्ष रोजगाराची संद मेळटली अशी अपेक्षा आसा. ते भायर खण वेवसायांतल्यान सुमार जाणांक अप्रत्यक्ष रोजगाराची जशे येरादारी, मव्याचें काम आदी संद मेळटली.

उदक: प्रकल्पाची उदकाची गरज चडांत चड 300 केएलडी असो अदमास आसा. हातूंतल्यान घरगुती खातीर 8 केएलडी, ग्रीन बेल्टा खातीर 10 केएलडी, चाक धुवपा खातीर 50 केएलडी, वर्कशॉपा खातीर 10 केएलडी आनी धुल्ल दवरपा खातीर उरिल्लें 222 केएलडी जाय पडटा. खण लीज वाठारा भितरल्या मिनाफोंडांत सांठयल्ल्या पावसाच्या उदकांतल्यान आनी घरगुती कामां खातीर नोंदणीकृत उदक विक्रेत्या कडल्यान घेतिल्ल्या टँकरांतल्यान उदकाची गरज भागतली. विशिश्ट उदकाचो वापर वर्साक वर्स उणो करपाचे यत्न जातले.

तपशील	प्रमाण (केएलडी)	स्त्रोत
धुल्ल दमन करप	222	खण खड्ड्यांत एकठांय केल्ल्या पावसाच्या उदका कडल्यान आनी टँकरांतल्यान नोंदणीकृत उदक विक्रेत्या कडल्यान.
ग्रीन बेल्ट आनी प्लांटेशन	10	
चाकां धुवप	50	
कार्यशाळा	10	
घरगुती वापर	8	नोंदणीकृत उदक विक्रेत्या वरवीं
एकूण	300	

गोंयच्या उदका संसाधन खात्या कडल्यान भूंयगत उदक काडपा खातीर प्रकल्प प्रस्तावकान पयलींच अर्ज केला.

वीज: 1.64 MW/day जो सरकारी वीज जाळये वयल्यान मेळटलो, 82.5 केव्हीए क्षमताय आशिल्लो डिझेल जनरेटर बॅकअप म्हणून वापरतले.

2.3 पुनर्वसन

खणीच्या पुराय जिवितांत पुनर्वसन करपाचो प्रस्ताव ना.

3.0 पर्यावरणाचें वर्णन

ब्लॉक IV - कालय खनीज ब्लॉक हो सद्याच्या ई.आय.ए. अभ्यासा खातीर मुळावो वाठार आसा. बफर झोनाची व्याख्या गर्भीत झोनाचे शिमे सावन 10 कि.मी. आस्पावपी वाठार अशी केल्या. गर्भीत झोन आनी बफर झोन एकठांय येवन अभ्यास क्षेत्र तयार जाता.

सुक्षीम हवामानशास्त्र, हवा, उदक, आवाज, माती हांचे संदर्भांत मुळावो पर्यावरणीय डेटा 2023 वर्साच्या गिमांत एकठांय केल्लो. नमुने घेवप आनी विश्लेशण एन.ए.बी.एल. मान्यताय प्राप्त आनी सी.पी.सी.बी./एम.ओ.ई.एफ. अँड सी.सी. कडल्यान मान्यताय प्राप्त प्रयोगशाळा मे. एनविरोनमेंटल लॅबोरेटरी (मिनरल इंजिनिअरिंग सर्विसीसचो एक भाग), बेंगळुरू हांणी केलें.

• वाऱ्याचो वेग & दिका (वार्याचे गुलाब), तापमान, आनी आर्द्रतेचेर स्थळ विशिश्ट सूक्ष्म हवामानशास्त्रीय डेटा (कोर झोनांतल्यान वराक वाचन).
• 24 वरां च्या तत्त्वाचेर 8 स्टेशनां वयल्यान, सप्तकांतले 2 दीस उमाशेच्या हंगामांत 13 सप्तकां खातीर, कण, एसओ2, एनओ2, सीओ, ओझोनांतल्या जड धातूच्या विश्लेशणा खातीर पीएम10, पीएम2.5, आनी जड धातू विश्लेशणा खातीर परिवेशी हवेच्या दर्ज्याचे नमुने घेवप , बेंझीन आनी बेंझो(अ)पायरीन.
• अभ्यास काळांत एकदां मोलां, Leq दीस आनी रात खातीर 8 सुवातींनी आवाज पातळेचें मापन
• अभ्यास काळांत एक फावट नमुने हडप करून उदकाचो दर्जो नमुनो घेवप
1. पृश्ठभागाचें उदक -6 सुवाती
2. भूंयगत उदक -8 सुवाती
• अभ्यास काळांत एक फावट 6 सुवातींनी मातयेच्या दर्ज्याचे नमुने घेवप साठी
• पोत आनी भौतिक मापदंड पोशक तत्वां (एनपीके सारके, आदी) & सूक्ष्म पोशक तत्वां
• एनआरएससी कडल्यान LISS IV Mx डेटा वापरून जमनीचो वापर & जमनीचो आच्छादन नमुनो
• जैव घटक
• वनस्पत आनी मोनजात –कोर आनी बफर झोन
• समाजीक-आर्थीक स्वरूप, 2011-जनगणना आनी सर्वेक्षण 2023 हांचेर आदारीत.

3.1 भूंयवर्णन

अभ्यास वाठाराची भूंयवर्णन वयर सकयल आनी दोंगराळ आसून तातूंत 10 ते 20 अंश सौम्य ग्रेडियेंट आसा. अभ्यास वाठारांतली सगळ्यांत चड उंचाय आग्नेय दिकेन 640 मी. कोर झोनांत सगळ्यांत उंचेली पातळी डंप क्र. 1 आनी सगळ्यांत सकयली पातळी -0.5 मी. एमएसएल मिनाफोंडांत लीजचे उत्तरेकडेन आसा. अस्तंतेकडल्यान उदेंतेक ब्लॉकाभोंवतणी व्हांवपी हंगामी नाला आसून तो ब्लॉक शिमेचे उदेंतेक व्हांवपी कालय न्हंयेक मेळटा.

3.2 वातावरणीय हवेची गुणवत्ता

सगळ्या दिकांचो आसपाव करून 8 सुवातींनी परिवेशी हवेचे गुणवत्तेचेर तपासणी केल्या. निरिक्षणाची

वारंवारता 3 म्हयन्यां खातीर 2 दीस/ सप्तक आशिल्ली आनी आसपाव केल्ले मापदंड सी.पी.सी.बी. एन.क्यू.ए.एस. मार्गदर्शक तत्वां प्रमाण आशिल्ले.

परिवेशी हवेच्या दर्ज्याचें सांख्यिकी विश्लेशण अशें आसा, कोर झोन स्टेशनांत SO2, NO2, PM10 & PM2.5 ची चडांत चड मोलां 15, 16, 55 & 33 μg/m3 आनी बफर झोन गांवांनी, चडांत चड मोलां 15, 18, 57 & 42 μg/m3 अशीं मेळ्ळीं.

CO, O3, NH3, Pb, As, Ni, Benzene (C6H6) & Benzo(a)Pyrene (BaP) ह्या हेर सगळ्या मापदंडांचेय नमुने घेतात आनी विश्लेशणाचे परिणाम NAAQ's च्या मर्यादेंत आशिल्ल्याचें दिसून आयलें.

3.3 आवाजाची पातळी

आवाजाचे पातळेची 8 सुवातींनी तपासणी केली, जातूंत गर्भीत झोनांत एक सुवात आनी बफर झोनांत 7 सुवातींचो आसपाव आशिल्लो आनी Leq दीस आनी रात नोंद केली.

गर्भीत झोनांतल्या दिसाच्या आनी रातच्या वेळार Leq मोल अनुक्रमान 44.9 डीबी(ए) आनी 38.7 डीबी(ए) अशें दिश्टी पडलें. बफर झोनांत दिसाच्या आनी रातच्या वेळार आवाजाची पातळी अनुक्रमान 50.2 डीबी(ए) ते 35.0 डीबी(ए) प्रमाणांत आशिल्ल्याचें दिश्टी पडलें. गर्भीत झोन आनी बफर झोन ह्या दोनूय वाठारांनी आवाजाची पातळी उद्देगीक, वेपारी आनी निवासी वाठारां खातीर आवाजाचे गुणवत्तेच्या मानकां भितर, परवानगी दिल्ल्या मर्यादे भितर आशिल्ल्याचें दिश्टी पडलें.

3.4 उदकाची गुणवत्ता

गिमाच्या हंगामांत बफर झोनांतल्या 5 सुवातींनी, 1 मिनाफोंडांचे उदक ग्रॅब नमुने घेवपाचे पद्दतीन नमुने घेवन पृश्ठभागाचेर उदकाच्या दर्ज्याचेर निरिक्षण केलें. 8 सुवातींनी भूंयगत उदका खातीर ग्रॅब नमुने घेवपाचे पद्दतीन उदकाचे नमुने एकठांय करून विश्लेशण केलें. आय.एस.: 3025, ए.पी.एच.ए., आनी आय.एस.:1622 प्रमाण चांचणी पद्दती विश्लेशणा खातीर वापरल्यो. विश्लेशणाच्या परिणामांची तुळा पृश्ठभागाचेर आशिल्ल्या उदका खातीर आयएस:422ई, आयएस:2296 आनी भूंयगत उदका खातीर आयएस:10500:2012 मानकां कडेन केल्ली.

एकाच सुवातेर म्हळ्यार जुआरी न्हंयच्या पृश्ठभागाचेर आशिल्ल्या उदकाच्या नमुन्यांच्या परिणामांतल्यान टीडीएस आनी क्लोरायड चड दिसून येतात. हाका मुखेलपणान खाडीच्या उदकाचो प्रभाव पडला. उक्त्या बांयच्या नमुन्यांचे पीएच मात्शें अम्लीय स्वरुपाचें आशिल्ल्याचें दिसून आयलें. हाका लागून लॅटरायटीक धातुकाच्या प्रकाराक लागून जाता. जंय हेर मापदंड त्या त्या मानकांच्या परवानगी दिल्ल्या मर्यादेंत आसात.

3.5 मातयेची गुणवत्ता

खनीज ब्लॉकांतल्यान एक आनी लागसारच्या गांवच्या शेतकी मळां वयल्या हेर पांच सुवातीं सयत 6 सुवातींनी मातयेचे गुणवत्तेचे नमुने घेतले आनी अभ्यास काळांत भौतीक आनी रसायनीक मापदंडां खातीर तांचें विश्लेशण केलें. जमनीची गुणवत्ता लागवडी खातीर योग्य आशिल्ल्याचें दिश्टी पडलें.

3.6 जमनीचें वातावरण

10 कि.मी. त्रिज्याच्या बफर वाठाराचो आसपाव आशिल्ल्या अभ्यास वाठाराच्या सद्याच्या जमनीच्या वापरांत 2.07% उदका स्रोत, 33.78% राखीव रानां, 13.99% दाट रान, 3.49% शेतकी जमीन, 15.55% वांझ/तण जमीन, 22.53% वनस्पत आनी 4.59% वसणूक वाठार हांचो आसपाव जाता.

संकल्पनात्मक टप्प्यांत खनीज काडून जातकीच फोडिल्लो वाठार भरून काडून ल्हवू ल्हवू काजू, आंबो, जांबूळ, भिण्णां, टर्मिनॅलिया आदी थळाव्यो जाती लावन ताचें पुनर्वसन करतले. वनस्पत तिगाव आनी वाडपाचें बरें प्रमाण मेळचें हे खातीर सगळे यत्न करतले. वनस्पत चडांत चड तिगून उरपा खातीर आनी वाडपा खातीर सगळे यत्न करतले.

3.7 जैव वातावरण

खण वाठार भगवान महावीर वन्यजीव अभयारण्या पासून सुमार १.०४ किमी., पूण खण वेवस्थापन रान खात्या वांगडा काम करूंक शकता आनी ईएमपींत सुचयल्ल्या जातीं प्रमाण पर्यावरणीय पुनर्स्थापना करपाक मदत करूंक शकता.

वनस्पत

हंगामी निरिक्षणांतल्यान कोर वाठारांत वट्ट ४५ जाती नोंद जाल्यात, तातूंत २१ झाडांच्यो जाती, ११ झुडपाच्यो जाती आनी १३ जडीबूटी जाती आसात.

मोनजात

कोर वाठाराभितर वट्ट १६ जाती दिसून आयल्यो, तातूंतली ९ जाती सुकणीं, ३ जाती सस्तन प्राणी आनी ४ जाती सरपटपी प्राणी आशिल्ल्यो.

<u>बफर वाठारांतली वनस्पत आनी मोनजात</u>

वनस्पत

बफर झोनांत वट्ट १९८ वनस्पती जाती नोंद जाल्यात, तातूंतले ८९ जाती झाडां, ४२ जाती झोंपां आनी २८ जाती वनस्पती जाती राखीव रान आनी दर्यादिगेवेल्या रावपाच्या सुवातींनी नोंद जाल्यात. तेभायर 39 वनस्पती जातींचो अहवाल बायोडायव्हर्सिटी बोर्ड, गोंयान केला.

मोनजात

एकंदरीत प्राथमीक निरिक्षण आनी दुय्यम प्रकाशन आनी अहवाल ह्या दोनूय प्रकारांतल्यान २६२ जाती नोंद केल्यात, प्राण्यांच्या बाबतींत सस्तन प्राण्यांची २२ जाती, सरपटपी प्राण्यांची २४ जाती, Tod's & Amphibians ची १७ जाती, सुकण्यांची १५४ जाती, फुलपाखरांच्यो २७ जाती आनी ह्या वाठारांतल्यान उदकांतल्या जातींच्यो १८ जाती मेळ्ळ्यो.

10 किमी त्रिज्याच्या अभ्यास क्षेत्रांत वट्ट 48 जातींच्यो मोनजाती आसात जी अनुसुची I खाला वन्यजीव संरक्षण कायदो 1972 च्या वर्गांत येता.

S. No.	Local Name	Scientific name	Family	WPA-Schedule
	Mammal			
1	Common grey mongoose	Urva edwardsii	Herpestidae	LC/I
2	Indian porcupine	Hystrix indica	Hystricidae	LC/I
3	Malabar gain squirrel	Ratufa indica	Sciuridae	VU/I
4	Common leopard*	Panthera pardus	Felidae	VU/I
5	Leopard cat*	Pronailurus bengalensis	Felidae	LC/I
6	Wronghto's Gaint Mastiff Bat	Otomops wroughtoni	Molossidae	LC/I
7	Slender Loris	Loris lydekkerianus	Lorisidae	NT/I
8	Tiger	Panthera tigris	Felidae	EN/I
9	Mouse Deer	Moschiola indica	Tragulidae	LC/I
10	Four Horned Antelope	Tetracerus quadricornis	Bovidae	VU/I
11	Gaur or Indian Bison	Bos gaurus	Bovidae	VU/I
12	Indian Pangolin*	Manis crassicaudata	Manidae	EN/I
13	Sloth bear*	Melursus ursinus	Ursidae	VU/I
14	Small Indian civet*	Viverricula indica	Viverridae	LC/I
15	Bonnet macaque	Macaca radiata	Cercopithecidae	LC/I
16	Wild dog	Cuon alpines	Canidae	EN/I
	Birds			
17	White-bellied Sea-Eagle	Haliaeetus leucogaster	Accipitridae	LC/I
18	Indian Peafowl	Pavo cristatus	Phasianidae	LC/I
19	Shikra	Accipiter badius	Accipitridae	LC/I
20	Osprey	Pandion haliaetus	Pandionidae	LC/I
21	Chestnut Bittern*	Ixobrychus cinnamomeus	Ardeidae	LC/I
22	Cotton Teal	Nettapus coromandelianus	Anatidae	LC/I
23	Brahminy Kite	Haliastur indus	Accipitridae	LC/I
24	Long-billed Vulture	Gyps indicus	Accipitridae	CR/I
25	Crested Serpent Eagle*	Spilornis cheela	Accipitridae	LC/I
26	Eurasian Marsh Harrier	Circus aeruginosus	Accipitridae	LC/I
27	Crested Goshawk	Accipiter trivirgatus	Accipitridae	LC/I
28	Besra Sparrowhawk	Accipiter virgatus	Accipitridae	LC/I
29	Black Eagle*	Ictinaetus malayensis	Accipitridae	LC/I
30	Crested Tree-swift	Hemiprocne coronate	Hemiprocnidae	LC/I
31	Brown Wood Owl	Strix leptogrammica	Strigidae	LC/I
32	Common Hill-Myna	Gracula religiosa	Sturnidae	LC/I
33	Grey Junglefowl	Gallus sonneratii	Phasianidae	LC/I
34	Nilgiri Wood Pigeon	Columba elphinstonii	Columbidae	VU/I
35	Small Minivet *	Pericrocotus cinnamomeus	Campephagidae	LC/I
36	Forest Eagle-Owl	Bubo nipalensis	Strigidae	LC/I

	Reptiles			
37	Indian Rock Python*	Python molurus molurus	Pythonidae	NT/I
38	Marsh Crocodile	Crocodylus palustris	Crocodylidae	VU/I
39	Indian Falpshell Turtle	Lissemys punctata	Trionychidae	VU/I
40	Common Indian Monitor Lizard	Varanus bengalensis	Varanidae	NT/I
41	Russell's Viper	Daboia russelii	Viperidae	LC/I
42	Cobra	Naja naja	Elapidae	LC/I
43	King cobra*	Ophiophagus hannah	Elapidae	VU/I
44	Green Forest lizard	Calotes calotes	Agamidae	LC/I
45	Checkered Keelback	Fowlea piscator	Colubridae	LC/I
46	Common Kukri Snake*	Oligodon arnensis	Colubridae	LC/I
47	Whitaker's Boa*	Eryx whitakeri	Boidae	NT/I
48	Common Indian monitor lizard	Varanus bengalensis	Varanidae	NT/I

ईएमपींत सुचयल्ले प्रमाण वनस्पत आनी मोनजातीचें संवर्धन प्रस्तावीत करतले, सगळ्या शिमेचेर, वापरूंक नाशिल्ले वाठार, निश्क्रीय डंप उतार आनी रस्त्या कुशीक कोर आनी बफर वाठारांनी ग्रीनबेल्ट विकसीत करतले. प्रस्तावीत जैवविविधताय वेवस्थापन येवजण राज्य रान खात्या वरवीं चालीक लायतले.

राखीव रानांतली मुखेल जाती म्हळ्यार अनाकार्डियम ऑक्सिडेंटल, आनी ॲकॅसिया ऑरिक्युलिफॉर्मिस, ह्यो खाजगी आनी उणाव जाल्ल्या सरकारी जमनीचेर म्हत्वाचो प्रचार केला. शेतकी बंड आनी घरांच्या फाटल्या आंगणांचेर शेतकारांक आंबो आनी नाल्ल बागांचो म्हत्वाचो प्रचार जाता. कोर वाठारांत वनस्पत वा मोनजात हांचीं धोक्यांत आशिल्लीं वा थळावीं जाती नात.

3.8 समाजीक-आर्थीक वातावरण

खण प्रकल्पाक लागून भोंवतणच्या गांवांनी प्रत्यक्ष आनी अप्रत्यक्ष रोजगाराची संद निर्माण जातली. खणींनी थेट रोजगार सोडल्यार, कॅन्टीना सारकें अप्रत्यक्ष रोजगार/वेवसायीक समाजीक-अर्थशास्त्र तयार जातलें, आनी लोखण धातुकाची येरादारी खातीर थळाव्या टिपरांक गुंतयतले.

प्रकल्पाक लागून येरादारी, मळ्यां, कार्यशाळा आनी गॅरेजी, आनी संबंदीत कार्यावळी अशा कंत्राटाच्या रुपांत खूब रोजगार निर्माण जातलो.

खण कार्यावळी भौतिक & समाजीक मुळाव्या साधनसुविधांचो फुडलो विकास सयत ह्या वाठाराच्या टिकावू उदरगतींत मदत करतात.

खण कार्यावळींतल्यान राज्य आनी केंद्राक कर रॉयल्टी आदी रुपांत येणावळ मेळटा. प्रकल्प प्रस्तावकान डीजीएमएस मार्गदर्शक तत्वां प्रमाण कामगारांच्या भलायकी स्थितीचें मुल्यांकन करतले. आवाज, हवेचो आनी उदकाचो दर्जो मर्यादे भितर बरोच सांबाळटलो.

4.0 अदमाशीत पर्यावरणीय परिणाम आनी उपाय येवजण्यो

ब्लॉक IV– कालय खनीज ब्लॉकांत आजून खणकाम सुरू करूंक ना. सगळे नियंत्रक उपाय सुनिश्चीत करून आनी थारायिल्ल्या मानकांक पाळो दिवन, हवा, उदक, आवाज आनी माती हांचेर खण वेवसायाचे जावपी संभाव्य परिणाम उणे करपा खातीर सगळे खबरदारीचे उपाय करुनूच काम सुरू करतले.

4.1 हवा वातावरण

हवाई पर्यावरणाचेर जावपी परिणामांचें मुल्यांकन एअरमोड मॉडेलिंगांतल्यान जाता आनी परिणाम दाखयतात की खणकाम सुरू जाले उपरांत भोंवतणच्या बफर झोन गांवांचेर जावपी संचयीक परिणाम परवानगी दिल्ल्या मर्यादे भितर आसतले

खणकाम कार्यावळी वेळार वायु प्रदुशण/धुल्ल निर्माण जावपाचेर नियंत्रण दवरपा खातीर फुडले उपाय करतले: -

- रस्त्यांचेर & लोडिंग पॉयंटांचेर नेमान उदक शिंपडप जातलें.
- भाडें शिमे, रस्ते, डंप आदी भोंवतणी ग्रीन बेल्ट/प्लांटेशनाची उदरगत.
- खण हालोवपाचे रस्ते बऱ्या स्थितींत दवरल्यार आनी गती मर्यादा चालीक लायल्यार धुल्ल प्रदुशण आडावपाची खात्री जातली
- सगळ्या जड धर्तरी हालयपी यंत्रणेंत वातानुकूलित कॅबिन आसतले अशे तरेन संचालकांक प्रदुशण मुक्त वातावरण मेळटलें.
- परिवेशी हवेच्या दर्ज्याचें मुल्यांकन करपा खातीर नेमान वातावरणीय हवेच्या दर्ज्याचेर नियंत्रण दवरतले.
- खण कामगारांनी धुल्ल मास्क, कान प्लग आदी वैयक्तीक संरक्षण उपकरणां (पीपीई) वापरप.

4.2 उदकाचें वातावरण

पावसाचें उदक खणीच्या खड्ड्यांत वळयल्यार धुल्ल दवरप, वाहन धुवप, बागकाम आदी वेगवेगळ्या कार्यावळीं खातीर वापरतले. भूंयगत उदक खड्ड्यांत जरी मेळटलें तरी प्रभावाची त्रिज्या म्हणून खड्ड्यांतल्यान उदक काडपाक लागून वायट परिणाम जावचो ना खड्ड्यांतल्यान उदक काडपाक लागून.

उदकाच्या प्रदुशणाचेर नियंत्रण दवरपा खातीर डंप उतार, माळ निचरो, खंदक, वसणूक टांकयो, लॅटरायट बोल्डर वण्टींनी कोको लॉग लावपाक भूकापड वापरपाच्या रुपांतले संरक्षणात्मक उपाय हातांत घेतले.

अशे तरेन पृश्ठभागाचेर आनी भूंयगत उदकाचेर वायट परिणाम जावचे नात. खरें म्हणल्यार खड्ड्या भितर काडिल्लें निवळ पावसाचे उदक सोडल्यार थळाव्या गांवकारांक फायदो जातलो.

जलभूंयशास्त्राचेर खणकामाच्या कार्यावळींचो परिणाम:-

खनिज ब्लॉकाच्या शिमेसावन 10 किमी त्रिज्यांत सविस्तर जलभूवैज्ञानिक अभ्यास केलो आनी खनिज ब्लॉका भोंवतणी सगळ्या दिकांनी भालो मारपी 15 उक्ते खणून काडिल्लीं बांय विचारांत घेतल्यो, चड करून उथळ

जलस्तरांचो टॅप करून अभ्यास वाठारांतल्या भूंयगत उदकाची पद्दत रेखांकित करपाखातीर 2023 वर्साच्या उमाशेच्या हंगामांत अहवालाचे सकयल दिल्ले आसात:

i. सांगे तालुक्यांत भूंयगत उदकाच्या उदरगतीची पांवडी 16.97% आसा आनी भूंयगत उदकाची उदरगत आनी वेवस्थापनाचे नदरेन सुरक्षीत अशें वर्गीकरण केलां.

ii. सादारणपणान उदकाचो दर्जो सगळ्या सुवातींनी सुरक्षीत आनी पिवपाक योग्य आसता आनी भारतीय मानक ब्युरोच्या (बीआयएस) चडांत चड परवानगी दिल्ल्या मर्यादे भितर आसता.

iii. उदकाचे पातळेमेरेन खोलाय २ मी.बी.जी.एल.परस उणी ते १४ मी.बी.जी.एल.परस चड आसताली.

iv. खणी खातीर उदकाची गरज 300 मी3/दिस आसा.

v. ह्या वाठारांत वर्सुकी सरासरी पावस सुमार 4000 मिमी. प्रकल्प वाठारांतल्यान पावसाचे उदक खण खड्ड्यांनी आनी वसणुकेच्या तळ्यांत व्हरतले.

vi. लोखण धातुकाच्या मुखेल सांठ्याक कोडली-किर्लापाल-कोस्टी सांठो अशें म्हण्टात. खनिज खंडांत वयरसावन सकयल मेरेन दिसपी थरांची सादारण क्रमवारी म्हळ्यार लॅटरायट (सुमार १५ – २० मी.), ऑल्टरड डायक (इंट्रूसिव्ह), फेरिजिनस/फिलायटीक/ लिमोनिटिक क्ले (१० – १५ मी.), आयरन ओर बॉडी (२० - २० मी. ३० मी.) आनी सिलिसियस मॅंगनीफेरस क्ले आनी वेदरड बीएचक्यू (पांयांची वण्टी तयार करता).

vii. लॅटरायट ही सगळ्यांत म्हत्वाची उदक धारण करपी निर्मिती आसून ती ६० टक्क्यांवयर वाठार आस्पावता. दक्षिण गोंय जिल्ह्यांतल्या सांगुएम, क्केपेम आनी कॉंकोना तालुक्यांच्या कांय वाठारांनी मेटाज्वालामुखी निर्मिती पातळ्ळ्या. मेटाबासाल्ट आनी मेटाग्रेवॅक हांचे उदक धारण करपी गुणधर्म आनी ताचेकडेन संबंदीत आशिल्ले खडप कॅम्ब्रियन काळापयलींच्या काळांतल्या खडपांचोय खडपांत आशिल्ल्या भग्नावस्थेचेर, सांधे आनी पानांचेर आदारून आसतात.

viii. जलस्तर प्रणालीची दोन प्रकार दिसतात म्हळ्यार जलस्तर-I जो उथळ फ्रेटिक जलस्तर आनी जलस्तर-II जो खोल भग्न जलस्तर तयार करता. जलस्तर-I हातूंत लॅटरायट, जलोढ, हवामानांतल्यान मेटा ज्वालामुखी आनी हवामानांतल्यान मेटा गाळाचो आस्पाव जाता, सादारणपणान ९-४२ मी.बी.जी.एल. जलस्तर-II हातूंत भग्न मेटा-गाळ, ग्रेनाइट ग्नीस आनी शिस्टोज खडप हांचो आस्पाव जाता. जलस्तराची घडणूक खोलाय २५ ते १८० मी.बी.जी.एल.

ix. ९ ते १६ मीटर इतली चड भग्न जलस्तराची दाटाय कालयच्या सांवोर्देम लागसार मध्य अस्तंत भागांत वेगळे केल्ले पॅच दिसून येतात.

x. भग्न जलस्तराची दाटाय 0.10 ते १६ मी.मेरेन आशिल्ल्याचें दाखयता, तरीपूण राज्यांतल्या जायत्या वाठारांनी २-५ मीटर जलस्तराची दाटाय दिसून येता

xi. भाडें वाठारांत चांचणी केल्ल्या खणून काडिल्ल्या बांयचो स्त्राव 14.38 मी3/ तास आसता. 20.43 मी.च्या ड्रॉ डावन खातीर संप्रेषणक्षमता 16.84 मी2/ दीस असो अदमास आसा.

xii. ब्लॉक IV - कालय खनिज ब्लॉक सुमार १८ - ९४ मीटर उंचायेचेर मळा प्रदेशाचेर वसला आनी तातूंत पृश्ठभागाचेर उदकाचे कुडके नात. उक्त्या बांयांचेर केल्ल्या अभ्यासावयल्यान दिसून आयलें की, फ्रॅटिक जलस्तरांतली उदकाची पातळी चडशी उथळ आसता, जंय भूंयगत उदक काडपाचीं संरचनां १८ मीटर ते ९४ मीटर उंचायेचेर आसतात. खोल खण पातळेचेर आशिल्लो जलस्तर उणो संभाव्य आसून तो मातयेच्या आंतराळांतल्यान तयार केल्लो आसता आनी चडसो उदकांतल्यान भायर सरपी

आसता. खोल अर्द मर्यादीत जलस्ताराच्या पीझोमेट्रीक पृश्ठाचेर वाडत वचपी प्रवृत्तीकडेन स्थिर स्थिती दिसून येता आनी पडपाची प्रवृत्ती दिसना. खणकामाच्या वावराक लागून भूंयगत उदकाच्या वेवस्थेचेर कसलोच वायट परिणाम जावचो ना.

4.3 आवाज वातावरण

चडसो आवाज माती उसपुपी यंत्रां चलिल्ल्यान आनी डंपरांच्या हालचालींतल्यान निर्माण जाता. प्रकल्प खनीज ब्लॉकांत बोरींग आनी स्फोट अपेक्षीत नात. आवाज प्रदुशण उणें करपा खातीर खण लीज भोंवतणी ग्रीन बेल्ट निर्माण करतले. आवाज उणो करपा खातीर उत्पादकांचे शिफारशी प्रमाण खण उपकरणां, यंत्रां आनी सगळ्या वाहनांची नेमान देखरेख करतले.

आवाजाची पातळी नियंत्रीत करपा खातीर फुडले वेवस्थापन उपाय आपणायतले:

- गरजेचे सगळे उपाय करून वातावरणीय आवाजाची पातळी दिसाच्या वेळार 75 dB(A) परस उणी & रातच्या वेळार 70 dB(A) परस उणी सुनिश्चीत करतले.
- कसलेंच ड्रिलिंग आनी ब्लास्टिंग ना.
- सगळ्या हेमांत वातानुकूलित, आवाज-प्रूफ कॅबिन आसात
- खणींत आवाज प्रवण आशिल्ल्या वाठारांनी कामगारांक ध्वनीक्षेपक लोकर, कानांतले प्लग आनी कानमफ सारकिलीं संरक्षणात्मक उपकरणां दिवप
- भाडें शिमेचेर आनी येरादारी रस्त्यांचेर ग्रीनबेल्ट विकसीत करतले.

4.4 जमनीच्या वातावरणाचेर परिणाम

खणकामाच्या आयुश्याच्या शेवटाक, वट्ट 89.97 हॅक्टरां परस चड ग्रीनबेल्ट/रोपण 1500 रोंपयो/ हेक्टर लावून विकसीत करतले जें पर्यावरणाक फायदेशीर थारतलें & सौंदर्य आकर्शणूय तयार करतले. थळाव्या जातींनी काजू, जॅकफ्रूट आनी रानवटी जाती सारकिल्या फळां दिवपी झाडांचो मेळ लावचो पडटलो.

44.14 हेक्टर क्षेत्रफळ उदकाचो सांठो म्हणून सांबाळटले. उदकाचो सांठो ह्या वाठारांतल्या भूंयगत उदकाची स्थिती वाडोवपाचें काम करतलो आनी तशेंच खड्ड्यांतल्यान भायर सरपी उदक थळाव्या गांवकारांक शेतकी हेतून पुरवण करतले.

4.5 जैव वातावरणाचेर जावपी परिणाम

संकल्पनात्मक पांवड्यार काजू, बांबू, अर्जुन, आल्वा आदी थळाव्या फळां दिवपी झाडांची 1,34,955 रोंपयो लायून 89.97 हेक्टर क्षेत्रफळ परतून मेळयतले आनी 44.14 हेक्टर क्षेत्रफळ उदकाच्या सांठ्यांत रुपांतरीत करतले, जें आसतलें समाजाक आनी अविफॉनाक फायदेशीर. खणीच्या आयुश्याच्या निमाणें पुराय ब्लॉक वाठार अशे तरेन परतून मेळटलो की तो भोंवतणच्या वाठारांक आनी मोट्या प्रमाणांत सैमाक पूरक आसतलो.

4.6 समाजीक-अर्थीक वातावरणाचेर परिणाम

खण प्रकल्पाक लागून भोंवतणच्या गांवांनी प्रत्यक्ष आनी अप्रत्यक्ष रोजगाराची संद निर्माण जातली. खणींनी थेट रोजगार सोडल्यार, कॅन्टीन सारकी अप्रत्यक्ष रोजगार/वेवसाय संद निर्माण जातली, आनी लोखण धातुकाची येरादारी खातीर थळाव्या टिपरांक गुंतयतले.

हाचे परस चड येरादारी, मव्यां, कार्यशाळा आनी गॅरेजी, आनी संबंदीत कार्यावळी अशा कंत्राटाच्या रुपांत खूब रोजगार निर्माण जातलो.

खण कार्यावळी भौतिक & समाजीक मुळाव्या साधनसुविधांचो फुडलो विकास सयत ह्या वाठाराच्या टिकावू उदरगतींत मदत करतात. खणकामाच्या वावराक लागून राज्य आनी केंद्राक कर, रॉयल्टी आदी रुपांत येणावळ मेळटा.

प्रकल्प प्रस्तावक डीजीएमएस मार्गदर्शक तत्वां प्रमाण कामगारांच्या भलायकी स्थितीचें मुल्यांकन करतलो. आवाज, हवेचो आनी उदकाचो दर्जो मर्यादे भितर बरोच सांबाळटलो.

5.0 अतिरिक्त अभ्यास

अतिरिक्त अभ्यासांत, जोखीम विश्लेशण आनी ताचे उपरांत आपत्ती वेवस्थापन येवजण तयार केल्या, जी संभाव्य जोखीम वळखुपाक मदत करतली आनी खंयच्याय अपघाताक आडावपाची तयारी वाडोवपाक मदत करतली. जोखीम विश्लेशण आनी आपत्ती वेवस्थापन येवजण ई.आय.ए. अहवालांत आसपावल्या.

6.0 पर्यावरण वेवस्थापन आराखडो

हरीत पट्ट्याचे उदरगती सयत एक समावेशक पर्यावरण वेवस्थापन येवजण सुचयल्या. प्रकल्पाच्या सगव्या संभाव्य पर्यावरणीय परिणामांची वळख करप हें पर्यावरणीय प्रभाव मुल्यांकनाचें एक गरजेचें पावल आसा. परिणामांची विमर्शीक तपासणी करतात आनी मुखेल परिणामांचो फुडलो अभ्यास करतात. खण प्रकल्पांतलें भूंयवर्णन आनी भूंय वापर, हवेचें प्रदुशण, उदक प्रदुशण, कोयर वेवस्थापन, जैवविविधताय आनी समाजीक-साधनसुविधा हांचेर जावपी परिणामांचें अनुमान करतात.

खण उपक्रमाचो हवा, उदक, आवाज आनी मातयेचेर जावपी परिणाम उणो करपा खातीर सगले खबरदारीचे उपाय करून आनी सगव्या नियंत्रक उपायांनी पर्यावरणी गुणवत्ते संबंदांत थारायिल्ल्या मानकांक पाळो दितले, हाची खात्री करून खण चलयतले. जमनीच्या वापरांत बदल जावपाचो परिणाम फकत सकारात्मक आसतलो, कारण मिनाफोंडाच्या एका भागाचें कांय प्रमाणांत पुनर्भरण करपाची वेवस्था जातली, फुडें उरिल्लो भाग उदकाचो सांठो म्हणून सोडटले, जो थळाव्या गांवकारांक फायदेशीर थारतलो. एमएल वाठाराचे शिमेचेर ग्रीन बेल्ट तयार केल्यान बरे वातावरण मेळटलें. प्रस्तावीत ईएमपी कडेन अर्थसंकल्पीय खर्च वर्साक 45.45 लाख रुपया आसा.

6.1 कॉर्पोरेट समाजीक जापसालदारकी

प्रकल्प प्रस्तावक खण प्रकल्पाच्या कार्यावळी वेळार कॉर्पोरेट समाजीक जापसालदारकी उपक्रमांतल्यान जायते उपक्रम हातांत घेवपाचो प्रस्ताव मांडटा. रॅपिड ग्रामीण मूल्यांकना वेळार गांवकारांनी उक्तायिल्ल्या जाणवपी गरजां प्रमाण भांडवल सीएसआर अर्थसंकल्प तयार केला. प्रस्तावीत अर्थसंकल्प 30 लाख /वर्सा रुपया मेरेन आसा आनी अभ्यास क्षेत्राच्या गांवांनी खर्च करतले.

7.0 पर्यावरण निरिक्षण कार्यावळ

प्रस्तावीत प्रकल्पाच्या कार्यावळीच्या टप्प्यांत वातावरणीय हवेचो, उदकाचो आनी आवाजाची पातळी जाणून घेवपाक आनी गरजेचे दुरुस्ती उपाय करपाक, नियामक प्राधिकरणांनी थारायिल्ल्या नेमांक पाळो दिवंक नाशिल्ल्यान, पर्यावरणाचेर नियंत्रण दवरप गरजेचें आसा. पर्यावरण निरिक्षण करपा खातीर आपणायिल्ली पद्दत सीपीसीबी, एसपीसीबी आनी इंडियन ब्युरो ऑफ मायन्स हांच्या गरजां प्रमाण आसतली.

8.0 प्रतिकूल परिणाम कशे कमी करतात हाचें स्पश्टीकरण

ई.आय.ए./ई.एम.पी. अहवालांत प्रकल्प वाठाराचें मुळावें वातावरण निश्चीत केलां आनी एकंदर पर्यावरण आनी पर्यावरणाचेर प्रकल्पाच्या संभाव्य परिणामांचें मुल्यांकन केलां. ते प्रमाण मुखेल पर्यावरणीय मापदंडांच्या वेवस्थापना खातीर सामान्य तशेंच विशिश्ट उपाय येवजण्यो सुचयल्यात.

तशेंच पर्यावरण वेवस्थापन येवजणेचेर देखरेख आनी तिची अंमलबजावणी करपा खातीर विशिश्ट उपाय सुचयल्यात. तशेंच प्रदुशण नियंत्रण उपाय चालीक लावपाक जाय आशिल्ल्या निधीचो तपशील अहवालांत आसपावीत केला. सुचयल्ली पर्यावरण वेवस्थापन येवजण चालीक लायल्यार प्रकल्पाचे प्रतिकूल परिणाम कमी करूं येतात.

9.0 निश्कर्श

ब्लॉक IV - कालय खनिज ब्लॉक हो नव्यान लिलाव केल्लो खनिज ब्लॉक आसा. वेगवेगळ्या पर्यावरणीय गुणधर्मां खातीर अदमास केल्ले परिणाम सकारात्मक प्रमाणांत आशिल्ल्याचें दिसून आयलें. प्रस्तावीत केल्ल्या ईएमपीचो भोंवतणच्या वातावरणाचेर आनी वाठाराच्या भूंयप्रदेशाचेर सकारात्मक परिणाम जातलो. कंपनीन केल्ल्या रोजगार आनी सीएसआर कार्यावळींच्या माध्यमांतल्यान थळाव्या लोकांक ह्या प्रकल्पाचो फायदो जातलो.

DRAFT ENVIRONMENTAL IMPACT ASSESSMENT
&
ENVIRONMENT MANAGEMENT PLAN

Project	**Block-IV Kalay Mineral Block**
Sector and Category	**1(a) – Cat-'B'**
Area	**152.5073 Ha.**
Location	**Santona village, Sanguem Taluka, South Goa District, Goa State.**
Project Proponent	**Fomento Resources Private Limited.,**
Office Address	**1st Floor, 102, Kamat Metropolis-1, Behind Caculo Mall, St. Inez, Panaji, Goa 403001.**
Baseline data Collected	**Summer 2023 (March to May-2023)**
Name of MoEF& CC Accredited laboratory	**Environmental Laboratory (unit Mineral Engineering Services), Bengaluru**

November -2024

EIA Consultant

MINERAL ENGINEERING SERVICES
(Accredited by QCI-NABET ORG000756)
25/XXV, Club Road, Ballari-583103, Karnataka,
Tel 08392-267421, Mob: +91-9448367421,
Email : mes_msraju@yahoo.co.uk & mesbly25@gmail.com

Undertaking

This is to confirm, that Mineral Engineering Services, having office at 25/XXV, Club Road, Ballari-583103, Karnataka, has been appointed by the Fomento Resources Private Limited to conduct the EIA study for Block IV – Kalay Mineral Block having an area of 152.5073 ha, located at village Santona of Sanguem Taluka, South Goa District, Goa.

We further certify that we have reviewed the EIA & EMP report and take full responsibility and ownership of the contents presented in the EIA & EMP report prepared by Mineral Engineering Services accredited NABET Consultant (QCI No. ORG000756). EIA & EMP report was prepared as per guidelines of EIA notification, 2006. We also assure that there is no litigation pending against the project and/or any direction /order passed by any Court of law against the proposed project and that for any such litigation whatsoever, the sole responsibilities will be borne by Company.

Date: 19-11-2024

Place: Panjim, Goa

For and on behalf of
Fomento Resources Private Limited

SandeepMorajkar
(Authorized Representative)

UNDERTAKING

This is to declare that the prescribed ToRs have been complied with and that the data submitted is factually correct in respect of EIA & EMP report prepared for Block IV - Kalay Mineral Block granted to M/s.Fomento Resources Pvt Ltd over an extent of 152.5073 Ha, located at village Santona, Sanguem Taluka, South Goa District, Goa.

For Mineral Engineering Services



(M.S.Raju)
Consultant

Date: 19.11.2024
Place: Ballari

25/XXV, Club Road, Ballari-583103, Karnataka. Landline no.: 08392-267421.
E-mail: mes_msraju@yahoo.co.uk, mesbly25@gmail.com **Website : www.envtest.com**

QUALITY COUNCIL® OF INDIA
Creating an Ecosystem for Quality

National Accreditation Board for Education and Training

Certificate of Accreditation

Mineral Engineering Services, Bellary

25/XXV, Club Road, Bellary, Karnataka- 583103

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

S.No	Sector Description	Sector (as per)		Cat.
		NABET	MoEFCC	
1	Mining of minerals including open cast and underground mining	1	1 (a) (i)	A
2	Mineral beneficiation	7	2 (b)	A

Note: Names of approved EIA Coordinators and Functional Area Experts are mentioned in RAAC minutes dated July 04, 2023 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/23/2806 dated July 28, 2023. The accreditation needs to be renewed before the expiry date by Mineral Engineering Services, Bellary following due process of assessment.

Sr. Director, NABET
Dated: July 28, 2023

Certificate No.
NABET/EIA/2326/RA 0296

Valid up to
May 15, 2026

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

TOR

COMPLIANCE

Item-wise Compliance Status of TOR conditions issued by Ministry of Environment Forest & Climate Change (MoEF & CC) ToR identification no. TO23B0000GA5122365N dated 08/01/2024.

Specific Terms of Reference for (Mining of Minerals)		
S. No.	**Terms of Reference**	**Status**
1. Court Case		
1.1	The instant TOR is subject to the outcome of the said court case i.e., WP 592 of 2022 before the High Court of Bombay at Goa.	The WP 592 of 2022 before the High Court of Bombay at Goa stands dismissed vide order dated 12/02/2024.
2. Sequence of Mining		
2.1	The Project Proponent needs to submit the year wise sequence of mining operation and plan for backfilling.	The year-wise sequence of mining operation during first five year plan period and plan for backfilling is enclosed as **Annexure 19**.
3. EMP for Normative /Peak production		
3.1	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 due to HEMM.	Environmental Management Plan (EMP) is prepared considering the scenario of pollution to be generated for normative and peak total excavation for assessing air pollution, noise level referred in, **Para 10.5 of Chapter - 10.** Ground vibration due to HEMM will be carried out after commencement of mining operations.
4. Road Transportation		
4.1	The Project Proponent needs to submit the map showing the transport route of the mineral from the mine lease area to the destination, impact details of habitation at a distance of 100m from the center on both sides of road, details of no. of trips/day to and fro, capacity of the dumper/tipper to be deployed and the dimensions of the road and the carrying capacity of the road. Project Proponent needs to submit SOP for transportation.	The details of Ore transportation along with SOP for transportation is enclosed as **Annexure 15.**
5. Environment Monitoring and EMP		
5.1	The Project Proponent needs to monitor the ambient air quality and noise level at the mine lease boundary, nearest village, crusher, predominant downwind direction and at	Ambient Air quality and noise level monitoring at the mine lease boundary, nearest village, predominant downwind direction and at other sensitive receptors was carried out and

	other sensitive receptors. Project Proponent shall propose to install Continuous Ambient Air Quality Monitoring Station within certain timeline.	the monitoring report is enclosed as **Annexure 7.** PP is proposing to install continuous air quality monitoring station during the first five-year approved mining plan period.
6. Socio Economic		
6.1	The Project Proponent needs to carry out the Public Hearing as per provisions of ElA Notification, 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.	After public hearing the PP shall submit the time bound action plan through a separate budget with capital expenditure on the concerns of public.
7. Groundwater		
7.1	The Project Proponent shall carry out the assessment of impact due to the proposed project as the guidelines issued by the Central Ground Water Authority from time to time and submit the same as a part of the EIA/EMP. 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.	Hydrological study for projects involving intersection of ground water table as per the guidelines issued by the Central Ground Water Authority has been conducted and the report of the same is enclosed as **Appendix 2.**
7.2	The Project Proponent shall explore the possibility of reduction of specific water requirement by optimization / technology upgradation, etc. The efforts shall be delineated in the EIA/EMP.	1. Dust suppression will be carried out on haul roads using water sprinklers and in areas wherever feasible. 2. Environment friendly dust suppressants to reduce the water consumption for dust suppression. 3. Use of fixed dust suppression systems like sprinklers, fog guns, etc. which will further reduce water consumption as well as reduce fuel consumption for plying water tankers.

		4. Monitoring of specific water consumption on monthly basis and take annual specific water consumption reduction targets 5. Use of water tankers with special nozzles to make optimum use of water and covering more areas with less water. 6. Use of drip irrigation system for watering plants. 7. Imparting awareness amongst the employees on avoiding water wastage. Please refer **Para 10.6.3** of **Chapter 10**.
7.3	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 seeking NOC for ground water withdrawal and the shall submit as part of EIA/EMP report.	PP has carried out the detailed hydrogeological study of the project. Kindly refer **Appendix- 2**. Water conservations measures proposed follows the guidelines of CGWA and the measures undertaken are explained in **Para 10.6.3** of **Chapter-10.** Water utilized in workshop and wheelwashing system will be recycled as explained in **Para 2.8.10.4** in **Fig. 2.2.**
8. Drone Survey		
8.1	The Project Proponent shall conduct drone survey of the mine lease area and buffer area and submit during the appraisal for EC.	The Project Proponent has conducted drone survey of the mine lease area and buffer area and the same will be submitted during the appraisal for Environmental Clearance.
9. Greenbelt & Afforestation		
9.1	The Project Proponent needs to submit the greenbelt/afforestation development plan for undertaking plantation in the periphery of the mine lease boundary, safety zone etc., The details of the no. of saplings proposed, type of species, spacing and the area to be covered including the cost and timeline for completion of plantation needs to be provided in the EIA report.	The green belt development plan for five-year plan period is about 2.80 Ha area and 7500 saplings proposed. The detailed plan is given vide **Chapter-10**, **Para. 10.6.7.2**
10. Employment		
10.1	The Project Proponent needs to submit the employment-based skill development plan for	Employment-based skill development plan for the local people is prepared and enclosed as

	the local people and thrust should be to provide employment to local people after imparting training.	**Annexure 16.**
11. Transportation through rail		
11.1	The Project Proponent needs to explore the possibility of evacuating the material through rail.	Historically, transportation of material/ore from mine to jetties was carried out by road with 10.5 Tonne tipper trucks by the earlier lessee. The nearest jetties are located at a distance of 12 to 14 km from the mine. Further the material/ore was transported through inland waterways for onward sales/exports. Across the State of Goa, the local stakeholders were engaged in transportation of material/ore from mines to plants/jetties by using 10.5 Tonne tipper trucks which was their only livelihood. Along with the transportation business many other local businesses which are interdependent like garages, spare retailers, hotels, shops, etc. which takes care of their livelihood. Though the transportation/evacuation of material/ore through the rail would be environmentally friendly and cost effective, it will seriously affect livelihood of the local villagers and will result into a social discord and disorder. In future if need arises the project proponent shall explore the possibility of evacuating the material/ore through rail.
12. Railway line		
12.1	The Project Proponent needs to submit the map demarcating the exact distance of the railway line and railway boundary from the mine lease area. The Project Proponent also needs to submit the details of train passing and their frequency.	A map demarcating the exact distance of the railway line and railway boundary from the mine lease area, train passing and their frequency and measures taken to protect the railway line from the mining activity are enclosed as **Annexure 17**.

	Further, the Project Proponent needs to submit the measures taken to protect the railway line from the mining activity.	
13. Habitations		
13.1	The Project Proponent needs to submit the action plan for Shifting the habitations inside the mine lease area.	As per Approved Mining Plan no mining operations is proposed to be carried out within 50 meters of habitation inside the mine lease area. Further, there is no drilling and blasting proposed during the mining operations and as such there is no possibility of any ground vibrations affecting the habitations inside the mine lease area. A 50 m statutory barrier will be maintained form the habitation. Therefore, we would like to inform that there won't be any impact of the mining operations on the habitations and as such shifting of these habitations is not proposed.
14. Mine Inundation		
14.1	The Project Proponent needs to explore the likelihood of river water entering into the mine pit below the RL of the HFL and the measures that are required to be taken for prevention of seepage and in the event of seepage to drain out the water through settling tank. PP also needs to submit the measures to be taken for protection of river in the vicinity of the mine lease area due to mining activity.	The influence of HFL of Kalay River has no impact on mining area. The topography of the area is sloping from west towards east. The flow of the water is from west to east towards Kalay River. The HFL of Kalay River is 36.6 m AMSL. The Mineral Block has an elevation of about 10 m above the HFL of Kalay River. Hence, there is no likelihood of river water entering into the mine pit. The proposed mine working area is at a distance of about 430 m. hence, there is no chance of seepage. The conditions laid under Regulation 127 and 128 of The Metalliferous Mines Regulations, 1961, will be complied

		with. A detailed study on likelihood of river water entering into the mine pit of Block IV – Kalay Mineral Block, was conducted by Government Engineering College, Farmagudi, Goa. Kindly refer **Appendix - 4.**
15. Engineering Design		
15.1	The Project Proponent needs to submit the detailed report on the engineering design for garland drain, settling tank and check dams and its efficacy through recognized institution. The study should also include the per day silt load, settling velocity of the silt, retention time required based on the annual rainfall with a provision to monitor the turbidity of the overflow from the siltation tank as well as monitoring of the turbidity into the drains.	The detailed report on the engineering design for garland drain, settling tank and check dams and its efficacy has been carried out by Government Engineering College, Farmagudi, Goa. Copy of the report is Enclosed as **Appendix - 4.**
16. Ecology Restoration Plan		
16.1	The project Proponent needs to submit the ecology restoration plan.	Ecological restoration Plan is prepared and enclosed as **Annexure 18.**
Standard Terms of Reference for (Mining of Minerals)		
1. Project Details		
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. The production details need to submit since inception of mine duly authenticated by Department of Mines & Geology, State Government.	The Goa Government has auctioned the Block IV – Kalay Mineral Block as a fresh Lease and Letter of Intent (LOI) dated 13/01/2023 is issued to Fomento Resources Private Limited. The Mineral Block is a fresh grant through e-auction and hence the year-wise production since 1994 is not applicable.
1.2	A copy of the document in support of rightful lessee of the mine should be submitted. In case of new mines copy of LoI granted by State Government to be submitted. PP should ensure that LoI is valid at the time of grant of	Copy of Letter of Intent dated 13/01/2023 in support of rightful lessee of the mine is enclosed as **Annexure - 2**.

	ToR. PP should submit the copy of lease deed/supplementary lease deed / extension letter/transfer deed, from its initial grant to subsequent renewals/ transfer/extension of validity.	
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.	Mining Lease area, production levels, waste generation and its management, mining technology, etc. are compatible with IBM Approved Mine Plan and Draft EIA/EMP. This compatibility will be further maintained in final EIA/EMP. All documents are in the name of Fomento Resources Private Limited.
1.4	PP should submit the District Survey Report (DSR) as per S.O. 3611(E) dated 25.07.2018 in case of minor minerals.	Not Applicable
1.5	Brief of proposal to be submitted which include total excavation of the material required for the production of certain quantity of the minerals, location of the project, mining lease area, latitude longitude, seismic zone etc. In case of expansion project details of expansion viz. expansion in mining lease area or expansion in production of any particular mineral or expansion in total excavation, latest certified Compliance report (CCR) from IRO of conditions granted in existing EC needs to be submitted.	The Mineral Block is a fresh grant through e-auction. Brief of proposal to be submitted which include total excavation of the material required for the production of certain quantity of the minerals, location of the project, mining lease area, latitude longitude, seismic zone etc., during the mining plan period, is given **Chapter – 2.**
1.6	The PP should submit the real-time aerial video footage & video of the mining lease area and of the transportation route.	Project Proponent has collected real-time aerial video footage & video of the mining lease area and transport route, and the same will be submitted during the appraisal for Environmental Clearance.
1.7	All corner coordinates of the mine lease area, superimposed on a High-Resolution Imagery / topo sheet, topographic sheet, geomorphology and geology of the area should be provided. Such an Imagery of the	All corner coordinates of the Mineral Block area are superimposed on High Resolution Imagery and Toposheet (1:50,000) in **Plate Nos. 4 & 3 respectively.** These images show the Mining Lease area along with land use and

	proposed area should clearly show the land use and other ecological features of the study area (Core and buffer zone).	other ecological features of the study area (core and buffer zone). The Mineral Block area is also superimposed on Geomorphology Map of the Study area in **Plate No. 10** & in Map showing Geological Formation of the Study Area in **Plate No. 9.**
1.8	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.	Mining Lease area is superimposed on Toposheet (1:50,000) in **Plate No. 3.** Mineral Block area has been superimposed on Geological Formation of the Study Area shown in **Plate No. 9** and in Geomorphological maps in **Plate No.10**. Information with respect to existing minerals is given in **Para 3.5.1** of **Chapter 3**. While, **Table 3.4** of **Chapter-3** gives information on important water bodies, streams and rivers in Para and soil characteristics in **Para 3.4.5** of **Chapter - 3**.
1.9	The PP should collect the Baseline data (BLD) in respect of initial level of the mining lease. For this permanent bench marks (BM) needs to be established at prominent location preferably close to mining leases in question and should have precisely known relationship to the level datum of the area, typically mean sea level.	Permanent Bench Mark has been established at the site and the location is referred under WGS 84 datum. Baseline data (BLD) is in respect of initial level of the mining lease, which is collected based on the Bench Mark.
1.10	In case of sand mining, the entire mining lease area should be divided suitably into grids of 25 m x 25 m with the help of sections across the width of river and along the direction of flow of the river. The levels (MSL & RL) of the corner point of each grid needs to be recorded. Each Grid should be suitably numbered for identification. PP should identity grids which	Not applicable as the Mineral Block is a Iron Ore Mining Lease.

	will be worked out and grids which will come under no mining zone i.e. safety barriers from the river bank. PP should comply with the sustainable sand mining management guidelines 2016 and enforcement and monitoring guidelines, 2020 etc.	
1.11	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.	The time bound Progressive greenbelt development plan for five-year mining plan period is proposed for an area of about 2.8 Ha with plantation of 7500 saplings. Details of greenbelt development during the mining plan period is provided in **Table 10.6**. List of the local and native species suggested for future plantation is provided in **Table 10.7**. The details of plantation and greenbelt development is provided in **Table 10.6, Para 10.6.7.2** in **Chapter-10**.
1.12	Details of the onsite shelter and facilities to be provided to the mine workers should be included in the EIA report.	The following site services will be provided in the vicinity of the project site. 1. Canteen 2. Rest shelters 3. Drinking water facility 4. Latrines and urinals 5. First-Aid station Please refer **Para 2.8.10.5** of **Chapter - 2.**
1.13	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.	Conceptual post mining land use and Reclamation and Restoration of mined out areas and the plans with adequate number of sections have been included in the EIA report. Please refer **Para 10.6.7** of **Chapter - 10** and **Plate Nos. 8 & 22**.

1.14	The cost of the Project (Capital cost and recurring cost) as well as the cost towards implementation of EMP should be clearly spelt out.	The cost of the Project is **Rs 3680 lakhs**. An amount of Rs. 74 Lakhs as capital cost and Rs. 45.45 Lakhs as recurring cost is estimated towards the implementation of EMP.
1.15	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 implementation of the project on environmental, social, economic benefits and employment potential of the mine proposal is covered in **Chapter 8.**
2. Forest		
2.1	PP shall submit a certificate from Chief Conservator of Forests regarding involvement of Forest Land in the mining lease area if any. In case forest land is involved i) PP should submit the proof of application made for obtaining forest clearance and ii) a map clearly showing the forest & non-forest area.	Communication from the Office of the Principal Chief Conservator of Forests has been obtained informing the presence of 21.133 ha. of forest land within the Mineral Block. The copy of the communication is enclosed as Annexure 20. i) The Project Proponent filed an application in Form-A under Section 2 of Forest (Conservation) Act, 1980, for the diversion of forest area of 21.133 Ha. Copy of the application bearing proposal no. FP/GA/MIN/QRY/472990/2024 dated 5/05/2024 is enclosed as Annexure 6. ii) Cadastral Map showing Mining lease boundary of Block IV – Kalay Mineral Block along with demarcation of forest area is enclosed as Plate No. 22.
2.2	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.	An application has been filed under Section 2 of Forest Conservation Act, 1980, bearing proposal no. FP/GA/MIN/QRY/472990/2024 dated 15/05/2024, for diversion of 21.1330 ha. of forest land lying within the Mineral Block

		and the same is under process. A copy application dated 15/05/2024 is enclosed as **Annexure 6.** Net Present Value and Compensatory Afforestation will be deposited as after the grant of forest clearance. On grant, the Project Proponent will furnish a copy of Forest Clearance obtained for an area of 21.133 ha.
2.3	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.	A letter has been submitted to the District Collector, South Goa, Goa requesting to provide implementation status of recognition of forest rights under the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006. The reply is awaited. A copy of the letter dated 24/10/2024 has been enclosed as **Annexure 21.**
2.4	The vegetation in the RF/PF area in the study area, with necessary details, should be given.	Biological study has been carried out in the study area i.e. buffer zone of the proposed Project. The flora & fauna present in the study area has been listed in **Table 3.28a & b** of **Para 3.6.9.4** of **Chapter 3**.
3. Court Matters		
3.1	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. Writ Petition 592 of 2022 in Hon'ble High Court of Bombay at Goa. • The said petition seeks to challenge the constitutionality of the tender documents of Phase I auction of Goa mines. • The petition alleges that there is a non-disclosure of essential facts such as bore hole data, approved mining plan, production data of the previous five years and exploration data and has therefore prayed for quashing of auction notice to the extent it fails to include the essential facts which is

		against the principle that level playing field should be provided to the petitioner for its participation in the auction. 2. As per the last order, Fomento Resources Private Limited is added as a party to the petition as it has acquired Block IV - Kalay Mineral Block in e-auction tendered vide NIT dated 30/09/2022. 3. No stay on conducting the e-auction of Mineral Block granted and the Case is pending for disposal.
4. Land Environment		
4.1	PP should submit the details of survey number [viz. survey no, area in hectare, classification of land (government, private, forest, grazing land etc.), villages] duly authenticated by State Government, falling in the mining lease area.	Details of land provided by Directorate of Mines & Geology, Government of Goa depicted in Block IV - Kalay Mineral Block Tender document summary is as mentioned below: 1. Total Concession Area - 179.1826 Ha. further reduced to 152.5073 Ha. 2. Forest Land with Status - Not Applicable 3. Land Owned by the State Government - 79.5398 Ha. 4. Land not owned by the State Government - 72.9675 Ha. Block IV - Kalay Mineral Block Tender Document Summary is enclosed as **Annexure 10.** Details of survey nos. and its area falling within Mineral Block, is provided in authenticated DGPS Map enclosed as **Plate No. 2.**
4.2	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 the Mineral Block area and 10 kms radius around the mine lease from lease periphery. The EIA covers all the activities upto the end of Mining Lease Period. Please refer **Chapter-2.**

4.3	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 and Land Cover study of the study area was carried out to indicate forest area, agricultural land, grazing land, water bodies, human settlements and other ecological features and the same is detailed in **Para 3.6.8** of **Chapter-3**. Land Use Land Cover Plan is enclosed as **Plate No. 19.** Land use pattern of preoperational (Existing), operational (plan period) and post operational (conceptual) phases of the Mining Lease area are shown in **Para 2.8.7** of **Chapter - 2.** Land Use Plan is enclosed as **Plate No. 19.** Impact on land cover and mitigative measures are covered in **Para 4.3** of **Chapter - 4.**
4.4	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.	There is no proposal to stack the Over Burden/Waste outside the Mining Lease area.
5. Wildlife		
5.1	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.	Detailed flora & fauna study was conducted to ascertain the impact of the Mining Project on wildlife in the study area. Anticipated impacts of proposed project on wildlife of the study area and mitigation measures are given in **Para 4.8** in **Chapter-4**. The budget allocated for wildlife conservation and mitigative measures is given in **Para 10.7.1** of **Chapter-10**. The Wildlife Conservation Plan is prepared in consultation with Forest Department, Goa and submitted to Chief Wildlife Warden. Wildlife Conservation Plan is enclosed as **Appendix-1**. A copy of acknowledgement letter of submission dated 05.03.2024 is enclosed as **Annexure 8**.

5.2	A detailed biological study of the study area [core zone and buffer zone] 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. PP shall submit list of schedule-I species present in core and buffer zone duly authenticated by CWLW. 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/Wildlife Department and details furnished. Necessary allocation of funds for implementing the same should be made as part of the project cost. Proof of its submission of conservation plan to the CWLW needs to be submitted.	The detailed biological study was conducted during summer season 2023, and recorded some schedule-1 fauna within 10 km radius which is listed in **Para 3.6.9.4** of **Chapter-3**. The authenticated list of flora & fauna from Dy. Conservator of Forest, South Goa is enclosed as **Annexure 11**. Budgetary provision for wild life conservation plan is provided in Para 10.7.1 of chapter 10. The Wildlife Conservation Plan is prepared and enclosed as **Appendix-1** and submitted to Chief Wildlife Warden, copy enclosed as **Annexure-8**.
5.3	PP shall submit a certificate from Chief Wildlife Warden regarding distance of mining lease from the protected area falling within 10 KM of the mining lease. In case project requires clearance under Wildlife (Protection) Act, 1972 then copy of application made for the same needs to be submitted.	Copy of a letter issued by Forest Department mentioning the distance of Bhagwan Mahaveer Wildlife Sanctuary from Mineral Block boundary, along with authenticated location Map, is enclosed as **Annexure 12**. A copy of letter from MoEF&CC (through RTI) mentioning that based on the inspection, clarification from the State Forest Department and Environment Department, Block IV- Kalay Mineral Block area (Auction Block) of M/s Fomento Resources Private Limited located at village Santona, Sanguem Taluka, South Goa District Goa falls outside of ESZ of Bhagwan Mahaveer Wildlife Sanctuary and National Park and ESA of Western Ghats. Enclosed as **Annexure 13**. Letter issued by the Department of

		Environment & Climate Change, Goa mentioning that the Mineral Block falls outside the Eco-Sensitive Area of Western Ghats is enclosed as **Annexure 14**.
6. Baseline Environment		
6.1	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-dominate downwind direction and location of sensitive receptors. There should be at least one monitoring station within 500m of the mine lease in the pre-dominant downwind direction. The mineralogical composition of PM10, particularly for free silica, should be given.	One season baseline data in the study area (Core and Buffer zone), covering summer season-2023, on ambient air quality as per CPCB Notification of 2009, water quality, noise level, soil and flora and fauna has been collected and date wise data presented in the EIA Report enclosed as **Annexure 7.** Site-specific meteorological data has also been collected and included in the EIA Report. The location of monitoring stations has been finalized to represent whole of the study area, keeping in view the predominant downwind direction and location of sensitive receptors. One monitoring station is located within 500 m of the mine lease in the predominant downwind direction. The monitoring location details and the monitoring results are discussed in **Chapter-3** of the EIA report. The details of mineralogical composition of PM10, particularly for free silica are also presented in the EIA Report and enclosed as **Annexure 7**.
6.2	Air quality modelling 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 on a modelling should be provided. The air quality contours may be shown on a location map clearly indicating the location of the site,	The air quality modelling was carried out for the mining project using AERMOD software. Results of air quality modelling along with Windrose showing pre-dominant wind direction indicated on the map is presented in **Para 4.5** of **Chapter-4.**

	location of sensitive receptors, if any, and the habitation. The Windrose showing pre-dominant wind direction may also be indicated on the map.	
6.3	The PP should submit the photograph of monitoring stations & sampling locations. The photograph should bear the date, time, latitude & longitude of the monitoring station/sampling location. In addition to this, PP should submit the original test reports and certificates of the labs from which samples were analysed.	Photographs of some of the monitoring stations & sampling locations bearing date, time, latitude & longitude are enclosed in **Chapter 3** of EIA/EMP Report. Original test reports are enclosed as **Annexure 7** and certificate of the lab from which the samples are analysed is enclosed in the EIA/EMP report.
7. Water Environment		
7.1	The water requirement for the Project, its availability and source should be furnished. Quantity of surface or ground water to be used for the project should be indicated. A detailed water balance should also be provided. Submit the year wise target for reduction in consumption of the ground/surface water by developing alternative source of water through rain water harvesting measures. 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. The capital and recurring expenditure to be incurred needs to be submitted.	The total water requirement for the Mine is 300 m3/day. Water requirement will be met from the harvested rain water in the mine pit within the mining lease area and from the registered water vendors through tankers for domestic purpose. Water requirement and detailed water balance is given in **Fig. 2.2** in Para **2.8.10.4.** Rain water harvesting will be extensively practiced details of which is give in **Paras 3.5.3** and **4.2.1.3**. Such harvested rain water will be utilised for dust separation, green belt development etc., is given in **Para 2.8.10.4**.
7.2	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.	Impact of the project on the surface and ground water environment and mitigation measures are discussed in **Para 4.7** of **Chapter-4** and the necessary mitigation measures are mentioned in **Para 10.6.3** of **Chapter-10**.
8. Hydro Geology		
8.1	Details of any stream, seasonal or otherwise, passing through the lease area and modification / diversion proposed, if any, and	There exists one seasonal nallah within the Mineral Block passing from the West to the East of the Mineral Block as shown in the plan

	the impact of the same on the hydrology should be brought out.	attached as **Plate No. 5.** Detailed hydrogeological study has been conducted for the entire Project area. As per the approved mining plan, currently we do not have any proposal to divert the nallah. However, during the conceptual period, based upon the requirement, the proposal to divert the nallah will be undertaken only after conducting the impact studies of the same on the hydrology and after obtaining necessary approvals of the same from IBM and other competent authorities.
8.2	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.	The highest and lowest elevation in the Mining Lease is 102 m AMSL (Dump height) & -0.5 m AMSL (pit bottom) respectively. Mine will be worked upto an elevation of -31m AMSL (75m bgl) and the ultimate pit depth will be upto 133 m (75m bgl) (including dump height). Average depth of ground water level within the mine is at an elevation of about 39 m AMSL (about 5 m bgl).
8.3	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 case of surface water is proposed to be utilised then Necessary clearance from the	The Mineral Block has been granted by the Goa State Govt. through e-auction process. The Mineral block was operated by the erstwhile lessee and the mine has intersected groundwater table. A detailed hydrogeological study has been conducted with respect to Block IV – Kalay Mineral Block, enclosed as **Appendix - 2**. Necessary permission has been obtained from the Water Resource Department, Govt. of Goa for drawl of ground water. Permission enclosed as **Annexure 9.** Surface water from natural water bodies will

	Competent Authority for drawl of requisite quantity of water for the Project should be provided.	not be drawn.
9. Transportation		
9.1	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 of 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 traffic density study is carried out as per Indian Road Congress Guidelines. Impact on local transport infrastructure due to the Project has been assessed. There shall not be any significant impact on the local transport. Please refer **Para 3.7** of **Chapter-3** & **Para 4.11** of **Chapter-4.**
10. Land Acquisition And R&R		
10.1	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 of the concerned authority.	Subsequent to the successful conclusion of the auction conducted as per the Mineral (Auction) Rules 2015, DMG declared Fomento Resources Private Limited as Preferred Bidder on 22/12/2022 and issued Letter of Intent (LOI) dated 13/01/2023 for Grant of Mining Lease for Block IV – Kalay Mineral Block for Iron Ore Mineral in Santona Village, Sanguem Taluka, South Goa District, Goa. LOI is enclosed as **Annexure 1,** along with details of land proposed for mining activity in **Plate No. 2.**
10.2	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	As the mining operation will not affect the habitation as 50 m statutory barrier will be maintained form the habitation, there will not be any shifting of habitation located within the mineral block. Hence R&R is not required and the same is not proposed. Family-wise, need based sample survey, has been carried out in the study area to assess

	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.	requirements of SCs /STs and other weaker sections of the society, in the EIA baseline study. The action plan programme is prepared and included in the EIA Report under Socio-economic studies provided in **Para 3.6.10** of **Chapter-3.**
11. Socio-economic Environment		
11.1	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.	The public health implications due to the Project and mitigation measures are discussed in **Para 3.6.10.4 G** of **Chapter-3** and **Para 4.10** of **Chapter-4**. Budgetary allocation for the public health as a part of CSR is provided in **Para 8.1** of **Chapter-8**.
11.2	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.	Detailed socio-economic study in the study area carried out is and provided in **Para 4.10** of **Chapter-4.** **Para 8.2** of **Chapter-8** details the socio-economic benefits. Budgetary allocation towards CSR is provided in **Table 8.1** in **Chapter-8.**
11.3	Public Hearing points raised and commitment of the Project Proponent on the same along with the 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.	After completion of public hearing, the action plan for public demand with timeline shall be provided in Final EIA & EMP Report.
11.4	Activity-wise time-bound action plan on the issues raised and commitment made during public hearing to be submitted as part of the final EMP Report in compliance of the Ministry's OM F.No.22-65/2017-IA.III dated 30th September, 2020.	Shall be submitted after Public Hearing is conducted.

12. Environmental Monitoring and Management		
12.1	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 proposed safeguard measures in each case should also be provided.	The Project Proponent has a well laid down Environmental Policy the details are given in **Para 10.3.** An Environmental Management Cell will be constituted to deal with the environmental issues, ensuring compliance with the EC conditions, as well as for reporting of non-compliances / violations of environmental norms. Details are furnished in **Para 10.4** of **Chapter-10**.
12.2	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.	Detailed Environmental Management Plan (EMP) to mitigate the environmental impacts has been prepared, which also includes the impacts of the project on change of land use and proposed mitigation measures is presented in **Chapter 10.** Occupational health impacts and mitigation measures are discussed in **Para 10.10** of **Chapter 10.**
13. Critically Polluted Areas, Aravali & CRZ		
13.1	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	The Mineral Block area does not fall under any Coastal Regulation Zone (CRZ).

	approval of the concerned Coastal Zone Management Authority).	
13.2	Proximity to Areas declared as 'Critically polluted' or the Project area 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.	There is no Critically Polluted Area within 10km radius from the Mineral Block boundary. Also, the Project does not come under the 'Aravali Range'.
14. Risk Assessment & Disaster Management		
14.1	Issues relating to Mines 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.	The proposed Mine is an Open Cast Mine. Mining operation will be carried out by mechanised open cast mining method. The process will involve ripping of hard ground by ripper & dozer and by avoiding conventional drilling and blasting operations. The mining operations will be carried out in accordance with the IBM Approved Mining Plan. The details of Mining Process is provided in **Para 2.8** of **Chapter-2**. Slope stability study has been carried out by National Institute of Technology Karnataka, Surathkal. Copy of slope stability report is enclosed as **Appendix-3.** Issues with respect to mine safety and safety measures has been discussed in **Para 7.2** of **Chapter-7**.
14.2	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	Detailed Occupational Health Impacts of the Project and their mitigative measures are given in **Para 7.5** of **Chapter-7**. Details of pre-placement medical examination and periodical medical examination schedules

	project specific occupational health mitigation measures with required facilities proposed in the mining area may be detailed.	is given in **Para 7.5.5**. Occupational Safety & Health plan is provided in **Para 10.11** of **Chapter 10**.
14.3	A Disaster management Plan shall be prepared and included in the EIA/EMP Report.	Disaster management Plan is detailed in **Para 7.4** of **Chapter-7**.
15. Miscellaneous		
15.1	General points are also to be followed: - a) All documents with proper reference 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&CC 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	a) All documents are properly referenced and the entire EIA report are continuously paginated. b) Period of data and sources are indicated. c) Baseline data collected by Environmental Laboratory unit of M/s. Mineral Engineering Services, which is accredited by MoEF&CC is enclosed vide **Annexure 7**. d) All documents are in English e) Questionnaire will be filled and submitted at the time of environmental appraisal of the project. f) EIA report is prepared as per the instructions for the consultants issued by MoEF&CC vide O.M.No J-11013/41/2006-IA.II(I) dated 4th august 2009. g) There are no changes in the basic scope.

	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 revised documentation.	
	h) As per the circular no. J-11011/618/2010-IA.II(I) dated 30.05.2012, 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 regional office of ministry of environment, forest and climate change, as may be applicable.	h) Not applicable as the mining project is freshly granted through e-auction and EC is yet to be obtained.
	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.	i) The EIA report includes- (i) Surface plan of the area indicating contours of main topographic features, drainage and mining area, (ii) geological maps and sections and (iii) Relevant sections of the mine pit are enclosed. Dumping of waste outside the Mineral Block is not proposed.

Item-wise Compliance Status of Amended TOR conditions issued by Ministry of Environment Forest & Climate Change (MoEF & CC) ToR identification no. TO24B0000GA5934761A dated 19/11/2024.

Specific Conditions		
S. No.	**Terms of Reference**	**Status**
1.	PP needs to submit the stage-1 Forest Clearance for the forest land of 21.133 ha lying within the ML area.	An application has been filed under Section 2 of Forest Conservation Act, 1980, bearing proposal no. FP/GA/MIN/QRY/472990/2024 dated 15/05/2024, for diversion of 21.1330 ha. of forest land lying within the Mineral Block

		and the same is under process. On grant, the Project Proponent will submit Stage-1 Forest Clearance obtained for an area of 21.133 ha. of at the time of EC appraisal.
2.	The Project Proponent needs to submit the revised Mine Plan at the time of Environmental Clearance application, incorporating the newly identified forest area of 21.133 hectares.	In view of the involvement of forest area of 21.1330 Ha., confirmed by the Office of the Principal Chief Conservator of Forest, Forest Department, Goa vide their letter dated 19/06/2024, the approved Mining Plan vide letter No. MCDR-MPCOFE/2/2O23-GOA-IBM_RO_GOA dated 30/06/2023 was modified accordingly. Subsequently, the modified mining plan was approved by the IBM, vide letter No. MCDR-MPC0FE/6/2024-GOA-IBM_RO_GOA dated 23/08/2024. Copy of the approval letters for Mining plan dated 19/06/2024 and 23/08/2024 issued by IBM are enclosed as **Annexure 3**.
3.	PP needs to explore whether freshwater requirement can be reduced for the project. Construction of water reservoir in the lease are should also be explored.	The Project Proponent will explore methods to reduce freshwater requirement for the Project. Some of the measures proposed to conserve water and reduce the water consumption are given under **Para 10.6.3.** It is also proposed to construct pond to store pumped out water and to collect storm water as a reservoir. The collected water in this pond will be used for plantation, dust suppression, etc.
4.	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	Some of the most effective and commonly used best available technology for pollution control measures in mining industry that are proposed to be installed within the Mineral Block during mining

	compare with the best available technology in the field.	operations are given below: • Dust suppression: Dust suppression systems such as sprinklers, fog guns, etc. will be installed at loading, hauling, and unloading points and also at strategic locations in place of sprinkling of water through water tankers. The dust suppression arrangement will reduce water consumption as well as fuel consumption in comparison with traditional water tankers. • Road maintenance: Haul roads within the mine will be maintained in good condition by engaging motor grader and by regular spraying of water. Such arrangement will help in reduction of fuel consumption, frequent breakdowns of trucks plying and reduction in wear and tear of vehicle tyres. • Mechanical sweepers will be engaged for sweeping of the transportation road ensuring reduced dust pollution and improved road safety. Dedicated manpower to clean the ore spillage on the public road by manual sweeping and washing. • Green belt development: Develop green belt along periphery of the Mineral Block, inactive dumps, unused area to arrest the spread of dust and act as a barrier to noise propagation.

		• State of the art heavy earth moving machineries which are fuel efficient and less noise emitting machines. • Establishing wheel washing system at the exit of the Mineral Block to clean off dust from the trucks leaving the Mineral Block. • Care will be taken that the trucks will not be overloaded. The cargo box of the ore carrying trucks will be covered with tarpaulin of sufficient thickness and maintain sufficient free board to avoid spillage of ore during transportation. • Establish air quality monitoring at strategic locations to monitor dust originating from the operation of the Mineral Block. • DG sets with acoustic insulators as per manufacturers specifications will be deployed. DG sets will be provided with stacks of sufficient height. Air quality and noise levels emitted for the DG sets will be monitored regularly. • Use of solar energy for the purpose of illumination during night time will be made. Feasibility of using Solar energy for office area will be carried out.

EIA & EMP

Text

CONTENTS

TABLE OF CONTENTS

Particulars				Page No.
CHAPTER 1: INTRODUCTION				**1**
1.1			Brief introduction	2
1.2			Purpose of the report	2
1.3			Identification of project proponent & project	4
	1.3.1		Identification of project proponent	4
	1.3.2		Identification of the Project	4
1.4			Brief description of nature, size and location of the project and its importance to the country, region	5
	1.4.1		Brief description of nature and size of the project	5
	1.4.2		Location and accessibility of the project	5
	1.4.3		Importance of the Project to the Country and Region	6
1.5			Statutory clearances	7
	1.5.1		Mining plan	7
	1.5.2		Clearance from National Board of Wildlife	8
	1.5.3		Forest clearance	8
	1.5.4		Clearance under Coastal Regulation Zone (CRZ)	8
1.6			Scope of the Study	8
	1.6.1		Baseline data generation	9
	1.6.2		Data collection	9
	1.6.3		Secondary data collection	10
1.7			Structure & preparation of EIA & EMP report	11
	1.7.1		Structure of EIA & EMP report	11
	1.7.2		Preparation of EIA & EMP report	11
CHAPTER 2: PROJECT DESCRIPTION				**14**
2.1			Type of project	15
2.2			Year - wise production details	15
2.3			Need for the project	15
2.4			Location of the project	16
2.5			Environmental setting	17
2.6			Size or magnitude of operation	19
2.7			Proposed schedule for approval & project implementation	20
2.8			Project description – including drawings showing project layout, components of the project etc.	21
	2.8.1		Geology	21
	2.8.2		Structure	21
	2.8.3		Exploration And Reserve Estimation	22
		2.8.3.1	Exploration	22
		2.8.3.2	Proposed Exploration	22
	2.8.4		Existing Mine workings	23
	2.8.5		Proposed Mine workings	23
	2.8.6		Proposed development and production of Iron Ore	24
	2.8.7		Land Use pattern of mine lease area	24
	2.8.8		Mining and operation process	25
	2.8.9		Waste Generation	26
		2.8.9.1	Generation of waste	26
		2.8.9.2	Waste Management	26

	2.8.10		Resource Requirement	27
		2.8.10.1	Machinery Requirement	27
		2.8.10.2	Fuel and Power Requirement	27
		2.8.10.3	Manpower Requirement	27
		2.8.10.4	Water Requirement	28
		2.8.10.5	Site Services	28
2.9			Description of mitigation measures incorporated into the project to meet environmental standards, environmental operating conditions, or other EIA requirements (as required by the scope).	29
2.10			Assessment of new & untested technology for the risk of technological failure	32
CHAPTER 3: DESCRIPTION OF THE ENVIRONMENT				**33**
3.1			Study area	34
3.2			Study period	34
3.3			Environmental components	34
3.4			Methodology & description	35
	3.4.1		Micrometeorology	35
	3.4.2		Ambient air quality	35
	3.4.3		Noise levels	36
	3.4.4		Water quality	36
	3.4.5		Soil characteristics & methodology	37
	3.4.6		Calibration	38
	3.4.7		Flora-fauna	39
	3.4.8		Socio-economic survey	39
	3.4.9		Land environment	39
	3.4.10		Geology	39
	3.4.11		Hydrogeology	39
3.5			Environmental scenario	40
	3.5.1		Geology	40
		3.5.1.1	Regional geology	40
		3.5.1.2	Local geology	41
	3.5.2		Geomorphology & topography	42
		3.5.2.1	Geomorphology	42
		3.5.2.2	Topography	42
	3.5.3		Drainage pattern	42
	3.5.4		Hydrogeology	44
3.6			Baseline & base maps - environmental components	45
	3.6.1		Baseline schedule	45
	3.6.2		Micrometeorological status	47
	3.6.3		Air environment	52
		3.6.3.1	Selection of sampling stations	52
		3.6.3.2	Frequency of monitoring	54
		3.6.3.3	Method of analysis	54
		3.6.3.4	Observations	55
		3.6.3.5	Results	56
	3.6.4		Mineralogical composition of PM10	57
	3.6.5		Noise environment	57
		3.6.5.1	Noise monitoring stations	57

		3.6.5.2	Results	58
	3.6.6		Water environment	59
		3.6.6.1	Surface water quality	59
		3.6.6.2	Results interpretations	62
		3.6.6.3	Ground water quality	63
		3.6.6.4	Results interpretation	66
	3.6.7		Soil quality	66
		3.6.7.1	Soil sampling stations	66
		3.6.7.2	Result interpretation	69
	3.6.8		Land environment	69
		3.6.8.1	Land use and land cover of the study area	69
		3.6.8.2	Land use of mineral block area	69
	3.6.9		Biological environment	70
		3.6.9.1	Study region	71
		3.6.9.2	Methodology	72
		3.6.9.3	Field survey	75
		3.6.9.4	Observations and discussions	76
		3.6.9.5	Conservation threat status	87
	3.6.10		Socio-economic environment	94
		3.6.10.1	Description of environment	94
		3.6.10.2	Socio-economic analysis based on sample survey	95
		3.6.10.3	Demographic status as per 2011 census	96
		3.6.10.4	Social status	97
		3.6.10.5	Need assessment study	108
3.7			Traffic density measurement	110
CHAPTER 4: ANTICIPATED ENVIRONMENTAL IMPACTS & MITIGATION MEASURES				**113**
4.1			Environmental impacts	114
4.2			Impact due to project location & proposed mitigative measures for the project	115
	4.2.1		Impacts on land environment	115
		4.2.1.1	Impacts on land use due to mining activity	115
		4.2.1.2	Impact due to waste generation of the mining activities	115
		4.2.1.3	Mitigation measures	116
	4.2.2		Impact due to possible accidents & proposed mitigative measures	117
		4.2.2.1	Impact due to accidents caused by vehicles used in mining operations	117
		4.2.2.2	Mitigation measures to prevent accidents	117
		4.2.2.3	Impacts due to land slide	118
		4.2.2.4	Mitigation measures	118
4.3			Impacts due to project design and project construction, regular operations and proposed mitigative measures, final decommissioning or rehabilitation of completed project.	119
	4.3.1		Land use	119
	4.3.2		Mitigation measures for mined out land and mine closure	120
4.4			Impacts due to operations & proposed mitigative measures	121
4.5			Impact on air environment & proposed mitigative measures	121
	4.5.1		Impact on air quality	121
	4.5.2		Air quality prediction through mathematical modelling– impact of mining operations on environment	123

		4.5.2.1	Air quality predictions through mathematical modelling	123
		4.5.2.2	Meteorological conditions used in predictions	128
		4.5.2.3	Results and discussions	128
	4.5.3		Air quality prediction – impact of traffic on environment	132
4.6			Impact of noise level & vibration on environment	133
	4.6.1		Impact of noise and vibration	133
	4.6.2		Mitigation measures	133
		4.6.2.1	Controlling noise level of machineries-engineering controls	133
		4.6.2.2	Use of protective equipment- administrative control	134
4.7			Impacts on water and proposed mitigative measures	134
	4.7.1		Impact on surface water	134
	4.7.2		Impact on ground water	135
	4.7.3		Mitigation measures	136
4.8			Anticipated impacts and mitigation measures on biological environment (ecology)	136
4.9			Anticipated impacts on flora and fauna and it's mitigation measures	139
	4.9.1		Impact on flora	139
	4.9.2		Mitigation measures with respect to flora	139
	4.9.3		Impact on fauna	140
	4.9.4		Mitigation measures	140
	4.9.5		Impact on Wetlands	141
	4.9.6		Mitigation Measures`	141
4.10			Socioeconomic impact of Block IV - Kalay Mineral Block (anticipated impact)	142
	4.10.1		Impact on human habitations	142
	4.10.2		Livelihood	143
	4.10.3		Economics	143
	4.10.4		Impact on the cropping pattern and the crop production in the buffer zone	143
	4.10.5		Compensation for loss of land and crops	143
	4.10.6		Impact on the community resources such as grazing land	143
	4.10.7		Mitigation measures	144
4.11			Impact on local transport infrastructure due to the project –Proponent shall conduct impact of transportation study as per Indian Road Congress guidelines	145
4.12			Evaluation of impacts	147
	4.12.1		Biological environment	149
	4.12.2		Environmental pollution	150
	4.12.3		Aesthetic environment	152
	4.12.4		Human interest	153
CHAPTER 5: ANALYSIS OF ALTERNATIVES (TECHNOLOGY & SITE)				**156**
5.1			Analysis of alternative technologies	157
5.2			Analysis of alternative sites	157
CHAPTER 6: ENVIRONMENTAL MONITORING PROGRAM				**159**
6.1			Introduction	160
6.2			Scope of environmental monitoring program	160
6.3			Technical aspects	160

	6.3.1		Methodologies	160
	6.3.2		Frequency & locations of environmental monitoring	161
	6.3.3		Data analysis	161
		6.3.3.1	Micrometeorology	162
		6.3.3.2	Air quality	162
		6.3.3.3	Work zone air quality	163
		6.3.3.4	Ground water levels	163
		6.3.3.5	Surface and ground water quality	163
		6.3.3.6	Ambient noise levels	163
		6.3.3.7	Work zone noise levels	163
		6.3.3.8	Occupational health and safety	163
		6.3.3.9	Plantation and green belt development	164
6.4			Reporting schedule	164
6.5			Environmental management cell	164
	6.5.1		Emergency procedure	165
	6.5.2		Detailed budget & procurement schedules	165
CHAPTER 6: ADDITIONAL STUDIES				**168**
7.1			Public consultation	169
7.2			Risk assessment	169
7.3			Emergency preparedness & response plan	175
	7.3.1		Objectives of emergency preparedness & response plan	175
	7.3.2		Emergencies	175
7.4			Disasters	185
	7.4.1		Disaster management plan	185
	7.4.2		Duties of Mines Manager	186
	7.4.3		Duties of assistant mines manager	187
	7.4.4		Duties of mechanical engineer	187
	7.4.5		Duties of electrical engineer	188
	7.4.6		Duties of mine surveyor	188
	7.4.7		Duties of medical officer:	188
	7.4.8		Duties of security officer	188
	7.4.9		Duties of security guard	188
7.5			Occupational health & safety	189
	7.5.1		Occupational health risks	190
	7.5.2		Precautionary measures	190
	7.5.3		Personal Protective Equipment (PPE)	191
	7.5.4		Training	191
	7.5.5		Occupational health surveillance	191
	7.5.6		Pit safety committee	192
	7.5.7		Fire protection	192
7.6			R & R action plan	193
7.7			Care and maintenance during temporary discontinuance	193
CHAPTER 8: PROJECT BENEFITS				**195**
8.1			Introduction	196
8.2			Socio-economic benefits	196
	8.2.1		Employment opportunity	196
	8.2.2		Social benefits	196
8.3			Environmental benefits	198

8.4			Budget for socio-economic welfare activities	199
CHAPTER 9: COST BENEFIT ANALYSIS				**200**
9.1			Introduction	201
9.2			Cost Benefit Analysis	201
CHAPTER 10: ENVIRONMENTAL MANAGEMENT PLAN				**204**
10.1			Objective	205
10.2			Environmental management cell	206
10.3			Health, safety & environment policy	207
10.4			System of complying with legal requirements and reviewing by management/ board members	209
10.5			Training	209
10.6			Environmental management plan	210
	10.6.1		Air pollution control	210
	10.6.2		Wastewater management	211
	10.6.3		Water management	211
	10.6.4		Noise pollution control	213
	10.6.5		Protective measures for ground vibrations/air blast caused by blasting	214
	10.6.6		Solid & hazardous waste management	214
	10.6.7		Land reclamation & land rehabilitation	216
		10.6.7.1	Land reclamation	216
		10.6.7.2	Land rehabilitation	217
10.7			Wildlife management and conservation plan	220
		10.7.1	Brief mitigation measures for conservation of wildlife	222
10.8			Budget for environment management plan (EMP)	225
10.9			Environmental monitoring strategy	226
10.10			Occupational safety and health plan	226
	10.10.1		Hearing impairment	227
	10.10.2		Skin diseases	237
	10.10.3		Eye diseases	227
	10.10.4		Job stress because of working in accident prone environment	227
	10.10.5		Respiratory diseases	227
	10.10.6		Hazards due to materials like asbestos, silica, chrome dust, etc.	228
10.11			Occupational safety	228
	10.11.1		Provision of rest shelter for workers with facilities of drinking water	228
	10.11.2		Awareness of safety and use of personal protective equipment (PPE)	228
	10.11.3		Regular maintenance of testing of equipment.	228
	10.11.4		Medical examination of all employees	228
	10.11.5		Safety measures of risk assessment in underground mining	229
	10.11.6		Conduct of mock drill	229
	10.11.7		Safe storage of handling of explosives	229
10.12			Socio-economic conditions of the region	229
	10.12.1		Medical assistance	229
	10.12.2		Primary education	229
	10.12.3		Rural water supply	229
	10.12.4		Vocational training	229
	10.12.5		Employment	230
	10.12.6		Communication and accessibility	230

CHAPTER 11: SUMMARY AND CONCLUSION				231
11.1			Introduction	232
11.2			Project Description	232
11.3			Environmental Sensitivity	233
11.4			Grant of TOR and Baseline data collection	233
11.5			Mining methodology	234
11.6			Production, reserves and life of mine	234
11.7			Manpower, water and power requirement	234
11.8			Resettlement and Rehabilitation	235
11.9			Description of the environment	235
	11.9.1		Topography	235
	11.9.2		Drainage	235
	11.9.3		Ambient air quality	236
	11.9.4		Noise levels	236
	11.9.5		Water quality	236
	11.9.6		Soil quality	236
	11.9.7		Land environment	237
	11.9.8		Biological environment	237
	11.9.9		Socio-economic environment	238
11.10			Anticipated Environmental Impacts and mitigation measures	238
	11.10.1		Air environment	238
	11.10.2		Water environment	239
	11.10.3		Noise Environment	239
	11.10.4		Impact on land environment	240
	11.10.5		Impact on biological environment	240
	11.10.6		Impact on socio-economic environment	240
11.11			Additional studies	240
11.12			Environment Management Plan	241
11.13			Corporate Social Responsibility	241
11.14			Corporate Environment Responsibility	241
11.15			Environmental Monitoring Programme	241
11.16			Explanation on how adverse effects are mitigated	242
11.17			Conclusion	242
CHAPTER 12: DISCLOSURE OF CONSULTANTS ENGAGED				243
			Disclosure of Consultants	244

List of Tables

Particulars		Page
Table 1.1	Co-ordinates of lease boundary pillars of Block IV – Kalay Mineral Block	5
Table 1.2	EIA Report Structure	11
Table 1.3	Environmental attributes and frequency of monitoring	12
Table 2.1	Boundary co-ordinates of the Mining Lease	16
Table 2.2	Project Details	17
Table 2.3	Environmental Setting	18
Table 2.4	List of Industries and mines falling within 10 km radius in Study area	19
Table 2.5	Areas under different levels of exploration	20
Table 2.6	Mineral Reserves and Resources estimated as on 01/02/2023	20

Table 2.7	Tentative Schedule for Approval & Project Implementation	21
Table 2.8	Details of exploration already carried out in the Mine Lease area	22
Table 2.9	Proposed exploration by way of boreholes	23
Table 2.10	Details of Mine Pits	23
Table 2.11	Details of Production and Development	24
Table 2.12	Land Use pattern of mine lease area	24
Table 2.13	Proposed Year-wise generation of overburden/waste during the plan period	26
Table 2.14	Year-wise dump development and its stabilization	26
Table 2.15	List of Machinery proposed to be engaged in mining operations	27
Table 2.16	List of proposed manpower	28
Table 2.17	Water Requirement for the project	28
Table 2.18	Anticipated Environmental Impacts and Mitigation Measures Proposed	30
Table 3.1	Parameters for air quality monitoring, methodology and frequency of measurement	35
Table 3.2	Standard/Method followed for Analysis of Water Parameters	36
Table 3.3	Geological sequence of the rocks of Goa region	40
Table 3.4	Distance & Direction of River/ Stream/Nallah within buffer zone	43
Table 3.5	Distance & Direction of Reservoir within the buffer zone	43
Table 3.6	Baseline Schedule	45
Table 3.7	Environmental Attributes & Frequency of Monitoring	46
Table 3.8	Annual Rainfall Data from 2007-2022 in mm	48
Table 3.9	Site-Specific Micro-Meteorological Data Summer 2023	49
Table 3.10	Location of Ambient Air Quality Monitoring Stations	53
Table 3.11	National Ambient Air Quality Standards	54
Table 3.12	Statistical Report of Ambient Air Quality	55
Table 3.13	Noise level monitoring locations	57
Table 3.14	Summary of Noise monitoring	58
Table 3.15	Noise Quality Standards	59
Table 3.16	Location of Surface Water Sampling Stations	60
Table 3.17	Surface water monitoring result of mine pit water	61
Table 3.18	Surface water monitoring result	61
Table 3.19	Location of Ground Water Sampling Stations	63
Table 3.20	Ground water monitoring result	64
Table 3.21	Location of Soil Sampling Stations	66
Table 3.22	Soil monitoring results	67
Table 3.23	Land Use pattern of buffer zone	69
Table 3.24	Existing Land use of Mineral Block	70
Table 3.25	Land use of Mineral Block at the Conceptual stage	70
Table 3.26	Flora species recorded within core zone	77
Table 3.27	List of faunal species within core zone	78
Table 3.28a	Ecologically Important habitat from the Project boundary	79
Table 3.28b	General description of landscape within buffer zone	79
Table 3.29	Trees growing in buffer zone	81
Table 3.30	Shrubs recorded in buffer zone	83
Table 3.31	List of Herbs and Climbers within buffer zone	84
Table 3.32	List of Secondary tree species documented by Biodiversity Board, Goa	85
Table 3.33	Flora species recorded in farmlands/roadside within buffer zone	86
Table 3.34	Domesticated and cultivated species recorded in buffer zone	86

Table 3.35	Endemic, Keystone and Threatened species recorded in buffer zone	87
Table 3.36	List of mammal species recorded within buffer zone	87
Table 3.37	Checklist of Reptiles reported from the buffer zone	88
Table 3.38	List of toads and amphibians reported within buffer zone	89
Table 3.39	List of birds recorded within buffer zone	90
Table 3.40	List of butterfly species recorded within buffer zone	93
Table 3.41	List of fishes and crab species reported within buffer zone	94
Table 3.42	Population as per census 2011	96
Table 3.43	Population by Broad Caste Groups in Buffer Zone, Census 2011	98
Table 3.44	Percentage Distribution of Population by Broad Caste Groups in Buffer Zone, Census 2011	99
Table 3.45	Literacy Rates	99
Table 3.46	Employment, Agriculture and Industrial status as per census 2011	103
Table 3.47	Number of Patients suffering from the following Diseases in Buffer Zone and around it, Survey 2023	107
Table 3.48	Distance of medical laboratories conducing following Tests from the Buffer Zone, Survey 2023	108
Table 4.1	Maximum quantity of material handling during fourth year	115
Table 4.2	Proposed dumping of the waste/overburden during the plan period	116
Table 4.3	Protective measures proposed to be undertaken during Mining plan period	117
Table 4.4	Current Land use of the Mineral Block	119
Table 4.5	Land Use of Mineral Block at the Conceptual Stage	119
Table 4.6	Quantity of dust emission calculated for excavation of Iron Ore, Waste	125
Table 4.7	Quantity of dust emission calculated for ore and waste transportation	125
Table 4.8	Quantity of dust emission calculated for transportation of Iron ore to Capxem & Sanvordem Jetty	126
Table 4.9A	Predicted concentrations of PM10 and PM2.5	129
Table 4.9B	Predicted concentrations of SO2 and NOx	129
Table 4.10	Impacts and proposed mitigative measures to control air pollution	132
Table 4.11	Significance of Impact on Biological Environment	137
Table 4.12	Impact Parameters	144
Table 4.13	Environmental Evaluation: Biological Environment	150
Table 4.14	Environmental Evaluation of Environmental Pollution	151
Table 4.15	Environmental Evaluation of Aesthetic Environment	152
Table 4.16	Environmental evaluation of human interest	153
Table 4.17	Summary of environmental evaluation	154
Table 4.11a	Scenario A - Unequal PIUs (Current Evaluation)	154
Table 4.17b	Scenario B - Equal PIUs (Hypothetical Evaluation)	155
Table 6.1	Monitoring Schedule for Environmental Parameters	161
Table 6.2	Estimated budgetary allocation for environmental monitoring	166
Table 6.3	Environmental Monitoring Program	166
Table 7.1	Summary of risks and their control measures	174
Table 8.1	Approximate Annual proposed Expenditure (in Rs.) towards CSR for the 1st Five-year Mining Plan Period	199
Table 9.1	Cost Benefit Analysis of Block IV – Kalay Mineral Block	201
Table 10.1	Air Pollution Management and Control Measures	211
Table 10.2	Proposed year-wise construction of garland drains & retaining wall	212
Table 10.3	Noise Pollution Management and Control measure	213

Table 10.4	Overburden/waste dump details	214
Table 10.5	Proposed dumping of the waste/overburden during the plan period	215
Table 10.6	Green belt planning during mining plan period	219
Table 10.7	List of species suggested for future green belt development	219
Table 10.8	List of Scheduled I Wildlife species	221
Table 10.9	EMP Cost	225
Table 10.10	Monitoring Schedule for Environmental Parameters	226

List of Figures

Particulars		Page
Fig. 2.1	Flowchart showing process of mining operation	25
Fig. 2.2	Flowchart showing water requirement	29
Fig. 3.1	Month-wise rainfall of South Goa District	48
Fig. 3.2	Windrose diagram (Summer 2023)	52
Fig. 3.3	Noise Levels observed during Day-time	59
Fig. 3.4	Noise Levels observed during Night-time	59
Fig. 3.5	Graphical representation of results of some of the surface water parameters	62
Fig. 3.6	Graphical representation of results of some of the groundwater parameters	65
Fig. 3.7	Graphical representation of results of some of the soil parameters	68
Fig. 3.8	Schematic diagram showing the four quartiles for biodiversity sampling	72
Fig. 3.9	Sub-quadrat nested within the quadrat for shrubs, herbs, climbers & grass	73
Fig. 3.10	IUCN categories showing threatened species categories	74
Fig. 3.11	Forest Type of Block IV – Kalay Mineral Block	76
Fig. 3.12	Buffer zone of proposed Block IV – Kalay Mineral Block indicating Quartiles	80
Fig. 3.13	Total population distribution	97
Fig. 3.14	Caste distribution	99
Fig. 3.15	Literacy rates	101
Fig. 3.16	Employment, Agriculture and Industrial Status as per Census 2011	102
Fig. 3.17	Google Earth Image showing transportation route	111
Fig. 3.18	Average daily Traffic distribution	112
Fig. 4.1	PM10 Prediction	130
Fig. 4.2	PM2.5 Prediction	130
Fig. 4.3	SO2 Prediction	131
Fig. 4.4	NOX Prediction	131
Fig. 4.5	Assigned weights for environmental parameters	148
Fig. 6.1	Environmental Management Cell (EMC)	165
Fig. 7.1	Organizational chart for disaster management	186
Fig. 10.1	Environmental Management Cell	206

List of Plates

Particulars		Page
Plate No. 1	Location Plan	246
Plate No. 2	Lease Plan	247
Plate No. 3	Key Plan	248
Plate No. 4	High Resolution Satellite Imagery	249

Plate No. 5	Surface plan	250
Plate No. 6	Geological Plan	251
Plate No. 7	Geological Cross sections	252
Plate No. 8	Conceptual Plan	259
Plate No. 9	Geological map of study area	260
Plate No. 10	Geomorphological map	261
Plate No. 11	Digital elevation map	262
Plate No. 12	Drainage Map	263
Plate No. 13	Contour Map	264
Plate No. 14	Key plan showing Air monitoring locations	265
Plate No. 15	Key plan showing Noise monitoring locations	266
Plate No. 16	Key plan showing surface water monitoring locations	267
Plate No. 17	Key plan showing ground water monitoring locations	268
Plate No. 18	Key plan showing soil sampling stations	269
Plate No. 19	Land Use Land Cover Map	270
Plate No. 20	Normalised Difference Vegetation Index Map	271
Plate No. 21	Environment Plan	272
Plate No. 22	Cadastral Map demarcating forest area	273

List of Annexures

Annexures	Description	Page No.
Annexure 1	Letter of Intent	275
Annexure 2	Letter communicating revision of Mineral Block area	280
Annexure 3	Mining Plan Approval letters from IBM	282
Annexure 4	Terms of Reference and Amended ToR	286
Annexure 5	Letter and authenticated plan from Directorate of Mines & Geology on ESZ	316
Annexure 6	FCA application under Section 2	319
Annexure 7	Environmental Baseline Report	329
Annexure 8	Acknowledgement from Chief Wildlife Warden	370
Annexure 9	Permission from Water Resources Department, Goa.	373
Annexure 10	Summary of Tender Document	376
Annexure 11	Authenticated List of Flora and Fauna	380
Annexure 12	Letter from Forest Department confirming Mineral Block falls outside ESZ of BMWLS	404
Annexure 13	MoEF & CC Letter (through RTI) Mineral Block Area falls outside ESZ and ESA	408
Annexure 14	Letter from Dept. of Environment & climate Change, Goa mentioning that the Mineral Block does not fall within the Eco-Sensitive Area of Western Ghats	466
Annexure 15	Road transportation - Impact, Measures and SOP.	467
Annexure 16	Employment based skill development plan.	475
Annexure 17	Railway line - map, train frequency and measures.	479
Annexure 18	Ecology Restoration plan	483
Annexure 19	Sequence of mining operation and plan for backfilling.	491
Annexure 20	Communication from Office of the PCCF, Government of Goa, informing the presence of forest land within Block IV.	499
Annexure 21	Letter submitted to District Collector, requesting to provide status of FRA	501

List of Appendix

Appendix	Description	Page No.
Appendix 1	Wildlife Conservation Plan	505
Appendix 2	Hydrogeological study report	567
Appendix 3	Slope stability report	674
Appendix 4	Engineering design report	747

Chapter-1

Introduction

1.1 BRIEF INTRODUCTION

Block IV – Kalay Mineral Block, having an area of 152.5073 Ha is located in Santona Village, Sanguem Taluka, South Goa District, Goa State.

Government of Goa, through Directorate of Mines and Geology (DMG), issued Notice Inviting Tender (NIT) on 30/09/2022 in accordance with the Mineral (Auction) Rules, 2015. As per the said NIT, the auction process for Block IV – Kalay Mineral Block for Iron Ore mineral was conducted. Upon conclusion of the aforesaid auction, DMG, Govt. of Goa, declared Fomento Resources Private Limited as Preferred Bidder for Block IV – Kalay Mineral Block on 22/12/2022. Pursuant to the declaration as Preferred Bidder under Rule 9(9)(iii) of Auction Rules, DMG was pleased to issue the Letter of Intent (LOI) dated 13/01/2023 for grant of Mining Lease over an area of 179.1826 Ha. Further, vide letter dated 13/03/2023, DMG, Govt. of Goa revised the area of the Block from 179.1826 Ha to 152.5073 Ha., excluding the Eco Sensitive Zone (ESZ) with respect to Bhagwan Mahaveer Wildlife Sanctuary and National Park for the grant of Mining Lease for Block IV - Kalay Mineral Block for Iron Ore Mineral. The executed Mining Lease will be valid for a period of 50 years from the date of registration of Mining Lease Deed. A copy of the Letter of Intent dated 13/01/2023 is enclosed as **Annexure 1** and a copy of letter dated 13/03/2023 is enclosed as **Annexure 2**.

Fomento Resources Private Limited intends to obtain prior Environmental Clearance from MoEF&CC for production of 0.75 MPTA of Iron Ore from Block IV - Kalay Mineral Block.

Mining Plan was prepared and submitted to Indian Bureau of Mines for its approval for the proposed production capacity of 0.75 MTPA under the provisions of Rule 16(1) of MCR 2016. Mining Plan was approved by the Indian Bureau of Mines (IBM), Goa Region vide letter No. MCDR-MPCOFE/2/2O23-GOA-IBM_RO_GOA dated 30/06/2023. Subsequently, in view of the involvement of forest area of 21.1330 Ha., confirmed by the Office of the Principal Chief Conservator of Forest, Forest Department, Goa vide their letter dated 19/06/2024, the Mining Plan was accordingly modified and approved by the IBM, vide letter bearing No. MCDR-MPC0FE/6/2024-GOA-IBM_RO_GOA dated 23/08/2024. Copy of the approval letters for Mining plan dated 19/06/2024 & 23/08/2024 issued by IBM are enclosed as **Annexure 3**.

1.2 PURPOSE OF THE REPORT

The Letter of Intent dated 13/01/2023 granted by DMG, Govt. of Goa, prerequisites obtaining various Consents, Approvals, Permits, NOC as may be required under

applicable laws for the commencement of mining operations, which will culminate into signing of Mine Development and Production Agreement (MDPA) and subsequent execution of Mining Lease Deed and commencement of mining operations. In view of the above, the project proponent intends to obtain prior Environmental Clearance from MoEF & CC for production of 0.75 MPTA of Iron Ore from Kalay Mineral Block located at Santona village, Sanguem Taluka, South Goa District, Goa.

As per the Schedule of Environment Impact Assessment (EIA) Notification dated 14th September 2006 and its subsequent amendments, the proposed project falls under activity 1(a) 'Mining of Minerals' and categorized as Category 'B'. As the General Conditions are applicable, the proposed project is appraised at the Ministry of Environment, Forest & Climate Change.

The project proponent filed an online application in PARIVESH Portal of MoEF & CC for the grant of Terms of Reference (ToR) to conduct Environmental Impact Assessment for the project Block IV- Kalay Mineral Block with a proposed production capacity of 0.75 MTPA of Iron Ore. ToR was granted by MoEF & CC vide its TOR Identification No. TO23B0000GA5122365N dated 08/01/2024.
Condition no. 2.1 of ToR stipulates as under:

> *"2.1 PP shall submit a certificate from Chief Conservator of Forests regarding involvement of Forest Land in the mining lease area if any. In case forest land is involved i) PP should submit the proof of application made for obtaining forest clearance and ii) a map clearly showing the forest & nonforest area."*

In compliance to the above condition no. 2.1, and subsequent to our communication, the Office of the Principal Chief Conservator of Forest, Panaji, Goa, vide its letter No. 6-13-(177)-2024-25-FD/1088 dated 19/06/2024, informed that Block IV - Kalay Mineral Block includes Unclassed Forest area of 18.2210 Ha. and Prospective Private Forest area of 2.901 Ha. within the Mineral Block area of 152.5073 Ha.

In view of the involvement of the forest area within the Mineral Block, the Project Proponent filed an online application on PARIVESH Portal of MoEF&CC for amendment in ToR granted on 08/01/2024. The MoEFCC was pleased to amend the TOR dated 08/01/2024 by addition of following specific conditions as mentioned in the Amended TOR dated 19/11/2024.

Additional Specific Conditions

1.	PP needs to submit the stage-1 Forest Clearance for the forest land of 21.133 ha lying within the ML area.
2.	The Project Proponent needs to submit the revised Mine Plan at the time of Environmental Clearance application, incorporating the newly identified forest area of 21.133 hectares.
3.	PP needs to explore whether fresh water requirement can be reduced for the project. Construction of water reservoir in the lease area should also be explored.
4.	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.

A copy of TOR dated 08/01/2024 and amended ToR dated 19/11/2024 are enclosed as **Annexure 4**.

This report is prepared in accordance with the EIA Notification, 2006 and addresses all the conditions of the approved ToR. This report presents the baseline condition of the project area, the possible impacts in the surroundings due to the project, mitigation measures and management plan.

1.3 IDENTIFICATION OF PROJECT PROPONENT & PROJECT

1.3.1 IDENTIFICATION OF PROJECT PROPONENT

Fomento Resources Private Limited is the project proponent whose details are provided herein below:

Registered Address: Fomento Resources Private Limited

1st Floor, 102, Kamat metropolis -1
Behind Caculo Mall, St. Inez
Panaji- Goa- 403001

Email : fomento@fomento.com

Phone no. : 08322441000

1.3.2 IDENTIFICATION OF THE PROJECT

Block IV-Kalay Mineral Block is an Iron Ore Mines having an area of 152.5073 Ha, located at Santona Village, Sanguem Taluka, South Goa District, Goa.

The Govt. of Goa through Directorate of Mine and Geology (DMG), conducted e-auction of the Block vide its NIT dated 30/09/2022. Fomento Resources Private Limited was declared as Preferred Bidder for Block IV - Kalay Mineral Block on 22/12/2022. Furtherance to the issuance of LOI dated 13/01/2023 read with letter dated 13/03/2023.

1.4 BRIEF DESCRIPTION OF NATURE, SIZE AND LOCATION OF THE PROJECT AND ITS IMPORTANCE TO THE COUNTRY, REGION

1.4.1 BRIEF DESCRIPTION OF NATURE AND SIZE OF THE PROJECT

The proposed project is a fully mechanized opencast mine having an area of 152.5073 Ha. The project is of standalone type and will involve extraction of Iron Ore.

Based on the exploration details provided in the Geological Report by the Directorate of Mines and Geology, Govt. of Goa, the total mineral reserves/resources of iron Ore as on 01.02.2023 is 16.731 Million Tonnes. The proposed extraction capacity of Iron Ore is 0.75 MTPA.

1.4.2 LOCATION AND ACCESSIBILITY OF THE PROJECT

The proposed project is located at Santona Village, Sanguem Taluka, South Goa District, Goa. All the coordinates of the lease boundary corner as per DGPS Plan approved from Directorate of Mines and Geology, Govt. of Goa are given in Table 1.1.

Table 1.1: Co-ordinates of lease boundary pillars of Block IV – Kalay Mineral Block

Pillar No.	Pillar Latitude (dd:mm:ss.ss)	Pillar Longitude (dd:mm:ss.ss)
BP 1	15° 17′ 58.2803″N	74° 09′ 31.3905″E
BP 2	15° 18′ 02.6197″N	74° 09′ 29.8008″E
BP 3	15° 18′ 08.7974″N	74° 08′ 55.2583″E
BP 4	15° 17′ 40.1839″N	74° 09′ 03.3467″E
BP 5	15° 17′ 30.9847″N	74° 09′ 08.5955″E
BP 6	15° 17′ 01.6125″N	74° 09′ 13.1548″E
BP 7	15° 17′ 12.4794″N	74° 09′ 41.2969″E
BP 8	15° 17′ 13.0200″N	74° 09′ 44.8333″E
BP 9	15° 17′ 16.8213″N	74° 09′ 43.9885″E
BP 10	15° 17′ 19.1419″N	74° 09′ 40.8072″E
BP 11	15° 17′ 23.3295″N	74° 09′ 36.4971″E

BP 12	15° 17′ 26.7696″N	74° 09′ 33.4331″E
BP 13	15° 17′ 30.5546″N	74° 09′ 31.2826″E
BP 14	15° 17′ 36.0551″N	74° 09′ 29.0348″E
BP 15	15° 17′ 40.9091″N	74° 09′ 28.2686″E
BP 16	15° 17′ 44.5813″N	74° 09′ 28.2599″E
BP 17	15° 17′ 49.1710″N	74° 09′ 29.2119″E
BP 18	15° 17′ 54.4169″N	74° 09′ 30.5870″E

The Mineral Block is accessible by tar road. The Mineral Block is located at a distance of 1.27 Km from State Highway Road No. SH-7 viz. the Sanvordem-Dabal-Dharbandora Road. National Highway NH748 connecting the states of Karnataka and Goa runs on the North-North East side of the Mineral Block at an distance of approximately 7.0 Km. Jetties are accessible via State Highway SH-7 and gives access to the waterway joining Zuari River in the upstream and opening in to the Arabian Sea at the downstream. The nearest railway station is Kalay Railway station, located at a distance of about 4.0 km. Dabolim airport is at a distance of 49 Km from the Mineral Block. Location plan, lease plan and key plan are enclosed vide **Plate No. 1, Plate No. 2 & Plate No. 3,** respectively.

There are no critically polluted areas identified by CPCB/ MoEF&CC in the vicinity of the proposed project.

1.4.3 IMPORTANCE OF THE PROJECT TO THE COUNTRY AND REGION

Iron ore is the raw material used in manufacturing steel, which in turn is the building block for infrastructure development. As steel is involved in a long-term business proposition, Indian Bureau of Mines have emphasized in its report 'Iron and Steel – Vision 2020' the necessity to plan the availability of raw material resources at least for a period of 50 years. Availability of manpower and presence of abundant Iron Ore reserves make India competitive in the global set up.

Therefore, to meet the growing demand of steel and to support in country's GDP extraction of raw materials becomes imperative & inescapable endeavor.

The project will generate employment and business opportunities to the interior population of the State, thereby increasing their socio-economic status and provide livelihood.

The project will contribute towards statutory payments such as Bid Premium, Royalty, DMF, NMET, GIOPF, etc., to the State & Central Government exchequer in addition to various applicable taxes.

The proposed project shall extend social benefits like provision of drinking water, support in health care and education to the neighboring villages in addition to generation of employment. Further, this project is expected to yield a positive impact on the socio-economic environment of the region. It will contribute towards sustainable development of this area including further development of physical infrastructural facilities.

1.5 STATUTORY CLEARANCES

Fomento Resources Private Limited shall obtain all the necessary Statutory Clearances viz. Environmental Clearance, Consent to Operate (CTO) from Goa State Pollution Control Board, Ground Water Clearance from Water Resource Department of Goa, and other applicable permissions/ clearances before the commencement of mining operations.

All the documents/approvals/permissions including Approved Mining Plan and EIA-EMP are compatible with one another in terms of the Mining Lease area, production levels, waste generation and its management, mining technology, etc.

1.5.1 MINING PLAN

Mining Plan was prepared and submitted to Indian Bureau of Mines for its approval for the proposed production capacity of 0.75 MTPA under the provisions of Rule 16(1) of MCR 2016. Mining Plan was approved by the Indian Bureau of Mines (IBM), Goa Region vide letter No. MCDR-MPCOFE/2/2O23-GOA-IBM_RO_GOA dated 30/06/2023. Subsequently, in view of the involvement of forest area of 21.1330 Ha., confirmed by the Office of the Principal Chief Conservator of Forest, Forest Department, Goa vide their letter dated 19/06/2024, the Mining Plan was accordingly modified and approved by the IBM, vide letter No. MCDR-MPC0FE/6/2024-GOA-IBM_RO_GOA dated 23/08/2024.

Copy of the approval letters for Mining plan dated 19/06/2024 and 23/08/2024 issued by IBM are enclosed as **Annexure 3**.

1.5.2 CLEARANCE FROM NATIONAL BOARD OF WILDLIFE

Clearance from the National Board of Wildlife is not applicable for the proposed project.

There are no Sanctuaries, National Parks, ESZ or ESA within Mining Lease area. Block IV – Kalay Mineral Block falls outside the notified ESZ of 1 Km of Bhagwan Mahaveer Wildlife Sanctuary & National Park.

The Dy. Conservator of Forests, Working Plan Division, Govt. of Goa, issued vide letter no. DCF(WP)/S-D/Vol-I/67/2022-23/347 dated 05/07/2023 and an authenticated plan, through the Directorate of Mines and Geology, Govt. of Goa, certifying that the Block IV – Kalay Mineral Block falls outside the notified ESZ boundary of Bhagwan Mahaveer Wildlife Sanctuary and National Park. A copy of the above communication dated 05/07/2023 is enclosed as **Annexure 5.**

1.5.3 FOREST CLEARANCE

Office of the Principal Chief Conservator of Forest, Panaji, Goa, vide its letter No. 6-13-(177)-2024-25-FD/ 1088 dated 19/06/2024, informed that Block IV - Kalay Mineral Block includes Unclassed Forest area of 18.2210 Ha. and Prospective Private Forest area of 2.901 Ha. within the Mineral Block area of 152.5073 Ha.

Accordingly, an application has been filed under Section 2 of Forest Conservation Act, 1980, bearing proposal no. FP/GA/MIN/QRY/472990/2024 dated 15/05/2024, for diversion of the said Forest land. A copy of application in Form-A filed online for diversion of forest land is enclosed as **Annexure 6.**

1.5.4 CLEARANCE UNDER COASTAL REGULATION ZONE (CRZ)

The proposed Project 'Block IV - Kalay Mineral Block' does not fall under Coastal Regulatory Zone area and hence is not applicable.

1.6 SCOPE OF THE STUDY

Block IV – Kalay Mineral Block falls under "Category B" as per EIA notification dated on 14th September, 2006 of MoEF&CC and as amended vide EIA Notification dated 20/04/2022, as the project area is less than 250 Ha. As General Conditions are applicable, the proposed project is appraised at the MoE& CC. The Expert Appraisal Committee (EAC), MoEF&CC appraised the application and granted ToR vide its letter No. TO23B0000GA5122365N, dated 08/01/2024 and subsequent to ToR

amendment application dated 27/06/2024, ToR was amended vide letter No. TO24B0000GA5934761A dated 19/11/2024. ToR dated 08/01/2024 and ToR amendment dated 19/11/2024 was used as guidelines to prepare the Environmental Impact Assessment and Environmental Management Plan.

The EIA study broadly includes –

i. Detailed characterization of various environmental components like Meteorology, Air, Noise, Water, Soil, Land and Socio-economics within 10 km radius around the Mineral Block area.
ii. Baseline study including Hydrology study, Ground water study, Ecology and Biodiversity assessment and Land Use & Land Cover within in 10 Km radius around the Mineral Block area. The EIA is based on collection of data for Summer Season (March 2023 to May 2023).
iii. Mine Slope Stability Study with respect to the Mineral Block.
iv. Risk Assessment Study
v. Traffic Density Study

1.6.1 BASELINE DATA GENERATION

QCI/NABET accredited consultant, Mineral Engineering Services, Bellary, has been allocated work to undertake Environmental Impact Assessment (EIA) studies as per the Terms of Reference (ToR) and to assess the impacts of the project on various environmental parameters and prepare a suitable Environment Management Plan for the project.

The baseline data was generated by Environment Laboratory (Unit of Mineral Engineering Services, Bellary) is a NABL accredited laboratory and recognized by MoEF & CC. The baseline data generation is in accordance with the statutory requirement and is for a period from March 2023 to May 2023 (Summer Season). The baseline data includes micro-meteorological parameters, ambient air quality, noise levels, surface & ground water quality and soil characteristics.

1.6.2 DATA COLLECTION

The EIA study is carried out for the Core Zone (Mineral Block) and Buffer Zone of 10 km radius from the Mineral Block boundary, both of which comprises the study area.

The following data has been collected from the study area by Environment Laboratory (Unit of Mineral Engineering Services, Bellary) through field survey and other secondary sources for preparing the EIA/EMP for the project.

- Details of fauna and flora within core zone and buffer zone.
- Eco-sensitive places, sanctuaries, biosphere reserves.
- Physical environment (Air, Water, Soil, & noise) baseline data.
- Religious places / historical monuments and tourist places.
- Land use pattern based on Survey of India toposheet map and satellite image.
- Demography and Socio-economics based on primary data obtained from field survey & latest available Census data for entire study area.
- Relevant meteorological data, for previous decades from Indian Meteorological Department (IMD) and primary data.
- Transportation study
- Study of present environmental protection and mitigation measures in nearby operating similar projects, if any.
- Identification of water bodies, hills, roads, etc.

1.6.3 SECONDARY DATA COLLECTION

Secondary data was collected from the following sources:

- India Meteorological Department (IMD)
- Geological Survey of India (GSI)
- Botanical Survey of India
- Zoological Survey of India
- Central Ground Water Board (CGWB)
- National Remote Sensing Centre (NRSC)
- Survey of India (SOI)
- Indian Council of Agricultural Research (ICAR)
- National Bureau of Soil Survey and Land Use Planning (NBSS & LUP)
- Census of India, 2011
- Approved Mining Plan

1.7 STRUCTURE & PREPARATION OF EIA & EMP REPORT

1.7.1 STRUCTURE OF EIA & EMP REPORT

The EIA-EMP is prepared as per the generic structure '*Appendix III - Generic Structure of Environmental Impact Assessment Document'*, defined in the EIA notification dated 14th September 2006 and as amended from time to time addressing all the TOR conditions stipulated by EAC, MoEF&CC.

Table 1.2: EIA Report Structure

Chapter Number	EIA Structure
1	Introduction
2	Project Description
3	Description of the Environment
4	Anticipated Environmental Impact & Mitigation Measures
5	Analysis of Alternatives (Technology & Site)
6	Environmental Monitoring Program
7	Additional Studies
8	Project Benefits
9	Environmental Cost Benefits
10	Environment Management Plan (EMP)
11	Executive Summary & Conclusion
12	Disclosure of Consultant Engaged

1.7.2 PREPARATION OF EIA & EMP REPORT

The EIA/EMP will include the following details:

- Present Environmental setting.
- Identification, prediction, and evaluation of anticipated impacts with respect to various environmental parameters in the core and buffer zone due to the proposed mining and allied activities.
- Sensitive Places/Historical Monuments existing in the surrounding area of the project.
- Measures to control surface and ground water pollution due to various effluents discharged, if any.
- Measures to control air pollution due to proposed mining and allied activities.
- Green belt development plan of mine.

- Measures to contain noise pollution & mitigate adverse impact caused to the workers and habitat in core and buffer zone.
- Pronounce the improvement in socio-economic conditions & benefits to local community on implementation of the project.
- Capital and recurring cost of implementation of Environmental Management Plan.
- Suggest Environmental monitoring programme its implementation, organization and feedback mechanism for effective mid-course corrections.
- Identification of native floral species for green belt development.

Field studies with respect to baseline environmental monitoring (ambient air, ambient noise, surface and groundwater and soil attributes) were conducted for a period of three months (Summer Season). Various environmental attributes and the frequency of study is outlined in **Table 1.3** given below. The scope also includes all the conditions prescribed in the ToR.

Table 1.3: Environmental attributes and frequency of monitoring

S. No.	Attributes	Parameters	Frequency and Source
1	Ambient Air Quality	PM10, PM2.5, SO_2, NO2, CO, NH3, O3, Benzene, Benzo(a)pyrene, As, Pb, Ni & mineralogical composition of PM10, particularly for free silica	24 hourly samples, twice a week for three months at 8 locations.
2	Meteorology	Wind speed, Wind direction, Temperature, and Relative humidity	Continuous hourly recording (one season) at project site. Secondary data from the nearest IMD station.
3	Water quality (Surface and Ground water)	Physical and Chemical parameters.	Grab samples collected once during study period (summer season) from 6 surface water locations and 8 ground water locations.
4	Soil Quality	Physical and Chemical parameters.	Grab samples collected once during study period (summer season) from 7 locations.
5	Ecology & Biodiversity	• Existing terrestrial flora and fauna in Core Zone & Buffer Zone. • Existing aquatic ecological status in Buffer Zone	Through field studies once during study period (summer season).
6	Noise levels	Noise levels in Leq Day and Night time	24 hourly Noise levels once in study period (Summer season) at 8 locations.
7	Land use	Current land use scenario	Once during study period (Summer

S. No.	Attributes	Parameters	Frequency and Source
			season) based on recent satellite imagery and ground-truthing at site.
8	Geology	Geological details	Once during study period (Summer season). Data collected from secondary sources (Mining Plan).
9	Hydrology and Hydrogeology	Drainage pattern, nature of streams, aquifer characteristics, recharge, and discharge areas, etc.	Based on primary and secondary sources, once during study period (Summer season).
10	Socio-Economic aspects	Socio-economic aspects like demography, population dynamics, infrastructure resources, health status, economic resources, etc.	From primary and secondary sources (like census abstracts of census of India 2011) once during the study period.

Chapter-2

Project Description

2.1 TYPE OF PROJECT

The proposed project, 'Block IV – Kalay Mineral Block' is an e - auctioned Mineral Block for grant of mining lease auctioned by Director of Mines and Geology, Govt. of Goa, under the Mineral (Auction) Rules, 2015 for which Environmental Clearance is being sought. This project falls under Category 'B' [S. No. 1(a)(i): Mining of Minerals] i.e. <250 ha of mining lease area in respect of non-coal mining in the Schedule - 'List of projects or activities requiring prior Environmental Clearance' of the EIA Notification dated 14th September, 2006 and amended from time to time. As General Conditions are applicable, the project is to be appraised at MoEF & CC, New Delhi. Mining operations will be carried out by following mechanized open cast method of mining by engaging Heavy Earth Moving Machinery (HEMM) like Ripper-Dozer, Hydraulic excavators, Wheel loaders and Trucks. There will be no drilling and blasting activities involved during the course of mining. Mining operations will commence after obtaining all the statutory permissions and approvals and after registration of executed Mining Lease Deed.

2.2 YEAR - WISE PRODUCTION DETAILS

The Mineral Block is a newly auctioned mining lease. Mining operations will be commenced after obtaining all the statutory permissions and approvals and after registration of executed Mining Lease Deed.

2.3 NEED FOR THE PROJECT

The Mining Project proposes to produce 0.75 MTPA of Iron Ore. Based on the present estimated reserves & resources of Iron Ore, the life of the mine is expected to be 24 years, which may enhance based on results of future exploration during the Mining Plan period.

Iron ore is the raw material used in the manufacture of steel, which in turn is the building block for infrastructure development. As steel is involved in a long term business proposition, Indian Bureau of Mines have emphasized in its report 'Iron and Steel – Vision 2020' the necessity to plan the availability of raw material resources at least for a period of 50 years. Easy availability of manpower and presence of abundant Iron Ore reserves make India competitive in the global set up. Therefore, to meet the growing demand of steel and to support in country's GDP extraction of raw materials becomes unavoidable.

This project is expected to yield a positive impact on the socio-economic environment of the region. It helps in the sustainable development of this area including further development of physical infrastructural facilities. The project will generate employment and business opportunities to the interior population of the State, thereby improving their socio-economic status and their livelihood. The proposed project shall extend social benefits like health care measure, educational benefits, drinking water etc. to the neighboring villagers in addition to employment.

The project will contribute towards statutory payments such as Bid Premium, Royalty, DMF, NMET, GIOPF, etc., to the State & Central Government exchequer in addition to various applicable taxes.

2.4 LOCATION OF THE PROJECT

The Mineral Block is located in Santona Village, Sanguem Taluka, South Goa District, Goa, having boundary pillar co-ordinates shown in **Table 2.1** below.

Table 2.1: Boundary co-ordinates of the Mining Lease

Mineral Block Boundary Pillar Nos.	Co-ordinates (Datum: WGS84)	
	Latitude (Northing)	Longitude (Easting)
BP-1	15° 17′ 58.2803″	74° 09′ 31.3905″
BP-2	15° 18′ 02.6197″	74° 09′ 29.8008″
BP-3	15° 18′ 08.7974″	74° 08′ 55.2583″
BP-4	15° 17′ 40.1839″	74° 09′ 03.3467″
BP-5	15° 17′ 30.9847″	74° 09′ 08.5955″
BP-6	15° 17′ 01.6125″	74° 09′ 13.1548″
BP-7	15° 17′ 12.4794″	74° 09′ 41.2969″
BP-8	15° 17′ 13.0200″	74° 09′ 44.8333″
BP-9	15° 17′ 16.8213″	74° 09′ 43.9885″
BP-10	15° 17′ 19.1419″	74° 09′ 40.8072″
BP-11	15° 17′ 23.3295″	74° 09′ 36.4971″
BP-12	15° 17′ 26.7696″	74° 09′ 33.4331″
BP-13	15° 17′ 30.5546″	74° 09′ 31.2826″
BP-14	15° 17′ 36.0551″	74° 09′ 29.0348″
BP-15	15° 17′ 40.9091″	74° 09′ 28.2686″
BP-16	15° 17′ 44.5813″	74° 09′ 28.2599″
BP-17	15° 17′ 49.1710″	74° 09′ 29.2119″
BP-18	15° 17′ 54.4169″	74° 09′ 30.5870″

The Location Plan and Key plan of Mining lease area are enclosed as **Plate No.1** and **Plate No.3** respectively. Directorate of Mines and Geology, Govt. of Goa certified Geo-referenced Cadastral Map (DGPS) is enclosed as **Plate No. 2**, Mining Lease superimposed on High Resolution Satellite Imagery and Surface plan of the Mining Lease are enclosed as **Plate Nos. 4 & 5** respectively. The geographical aspect of the

Mine Location is given below.

2.5 ENVIRONMENTAL SETTING

Table 2.2: Project Details

Land Details & Survey Nos	Mineral Block area: 152.5073 Santona Village: 7/1,8/1,8/2, 11/1,15/1,15/2,16/1,23/1,24/1, 25/1,25/2,26/1,27/1.28/3,28/4,28/5,28/6,29/1,38/1,38/3, 39/1,40/1,40/2,40/3,40/4,40/5,40/6,40/7,40/8,40/9,40/10 40/11,40/12,40/13,41/1,42/1,43/1, road & nallah.
Geographical Coordinates	Boundary co-ordinates are shown above in Table 2.1
Survey of India (SOI) Topo-sheet No.	D43C3
Topography of project site	Gradually Sloping from East to West
Reserves & Resources	16.731 million tonnes of Iron Ore
Production Capacity	0.75 Million Tonnes Per Annum (As per Approved Mining Plan)
Life of the Mine	24 Years The mining lease will be valid for 50 years as per MMDR (Amendment) Act, 2015, from the date of Registration of Mining Lease Deed.
Water requirement	300 KLD
Power requirement	1.64 MW/d
Average no. of working days	200 (Actual Mine Handling days excluding monsoon & holidays)
Number of shifts	2
Working hours	14 (Effective working hours)
Man Power Requirement	Direct employment : 127 persons Indirect employment : 200 persons
Environmental Protection Cost	Capital Cost : Rs. 74 Lakhs Recurring Cost : Rs. 45.45 Lakhs/Annum
Project Cost	₹ 3680 lakhs

Table 2.3: Environmental Setting

Particulars	Details	Aerial Distance and direction
Topography of project site	Gradually Sloping from East to West	-
Sanctuary/ National Park / Tiger Reserve/ Elephant / any other Reserve Forest	Bhagwan Mahaveer Wildlife Sanctuary & National Park	1.04 Km (E direction)
	Biodiversity Park Mollem	8.32 Km
	Guddemal RF	0.94 Km ((West)
	Ambeudeak RF	0.45 Km (West)
	RF Near Kashti	0.79 Km (South)
	RF Near Periudak	0.25 km (West)
	RF Near Bandoli	2.49 Km (West)
	Vasali Dongar RF	7.84 km (South-West)
Biosphere Reserve	None	-
Ramsar site	Nanda Lake	7.0 km
Water Bodies	Seasonal Nalla Flows W-E across the Mineral Block. Kalay River runs along Eastern Boundary of the Mineral Block from S-N.	Seasonal Nalla – within lease Kalay River - 0.005 km (E direction)
	Dudhsagar River	4.0 km (North)
	Sanguem River	5.66 km (South)
	Panduranga Nala	6.55 km (West North West)
	Ugem River	5.57 km (South)
	Zuari River	3.79 km (South)
	Udani River	8.80 km (North West)
	Guloli River	7.20 km (South)
	Paroda River	8.6 km (South West)
Wet Land	Xeldem lake	8.0 km (South West)
Defense Installation	None	-
Nearest airport	Dabolim Airport	35km (South West)
Nearest Railway Station	Kalay Railway Station	2.4 km (South East)
Nearest Highway	State Highway (SH7)	1.3 km (West)
Seismic Zone	III	As per IS 1893 (Part-I): 2016
Nearest Habitat	Within the lease	Min. Buffer of 50 m will be provided and no drilling and blasting will be carried out.
Archaeological monuments	Mahadev Temple in Curdi Village	8.89 Km (South)
Protected Monuments	Shigao Caves	5.3 km (North East)
Public utilities	None	
Coastal Regulation Zone (CRZ)	Not Applicable	-
Distance from the HFL of the river in m	Kalay River	5 m from eastern Boundary. There is enough elevation difference.
Nearest School	Shree Somnath Pre-Primary. Primary & Secondary School, Savargal, Kirlapal, Dharbandora, Goa.	1.57 km (North NorthWest)

TABLE 2.4: List of industries and mines falling within 10 km radius in study area

S. No.	Name of the Industry	Type of Industry	Approx. aerial Distance and Direction
1.	AR Industries	Minerals & Alloys	~5.47 km in SSW direction
2.	Praveena Industries	Extension Unit of Supplier Earth Moving Machine	~5.84 km in SSW direction
3.	Goa Sponge and Power limited	Sponge iron and Steel billets	~0.66 km in SSW direction
4.	Kamakshi Metal Industry	Metal Industry	~5.71 km in SSW direction
5.	Dementro Vital Fernandes	Basalt Stone Quarry	~1.52 km in SW direction
6.	Fluidmac Hose Industries	Manufacturer industry	~5.70 km in SSW direction
7.	Shraddha Ispat Private Limited (Sponge Division)	Sponge iron	~0.50 km in South direction
8.	Timblo Dry Docks Pvt Ltd.	Shipyard	~8.54 km in WSW direction
9.	Greater Ferromet Wet Beneficiation Plant	Beneficiation Plant	~360 Meters in South direction
10.	Gosalia ruber industries	Rubber industries	~6.0 km in SSW direction
11.	United wood industry	Sawmill	~7.32 km in SW direction
12.	Forte spirits Pvt. ltd	Manufacturer	~9.85 km in NNW direction
13.	AMI Industry	Plastic injection moulding	~9.75 km in SW direction
14.	AK Enterprises	Manufacturer	~9.66 km in WSW direction
15.	Coral Distillery	Distillery	~9.32 km in WSW direction

2.6 SIZE OR MAGNITUDE OF OPERATION (Including associated activities required by or for the project)

The proposed project extends over an area of 152.5073 Ha consisting of 131.3743 Ha. non-forest land and 21.1330 Ha. of Forest Land. The Iron ore reserves estimated within the Mineral Block as per the approved mining plan is 16.731 million tonnes as on 01/02/2023.

Parameters:

Total Mineral Reserves & Resource : 16.731million tonnes
Nature of ore : Iron ore
Max. Proposed Production : 0.75 Million Tonnes Per Annum
Ore to waste ratio (average) : 1 : 4

Mineral Reserves/Resources: The estimated Mineral reserves and resources are as per Geological Report provided by Directorate of Mines and Geology, Govt. of Goa and are based on the level of exploration, with reference to the threshold value of

minerals declared by IBM. The areas under different levels of exploration are shown below in **Table 2.5** & Mineral Reserves and Resources estimated as on 01/08/2023 are shown below in **Table 2.6**.

Table 2.5: Areas under different levels of exploration

Level of exploration	Area in Ha		Total area in Ha.
	Forest	Non-forest	
G-1	4.8800	44.0850	48.965
G-2	0	0	0
G-3	3.3800	30.1800	33.56
G-4	0	0	0
Area proved as Non-mineralized	12.8730	57.1093	69.9823
Area to be explored	0	0	0
Total	**21.1330**	**131.3743**	**152.5073**

Table 2.6: Mineral Reserves and Resources estimated as on 01/02/2023

Classification	Code	Quantity			Grade	
		Forest	Non-Forest	Total	Forest	Non-Forest
A. Mineral Reserve						
1. Proved Mineral Reserve (A)	111	358999.65	7829035	8188034.65	-	56.5%Fe
2. Probable Mineral Reserve (A)	121	-	-	-	-	-
3. Probable Mineral Reserve (A)	122	-	-	-	-	-
B. Remaining Resources						
1. Feasibility Mineral Resource (B)	211	-	-	-	-	-
2. Prefeasibility Mineral Resource (B)	221	-	-	-	-	-
3. Prefeasibility Mineral Resource (B)	222	-	-	-	-	-
4. Measured Mineral Resource (B)	331	-	-	-	-	-
5. Indicated Mineral Resource (B)	332	-	-	-	-	-
6. Inferred Mineral Resource (B)	333	1399046.40	7143490.45	8542536.85	-	+45%Fe
7. Reconnaissance Mineral Resource (B)	334	-	-	-	-	-
Total Mineral Resources (A+B)		**1758046.05**	**14972525.45**	**16730571.5**	**-**	**+45%Fe**

The Geological Plan is enclosed as **Plate No. 6.**

2.7 PROPOSED SCHEDULE FOR APPROVAL & PROJECT IMPLEMENTATION

Mining operations will be commenced after obtaining all the statutory permissions and approvals and after registration of executed Mining Lease Deed. The following is the tentative schedule for Environmental Clearance by EAC, MoEF&CC.

Table 2.7: Tentative Schedule for Approval & Project Implementation

Sr.No	Activity	Timeline
1	Baseline Data Collection & Environment Impact Assessment (EIA) Study	Mar-May 2023
2	Preparation of Draft EIA Report	Oct- 2024
3	Submission of EIA Report to Goa Pollution Control Board (GSPCB)	Oct-2024
4	Public Consultation	Dec- 2024
5	Submission of Final EIA Report incorporating Response to the MOM of public Hearing	Jan-2025
6	Appraisal by Expert Appraisal Committee	Mar-2025
7	Grant of Environmental Clearance by MoEF&CC	Sep-2025

2.8 PROJECT DESCRIPTION – INCLUDING DRAWINGS SHOWING PROJECT LAYOUT, COMPONENTS OF THE PROJECT, ETC.

2.8.1 GEOLOGY

The main Iron Ore deposit where this mine is located is called Codli-Kirlapal-Costi deposit. The general succession of the strata from top to bottom is as follows. Laterite (about 15m - 20m) Altered Dyke (Intrusive) Ferrugenous/Phyllitic/Limonitic Clay (10m - 15m) Iron Ore body (20m - 30m) Siliceous Manganiferous Clay & Weathered BHQ (forms foot wall). Most of the total lease area is broken up by mining and allied activities. The remaining area is mostly covered with a capping of laterite. Based on the exposed rocks formation and the available borehole data, the ore body and the associated rocks are folded.

The lithology of geological formation is given below:

Lithology	
Type	**Depth**
Laterite	15-20m
Altered Dyke (Intrusive) Ferrugenous/ Phyllitic/ Limonitic Clay	10 to 15m
Iron ore Body	20 to 30m
Siliceous Manganiferous Clay & Weathered BHQ	Footwall

2.8.2 STRUCTURE

Structurally ore body and associated formations appears to be subjected to folding with dips towards both Easterly and Westerly direction. The ore body has a general strike direction as N 10°-20° W to S 10°-20° E and folded into anticlines and synclines

with amount of dip varying from 10°- 40°. The synclinal portions are preserved whereas anticlinal portions are eroded. The ore body is plunging towards south with an average angle of 5° to 10°. The total length of Ore body is about 2000 m and width varies from 300m to 400m. The thickness of the ore body is 20m to 30m. Due to igneous activity, a number of weathered and altered sills & dykes exist in the form of clays along and across the ore body.

2.8.3 EXPLORATION AND RESERVE ESTIMATION

2.8.3.1 EXPLORATION

The Director of Mines and Geology has provided Geological Report (GR) as per which the erstwhile lessee has carried out exploration by drilling 227 holes with a cumulative depth of 11168.1 m. as shown in **Table 2.8**. Based upon the geological mapping and the core drilling done so far in the area, geological cross sections are prepared. Refer typical Geological cross sections enclosed as **Plate No. 7**.

Table 2.8: Details of exploration already carried out in the Mine Lease area

Sl. No	Exploration agency	Core holes		Non-core (RC/DTH)		Grand total	
		No. of boreholes drilled	Total meter (m)	No. of boreholes drilled	Total meter (m)	Total boreholes	Total meter (m)
1	M/s. N.S. Narvekar	227	11168.10	0	0	227	11168.10

2.8.3.2 PROPOSED EXPLORATION

As per the Minerals (Evidence of Mineral Contents) Rules 2015, the deposit is classified under Bedded Stratiform and Tabular deposit of regular habit. Rule 12(4) of MCDR 2017 mandates to conduct detailed exploration for Iron ore on G1 level of exploration over the entire potentially mineralized area and for quality confirmation.

Accordingly, 66 boreholes with a tentative total meterage of 3960 m have been proposed over Mining Plan period of 5 years, as shown below in **Table 2.9**.

Table 2.9: Proposed exploration by way of boreholes

Sl. No	Year	In forest area				In Non-forest				Total borehole	Total Meters (m)
		No. of boreholes	Total Meters (m)	Type of borehole	Grid interval (m x m)	No. of boreholes	Total Meters (m)	Type of borehole	Grid interval (m)		
1	Year 1	Nil	Nil	Nil	Nil	10	600	Core	100	10	600
2	Year 2	02	120	Core	100	10	600	Core	100	12	720
3	Year 3	04	240	Core	100	11	660	Core	100	15	900
4	Year 4	04	240	Core	100	11	660	Core	100	15	900
5	Year 5	Nil	Nil	Nil	Nil	14	840	Core	100	14	840
Total		**10**	**600**	**Nil**	**Nil**	**56**	**3360**	**-**	**-**	**66**	**3960**

2.8.4 EXISTING MINE WORKINGS

Block IV - Kalay Mineral Block is an e-auctioned Mineral Block. The Letter of Intent was issued on 13/03/2023, for the grant of Mining Lease. Presently no mining operations are being carried out in the subject mine.

2.8.5 PROPOSED MINE WORKINGS

Currently, there are three mine pits located within the Block IV- Kalay Mineral Block. These mine pits cover an area of 74.30 hectares, details of which is shown below in **Table 2.10**. Mining operations will be carried out in accordance with the approved Mining Plan.

Table 2.10: Details of Mine Pits

S. No	Pit ID	Area Covered by Pit (Ha)	Pit Dimensions (L*W*D)
1	Pit - 1 Active	29.11	860*400*54.9
2	Pit - 2 Active	2.87	300*130*14.8
3	Pit - 3 Active	42.32	860*540*78

Method of mining will be opencast mechanized mining, engaging Heavy Earth Moving Machinery (HEMM) i.e. with a combination of Excavator, ripper dozers, loaders and trucks. The project will not engage drilling and blasting activities in the Mineral Block. Systematic method of mining is proposed by maintaining benches of 6m height and 8 m width in waste rock and ore body with a pit slope of less than 30 degrees from horizontal. Haul roads of sufficient width are proposed for the movement of HEMM that will be engaged for mining operation.

2.8.6 PROPOSED DEVELOPMENT AND PRODUCTION OF IRON ORE

Exploration carried out within Mining Lease confirmed the total Mineral Reserves and Resources as on 01/02/2023 as 16.731 Million Tonnes of Iron Ore. Considering the available reserves and resources, rate of production has been proposed as 0.75 MTPA of Iron Ore. The Production and Development Plan as per first five years of the mining plan period is given below in **Table 2.11.**

Table 2.11: Details of Production and Development

Sr. No.	Year	Pit ID	Total Over Burden/ Waste Volume (m^3)	Total Over Burden/ Waste Quantity (t)	Total ROM Volume (m^3)	Total ROM Quantity (t)
1	Year1	Pit-1 & Pit-3	716000.00	1432000.00	123674.91	350000
2	Year2	Pit-1 & Pit-3	1064000.00	2128000.00	176678.45	500000
3	Year3	Pit-1 & Pit-3	1151500.00	2303000.00	265017.67	750000
4	Year4	Pit-1 & Pit-3	1192000.00	2384000.00	265017.67	750000
5	Year5	Pit-1 & Pit-3	590000.00	1180000.00	265017.67	750000
		TOTAL	**4713500.00**	**9427000.00**	**1095406.37**	**3100000**

2.8.7 LAND USE PATTERN OF MINE LEASE AREA

Land use pattern of Mine Lease Area for existing, plan period and at conceptual stage is shown below in **Table 2.12.**

Table 2.12: Land Use pattern of mine lease area

S. No.	Details	Land use in Ha		
		Existing	Plan Period	Conceptual Stage
1	Area under Mining	74.3004	74.9965	0
2	Overburden/dumps	23.0618	25.1818	0
3	Mineral storage/sub-grade stack	0	0	0
4	Infrastructure	4.8326	4.8326	1.1398
5	Village Road	1.6292	1.6292	1.5377
6	Mine Road	3.2766	3.2766	1.2857
7	Drain	0.1767	0.1767	0
8	Protective Measures	6.3878	6.9816	10.3998
9	Reclaimed Pit	2.0843	2.0843	29.0675
10	Pit Reclaimed and Rehabilitated	3.115	3.115	26.2555
11	Pit as Water Reservoir	0	0	44.1356
12	Dump Rehabilitated	5.5992	5.5992	21.2162
13	Nalla	0.8255	0.8255	0.8255
14	Green Belt	0	0	3.0288

15	Other Mining Utilities	3.3491	3.3491	0
16	Unused	23.8691	20.4592	13.6152
	Total	**152.5073**	**152.5073**	**152.5073**

2.8.8 MINING AND OPERATION PROCESS

Open cast mechanized method of mining is proposed to be undertaken in the area using Heavy Earth Moving Machinery. Drilling and blasting is replaced with Ripping and Dozing.

The mining operations are proposed to be conducted in a scientific, systematic, and sustainable manner as per the Mining Plan approved by Indian Bureau of Mines. The development and production will be carried out systematically by maintaining benches of 6m height and 8 m width. The overall pit slope will be maintained less than 30 degrees. Activities involved during mining operation will include ground preparation, wherein, ripping of hard laterite terrain will be done by Ripper-Dozer followed by excavation of Ore/waste by Excavators. Further, Excavators will load such excavated ROM (Iron Ore) and waste in trucks.

Trucks will haul the ROM and waste by road within the Mineral Block to a designated stacking area. ROM (Iron ore) material will be transported by trucks out of the mineral block by road.

Mining operation process has been explained using a process flowchart given below in **Fig. 2.1**

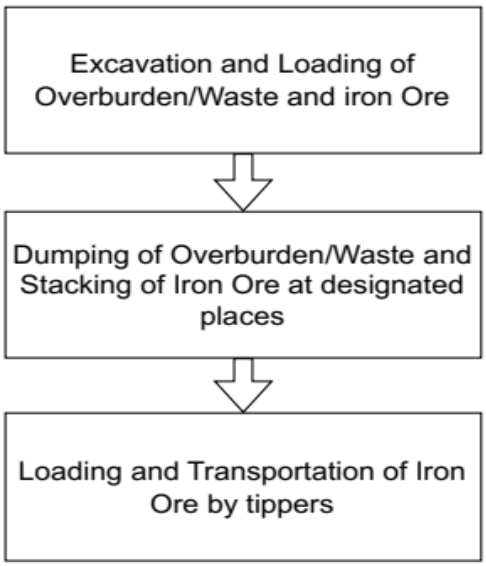


Fig. 2.1: Flowchart showing process of mining operation.

2.8.9 WASTE GENERATION

2.8.9.1 GENERATION OF WASTE

The total overburden/waste proposed to be generated during the first 5 years of Mining Plan Period is 9427000 tonnes. The proposed year-wise waste generated during the plan period is as shown in **Table 2.13** below.

Table 2.13: Proposed Year-wise generation of overburden/waste during the plan period

Year	Overburden/Waste Quantity (tonnes)
Year 1	1432000
Year 2	2128000
Year 3	2303000
Year 4	2384000
Year 5	1180000
Total	**9427000**

2.8.9.2 WASTE MANAGEMENT

Waste will be temporarily dumped within the Mineral Block at proposed location as per IBM Approved Mining Plan. Once finalized, dumps and dump slopes will be stabilized by planting saplings of native species. Various protective measures such as garland drains, protective bunds, geotextiles, etc., will be provided for the dumps to prevent runoff during monsoon. Year-wise development and stabilization plan along with provision of protective measures is given below in **Table 2.14**.

Table 2.14: Year-wise dump development and its stabilization

S. No	Year	Dump ID	No of Terraces	Average Height of Terraces (m)	Length of Toe Wall (m)	Length of Garland Drain (m)	Area Stabilized (Ha)	Method of Stabilization	Settling Ponds (nos.)
1	Year 1	Dump-6A & Dump-1	1	6	330	1120	0.60	Plantation	Nil
2	Year 2	Dump-6 & Dump-1	1	10	75	1320	0.60	Plantation	Nil
3	Year 3	Dump-6A & Dump-1	1	12	190	1305	0.60	Plantation	Nil
4	Year 4	TD-2 & Dump-1	1	15	370	1515	0.60	Plantation	Nil
5	Year 5	Dump-6 & Dump-1	1	15	250	1090	0.60	Plantation	Nil

The area proposed for working during the plan period is devoid of top soil.

During conceptual period, an area of 21.22 Ha will be brought under dumping. A copy of the approved Conceptual Plan showing earmarked location for dumping is enclosed as **Plate No. 8**.

2.8.10 RESOURCE REQUIREMENT

2.8.10.1 MACHINERY REQUIREMENT

As per the Approved Mining Plan, Heavy Earth Moving Machinery (HEMM) proposed to be engaged in the mining operations at mine are listed below in **Table 2.15**.

Table 2.15: List of Machinery proposed to be engaged in mining operations

S. No.	TYPE	NO. OF EQUIPMENT
1	Hydraulic Excavator	4
2	Hydraulic Excavator	2
3	Ripper and Dozer	1
4	Dozer	2
5	WL-L120 Wheel Loader	2
6	Trucks	75

2.8.10.2 FUEL AND POWER REQUIREMENT

Diesel fuel of approximately 4758 liters/day will be consumed to operate HEMM such as Excavators, Ripper Dozers, etc. Annual Power requirement is approximately 1.64 MW/day which will be sourced from Government Power Grid, a diesel generator having 82.5 KVA capacity will be utilized as a backup in case of power failure.

2.8.10.3 MANPOWER REQUIREMENT

The Project is expected to offer employment opportunities for approximately 127 individuals, in various positions such as Mine officials (Managerial, supervisory roles), skilled workers, semi-skilled workers and unskilled workers. Additionally, mining operations will generate indirect employment opportunities to about 200 persons. The list of proposed manpower for direct employment is shown below in **Table 2.16**.

Table 2.16: List of proposed manpower

S. No.	Particulars	Shift 1	Shift 2	Shift 3	General	Total No. of Persons per day
		Number of Persons				
Managerial						
1	1st Class Mines Manager	Nil	Nil	Nil	1	1
2	Mining Engineer	1	2	Nil	Nil	3
3	2nd Class Manager	1	2	Nil	1	4
4	Geologist	Nil	Nil	Nil	1	1
5	other	Nil	Nil	Nil	2	2
Supervisory						
1	Foreman	2	3	Nil	1	6
2	Mine-mate	1	1	Nil	Nil	2
Skilled workers / operators						
1	Operator	41	41	Nil	Nil	82
2	Pump Operators	3	3	Nil	Nil	6
Semi-skilled workers						
1	-	7	7	Nil	Nil	14
Unskilled workers						
1	-	3	3	Nil	Nil	6
No of Persons Engaged Per Day		59	62	Nil	6	127

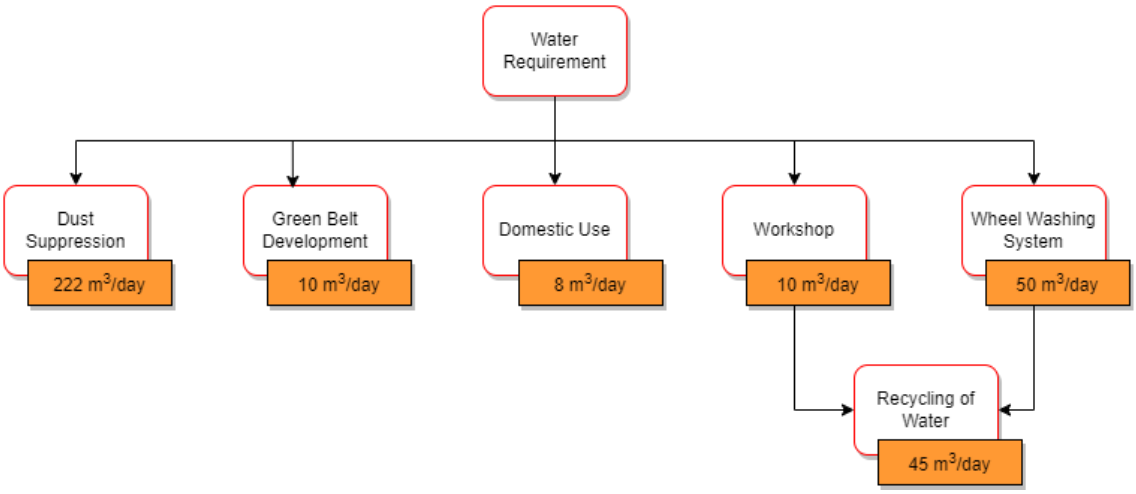
2.8.10.4 WATER REQUIREMENT

Total water requirement for the project will be 300 KLD as shown in **Table 2.17.** Water requirement will be met from the harvested rain water in the mine pit within the mining lease area and from the registered water vendors through tankers for domestic purposes.

Table 2.17: Water Requirement for the project

Purpose	QTY (KLD)	Source
Dust Suppression	222	Rain water harvested in mine pit
Green Belt	10	
Wheel washing	50	
Workshop	10	
Domestic	8	Open Well water
Total	**300**	

Fig. 2.2: Flowchart showing water requirement



2.8.10.5 SITE SERVICES

The following site services will be provided in the vicinity of project site:

1. Rest shelters.
2. Provision of drinking water
3. First Aid Station
4. Toilet blocks
5. Canteen facility

2.9 DESCRIPTION OF MITIGATION MEASURES INCORPORATED INTO THE PROJECT TO MEET ENVIRONMENTAL STANDARDS, ENVIRONMENTAL OPERATING CONDITIONS, OR OTHER EIA REQUIREMENTS (AS REQUIRED BY THE SCOPE).

Considering the scope of the project and EIA requirements of the project activities, environmental operating conditions and their impacts have been assessed and the same have been discussed in depth in the subsequent chapters.

The anticipated adverse environmental impacts and their mitigation measures are summarized in **Table 2.18.**

Table 2.18: Anticipated Environmental Impacts and Mitigation Measures Proposed

Environmental Component	Project Activities	Environmental Impact	Mitigation Measures
Air Quality	Excavation, Screening, Loading & unloading	Increase in Respirable Particulate Matter (RPM) level due to dust generation and SO_2/NOx concentration levels in ambient air due to vehicular emissions. Occupational health impacts due to exposure to airborne particulate matter.	• Full fledge efforts will be made to reduce generation of dust at source itself. • Dust suppression through sprinkling of water on working faces and haul Roads. • Development of green belt and plantation. • Periodic maintenance of mining machinery • Periodical Ambient Air Quality Monitoring in Core and Buffer zone will be carried out. • Provision of dust masks to workers exposed to dusty operational areas.
	Transportation of Mineral	Increase in RPM level due to dust generation and SO_2/NOx concentration levels in ambient air due to vehicular emissions. Occupational health impacts due to exposure to airborne particulate matter.	• Sprinkling of water on haul and access roads. • Periodic maintenance of transport vehicles. • Periodic maintenance of haul roads • trucks carrying Ore from mines to jetty will be covered with tarpaulin. • Provision of dust masks to workers exposed to dusty operational areas.
Noise Environment	Generation of Noise from HEMM during mining operation, Screening operation & from trucks during transportation of Ore & Overburden.	High Noise levels induce health impacts such as Annoyance, Fatigue, Temporary shift of threshold limit of hearing. Permanent loss of hearing and Hypertension	• Periodic maintenance of all mining machinery and transport vehicles • Provision of ear plugs/earmuffs to workers exposed to high noise generating operations • Development of plantation in Mining Lease to serve as a noise barrier. • Regular noise monitoring will be carried out.

Water Resources and Quality	Dewatering	Reduction in groundwater availability Deterioration in surface/ground water quality of receiving body.	• During monsoon, storm water/ rainwater from the mining area will be collected in to mine pit. The collected rainwater will be pumped out into a series of settling ponds and treated water will be discharged into nearby water bodies. The discharged water will be utilized for agricultural and other purposes downstream. Mine pit water will also be used for dust suppression and plantation. • Mine pit will serve as groundwater recharge structure. • There will not be any process effluent discharge from the mine. • Domestic effluent will be discharged in septic tank and soak pit. • At conceptual stage, mined out pit will be converted into water reservoir, which will help in recharging ground water table and will be available to nearby villagers as an additional surface water body.
	Waste water generated from domestic usage at mine.	Deterioration in ground water and soil quality when discharged untreated for greenbelt development	• There will not be any process effluent discharge from the mine. • Domestic effluent will be discharged in septic tank and soak pit.
Waste Management	Mining activities	Land Degradation within mining lease due to disposal of waste	Waste generated at the mine will be transported to backfilling/ dumping site by trucks. The entire waste shall be surface dumped and/or backfilled in the exhausted portion of the pit. The finalized dumps shall be rehabilitated by planting native plant species, which will benefit the local community.
Environmental Pollution,	Overall Mining operation	Occupational health issues for workers risk of	• Adoption of suitable pollution control measures in the mines

Health, Safety		accidents, etc.	• Conducting initial and periodic medical examination • Adoption of safe working practices • Maintaining proper housekeeping at working places. • Provision of necessary personal protective equipment's to all mine workers • Periodic maintenance of mine machinery and transport vehicles • Display of warning signals at strategic locations.
Socio-economic Aspects	Mining operations	Increase in employment opportunities both direct and indirect thereby increasing economic status of people of the region.	• Will generate direct and indirect employment opportunities in the nearby villages. • Business opportunities in the region will generate secondary employment. • Mostly local people will be employed in the mine. Mine management will carry out CSR activities such as skill development, providing educational facilities, medical support, etc. in the nearby villages to improve the socio-economic conditions of the villages.

2.10 ASSESSMENT OF NEW & UNTESTED TECHNOLOGY FOR THE RISK OF TECHNOLOGICAL FAILURE

Open Cast Mining method proposed to be followed at the mine is a conventional and widely accepted technology all over the world.

The entire activities involved in the project will be carried out under the supervision of technically qualified Mine Manager assisted by qualified Assistant Mine Managers, Mine Foremen, Engineers, Geologists, Surveyors, etc.

The required technical studies such as slope stability; hydrogeological study of lease area is carried out for mitigating risk involved in the project.

Chapter-3

Description of the Environment

3.1 STUDY AREA

Mineral Block is the Core Zone and the 10 km radius area around the Mineral Block is the Buffer Zone, together comprises the study area. The study area falls in Topo sheet No. 48I/3, 48I/7 & 48I/4 of Survey of India.

3.2 STUDY PERIOD

The base line data have been collected for various environmental components during the summer season between Mar'23 to May'23. The Environmental baseline data generated during Summer Season, 2023 is presented enclosed as **Annexure 7.**

3.3 ENVIRONMENTAL COMPONENTS

Considering the Environmental setting of the project, the project activities & their interaction, environmental regulations & standards, the following environmental attributes have been included in the EIA Study during Summer Season, 2023, as a part of baseline data.

- Site Specific Micrometeorological Data (hourly readings from core zone) on wind speed, wind direction (windrose), temperature, humidity, atmospheric pressure and rainfall.
- Ambient Air Quality Monitoring at 8 Stations on 24-hourly basis, for 2 days in a week, for 3 months, for parameters $PM_{2.5}$, PM_{10}, for Heavy Metals analysis in Particulates, SO_2, NO_2, CO, Ammonia (NH_3), Ozone, Benzene and Benzo(a)pyrene.
- Noise Level Measurements at 8 stations for Leq, Lmin & Lmax values, during day and night, once in the season
- Water Quality Monitoring by grab sampling once in a season
  - Surface Water (6 locations)
  - Ground Water (8 Locations)
- Soil Quality Monitoring at 7 locations once in the study period for
  - Textural & Physical
  - Nutrients (NPK, Micro Nutrients, etc.)
- Land use pattern based on Satellite Imagery using LISS IV Mx Data from NRSC
- Biotic Attributes
  - Flora & Fauna in Core & Buffer Zones
- Socio-Economic Profile, based on 2011-Census and Survey 2023 for

- Total Population, Household Size, Age
- Gender Composition
- S.C & S.T
- Literacy Level
- Occupational Structure

3.4 METHODOLOGY & DESCRIPTION

The methodologies followed for baseline studies are detailed below.

3.4.1 MICROMETEOROLOGY

As a part of the study, the micrometeorology and microclimatic parameters have been recorded by installing a Weather Monitoring Station. The data on wind Speed, wind direction, ambient temperature and relative humidity, have been recorded at hourly intervals along with rainfall during the monitoring period.

3.4.2 AMBIENT AIR QUALITY

The study area represents the Industrial, Residential, Rural and Other Areas. Calibrated Fine Particulate Samplers have been used for monitoring $PM_{2.5}$. Calibrated Respirable Dust Samplers have been used for monitoring of PM_{10}. Gaseous samples have been collected by integrated gas sampling assembly. Parameters for air quality monitoring, method of analysis and frequency of measurement is given in **Table 3.1**.

Table 3.1: Parameters for air quality monitoring, methodology and frequency of measurement

Monitored parameters & duration	Method used	Frequency of monitoring
PM_{10}, $PM_{2.5}$	Gravimetric Sampling using Respirable Dust Sampler & Fine Particulate Sampler (FPS)	24 hourly monitoring: Twice a week for 3 months in one season
Sulphur Dioxide (SO_2)	Modified West & Gaeke Method	
Nitrogen Dioxide (NO_2)	Jacob & Hoechhiesher Method	
Ammonia	Indo Phenol blue method	
Benzene	Adsorption & desorption followed by GC analysis	
Lead	AAS Method after sampling on EPM 2000 or equivalent filter Paper	
Nickel		
Arsenic		
Benzo(*a*)pyrene	Solvent extraction followed by GC analysis	
CO	Non dispersive Infrared (NDIR), Spectroscopy	Hourly Monitoring: Twice a week for 3 months in one season
Ozone	Chemical method	

3.4.3 NOISE LEVELS

Noise levels were monitored at the selected locations during day time as well as night time. The sound level meters are used in accordance with IS: 9979 and IEC 651 standards for noise survey. The basic unit of measurement is A-weighted sound level, the most widely used scale. Measurements are taken in fast mode and were sampled to yield **Leq** (logarithm equivalent noise level).

3.4.4 WATER QUALITY

Samples of groundwater and surface water were collected and analysed for physico-chemical and bacteriological parameters. Samples for chemical analysis were collected according to CPCB Guidelines for Water Quality Monitoring DOC no. MINARS/27/2007-08. Sterilized bottles were used for collection of water samples for bacteriological analysis. Due care was taken to ascertain the integrity during transportation of samples. Standards and method followed for analysis of various water Parameters is shown in **Table 3.2**.

Table 3.2: Standard/Method followed for Analysis of Water Parameters

S. No.	Parameter	Unit	Reference
1	Taste	-	IS:3025 (5)
2	Odour	-	IS:3025 (7)
3	pH	-	IS:3025 (11)
4	Colour	Hazen units	IS:3025(04)
5	Turbidity	NTU	IS:3025 (10)
6	Total Dissolved Solids	mg/l	IS:3025 (16)
7	Total Hardness	mg/l	IS:3025(21)
8	Iron (as Fe)	mg/l	IS:3025 (53)
9	Chlorides (as CI)	mg/l	IS:3025(32)
10	Residual Chlorine	mg/l	IS:3025(26)
11	Calcium (as Ca)	mg/l	IS:3025(40)
12	Magnesium (as Mg)	mg/l	IS:3025(46)
13	Alkalinity (as $CaCO_3$)	mg/l	IS:3025(23)
14	Dissolved Oxygen	mg/l	IS:3025(38)
15	Sulphate (as SO_4)	mg/l	IS:3025(24)
16	Fluoride (as F)	mg/l	IS:3025 (60)
17	Nitrate (as NO_3)	mg/l	IS:3025(34)
18	Cyanide (as CN)	mg/l	IS:3025(27)
19	Pesticides	mg/l	APHA 23rd ED
20	Phenols (as C_6H_5OH)	mg/l	IS:3025(43)
21	Manganese (as Mn)	mg/l	IS:3025 (59)
22	Chromium (as Cr)	mg/l	IS:3025 (52)
23	Copper (as Cu)	mg/l	IS:3025(42)
24	Selenium (as Se)	mg/l	IS:3025 (56)
25	Cadmium (as Cd)	mg/l	IS:3025 (41)

S. No.	Parameter	Unit	Reference
26	Arsenic (as As)	mg/l	IS:3025(37)
27	Boron (as B)	mg/l	IS:3025(57)
28	Mercury (as Hg)	mg/l	IS:3025(48)
29	Lead (as Pb)	mg/l	IS:3025(47)
30	Zinc (as Zn)	mg/l	IS:3025(49)
31	Percent sodium	mg/l	APHA 23rd ED
32	BOD_3 days @ 27 °c	mg/l	IS:3025(44)
33	COD	mg/l	IS:3025 (58)
34	Oil & Grease	mg/l	IS:3025(39)
35	Total Coliform per 100 ml	--	IS:15185:2016
36	E. Coli per 100 ml	--	IS:15185:2016
37	Total Suspended Solids	mg/l	IS: 3025(17)
38	Barium (as Ba)	mg/l	IS : 3025 (P-2) :2019
39	Aluminum (as Al)	mg/l	IS: 3025(P-55) : 2019
40	Ammonia (as total Ammonia-N)	mg/l	IS : 3025 (P-34) 2019
41	Anionic Detergents (as MBAS)	mg/l	Annex K of IS:13428 :2022
42	Silver (as Ag)	mg/l	IS : 3025 (P-2) : 2019
43	Molybdenum (as Mo)	mg/l	IS: 3025 (P-2) :2019
44	Sulphide (as H_2S)	mg/l	IS: 3025 (P-21) : 2019
45	Mineral Oil	mg/l	IS : 3025 (P-39) : 2021
46	Chloramines (as Cl_2)	mg/l	IS: 3025 (P-26) : 2021
47	Nickel (as Ni)	mg/l	IS: 3025(P-2): 2019
48	Potassium (as K)	mg/l	IS: 3025(P-45)
49	Electric Conductivity	µmhos/cm	IS: 3025(P-14)
50	Temperature	^0C	IS : 3025(P-9)

3.4.5 SOIL CHARACTERSTICS & METHODOLOGY

Soil Characteristics:

The soils of the district are derived from Granites, Gneisses and Schistose rocks. The Sandy loam soil mixed with black and grey soil occurs along the stream beds. These are originated from gneisses and granites. They are permeable and mildly alkaline in nature. The thickness of the soil varies from 0.2 to 1.00m. Soils of the district can be classified into 4 types namely (i) Laterite soil (ii) Saline soil (iii) Marshy soil and (iv) Alluvial soil.

(i) Lateritic soil is the major soil type in the district. It is highly porous & permeable, slightly acidic with low pH values, low in organic matter, Calcium and Phosphorus.

(ii) Saline soil in the district occurs in the flood plains of Zuari, Sal, Saleri, Talpona and Galjibagh rivers in Salcete, Marmugao, Quepem and Canacona taluks. It also occurs to a very limited extent in Sanguem taluk. The soil is

deep, poorly drained and less permeable. It is saline, high in pH and contains humus and organic matter.

(iii) Marshy soil occurs to a large extent in Salcete taluk and towards the western part of Canacona taluk. It also occurs in Marmugao taluk. This type of soil occurs in low-lying water logged and tidal affected areas.

(iv) Alluvial soil occurs as very thin strip along the coastline towards western part of Salcete taluk and also a limited exposure occurs in Canacona taluk. It is reddish brown to yellowish, coarse grained and confined to narrow valleys of rivers. It is well drained, acidic with low pH and organic.

Methodology:

Soil samples were collected using sampling augers from 7 locations for analysis of physical and chemical parameters. Each monitoring location was traversed. After scrapping away surface liter, a uniform thick slice of soil was obtained from the surface upto the plough depth at each location. A "V'' shaped cut to a depth of 15cm was made using spade to obtain 1 to 2 cm slice of soil. A slice of the plough layer was collected at intervals of 15 to 20 steps or based on the area to be covered and placed in a bucket or tray. In case of hard soil, samples were collected with the help of auger. At least 10 to 15 samples from each sampling location need to be collected. The collected sample from each location was uniformly mixed before homogenizing the soil samples.

Sr. No	Crop	Soil Sampling Depth (Inches)
1	Grasses and grasslands	5-7
2	Rice, finger millet, groundnut, pearl millet, small millets etc. (shallow rooted crops)	15-20
3	Cotton, Red gram, sugarcane, banana, tapioca, vegetables etc., (deep rooted crops)	22-25
4	Perennial crops, plantations and orchard crops	Three soil samples at 30,60 and 90 cm

Source: -CPCB guidelines for Soil Sampling

3.4.6 CALIBRATION

The monitoring and analytical instruments are being calibrated periodically. The correction factors, if any, are being applied in the computation of the data.

3.4.7 FLORA-FAUNA

A general ecological survey has been conducted in the buffer zone using least count quadrate method and reported. Flora was randomly sampled in each quadrates for trees (25m x 25m), shrubs (10m x 10m) and herbs (2m x 2m) depending upon prevailing geographical conditions and bio-diversity aspects of study area. The data obtained was further used to estimate Relative Dominance, Relative Density (RD), Relative Frequency (RF) and Importance Value index (IVI) as per the formulae. Faunal survey covers the Terrestrial Fauna, Avian Fauna and Aquatic Fauna.

The survey was based on personal observation, enquiry with local population and records available. This study included the identification of endangered and rare species as per Red Book.

3.4.8 SOCIO-ECONOMIC SURVEY

The Socio-Economic profile of the population living in study area has been prepared based on Census 2011 data and Survey 2023.

3.4.9 LAND ENVIRONMENT

Land Use and Land Cover:

Study of existing land use was carried out through satellite image processing. The data used for analysis was sourced from RESOURCESAT-2 LISS IV with 5.0 m resolution, dated 08/03/2023.

3.4.10 GEOLOGY

The geology of the region was studied to understand the rock formations and mineral compositions, terrain, using topographic maps and relief maps.

3.4.11 HYDROGEOLOGY

The study involved finding sources of water including ground and surface water bodies in the study area. The drainage pattern in the region was studied.

3.5 ENVIRONMENTAL SCENERIO

3.5.1 GEOLOGY

3.5.1.1 REGIONAL GEOLOGY

Goa is dominantly covered by rocks of the Goa Group of rocks belonging to Dharwar Super Group of the Archaean to Proterozoic age except for a narrow strip along the northeastern corner occupied by the Deccan Trap of Upper Cretaceous to Lower Eocene age. The Iron ore formations of Goa belong to Dharwar super group of the Archaean-Proterozoic age. The Goa Group consists of assemblage of rocks and is divided into four Formations that in the order of superposition are Barcem Formation, Sanvordem Formation, Bicholim Formation and Vageri Formation. Barcem Formation includes essentially metavolcanic rocks with minor metasedimentaries.

All the formations are very important and from commercial point of view, it contains all the iron and manganese ore deposits of Goa, which is the backbone of Goa's economy.

The Goa Group of rocks is disposed in a NW-SE direction in the northern, central, eastern and southern parts of Goa and in E-W direction in the South Goa. The rocks have been subjected to at least three generations of folding.

The intensity of different generations of folding and degree of expression of their effect are however observed to vary widely from place to place.

Geological sequence of the rocks of Goa region, on regional scale is mentioned in **Table 3.3** below.

Table 3.3: Geological sequence of the rocks of Goa region

Sub-Recent to Recent			Sea Sand & Laterite
Upper Cretaceous to Lower Eocene		Deccan Trap	Basalt
Proterozoic		Basic Intrusives	Dolerite, Gabbro
		Acid Intrusives	Pegmatite, vein quartz Porphyritic Granite Hornblende Granite Felspathic Gneiss Granite Gneiss
Archaean to Proterozoic.	Goa Group	Vageri Formation	Meta-basalt Meta-greywacke
		Bicholim Formation	Banded Ferruginous Quartzite

			Manganiferous Chert Breccia With Pink Ferruginous Phyllite Limestone Pink Ferruginous Phyllite Qzt-Chlorite-Amphibole Schist
		Sanvordem Formation	Argillite, Quartzite, Tilloid, Metagreywacke
		Barcem Formation	Metagabbro, Peridotite, Talc-Chlorite Schist, Variegate Phyllite Quartz-Chlorite Schist, Quartzite, Quartz-Sericite Schist, Red Phyllite Quartz Porphyry, Massive, Schistose and Vesicular Metabasalt.

3.5.1.2 LOCAL GEOLOGY

The main Iron Ore deposit where this mine is located is called as Codli-Kirlapal-Costi deposit. The general succession of the strata from top to bottom is as follows. Laterite (about 15m - 20m), Altered Dyke (Intrusive) Ferrugenous/Phyllitic/Limonitic Clay (10m- 15m), Iron Ore body (20m - 30m), Siliceous Manganiferous Clay & Weathered BHQ (forms foot wall). Most of the total lease area is broken up by mining and allied activities.

The remaining area is mostly covered with a capping of laterite. Based on the exposed rocks formation and the available borehole data, the ore body and the associated rocks are folded.

Structurally ore body and associated formations appears to be subjected to folding with dips towards both Easterly and Westerly direction. The ore body has a general strike direction as N 10°-20° W to S 10°-20° E and folded into anticlines and synclines with amount of dip varying from 10°-40°. The synclinal portions are preserved whereas anticlinal portions are eroded. The ore body is plunging towards south with an average angle of 5° to 10°.

The total length of Ore body is about 2000 m and width varies from of 300 m to 400 m. The thickness of the ore body is 20m to 30m. Due to igneous activity, a number of weathered and altered sills & dykes exist in the form of clays along and across the ore body. Geological map of study area is enclosed as **Plate No. 9.**

Type of Deposit	**:**	Bedded, Stratiform and Tabular deposit of regular habit
Strike / Trend of the Ore Body	**:**	N10°~20°W to S10°~20°E
Amount of dip of Ore body:	**:**	10° to 40°
Dip Direction of the Ore Body	**:**	North East – South West

Depth	**:**	Depth varies from 20 to 30 meters
Nature/ Form of Mineral	**:**	Lumpy at surface and tends to be powdery ore at depth.

3.5.2 GEOMORPHOLOGY & TOPOGRAPHY

3.5.2.1 GEOMORPHOLOGY

Geomorphologically, the state is divided into four morphological units namely;

1. The coastal plains with dominant marine land forms on the west,
2. Vast etch plain,
3. Low dissected denudational hills with valleys
4. Deeply dissected high Western Ghats with denudational hills rising to a maximum of 832m amsl and occurring all along the eastern part of the state.

The 10km buffer zone study area comprises of stretched low lying plains, hills and valleys along with the deeply dissecting high Western Ghats with denudational hills.

Many first order streams originate from the hill top downwards forming a dendritic drainage pattern. The geomorphologic map, and Digital Elevation Map of the study area is given vide **Plate Nos. 10 & 11.**

3.5.2.2 TOPOGRAPHY

The topography of the Study area is undulating & hilly with gentle gradient of 10 to 20 degrees towards east. Highest elevation in the study area is 640 m MSL in South East direction.

In the core zone the highest level is 102 m MSL towards North East of lease on Dump no. 1 and lowest level is -0.5 m MSL towards North of lease in pit no.3. There is a seasonal nalla flowing across the block from west to east and joins Kalay River flowing towards the eastern side of the block boundary.

3.5.3 DRAINAGE PATTERN

Regionally, dendritic drainage pattern is observed in the 10km buffer zone with many first order streams originating from the hill top downwards flowing into major rivers. The study area comprises of the rivers such Kalay River, Zuari River and Dhudsagar River.

The main drainage for this mineral block is the Kalay River flowing from South to North towards the eastern side of the block boundary.

The catchment area of Kalay River is all high ground towards eastern of the block to a distance of 5 to 6 kms from the Kalay River.

Also a second order seasonal nallah exists outside the Mineral Block which flows from the north west of the block towards the south and flows across the Mineral Block from west to east, ultimately joining Kalay River. The catchment area for the seasonal nalla is all high ground towards west of the lease to a distance of 300 to 600 meters from the nalla. Distances & directions to some of the important rivers and reservoirs from the Mineral Block in the buffer zone is given it **Table 3.4 & 3.5** respectively.

Table 3.4: Distance & Direction of Rivers within buffer zone

Name of the River/Stream/Nallah	Distance fromProject Site (Km)	Direction from Project Site
Kalay River	0.005	East
Dhudsagar River	4.0	North – North East
Zuari River	3.79	South
Sanguem River	5.66 km	South
Panduranga Nala	6.55 km	West - North West
Ugem River	5.57 km	South
Udani River	8.80 km	North West
Guloli River	7.20 km	South
Paroda River	8.6 km	South West

Table 3.5: Distance & Direction of Reservoirs within buffer zone

Name of the Reservoir	Distance fromProject Site (Km)	Direction fromProject Site
Salaulim Dam	7.83	South
Moissal Dam	4.32	West

The mine area receives an annual average rainfall of about 4000mm. There are 3 open mining pits existing in the block of which 2 are water logged.

During monsoon, garland drains will be constructed along the toe of the waste dumps and mining benches to divert the rain water into the mining pits and settling ponds. Settling ponds will be constructed along the course of the garland drains. Bunds will be constructed along the toe of the dumps to avoid solid wash-off. Water accumulated in the mine pit will be allowed to stand to facilitate sedimentation of suspended solids before discharging. The pumped-out water will be passed through

a series of settling ponds, where it will be treated with lime and flocculants to expedite rate of sedimentation of solid suspended particles. Clear water overflow from the settling ponds will be discharged into the seasonal nallah.

The drainage map & contour map is shown in **Plate Nos. 12 & Plate No. 13**.

3.5.4 HYDROGEOLOGY

Detailed hydrogeological study was conducted within 10km radius from the boundary of Mineral Block considering 15 open dug wells spearing in all directions around the Mineral Block, tapping mostly shallow aquifers to delineate the ground water regime in the study area during summer season 2023. The significant findings of the report are given below:

a. Stage of Ground Water development in Sanguem Taluka is 16.97% and categorised as SAFE in ground water development and management point of view.
b. Water quality in general is safe and potable in all the sites and is within the maximum permissible limits of the Bureau of Indian Standards (BIS).
c. Depth to water level varied from less than 2 m bgl to more than 14 m bgl.
d. The water requirement for the mine is 300 m3/day.
e. Annual average rainfall received in the area is about 4000 mm. Rainwater from the project area will be channelized into the mining pits and settling ponds.
f. The main iron ore deposit is called as Codli-Kirlapal-Costi deposit. The general succession of the strata observed in the mineral block from top to bottom is Laterite (about 15 – 20 m), Altered Dyke (Intrusive), Ferruginous/Phyllitic/ Limonitic Clay (10 – 15 m), Iron Ore body (20 - 30 m) and Siliceous Manganiferous Clay & Weathered BHQ (forms foot wall).
g. Laterites are the most important water bearing formation covering over 60 percent of the area. Metavolcanics formation spreads in parts of Sanguem, Quepem and Cancona talukas of South Goa district. The water bearing properties of metabasalt and metagreywacks and the associated rocks of pre Cambrian age are also dependent on fracturing, jointing and foliation present in the rocks.
h. Two types of aquifer system are observed i.e., Aquifer-I which is shallow phreatic aquifer and Aquifer-II which constitutes the deep fractured aquifer. Aquifer-I comprises of Laterite, Alluvium, weathered meta

volcanic and weathered meta sedimentaries, generally occurs in depth ranges of 9-42 m bgl. Aquifer-II comprises of fractured meta-sedimentaries, Granite gneiss and schistose rock. Depth of occurrence of aquifer ranges from 25 to 180 m bgl.

i. The higher fractured aquifer thickness of 9 to 16 m is observed isolated patches in the central western parts near Sacordem, Kalay.
j. Fractured aquifer thickness indicates that it ranges from 0.10 to 16 m, however aquifer thickness of 2-5 m is observed in many parts of the state.
k. The discharge of the dug well tested in the lease area is 14.38 m3/ hr. Transmissivity estimated as 16.84 m2/ day for draw down of 20.43 m.
l. Block IV –Kalay Mineral Block is situated on a Plain region at an elevation of about 18 - 94 m amsl and does not have any surface water bodies. It was observed from the studies carried out on the open wells, that water levels in Phreatic aquifer is mostly shallow where the ground water abstraction structures are located at an elevation of 18 m to 94 amsl. The aquifer at deeper mining level has less potential and is made of clayey intercalations and mostly aquicludes. The piezometric surface of deeper semiconfined aquifer shows steady state to rising trend and not showing falling trend. Mining activity will not have any negative impact on ground water regime.

Hydrogeological study report is enclosed as **Appendix 2**.

3.6 BASE LINE & BASE MAPS - ENVIRONMENTAL COMPONENTS

3.6.1 BASELINE SCHEDULE

The location of air, water, noise and soil sampling stations were selected for appropriate monitoring. A monitoring station was positioned at Core zone (project site) for micro-meteorological data collection. The schedule of the environmental monitoring programme is described below:

Table 3.6: Baseline Schedule

Environmental component	Monitoring period	No. of Sampling Stations	Parameters
Micro-Metrology	Mar to May - 2023	One station	Temperature, Relative humidity, Rainfall, Wind speed, wind direction
Air Quality	Mar to May - 2023	8 Stations	PM_{10}, $PM_{2.5}$, SO_2, NO_2, CO, NH_3, C_6H_6, B(a)P, O3, As, Lead & Nickel
Surface water Quality	May, 2023	6 stations	Surface water - IS : 2296, 1982 Class C Norms
Ground Water Quality	May, 2023	8 stations	Groundwater - IS-10500:2012 & CPCB Norms

Noise	April, 2023	8 Stations	L_{day}, L_{night}, & L_{eq}
Soil	May, 2023	7 Samples	Physico-chemical parameters & micro-nutirents (IS: 2720)
Land use	May-2023	Core & Buffer Zone	--
Ecology & Biodiversity	April 2023	Core & Buffer Zone	Flora & Fauna Survey
Socio-Economic	May -2023	10 Kms Study area	Socio-economic Survey
Hydrogeological Studies	September - 2023	Core & Buffer Zone	Groundwater study

Table 3.7: Environmental Attributes & Frequency of Monitoring

Environmental Component	Sampling Locations	Sampling Parameters	Total Sampling period	Sampling Frequency
Meteorology	Core zone	Wind speed, Wind Direction	3 months	Hourly
		Rainfall, cloud cover		Daily
		Temp and relative humidity		Twice, Thrice & daily
Ambient Air Quality	A1 - Kalay Mineral Block Mine Office (Core Zone) A2 - Costi Village (Near Chowgule colony) A3 - Kalay village A4 - Devonamol Village A5- Cormonem village - Meditation Centre A6 – Bandoli village (Morcani) A7 - Santona village (Ambeudok) A8 - Near SFIPL Plant Office	PM10, PM2.5, SO_2, NO_X, CO, NH_3, B(a)P, Heavy Metals - Pb, As, Ni, Hg & Free silica	2 days/ week	24 hourly
Surface Water Quality	PW- Kalay Mineral Block Mine pit water SW1 - Kalay River upstream SW2 - Kalay River Downstream SW3 - Zuvari river SW4 – Moisal dam SW5 - Dudhsagar river	As per IS: 422E As per IS:2296	Once during study period	Grab Sampling
Ground Water Quality	GW1- Kalay Mineral Block GW2- Near SFIPL Plant Office GW3- Santona Village – (Ambeudak) Near Saibaba temple GW4 – Bandoli village -(Gavaliwada) GW5 – Costi village (Near Chowgule Colony) GW6 – Devonamol – Kalay village GW7 – Savargal village	IS – 10500: 2012	Once during study period	Grab Sampling

	GW8 - Kalsai village (All Samples collected were open well water)			
Noise	N1 – Kalay Mineral Block Mine office (Core zone) N2 – Cormonem village – Meditation centre N3- Santona Village (Ambeudok) N4 – Near SFIPL Plant Office N5 - Mestri Bhat - Santona Village N6 - Costi Village (Near Chowgule colony) N7- Devonamol village N8 – Bandolivillage (Marconi)	Lday, Lnight & Leq	24 Hourly composite	Once during study period
Soil	S1 – Dump Soil of Kalay Mineral Block S2 - Costi village Agriculture soil S3 – RF near Devnamol Village S4 – Santona Village (Mestri Bhat) Agriculture land S5- Cormonem village Agriculture land S6 - Bandoli village Agriculture land S7 – Santona Village (Ambeudhok) Agriculture land	Physical, Chemical constituents and Micro-nutrients suitability for agricultureal growth	Composite Sample	Once during study period
Land use	Core & Buffer Zone	--	Once during study period	
Ecology & Biodiversity	Core & Buffer Zone	Flora & Fauna Survey	Once during study period	Quadart Method
Socio-Economic	10 Km Study area	Socio-economic Survey	Once during study period	Random Survey

3.6.2 MICROMETEOROLOGICAL STATUS

Sub-tropical climate prevails over the study area. May is the hottest month where the mean daily temperature increases to 30^0C. January is the coolest month with mean daily temperature is about 23^0C. The temperature is highest (around 33°C) in pre–monsoon months of April & May and again in post-monsoon during months of November & January. Due to its proximity to the Arabian Sea, humidity throughout the year is more than 60% with range from 80 to 90% during the monsoon period.

As a result of geographic influence, rainfall increases towards the Western Ghats, with an average annual rainfall for last 15years is about 3959 mm. Over 90% of the

annual rainfall occurs during monsoon months.

The average annual rainfall recorded is 395.9 cm in Santona village of Sanguem taluka of South Goa District. Month-wise annual rainfall recorded by the Hydromet Division, Indian Meterological Department, New Delhi is shown below in **Table 3.8.**

Month-wise rainfall data is depicted in **Fig. 3.1**.

Table 3.8: Annual Rainfall Data from 2007-2022 in mm

Years	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Total
2007	0	0	0	0	67	887	1007	1193	670	285	0	0	4111
2008	0	0	120	0	56	1074	658	1224	642	14	4	12	3804
2009	0	0	0	0	49	701	1672	455	660	238	125	0	3901
2010	15	0	0	49	3	688	1697	874	524	280	215	3	4347
2011	0	0	0	0	17	1196	1481	1004	646	36	0	0	4382
2012	0	0	0	0	0	861	1082	1159	372	151	29	0	3653
2013	0	0	0	0	72	1316	2288	867	474	285	33	0	5335
2014	0	0	0	0	80	650	1584	1302	499	207	0	19	4342
2015	5	0	29	1	55	796	967	646	305	139	40	0	2984
2016	0	0	0	0	0	700	924	599	449	70	0	0	2743
2017	0	0	0	0	137	904	1017	590	386	136	0	13	3183
2018	0	0	0	0	0	932	1149	744	128	79	0	0	3032
2019	0	0	0	0	0	804	1794	1775	751	438	0	0	5563
2020	0	0	0	0	86	820	1129	1522	801	114	0	0	4471
2021	0	0	0	0	220	1047	1413	398	485	253	226	0	4042
2022	0	0	0	84	110	595	1600	451	359	246	5	10	3460

Source: Hydromet Division, Indian Meterological Department, New Delhi

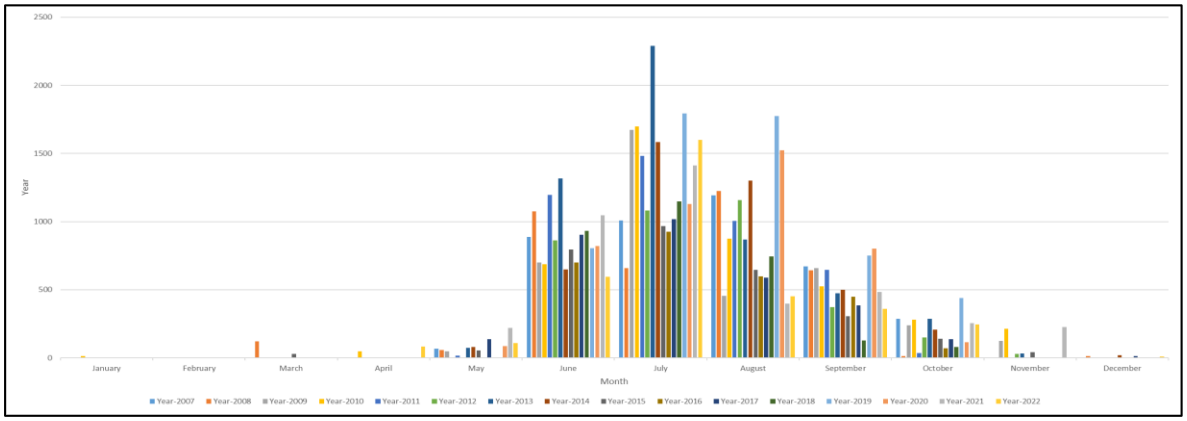


Fig. 3.1: Month-wise rainfall of South Goa District

Hourly micrometeorological data of wind speed, direction, temperature, relative humidity, rainfall was collected during March 2023 to May 2023 (Summer season), are presented in **Table 3.9** and windrose diagram presented in **Fig. 3.2**.

Observations:

Observations during the study period are as given below:

- Predominant wind direction is towards East
- Calm condition prevailed for 20.7% of the study period
- Temperature readings ranged between Min. 21.0 °C to Max 39.5 °C,
- Relative humidity values ranging in between 23.6 % to 88%,
- There were no rainy days

The collected meteorological data during this season represents the local weather phenomena.

Table 3.9: Site-Specific Micro-Meteorological Data Summer 2023

Date	Temperature (°C)		Relative Humidity (%)	
	Min.	Max.	Min.	Max.
01-03-2023	26.1	36.1	48.1	87.3
02-03-2023	24.1	37.2	43.2	88
03-03-2023	23	36	47.4	87.4
04-03-2023	24.3	36.3	47.1	85.4
05-03-2023	27.2	38.6	45.2	86.5
06-03-2023	26.2	39.5	41	87.5
07-03-2023	24	38.2	43.1	86
08-03-2023	23.3	37.2	43.3	86.4
09-03-2023	24	38.2	40.2	87.1
10-03-2023	23	36.3	32.5	87.6
11-03-2023	23.1	37.5	37.2	87.1
12-03-2023	24	36.5	45.2	85
13-03-2023	23.2	37.3	47	87.5
14-03-2023	26	37.5	46	84.7
15-03-2023	27.1	36.1	53	86
16-03-2023	26.2	36.5	55.6	86.1
17-03-2023	23.5	38.2	53.5	84.3
18-03-2023	22.6	36.2	50.5	80.1
19-03-2023	25.1	37.6	45.3	78.6
20-03-2023	22.2	37.3	37.2	87.5
21-03-2023	23	37.8	34.1	79
22-03-2023	25	36.6	44.3	80
23-03-2023	27	37.4	31	82
24-03-2023	24	36.5	51	76.7
25-03-2023	26.3	37.5	42.3	84.2
26-03-2023	23	38.8	41.3	86.4
27-03-2023	25.2	37.1	46.1	87.5
28-03-2023	25	36.5	59.2	88

29-03-2023	23.1	38.2	37.5	82
30-03-2023	26.3	37.4	49.5	78
31-03-2023	26.1	37.2	42.1	80

Date	Temperature (°C)		Relative Humidity (%)	
	Min.	Max.	Min.	Min.
01-04-2023	25.3	37.3	39.2	86.4
02-04-2023	23.3	37.9	39	82.1
03-04-2023	26.2	37.5	40.3	88
04-04-2023	27	38.2	50.5	86.4
05-04-2023	25	35.6	38.6	84.7
06-04-2023	27	36.7	48	86.6
07-04-2023	27.1	36.2	55.1	86.5
08-04-2023	28	38.2	58	87.4
09-04-2023	27	33.4	64.5	84
10-04-2023	27	35.5	59	87.6
11-04-2023	24	35.1	55.2	82.4
12-04-2023	23.1	36.2	64.1	87.6
13-04-2023	24.3	38.3	85.2	86.4
14-04-2023	25.1	36.5	62.5	87.3
15-04-2023	24	35.4	58.1	83
16-04-2023	23.3	36.5	42.1	78.6
17-04-2023	25.2	36.5	50.2	79
18-04-2023	24.6	37.5	47.1	87.6
19-04-2023	21	37.6	34.2	84
20-04-2023	22.3	37.5	42.2	80
21-04-2023	22.3	38.3	39.2	78
22-04-2023	24.5	37.3	38.2	68
23-04-2023	21	36.8	34.2	80
24-04-2023	22.3	38.3	42.2	70
25-04-2023	22.3	35.8	39.2	72
26-04-2023	24.5	38.5	38.2	84
27-04-2023	24.3	37.9	23.6	76
28-04-2023	24.1	36.8	31.1	87.3
29-04-2023	26	38.5	38	88
30-04-2023	24.2	37.4	39.2	86.4

Date	Temperature (°C)		Relative Humidity (%)	
	Min.	Max.	Min.	Max.
01-05-2023	23.1	37.6	35.1	87.5
02-05-2023	22.2	36.8	34.2	84
03-05-2023	25	38.5	40.4	80.3

04-05-2023	24	36.2	39	78.6
05-05-2023	24	37.2	32	80
06-05-2023	24.4	37.5	37.2	66
07-05-2023	25	36.8	41.5	64
08-05-2023	27	37.5	54.2	80
09-05-2023	28	37.3	53.1	84.6
10-05-2023	27.1	37.6	51.6	87.6
11-05-2023	26.2	37.1	53	85
12-05-2023	28	38.6	42.4	87
13-05-2023	26.1	38.2	51	80.5
14-05-2023	28	37.3	51.1	87.6
15-05-2023	26	36.8	50.3	88
16-05-2023	25.2	37.6	41	87.5
17-05-2023	24.1	36.8	34.2	87.2
18-05-2023	27	38.5	41.5	86.5
19-05-2023	27	37.4	48	86.7
20-05-2023	27	37.2	42.1	85.5
21-05-2023	28	35.8	45.2	86.3
22-05-2023	25	36.5	43	87.2
23-05-2023	23	37.1	51.4	86
24-05-2023	25	38.2	47	84.6
25-05-2023	26	37.3	47	85.8
26-05-2023	26.1	36.6	51	80
27-05-2023	27.1	35.6	37.5	83
28-05-2023	25.3	37	44.4	78.6
29-05-2023	26.1	37.6	40.6	80.4
30-05-2023	28	38.2	45.2	87.6
31-05-2023	26.2	37.2	49.3	87.2

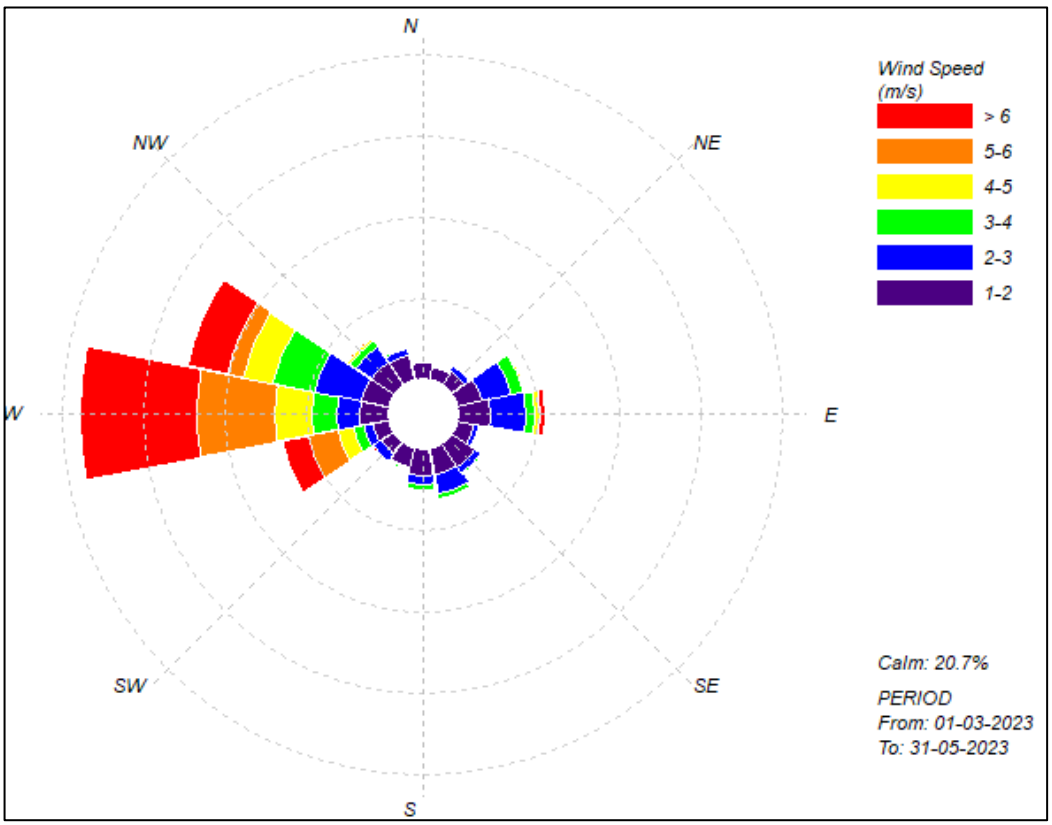


Fig. 3.2: Windrose diagram (Summer 2023)

3.6.3 AIR ENVIRONMENT

The prime objective of baseline air quality survey is to assess the existing air quality of the study area. This will also be useful in assessing the conformity to standard Ambient Air Quality.

Baseline information of ambient air quality with respect to the study area was collected. The study area represents mostly a rural environment. Various sources of air pollution in the region are vehicular traffic, dust arising from unpaved village roads & domestic fuel burning.

3.6.3.1 SELECTION OF SAMPLING STATIONS

The baseline status of the Ambient Air Quality can be assessed through a scientifically designed Ambient Air Quality Monitoring Network.

The selection of sampling locations for the air quality surveillance programme is based on the following.

(a) Representation of the Mineral Block area
(b) Representation of downwind direction

(c) Representation of upwind direction
(d) Representation of crosswind direction
(e) Representation of residential areas
(f) Representation of regional background levels
(g) Representation of sensitive receptors

Since the ground level concentration of the pollutants, mainly dust released from the proposed Mineral Block will not spread beyond 5 km radius, the locations of monitoring stations in the buffer zone have been kept close to the proposed ML area. The wind direction conditions have been considered and correlated during the AAQ monitoring. The stations monitored for Ambient Air Quality and for source monitoring are furnished below:

Table 3.10: Location of Ambient Air Quality Monitoring Stations

Code	Location	Distance in (Km)	Direction	Latitude			Longitude		
				Deg	Min	Sec	Deg	Min	Sec
A1	Kalay Mineral Block Mine office (core zone)	--	--	15	17	37.62	74	9	9.69
A2	Costi village (Near Chowgule Colony)	1.82	SSE	15	16	15.89	74	10	0.15
A3	Kalay village	2.5	E	15	17	30.15	74	10	54.05
A4	Devonamol Village	0.27	NE	15	18	1.40	74	9	40.00
A5	Cormonem village - Meditation Centre	2.64	N	15	19	31.72	74	9	11.09
A6	Bandoli village (Morcani)	1.13	NW	15	18	6.90	74	8	17.20
A7	Santona village (Ambeudok)	0.34	SWW	15	17	26.22	74	8	57.63
A8	Near SFIPL Plant Office	0.6	NNE	15	18	22.87	74	9	27.46

Their locations are marked in key plan in **Plate No. 14.**

Photographs of Air Quality Monitoring Locations



Mestri Bhat Santona Village



Devnamol Village

3.6.3.2 FREQUENCY OF MONITORING

Ambient Air Quality (AAQ) samples were collected on basis of 24-hour sampling, twice a week at each site. The ambient air quality samples were collected for 13-weeks beginning from 1st March to 31st May, 2023.

The samples were preserved and analysed as per the standard methods recommended by Standard Operating Procedure (SOPs) of Central Pollution Control Board (CPCB 2011). Ozone (O_3) and Carbon Monoxide (CO) were monitored by randomly collecting the gas through one hour sampling procedure. Samples for Ammonia (NH_3) were randomly monitored for its presence.

3.6.3.3 METHOD OF ANALYSIS

Ambient air samples were analysed with Gravimetric, Colorimetric or Atomic Absorption Spectrophotometric (AAS) method as per standard methods specified by Central Pollution Control Board (CPCB 2011). National Ambient Air Quality Standards (NAAQS) are given below in **Table 3.11.**

Table 3.11: National Ambient Air Quality Standards

S. no	Pollutants	Time Weighted Average	Concentration in Ambient Air		Methods of Measurement
			Industrial, Residential, Rural and other Areas	Ecologically, Sensitive Area (Notified by Central, Government)	
1	Sulphur Dioxide (SO2), µg/m³	Annual * 24 Hours **	50 80	20 80	-Improved West and Gaeke Method -Ultraviolet Fluorescence
2	Nitrogen Dioxide (NO2), µg/m³	Annual * 24 Hours **	40 80	30 80	-Jacob & Hochheiser modified (NaOH-NaAsO2) Method -Gas Phase Chemiluminescence
3	Particulate Matter (Size less than 10 µ) or PM_{10}, µg/m³	Annual * 24 Hours **	60 100	60 100	-Gravimetric -TEOM -Beta attenuation
4	Particulate Matter (Size less than 2.5 µ) or $PM_{2.5}$, µg/m³	Annual * 24 Hours **	40 60	40 60	-Gravimetric -TEOM -Beta attenuation
5	Ozone (O3) µg/m³	8 Hours * 1 Hour **	100 180	100 180	-UV Photometric -Chemiluminescence
6	Lead (Pb) µg/m³	Annual * 24 Hours **	0.50 1.0	0.50 1.0	-AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper -ED-XRF using Teflon filter
7	Carbon Monoxide (CO), mg/m³	8 Hours ** 1 Hour **	02 04	02 04	-Non dispersive Infrared (NDIR) Spectroscopy

8	Ammonia (NH3), µg/m³	Annual * 24 Hours **	100 400	100 400	-Chemiluminescence -Indophenol blue method
9	Benzene (C6H6), µg/m³	Annual *	05	05	-Gas Chromatography (GC) based continuous analyzer -Adsorption and desorption followed by GC analysis
10	Benzo(a)Pyrene (BaP) Particulate phase only, ng/m³	Annual *	01	01	-Solvent extraction followed by HPLC/ GC analysis
11	Arsenic (As), ng/m³	Annual *	06	06	-AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper
12	Nickel (Ni), ng/m³	Annual *	20	20	-AAS/ICP Method after sampling on EPM 2000 or equivalent filter paper
13	Free silica				

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

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

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

3.6.3.4 OBSERVATIONS

All the parameters in the Ambient Air Quality monitoring were found to be well within the permissible limits. Statistical analysis data with respect to SO_2, NO_2 PM_{10} & $PM_{2.5}$ are presented below in **Table 3.12**. Results for all the stations for the Summer Season 2023 are presented as **Annexure 7.**

Table 3.12: Statistical Report of Ambient Air Quality

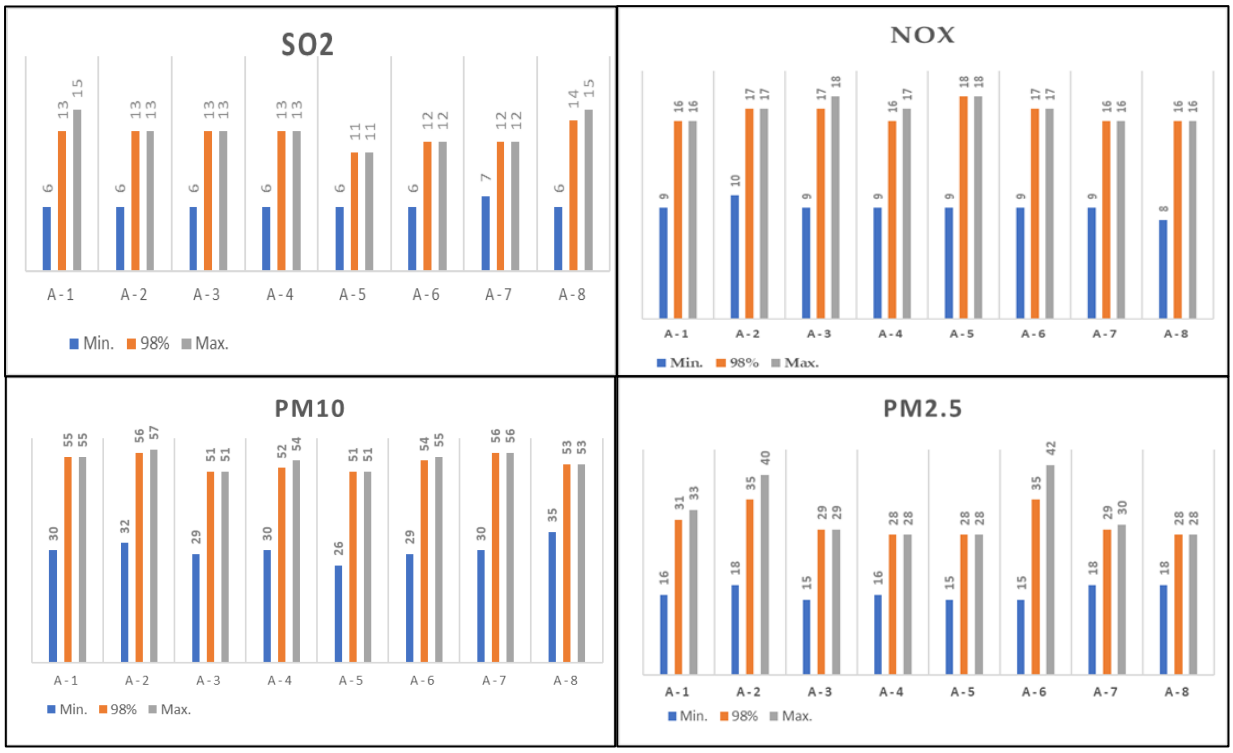
Stations Code	**A1 – Kalay Mineral Block Mine office (Core zone)**				**A2 - Costi village (Near Chowgule Colony)**				**A3 - Kalay village**			
Parameters	**SO_2**	**NO_2**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**NO_2**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**NO_2**	**PM_{10}**	**$PM_{2.5}$**
Min.	6	9	30	16	6	10	32	18	6	9	29	15
98%	13	16	55	31	13	17	56	35	13	17	51	29
Max.	15	16	55	33	13	17	57	40	13	18	51	29
Avg.	9	12	44	24	9	12	45	25	9	12	41	22
SD	2	2	7	4	2	2	7	4	2	2	6	4
No. of obs	26				26				26			
Stations Code	**A4 - Devonamol village**				**A5 - Cormonem village - Meditation Centre**				**A6 - Bandoli village (Morcani)**			
Parameters	**SO_2**	**NO_2**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**NO_2**	**PM_{10}**	**$PM_{2.5}$**	**SO_2**	**NO_2**	**PM_{10}**	**$PM_{2.5}$**
Min.	6	9	30	16	6	9	26	15	6	9	29	15
98%	13	16	52	28	11	18	51	28	12	17	54	35
Max.	13	17	54	28	11	18	51	28	12	17	55	42
Avg.	10	12	41	22	9	12	39	22	9	12	42	23
SD	2	2	6	4	2	2	7	4	2	2	7	5
No. of obs	26				26				26			

Stations Code	A7 - Santona village (Ambeudok)				A8 - Near SFIPL Plant office			
Parameters	SO_2	NO_2	PM_{10}	$PM_{2.5}$	SO_2	NO_2	PM_{10}	$PM_{2.5}$
Min.	7	9	30	18	6	8	35	18
98%	12	16	56	29	14	16	53	28
Max.	12	16	56	30	15	16	53	28
Avg.	10	12	46	25	10	12	45	24
SD	2	2	7	3	2	2	6	4
No. of obs	26				26			

3.6.3.5 RESULTS

As per the NAAQS of Central Pollution Control Board (CPCB), levels of parameters such as Ammonia, Benzene, Benzo-(a)-pyrene, Arsenic & Nickel analyzed were well below detectable limits (BDL), well within the standards.

Details with respect to the parameters monitored as per CPCB NAAQ standards are summarized below:



Sulphur Dioxide (SO_2)

A maximum value of 15.0 µg/m^3 was observed at Kalay Mineral Block & SFIPL plant area and minimum value of 6.0 µg/m3 was observed at the seven Monitoring stations, i.e., Costi, Kalay, Devanamol, Cormonem, Bandoli, Kalay Mineral Block and

SFIPL Plant Office.

Oxides of Nitrogen (NO_2)

A maximum value of 18.0 µg/m^3 was observed at Kalay and Cormonem Villages and minimum value of 8.0 µg/m^3 was observed at CGL Plant Office.

Particulate Matter (PM10)

A maximum value of 57 µg/m3 was observed at Costi village and minimum value of 26.0 µg/m3 was observed at Cormonem village.

Respirable Particulate Matter ($PM_{2.5}$)

A maximum value of 42.0 µg/m3 was observed at Bandoli Village and minimum value of 15.0 µg/m3 was observed at Kalay, Cormonem and Bondli Villages.

3.6.4 MINERALOGICAL COMPOSITION OF PM10

The Free Silica content in PM_{10} Filter paper was Below Detectable Level. A copy of the report on Air borne dust and free silica analysis is enclosed as **Annexure 7.**

3.6.5 NOISE ENVIRONMENT

3.6.5.1 NOISE MONITORING STATIONS

Location of Noise Monitoring Stations is shown in **Table 3.13.**

Table 3.13: Noise level monitoring locations

Noise Monitoring Stations										
Code	Location	Criteria	Distance in (Km)	Direction	Latitude			Longitude		
					Deg	Min	Sec	Deg	Min	Sec
N1	Kalay Mineral Block Mine office (Core zone)	Industrial area	--	--	15	18	3.26	74	9	18.38
N2	Cormonem village-Meditation Centre	Residential area	2.46	N	15	19	24.52	74	9	8.64
N3	Santona Village (Ambeudok)	Residential area	0.5	SWW	15	17	27.57	74	8	51.88
N4	Near SFIPL Plant Office	Industrial area	0.4	NNE	15	18	16.10	74	9	13.80
N5	Mestri Bhat - Santona Village	Residential area	0.33	NNE	15	18	12.62	74	9	34.40
N6	Costi Village (Near Chowgule Colony)	Residential area	1.89	SSE	15	16	14.68	74	9	59.24

N7	Devonamol Village	Silent Zone	0.27	NE	15	18	1.40	74	9	40.00
N8	Bandoli Village (Morcani)	Residential area	1.09	NW	15	18	7.81	74	8	18.71

Photographs of Noise Quality Monitoring Locations



Mestri Bhat Santona Village



Devnamol Village

Zones such as Industrial area, Silent zone & Residential zone were taken into considerations for noise level monitoring. Noise level monitoring stations are marked in key plan **Plate No. 15.**

3.6.5.2 RESULTS

Ambient noise quality monitoring results for all the stations for the Summer season 2023 are presented as **Annexure 7.** Summary of Noise monitoring in Leq for both Day & Night are shown below in **Table 3.14**.

The noise monitoring results are compared with the Ambient Noise Quality Standard notified under Environment (Protection) Act, 1986, given below in **Table 3.15** and were found to be well within the permissible limits.

Table 3.14: Summary of Noise monitoring

Code No.	Monitoring stations	Day	Night
		L_{eq}	L_{eq}
Core Zone			
N1	Kalay Mineral Block Mine office (Core zone)	44.9	38.7
Buffer Zone			
N2	Cormonem village- Meditation Centre	46.7	38.5
N3	Santona Village (Ambeudok)	49.1	39.6
N4	Near SFIPL Plant Office	50.2	39.9
N5	Mestri Bhat - Santona Village	48.0	38.8

N6	Costi Village (Near Chowgule Colony)	45.2	38.0
N7	Devonamol Village	44.5	35.0
N8	Bandoli Village (Morcani)	44.7	37.6

Table 3.15: Noise Quality Standards

Permissible limits as per ILO Code of Practice	Ambient Noise Levels	Leq. Limit dB(A)	
		Day	Night
For Unprotected ear - 8 hrs working shift	Industrial areas	75	70
Warning limit - 85 dB(A)	Commercial area	65	55
Danger limit - 90 dB(A)	Residential area	55	45
Worker not to be exposed for more than 115 dB(A)	Silence Zone	50	40

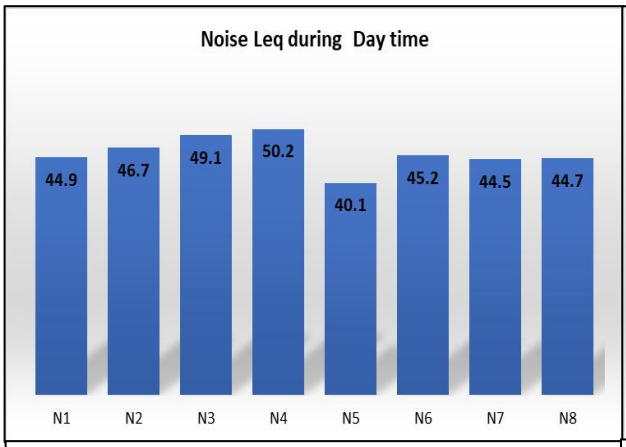


Fig. 3.3: Noise Levels oberserved during Day-time

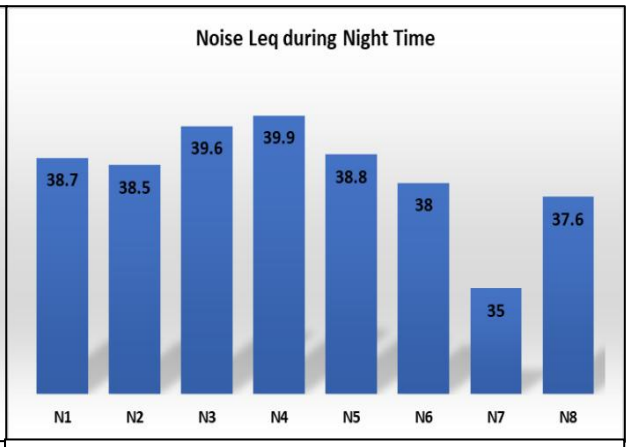


Fig. 3.4: Noise Levels oberserved during Night-time

3.6.6 WATER ENVIRONMENT

3.6.6.1 SURFACE WATER QUALITY

Kalay River exists on the Eastern side of the Mineral Block flowing from South to North. A second order seasonal nallah exists outside the Mineral Block which flows from the North West of the block towards the south and flows across the Mineral Block from west to east, ultimately joining Kalay River.

Surface water samples were collected from 6 locations, of which one is pit water sample and the remaining 5 surface water samples were from buffer zone. The water samples were analysed and the results were compared with GSR 422(E) standards for pit water and IS: 2296 for surface water samples.

All the parameters were found to be well within the permissible limits. Location of surface water sampling stations are listed below in **Table 3.16** and are marked in a

key plan enclosed as **Plate No. 16.** Brief summary of the Surface water analysis results is shown below in **Table 3.17 & Table 3.18** and the report is enclosed as **Annexure 7.**

Table 3.16: Location of Surface Water Sampling Stations

Code	Location	Phyiscal Observation	Distance in (Km)	Direction	Latitude			Longitude		
					Deg	Min	Sec	Deg	Min	Sec
PW	Kalay Mineral Block Mine Pit Water	Brown color, tiny Suspended solids were observed	--	--	15	17	29.43	74	9	15.44
SW1	Kalay river upstream	The river water was observed to be green in color, Stagant water, Suspended soilds observed	0.29	SE	15	17	6.69	74	9	51.73
SW2	Kalay River Downstream	The water was stagnat, green color was observed due to algae formation, presence suspended soilds. Zooplanktons are grown surrounding the river, used for domestic purpose nearby villagers	0.57	NNE	15	18	20.67	74	9	33.45
SW3	Zuvari River	Green color observed, Suspended solids present, some domestic waste was seen on the banks of the river	4.38	SW	15	15	14.60	74	7	40.04
SW4	Moisal Dam	Light brown color was observed, no water flow, Suspended soils observed	5.47	W	15	17	22.37	74	6	2.40
SW5	Dhudhsagar River	The river was observed in	6.60	NNW	15	21	29.32	74	7	36.62

		green color, no human activity seen, plants are surrounded across the river, small aquatic fishes are present, small suspended solids are observed								

Photographs of Surface Water Quality Monitoring Locations



Zuari River



Kalay River Downstream

Table 3.17: Surface water monitoring result of mine pit water

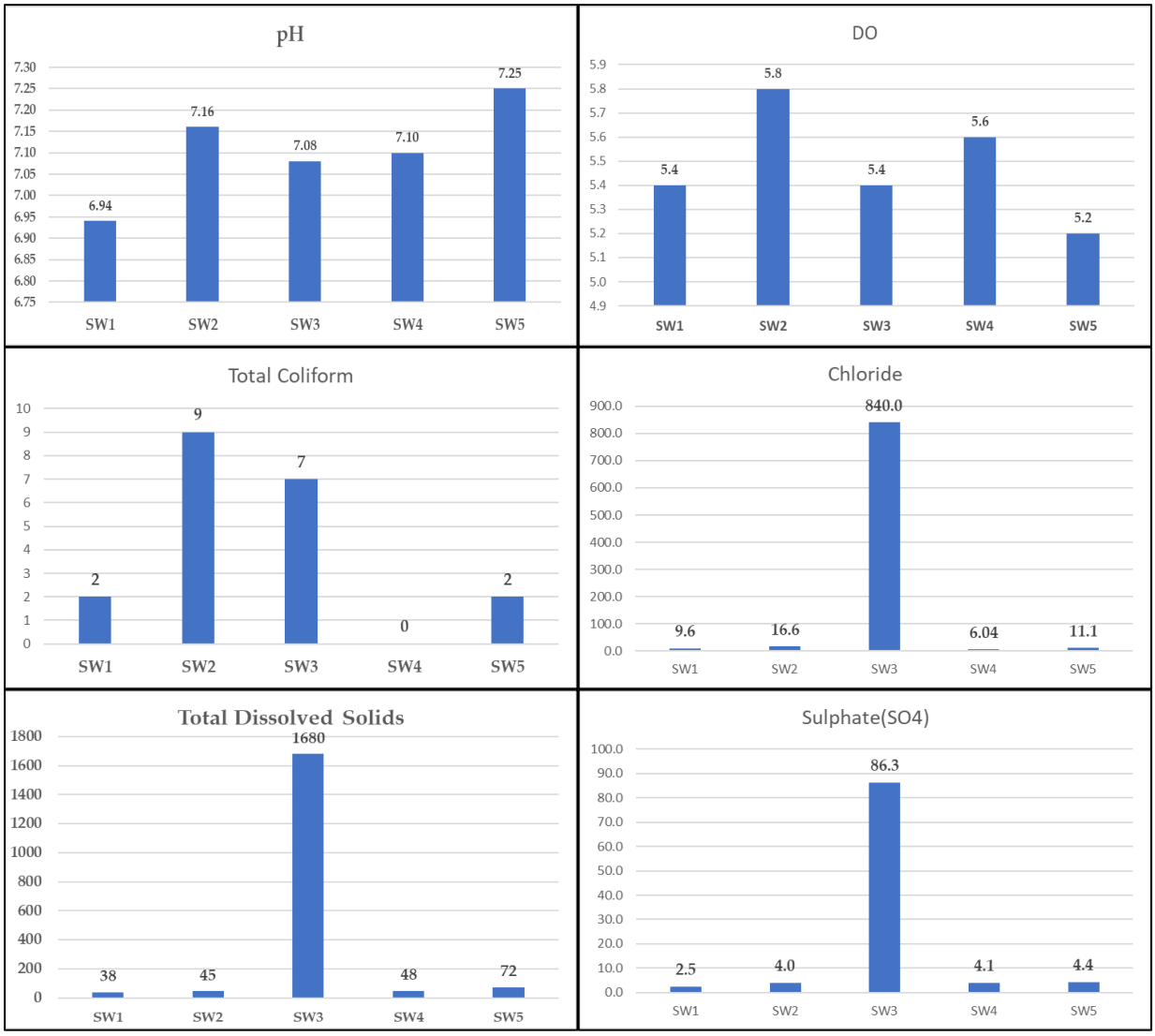
Parameters	Results PW	General Standards for Effluent Discharge of Environmental Pollutants
pH	7.05	6.0-9.0
Chemical Oxygen Demand (COD) mg/l	41.6	250
Biochemical Oxygen Demand mg/l, BOD, 27^0 C	8	30
Total Suspended Solids, mg/l	10	100
Fixed Dissolved Solids (FDS) mg/l	53	2100
Iron (as Fe), mg/l	0.075	3

Table 3.18: Surface water monitoring result

Parameters	Results					Limits For Stream Water Standards
	SW1	SW2	SW3	SW4	SW5	
pH	6.94	7.16	7.08	7.10	7.25	6.5 to 8.5
Dissolved Oxygen (as O_2), mg/l, Min	5.4	5.8	5.4	5.6	5.2	4
Total Dissolved Solids (mg/l), Max	38	45	1680	48	72	1500
Chloride (as Cl),mg/l, Max	9.6	16.6	840.0	6.04	11.1	600

Iron (as Fe), mg/l, Max	0.083	0.104	0.054	0.097	0.090	50
Sulphates as SO_4 (mg/l), Max	2.5	4.0	86.3	4.1	4.4	400
Total Coliform (mpn/100ml), Max	2	9	7	<1	2	5000
Total Suspended Solids (mg/l)	10	12	14	14	15	-
Total Hardness (as $CaCO_3$),mg/l	40	28	288	30	54	-
Chemical Oxygen Demand (COD) mg/l	22	24	22	20	26	-

Fig. 3.5: Graphical representation of results of some of the surface water parameters



3.6.6.2 RESULTS INTERPRETATIONS

The analysis results were compared to Stream Water Standards IS 2296, 1982 Class C norms for surface water bodies. It was observed that for one location i.e. Zuari River, the parameters TDS and Chlorides were exceeding the limits due to the influence of creek water.

3.6.6.3 GROUND WATER QUALITY

Ground water Samples were collected from 8 locations. One location was from within the Mineral Block and the remaining seven locations from the Buffer Zone. The samples were analyzed and compared with IS 10500 standards. Locations of Ground water sampling stations are shown in below **Table 3.19** and are marked in a key plan enclosed as **Plate No. 17.** Parameter wise ground water quality is shown below in **Table 3.20** and enclosed as **Annexure 7.**

Table 3.19: Location of Ground Water Sampling Stations

Code	Location	Physical Observation	Distance (Km)	Direction	Latitude			Longitude		
					D	M	S	D	M	S
GW1	Kalay Mineral Block	Water colourless & odourless. Dry leaves seen on the upper layer of well	--	--	15	17	35.9	74	9	10.0
GW2	Near SFIPL Plant Office	Water colourless & odourless, clear with no suspended solids. Water used for domestic purpose	0.511	E	15	17	32.85	74	9	41.51
GW3	Santona Village,(Ambeudok) Near Saibaba Temple	Water colourless & odourless without suspended solids.	0.49	W	15	17	26.3	74	8	55.1
GW4	Bandoli (Village – - Gavaliwada	Water colourless & odourless with less suspended solids, dry leaves were seen on the upper surface	1.23	NWW	15	18	20.6	74	8	4.36
GW5	Costi Village (Near Chowgule Colony)	Water colourless & odourless	2.06	SE	15	16	15.7	74	10	13.7
GW6	Devonamol – Kalay Village	Water colourless & odourless, Water used for domestic purpose	0.4	E	15	17	38.9	74	10	0.32
GW7	Savargal Village	Water colourless & odourless	1.75	S	15	18	59.3	74	9	31.22
GW8	Kalsai village	Water colourless & odourless	1.9	NW	15	20	43.45	74	7	3.16

Photographs of Ground Water Quality Monitoring Locations



Devnamol Village



Near Chowgule colony at Costi village

Table 3.20: Ground water monitoring result

Parameters	Results				Desirable Limits	Permissible Limits
	GW1	GW2	GW3	GW4		
pH	6.85	5.78	6.22	6.26	6.5 to 8.5	6.5 - 8.5
Electrical Conductivity (µmhos/cm)	60	52	61	110	-	-
Total Dissolved Solids, mg/l, Max	33.0	32.0	37.0	58.0	500	2000
Calcium (as Ca),mg/l, Max	4.80	2.40	3.20	8.20	75	200
Chloride as Cl (mg/l), mg/l, Max	10	13	10.6	17.1	250	1000
Magnesium (as Mg) mg/l, Max	2	<1	<1	4.86	30	100
Nitrates (as NO_3), mg/l, Max	1.0	0.33	0.55	0.38	45	45
Sulphates (as SO_4), mg/l, Max	2.5	<1	3.28	7.85	200	600
Alkalinity (as $CaCO_3$) mg/l, Max	28	10	15	20	200	600
Total Hardness (as $CaCO_3$) mg/l, Max	36	10.2	12.1	40.8	200	600
Parameters	**Results**				**Desirable Limits**	**Permissible Limits**
	GW5	**GW6**	**GW7**	**GW8**		
pH	6.08	5.73	6.67	6.33	6.5 to 8.5	6.5 - 8.5
Electrical Conductivity (µmhos/cm)	60	34	52	72	-	-
Total Dissolved Solids, mg/l, Max	36.0	21.0	32.0	44.0	500	2000
Calcium (as Ca),mg/l, Max	3.60	2.45	5.72	<2	75	200
Chloride as Cl (mg/l),mg/l, Max	12.58	9.06	7.04	16	250	1000
Magnesium (as Mg)mg/l, Max	2.2	<1	<1	<1.0	30	100
Nitrates (as NO_3),mg/l, Max	0.175	0.2	0.22	0.16	45	45
Sulphates (as SO_4),mg/l, Max	1.57	<1	<1	2.57	200	600
Alkalinity (as $CaCO_3$) mg/l, Max	15	5	20	15	200	600
Total Hardness (as $CaCO_3$),mg/l, Max	18	10.2	18.36	9.1	200	600

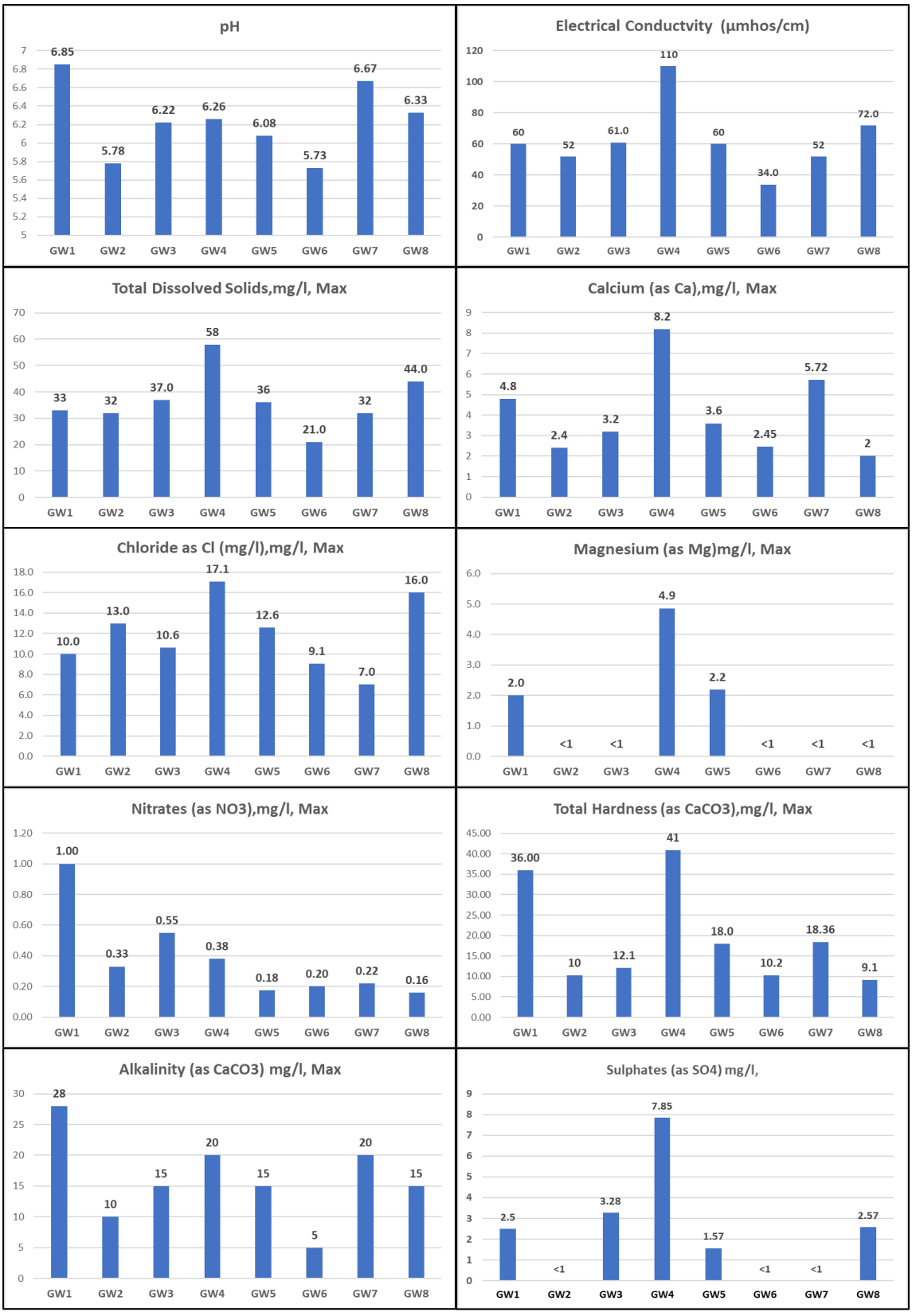


Fig. 3.6: Graphical representation of results of some pf the groundwater parameters

3.6.6.4 RESULTS INTERPRETATION

The open well samples were found to have slightly acidic pH. This is possibly due to the occurrence of lateritic soil. The soil is rich in Iron and Aluminum oxides and hence it makes the ground water slightly acidic in nature, while all other parameters were found to be within permissible limits.

3.6.7 SOIL QUALITY

3.6.7.1 SOIL SAMPLING STATIONS

Soil samples were collected from various locations in the core and buffer zone and analyzed. Location of soil sampling stations are shown below in **Table 3.21** and the demarcated on the key plan is enclosed as **Plate No. 18.** Soil monitoring results are tabulated in **Table 3.22.**

Table 3.21: Location of Soil Sampling Stations

Code No	Locations	Physical Observation	Distance (km)	Direction	Latitude			Longitude		
					D	M	S	D	M	S
S1	Dump soil of Kalay Mineral Block	The mine is not working due to which the plantation is observed around the Mineral Block area	--	--	15	18	34	74	9	24
S2	Costi Village Agricultural Soil	The soil is observed to be red color. It is mixed jungle were the trees of cashew nut trees, Peepel trees, etc are seen	2.03	SE	15	16	15.7	74	10	13.8
S3	RF Near Devonamol Village	Red soil Reserve forest (Kaju Plantation)	1.3	E	15	17	44.3	74	10	10.9
S4	Santona village (Mestri Bhat) Agricultural Land	Red soil Coconut Plantation	0.38	NNE	15	18	12.62	74	9	34.4
S5	Cormonem village Agricultural Land	Red Soil Coconut Plantation	2.6	N	15	19	28.5	74	9	17.0
S6	Bandoli village-Agricultural Land	Red Soil Coconut Plantation	1.1	NW	15	18	6.5	74	8	19.6
S7	Santona Village (Ambeudok)Agricultural Soil	Red Soil Coconut Plantation	0.42	W	15	17	26.6	74	8	55.1

Photographs showing collection of Soil samples



RF Near Devnamol Village



Bandoli Village

Table 3.22: Soil monitoring results

S. No.	Parameters	Unit	S1	S2	S3	S4	S5	S6	S7	Normal	High
Physical properties											
1	Colour	--	Red soil	Red soil	Red soil	Red soil	Red soil	Red soil	Red soil	--	--
2	Textural class	--	Clay Loam	Clay loam	Clay loam	Clay loam	Clay loam	Clay loam	Clay loam	--	--
3	pH	--	6.28	6.19	6.45	6.08	6.22	6.15	5.99		
Size Distribution											
3	EC	m.mohs/cm	0.283	0.363	0.315	0.296	0.248	0.315	0.63	1.0 to 2.0	>2
Chemical Properties											
4	Nitrogen as N	Kg/Ha	208	175	190	160	270	135	175	280-560	>560
5	Potassium as K_2O	Kg/Ha	260	260	270	260	270	280	260	50 to 120	>120
6	Sodium as Na_2O	mg/Kg	160	162	148	162	172	148	162	--	--
Micro- nutrients											
7	Zinc (as Zn)	mg/Kg	0.18	0.19	0.29	0.48	0.44	0.25	0.34	--	--
8	Iron (as Fe)	%	4.89	4.72	3.26	3.08	3.48	4.18	4.72	--	--

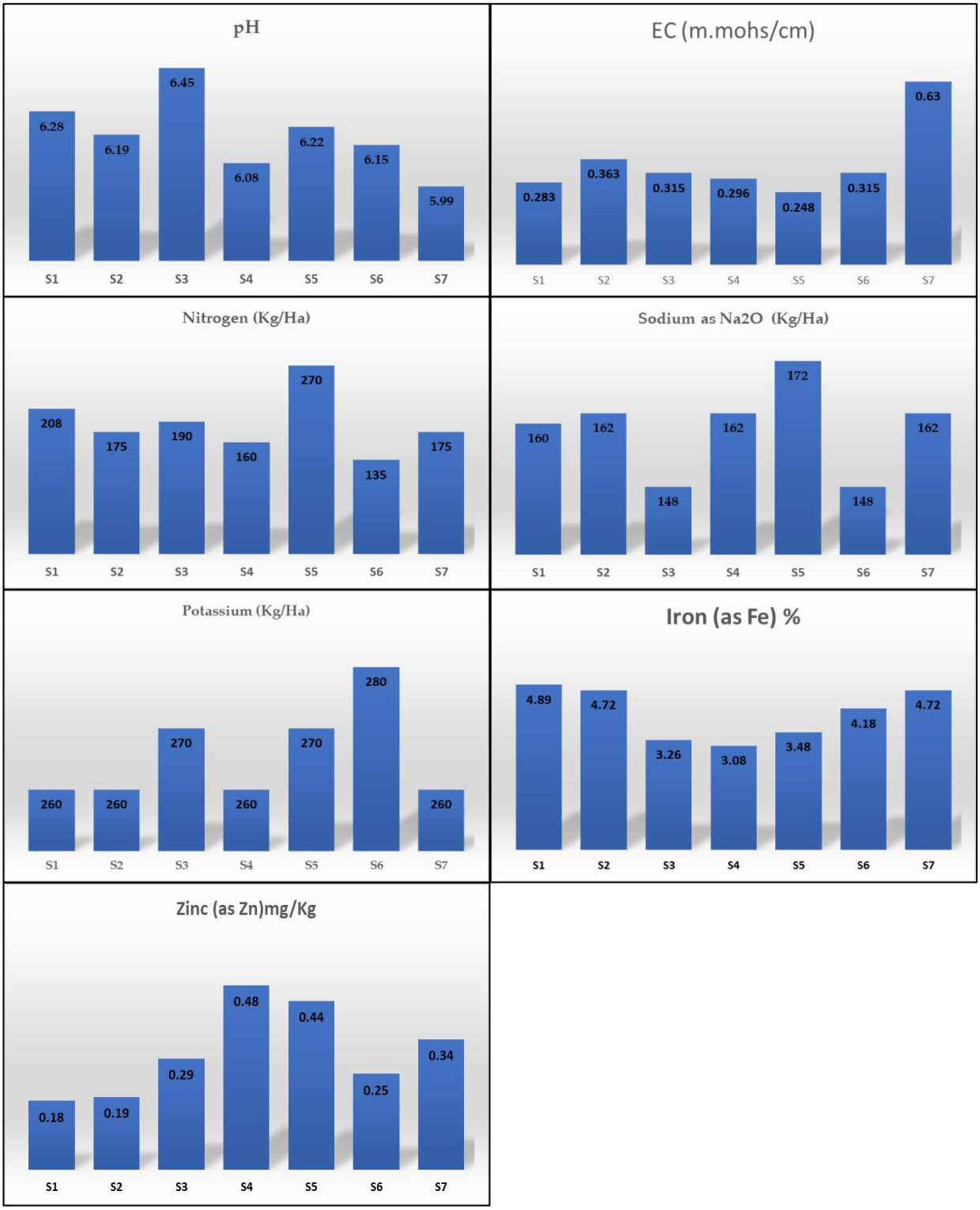


Fig. 3.7: Graphical representation of results of some of the soil parameters

3.6.7.2 RESULT INTERPRETATION

The dominant soil type observed in the mining lease is lateritic. The results show that the pH of soil was between 5.89 and 6.22. Texture varied from sandy clay to clay loam. Electrical Conductivity ranged from 0.283 to 0.363 mhos/cm, which is a measure of the soluble salts and ionic activity in the soil. All other parameters analysed were observed to be within permissible limits.

3.6.8 LAND ENVIRONMENT

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 are indicated. Land use plan of the Mineral Block area is prepared to encompass pre-operational, operational and post operational phases and submitted.

3.6.8.1 LAND USE AND LAND COVER OF THE STUDY AREA

Table 3.23: Land Use pattern of buffer zone

S. No.	Description	Area (Ha)	%
1	Dense Reserve Forest	5227.0	13.99
2	Reserve Forest	12638.1	33.83
3	Vegetation	8416.0	22.53
4	Settlements	1714.3	4.59
5	Water Bodies	772.0	2.07
6	Broken up Area & Pit Water Bodies	1426.9	3.82
7	Agricultural Land	1304.8	3.49
8	Barren/Grass Land	5810.2	15.55
9	Industry	46.7	0.13
	Total	37356.0	100

3.6.8.2 LAND USE OF MINERAL BLOCK AREA

Existing land use and conceptual land use of the Mineral Block area is shown below in **Table 3.24 & Table 3.25** respectively**.**

Table 3.24: Existing Land use of Mineral Block

Land Use	Area (Ha)
Barren / Waste land with small bushes & shrubs	Nil
Land under Agriculture / Crops	Nil
Land covered with Plants	Nil
Land under Grass Cover	Nil
Land under Public Infrastructure / Utilities (water bodies, roads, railways, electric lines, telephone lines etc.)	2.6314
Land under Habitation	Nil
Land under Monuments & places of Historical Importance	Nil
Degraded by Pits & Excavation	79.4997
Degraded by Dumps & Material Stacking	28.6610
Covered under Mine Infrastructure (plants, shades, buildings etc.)	4.8326
Land under Forest	Nil
Historically, Culturally & Ecologically Important Places	Nil
Any Other, please specify below	36.8826
Total	**152.5073**
Date of Observation	**01-02-2023**

Table 3.25: Land use of Mineral Block at the Conceptual stage

Land Use	Area (Ha)
Degradation by Excavation	99.4586
Degradation by Dumps & Material Stacking	21.2162
Covered under Plants, Shades & Buildings	1.1398
Covered by Roads & Approaches	2.8234
Any Other, please specify below	27.8693
Total	**152.5073**

Existing land use and land cover map and Normalised Difference Vegetation Index Map (NDVI) of the study area is enclosed as **Plate No. 19 & Plate No. 20,** respectively**.**

3.6.9 BIOLOGICAL ENVIRONMENT

Biodiversity is crucial for well-being of the people and earth environment. Ecological communities maintain ecological and evolutionary processes that sustain life. These are necessary to help maintain planet's chemical balance, moderate climate, renew soil, and conserve species diversity.

Plants, animals and other species have intrinsic worth. They are also the source of all biological wealth-supplying food, raw materials, medicines, recreational resources and a store of other goods and services worth many billions of dollars per year.

The genetic stocks within crop varieties, livestock breeds and their wild relatives

provide essential traits for increasing and improving agricultural production and the development in biotechnologies.

The basic objectives of the assignment are to rationalize the protocol for an effective Biodiversity management plan for the proposed project area. This has been attempted by the following objectives.

- Collection and synthesis of secondary information on the status of biodiversity in study region.
- Undertake field survey to assess the status of floral component in different habitats (tree, shrubs, herbs, grass and creepers) and similarly, faunal groups (amphibians, reptiles, terrestrial and aquatic birds and mammals) in core and buffer areas of project sites.
- Authenticating the report on Wildlife management plan of Schedule – I species by forest department.
- Identification and listing of flora and fauna which are important as per the Wildlife (Protection) Act 1972.
- Suggest Wildlife conservation (species specific/habitat specific) and management plan for the threatened (critically endangered & endangered species - schedule I) faunal species if any reported within the study area.

3.6.9.1 STUDY REGION

Focus group discussion and consultative approach was followed to assess the Ecology & Biodiversity of the region. Such Focus group discussion and consultative approach was followed with diverse stakeholders, viz. mining staff to gather information about core area, consultation with communities and farmers with respect to history of landscapes, forest department with respect to flora and fauna, which will help to gather information about the land use and land cover within Buffer zone. Further, available lliterature survey including forest working plan, Census hand book, Gazetteer and other records related to the ecology of the region were referred.

A team comprising flora and fauna specialist from Mineral Engineering Services along with Mr. M.S. Raju (EIA coordinator) have visited the project site 'Block IV – Kalay Mineral Block' and 10km buffer zone during 6th to 9th April 2023.

3.6.9.2 METHODOLOGY

Forest Types

Forest types were closely observed on the ground and identified using Champion & Sheth (1978), forest classification of India. The forest types are based on the composition of the forests and the dominant species found. The identified forest types were verified, and confirmed from forest working plan of the south Goa Forest Division with specific emphasis on Ponda and Mollem forest ranges, published and other authenticated sources.

Quartile Approach

In order to provide representative ecological status, buffer zone was divided into four quartiles for biodiversity sampling, i.e., NE (Q-1), NW (Q-2) SW (Q-3) and SE (Q-4) as shown in **Fig. 3.8.** Each of the quartiles have been examined for representative flora on randomly sampled quadrats for trees (25x25-m), shrubs (10x10-m) and herbs (2x2-m) depending upon prevailing geographical conditions and bio-diversity aspects of study area.

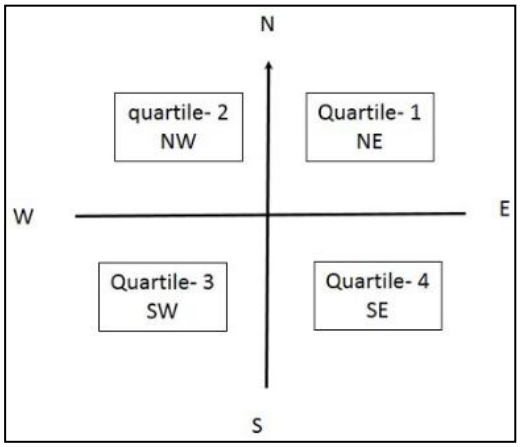


Fig. 3.8: Schematic diagram showing the four quartiles for biodiversity sampling

Phyto-sociological parameters, viz., Abundance, Density, Frequency (%) were measured as per formula shown below. A total of 10 quadrats were laid down randomly within core zone and 40 quadrats were laid down within the four quartiles randomly (10/quartile) in buffer zone each.

Quadrat method

Quadrats of 25 × 25-m were laid down randomly within core and 10-km buffer area; each quadrat was laid to assess the trees (>5 cm GBH) and one, 10 × 10-m sub-

quadrat nested within the quadrat for shrubs, and two, plots 2 × 2-m for herbs, climbers & grass is given in **Fig. 3.9**. The quadrats were laid randomly to cover the area to maximize the sampling efforts and minimize the species homogeneity, such as small stream area, trees in agricultural bunds, tank bunds, farm forestry plantations, wildlife areas, natural forest area, avenue plantations, house backyards, etc.

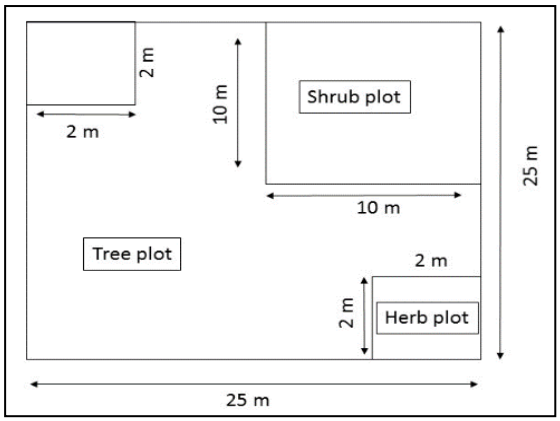


Fig. 3.9: Sub-quadrat nested within the quadrat for shrubs, herbs, climbers & grass

Following formulae was used for calculating the frequency (%), abundance and density of the floral species

$$\% \text{ Frequency of species A} = \frac{\text{Number of quadrats of occurrence of species A}}{\text{Total number of quadrats studied}} \text{ x } 100$$

$$\text{Abundance of species A} = \frac{\text{Number of individuals of species A in total quadrats studied}}{\text{Number of quadrats of occurrence of species A}}$$

$$\text{Density of species A} = \frac{\text{Number of individuals of species A in total quadrats studied}}{\text{Total area studied}}$$

Biodiversity Analysis using index

Species diversity will be calculated by using Shannon and Wiener (1963) formula as follows:

$$H' = -\sum_{i=1}^{R} p_i \ln p_i$$

H' - Shannon index of general diversity,

p_i - the proportion of individuals belonging to the ith species in the dataset of interest.

p_i

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 (*see* http://www.iucnredlist.org/static/categories_criteria_3_1).

Keystone species are 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 subpopulations on a global scale in order to highlight taxa threatened with extinction, and therefore promote their conservation.

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 (**Fig. 3.10**).

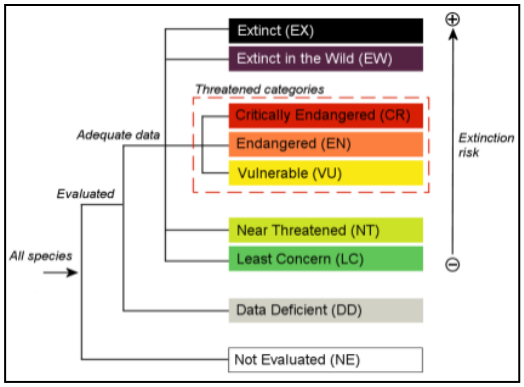


Fig. 3.10: IUCN categories showing threatened species categories

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 categorized as *Extinct* or *Extinct in the Wild*; on taxa that cannot be evaluated because of insufficient information (i.e. are *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. are *Near Threatened*).

3.6.9.3 FIELD SURVEY

Plant assessment: Rope used for quadrat demarcation and measuring tape for quantifying plants. For more detailed identification, we used binoculars to observe canopy tree leaves and flowers/fruits, along with magnifying lenses for finer floral pattern identification.

Faunal assessment: For each transect, we used measuring tapes to demarcate the transact. Binoculars were used for bird observation and direct wildlife sightings. Additionally, indirect methods viz. pug mark, scat identifying, etc., and field guides such as "Mammals" by Vivek Menon, "Butterflies" by Isaac Kehimkar, and "Birds of India" by Krys Kazmierczak were referred.

Mammals: Mammals were observed using indirect methods such as feacal matter (i.e. scat) and pug mark by establishing 10 × 100m linear transects depending on the habitat (i.e. existing wildlife game routes/forest trails used). Few mammals were documented by direct sighting.

Birds: Point count method was used for bird documentation as per standard method by Sutherland (1996), which involved 10 minute observation in each point during early morning hours (6.00 to 10.00 AM). We have enumerated 20 point-counts in each quartile, which constitute a total of 80 points-counts (20 × 4) within 10km radius area.

Butterfly: Butterfly were enumerated by two linear transects of 10 × 100 m were laid at each quartile at an interval of 1 km.

Reptiles: Information was gathered from consultation with local people and wildlife experts and secondary information available were used to document the reptiles and fishes.

Apart from field observation, consultations were held with knowledgeable persons of the villages and frontline forest department officials to validate the field

observation and information cited in the literature. To know the endemic or conservation status of the fauna, Schedule-I of the Wildlife Preservation Act (1972) and its Amendment, 2022 was referred.

3.6.9.4 OBSERVATIONS AND DISCUSSIONS

OVERVIEW OF THE PROJECT AREA

The forest in the region was categorised as Southern moist deciduous mixed forests and Southern secondary moist mixed deciduous forests (Champion & Seth, 1968), in *'A revised survey of the forest types of India'*. The region presents a wide range of altitudes, aspects, slopes, drainage, and spills giving rise to a variety of locality factors reflected in the occurrence of number of forest types from tropical semi-evergreen to mangrove forests. These types are broadly differentiated and described here as recognized and revised forest classification of Champion & Seth.

- 1A/C4 West Coast Tropical Ever Green Forest
- 2A/C2 West Coast Semi Evergreen Forests
- 3B/C2 Southern Moist Mixed Deciduous Forest

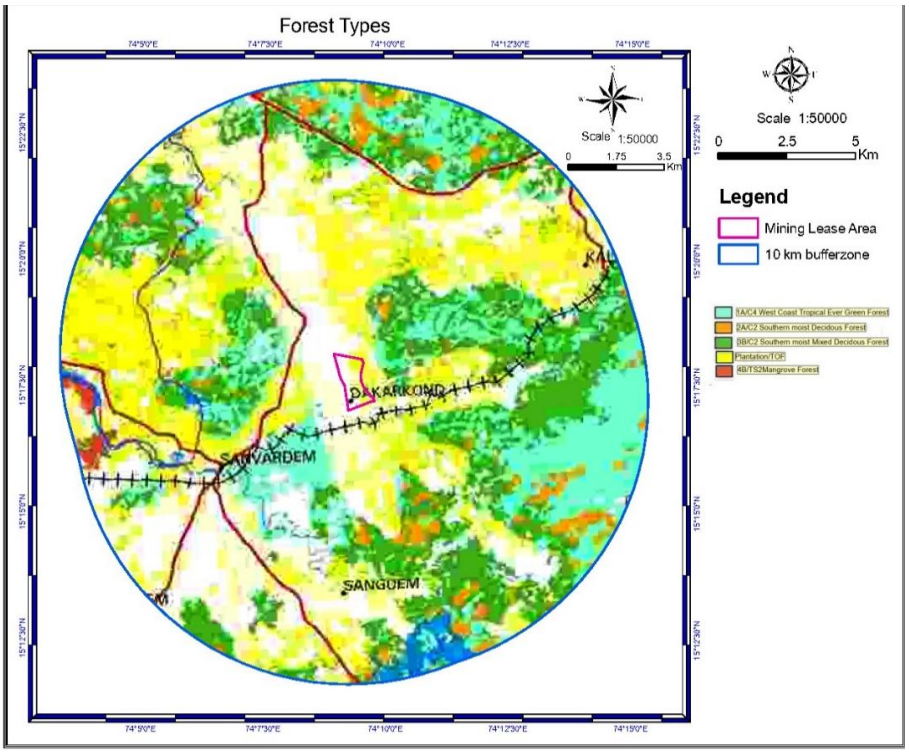


Fig. 3.11: Forest Type of Block IV – Kalay Mineral Block

These forest types have essentially a deciduous vegetation over a period of the year. However, few evergreen species occur sporadically due to favorable soil and

moisture conditions along the rivulet and depressions.

CORE ZONE

FLORA: Total 45 species were recorded within core zone, of which 21 species were trees, 11 species were shrubs and 13 species were herbs. List of Flora within the core zone is tabulated in **Table 3.26**.

Table 3.26: **Flora species recorded within core zone**

S.No	Species name	Family	Common Name
TREE			
1	*Anacardium occidentale*	Anacardiaceae	Cashew
2	*Acacia auriculiformis* *	Fabaceae	Acacia
3	*Casurina equisettifolia*	Casuarinaceae	Suru
4	*Alstonia scholaris*	Apocynaceae	Saten
5	*Bauhinia racemose*	Fabacaeae	Apto
6	*Artocarpus heterophyllus*	Moraceae	Phanas
7	*Bombox ceiba*	Bombacaceae	Sanwar
8	*Delonix regia*	Fabacaeae	Gulmohar
9	*Emblica officinalis*	Phyllanthaceae	Aonia
10	*Garcinia indica*	Clusiaceae	Kokum
11	*Gmelina arborea*	Lamiaceae	Shivan
12	*Leucaena leucocephala*	Fabacaeae	Subabul
13	*Mangifera indica*	Anacardiaceae	Mango
14	*Trema orientalis*	Cannabaceae	Charcoal tree
15	*Canthium dicoccum*	Rubiaceae	Ceylon boxwood
16	*Ziziphus mauritiana*	Rhamnaceae	Indian jujube
17	*Holigarna arnottiana*	Anacardiaceae	Black varnish tree
18	*Carryota urens*	Arecaceae	foxtail palm
19	*Grewia tiliifolia*	malvaceae	Dhaman
20	*Macaranga peltata*	Euphorbiaceae	Chandada
21	*Psidium guajava*	Myrtaceae	Guava
SHRUBS			
22	*Acacia paniculate*	Mimosaceae	sickle wattle
23	*Calotropis gigantean*	Asclepidiaceae	crown flower
24	*Carissa congesta*	Apocynaceae	Karamda
25	*Helictris isora*	Malvaceae	Marodphali
26	*Lantana camara**	Verbenaceae	Lantana
27	*Ixora coccinea*	Rubiaceae	Jungel gerenium
28	*Ziziphus oenoplea*	Rhamnaceae	Jackal jujube
29	*Musaaanda glabrata*	Rubiaceae	Dhobi tree
30	*Getonia floribunda*	Combrataceae	Paper flower
31	Antidesma acidum	Euphotbiaceae	Black berry
32	*Breyania retusa*	Euphotbiaceae	Cup and soucer
HERBS AND CLIMBERS			
33	*Asparagus racemosa*	Asparagaceae	Satavar
34	*Bidens biternata*	Asteraceae	Chirchitta

35	*Ipomea cmuricata*	Convolvulaceae	Bhingari
36	*Ocimum sanctum*	Lamiaceae	Tulsi
37	*Commelina odoreta*	Asteraceae	Slam weed
38	*Smilax zeylanica*	Smilacaceae	Kumarika
39	*Momordica diocia*	Cucurbitaceae	Spiny guard
40	*Dioscorea bulbifera*	Dioscoreaceae	air potato
41	*Impatiens balsmina*	Balsaminaceae	Spotted snapweed
42	*Impatiens minor*	Balsamaceae	lesser balsam
43	*Begonia crenata*	Begoniaceae	common begonia
44	Curculigo orchioides	Hycinthacieae	
45	*Curcuma sp.*	Zingiberaceae	wild ginger

FAUNA: Total 16 species were observed within the core zone, of which 9 species were birds, 3 species were mammals and 4 species were reptiles. List of fauna species within the core zone is tabulated in **Table 3.27**.

Table 3.27: List of faunal species within core zone

S. No.	Common name	Scientific name	Family	IUCN / WPA 1972 & Amnd. 2022
	BIRDS			
1	Common Iora	*Aegithina tiphia*	Irenidae	LC/II
2	Green Bee Eater	*Merops orientalis*	Meropidae	LC/II
3	House Crow	*Corvus splendens*	Corvidae	LC/II
4	House Sparrow	*Passer domesticus*	Passeridae	LC/II
5	House Swift	*Apus affinis*	Apodidae	LC/II
6	Indian Robin	*Saxicoloides fulicata*	Turdinae	LC/IV
7	Jungle Crow *	*Corvus macrorhynchos*	Corvidae	LC/II
8	Jungle Myna	*Acridotheres fuscus*	Sturnidae	LC/II
9	Red-whiskered Bulbul	*Pycnonotus jocosus*	Pycnonotidae	LC/II
	MAMMALS			
10	Indian Hare*	*Lepus nigricollis*	Leporidae	LC/II
11	Rat	*Rattus rattus*	Muridae	LC/IV
12	Striped squirrel	*Funambulus palmarum*	Sciuridae	LC/IV
	REPTILES			
13	Green Forest Lizard	*Calotes calotes*	Agamidae	LC/IV
14	Roux's Forest lizard	*Calotes rouxii*	Agamidae	LC/IV
15	Garden lizard	*Calotes elloti*	Agamidae	LC/IV
16	Russel's Viper	*Daboia russelii*	Viperidae	Schedule II

BUFFER ZONE

An overview of eco-sensitive areas, plantations, and development activities in all 4 directional quartiles in the buffer zone is presented in **Table 3.23a & b**. Buffer zone of Block IV – Kalay Mineral Block indicating Quartiles is shown in **Fig. 3.12**.

Table 3.28a: Ecologically Important habitat from the Project boundary

S. No.	Quartile	Importance ecosystem	Direction	Distance from Project boundary
1	Q1	Bhagavan mahveer WLS	E	1.04
2		Dudsagar River	N	4.00
3		Kalay River	E	0.12
4		Dongarwada RF	N	8.80
5	Q2	Mahadayi River	N	4.30
6		Udnai Nadi	NW	8.80
7		Carmonem RF	N	0.75
8		Comarconda RF	W	3.43
9	Q3	Barazona Dongor RF	SW	0.80
10		Moisal dam	W	4.80
11		Guddemal RF	SW	0.88
12		Zuvari River	SW	3.80
13		Ambeudhok RF	SW	0.18
14		Kushavathi River	SSW	9.00
15		Odsorvo RF	SW	0.80
16	Q4	Netravali WLS	SE	9.34
17		Ugem Nadi	SE	6.10
18		Salauli dam	SE	7.90
19		Gouli Nadi	S	7.20

Table 3.28b: General description of landscape within buffer zone

Quartiles	Trees/ Shrubs	Species richness	Density/ha	Species diversity (H')	Habitat Characteristics **
Quartile 1 North-East	Trees	42	1834	2.37	Bhagavan Mahavir WLs; Reserve Forest Open mixed forest Main Power line; Dudhsagar River
	Shrubs	13	4710	2.14	
	Herbs	10	86500	2.16	
Quartile 2 North-West	Trees	35	1714	2.78	Dense Forest; Cashew mixed forest RF, Zuari River, Mahadayi River Udnai Nadi. CARMONEM RF Comarconda RF
	Shrubs	9	2120	1.84	
	Herbs	9	2050	2.36	
Quartile 3 South-West	Trees	54	234	1.87	Reserve Forest; Zuvari River; South Central Railway Track; Zuari River.
	Shrubs	8	1220	1.84	
	Herbs	10	2500	1.36	
Quartile 4 South-East	Trees	44	734	2.17	Solaulim dam reservoir, Reserve Forest , Bhagavan Mahveer WLS, Netravali WLS, Ugem Nadi, Salauli dam back water, Gouli Nadi
	Shrubs	11	3820	2.64	
	Herbs	9	11500	2.06	

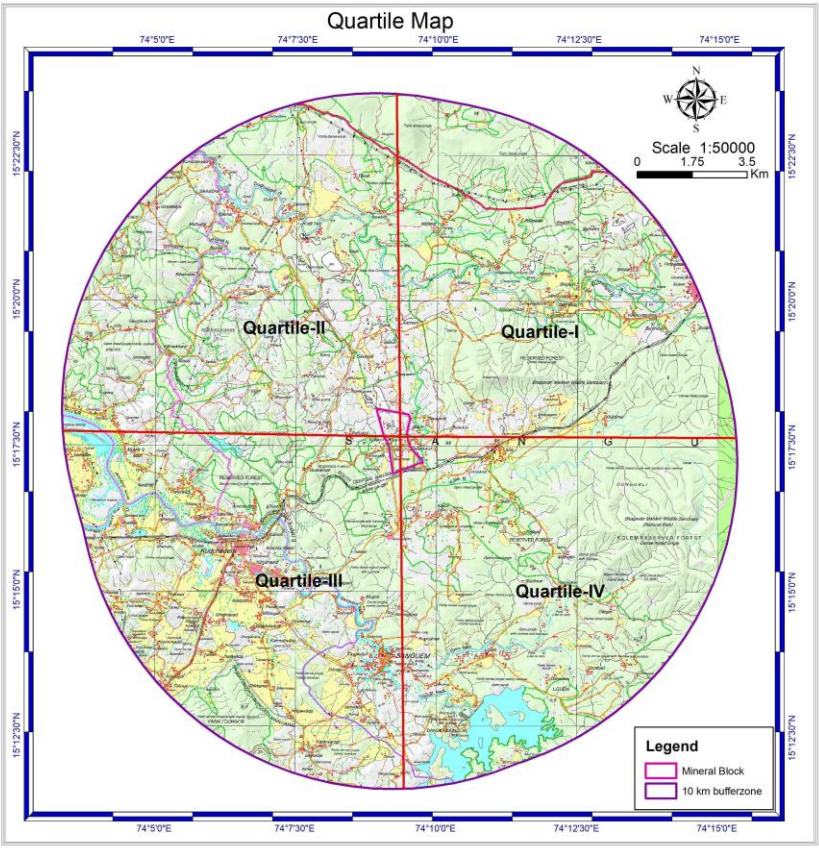


Fig. 3.12: Buffer zone of proposed Block IV – Kalay Mineral Block indicating Quartiles

FLORA

Total 198 flora species were reported in buffer zone covering areas included under reserve forest, riparian vegetation, cultivated as well as avenue trees and also Bhagwan Mahavir wildlife sanctuary. The detailed list of species and family are given in **Table 3.29** (tree 89), **Table 3.30** (shrubs 42), & **Table 3.31** (Herbs 28). In addition, 39 floral species, shown in **Table 3.32**, were reported from secondary sources such as Biodiversity Board, Goa. We also documented farmland in **Table 3.33** (Farmland/Road side – 20), Domesticated / cultivated speices in **Table 3.34** (13 species).

TREES: Overall, 128, of which 89 species from the primary survey and 39 species from the report by Biodiversity Board. The results shows that the buffer area recorded 89 tree species compared to 7 species of the core area. Again we can see that exotic species Acacia auriculiformis and Anacardium occidentale have dominated in the core area. In addition, 39 species reported as secondary information from

Biodiversity Board, Goa (https://gsbb.goa.gov.in/wp-content/uploads/2020/05/List-of-plants.pdf)

Table 3.29: Trees growing in buffer zone

S. No.	Species name	Family	Frequency %	Abundance	Density
1	*Acacia auriculiformis*	Mimosaceae	21	1.7	5.7
2	*Albizia odoratisima* Benth.	Mimosaceae	21	3.0	10.3
3	*Anacardium occidentale* L.	Anacardiaceae	21	3.0	10.3
4	*Anogeissus latifolia* (Roxb. ex DC.)	Combretaceae	29	2.8	12.6
5	*Ardisia solanacea Roxb.*	Myrsinaceae	29	2.5	11.4
6	*Areca catechu* L.	Arecaceae	29	2.0	9.1
7	*Artocarpus heterophyllus* Lam.	Moraceae	29	2.5	11.4
8	*Bauhinia malabarica* Roxb.	Fabaceae	29	3.8	17.1
9	*Bauhinia racemosa* Lam.	Fabaceae	29	2.3	10.3
10	*Bischofia javanica* Bl.	Phyllanthaceae	29	4.0	18.3
11	*Bombax malabaricum* DC.	Bombacaceae	14	3.0	6.9
12	*Bridelia retusa* Spreng.	Euphorbiaceae	14	2.5	5.7
13	*Buchnania lanzan*	Anacardiaceae	14	3.0	6.9
14	*Buchanania latifolia Roxb.*	Anacardiaceae	14	2.5	5.7
15	*Caesalpinia bonducella* (L.) Fleming	Caesalpinaceae	14	3.0	6.9
16	*Callicarpa tomentosa* (L.) Murr.	Verbinaceae	14	2.0	4.6
17	*Canthium dicocum* (Gaert.) T. & B.	Rubiaceae	29	3.0	13.7
18	*Canarium strictum* Roxb.	Burseraceae	29	2.3	10.3
19	*Careya arborea* Roxb.	Lecythidaceae	29	3.5	16.0
20	*Caryota urens* L. (Kithul) sap.	Arecaceae	29	3.5	16.0
21	*Cassia fistula L.*	Fabacaeae	29	2.5	11.4
22	*Casearia ovoidea Sleumer.*	Flacourtiaceae	29	2.8	12.6
23	*Cassia siamea* Lam.	Fabaceae	21	3.7	12.6
24	*Clerodendrum viscosum* Vent.	Euphorbiaceae	21	3.0	10.3
25	*Crotalaria retusa L.*	Fabaceae	21	4.0	13.7
26	*Dalbergia lanceolaria*	Fabacaeae	21	2.0	6.9
27	*Dalbergia latifolia* Roxb	Fabacaeae	21	2.7	9.1
28	*Dalbergia volubilis* Roxb.	Fabaceae	21	2.7	9.1
29	*Delonix regia* (Hk.) Raf.	Fabaceae	21	2.7	9.1
30	*Diospyros ebenum* Koenig.	Ebenaceae	21	1.0	3.4
31	*Diospyros montana Roxb.*	Ebenaceae	21	3.7	12.6
32	*Diospyros paniculata* Dalz.	Ebenaceae	21	2.0	6.9
33	*Emblica officinalis* Gaertn.	Euphorbiaceae	21	2.3	8.0
34	*Erythrina indica L.*	Fabacaeae	21	4.0	13.7
35	*Ficus arnottiana* (Miq.) Miq.	Moraceae	21	2.0	6.9
36	*Ficus microcarpa* L.f.	Moraceae	21	2.7	9.1
37	*Ficus virens L.*	Moraceae	21	3.0	10.3
38	*Gardenia tergida*	Rubiaceae	14	3.0	6.9
39	*Gliricidia sepium* (Jacq.) Kunth	Fabaceae	14	2.5	5.7
40	*Gmelina arborea* Roxb.	Verbenaceae	14	3.5	8.0
41	*Grewia robusta*	Malvaceae	14	3.0	6.9
42	*Grewia tilifolia* Vahl.	Malvaceae	14	3.0	6.9

43	*Hardwickia binata* Roxb.	Cesalpinaceae	14	2.5	5.7
44	*Holoptelea integrifolia* (Roxb.) Planch.	Ulmaceae	14	3.0	6.9
45	*Holigarna niger* Bourd.	Anacardiaceae	14	3.0	6.9
46	*Holarrhena pubescens* (Buch.-Ham.)	Apocynaceae	14	3.5	8.0
47	*Hopea acuminata* Merr.	Dipterocarpaceae	14	1.5	3.4
48	*Ixora brachiata* L.	Rubiaceae	14	3.5	8.0
49	*Lagerstroemia lanceolata* Clarke	Lythraceae	14	2.0	4.6
50	*Lannea coromandelica*	Anacardiceae	14	1.0	2.3
51	*Leucaena leucocephala* (Lam.) de Wit.	Mimosaceae	14	2.0	4.6
52	*Litsea glabrata*	Lauraceae	14	5.0	11.4
53	*Litsea zeylanica* Nees & T. Nees.	Lauraceae	14	2.5	5.7
54	*Maesa indica Roxb.*	Myrsinaceae	14	3.5	8.0
55	*Mallotus philippensis* (Lam.) Muell.	Euphorbiaceae	14	2.5	5.7
56	*Mangifera indica* L.	Anacardiaceae	14	3.0	6.9
57	*Mecranga peltata* (Roxb.) Muell.	Euphorbiaceae	14	3.5	8.0
58	*Melia composita Willd.*	Meliaceae	14	1.0	2.3
59	*Memecylon umbellatum Burm.*	Melastomataceae	14	3.0	6.9
60	*Mitragyna parviflora (Roxb.) Korth.*	Rubiaceae	14	2.0	4.6
61	*Murraya keenigii (Linn.) Spreng*	Rutaceae	14	3.0	6.9
62	*Musa paradisiaca Auct.*	Musaceae	14	3.5	8.0
63	*Myristica sp.*	Myristicaceae	14	3.0	6.9
64	*Nothopegia colebrookiana (Wight)*	Anacardiaceae	14	3.5	8.0
65	*Olea dioica Roxb.*	Oleaceae	14	4.0	9.1
66	*Peltophorum pterocarpum (DC.)*	Fabaceae	14	3.5	8.0
67	*Pogostemon cablin (Blanco) Benth.*	Lamiaceae	14	2.0	4.6
68	*Pongamia pinnata* (L.) Pierre	Fabiaceae	14	1.5	3.4
69	*Pterocarpus marsupium Roxb.*	Fabaceae	14	3.5	8.0
70	*Randia dumetorum L.*	Rubiaceae	14	3.5	8.0
71	*Randia malabarica Lam.*	Rubiaceae	14	3.0	6.9
72	*Samanea saman (Jacq.) Merr*	Cesalpinaceae	14	4.5	10.3
73	*Sapindus emarginatus L.*	Sapindaceae	14	2.5	5.7
74	*Saraca indica Auct.*	Cesalpinaceae	14	1.5	3.4
75	*Schleichera oleosa (Lour.) Oken*	Sapindaceae	14	3.0	6.9
76	*Scolopia crenulate*	Flacourtiaceae	14	2.5	5.7
77	*Spondias acuminata Roxb.*	Sapindaceae	14	4.0	9.1
78	*Sterospermum personatum (Hassk.)*	Bignoniaceae	14	2.5	5.7
79	*Strychnos nux vomica L.*	Loganiaceae	14	4.0	9.1
80	*Syzgium callophylum (L.) Alton*	Myrtaceae	14	1.0	2.3
81	*Syzgium cumini (L.) Skeels*	Myrtaceae	14	4.0	9.1
82	*Tectona grandis L.f.*	Verbinaceae	14	3.0	6.9
83	*Terminalia bellerica (Gaertn.) Roxb.*	Combretaceae	14	4.5	10.3
84	*Terminalia paniculata Roth* *	Combretaceae	14	2.5	5.7
85	*Terminalia tomentosa (DC.) W. & A.**	Combretaceae	14	3.0	6.9
86	*Trema orientalis (L.) Bl.*	Ulmaceae	14	4.0	9.1
87	*Vateria indica L.*	Cannabaceae	14	1.5	3.4
88	*Vitex altissima L.f*	Verbinaceae	14	2.5	5.7
89	*Ziziphus mauritiana Lam.*	Rhamnaceae	14	4.5	10.3

SHRUBS: Total 42 species of shrubs were recorded in the Buffer zone. Overall, from this data we can interpret that the mining site possesses less shrubs species and commonly overgrown exotic species such as *Lantana camara,* and *Chromolina odorata,* and less native species in abundance, whereas the buffer area recorded higher number of native species (**Table 3.30**).

Table 3.30: Shrubs recorded in buffer zone

S. No.	Species name	Family	Frequency %	Abundance	Density
1	*Abrus precatorius L.*	Ceasalpinaceae	21	1.7	35.7
2	*Acacia paniculata Willd.*	Mimosaceae	21	2.7	57.1
3	*Adathoda vasica L.*	Acanthaceae	7	1.0	7.1
4	*Amaranthus spinosus L.*	Amaranthaceae	21	1.7	35.7
5	*Annona muricata L.*	Annonaceae	14	1.5	21.4
6	*Antidesma menasu (Tul.) Müll.Arg*	Euphorbiaceae	7	3.0	21.4
7	*Aphanamixis polystachya (wall.)*	Rosaceae	7	4.0	28.6
8	*Apnomixis polystachia*	Rosaceae	14	1.0	14.3
9	*Bryneya species*	Euphorbiaceae	7	1.0	7.1
10	*Calotropis gigantean L.*	Asclepidiaceae	14	1.5	21.4
11	*Canthium parviflorum Lam.*	Rubiaceae	14	2.5	35.7
12	*Carissa carandas L.*	Apocynaceae	14	2.0	28.6
13	*Carissa congesta L.*	Apocynaceae	21	2.0	42.9
14	*Cassia hirsuta L.**	Ceasalpinaceae	21	2.3	50.0
15	*Chromolaena odorata (L.) K.R.*	Astraceae	21	2.3	50.0
16	*Croton lacciferus L.*	Euphorbiaceae	29	2.0	57.1
17	*Crotolaria virosa (Roxb.) Bake.*	Fabacaeae	21	1.3	28.6
18	*Dendrocalamus strictus*	Poaceae	29	1.3	35.7
19	*Euphorbia totircornis L.*	Euphorbiaceae	7	1.0	7.1
20	*Gossypium arboretum L.*	Malvaceae	7	4.0	28.6
21	*Helictris isora L.*	Malvaceae	29	2.8	78.6
22	*Hibiscus tiliaceus Wild.*	Malvaceae	7	1.0	7.1
23	*Ixora brachiata Roxb. ex DC*	Rubiaceae	21	1.7	35.7
24	*Ixora javanica DC, Prodr.*	Rubiaceae	7	1.0	7.1
25	*Jatropha gossypiifolia*	Euphorbiaceae	21	2.0	42.9
26	*Lantana camara L.*	Verbenaceae	29	2.0	57.1
27	*Leea indica (Burm.f.) Merr.*	Leaceae	29	2.5	71.4
28	*Niligirianthus barbatus (Nees)*	Acanthaceae	7	1.0	7.1
29	*Pandanus odoratissimus L.*	Pandanaceae	7	1.0	7.1
30	*Pavetta indica L.*	Rubiaceae	7	1.0	7.1
31	*Psychotria bisulcata Wight & Arn.*	Rubiaceae	7	1.0	7.1
32	*Ricinus communis L.*	Euphorbiaceae	7	3.0	21.4
33	*Rosa chinensis Jacq.*	Rosaceae	29	1.8	50.0
34	*Saprosma ceylanicum (Gardner)*	Rubiaceae	7	1.0	7.1
35	*Sida acuta N.L. Burman.*	Malvaceae	29	2.3	64.3

36	*Solanum indicum L.*	Solanaceae	29	1.8	50.0
37	*Techoma stans (L.) Juss. Ex Kunth.*	Bignoniaceae	7	4.0	28.6
38	*Tephrosia purpuria (L.) Pers.*	Fabaceae	21	1.3	28.6
39	*Vitex sp*	Verbenaceae	14	1.0	14.3
40	*Vitex nigundo L.*	Verbenaceae	7	3.0	21.4
41	*Ziziphus oenoplea Miller.*	Rhamnaceae	21	2.3	50.0
42	*Trema orientalis*	Cannabaceae	14	1.5	32.0

***Note**: * Secondary information from forest working plan and published literature*

HERBS: Total 28 Species of herbs reported from the buffer region.

Table 3.31: List of Herbs and Climbers within buffer zone

S. No.	Species name	Family	Frequency %	Abundance	Density
1	*Acrostichum aureum*	Pteridaceae	25	4.7	2946
2	*Ageratum conyzoides*	Astraceae	4	1.0	89
3	*Alternathara sessilis*	Amaranthaceae	18	5.8	2589
4	*Andropogon annulatus*	Poaceae	7	4.5	804
5	*Asparagus racemose*	Asparagaceae	11	3.3	893
6	*Atlantia species*	Rutaceae	29	3.4	2411
7	*Bidens biternata*	Asteraceae	7	2.5	446
8	*Bidens comosa*	Asteraceae	4	6.0	536
9	*Borreria articulata*	Rubiaceae	39	3.7	3661
10	*Cassia tora*	Caesalpinaceae	7	1.5	268
11	*Clematis gouriana*	Ranunculaceae	29	4.9	3482
12	*Clerodendron inerme*	Lamiaceae	22	4.2	1429
13	*Cordia myxa*	Boraginaceae	39	2.9	2857
14	*Crotolaria virosa*	Fabacaeae	14	2.0	714
15	*Cymbopogon citratus*	Poaceae	36	2.6	2321
16	*Cyperus difformis**	Cyperaceae	21	3.0	1607
17	*Desmodium triflorum*	Fabaceae	39	3.5	3393
18	*Ipomea cmuricata*	Convolvulaceae	14	4.3	1518
19	*Ocimum sanctum*	Lamiaceae	32	3.1	2500
20	*Parthenium spp**	Asteraceae	7	3.0	536
21	*Premna coriacea*	Verbenaceae	7	2.5	446
22	*Sida acuta*	Malvaceae	29	4.9	3482
23	*Sida cordifolia*	Malvaceae	36	4.8	4286
24	*Smilax zeylanica**	Smilacaceae	7	8.5	1518
25	*Solanum indicum*	Solanaceae	14	2.0	714
26	*Spermacoce sp.*	Rubiaceae	36	3.0	2679
27	*Stylosanthus sp.*	Fabaceae	39	3.3	3214
28	*Urena lobate*	Malvaceae	36	3.8	3393

***Note:** * Secondary information from Goa forest & Biodiversity department and published literature*

Table 3.32: List of Secondary tree species documented by Biodiversity Board, Goa

Sl. No.	*Scientific Name **	**Common Name**
1	*Aegle marmelos*	Bel
2	*Albizia lebbeck*	Siris
3	*Alstonia scholaris*	Santvin
4	*Annona murigata*	Palpanas
5	*Annona squamosa*	Sitaphal
6	*Anthocephalus cadamba*	Kadamb
7	*Artocarpus altilis*	Nirpanas
8	*Artocarpus heterocarpus*	Phanas
9	*Averrhoa carambola*	Karmal
10	*Averrhoea bilimbi*	Bimbal, bilimbi
11	*Azadirachta indica*	Neem
12	*Bauhinia variegate*	Kachnar
13	*Bombax ceiba*	Savar
14	*Butea monosperma*	Palas
15	*Cinnamomum zeylanicum*	Tikhi
16	*Cocos nucifera*	Mad
17	*Dalbergia sisso*	Shisam
18	*Ficus bengalensis*	Vad tree
19	*Ficus glomerata/racemosa*	Rumad
20	*Flacourtia jangomas*	Jagma
21	*Flacourtia montana*	Chafra
22	*Garcinia gummigutta*	Malabar tamarind
23	*Garcinia indica*	Bhirand
24	*Gmelina arborea*	Shivan
25	*Hardwickia binata*	Anjan
26	*Mesua ferrea*	Nagkesar
27	*Milingtonia hortensis*	Neem Chameli
28	*Millettia pinnata*	Karanjei
29	*Mimusops elengi*	Ovala
30	*Myristica fragrans*	Jaiphal
31	*Nothaphodytes nimmoniana*	Narkya, Ghaneri
32	*Peltophorum pterocarpum*	Copperpod tree
33	*Pouteria campechiana*	Egg fruit
34	*Psidium guajava*	Guava
35	*Sapinduslaurifolius/ mukorossi*	Ritho
36	*Saraca asoca*	Sita Ashok
37	*Stercularia urens*	Dhavorukh/ Arjun
38	*Syzyzium aqueum*	Zam
39	*Terminalia elliptica*	Madat

Note: ** Secondary information from Biodiversity Board, Goa, (https://gsbb.goa.gov.in/wp-content/uploads/2020/05/List-of-plants.pdf) and published literature*

***FARMLAND/ ROAD SIDE*:** Total 20 species recorded within the buffer area from the farmlands/road side (**Table 3.28**).

Table 3.33: Flora species recorded in farmlands/road side within buffer zone

S.No.	Species name	Common name	Family	Habit
1	*Tamarindus indica*	Tamrind/imli	Cesalpinaceae	Tree
2	*Annona reticulata*	Ramphal	Annonaceae	Tree
3	*Bambusa* sp	Bamboo	Bambocaceae	Tree
4	*Bougainvillea spectabilis*	Bouganvilla	Nyctaginaceae	Tree
5	*Cassia fistula*	Amaltas	Fabaceae	Tree
6	*Dalbergia latifolia*	Shisam/ Shisoo	Fabaceae	Tree
7	*Delonix regia*	Gulmohar	Fabaceae	Tree
8	*Phyllanthus emblica*	Awala/.Avala	Phyllanthaceae	Tree
9	*Psidium guajava*	Peru/Gauva	Myrtaceae	Tree
10	*Samanea saman*	Rain tree	Fabaceae	Tree
11	*Sapindus mukorossi*	Ritha/Reetha	Sapindaceae	Tree
12	*Swetenia mahagoni*	Mohagony	Meliaceae	Tree
13	*Syzygium cumini*	Jamun	Myrtaceae	Tree
14	*Terminalia bellerica*	Ghoting/behada	Combretaceae	Tree
15	*Acacia auriculiformis*		Mimosaceae	Tree
16	*Garcinia indica*		Clusiaceae	Tree
17	*Pongamia pinnata*		Fabaceae	Tree
18	*Ficus benghalensis*		Moraceae	Tree
19	*Ficus religiosa*		Moraceae	Tree
20	*Ixora coccinea*		Rubiaceae	Shrub

DOMESTICATED / CULTIVATED SPECIES: Total 13 different crops and commercial species observed from the buffer area (**Table 3.29**)

Table 3.34: Domesticated and cultivated species recorded in buffer zone

S. No.	Species name	Common name	Family	Habit
1	*Annona reticulata*	Ramphal	Annonaceae	Tree
2	*Phyllanthus emblica*	Awala/.Avala	Phyllanthaceae	Tree
3	*Psidium guajava*	Peru/Gauva	Myrtaceae	Tree
4	*Carica papaya*	Caricaceae	Caricaceae	Tree
5	*Musa paradisiaca*	Bannana	Musaceae	Tree
6	*Acacia auriculiformis*		Mimosaceae	Tree
7	*Anacardium occidentale*		Anacardiaceae	Tree
8	*Areca catechu*		Arecaceae	Tree
9	*Cocos nucifera*		Arecaceae	Tree
10	*Garcinia indica*		Clusiaceae	Tree
11	*Tamarindus indica*		Cesalpinaceae	Tree
12	*Oryza sativa*	Paddy	Poaceae	herb
13	Vegetable cultivation			herb

3.6.9.5 CONSERVATION THREAT STATUS

FLORA: The plant species recorded in the study area was grouped into three categories i.e endemic, rare and keystone species. Overall, 5 important species were recorded within the study area. Within Study area one rare, three keystone species and three species endemic to Western Ghats were recorded in the buffer zone. These flora species are listed in **Table 3.35**.

Table 3.35: Endemic, Keystone and Threatened species recorded in buffer zone

S. No.	Species	Family	Core/ buffer	Habitat	Status
1	*Artocarpus heterophyllus* Lam.	Moraceae	Buffer	Tree	Endemic
2	*Ficus arnottiana* (Miq.) Miq.	Moraceae	Buffer	Open	Keystone
3	*Ficus microcarpa* L. f.	Moraceae	Buffer	Open/Rivulets	Keystone
4	*Ficus virens L.*	Moraceae	Buffer	Open	Keystone
5	*Holigarna nigra* Bourd.	Anacardiaceae	Buffer	Rivulets	Endemic
6	*Strychnos nux- vomica* L.	Loganiaceae	Buffer	Open	Rare
7	*Terminalia paniculata* Roth	Combretaceae	Buffer	Open / Scrub forest	Endemic

FAUNA

***FAUNAL DIVERSITY*:** Total 262 faunal species were reported by secondary and primary observation from buffer zone which included 22 species of mammals, 24 species of reptiles, 17 species of amphibians and toads, 154 species of birds, 27 species of butterflies and 18 species of crabs and fishes.

Total 22 species mammals were recorded within buffer zone (**Table 3.36**), of which four arboreal mammals such as Flying fox, Squirrel, macaque, Wronghto's Gaint Mastiff Bat and remaining were ground dwellers. The Malabar giant squirrel encounter only within the Wildlife Sanctuaries (WLs). Further one carnivore Leopard, omnivore Mongoose, Indian muntjac, and Jackal as hinted by rural communities.

Table 3.36: List of mammal species recorded within buffer zone

S. No.	Local Name	Scientific name	Family	IUCN / WPA 1972 &Amnd. 2022
1	Common grey mongoose	*Urva edwardsii*	Herpestidae	LC/I
2	Indian porcupine	*Hystrix indica*	Hystricidae	LC/I
3	Malabar gain squirrel	*Ratufa indica*	Sciuridae	VU/I

4	Common leopard*	*Panthera pardus*	Felidae	VU/I
5	Leopard cat*	*Pronailurus bengalensis*	Felidae	LC/I
6	Wronghto's Gaint Mastiff Bat*	*Otomops wroughtoni*	Molossidae	LC/I
7	Slender Loris	*Loris lydekkerianus*	Lorisidae	NT/I
8	Tiger*	*Panthera tigris*	Felidae	EN/I
9	Mouse Deer	*Moschiola indica*	Tragulidae	LC/I
10	Four Horned Antelope*	*Tetracerus quadricornis*	Bovidae	VU/I
11	Gaur or Indian Bison*	*Bos gaurus*	Bovidae	VU/I
12	Indian Pangolin*	*Manis crassicaudata*	Manidae	EN/I
13	Sloth bear*	*Melursus ursinus*	Ursidae	VU/I
14	Small Indian civet*	*Viverricula indica*	Viverridae	LC/I
15	Bonnet macaque	*Macaca radiata*	Cercopithecidae	LC/I
16	Wild dog*	*Cuon alpines*	Canidae	EN/I
17	Indian Hare	*Lepus nigricollis*	Leporidae	LC/II
18	Flying fox bat*	*Pteropus Giganteus*	Pteropodidae	LC/II
19	Rat	*Rattus rattus*	Muridae	LC/IV
20	Wild boar*	*Sus scrofa*	Suidae	LC/II
21	Striped squirrel	*Funambulus palmarum*	Sciuridae	LC/IV
22	Indian muntjac*	*Muntiacus muntjac*	Cervidae	LC/IV

***Note** * Secondary information from the Bhagawan Mahavir WLs report from Goa forest department , Gazette Notification of Bhagwan wildlife Sanctuary dated 23.01.2015*

REPTILES: Total 24 reptile species were recorded within the buffer zone of which 18 species of snakes and 5 species were lizards (**Table 3.37**). Indian rock python, Krait, Cobra and King cobras identified as rare species under the IUCN status and most of them were common as per the IUCN status.

Table 3.37: Checklist of Reptiles reported from the buffer zone

S. No.	Common name	Scientific name	Family	IUCN / WPA 1972 &Amnd. 2022
1	Indian Rock Python*	*Python molurus molurus*	Pythonidae	NT/I
2	Marsh Crocodile *	*Crocodylus palustris*	Crocodylidae	VU/I
3	Indian Falpshell Turtle *	*Lissemys punctata*	Trionychidae	VU/I
4	Common Indian Monitor Lizard	*Varanus bengalensis*	Varanidae	NT/I
5	Russell's Viper	*Daboia russelii*	Viperidae	LC/I
6	Cobra	*Naja naja*	Elapidae	LC/I
7	King cobra*	*Ophiophagus hannah*	Elapidae	VU/I
8	Green Forest lizard	*Calotes calotes*	*Agamidae*	LC/I
9	Checkered Keelback	*Fowlea piscator*	*Colubridae*	LC/I
10	Common Kukri Snake*	*Oligodon arnensis*	Colubridae	LC/I
11	Whitaker's Boa*	*Eryx whitakeri*	Boidae	NT/I
12	Common Indian monitor lizard	*Varanus bengalensis*	*Varanidae*	NT/I
13	Common Sand Boa*	*Gongylophis conicus*	Boidae	LC/IV
14	Montane trinket snake*	*Coelognathus helena monticollaris*	Colubridae	LC/IV
15	Indian rat Snake*	*Ptyas muscosa*	Colubridae	LC/IV
16	Western Kukri Snake*	*Oligodon affinis*	Colubridae	LC/IV
17	Striped Keelback*	*Amphiesma stolatum*	*Colubridae*	LC/IV

18	Hill keelback	*Amphiesma monticola*	*Colubridae*	LC/IV
19	Saw scaled Viper*	*Echis carinathus*	Viperidae	LC/IV
20	Common krait*	*Bungarus caeruleus*	Elapidae	LC/IV
21	Ceylon Cat Snake*	*Boiga ceylonensis*	Colubridae	LC/IV
22	Common Indian cat snake*	*Boiga trigonata*	Colubridae	LC/IV
23	Bamboo Pit Viper*	*Trimeresurus gramineus*	Viperidae	LC/IV
24	Bark/Marbled Tree gecko	*Hemidactylus leschenaultia*	*Gekkonidae*	LC/IV

***Note** * Secondary information from the Bhagawan Mahavir WLs report*

TOADS AND AMPHIBIANS: Total 17 species of frogs were recorded within the various habitat ranges from paddy field, scrub jungle, riparian forest, streams, and evergreen forest patches (**Table 3.38**). The Jerdon's narrow mouthed frog and Bronzed frog are near threatened and one Konkan bush frog vulnerable under IUCN was reported and the rest were under the Least Concern category. As per WPA, 15 species were recorded under Schedule IV.

Table 3.38: List of toads and amphibians reported within buffer zone

S. No.	Common name	Scientific name	Family	IUCN / WPA 1972 &Amnd. 2022
1	Common Indian toad	*Bufo melanostictus*	Bufonidae	LC/IV
2	Jerdon's narrow mouthed frog*	*Ramanella montana*	Microhylidae	LC/IV
3	Konkan bush frog*	*Philautus bombayensis*	Rhacophoridae	LC/IV
4	Marten's bush frog*	*Philautus leucorhinus*	Rhacophoridae	LC/IV
5	Bamboo tree frog*	*Polypedates leucomystax*	Rhacophoridae	LC/IV
6	Common tree frog*	*Polypedates maculatus*	Rhacophoridae	LC/IV
7	Malabar gliding frog	*Rhacophorus malabaricus*	Rhacophoridae	LC/IV
8	Skipper frog*	*Euphlyctis cyanophlyctis*	Ranidae	LC/II
9	Jerdon's bull frog*	*Hoplobatrachus crassus*	Ranidae	LC/IV
10	Indian bull frog*	*Hoplobatrachus tigerinus*	Ranidae	LC/II
11	Brown leaping frog	*Indirana semipalmata*	Ranidae	LC/IV
12	Paddyfield frog*	*Limnonectes limnocharis*	Ranidae	LC/IV
13	Hill cricket frog	*Limnonectes syhadrensis*	Ranidae	LC/IV
14	Fungoid frog	*Rana malabaricus*	Ranidae	LC/IV
15	Bronzed frog*	*Rana temporalis*	Ranidae	LC/IV
16	Indian burrowing frog	*Tomopterna breviceps*	Ranidae	LC/IV
17	Dobson's burrowing frog*	*Tomopterna dobsoni*	Dicroglossidae	LC/IV

***Note:** LC - Least concern, NT - near threaten, VU – Vulnerable, Wildlife Protection Act –Schedule -IV; * Secondary information from the Bhagawan Mahavir WLs report*

BIRDS: Total 154 species of birds were recorded within the habitat ranges from paddy field to evergreen forest (**Table 3.39**). About 123 species were resident locally, of which, 2 were endemic to the Western Ghats, 7 species were locally migratory and 2 were vulnerable species.

Table 3.39: List of birds recorded within buffer zone

S. No	Common name	Scientific name	Family	IUCN / WPA 1972 &Amnd. 2022
1	White-bellied Sea-Eagle	*Haliaeetus leucogaster*	Accipitridae	LC/I
2	Indian Peafowl	*Pavo cristatus*	Phasianidae	LC/I
3	Shikra	*Accipiter badius*	Accipitridae	LC/I
4	Osprey	*Pandion haliaetus*	Pandionidae	LC/I
5	Chestnut Bittern*	*Ixobrychus cinnamomeus*	Ardeidae	LC/I
6	Cotton Teal	*Nettapus coromandelianus*	Anatidae	LC/I
7	Brahminy Kite	*Haliastur indus*	Accipitridae	LC/I
8	Long-billed Vulture *	*Gyps indicus*	Accipitridae	CR/I
9	Crested Serpent Eagle*	*Spilornis cheela*	Accipitridae	LC/I
10	Eurasian Marsh Harrier *	*Circus aeruginosus*	Accipitridae	LC/I
11	Crested Goshawk	*Accipiter trivirgatus*	Accipitridae	LC/I
12	Besra Sparrowhawk *	*Accipiter virgatus*	Accipitridae	LC/I
13	Black Eagle*	*Ictinaetus malayensis*	Accipitridae	LC/I
14	Crested Tree-swift	*Hemiprocne coronate*	Hemiprocnidae	LC/I
15	Brown Wood Owl	*Strix leptogrammica*	Strigidae	LC/I
16	Common Hill-Myna	*Gracula religiosa*	Sturnidae	LC/I
17	Grey Junglefowl	*Gallus sonneratii*	Phasianidae	LC/I
18	Nilgiri Wood Pigeon	*Columba elphinstonii*	Columbidae	VU/I
19	Small Minivet *	*Pericrocotus cinnamomeus*	Campephagidae	LC/I
20	Forest Eagle-Owl *	*Bubo nipalensis*	Strigidae	LC/I
21	Little Grebe	*Tachybaptus ruficollis*	Podicipedidae	LC/II
22	Little Cormorant	*Phalacrocorax niger*	Phalacrocoracidae	LC/II
23	Indian Shag	*Phalacrocorax fuscicollis*	Phalacrocoracidae	LC/II
24	Great Cormorant	*Phalacrocorax carbo*	Phalacrocoracidae	LC/IV
25	Darter	*Anhinga melanogaster*	Phalacrocoracidae	LC/II
26	Little Egret	*Egretta garzetta*	Ardeidae	LC/II
27	Western Reef Egret	*Egretta gularis*	Ardeidae	LC/II
28	Grey Heron	*Ardea cinerea*	Ardeidae	LC/II
29	Purple Heron	*Ardea purpurea*	Ardeidae	LC/II
30	Large Egret	*Casmerodius albus*	Ardeidae	LC/II
31	Median Egret	*Mesophoyx intermedia*	Ardeidae	LC/II
32	Cattle Egret	*Bubulcus ibis*	Ardeidae	LC/II
33	Indian Pond-Heron	*Ardeola grayii*	Ardeidae	LC/II
34	Little Green Heron	*Butorides striatus*	Ardeidae	LC/IV
35	Black-crowned Night Heron	*Nycticorax nycticorax*	Ardeidae	LC/II
36	Malayan Night Heron*	*Gorsachius melanocephalus*	Ardeidae	LC/II
37	Black Bittern	*Dupetor flavicollis*	Ardeidae	LC/IV
38	Painted Stork*	*Mycteria leucocephala*	Cioniidae	LC/II
39	Lesser Whistling-Duck	*Dendrocygna javanica*	Anatidae	LC/II
40	Spot-billed Duck*	*Anas poecilorhyncha*	Anatidae	LC/II
41	Oriental Honey-buzzard	*Pernis ptilorhyncus*	Accipitridae	LC/II
42	Black Kite*	*Milvus migrans*	Accipitridae	LC/II
43	Jungle Bush Quail*	*Perdicula asiatica*	Phasianidae	LC/II
44	Red Spurfowl*	*Galloperdix spadicea*	Phasianidae	LC/II
45	Common Buttonquail *	*Turnix suscitator*	Turnicidae	LC/II

46	Blue-breasted Rail	*Gallirallus striatus*	Rallidae	LC/IV
47	White-breasted Waterhen*	*Amaurornis phoenicurus*	Rallidae	LC/II
48	Purple Moorhen	*Porphyrio porphyrio*	Rallidae	LC/IV
49	Pheasant-tailed*	*Hydrophasianus chirurgus*	Jacanidae	LC/II
50	Bronze-winged Jacana	*Metopidius indicus*	Jacanidae	LC/II
51	Common Ringed Plover	*Charadrius hiaticula*	Charadriidae	LC/II
52	Little Ringed Plover	*Charadrius dubius*	Charadriidae	LC/II
53	Kentish Plover*	*Charadrius alexandrines*	Charadriidae	LC/II
54	Yellow-wattled Lapwing	*Vanellus malarbaricus*	Charadriidae	LC/IV
55	Red-wattled Lapwing	*Vanellus indicus*	Charadriidae	LC/II
56	Eurasian Woodcock	*Scolopax rusticola*	Scolopacidae	LC/II
57	Spotted Dove	*Streptopelia chinensis*	Columbidae	LC/II
58	Emerald Dove*	*Chalcophaps indica*	Columbidae	LC/II
59	Green Imperial Pigeon	*Ducula aenea*	Columbidae	LC/II
60	Mountain Imperial-Pigeon	*Ducula badia*	Columbidae	LC/II
61	Indian Hanging-Parrot	*Parrot Loriculus vernalis*	Psittacidae	LC/IV
62	Rose-ringed Parakeet	*Psittacula krameria*	Psittacidae	LC/II
63	Plum-headed Parakeet	*Psittacula cyanocephala*	Psittacidae	LC/II
64	Blue-winged Parakeet	*Psittacula columboides*	Psittacidae	LC/II
65	Brainfever Bird *	*Hierococcyx varius*	Cuculidae	LC/II
66	Indian Cuckoo	*Cuculus Micropterus*	Cuculidae	LC/II
67	Common Cuckoo	*Cuculus Micropterus*	Cuculidae	LC/II
68	Banded Bay Cuckoo	*Cacomantis sonneratii*	Cuculidae	LC/II
69	Indian Plaintve Cuckoo	*Cacomantis passerinus*	Cuculidae	LC/II
70	Drongo Cuckoo	*Surniculus lugubris*	Cuculidae	LC/II
71	Asian Koel	*Eudynamys scolopacea*	Cuculidae	LC/II
72	Small Green-billed Malkoha	*Phaenicophaeus viridirostris*	Cuculidae	LC/II
73	Greater Coucal*	*Centropus sinensis*	Cuculidae	LC/II
74	Lesser Coucal *	*Centropus bengalensis*	Cuculidae	LC/II
75	Oriental Scops-Owl	*Otus sunia*	Strigidae	LC/II
76	*Brown Fish-Owl *	*Ketupa zeylonensis*	Strigidae	LC/IV
77	Jungle Owlet *	*Glaucidium radiatum*	Strigidae	LC/IV
78	Spotted Owlet	*Athene brama*	Strigidae	LC/II
79	Indian Jungle Nightjar *	*Caprimulgus indicus*	Caprimulgidae	LC/II
80	Indian Edible-nest Swiftlet *	*Collocalia unicolor*	Apodidae	LC/IV
81	White-rumped Needletail-Swift	*Zoonavena sylvatica*	Apodidae	LC/II
82	Brown-backed Needletail-Swift	*Hirundapus giganteus*	Apodidae	LC/II
83	Asian Palm Swift	*Cypsiurus balasiensis*	Apodidae	LC/II
84	Alpine Swift *	*Tachymarptis melba*	Apodidae	LC/II
85	Pacific Swift	*Apus pacificus*	Apodidae	LC/II
86	House Swift	*Apus affinis*	Apodidae	LC/II
87	Malabar Trogon*	*Harpactes fasciatus*	Trogonidae	LC/II
88	Small Blue Kingfisher	*Alcedo atthis*	Alcedinidae	LC/II
89	Oriental Dwarf Kingfisher	*Ceyx Erithacus*	Alcedinidae	LC/II
90	Stork-billed Kingfisher	*Halcyon capensis*	Alcedinidae	LC/IV
91	White-breasted Kingfisher	*Halcyon smyrnensis*	Alcedinidae	LC/IV
92	Black-capped Kingfisher	*Halcyon pileate*	Alcedinidae	LC/II
93	Collared Kingfisher *	*Todiramphus chloris*	Alcedinidae	LC/II
94	Blue-eared Kingfisher	*Alcedo meningting*	Alcedinidae	LC/II

95	Ceryle rudis *	*Lesser Pied Kingfisher*	Alcedinidae	LC/IV
96	Blue-bearded Bee-eater	*Nyctyornis athertoni*	Meropidae	LC/II
97	Small Bee-eater	*Merops orientalis*	Meropidae	LC/II
98	Blue-tailed Bee-eater	*Merops philippinus*	Meropidae	LC/II
99	Chestnut-headed Bee-eater*	*Merops leschenaultia*	Meropidae	LC/II
100	Brown-headed Barbet	*Megalaima zeylanica*	Capitonidae	LC/II
101	Crimson-throated Barbet	*Megalaima rubricapilla*	Capitonidae	LC/IV
102	Coppersmith Barbet	*Megalaima haemacephala*	Capitonidae	LC/II
103	Brown-capped Pygmy woodpecker	*Dendrocopos nanus*	Picidae	LC/IV
104	Yellow-fronted Pied woodpecker	*Dendrocopos mahrattensis*	Picidae	LC/IV
105	Wire-tailed Swallow	*Hirundo smithii*	Hirudinidae	LC/II
106	Red-rumped Swallow	*Hirundo daurica*	Hirudinidae	LC/IV
107	Large Pied Wagtail*	*Motacilla maderaspatensis*	Motacillidae	LC/II
108	Yellow Wagtail	*Motacilla flava*	Motacillidae	LC/IV
109	Paddyfield Pipit	*Anthus rufulus*	Motacillidae	LC/II
110	Large Cuckoo-shrike	*Coracina macei*	Campephagidae	LC/II
111	Scarlet Minivet	*Pericrocotus flammeus*	Campephagidae	LC/II
112	Red-whiskered Bulbul	*Pycnonotus jocosus*	Pycnonotidae	LC/II
113	Red-vented Bulbul *	*Pycnonotus cafer*	Pycnonotidae	LC/II
114	White-browed Bulbul	*Pycnonotus luteolus*	Pycnonotidae	LC/II
115	Yellow-browed Bulbul	*Iole indica*	Pycnonotidae	LC/IV
116	Common Iora	*Aegithina tiphia*	Irenidae	LC/II
117	Asian Fairy-Bluebird	*Irena puella*	Irenidae	LC/IV
118	Jerdon's Chloropsis *	*Chloropsis cochinchinensis*	Irenidae	LC/II
119	Malabar Whistling Thrush	*Myophonus horsfieldii*	Turdinae	LC/II
120	Orange-headed Thrush	*Zoothera citrinacyanotus*	Turdinae	LC/II
121	Oriental Magpie-Robin	*Copsychus saularis*	Turdinae	LC/II
122	White-rumped Shama	*Copsychus malabaricus*	Turdinae	LC/IV
123	Indian Robin	*Saxicoloides fulicata*	Turdinae	LC/IV
124	Pied Bushchat *	*Saxicola caprata*	Turdinae	LC/II
125	Spotted Babbler	*Pellorneum ruficeps*	Timaliinae	LC/II
126	Indian Scimitar Babbler*	*Pomatorhinus horsfieldii*	Timaliinae	LC/II
127	Rufous-bellied Babbler*	*Dumetia hyperythra*	Timaliinae	LC/IV
128	Black-headed Babbler *	*Rhopocichla atriceps*	Timaliinae	LC/IV
129	Yellow-eyed Babbler	*Chrysomma sinense*	Timaliinae	LC/IV
130	Rufous Babbler *	*Turdoides subrufus*	Timaliinae	LC/IV
131	Jungle Babbler	*Turdoides striatus*	Timaliinae	LC/II
132	Quaker Tit-Babbler*	*Alcippe poioicephalA*	Timaliinae	LC/II
133	Streaked Fantail-Warbler *	*Cisticola juncidis*	Sylviinae	LC/II
134	Franklin's Prinia *	*Prinia hodgsonii*	Sylviinae	LC/II
135	Ashy Prinia	*Prinia socialis*	Sylviinae	LC/II
136	Plain Prinia *	*Prinia inornate*	Sylviinae	LC/II
137	Common Tailorbird	*Orthotomus sutorius*	Sylviinae	LC/II
138	Tickell's Blue-Flycatcher *	*Cyornis tickelliae*	Muscicapinae	LC/II
139	Tickell's Flowerpecker *	*Dicaeum erythrorynchos*	Dicaeidae	LC/II
140	Plain Flowerpecker	*Dicaeum concolor*	Dicaeidae	LC/II
141	Purple-rumped Sunbird	*Nectarinia zeylonica*	Nectariniidae	LC/IV
142	Black-headed Munia	*Lonchura malacca*	Estrildidae	LC/II
143	House Sparrow	*Passer domesticus*	Passeridae	LC/II

144	Yellow-thraoted Sparrow	*Petronia xanthocollis*	Passeridae	LC/IV
145	Common Myna	*Acridotheres tristis*	Sturnidae	LC/II
146	Jungle Myna	*Acridotheres fuscus*	Sturnidae	LC/II
147	Black Drongo	*Dicrurus macrocercus*	Dicruridae	LC/II
148	Ashy Drongo	*Dicrurus leucophaeus*	Dicruridae	LC/II
149	Bronzed Drongo	*Dicrurus aeneus*	Dicruridae	LC/II
150	Greater Racket-tailed Drongo	*Dicrurus paradiseus*	Dicruridae	LC/II
151	Indian Treepie *	*Dendrocitta vagabunda*	Corvidae	LC/II
152	White-bellied Tree Pie	*Dendrocitta leucogaster*	Corvidae	LC/II
153	House Crow	*Corvus splendens*	Corvidae	LC/II
154	Jungle Crow	*Corvus macrorhynchos*	Corvidae	LC/II

Note: *M - Migratory, R - Resident, U - unclear, E - Endemic, CE - Critically endangered, NT - Near threatened, V - Vulnerable. WPA Schedule –I – IV,* * Secondary information from the Bhagawan Mahavir WLs report.

BUTTERFLIES: Total 27 species of butterfly were recorded within various habitats such as Paddy field, degraded habitat, scrub forest, open grassland, evergreen forest and near settlements (**Table 3.40**).

Table 3.40: List of butterfly species recorded within buffer zone

S. No.	Common name	Scientific name	Family	IUCN / WPA 1972 &Amnd. 2022
1	Crimson rose	*Pachiopta hector Linnaeus*	Papilionidae	LC/II
2	Danaid Eggfly	*Hypolimnas misippus*	Nymphalidae	LC/II
3	Spot swordtail*	*Graphium nomius Esper*	Papilionidae	LC/IV
4	Southern birdwing	*Troides minos Cramer*	Papilionidae	LC/II
5	Red helan	*Princepes helenus helenus Hampson*	Papilionidae	LC/IV
6	Malabar banded peacock*	*Papilio buddh Westwood*	Papilionidae	LC/II
7	Lime butterfly	*Papilio demoleus Linnaeus*	Papilionidae	LC/IV
8	Chocolate albatross	*Appias lyncida Cramer*	Pierinae	LC/II
9	Common Jezebel	*Delias eucharis Drury*	Pierinae	LC/IV
10	Common emigrant*	*Catopsilla pomona Fabricius*	Coliadinae	LC/IV
11	Common grass Yellow	*Eurema hecabe contubernalis Moore*	Coliadinae	LC/IV
12	Angled Sunbeam*	*Curetis dentata Moore*	Curetinae	LC/IV
13	Common Silverline	*Spindasis vulcans fusca Moore*	Theclinae	LC/IV
14	Angled pierrot*	*Caleta caleta decidia Cromer*	Polypmmatinae	LC/IV
15	Pea Blue	*Lamipes boeticus*	Polypmmatinae	LC/IV
16	Dark pierrot	*Tarueus Ananda*	Polypmmatinae	LC/IV
17	Common four ring	*Ypthima hubenri hubenri Fabricius*	Polypmmatinae	LC/IV
18	Common nawab*	*Polyura athamas athamas Drury*	Charaxinae	LC/II
19	Angled Castor*	*Ariadne ariadne pallidior Frusthorfer*	Nymphalinae	LC/IV
20	Common castor	*Ariadne merione assama Evans*	Nymphalinae	LC/IV
21	Lemon pansy *	*Precis lemonias lemonias L*	Nymphalinae	LC/IV
22	Commander	*Moduza procis procis Cramer*	Nymphalinae	LC/IV
23	Tree Nymph	*Idea malabarica Moore*	Danainae	LC/II
24	Common Indian Crow	*Euploea core Cramer*	Danainae	LC/IV
25	Plain Tiger*	*Danaus (Anosia) chrysippus L*	Danainae	LC/IV
26	Grass demon *	*Edaspes folcus Cramer*	Hesperiidae	LC/IV

27	Common dart*	*Potanthus spp Fabricius*	Hesperiidae	LC/IV

Note: *LC : Least Concern, CE - Critically endangered, NT - Near threatened, V - Vulnerable. WPA Schedule –I – IV, ** Secondary information from the Bhagawan Mahavir WLs report.

AQUATIC SPECIES: CRAB/FISHES: Total 16 species of fishes were recorded within the regions and 2 species of crabs in the streams, rivers, and estuaries. The species *Thunnus albacares* under near threatened and *Thunnus obesus* are Vulnerable, and most of them were not being evaluated IUCN status (**Table 3.41**)

Table 3.41: List of fishes and crab species reported within buffer zone

S. No.	Common name	Scientific name	Family	IUCN / WPA 1972 &Amnd. 2022
1	Spangled emperor	*Lethrinus nebulosus*	Lethrinidae	LC/IV
2	Mangrove red snapper	*Lutjanus argentimaculatus*	Lutjanidae	LC/IV
3	Malabar blood snapper	*Lutjanus malabaricus*	Lutjanidae	NE/IV
4	John's snapper	*Lutjanus johni*	Lutjanidae	LC/IV
5	Yellowfin tuna	*Thunnus albacares*	Lutjanidae	LC/IV
6	Bigeye tuna	*Thunnus obesus*	Lutjanidae	LC/IV
7	Indian mackerel	*Rastrelliger kanagurta*	Lutjanidae	DD/IV
8	Black marlin	*Makaira indica*	Lutjanidae	LC/IV
9	Goatee croaker	*Dendrophysa russelli*	Sciaendae	LC/IV
10	Blotched croaker	*Nibea maculate*	Sciaendae	LC/IV
11	Indian oil-Sardinella	*Sardinella longiceps*	Sciaendae	LC/IV
12	Indian spiny turbot	*Psettodes erumei*	Psettodidae	LC/IV
13	Malabar tonguesole	*Cynoglossus macrostomus*	Cynoglossidea	LC/IV
14	Dorab wolf-herrings	*Chirocentrus dorab*	Chirocentridae	LC/IV
15	Chacunda gizzard-shad	*Anodontostoma Chacunda*	Clupeidae	LC/IV
16	Engraved catfish	*Arius caelatus*	Ariidae	LC/IV
17	Christian crabs	*Charybdis cruciate*	Portunidae	LC/IV
18	Blue swimming crab	*Portunus Pelagicus*	Portunidae	LC/IV

Note: Not Evaluated (NE), and one as Data Deficient (DD). *LC: Least Concern, CE - Critically endangered,. WPA Schedule –I – IV, * Secondary information from the Bhagawan Mahavir WLs report & Atkore, Vidyadhar PhD work on fish diversity and turnover across multiple spatial scales in the Western ghats*

3.6.10 SOCIO-ECONOMIC ENVIRONMENT

3.6.10.1 DESCRIPTION OF ENVIRONMENT

The data for the socio-economic study was collected in May 2023 using methods like random sample survey of households, in-depth interviews and Focus Group Discussions (FGDs). Data on socio-economic status of population have been collected by using random sample survey of households. Data on the infrastructure facilities have been collected from the village elders and local officials and secondary sources. Assessment of minimum needs of the community has been collected using FGDs and in-depth interviews. Data on morbidity pattern have been collected from any one or

more health institutions (PHC or CHC or Clinic or Dispensary) in the buffer zone.

Data on village population, caste composition, literacy status, labour force participation, occupational classification and industrial classification of workers have been collected from Census 2011.

3.6.10.2 SOCIO-ECONOMIC ANALYSIS BASED ON SAMPLE SURVEY

Sampling, Design and Composition of the questionnaire.

The sample of villages as well as the respondent / households within each sampled village has been selected by two stage stratified random sampling – 1) On the first stage, villages from each district are selected on the basis of its area in the total study area and 2) On the second stage, households/ respondents are selected from sampled village by simple random sampling.

Households/ respondents were interviewed with the structured questionnaire specifically designed for this study keeping in view the objectives of the study. The questionnaire consists of following major sections:

- Composition and size of family
- Educational status
- Information on agricultural situation (holding size, Land use, cropping pattern, productivity, net return, etc.)
- Employment (sources of employment)
- Income (income from various sources)

The analysis is based on the census 2011





Photographs: 3.3: Socio-Economic Survey of Study area

3.6.10.3 DEMOGRAPHIC STATUS AS PER 2011 CENSUS

There are 51 villages in the buffer zone. These villages are in Sanguem, Dharbandora, Ponda, Quepem & Salcete talukas of Goa state. The total population of these villages is 113340 according to census 2011. As per Census 2011 villages Antoriem and Salaulim are uninhabited. The village population size varies widely as it ranges from a minimum of 8 persons in Moissal to a maximum of 22,730 persons in Curchorem-Cacora (Municipal Council). The sex ratio is 993 males per 1000 females according to 2011 census. List of villages in the study area and its population as per census 2011 is given in **Table 3.42** and total population distribution is given in **Fig. 3.13.**

Table 3.42: Population as per census 2011

S. No.	Name	No_HH	TOT_P	TOT_M	TOT_F
1	Colem	995	4195	2092	2103
2	Sigao	405	1724	879	845
3	Sangod	236	1083	557	526
4	Cormonem	152	645	358	287
5	Codli	884	3801	1955	1846
6	Camarconda	173	793	395	398
7	Moissal	2	8	5	3
8	Bandoli	231	1060	512	548
9	Rumbrem	131	646	300	346
10	Santona	343	1403	739	664
11	Calem	574	2683	1316	1367
12	Maulinguem	72	354	178	176
13	Dudal	97	446	229	217
14	Costi	196	881	503	378
15	Coranginim	9	32	14	18
16	Comproi	150	620	301	319
17	Muguli	119	508	225	283
18	Uguem	608	2557	1248	1309
19	Sanguem (M Cl)	1545	6444	3162	3282
20	Sanvordem (CT)	1187	5103	2552	2551
21	Assolda	309	1257	634	623
22	Bati	438	1933	959	974
23	Chandor	184	707	307	400
24	Conxem	39	186	94	92
25	Cotarli	258	1121	563	558
26	Curchorem-Cacora (M Cl)	5667	22730	11601	11129
27	Darbandora	672	2991	1493	1498
28	Dongurli	339	1534	753	781
29	Guirdolim	909	3622	1736	1886
30	Macasana	503	1972	880	1092
31	Molcopona	93	457	224	233
32	Molcarnem	347	1507	707	800
33	Molem	383	1715	883	832

34	Nagvem	100	475	238	237
35	Nirancal	406	1772	880	892
36	Odar	143	569	284	285
37	Oxel	633	2794	1329	1465
38	Patiem	60	292	158	134
39	Ponchavadi	931	4295	2140	2155
40	Sancordem	273	1233	624	609
41	Siroda	3197	14041	6886	7155
42	Sirvoi	281	1129	559	570
43	Tudou	9	35	17	18
44	Undorna	53	176	93	83
45	Xeldem (CT)	1815	7434	3693	3741
46	Xelpem	66	255	122	133
47	Xelvona	418	1725	870	855
48	Xic-Xelvona	28	125	67	58
49	Zanodem	61	272	138	134
	Total	**26724**	**113340**	**56452**	**56888**

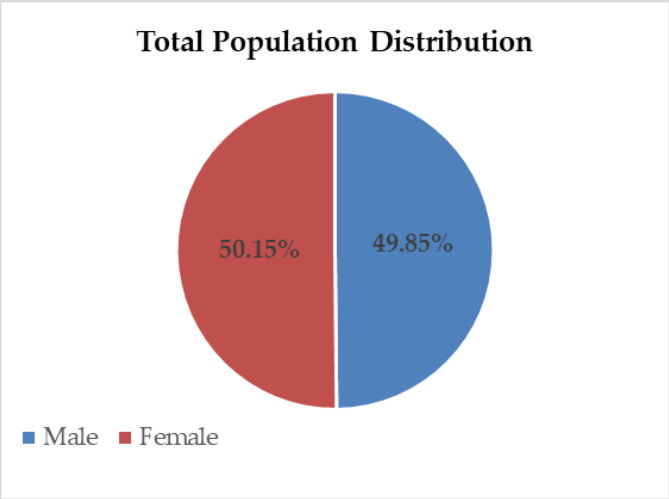


Fig. 3.13: Total population distribution

3.6.10.4 SOCIAL STATUS

A. SCHEDULE CAST, SCHEDULE TRIBES & OTHER CASTE (2011 CENSUS)

The population by broad caste groups in buffer zone as per census 2011 has been presented in **Table 3.43.**

The percentage of SC population in the buffer zone is about 1.4% according to census 2011 and is not uniform across villages. The percentage of ST population is higher in the buffer zone and is around 14.41% according to census 2011 and is shown in **Table 3.43**. The percentage distribution of population by broad caste groups in buffer zone, census 2011 is shown in **Table 3.44** and **Fig. 3.14**.

Table 3.43: Population by Broad Caste Groups in Buffer Zone, Census 2011.

Villages	P_SC	M_SC	F_SC	P_ST	M_ST	F_ST	Other Caste
Colem	86	42	44	106	51	55	4003
Sigao	0	0	0	192	99	93	1532
Sangod	8	5	3	134	62	72	941
Cormonem	0	0	0	282	148	134	363
Codli	55	26	29	628	305	323	3118
Camarconda	0	0	0	553	262	291	240
Moissal	0	0	0	3	2	1	5
Bandoli	14	4	10	546	271	275	500
Rumbrem	11	5	6	7	2	5	628
Santona	5	2	3	29	17	12	1369
Calem	42	20	22	568	277	291	2073
Maulinguem	0	0	0	215	104	111	139
Dudal	0	0	0	155	82	73	291
Costi	0	0	0	1	1	0	880
Coranginim	0	0	0	0	0	0	32
Comproi	0	0	0	3	1	2	617
Muguli	0	0	0	334	140	194	174
Uguem	57	25	32	540	272	268	1960
Sanguem (M Cl)	72	36	36	379	191	188	5993
Sanvordem (CT)	141	69	72	48	23	25	4914
Assolda	12	6	6	540	266	274	705
Bati	4	2	2	768	371	397	1161
Chandor	0	0	0	5	3	2	702
Conxem	0	0	0	0	0	0	186
Cotarli	4	3	1	293	146	147	824
Curchorem-Cacora (M Cl)	338	168	170	1362	667	695	21030
Darbandora	6	3	3	1689	796	893	1296
Dongurli	231	98	133	0	0	0	1303
Guirdolim	27	12	15	317	164	153	3278
Macasana	0	0	0	0	0	0	1972
Molcopona	0	0	0	419	204	215	38
Molcarnem	8	3	5	604	282	322	104
Molem	2	1	1	45	27	18	1668
Nagvem	0	0	0	276	138	138	199
Nirancal	0	0	0	278	136	142	1494
Odar	9	4	5	25	15	10	535
Oxel	8	4	4	1	1	0	2785
Patiem	0	0	0	0	0	0	292
Ponchavadi	3	2	1	882	423	459	3410
Sancordem	15	6	9	95	49	46	1123
Siroda	297	135	162	2895	1415	1480	10849
Sirvoi	6	1	5	375	174	201	748
Tudou	0	0	0	6	2	4	29
Undorna	3	1	2	93	47	46	80
Xeldem (CT)	114	52	62	946	423	523	6374

Xelpem	0	0	0	65	35	30	190
Xelvona	0	0	0	0	0	0	1725
Xic-Xelvona	0	0	0	0	0	0	125
Zanodem	0	0	0	19	9	10	253
Total	**1578**	**735**	**843**	**16781**	**8103**	**8618**	**94250**

Table 3.44: Percentage Distribution of Population by Broad Caste Groups in Buffer Zone, Census 2011.

Village	% SC	% ST	% Others	Total
Buffer Zone	1.40	14.41	84.19	100

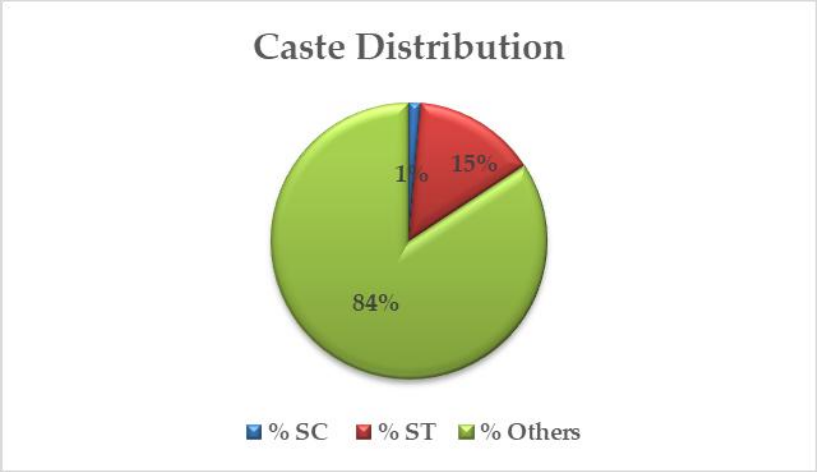


Fig. 3.14: Caste distribution

B. EDUCATIONAL STATUS (2011 CENSUS)

Literacy status:

The literacy rates from census 2011 have been presented in **Table 3.45**. About 77% of the population is literate according to the census. The literacy rates vary among villages from 87% in Moissal to 67.26% in Dudal.

Table 3.45: Literacy Rates

Villages	P_LIT	Percentage (%)	M_LIT	F_LIT
Colem	3215	76.64	1695	1520
Sigao	1270	73.67	695	575
Sangod	809	74.70	438	371
Cormonem	482	74.73	282	200
Codli	2952	77.66	1627	1325
Camarconda	583	73.52	318	265
Moissal	7	87.50	4	3
Bandoli	688	64.91	346	342
Rumbrem	450	69.66	222	228

Santona	992	70.71	562	430
Calem	2034	75.81	1074	960
Maulinguem	247	69.77	138	109
Dudal	300	67.26	169	131
Costi	671	76.16	420	251
Coranginim	27	84.38	14	13
Comproi	489	78.87	261	228
Muguli	374	73.62	190	184
Uguem	1799	70.36	945	854
Sanguem (M Cl)	5109	79.28	2631	2478
Sanvordem (CT)	3844	75.33	2028	1816
Assolda	931	74.07	490	441
Bati	1421	73.51	767	654
Chandor	542	76.66	247	295
Conxem	137	73.66	77	60
Cotarli	848	75.65	459	389
Curchorem-Cacora (M Cl)	18066	79.48	9597	8469
Darbandora	2260	75.56	1229	1031
Dongurli	1156	75.36	616	540
Guirdolim	2944	81.28	1473	1471
Macasana	1572	79.72	723	849
Molcopona	324	70.90	168	156
Molcarnem	1441	79.74	505	576
Molem	1220	71.14	672	548
Nagvem	345	72.63	189	156
Nirancal	1369	77.26	734	635
Odar	477	83.83	245	232
Oxel	2378	85.11	1183	1195
Patiem	186	63.70	109	77
Ponchavadi	3360	78.23	1758	1602
Sancordem	960	77.86	521	439
Siroda	11190	79.70	5806	5384
Sirvoi	832	73.69	439	393
Tudou	29	82.86	15	14
Undorna	91	51.70	50	41
Xeldem (CT)	5421	72.92	2828	2593
Xelpem	205	80.39	105	100
Xelvona	1435	83.19	750	685
Xic-Xelvona	108	86.40	60	48
Zanodem	188	69.12	96	92
Total	87778	78.47	45970	41448

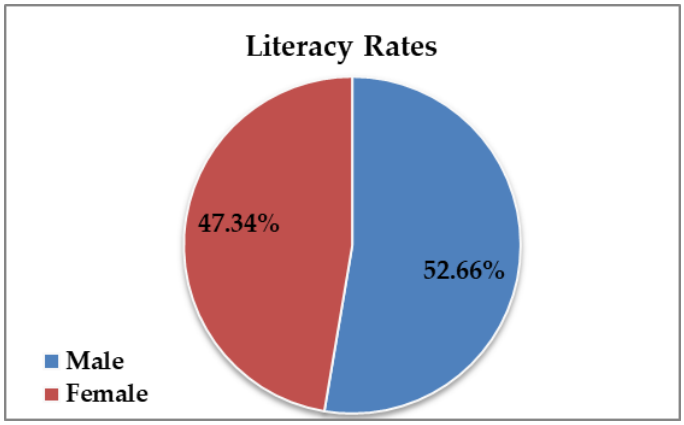


Fig. 3.15: Literacy rates

Schools within 3 Km radius

Schools Within 3 km	G.P.S. Costimol, Kalay	1.90Km (S)
	G.P.S. Dudhal, Kalay	2.67 km (SE)
	G.P.S. Guddamol	2.65 km (W)
	G. P. S. Kalay	1.66 Km (SEE)
	G.H.S. Kalay	1.90 km (SEE)
	G.P.S. Ambeudak	0.33 Km (W)
	G.P.S. Pokarmol, Kalay	2.95 Km (E)
	G.P.S. Devnamol	0.95 Km (E)
	Somnath English High School	1.57 Km (NNW)
	G.P.S. Matoje	1.45 km (N)
	G.P.S. Valdav, Kalay	2.96 km (NNE)

C. EMPLOYMENT STATUS (2011 CENSUS)

The labour force participation rates (percentage of workers to the total population) from the census 2011 have been presented in **Table 3.46.**

Village Level Industrial Status: The dependence on non-agriculture or the percentage of workers engaged in household industry and service sectors varies among villages in the buffer zone. The percentage of workers in non-agriculture sector is presented in **Table 3.46**. Distribution of population in accordance to work force is shown in **Fig. 3.16**.

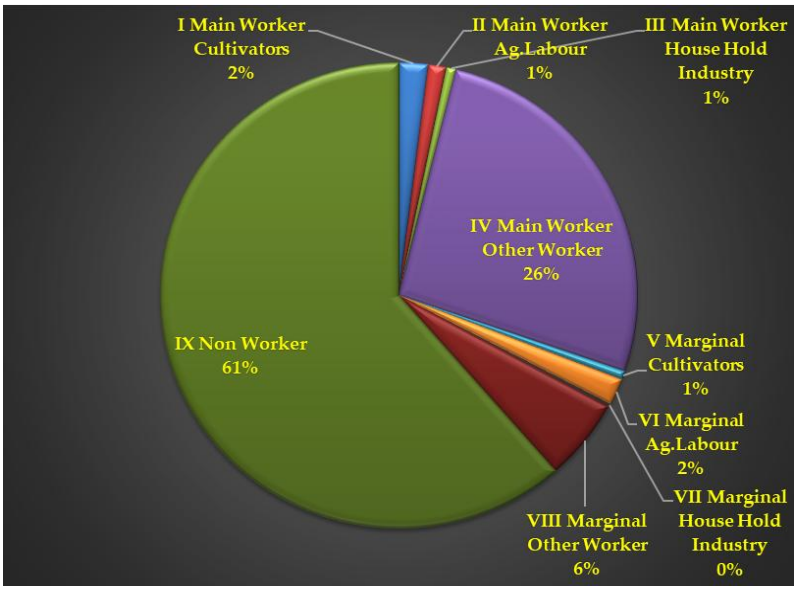


Fig. 3.16: Employment, Agriculture and Industrial Status as per Census 2011

Table 3.46: Employment, Agriculture and Industrial status as per census 2011

Village Name	Total Main Worker		I Culti vators		II Ag. Labour		III Household Industry		IV Other Worker		Marginal Worker		I Culti vators		II Ag. Labour		II Household Industry		IV Other Worker		Non-Worker	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
Colem	742	274	60	47	26	22	13	9	643	196	442	237	25	22	63	20	14	4	340	191	908	1592
Sigao	381	108	32	37	28	20	63	3	258	48	154	140	11	9	67	32	8	14	68	85	344	597
Sangod	264	64	13	9	21	14	2	0	228	41	68	22	4	1	15	13	0	0	49	8	225	440
Cormonem	190	23	8	4	2	0	0	0	180	19	16	9	1	1	1	3	0	0	14	5	152	255
Codli	959	232	75	44	20	22	9	3	855	163	223	119	35	37	50	40	2	5	136	37	773	1495
Camarconda	132	26	23	10	0	0	1	0	108	16	108	43	12	10	42	21	1	0	53	12	155	329
Moissal	3	1	0	0	0	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	2	2
Bandoli	215	62	15	13	1	2	2	1	197	46	81	95	10	15	35	62	1	1	35	17	216	391
Rumbrem	95	37	6	7	0	4	2	0	87	26	86	65	2	3	3	0	0	1	81	61	119	244
Santona	404	87	13	16	5	0	0	1	386	70	70	16	2	3	2	0	0	0	66	13	265	561
Calem	573	181	70	35	9	9	8	0	486	137	105	52	7	10	41	25	0	0	57	17	638	1134
Maulinguem	90	34	3	2	3	8	0	0	84	24	22	8	1	1	7	5	0	0	14	2	66	134
Dudal	80	28	1	0	2	7	0	0	77	21	42	76	0	2	14	58	1	1	27	15	107	113
Costi	318	46	12	4	3	1	1	0	302	41	24	6	7	3	0	0	0	0	17	3	161	326
Coranginim	7	1	0	0	0	0	0	0	7	1	3	0	0	0	1	0	0	0	2	0	4	17
Comproi	157	46	5	8	0	1	1	0	151	37	16	7	1	0	0	0	0	0	15	7	128	266
Muguli	92	33	3	5	0	3	1	0	88	25	53	71	1	1	34	48	0	1	18	21	80	179
Uguem	587	200	36	24	43	30	5	4	503	142	130	86	11	5	39	42	2	3	78	36	531	1023
Sanguem (M Cl)	1575	502	33	18	29	22	16	8	1497	454	183	216	9	1	5	13	0	0	169	202	1404	2564
Sanvordem (CT)	1420	452	12	12	3	11	8	5	1397	424	128	143	5	11	1	2	1	1	121	129	1004	1956
Assolda	317	134	25	8	13	22	9	5	270	99	46	62	6	11	2	26	0	0	38	25	271	427
Bati	475	200	73	57	26	27	15	5	361	111	75	49	8	5	17	16	4	5	46	23	409	725
Chandor	99	58	1	8	0	0	1	0	97	50	17	9	1	0	3	3	0	1	13	5	191	333
Conxem	44	11	17	3	0	0	0	0	27	8	13	7	1	0	3	2	0	0	9	5	37	74
Cotarli	283	111	16	14	18	7	7	3	242	87	35	40	1	0	19	15	0	1	15	24	245	407

Curchorem-Cacora (M Cl)	5842	1803	61	19	55	37	121	70	5605	1677	771	717	19	20	38	54	30	28	684	615	4988	8609
Darbandora	738	239	62	39	80	56	29	4	567	140	176	126	16	13	51	68	12	2	97	43	579	1133
Dongurli	217	67	22	9	11	20	6	3	178	35	197	55	20	1	70	27	19	11	88	16	339	659
Guirdolim	637	263	32	45	10	9	17	3	578	206	129	53	6	8	4	2	2	0	117	43	970	1570
Macasana	305	131	16	22	12	1	15	4	262	104	36	15	6	2	4	7	3	2	23	4	539	946
Molcopona	91	20	19	4	19	9	0	0	53	7	35	48	5	5	23	33	4	4	3	6	98	165
Molcarnem	294	189	37	32	111	110	10	4	136	43	87	55	87	10	34	36	1	2	25	7	326	556
Molem	329	78	17	8	4	8	8	2	300	60	168	106	22	27	22	26	3	5	121	48	386	648
Nagvem	26	8	3	1	1	0	1	1	21	6	107	46	11	3	49	32	0	0	47	11	105	183
Nirancal	389	99	53	21	5	4	3	1	328	73	94	58	4	2	48	27	0	0	42	29	397	735
Odar	139	41	9	8	0	0	0	0	130	33	17	10	1	1	0	0	0	0	16	9	128	234
Oxel	637	176	40	37	10	4	7	0	580	135	61	17	3	1	7	1	0	0	51	15	631	1272
Patiem	74	19	5	3	2	0	0	0	67	16	4	3	0	0	0	0	0	0	4	3	80	112
Ponchavadi	962	293	46	40	105	24	38	13	773	216	188	125	6	6	39	31	5	3	138	85	990	1737
Sancordem	340	99	19	10	27	20	0	0	294	69	30	45	3	2	14	28	0	0	13	15	254	465
Siroda	3103	1161	250	183	119	49	102	47	2632	882	641	467	36	23	120	84	29	36	456	324	3142	5527
Sirvoi	272	118	14	22	30	35	1	1	227	60	19	33	2	0	10	27	0	0	7	6	268	419
Tudou	5	2	1	1	4	1	0	0	0	0	2	0	1	0	0	0	0	0	1	0	10	16
Undorna	4	3	0	1	1	0	0	1	3	1	56	48	1	2	21	23	3	2	31	21	33	32
Xeldem (CT)	1628	523	40	22	53	41	27	2	1508	458	326	188	12	7	44	47	4	4	266	130	1739	3030
Xelpem	55	16	4	6	0	1	0	0	51	9	10	4	3	0	4	3	0	0	3	1	57	113
Xelvona	267	117	16	14	5	2	2	1	244	100	181	93	6	6	4	3	1	0	170	84	422	645
Xic-Xelvona	31	10	4	3	1	0	0	0	26	7	3	2	0	1	0	0	0	0	3	1	33	46
Zanodem	18	8	2	3	4	2	0	0	12	3	55	21	8	2	20	13	0	0	27	6	65	105

D. TRANSPORTATION & COMMUNICATION FACILITIES

The state has well-developed transport and communication facilities.

Transportation by road in Goa is considered to be the dominant medium for both passenger and freight. It has 224 Km of National highway, 232 Km of State Highway and 815 Km of District Highway. Two National Highways namely NH-17 and NH-4A are passing through Goa. NH-17 links Goa to Mumbai in the North and Mangalore to the South. NH-4A connects capital city of Goa, Panaji to Belgaum in the east. The NH-17 A connects NH-17 to Mormugao Harbour from Cortalim and the new NH-17B, four lane highway connects Momugao Harbour to NH-17 at another location, Verna via Dabolim airport

The network of communication facilities in the south Goa comprises of Post Office in urban – 26 nos & rural – 73 nos, telephone exchange is about 54 nos, Public call office are about 339 nos.

E. BANKING FACILITIES

Commercial banking facilities are 819 banking facilities in South goa district as per census 2011

F. TRANSPORTATION FACILITIES

Transport facilities are available in 98.49 per cent of the villages in the taluk as per 2011 survey, mainly in the form of public transport, which include bus services, rail facility and navigable waterway. Bus transport is the most common public transport in the talukas. There are three Railway stations within the buffer zone, nearest being Kalay Railway Station.

G. DATA RELATING TO HISTORICALLY, CULTURALLY, AND ECOLOGICALLY IMPORTANT PLACES IN CORE AS WELL AS BUFFER ZONE.

There are no historically, culturally, and ecologically important places in core zone. The following places of historical & cultural importance lie in the buffer zone.

Places of worship within 3 km

Places of worship within 3 km	Place of worship -Ambeudak temple	0.3 km (W direction)
	Shri kutimaya sateri	1.70 Km (NNE)
	Shri Devdeveshwar Devalaya	0.50 Km (NE)
	Shirdi SaiBaba Temple – Santona	0.31 km (E)
	Our lady of Fatima chapel	1.82 Km (S)
	Our Lady of Help Chapel-Santona	1.07 km (W)

H. HEALTH STATUS OF THE POPULATION IN THE STUDY AREA AS PER 2023 SURVEY

Morbidity status:

Morbidity data have been collected from Primary Health Center in Darbandora village. The reference period is three months prior to the date of survey. The relevant data have been presented in **Table 3.47.**

Cholera, Typhoid/paratyphoid, Tuberculosis (TB), Leprosy, Tetanus, Dengue fever, Jaundice, Malaria, Filariasis, STD, AIDS, Cancer, Goitre, Disease of thyroid gland, Disease of Kidney, Heart disease, Pleurisy, Pneumonia, Whooping cough, Poliomyelitis, Measles, Epilepsy, Piles, Gout or any joint problems accompanied by fever, Arthritis, Rheumatism-pain, Malnutrition, Pregnancy related diseases, Food poisoning, Burns and Vomiting have not been reported in the last three months.Rarely reported diseases, less than one per cent, are Disease of mouth, teeth, and gums, Mental disorder, Anemia and Disease of eye.

Often reported diseases is between 1 to 5 percent, includes diseases of ENT, Skin diseases, Throat infection, Fever not classified elsewhere, Gastroenteritis, Cough and fever, Diabetes, Blood Pressure and Asthma or Bronchitis.

Very often reported diseases (more than 5 per cent) include Influenza, Accidents, Gastroenteritis, Dysentery, Cough cold with fever and Cough cold without fever.

Inference focusing on need assessment: Iron ore does not contain toxic elements and as such the possibility of health hazards due to toxic elements does not arise. The most significant occupational health hazards are noise induced hearing loss and occupational lung diseases due to inhalation of dust. However, the Project management will take necessary measures to minimize these occupational health

hazards.

Episodes of Pneumonia have not been reported. The percentage of Asthma or Bronchitis is high (4.7 percent). The percentage of Asthma or Bronchitis and Pneumonia are because of other vices like consumption of tobacco and alcohol, especially among males. There are few cases of hearing loss mostly associated with old age. The percentage of skin allergies cases is not high (1.3 percent). These cases mostly are associated with personal hygiene.

Morbidity data presented in **Table 3.47** were collected from two PHCs centers in the buffer zone during the survey period.

Table 3.47: Number of patients suffering from the following diseases in buffer zone, survey 2023

S. No.	Morbidity	% patients visited doctor or clinic
1	Cholera	0.0000
2	Typhoid/paratyphoid	0.0000
3	Gastroenteritis	1.7403
4	Gastroenterities, Dysentery	14.0562
5	Tuberculosis (TB)	0.0000
6	Leprosy	0.0000
7	Tetanus	0.0000
8	Dengue fever	0.0000
9	Jaundice	0.0000
10	Malaria	0.0000
11	Filariasis	0.0000
12	STD	0.0000
13	AIDS	0.0000
14	Cancer	0.0000
15	Goitre, Disease of thyroid gland	0.0000
16	Diabetes	2.2758
17	Blood Pressure	2.6774
18	Disease of Kidney	0.0000
19	Heart disease	0.0000
20	Asthma, Bronchitis	4.6854
21	Pleurisy	0.0000
22	Influenza	6.0241
23	Pneumonia	0.0000
24	Whooping cough	0.0000
25	Poliomyelitis	0.0000
26	Measles	0.0000
27	Epilepsy	0.0000
28	Piles	0.0000
29	Disease of eye	0.8032
30	Disease of ENT	1.2048

31	Gout or any joint problems accompanied by fever	0.0000
32	Arthritis, Rheumatism-pain	0.0000
33	Skin diseases	1.3387
34	Disease of mouth, teeth, gums	0.2677
35	Throat infection	1.3387
36	Malnutrition	0.0000
37	Anemia	0.6693
38	Pregnancy related diseases	0.0000
39	Food poisoning	0.0000
40	Accidents	11.9143
41	Burns	0.0000
42	Mental disorder	0.2677
43	Vomiting	0.0000
44	Cough and fever	1.7403
45	Cough cold without fever	26.6399
46	Cough cold with fever	21.0174
47	Fever not classified elsewhere	1.3387
48	Others	0.0000
49	Total	100.0000 (747)

Medical lab facilities:

The data on nearest medical laboratory facilities are presented in **Table 3.48**. The villagers must travel to Dharbandora to avail various medical lab facilities.

Table 3.48: Distance of medical laboratories conducting following tests from the buffer zone, Survey 2023.

Medical test	Place
X-ray	Dharbandora
Pulmonary functions test	Ponda
Testing of hearing	Dharbandora
Identifying tuberculosis	Ponda
Blood test	Dharbandora
Urine test	Dharbandora

3.6.10.5 NEED ASSESSMENT STUDY

Socio-economic status of the buffer zone is briefly summarized based on findings from household survey and census. The survey was conducted in selected villages and at least three respondents were selected randomly to account intra-village variability among the respondents. Samples of 30 respondents have been surveyed and the sample covers 100 persons. While indirect need assessment is based on findings from household survey and census, direct needs assessment is based on

findings from Focus Group Discussions (FGDs) and in-depth interviews. The assessment study was conducted during May 2023 at the study area at certain village panchayats. The FGDs and in-depth interviews have been focused on issues like health needs, communication needs, sanitation needs, education needs and other social issues like tree plantation and maintenance of schools, temples and village roads. The direct needs have been presented according to the respondents' priority.

Indirect assessment of community needs.

- About 15 per cent of the population is elderly (60+) needing health and other elderly assisting programs. Some feasible welfare programs such as general health check-up, eye checkup, providing vision glasses and old age supporting equipment like walking sticks, and the like can be planned.

- About 5 per cent of the population in school going age (5-9 years) needing feasible programs like supply of school uniforms and books, transport, tuitions and supporting mid-day meal program and the like.

- About 20 per cent of the population in the age group of 14-19, who can enter into labour force, may be made self-employable by organizing vocational training programs through CSR activities.

- About 60 per cent of the population is in the working age group. Many of them need employment, especially females. The project proponent can formulate feasible female oriented self-employment schemes like milk dairy, poultry, sheep rearing, piggery and the like.

- The general literacy rates are high in buffer zone. Some villages in buffer zone are having marginally low literacy rates. School going children in these villages can be supported by providing school uniforms, books, transport and the like to boost literacy levels and discouraging school dropouts.

- There is unemployment in the buffer zone as elsewhere. This is because local industry and economy is unable to keep pace with fast growing working population to provide jobs. The solution for this is vocational training courses to meet local industrial need. Such an attempt can be made.

- To rejuvenate primary sector, agriculture related activities like milk diary, poultry, sheep rearing and piggery can be encouraged and farmers can be supported by supplying high yielding varieties and the like.

Direct assessment of community needs

1) Employment
2) Heath care
3) Vocational training centres,
4) Construction and maintenance of temples,
5) Construction village roads and maintenance,
6) Tree plantation

3.7 TRAFFIC DENSITY MEASURMENT

The traffic survey is essential to realistically and accurately assess the prevailing traffic volumes and travel characteristics by undertaking classified volume count. The objective of traffic volume count survey is to assess the traffic intensity on the most vulnerable section of the road under question. Twenty-four hrs. continuous volume count was manually undertaken during May-2023 at following routes:

Route 1: Kalay Block to Sanvordem Jetty/Capxem Jetty via Ambeudoc, Sanvordem Junction.

Route 2: Kalay Block to Sanvordem Jetty/Capxem Jetty via Bandoli, Sanvordem junction.

The analysis of traffic counts provides an estimate of average daily traffic (ADT). In order to convert recorded vehicles into a common scale, the passenger car units (PCU) equivalent factor as per IRC: 64 has been adopted. The following tables reveal ADT (Average daily Traffic) in terms of number which translates into PCU (Passengers Cars Units).

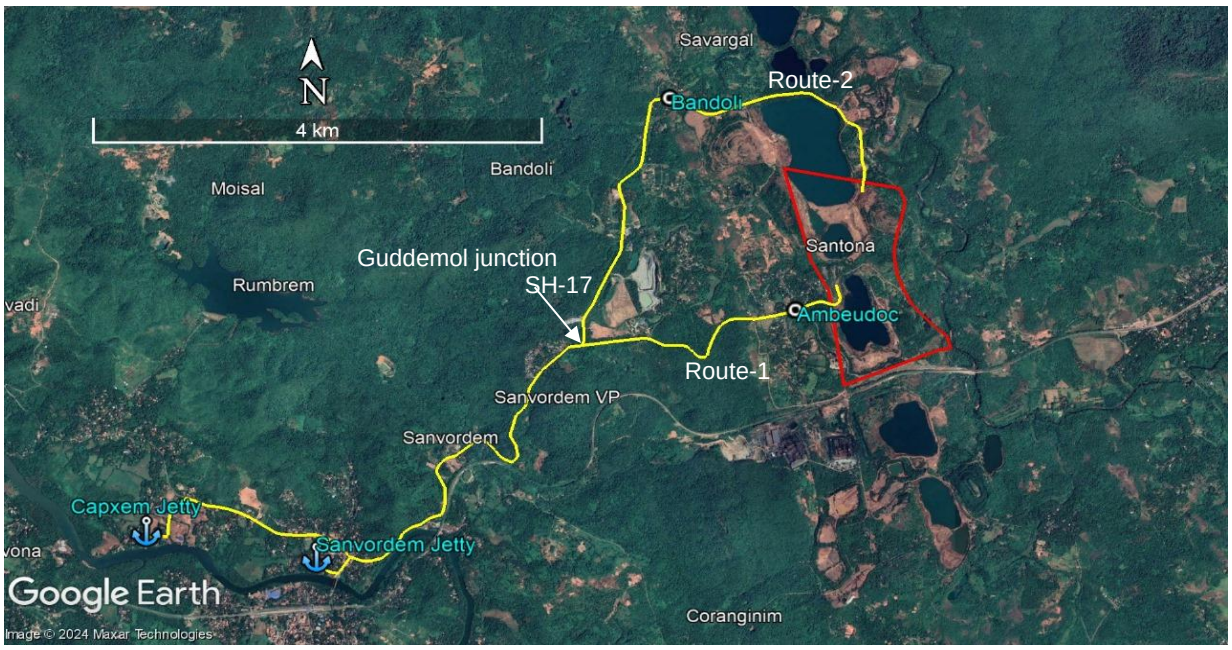


Fig 3.17: Google Earth Image showing Transportation Route

Average Daily Traffic:Time	Motor Cycle		Passenger Car		Agricultural tractor, Light Commercial Vehicle		Truck or Buses		Agricultural tractor Trailer, Truck Trailer	
	From	To	From	To	From	To	From	To	From	To
00:00:00	0	12	3	2	0	0	0	0	0	0
01:00:00	10	0	0	4	0	2	0	0	0	0
02:00:00	0	0	5	6	0	0	0	0	0	0
03:00:00	0	0	5	8	0	2	0	0	0	0
04:00:00	0	2	4	3	0	3	0	2	0	0
05:00:00	4	6	2	8	0	0	0	4	0	0
06:00:00	0	7	4	3	0	0	2	0	0	0
07:00:00	4	8	5	4	0	0	0	4	0	0
08:00:00	26	23	3	2	0	0	3	2	0	0
09:00:00	25	22	15	14	18	10	3	2	0	0
10:00:00	24	26	14	12	16	15	10	12	0	0
11:00:00	25	23	21	19	23	15	14	17	0	0
12:00:00	39	44	33	23	13	20	7	21	1	0
13:00:00	34	40	0	0	0	0	9	11	1	2
14:00:00	33	41	23	29	18	20	12	15	0	0
15:00:00	49	52	21	27	22	16	7	13	0	0
16:00:00	54	61	18	23	12	20	10	16	0	1
17:00:00	67	60	25	32	30	26	14	21	0	0
18:00:00	28	27	12	10	14	15	2	4	0	0
19:00:00	22	16	8	12	0	0	3	6	0	0
20:00:00	16	13	6	4	0	0	2	5	0	0
21:00:00	18	6	7	6	0	0	6	3	0	0
22:00:00	20	14	8	4	0	0	0	0	0	0
23:00:00	6	5	4	7	0	0	0	0	0	0
Total	504	508	246	262	166	164	104	158	2	3

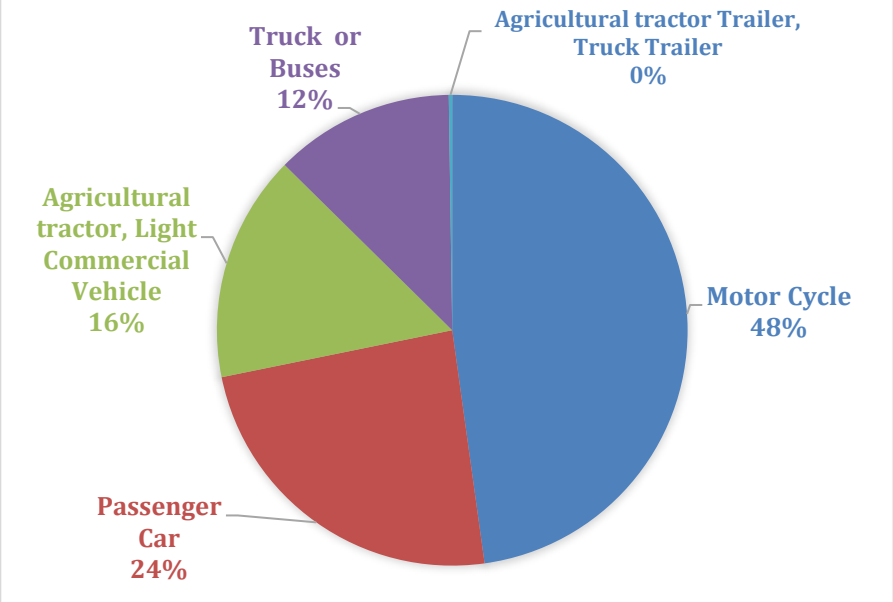


Fig 3.18: Average daily Traffic distribution

PCU factor (Traffic Volume Count)

Type of Vehicle	PCU Factor	No. of Vehicles /Day	No. PCU/Day
Motor Cycle	0.5	1012	506
Passenger Car	1	508	508
Agricultural tractor, Light Commercial Vehicle	1.5	330	495
Truck or Buses	3	262	786
Agricultural tractor Trailer, Truck Trailer	4.5	5	22.5
Total			**2317.5**

As per guidelines for capacity of roads in rural areas of IRC, recommended design series volumes for two lane roads are 15000 PCU/day.

Existing Traffic Scenario and LOS (Level of Service)

Road	V (Volume in PCU/day)	C (Capacity in PCU/day)	Existing V/C Ratio	LOS
State Highway SH-7	2317.5	15000	0.155	A Excellent

LOS (Level of Service) as per IRC: 64-1990

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
0.6 – 0.8	D	Average / Fair
0.8 – 1.0	E	Poor
> 1.0	F	Very Poor

Chapter-4

Anticipated Environmental Impacts & Mitigation Measures

4.1 ENVIRONMENTAL IMPACTS

The mining activities proposed will have both positive and negative effects on the surroundings, which are called impacts. The impact could be either beneficial or detrimental to the environment. The net impact could be determined by evaluating the impact on various parameters.

The parameters with adverse impact due to certain unavoidable reasons have to be nullified, kept to the minimum or brought to have positive effects by taking suitable corrective measures. With a proper understanding of cause and effect and designing suitable measures, it is possible to create better environment.

The proposed project will have a bearing on the socio-economic aspects as well as on the environment due to mining and other incidental activities. The impact depends upon the magnitude, mechanization and method of mining, extent of infrastructural facilities, environmental profile and characteristics of environment.

The impact prediction due to the project has been made in respect of the parameters considered in the present scenario. The quality parameters of ambient air, water, socio-economics aspects, inventory of flora & fauna due to mining operations in the buffer zone over a period of one season is available. These help in prediction of the impacts. The Environmental Impacts can be broadly categorized into Primary and Secondary Impacts. If the impact is directly due to the Project Activity, it is termed as Primary Impact. In case, the impacts are indirectly induced, then it is called Secondary Impact. The project can create impact in two phases, 1) during construction phase, which is temporary and short term in nature, 2) during the operation phase, which can have long term impacts. In the present scenario since the Mineral Block was already worked by the previous lessee the impact due to construction phase is minimal.

Environmental impacts due to project location, possible accidents, project design, project construction, mining operations, final decommissioning or rehabilitation of a completed project are discussed in this Chapter.

4.2 IMPACT DUE TO PROJECT LOCATION & PROPOSED MITIGATIVE MEASURES FOR THE PROJECT

Block IV – Kalay Mineral Block is located in Santona village of Sanguem Taluka, South Goa District, Goa State, having an area of 152.5073 Ha.

4.2.1 IMPACTS ON LAND ENVIRONMENT

4.2.1.1 IMPACTS ON LAND USE DUE TO MINING ACTIVITY

The Mineral Block is already broken up area. Further, due to proposed mining activity in this area, there will be change in the ground profile in the form of pit and waste dumps. The ore bearing area will be mechanically mined-out to the ultimate pit limit, while maintaining required bench height and width giving due consideration towards slope stability.

Vegetation Loss:

The proposed Mineral Block is already stripped off the major vegetative cover to win the ore. Once the lease is executed, portion of vegetative cover majorly Acacia species (*Acacia Auriculiformis*) shall be removed.

4.2.1.2 IMPACT DUE TO WASTE GENERATION OF THE MINING ACTIVITIES

The project proponent intends to produce a maximum quantity of 0.75 MTPA of Iron Ore. The ore to overburden ratio is 1:4. The maximum quantity of material will be handled during the fourth year of the Approved Mining Plan period, details of which is given in **Table 4.1** below.

Table 4.1: Maximum quantity of material handling during fourth year

S. No.	Production of	Quantity in Tonnes
1	ROM	750000
2	Waste	2384000
3	Total handling	3134000

The lateritic material generated during the five years of mining plan period will be utilized for environmental protective measures like construction of bunds, retention walls, covering on dump slopes, mulching, etc. Proposed dumping of waste/overburden during the Mining plan period is shown in **Table 4.2**.

Table 4.2: Proposed dumping of the waste/overburden during the plan period

S. No.	Year	Dump Id	Type of Dump	Proposed Area (ha)	Total Dump Quantity (m^3)
1	Year1	Dump-6A	Waste	2.54	152400
2	Year1	TD-2	Waste	4.13	563600
3	Year2	TD-1	Waste	7.10	675440
4	Year2	TD-2	Waste	3.24	388560
5	Year3	TD-1	Waste	6.02	496270
6	Year3	TD-2	Waste	3.51	526800
7	Year3	Dump-6A	Waste	1.43	128430
8	Year4	TD-2	Waste	4.77	547640
9	Year4	Dump-6A	Waste	4.21	505560
10	Year4	Dump-6	Waste	3.47	138800
11	Year5	Dump-6	Waste	5.11	263150
12	Year5	Dump-6A	Waste	2.18	326850

4.2.1.3 MITIGATION MEASURES

The following protective measures will be undertaken to prevent any surface run-off from the working area, dumping and backfilled areas.

- Proper slope will be maintained on the dump top to prevent erosion of dump slope.
- Retaining walls will be constructed all along the toe of the dump followed by trenches, which would be connected to a series of settling ponds.
- Storm and rainwater management will be an important aspect of dump management plan, wherein use of pipes, garland drains, trenches will be provided to channelize the rain water from dump to the settling ponds, to minimize erosion.
- Before the onset of monsoon, geotextile laid areas wherever provided will be sprayed with a mixture of organic manure and grass seeds so as to develop a green cover.
- Further, plantation of native species on final inactive dumps will be taken up in consultation with State Forest department.
- Native forest and horticultural species will be planted. Some of the plant species which would be planted are Cashew, Kokum, Avla, Arjun, Bayo, Bamboo, Ber, Glyricidia, Ficus, Mango, *Terminalia* species, Jambul, etc.
- Entire rain water that is encountered in the mining area will be properly channelized through trenches into the mining pit and settling ponds.
- Water accumulated in the mining pit will be passed through a series of settling ponds to allow settling of suspended particles and water will be

treated with lime to expedite the sedimentation rate of suspended particles. Clear water will be discharged from the Mineral Block.

By providing these protective measures, suspended solids in the runoff water flowing through the dump will be reduced considerably. Various protective measures proposed to be undertaken during Mining plan period is given in **Table 4.3**.

Table 4.3: **Protective measures proposed to be undertaken during Mining plan period**

Plan Period	Plantation			Retaining Wall (m)	Garland drains/ Bunds (m)
	Area (Ha.)	No. of Saplings	Name of species		
Year 1	0.60	1500	Native Species such as, Ficus species, *Terminalia* Sp., *Cassia* Sp., Bamboo Sp., Cashew, Mango, Jambul, Avla, etc.	330	1120
Year 2	0.60	1500		75	1320
Year 3	0.60	1500		200	1305
Year 4	0.60	1500		370	1515
Year 5	0.60	1500		250	1090

4.2.2 IMPACT DUE TO POSSIBLE ACCIDENTS & PROPOSED MITIGATIVE MEASURES

The impact due to possible accidents on the environment and the mitigative measures are as proposed below.

4.2.2.1 IMPACT DUE TO ACCIDENTS CAUSED BY VEHICLES USED IN MINING OPERATIONS

The accidents in mines involving men and machinery may lead to damage to vehicles, spillage of diesel & oil, injury to employees.

4.2.2.2 MITIGATION MEASURES TO PREVENT ACCIDENTS

Safety will be given prime importance in the mining operations. All the employees working in mines will be provided with safety training and awareness on various risks and hazards in the mines.

Following measures would be taken-up to prevent accidents:

1. Safety Management Plan will be formulated and implemented.
2. Haulage roads will be maintained regularly
3. Proper illumination of the roads and mine

4. Regular maintenance of all the mining machinery to meet the requirement of environmental standards
5. Speed limit of 25 km/hr will be implemented in the mine, sign boards will be displayed at strategic locations in the mines
6. Appropriate mine road design such as road width and gradient will be maintained
7. Proper Personal Protective Equipment (PPE) will be provided to all employees
8. Road signs and signals will be placed at strategic locations
9. Any diesel and oil spilled shall be cleared, collected and places of spillage shall be cleaned immediately. Used oil (spend oil) generated shall be stored in leak proof containers and disposed to recyclers authorized by the State Pollution Control Board.
10. In case of accidents, the vehicles / machinery will be vacated from the area as soon as possible to prevent any obstruction.
11. Necessary First Aid and medical treatment shall be provided to injured persons.

4.2.2.3 IMPACTS DUE TO LAND SLIDE

Opencast mining particularly in regions receiving heavy rainfall may be vulnerable to landslides, which may result in loss of human life, property and deforestation, depending on the condition at the site.

4.2.2.4 MITIGATION MEASURES

Slope stability study is conducted by National Institute of Technology, Karnataka, (NITK) Surathkal for safe working and optimum design of the Project, to take maximum care during mining operation which will prevent any mine slope failures.

Mining will be carried out by forming benches with maximum height of each bench as 6 m. The width of the benches shall be 8-10 m. The slope of the benches shall be maintained at 60^0 with overall pit slope of less than 30°. Finalized inactive waste dumps shall be stabilized by using geotextiles, plantation of dump slopes and other engineering structures as envisaged in R&R Plans. No mining activity other than environmental protective measures shall be carried out during monsoon season.

4.3 IMPACTS DUE TO PROJECT DESIGN AND PROJECT CONSTRUCTION, REGULAR OPERATIONS AND PROPOSED MITIGATIVE MEASURES, FINAL DECOMMISSIONING OR REHABILITATION OF COMPLETED PROJECT.

4.3.1 LAND USE

The mining project has been already worked in the past by the erstwhile lessee who undertook all the construction activities such as mine office and other infrastructure facilities. As such, no further major construction activity is required to be undertaken. During the mining operations the land use shall be altered to win the ore. As per the Modified Mining Plan approved by IBM, the current land use and conceptual land use are given in Table **4.4** and **Table 4.5** below.

Table 4.4: Current Land use of the Mineral Block

S. No.	Details	Existing Land use (Ha.)
1	Area under Mining	74.3004
2	Overburden/dumps	23.0618
3	Mineral storage/sub-grade stack	0.0000
4	Infrastructure	4.8326
5	Village Road	1.6292
6	Mine Road	3.2766
7	Drain	0.1767
8	Protective Measures	6.3878
9	Reclaimed Pit	2.0843
10	Pit Reclaimed and Rehabilitated	3.1150
11	Pit as Water Reservoir	0.00
12	Dump Rehabilitated	5.5992
13	Nalla	0.8255
14	Green Belt	0.0000
15	Other Mining Utilities	3.3491
16	Unused	23.8691
	Total	**152.5073**

Table 4.5: Land Use of Mineral Block at the Conceptual Stage

S. No.	Details	Conceptual Stage Land use (Ha.)
1	Area under Mining	0.0000
2	Overburden/dumps	0.0000
3	Mineral storage/sub-grade stack	0.0000
4	Infrastructure	1.1398
5	Village Road	1.5377
6	Mine Road	3.2766

7	Drain	0.0000
8	Protective Measures	10.3998
9	Reclaimed Pit	29.0675
10	Pit Reclaimed and Rehabilitated	26.2555
11	Pit as Water Reservoir	44.1356
12	Dump Rehabilitated	21.2162
13	Nalla	0.8255
14	Green Belt	3.0288
15	Other Mining Utilities	0.0000
16	Unused	13.6152
	Total	**152.5073**

4.3.2 MITIGATION MEASURES FOR MINED OUT LAND AND MINE CLOSURE

Out of the 102.8315 Ha of land degraded by excavation, at conceptual stage an area of 89.87 Ha will be reclaimed by planting 1500 saplings /Ha i.e., 134805 saplings of native plants and fruit bearing species such as Cashew, Bamboo, Arjuna, Alva etc. An area of 44.1356 Ha. shall be converted into a water reservoir which will be beneficial to the society and also to the migratory avifauna.

Dumping of waste will be carried out scientifically in stages and by intermediate terracing. Retaining walls and garland drains will be provided at the toe of the dumps. Before taking up active plantation, terraces of inactive waste dumps will be planted with suitable grass and leguminous local plant species as a temporary stabilization measure. The Environment Plan is enclosed as **Plate No. 21**.

Mine Closure will be carried out considering the following aspects:

1. Prevent spread of fugitive dust and noise generated due to mining and allied activities.
2. Help stabilize slopes of waste dump and control soil erosion
3. Increase green cover and improve aesthetics
4. Attract birds to re-colonize the area when the mine is abandoned
5. Mitigation needed towards the damage caused to vegetation due to mining operation.

4.4 IMPACTS DUE TO OPERATIONS & PROPOSED MITIGATIVE MEASURES

Block IV – Kalay Mineral Block shall be operated by taking all precautionary measures to reduce the impact of mining operations on Air, Water, Noise, Soil, Land use and Biological environment.

The impacts on Land environment is evaluated in detail in **Para 4.11**.

4.5 IMPACT ON AIR ENVIRONMENT & PROPOSED MITIGATIVE MEASURES

Various activities proposed to be carried out in the Mine viz., ore excavation, loading & unloading, transportation, etc., are likely to generate dust, which will have an impact on the Air Environment.

4.5.1 IMPACT ON AIR QUALITY

The proposed mine with its capacity of 0.75 million TPA of ROM, is likely to generate dust, NO_2 and SO_2. The impact on air quality depends on the size of iron ore extraction, transportation, etc. The intensity of operation is directly related to the rate of generation of ore and waste from the mine, transportation, etc.

The ambient air quality monitoring results show that PM_{10} concentrations are within the prescribed limits (CPCB standards) in the villages around the Mineral Block area. However, at present the only source of pollution are domestic activities and vehicular movement in the surrounding villages. Once the mining operation starts, it is anticipated that marginal increase in the particulate levels of the core and the buffer zones will occur. Dust suppression measures are, therefore, of utmost importance. Vehicular movements within the mine site will add marginally to NO_2 and CO concentrations. Monitored values of SO_2, NO_2 and CO in the ambient air are reported to be low in the study area. It is proposed that the Project Proponent ensures regular maintenance of vehicles so that the emission levels remain within the prescribed limits.

As adequate dust suppression measures will be provided, the dust particles will not get transported in the downwind direction of the impact area. PM levels will be higher within the active operational areas (mine area) due to excavation and transportation. However, the buffer zone is not likely to be affected with dust

problems, provided proper dust suppression and mitigation measures are taken up.

Air pollution sources at the proposed opencast mine can be classified into four categories, viz., Area Sources and Line Sources as described below:

Area Source: These are stationary sources, which emit air pollutants into the atmosphere from a certain fixed point. The total mine area with all mining activities like excavation, operation of equipment/machinery, active mine pit, mineral stock yard and waste dump locations and haul roads constitute the area source, which lead to increase in air pollution in and around mineral block area.

Mining: Overburden and ore benches would be developed in scientific and sustainable open cast method using hydraulic excavator along with matching trucks.

Dozing: Dozing is envisaged during mining operations. The dozing activity is likely to contribute to air pollution in the form of PM, SO_2, NO_2 and hydrocarbons due to use of diesel operated machines.

Loading & unloading of waste/ore: The loading of Waste/Ore is proposed to be done by excavators. These activities are likely to contribute air pollution in the form of dust/ particulate matter during discharge of material from bucket. Gaseous pollutants like SO_2, NO_2 and hydrocarbons will be generated due to combustion of diesel in the loading & unloading machinery. The generated waste/ore will be transported by trucks and unloaded at the designated locations i.e. at dump site or ore stacking.

***Line Sources*:** These are normally mobile sources, which emit pollutants in the area through which they pass. The following are the sources of air pollution falling under this category.

Transportation: Surface transport consists of transport of overburden and Iron Ore. Overburden will be transported by trucks to respective waste dumps. Separate haul roads have been provided for movement of trucks. Transportation also includes movement of iron ore to the nearest jetty. The traffic on the haul roads is likely to contribute towards increase in dust and gaseous pollutants concentration in the mining area.

The size of the dust particles emitted into the atmosphere plays a major role in deciding the distance to which they may be transported. Particles of larger size fall

fairly rapidly and closer to their source because of gravitational settling. The composition of these particles largely depends on the composition of the mineral being handled i.e. iron Ore in this case. Prediction of fugitive dust level in the surrounding area is carried out with the help of AERMOD. This AERMOD model for area sources uses the steady state Gaussian plume equation for a continuous source. The model was developed by 'Envitrans'.

4.5.2 AIR QUALITY PREDICTION THROUGH MATHEMATICAL MODELLING– IMPACT OF MINING OPERATIONS ON ENVIRONMENT

Prediction of fugitive dust level in the surrounding areas is carried out with the help of AERMOD. This model uses the steady state Gaussian plume equation for a continuous source. Isopleths representing PM_{10}, $PM_{2.5}$, SO_2 & NO_2 are presented along with Ground-Level Concentrations (GLC) at core and buffer zone to estimate the total impact load.

4.5.2.1 AIR QUALITY PREDICTIONS THROUGH MATHEMATICAL MODELLING

Air Pollution Modeling:

Air quality models are the primary tools for relating emissions to air quality impacts. Models, in turn, require acceptable input data for emissions, surface topography, meteorological parameters, receptor configurations, baseline air quality and initial boundary conditions for each modeling scenario. Since the quality and reliability of model outputs can never be any better than the inputs, input of the quality data is very important.

Prediction of impacts on air environment has been carried out using AERMOD dispersion model, which is based on steady state Gaussian plume dispersion, designed for area sources for short term. The AERMOD is developed by United States Environmental Protection Agency [USEPA] has been used for simulations from point sources and also line source for transportation of ore.

Pollutants Considered for Computation:

The model simulations are done for the air pollutant arising from the mining operations, namely, PM10, PM2.5, SO2 & NOx. GLCs for PM10, PM2.5, SO2 & NOx have been computed using hourly meteorological data.

Modeling is done for maximum production & development to know the GLC. The maximum production capacity for the Mineral Block is 0.75 MTPA and the maximum material handling due to production and development is expected to be 3.134 MTPA in this project. Hence the study details for this modeling purpose are as follows:

ACTIVITY, TYPE AND EMISSION SOURCES:

Pollution source type from the activities of Block IV - Kalay Mineral Block are as follows:

Sr. No.	Activity	Source	Type of Pollution
1	Excavation of Iron ore and waste including all mining operations	Working Mine pit area	Area
2	Transportation of Iron and Waste	Transportation route	Line source

Note: For the proposed Project, Iron ore screening and sizing activity is not proposed.

Quantification of Pollutants

Quantification of particulate emissions has been carried out by the emission factor technique. Emission factor is a statistical average of the rate at which a pollutant is released during an activity. This factor when multiplied by the level of that activity in a given situation will give the overall effect. Particulate emissions have been predicted by using standard equations given in "Indian Mine and Engineering Journal" and suggested by USEPA for mining & allied activities.

1. Equations for following mining activities are given below:
   A. Excavation of ore & waste
   B. Transportation ore & waste

Emission factor is calculated by the following empirical formula:

A. Equation for Excavation of ore and waste

23.6 kg/hr particulate matter for every 1000 Tonnes per hour material handling

B. Equation for Transportation of ore and waste

DT = Tv x 0.2 x d

DT = Dust emission in kg/hr

Tv = No. of transport vehicles plying in one hour

0.2 kg/vehicle/km. – dust generated per vehicle per km

i. Quantification of particulate emissions with respect to Excavation of Iron Ore, Waste.

The maximum production and development of Block IV - Kalay Mineral Block is 3134000 TPA. Accordingly, the dust emission was calculated as shown below in **Table 4.6**.

Table 4.6: Quantity of dust emission calculated for excavation of Iron Ore, Waste.

Particulars of activity	Total
Excavation of ore & waste (T/A)	3.134 (MTPA) or 3134000 Tonnes/annum
Excavation of ore & waste in TPD taking 200 as working days per year	15670 Tonnes/day
Material excavated/tph (14hrs)	1119.28 Tonnes/hr
Dust emission kg/hr during excavation	26.41 Kg/hr or 7.34 g/sec

ii. Quantification of particulate emissions with respect to transportation of Iron ore and waste (within the Mineral Block)

Dust emission from the transport vehicles plying for the movement of Iron ore & waste are estimated using empirical value of 0.2 kg/vehicle/km (Source: AP-42, USEPA) and the following empirical formula.

DT = Tv x 0.2 x d

DT = Dust emission in kg/hr

Tv = No. of transport vehicles plying in one hour

0.2 kg/vehicle/km. – dust generated per vehicle per km

The dust emission w.r.t transportation of ore & waste within the mineral block was calculated as shown below in **Table 4.7**.

Table 4.7: Quantity of dust emission calculated for ore and waste transportation

Particulars of activity	Details & Calculation
Iron ore & waste excavated	1119.28 tones/hr
Lead	2 Km
Maximum no. of Trips per hour	44.77
Dust emission during transportation	44.77 (Tv) x 0.2 x 2 (d) = 17.908 kg/hr or 4.97 gm/sec

iii. Quantification of particulate emissions with respect to transportation of Iron ore to Capxem & Sanvordem Jetty

Dust emission from the transport vehicles plying for the movement of Iron ore & waste are estimated using empirical value of 0.2 kg/vehicle/km (Source: AP-42, USEPA) and the following empirical formula.

DT = Tv x 0.2 x d

DT = Dust emission in kg/hr

Tv = No. of transport vehicles plying in one hour

0.2 kg/vehicle/km. – dust generated per vehicle per km

The dust emission w.r.t transportation of Iron ore to Capxem & Sanvordem Jetty was calculated as shown below in **Table 4.8**.

Table 4.8: Quantity of dust emission calculated for transportation of Iron ore to Capxem & Sanvordem Jetty

Particulars of activity	Details & Calculation
Production capacity of the Mineral Block	7,50,000 Tonnes Per Annum
Quantity of Iron Ore to be transported outside the Mineral Block	7,50,000 Tonnes Per Annum
Lead	14 Km
Dust emission during transportation	29.76 (Tv) x 0.2 x 14 (d) = 83.33 Kg/hr = 23.14 gms/sec

Considering the above, the emission rates are derived and used in the model.

iv. Gases Emissions

To calculate the pollution factor gaseous emissions, fuel consumption by the mining machinery is considered. For the proposed project, approximately 793000 Kg/Annum of HSD will be consumed.

a. SO_2 Emission

SO_2 emission is calculated based on the hourly fuel consumption of each equipment and the Sulphur content in the fuel as provided by the fuel supplier.

Excavation

The daily max consumption of Fuel is 180 Kg/hr and assuming the Diesel fuel

emits 100 mg/kg of fuel consumed, the emission rate will be 0.005 g /s.

Transportation & Miscellaneous activities

The daily max consumption of Fuel is 150 Kg/hr and assuming the Diesel fuel emits 100 mg/kg of fuel consumed, the emission rate will be 0.0038 g/s.

b. NO_x Emission

NO_X emission is calculated based on the hourly fuel consumption of each equipment and the Nitrogen oxide content in the fuel as provided by the fuel supplier.

Excavation

The daily max consumption of Fuel is 180 Kg/hr and assuming the Diesel fuel emits 200 mg/kg of fuel consumed is 0.01 g/s.

Transportation & Miscellaneous activities

The daily max consumption of Fuel is 150 Kg/hr and assuming the Diesel fuel emits 200 mg/kg of fuel consumed, the emission rate will be 0.0076 g/s.

Based on the above, the expected emission rate due to various operations in this project without control measures is calculated and is given below: Emission rate and Emission sources without control measures.

The cumulative emissions from Excavation including various mining operations and Transportation of ore within the Mineral Block and Outside is given below:

Activities/ Pollutants	PM10	PM2.5	SO2	NOx
Excavation including all mining activities	7.33	2.19	0.005	0.01
Transportation & Miscellaneous	31.93	9.58	0.0038	0.0076
Total (gm/s)	**39.26**	**11.77**	**0.0088**	**0.0176**

EMISSION SOURCE COORDINATES

The center of Mineral Block was considered (0, 0) in mathematical modeling.

MATHEMATICAL MODEL FOR POLLUTANTS DISPERSION

In the present case, AERMOD model has been used to predict the impacts. This model for area sources uses the steady state Gaussian plume equation for a continuous source.

Further the model has following specialties:

- Simulates dispersion from single/multiple/area/line/volume sources. Allows calculations to be made at a user specified regular rectangular/radial grid or at specified special receptors.
- Provides estimates of concentrations for any averaging time period for the entire period of input meteorology. Allows calculations to be underwritten for source groups as selected by the user.
- Uses Pasquill-Gifford or Briggs dispersion curves (for urban areas) as selected by the user, to derive the plume spread parameters.
- Adjusts dispersion curves to account for user specified information on aerodynamic roughness.
- Adjusts for wind speed variation with height, using user specified default urban/rural power law coefficients.
- Simulates dispersion from buoyant, non-buoyant point sources, non- buoyant area, non-buoyant volume sources and non-buoyant line sources.
- Simulates dry deposition using a simple tilted plume model with user specified reflection coefficients.
- Simulates building wake effects and includes the effects of exponential decay. Uses Briggs' 1975 plume rise algorithm to calculate plume height.

4.5.2.2 METEOROLOGICAL CONDITIONS USED IN PREDICTIONS

The hourly meteorological data has been generated at the site for Summer season of 2023 (Mar to May-2023) and the same has been used in the predictions.

4.5.2.3 RESULTS AND DISCUSSIONS

Ground level concentrations (GLC) have been computed and its details are given below:

The results of the Peak GLC's for various environmental parameters with control measures are given below:

S. No.	Parameters	Peak incremental concentration μg/m³
1	PM 10	8.6
2	PM 2.5	2.1
3	SO_2	0.00161
4	NO_x	0.00058

The Isopleths of PM_{10}, $PM_{2.5}$, SO_2 & NO_x concentrations is given in **Fig. 4.1** to **Fig. 4.4.**

It is observed that the peak incremental concentration for PM_{10}, $PM_{2.5}$, SO_2 & NO_X is occurring very near the source only towards west direction at a distance of 600 m. At places away from the active source, the values are getting reduced due to wind dispersion and distance effects. However, various mitigation measures as mentioned above will be strictly enforced in this project during working and the GLC values will be brought down substantially.

The predicted concentrations of PM_{10}, $PM_{2.5}$, SO_2 & NO_X at Receptors i.e. Villages within the buffer zone area where baseline data was collected and AERMOD was run by selecting these villages as receptors. The predicted concentrations of PM_{10}, $PM_{2.5}$, SO_2 & NO_X is given in the **Table 4.9A & 4.9B**.

Table 4.9A: Predicted concentrations of PM10 and PM2.5

S. No.	Location	PM10 (µg/m3)			PM 2.5 (µg/m3)		
		Baseline	Increment	Total	Baseline	Increment	Total
1	A1 - Kalay Mineral Block Mine Office (Core zone)	55	4.7	59.7	33	1.2	34.2
2	A2 - Costi village (Near Chowgule Colony)	57	1.6	58.6	40	0.4	40.4
3	A3 - Kalay village	51	2.2	53.2	29	0.5	29.5
4	A4 - Devonamol village	54	0.9	54.9	28	0.2	28.2
5	A5 - Cormonem village	51	1.4	52.4	28	0.3	28.3
6	A6 - Bandoli village (Morcani)	55	0.3	55.3	42	0.1	42.1
7	A7 - Santona Village (Ambeudok)	46	8.6	54.6	30	2.1	32.1
8	A8 - Near SFIPL Plant office	45	2.6	47.6	28	0.6	28.6

Table 4.9B: Predicted concentrations of SO_2 and NOx

S. No.	Location	SO_2 (µg/m3)			NOx (µg/m3)		
		Baseline	Increment	Total	Baseline	Increment	Total
1	A1 - Kalay Mineral Block Mine Office (Core zone)	15	0.00088	15.00088	12	0.00173	12.00173
2	A2 - Costi village (Near Chowgule Colony)	13	0.00030	13.00030	17	0.00058	17.00058
3	A3 - Kalay village	13	0.00041	13.00041	18	0.00005	18.00005
4	A4 - Devonamol village	13	0.00017	13.00017	12	0.00003	12.00003
5	A5 - Cormonem village	11	0.00025	11.00025	18	0.00006	18.00006
6	A6 - Bandoli village (Morcani)	12	0.00006	12.00006	17	0.00001	17.00001
7	A7 - Santona Village (Ambeudok)	12	0.00161	12.00161	16	0.00078	16.00078
8	A8 - Near SFIPL Plant office	10	0.00048	10.00048	16	0.00008	16.00008

NAAQS standards (µg/m3)

	SO_2	NO_2	PM 10	PM 2.5
24hrs	80	80	100	60

From the predicted concentrations, the values of PM_{10}, $PM_{2.5}$, SO_2 & NO_X is found to

be within the permissible limits

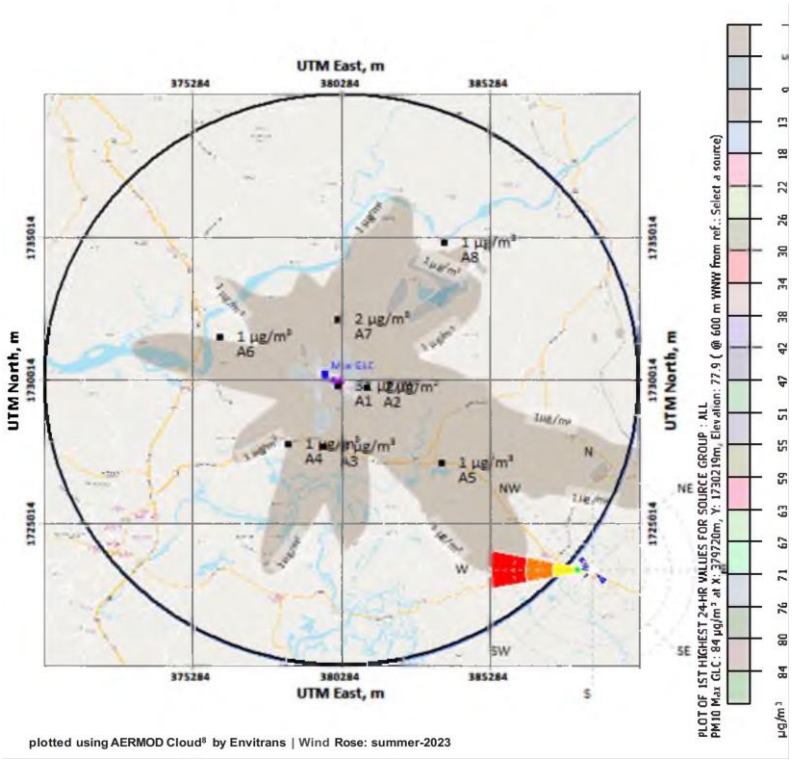


Fig. 4.1: PM10 Prediction

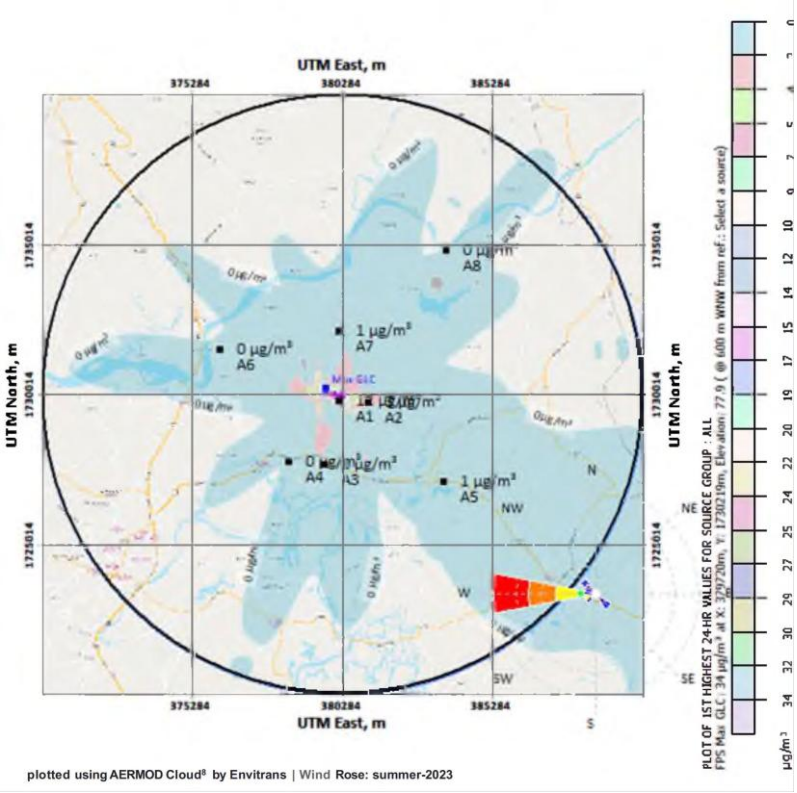


Fig. 4.2: PM2.5 Prediction

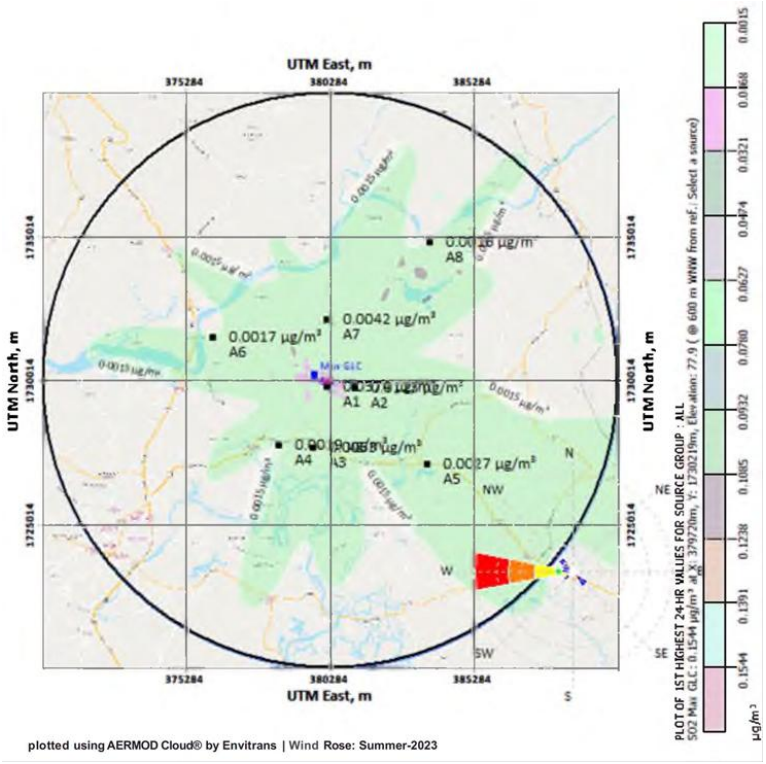


Fig. 4.3: SO_2 Prediction

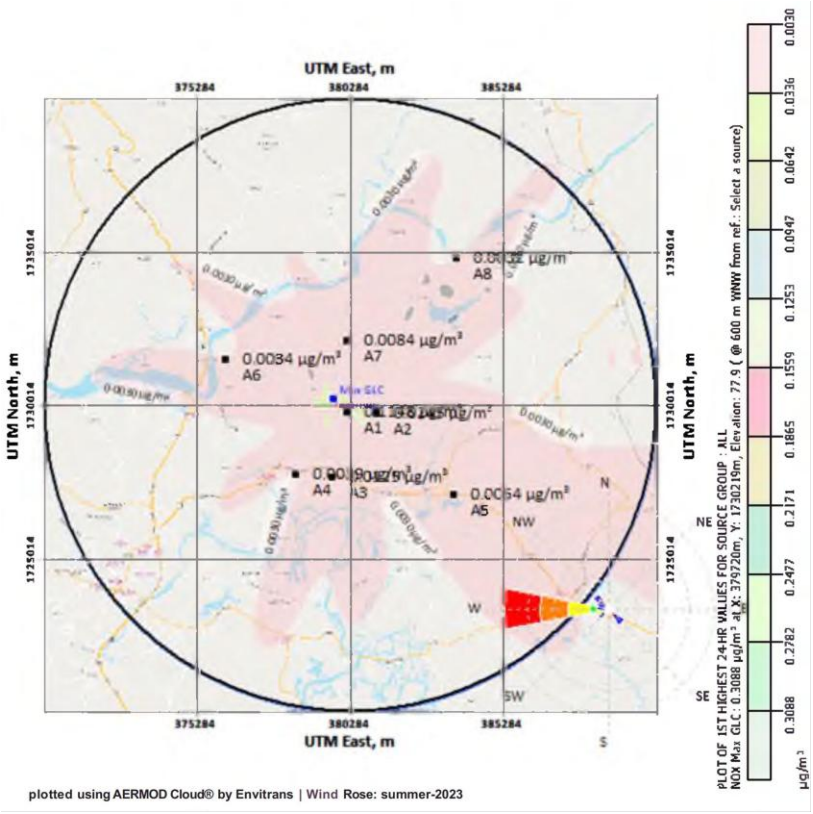


Fig. 4.4: NO_x Prediction

Table 4.10: Impacts and proposed mitigative measures to control air pollution

S. No.	Mining Activities	Air Pollutants	Impacts	Mitigative measures proposed
1	Ripping & dozing	PM_{10} & $PM_{2.5}$	Air pollution due to dust emission.	Before starting activity of ripping and dozing, the area shall be sprayed with water. Regular maintenance of ripper and dozer. Vocational training shall be provided to Ripper and Dozer operators.
2	Loading & unloading	PM_{10}, $PM_{2.5}$, SO_2 & NO_2	Dust & Exhaust gas	Regular dust suppression by water sprinkling, proper maintenance of mining machinery & equipment as per manufactures specification.
3	Haul Road	PM_{10} & $PM_{2.5}$, SO_2 & NO_2	Dust & Exhaust gas	Water spray on mine haul roads, It is proposed about 222 KLD of water for dust suppression, speed restriction, proper maintenance of roads, proper maintenance of machinery & equipment as per manufactures specification
4	Mining area	PM_{10} & $PM_{2.5}$, SO_2 & NO_2	Dust emission due to excavation	Green belt shall be maintained/developed within Mineral Block area. Proper maintenance of mining machinery & equipment, regular dust suppression in the mining area.
5	Transportation	PM_{10} & $PM_{2.5}$, SO_2 & NO_2	Emission due to dust to the nearby habitation	Overloading of trucks shall be strictly restricted, enforce speed restrictions, carrier of trucks transporting ore will be covered with tarpauline before going out on public road, plantation along the road side, proper maintenance of machinery & equipment as per manufactures specification, PUC for transport vehicle, maintenance of transport roads.
6	Waste Handling	PM_{10} & $PM_{2.5}$	Dust emission	Stabilization of waste dumps with proper wind erosion control measures, initial reclamation through plantation of grasses and mulches, subsequently plantation with native species.

4.5.3 AIR QUALITY PREDICTION – IMPACT OF TRAFFIC ON ENVIRONMENT

The offsite traffic will be resulting from movement of trucks in and out of the Mine. The entire transportation of Iron ore will be through trucks mainly via existing transport route. Major transportation of ore from the mine to beneficiation plant existing in the vicinity of the Mineral Block limiting utilization of public roads. The

ROM (Iron ore) will also be transported to nearby jetties depending on market demand.

Tipper trucks having valid PUC certificate and complying to emission norms prescribed by CPCB will be engaged. Carrier of tipper trucks carrying Iron ore will be covered by tarpaulin sheet to prevent dust from getting airborne. Wheel wash system will be engaged to clean the tyres of trucks before entering public roads. The regular maintenance of the road and regular dust suppression will be carried out.

4.6 IMPACT OF NOISE LEVEL & VIBRATION ON ENVIRONMENT

4.6.1 IMPACT OF NOISE AND VIBRATION

During the mining operation, noise will be generated from sources such as mining machineries, hauling of ore and waste, etc. With increasing distance from the source, the noise level decreases due to wave divergence. Additional decrease also occurs due to atmospheric effects and interaction with objects in the transmission paths.

Machinery / equipment proposed to be deployed for mining operations are used as input as noise generating sources. Noise generation is assumed 1m above ground and spreading on a flat terrain devoid of any barriers.

Noise attenuation effects due to barriers like shrubs, bushes and trees, absorption by air, wind, temperature and humidity shall also reduce the noise levels. The noise level will remain well within the prescribed CPCB standards and thus the impact of the project operation on the ambient noise level of study area will be insignificant.

As there is no proposal of drilling and blasting, there will be no vibration generated. However, due to movement of Heavy Earth Moving Machinery, small amount of vibration will be generated, which will not significantly affect the environment. Vibration studies will be conducted after the commencement of mining operations.

4.6.2 MITIGATION MEASURES

4.6.2.1 CONTROLLING NOISE LEVEL OF MACHINERIES-ENGINEERING CONTROLS

The following mitigation measures will be adopted to control noise levels:

1. Drilling and blasting activities are not proposed due to which major generation of impulsive noise and ground vibrations are avoided.

2. State of the art HEMM will be used for mining operations, which will have less noise emission and also provides acoustic insulation for the operators.
3. Reduction of noise level is achieved by proper maintenance of machinery and equipment.
4. Vehicular traffic within the mine is restricted by reducing the number of trips, using heavy duty trucks.
5. PUC certified trucks will be engaged for transportation of ore.
6. Personal Protective Equipment (PPE) like earmuffs/ear plugs will be provided to the operators and workers.
7. Training will be imparted to the mine workers deployed in the mine working area or other areas involving high noise levels.
8. Greenbelt development of 7.5m width will act as a natural barrier to the propagation of noise.

4.6.2.2 USE OF PROTECTIVE EQUIPMENT- ADMINISTRATIVE CONTROL

As part of a hearing protection the proponent shall consider:

- Defining hearing protector areas.
- Issuing of hearing protection equipment to individuals.
- Cleaning, maintenance and replacement of hearing protectors.
- Training and education to people wearing hearing protectors.
- Provision of job rotation in noisy areas that will reduce personal exposure.
- Setting targets for noise levels in existing work areas.
- Training will be imparted to workers on impact of noise and its consequences.
- Include noise aspects in work agreements with contractors.

4.7 IMPACTS ON WATER AND PROPOSED MITIGATIVE MEASURES

4.7.1 IMPACT ON SURFACE WATER

The catchment area of Kalay River is all high ground towards eastern direction of the block to a distance of 5 to 6 kms from the Kalay River. Also a second order seasonal nallah exists outside the Mineral Block which flows from the north west of the block towards the south and flows across the Mineral Block from west to east, ultimately joining Kalay River. The catchment area for the seasonal nalla is all high ground towards west of the lease to a distance of 300 to 600 meters from the nalla.

The study area drainage pattern is dendritic and sub-dendritic.

Distance & direction of River/ Stream/Nallah within the buffer zone

Name of the River/Stream/Nallah	Distance fromProject Site (Km)	Direction from Project Site
Kalay River	0.005	East
Dhudsagar River	4.0	North – North East
Zuari River	3.79	South
Sanguem River	5.66 km	South
Panduranga Nala	6.55 km	West - North West
Ugem River	5.57 km	South
Udani River	8.80 km	North West
Guloli River	7.20 km	South
Paroda River	8.6 km	South West

Distance & Direction of Reservoir within the buffer zone

Name of the Reservoir	Distance from Project Site (Km)	Direction from Project Site
Salaulim Dam	7.83	South
Moissal Dam	4.32	East

4.7.2 IMPACT ON GROUND WATER

The mining operations shall intersect the ground water table as the deepest mine workings in the mining plan period is -7 m. The average depth of Groundwater level within the mine is about 6 m bgl. Therefore, it requires major pumping operations. The average annual rainfall in the area is about 4000 mm.

The total monsoon water either drains outside the lease area through natural valleys and surface runoff from the operational area is collected in the mining pits.

No leachable heavy/toxic metals/elements are present in the ore and the wastes. The suspended solids content in the surface water samples are also well within the limits and therefore there shall be no effect on aquatic life.

As per studies conducted by the Water Resources Department in association with the Central Ground Water Board, the Taluka in general and study area of Block IV - Kalay Mineral Block falls in **SAFE** category in ground water development point of view.

4.7.3 MITIGATION MEASURES

The mitigative measures proposed are.

1. Retaining wall and garland drains will be provided at the foot of the dump to arrest the flow of sediment runoff.
2. Construction of Garland drains over a length of 6350 m of appropriate dimension to divert run-off water to the settling pond and arresting suspended solids. Slopes of the dumps shall be covered with lateritic material, laying of geotextiles wherever necessary, plantation with grasses, legumes and bush variety of species to prevent siltation of nearby waterbodies.
3. Construction of retaining wall of about 1225 m is proposed to arrest the erosion.
4. Surface water runoff from the mine catchment is diverted into mine pit and settling ponds where the sediment is allowed to settle.

The detailed evaluation of impact using BEE's methodology is undertaken which is a weighing scaling checklist under the ***Para 4.11.***

4.8 ANTICIPATED IMPACTS AND MITIGATION MEASURES ON BIOLOGICAL ENVIRONMENT (ECOLOGY)

Identification of all potential environmental impacts due to a project is an essential step of Environmental Impact Assessment. Mining is normally carried out over a long period of time and its impact on biodiversity would be high if the project is located close to a sensitive area.

Impact of biological environment was assessed based on the ground observation and distance from the project. The impact will be assessed 1 to 10 scale, if the scale 1 indicate highest chances of impact on biodiversity and 10 score will be least impact on biodiversity as given in the **Table 4.11.**

Range of scores and its corresponding impact significance (Eco-sensitive Scale Range) on Biological Environment are as follows:

1 – Highest Impact,
2 to 4 – Higher Impact,
5 to 7 – Moderate to high impact;
8 to 10 – Moderate to less impact on Biodiversity

Table 4.11: Significance of Impact on Biological Environment

Issues	Observations
Proximity to national park / wildlife sanctuary/ reserve forest/mangroves/ coastline/estuary/sea	Bhagwan Mahavir WLS is 1.04 km from the core zone (East direction) **Eco-sensitive scale range - 1**
	The 1st, 2nd & 3rd order streams, Dudsagar River – 3.5 km, Kalay River – 0.005 km. **Eco-sensitive scale range - 1**
	Zuari River flows at a distance of 3.8 km, **Eco-sensitive scale ranges – 8-10**
Activities of the project affects the breeding/nesting sites of birds and animals	Migratory bird species may be affected due to the noise and dust from the vehicles etc., (***see*** Table 3.39). Further Yellow wattled lapwing and Red-wattled lapwings (Resident) which prefer the ground for their nesting, which may affect only closer to the core areas. **Eco-sensitive scale ranges - 8-10**
	The reptiles (***see*** Table 3.37), may be affected due to the excavation of the core area **Eco-sensitive scale ranges - 8-10**
	Fishes and crabs (***see*** Table 3.41) may be affected due to nearby mining due to human settlements and layouts which get nutritional demands of peoples **Eco-sensitive scale ranges - 8-10**
Located near an area populated by rare or endangered species	Rare plant species *Strychnos nux vomica,* reported in buffer zone and not in core zone, (***see*** Table 3.33). **Eco-sensitive scale ranges - 10**
	Amongst the fauna species (*see* Table 3.36 to 3.41**),** very few species were migratory, while many of them were local species. **Eco-sensitive scale ranges - 8**
	Many schedule Butterfly species can be enhanced within the ML area by planting a species that provides larval food plants. **Eco-sensitive scale ranges - 8**
Proposed project restricts access to waterholes for wildlife.	Kalay river exists on the eastern side of the Mineral Block, which forms a natural barrier. Thus, there is no crossing over of wild animals from wildlife sanctuary located at the Eastern side of the Kalay river towards the Mineral Block. **Eco-sensitive scale ranges - 8**
The proposed mining project impacts surface water quality that also provide water to wildlife	No such water is effectively used for wildlife. Rainwater harvested in mine pits is utilized within the mine for dust suppression, green belt development, etc. and is also utilized for useful gains downstream such as agriculture, horticulture, etc. **Eco-sensitive scale ranges - 8**
Proposed mining project increase siltation that would affect nearby Biodiversity area.	Environmental protective measures such as retention walls, trenches, settling ponds will facilitate sedimentation of any sediment runoff within the Mineral Block. Such measures will prevent siltation of nearby rivers and Biodiversity area. **Eco-sensitive scale ranges - 8**

Risk of fall/slip or cause death to wild animals due to project activities	Kalay river exists on the eastern side of the Mineral Block, which forms a natural barrier. Thus, there is no crossing over of wild animals from wildlife sanctuary located at the Eastern side of the Kalay River towards the Mineral Block. Further, the proposed Mineral Block area will be fenced, preventing any such deaths to wild animals. In case of any such incidence; assistance will be taken from veterinary doctor and wildlife expert. **Eco-sensitive scale ranges - 8**
The project releases effluents into a water body that also supplies water to wildlife	Industrial effluents will not be generated from the mining activity. Waste water from workshop and wheel washing system will be recycled and reused. No such effluents will be released from the project area. **Eco-sensitive scale ranges – 9**
Mining projects affect the forest-based livelihood/ any specific forest product on which local livelihood depended	The proposed mine does not have any timber based or any forest product on which the local livelihood depend. **Eco-sensitive scale ranges - 8**
Project likely to affect migration routes	No such wildlife corridors exists within the Mineral block area. **Eco-sensitive scale ranges - 10**
Project likely to affect flora of an area, which have medicinal value.	No such significantly important medicinal value species exists within the Mineral Block. **Eco-sensitive scale ranges - 10**
The project likely to affect wetlands, fish breeding grounds, marine ecology	Clean water will be discharged after treating from the Mineral Block. Wetlands Nanda Lake is at a distance of 7 km and Xeldem lake is at a distance of 8 km from the project boundary. Hence, wetlands, fish breeding grounds, marine ecology will not be affected due to the proposed project. **Eco-sensitive scale ranges - 9**

The Mineral Block area is located 1.04 km away from Bhagwan Mahavir Wildlife Sanctuary. Kalay river exists on the eastern side of the Mineral Block, which forms a natural barrier. Thus, there is no crossing over of wild animals from wildlife sanctuary located on the Eastern side of Kalay river. Hence, the anticipated impact of the Project on the wildlife in the wildlife sanctuary will be negligible.

During the wildlife survey near the wildlife sanctuary, an Indian Muntjac was spotted. The degraded habitat outside the protected areas has been colonized by fast-growing exotic species like *Acacia auriculiformis*, *Chromolina* sp., and *L. camara*, which suppress native species and affect the soil seed bank for future native forest establishment.

Common threats observed in the buffer zone include grazing and fuelwood collection by local communities. These disturbances are mainly limited to the forest lands within the sanctuary.

Additionally, the dust from the mineral block and transportation also affects plants and animals. Dust fallout on leaves hampers gaseous exchange, and the high levels

of suspended dust particles lead to respiratory diseases in humans and animals. For these reasons adequate dust suppression measures should be provided.

In aquatic ecosystems, the dust fallout can impact phytoplankton and zooplankton. The elevated atmospheric temperature disrupts phytoplankton and zooplankton as well as benthic activity in rivers. The study site experiences high precipitation levels (ranging from 3000-3500 mm), contributing to increased turbidity due to soil erosion. This turbidity affects both lentic and lotic ecosystems and riparian vegetation. Since Kalay River exists at a distance of 0.005 km from the project boundary, protective measures to prevent soil erosion and provision of settling ponds, garland pits must be established before project implementation.

4.9 ANTICIPATED IMPACTS ON FLORA AND FAUNA AND IT'S MITIGATION MEASURES

4.9.1 IMPACT ON FLORA

The mining activity will generate dust, which may impact the vegetation in the study area.

4.9.2 MITIGATION MEASURES WITH RESPECT TO FLORA

- In core zone there are no significant vegetation such as rare or endangered species including forest species, since the land is already broken up. The degraded landscape of the Mineral Block were colonized by fast growing species such as *Acacia auriculiformis*, *Chromolina* sp., and *L. camara,* etc. Hence, no significant impact on flora is envisaged.
- In buffer zone there is good vegetation such as *Albizia* sp. As mining will be limited to the core zone, the flora and fauna in the buffer zone will not be affected.
- A 7.5 m wide greenbelt area consisting of native species of fruit and flower bearing saplings will be developed and maintained within the core zone, which will form a natural barrier to dust and noise.
- Average plantation of 1500 saplings will be done per year within the Mineral Block area in accordance with approved mining plan in consultation with the forest department.
- Progressive Mine closure plan as per approved mining plan along with rehabilitation of the broken up area for gainful use shall be taken up.

4.9.3 IMPACT ON FAUNA

The following impacts may be anticipated due to the project

- Noise from mining equipment, transportation, changes in land use may affect the migration of avifauna.
- Human–animal conflicts
- Soil erosion and water shortage in summer
- Create micro-level imbalance in tropic level and food chain
- Frugivorous birds replace insectivorous birds
- Lack of Reduction of pollinators and fruit dispersal agents within the mining area
- Transportation / vehicle movement act as a barrier for many elusive / cryptic mammals and also often road transportation may kill many cold-blooded animals like snakes, lizards, frogs and butterflies.

4.9.4 MITIGATION MEASURES

- The nearest Protective Area is Bhagwan Mahaveer Wildlife Sanctuary, which is 1.04 Km in East direction from the Mineral Block boundary. Kalay river exists on the eastern side of the Mineral Block, which forms a natural barrier. Thus, there is no crossing over of wild animals from wildlife sanctuary located at the Eastern side of Kalay river. Hence, the anticipated impact of the Project on the wildlife in the wildlife sanctuary will be negligible.
- Mining including transportation will be carried out during the day time.
- Water from the Mineral Block will be adequately treated, thereby discharging clean water, hence the receiving water bodies and the aqua-fauna will not be affected.
- Protective measures will be taken up such as reclamation and green belt development to enhance the vegetation in core zone, which will provide acoustic barrier and therefore will reduce noise propagation. Emphasis will be given to plantation of local species & plants of economic importance.
- To improve habitat conditions by taking up afforestation with bamboo and fruit yielding species, which attract faunal diversity and soil conservation measures.

- During the conceptual period, to improve habitat conditions, plantation of bamboo and fruit yielding species will be taken up, which will attract faunal diversity and facilitate soil conservation.
- Measures for protection and conservation of wildlife species will be done by organizing awareness campaigns and vigilance program by involvement of community youth against poaching of animals.
- Forest Wildlife department will be facilitated whenever necessary to conserve the fauna in the surrounding areas.

The detailed evaluation of Impact on Biological environment is given under **Para 4.12**.

4.9.5 IMPACT ON WETLANDS

There are two wet lands present within the study area of 10 kms radius.
Xeldem Lake: 8.0 kms
Nanda Lake: 7.0 kms (Ramsar Site)

Major impact

The proposed mining activity is at a nearest distance of 7.0 km to the wetland and the ore transportation route is situated at a distance of about 4.0 km. The Mining operation will not generate any hazardous toxic metals, or acid drainage and hence will not pollute surface or groundwater. Further, the harvested rainwater during monsoon in to the mine pit will be treated and clean water will be discharged into Kalay River. The siting of the project, its operation and the harvested rainwater discharge from the project site does not influence Nanda lake or Xeldem lake directly or indirectly. Hence, the project will not cause any destruction to wetland habitat or migration of birds to the wetland habitats.

4.9.6 MITIGATION MEASURES:

As the proposed mining activity is at a nearest distance of 7.0 km to the wetland, it does not affect the wetlands in any way and hence, implementation of Wetlands (Conservation and Management) Rules, 2017 is not applicable.

4.10 SOCIOECONOMIC IMPACT OF BLOCK IV - KALAY MINERAL BLOCK (ANTICIPATED IMPACT)

4.10.1 IMPACT ON HUMAN HABITATIONS

a) Displacement of population in the core area.

There are a few habitations within the Mineral Block. The mining operations and habitations have co-existed since many decades. Mining operations does not propose drilling and blasting activities and sufficient safety barrier from such habitation shall be maintained. No Population need to be displaced because of mining operations.

Household income from agriculture being low, farmers are looking for income from other sources. Mining is the only other source providing direct or indirect employment for local people rejuvenating household income.

b) Impact on population in buffer zone.

The project will have a net positive impact in the local area and the region.

Already, the State and the Central Governments have been implementing many rural developmental and welfare programs. In addition to these programs, the CSR activities implemented by the project will have a positive impact on the village economy and socio-economic development. Some of the CSR activities may include welfare measures such as provision of drinking water, provision of health care facilities, promotion of education such as distribution of school uniforms, rain wear, notebooks, etc., skill development / Women empowerment, sanitation, plantation in community, rainwater harvesting, installation of solar street lights, etc.

The welfare programs may bring some changes in the community and in the individual lifestyles. They have been listed below.

- Use of latest technology in agriculture thus making it less labour intensive.
- Employment in non-agriculture sector will increase,
- The literacy rates will improve,
- Money circulation will increase,
- Standard of living will improve,
- Aspirations among people will increase, and
- Infrastructural facilities like transport and communication will improve.

There are some aspects which will not change because of mining activity, which are

- Water quality will remain the same,
- Human settlements will not be disturbed,
- Common property resources, in particular, grazing land will not decline.

The population will not be displaced because of the proposed Mineral Block. Income from agriculture being meager, farmers depend on casual labor. Some male populations have migrated to nearby towns and cities in search of jobs. The proposed Mining project will rejuvenate household income from non-agriculture sector and also bring back the migrated population. In fact, the proposed project will provide direct or indirect employment for local people.

4.10.2 LIVELIHOOD

In general, along with mining, agriculture sectors will also flourish. As an impact of the project, cash flow in the local market will increase. Income from non-agriculture is going to be the significant source of household economy. The project will enable regular income source from direct and indirect employment.

4.10.3 ECONOMICS

Local economy will become vibrant because of proposed mining activities. The village economy will be rejuvenated because of money flow and monetization.

4.10.4 IMPACT ON THE CROPPING PATTERN AND THE CROP PRODUCTION IN THE BUFFER ZONE

It is observed from the informal meetings, focus group discussions and in-depth interviews that mining will have least impact on agriculture yield.

4.10.5 COMPENSATION FOR LOSS OF LAND AND CROPS

The project is a fresh grant of mining lease and as such there are no compensation claims towards the company.

4.10.6 IMPACT ON THE COMMUNITY RESOURCES SUCH AS GRAZING LAND

The mining activities will have least impact on the grazing land.

4.10.7 MITIGATION MEASURES

The following are tentative mitigating measures which are not exhaustive, but only suggestive.

- Supply of drinking water to villagers,
- Support Self-employment program (such as tailoring, wire netting, doll making, cane furniture, etc.) for women members of SHGs.
- Provide vocational training,
- Engaging villagers in tree plantation, constructing environmental protective measures, etc.
- Provide health, safety and medical facilities like first aid and basic medicines.
- Support students in education by providing uniforms, books, transportation, etc.
- Provide direct and indirect employment for locals.

Table 4.12: Impact Parameters

S. No	Impact Parameter	Positive Impact (Predicted)	Negative Impact (Predicted)
1	Human Settlement	• Existing land is already converted for Industrial purpose. • Additional land requirement does not arise.	Nil
2	Livelihood	• No loss of existing livelihoods. • Direct or indirect employment is expected to occur involving locals. • Additional non-farm livelihood opportunities are expected both directly and as spinoffs.	Nil
3	Employment Generation	• Local people will be given preference. • Indirect employment as a sequel to income multiplier effect and induced growth during operation phases of the project.	Nil
4	Incomes and Revenues	• Improvement of incomes of locals engaged in tertiary businesses by an average 10-15 % through induced spending. • The successful commissioning and running of the proposed project will attract more industrial investments which in turn will benefit the community.	Nil
5	Demographics	• The population levels of the Study villages are not likely to change in any significant manner. • The lifestyles of people are expected to improve in tune with the rise in incomes and improvement in infrastructure facilities.	Nil

		• The skill sets of the local residents are expected to improve in keeping with the emerging employment opportunities.	
6	Community Health	• Health of people residing in buffer zone/Study area is not likely to be impacted adversely considering the nature of emissions and the state-of-art Emission control systems planned. • Health initiatives and Environment Management Plan are planned and will be executed for well-being of the peripheral villages.	➢ If mitigation measure pertaining with Pollution are not appropriately carried out or addressed, it may raise community health issue. ➢ Adequate health care facilities without adequate health workers makes the community vulnerable.
7	Education	Initiatives pertaining to education shall be promoted.	Nil
8	Physical Infrastructure	• Road and power network in the area is expected to be strengthened as a sequel to industrial development around. • Provision for drinking water may be one of the Socio-Economic development initiatives.	➢ Increase in vehicular traffic may lead to higher incidences of road accidents. ➢ There shall not be any additional influx as only workers and staff come from local villages.
9	Social Infrastructure	➢ Improvement in housing stock and educational facilities could be expected in the long run as the Project gains acceleration. ➢ Quality of Life (QoL) is considered to get boosted.	Nil

4.11 IMPACT ON LOCAL TRANSPORT INFRASTRUCTURE DUE TO THE PROJECT - PROPONENT SHALL CONDUCT IMPACT OF TRANSPORTATION STUDY AS PER INDIAN ROAD CONGRESS GUIDELINES

The traffic survey is essential to realistically and accurately assess the prevailing traffic volumes and travel characteristics by undertaking classified volume count. The objective of traffic volume count survey is to assess the traffic intensity on the most vulnerable section of the road under question. Twenty-Four hrs. Continuous volume count was manually undertaken during May-2023 at following routes:

Route 1: Kalay Block to Sanvordem Jetty/Capxem Jetty via Ambeudoc, Sanvordem Junction.

Route 2: Kalay Block to Sanvordem Jetty/Capxem Jetty via Bandoli, Sanvordem junction.

Transportation route from mine to Jetty traffic load

Transportation route works only 200 days in year & capacity of truck is 10.5 ton as instructed by Dept. of Mines & Geology, Goa

Quantity of Ore Transported Tonnes per annum	**No. of Transportation days per annum**	**Tonnes per Day**	**Total Trips per day**	**Total Trips per day (to and fro)**	**Mode of Transport**
7,50,000	200	3750	358	716	Road

Additional load of traffic

Total no. of increased trucks/tankers per day = 716

Total PCU/day = 716 * 3 = 2148 PCU

Additional Load is 2148 PCU per day

Road	V (Volume in PCU/day.)	C (Capacity in PCU/day.)	Existing V/C Ratio	LOS
State Highway SH-7	4465.5	15000	0.298	B Very Good

LOS (Level of Service) as per IRC: 64-1990

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 /
0.6 – 0.8	D	Average / Fair
0.8 – 1.0	E	Poor
> 1.0	F	Very Poor

Traffic Projection & Impact due to Transportation:

Due to the proposed project, there will be addition of Heavy and Light motor vehicles in the existing traffic.

The LOS value is "B"; thus, it can be concluded that the present road network is Very Good to bear the increased traffic load. However, internal and nearby roads will be maintained as and when needed to facilitate transportation.

Besides this, the project proponent will take all appropriate measures to reduce the impact of transportation. Proper mitigation measures will be adopted to minimize traffic flow to the best possible extent resulting in low level of dust, noise and gaseous emissions.

4.12 EVALUATION OF IMPACTS

In order to evaluate environmental quality at Block IV - Kalay Mineral Block, Battelle Environmental Evaluation System (BEES) methodology has been adopted. This methodology is the most commonly adopted method for evaluation, through a scaling weighting checklist. The checklist for the present opencast iron ore mine would consist of 47 selected parameters identified for this purpose. All these parameters have been assigned importance weight points by the experts in different fields. The resultant importance weight points i.e., Parameters Importance Unit (PIU) are presented in **Fig. 4.5** by indicating the numbers in the parenthesis. Typical functional relationships also called value function graphs have been developed for various parameters.

The Environmental Quality (EQ) is represented on a scale of 0 to 1, wherein 0 representing poor environmental quality and 1 representing good environmental quality. An Index is obtained in Environmental Impact Unit (EIU) for each alternative and baseline environmental conditions (i.e., EIU with EMP (Environmental Management Plan), EMP & EIU without EMP).

$$EIU_j = \sum_{i=1}^{n} (EQ)_{ij} \times (PIU)_i$$

Where,
EIUj = Environmental Impact units for jth alternative
EQij = Environmental Quality Scale for ith factor
PIUi = Parameter Importance Unit for ith factor

All the parameters identified for this project have been distributed in four major categories viz.,

1) Biological Environment
2) Environmental Pollution
3) Aesthetics
4) Human Interest

ENVIRONMENTAL IMPACT (1000)

Biological Environment (300)

TERRESTRIAL		(200)
.	Natural Vegetation	(40)
.	Crops	(30)
.	Species diversity	(30)
.	Foodweb Index	(20)
.	Rare & Endangered Plant species	(30)
.	Pest Species	(20)
.	Soil Microbiology	(30)
AQUATIC		(100)
Natural vegetation		30
Foodweb Index		10
Species diversity		15
Rare and endangered Species		10
Ground water Characteristics		20
Pests species		15

Environmental Pollution (450)

WATER		(100)
.	Temperature	(10)
.	pH	(15)
.	B.O.D	(15)
.	D.O	(10)
.	Nutrients	(10)
.	T.D.S	(10)
.	Turbidity	(10)
.	Feacal Coliform	(10)
.	Toxic substances	(10)
AIR		(150)
.	SPM	(70)
.	SO_2	(40)
.	Nox	(40)
LAND		(140)
.	Landuse Pattern	(80)
.	Soil erosion	(30)
.	Soil chemistry	(30)
NOISE		(60)
.	Community noise	(15)
.	Occupational noise	(45)

Aesthetics (100)

.	Topographic Character	(20)
.	Appearance of Water body	(10)
.	Odor	(10)
.	Landscape	(10)
.	Sound	(10)
.	Visual quality Of air	(20)
.	Natural fauna	(10)
.	Green belt	(10)

Human Interest (150)

.	Economy output	(20)
.	Employment	(25)
.	Housing	(15)
.	Education	(15)
.	Drinking water supply	(15)
.	Sanitation	(10)
.	Transportation & Communication	(15)
.	Community health	(20)
.	Occupational health	(15)

4.12.1 BIOLOGICAL ENVIRONMENT

(A) Terrestrial Environment:

The impacts of Iron ore mining activities are presented in **Table 4.13**.

The tree species found within the core zone represent the dry-deciduous type. Diversity of plant species and foodweb Index of the area reduces to certain extent. However, if the proposed reclamation of the mining area using proper re-vegetation techniques and development of green belt around the ultimate pit limit is considered, there shall be an improvement in the species diversity and foodweb Index.

(B) Aquatic Environment:

The existing quality of natural vegetation in the aquatic environment is good. However, due to the temporary dumping of overburden from the mines may lead to soil erosion ultimately affecting the turbidity and chemical characteristics of surface water. This in turn will alter the aquatic natural vegetation by way of change in species diversity. With the provision of proper environmental management measures there shall be reduction in soil erosion. This in turn will improve the natural vegetation by improving the species diversity, food web Index and surface water characteristics.

There are no rare and endangered aquatic species reported in the study area. There are no aquatic weeds reported in the surface waters. Hence no change in these parameters is anticipated.

In general, due to various mining activities, adverse impacts can be anticipated in terrestrial and aquatic components of the Biological Environment. However, with the implementation of the EMP, which is being proposed, there will be significant improvement in the parameters of biological environment (**Table 4.13**).

Table 4.13: Environmental Evaluation: Biological Environment

Environmental Parameters	PIU/EQU EIU	Baseline (A) EIU	Without EMP (B) EIU	With EMP (C) EIU	Change In EIU (C-B)	Change In EIU (B-A)	NET Change EIU (C-A)
TERESTRIAL							
Natural vegetation	40	24	16	32	16	-8	8
Crops	30	18	12	21	9	-6	3
Species diversity	30	15	12	18	6	-3	3
Foodweb Index	20	15	12	16	4	-3	1
Rare and endangered Plant species	30	22	18	21	3	-4	-1
Pests species	20	14	10	14	4	-4	0
Soil microbiology	30	21	15	21	6	-6	0
Sub-Total	**200**	**129**	**95**	**143**	**48**	**-34**	**14**
AQUATIC							
Natural vegetation	30	24	21	22.5	1.5	-3	-1.5
Foodweb Index	10	7	6	7	1	-1	0
Species diversity	15	9	7.5	12	4.5	-1.5	3
Rare and endangered species	10	7	6	7	1	-1	0
Ground water Characteristics	20	12	10	12	2	-2	0
Pests species	15	9	7.5	9	1.5	-1.5	0
Sub-Total	**100**	**68**	**58**	**69.5**	**11.5**	**-10**	**1.5**
Total	**300**	**197**	**153**	**212.5**	**59.5**	**-44**	**15.5**

4.12.2 ENVIRONMENTAL POLLUTION

Due to the continuity of the mining activities of the project the following four components are affected, viz., Air, Water, Land, Noise & Vibration.

Air Environment:

In the proposed opencast mine operations like ripping, dozing, excavation of ore, loading, transportation and unloading operations of overburden and iron ore, may deteriorate the air quality.

The baseline levels of ambient air quality in the buffer zone villages are well within the permissible limits.

However, the dust concentrations in the fugitive sources are likely to increase during

mining operations. The concentration of NO_x and SO_2 are below the permissible limits.

Reduction in dust concentration is anticipated by green belt development and dust suppression by means of water spraying on mine working area, haul roads.

Water Environment:

Major Parameters which represent the water environment are BOD, DO, Total Solids (TS), Turbidity, Fecal coliforms, toxic metals, pH, temperature and nutrients.

The water flowing through the overburden dumps will carry suspended solids, dissolved solids such as salts and minerals, which, if flows in the nearby water bodies may affect the quality of the groundwater as well as surface waters.

Provision of protective measures such as rubble walls, garland drains, settling ponds and plantations of trees, etc., on the inactive benches will arrest soil erosion to a great extent. Further, treatment of water to expedite the rate of sedimentation along with allowing the water to stand for longer period, will result in clear water. Provision of such protective measures will improve the water quality.

Land Environment:

As the mining activity will be confined within the Mineral Block, there will not be any adverse effect on the land in the buffer zone. With the measures proposed under EMP there will not be any effect of land degradation other than the Mineral Block area.

Noise:

The sources of noise in mining area are due to ripping, dozing, excavation of Iron Ore, loading, haulage and unloading of Iron ore and waste using HEMM, trucks and transportation of ore from Mine to the jetty.

Table 4.14: Environmental Evaluation of Environmental Pollution

Environmental Parameters	PIU/EQU	Baseline (A) EIU	Without EMP (B) EIU	With EMP (C) EIU	Change In EIU (C-B)	Change In EIU (B-A)	NET Change EIU (C-A)
WATER							
Temperature	10	7	5	6	1	-2	-1
pH	15	10.5	7.5	9	1.5	-3	-1.5
B.O.D	15	12	9	10.5	1.5	-3	-1.5

D.O	10	8	6	7	1	-2	-1
Nutrients	10	7	5	7	2	-2	0
T.D.S	10	8	6	7	1	-2	-1
Turbidity	10	7	5	6	1	-2	-1
Faecal Coliform	10	8	6	7	1	-2	-1
Toxic Substances	10	8	6	7	1	-2	-1
Sub-Total	**100**	**75.5**	**55.5**	**66.5**	**11**	**-20**	**-9**
AIR							
PM10	70	49	28	45.5	17.5	-21	-3.5
SO2	40	28	16	24	8	-12	-4
NOx	40	28	16	24	8	-12	-4
Sub-Total	**150**	**105**	**60**	**93.5**	**33.5**	**-45**	**-11.5**
LAND							
Land use pattern	80	56	40	52	12	-16	-4
Soil erosion	30	24	18	21	3	-6	-3
Soil Chemistry	30	24	18	21	3	-6	-3
Sub-Total	**140**	**104**	**76**	**94**	**18**	**-28**	**-10**
NOISE							
Community Noise	15	12	7.5	10.5	3	-4.5	-1.5
Occupational Noise	45	36	22.5	27	4.5	-13.5	-9
Sub-Total	**60**	**48**	**30**	**37.5**	**7.5**	**-18**	**-10.5**
TOTAL	**450**	**332.5**	**221.5**	**291.5**	**70**	**-111**	**-41**

4.12.3 AESTHETIC ENVIRONMENT

The topography of the mining area i.e. gently hilly terrain shall alter to certain extent due to excavation of ore and dumping of overburden. The development of proposed green belt around the ultimate pit limit and plantation of backfilled areas will enhance diversity of vegetation. The aesthetic parameters with EMP and without EMP have been presented in **Table 4.15.**

Table 4.15: Environmental Evaluation of Aesthetic Environment

Environmental Parameters	PIU/EQU	Baseline (A) EIU	Without EMP (B) EIU	With EMP (C) EIU	Change In EIU (C-B)	Change In EIU (B-A)	NET Change EIU (C-A)
Topographic Character	20	16	12	15	3	-4	-1
Appearance of waterbody	10	7	5	7	2	-2	0
Odour	10	9	7	9	2	-2	0
Land scape	10	9	5	8	3	-4	-1
Sound	10	8	6	7	1	-2	-1
Visual Quality of air	20	16	12	16	4	-4	0
Natural fauna	10	8	5	8	3	-3	0
Greenbelt	10	7	6	9	3	-1	2
Total	**100**	**80**	**58**	**79**	**21**	**-22**	**-1**

4.12.4 HUMAN INTEREST

Mining operation and associated activities will have direct and indirect consequences on some socio-economic impacts. The social status of the people will improve due to increased income for workers as a result of increase in employment opportunities. There will be occupational problems due to the mining activity, but these problems can be contained by adopting all the measures suggested in EMP.

Education and sanitation status will improve in this area due to this project. The respective score for all the human interest parameters is presented in **Table 4.16**.

Table 4.16: Environmental evaluation of human interest

Environmental Parameters	PIU/EQU	Baseline (A) EIU	Without EMP (B) EIU	With EMP (C) EIU	Change In EIU (C-B)	Change In EIU (B-A)	NET Change EIU (C-A)
Economy output	20	5	12	19	7	7	14
Employment	25	10	16	23	7	6	13
Housing	15	5	10	12	2	5	7
Education	15	8	10	12	2	2	4
Drinking Water supply	15	8	9	12	3	1	4
Sanitation	10	6	8	10	2	2	4
Transportation & Communication	15	10	10	12	2	0	2
Community Health	20	12	13	15	2	1	3
Occupational Health	15	9	7.5	12	4.5	-1.5	3
Total	**150**	**73**	**95.5**	**127**	**31.5**	**22.5**	**54**

The Net Environmental Impact of Block IV - Kalay Mineral Block for biological category is +15.5. This is due to the increased plantation and proper land use as envisaged in the EMP.

The Net Impact under environmental pollution category is negative with -41 points. This negative impact is due to mining operations and transportation activities. The dust levels are bound to increase. The noise levels also will increase due to the operation of various mining equipment.

The Net Impact under Aesthetic category is negative with -1, as a result of minor impacts due to change in appearance of water, diversity of vegetation and marginal change in visual quality. The human interest parameters show positive impact of 54, due to increased job opportunities, transportation, medical facilities, etc.

The summary of environmental evaluation is presented vide **Table 4.17.**

Table 4.17: Summary of environmental evaluation

Environmental Parameters	PIU/EQU	Baseline (A) EIU	Without EMP (B) EIU	With EMP (C) EIU	Change In EIU (C-B)	Change In EIU (B-A)	NET Change EIU (C-A)
Biological Environment	300	197	153	212.5	59.5	-44	15.5
Environmental Pollution	450	332.5	221.5	291.5	70	-111	-41
Aesthetic	100	80	58	79	21	-22	-1
Human Interest	150	73	95.5	127	31.5	22.5	54
Total	**1000**	**682.5**	**528**	**710**	**182**	**-154.5**	**27.5**

It is observed that the estimated change in EIU from baseline to the project without EMP is -154.5. The overall change in EIU due to the project with EMP over the baseline is a positive of +27.5. The total Net impact is therefore positive for this project.

With a view to analyse subjectivity and uncertainty in decision making for the continuation of this mining project, two evaluation scenarios with equal and unequal PIUs are considered. The results are tabulated in **Table 4.17a & 4.17b**. The project evaluation scores with assigned set of PIUs and those with equal PIUs have been analysed. The current evaluation score with unequal PIUs is +27.5 units whereas with equal PIUs (Hypothetical Evaluation) the score is +61.81. Therefore, the continuity of project contributes positively.

Table 4.17a: Scenario A - Unequal PIUs (Current Evaluation)

Environmental Parameters	PIU/EQU	Baseline (A) EIU	Without EMP (B) EIU	With EMP (C) EIU	Change In EIU (C-B)	Change In EIU (B-A)	NET Change EIU (C-A)
Biological Environment	300	197	153	212.5	59.5	-44	15.5
Environmental Pollution	450	332.5	221.5	291.5	70	-111	-41
Aesthetic	100	80	58	79	21	-22	-1
Human Interest	150	73	95.5	127	31.5	22.5	54
Total	**1000**	**682.5**	**528**	**710**	**182**	**-154.5**	**27.5**

Table 4.17b: Scenario B - Equal PIUs (Hypothetical Evaluation)

Environmental Parameters	PIU/EQU	Baseline (A) EIU	Without EMP (B) EIU	With EMP (C) EIU	Change In EIU (C-B)	Change In EIU (B-A)	NET Change EIU (C-A)
Biological Environment	250	174.16	124.167	187.08	62.92	-49.99	12.92
Environmental Pollution	250	184.72	123.056	161.94	38.89	-61.67	-22.78
Aesthetic	250	200	145	197.5	52.5	-55	-2.5
Human Interest	250	121.67	152.5	195.83	43.33	30.83	74.17
Total	1000	680.55	544.72	742.36	197.64	-135.827	61.81

Chapter-5

Analysis of Alternatives (Technology & Site)

5.1 ANALYSIS OF ALTERNATIVE TECHNOLOGIES

Block IV – Kalay Mineral Block is proposed to be operated by Opencast Mechanized method of mining in a scientific, systematic and sustainable manner, using Heavy Earth Moving Machinery, a conventional method used worldwide. Ripping and Dozing method of breaking hard rock strata will be used as an alternative to the conventional drilling and blasting methods. To achieve the proposed production of 0.75 MTPA of Iron Ore, the mining parameters such as bench slope, haul road, dump slope and extent of mechanization are designed in such a way that the mine will be able to achieve the planned production in accordance with Approved Mining Plan. The method of mining for excavation of ore and handling of waste by engaging HEMM are mentioned in section 2.8.1 of Chapter 2 (Project Description). Further, opencast method of mining is preferable due to the following reasons:

- Iron ores mineral is available near to the surface, hence underground mining is not practically feasible.
- The opencast method of mining is productive & economical as compared to underground method of mining.

5.2 ANALYSIS OF ALTERNATIVE SITES

Alternatives sites cannot be selected for the proposed project for the following reasons:

1. As the mining project is site specific and is located where the mineral deposit exists, no other alternative site can be selected.
2. The Government of Goa through Directorate of Mines and Geology auctioned 'Block IV – Kalay Mineral Block', after demarcating the Mineral Block boundary, which is to be leased over a period of 50 years after fulfilment of conditions stipulated in the Letter of Intent.
3. The location of the site for Iron Ore Mining operation fully depends upon the nature of deposit and geological structure of mineral deposit and therefore the question of exploring alternative site for the mining purpose does not arise.
4. The Mineral Block area of the project is mineralized having Reserves and Resources of 16.731 Million Tonnes of Iron Ore, which may increase on future exploration.

5. This project will create employment and livelihood opportunities to the surrounding villages. In view of the above, no alternative site was considered.

Chapter-6

Environmental Monitoring Program

6.1 INTRODUCTION

The mitigation measures suggested in Chapter 4 aims to reduce the Impact on environment due to mining and allied activities proposed at Block IV – Kalay Mineral Block. Environmental monitoring is an essential component to determine the impacts due to mining and its allied activities, suggest their mitigation measures and to ascertain the efficiency of the implemented mitigation measures. The chapter touches upon the technical aspects of environmental monitoring, including monitoring parameters, sampling locations, standard methods for sampling, frequency of sampling, data analysis, etc. This chapter also highlights the management aspects with respect to implementation and assessment of such monitoring program.

6.2 SCOPE OF ENVIRONMENTAL MONITORING PROGRAM

The scope pertaining to Environmental Monitoring Program proposed for 'Block IV – Kalay Mineral Block' involves the following:

i. Carrying out monitoring of key environmental parameters within the core zone and buffer zone of the project in accordance to the prescribed norms.
ii. Collection, analysis and interpretation of results from environmental monitoring program.
iii. Comparison of the extent & severity of the environmental impacts of the project against the predicted impacts and baseline data.
iv. Assessing the effectiveness of implemented EMP measures.
v. Assessment of the requirement of additional EMP Measures.
vi. Assessment of the overall Environment Protection Measures of the Project vis-à- vis applicable regulatory requirements and conditions of Environment Clearance granted by MoEF&CC.
vii. Reporting of compliances with respect to stipulated conditions along with suggested environmental monitoring program to all concerned Authorities including the Regional Office of MoEF&CC.

6.3 TECHNICAL ASPECTS

6.3.1 METHODOLOGIES

Environmental monitoring is required to know the Quality of Ambient Air, Water and Noise Levels during the operation phase of the proposed project and take required corrective measures, in case of any non-compliance with the norms

stipulated by regulatory authorities. The methodologies adopted for environmental monitoring will be in accordance with the CPCB guidelines. Environmental Monitoring will be done in accordance with National Ambient Air Quality Monitoring Series: NAAQS/2003-04, Guidelines for Ambient Air Quality Monitoring, Central Pollution Control Board, April, 2003, Guidelines For The Measurement of Ambient Air Pollutants Central Pollution Control Board May, 2011, Minars/27/2007-08, Guidelines For Water Quality Monitoring, Central Pollution Control Board Methods of Monitoring and Analysis, Annex IV of guidelines. A planned monitoring program to evaluate the effectiveness of various/specific aspects of technological/ mitigation measures shall be drawn. Monitoring shall be conducted by the Environmental Management cell by engaging a laboratory recognized by MoEF&CC/CPCB and accredited by NABL.

6.3.2 FREQUENCY & LOCATIONS OF ENVIRONMENTAL MONITORING

A comprehensive monitoring program is given under.

Table 6.1: Monitoring Schedule for Environmental Parameters

S. No.	Particulars	Frequency of Monitoring	Sampling	Parameters Required to be Monitored
Air Quality				
1	Ambient Air quality in core and buffer zone	Twice a week	24 hours continuously	$PM_{2.5}$, PM_{10}, SO_2 & NO_2
Water Quality				
2	Surface water quality in the Core and Buffer zone	Once in a Month	Grab Sampling	As per IS: 2296
3	Groundwater quality in the core and buffer zone	Once in a Season	Grab Sampling	As per IS: 10500
Noise Level Monitoring				
3	Ambient Noise levels & work place Noise monitoring	Once in a Quarter	Continuous for 24 hours with 1-hour interval	Noise Level
Soil Quality				
4	Soil Quality around the Mine	Once in a year or season	Grab Sampling	IS: 2720

6.3.3 DATA ANALYSIS

The procedures that will be followed for analyzing the parameters are indicated below:

- Water samples will be analyzed for various parameters as per IS: 10500
- $PM_{2.5}$ & PM_{10} will be analyzed as per IS: 5182 Part IV, SO_2& NO_2 as per IS: 5182 Part II & Part VI respectively using APM 550 dust sampler or equivalent.

- SO_2 samples will be analyzed using improved West-Gaeke method for air samples with the help of spectrophotometer.
- NO_2 samples will be analyzed using Jacob and Hocheiser modified (Na-As) method for air samples with the help of spectrophotometer.

6.3.3.1 MICROMETEOROLOGY

A micro-meteorological station will be set-up as close as possible at the central location of the mine lease. The site selected shall be free from obstructions to ensure free movement of air.

An "Automatic Weather Station" will be installed at least 5 m above the ground. The following attributes will be measured at one-hour interval continuously round the clock:

- Wind Speed
- Wind Direction
- Air Temperature
- Relative Humidity
- Precipitation will be recorded on a daily basis.

The data will be recorded automatically on a data logger.

6.3.3.2 AIR QUALITY

Air quality will be monitored at 8 locations on a regular basis. Totally 4 buffer zone stations and 1 core zone station and 3 fugitive stations shall be monitored & in the up-wind and down-wind direction w.r.t. the ML area. The number of stations may be increased as directed by State Pollution Control Board (SPCB).

The monitoring locations may change as directed by State Pollution Control Board (SPCB). Selected parameters of National Ambient Air Quality Norms [PM_{10}, $PM_{2.5}$, SO_2 & NO_2,] shall be monitored.

Ambient air and Core zone stations will be monitored on 24 hourly basis and shall be collected twice a week at all the stations. The fugitive dust samples shall be collected as per IBM and DGMS guidelines.

6.3.3.3 WORK ZONE AIR QUALITY

Work-zone air quality shall be monitored at various strategic locations (mine faces, crushing plant, loading-unloading points, screening plant, and haulage road). Samples (8 hourly) shall be collected at each of the locations twice a month.

6.3.3.4 GROUND WATER LEVELS

Water levels in wells in the Core and Buffer Zone shall be monitored every month.

6.3.3.5 SURFACE AND GROUND WATER QUALITY

Surface water samples shall be collected at 6 locations in study area which includes mine water discharge points and upstream and downstream of Kalay River. Samples shall be collected once a month. The parameters listed in IS:2296 shall be analyzed and monitored. Ground water samples shall be collected at 8 different locations in the study area. Samples will be collected once in a season. The parameters listed in IS:10500 shall be analyzed and monitored.

6.3.3.6 AMBIENT NOISE LEVELS

Ambient noise levels shall be monitored at 8 locations in the study area including the habitation near transportation route. Noise levels shall be recorded at one-hour intervals continuously for 24 hours at each of the locations once in a season.

6.3.3.7 WORK ZONE NOISE LEVELS

Work-zone noise levels shall be monitored at various strategic locations (mine faces, crushing plant, loading-unloading points, mine workshop(s), mine office, etc.).

Additional locations may be covered if directed by concerned statutory authorities (SPCB, MoEF&CC and DGMS). Noise levels shall be recorded at one-hour intervals continuously for 8 hours at each of the locations once a month.

6.3.3.8 OCCUPATIONAL HEALTH AND SAFETY

The main factors affecting the occupational health in mine are fugitive dust and noise. Safety of employees during mining operation and maintenance of mining equipment shall be observed under the provision of applicable rules and relevant

DGMS circulars. To avoid any adverse effects on the health of workers, the following will be implemented:

- Initial and periodic medical examination
- Provision of Personnel Protective Equipment.
- Personal dust monitoring to be carried out as prescribed in the DGMS circulars.
- Occupational Health Survey of the employees will be carried out at regular intervals at Occupational Health Centre (OHC).
- Provision of First-aid facilities.
- Provision of rest shelters with amenities like drinking water, toilets etc.

6.3.3.9 PLANTATION AND GREEN BELT DEVELOPMENT

To mitigate adverse environmental impacts, plantation and green belt development will be carried out within the Mining Lease and safety zone area as per IBM Approved Mining Plan, Plantation will be carried out in consultation with the State Forest Department. Regular monitoring and maintenance of plantation shall be carried out.

Green belt development will include plantation of native species over the permanent backfilled area as well as along the Eastern boundary of the Mine within the statutory barrier of 7.5m of the Mineral Block. Every year about 1500 saplings will be planted covering a minimum area of about 0.50 Ha. per year.

6.4 REPORTING SCHEDULE

Compliance report including, the analytical reports of monitoring of environmental parameters will be submitted to MoEF&CC, Goa State Pollution Control Board & CPCB on a half-yearly basis, i.e. 1st June and 1st December of each calendar year. Copies of compliances will be maintained at the Mine and will be made available to the inspecting authorities including MoEF&CC, GSPCB, Indian Bureau of Mines (IBM), etc.

6.5 ENVIRONMENTAL MANAGEMENT CELL

An Environmental Management Cell (EMC) will be established in the mine under the control of Senior Mine Manager who shall directly report to the Nominated Owner/Agent.

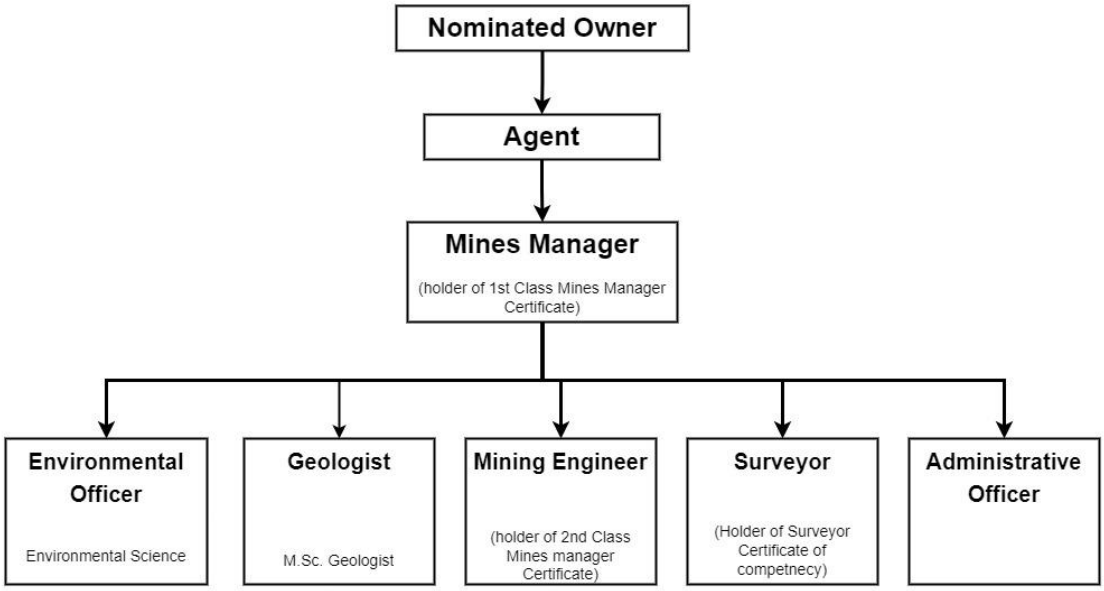


Fig 6.1: Environmental Management Cell (EMC)

The responsibilities of EMC will be as follows:

1. Implementation of pollution control measures as recommended.
2. Conducting environmental monitoring as per EMP and as per conditions stipulated in the EC.
3. Ensuring compliance with conditions stipulated in Environmental Clearance, Consent to Operate granted by SPCB or any other approvals granted to the project.
4. Timely submission of compliance status to MoEF&CC / SPCB

6.5.1 EMERGENCY PROCEDURE

As there is no point source of emission and no generation of any industrial effluent, the possibility of emission/waste water discharge exceeding the norm & leading to emergency situation is not anticipated.

6.5.2 DETAILED BUDGET & PROCUREMENT SCHEDULES

The budgetary allocation for Environmental Monitoring is around Rs. 16.4 lakhs per annum. A third-party laboratory recognized by CPCB, MoEF&CC shall be engaged to monitor all the environmental parameters. Hence, no procurement of any

monitoring equipment is required.

Table 6.2: Estimated budgetary allocation for environmental monitoring

Sl. No.	Environmental Attributes	Tentative Cost (Rs.) /Annum
1	Micrometeorology	80000/-
2	Air Quality Monitoring	13,00,000/-
3	Surface Water Quality Monitoring	1,50,000/-
4	Ground Water Quality Monitoring	50,000/-
5	Noise Monitoring	20,000/-
6	Soil Monitoring	40,000/-
Total Cost		**16,40,000/-**

Table 6.3: Environmental Monitoring Programme

Environmental Issue/ Impacts	Mitigation Measure	Approximate Location	Responsibility
Meteorology	Meteorological parameters through a continuous monitoring system.	Near Mine office	EMC
Ambient Air Quality	Ambient Air Quality with respect to RPM, SO_2, NOx shall be monitored	1 control station in upwind side and remaining stations in downwind side w.r.t quarries and external dumps	EMC
Work Zone Air Quality	Work Zone Air Quality with respect to RPM, SO_2, NOx shall be monitored	At loading/unloading point near Mine & main haul road	EMC
Ambient Noise	Periodic measurement with Noise meter	At nearest villages/ settlements alongside the lease	EMC
Work Zone Noise levels	Periodic measurement with Noise meter	At loading/unloading point near quarry & main haul road	EMC
Surface Water Quality	Changes in surface water quality will be monitored by water quality analysis.	All mine discharge points, Upstream and Downstream of river	EMC
Ground Water Quality	Changes in ground water quality will be monitored through water quality analysis.	Changes in ground water quality will be monitored in the up- gradient and down gradient w.r.t. the mine	EMC
Solid Waste Generation, OB Dumping & Backfilling	Overburden generated during mining operations will be either dumped in pre-identified dumping area or will be backfilled within the exhausted quarry areas.	Backfilled areas	Mines manager/ Technical services
Slope Failure	Regular examination will be carried out to look for slope failure on open cast	Backfilled areas / Quarry benches/ Fines stacks	Mine manager/ Technical

	mine faces, ore and overburden benches etc.		services
Maintenance of Storm Water Drainage System	The drains will be periodically cleared to maintain storm water flow.	Drainage network within the lease area.	Operations
Green Belt and Progressive Afforestation	Progressive afforestation, green belt development & maintenance of safety zone.	Planting trees in the open area	EMC
Occupational Health	Health checkup, Training	Workers at Mine site, workshop, siding, crusher house & other units in the premises.	Plant Medical Unit
Socio-economic Development	Structured interactions with the community	Stake Holders	Operations/CSR / EMC

Note: EMP - Environmental Management Plan, EMD - Environment Management Division, CSR - Corporate Social Responsibility.

Chapter-7

Additional Studies

7.1 PUBLIC CONSULTATION

Draft EIA/EMP for the proposed Block IV – Kalay Mineral Block having an area of 152.5073 Ha, located in Santona Village, Sanguem Taluka, South Goa District, Goa is prepared as per the Terms of Reference (ToR) issued by the Ministry of Environment, Forests & Climate Change vide its TOR Identification No. TO23B0000GA5122365N dated 08/01/2024 and ToR amendment vide dated 19/11/2024 bearing identification no. TO24B0000GA5934761A. For the preparation of the EIA Report, information on parameters related to mining operations, mining lease area, production levels, mining technology, waste generation, handling & storing, etc., with respect to Kalay Mineral Block from the Mining Plan approved by Indian Bureau of Mines was used.

Final EIA/EMP report will be prepared under the provisions of EIA notification, 2006, after completion of Public Hearing process. The points raised during the Public Hearing and commitment / clarification along with action plan proposed by the Project Proponent will be incorporated in the final EIA/EMP report.

7.2 RISK ASSESSMENT

Hazard analysis involves identification and quantification of various hazards (unsafe conditions) that exist in the mine. Risk assessment is the process of identifying, analyzing and evaluating potential hazards and danger associated with mining operation. It involves assessing the likelihood of these risks and their potential impact on health, safety and environment and overall mining project.

The proposed mining process would be designed and engineered with all possible safety measures and standard code of practices. In spite of this, there may be some deficiency in the planning/design or errors in operation and maintenance, thereby causing accidents leading to damage of life and property. This chapter presents an overview of environmental and health risks associated with various mining operations and suggest remedial measures.

The following are the objectives of risk assessment –

- Identification of potential hazardous areas to minimize the probability of accidental events.
- Identification of potential areas of disaster to implement proper design of installations and their control operations.

- Preparation of an action plan to manage anticipated emergency situation or disastrous event emerging from mining operations.

Fomento Resources Private Limited will carry out mining operations under the management, control and supervision of a qualified Mine Manager holding a First-Class Mine Manager certificate of competency under MMR, 1961. The DGMS have been regularly issuing standing orders and circulars to be followed by the mine management in case of disaster, if any. The management system that will be followed orients towards the provision and maintenance of a healthy, safe and sustainable work environment in accordance with legislation, by providing adequate training to staff, thereby ensuring competency and pro-actively reducing the risks of accidents or environmental issues. The proposed mining operations, storage and handling of ore and overburden have been studied to identify and assess the Risks (Hazards) and prepare Emergency Preparedness and Response Plan & Disaster Management Plan for natural calamities. Based on the Hazard Identification and Analysis, major emergency scenarios have been predicted to estimate the consequence of failure.

Risks involved in a mine includes (a) Environmental Risk, (b) Safety and health risk (c) Community and social risk (d) land use risk (e) legal and financial risk and (f) technical risk.

Risks involved due to human induced activities in connection with mining operations & allied activities are:

1. Mine pit slope failure
2. Dump slope failure
3. Water Inundation
4. Fire hazards
5. Accident due to heavy mining equipment, Trucks
6. Fly rock generation from blasting
7. Storage of explosives

1. Mine Pit slope failure

In order to cope up with dangers due to mine pit slope failure, slope stability estimations will be made for the mine pit after determining various physical parameters of the ground mass like uni-axial compressive strength, tri-axial compressive strength, cohesion, angle of friction, specific gravity of the rock,

water pressure, etc.

Besides, the identification of risks or pit slope failure and pragmatic approach towards preventive action of such slope failure shall be taken up in case of any chance of planar failure or wedge failure, which may be due to the result of discontinuities.

The slope stability study was done by Department of Mining Engineering, National Institute of Technology, Surathkal, Mangalore, Karnataka.

Measures to prevent Pit Slope failure

Based on the Slope Stability study carried out, significant recommendation suggested to be implemented during the mining operation will be strictly adhered to. A copy of Slope Stability Report carried out by the Department of Mining Engineering, National Institute of Technology, Surathkal, Mangalore, Karnataka is attached as **Appendix 3**.

2. Dump slope failure

Dumps will be stacked at pre-defined area following a systematic and scientific method. The slope of the dump shall be maintained as per Approved Mining Plan. Dumping is proposed in stages with terracing, which provides good stability to the dump and also provides adequate area for plantation.

Measures to prevent dump slope failure

- Use of geotextiles, grass and plantation of native species will help stabilize the dump slopes and prevent slope failure.
- Inward slope will be provided to each dump stage so that the run-off water is diverted to garland drains which will be channelized to settling ponds and mine pit.
- Proper maintenance and monitoring of dumps will prevent dump failure.

3. Water Inundation

During monsoon, rainwater from the catchment area of the mine will be diverted to the mine pit. Sufficient capacity of pumps will be made available to maintain safe water level in the mine pit during monsoon season. The pumped

water will be allowed to pass through a series of settling ponds, where water will be treated if necessary and further discharged out of the Mining Lease in a controlled manner.

The procedure of harvesting rainwater is followed for its utilization during mine operation in the non-monsoon season.

The topographical features of the region, including elevation differences and natural drainage patterns confirms that there will be no water inundation originating from the nearby river, which is situated at a distance of 0.005 km.

4. Fire Hazards

In the mining premises, cutting burners, welding appliances or any other equipment which may generate sparks of any kind would be used only under proper supervision of competent persons where there is a risk of fire. Fire extinguishers shall be kept at engine rooms, generators, workshops, near transformers etc. Automatic fire extinguishers will be installed on all the Heavy earth-moving Machinery.

Also spillage of HSD can be a fire Hazard when come with contact with heat source or open flame. Proper handling, storage and immediate cleanup of any spills are essential to minimize the risk of fire. The quantity of HSD which can spill is not much and can be easily controlled.

Measures to prevent fire hazards

As soon as any fire is reported, the shift-in-charge shall invoke the Disaster Management Plan. In case of serious fire and depending on the significance of the situation, the Mine Manager may take charge and deploy personnel trained in dealing with fire with specialized equipment. Meanwhile the hospital will be informed to handle causalities, if any. The fire area will be cordoned off until the fire is fully extinguished and remain so until all wreckage and debris is cleared away.

To prevent fire, sufficient fire extinguishers of suitable type and make will be made available at strategic locations in the mine lease area to control any fire/explosion incident. Provision of first-aid facility will be provided in the mine office premises.

A competent person shall inspect all equipment, material and arrangement provided for firefighting at least once in a month and record of such inspection shall be maintained in a register. Fire extinguishers shall be inspected by a competent person at least once in 3 months.

5. Accidents due to heavy mining equipment, Trucks

The main hazards arising from the use of such machines are incompetent drivers, poor maintenance of machinery, brake failure, lack of visibility from the driver's position, vehicle movements particularly reversing, etc.

Measures to prevent accidents due to Heavy mining equipment, trucks are as follows.

- All transportation within the mining area would be carried out under the direct supervision and control of the management.
- The mining machinery will be maintained in good working condition by carrying out periodic inspection and maintenance by a competent person authorized for this purpose.
- Breaking system of the transport vehicles shall be examined periodically.
- Only trained drivers/ operators will be engaged.
- Sign boards would be provided at each and every turning point especially for the guidance of the drivers.
- To avoid dangers while reversing the vehicles, vehicles will be provided with audio-visual reversal alarms. Further, areas as far as possible will be made man free.
- A statutory provision of the fence, constant education, training etc. will go a long way in reducing the incidence of such accidents.
- Conduct regular safety audits and inspection to identify potential issue and address them promptly.
- Ensure regular health and fitness check up of operators and drivers
- Develop emergency response plan in case of accidents.
- Utilize advance technology and automation where possible to reduce the need of human intervention in high- risk situation.

6. Fly rock generation from blasting

Not applicable as no drilling and blasting activity is proposed.

7. From Storage of explosives

No explosives will be used.

Table 7.1: Summary of risks and their control measures

S. No.	Activity/ Scenario	Risk	Cause	Control Measure
1.	Removal of Mineral	Landslide	Loose Soil Angle of Bench being steep	The following safety measures will be followed and the same will be ensured for the proposed project. • Bench height of 6 m, width of 8 m and with individual bench slope of 60^0. • Overall slope angle as approved in Mining Plan. • Bench slopes of inactive dumps will be terraced and mulched, covered with geotextiles and planted with native floral species.
2.	Movement of Mineral, Wastes etc., in trucks	Accident causing injuries to human/ /damage to properties	Operating vehicle in reverse direction, Loss of control of trucks while driving, Speeding, Overtaking, Overloading, Not using hand brake, Drunken Driving	• Imparting vocational training. • Providing awareness training to truck drivers on safe driving, clearly explaining DOs & DON'Ts. • Implementation of traffic rules. • Providing and ensuring use of appropriate Personal Protective Equipment. • Undertaking Alcohol Checks
3.	Fire Accident	Causing injuries to human/ /damage to properties	Electrical Short Circuit	• Ensuring storing of inflammable materials separately. • Restricting smoking. • Keeping Fire Extinguishers near the storage area. • Automatic fire extinguisher system for HEMM.
4.	Water inundation	Threat to life of mine operators Damage to mining machinery/ trucks	Heavy rain/ flood Intersection of ground water table	• No impact of HFL or water inundation on mine site.

7.3 EMERGENCY PREPAREDNESS & RESPONSE PLAN

7.3.1 OBJECTIVES OF EMERGENCY PREPAREDNESS & RESPONSE PLAN

The Emergency Preparedness and Response Plan is aimed to ensure safety of life, protection of environment, protection of equipment and restoration of production, in this same order of priorities. For effective implementation, the Emergency Preparedness and Response Plan shall be widely circulated and the personnel shall be trained through rehearsals/mock drills. To tackle the consequences of a major emergency inside the mine, an Emergency Preparedness and Response Plan has been formulated.

The objective of the Emergency preparedness and Response Plan is to make use of the combined resources of the Mine and the outside services to achieve the following.

- Control and bring the emergency situation to a safe condition
- Safeguard employees
- Arrange rescue and medical treatment of causalities
- Minimize damage to property and the environment
- Secure the affected areas
- Preserve relevant records and equipment for subsequent enquiry to identify the cause and circumstances leading to emergency.
- Post emergency, conduct enquiry and identify improvement in area and update emergency plan accordingly.

7.3.2 EMERGENCIES

The emergencies that could be envisaged in the Mine are as follows:

A. Dump slide / bench collapse
B. Fall of person
C. Drowning
D. Collision
E. Fall of vehicle
F. Fire to equipment

A. <u>SITUATION: DUMP SLIDE/BENCH COLLAPSE</u>

Overall Responsibility: Mine Manager

In absence of Mine Manager, Shift In-charge shall take control of the situation.

Resources needed:

1. Safety equipment's such as wire ropes and wireless sets/mobile phones
2. First Aiders
3. Personal Protective Equipment

Emergency Response Plan:

1. Work Person: Work Person or Operator whose truck is stuck up while dump collapses shall inform the supervisor.
2. As soon as the information is given to the Supervisor (Competent person), the same will also be communicated to the Shift In-charge on wireless set or by any other means. The Supervisor (Competent person) will cordon off the affected area to prevent any unauthorized entries to the affected area.
3. Shift In-charge: Shall inform the Safety Officer/Mine Manager and initiate the process of rescue using the manpower and machineries available at the site. He will also make arrangement to provide first aid for the injured person.
4. Safety Officer: Safety Officer will inform Doctor/Compounder/First Aider and arrange for the ambulance.
5. Doctor/Compounder/First Aider: After receiving the information will rush to the site with ambulance with the First Aid Kit and give necessary First Aid to the victim.
6. Mine Manager: Shall rush to the site and make additional arrangements to rescue men and machineries and to deal with the emergency, he shall also inform the hospital, fire station and statutory authorities.

Mitigation Measures:

1. Mock Drills shall be conducted as per schedule.
2. Dumping activity shall be carried out systematically in stages and terracing and maintaining safe height and slope as per law in force, under the control of the Mine Manager/Location In-charge.
3. Wet material shall be unloaded separately and not on the active dump site to prevent collapse.
4. Inward slope shall be maintained for each stage of the dump for proper drainage during monsoon.
5. Regular dump slope monitoring shall be carried out.

6. Geo-textiles, wherever necessary, shall be laid along the slopes of inactive portion of the waste dump before monsoon and plantation carried out to increase the stability of the dump.

Legal obligations in case of emergency, if any: Nil

Records to be maintained:

- Mock Drill Report
- Incident report
- Incident Investigation Report

Reporting of emergency:

Any emergency will be immediately reported to Mines Manager, Head of operations, Head –Admin, Security In-charge and In house Doctor and if required Local police (100), Ambulance (108) and government officials

B. SITUATION: FALL OF PERSON

Overall Responsibility: Mine Manager

In absence of Mine Manager, Shift In-charge shall take charge of the situation.

Resources needed:

1. Safety equipment such as ropes and wireless sets
2. First-Aiders
3. Personal Protective Equipment

Emergency Response Plan:

1. Work Person: Work person accompanying the victim shall throw rope towards the fallen person.
2. If this does not help or fallen person is severely injured, he shall give a wireless message to the shift engineer or shift in-charge or land transport office. If the injured person has been pulled up, immediate first-aid shall be provided
3. Shift In-charge: As soon as the information is received by the Shift In-charge, Shift In-charge shall inform Mines Manager/Safety Officer on wireless set and ask for ambulance.

4. Safety Officer: Safety Officer will inform Doctor/Compounder/First Aider and arrange for the ambulance.
5. Doctor/Compounder/First Aider: After receiving the information will rush to the site with ambulance with the First Aid Kit and give necessary First Aid to the victim.
6. Mines Manager: Will rush to the site and make additional arrangements to deal with the emergency if required.
7. The General Emergency Preparedness Plan (EPP) in place for the mine shall be followed by Mines Manager.

Mitigation Measures

1. Mock Drills shall be conducted as per schedule.
2. Areas with loose strata, undercut shall be barricaded.
3. Workers shall be given training and refresher training on unsafe act/conditions.
4. Workers shall be motivated & rewarded in reporting unsafe acts/conditions and near-misses.
5. During dark hours illumination shall be provided

Legal obligations in case of emergency, if any:

In case of any incident in the mine involving serious injury or fatality or major fire incident, the same will be reported to DGMS/DMS by Mine Manager

Records to be maintained:

- Mock Drill Report
- Incident report
- Incident Investigation Report

Reporting of emergency:

Any emergency will be immediately reported to Mines Manager, Head of operations, Head – Safety, Security in-charge and in-house Doctor and if required Local police (100), Ambulance (108) and government officials

C. SITUATION: DROWNING

Overall Responsibility: Mine Manager

In absence of Mine Manager, Shift In-charge shall take the charge of the situation.

Resources needed:

1. Safety equipment such as nylon/jute ropes, wireless sets, mobile phones, life buoys, life jackets and life line
2. Personal Protective Equipment
3. First Aiders

Emergency Response Plan:

1. Work Person: Work person present at the site shall throw a life buoy tied to the rope/lifeline towards the drowning person. If he finds that this help is not yielding any result, he shall give a wireless message to the Supervisor or Shift In-charge.
2. Shift In-charge: As soon as the information is given to the Shift In-charge, he shall inform the Mines Manager and safety officer as applicable through wireless message/phone and ask for ambulance.
3. Safety Officer: Safety Officer will arrange for the ambulance and inform the Doctor/Compounder/First Aider.
4. Doctor/ Compounder/First Aider: will rush to the site with ambulance with the First Aid Kit and give necessary First Aid to the victim, after receiving the information.
5. Mines Manager: Will rush to the site and make additional arrangement to deal with the emergency if required

Mitigation Measures:

1. A strong life-line and adequate number of life buoys and life jackets shall be kept at each pump site.
2. Pump area shall be adequately fenced.
3. A safe approach road on dry ground shall be maintained to the pump sites on which track- mounted machinery can travel safely.
4. Persons engaged in water pumping operations shall be only those who know swimming.
5. No person shall be allowed to board a pontoon/float without wearing life jacket.
6. Whenever a person gets on to the float, at least one person shall be present nearby the shore to assist in case of any untoward incident. Not more than 4 persons shall ride the float at any time.

7. Water pumping operations shall be carried out under the supervision of a competent person / De-watering In-charge.
8. The pontoons used for floating water pumps shall be inspected and certified for buoyancy at least once a year by a competent authority.
9. The pontoons in use shall be adequately secured / anchored by ropes.

Legal obligations in case of emergency, if any:

In case of any incident in the mine involving serious injury or fatality, the same will be reported to DGMS/DMS by Mine Manager.

Records to be maintained:

- Mock Drill Report
- Incident report
- Incident Investigation Report

Reporting of emergency:

Any emergency will be immediately reported to Mine Manager, Head of operations, Head –Admin, Security In-charge and In house Doctor and if required Local police (100), Ambulance (108) and government officials

D. SITUATION: COLLISION

COLLISION: Includes Collision of truck with light vehicle, truck with truck, truck with shovel, truck with compressor, or collision with permanent / temporary structures etc.

Overall Responsibility: Mines Manager

In absence of Mines Manager, Shift In-charge shall take control of the situation.

Resources needed:

1. Safety equipment such as hand-held Walkie-talkies, wireless sets in vehicles and/or mobile phones
2. Personal Protective Equipment
3. First Aiders

Emergency Response Plan:

1. Work Person/ Driver of the vehicle: Driver of the vehicle, if in a position of informing to the supervisor, shall do so immediately. Work person witnessing the accident shall inform the supervisor/Shift In-charge nearest available.
2. Shift In-charge: As soon as the information is given to the Shift In-charge, he shall inform the same to the Mines Manager and Safety Officer on wireless set/phone and ask for ambulance and rush to the site for rescue operation.
3. Safety Officer: Safety Officer will arrange for the ambulance and inform the Doctor/Compounder/First Aider.
4. Doctor/Compounder/First Aider: After receiving the information, will rush to the site with ambulance with the First Aid Kit and give necessary First Aid to the victim,
5. Mines Manager: Shall rush to the site and make additional arrangements to deal with the emergency if required.

Mitigation Measures:

1. Mock Drills shall be conducted as per schedule.
2. Training and refresher training shall be conducted as per the schedule and drivers shall be assessed.
3. Drivers with rough performance or bad records shall be given special attention and training.

Legal obligations in case of emergency, if any:

In case of any incident in the mine involving serious injury or fatality, the same will be reported to DGMS/DMS by Mines Manager.

Records to be maintained:

- Mock Drill Report
- Incident report
- Incident Investigation Report

Reporting of emergency:

Any emergency will be immediately reported to Mines Manager, Head of operations, Head –Admin, Security In-charge and In house Doctor and if required

Local police (100), Ambulance (108) and government officials

E. SITUATION: FALL OF VEHICLE

Overall Responsibility: Mine Manager

In absence of Mine Manager, Shift In-charge shall take hold of situation.

Resources needed:

1. Safety equipment such as hand-held Walkie-talkies, wireless sets in vehicles and/or mobile phones
2. Personal Protective Equipment
3. First Aiders

Emergency Response Plan:

1. Work Person: Any Work Person including the driver of the vehicle witnessing the accident shall give the information to the nearest available supervisor / Shift In-charge.
2. Shift In-charge: As soon as the information is given to the Shift In-charge, he shall inform the same to the Mine Manager, Safety Officer and Mechanical Engineer on wireless set/phone and rush to the site for rescue operation.
3. Safety Officer: Safety Officer will arrange for the ambulance and inform the Doctor/Compounder/First Aider.
4. Doctor/Compounder/First Aider: After receiving the information, will rush to the site with ambulance with the First Aid Kit and give necessary First Aid to the victim,
5. Mine Manager: Shall rush to the site and make additional arrangements to deal with the emergency if required.

Mitigation Measures:

1. Mock Drills shall be conducted as per the schedule.
2. Road markings, sign boards, convex mirrors, speed breakers, escape lanes, embankments, fluorescent poles, traffic islands, etc. shall be provided as per requirement.
3. Haul road width and gradient shall be maintained as per law enforce.
4. Roll over cabin protection shall be provided on truck as applicable.

Legal obligations in case of emergency, if any:

In case of any incident in the mine involving serious injury or fatality, the same will be reported to DGMS/DMS by Mines Manager.

Records to be maintained:

- Mock Drill Report
- Incident report
- Incident Investigation Report

Reporting of emergency:

Any emergency will be immediately reported to Mines Manager, Head of operations, Head –Admin, Security In-charge and In house Doctor and if required Local police (100), Ambulance (108) and government officials

F. SITUATION: FIRE

FIRE: Includes fire to the hauling or loading machines.

Overall Responsibility: Mine Manager

In absence of Mines Manager, Shift In-charge shall take control of the situation.

Resources needed:

1. Safety equipment such as fire extinguishers, fire suppression system and wireless sets
2. Water tankers with water hose
3. First Aiders & Fire fighters
4. Personal Protective Equipment

Emergency Response Plan:

1. Operator: Operator shall be well versed with the operation of fire extinguishers and fire suppression system. Operator shall also inform the available supervisor / Shift In-charge.
2. Shift In-charge: As soon as the information is given to the Shift In-charge, he shall inform the same to the Mine Manager and Safety Officer on wireless set/phone and rush to the site for rescue operation.

3. Safety Officer: Safety Officer will arrange for the ambulance and inform the Doctor/Compounder/First Aider.
4. Doctor/Compounder/First Aider: After receiving the information, will rush to the site with ambulance with the First Aid Kit and give necessary First Aid to the victim,
5. Mine Manager: Shall rush to the site and make additional arrangements to deal with the emergency if required.

Mitigation Measures:

1. All HEMM shall be equipped with operational fire extinguishers and fire suppression system.
2. Regular housekeeping of HEMM shall be followed.
3. Avoid spillage of oil and grease on hot parts of machinery.
4. If any smoke or burning smell sensed by operator, he shall immediately stop the machinery and inform the Engineer.
5. Mock drills shall be conducted as per schedule.
6. Response time analysis of mock drill will be carried out for further improvement.
7. All operators/supervisors shall be trained in firefighting and operating fire extinguishers and fire suppression system.

Legal obligations in case of emergency, if any:

In case of any incident in the mine involving serious injury or fatality or major fire incident, the same will be reported to DGMS/DMS by Mine Manager

Records to be maintained:

- Mock Drill Report
- Incident report
- Incident Investigation Report

Reporting of emergency:

Any emergency will be immediately reported to Mine Manager, Head of operations, Head –Admin, Security In-charge and In house Doctor and if required Local police (100), Ambulance (108) and government officials

7.4 DISASTERS

7.4.1 DISASTER MANAGEMENT PLAN

Block IV – Kalay Mineral Block is situated in Santona village, Sanguem Taluka, South Goa District, Goa. Goa falls under the Seismic Zone III category and hence disasters due to Seismic activity will not affect the proposed project.

The Disaster Management Plan is aimed to ensure safety of life, protection of environment, protection of installation, restoration of production and salvage operations in this same order of priorities. For effective implementation of the Disaster Management Plan, it should be widely circulated and personnel training through rehearsals/drills.

The objective of the Disaster Management Plan is to make use of the combined resources of the mine and the outside services to achieve the following

- Effect the rescue and medical treatment of casualties
- Safeguard other people
- Minimize damage to property and the environment
- Initially contain and ultimately bring the incident under control
- Secure the safe rehabilitation of affected area, and
- Preserve relevant records and equipment for the subsequent inquiry into the cause and circumstances of the emergency.

In order to prevent disasters if any the following control measures are planned to be adopted.

An important element of mitigation is emergency planning. i.e., recognizing that accidents are possible, assessing the consequences of such possible accidents and deciding on the emergency procedures, in advance, both on-site and off-site, that would need to be implemented in the event of an emergency, systematically and without confusion and delays.

Maintenance of proper bench geometry, observing safety precautions for transport, proper storage, safe handling and use of fuel etc., good maintenance of roads and transport units, fire prevention measures, good dump management, shall go a long way in preventing accidents/disasters.

Mining will be carried-out strictly as per Mines Act, 1952 and all other rules and regulations.

Mobile communication facility will be provided for quick passing of information. Proper training will also be given to the work persons periodically at Group Vocation Training Center (GVTC) as per Mines Vocational Training Rules, 1966.

A hierarchical system to carry out the risk assessment along with duties in case of any disaster is in place and the same is shown below.

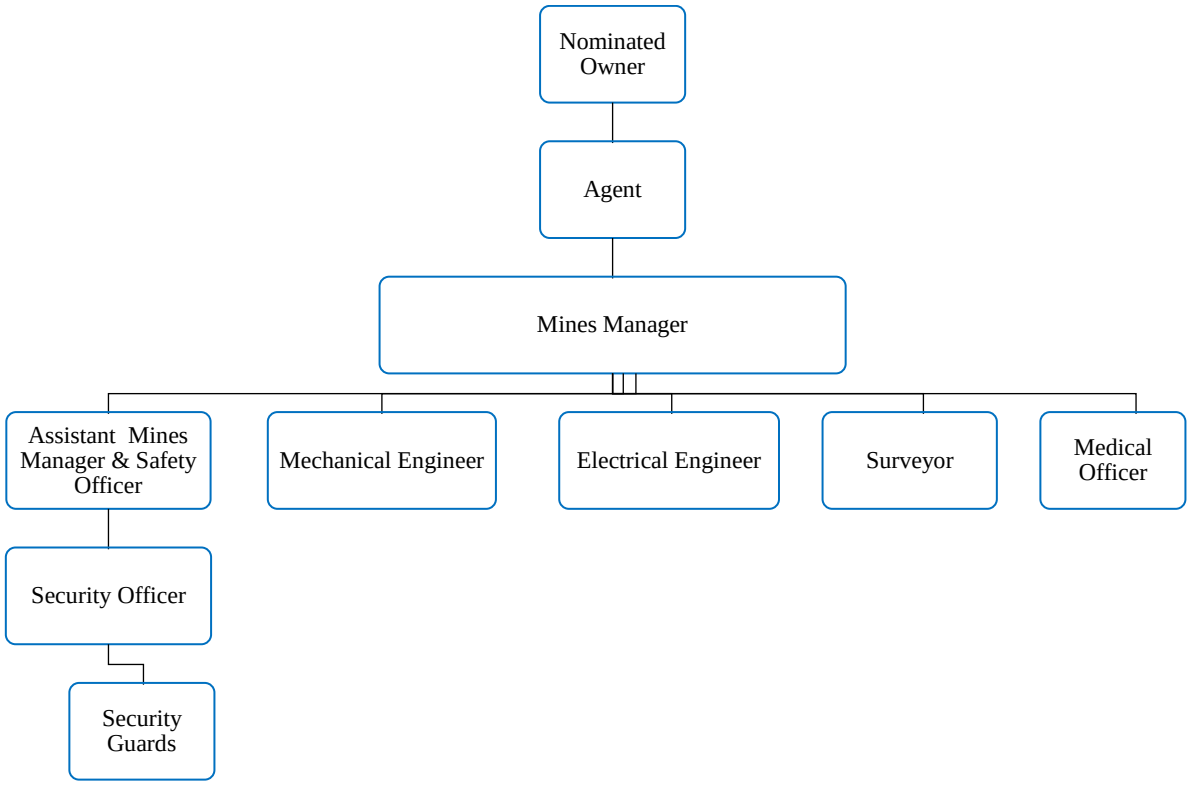


Fig. 7.1: Organizational chart for disaster management

7.4.2 DUTIES OF MINE MANAGER

1. As soon as he receives the information, he shall assess the situation by personal visit to the affected area.
2. He shall ensure necessary action listed in respect of Assistant Manager / Engineer that might not have been taken by him or rectify the action taken already by Asst. Mine Manager / Engineer.
3. He shall ensure to keep the required equipment at site.
4. He shall arrange to procure additional required equipment from other places.

5. He shall inform Agent & concerned authorities about the occurrence and a progress of action taken by him.
6. He shall keep the local Police / Mamlatdar informed, if necessary.
7. He shall activate the Emergency Preparedness Team, which is specially formed / trained to deal with disasters.
8. He shall inform the higher officials about the situation and actions taken by him so far, and request for assistance that may be required from the Superiors.
9. In the absence of Mine Manager or otherwise any official superior to the Mine Manager may assume the charge of Mines Manager for this purpose.

7.4.3 *DUTIES OF ASSISTANT MINES MANAGER*

1. Shall daily inspect the Mine in the beginning of the shift and before end of the shift. He shall personally inspect all the Mine faces, all the garland drains, intermittent trenches in benches for any wash off /blockage or breach in trenches and garland drains. Ile shall record his observations in a register kept for the purpose.
2. Shall be responsible for monitoring any alarming rise in water level along with surveyor in the Mine pit and report the same to the Mine Manager immediately and also shall clean the settling ponds regularly so that its water holding capacity is maintained.
3. The entire shift working shall be under the control of Asst. Mine Manager. He shall hand over the shift charge to incoming Asst. Mine Manager with proper briefing of the work clone and to be done.
4. He shall report to the Mine Manager of any danger observed in his shift and also if any action.

7.4.4 DUTIES OF MECHANICAL ENGINEER

1. Responsible for availing all the machinery in good working condition at any given point of time.
2. Entire pumping operation will be under his charge and shall chalk out schedule for pumping operation and maintenance of all the available pumps in good working condition with spare capacity
3. He shall maintain the history of all the machinery for its operational reliability.
4. He shall report to the Mine Manager on day to day basis the availability of machinery and equipollents specially pumps and Machinery.

7.4.5 DUTIES OF ELECTRICAL ENGINEER

1. He shall be responsible for operation and Maintenance of all the electrical equipment available at mines.
2. He shall be responsible for general lighting in mines during the night shift.
3. He shall be responsible for keeping available in stock of spares such as starters, cables. Metalloid bulbs, etc.
4. He shall be responsible for maintaining electrical safety during Monsoon.

7.4.6 DUTIES OF MINE SURVEYOR

On receiving the message of occurrence of disaster, he shall keep ready all the necessary instruments, and he shall immediately undertake survey work in case of slope failure / slides to monitor ground movement.

7.4.7 DUTIES OF MEDICAL OFFICER:

He shall take immediate steps on the following:

1. Arrange First Aid to the injured persons.
2. Arrange Ambulance van to the affected persons to take them to nearest medical facility center.
3. Arrangement of sending additional security personnel, if required at the affected area.

7.4.8 DUTIES OF SECURITY OFFICER

1. He shall be responsible for restricting any entry in the mines.
2. In case of any emergency. He shall facilitate availability of transport vehicles. ambulance and First-Aid
3. Any danger observed shall be directly reported to the Mines Manager.
4. He shall be responsible for maintaining the housekeeping.

7.4.9 DUTIES OF SECURITY GUARD

In case of emergency situations, Security Guards should:

1. Use the different type of Fire Extinguishers as per the type of fire.
2. Not allow visitors / unauthorized persons in the affected area without the permission of authorised persons.
3. Inform their superiors about the situation.
4. Write the head counts in the board and ensure the attendance of persons present in the premises and cross check.

5. To maintain law and order.
6. Hoot the Emergency Siren, and in case of power failure, use the hand siren.

Emergency Contact numbers of Police station, Fire station, Hospitals and ambulance services are being maintained with the Mines Manager, whom is to be contacted at any emergency situation. The aim of disaster management is to identify potential dangers associated with the mining operations like:

a. Loading,
b. Hauling,
c. Dumping,
d. Storage and use of HSD, industrial gases, electricity etc. and with associated problems .

Mines Manager is the person responsible for the disaster management and he needs to be contacted in case of any disaster.

7.5 OCCUPATIONAL HEALTH & SAFETY

As no additional construction of any civil structures are envisaged in this mine, the Occupational Health and Safety related issues are restricted to operational stage only. The existing practices with regard to Occupational Health & Safety will be ensured for the existing mining operations.

The Occupational Health and Safety (OHS) Plan aims to

- Ensure that all known safety factors are taken into account in the operation and maintenance of HEMM and trucks
- Allocate sufficient resources to maintain safe and healthy conditions at work place
- Ensure that adequate OHS knowledge is imparted to all employees
- Provide necessary protective equipment and safety appliances and ensure their proper use
- Make the employees aware of the mine operations and the potential hazards
- Train the employees to take preventive steps in a proactive manner and execute the work safely and understand occupational health issues
- Review all operations and methods of work for making necessary changes from the safety point of view in the light of experience and up to date knowledge

- Provide appropriate facilities for first aid and prompt treatment of injuries and illness at work
- Ensure that adequate publicity is given to OHS matters
- Ensure proper precautions are taken to prevent fire and provide appropriate firefighting facilities
- Publish instructions and notices in the local language to employees
- Prepare safe operating procedure for all operations
- Ensure regular inspection by a competent person at regular intervals for identifying any deviations in safety and occupational health related matters
- Provide rrelaxation facilities to workers with good ventilation & air circulation
- Ensure Good Housekeeping Practices
- Provide enclosure for noise generating sources
- Isolate diesel storage areas
- Rotate employees in specific areas to avoid continuous exposure

7.5.1 OCCUPATIONAL HEALTH RISKS

The principal Occupational Health Risks associated with the project are likely incidence of tuberculosis, silicosis, hearing loss, accidents due to inundation of mine working pits, fire and slope failure. The order of severity on health status of workers in mining is tuberculosis, silicosis, respiratory diseases and hearing loss.

7.5.2 PRECAUTIONARY MEASURES

a. Dust

As dust is a major pollutant, that can cause a heath disorder, the following precautionary measures are followed.

- Sprinkling of water on the haul roads and working places
- Maintenance of the mining machinery and vehicles used as per the manufactures specifications to ensure their efficient operation
- Ensuring usage of Personal Protective Equipment like respiratory masks.
- Development of wide green belt proposed to attenuate the spread of dust and also the noise generated from mining operations
- Conducting periodical health check-up of workers.

b. Noise

Workmen and staff exposed to higher sound levels will be provided with ear plugs/mufflers of approved type by DGMS to guard them against any hearing impairment is being followed to ensure noise levels are within limits. Regular maintenance of HEMM for controlling noise levels.

c. Injuries

By ensuring that all employees are following safe operating procedure and using the required Personal Protective Equipment, the risk of injuries due to accidents can be prevented.

7.5.3 PERSONAL PROTECTIVE EQUIPMENT (PPE)

The following Personal Protective Equipment (PPE) are provided to the Mine employees

- Industrial Safety Helmets
- Zero power plain goggles with cut type filters on both ends
- Cylindrical type earplugs/Earmuffs
- Industrial safety shoes with steel toe
- Provision of fluorescent jackets, hand gloves

7.5.4 TRAINING

All the workers shall be imparted with initial vocational training (Induction) as per the statute to make them familiar with their jobs covering the occupational hazards involved, need to use Personal Protective Equipment, following safe operating procedures and the safety precautions to be taken while doing their jobs. Awareness programme for the workers on work related health hazard, HIV prevention etc. are being conducted. They shall also be given refresher training as per statute after completing one year of service.

7.5.5 OCCUPATIONAL HEALTH SURVEILLANCE

Impact of mining on health shall be assessed by a trained doctor in occupational health and the tests conducted include general health checkup, spirometry, audiometry and vision test in addition to X-Ray and ECG examination.

In order to evaluate the impacts on mining on the health of workers, baseline health

studies shall be carried out for every worker in accordance with Rule 29B of the Mines Rule, 1955.

7.5.6 PIT SAFETY COMMITTEE

The pit safety committee headed by Mines Manager consists of

Mines Manager	-	1
Safety Officer	-	1
Asstt. Mines Manager	-	1
Surveyor / Geologist	-	1
Mines Foreman	-	1
Mining Engineer/Environmental Officer	-	1
Medical Officer	-	1
Workers	-	2

The functions of the Pit Safety Committee are:

- Ensuring remedial measures against the unsafe conditions and practices in the mine as pointed out by the workmen or Inspectors or otherwise brought to the notice of the committee
- Planning safety and health measures including related codes of practice and making appropriate recommendations before commencement of any new section of the mine or introduction of any new mining technique
- Ensuring investigation of accidents that take place in the Mine and making appropriate recommendations
- Ensuring meeting at least once in 30 days to consider the matters placed before it and any other matter that may be raised by the members and making such recommendations as it may deem fit
- Serving as a forum of communication on safety and occupational health matters

7.5.7 FIRE PROTECTION

Firefighting equipment such as Carbon dioxide, DCP, Soda acid type, Fire buckets shall be provided. Regular inspection of Fire Extinguishers to ensure replacement of refills and the working condition of the extinguishers shall be carried out.

7.6 R&R ACTION PLAN

This proposed project area does not have any habitation in the Mining Lease Area. Hence, no Rehabilitation & Resettlement Plan is required.

7.7 CARE AND MAINTENANCE DURING TEMPORARY DISCONTINUANCE

a) Precautions to be taken

An emergency plan for the situation of temporary discontinuance due to court order or due to statutory requirements or any other unforeseen circumstances may indicate measures of care, maintenance and monitoring of status of discontinued mining operations expected to re-open in near future.

Although no temporary closure is planned or expected, the following protective measures would be taken to deal with the unforeseen circumstances which may be created due to temporary closure of the mine.

1. All heavy earthmoving mining machineries deployed in various blocks of iron ore mine will be withdrawn and brought to the safe place so that these do not get buried due to bench collapse, if any, and get damaged during discontinuance. These will be subjected to preventive maintenance.
2. The entries to the mine pits will be fenced off with display of notice boards prohibiting unauthorized persons.
3. At the entrance and strategic points in the mine areas, sentries and watchman would be deployed to guard the sensitive/important mine area, explosive magazine and other sensitive stores and services. They would be provided with mobile phones / walky-talkies to contact mine authorities/police/fire station etc. for help during emergency.
4. The mine area would be kept well illuminated during night time.
5. Audible warning sirens would be established at strategic points to be used during emergency so that prompt help can be received from proper sources and protective measures are immediately taken by all personnel available.
6. Managerial, supervisory and competent persons of the mine would be engaged elsewhere in other mines of the company as per the needs.

b) Manpower retrenchment, compensation to be given, socio-economic repercussions and remedial measures consequent to the closure of mines should be described, specifically stating the following:

It is too early to discuss the socio-economic repercussions and remedial measures consequent to the closure of mines. However, the workers shall be employed from surrounding areas who are basically agricultural labourer. In case of closure, they will go back to their family occupation.

i. **Number of local residents employed in the mine, status of the continuation family occupation and scope of joining the occupation back**:

   Most of the workers shall be employed from the surrounding areas who are basically dependent upon agriculture activity. In case of closure, they will go back to their family occupation.

ii. **Compensation given or to be given to the employees connecting with sustenance of himself and their family members:**

   Compensation will be paid as per government rules.

iii. **Satellite occupations connected to the mining industry number of persons engaged therein continuance of such business after mine closes:**

   There can be no satellite occupation connected to the mining industry.

iv. **Continued engagement of employees in the rehabilitated status of mining lease area and any other remnant activities:**

   Not Applicable.

Chapter-8

Project Benefits

8.1 INTRODUCTION

Mining operation at the proposed project will have a positive impact at local and regional levels of community of the State, wherein, basic requirement of the community needs will be strengthened by the project by extending the health care, educational facilities developed in the community, providing clean drinking water to the villages, generating employment opportunities in the area, etc.

The project will benefit the direct and indirect stakeholders through creation of secondary & tertiary Business Opportunities for the local people in the form of Service Industry resulting in development of ancillary & allied services like Canteen facility, Transport, Machinery Repair & Maintenance, etc.

Project Benefits

The project is expected to benefit the following stakeholders during the life of the mine:

1. Socio-Economic benefits
2. Environment benefits
3. Benefits to State and Central Government

8.2 SOCIO-ECONOMIC BENEFITS

8.2.1 EMPLOYMENT OPPORTUNITY

The proposed project will generate employment for around 327 people which includes direct and indirect employment during its operation. The project will benefit about 1250 persons from nearby villages by way of allied business activities such as transportation of ore, canteen, garages and workshops, tea stalls, barges, environmental protective works, etc.

As the project will offer regular and consistent income through jobs to the local people from nearby villages, the project will have an overall positive impact on the local community.

8.2.2 SOCIAL BENEFITS

Fomento Resources Private Limited will undertake activities for the upliftment of the social community as given under:

i. Providing Educational support

- Providing support to schools/educational institutions to promote various activities towards the development of children.
- Providing support to Anganwadi centers/schools for building/ upgrading infrastructure, providing books, school uniforms, etc.) for promoting education.
- Scholarship to underprivileged and meritorious students for undertaking/ continuing technical and professional courses.
- Imparting vocational training to local workers and operators and truck operators.
- Transport facility for students, to provide educational aids to students.

ii. Health & Family Welfare Programmes

- Arranging Health Camps and medical assistance for villagers.
- Support in ODF by way of construction or maintenance of toilets.
- Awareness program on healthcare.

iii Infrastructure Development

- Maintenance and repairs of transport road.
- Construction of retaining wall, stone pitching, pond desilting work.
- Maintenance and repair of school premises in nearby villages.
- Contribution towards development of facilities to village panchayat, etc.

***iv.* Social Welfare & Skill Development Activities**

- Promotion of Art and Culture by associating with various agencies through sponsorship, support, contribution, etc.
- Maintenance works at worship places
- Other CSR programme coordination including brochures, painting, leaflets, CSR documentary film, display boards inauguration function etc.
- Providing saplings/ plants for villagers / nearby localities / schools for plantation
- Providing support to women self-help groups.
- Employment: Preference will be given to locals while providing direct employment to work on the mines. The mining operations will also provide significant employment opportunities to local in the form of ore transportation contracts.

- The mining operations will also lead to employment opportunities to locals in the form of setting up businesses to provide ancillary facilities like garages, hotels, etc.

Thus, this project is expected to yield a positive impact on the socio-economic environment of the region. It will help in sustainable development of this area including further development of physical & social infrastructural facilities. This project would create direct and indirect employment, a skilled and educated talent pool and entrepreneurs through its various social beneficiary programs. The production of iron ore would generate revenue to the country in terms of taxes on ore production and exchequer revenue for the State in terms of Bid Premium, Royalty etc.

8.3 ENVIRONMENTAL BENEFITS

Mining project will be beneficial for environment in many ways which are as following:

- At the conceptual stage total excavated area will be 74.9965 Ha out of which 29.0675 Ha area will be backfilled. The pit will be used as reservoir. The water reservoir will be helpful for recharging the ground water in the surrounding areas.
- At conceptual stage of mine, Greenbelt/Plantation of over 3.0288 Ha will be developed by planting native fruit bearing species, which will be beneficial to the Environment & will also create an aesthetic appeal.
- Clean water shall be released from the mining pit into the seasonal nallah which will be used and helpful for horticulture and cattle rearing.

Benefits to the State and Central Government

1. The Lease area of the project is mineralized having Reserves & Resources of 16.73 Million Tonnes of Iron Ore. Based on the proposed production of 0.75 Million Metric Tonnes of Iron Ore per Annum, the expected life of the mine will be 23 years, which may enhance depending on results of proposed exploration planned during the Mining Plan period. Thus, operation of the mine will benefit the overall economy of the State.
2. The project will contribute towards statutory payments such as Bid premium, Royalty, DMF, NMET, GIOPF, etc., to the State & Central Government exchequer in addition to various applicable taxes.

3. After entire iron ore is mined out up to its economical depth, the mine pit would act as a Rainwater Harvesting Structure, thereby accumulating and harvesting rain water. By means of percolation, the harvested rainwater will ultimately aid in the enhancement of groundwater table in the Project Area. The project will enhance the groundwater condition in a small region of the state.

8.4 BUDGET FOR SOCIO-ECONOMIC WELFARE ACTIVITIES

Approximate Annual proposed Expenditure towards CSR is given below in **Table 8.1**.

Budget towards CSR has been allocated based on the proposed production during the 1st 5-year Mining Plan period. Fomento Resources Private Limited is a Company registered under The Companies Act, 1956, now The Companies Act, 2013 and accordingly, CSR expenditure is estimated at the rate of 2% of the foreseen profits. Further, CSR activities will be identified as per public comments during public hearing.

Table 8.1: Approximate Annual proposed Expenditure (in Rs.) towards CSR for the 1st Five-year Mining Plan Period

S. No.	Activities	First Year	Second Year	Third Year	Fourth Year	Fifth Year
1	Promotion towards education • Transportation for students • Scholarship • Distribution of uniforms and books	6,00,000	6,00,000	6,00,000	6,00,000	6,00,000
2	Health care • Medical Camps • Conducting awareness programme • Providing facilities towards medical emergencies	6,00,000	6,00,000	6,00,000	6,00,000	6,00,000
3	Skill development / women empowerment	2,00,000	2,00,000	2,00,000	2,00,000	2,00,000
4	Provision of drinking water & sanitation	8,00,000	8,00,000	8,00,000	8,00,000	8,00,000
5	Plantation in community	2,00,000	2,00,000	2,00,000	2,00,000	2,00,000
6	Rainwater harvesting	2,00,000	2,00,000	2,00,000	2,00,000	2,00,000
7	Installation of solar PV Panels and or provision of solar streetlights in nearby villages at public places	4,00,000	4,00,000	4,00,000	4,00,000	4,00,000
Total		**30,00,000**	**30,00,000**	**30,00,000**	**30,00,000**	**30,00,000**

Chapter-9

Environmental Cost Benefits

9.1 INTRODUCTION

Mining operations and its allied activities of Block IV – Kalay Mineral Block are proposed within the Mineral Block area of 152.5073 Ha. The Mineral Block involves forest area of 21.1330 Ha, which includes Unclassed Forest having an area of 18.2210 Ha. and an area of 2.901 Ha. as Prospective Private Forest. An application has been filed under Section 2 of Forest Conservation Act, 1980, bearing proposal no. FP/GA/MIN/QRY/472990/2024 dated 15/05/2024, for diversion of the said Forest land.

9.2 COST BENEFITS ANALYSIS

To analyse the Cost Benefits occurring due to implementation of this project, consolidated guidelines and clarifications issued under Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980 and Van (Sanrakshan Evam Samvardhan) Rules, 2023 are considered. Guidelines were also referred to analyse NPV. Cost Benefit analysis has been carried out for an area of 21.1330 Ha. and is provided in Table 9.1 below.

Table 9.1: Cost Benefit Analysis of Block IV – Kalay Mineral Block

Estimation of cost of forest diversion

S. No.	Parameters	Amount in Lakh Rupees
1	Ecosystem services losses due to proposed forest diversion (NPV) @ 11,16,900/Ha., for an area of 21.1330 Ha. = 21.1330x1116900 = 23603447.70	236.03
2	Loss of animal husbandry productivity, including loss of fodder. (10% of NPV)	23.60
3	Cost of human resettlement.	Nil. There is no proposal for human resettlement as per Resettlement & Rehabilitation Plan.
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. There is no proposal for diversion of public facilities and administrative infrastructure within the Project
5	Possession value of forest land diverted *(30% of environmental costs (NPV) due to loss of forests or circle rate of adjoining area in the district should be added as a cost component as possession value of forest land whichever is maximum) (As per Circle rate)*	317.00
6	Cost of suffering to oustees.	**Nil.** There are no oustees from the Mineral Block

7	Habitat Fragmentation Cost (while the relationship between fragmentation and forest goods and service is complex, for the sake of simplicity the cost due to fragmentation has been pegged at 50% of NPV applicable as a thumb rule).	118.02
8	Compensatory Afforestation and soil & moisture conservation cost.@ Rs. 10 Lakhs / Ha. (i) Land (Ha) = 21.1330 (ii) CA Rate Rs. 10.00 Lakh/Ha. = 21.1330 X 10 = 211.330 Lakh *Note: Rule 13 (1) of Van (*Sanrakshan Evam Samvardhan) Rules, 2023 provides that if the non-forest land being made available for Compensatory Afforestation already bears vegetation of 0.4 canopy density or more, there shall not be an additional requirement of planting of trees on such lands but a program for improvement of the forest crop shall be implemented by forest department in a time bound manner.*	211.33
	Total	**905.98**

Existing guidelines for estimating benefits of forest-diversion in CBA

S. No.	Parameters	Remarks	Amount in Lakh
1	Increase in productively attribute to the specific project.	• Incremental reserves due to proposed diversion of Forest Land = 1758000 tonnes • Assumed Sale Price =Rs.4300/Tonne • Cost of Production = Rs.500/Tonne Increase in productivity = (1758000 x 4300) - (1758000 x 500) =Rs. 6,68,04,00,000/-	66804.00
2	Benefits to economy due to the specific project. (Rs. In Lakhs) *Note: Calculations are based on Average Sale Price declared by IBM for last 12 months from April 2023 to May 2024.	Royalty (15%) of IBM ASP : 3085.88 DMF (10% of Royalty) : 308.59 NMET (2% of Royalty) : 61.72 GIOPF (10% IBM ASP) : 2057.25 Bid Premium to State Govt. : 17774.64	28801.50
3	No. of population benefited due to specific project.	1250 persons @ Rs. 10000/month =1250x10000x12 = Rs. 150000000/-	1500.00
4	Economic benefits due to direct and indirect employment due to the project.	(i) Direct: 127 @ 35,000/month = 533.40 Lakh (ii) Indirect: 200 @ 20,000/ month = 320.00 Lakh (iii) Income from truck transportation belonging to villagers = 750000x18x14= Rs. 1890 Lakhs	2743.40

5	Economic benefits due to Compensatory afforestation for the life of the mine.	Economic Benefits due to Compensatory afforestation is: (iii) Land (Ha) = 21.1330 (iv) Declared CA Rate Rs. 0.88 Lakh/Ha. = 21.1330 X 0.88 = 18.60 Lakh	18.60
	Total Estimated Benefits		**99867.50**
	Cost Benefit Ratio Total Estimated Benefits (Table C)/ Total Estimated Cost (Table B) **=** **99867.50/905.98** **= 110.23**		**1 : 110.23**

Chapter-10

Environmental Management Plan

10.1 OBJECTIVE

The objective of the Environmental Management Plan (EMP) is to identify administrative aspects for ensuring that the mitigation measures are implemented and their effectiveness is monitored.

The EMP focuses on direct impacts viz. the impacts having the potential to cause significant influence on the environment.

The broad objectives of EMP are:

- To implement specific measures to prevent, reduce or manage the environmental impacts during operation of the project; and
- To identify the level of environmental performance expected during the operation of the project.

Project Proponent will be committed to implement Environment Management Plan towards environmental protection and conservation with respect to the proposed project. Based on the evaluation of impacts and baseline conditions, Environmental Management Plan (EMP) has been delineated to mitigate the adverse impacts due to the project on the environment.

The environmental management plan takes into consideration waste minimization, impact mitigation, management, monitoring and institutional measures, during operation of the project to eliminate adverse environmental impacts or reduce them to acceptable levels. The present Environmental Management Plan addresses the components of environmental attributes affected by mining operation.

The objectives of EMP are:

- Overall conservation of environment.
- Minimization of waste generation and pollution.
- Judicious use of natural resources and water.
- Safety, welfare and good health of the work force and populace.
- Ensure effective operation of all control measures.
- Vigilance against probable disasters and accidents.
- Monitoring of cumulative and long-term impacts.
- Ensure effective operation of all control measures.

10.2 ENVIRONMENTAL MANAGEMENT CELL

The Environmental Management Cell (EMC) shall be headed by Mines Manager who will report to the Agent of the Unit and also have direct access to Head of Organization i.e. Nominated owner.

ENVIRONMENTAL MANAGEMENT CELL

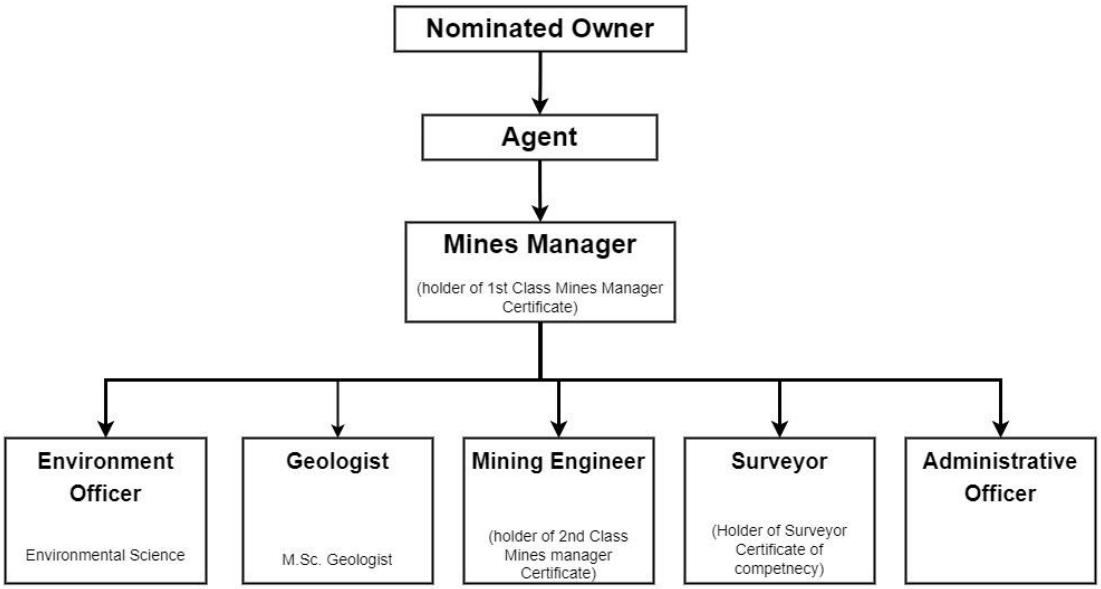


Fig. 10.1: Environmental Management Cell

A mechanism for reporting on compliance of the Environmental and other related aspects has been formulated. As per guidelines of MoEFCC, New Delhi, the status of environment compliance will be uploaded on the company website regularly. Periodic reviewing and performance measurement will also be taken up to look for improvement areas. The Environment Management Plan (EMP) which includes works like storm water management (drainages, settling ponds, trenches, desilting etc.), dump stabilization (inward slope to dump surface, laying of geotextiles wherever feasible, grass seeds, etc.), plantation, etc. will be planned jointly by a team comprising of mines manager, surveyor, geologist and environment officer.

The team will meet frequently to assess the progress of EMP so that the storm water management and dump stabilization jobs are completed well before the onset of monsoon and plantation is carried out during monsoon. The status will be reviewed by senior management on a weekly basis.

For successful implementation of the environmental management plan, assistance from other agencies/institutions may be sought whenever necessary for regulatory requirements and technical support. The coordinating agencies, which may be involved in specific environmental and project-related activities, are given below: -

- Interaction with State Pollution Control Board for legal compliance, new updates in environmental law, awareness, etc.
- Interaction with State Agriculture and Forest Department for engagement w.r.t plantation.
- Interaction with consultants, and reputed institutes for various projects related to mine reclamation, water positivity study, and projects on carbon footprint.

The Environment Management Cell will also coordinate to carry out environment monitoring as stipulated by the authorities. The monitoring will be undertaken by an Environmental Laboratory recognized by MoEF&CC. The monitoring data will be regularly submitted to the authorities like GSPCB, regional office of MoEF&CC.

10.3 HEALTH, SAFETY & ENVIRONMENT POLICY

Policy Statement

Fomento Resources Private Limited is aware that conservation of environment is one of the most important aspects. The company continuously strives and is committed to implement environment friendly mining by adopting latest pollution control devises, best reclamation practices, waste minimization techniques to conserve natural resources, water management system, complying with statutory requirements and work proactively to conserve biodiversity, maintaining ecological balance thereby bringing long- term positive impact on the employees and surrounding community to achieve the goal of sustainable development. We ensure that the management, officers, employees and contractors are aware of this Policy as well as the relevant responsibilities which are set out in these policies.

Environmental Policy:

We consider that the climate change to be the greatest threat affecting economic stability, vulnerable communities and the Society. We strive to make our operations as reliable and effective as possible, driving increased standards for environmental performance by:

- Strive to prevent environmental contamination, reduce negative

environmental impact by making every effort to comply with all applicable environmental laws, regulations and requirements.

- Protect the environment by implementing eco-efficient processes like reclamation, afforestation, adoption of improved technology and optimum conservation of the natural resources.
- Establishing and maintaining management systems to identify, monitor, assess and taking adequate mitigative measures to control negative environmental impact of our activities. Wherever appropriate, ensuring that employee undertake training to ensure they are complying with best industry practices and all applicable environmental laws, regulations and requirements.
- By ensuring that resources are available to meet our reclamation and environmental obligations.
- By ensuring that our employees and contractors carry out their responsibilities in accordance with this Policy, applicable law and the industry standards.
- By engaging and working with local representatives in the area in which we operate to educate the community on the environmental obligations associated with our activities.
- By transparent communication and consultation with interested and affected parties on environmental aspects of our activities.
- By working towards continual improvement of our environment performance over a period of time, including with regard to increasing our energy efficiency, reducing emission and waste and to promote sustainable development in the areas in which we operate.
- By conducting audits to monitor, measure and evaluate the effectiveness of our environmental management system, and communicate the findings to the safety, health and environmental cell. We will strive to increase transparency on environmental matters.
- Integrate water management system based on the principle 'Reduce, Reuse and Recycle of wastewater, harvesting of rainwater and artificial recharge for a sustainable water resource.

Environment Vision:

By thinking globally and acting locally, the organization plays an active role in society to address emerging global environmental issues such as climate change, desertification, biodiversity, etc., while committed to economic development.

10.4 SYSTEM OF COMPLYING WITH LEGAL REQUIREMENTS AND REVIEWING BY MANAGEMENT/ BOARD MEMBERS

a. **Responsibility**

- Identification of departments to ensure compliance with legal requirements.
- Dissemination of checklist to Head of departments (HODs) and their sub-ordinate teams towards information sharing and ensuring compliance with legal requirements.
- Responsibility is fixed on a particular person in each department for ensuring compliance; and
- Person responsible for ensuring compliance reports the compliance status to the HOD, monthly & periodically.

b. Reporting Mechanism

- HOD reviews the compliance status reported to him and shares the same to be reviewed by the management.
- If any non-compliance is reported, HOD devises an action plan to meet the compliance in a time bound manner.
- Non-compliance reported is shared with senior management and internal auditors for appraisal and review.

c. System of Positive Assurance

- The Senior Management shall review the status of non-compliance with the HODs, EMC and legal department.
- The Senior Management in discussion with HODs, EMC and legal department shall formulate procedures to prevent such non-compliances.

10.5 TRAINING

Training will be imparted to the employees as per job requirements on various aspects like environment management, natural resource conservation, reporting of environmental incidents, legal requirements, environmental monitoring, waste management, general environment awareness, etc. The training will be imparted by internal as well as external resources.

10.6 ENVIRONMENTAL MANAGEMENT PLAN

The Environmental Impact Assessment revealed that the study area has not been affected adversely and is likely to get new economic boost.

Block IV - Kalay Mineral Block is auctioned as a new/ fresh mine and it will be operated taking all precautionary measures to reduce the impact of mining operations on Air, Water, Noise and Soil and ensuring all control measures to comply with the prescribed standards.

The proposed production of Iron Ore within the existing Mineral Block Area will be carried out following the conventional Open Cast method of mining, which involves no drilling and blasting. All the necessary environmental protective measures will be implemented.

Further, regular Environmental Monitoring will be conducted throughout the life of the mine (within the project site and in the surrounding) to control the level of pollutants resulting from the mining activity within permissible limits.

10.6.1 AIR POLLUTION CONTROL

Control of Fugitive Emissions

- Regular water sprinkling on haul roads & loading points will be carried out.
- Development of green belt/plantation around the lease boundary, along the roads, on the dumps, etc.
- Maintaining the mine haul roads in good condition and implementing speed limit will prevent dust pollution.
- All the Heavy Earth Moving Machinery will have air-conditioned cabins thus providing pollution free atmosphere to the operators.
- Ambient Air Quality Monitoring will be conducted on regularly basis to assess the quality of ambient air.
- Use of Personal Protection Equipment (PPE) like dust masks, ear plugs, etc. by the workers.

Air pollution, management and control measures to be carried out during mining operations is tabulated below in **Table 10.1.**

Table 10.1: Air Pollution Management and Control Measures

Potential Impact	Actions/Measures	Parameters for Monitoring
Air Emissions	All equipment are operated within specified design parameters.	Random checks of equipment
	Vehicle trips to be minimized to the extent possible	Vehicle logs / automatic vehicle monitoring system/ Increase the capacity of vehicle
	Ensure regular checks of vehicular pollution	Pollution under control certificate of vehicle
	Covering of Vehicles transporting the mined mineral	No. of Trucks with covering / Random checks of trucks on roads
	Plantation of trees on the safety zone barrier of the Lease boundary of the Mineral Block area, which will reduce dust and noise in the vicinity.	No. of Saplings per year and area covered by plantation
	Regular water spraying shall be done in the mine area	Maintain moisture content of the surface of the activity area.
	Ambient air quality within the premises of the proposed unit to be monitored.	The Ambient Air Quality shall conform to the standards

10.6.2 WASTEWATER MANAGEMENT

- No generation of industrial wastewater from mining operations.
- Treatment of domestic wastewater shall be treated in septic tanks and soak pit arrangements.

10.6.3 WATER MANAGEMENT

- The surface runoff generated during monsoon season shall be diverted and channelized through hume pipes, garland drains, into the mining pit, there by harvesting rainwater.
- Harvested rainwater will be utilized for dust suppression, plantations, greenbelt development, used in workshop, wheel washing system, etc. during the mining operaions.
- The rainwater harvested in mine pits will be passed through a series of settling ponds where water will be treated with lime and flocculant to expedite the rate of sedimentation of sediment and clean water will be discharged from the mine. The water so discharged will be of good quality which will be gainfully utilized for irrigation.
- The discharge water will help recharge river water in the downstream and thereby maintaining a flow in the reviver system.

- The inactive dump slopes will be stabilized by geotextile wherever feasible, planting grasses, legumes and local native plant species in consultation with the Forest Department. Such plantation will prevent soil erosion thereby controlling sediment runoff.
- The toe of dumps shall be provided with retention walls to arrest silt run-off.

The proposed year-wise construction of garland drains & retaining wall during the plan period given below in **Table 10.2.**

Table 10.2: Proposed year-wise construction of garland drains & retaining wall

Year	Proposed Length (m)	Latitude (From-to)	Longitude (From-to)
Retaining Wall			
1	330	15:17:05.82 to 15:17:10.42	74:09:15.82 to 74:09:26.20
2	75	15:17:15.32 to 15:17:16.96	74:09:32.21 to 74:09:34.56
3	200	15:17:09.44 to 15:17:13.37	74:09:25.87 to 74:09:31.56
4	370	15:17:40.61 to 15:17:47.15	74:09:05.29 to 74:09:13.32
5	250	15:17:22.46 to 15:17:28.35	74:09:26.82 to 74:09:33.51
Garland Drains			
1	1120	15:17:39.28 to 15:18:03.78	74:08:57.92 to 74:09:21.30
2	1320	15:17:07.45 to 15:18:05.11	74:09:15.15 to 74:09:28.00
3	1305	15:17:12.64 to 15:18:01.28	74:09:09.43 to 74:09:29.02
4	1515	15:17:05.45 to 15:17:55.35	74:09:03.09 to 74:09:31.39
5	1090	15:17:11.37 to 15:18:01.22	74:09:18.82 to 74:09:34.38

The **Environmental Plan** showing various Environmental protective measures is enclosed as **Plate No. 21.**

Water Conservation Measures:

The project proponent shall take all the necessary steps to conserve water and reduce the specific water consumption as given below:

- Use of water tankers with special nozzles to make optimum use of water and thereby cover more areas with less water.
- Feasibility of using lignin based or other environment-friendly dust suppressants to reduce the water consumption for dust suppression.
- Use of fixed dust suppression systems like sprinklers, fog guns, etc., which will further reduce water consumption as well as reduce fuel consumption for plying water tankers.
- Monitoring of specific water consumption on monthly basis and take annual specific water consumption reduction targets.

10.6.4 NOISE POLLUTION CONTROL

- Ambient noise levels will be ensured to less than 75 dB(A) during daytime & less than 70 dB(A) during night time, by taking all necessary measures.
- Drilling and Blasting activities are not proposed for the Project.
- All the HEMM are provided with air conditioners and acoustically insulated cabins.
- Providing PPE such as like earplugs, earmuffs to the workmen in noise prone zones in the mine.
- Green belt will be developed all along the lease boundary.

Noise pollution management and control measures during mining operations and transportation are given below in **Table 10.3**.

Table 10.3: Noise Pollution Management and Control measure

Potential Impact	Actions/Measures	Parameters for Monitoring
Noise	Selection of State-of-art HEMM in good working condition with periodic maintenance to be engaged for mining operations.	Equipment logs, noise reading
	Implement good working practices (equipment selection and siting) to minimize noise and also reduce its impacts on human health (ear muffs, safe distances and enclosures).	Site working practices records, noise level readings and record of PPE's issued.
	Ambient Noise monitoring near the lease boundary. The Noise level should not exceed the permissible limit both during day and night time.	Noise levels
	All equipment operated within specified design parameters.	Random checks of equipment logs/ manuals
	Greenbelt development along the periphery of the Mineral Block will act a barrier to the propagation of noise as well as dust.	Around 1500 saplings of native species will be planted every year by way of gap filling strengthening the existing greenbelt.

10.6.5 PROTECTIVE MEASURES FOR GROUND VIBRATIONS/AIR BLAST CAUSED BY BLASTING

Drilling and Blasting activities are not proposed for the Project.

10.6.6 SOLID & HAZARDOUS WASTE MANAGEMENT

The solid waste generated is overburden. Overburden (waste) of 2384000 T will be generated during fourth year of the plan period to produce 750000 T of iron ore. Overburden waste is stacked in designated locations as shown in **Table 10.4.** The lateritic waste generated during mining operations will be used for erection of retention walls at the toe of the dumps, and also as safety barriers (bunds) all along the haul roads. Proposed dumping of the waste/overburden during the plan period is given in **Table 10.5.**

Table 10.4: Overburden/waste dump details

S. No.	Dump ID	Dump Status (Stabilized/ Dead/ Active)	Type of Dump (waste/ MR)	Total Dump Quantity (t)	Area covered by Dump (Ha)	Height (m)	Location
1	Dump-1	Active	Waste	7430000	10.3378	42.5	15:17:44.22 to 15:18:05.43 74:09:15.33 to 74:09:27.00
2	Dump-2	Active	Waste	220000	1.7902	15.2	15:17:39.02 to 15:17:47.84 74:09:15.36 to 74:09:23.71
3	Dump-3	Active	Waste	200000	1.6279	18	15:17:44.80 to 15:18:05.99 74:08:55.89 to 74:09:02.85
4	Dump-4	Stabilized	Waste	373000	2.6080	20	15:17:34.48 to 15:17:41.03 74:09:21.07 to 74:09:30.11
5	Dump-6	Active	Waste	1300000	11.4926	26	15:17:12.35 to 15:17:35.19 74:09:19.49 to 74:09:35.83
6	Dump-7	Active	Waste	200000	0.3320	10	15:17:11.65 to 15:17:24.70 74:09:08.76 to 74:09:13.74
7	Dump-8	Dead	Waste	60000	0.2852	8	15:17:20.22 to 15:17:25.11 74:09:35.21 to 74:09:36.88
8	Dump-9	Dead	Waste	30000	0.1873	8	15:17:10.78 to 15:17:13.73 74:09:36.59 to 74:09:39.27

Table 10.5: Proposed dumping of the waste/overburden during the plan period

Sr. No.	Year	Dump Id	Type of Dump	Proposed Area (ha)	Total Dump Quantity (m^3)
1	Year1	Dump-6A	Waste	2.54	152400.00
2	Year1	TD-2	Waste	4.13	563600.00
3	Year2	TD-1	Waste	7.10	675440.00
4	Year2	TD-2	Waste	3.24	388560.00
5	Year3	TD-1	Waste	6.02	496270.00
6	Year3	TD-2	Waste	3.51	526800.00
7	Year3	Dump-6A	Waste	1.43	128430.00
8	Year4	TD-2	Waste	4.77	547640.00
9	Year4	Dump-6A	Waste	4.21	505560.00
10	Year4	Dump-6	Waste	3.47	138800.0
11	Year5	Dump-6	Waste	5.11	263150.0
12	Year5	Dump-6A	Waste	2.18	326850.00

The following environment management measures are undertaken to prevent soil erosion

- Terracing, mulching, plantation of grasses, legumes, etc. on the inactive slopes.
- The wastes and ore generated are non-toxic and non-acidic. The possible pollutants in the water are suspended solids from mining areas and dumps. Rainwater from the entire broken area is harvested in mining pits through trenches and garland drains. The water is allowed to settle within the pit helping in groundwater recharge. During operational period, the pumped out water from the pit is passed through series of settling ponds to remove the solid suspensions and clear water shall be discharged from the Mineral Block area.
- Provision of retention walls at the toe of the waste dump to arrest runoff.
- Provision of garland drains around the waste dump and diversion of water to settling ponds and mine pit for sedimentation of suspended particles.
- Drains will be provided along the haul roads to divert the monsoon runoff into settling ponds and mine pit.
- The following engineering control structures will be constructed such as check dams, retaining walls and settling ponds to store the runoff water.
- Covering the dump slopes with biodegradable geotextiles wherever feasible and carrying out afforestation on the dump slopes.

Overburden waste i.e backfilled during the plan period is given below

1. Temporary Backfilling
2. Ore reserves at the common boundary with CGL
3. Proposed exploration and enhancement of life of the mine
4. Conceptual plan

Hazardous waste:

The mine shall generate minor quantities of Hazardous waste in the form of used oil (spent oil) due to maintenance of mining machineries. Hazardous waste authorization will be obtained from Goa State Pollution Control Board for collection, storage and disposal of hazardous waste. The quantity of hazardous waste likely to be generated is about namely spent oil 7 Tonnes per Annum, waste residue contaminated with oil 2 Tonnes per Annum. The hazardous waste will be properly segregated and stored at dedicated place and disposed to authorized recyclers State Pollution Control Board.

10.6.7 LAND RECLAMATION & LAND REHABILITATION

10.6.7.1 LAND RECLAMATION

Mining operation will be carried out in accordance with the Approved Mining Plan along with Progressive Mine Closure Plan. The impact on topography and surface drainage is localized and restricted to mining activity area.

The following mitigative measures will be taken up-

- Levelling and grading of dump surface will be taken up followed by subsequent plantation.
- Slope study of the project site has been carried out through a reputed institute viz. "National Institute of Technology Karnataka" Suratkal (NITK). Recommendations suggested by the Institute in the study report will be followed. If needed, such slope stability study will be carried out further.
- Disposal of waste will be done at earmarked place only.
- The waste dumps will be terraced and will be provided with garland drains at the toe of the dumps, retention walls and series of settling ponds at strategic locations to arrest the silt/sediment from the runoff during monsoon.
- The matured portion of the waste dumps will be stabilized by geo-textile

wherever feasible and will be progressively planted and rehabilitated with suitable native species.

At the conceptual period, waste dumps shall be reclaimed by plantation and thus impact will be minimized.

10.6.7.2 LAND REHABILITATION

Land rehabilitation will involve plantation of saplings of native species generally grown in the state of Goa, comprising of mixed species with more preference given to fruit tree species such as cashew, mango, jamun, avla, etc., which attracts birds. Plantation will be carried out as per CPCB guidelines "Guidelines for Developing Greenbelts" and also in consultation with the state forest and agriculture departments. Fruit trees can generate revenue to the locals in future.

a) Plantation along mining lease boundary

Kalay Mineral Block is already having a 7.5m wide green belt all along the eastern boundary and partly on the western and southern boundary of the Mineral Block. As the Mineral Block shares a common boundary with adjoining mine, there is no green belt on its northern boundary.

b) **Plantation around office building & road**

Avenue plantation already exists around the built-up areas and in open spaces around the office premises.

c) **Plantation on dump slopes**

The matured portion of the waste dumps will be terraced at suitable intervals and the slopes will be stabilized by laying geo-textile wherever feasible and the same will be progressively planted and rehabilitated with suitable native species. Pits of size 60cm x 60cm will be dug at 1.5m interval and filled with a mixture of top soil, organic manure and phosphate fertilizer and covered with a layer of soil held with coir net blanket. Seeds of grass and small scrubs of local varieties will be sprinkled on the soil covering the dump slope. Seedling of the plants will be planted in pit on the slopes.

d) **Plantation on Backfilled areas**

Plantation on the mine benches will be taken up during the final mine closure period. The mine pit, after backfilling and levelling, a layer of lateritic material

will be spread. Grass seeds/ seedlings will be planted to stabilize the soil. Plants having drought hardy, with fast growth rate with glabrous/ pendulous leaves, will be selected for plantation. The reclaimed mine benches will be provided with garland drains sloping along the mining benches to facilitate the conveying of water from higher benches to the next lower benches.

At the conceptual stage around 99.45 ha of the Mineral Block area will be degraded due to pits and excavation. Around 89.87 Ha of area will be reclaimed and rehabilitated by plantation. An area of about 44.14 Ha will be maintained as a water reservoir and an area of about 14.36 Ha will have mining infrastructure like buildings.

The company will adopt the following practices for carrying out scientific and systematic eco-restoration of the mine during the conceptual period:

1. Use of the latest software for mine planning
2. Associating with various research institutes like NEERI, ICAR, ICFRE and consultants for mine reclamation projects as and when required.
3. Associating with various technical departments of state government like Forest department, Agriculture department, Fisheries department, Water Resource department etc.
4. Identifying all the stakeholders and engaging with them in a structured manner throughout the life of the mine. This will help to identify the issues, concerns of the stakeholders and satisfy them in a systematic manner. It will also help to take inputs form the stakeholders in eco-restoration of the mines.
5. Regular Biodiversity Assessment to help the company to achieve a No Net Loss w.r.t biodiversity.
6. Converting of mining pits into water reservoirs, ponds with other ecotourism facilities like water sports, boating, fishing, etc. based on the requirement of the local people.
7. Develop Pisciculture in mine pits and also involve the community for cage fishing to make it a commercially viable venture, based on the requirement of the local people.
8. Developing theme-based gardens like medicinal gardens, horticulture gardens, spice gardens.
9. Converting the mining infrastructure like office buildings, workshops, etc into public utility infrastructure like schools, training center, medical centre, etc.

The objective of the Eco restoration would be to create a positive landscape which will help the community or the mining employees to generate revenue even after the mining operations close. Scientifically developed green belts, water bodies, and other infrastructure.

As per the Approved Mining Plan, green belt development for the 5 year plan period is given in **Table 10.6.**

Table 10.6: Green belt planning during mining plan period

Year	Green Belt Location(s)	Area Proposed to be Covered (Ha)	Number of saplings Proposed	Estimated Expenditure (INR)
1	Dump1	0.60	1500	150000
2	Dump1	0.60	1500	150000
3	Dump1	0.60	1500	150000
4	Dump1 & Along Eastern Block Boundary	0.50	1500	150000
5	Dump1 & Along Eastern Block Boundary	0.50	1500	150000

Potential species suggested for green belt development is listed in **Table 10.7.**

Table 10.7: List of species suggested for future green belt development

S. No.	Botanical Name	Family	Common Name	S/T	Habitat	Height
Shrubs - < 5m (1st tier of Plantation)						
1	*Citrus limon*	Rutaceae	Lemon	T	Shrub	3m
2	*Duranta repens*	Verenaceae	Golden Dew Drop	T	Shrub	3m
3	*Hibiscus rosa sinensis*	Malvaceae	China Rose/ DasavaLa	T	Shrub	3m
4	*Nerium indicum*	Apocynaceae	Oleander/Chandaatha	T	Shrub	5m
Trees 5 - 10m (2nd tier of Plantation)						
5	*Acacia nilotica*	Mimoseae	Gum Arabic/ Babli	T	Tree	8m
6	*Bauhinia varigata*	Caesalpinaceae	Kachnar/ Arisinantige	T	Tree	5m
7	*Annona squamosa*	Annonaceae	Setha palla	T	Tree	6m
8	*Butea monosperma*	Fabaceae	Flame of the Forest/ Muttuga	T	Tree	10m
9	*Gardenia jasminoides*	Rubiaceae	Cape jasmine/ Suvasane Malle	T	Tree	5m
10	*Moringa oleifera*	Moringaceae	Drumstick Tree/Guggala	S	Tree	10m
11	*Pithecellobium dulce*	Mimosaceae	Manilla Tamarind/Seeme hunase	T	Tree	8m
12	*Thevetia peruviana*	Apocynaceae	Mexican oleander	T	Shrub	6m
13	*Phyllanthus emblica*	Phyllanthaceae	Ambla	T	Shrub	7m
Trees >10m (3rd tier of Plantation)						

14	*Aegle marmelos*	Rutaceae	Maredu / Bilva	T	Tree	12m
15	*Albizia lebbeck*	Mimoseae	Siris tree	T	Tree	20m
16	*Albizia procera*	Mimoseae	White siris/Belari	T	Tree	20m
17	*Alstona scholaris*	Apocynaceae	Devil Tree/ Aelele Haale	T	Tree	15m
18	*Azadirachta indica*	Meliaceae	Neem/ Turakabevu	T	Tree	20m
19	*Bambusa vulgaris*	Poaceae	Yellow Bamboo	T	Perennial grass	15m
20	*Cassia fistula*	Caesalpinaceae	Golden Shower/ Kakke	T	Tree	12m
21	*Delonix regia*	Caesalpinaceae	Flame Tree/ Kempu torai	T	Tree	15m
22	*Ficus benghalensis*	Moraceae	Banyan tree/ Aaladamara	T	Tree	20m
23	*Ficus religiosa*	Moraceae	Peepal/ Arali	T	Tree	20m
24	*Mangifera indica*	Anacardiaceae	Mango/ Mavinamara	S	Tree	15m
25	*Polythia longifolia*	Anonaceae	Ashok/Ubbina	S	Tree	15m
26	*Wrightia tinctoria*	Apocynaceae	Alae mara	T	Tree	12 m
27	*Hardwickia binata*	Fabaceae	Small leaves	T	Shrub	6m
28	*Syzygium cumini*	Myrtaceae	Neredu/ Neereedu	T	Tree	20m
29	*Tectona grandis*	Verbenaceae	Teak	T	Tree	20m

e) **Post-Plantation Care**

Post-plantation care is very important and will be an integral part of mine management. Dedicated manpower will be engaged in the mine for post-plantation care, the activities of which include, regular watering, de-weeding, manuring, providing protective measures to protect planted saplings, etc. Diseased and dead plants shall be replaced by fresh saplings.

Regular monitoring of the survival rate and remedial action will be done in an organized and planned manner.

10.7 WILDLIFE MANAGEMENT AND CONSERVATION PLAN

Wildlife management needs to consider multifaceted factors such as food-web, resources competitions, anthropogenic factors, forest fragmentation and sociological issues such as community livelihoods, culture, ethics, forest dependency, etc.

Detailed Wildlife Conservation Plan is enclosed as Appendix-1 and the acknowledgement from Chief Wildlife Warden is enclosed as Annexure-8.

Total of 48 species of fauna falls within the category of Wildlife Protection Act 1972 and amendment 2022 under Schedule I. The details of each species is given below in

Table 10.8.

Table 10.8: List of Scheduled I Wildlife species

S. No.	Local Name	Scientific name	Family	WPA-Schedule
	Mammal			
1	Common grey mongoose	*Urva edwardsii*	Herpestidae	LC/I
2	Indian porcupine	*Hystrix indica*	Hystricidae	LC/I
3	Malabar gain squirrel	*Ratufa indica*	Sciuridae	VU/I
4	Common leopard*	*Panthera pardus*	Felidae	VU/I
5	Leopard cat*	*Pronailurus bengalensis*	Felidae	LC/I
6	Wronghto's Gaint Mastiff Bat*	*Otomops wroughtoni*	Molossidae	LC/I
7	Slender Loris	*Loris lydekkerianus*	Lorisidae	NT/I
8	Tiger*	*Panthera tigris*	Felidae	EN/I
9	Mouse Deer	*Moschiola indica*	Tragulidae	LC/I
10	Four Horned Antelope*	*Tetracerus quadricornis*	Bovidae	VU/I
11	Gaur or Indian Bison	*Bos gaurus*	Bovidae	VU/I
12	Indian Pangolin*	*Manis crassicaudata*	Manidae	EN/I
13	Sloth bear*	*Melursus ursinus*	Ursidae	VU/I
14	Small Indian civet*	*Viverricula indica*	Viverridae	LC/I
15	Bonnet macaque	*Macaca radiata*	Cercopithecidae	LC/I
16	Wild dog*	*Cuon alpines*	Canidae	EN/I
	Birds			
17	White-bellied Sea-Eagle	*Haliaeetus leucogaster*	Accipitridae	LC/I
18	Indian Peafowl	*Pavo cristatus*	Phasianidae	LC/I
19	Shikra	*Accipiter badius*	Accipitridae	LC/I
20	Osprey	*Pandion haliaetus*	Pandionidae	LC/I
21	Chestnut Bittern*	*Ixobrychus cinnamomeus*	Ardeidae	LC/I
22	Cotton Teal	*Nettapus coromandelianus*	Anatidae	LC/I
23	Brahminy Kite	*Haliastur indus*	Accipitridae	LC/I
24	Long-billed Vulture *	*Gyps indicus*	Accipitridae	CR/I
25	Crested Serpent Eagle*	*Spilornis cheela*	Accipitridae	LC/I
26	Eurasian Marsh Harrier *	*Circus aeruginosus*	Accipitridae	LC/I
27	Crested Goshawk	*Accipiter trivirgatus*	Accipitridae	LC/I
28	Besra Sparrowhawk*	*Accipiter virgatus*	Accipitridae	LC/I
29	Black Eagle*	*Ictinaetus malayensis*	Accipitridae	LC/I
30	Crested Tree-swift	*Hemiprocne coronate*	Hemiprocnidae	LC/I
31	Brown Wood Owl	*Strix leptogrammica*	Strigidae	LC/I
32	Common Hill-Myna	*Gracula religiosa*	Sturnidae	LC/I
33	Grey Junglefowl	*Gallus sonneratii*	Phasianidae	LC/I
34	Nilgiri Wood Pigeon	*Columba elphinstonii*	Columbidae	VU/I
35	Small Minivet *	*Pericrocotus cinnamomeus*	Campephagidae	LC/I
36	Forest Eagle-Owl *	*Bubo nipalensis*	Strigidae	LC/I

	Reptiles			
37	Indian Rock Python*	*Python molurus molurus*	Pythonidae	NT/I
38	Marsh Crocodile *	*Crocodylus palustris*	Crocodylidae	VU/I
39	Indian Falpshell Turtle *	*Lissemys punctata*	Trionychidae	VU/I
40	Common Indian Monitor Lizard	*Varanus bengalensis*	Varanidae	NT/I
41	Russell's Viper	*Daboia russelii*	Viperidae	LC/I
42	Cobra	*Naja naja*	Elapidae	LC/I
43	King cobra*	*Ophiophagus hannah*	Elapidae	VU/I
44	Green Forest lizard	*Calotes calotes*	*Agamidae*	LC/I
45	Checkered Keelback	*Fowlea piscator*	*Colubridae*	LC/I
46	Common Kukri Snake*	*Oligodon arnensis*	Colubridae	LC/I
47	Whitaker's Boa*	*Eryx whitakeri*	Boidae	NT/I
48	Common Indian monitor lizard	*Varanus bengalensis*	*Varanidae*	NT/I

10.7.1 BRIEF MITIGATION MEASURES FOR CONSERVATION OF WILDLIFE

i. Water holes for habitat improvement

Animals and birds need a regular water source for their daily consumption. During hot summer wild animals and birds stray outside forest in search of water source for quenching thirst. It is therefore proposed to construct water holes in the forested area in the buffer zone at convenient points. These water holes should be large enough to store the water to meet the 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 should be 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 for nesting and food for birds and shade for wild animals.

ii. Noise levels

During mine operations, noise levels will increase due to the movement of HEMM. Similar to human beings, the wildlife is also sensitive to higher noise levels. To reduce the noise levels during mining operations the following measures are proposed.

- Use of well-maintained loading machines with sharp bucket teeth
- Well-maintained roads.
- No over speeding of vehicles
- No drilling and blasting is proposed.

- State-of-the-art HEMM will be engaged for mining operations, which will have less noise emission and also provide acoustic insulation for the operators.
- Reduction of noise level is achieved by proper maintenance of machinery and equipment.
- Vehicular traffic within the mine will be restricted by reducing the number of trips, using heavy-duty trucks.
- PUC-certified trucks will be engaged for the transportation of ore.
- Interruption of noise path from the source to the receiver is achieved by the development of 7.5m wide green belt.

Periodical monitoring of noise levels will be carried out in the core and buffer zone.

iii. Air Quality:

Ambient air quality shall be maintained within prescribed CPCB limits. For this, the following steps are proposed-

- Regular sprinkling of water on haul roads within the mining area.
- No overloading of transport tipper trucks to avoid spillage of ore and carriers of ore-carrying tipper trucks will be covered with tarpaulins.
- Green belt development around the mine area and avenue plantation with thick foliage to arrest dust.

iv. Green Belt Development

Green belt of 7.5m width will be developed along the periphery of the Mineral Block area. The green belt developed will help mitigate the effects of air and noise pollution from the Project activity.

The species proposed to be planted shall be selected based on the criteria prescribed by CPCB as "Guidelines for Developing Greenbelts" and also in consultation with the local forest department.

v. Training staff and Awareness activity:

All the mine workers and staff shall be provided awareness and training in the conservation of wildlife and develop a liking for wildlife conservation by celebrating Environment Day involving local village people and school students.

The drivers shall be trained to give way for wildlife with the support of the local

forest department.

The villagers are also made aware of wildlife conservation by conducting meetings using pamphlets, audio and video means. Various biodiversity/wildlife awareness activities like conducting quizzes, drawings, painting competitions and essay writing for school students.

Villagers are awarded for their contribution towards protecting and preventing wood theft and tree cutting helping Forest Dept. in catching Poachers. Conservation activities for the protection of flora & fauna shall be implemented in consultation with Forest Department officials.

vi. Watch towers:

One machan (watch tower) shall be erected near the water reservoir to prevent any poaching in the area.

vii. Fund for wildlife conservation:

The approved wild life conservation plan will be implemented by forest department and financially supported by the project proponent. The budgetary allocation of funds towards wildlife conservation shall be **12.5 Lakhs** for five years.

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.
- Rock fill dams and check dams shall be constructed in the forest area of buffer zone to prevent the soil erosion. This will be able to store sufficient quantity of filtered water in the area and will act as water holes for the faunal life present in the region.

- 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.
- Awareness programme for the local people/schools 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 rakes, shovels, billhook, bucket etc. and suitable dresses.

The forest department has to carry out conservation of wildlife in the protected and forest areas. The Project Proponent will support the department by allocating and providing funds for implementation of scheme for conservation of wildlife. The measures for protection of environment within the core zone (Mineral Block) would be the responsibility of Project Proponent and will be carried out as required.

10.8 BUDGET FOR ENVIRONMENT MANAGEMENT PLAN (EMP)

Table 10.9: EMP Cost.

Details	Capital Cost (Rs.) one time	Recurring Cost (Rs.) per annum	Remarks
Plantation	1,50,000	45,000	Capital cost towards plantation and laying of drip irrigation system.
			Recurring cost towards post plantation care and maintenance of drip irrigation.
Continuous Environment monitoring	30,00,000	1,00,000	Air, water, Noise, CAAQMS, AMCs
Air pollution control measures	25,00,000	30,00,000	Capital cost towards wheel wash, manual road sweeping machine and water sprinkling system.
			Recurring cost towards – 1) dust suppression in mines, maintenance of roads.2) annual maintenance of wheel wash system, 3) water supply to wheel wash system, 4) operation of road sweeping machine, 5) road washing with

			water tanker
Water pollution control measures and monsoon measures	5,00,000	3,00,000	
Personal protective equipment	0	3,00,000	safety shoes & gumboots, helmet, ear plugs, dust masks, goggles
maintenance of fire protection systems	100000	1,60,000	
Environment awareness & training	0	1,50,000	
Health	2,50,000	4,90,000	
Total	74,00,000	45,45,000	

10.9 ENVIRONMENTAL MONITORING STRATEGY

Environmental quality monitoring is an important feature to monitor the efficiency of various mitigation measures implemented in the Project during its operation.

For analysis of Environmental Parameters and monitoring, services of an approved and recognized laboratory will be engaged. A budgetary allocation of Rs. 16,40,000/- lakhs/annum have been earmarked for Environmental monitoring. A comprehensive monitoring programme is given under.

Table 10.10: Monitoring Schedule for Environmental Parameters

S. No.	Particulars	Frequency of Monitoring	Sampling	Parameters Required to be Monitored
Air Quality				
1	Ambient Air quality in and around the Mine	Twice a week	24 hours continuously	PM2.5, PM10, SO2 & NO2
Water Quality				
2	Water Quality around the Mine	Once in a Month	Grab Sampling	As per IS: 10500
Noise Level Monitoring				
3	Ambient Noise levels in and around the Mine	Once in a Quarter	Continuous for 24 hours with 1 hour interval	Noise Level
Soil Quality				
4	Soil Quality around the Mine	Once in a year	Grab Sampling	IS: 2720

10.10 OCCUPATIONAL SAFETY AND HEALTH PLAN

Occupational Safety and health plan to evaluate the impacts of mining on the health of employees shall be carried out in accordance with Rule 29B of the Mines Rule, 1955 and the same will be adhered to as a Health Policy. Such health policy will be

implemented until the life of the mine.

10.10.1 HEARING IMPAIRMENT

The most significant occupational health hazard is noise induced hearing loss. There are no reported cases of hearing loss due to noise pollution as per the observation of local doctors. Mining authorities will conduct periodic health checkups for any hearing impairment of employees.

10.10.2 SKIN DISEASES

According to local doctors, 2.2 per cent of the patients have suffered from skin diseases, which is because of lack of personal hygiene rather than due to mining. The company will maintain good sanitary conditions in an around the mineral block premises and also impart awareness on sanitization and personal hygiene to the employees.

Mining authorities will conduct health checkups to detect any skin allergies among employees.

10.10.3 EYE DISEASES

According to local doctors, patients suffering from eye related problems are low. Eye infections are generally not related to dust pollution and is mostly due to general bacterial infection and old age. Mining authorities will take adequate precautionary measures to minimize dust pollution. Further, mining authorities will conduct periodic health checkups to detect eye diseases among employees.

10.10.4 JOB STRESS BECAUSE OF WORKING IN ACCIDENT PRONE ENVIRONMENT

The job stress is expected to be low because of incentives like providing food in workplace, weekly holidays and recreational facilities.

10.10.5 RESPIRATORY DISEASES

Iron ore does not contain any toxic elements in it. Hence, the possibility of any health hazards due to such toxic elements does not arise. The most observed occupational health hazard is lung diseases due to inhalation of respirable dust. However, management will take necessary measures to minimize such occupational health hazards.

The percentage of Pneumonia episodes observed in the buffer zone is 0.11, which is very low. The percentage of Asthma or Bronchitis is moderately high 3.7. Pneumonia and Asthma episodes are because of vices like consumption of tobacco and alcohol, especially among males. Mining authorities will conduct periodic health checkups for any respiratory infections amongst employees.

10.10.6 HAZARDS DUE TO MATERIALS LIKE ASBESTOS, SILICA, CHROME DUST, ETC.

Hazardous materials such as Asbestos, Silica, Chrome dust, etc. are not utilized /generated in the said Project, either for construction or for any other use. Hence, there is no risk associated.

10.11 OCCUPATIONAL SAFETY

10.11.1 PROVISION OF REST SHELTER FOR WORKERS WITH FACILITIES OF DRINKING WATER

Rest room with fresh drinking water and toilet facilities with running water for wash will be provided at the work site for all employees. Canteen and Dispensary shall also be provided.

10.11.2 AWARENESS OF SAFETY AND USE OF PERSONAL PROTECTIVE EQUIPMENT (PPE)

All employees will be made aware of safety measures to be followed at the work site. Awareness programmes will be conducted by professionals who have graduated in the industrial safety. All the workers will be given helmet, gum shoes, safety shoes, etc.

10.11.3 REGULAR MAINTENANCE OF TESTING OF EQUIPMENT

The safety and testing of equipment will be carried out as per statutes.

10.11.4 MEDICAL EXAMINATION OF ALL EMPLOYEES

Medical examination of all the employees will be carried out in accordance with Rule 29B of the Mines Rule, 1955.

10.11.5 SAFETY MEASURES OF RISK ASSESSMENT IN UNDERGROUND MINING

There is no underground mining activity

10.11.6 CONDUCT OF MOCK DRILL

Mock drill will be regularly conducted for all the emergency situations identified, like fire, land slide, drowning, etc.

10.11.7 SAFE STORAGE OF HANDLING OF EXPLOSIVES

Drilling and blasting is not proposed.

10.12 SOCIO-ECONOMIC CONDITIONS OF THE REGION

10.12.1 MEDICAL ASSISTANCE

First-aid centre will be established in the mine premises. Regular health check-ups for employees will be conducted as per provisions under Rule 29B of Mines Rules 1955. Health camps will be conducted in surrounding villages.

10.12.2 PRIMARY EDUCATION

Budgetary provision will be made to provide assistance to school children, by providing school uniforms, books, scholarships to underprivileged and meritorious students.

Imparting employability training, vocational courses and skill development will be planned.

10.12.3 RURAL WATER SUPPLY

All the villages are connected with government water supply. In case of any such requirement support will be provided to strengthen the government system.

10.12.4 VOCATIONAL TRAINING

Vocational training will be included in the welfare programs in future. It is going to be an important welfare program that can counter the unemployment.

10.12.5 EMPLOYMENT

The mining project will create direct and indirect employment opportunities in the surrounding villages. Apart from direct employment in the mines, indirect employment/business opportunities will be generated like canteen, engaging local trucks for transportation of Iron ore.

10.12.6 COMMUNICATION AND ACCESSIBILITY

All Villages are well connected by roads leading to taluka or district headquarters.

Chapter-11

Summary & Conclusion

This Chapter provides the summary of the Key Project Parameters along with overall justification for implementation of the project and explanation of how the possible impacts have been mitigated as required under the generic structure of Appendix III of the EIA Notification 2006. Further, the conclusion on the studies undertaken is also included in this Chapter.

11.1 INTRODUCTION

In pursuant to the notice inviting tender dated 30.09.2022 by the Government of Goa in accordance with Mines and Minerals (Development and Regulation) Act 1957, and the Mineral (Auction) Rules, 2015 and as amended from time to time, declared Fomento Resources Private Limited intends to obtain prior Environmental Clearance from MoEF&CC for a production of 0.75 MPTA of iron ore in Block-IV Kalay Mineral Block located in Santona village, Sanguem Taluka, South Goa District, Goa.

The e-auction process was conducted in accordance with the Tender Document for said Mineral Block. Fomento Resources Private Limited emerged as the highest qualified bidder having submitted the highest final price offer and was declared as the preferred bidder under Rule 9(9) (iii) of Auction Rules.

Further, upon submission of the first instalment, being 20% of the upfront payment, Government of Goa issued a Letter of Intent (LOI) vide letter no. DMG/25/Auction Cell/LOI-function/2023/2804 dated 13.01.2023 for the grant of a mining lease for Block-IV – Kalay Mineral Block in Santona village, Sanguem Taluka, South Goa District, Goa over an extent of 152.5073 Ha for a period of 50 years.

11.2 PROJECT DESCRIPTION

The Block area of 152.5073 Ha falls under Block-IV – Kalay Mineral Block in Santona village, Sanguem Taluka, South Goa District, Goa.

The proposed lease area is having about 16.731 million tonnes of mineral reserves & resources. The mined Iron Ore shall be utilized at the domestic and export markets.

The block area falls under Toposheet No. D43C3, Survey of India and bounded by latitude of 15° 17′ 01.6125″ N to 15° 17′ 58.2803″ N & longitude of 74° 09′ 03.3467″E to 74° 08′ 55.2583″ E. The general elevation of ML area varies from 102 m to -0.5 m above MSL. State Highway SH-7 is about 2 km from ML area, the nearest Railway station is Kalay Railway station which is at a distance of 4 km by road, and the nearest Airport is Dabolim Airport at a distance of 49 km.

The Office of the Principal Chief Conservator of Forest, Panaji, Goa, vide its letter No. 6-13-(177)-2024-25-FD/ 1088 dated 19/06/2024, informed that Block IV - Kalay Mineral Block includes Unclassed Forest area of 18.2210 Ha. and Prospective Private

Forest area of 2.901 Ha. within the Mineral Block area of 152.5073 Ha. Accordingly, an application has been filed under Section 2 of Forest Conservation Act, 1980, bearing proposal no. FP/GA/MIN/QRY/472990/2024 dated 15/05/2024, for diversion of the said Forest land.

11.3 ENVIRONMENTAL SENSITIVITY

No National Park, Wildlife Sanctuary or Migratory Corridors of Fauna is present inside the Project Site. The Bhagwan Mahaveer Wildlife is about 1.04 km from Mineral block boundary. Seasonal Nallah Flows W-E across the Mineral Block, Kalay River runs along Eastern Boundary of the Mineral Block from S-N is about 0.005km

11.4 GRANT OF TOR AND BASE LINE DATA COLLECTION

ToR was granted by MoEF & CC vide its TOR Identification No. TO23B0000GA5122365N dated 08/01/2024.

Condition no. 2.1 of ToR stipulates as under:

> *"2.1 PP shall submit a certificate from Chief Conservator of Forests regarding involvement of Forest Land in the mining lease area if any. In case forest land is involved i) PP should submit the proof of application made for obtaining forest clearance and ii) a map clearly showing the forest & nonforest area."*

In compliance to the above condition no. 2.1, subsequent to our communication, Office of the Principal Chief Conservator of Forest, Panaji, Goa, vide its letter No. 6-13-(177)-2024-25-FD/1088 dated 19/06/2024, informed that Block IV - Kalay Mineral Block includes Unclassed Forest area of 18.2210 Ha. and Prospective Private Forest area of 2.901 Ha. within the Mineral Block area of 152.5073 Ha.

In view of the involvement of the forest area within the Mineral Block, the Project Proponent filed an online application on PARIVESH Portal of MoEF&CC for amendment in ToR granted on 08/01/2024. The MoEFCC was pleased to amend the TOR dated 08/01/2024 by addition of following specific conditions as mentioned in the Amended TOR dated 19/11/2024. TOR dated 08/01/2024 and TOR amendment dated 19/11/2024 was used as guidelines to prepare the Environmental Impact Assessment and Environmental Management Plan.

Baseline study was carried out during Summer Season i.e. during March to May, 2023.

11.5 MINING METHODOLOGY

The proposal is for obtaining environment clearance for 0.75 Million tonnes per year with overall overburden ratio of 1: 7. Mining operations will be by way of mechanized opencast method without drilling & blasting, complying with all the statutory requirements using Heavy earth moving machineries like Rippers & Dozers, shovels, trucks, wheel loaders and trucks. Rippers & Dozers will be used for ripping of hard material and wheel loaders are used for loading and dozers for levelling. The Run of Mine (ROM) Iron Ore will be subjected to dry crushing and screening. Finished product (Lumps & Fines)/ROM will be sold to domestic steel industries and for export markets. The ore transportation from mine to the jetty will be carried out by trucks with the capacity of 10.5 Tonnes.

11.6 PRODUCTION, RESERVES AND LIFE OF MINE

The total reserves/resources as on 01.02.2023 are 16.731 Million Tonnes, which is considered for defining the Life of the Mine. The life of the mine will be 24 years which may enhance based on the future results of exploration planned during the Mining Plan period. However, the lease is valid for 50 years.

11.7 MANPOWER, WATER & POWER REQUIREMENT

MAN POWER: The Project shall provide direct employment to about 127 people, which includes mine officials, skilled, semi-skilled and unskilled labour and about 200 indirect employment opportunities to the locals. Over and above a lot of indirect employment will be generated in the form of contracts like transportation, plantation, workshops and garages, and allied activities .

WATER REQUIREMENT: The Water Requirement of the Project is estimated to be maximum 300 KLD. Out of this, 8 KLD of the water is required for domestic, 10KLD for green belt, 50KLD for wheel washing, 10KLD for workshop and the balance 222 KLD for dust suppression. The entire water requirement except that of domestic consumption will be met through Rain water harvested within the mine pits. Efforts will be put for reduction of specific water consumption year on year.

POWER REQUIREMENT: 1.64 MW/day which will be sourced from Government Power Grid, a diesel generator having 82.5 KVA capacity will be utilized as a backup in case of power failure. LED lights will be used, within the office and workshop premises. Feasibility of using Solar energy for office area will be carried out. Diesel Fuel is used by Heavy Earth Moving Machineries like excavator, loader and

transport vehicles etc. Trials of using electric HEMM like wheel loaders and excavators will also be taken up.

11.8 RESETTLEMENT & REHABILITATION

There is no proposal for Resettlement & Rehabilitation during the entire life of the mine.

11.9 DESCRIPTION OF THE ENVIRONMENT

The Block-IV Kalay Mineral Block is the core zone for the present EIA study. The area encompassing 10 km radius from the boundary of the core zone has been defined as the buffer zone. The core zone and the buffer zone together constitute the study area.

The Baseline Environmental data with respect to Air, Water, Noise and Soil Quality in the study area for the present EIA study is collected for the Summer Season 2023. The various studies on hydrogeology, flora, fauna, and socioeconomic study were also conducted during the same period. Sampling and analysis has been carried out by M/s. Environmental Laboratory (Unit of Mineral Engineering Services), Bangalore, Laboratory accredited by NABL and recognized by CPCB/MoEF&CC.

11.9.1 TOPOGRAPHY

The topography of the Study area is undulating & hilly with gentle gradient of 10 to 20 degrees. Highest elevation in the study area is 640 m MSL in south east direction.

In the core zone the highest level is 102 m MSL towards North East of lease on Dump no. 1 and lowest level is -0.5 m MSL towards North of lease in pit no.3. There is a seasonal nalla flowing across the block from west to east and joins Kalay River flowing towards the eastern side of the block boundary.

11.9.2 DRAINAGE

The drainage pattern is dendritic in the study area of 10km buffer zone with many first order streams originating from the hill top downwards flowing into major rivers. The study area comprises of the rivers such Kalay River, Zuari River and Dhudsagar River. The main drainage for this mineral block is the Kalay River flowing from South to North towards the eastern side of the block boundary. The catchment area of Kalay River is all high ground towards eastern side of the block upto a distance of 5 to 6 kms from Kalay River.

11.9.3 AMBIENT AIR QUALITY

For Ambient air quality, 8 stations have been fixed covering all the directions, the frequency of monitoring is 2 days/ week for 3 months and the parameters covered were as per CPCB NAAQS guidelines.

The statistical analysis of Ambient Air Quality is as follows, the maximum values of SO_2, NO_2, PM_{10} & $PM_{2.5}$ in the core zone are observed to be 15, 18, 57 & 42 μg/m3 respectively.

All the parameters including CO, Pb, and O3 as per NAAQS are monitored and monitoring results compared to AAQ are observed to be well within the limits.

11.9.4 NOISE LEVELS

For noise quality 8 stations including one station in core zone and 7 in buffer zone villages were monitored and Leq during day & night are observed. The Leq value during day in the core zone is observed as 44.9 dB(A) and in night 38.7 dB(A) and in buffer area it is observed as in day 50.2 dB(A) and in night 35.0 dB(A) monitoring results when compared to Noise Quality Standards are well within limits.

11.9.5 WATER QUALITY

Water Quality Monitoring was done by grab sampling once in a season for 5 surface Water, 1 Pit water and 8 Ground Water samples. IS: 3025, APHA, & IS:1622 standards are used for analysis. Thus, the analysis results are compared to IS standards, IS 422E, IS: 2296 & IS: 10500:2012. The results of one location i.e., Zuari river surface water samples show high TDS and Chlorides. This is mainly because of the influence of creek water. The open well samples were found to have pH slightly acidic in nature. This is due to the occurrence of lateritic ore. Whereas other parameters are within permissible limits of respective standards.

11.9.6 SOIL QUALITY

Soil Quality Monitoring at 7 locations including one from the ML area and others from nearby village agricultural fields are collected and analyzed, during the study period for Physical Parameters and chemical parameters. They are all observed to be within normal soil quality fit for cultivation.

11.9.7 LAND ENVIRONMENT

The existing major land use of study area covering 10 km radius are 2.07% of water bodies, 33.83% reserve forests, 13.99 % dense reserve forest, 3.49% of agriculture land, 15.55% of barren/grass land, 22.53% of Vegetation and 4.59% of Settlement area.

After the ore is exhausted in the pits the broken-up land will be backfilled and will be progressively planted and rehabilitated with local species like Cashew, mango, Jamun, Cocum, Terminalia etc. All the efforts will be taken for maximum survival and growth of the plants.

11.9.8 BIOLOGICAL ENVIRONMENT

The Mine area is located at the distance of around 1.04 km from the Bhagwan Wildlife Sanctuary, however, mine management could work with downstream riparian and forest and assist in ecological restoration as per the species suggested in EMP.

The Mine pit area is already degraded and away from community settlement usage, hence there is not much additional impact or social constraints.

In case of conservation of flora and fauna as suggested in EMP, greenbelt shall be developed all along the boundary, unused areas, inactive dump slopes and roadside of core and buffer areas. The core area have flora of about 45 species and fauna found to be 15 species in core area. The proposed biodiversity management plan will be implemented as per the standard guidelines prescribed by regulatory authorities.

Budget allocations and time bound interventions will be monitored by local authority to ensure that the conservation of biodiversity and no damage occurs to the existing ecosystem habitats in the study area.

The dominant species in the reserved forest were Anacardium occidentale, Cassurina equisatifoilia and Acacia auriculiformis, which have been promoted significantly on both private and degraded government land.

The Mango and Coconut orchards is significantly promoted to farmers on agricultural bunds and house backyards. There are no endangered or endemic species of flora or fauna in the core zone.

11.9.9 SOCIO-ECONOMIC ENVIRONMENT

There are 48 villages in the buffer zone. These villages are in Sanguem, Satari, Ponda, Quepem & Salcete talukas of South Goa district of Goa state. The total population of these villages is 113340 according to census 2011.

Usually, villagers grow coconuts, cashew or mango in the small piece of land. In the absence of mining activity, agriculture and tourism are the only source for employment.

The infrastructure and amenities available in the study area denotes the economic well-being of the region. It is observed that good infrastructure facilities are available in the project study area, which consists of education, health care, drinking water facilities, communications, transportation, etc.

Due to the proposed mining activity, no significant adverse changes are visualized in the traditional way of life of the people residing in the villages in the buffer zone. Further people residing in the nearby villages will be benefited by the direct and indirect employment opportunities created by the mining activities along with the various socio-economic development activities proposed by the company. The communication, health and education facilities will improve and thus the mining activity will be beneficial and will have a positive impact in the region.

11.10 ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION *MEASURES*

The Block-IV Kalay Mineral Block is yet to start mining and shall operate taking all precautionary measures to reduce the impact of mining operations on Air, Water, Noise and Soil and ensuring all control measures to comply with the prescribed standards.

11.10.1 AIR ENVIRONMENT

The impacts on Air Environment are assessed through Aermod Modelling and results show the cumulative impacts on the surrounding buffer zone villages after commencement of mining operations are within the permissible limits

Following measures will be undertaken to control the Air pollution/dust generation during the mining activities: -

- Due to high inherent moisture of the ore as well as waste, generation of dust while loading will be minimal. Speed limit of transport vehicles will be enforced.

- Transportation trucks will be loaded to the prescribed capacity and covered with tarpaulin.
- Dust sprinkling system with a fine mist spray will be used for dust suppression along the road as well as stacks.
- The dump slopes will be covered with geotextiles, which will prevent generation of dust. During the monsoon the finalized geotextile laid areas will be taken up for plantation.
- Plantation done on the slope of waste dump itself act as a wind breaker.
- Latest machinery having air-conditioned cabin will be used for loading and dozing operations.
- Proper maintenance of transport machinery with regular PUC will be done.
- Providing acoustic enclosure and proper exhaust chimney height to DG set.
- Proper dust suppression measures at crushing and screening plant.
- General aspects of air quality management will be included in induction training to be provided to all employees.

11.10.2 WATER ENVIRONMENT

The rain water is diverted into mine pits which is used for various mining activities like dust suppression, vehicle washing, gardening etc. Though the ground water shall be encountered in the pit, there shall be no adverse impact due to pit dewatering. The protective measures in the form of garland drainages, trenches, settling tanks, retention wall application of coco logs will be undertaken to control the water pollution.

Thus, there shall be no adverse impacts on surface and ground waters. In fact, the local villagers will be benefited by supply of pit discharge water after treatment.

11.10.3 NOISE ENVIRONMENT

Maximum noise is produced from operation of earth moving machineries & movement of truck s. No drilling and blasting operations are involved. Wide green belt shall be provided surrounding mineral block to attenuate noise pollution. Regular maintenance of mining equipment, machinery & all vehicles as per the manufactures recommendations to minimize the Noise generation shall be followed.

Following management measures will be adopted to control noise levels:

1. Provision of acoustic cabins for operators deployed on HEMM
2. Selection of new low-noise equipment from the manufactures failing which use of additional retrofits if available.
3. Green belt developed all around the mine acts as an acoustic barrier.

11.10.4 IMPACT ON LAND ENVIRONMENT

At the conceptual stage around 99.45 ha of the Mineral Block area will be degraded due to pits and excavation. Around 63.8347 ha of area will be reclaimed and rehabilitated by plantation. An area of about 44.14 ha will be maintained as a water reservoir and an area of about 14.36 ha will have mining infrastructure like buildings.

This water reservoir will serve in augmenting the ground water condition of the region and also the pit discharge water will be supplied to local villagers for agricultural purpose.

11.10.5 IMPACT ON BIOLOGICAL ENVIRONMENT

As there exists schedule I species falling within 10 km radius of the mineral block, a full-fledged biodiversity assessment study has been taken up by the proponent along with wildlife conservation plan with financial outlay to assist the local forest department. The proponent shall take mitigation steps within ML area for immigration of wildlife through massive afforestation.

11.10.6 IMPACT ON SOCIO ECONOMIC ENVIRONMENT

This mine shall provide direct employment to about 127 people, which includes mine officials, skilled, semi-skilled and unskilled labour and about 200 indirect employment opportunities to locals in the form of hired truck drivers, hired machine operators, local workshops, contract workers for construction works like parapet wall, work of covering trucks with tarpaulin, plantation work, cleaning works etc. The mining activities help in sustainable development of this area including further development of physical & social infrastructural facilities.

The mining activity provides revenue to the state and center in form of taxes and royalty etc. The project proponent shall assess the health conditions of the workers as per the DGMS guidelines. Noise, air, water quality will be maintained well within the limits.

11.11 ADDITIONAL STUDIES

In additional studies, Risk Analysis followed by Disaster Management Plan, which will help in identifying the possible risks and to promote towards preparedness to counter any mishap. Risk analysis and disaster management plan have been prepared and incorporated in EIA Report.

11.12 ENVIRONMENT MANAGEMENT PLAN

A Comprehensive Environment Management Plan including development of Green Belt has been suggested. Identification of all potential environmental impacts of a project is an essential step of Environmental impact Assessment. These are critically examined and major impacts are further studied. In case of mining projects, change in topography and land use, air pollution, water pollution, waste management, biodiversity and socio-infrastructure issues are significant. The Mine will be operated taking all precautionary measures to reduce the impact of mining operations on Air, Water, Noise and Soil and ensuring all control measures to comply with the prescribed standards. The impact of change of land use will be positive only, as a part of abandoned pit is partially backfilled and afforested and balance portion is left as water reservoir which is beneficial to local villagers. Development of green belt along the boundary of ML area will ensure a better environment.

11.13 CORPORATE SOCIAL RESPONSIBILITY

The Project Proponent proposes to undertake a number of activities under the Corporate Social Responsibility Initiative during the operation of Mining Project. The capital CSR Budget has been worked out as per the expressed felt needs of villagers during Rapid Rural Appraisal. The proposed budget is to the extent Rs. 30 Lakhs / year and will be spent in villages of study area.

11.14 CORPORATE ENVIRONMENT RESPONSIBILITY

In addition to the CSR, the Lessee proposes to undertake a number of activities as one time measure under the Corporate Environment Responsibility Initiative during the operation of Mining Project.

Necessary budgetary provisions will be made after obtaining the response from locals during the Public Hearing for implementing the CER Activities in line with the MoEF&CC OM dated 30th September 2020 and 20th October 2020.

11.15 ENVIRONMENTAL MONITORING PROGRAM

Environmental monitoring is required to know the Quality of Ambient Air, Water and Noise Levels during the operation phase of the proposed project and take required corrective measures, in case of any non-compliance with the norms stipulated by regulatory authorities. The methodologies adopted for environmental monitoring will be in accordance with the CPCB, SPCB and Indian Bureau of Mines requirement.

11.16 EXPLANATION ON HOW ADVERSE EFFECTS ARE MITIGATED

The EIA/EMP Report has established the Base Line Environment of the Project Area and has assessed anticipated impacts of the Project on the overall ecology & environment. Accordingly, general as well as specific mitigation measures for management of the Key Environmental Parameters have been suggested. Further, specific measures towards monitoring and implementation of the Environment Management Plan along with details of the funds required towards implementation of the Pollution Control Measures are also included in the Report. By implementing the suggested Environment Management Plan adverse effects of the Project can be mitigated.

11.17 CONCLUSION

The Block- IV Kalay Mineral Block is newly auctioned mineral block. The Impacts predicted for various Environmental Attributes were found to be on the positive scale. The EMP proposed will have a positive impact on the surrounding environment and the landscape of the area. The local population will be benefitted from this project by way of employment and CSR activities carried out by the company.

Chapter-12

Disclosure of Consultants Engaged

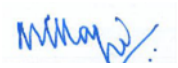
DISCLOSURE OF CONSULTANTS

Declaration by ACO and Experts contributing to the EIA Report

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

EIA coordinator (EC): M. S Raju

Name: M.S Raju

Signature and Date: 

Period of involvement: Mar to Till now

Contact information: 080-25432969

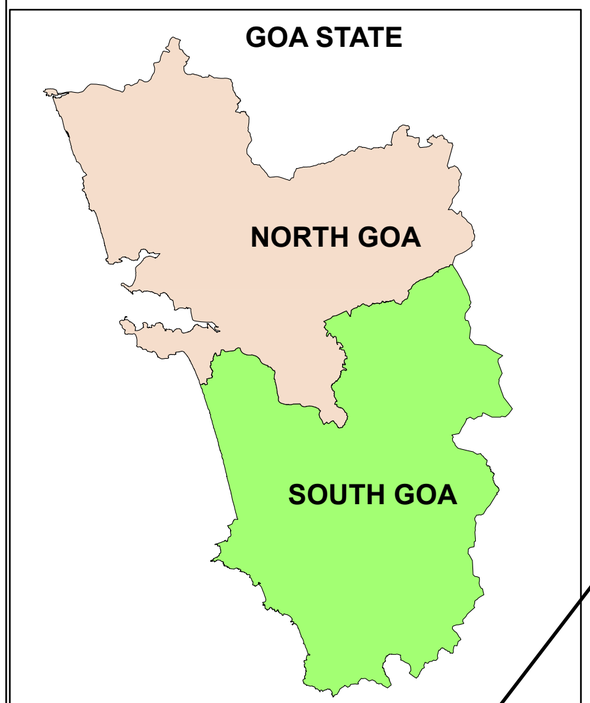
Functional area experts:

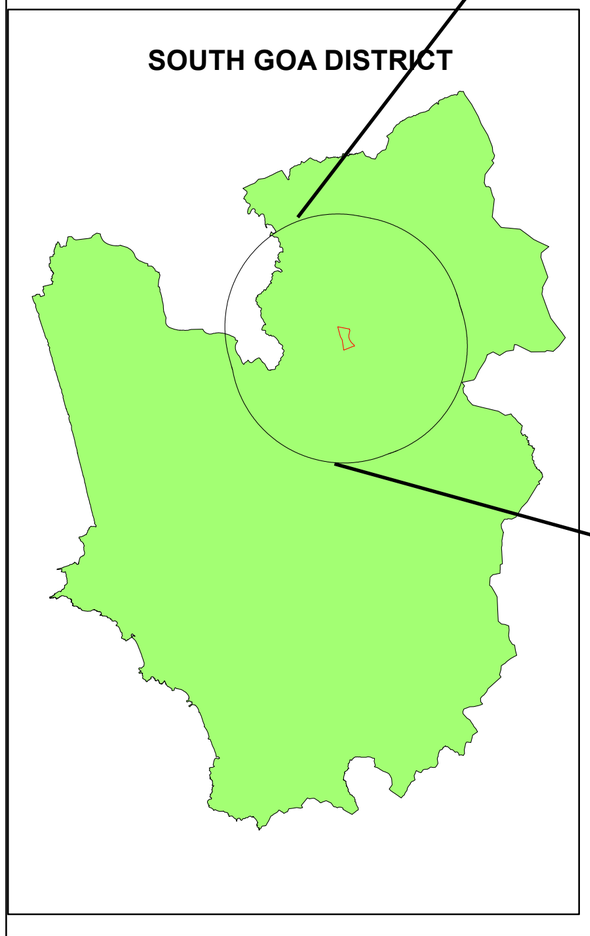
S. No.	Functional areas	Name of the expert/s	Involvement (period and task**)	Signature and date
1	AP	M. Sachin Raju	Mar to Jun 2023	
	Team Member :AP	M.R.Durga Prasad	Mar-2023 to Jun-2023	
2	WP	M.Sachin Raju	Mar to Jun 2023	
	Team Member :WP	K. Janaki	Mar to Jun-2023	
3	SHW	M.S.Raju	Mar to Jun 2023	
4	SE	K.N.M.Raju	Sept-2023	
5	EB	H C Chetan	April-2023	
6	HG	Neeraj Kumar Sharma	Mar to June 2023	
7	GEO	M.S.Raju	Mar to June 2023	
8	SC	Nagaraja B C	Mar to Apr- 2023	
9	AQ	M. Sachin Raju	Mar to June 2023	
10	NV	M.S.Raju	Mar to June 2023	
11	LU	Neeraj Kumar Sharma	Mar to Apr- 2023	
	Team Member: LU	M.R.Durga Prasad	Mar-2023 to June-2023	
12	RH	M.S.Raju	Mar to June 2023	

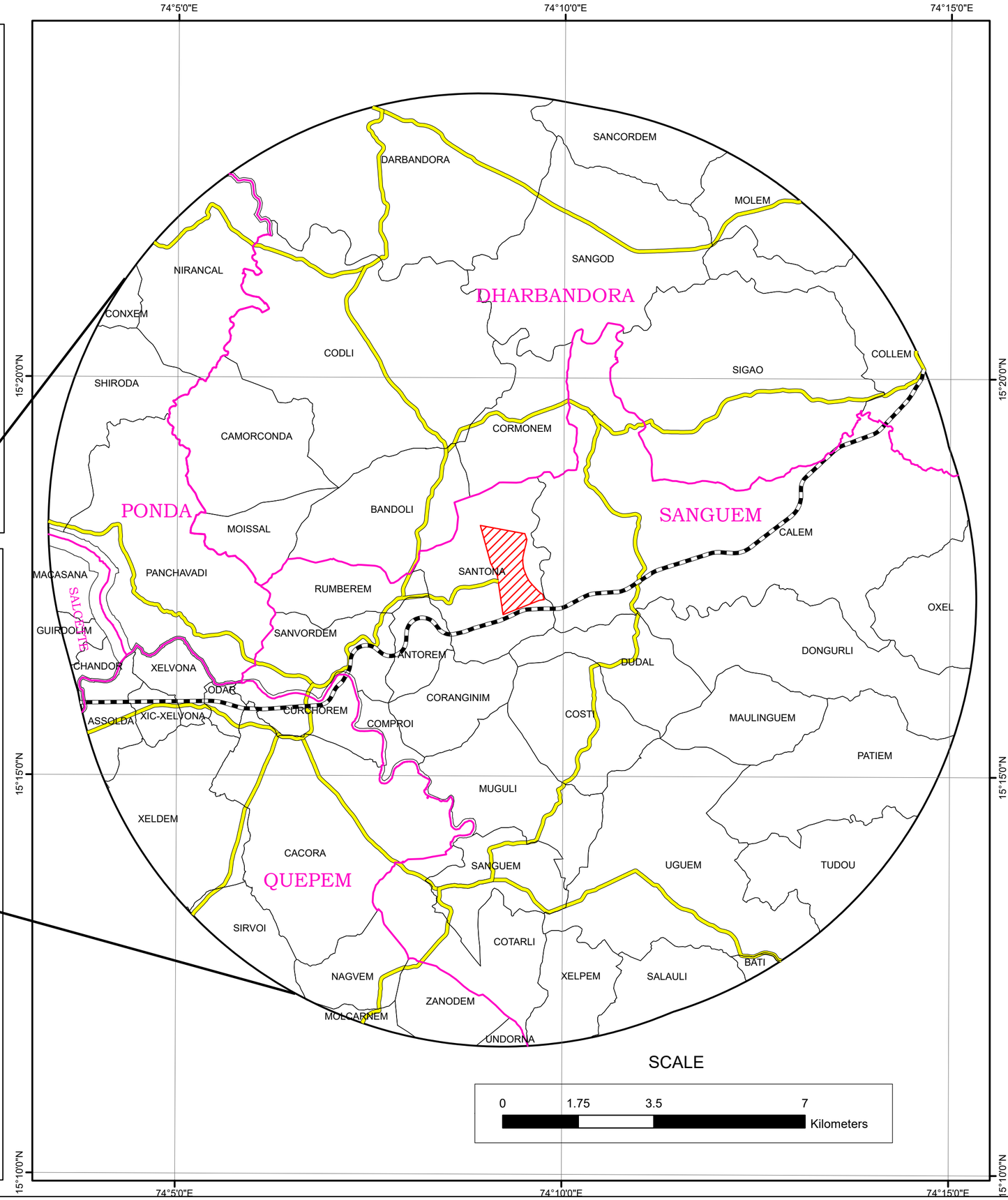
Plates

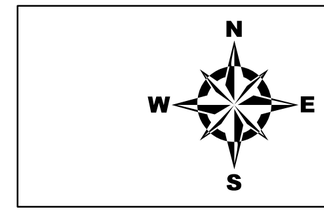
Plate No. 1

Location Map









TITLE : LOCATION PLAN

Legend

- Mineral Block Area
- Taluka
- Villages
- Railways
- Major Roads
- 10 km Buffer Zone

Plate No. 2

Plan Showing Mining Lease Boundary of BLOCK IV-KALAY MINERAL BLOCK, on Georeferenced and Vectorised Cadastral Map, situated in Santona Village of Sanguem Taluka, South Goa District. Goa State

CUDDEGALIVORIL SODDO MINING LEASE
T.C. NO. 62 OF 1951

BLOCK IV-KALAY MINERAL BLOCK

BP 1 BP 2 BP 3 BP 4 BP 5 BP 6 BP 7 BP 8 BP 9 BP 10 BP 11 BP 12 BP 13 BP 14 BP 15 BP 16 BP 17 BP 18

SCALE 1 : 3960

0 50 100 200 300 400 500 Meters

LOCATION MAP

Not to scale

KEY PLAN

Not to scale

T.C. NO. 62 OF 1951

BLOCK IV-KALAY MINERAL BLOCK

DATUM: WGS 84
PROJECTION : UTM_Zone_43 N

Date of Survey: 09-11-2022

Sno.	BEACON NO.	LATITUDE	LONGITUDE	EASTING	NORTHING
1	BP 1	15° 17' 58.2803" N	74° 09' 31.363" E	691629.9007	4096380803
2	BP 2	15° 18' 02.6197" N	74° 09' 29.808" E	691676342393	40963340239
3	BP 3	15° 18' 07.4774" N	74° 08' 55.258" E	691957.26383	40867401653
4	BP 4	15° 17' 49.1741" N	74° 08' 53.316" E	691977.10693	40881183170
5	BP 5	15° 17' 30.9847" N	74° 09' 18.595" E	692793.82945	40899727W8
6	BP 6	15° 17' 16.6125" N	74° 09' 13.134" E	IMRBW.77419	40012974092
7	BP 7	15° 17' 12.479" N	74° 09' 41.296" E	I6WJ3.43939	40997040182
8	BP 8	witimwii	74° 09' 4*8333*8	I6W237.63266	41007594036
9	BP 9	15° 17' 16.6213" N	74° 09' 43.WBS" E	1697354.53*20	41005119470
10	BP 10	15° 17' 19.14» N	74° 09' 40.6072" E	><60426.2030	4099».5872
11	BP 11	15° 17'23.3295" N	74° 09' 36.4971" E	16905».37540	40982853230
12	BP 12	15° 17'26.7096" N	74° 09'34.3331" R	1690661.43320	40973755770
13	BP 13	15° 17'30.3346' N	74° 09' »31.2836'8	]«<7777 «410	40967386810
14	BP 14	15° 17'36.0351'N	74° 09' »29.0348' E	I697M7.2S690	40960748350
15	BP 15	15° 17' 40.9091' N	74° 09' 28.2686' E	1691096.49390	4C6585.20930
16	BP 16	15° 17' 44.5813' N	74° 09' 28.259» E	1691209.33190	4CO5H5MIII
17	BP 17	15° 17' 49.171" N	74° 09' 292119 E	16913502.5070	«0*1432540
18	BP 18	15° 17' 54.4169' N	74° 09' 30.387' E	1091511.28X87	«0*5596260

Sno.	Village Name	Survey No.	Area in Ha.
1	Santana	7[Part]	01758
2	Santana	8[Part]	1.3202
3	Santana	iKPart	0.0721
7	Santana	IS IP>n]	50.0560
8	Santana	I61P.HI	14.6805
9	Santana	23(P.H]	1.0674
10	Santana	2HPati]	2.3762
11	Santana	25(P.r>]	7.4616
12	Santana	26(.>n]	134539
13	Santana	27(Rirt]	09959
14	Santana	28IP.HI	1.9161
15	Santana	29IP.HI	29.0892
16	Santana	38[Part]	20224
17	Santana	39iP.nl	4.7637
18	Santana	40	60750
19	Santana	41 IP.HI	60940
20	Santana	42	36548
21	Santana	431P.ni	4.7671
22	Santana	NalUh	13753
23	Santana	Road	11609
		Total	162*073

Prepared By :

Sinha Mining Consultancy-Goa
Prop: N.P. Sinha

Off No. 9, Gr.Floor, D Costa Commercial Apartmant,
Malbhat Margao Goa

LEGEND

- DGPS POINT OF LEASE BOUNDARY
- MINING LEASE BOUNDARY AS PER DGPS SURVEY
- SURVEY NUMBER BOUNDARY
- SUB-DIVISION OF THE SURVEY NUMBER.
- VILLAGE BOUNDARY

CERTIFICATE

This is to certify that the Mining Lease Boundary Pillars have been verified along with officials of Directorate of Mines and Geology, Goa (DMG) on 09-02-2023 based on the survey data of Mining Lease boundary pillars which were surveyed by Sinha Mining Consultancy-Goa by using DGPS (Differential Global Positioning System) on 09-11-2022

K.M.Shivaprasad
(Surveyor)

CERTIFICATE BY ACCREDITED AGENCY

This is to certify that the Mining Lease Boundary Pillars have been Surveyed by using DGPS (Differential Global Positioning System) The Survey was conducted as per Directorate of Mines and Geology, Goa (DMG) Letter No DMG/09/Auction Cell/Misc/2022/2090. dated: 08-11-2022

For Sinha Mining Consultancy - Goa

(Prop: N.P. Sinha)

N.P. Sinha
Mining Consultant
Sinha Mining ... Reg. No.:
SUV/Metal/Unrest./225
SUV/Metal/Restl./631

DIRECTORATE OF MINES AND GEOLOGY - PANAJI - GOA

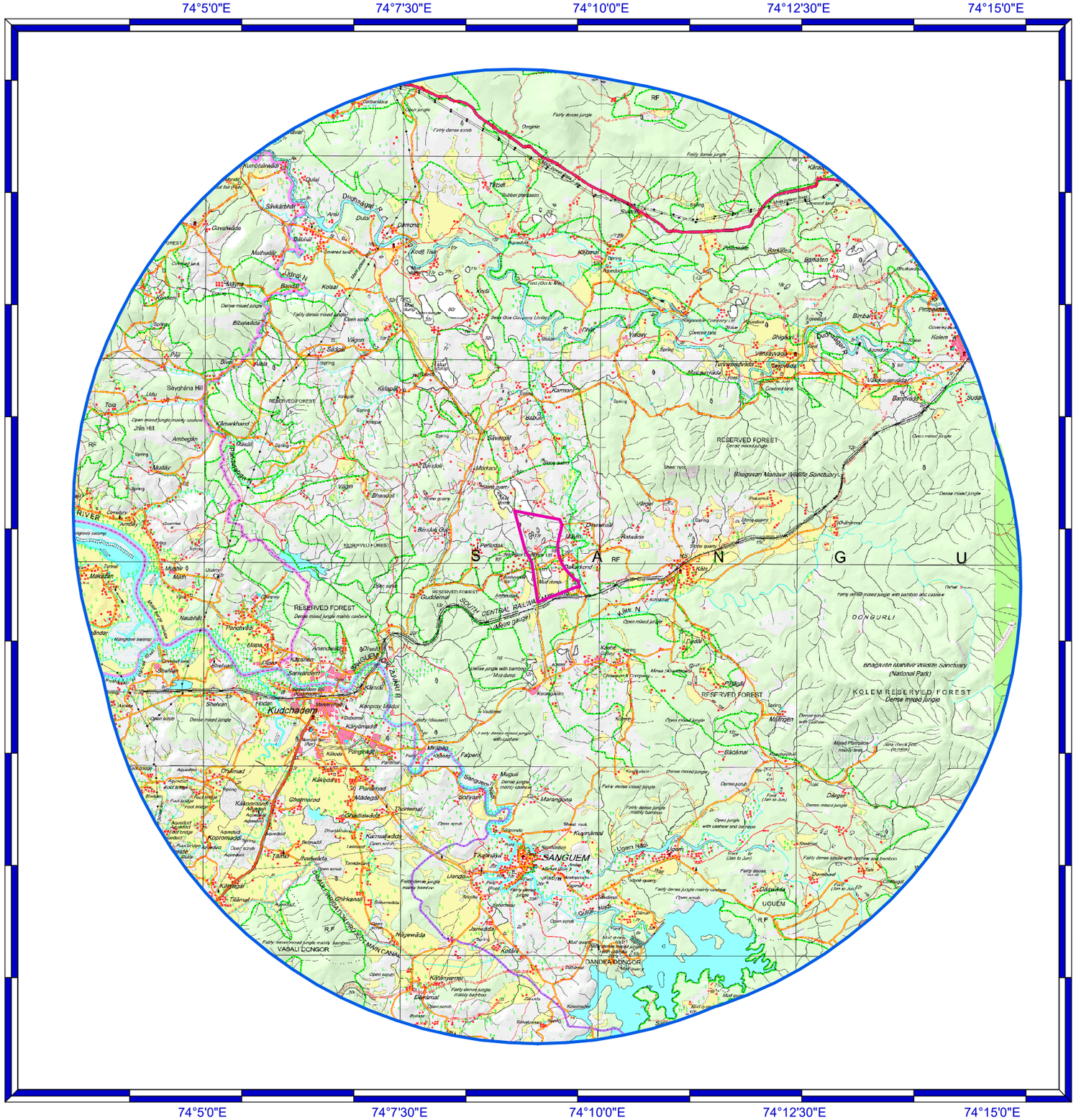
Checked and Certified by

Director of Mines & Geology,
Directorate of Mines & Geology,
Government of Goa,
Panaji - Goa.

Assistant Geologist
Directorate of Mines & Geology
Government of Goa
Panaji-Goa

Plate No. 3

Key Plan



N
W E
S

Scale 1:50000

0 2.5 5 Km

Toposheet No

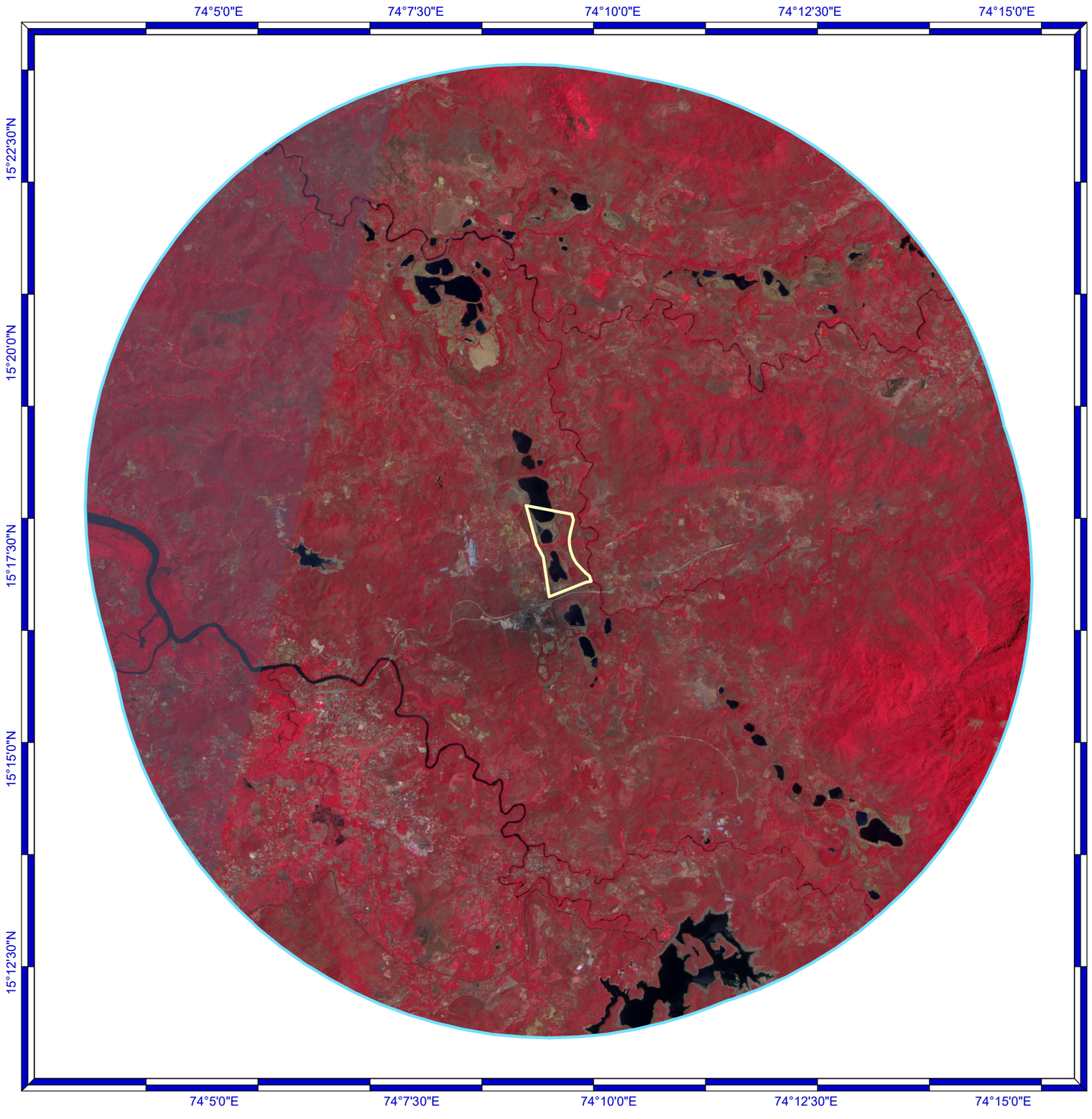
48I/3	48I/7
48I/4	48I/8

Legend

- Mineral Block
- 10 km bufferzone

Block IV – Kalay Mineral Block Located at Santona Village, Sanguem taluka, South Goa District, Goa		
Fomento Resources Private Ltd.,		
Scale	1:50000	
Topo Sheets No.	New	Old
	D43C3, D43C7 & D43C4	48I/3, 48I/7 & 48I/4
Map Prepared By	Mineral Engineering Services 25/XXV Club Road, Ballari -583103	

High Resolution Imagery





Scale 1:50,000

0 2.5 5 Km

Legend

- Mineral Block
- 10 km bufferzone

Block IV – Kalay Mineral Block

Located at Santona Village, Sanguem taluka,
South Goa District, Goa

Fomento Resources Private Ltd.,

Title	High Resolution Imagery
Scale	1:50,000
Data Used	IRS-R2, Mx
Resolution	5m
Date of Pass	01.04.2023 & 08.03.2023
Map Prepared By	Mineral Engineering Services 25/XXV Club Road, Ballari -583103

Plate No. 5

N

E 408600 E 408800 E 409000 E 409200 E 409400 E 409600 E 409800 E 410000 E 410200

N1692000 N1691800 N1691600 N1691400 N1691200 N1691000 N1690800 N1690600 N1690400 N1690200 N1690000 N1689800

BP 3 M-2' M-1' M0' M1' M2' M3' M4' M5' M6' M7' M8' M9' M10' M11' BP 2 M12' BP 1 BP 18 BP 17 P2' P3' BP 16 P4' Final Discharge Point P5' BP 15 P6' P7' P8' BP 14 P9' P10' P11' BP 13 P12' P13' P14' BP 12 P15' P16' P17' BP 11 P18' P19' P20' BP 10 P21' P22' BP 9 P23' P24' BP 8 BP 7 BP 6 P21 P20 P19 P18 P17 P16 P15 P14 P13 P12 P11 P10 P9 P8 P7 P6 P5 P4 BP 5 P4 P3 P2 BP 4 M12 M11 M10 M9 M8 M7 M6 M5 M4 M3 M2 M1 M0 M-1 M-2 BP 3

PIT NO. 3

DUMP - 3

DUMP - 1

DUMP - 2

DUMP - 4

DUMP - 5

DUMP - 8

DUMP - 6

DUMP - 9

PIT NO. 1

PIT NO. 2

IDEA TOWER

PIPELINE

REF LINE

WATER LOGGED AREA

WEIGHBRIDGE

WELL

I N D E X

- MINERAL BLOCK BOUNDARY
- BENCHES
- EXISTING DUMP/ BACKFILLING
- BOREHOLE (NSN S-38, 68.5)
- CONTOUR (60)
- MINE ROADS
- VILLAGE ROADS
- HIGH TENSION POWER LINE
- LOW TENSION POWER LINE
- RUBBLE WALL
- STRUCTURES
- NALLAH
- DRAIN
- EXISTING SETTLING PONDS
- PIT PERIPHERY
- PERMANENT BACKFILLING
- PLANTATION
- EXISTING DUMPS
- 7.5 m STATUTORY BARRIER
- BENCH MARK (BM-LL PPP NSG)

SCALE - 1 : 2000

20 0 20 40 60 80 100 200 300 400 500

FOMENTO RESOURCES PRIVATE LIMITED

BLOCK IV - KALAY MINERAL BLOCK

AREA - 152.5073 Ha.

VILLAGE - SANTONA TALUKA - SANGUEM

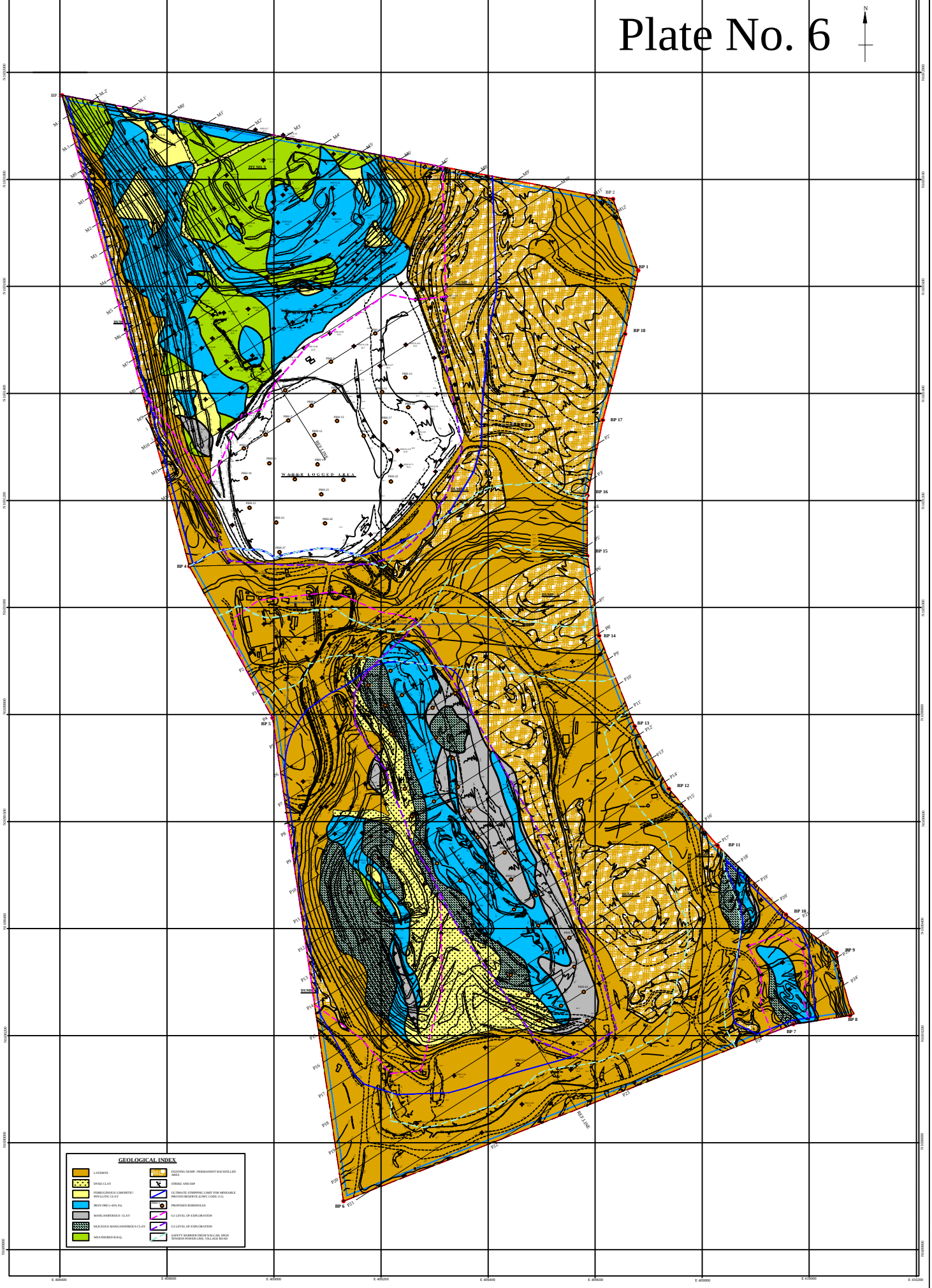
PURPOSE OF THE PLAN: SURFACE PLAN

DATE	SCALE	
	1 : 2000	Certified that the Plan is prepared based on the Geo-referenced Cadastral DGPS Plan authenticated by the State Government and is correct to the best of our knowledge

Roshel Fernandes
Qualified Person

Amit Ashok Ghogale
Qualified Person

Plate No. 6



I N D E X

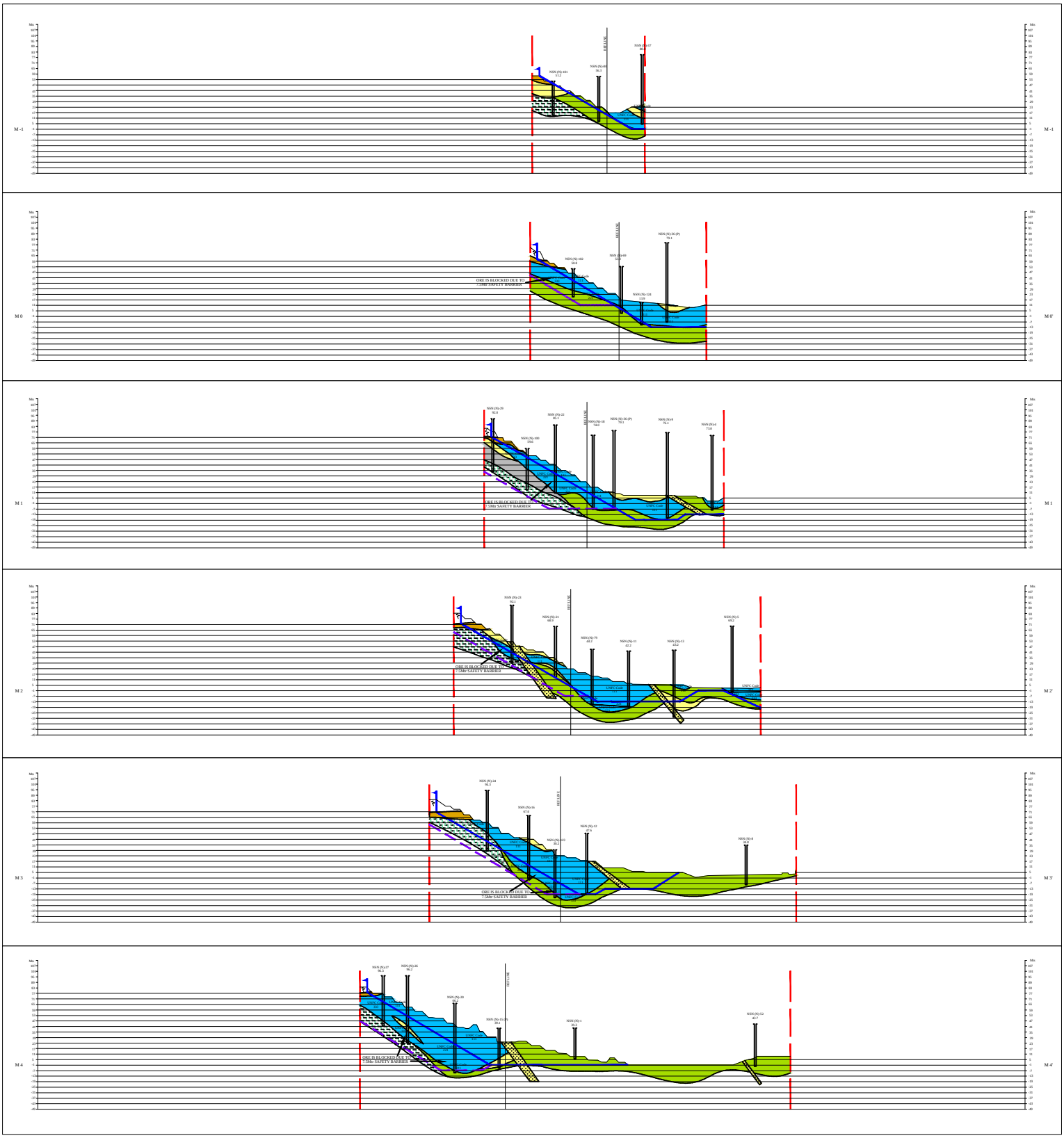
- MINERAL BLOCK BOUNDARY
- BENCHES
- EXISTING DUMP/ BACKFILLING
- BOREHOLE
- CONTOUR
- ROADS
- HIGH TENSION POWER LINE
- LOW TENSION POWER LINE
- RUBBLE WALL
- STRUCTURES
- NALLAH
- T.L.o STATUTORY BARRIER

SCALE - 1 : 2000

20 0 20 40 60 80 100 200 300 400 500

FOMENTO RESOURCES PRIVATE LIMITED	
BLOCK IV - KALAY MINES, GOA	
AREA - 152.5073 Ha.	
VILLAGE - SANTONA	TALUKA - SANGUEM
PURPOSE OF THE PLAN: SURFACE GEOLOGICAL PLAN	
DATE	SCALE: 1 : 2000
Certified that the Plan is prepared based on the Geo-referenced Cadastral DGPS Plan authenticated by the State Government and is correct to the best of our knowledge	

Plate No. 7



I N D E X

- MINERAL BLOCK BOUNDARY
- LATERITE
- IRON ORE (+45% Fe)
- SILICEOUS ORE
- FERRUGINOUS / LIMONITIC / PHYLLITIC CLAY
- WEATHERED B.H.Q/SILICA
- MANGANIFERROUS CLAY
- DYKE
- SILICEOUS MANGANIFERROUS CLAY
- TEMPORARY BACKFILLING
- DUMP
- ULTIMATE STRIPPING LIMIT FOR MINEABLE PROVED RESERVE (UNFC CODE 111)
- STRIPPING LIMIT FOR PRE FEASIBILITY MINERAL RESOURCE (UNFC CODE 221)
- EXISTING BOREHOLES

FOMENTO RESOURCES PRIVATE LIMITED

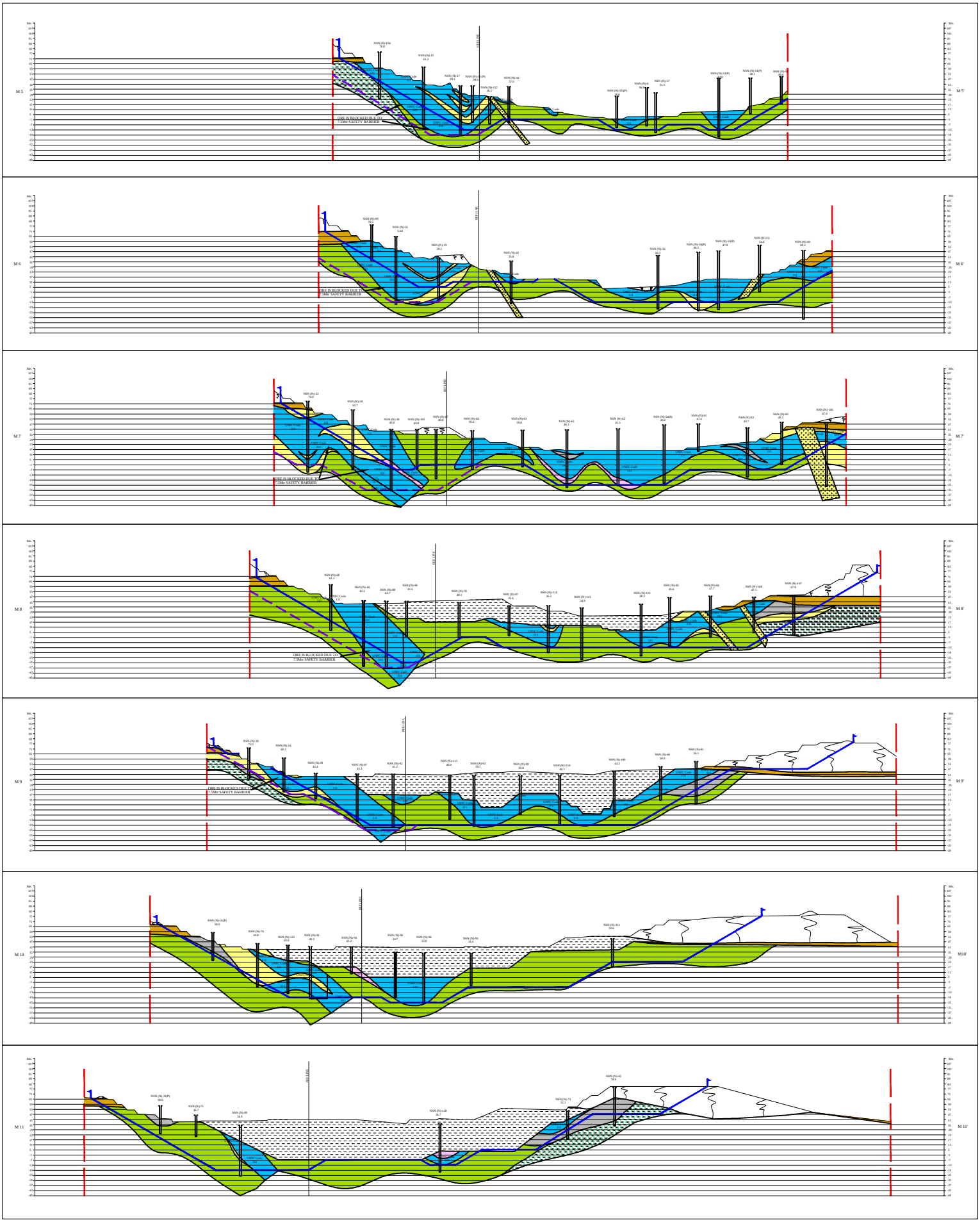
BLOCK IV - KALAY MINERAL BLOCK

AREA - 152.5073 Ha.

VILLAGE - SANTONA TALUKA - SANGUEM

PURPOSE OF THE PLAN: GEOLOGICAL CROSS SECTIONS

DATE	SCALE	
	1 : 2000	Certified that the Section is prepared based on the Geo-referenced Cadastral DGPS Plan authenticated by the State Government and is correct to the best of our knowledge



I N D E X

- MINERAL BLOCK BOUNDARY
- LATERITE
- IRON ORE (+45% Fe)
- SILICEOUS ORE
- FERRUGINOUS / LIMONITIC / PHYLLITIC CLAY
- WEATHERED B.H.Q/SILICA
- MANGANIFERROUS CLAY
- DYKE
- SILICEOUS MANGANIFERROUS CLAY
- TEMPORARY BACKFILLING
- DUMP
- ULTIMATE STRIPPING LIMIT FOR MINEABLE PROVED RESERVE (UNFC CODE 111)
- STRIPPING LIMIT FOR PRE FEASIBILITY MINERAL RESOURCE (UNFC CODE 221)
- EXISTING BOREHOLES

FOMENTO RESOURCES PRIVATE LIMITED

BLOCK IV - KALAY MINERAL BLOCK

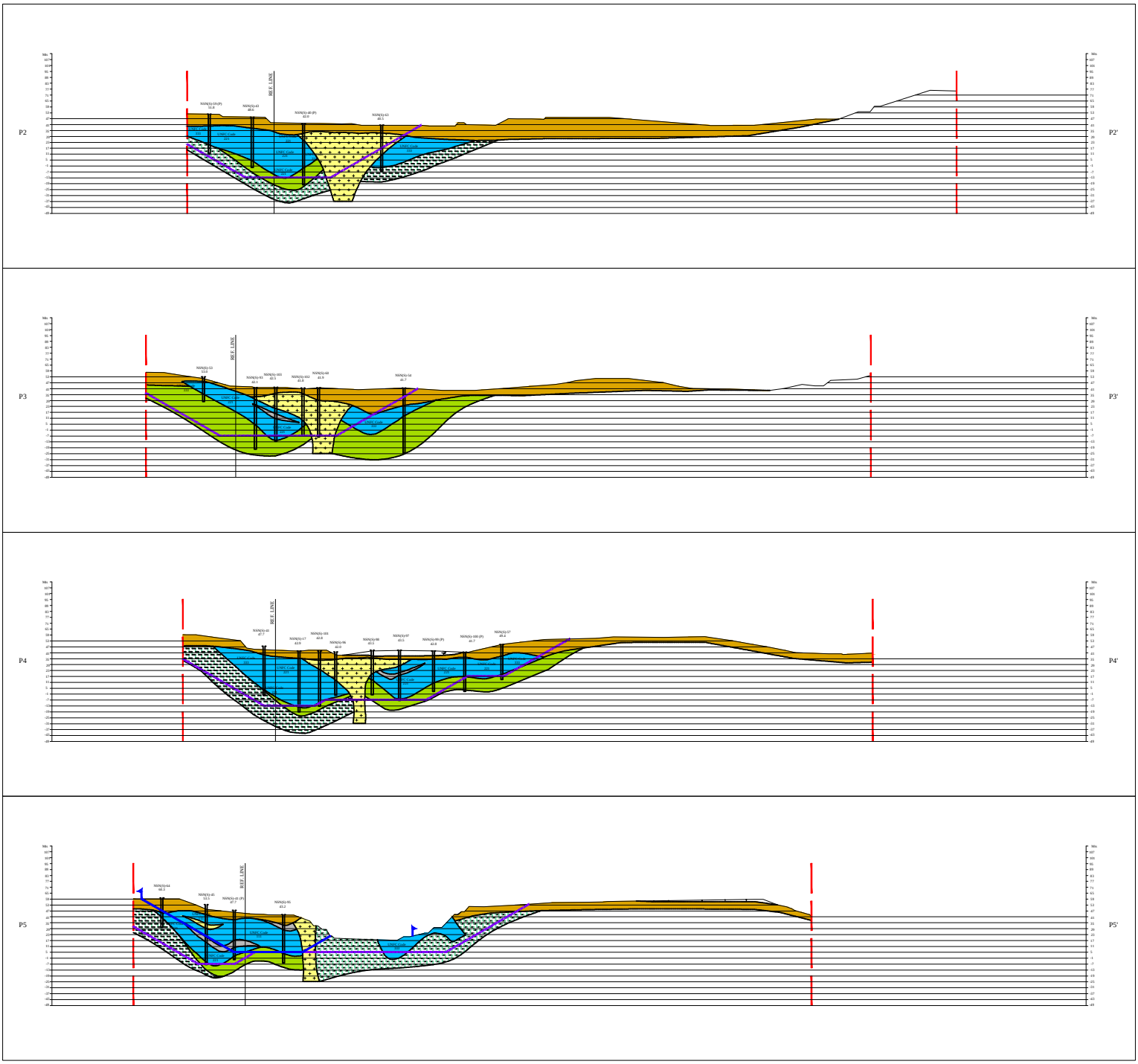
AREA - 152.5073 Ha.

VILLAGE - SANTONA TALUKA - SANGUEM

PURPOSE OF THE PLAN: GEOLOGICAL CROSS SECTIONS

DATE	SCALE
	1 : 2000

Certified that the Section is prepared on the Geo-referenced Cadastral DGPS Plan authenticated by the Government and is correct to the best of our knowledge



I N D E X

- MINERAL BLOCK BOUNDARY
- LATERITE
- IRON ORE (+45% Fe)
- SILICEOUS ORE
- FERRUGINOUS / LIMONITIC / PHYLLITIC CLAY
- WEATHERED B.H.Q/SILICA
- MANGANIFERROUS CLAY
- DYKE
- SILICEOUS MANGANIFERROUS CLAY
- TEMPORARY BACKFILLING
- DUMP
- ULTIMATE STRIPPING LIMIT FOR MINEABLE PROVED RESERVE (UNFC CODE 111)
- STRIPPING LIMIT FOR PRE FEASIBILITY MINERAL RESOURCE (UNFC CODE 221)
- EXISTING BOREHOLES

FOMENTO RESOURCES PRIVATE LIMITED

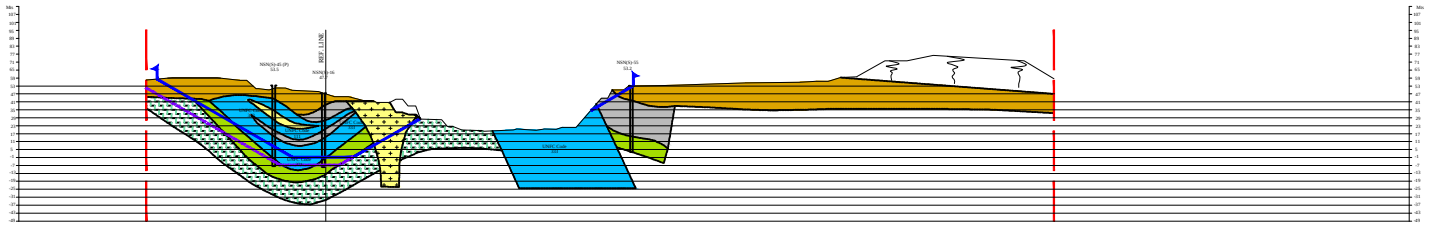
BLOCK IV - KALAY MINERAL BLOCK

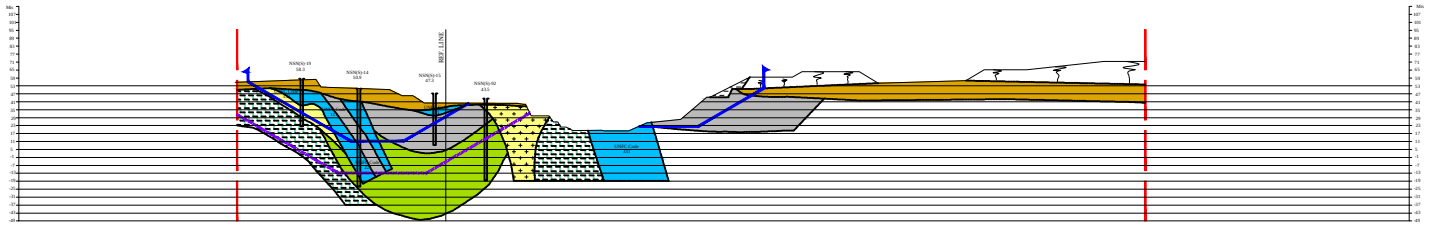
AREA - 152.5073 Ha.

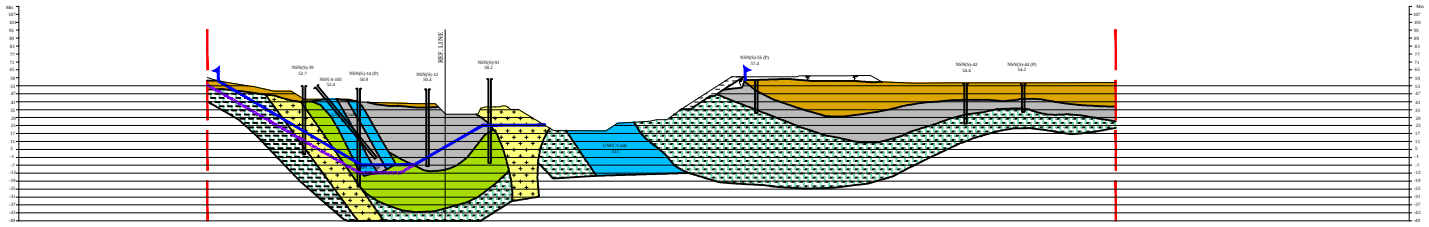
VILLAGE - SANTONA TALUKA - SANGUEM

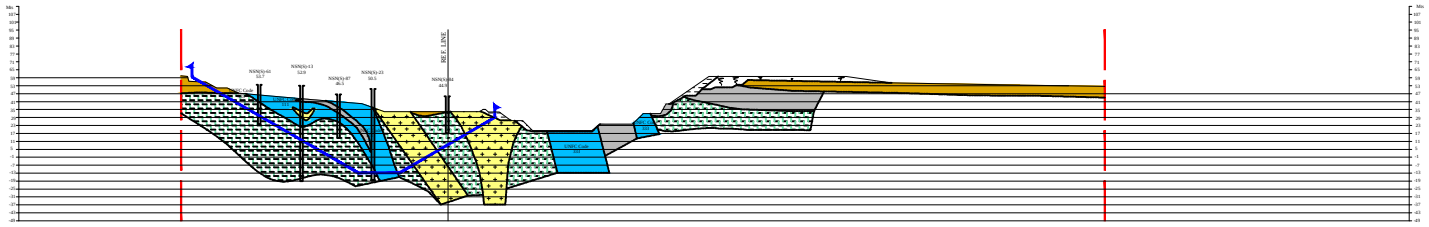
PURPOSE OF THE PLAN: GEOLOGICAL CROSS SECTIONS

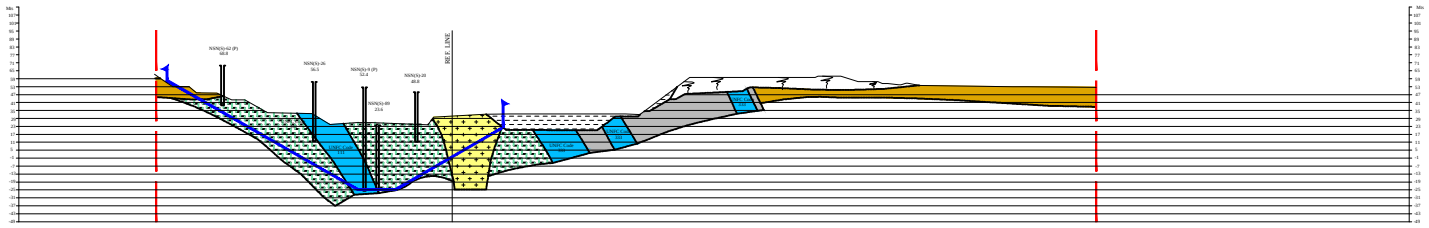
DATE	SCALE	
	1 : 2000	Certified that the Section is prepared based on the Geo-referenced Cadastral DGPS Plan authenticated by the State Government and is correct to the best of our knowledge











I N D E X

- MINERAL BLOCK BOUNDARY
- LATERITE
- IRON ORE (+45% Fe)
- SILICEOUS ORE
- FERRUGINOUS / LIMONITIC / PHYLLITIC CLAY
- WEATHERED B.H.Q/SILICA
- MANGANIFERROUS CLAY
- DYKE
- SILICEOUS MANGANIFERROUS CLAY
- TEMPORARY BACKFILLING
- DUMP
- ULTIMATE STRIPPING LIMIT FOR MINEABLE PROVED RESERVE (UNFC CODE 111)
- STRIPPING LIMIT FOR PRE FEASIBILITY MINERAL RESOURCE (UNFC CODE 221)
- EXISTING BOREHOLES

FOMENTO RESOURCES PRIVATE LIMITED

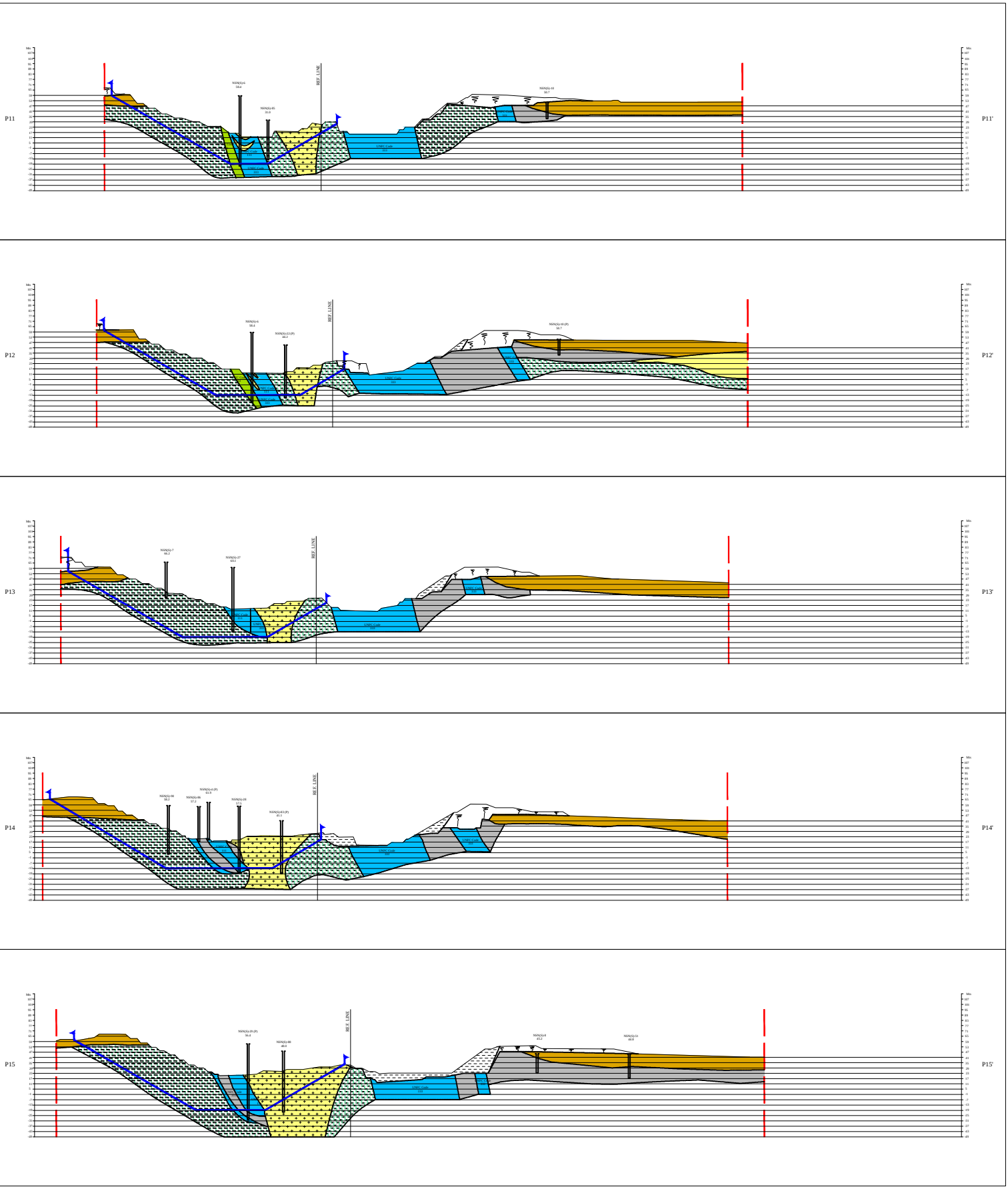
BLOCK IV - KALAY MINERAL BLOCK

AREA - 152.5073 Ha.

VILLAGE - SANTONA TALUKA - SANGUEM

PURPOSE OF THE PLAN: GEOLOGICAL CROSS SECTIONS

DATE	SCALE	Certified that the Section is prepared based on the Geo-referenced Cadastral DGPS Plan authenticated by the State Government and is correct to the best of our knowledge
	1 : 2000	



I N D E X

- MINERAL BLOCK BOUNDARY
- LATERITE
- IRON ORE (+45% Fe)
- SILICEOUS ORE
- FERRUGINOUS / LIMONITIC / PHYLLITIC CLAY
- WEATHERED B.H.Q/SILICA
- MANGANIFERROUS CLAY
- DYKE
- SILICEOUS MANGANIFERROUS CLAY
- TEMPORARY BACKFILLING
- DUMP
- ULTIMATE STRIPPING LIMIT FOR MINEABLE PROVED RESERVE (UNFC CODE 111)
- STRIPPING LIMIT FOR PRE FEASIBILITY MINERAL RESOURCE (UNFC CODE 221)
- EXISTING BOREHOLES

FOMENTO RESOURCES PRIVATE LIMITED

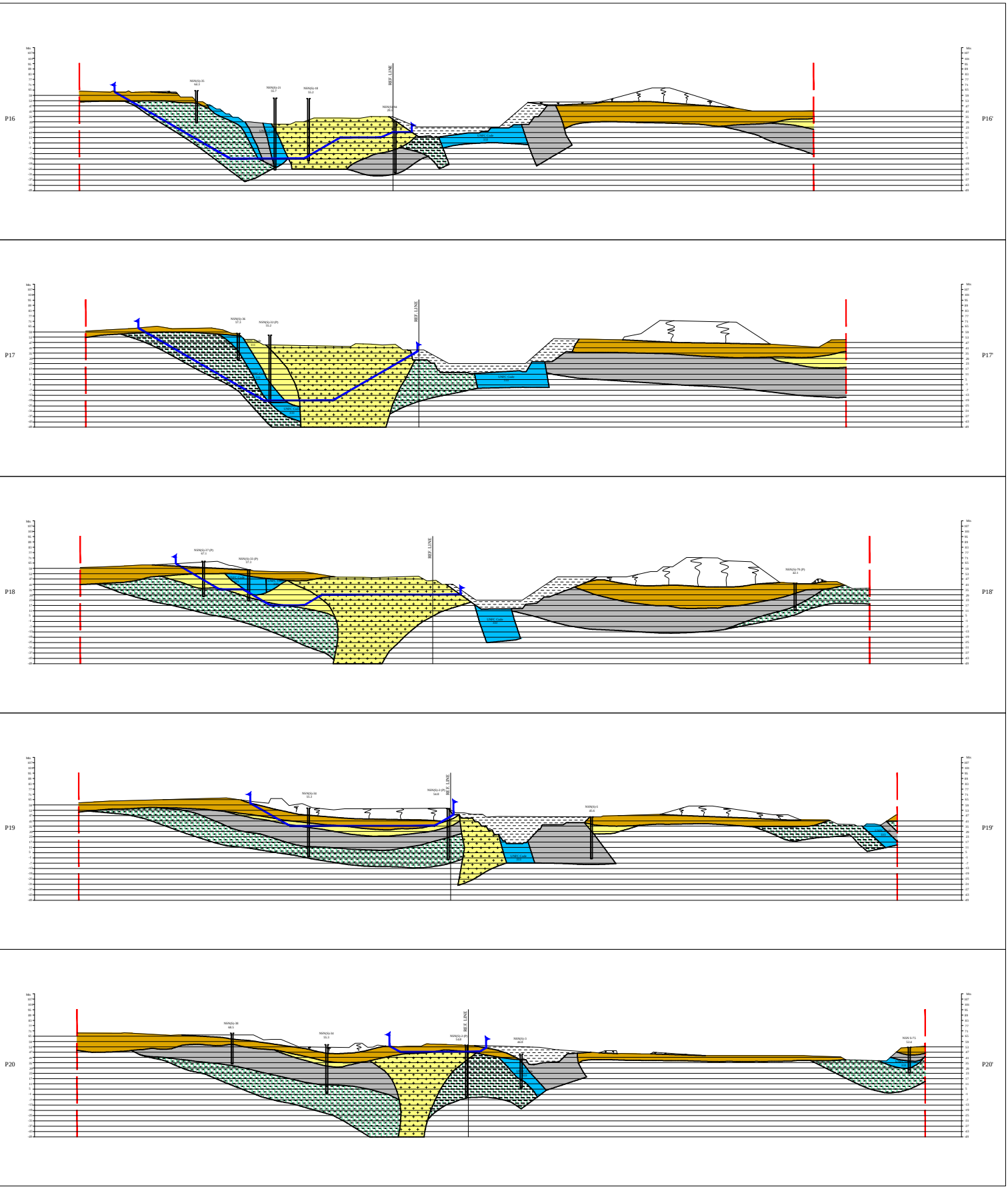
BLOCK IV - KALAY MINERAL BLOCK

AREA - 152.5073 Ha.

VILLAGE - SANTONA TALUKA - SANGUEM

PURPOSE OF THE PLAN: GEOLOGICAL CROSS SECTIONS

DATE	SCALE	Certified that the Section is prepared based on the Geo-referenced Cadastral DGPS Plan authenticated by the State Government and is correct to the best of our knowledge
	1 : 2000	



I N D E X

- MINERAL BLOCK BOUNDARY
- LATERITE
- IRON ORE (+45% Fe)
- SILICEOUS ORE
- FERRUGINOUS / LIMONITIC / PHYLLITIC CLAY
- WEATHERED B.H.Q/SILICA
- MANGANIFERROUS CLAY
- DYKE
- SILICEOUS MANGANIFERROUS CLAY
- TEMPORARY BACKFILLING
- DUMP
- ULTIMATE STRIPPING LIMIT FOR MINEABLE PROVED RESERVE (UNFC CODE 111)
- STRIPPING LIMIT FOR PRE FEASIBILITY MINERAL RESOURCE (UNFC CODE 221)
- EXISTING BOREHOLES

FOMENTO RESOURCES PRIVATE LIMITED

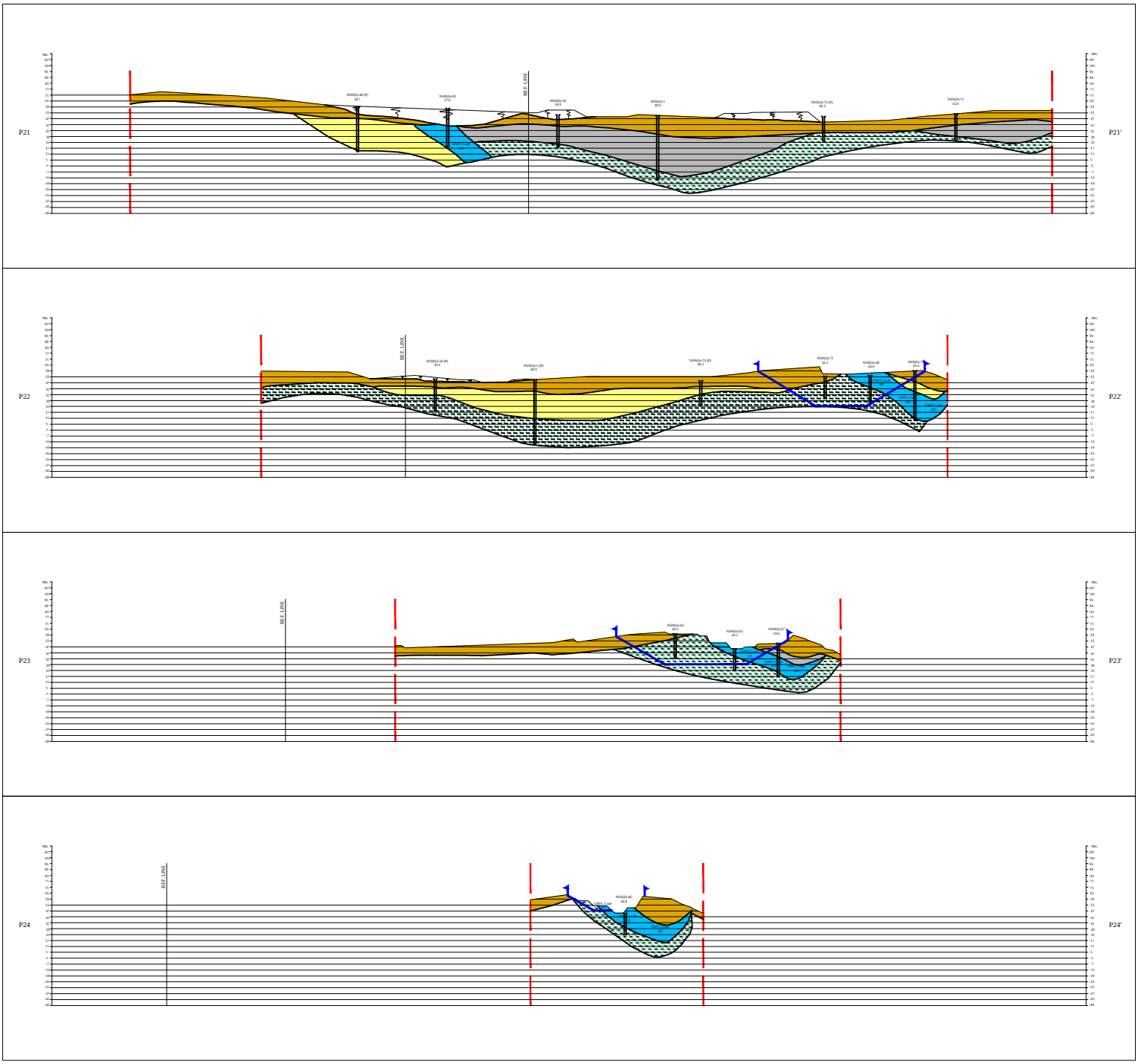
BLOCK IV - KALAY MINERAL BLOCK

AREA - 152.5073 Ha.

VILLAGE - SANTONA TALUKA - SANGUEM

PURPOSE OF THE PLAN: GEOLOGICAL CROSS SECTIONS

DATE	SCALE	Certified that the Section is prepared based on the Geo-referenced Cadastral DGPS Plan authenticated by the State Government and is correct to the best of our knowledge
	1 : 2000	



I N D E X

- MINERAL BLOCK BOUNDARY
- LATERITE
- IRON ORE (+45% Fe)
- SILICEOUS ORE
- FERRUGINOUS / LIMONITIC / PHYLLITIC CLAY
- WEATHERED B.H.Q/SILICA
- MANGANIFERROUS CLAY
- DYKE
- SILICEOUS MANGANIFERROUS CLAY
- TEMPORARY BACKFILLING
- DUMP
- ULTIMATE STRIPPING LIMIT FOR MINEABLE PROVED RESERVE (UNFC CODE 111)
- STRIPPING LIMIT FOR PRE FEASIBILITY MINERAL RESOURCE (UNFC CODE 221)
- EXISTING BOREHOLES

FOMENTO RESOURCES PRIVATE LIMITED

BLOCK IV - KALAY MINERAL BLOCK

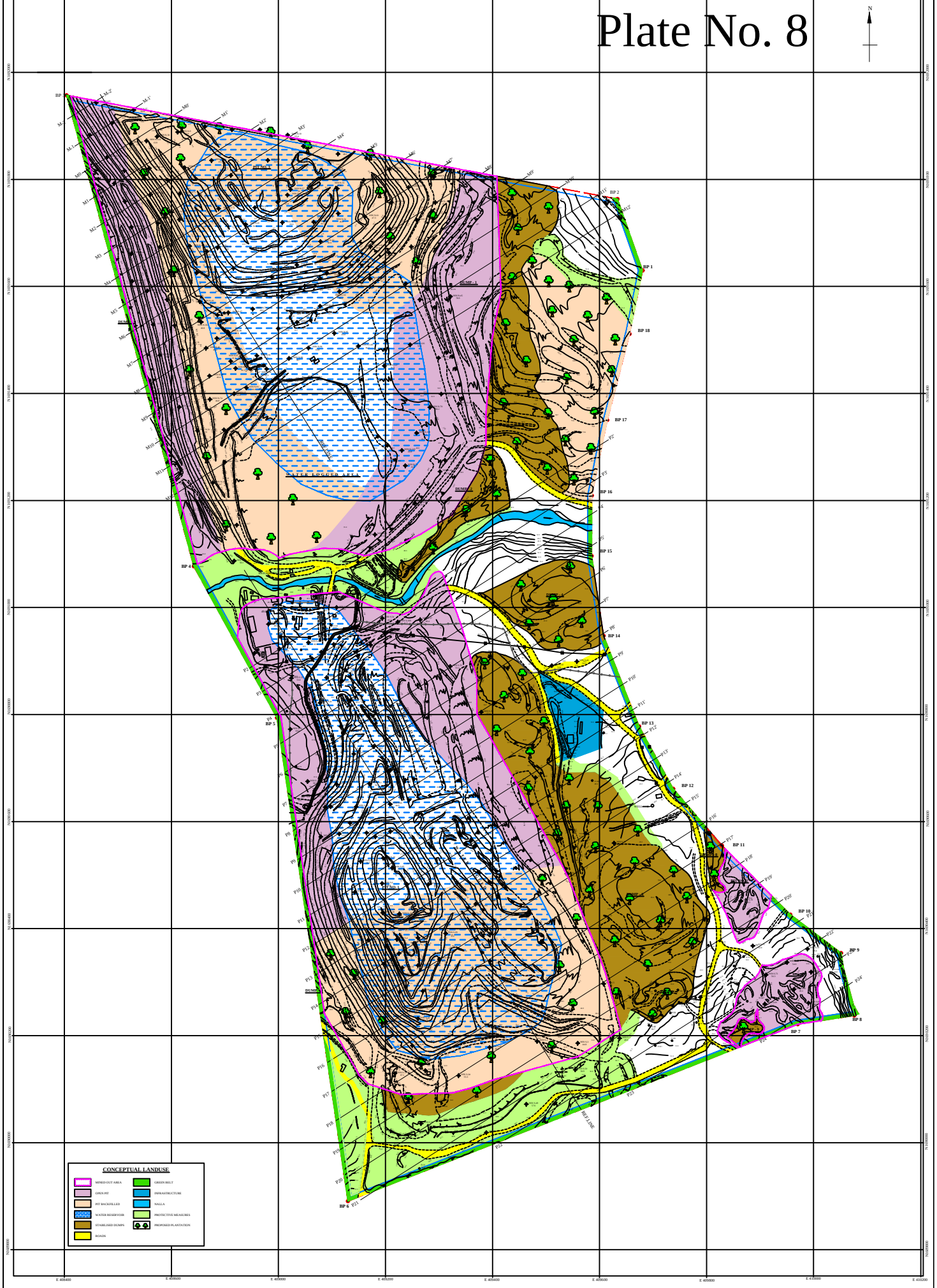
AREA - 152.5073 Ha.

VILLAGE - SANTONA TALUKA - SANGUEM

PURPOSE OF THE PLAN: GEOLOGICAL CROSS SECTIONS

DATE	SCALE	
	1 : 2000	Certified that the Section is prepared based on the Geo-referenced Cadastral DGPS Plan authenticated by the State Government and is correct to the best of our knowledge

Plate No. 8



INDEX

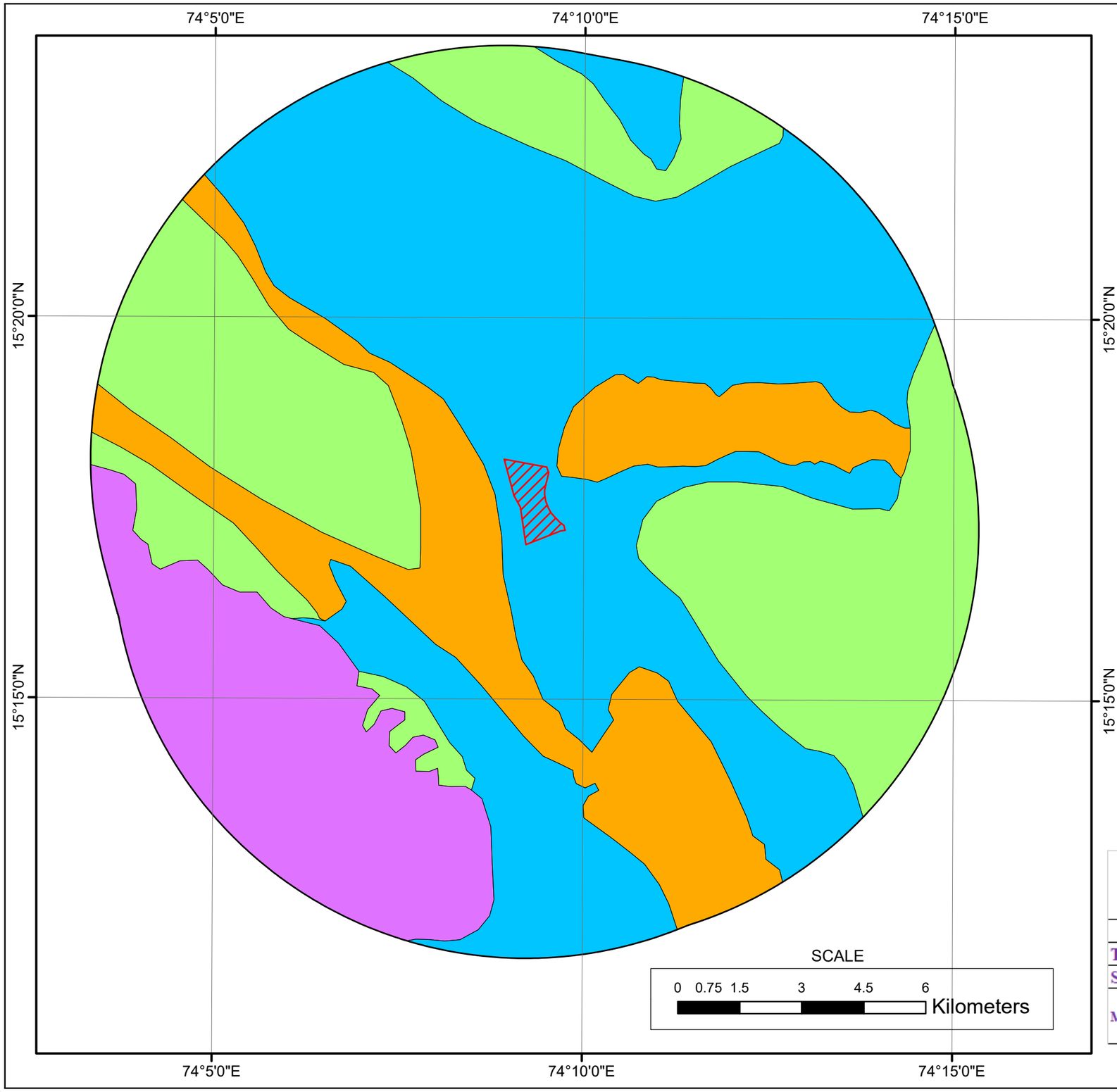
- MINERAL BLOCK BOUNDARY
- BENCHES
- EXISTING DUMP/ BACKFILLING
- BOREHOLE
- CONTOUR
- ROADS
- HIGH TENSION POWER LINE
- LOW TENSION POWER LINE
- RUBBLE WALL
- STRUCTURES
- NALLAH
- T.I.m STATUTORY BARRIER

SCALE 1 : 2000

FOMENTO RESOURCES PRIVATE LIMITED	
BLOCK IV - KALAY MINERAL BLOCK	
AREA - 152.5073 Ha.	
VILLAGE - SANTONA	TALUKA - SANGUEM
PURPOSE OF THE PLAN: CONCEPTUAL PLAN	
DATE	SCALE: 1 : 2000
Certified that the Plan is prepared based on the Geo-referenced Cadastral DGPS Plan authenticated by the State Government and is correct to the best of our knowledge	

Geological Map

Plate No. 9



N
W E
S

TITLE : GEOLOGY

Legend

Mineral Block Area

10 Km Buffer Zone

GEOLOGICAL INDEX

- Bicholim Formation BIF
- Sanvordem Formation
- Barcem Formation
- Peninsular Gneiss

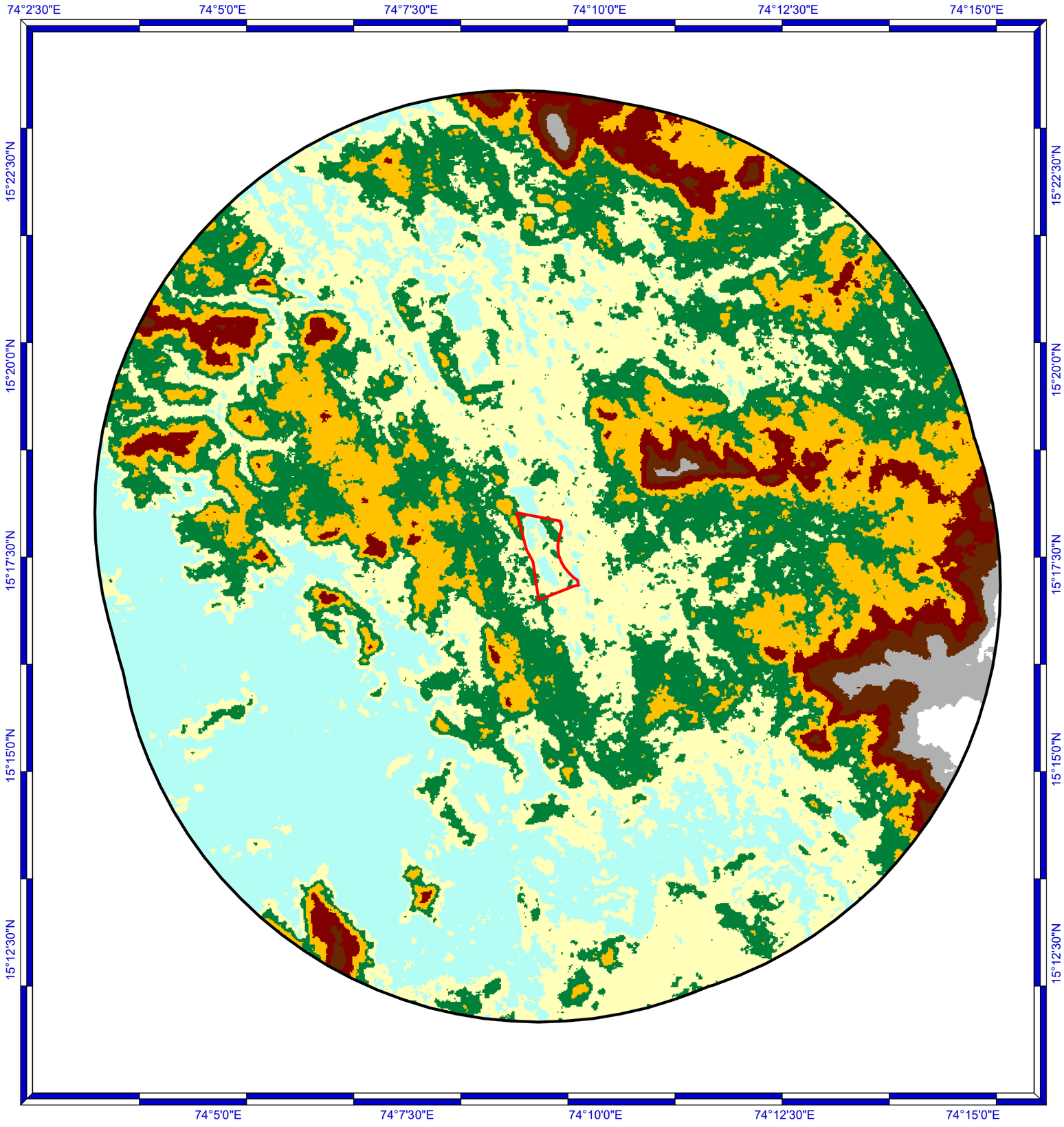
Block IV – Kalay Mineral Block
Located at Santona Village, Sanguem taluka,
South Goa District, Goa

Fomento Resources Private Ltd.,

Title	Geological Plan of Study Area
Scale	1:50,000
Map Prepared By	Mineral Engineering Services 25/XXV Club Road, Ballari -583103

Digital Elevation Map

Plate No. 10



N
W E
S

Scale 1:50,000

0 2.5 5 Km

Legend

- Mining Lease Area
- 10 km bufferzone

Elevation (m)

- 0 - 34
- 34.1 - 63
- 63.1 - 94
- 94.1 - 135
- 135.1 - 198
- 198.1 - 292
- 292.1 - 427
- 427.1 - 640

Block IV – Kalay Mineral Block

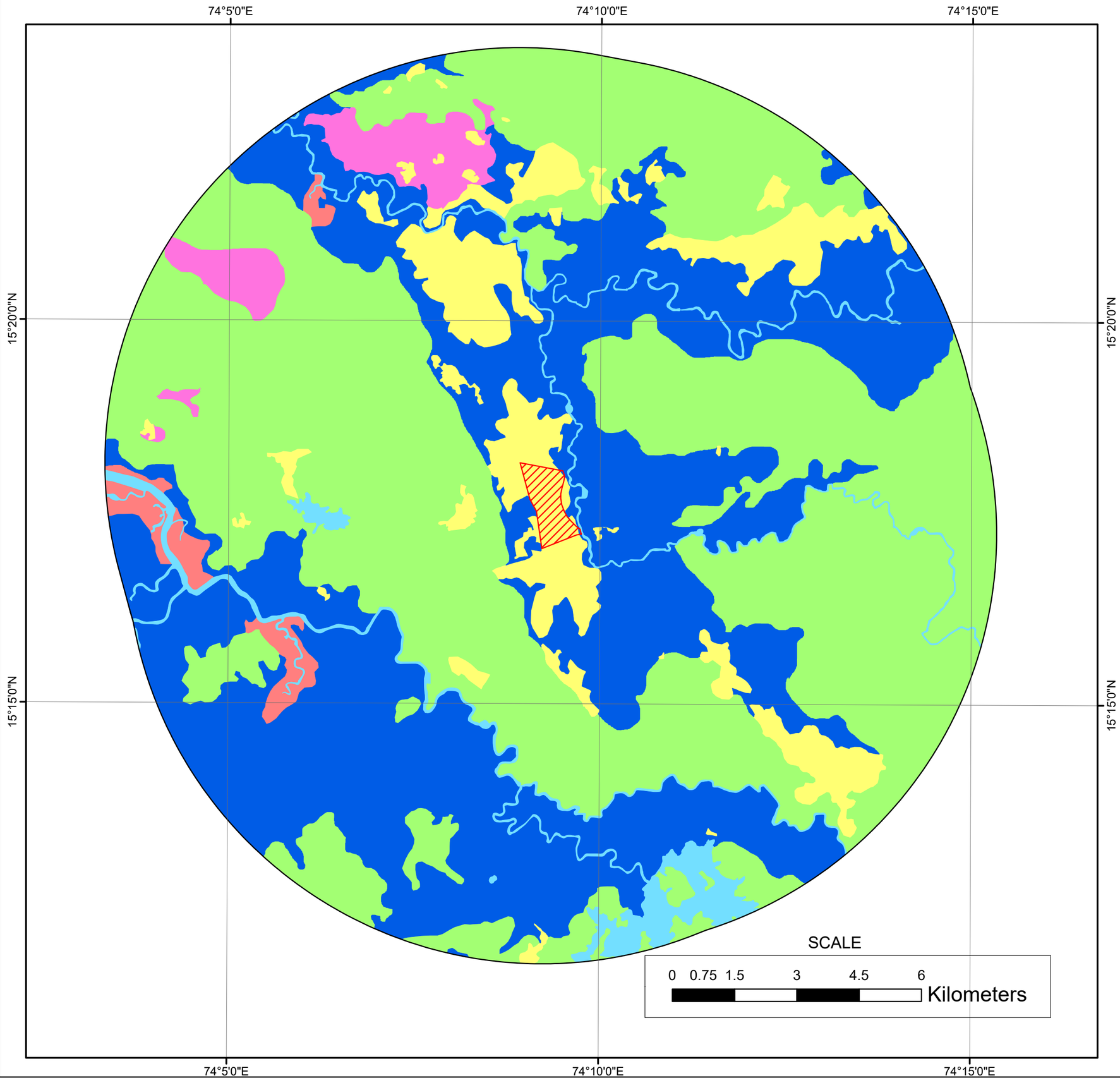
Located at Santona Village, Sanguem taluka,
South Goa District, Goa

Fomento Resources Private Ltd.,

Title	Digital Elevation Model
Scale	1:50,000
Map Prepared By	Mineral Engineering Services 25/XXV Club Road, Ballari -583103

Plate No. 11

Geomorphology of Study Area



N
W E
S

TITLE : GEOMORPHOLOGY

Legend

- Mineral Block Area
- 10 Km Buffer Zone

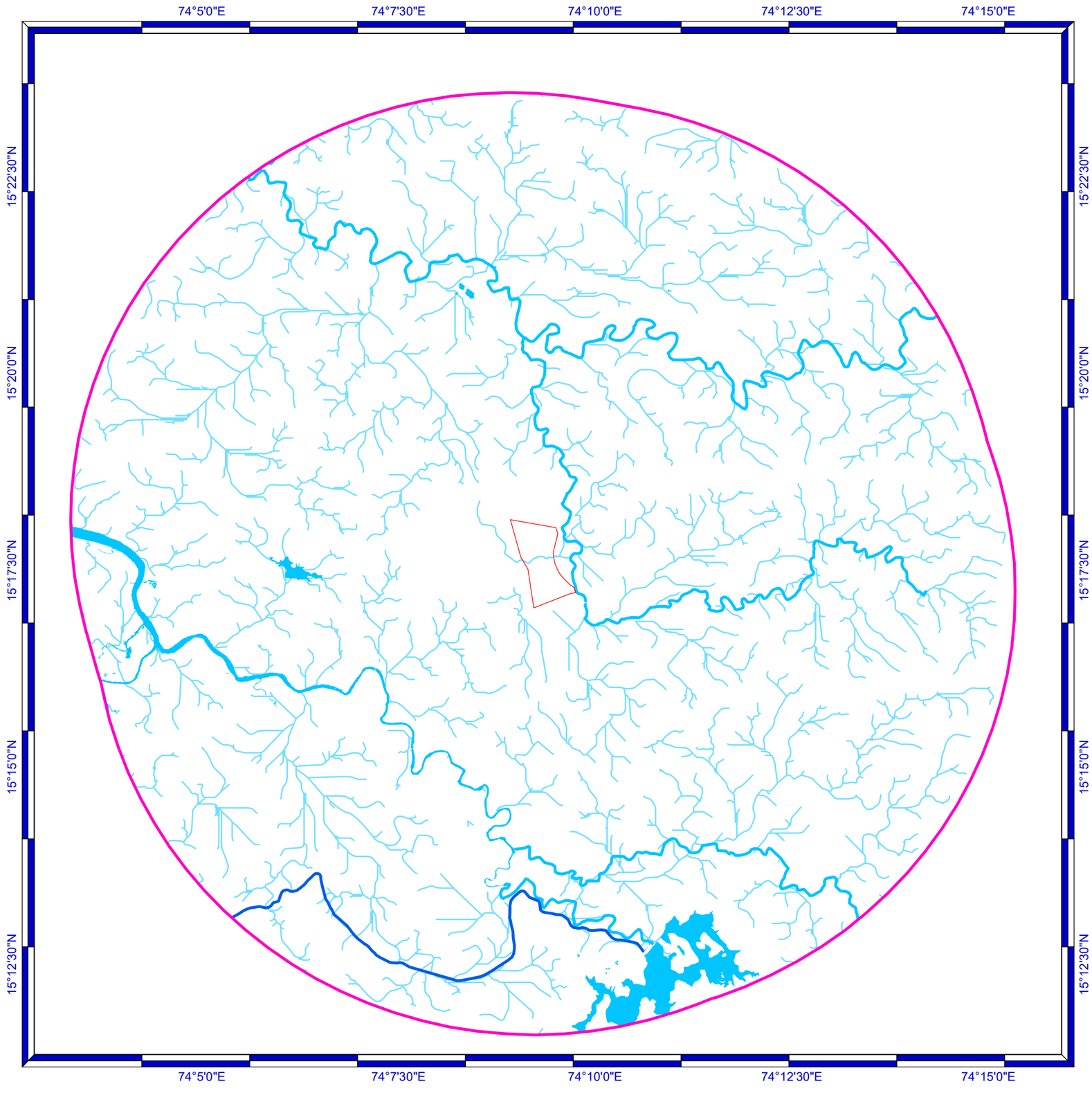
GEOMORPHOLOGICAL INDEX

- WATER BODIES/RIVER
- COASTAL PLAINS
- PLATEAU
- PEDIMENT PEDIPLAIN COMPLEX
- QUARRY AND MINING AREA
- HILLS AND VALLEYS

Block IV – Kalay Mineral Block Located at Santona Village, Sanguem taluka, South Goa District, Goa	
Fomento Resources Private Ltd.,	
Title	Geomorphology of Study Area
Scale	1:50,000
Map Prepared By	Mineral Engineering Services 25/XXV Club Road, Ballari -583103

Drainage Map

Plate No. 12





Scale 1:50,000

0 2.5 5 km

Legend

- Mineral Block
- 10 km bufferzone
- canal
- Rivers
- Water bodies
- Drainage

Block IV – Kalay Mineral Block

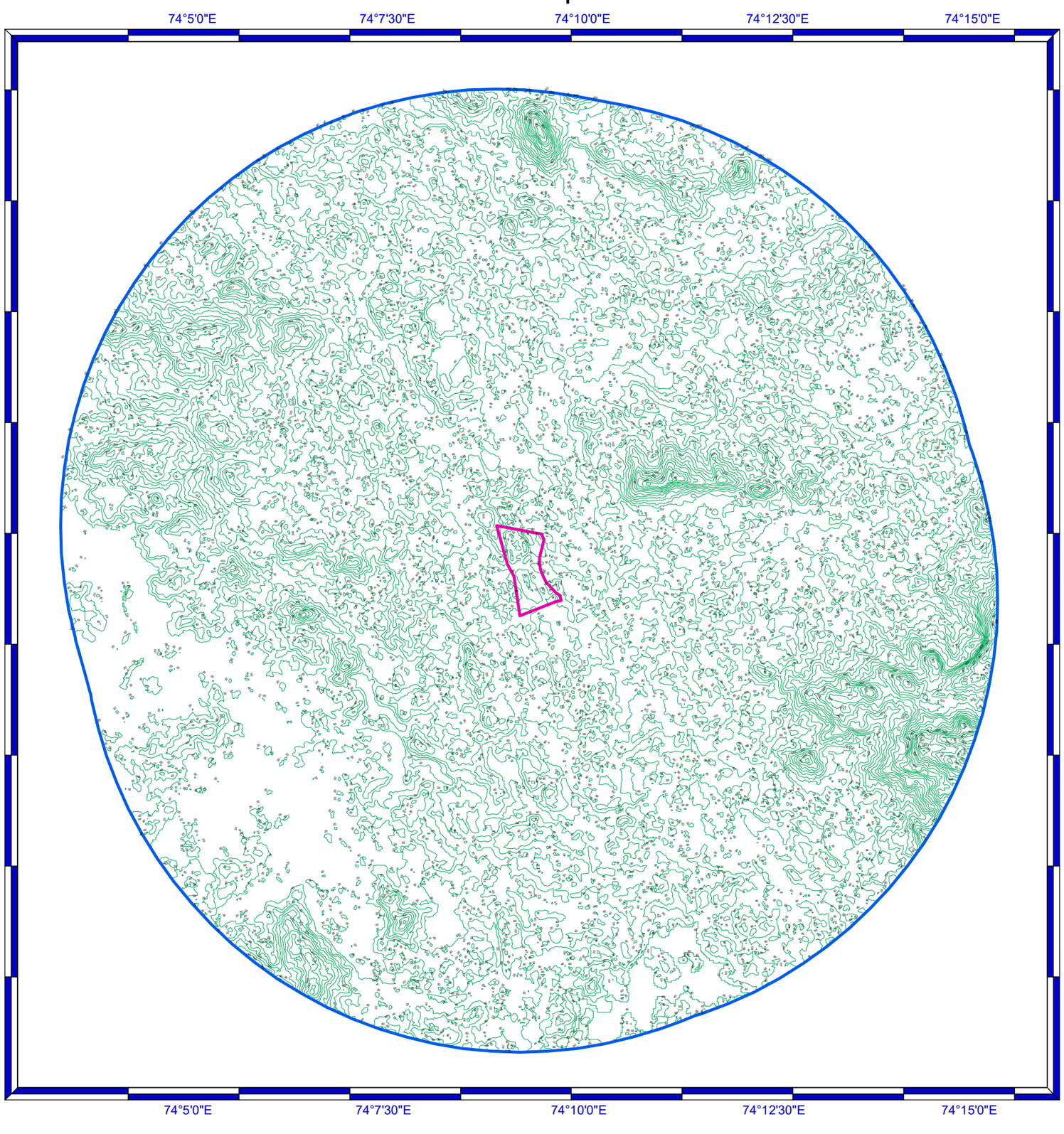
Located at Santona Village, Sanguem taluka,
South Goa District, Goa

Fomento Resources Private Ltd.,

Title	Drainage Map
Scale	1:50,000
Map Prepared By	Mineral Engineering Services 25/XXV Club Road, Ballari -583103

Contour Map

Plate No. 13



N
W E
S

Scale 1:50000

0 2.5 5 Km

Legend

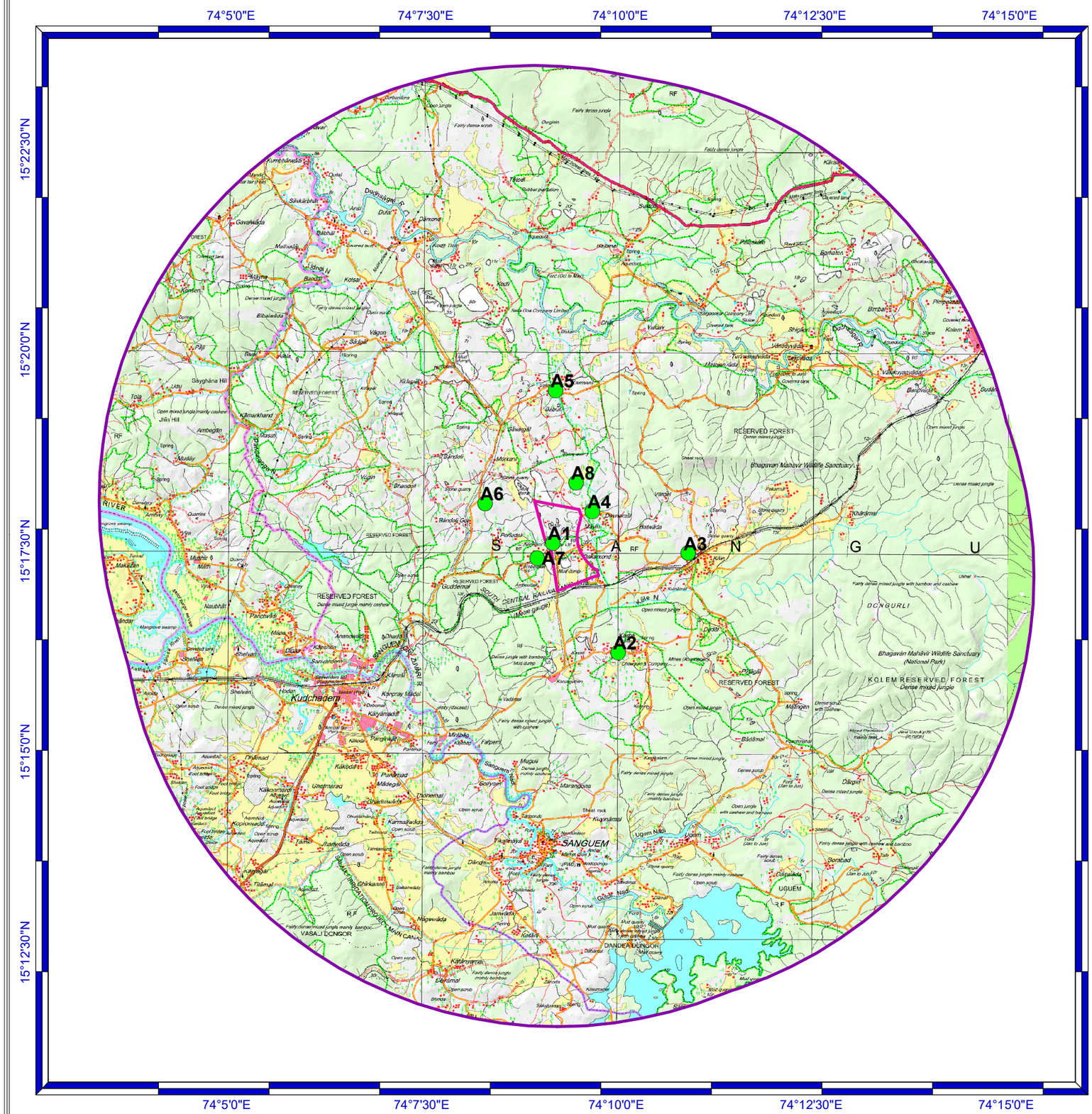
- Mining Lease Area
- 10 km bufferzone
- 20m contours

Plate No. 13

Block IV – Kalay Mineral Block Located at Santona Village, Sanguem taluka, South Goa District, Goa	
Fomento Resources Private Ltd.,	
Title	Contour Map
Scale	1:50,000
Map Prepared By	Mineral Engineering Services 25/XXV Club Road, Ballari -583103

Key Plan Showing Air Monitoring Locations

Plate No. 14



N
W E
S

Scale 1:50000

0 2.5 5 Km

Legend

- Mineral Block
- 10 km bufferzone
- Air_Monitoring_Location

Ambient Air Monitoring Stations

Code	Location	Distance Km	Direction	Latitude D	Latitude M	Latitude S	Longitude D	Longitude M	Longitude S
A1	Kalay Mineral Block Mine office (core zone)	--	--	15	17	37.62	74	9	9.69
A2	Costi village (Near Chowgule Colony)	1.82	SSE	15	16	15.89	74	10	0.15
A3	Kalay village	2.5	E	15	17	30.15	74	10	54.05
A4	Devonamol Village	0.27	NE	15	18	1.40	74	9	40.00
A5	Cormonem village - Meditation Centre	2.64	N	15	19	31.72	74	9	11.09
A6	Bandoli village (Morkani)	1.13	NW	15	18	6.90	74	8	17.20
A7	Santona village (Ambeudok)	0.34	SWW	15	17	26.22	74	8	57.63
A8	Near SFIPL Plant Office	0.6	NNE	15	18	22.87	74	9	27.46

Block IV – Kalay Mineral Block

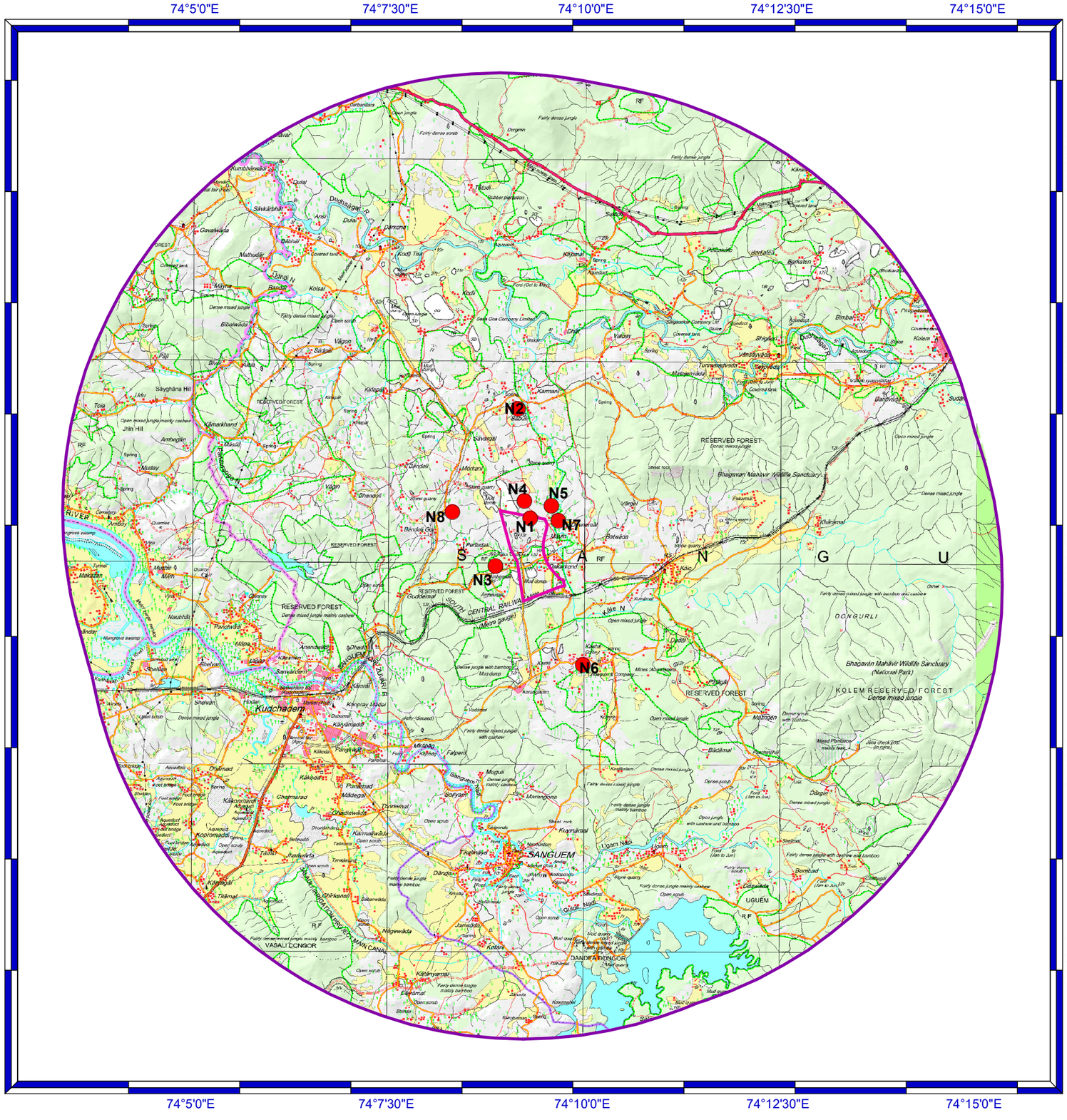
Located at Santona Village, Sanguem taluka, South Goa District, Goa

Fomento Resources Private Ltd.,

Title	AAQ Monitoring Stations
Scale	1:10000
Map Prepared By	Mineral Engineering Services 25/XXV Club Road, Ballari -583103

Key Plan Showing Noise Monitoring Locations

Plate No. 15



N
W E
S

Scale 1:50000

0 2.5 5 Km

Legend

- Mineral Block
- 10 km bufferzone
- Noise Monitoring Locations

Noise Monitoring Stations

Code	Location	Distance Km	Direction	Latitude D	Latitude M	Latitude S	Longitude D	Longitude M	Longitude S
N1	Kalay Mineral Block Mine office (Core zone)	--	--	15	18	3.26	74	9	18.38
N2	Cormonem village-Meditation Centre	2.46	N	15	19	24.52	74	9	8.64
N3	Santona village (Ambeudok)	0.5	SWW	15	17	27.57	74	8	51.88
N4	Near SFIPL Plant Office	0.4	NNE	15	18	16.10	74	9	13.8
N5	Mestri Bhat - Santona Village	0.33	NNE	15	18	12.62	74	9	34.4
N6	Costi Village (Near Chowgule Colony)	1.89	SSE	15	16	14.68	74	9	59.24
N7	Devonamol Village)	0.27	NE	15	18	1.40	74	9	40.00
N8	Bandoli Village (Morcani)	1.09	NW	15	18	7.81	74	8	18.71

Block IV – Kalay Mineral Block

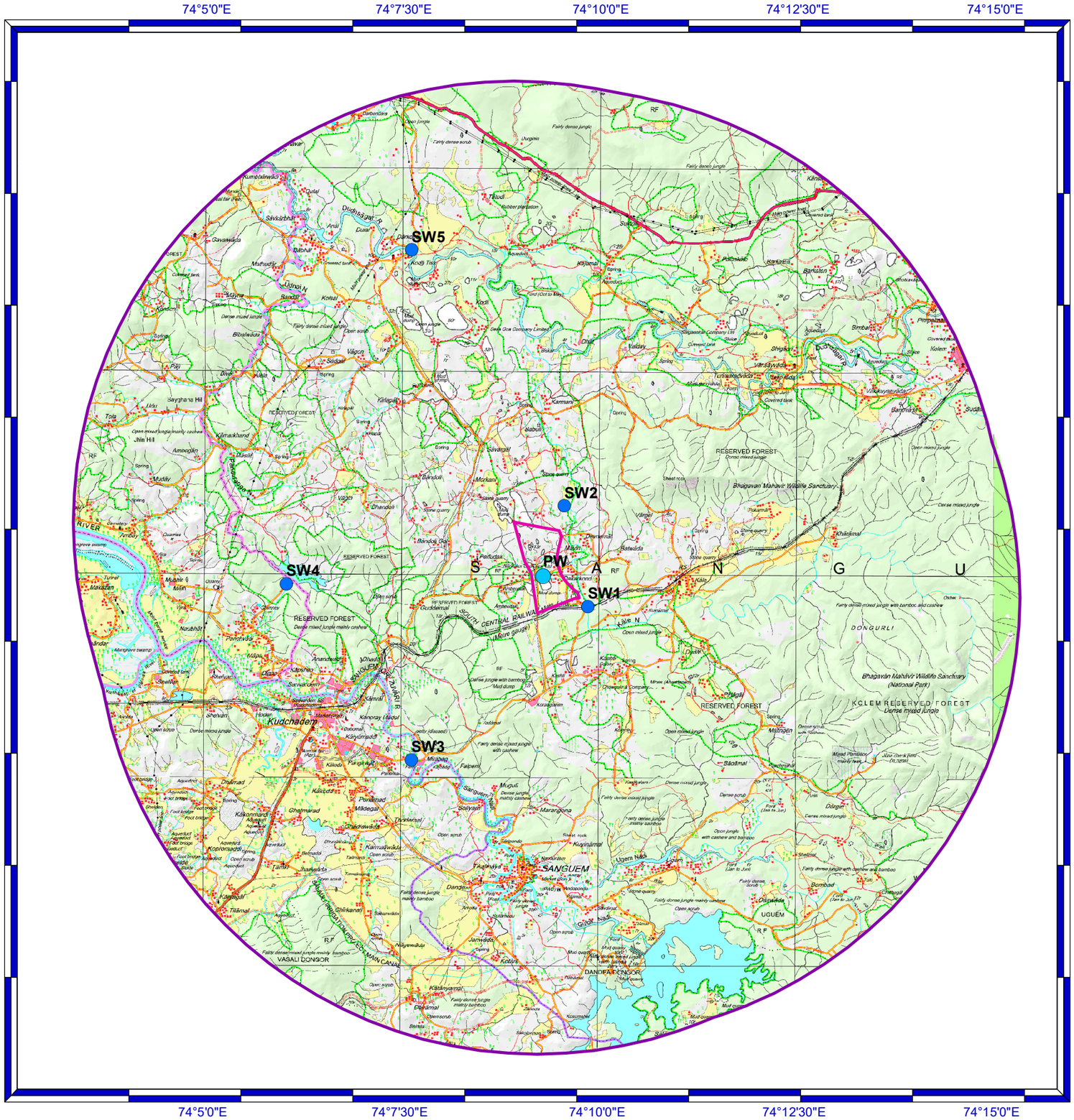
Located at Santona Village, Sanguem taluka, South Goa District, Goa

Fomento Resources Private Ltd.,

Title	Noise Monitoring Locations
Scale	1:50000
	25/XXV Club Road, Ballari -583103

Key Plan Showing Surface Water Sampling

Plate No. 16



N
W E
S

Scale 1:50000

0 2.5 5 Km

Legend

- Pit Water (PW)
- SW
- Mineral Block
- 10 km bufferzone

Pit Water Sampling Loction

Code	Location	Distance Km	Direction	Latitude			Longitude		
				Deg	Min	Sec	Deg	Min	Sec
PW	Kalay Mineral Block pit water	--	--	15	17	29.43	74	9	15.44

Surface Water Sampling Locations

Code	Location	Distance Km	Direction	Latitude			Longitude		
				D	M	S	D	M	S
SW1	Kalay River up stream	0.29	SE	15	17	6.69	74	9	51.73
SW2	Kalay River down stream	0.57	NNE	15	18	20.67	74	9	33.45
SW3	Zuvari River	4.38	SW	15	15	14.60	74	7	40.04
SW4	Moisai Dam	5.47	W	15	17	22.37	74	6	2.4
SW5	Dhudhsagar river	6.6	NNW	15	21	29.32	74	7	36.6

Block IV – Kalay Mineral Block

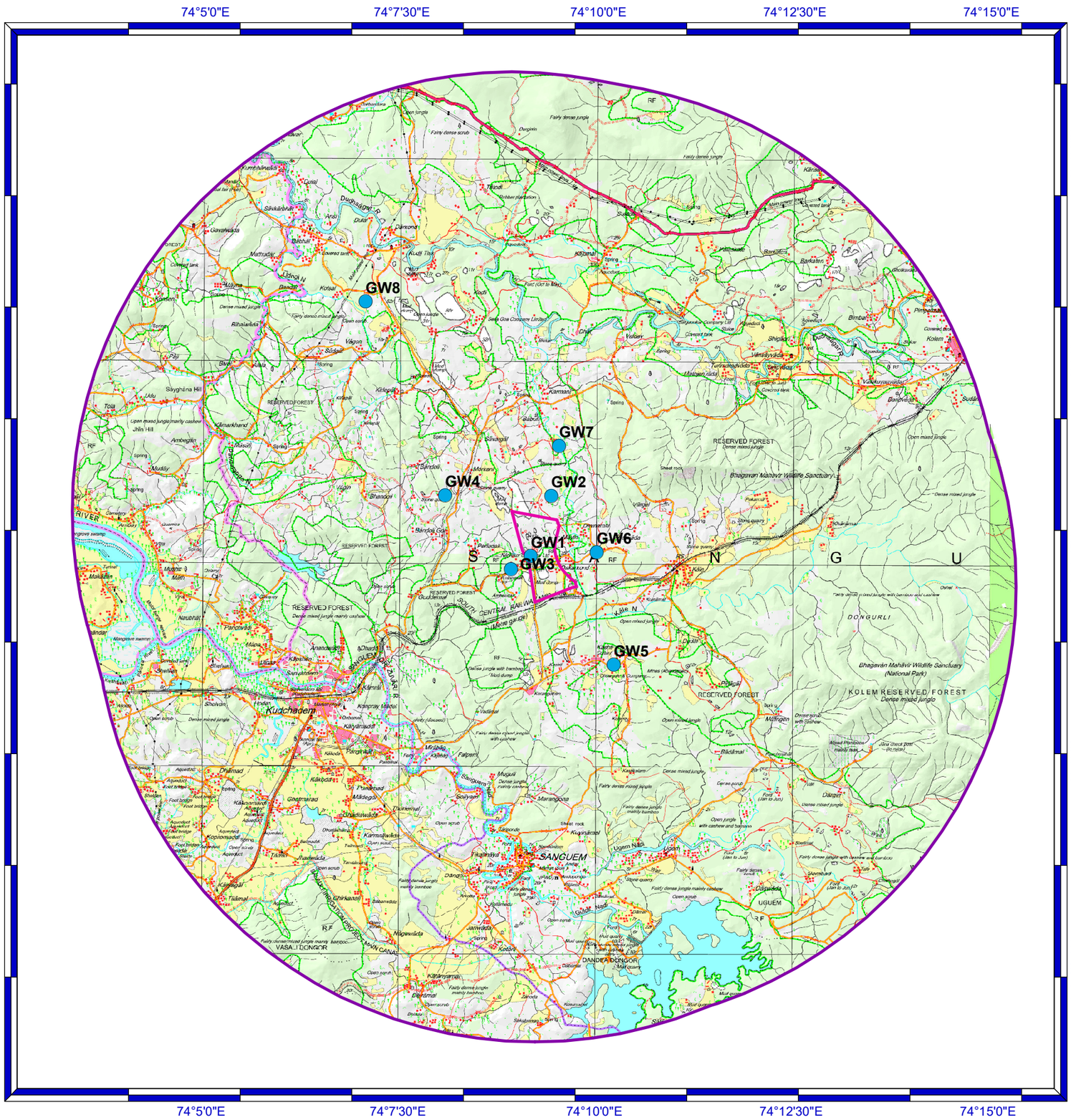
Located at Santona Village, Sanguem taluka, South Goa District, Goa

Fomento Resources Private Ltd.,

Title	Suraface Water Sampling Locations
Scale	1:50000
Map Prepared By	Mineral Engineering Services 25/XXV Club Road, Ballari -583103

Key Plan Showing Ground Water Sampling

Plate No. 17



N
W E
S

Scale 1:50000

0 2.5 5 Km

Legend

- Mineral Block
- 10 km bufferzone
- Ground Water Samples

Ground Water (open Wells) Sampling Locations

Code	Location	Distance Km	Direction	Latitude D	Latitude M	Latitude S	Longitude D	Longitude M	Longitude S
GW1	Within Kalay Mineral Block	--	--	15	17	35.9	74	9	10
GW2	Near SFIPL Plant Office	0.511	E	15	17	32.85	74	9	41.5
GW3	Santona Village,(Ambeudok) Near Saibaba Temple	0.49	W	15	17	26.3	74	8	55.1
GW4	Bandoli Village – Gavaliwada	1.56	NWW	15	18	20.6	74	8	4.36
GW5	Costi Village (Near Chowgule Colony)	2.06	SE	15	16	15.7	74	10	13.7
GW6	Devonamol – Kalay Village	0.4	E	15	17	38.9	74	10	0.32
GW7	Savargal Village	1.75	S	15	18	59.3	74	9	31.2
GW8	Kalsai village	1.9	NW	15	20	43.45	74	7	3.16

Block IV – Kalay Mineral Block

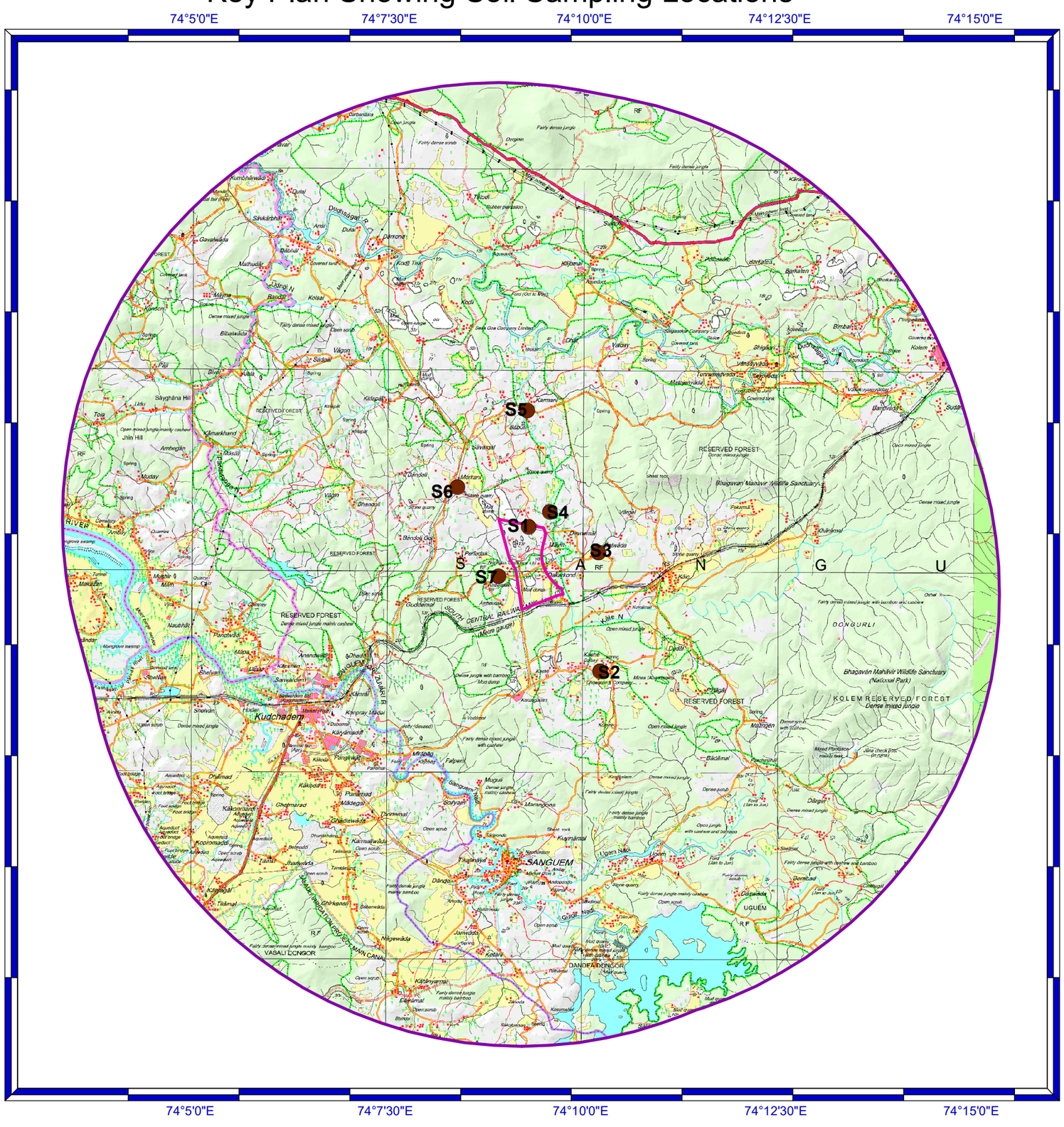
Located at Santona Village, Sanguem taluka, South Goa District, Goa

Fomento Resources Private Ltd.,

Title	Ground Water Sampling Locations
Scale	1:50000
Map Prepared By	Mineral Engineering Services 25/XXV Club Road, Ballari -583103

Key Plan Showing Soil Sampling Locations

Plate No. 18



N
W E
S

Scale 1:50000

0 2.5 5 Km

Legend

- Mineral Block
- 10 km bufferzone
- Soil Sampling Location

Soil Sampling Stations

Code	Location	Distance in (Km)	Direction	Latitude D	Latitude M	Latitude S	Longitude D	Longitude M	Longitude S
S1	Dump Soil of Kalay Mineral Block	--	--	15	18	34	74	9	24
S2	Costi village Agricultural Soil	2.03	SE	15	16	15.7	74	10	13.8
S3	RF Near Devonamol Village	1.3	E	15	17	44.3	74	10	10.9
S4	Santona village (Mestri Bhat)	0.38	NNE	15	18	12.62	74	9	34.4
S5	Cormonem village Agricultural Land	2.6	N	15	19	28.5	74	9	17.0
S6	Bandoli Village Agriculturla Land	1.1	NW	15	18	6.5	74	8	19.6
S7	Santona Village(Ambeudhok) Agricultural soil	0.42	W	15	17	26.6	74	8	55.1

Block IV – Kalay Mineral Block

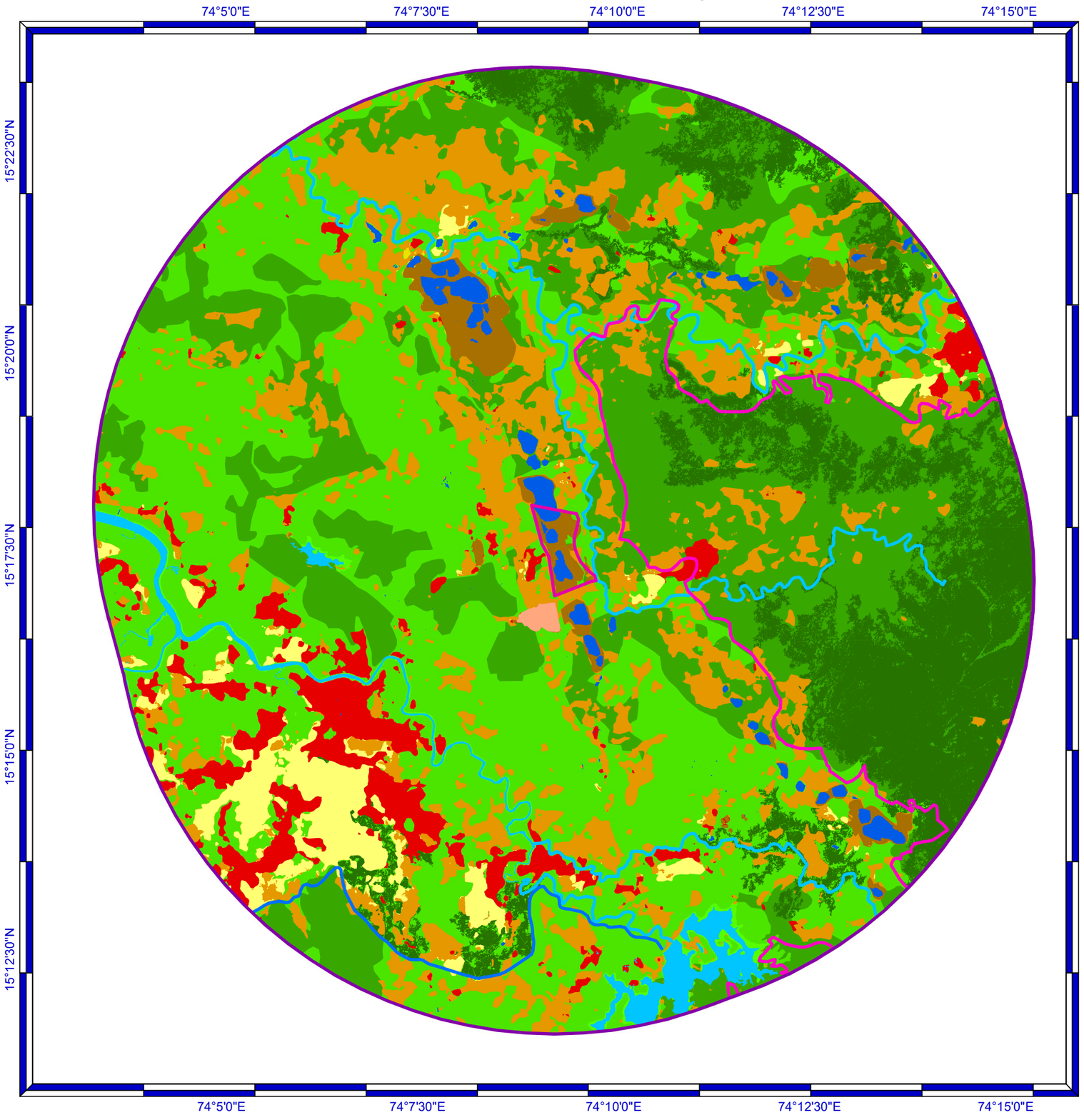
Located at Santona Village, Sanguem taluka, South Goa District, Goa

Fomento Resources Private Ltd.,

Title	Soil Sampling Locations
Scale	1:50000
Map Prepared By	Mineral Engineering Services 25/XXV Club Road, Ballari -583103

Land Use & Land Cover Map

Plate No. 19



N
W E
S

Scale 1:50000

0 2.5 5 Km

Legend

- Mineral Block
- 10 Km Bufferzone
- Rivers
- Wildlife sanctuary Boundary
- canal
- Dense Reserve Forest
- Reserve Forest
- Vegetation
- Agricultural Land
- Water Bodies
- Mine Broken up Area
- Mine Pit Water
- Barren/Grass Land
- Settlements
- Industry

Sl. No	Descripition	Area_Ha	%
1	Dense Reserve Forest	5227.0	13.99
2	Reserve Forest	12638.1	33.83
3	Vegetation	8416.0	22.53
4	Settlements	1714.3	4.59
5	Water Bodies	772.0	2.07
6	Broken up Area & Pit Water Bodies	1426.9	3.82
7	Agricultural Land	1304.8	3.49
8	Barren/Grass Land	5810.2	15.55
9	Industry	46.7	0.13
Total		37356.0	100.0

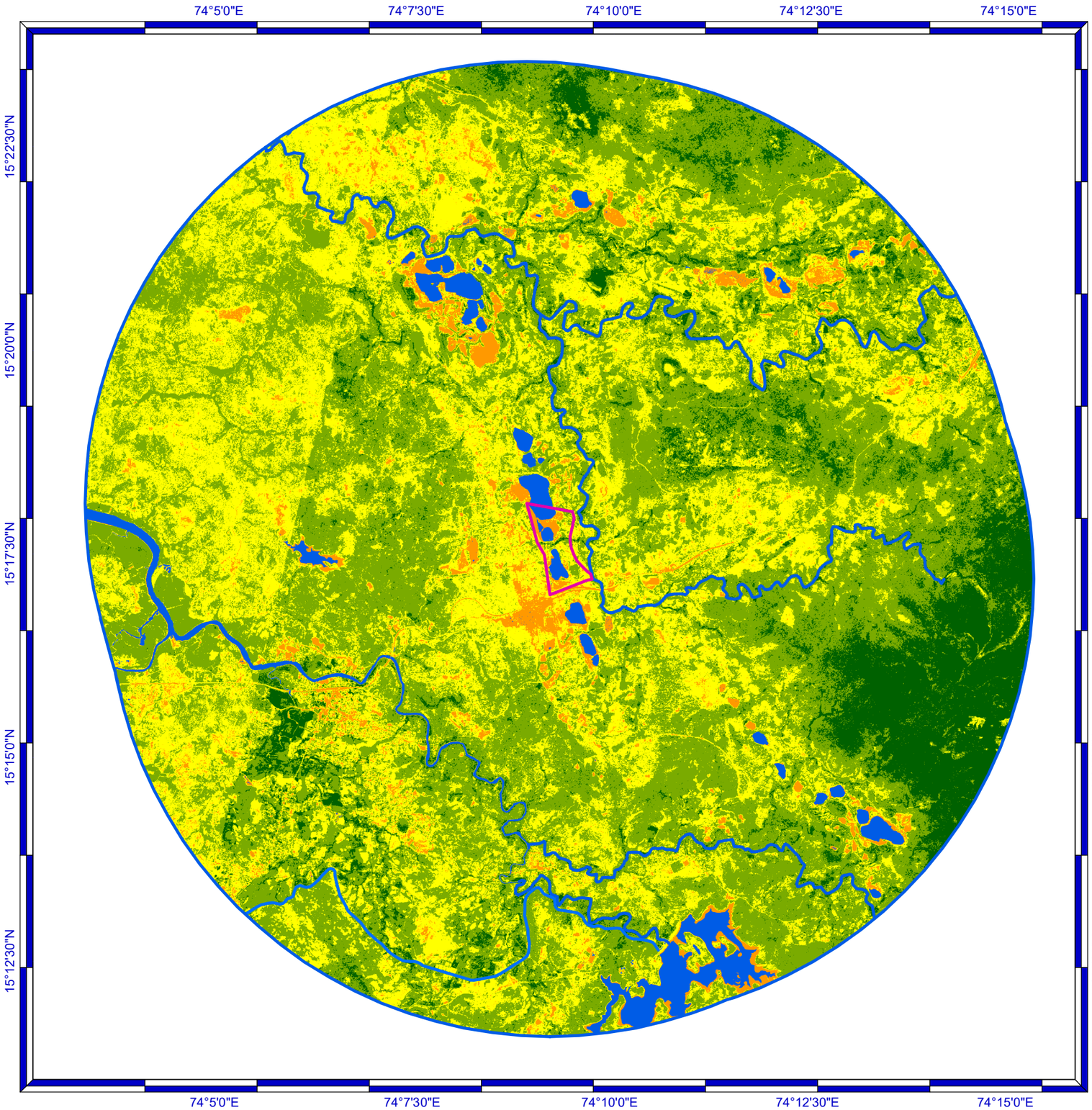
Block IV – Kalay Mineral Block

Located at Santona Village, Sanguem taluka, South Goa District, Goa

Fomento Resources Private Ltd.,

Title	Land Use Land Cover
Scale	1:50000
Data Used	IRS-R2, Mx
Resolution	5m
Date of Pass	01.04.2023 & 08.03.2023
Map Prepared By	Mineral Engineering Services 25/XXV Club Road, Ballari -583103

Normalized Difference Vegetation Index(NDVI)



N
W E
S

Scale 1:50,000

0 2.5 5 Km

Legend

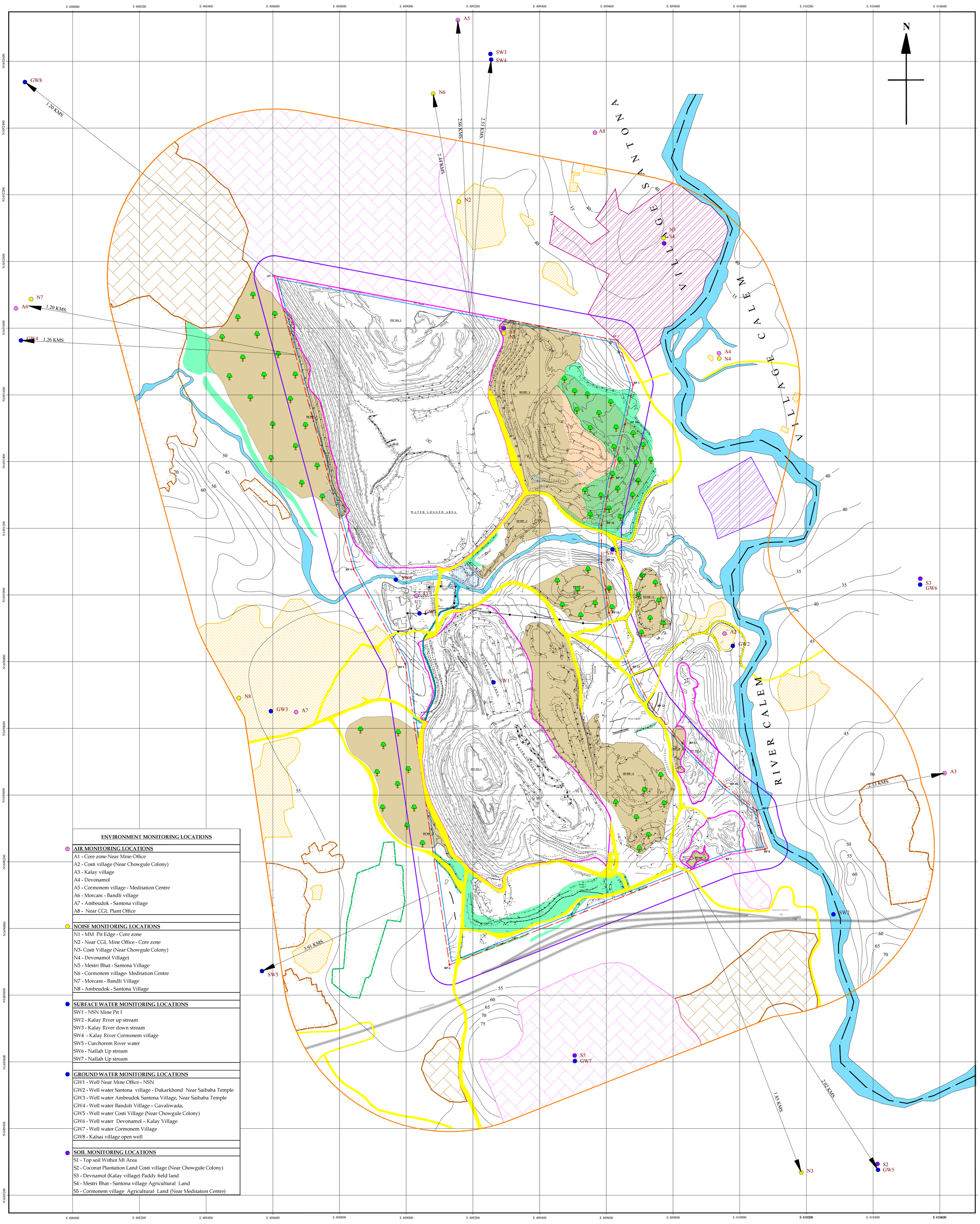
- Mineral Block
- 10 km bufferzone
- 0.01 - 0.17
- 0.18 - 0.38
- 0.39 - 0.58
- 0.59 - 0.79
- Water bodies/Pit water /Canal

Block IV – Kalay Mineral Block

Located at Santona Village, Sanguem taluka,
South Goa District, Goa

Fomento Resources Private Ltd.,

Title	NDVI
Scale	1:50,000
Data Used	IRS-R2, Mx
Resolution	5m
Date of Pass	01.04.2023 & 08.03.2023
Map Prepared By	Mineral Engineering Services 25/XXV Club Road, Ballari -583103



ENVIRONMENT MONITORING LOCATIONS

AIR MONITORING LOCATIONS

- A1 - Core zone Near Mine Office
- A2 - Costi village (Near Chowgule Colony)
- A3 - Kalay village
- A4 - Devonamol
- A5 - Cormonem village - Meditation Centre
- A6 - Morcani - Bandli village
- A7 - Ambeudok - Santona village
- A8 - Near CGL Plant Office

NOISE MONITORING LOCATIONS

- N1 - MM Pit Edge - Core zone
- N2 - Near CGL Mine Office - Core zone
- N3- Costi Village (Near Chowgule Colony)
- N4 - Devonamol Village)
- N5 - Mestri Bhat - Santona Village
- N6 - Cormonem village- Meditation Centre
- N7 - Morcani - Bandli Village
- N8 - Ambeudok - Santona Village

SURFACE WATER MONITORING LOCATIONS

- SW1 - NSN Mine Pit 1
- SW2 - Kalay River up stream
- SW3 - Kalay River down stream
- SW4 - Kalay River Cormonem village
- SW5 - Curchorem River water
- SW6 - Nallah Up stream
- SW7 - Nallah Up stream

GROUND WATER MONITORING LOCATIONS

- GW1 - Well Near Mine Office - NSN
- GW2 - Well water Santona village - Dukarkhond Near Saibaba Temple
- GW3 - Well water Ambeudok Santona Village, Near Saibaba Temple
- GW4 - Well water Bandoli Village – Gavaliwada,
- GW5 - Well water Costi Village (Near Chowgule Colony)
- GW6 - Well water Devonamol – Kalay Village
- GW7 - Well water Cormonem Village
- GW8 - Kalsai village open well

SOIL MONITORING LOCATIONS

- S1 - Top soil Within Ml Area
- S2 - Coconut Plantation Land Costi village (Near Chowgule Colony)
- S3 - Devnamol (Kalay village) Paddy field land
- S4 - Mestri Bhat - Santona village Agricultural Land
- S5 - Cormonem village Agricultural Land (Near Meditation Centre)

I N D E X

MINERAL BLOCK BOUNDARY	HIGH TENSION POWER LINE	PIT PERIPHERY	DRAIN	SETTLEMENT
CONTOURS	LOW TENSION POWER LINE	PIT RECLAIMED	60 m BUFFER AREA	AGRICULTURAL LAND
MINE BENCHES	STRUCTURES	PIT REHABILITATED	500 m BUFFER AREA	PRIVATE PLANATION
EXISTING DUMP	7.5 M STATUTORY BARRIER	SETTLING POND	VILLAGE BOUNDARY	INDUSTRIAL AREA
ROADS	RUBBLE WALL	PROTECTIVE BUND	DUMPS OF OTHER LESSEE	QUARRY
RIVER/ NALLA	RAILWAYS	PLANTATION	PITS OF OTHER LESSEE	

FOMENTO RESOURCES PRIVATE LIMITED

BLOCK IV - KALAY MINERAL BLOCK

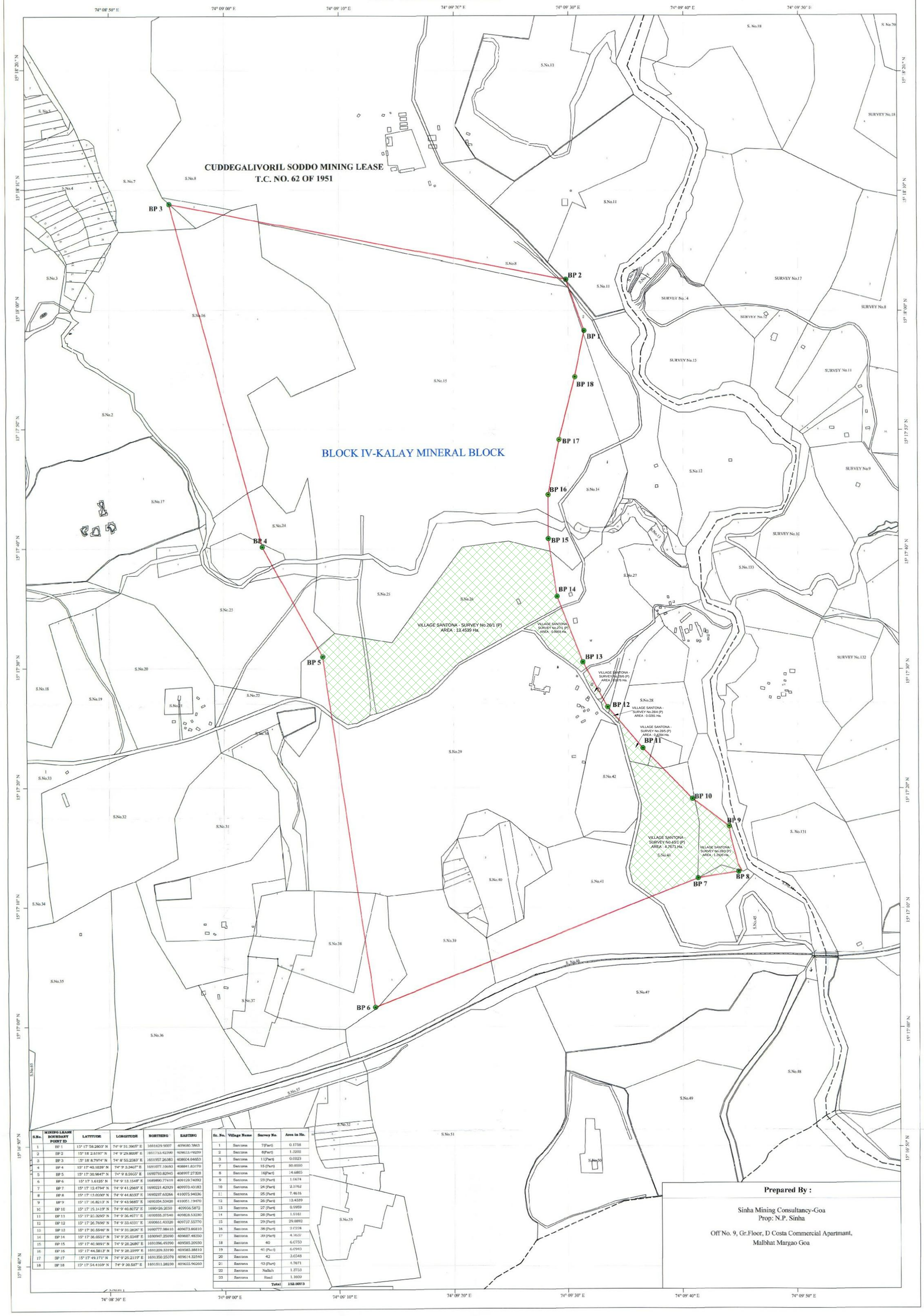
AREA - 152.5073 Ha.

VILLAGE - SANTONA TALUKA - SANGUEM

PURPOSE OF THE PLAN: ENVIRONMENT PLAN

DATE	SCALE	Certified that the Plan is prepared based on the lease map authenticated by the State Government and is correct to the best of our knowledge
	1 : 5000	Roshel Fernandes, Qualified Person — Amit Ashok Ghogale, Qualified Person

Plan Showing Mining Lease Boundary of BLOCK IV-KALAY MINERAL BLOCK, on Georeferenced and Vectorised Cadastral Map, situated in Santona Village of Sanguem Taluka, South Goa District. Goa State



S.No.	MINING LEASE BOUNDARY POINT ID	LATITUDE	LONGITUDE	NORTHING	EASTING
1	BP 1	15° 17' 58.2803" N	74° 9' 31.3905" E	1691629.9007	409680.3863
2	BP 2	15° 18' 2.5197" N	74° 9' 29.8608" E	1691753.92390	409633.99239
3	BP 3	15° 18' 8.7974" N	74° 8' 55.2583" E	1691957.26383	408604.04653
4	BP 4	15° 17' 40.1839" N	74° 9' 3.3407" E	1691077.10693	408911.83170
5	BP 5	15° 17' 30.9847" N	74° 9' 8.5935" E	1690793.82945	408997.27328
6	BP 6	15° 17' 1.6125" N	74° 9' 13.1548" E	1689890.77419	409129.74092
7	BP 7	15° 17' 12.4794" N	74° 9' 41.2969" E	1690221.42929	409970.60182
8	BP 8	15° 17' 13.0200" N	74° 9' 44.8333" E	1690237.63266	410075.94036
9	BP 9	15° 17' 16.8213" N	74° 9' 43.9885" E	1690354.53420	410051.19470
10	BP 10	15° 17' 15.1419" N	74° 9' 46.8672" E	1690426.2650	409936.5872
11	BP 11	15° 17' 23.3290" N	74° 9' 36.4671" E	1690688.35340	409626.53280
12	BP 12	15° 17' 26.7690" N	74° 9' 33.4331" E	1690651.43320	409737.55770
13	BP 13	15° 17' 36.8846" N	74° 9' 31.2826" E	1690777.98410	409673.86810
14	BP 14	15° 17' 36.0551" N	74° 9' 25.0348" E	1690947.28590	409607.48350
15	BP 15	15° 17' 40.9091" N	74° 9' 28.2686" E	1691096.49390	409585.20930
16	BP 16	15° 17' 44.5813" N	74° 9' 28.2599" E	1691209.33190	409585.38610
17	BP 17	15° 17' 49.1717" N	74° 9' 29.2119" E	1691350.25570	409614.32540
18	BP 18	15° 17' 54.4169" N	74° 9' 30.5877" E	1691511.28230	409655.96260

Sr. No.	Village Name	Survey No.	Area in Ha.
1	Santona	73(Part)	0.1758
2	Santona	88(Part)	1.3202
3	Santona	11(Part)	0.0023
7	Santona	15 (Part)	50.0550
8	Santona	16(Part)	14.6805
9	Santona	23 (Part)	1.0674
10	Santona	24 (Part)	2.3762
11	Santona	25 (Part)	7.4616
12	Santona	26 (Part)	13.4539
13	Santona	27 (Part)	0.9959
14	Santona	28 (Part)	1.5161
15	Santona	29 (Part)	29.8892
16	Santona	38 (Part)	2.0204
17	Santona	39 (Part)	4.7635
18	Santona	40	6.0750
19	Santona	41 (Part)	6.0943
20	Santona	42	3.6548
21	Santona	43 (Part)	4.7671
22	Santona	Nallah	1.2753
23	Santona	Road	1.1609
		Total	**152.0073**

Prepared By :

Sinha Mining Consultancy-Goa
Prop: N.P. Sinha

Off No. 9, Gr.Floor, D Costa Commercial Apartmant,
Malbhat Margao Goa

N

W E

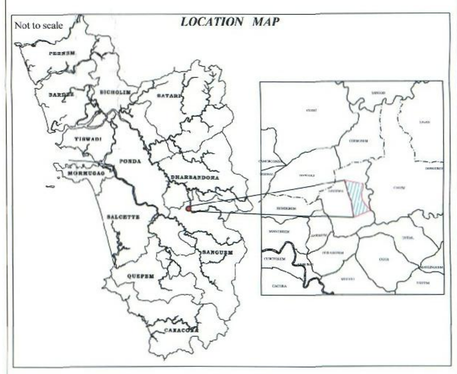
S

SCALE 1 : 3960

0 50 100 200 300 400 500 Meters

LOCATION MAP

Not to scale



KEY PLAN

N

Not to scale



DATUM: WGS 84
PROJECTION : UTM_Zone_43 N

Date of Survey: 09-11-2022

LEGEND

- DGPS POINT OF LEASE BOUNDARY
- MINING LEASE BOUNDARY AS PER DGPS SURVEY
- SURVEY NUMBER BOUNDARY
- SUB-DIVISION OF THE SURVEY NUMBER.
- VILLAGE BOUNDARY
- FOREST LAND

CERTIFICATE

This is to certify that the Mining Lease Boundary Pillars have been verified along with officials of Directorate of Mines and Geology, Goa (DMG) on 09-02-2023 based on the survey data of Mining Lease boundary pillars which were surveyed by Sinha Mining Consultancy-Goa by using DGPS (Differential Global Positioning System) on 09-11-2022

K.M.Shivaprasad
(Surveyor)

CERTIFICATE BY ACCREDITED AGENCY

This is to certify that the Mining Lease Boundary Pillars have been Surveyed by using DGPS (Differential Global Positioning System) The Survey was conducted as per Directorate of Mines and Geology, Goa (DMG) Letter No DMG/09/Auction Cell/Misc/2022/2090, dated: 08-11-2022

For Sinha Mining Consultancy - Goa

(Prop: N.P. Sinha)

Sinha Mining Consultancy
Reg. No.: GUV/MetalU/rest./229
GUV/MetalU/rest./531

DIRECTORATE OF MINES AND GEOLOGY - PANAJI - GOA

Checked and Certified by

Director of Mines & Geology,
Directorate of Mines & Geology,
Government of Goa,
Panaji - Goa.

Assistant Geologist
Directorate of Mines & Geology
Government of Goa
Panaji-Goa

Annexures

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/25/Auction Cell/LOI-function/2023/2804 Date:13/01/2023

Letter of Intent for Block IV- Kalay Mineral Block

To,
Fomento Resources Private Limited,
1st Floor, 102, Kamat Metropolis-1,
Behind Caculo Mall, St. Inez,
Panaji, Goa 403001.

***Sub**: Letter of intent with reference to e-auction dated December 21, 2022 for grant of a mining lease for Block IV- Kalay Mineral Block for Iron Ore mineral in Santona village, Sanguem Taluka, South Goa District on 179.1826 Hectare Area.*

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 September 30, 2022 to commence the auction process for grant of mining lease for **Block IV- Kalay Mineral Block** located in North Goa. The e-auction process was conducted in accordance with the tender document for the said mineral block and **Fomento Resources Private Limited** was declared as the 'Preferred Bidder' under Rule 9(9)(iii) of Auction Rules, having quoted a Final Price Offer of **86.40% (Eighty six point four zero percent)**.

1.2 As required under Rule 10(1) of the Auction Rules and the tender document for the said mineral block, **Fomento Resources Private Limited** has made payment of the first instalment, being 20%

DIRECTORATE OF MINES & GEOLOGY GOVT. OF GOA PANAJI-GOA

(twenty per cent) of the upfront payment of Rs. 5,54,91,122 (Rupees Five Crore Fifty Four Lakh Ninety One Thousand One Hundred Twenty Two) through e-Challan (e-Challan No. 202300001651) dated January 2, 2023, 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 **Block IV- Kalay Mineral Block** for Iron Ore in Santona village, Sanguem Taluka, South Goa District on 179.1826 Hectare Area to **Fomento Resources Private 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 **Fomento Resources Private 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.

Fomento Resources Private 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 **Fomento Resources Private 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":

Fomento Resources Private 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; and

(b) Signing of the Mine Development and Production Agreement

Fomento Resources Private 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, **Fomento Resources Private 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. The State Government reserves the 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 dumps presently located within the Mineral Block. Provided that such right shall be exercised by the State Government no later than 12 (twelve) months from the date of issuance of this Letter of Intent. It is clarified that the Successful Bidder shall, in accordance with Applicable Law, be entitled to dispose of only such part of the dumps in respect of which the State Government does not exercise the aforesaid right.

4. Validity

4.1. This Letter of Intent shall be valid only if **Fomento Resources Private 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 **Fomento Resources Private 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

DIRECTORATE OF MINES & GEOLOGY GOVT. OF GOA

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.

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 **January 27, 2023.**

(Dr. S. Shanbhogue)
Director



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.03/18/2023/Major/Mines/ 3286 Date:13/03/2023

To,
Fomento Resources Private Limited,
1st Floor, 102, Kamat Metropolis-1,
Behind Caculo Mall, St. Inez,
Panaji, Goa 403001.

***Sub**: Request for deletion of area falling under Eco Sensitive Zone (ESZ) with respect to Block IV- Kalay Mineral Block for Iron Ore mineral in Santona village, Sanguem Taluka, South Goa.*

Sir,

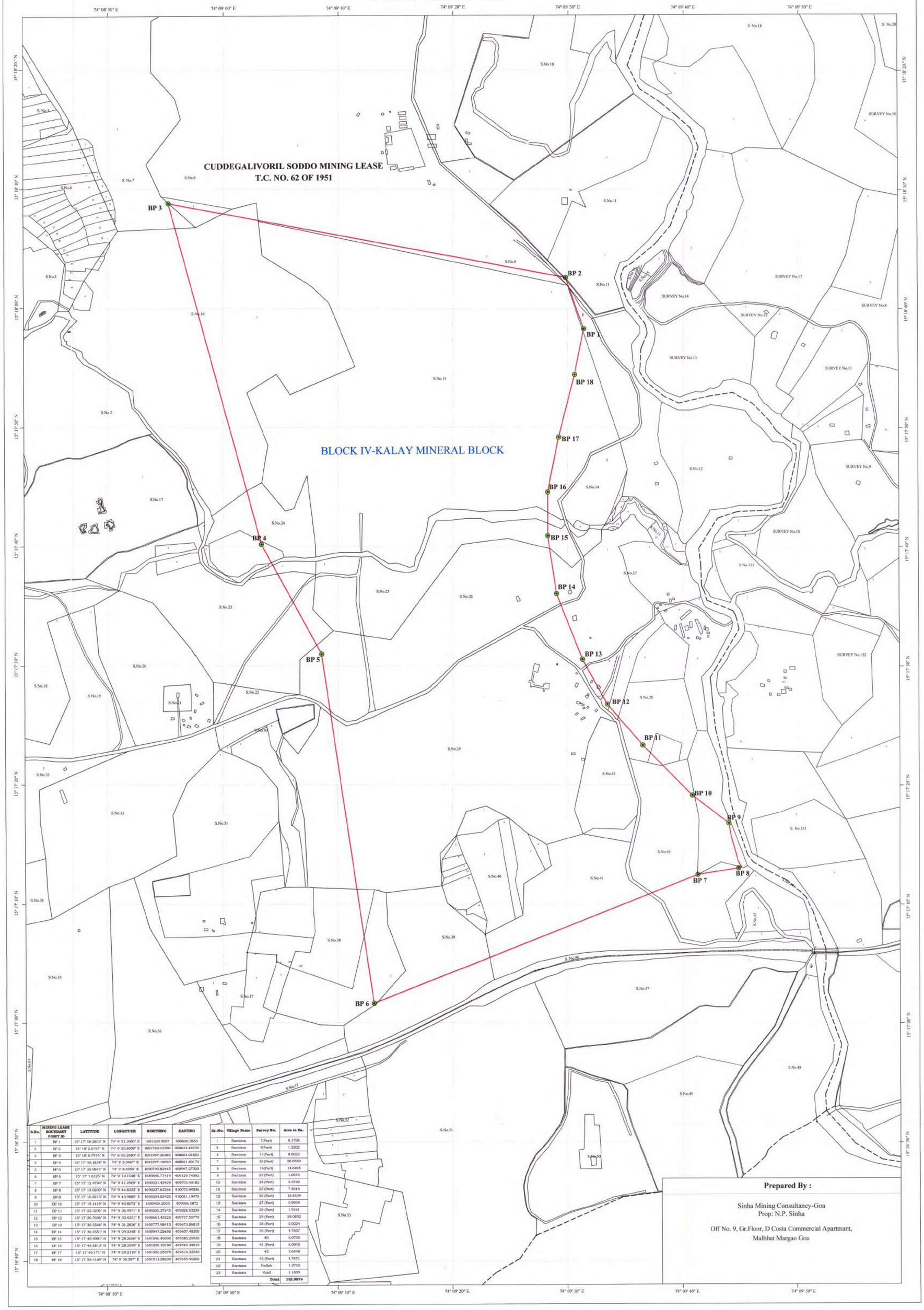
With reference to your letter dated 31.01.2023 on the subject cited above, approval of the Government is hereby conveyed to revise the area of Block IV- Kalay Mineral Block for Iron Ore from 179.1826Ha to 152.5073Ha. allotted to you vide Letter of Intent (LOI) No. DMG/25/Auction Cell/LOI-function/2023/2804, dated 13.01.2023. This revised area is excluding the Eco Sensitive Zone (ESZ) area of 26.6753Ha.

A copy of the plan giving the revised area of Block IV- Kalay Mineral Block for Iron Ore is enclosed for reference.

(Dr. S. Shanbhogue)
Director

Encl: As stated.

Plan Showing Mining Lease Boundary of BLOCK IV-KALAY MINERAL BLOCK, on Georeferenced and Vectorised Cadastral Map, situated in Santona Village of Sanguem Taluka, South Goa District. Goa State



S.No.	MINING LEASE BOUNDARY POINT ID	LATITUDE	LONGITUDE	NORTHING	EASTING
1	BP 1	15° 17' 58.2803" N	74° 9' 31.3905" E	1691629.9007	409680.3863
2	BP 2	15° 18' 2.6197" N	74° 9' 29.8008" E	1691763.42390	409633.49239
3	BP 3	15° 18' 8.7974" N	74° 8' 55.2583" E	1691957.26383	408604.04653
4	BP 4	15° 17' 40.1839" N	74° 9' 3.3467" E	1691077.10693	408841.83170
5	BP 5	15° 17' 30.9847" N	74° 9' 8.3955" E	1690793.82945	408997.27328
6	BP 6	15° 17' 1.6125" N	74° 9' 13.1548" E	1689890.77419	409129.74092
7	BP 7	15° 17' 12.4794" N	74° 9' 41.2569" E	1690221.42929	409970.49182
8	BP 8	15° 17' 13.0200" N	74° 9' 44.8333" E	1690237.63266	410075.94036
9	BP 9	15° 17' 16.8213" N	74° 9' 43.9885" E	1690354.53420	410051.19470
10	BP 10	15° 17' 19.1419" N	74° 9' 40.8072" E	1690426.2050	409956.5872
11	BP 11	15° 17' 23.3295" N	74° 9' 36.4971" E	1690555.37540	409828.53230
12	BP 12	15° 17' 26.7696" N	74° 9' 33.4331" E	1690661.43320	409737.55779
13	BP 13	15° 17' 30.5546" N	74° 9' 31.2826" E	1690777.98410	409673.86819
14	BP 14	15° 17' 36.6551" N	74° 9' 29.0348" E	1690947.25490	409607.48350
15	BP 15	15° 17' 40.9091" N	74° 9' 28.2686" E	1691096.49390	409585.20930
16	BP 16	15° 17' 44.5813" N	74° 9' 28.3599" E	1691208.33190	409585.38810
17	BP 17	15° 17' 49.171" N	74° 9' 29.2119" E	1691350.25070	409614.92540
18	BP 18	15° 17' 54.4169" N	74° 9' 30.587" E	1691511.28220	409655.96260

Sr. No.	Village Name	Survey No.	Area in Ha.
1	Santona	7(Part)	9.1758
2	Santona	8(Part)	1.3202
3	Santona	11(Part)	9.0023
7	Santona	15 (Part)	50.0550
8	Santona	16(Part)	14.6805
9	Santona	23 (Part)	1.0674
10	Santona	24 (Part)	2.3762
11	Santona	25 (Part)	7.4616
12	Santona	26 (Part)	13.4539
13	Santona	27 (Part)	0.9559
14	Santona	28 (Part)	1.9161
15	Santona	29 (Part)	29.0892
16	Santona	38 (Part)	2.0224
17	Santona	39 (Part)	4.7637
18	Santona	40	6.0750
19	Santona	41 (Part)	5.0940
20	Santona	42	3.6548
21	Santona	43 (Part)	4.7671
22	Santona	Nallah	1.3753
23	Santona	Road	1.1609
		Total	182.0073

Prepared By :

Sinha Mining Consultancy-Goa
Prop: N.P. Sinha

Off No. 9, Gr.Floor, D Costa Commercial Apartmant,
Malbhat Margao Goa

N

W E

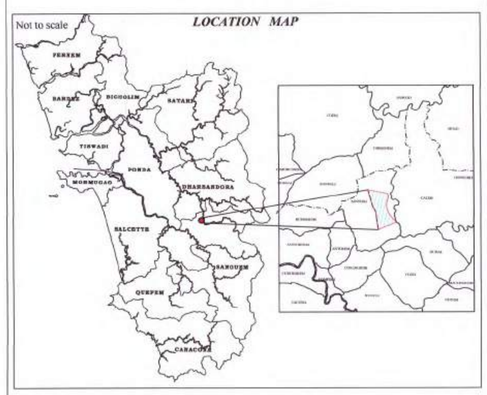
S

SCALE 1 : 3960

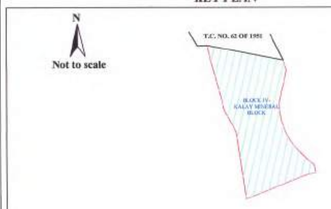
0 50 100 200 300 400 500 Meters

Not to scale

LOCATION MAP



KEY PLAN



DATUM: WGS 84
PROJECTION : UTM_Zone_43 N

Date of Survey: 09-11-2022

LEGEND

- DGPS POINT OF LEASE BOUNDARY
- MINING LEASE BOUNDARY AS PER DGPS SURVEY
- SURVEY NUMBER BOUNDARY
- SUB-DIVISION OF THE SURVEY NUMBER.
- VILLAGE BOUNDARY

CERTIFICATE

This is to certify that the Mining Lease Boundary Pillars have been verified along with officials of Directorate of Mines and Geology, Goa (DMG) on 09-02-2023 based on the survey data of Mining Lease boundary pillars which were surveyed by Sinha Mining Consultancy-Goa by using DGPS (Differential Global Positioning System) on 09-11-2022

K.M.Shivaprasad
(Surveyor)

CERTIFICATE BY ACCREDITED AGENCY

This is to certify that the Mining Lease Boundary Pillars have been Surveyed by using DGPS (Differential Global Positioning System) The Survey was conducted as per Directorate of Mines and Geology, Goa (DMG) Letter No DMG/09/Auction Cell/Misc/2022/2090. dated: 08-11-2022

For Sinha Mining Consultancy - Goa

(Prop: N.P. Sinha)

Sinha Mining ... Reg. No.: ...
GUV/Metal/Unreal/3229
GUV/Metal/Real/4931

DIRECTORATE OF MINES AND GEOLOGY - PANAJI - GOA

Checked and Certified by

Director of Mines & Geology,
Directorate of Mines & Geology,
Government of Goa,
Panaji - Goa.

Assistant Geologist
Directorate of Mines & Geology
Government of Goa
Panaji-Goa

By e-mail

GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES
OFFICE OF THE REGIONAL CONTROLLER OF MINES, GOA

No. MCDR-MPCOFE/2/2023-GOA-IBM_RO_GOA Dt : 30/06/2023

Shri/M/s. Fomento Resources Private Limited ,
102, 1st floor, Kamat Metropolis-I, Behind Caculo Mall, St. Inez, Panaji Tiswadi

BLOCK IV KALAY MINERAL BLOCK (PB63)

Sub : Approval of Mining Plan in respect of your BLOCK IV KALAY MINERAL BLOCK, over an area of 152.5073 Ha. situated in Santona Village, Sanguem Taluka, South Goa District of Goa State submitted under Rule 16(1) of Minerals (Other than Atomic and Hydro Carbons Energy Minerals) Concession Rules 2016.

Ref : (i) Receipt of draft Mining Plan in respect of aforesaid Block in MPAS Portal on 31.03.2023.

(ii) This office scrutiny comments on the examination of the draft copy of Mining plan sent through the MPAS portal of MTS dtd. 08.05.2023, 02.06.2023 & 23.06.2023.

(iii) Online final submission of the modified document i.r.o. aforesaid block on the MPAS portal on 26.06.2023

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 the 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 IV Kalay Mineral Block over an extent of 152.5073 Ha. situated in Santona Village of Sanguem Taluka, South Goa District 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 the aforesaid Mining Plan does not in any way imply the approval of the Government in terms of any other provisions of the 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 State Govt; shall be complied. 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 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 comments shall be taken immediately.
9. It shall be mandatory for the project proponent, abstracting groundwater to obtain a No Objection Certificate from Central Ground Water Authority or the Goa State Ground Water 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.

Approved

Yours faithfully,

(Naresh Kumar Kataria)

Deputy Controller of Mines & Officer-In-Charge

Copy forwarded for kind information to:

1. The Controller of Mines (SZ), Indian Bureau of Mines, Bangalore.
2. The Director, Directorate of Mines & Geology, Institute of Menezes Braganza Bldg, Panaji, Goa – 403001.
3. Technical Persons: Shri Amit Ashok Ghogale, Ms. Roshel Fernandes. (e-mail id: amit_0335@yahoo.co.in; roshel.fernandes05@gmail.com)

(Naresh Kumar Kataria)

Deputy Controller of Mines & Officer-In-Charge

Approved

I/38241/2024

By e-mail

GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES
OFFICE OF THE REGIONAL CONTROLLER OF MINES, GOA

No. MCDR-MPC0FE/6/2024-GOA-IBM_RO_GOA Dt : 23/08/2024

Shri/M/s. Fomento Resources Private Limited ,
102, 1st floor, Kamat Metropolis-I, Behind Caculo Mall, St. Inez, Panaji Tiswadi

BLOCK IV KALAY MINERAL BLOCK (PB63)

Sub : Approval of Modifications in Approved Mining Plan in respect of your BLOCK IV – KALAY MINERAL BLOCK over an area of 152.5073 Ha. situated in Santona Village, Sanguem Taluka, South Goa District 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 Modifications in Approved Mining Plan in respect of your aforesaid Block in the MPAS portal on 17.07.2024.

(ii) This office scrutiny comments on the examination of draft Modifications in Approved Mining Plan in respect of your aforesaid Block sent through the MPAS Portal on 20.08.2024.

(iii) Online submission/receipt of modified Modifications in Approved Mining Plan in respect of your aforesaid Block in the MPAS portal on 21.08.2024.

Sirs,

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 Modifications in Approved Mining Plan with Progressive Mine Closure Plan in respect of your Block No. IV – Kalay Mineral Block over an extent of 152.5073 Ha. situated in Santona Village, Sanguem Taluka, South Goa District 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. All conditions already levied in the earlier letter of approval of the Mining Plan approved vide this office Letter No. MCDR-MPC0FE/2/2023-GOA-IBM_RO_GOA dated 30.06.2023 remains unchanged.
2. This modification of the Approved Mining Plan document is approved in view of changes in land use pattern in respect of Survey Nos. 27(P), 28(P), 26/1 (P) & 43/1(P) of Santona Village, Sanguem Taluka which have been identified as 'Prospective Private Forest' and 'Unclassified Forest' by the State Govt. of Goa measuring to the total extent of 21.133 Ha.
3. The applicant shall obtain the necessary Forest Clearance and other approvals from the concerned Component Authorities before the commencement of mining operations.

Yours faithfully,

(Naresh Kumar Katariya)

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.

Approved

I/38241/2024

- The Director, Directorate of Mines Safety, Goa Region, Agali, Fatorda – Goa, 403602.
- Mr. Amit Ashok Ghogale, H.No. 307, Near Govt. High School, New Vaddem, Vasco-da-Gama, Goa. 403802
- Ms. Roshel Fernandes, H. No. 323/85, Behind Releaf Pharmacy, Fatorda, Margao Goa – 403723.

--sd--

(Naresh Kumar Katariya)

Regional Controller of Mines

Indian Bureau of Mines, Goa

BLOCK IV KALAY MINERAL BLOCK (PB63)

Approved

सत्यमेव जयते

File No: IA-J-11015/11/2023-IA-II(NCM)
Government of India
Ministry of Environment, Forest and Climate Change
IA Division
***

Dated **08/01/2024**

To,

M/s FOMENTO RESOURCES PRIVATE LIMITED
102, 1st Floor, Kamat Metropolis-I, Behind Caculo Mall, St. Inez, Panaji, North Goa, 403001, Panaji, NORTH GOA, GOA, 403001
morazkar@ilpl.biz

Subject: **Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Limited for mining of Iron Ore with proposed production capacity of 0.75 MTPA, Waste: 3.0 MTPA in the mine lease area of 152.5073 Ha, located at Village Santona, Sanguem Taluka, South Goa District, Goa - [F.No: IA-J-11015/ll/2023-IA-II(NCM), Proposal No: IA/GA/MIN/422578/2023 -Terms of Reference (ToR) - reg.**

Sir/Madam,

This is in reference to your application for grant of terms of reference to the project for **Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Limited for mining of Iron Ore with proposed production capacity of 0.75 MTPA, Waste: 3.0 MTPA in the mine lease area of 152.5073 Ha, located at Village Santona, Sanguem Taluka, South Goa District, Goa,** under the provision of the EIA Notification 2006.

2. The particulars of the proposal are as below :

(i) TOR Identification No.	TO23B0000GA5122365N
(ii) File No.	IA-J-11015/1l/2023-IA-II(NCM)
(iii) Clearance Type	TOR
(iv) Category	Bl
(v) Project/Activity Included Schedule No.	1(a) Mining of minerals
(vi) Sector	Non-Coal Mining
(vii) Name of Project	Block IV – Kalay Mineral Block
(viii) Name of Company/Organization	FOMENTO RESOURCES PRIVATE LIMITED
(ix) Location of Project (District, State)	SOUTH GOA, GOA
(x) Issuing Authority'	MoEF&CC
(xii) Applicability of General Conditions	yes
(xiii) Applicability of Specific Conditions	no

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

2. 4. The above-mentioned proposal has been considered by Expert Appraisal Committee of EAC in the meeting held on 05/12/2023. The minutes of the meeting and all the Application and documents submitted [(viz. Form-1 Part A, Part B, Part C EIA, EMP)] are available on PARIVESH portal which can be accessed by scanning the QR Code above.

3. 5. The brief about configuration of plant/equipment, products and byproducts and salient features of the project along with environment settings, as submitted by the Project proponent in Form-1 (Part A, B and C)/EIA & EMP Reports/presented during EAC.

4. 6. The EAC, in its meeting held on 05/12/2023, based on information & clarifications provided by the project proponent the EAC deliberated on the site inspection carried out by Regional Office on 05.10.2023 along with the representative from State Forest Department (North Goa & South Goa) and Department of Mining and Geology, Govt. of Goa and representatives from M/s Fomento Resources Private Limited. The EAC noted that the Regional Office vide letter dated 25.10.2023 concluded that the project site i.e. Block IV- Kalay Mineral Block area (Auction Block) of M/s Fomento Resources Private Limited located at village Santona, Sanguem Taluka, South Goa District Goa falls outside of ESZ of Bhagwan Mahaveer Wildlife Sanctuary and National Park and ESA of Western Ghats. The Project Proponent also briefed about the chronology of mine lease till the joint inspection report carried out by Regional Office on 05.10.2023.

5. After detailed deliberations made by the Project Proponent, the EAC in its meeting held during 5-7 December, 2023, under the provisions of EIA Notification, 2006 and its subsequent amendments therein, **recommended** the proposal for grant of Terms of Reference (ToR) to M/s Fomento Resources Private Limited for mining of Iron Ore in Kalay Mineral Block - Block IV (Auction Block) with proposed production capacity of 0.75 MTPA, Waste: 3.0 MTPA in the mine lease area of 152.5073 Ha, located at Village Santona, Sanguem Taluka, South Goa District, Goa for undertaking detailed EIA/EMP study subject to the following certain specific conditions in addition to the standard ToR conditions (Annexure 1) and applicable for non-coal mining projects, under the provision of EIA Notification, 2006.

6. 7. The MoEF&CC has examined the proposal in accordance with the Environment Impact Assessment (EIA) Notification, 2006 & further amendments thereto and after accepting the recommendations of the Expert Appraisal Committee hereby decided to grant Terms of Reference to the project for **Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Limited for mining of Iron Ore with proposed production capacity of 0.75 MTPA, Waste: 3.0 MTPA in the mine lease area of 152.5073 Ha, located at Village Santona, Sanguem Taluka, South Goa District, Goa,** under the provisions of EIA Notification, 2006 and as amended thereof.

7.

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

9. 9. The Terms of Reference to the aforementioned project is under provisions of EIA Notification, 2006. It does not tantamount to approvals/consent/permissions etc. required to be obtained under any other Act/Rule/regulation. The Project Proponent is under obligation to obtain approvals /clearances under any other Acts/ Regulations or Statutes, as applicable, to the project.

10. 10. The details of the project is at Annexure 2.

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

Copy To

1. **The Secretary,** Ministry of Mines, Government of India, Shastri Bhawan, New Delhi.
2. **The Secretary,** Department of Mines and Geology, Ground Floor of Institute Menezes Braganza, Government of Goa.
3. **The Director,** Department of Environment and Climate Change (DoE and CC), Government of Goa.

4. **The Secretary,** Department of Forests, Government of Goa, Goa Van Bhavan, Goa.
5. **The Chief Wildlife Warden**, Goa Van Bhavan, Forest Department, Altinho, Panaji Goa. 403001.
6. **The Deputy Director General of Forests (C),** Ministry of Env., Forest and Climate Change, Integrated Regional Office, Kendriya Sadan, 4th Floor, E&F Wings, 17th Main Road, Koramangala II Block, Bangalore - 560034.
7. **The Member Secretary,** Central Pollution Control Board, Parivesh Bhawan, CBD-Cum-Office Complex, East Arjun Nagar, New Delhi-110 032.
8. **The Member Secretary,** Central Ground Water Authority, 18/11, Jam Nagar House, Man Singh Road, New Delhi-110011.
9. **The Member Secretary,** Goa State Pollution Control Board, Nr. Pilerne Industrial Estate, Opp. Saligao Seminary, Saligao, Goa 403511.
10. **The Controller General,** Indian Bureau of Mines, Indira Bhavan, Civil Lines, Nagpur- 440 001.
11. **The District Collector,** South Goa District, Government of Goa.
12. **Guard File.**
13. **PARIVESH Portal.**

Annexure 1

Specific Terms of Reference for (Mining Of Minerals)

1. Court Case

S. No	Terms of Reference
1.1	The instant ToR is subject to the outcome of the said court case i.e., WP 592 of 2022 before the High Court of Bombay at Goa.

2. Sequence Of Mining

S. No	Terms of Reference
2.1	The Project Proponent needs to submit the year wise sequence of mining operation and plan for backfilling.

3. Emp For Normative/peak Production

S. No	Terms of Reference
3.1	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 due to HEMM.

4. Road Transportation

S. No	Terms of Reference
4.1	The Project Proponent needs to submit the map showing the transport route of the mineral from the mine lease area to the destination, impact of details of habitation at a distance of 100m from the center on both sides of road, details of no. of trips/day to and fro, capacity of the dumper/tipper to be deployed and the dimensions of the road, existing and additional traffic load to the NH and the carrying capacity of the road. Project Proponent needs to submit SOP for transportation.

5. Environment Monitoring And Emp

S. No	Terms of Reference
5.1	The Project Proponent needs to monitor the ambient air quality and noise level at the mine lease boundary, nearest village, crusher, predominant downwind direction and at other sensitive receptors. Accordingly, Project Proponent shall propose to install Continuous Ambient Air Quality Monitoring Station within certain timeline.

6. Socio Economic

S. No	Terms of Reference
6.1	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.

7. Groundwater

S. No	Terms of Reference
7.1	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. 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.
7.2	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.
7.3	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 seeking NoC for ground water withdrawal and the shall submit as part of EIA/EMP report.

8. Drone Survey

S. No	Terms of Reference
8.1	The Project Proponent shall conduct drone survey of the mine lease area and buffer area and submit during the appraisal for EC.

9. Greenbelt & Afforesttaion

S. No	Terms of Reference
9.1	The Project Proponent needs to submit the greenbelt/afforestation development plan for undertaking plantation in the periphery of the mine lease boundary, safety zone etc., The details of the no. of saplings proposed, type of species, spacing and the area to be covered including the cost and timeline for completion of plantation needs to be provided in the EIA report.

10. Employment

S. No	Terms of Reference
10.1	The Project Proponent needs to submit the employment based skill development plan for the local people and thrust should be to provide employment to local people after imparting training.

11. Transportation Through Rail

S. No	Terms of Reference
11.1	The Project Proponent needs to explore the possibility of evacuating the material through rail.

12. Railway Line

S. No	Terms of Reference
12.1	The Project Proponent needs to submit the map demarcating the exact distance of the railway line and railway boundary from the mine lease area. The Project Proponent also needs to submit the details of train passing and their frequency. Further, the Project Proponent needs to submit the measures taken to protect the railway line from the mining activity.

13. Habitations

S. No	Terms of Reference
13.1	The Project Proponent needs to submit the action plan for shifting the habitations inside the mine lease area.

14. Mine Inundation

S. No	Terms of Reference
14.1	The Project Proponent needs to explore the likelihood of river water entering into the mine pit

S. No	Terms of Reference
	below the RL of the HFL and the measures that are required to be taken for prevention of seepage and in the event of seepage to drain out the water through settling tank. PP also needs to submit the measures to be taken for protection of river in the vicinity of the mine lease area due to mining activity.

15. Engineering Design

S. No	Terms of Reference
15.1	The Project Proponent needs to submit the detailed report on the engineering design for garland drain, settling tank and check dams and its efficacy through recognized institution. The study should also include the per day silt load, settling velocity of the silt, retention time required based on the annual rainfall with a provision to monitor the turbidity of the overflow from the siltation tank as well as monitoring of the turbidity into the drains.

16. Ecology Restoration Plan

S. No	Terms of Reference
16.1	The Project Proponent needs to submit the ecology restoration plan.

Standard Terms of Reference for (Mining of minerals)

1. Project Details

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. The production details need to submit since inception of mine duly authenticated by Department of Mines & Geology, State Government.
1.2	A copy of the document in support of rightful lessee of the mine should be submitted. In case of new mines copy of LoI granted by State Government to be submitted. PP should ensure that LoI is valid at the time of grant of ToR. PP should submit the copy of lease deed/supplementary lease deed/extension letter/transfer deed, from its initial grant to subsequent renewals/ transfer/extension of validity.
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	PP should submit the District Survey Report (DSR) as per S.O. 3611(E) dated 25.07.2018 in case of minor minerals.
1.5	Brief of proposal to be submitted which include total excavation of the material required for the production of certain quantity of the minerals, location of the project, mining lease area, latitude

S. No	Terms of Reference
	longitude, seismic zone etc. In case of expansion project details of expansion viz. expansion in mining lease area or expansion in production of any particular mineral or expansion in total excavation, latest certified Compliance report (CCR) from IRO of conditions granted in existing EC needs to be submitted.
1.6	The PP should submit the real-time aerial video footage & video of the mining lease area and of the transportation route.
1.7	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).
1.8	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.
1.9	The PP should collect the Baseline data (BLD) in respect of initial level of the mining lease. For this permanent bench marks (BM) needs to be established at prominent location preferably close to mining leases in question and should have precisely known relationship to the level datum of the area, typically mean sea level.
1.10	In case of sand mining, the entire mining lease area should be divided suitably into grids of 25 m x 25 m with the help of sections across the width of river and along the direction of flow of the river. The levels (MSL & RL) of the corner point of each grid needs to be recorded. Each Grid should be suitably numbered for identification. PP should identity grids which will be worked out and grids which will come under no mining zone i.e. safety barriers from the river bank. PP should comply with the sustainable sand mining management guidelines 2016 and enforcement and monitoring guidelines, 2020 etc.
1.11	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.
1.12	Details of the onsite shelter and facilities to be provided to the mine workers should be included in the EIA Report.
1.13	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.
1.14	The cost of the Project (capital cost and recurring cost) as well as the cost towards implementation of EMP should be clearly spelt out.
1.15	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.

S. No	Terms of Reference
1.16	Compliance of the Ministry's Office Memorandum No. F: 3-50/2017-IA.III (Pt.), dated 30.05.2018 on the judgment 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 needs to be submitted and included in the EIA/EMP Report.

2. Forest

S. No	Terms of Reference
2.1	PP shall submit a certificate from Chief Conservator of Forests regarding involvement of Forest Land in the mining lease area if any. In case forest land is involved i) PP should submit the proof of application made for obtaining forest clearance and ii) a map clearly showing the forest & non-forest area.
2.2	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.
2.3	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.
2.4	The vegetation in the RF / PF areas in the study area, with necessary details, should be given.

3. Court Matters

S. No	Terms of Reference
3.1	Details of litigation pending against the project, if any, with direction /order passed by any Court of Law against the Project should be given.

4. Land Environment

S. No	Terms of Reference
4.1	PP should submit the details of survey number [viz. survey no, area in hectare, classification of land (government, private, forest, grazing land etc.), villages] duly authenticated by State Government, falling in the mining lease area.
4.2	The study area will comprise of 10km 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.
4.3	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.
4.4	Details of the land for any Over Burden Dumps outside the mine lease, such as extent of land area,

S. No	Terms of Reference
	distance from mine lease, its land use, R&R issues, if any, should be given.

5. Wildlife

S. No	Terms of Reference
5.1	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.
5.2	A detailed biological study of the study area [core zone and buffer zone] 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. PP shall submit list of Schedule-1 species present in core and buffer zone duly authenticated by CWLW. 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/Wildlife Department and details furnished. Necessary allocation of funds for implementing the same should be made as part of the project cost. Proof of its submission of conservation plan to the CWLW needs to be submitted.
5.3	PP shall submit a certificate from Chief Wildlife Warden regarding distance of mining lease from the protected area falling within 10 KM of the mining lease. In case project requires clearance under Wildlife (Protection) Act, 1972 then copy of application made for the same needs to be submitted.

6. Baseline Environment

S. No	Terms of Reference
6.1	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.
6.2	Air quality modelling 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 modelling 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 windrose showing pre-dominant wind direction may also be indicated on the map.
6.3	The PP should submit the photograph of monitoring stations & sampling locations. The photograph should bear the date, time, latitude & longitude of the monitoring station/sampling location. In addition to this, PP should submit the original test reports and certificates of the labs from which

S. No	Terms of Reference
	samples were analyzed.

7. Water Environment

S. No	Terms of Reference
7.1	The water requirement for the Project, its availability and source should be furnished. Quantity of surface or ground water to be used for the Project should be indicated. A detailed water balance should also be provided. Submit the year wise target for reduction in consumption of the ground/surface water by developing alternative source of water through rain water harvesting measures. 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. The capital and recurring expenditure to be incurred needs to be submitted.
7.2	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.

8. Hydro Geology

S. No	Terms of Reference
8.1	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.
8.2	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.
8.3	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 bench 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 case of surface water is proposed to be utilized then Necessary clearance from the Competent Authority for drawl of requisite quantity of water for the Project should be provided.

9. Transportation

S. No	Terms of Reference
9.1	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.

10. Land Acquisition And R&r

S. No	Terms of Reference
10.1	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.
10.2	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.

11. Socio-economic Environment

S. No	Terms of Reference
11.1	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.
11.2	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.
11.3	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.
11.4	Activity-wise time-bound action plan on the issues raised and commitment made during public hearing to be submitted as part of the final EMP Report in compliance of the Ministry's OM F.No.22-65/2017-IA.III dated 30th September, 2020.

12. Environmental Monitoring And Management

S. No	Terms of Reference
12.1	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 proposed safeguard measures in each case should also be provided.

S. No	Terms of Reference
12.2	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.

13. Critically Polluted Areas, Aravali & Crz

S. No	Terms of Reference
13.1	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.
13.2	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).

14. Risk Assessment & Disaster Management

S. No	Terms of Reference
14.1	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.
14.2	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.
14.3	A Disaster Management Plan shall be prepared and included in the EIA/EMP Report.

15. Miscellaneous

S. No	Terms of Reference
15.1	The 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,

S. No	Terms of Reference
	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.

Additional Terms of Reference

N/A

Annexure 2

Details of Products & By-products

Name of the product /By-product	Product / By-product	Quantity	Unit	Mode of Transport / Transmission	Remarks (eg. CAS number)
Iron Ore	Iron Ore	750000	Tons per Annum (TPA)	Road	

Validity unknownValidity unknown

Digitally Signed by Pankaj Verma
Member Secretary, EFCC (EC)

Date: 08/01/2024

सत्यमेव जयते

File No.: IA-J-11015/11/2023-IA-II(NCM)
Government of India
Ministry of Environment, Forest and Climate Change
IA Division
****

Dated **19/11/2024**

To,

Mr. Sandeep Morajkar
M/s. FOMENTO RESOURCES PRIVATE LIMITED
102, 1st Floor, Kamat Metropolis-I, Behind Caculo Mall, St. Inez, Panaji, North Goa, 403001, Panaji, NORTH GOA, GOA, Behind Caculo Mall, St. Inez, Panaji, 403001
morazkar@ilpl.biz

Subject: **Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Limited for mining of Iron Ore with proposed production capacity of 0.75 MTPA, Waste 3.0 MTPA in the mine lease area of 152.5073 Ha, located at Village Santona, Sanguem Taluka, South Goa District, Goa. - Amendment in Terms of Reference (ToR) dated 08.01.2024 - reg.**

Sir/Madam,

This is in reference to your application submitted to Ministry vide proposal number IA/GA/MIN/483891/2024 dated 18/03/2023 for grant of an amendment in prior Terms of Reference (ToR) to the project under the provision of the EIA Notification 2006-and as amended thereof.

2. The particulars of the proposal are as below :

(i) TOR Identification No.	TO24B0000GA5934761A
(ii) File No.	IA-J-11015/11/2023-IA-II(NCM)
(iii) Clearance Type	Amendment in TOR
(iv) Category	B1
(v) Schedule No./ Project Activity	1(a) Mining of minerals
(vi) Sector	Non-Coal Mining
(vii) Name of Project	Block IV – Kalay Mineral Block
(ix) Location of Project (District, State)	SOUTH GOA, GOA
(x) Issuing Authority	MoEF&CC
(xii) Applicability of General 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 the Expert Appraisal Committee (EAC) during its meeting held on 09/09/2024. The minutes of the meeting, along with all submitted application documents (including Form-1 Parts A and B), are available on the PARIVESH portal, which can be accessed by scanning the QR Code above.

5. The EAC during deliberations noted the following:

The instant proposal pertains to an amendment in the Terms of Reference (ToR) dated 08/01/2024, with reference to the standard condition No. 2.1. The Project Proponent presented their case for amending the Terms of Reference, highlighting the involvement of 21.133 hectares of forest land within the Mine Lease (ML) area. PP also mentioned that they have submitted an application for Stage-I Forest Clearance for the said 21.133 hectares of Forest Land on 15/05/2024 to obtain permission for the diversion of the forest area. The Committee reviewed the request from the Project Proponent and the letter dated 20/05/2024 and 19/06/2024 issued by the State Forest Department confirming the presence of 21.133 hectares of Forest land within the ML area.

In view of the above, the EAC opined that FC stage-I shall be required at the time of EC application for 21.133 ha of Forest Land and the existing mining plan has to be amended accordingly.

6. Based on above discussion, the Committee **recommended** the proposal for amendment in the Terms of Reference letter dated 08/01/2024 with additional specific conditions (Annexure I).

7. The Amendment Logs of the project is enclosed as Annexure (II).

8. The Standard ToR Conditions are enclosed as Annexure (III). Standard ToR conditions are in addition to specific conditions as mentioned in ToR issued by MoEFCC dated 08.01.2024.

9. The details of the project are enclosed as Annexure (IV)

10. The Ministry of Environment, Forests & Climate Change (MoEF&CC) has examined the proposal in accordance with the Environment Impact Assessment (EIA) Notification, 2006, and its subsequent amendments. After accepting the recommendations of the Expert Appraisal Committee (EAC), the Ministry has decided to grant amendment in Terms of Reference (ToR) for the Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Limited for mining of Iron Ore with proposed production capacity of 0.75 MTPA, Waste 3.0 MTPA in the mine lease area of 152.5073 Ha, located at Village Santona, Sanguem Taluka, South Goa District, Goa with additional specific conditions.

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

12. 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.

13. 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 04 years, as per the extant rules of the Ministry notified from time to time.

14. 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.

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

Copy
To

1. The Secretary, Ministry of Mines, Government of India, Shastri Bhawan, New Delhi. 110001
2. The Secretary, Department of Mines and Geology, Ground Floor of Institute Menezes Braganza, Government of Goa.
3. The Director, Department of Environment and Climate Change (DoE and CC), Government of Goa.
4. The Secretary, Department of Forests, Government of Goa, Goa Van Bhavan, Goa.
5. The Chief Wildlife Warden, Goa Van Bhavan, Forest Department, Altinho, Panaji Goa. 403001.
6. 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
7. The Member Secretary, Central Pollution Control Board, Parivesh Bhawan, East Arjun Nagar, Delhi - 110 032.
8. The Member Secretary, Central Ground Water Authority, 18/11, Jam Nagar House, Man Singh Road, New Delhi110011.
9. The Member Secretary, Goa State Pollution Control Board, Nr. Pilerne Industrial Estate, Opp. Saligao Seminary, Saligao, Goa 403511.
10. The Controller General, Indian Bureau of Mines, Indira Bhavan, Civil Lines, Nagpur- 440 001.
11. The District Collector, South Goa District, Government of Goa.
12. Guard File.
13. PARIVESH Portal

Annexure 1

Specific Terms of Reference for (Mining Of Minerals)

1. Specific Conditions

S. No	Terms of Reference
1.1	PP needs to submit the stage-1 Forest Clearance for the forest land of 21.133 ha lying within the ML area.
1.2	The Project Proponent needs to submit the revised Mine Plan at the time of Environmental Clearance application, incorporating the newly identified forest area of 21.133 hectares.
1.3	PP needs to explore whether fresh water requirement can be reduced for the project. Construction of water reservoir in the lease are should also be explored.
1.4	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.

Annexure 2

Amendment Logs

Description	Reference	Existing	Proposed / Amendment	Reason
Identification of Forest area by	Forest Serial 2, para 2.1 of	No forest land	Amendment	Application for TOR amendment due to identification of Forest area of 21.1330 Ha.,

Description	Reference	Existing	Proposed / Amendment	Reason
Forest Dept.	TOR	involved in the project		by Department of Forest, Govt. of Goa in Block IV Kalay Mineral Block. Copy of the letters from the forest dept. are enclosed

STANDARD TOR FOR NON-COAL MINING PROJECT

I. Project Details

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. The production details need to submit since inception of mine duly authenticated by Department of Mines & Geology, State Government.
2) A copy of the document in support of rightful lessee of the mine should be submitted. In case of new mines copy of LoI granted by State Government to be submitted. PP should ensure that LoI is valid at the time of grant of ToR. PP should submit the copy of lease deed/supplementary lease deed/extension letter/transfer deed, from its initial grant to subsequent renewals/ transfer/extension of validity.
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.
4) PP should submit the District Survey Report (DSR) as per S.O. 3611(E) dated 25.07.2018 in case of minor minerals.
5) Brief of proposal to be submitted which include total excavation of the material required for the production of certain quantity of the minerals, location of the project, mining lease area, latitude longitude, seismic zone etc. In case of expansion project details of expansion viz. expansion in mining lease area or expansion in production of any particular mineral or expansion in total excavation, latest certified Compliance report (CCR) from IRO of conditions granted in existing EC needs to be submitted.
6) The PP should submit the real-time aerial video footage & video of the mining lease area and of the transportation route.
7) 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).
8) 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.
9) The PP should collect the Baseline data (BLD) in respect of initial level of the mining lease. For this permanent bench marks (BM) needs to be established at prominent location preferably close to mining leases in question and should have precisely known relationship to the level datum of the area, typically mean sea level.
10) In case of sand mining, the entire mining lease area should be divided suitably into grids of 25 m x 25 m with the help of sections across the width of river and along the direction of flow of the river. The levels (MSL & RL) of the corner point of each grid

needs to be recorded. Each Grid should be suitably numbered for identification. PP should identity grids which will be worked out and grids which will come under no mining zone i.e. safety barriers from the river bank. PP should comply with the sustainable sand mining management guidelines 2016 and enforcement and monitoring guidelines, 2020 etc.

11) 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.
12) Details of the onsite shelter and facilities to be provided to the mine workers should be included in the EIA Report.
13) 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.
14) The cost of the Project (capital cost and recurring cost) as well as the cost towards implementation of EMP should be clearly spelt out.
15) 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.
16) Compliance of the Ministry's Office Memorandum No. F: 3-50/2017-IA.III (Pt.), dated 30.05.2018 on the judgment 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 needs to be submitted and included in the EIA/EMP Report.

II. Forest

17) PP shall submit a certificate from Chief Conservator of Forests regarding involvement of Forest Land in the mining lease area if any. In case forest land is involved i) PP should submit the proof of application made for obtaining forest clearance and ii) a map clearly showing the forest & non-forest area.
18) 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.
19) 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.
20) The vegetation in the RF / PF areas in the study area, with necessary details, should be given.

III. Court Matters

21) Details of litigation pending against the project, if any, with direction /order passed by any Court of Law against the Project should be given.

IV. Land Environment

22) PP should submit the details of survey number [viz. survey no, area in hectare, classification of land (government, private, forest, grazing land etc.), villages] duly authenticated by State Government, falling in the mining lease area.
23) The study area will comprise of 10km 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.
24) 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.
25) 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.

V. Wildlife

26) 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.
27) A detailed biological study of the study area [core zone and buffer zone] 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. PP shall submit list of Schedule-1 species present in core and buffer zone duly authenticated by CWLW. 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/Wildlife Department and details furnished. Necessary allocation of funds for implementing the same should be made as part of the project cost. Proof of its submission of conservation plan to the CWLW needs to be submitted.
28) PP shall submit a certificate from Chief Wildlife Warden regarding distance of mining lease from the protected area falling within 10 KM of the mining lease. In case project requires clearance under Wildlife (Protection) Act, 1972 then copy of application made for the same needs to be submitted.

VI. Baseline Environment:

29) 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.

30) Air quality modelling 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 modelling 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 windrose showing pre-dominant wind direction may also be indicated on the map.

31) The PP should submit the photograph of monitoring stations & sampling locations. The photograph should bear the date, time, latitude & longitude of the monitoring station/sampling location. In addition to this, PP should submit the original test reports and certificates of the labs from which samples were analyzed.

VII. Water Environment

32) The water requirement for the Project, its availability and source should be furnished. Quantity of surface or ground water to be used for the Project should be indicated. A detailed water balance should also be provided. Submit the year wise target for reduction in consumption of the ground/surface water by developing alternative source of water through rain water harvesting measures. 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. The capital and recurring expenditure to be incurred needs to be submitted.

33) 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.

VIII. Hydro Geology

34) 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.

35) 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.

36) 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 bench 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 case of surface water is proposed to be utilized then Necessary clearance from the Competent Authority for drawl of requisite quantity of water for the Project should be provided.

IX. Transportation

37) 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.

X. Land Acquisition and R&R

38) 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.

39) 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.

XI. Socio-Economic Environment

40) 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.

41) 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.
42) 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.
43) Activity-wise time-bound action plan on the issues raised and commitment made during public hearing to be submitted as part of the final EMP Report in compliance of the Ministry's OM F.No.22-65/2017-IA.III dated 30th September, 2020.

XII. Environmental Monitoring and Management

44) 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 proposed safeguard measures in each case should also be provided.
45) 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.

XIII. Critically Polluted Areas, Aravali & CRZ

46) 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.
47) 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).

XIV. Risk Assessment & Disaster Management

48) 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.

49) 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.

50) A Disaster Management Plan shall be prepared and included in the EIA/EMP Report.

XV. Miscellaneous

51) The 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.

* * * *

Annexure-IV

Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Limited for mining of Iron Ore with proposed production capacity of 0.75 MTPA, Waste 3.0 MTPA in the mine lease area of 152.5073 Ha, located at Village Santona, Sanguem Taluka, South Goa District, Goa.

The details of the project: -

2. The project Proponent has submitted their request to amend the Terms of Reference letter dated 08.01.2024 w.r.to the standard condition 2 which mandates the project proponent to submit a certificate from Forest Department regarding involvement of Forest Land if any. The condition is reproduced here in below for reference:

"PP shall submit a certificate from Chief Conservator of Forests regarding involvement of Forest Land in the mining lease area if any. In case forest land is involved i) PP should submit the proof of application made for obtaining forest clearance and ii) a map clearly showing the forest & non forest area".

3. In compliance to ToR granted (standard condition no. 2 Forest at S. No 2.1, page no 08 of 13), the Project proponent vide letter dated 16.05.2024 requested Forest Department Govt. of Goa to confirm involvement of Forest Land, if any within Block-IV. Vide letter dated 20.05.2024 the office of Dy. Conservator of Forest, South Goa informed the project proponent the status of Forest land as below:

"i. Survey No. 26 & 43 of Santona village, Sanguem taluka constitutes to be part of South Goa Working Plan Compartment No.20 & 21 of Santona Forest Block being Government unclassed forest.

ii. Survey No.27 (P) & 28 (P) Santona village, Sanguem taluka has been identified as prospective private forest by South Goa Forest Division Committee. (Araujo Committee).

4. The Project proponent accordingly applied for diversion of Forest land on Parivesh portal of MoEF& CC vide Proposal ID No. FP/GA/MIN/QRY/472990/2024.

5. Further, upon verification by field functionaries, vide letter dated 19/06/2024, the office of the Principal Chief Conservator of Forest, provided the Forest area w.r.t. 26/1(p), 43/1(p), 27(p) & 28(p) with details as tabulated below:

Sr. No.	Survey Nos.	Area in Ha.	Remarks
1	27 (p)	0.9959	Prospective Private Forest
2	28 (p)	1.9161	
3	26/1 (p)	13.4539	Unclassed Forest
4	43/1 (p)	4.7671	
	Total	**21.133**	

6. Accordingly, approved Mining Plan is modified for the involvement of Forest Land (in view of changes in land use pattern in respect of Survey nos. 27(p), 28(p), 26/1(p) & 43/1(p)) and approval from IBM has been obtained vide their letter dated 23/08/2024. Therefore, in view of involvement of forest land the present application is filed on 27/06/2024 for amendment of already granted TOR on 08/01/2024.

7. The details of the project as per the document submitted by the Project Proponent are mentioned below:

i. Project details:

Name of the Proposal	Block IV- Kalay Mineral Block	
Location	Village	Santona
	Tehsil/Taluka	Sanguem
	District	South Goa
	State / UT	Goa
	Latitudes & Longitudes	

<table>
<tr><td></td><td>All the co-ordinates of the lease boundary corner points as per the approved DGPS Plan from Directorate of Mines and Geology, Govt. of Goa are given as below:
<table>
<tr><th>Pillar No.</th><th>Pillar Latitude (dd:mm:ss.ss)</th><th>Pillar Longitude (dd:mm:ss.ss)</th></tr>
<tr><td>BP 1</td><td>15° 17′ 58.2803″N</td><td>74° 09′ 31.3905″E</td></tr>
<tr><td>BP 2</td><td>15° 18′ 02.6197″N</td><td>74° 09′ 29.8008″E</td></tr>
<tr><td>BP 3</td><td>15° 18′ 08.7974″N</td><td>74° 08′ 55.2583″E</td></tr>
<tr><td>BP 4</td><td>15° 17′ 40.1839″N</td><td>74° 09′ 03.3467″E</td></tr>
<tr><td>BP 5</td><td>15° 17′ 30.9847″N</td><td>74° 09′ 08.5955″E</td></tr>
<tr><td>BP 6</td><td>15° 17′ 01.6125″N</td><td>74° 09′ 13.1548″E</td></tr>
<tr><td>BP 7</td><td>15° 17′ 12.4794″N</td><td>74° 09′ 41.2969″E</td></tr>
<tr><td>BP 8</td><td>15° 17′ 13.0200″N</td><td>74° 09′ 44.8333″E</td></tr>
<tr><td>BP 9</td><td>15° 17′ 16.8213″N</td><td>74° 09′ 43.9885″E</td></tr>
<tr><td>BP 10</td><td>15° 17′ 19.1419″N</td><td>74° 09′ 40.8072″E</td></tr>
<tr><td>BP 11</td><td>15° 17′ 23.3295″N</td><td>74° 09′ 36.4971″E</td></tr>
<tr><td>BP 12</td><td>15° 17′ 26.7696″N</td><td>74° 09′ 33.4331″E</td></tr>
<tr><td>BP 13</td><td>15° 17′ 30.5546″N</td><td>74° 09′ 31.2826″E</td></tr>
<tr><td>BP 14</td><td>15° 17′ 36.0551″N</td><td>74° 09′ 29.0348″E</td></tr>
<tr><td>BP 15</td><td>15° 17′ 40.9091″N</td><td>74° 09′ 28.2686″E</td></tr>
<tr><td>BP 16</td><td>15° 17′ 44.5813″N</td><td>74° 09′ 28.2599″E</td></tr>
<tr><td>BP 17</td><td>15° 17′ 49.1710″N</td><td>74° 09′ 29.2119″E</td></tr>
<tr><td>BP 18</td><td>15° 17′ 54.4169″N</td><td>74° 09′ 30.5870″E</td></tr>
</table>
Topo sheet No. D43C3</td></tr>
<tr><td>Company’s Name</td><td>Fomento Resources Private Limited</td></tr>
<tr><td>KML file</td><td>Submitted as a file named - Block IV - Kalay Mineral Block</td></tr>
<tr><td>Seismic zone</td><td>III</td></tr>
</table>

ii. Category details:

Category of the project	B1
Schedule No.	1(a) Mining of Minerals
Mining lease Area (MLA) (in ha.)	152.5073 Ha
General Conditions (if any)	Bhagwan Mahaveer Wildlife Sanctuary & National Park is within 5 KM from the boundary of the Block IV – Kalay Mineral Block

iii. ToR Details:

Date of application	Proposal No.	Consideration by EAC	Details of ToR	Date of accord
24/04/2023	IA/GA/MIN/422578/2023	05/12/2023	TO23B0000GA5122365N	08/01/2024

iv. 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 No. DMG/25/Auction cell/LOI-function/2023/2804, read with letter No.03/18/2023/Major/Mines/3286 dated 13/03/2023 for revising area by excluding the Eco-sensitive zone (ESZ) area of 26.6753Ha.	13/01/2023 & 13/03/2023	Iron Ore (Major)	LOI valid for 3 years	Directorate of Mines and Geology	152.5073Ha.

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

Private land	72.9675 Ha.
Government land	58.4068 Ha.
Forest land	21.1330 Ha.
Total Mining lease area (MLA), ha	152.5073 Ha.
Private land for crusher, workshop & other infrastructure outside the MLA	Nil

vi. Water requirement:

Total water requirement	300KLD	Fresh water	246KLD
		Treated water	54KLD
Source	1. Rain & Storm water accumulated in the Mine Pit – used for Dust suppression, Workshop, Wheel wash System and Green belt/plantation. 2. Well water – used for Domestic purpose.		

Permission for withdrawal/ intersection along with details of grant and its validity	The Water Resources Department, Goa, has issued permission for drawl of water vide letter No. 3682and is valid upto 05.06.2026.

vii. 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	An application for diversion of Forest land for an area of 21.1330 Ha. has been filed online on Parivesh portal. The application has been accepted and is under process.
National Park	Yes	Bhagwan Mahaveer Wildlife Sanctuary & National Park is at a distance of 1.04 Km from the boundary of Mineral Block.
Wildlife Sanctuary	Yes	Bhagwan Mahaveer Wildlife Sanctuary& National Park is at a distance of 1.04Km from the boundary of Mineral Block.
Elephant/Tiger Reserve	No	--
Eco-Sensitive Zone(ESZ) /Eco-Sensitive Area(ESA)	Yes	1. Bhagwan Mahaveer Wildlife Sanctuary is located at 1.04km from the boundary towards Eastern side of the Block. 2. The Mineral Block does not fall within the Eco-Sensitive Areas of Western Ghats
Coastal Regulation Zone (CRZ)	No	--
Schedule-I species (Nos and name of schedule-I species with authenticated letter)	Yes	Details regarding Schedule-I species will be provided in the EIA report.
Wildlife Conservation Plan	Yes	A Wildlife Conservation Plan has been prepared in consultation with Forest Department based on the Schedule - I species reported in the buffer zone of the project and the same has been submitted to the Chief Wildlife Warden, Goa.

viii. Court case details:

Court Case, No. and its present status	1. Writ Petition 592 of 2022 in Hon'ble High Court of Bombay at Goa • The said petition seeks to challenge the constitutionality of the tender documents of Phase I auction of Goa mines.

	• The petitioner alleges that there is a non-disclosure of essential facts such as bore hole data, approved mining plan, production data of the previous five years and exploration data and has therefore prayed for quashing of auction notice to the extent, it fails to include the essential facts which is against the principle that level playing field should be provided to the petitioner for its participation in the auction. 2. As per the last order, Fomento Resources Private Limited is added as a party to the petition as it has acquired Block IV- Kalay Mineral Block in e-auction tendered vide NIT dated 30/09/2022. 3. Above said Writ Petition bearing no. 592 of 2022 in Hon'ble High Court of Bombay at Goa stands dismissed vide order dated 12/02/2024.

ix. Details of project cost and employment:

Particulars	(Rs. In Crore)
Total cost of EMP (Capital Cost of EMP + capital cost of Public hearing)	Not Applicable.
Project Cost	Rs.3680 Lakhs
Employment (Nos.)	Direct & indirect employment of 327 persons. Approximately 1500 peoples will benefit directly & in-directly by this project.

Azadi Ka Amrit Mahotsav

Government of Goa
Directorate of Mines & Geology
Institute Menezes Braganza, Panaji-Goa
Website: www.dmggoa.goa.gov.in **e-mail: dir-mine.goa@nic.in**

No.03/18/2023/Major/Mines/1235 Date: 07/07/2023

To,
Fomento Resources Private Limited,
1st Floor, 102, Kamat Metropolis-1,
Behind Caculo Mall, St. Inez,
Panaji, Goa 403001.

***Sub**: Request to provide authenticated Map and letter confirming that the Block IV- Kalay Mineral Block for Iron Ore mineral in Santona village of Sanguem Taluka, South Goa falls outside the Eco Sensitive Zone (ESZ) with respect to Bhagwan Mahavir wildlife sanctuary and National Park.*

***Ref**: Your letter dated 19/06/2023*

Sir,

With reference to your letter dated 19.06.2023 on the above cited subject, please find enclosed herewith a copy of letter No. DCF(WP)/S-D/Vol-I/67/2022-23/347 dated 05.07.2023 along with authenticated copy of map issued by the Dy. Conservator of Forests, Working Plan Division, Goa Van Bhavan, Altinho, Panaji, Goa informing that proposed Block IV- Kalay Mineral Block located at Santona Village Sanguem Taluka, South Goa District, Goa falls outside notified ESZ boundary of Bhagwan Mahavir Wildlife Sanctuary and National Park.

(Dr. S. Shanbhogue)
Director

Encl: As stated.

Directorate of Mines & Geology
Inward No. 3884
Dated 06/07/23
Signature

Government of Goa
Office of The Dy. Conservator of Forests
Working Plan Division
"Goa Van Bhavan"
Altinho Panaji Goa – 403 001

No:-DCF(WP)/S-D/Vol-I/67/2022-23/347 Dated: 05/07/2023

To,
The Director,
Directorate of Mines & Geology
Institute Menezes Braganza,
Panaji-Goa.

Sub:- Request to provide authenticated Map and letter confirming that the Block IV-Kalay Mineral Block for Iron Ore mineral in Santona Village of Sanguem Taluka, South Goa falls outside the Eco Sensitive Zone (ESZ) with respect to Bhagwan Mahavir wildlife sanctuary and National Park.

Ref No:- 03/18/2023/Major/Mines/1003 dated 21/06/2023.

Sir,

With reference to above cited letter dated on 21/06/2023, it is to inform that proposed Block IV-Kalay Mineral Block located at Santona Village Sanguem Taluka, South Goa District, Goa falls outside notified ESZ boundary of Bhagwan Mahavir Wildlife Sanctuary and National Park.

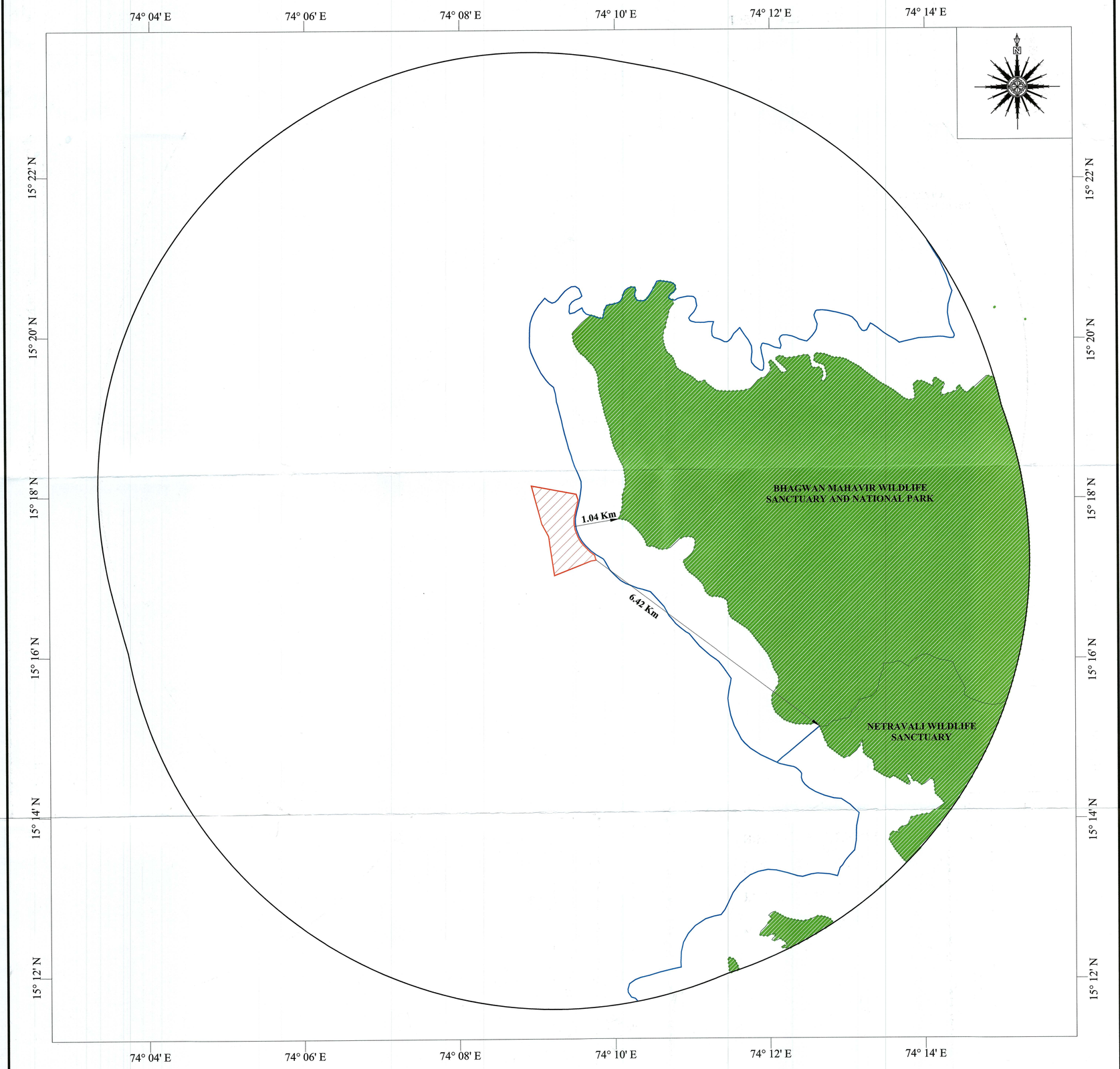
Yours Sincerely,

(Naveen Kumar P, IFS)
Dy. Conservator of Forests,
Working Plan Division,
Panaji-Goa.

Encl:- Authenticated Map.

Phone No.:- 0832-2492529 *Fax No.:- 2492529*

MAP SHOWING THE LOCATION OF THE BLOCK IV - KALAY MINERAL BLOCK WITH RESPECT TO ECO-SENSITIVE ZONE OF BHAGWAN MAHAVIR WILDLIFE SANCTUARY AND NATIONAL PARK

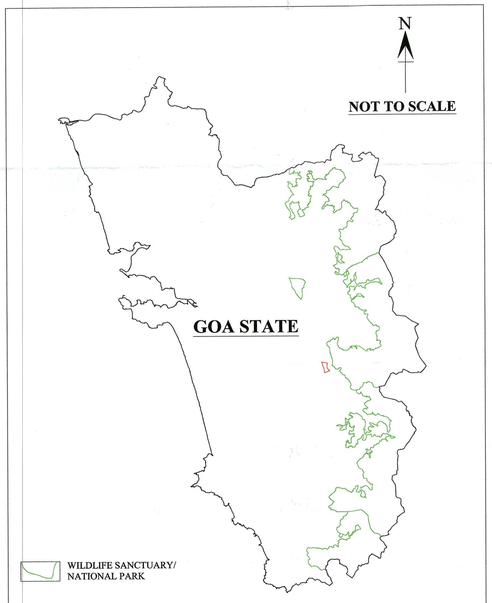


SCALE

2 1 0 2 Kms

I N D E X

- MINING LEASE OF BLOCK IV - KALAY MINERAL BLOCK
- 10Km FROM MINERAL BLOCK BOUNDARY
- WILDLIFE SANCTUARY/ NATIONAL PARK
- ECO-SENSITIVE ZONE (ESZ)



BLOCK IV - KALAY MINERAL BLOCK

MINING LEASE AREA : 152.5073 Ha.

VILLAGE SANTONA, TALUKA SANGUEM,

DISTRICT SOUTH GOA, GOA STATE.

CHIEF FOREST SURVEYOR
WORKING PLAN DIVISION
PANAJI - GOA

DEPUTY CONSERVATOR OF FORESTS
WORKING PLAN DIVISION
ALTINHO, PANAJI - GOA

Annexure 6

Form-A (Part-I): Diversion of Forest Land

Project Name:	Block IV – Kalay Mineral Block	**Single Window Number:**	SW/122918/2023
		Proposal Number:	FP/GA/MIN/QRY/472990/2024
State:	GOA	**Current Status:**	Pending at MS for Acceptance in PSC-I
Submission Date:	15/05/2024	**Area (in ha):**	21.133

Common Application Form

Project Details

1. Details of Project

1.1. Name of the Project	Block IV – Kalay Mineral Block
1.2. Project Proposal For	New
1.3. Project ID (Single Window Number)	SW/122918/2023
1.4. Description of Project	The Government of Goa, pursuant to the Mines and Minerals (Development and Regulation) Act, 1957 and its Rules thereunder and the Mineral (Auction) Rules, 2015, issued Notice Inviting Tender dated 30/09/2022 to commence the process for auction for grant of Mining Lease for Block IV – Kalay Mineral Block. The auction process was conducted on 21/12/2022 and Fomento Resources Private Limited was declared as "Preferred Bidder". The Letter of Intent was issued on 13/01/2023, to be read with letter dated 13/03/2023, for the grant of Mining Lease. The area of the Mineral Block is 152.5073 Ha and is located in Santona village, Sanguem Taluka, South Goa District, Goa. The proposed production capacity of Iron Ore is 0.75 MTPA. Mechanized open cast mining method will be adopted.

2. Details of the Company/Organization/User Agency making application

2.1. Legal Status of the Company/Organization/User Agency	Private Limited
2.2. Name of the Company/ Organization/User agency	FOMENTO RESOURCES PRIVATE LIMITED

Registered address

2.3. Address	102, 1st Floor, Kamat Metropolis-I, Behind Caculo Mall, St. Inez, Panaji, North Goa, 403001
2.4. Village /Town / City	Panaji
2.5. State	GOA
2.6. District	NORTH GOA
2.7. Pin Code	403001
2.8. Landmarks	Behind Caculo Mall, St. Inez, Panaji
2.9. E-mail address	morazkar@ilpl.biz
2.10. Mobile number	8805980524

3. Details of the person making application

3.1. Name	Sandeep Morajkar
3.2. Designation	General Manager

Correspondence address

3.3. Address	102, 1st Floor, Kamat Metropolis-I, Behind Caculo Mall, St. Inez, Panaji, North Goa, 403001
3.4. Village /Town / City	Panaji
3.5. State	GOA
3.6. District	NORTH GOA
3.7. Pin Code	403001

3.7. Pin Code	403001
3.8. Landmarks	Behind Caculo Mall, St. Inez, Panaji
3.9. E-mail address	morazkar@ilpl.biz
3.10. Mobile number	8805980524

Project Location

4. Location of the Project or Activity

4.1. Upload KML	Block IV - Kalay Mineral Block.kml
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	Sanguem	SANTONA	7/1,8/1,8/2,11/1,15/1,15/2,16/1,23/1,24/1,25/1,25/2,26/1,27/1,28/3,28/4,28/5,28/6,29/1,38/1,38/3,39/1,40/1,40/2,40/3,40/4,40/5,40/6,40/7,40/8,40/9,40/10,40/11,40/12,40/13,41/1,42/1,43/1,Nallah & Road

Remarks
N/A

6. Land Requirement (in Ha) of the project or activity

6.1.	Nature of Land involved	
6.2.	Non-Forest Land [A]	131.3743
6.3.	Forest Land [B]	21.133
6.4.	Total Land [A+B]	152.5073

Project Activity Cost

6. Project/Activity Cost

6.1. Total Cost of the Project at current price level (in Lakhs)	3680 Amount in Words : **Three Thousand Six Hundred Eighty Lakh(s) Only**

7. Employment likely to be generated

7.1. During construction phase

Permanent employment

Temporary employment

7.2. During operational phase

Permanent employment

7.2.1.	No. of permanent employment (No.s) [A]	127
7.2.2.	Period of employment (No. of days) [B]	365
7.2.3.	No. of man-days [X]=[A]*[B]	46355

Temporary employment

7.2.4.	Temporary / Contractual employment (No. of Man days) [Y]	40000
7.2.5.	Total [X] +[Y]	86355

Others

8. Whether Rehabilitation and Resettlement (R&R) involved?	NO
9. Whether project area involves shifting of watercourse/road/rail/Transmission line/water pipeline, etc.	NO

watercourse/road/rail/Transmission line/water pipeline, etc. required?	NO
10. 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
11. Whether there is any Government Order or Policy/ Court order relevant or restricting to the site?	NO
12. Whether there is any litigation pending against the project and/or land in which the project is proposed to be set up?	NO
13. Whether the proposal involves violation of Act/Rule/Regulation/Notification of Central/State Government?	NO

Form-A (Part-I): Diversion of Forest Land

Project Details

1. Forest Clearance

1.1. State	GOA
1. Upload a copy of note containing justification for **2** locating the Project in forest land	01. Justification note for locating the Project in forest land.pdf
1.3. Project Category	Mining / Quarrying
1.4. Exempted Category	NA
1.5. Is Related to Encrochment?	No
1.6. Whether any proposal seeking prior approval of Central Government under the Van (Sanrakshan Evam Samvardhan) Adhiniyam, 1980 for diversion of forest land required for this project has been submitted in the past?	No

Proposed Land

2. Details of Forestland proposed to be diverted (Village / Division / District Wise Breakup)

2.1. Total area of forestland proposed for diversion (ha.)	21.133
2.2. Total area of non- forestland required for this project (ha.)	131.3743

2.3. Legal Status of forest land proposed for diversion

Area (ha)	Legal Status of Forest Land
2.912	Prospective Private Forest
18.221	Unclassed Forests

2.3.1. Total Area (ha)	21.133
2.4. Total period for which the forestland is proposed to be diverted (No. of years)	50

KML Details

Division	South Division
No. of Patches	8
KML	4039413_FC_KML_1719233789612_BlockIVForest Land KML.kml

Location Details

Toposheet No.	District	Village	Range	Forest land proposed for diversion (ha)	Non Forest Land (ha)

D43C3	South Goa	SANTONA	Quepem	21.1330	131.3743

Patch Details

Patch/ Segment ID	Forest Area (ha)	Non-Forest Area (ha)	Remarks if any
1	1.292	131.3743	Total lease area is 152.5073 Ha.
2	0.1676	0	
3	0.4284	0	
4	0.0281	0	
5	0.9959	0	
6	13.4539	0	
7	0.1258	0	
8	4.6413	0	

Remarks Details

The forest area proposed for diversion falls in Sanguem Range.

Total Patch-wise Forest Land in the division (ha)	
2.5. Total Forest Land Area (ha)	21.1330
2.6. Total Non Forest Land Area (ha)	131.3743

Total KML-wise Forest Land in the division (ha.)	
2.7. Total Forest Land Area (ha)	21.133
2.8. Total Non Forest Land Area (ha)	131.3743
2.9. Total Area (ha)	152.5073

3. Component Wise Break Up

Component	Forest Land Proposed for Diversion (ha)	Non-forest Land (ha)
Mining	21.133	131.3743

4. Total Forest Land(ha)	21.133
5. Total Non Forest Land (ha)	131.3743
6. Upload map of the forest land proposed to be diverted prepared by using DGPS or Total Station (pdf only)	DGPS with Forest Land.pdf

Afforestation Details

7. Details of land identified for Compensatory Afforestation

7.1. Whether Compensatory Afforestation is applicable or not?	Yes
7.1.1. Type of Compensatory Afforestation	Non-forest Land
7.1.1.1. Whether Non-forest land is available?	Yes

7.1.2. Patch wise details

Kml File Name
Block IV CA Land.kml

TopoSheet No.	State	District	Village	Plot No. /Kasra No.	Present Owner	Area
D43C3	GOA	South Goa	ANTORIEM	11/1(part)	Sociedade de Fomento	21.1330

7.1.3. Number of patches.	1
7.1.4. No. of districts involved for raising Compensatory Afforestation.	1
7.1.5. Total CA Land	21.133
7.1.6. Upload a scanned copy of the map of the land identified for creation of Compensatory Afforestation prepared by using GPS or Total Station (pdf only)	Block IV CA Land on survey plan.pdf
7.1.7. Whether the area of non-forest land or Revenue forest land required to be provided by User Agency for raising Compensatory Afforestation is less than area of forest land proposed to be diverted?	No
7.1.8. Whether NFL is free from Non- Encumbrance	Yes
7.1.9. Whether the present owner of NFL is different from the User Agency	No
7.1.9.1. Upload MoU/agreement executed between the present owner and the user agency	N/A

Others

8. Cost-Benefit analysis

8.1. Whether Cost-Benefit analysis for the Project has been made?	Yes
8.1. Total Loss (Against the proposed forest land Diversion in crore)	9.0598
8.2. Estimated Benefits of Forest Diversion (in crore)	998.675
8.3. Cost Benefit Ratio	110.2315
8.4. Upload a copy of Cost-Benefit analysis	04. Cost Benefit Analysis.pdf

9. Environmental clearance Details

9.1. Whether the Project requires Clearance under the Environment (Protection) Act 1986 (Environmental clearance)?	Yes
9.1.1. Status of Environmental Clearance	Application submitted
9.1.1.1. Proposal No	IA/GA/MIN/422578/2023
9.1.1.2. Date of application	24/04/2023
9.1.1.3. MoEFCC / SEIAA File Number	IA-J-11015/11/2023-IA-II(NCM)
9.1.1.4. Status of application [Submitted recently / ToR Granted / PH Conducted / Under appraisal]	ToR Granted

10. Wildlife clearance Details

10.1. Whether the Project or a part thereof is located in any Protected Area or their Eco sensitive zone?	No

Category Specific Details

11. Sector specific detail/attachments	
11.1. Copy of approved mining plan along with approval letter	15. KALAY-Approved Mining Plan.pdf
11.2. Copy of map of the outer boundary of mining lease area (pdf only)	12. Map showing outer boundary of Mining Lease area.pdf
11.3. Copy of the detailed land use plan in 1:4,000 scale prepared by using DGPS or Total Station (Kml only)	Mining Land Use Plan.pdf
11.4. Copy of the prospecting licence and extension of the prospecting licence, if any	N/A
11.5. Copy of the approval accorded for MoEFCC for prospecting	N/A
11.6. Copy of note containing details of the plan for the transportation of the minerals proposed to be raised from the mining lease (pdf only)	13. Kalay - Note on transportation of Minerals.pdf

12. Period of validity of Mining Plan	
12.1. From	30/06/2023
12.2. To	29/06/2028
13. Period of Mining Lease(Years)	50
14. Name of approving authority for the Mining plan	Indian Bureau of Mines, Government of India
15. Details of Prospecting undertaken to assess mineral reserves	
15.1. Whether detailed prospecting to assess mineral reserves in the lease has been undertaken	No

16. Brief details of Prospecting activities undertaken in the mining lease

16.1. Details of bore holes drilled for prospecting

Forest Land		Non-Forest Land	
No. of Bore holes	**Diameters(Inch)**	**No. of Bore holes**	**Diameters(Inch)**
N/A	N/A	N/A	N/A

17. Mineral Reserves

Name of Mineral	Proved Reserves	Indicated Reserves	Inferred Reserves	Mineable Reserves	Remarks
Iron Ore	8.188	0.0001	8.543	16.731	

18. Estimated reserves in Forest / Non-Forest land if any

Name of Mineral	Estimated Reserve in Forest Land	Estimated Reserve in Non-Forest Land	Remarks
Iron Ore	1.758	14.973	The estimated reserves are based on geological report provided by Directorate of mines and Geology in the tender document

19. Details of Letter of Intent (LoI) / Vesting order / Mining Lease	
19.1. Date of issue of LoI/Vesting order/Minning Lease	13/01/2023
19.2. Period of validity of LoI / Vesting order (years and months)	03/00
19.3. Period of lease (years and months)	50/00
19.4. Date of expiry of lease	02/04/2074

19.5. Lease area (in ha) as per LoI/Vesting order/Mining Lease	152.5073
19.6. Production capacity (in MTPA) as per LoI / Vesting Order / Mining lease, if any prescribed	0.75
19.7. Details of Lease renewal(s), if any	
19.8. Other information, if any	Date of Expiry of the Mining Lease is estimated date. The Lease period will be 50 years from the registration of Executed Mining Lease.

20. Status of approval of Mining plan	Approved

21. Minerals to be mined

Name of Mineral	Classification	Production Capacity	Remarks
Iron Ore	Major	0.75	

22. Details of Total excavation (RoM) including Topsoil, Overburden, Mining waste, Rejects, etc.

22.1. Total excavation in MTPA	3.134
22.2. Total Excavation in M.Cu.m/Annum	1.457
22.3. Stripping Ratio	0.4649
22.4. Other information, if any	Stripping ratio is 1:4 (1 Tonne of ROM/Ore : 4 Tonnes of waste)

23. Life of mine (years and months)

23.1. Life of the mine as per approved mining plan (in years and months)	24/00
23.2. Life of the mine as per total estimated reserves, if any (in years and months)	24/00
23.3. Other information, if any	Mining Lease (ML) will be valid for 50 yrs from the date of execution. Mineral Reserves & Resources declared by Goa State Govt. are based on the limited exploration data. The life of the mine (24 yrs) has been arrived based on the present Reserves & Resources declared by Goa State Government. The ore body exposed in the Block & adjacent mines suggests the availability of additional Mineral Reserves & Resources, which will be proved by proposed exploration & the life of the Mine will extend.

24. Type and method of Mining Method

24.1. Type of mining	Opencast
24.2. Method of mining	Mechanized
24.3. Other information, if any	No Drilling and Blasting

25. Type of blasting, if any, to be adopted

25.1. Type of blasting	Drilling and Blasting is not proposed.
25.2. Mitigation measures for control of blast induced vibrations	Not Applicable as Blasting is not proposed.
25.3. Other information, if any	Environment friendly ripping and dozing method will be adopted.

26. Whether it is proposed to install beneficiation plant/Coal washery within the mining lease area?	No
26.1. Capacity of beneficiation/washery (in MTPA)	N/A
26.2. Proposed process	N/A
26.3. Beneficiation/Washing Technology	N/A
26.4. Other information, if any	

27. Whether it is proposed to install crusher within the mining lease areaa?	No
27.1. No. Of crushers	N/A
27.2. Capacity of crushers	N/A N/A
27.3. Total Capacity of crushers	N/A N/A

28. Dumping strategy

Description		Area in Ha	Maximum height in m	Remarks
External dump	0.0001	0.0001		There will be no external dumping
Internal dump	28.661	42.5		Dumping will be carried out within the mineral block in the form of benches with a maximum height of 8 m each.
Topsoil dump/ storage	0.0001	0.0001		Top soil will not be generated as most of the land is already broken.

29. Topsoil management

29.1. Total Topsoil excavated during the entire life of the mine (mm3)	0.0001
29.2. Utilization strategy of topsoil	Not Applicable
29.3. Other information, if any	Top soil will not be generated as most of the land is already broken.

30. Details of the Quarry/Mine Pit

30.1. Total Quarry Area (ha.)	99.4586
30.2. Area of final void (ha.)	44.14
30.3. Maximum Depth of final void (m)	40
30.4. Other information, if any	Final void of 40m will be kept after backfilling the mine pit.

31. Details of Transportation

31.1. Mode of transportation upto pit head	By road using tipper trucks/ dumpers
31.2. Mode of transportation from pit head to siding/loading	By road using tipper trucks/ dumpers
31.3. Mode of transport from loading point to consumers	By road using tipper trucks/ dumpers
31.4. Other information, if any	Nil

32. Details of reclamation/post mining land use

32.1. Plantation area (ha.)	89.9678

32.2.	Water body (ha.)	44.1356
32.3.	Public use (ha.)	1.5377
32.4.	Other uses (ha.)	16.8662

33. Copy of Additional Information, if any

S. No.	Document Name	Remark	Document
1	Undertaking NPV CA	Undertaking NPV CA	Undertaking NPV CA.pdf
2	Undertaking for exploitation of trees	Undertaking for exploitation of trees	Undertaking for exploitation of trees.pdf
3	Statement showing details of forest area proposed	Statement showing details of forest area proposed for diversion	Statement showing details of forest area proposed for diversion.pdf
4	Form I & XIV	Form I & XIV	Form I & XIV.pdf
5	Certificate use of Min forest land	Certificate use of Min forest land	Certificate use of Min forest land.pdf
6	Block IV - Undertaking No Violation under FCA	Block IV - Undertaking No Violation under FCA	Block IV - Undertaking No Violation under FCA.pdf
7	Block IV - Undertaking FRA	Block IV - Undertaking FRA	Block IV - Undertaking FRA.pdf
8	Block IV - Details of forest land for diversion	Block IV - Details of forest land for diversion	Block IV - Details of forest land for diversion.pdf
9	Affdavit for Survey Nos. within project area	Affdavit for Survey Nos. within project area	Affdavit for Survey Nos. within project area.pdf
10	Block IV - Brief note of the project	Brief note on the project	Block IV - Brief note of the project.pdf
11	Baseline Monitoring Plans	Baseline Monitoring Plans showing GPS locations	6. Baseline data plans.pdf
12	Baseline Data summary	Baseline Data summary of Monitoring	7. Baseline data summary.pdf
13	Toposheet	Toposheet showing Mining Lease and Forest area	19. Kalay-Forest Toposheet (New).pdf
14	Key Plan	Key Plan of 10 km radius	20. Kalay - Key Plan.pdf
15	Surface Plan	Surface Plan showing surface features	18. Contour Plan (surface plan).pdf
16	Environment Management Cell	Environmental Cell formed by Company	Kalay - Env Mng Cell.pdf
17	Certificate - Projects does not affect Monuments	Certifcate by Authorized repersentative	Certifcate - Monuments.pdf
18	undertaking for CA	undertaking by authorised representative	Undertaking for CA - LH.pdf
19	undertaking for exploitation of trees	undertaking by authorised representative for exploitation of trees	Undertaking for Exploitatin of Trees - LH.pdf
20	Board resolution for authorisation	Board resolution dated 06/05/2024	16. Resolution.pdf

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

34.	Name	Sandeep Morajkar
35.	Designation	General Manager
36.	Company	FOMENTO RESOURCES PRIVATE LIMITED
37.	Address	102, 1st Floor, Kamat Metropolis-I, Behind Caculo Mall, St. Inez, Panaji, North Goa, 403001
38.	Date	15/05/2024

ENVIRONMENTAL MONITORING REPORT

Summer Season, 2023

(March to May, 2023)

Project: BLOCK IV – KALAY MINERAL BLOCK

Santona village, Sanguem Taluka,

South Goa District, Goa

Proponent: ***Fomento Resources Pvt. Ltd.,***

1st Floor, 102, Kamat Metropolis-I,

Behind Caculo Mall, St. Inez, Panaji, Goa

CONSULTANT

MINERAL ENGINEERING SERVICES
(Accredited by QCI-NABET ORG000756)
25/XXV, Club Road, BELLARY-583103, Karnataka, Tel 08392-267421, Mob: 0919448367421,
Email : mes_msrcyu@yahoo.co.uk
mesbly25@gmail.com

ENVIRONMENTAL LABORATORY
Unit of Mineral Engineering Services)
(Accredited by NABL &, MOEF&CC Under E(P) 1986)
#948, 2nd Cross, Kammanahalli Main Road, St Thomas Town Post, Bangalore-560 084, Karnataka,

LIST OF TABLES

SL. NO.	PARTICULARS		TABLE NO.
1	Meteorological data		A to C
2	Test Report of Air Quality	March, 2023	1 to 8
		April, 2023	9 to 16
		May, 2023	17 to 24
3	Statistical Air Quality Report		25
4	Free Slica (Quartz)		26
5	Noise Level Data		27
6	Water Test Report As per GSR-422E		28
7	Surface Water Test Report As per IS 2296		29 & 30
8	Ground Water Test Report As per IS 10500		31 to 33
9	Ground Water Level		34
10	Soil Test Report		35 & 36

ENVIRONMENTAL LABORATORY

ISO 45001:2018

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. A

METEOROLOGICAL DATA

Project : Block IV - Kalay Mineral Block

Location : Mine site

Season : Summer, 2023

Date	Temperature in °C		Relative Humidity in %	
	Min.	Max.	Min.	Max.
01/03/2023	26.1	36.1	48.1	87.3
02/03/2023	24.1	37.2	43.2	88.0
03/03/2023	23.0	36.0	47.4	87.4
04/03/2023	24.3	37.4	47.1	85.4
05/03/2023	27.2	38.6	45.2	86.5
06/03/2023	26.2	39.5	41.0	87.5
07/03/2023	24.0	37.3	43.1	86.0
08/03/2023	23.3	37.2	43.3	86.4
09/03/2023	24.0	37.5	40.2	87.1
10/03/2023	23.0	37.5	32.5	87.6
11/03/2023	23.1	37.5	37.2	87.1
12/03/2023	24.0	36.5	45.2	85.0
13/03/2023	23.2	36.5	47.0	87.5
14/03/2023	26.0	37.5	46.0	84.7
15/03/2023	27.1	36.1	53.0	86.0
16/03/2023	26.2	36.5	55.6	86.1
17/03/2023	23.5	35.6	53.5	84.3
18/03/2023	22.6	36.2	50.5	80.1
19/03/2023	25.1	37.2	45.3	78.6
20/03/2023	22.2	37.3	37.2	87.5
21/03/2023	23.0	37.2	34.1	79.0
22/03/2023	25.0	36.6	44.3	80.0
23/03/2023	27.0	37.4	31.0	2.0
24/03/2023	24.0	37.3	51.0	76.7
25/03/2023	26.3	37.5	42.3	84.2
26/03/2023	23.0	37.4	41.3	86.4
27/03/2023	25.2	37.1	46.1	87.5
28/03/2023	25.0	36.5	59.2	88.0
29/03/2023	23.1	36.3	37.5	82.0
30/03/2023	26.3	37.4	49.5	78.0
31/03/2023	26.1	37.2	42.1	80.0

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

ISO 45001:2018

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. B

METEOROLOGICAL DATA

Project : Block IV - Kalay Mineral Block

Location : Mine site

Season : Summer, 2023

Date	Temperature in °C		Relative Humidity in %	
	Min.	Max.	Min.	Max.
01/04/2023	25.3	37.3	39.2	86.4
02/04/2023	23.3	36.8	39.0	82.1
03/04/2023	26.2	37.5	40.3	88.0
04/04/2023	27.0	37.3	50.5	86.4
05/04/2023	25.0	37.6	38.6	84.7
06/04/2023	27.0	36.7	48.0	86.6
07/04/2023	27.1	36.1	55.1	86.5
08/04/2023	28.0	34.3	58.0	87.4
09/04/2023	27.0	33.4	64.5	84.0
10/04/2023	27.0	35.5	59.0	87.6
11/04/2023	24.0	35.1	55.2	82.4
12/04/2023	23.1	35.1	64.1	87.6
13/04/2023	24.3	29.3	85.2	86.4
14/04/2023	25.1	36.5	62.5	87.3
15/04/2023	24.0	35.4	58.1	83.0
16/04/2023	23.3	37.2	42.1	78.6
17/04/2023	25.2	36.5	50.2	79.0
18/04/2023	24.6	37.2	47.1	87.6
19/04/2023	21.0	37.6	34.2	84.0
20/04/2023	22.3	37.5	42.2	80.0
21/04/2023	22.3	37.6	39.2	78.0
22/04/2023	24.5	37.6	38.2	68.0
23/04/2023	21.0	37.6	34.2	80.0
24/04/2023	22.3	37.3	42.2	70.0
25/04/2023	22.3	37.6	39.2	72.0
26/04/2023	24.5	37.6	38.2	84.0
27/04/2023	24.3	37.4	23.6	76.0
28/04/2023	24.1	37.1	31.1	87.3
29/04/2023	26.0	36.5	38.0	88.0
30/04/2023	24.2	37.4	39.2	86.4

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

ISO 45001:2018

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. C

METEOROLOGICAL DATA

Project : Block IV - Kalay Mineral Block

Location : Mine site

Season : Summer, 2023

Date	Temperature in °C		Relative Humidity in %	
	Min.	Max.	Min.	Max.
01/05/2023	23.1	37.6	35.1	87.5
02/05/2023	22.2	37.5	34.2	84.0
03/05/2023	25.0	37.5	40.4	80.3
04/05/2023	24.0	37.5	39.0	78.6
05/05/2023	24.0	37.2	32.0	80.0
06/05/2023	24.4	37.4	37.2	66.0
07/05/2023	25.0	37.5	41.5	64.0
08/05/2023	27.0	36.5	54.2	80.0
09/05/2023	28.0	37.3	53.1	84.6
10/05/2023	27.1	37.6	51.6	87.6
11/05/2023	26.2	37.1	53.0	85.0
12/05/2023	28.0	38.6	42.4	87.0
13/05/2023	26.1	37.5	51.0	80.5
14/05/2023	28.0	37.2	51.1	87.6
15/05/2023	26.0	37.5	50.3	88.0
16/05/2023	25.2	37.6	41.0	87.5
17/05/2023	24.1	37.2	34.2	87.2
18/05/2023	27.0	37.3	41.5	87.3
19/05/2023	27.0	36.3	48.0	86.7
20/05/2023	27.0	37.2	42.1	85.5
21/05/2023	28.0	37.2	45.2	86.3
22/05/2023	25.0	36.5	43.0	87.2
23/05/2023	23.0	37.1	51.4	86.0
24/05/2023	25.0	37.5	47.0	84.6
25/05/2023	26.0	37.3	47.0	85.8
26/05/2023	26.1	36.6	51.0	80.0
27/05/2023	27.1	37.6	37.5	83.0
28/05/2023	25.3	37.0	44.4	78.6
29/05/2023	26.1	37.6	40.6	80.4
30/05/2023	28.0	37.2	45.2	87.6
31/05/2023	26.2	37.5	49.3	87.2

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

ISO 45001:2018

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. 1

AMBIENT AIR QUALITY

Client	: Fomento Resources Pvt. Ltd.,
Project	: Block IV - Kalay Mineral Block Santona village Sanguem Taluka. South Goa Dist, Goa.,
Station at & Code	: A1 - Kalay Mineral Block Mine Office (Core zone)
Duration	: 24 Hrs
Issue Date	: 15.05.2023
Reference	IS 5182

Date of Sampling	Lab Code	Sulphur Dioxide (SO_2), $\mu g/m^3$	Nitrogen Dioxide (NO_2), $\mu g/m^3$	PM_{10}, ($\mu g/m^3$)	$PM_{2.5}$, ($\mu g/m^3$)	Ammonia (NH_3), $\mu g/m^3$	Benzene (C_6H_6), $\mu g/m^3$
04.03.2023	ED/23/03/2-0154	9	12	51	28	<20	<1
08.03.2023	ED/23/03/2-0225	9	11	38	18	<20	<1
11.03.2023	ED/23/03/3-0075	10	14	30	16	<20	<1
15.03.2023	ED/23/03/3-0134	11	12	43	25	<20	<1
18.03.2023	ED/23/03/4-0033	8	11	48	26	<20	<1
22.03.2023	ED/23/03/4-0096	7	10	34	18	<20	<1
25.03.2023	ED/23/03/5-0031	9	10	40	22	<20	<1
29.03.2023	ED/23/03/5-0102	11	13	50	27	<20	<1
Limits for Industrial, Residential, Rural and other Areas		**80** **24 Hrs**	**80** **24 Hrs**	**100** **24 Hrs**	**60** **24 Hrs**	**400** **24 Hrs**	**5** **Annual**

Date of Sampling	Lab Code	Lead (Pb), $\mu g/m^3$	Nickel (Ni), ng/m^3	Arsenic (As), ng/m^3	Benzo(a) Pyrene (BaP), ng/m^3	Carbon Monoxide* (CO), mg/m^3	Ozone* (O_3), $\mu g/m^3$
04.03.2023	ED/23/03/2-0154	0.07	<0.5	<0.5	<0.5	0.13	23
08.03.2023	ED/23/03/2-0225	0.09	<0.5	<0.5	<0.5	0.18	25
11.03.2023	ED/23/03/3-0075	0.11	<0.5	<0.5	<0.5	0.22	24
15.03.2023	ED/23/03/3-0134	<0.05	<0.5	<0.5	<0.5	0.15	21
18.03.2023	ED/23/03/4-0033	0.07	<0.5	<0.5	<0.5	0.09	20
22.03.2023	ED/23/03/4-0096	0.09	<0.5	<0.5	<0.5	0.18	21
25.03.2023	ED/23/03/5-0031	0.11	<0.5	<0.5	<0.5	0.31	20
29.03.2023	ED/23/03/5-0102	0.07	<0.5	<0.5	<0.5	0.11	23
Limits for Industrial, Residential, Rural and other Areas		**1.0** **24 Hrs**	**20** **Annual**	**6** **Annual**	**1** **Annual**	**4** **1 Hr**	**180** **1 Hr**

Note : * Parameters monitored for period of 1 hr

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

ISO 45001:2018

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory
Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. 2

AMBIENT AIR QUALITY

Client	: Fomento Resources Pvt. Ltd.,
Project	: Block IV - Kalay Mineral Block Santona village Sanguem Taluka. South Goa Dist, Goa.,
Station at & Code	: A2 - Costi village (Near Chowgule Colony)
Duration	: 24 Hrs
Issue Date	: 15.05.2023
Reference IS 5182	

Date of Sampling	Lab Code	Sulphur Dioxide (SO_2), µg/m³	Nitrogen Dioxide (NO_2), µg/m³	PM_{10}, (µg/m³)	$PM_{2.5}$, (µg/m³)	Ammonia (NH_3), µg/m³	Benzene (C_6H_6), µg/m³
03.03.2023	ED/23/03/2-0140	9	11	40	26	<20	<1
07.03.2023	ED/23/03/2-0211	11	13	43	24	<20	<1
10.03.2023	ED/23/03/3-0063	10	12	36	19	<20	<1
14.03.2023	ED/23/03/3-0124	7	12	32	18	<20	<1
17.03.2023	ED/23/03/4-0019	11	14	49	28	<20	<1
21.03.2023	ED/23/03/4-0086	12	13	46	27	<20	<1
24.03.2023	ED/23/03/5-0017	10	11	33	19	<20	<1
28.03.2023	ED/23/03/5-0088	9	10	48	24	<20	<1
31.03.2023	ED/23/04/2-0095	10	10	45	22	<20	<1
Limits for Industrial, Residential, Rural and other Areas		**80** **24 Hrs**	**80** **24 Hrs**	**100** **24 Hrs**	**60** **24 Hrs**	**400** **24 Hrs**	**5** **Annual**

Date of Sampling	Lab Code	Lead (Pb), µg/m³	Nickel (Ni), ng/m³	Arsenic (As), ng/m³	Benzo(a) Pyrene (BaP), ng/m³	Carbon Monoxide* (CO), mg/m³	Ozone* (O_3), µg/m³
03.03.2023	ED/23/03/2-0140	0.11	<0.5	<0.5	<0.5	0.08	23
07.03.2023	ED/23/03/2-0211	0.05	<0.5	<0.5	<0.5	0.16	26
10.03.2023	ED/23/03/3-0063	0.16	<0.5	<0.5	<0.5	0.05	28
14.03.2023	ED/23/03/3-0124	0.13	<0.5	<0.5	<0.5	0.15	21
17.03.2023	ED/23/03/4-0019	0.08	<0.5	<0.5	<0.5	0.22	20
21.03.2023	ED/23/03/4-0086	0.11	<0.5	<0.5	<0.5	0.18	21
24.03.2023	ED/23/03/5-0017	0.08	<0.5	<0.5	<0.5	0.31	23
28.03.2023	ED/23/03/5-0088	0.16	<0.5	<0.5	<0.5	0.15	25
31.03.2023	ED/23/04/2-0095	0.05	<0.5	<0.5	<0.5	0.24	22
Limits for Industrial, Residential, Rural and other Areas		**1.0** **24 Hrs**	**20** **Annual**	**6** **Annual**	**1** **Annual**	**4** **1 Hr**	**180** **1 Hr**
Note : * Parameters monitored for period of 1 hr							

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

ISO 45001:2018

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory
Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. 3

AMBIENT AIR QUALITY

Client	: **Fomento Resources Pvt. Ltd.,**
Project	: **Block IV - Kalay Mineral Block Santona village Sanguem Taluka. South Goa Dist, Goa.,**
Station at & Code	: **A3 - Kalay village**
Duration	: **24 Hrs**
Issue Date	: **15.05.2023**
Reference IS 5182	

Date of Sampling	Lab Code	Sulphur Dioxide (SO_2), µg/m^3	Nitrogen Dioxide (NO_2), µg/m^3	PM_{10}, (µg/m^3)	$PM_{2.5}$, (µg/m^3)	Ammonia (NH_3), µg/m^3	Benzene (C_6H_6), µg/m^3
04.03.2023	ED/23/03/2-0155	6	9	36	20	<20	<1
08.03.2023	ED/23/03/2-0226	11	13	35	19	<20	<1
11.03.2023	ED/23/03/3-0076	12	16	40	23	<20	<1
15.03.2023	ED/23/03/3-0135	9	11	36	21	<20	<1
18.03.2023	ED/23/03/4-0034	7	9	29	18	<20	<1
22.03.2023	ED/23/03/4-0097	11	12	46	24	<20	<1
25.03.2023	ED/23/03/5-0032	9	11	30	16	<20	<1
29.03.2023	ED/23/03/5-0103	10	10	38	19	<20	<1
Limits for Industrial , Residential, Rural and other Areas		**80 24 Hrs**	**80 24 Hrs**	**100 24 Hrs**	**60 24 Hrs**	**400 24 Hrs**	**5 Annual**

Date of Sampling	Lab Code	Lead (Pb), µg/m^3	Nickel (Ni), ng/m^3	Arsenic (As), ng/m^3	Benzo(a) Pyrene (BaP), ng/m^3	Carbon Monoxide* (CO), mg/m^3	Ozone* (O_3), µg/m^3
04.03.2023	ED/23/03/2-0155	0.08	<0.5	<0.5	<0.5	0.09	26
08.03.2023	ED/23/03/2-0226	0.13	<0.5	<0.5	<0.5	0.21	20
11.03.2023	ED/23/03/3-0076	0.07	<0.5	<0.5	<0.5	0.31	24
15.03.2023	ED/23/03/3-0135	0.15	<0.5	<0.5	<0.5	0.11	25
18.03.2023	ED/23/03/4-0034	0.08	<0.5	<0.5	<0.5	0.05	22
22.03.2023	ED/23/03/4-0097	0.13	<0.5	<0.5	<0.5	0.16	26
25.03.2023	ED/23/03/5-0032	0.06	<0.5	<0.5	<0.5	0.21	25
29.03.2023	ED/23/03/5-0103	0.12	<0.5	<0.5	<0.5	0.16	24
Limits for Industrial , Residential, Rural and other Areas		**1.0 24 Hrs**	**20 Annual**	**6 Annual**	**1 Annual**	**4 1 Hr**	**180 1 Hr**

Note : * Parameters monitored for period of 1 hr

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

ISO 45001:2018

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. 4

AMBIENT AIR QUALITY

Client : Fomento Resources Pvt. Ltd.,
Project : Block IV - Kalay Mineral Block
Santona village Sanguem Taluka. South Goa Dist, Goa.,
Station at & Code : A4 - Devonamol village
Duration : 24 Hrs
Issue Date : 15.05.2023
Reference IS 5182

Date of Sampling	Lab Code	Sulphur Dioxide (SO_2), µg/m^3	Nitrogen Dioxide (NO_2), µg/m^3	PM_{10}, (µg/m^3)	$PM_{2.5}$, (µg/m^3)	Ammonia (NH_3), µg/m^3	Benzene (C_6H_6), µg/m^3
04.03.2023	ED/23/03/2-0156	6	11	37	19	<20	<1
08.03.2023	ED/23/03/2-0227	12	15	40	21	<20	<1
11.03.2023	ED/23/03/3-0077	11	13	44	24	<20	<1
15.03.2023	ED/23/03/3-0136	9	11	38	21	<20	<1
18.03.2023	ED/23/03/4-0035	10	9	35	18	<20	<1
22.03.2023	ED/23/03/4-0098	11	11	30	17	<20	<1
25.03.2023	ED/23/03/5-0033	10	12	46	24	<20	<1
29.03.2023	ED/23/03/5-0104	9	10	37	18	<20	<1
Limits for Industrial, Residential, Rural and other Areas		**80 24 Hrs**	**80 24 Hrs**	**100 24 Hrs**	**60 24 Hrs**	**400 24 Hrs**	**5 Annual**

Date of Sampling	Lab Code	Lead (Pb), µg/m^3	Nickel (Ni), ng/m^3	Arsenic (As), ng/m^3	Benzo(a) Pyrene (BaP), ng/m^3	Carbon Monoxide* (CO), mg/m^3	Ozone* (O_3), µg/m^3
04.03.2023	ED/23/03/2-0156	0.13	<0.5	<0.5	<0.5	0.08	25
08.03.2023	ED/23/03/2-0227	0.09	<0.5	<0.5	<0.5	0.07	23
11.03.2023	ED/23/03/3-0077	0.06	<0.5	<0.5	<0.5	0.06	20
15.03.2023	ED/23/03/3-0136	0.17	<0.5	<0.5	<0.5	0.05	21
18.03.2023	ED/23/03/4-0035	0.11	<0.5	<0.5	<0.5	0.10	22
22.03.2023	ED/23/03/4-0098	0.08	<0.5	<0.5	<0.5	0.11	25
25.03.2023	ED/23/03/5-0033	0.13	<0.5	<0.5	<0.5	0.15	22
29.03.2023	ED/23/03/5-0104	0.05	<0.5	<0.5	<0.5	0.31	21
Limits for Industrial, Residential, Rural and other Areas		**1.0 24 Hrs**	**20 Annual**	**6 Annual**	**1 Annual**	**4 1 Hr**	**180 1 Hr**

Note : * Parameters monitored for period of 1 hr

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

ISO 45001:2018

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. 5

AMBIENT AIR QUALITY

Client : Fomento Resources Pvt. Ltd.,
Project : Block IV - Kalay Mineral Block
Santona village Sanguem Taluka. South Goa Dist, Goa.,
Station at & Code : A5 - Cormonem village - Meditation Centre
Duration : 24 Hrs
Issue Date : 15.05.2023
Reference IS 5182

Date of Sampling	Lab Code	Sulphur Dioxide (SO_2), µg/m^3	Nitrogen Dioxide (NO_2), µg/m^3	PM_{10}, (µg/m^3)	$PM_{2.5}$, (µg/m^3)	Ammonia (NH_3), µg/m^3	Benzene (C_6H_6), µg/m^3
02.03.2023	ED/23/03/1-0028	11	11	26	15	<20	<1
06.03.2023	ED/23/03/2-0182	9	10	40	21	<20	<1
09.03.2023	ED/23/03/2-0253	7	11	30	18	<20	<1
13.03.2023	ED/23/03/3-0099	9	10	43	24	<20	<1
16.03.2023	ED/23/03/3-0162	11	12	30	16	<20	<1
20.03.2023	ED/23/03/4-0061	7	9	36	19	<20	<1
23.03.2023	ED/23/03/4-0124	9	10	34	17	<20	<1
27.03.2023	ED/23/03/5-0059	6	9	44	26	<20	<1
30.03.2023	ED/23/04/1-0012	10	11	40	21	<20	<1
Limits for Industrial, Residential, Rural and other Areas		**80 24 Hrs**	**80 24 Hrs**	**100 24 Hrs**	**60 24 Hrs**	**400 24 Hrs**	**5 Annual**

Date of Sampling	Lab Code	Lead (Pb), µg/m^3	Nickel (Ni), ng/m^3	Arsenic (As), ng/m^3	Benzo(a) Pyrene (BaP), ng/m^3	Carbon Monoxide* (CO), mg/m^3	Ozone* (O_3), µg/m^3
02.03.2023	ED/23/03/1-0028	0.05	<0.5	<0.5	<0.5	0.21	23
06.03.2023	ED/23/03/2-0182	0.13	<0.5	<0.5	<0.5	0.05	25
09.03.2023	ED/23/03/2-0253	0.11	<0.5	<0.5	<0.5	0.11	26
13.03.2023	ED/23/03/3-0099	0.08	<0.5	<0.5	<0.5	0.05	20
16.03.2023	ED/23/03/3-0162	0.05	<0.5	<0.5	<0.5	0.07	24
20.03.2023	ED/23/03/4-0061	0.11	<0.5	<0.5	<0.5	0.19	20
23.03.2023	ED/23/03/4-0124	0.13	<0.5	<0.5	<0.5	0.05	22
27.03.2023	ED/23/03/5-0059	0.05	<0.5	<0.5	<0.5	0.18	21
30.03.2023	ED/23/04/1-0012	0.13	<0.5	<0.5	<0.5	0.31	20
Limits for Industrial, Residential, Rural and other Areas		**1.0 24 Hrs**	**20 Annual**	**6 Annual**	**1 Annual**	**4 1 Hr**	**180 1 Hr**

Note : * Parameters monitored for period of 1 hr

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

ISO 45001:2018

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. 6

AMBIENT AIR QUALITY

Client	: Fomento Resources Pvt. Ltd.,
Project	: Block IV - Kalay Mineral Block Santona village Sanguem Taluka. South Goa Dist, Goa.,
Station at & Code	: A6 - Bandoli village (Morcani)
Duration	: 24 Hrs
Issue Date	: 15.05.2023
Reference	IS 5182

Date of Sampling	Lab Code	Sulphur Dioxide (SO_2), $\mu g/m^3$	Nitrogen Dioxide (NO_2), $\mu g/m^3$	PM_{10}, ($\mu g/m^3$)	$PM_{2.5}$, ($\mu g/m^3$)	Ammonia (NH_3), $\mu g/m^3$	Benzene (C_6H_6), $\mu g/m^3$
04.03.2023	ED/23/03/2-0157	8	11	36	18	<20	<1
08.03.2023	ED/23/03/2-0228	6	9	33	15	<20	<1
11.03.2023	ED/23/03/3-0078	8	10	38	19	<20	<1
15.03.2023	ED/23/03/3-0137	9	10	43	24	<20	<1
18.03.2023	ED/23/03/4-0036	7	10	40	22	<20	<1
22.03.2023	ED/23/03/4-0099	6	9	47	26	<20	<1
25.03.2023	ED/23/03/5-0034	10	12	35	18	<20	<1
29.03.2023	ED/23/03/5-0105	6	9	43	21	<20	<1
Limits for Industrial, Residential, Rural and other Areas		**80** 24 Hrs	**80** 24 Hrs	**100** 24 Hrs	**60** 24 Hrs	**400** 24 Hrs	**5** Annual

Date of Sampling	Lab Code	Lead (Pb), $\mu g/m^3$	Nickel (Ni), ng/m^3	Arsenic (As), ng/m^3	Benzo(a) Pyrene (BaP), ng/m^3	Carbon Monoxide* (CO), mg/m^3	Ozone* (O_3), $\mu g/m^3$
04.03.2023	ED/23/03/2-0157	0.15	<0.5	<0.5	<0.5	0.10	22
08.03.2023	ED/23/03/2-0228	0.05	<0.5	<0.5	<0.5	0.21	23
11.03.2023	ED/23/03/3-0078	0.08	<0.5	<0.5	<0.5	0.15	25
15.03.2023	ED/23/03/3-0137	<0.05	<0.5	<0.5	<0.5	0.18	21
18.03.2023	ED/23/03/4-0036	0.09	<0.5	<0.5	<0.5	0.09	23
22.03.2023	ED/23/03/4-0099	0.05	<0.5	<0.5	<0.5	0.11	22
25.03.2023	ED/23/03/5-0034	0.13	<0.5	<0.5	<0.5	0.05	26
29.03.2023	ED/23/03/5-0105	0.11	<0.5	<0.5	<0.5	0.12	24
Limits for Industrial, Residential, Rural and other Areas		**1.0** 24 Hrs	**20** Annual	**6** Annual	**1** Annual	**4** 1 Hr	**180** 1 Hr

Note : * Parameters monitored for period of 1 hr

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

ISO 45001:2018

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. 7

AMBIENT AIR QUALITY

Client	: **Fomento Resources Pvt. Ltd.,**
Project	: **Block IV - Kalay Mineral Block Santona village Sanguem Taluka. South Goa Dist, Goa.,**
Station at & Code	: **A7 - Santona village (Ambeudok)**
Duration	: **24 Hrs**
Issue Date	: **15.05.2023**
Reference IS 5182	

Date of Sampling	Lab Code	Sulphur Dioxide (SO_2), µg/m³	Nitrogen Dioxide (NO_2), µg/m³	PM_{10}, (µg/m³)	$PM_{2.5}$, (µg/m³)	Ammonia (NH_3), µg/m³	Benzene (C_6H_6), µg/m³
03.03.2023	ED/23/03/2-0139	9	12	54	28	<20	<1
07.03.2023	ED/23/03/2-0210	11	11	40	22	<20	<1
10.03.2023	ED/23/03/3-0062	10	13	50	27	<20	<1
14.03.2023	ED/23/03/3-0123	12	14	30	19	<20	<1
17.03.2023	ED/23/03/4-0018	9	12	48	25	<20	<1
21.03.2023	ED/23/03/4-0085	12	13	37	19	<20	<1
24.03.2023	ED/23/03/5-0016	11	11	52	25	<20	<1
28.03.2023	ED/23/03/5-0087	12	16	45	22	<20	<1
31.03.2023	ED/23/04/2-0094	10	14	40	21	<20	<1
Limits for Industrial, Residential, Rural and other Areas		**80 24 Hrs**	**80 24 Hrs**	**100 24 Hrs**	**60 24 Hrs**	**400 24 Hrs**	**5 Annual**

Date of Sampling	Lab Code	Lead (Pb), µg/m³	Nickel (Ni), ng/m³	Arsenic (As), ng/m³	Benzo(a) Pyrene (BaP), ng/m³	Carbon Monoxide* (CO), mg/m³	Ozone* (O_3), µg/m³
03.03.2023	ED/23/03/2-0139	0.11	<0.5	<0.5	<0.5	0.31	25
07.03.2023	ED/23/03/2-0210	0.08	<0.5	<0.5	<0.5	0.15	28
10.03.2023	ED/23/03/3-0062	0.13	<0.5	<0.5	<0.5	0.08	25
14.03.2023	ED/23/03/3-0123	0.08	<0.5	<0.5	<0.5	0.21	27
17.03.2023	ED/23/03/4-0018	0.18	<0.5	<0.5	<0.5	0.22	26
21.03.2023	ED/23/03/4-0085	0.11	<0.5	<0.5	<0.5	0.25	27
24.03.2023	ED/23/03/5-0016	0.13	<0.5	<0.5	<0.5	0.34	30
28.03.2023	ED/23/03/5-0087	0.05	<0.5	<0.5	<0.5	0.11	28
31.03.2023	ED/23/04/2-0094	0.06	<0.5	<0.5	<0.5	0.08	22
Limits for Industrial, Residential, Rural and other Areas		**1.0 24 Hrs**	**20 Annual**	**6 Annual**	**1 Annual**	**4 1 Hr**	**180 1 Hr**

Note : * Parameters monitored for period of 1 hr

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

ISO 45001:2018

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. 8

AMBIENT AIR QUALITY

Client	: **Fomento Resources Pvt. Ltd.,**
Project	: **Block IV - Kalay Mineral Block Santona village Sanguem Taluka. South Goa Dist, Goa.,**
Station at & Code	: **A8 - Near SFIPL Plant Office**
Duration	: **24 Hrs**
Issue Date	: **15.05.2023**
Reference IS 5182	

Date of Sampling	Lab Code	Sulphur Dioxide (SO_2), $\mu g/m^3$	Nitrogen Dioxide (NO_2), $\mu g/m^3$	PM_{10}, ($\mu g/m^3$)	$PM_{2.5}$, ($\mu g/m^3$)	Ammonia (NH_3), $\mu g/m^3$	Benzene (C_6H_6), $\mu g/m^3$
04.03.2023	ED/23/03/2-0158	10	12	40	27	<20	<1
08.03.2023	ED/23/03/2-0229	9	11	35	18	<20	<1
11.03.2023	ED/23/03/3-0079	11	12	41	24	<20	<1
15.03.2023	ED/23/03/3-0138	9	11	39	20	<20	<1
18.03.2023	ED/23/03/4-0037	7	9	44	23	<20	<1
22.03.2023	ED/23/03/4-0100	8	9	40	22	<20	<1
25.03.2023	ED/23/03/5-0035	9	11	51	28	<20	<1
29.03.2023	ED/23/03/5-0106	10	12	46	22	<20	<1
Limits for Industrial, Residential, Rural and other Areas		**80 24 Hrs**	**80 24 Hrs**	**100 24 Hrs**	**60 24 Hrs**	**400 24 Hrs**	**5 Annual**

Date of Sampling	Lab Code	Lead (Pb), $\mu g/m^3$	Nickel (Ni), ng/m^3	Arsenic (As), ng/m^3	Benzo(a) Pyrene (BaP), ng/m^3	Carbon Monoxide* (CO), mg/m^3	Ozone* (O_3), $\mu g/m^3$
04.03.2023	ED/23/03/2-0158	0.13	<0.5	<0.5	<0.5	0.22	20
08.03.2023	ED/23/03/2-0229	0.07	<0.5	<0.5	<0.5	0.31	20
11.03.2023	ED/23/03/3-0079	0.13	<0.5	<0.5	<0.5	0.18	21
15.03.2023	ED/23/03/3-0138	0.08	<0.5	<0.5	<0.5	0.21	25
18.03.2023	ED/23/03/4-0037	0.11	<0.5	<0.5	<0.5	0.11	22
22.03.2023	ED/23/03/4-0100	0.13	<0.5	<0.5	<0.5	0.05	26
25.03.2023	ED/23/03/5-0035	0.08	<0.5	<0.5	<0.5	0.13	25
29.03.2023	ED/23/03/5-0106	0.13	<0.5	<0.5	<0.5	0.22	24
Limits for Industrial, Residential, Rural and other Areas		**1.0 24 Hrs**	**20 Annual**	**6 Annual**	**1 Annual**	**4 1 Hr**	**180 1 Hr**
Note : * Parameters monitored for period of 1 hr							

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

ISO 45001:2018

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. 9

AMBIENT AIR QUALITY

Client : Fomento Resources Pvt. Ltd.,
Project : Block IV - Kalay Mineral Block
Santona village Sanguem Taluka. South Goa Dist, Goa.,
Station at & Code : A1 - Kalay Mineral Block Mine Office (Core zone)
Duration : 24 Hrs
Issue Date : 15.05.2023
Reference IS 5182

Date of Sampling	Lab Code	Sulphur Dioxide (SO_2), $\mu g/m^3$	Nitrogen Dioxide (NO_2), $\mu g/m^3$	PM_{10}, ($\mu g/m^3$)	$PM_{2.5}$, ($\mu g/m^3$)	Ammonia (NH_3), $\mu g/m^3$	Benzene (C_6H_6), $\mu g/m^3$
01.04.2023	ED/23/04/2-0105	9	11	53	27	<20	<1
05.04.2023	ED/23/04/2-0164	10	15	41	21	<20	<1
08.04.2023	ED/23/04/3-0099	8	10	51	28	<20	<1
12.04.2023	ED/23/04/3-0170	11	12	36	18	<20	<1
15.04.2023	ED/23/04/4-0059	15	16	34	19	<20	<1
19.04.2023	ED/23/04/4-0118	7	11	52	26	<20	<1
21.04.2023	ED/23/04/5-0033	10	9	45	22	<20	<1
26.04.2023	ED/23/04/5-0114	6	10	43	23	<20	<1
29.04.2023	ED/23/05/1-0040	9	11	38	16	<20	<1
Limits for Industrial, Residential, Rural and other Areas		**80 24 Hrs**	**80 24 Hrs**	**100 24 Hrs**	**60 24 Hrs**	**400 24 Hrs**	**5 Annual**

Date of Sampling	Lab Code	Lead (Pb), $\mu g/m^3$	Nickel (Ni), ng/m^3	Arsenic (As), ng/m^3	Benzo(a) Pyrene (BaP), ng/m^3	Carbon Monoxide* (CO), mg/m^3	Ozone* (O_3), $\mu g/m^3$
01.04.2023	ED/23/04/2-0105	0.07	<0.5	<0.5	<0.5	0.09	23
05.04.2023	ED/23/04/2-0164	0.12	<0.5	<0.5	<0.5	0.05	21
08.04.2023	ED/23/04/3-0099	0.05	<0.5	<0.5	<0.5	0.11	25
12.04.2023	ED/23/04/3-0170	0.13	<0.5	<0.5	<0.5	0.28	21
15.04.2023	ED/23/04/4-0059	0.06	<0.5	<0.5	<0.5	0.16	20
19.04.2023	ED/23/04/4-0118	0.08	<0.5	<0.5	<0.5	0.25	23
21.04.2023	ED/23/04/5-0033	0.11	<0.5	<0.5	<0.5	0.15	21
26.04.2023	ED/23/04/5-0114	0.05	<0.5	<0.5	<0.5	0.33	22
29.04.2023	ED/23/05/1-0040	0.13	<0.5	<0.5	<0.5	0.21	25
Limits for Industrial, Residential, Rural and other Areas		**1.0 24 Hrs**	**20 Annual**	**6 Annual**	**1 Annual**	**4 1 Hr**	**180 1 Hr**

Note : * Parameters monitored for period of 1 hr

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

ISO 45001:2018

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. 10

AMBIENT AIR QUALITY

Client : Fomento Resources Pvt. Ltd.,
Project : Block IV - Kalay Mineral Block
Santona village Sanguem Taluka. South Goa Dist, Goa.,
Station at & Code : A2 - Costi village (Near Chowgule Colony)
Duration : 24 Hrs
Issue Date : 15.05.2023
Reference IS 5182

Date of Sampling	Lab Code	Sulphur Dioxide (SO_2), $\mu g/m^3$	Nitrogen Dioxide (NO_2), $\mu g/m^3$	PM_{10}, ($\mu g/m^3$)	$PM_{2.5}$, ($\mu g/m^3$)	Ammonia (NH_3), $\mu g/m^3$	Benzene (C_6H_6), $\mu g/m^3$
04.04.2023	ED/23/04/2-0154	8	11	46	26	<20	<1
07.04.2023	ED/23/04/3-0085	11	12	35	22	<20	<1
11.04.2023	ED/23/04/3-0156	7	10	50	26	<20	<1
14.04.2023	ED/23/04/4-0049	8	12	53	28	<20	<1
18.04.2023	ED/23/04/4-0108	12	13	44	26	<20	<1
21.04.2023	ED/23/04/5-0034	11	10	48	27	<20	<1
25.04.2023	ED/23/04/5-0100	10	14	42	25	<20	<1
28.04.2023	ED/23/05/1-0030	6	10	51	28	<20	<1
Limits for Industrial, Residential, Rural and other Areas		**80 24 Hrs**	**80 24 Hrs**	**100 24 Hrs**	**60 24 Hrs**	**400 24 Hrs**	**5 Annual**

Date of Sampling	Lab Code	Lead (Pb), $\mu g/m^3$	Nickel (Ni), ng/m^3	Arsenic (As), ng/m^3	Benzo(a) Pyrene (BaP), ng/m^3	Carbon Monoxide* (CO), mg/m^3	Ozone* (O_3), $\mu g/m^3$
04.04.2023	ED/23/04/2-0154	0.12	<0.5	<0.5	<0.5	0.11	20
07.04.2023	ED/23/04/3-0085	0.08	<0.5	<0.5	<0.5	0.13	23
11.04.2023	ED/23/04/3-0156	0.06	<0.5	<0.5	<0.5	0.05	25
14.04.2023	ED/23/04/4-0049	0.11	<0.5	<0.5	<0.5	0.16	24
18.04.2023	ED/23/04/4-0108	0.08	<0.5	<0.5	<0.5	0.24	21
21.04.2023	ED/23/04/5-0034	0.13	<0.5	<0.5	<0.5	0.15	23
25.04.2023	ED/23/04/5-0100	0.05	<0.5	<0.5	<0.5	0.33	20
28.04.2023	ED/23/05/1-0030	0.12	<0.5	<0.5	<0.5	0.21	22
Limits for Industrial, Residential, Rural and other Areas		**1.0 24 Hrs**	**20 Annual**	**6 Annual**	**1 Annual**	**4 1 Hr**	**180 1 Hr**

Note : * Parameters monitored for period of 1 hr

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

ISO 45001:2018

TEST REPORT

Table No. 11

AMBIENT AIR QUALITY

Client : Fomento Resources Pvt. Ltd.,
Project : Block IV - Kalay Mineral Block
Santona village Sanguem Taluka. South Goa Dist, Goa.,
Station at & Code : A3 - Kalay village
Duration : 24 Hrs
Issue Date : 15.05.2023
Reference IS 5182

Date of Sampling	Lab Code	Sulphur Dioxide (SO_2), µg/m³	Nitrogen Dioxide (NO_2), µg/m³	PM_{10}, (µg/m³)	$PM_{2.5}$, (µg/m³)	Ammonia (NH_3), µg/m³	Benzene (C_6H_6), µg/m³
01.04.2023	ED/23/04/2-0106	9	11	43	22	<20	<1
05.04.2023	ED/23/04/2-0165	7	10	39	21	<20	<1
08.04.2023	ED/23/04/3-0100	6	10	44	26	<20	<1
12.04.2023	ED/23/04/3-0171	13	14	51	29	<20	<1
15.04.2023	ED/23/04/4-0060	10	11	48	26	<20	<1
19.04.2023	ED/23/04/4-0119	8	9	50	28	<20	<1
21.04.2023	ED/23/04/5-0035	10	13	46	25	<20	<1
26.04.2023	ED/23/04/5-0115	10	10	40	22	<20	<1
29.04.2023	ED/23/05/1-0041	9	11	44	23	<20	<1
Limits for Industrial , Residential, Rural and other Areas		**80 24 Hrs**	**80 24 Hrs**	**100 24 Hrs**	**60 24 Hrs**	**400 24 Hrs**	**5 Annual**

Date of Sampling	Lab Code	Lead (Pb), µg/m³	Nickel (Ni), ng/m³	Arsenic (As), ng/m³	Benzo(a) Pyrene (BaP), ng/m³	Carbon Monoxide* (CO), mg/m³	Ozone* (O_3), µg/m³
01.04.2023	ED/23/04/2-0106	0.11	<0.5	<0.5	<0.5	0.21	20
05.04.2023	ED/23/04/2-0165	0.05	<0.5	<0.5	<0.5	0.13	23
08.04.2023	ED/23/04/3-0100	0.16	<0.5	<0.5	<0.5	0.08	25
12.04.2023	ED/23/04/3-0171	0.05	<0.5	<0.5	<0.5	0.09	26
15.04.2023	ED/23/04/4-0060	0.13	<0.5	<0.5	<0.5	0.11	28
19.04.2023	ED/23/04/4-0119	0.17	<0.5	<0.5	<0.5	0.05	21
21.04.2023	ED/23/04/5-0035	0.05	<0.5	<0.5	<0.5	0.31	23
26.04.2023	ED/23/04/5-0115	0.11	<0.5	<0.5	<0.5	0.22	25
29.04.2023	ED/23/05/1-0041	0.07	<0.5	<0.5	<0.5	0.12	20
Limits for Industrial , Residential, Rural and other Areas		**1.0 24 Hrs**	**20 Annual**	**6 Annual**	**1 Annual**	**4 1 Hr**	**180 1 Hr**

Note : * Parameters monitored for period of 1 hr

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

ISO 45001:2018

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. 12

AMBIENT AIR QUALITY

Client	: Fomento Resources Pvt. Ltd.,
Project	: Block IV - Kalay Mineral Block Santona village Sanguem Taluka. South Goa Dist, Goa.,
Station at & Code	: A4 - Devonamol village
Duration	: 24 Hrs
Issue Date	: 15.05.2023
Reference	IS 5182

Date of Sampling	Lab Code	Sulphur Dioxide (SO_2), $\mu g/m^3$	Nitrogen Dioxide (NO_2), $\mu g/m^3$	PM_{10}, ($\mu g/m^3$)	$PM_{2.5}$, ($\mu g/m^3$)	Ammonia (NH_3), $\mu g/m^3$	Benzene (C_6H_6), $\mu g/m^3$
01.04.2023	ED/23/04/2-0107	11	12	43	22	<20	<1
05.04.2023	ED/23/04/2-0166	9	10	37	20	<20	<1
08.04.2023	ED/23/04/3-0101	7	9	30	16	<20	<1
12.04.2023	ED/23/04/3-0172	8	11	35	17	<20	<1
15.04.2023	ED/23/04/4-0061	12	14	48	25	<20	<1
19.04.2023	ED/23/04/4-0120	9	10	44	23	<20	<1
21.04.2023	ED/23/04/5-0036	7	9	35	18	<20	<1
26.04.2023	ED/23/04/5-0116	7	11	41	22	<20	<1
29.04.2023	ED/23/05/1-0042	10	12	40	20	<20	<1
Limits for Industrial, Residential, Rural and other Areas		**80 24 Hrs**	**80 24 Hrs**	**100 24 Hrs**	**60 24 Hrs**	**400 24 Hrs**	**5 Annual**

Date of Sampling	Lab Code	Lead (Pb), $\mu g/m^3$	Nickel (Ni), ng/m^3	Arsenic (As), ng/m^3	Benzo(a) Pyrene (BaP), ng/m^3	Carbon Monoxide* (CO), mg/m^3	Ozone* (O_3), $\mu g/m^3$
01.04.2023	ED/23/04/2-0107	0.05	<0.5	<0.5	<0.5	0.06	23
05.04.2023	ED/23/04/2-0166	0.11	<0.5	<0.5	<0.5	0.13	21
08.04.2023	ED/23/04/3-0101	0.13	<0.5	<0.5	<0.5	<0.05	25
12.04.2023	ED/23/04/3-0172	0.06	<0.5	<0.5	<0.5	0.13	21
15.04.2023	ED/23/04/4-0061	0.08	<0.5	<0.5	<0.5	0.22	23
19.04.2023	ED/23/04/4-0120	0.05	<0.5	<0.5	<0.5	0.05	22
21.04.2023	ED/23/04/5-0036	0.11	<0.5	<0.5	<0.5	0.15	21
26.04.2023	ED/23/04/5-0116	0.06	<0.5	<0.5	<0.5	0.21	20
29.04.2023	ED/23/05/1-0042	0.09	<0.5	<0.5	<0.5	0.12	22
Limits for Industrial, Residential, Rural and other Areas		**1.0 24 Hrs**	**20 Annual**	**6 Annual**	**1 Annual**	**4 1 Hr**	**180 1 Hr**

Note : * Parameters monitored for period of 1 hr

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

ISO 45001:2018

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory
Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. 13

AMBIENT AIR QUALITY

Client	: Fomento Resources Pvt. Ltd.,
Project	: Block IV - Kalay Mineral Block Santona village Sanguem Taluka. South Goa Dist, Goa.,
Station at & Code	: A5 - Cormonem village - Meditation Centre
Duration	: 24 Hrs
Issue Date	: 15.05.2023
Reference	IS 5182

Date of Sampling	Lab Code	Sulphur Dioxide (SO_2), $\mu g/m^3$	Nitrogen Dioxide (NO_2), $\mu g/m^3$	PM_{10}, ($\mu g/m^3$)	$PM_{2.5}$, ($\mu g/m^3$)	Ammonia (NH_3), $\mu g/m^3$	Benzene (C_6H_6), $\mu g/m^3$
03.04.2023	ED/23/04/2-0129	8	9	50	26	<20	<1
06.04.2023	ED/23/04/2-0192	11	12	43	21	<20	<1
10.04.2023	ED/23/04/3-0127	9	11	34	19	<20	<1
13.04.2023	ED/23/04/3-0198	11	13	40	22	<20	<1
17.04.2023	ED/23/04/4-0083	10	14	36	19	<20	<1
20.04.2023	ED/23/04/4-0145	7	9	40	23	<20	<1
24.04.2023	ED/23/04/5-0071	8	10	48	26	<20	<1
27.04.2023	ED/23/04/5-0142	11	18	40	21	<20	<1
Limits for Industrial, Residential, Rural and other Areas		**80** **24 Hrs**	**80** **24 Hrs**	**100** **24 Hrs**	**60** **24 Hrs**	**400** **24 Hrs**	**5** **Annual**

Date of Sampling	Lab Code	Lead (Pb), $\mu g/m^3$	Nickel (Ni), ng/m^3	Arsenic (As), ng/m^3	Benzo(a) Pyrene (BaP), ng/m^3	Carbon Monoxide* (CO), mg/m^3	Ozone* (O_3), $\mu g/m^3$
03.04.2023	ED/23/04/2-0129	<0.05	<0.5	<0.5	<0.5	0.09	20
06.04.2023	ED/23/04/2-0192	0.08	<0.5	<0.5	<0.5	0.06	23
10.04.2023	ED/23/04/3-0127	0.12	<0.5	<0.5	<0.5	0.11	21
13.04.2023	ED/23/04/3-0198	0.07	<0.5	<0.5	<0.5	0.08	25
17.04.2023	ED/23/04/4-0083	0.15	<0.5	<0.5	<0.5	0.16	21
20.04.2023	ED/23/04/4-0145	0.09	<0.5	<0.5	<0.5	0.24	20
24.04.2023	ED/23/04/5-0071	0.11	<0.5	<0.5	<0.5	0.11	23
27.04.2023	ED/23/04/5-0142	0.05	<0.5	<0.5	<0.5	0.15	21
Limits for Industrial, Residential, Rural and other Areas		**1.0** **24 Hrs**	**20** **Annual**	**6** **Annual**	**1** **Annual**	**4** **1 Hr**	**180** **1 Hr**

Note : * Parameters monitored for period of 1 hr

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

ISO 45001:2018

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. 14

AMBIENT AIR QUALITY

Client : Fomento Resources Pvt. Ltd.,
Project : Block IV - Kalay Mineral Block
Santona village Sanguem Taluka. South Goa Dist, Goa.,
Station at & Code : A6 - Bandoli village (Morcani)
Duration : 24 Hrs
Issue Date : 15.05.2023
Reference IS 5182

Date of Sampling	Lab Code	Sulphur Dioxide (SO_2), µg/m^3	Nitrogen Dioxide (NO_2), µg/m^3	PM_{10}, (µg/m^3)	$PM_{2.5}$, (µg/m^3)	Ammonia (NH_3), µg/m^3	Benzene (C_6H_6), µg/m^3
01.04.2023	ED/23/04/2-0108	9	10	38	18	<20	<1
05.04.2023	ED/23/04/2-0167	10	11	41	22	<20	<1
08.04.2023	ED/23/04/3-0102	11	12	44	25	<20	<1
12.04.2023	ED/23/04/3-0173	10	11	50	27	<20	<1
15.04.2023	ED/23/04/4-0062	9	12	37	26	<20	<1
19.04.2023	ED/23/04/4-0121	7	11	35	18	<20	<1
21.04.2023	ED/23/04/5-0037	10	13	51	26	<20	<1
26.04.2023	ED/23/04/5-0117	11	13	46	24	<20	<1
29.04.2023	ED/23/05/1-0043	9	11	36	22	<20	<1
Limits for Industrial, Residential, Rural and other Areas		**80 24 Hrs**	**80 24 Hrs**	**100 24 Hrs**	**60 24 Hrs**	**400 24 Hrs**	**5 Annual**

Date of Sampling	Lab Code	Lead (Pb), µg/m^3	Nickel (Ni), ng/m^3	Arsenic (As), ng/m^3	Benzo(a) Pyrene (BaP), ng/m^3	Carbon Monoxide* (CO), mg/m^3	Ozone* (O_3), µg/m^3
01.04.2023	ED/23/04/2-0108	0.05	<0.5	<0.5	<0.5	0.13	23
05.04.2023	ED/23/04/2-0167	0.09	<0.5	<0.5	<0.5	0.05	25
08.04.2023	ED/23/04/3-0102	0.06	<0.5	<0.5	<0.5	0.17	21
12.04.2023	ED/23/04/3-0173	0.11	<0.5	<0.5	<0.5	0.15	20
15.04.2023	ED/23/04/4-0062	0.07	<0.5	<0.5	<0.5	0.22	21
19.04.2023	ED/23/04/4-0121	0.12	<0.5	<0.5	<0.5	0.31	23
21.04.2023	ED/23/04/5-0037	0.08	<0.5	<0.5	<0.5	0.08	22
26.04.2023	ED/23/04/5-0117	0.11	<0.5	<0.5	<0.5	0.21	21
29.04.2023	ED/23/05/1-0043	0.13	<0.5	<0.5	<0.5	0.15	20
Limits for Industrial, Residential, Rural and other Areas		**1.0 24 Hrs**	**20 Annual**	**6 Annual**	**1 Annual**	**4 1 Hr**	**180 1 Hr**

Note : * Parameters monitored for period of 1 hr

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

ISO 45001:2018

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. 15

AMBIENT AIR QUALITY

Client : Fomento Resources Pvt. Ltd.,
Project : Block IV - Kalay Mineral Block
Santona village Sanguem Taluka. South Goa Dist, Goa.,
Station at & Code : A7 - Santona village (Ambeudok)
Duration : 24 Hrs
Issue Date : 15.05.2023
Reference IS 5182

Date of Sampling	Lab Code	Sulphur Dioxide (SO_2), µg/m^3	Nitrogen Dioxide (NO_2), µg/m^3	PM_{10}, (µg/m^3)	$PM_{2.5}$, (µg/m^3)	Ammonia (NH_3), µg/m^3	Benzene (C_6H_6), µg/m^3
04.04.2023	ED/23/04/2-0153	12	12	56	28	<20	<1
07.04.2023	ED/23/04/3-0084	10	12	40	22	<20	<1
11.04.2023	ED/23/04/3-0155	8	10	50	27	<20	<1
14.04.2023	ED/23/04/4-0048	11	13	48	26	<20	<1
18.04.2023	ED/23/04/4-0107	10	11	46	25	<20	<1
21.04.2023	ED/23/04/5-0032	12	13	53	27	<20	<1
25.04.2023	ED/23/04/5-0099	9	11	41	22	<20	<1
28.04.2023	ED/23/05/1-0029	11	12	51	26	<20	<1
Limits for Industrial, Residential, Rural and other Areas		**80 24 Hrs**	**80 24 Hrs**	**100 24 Hrs**	**60 24 Hrs**	**400 24 Hrs**	**5 Annual**

Date of Sampling	Lab Code	Lead (Pb), µg/m^3	Nickel (Ni), ng/m^3	Arsenic (As), ng/m^3	Benzo(a) Pyrene (BaP), ng/m^3	Carbon Monoxide* (CO), mg/m^3	Ozone* (O_3), µg/m^3
04.04.2023	ED/23/04/2-0153	0.08	<0.5	<0.5	<0.5	0.13	20
07.04.2023	ED/23/04/3-0084	0.16	<0.5	<0.5	<0.5	0.22	21
11.04.2023	ED/23/04/3-0155	0.13	<0.5	<0.5	<0.5	0.13	25
14.04.2023	ED/23/04/4-0048	0.11	<0.5	<0.5	<0.5	0.19	29
18.04.2023	ED/23/04/4-0107	0.07	<0.5	<0.5	<0.5	0.16	28
21.04.2023	ED/23/04/5-0032	0.15	<0.5	<0.5	<0.5	0.21	26
25.04.2023	ED/23/04/5-0099	0.11	<0.5	<0.5	<0.5	0.35	28
28.04.2023	ED/23/05/1-0029	0.05	<0.5	<0.5	<0.5	0.33	<20
Limits for Industrial, Residential, Rural and other Areas		**1.0 24 Hrs**	**20 Annual**	**6 Annual**	**1 Annual**	**4 1 Hr**	**180 1 Hr**

Note : * Parameters monitored for period of 1 hr

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

ISO 45001:2018

TEST REPORT

Table No. 16

AMBIENT AIR QUALITY

Client	: Fomento Resources Pvt. Ltd.,
Project	: Block IV - Kalay Mineral Block Santona village Sanguem Taluka. South Goa Dist, Goa.,
Station at & Code	: A8 - Near SFIPL Plant Office
Duration	: 24 Hrs
Issue Date	: 15.05.2023
Reference	IS 5182

Date of Sampling	Lab Code	Sulphur Dioxide (SO_2), $\mu g/m^3$	Nitrogen Dioxide (NO_2), $\mu g/m^3$	PM_{10}, ($\mu g/m^3$)	$PM_{2.5}$, ($\mu g/m^3$)	Ammonia (NH_3), $\mu g/m^3$	Benzene (C_6H_6), $\mu g/m^3$
01.04.2023	ED/23/04/2-0109	12	14	53	28	<20	<1
05.04.2023	ED/23/04/2-0168	9	10	50	27	<20	<1
08.04.2023	ED/23/04/3-0103	9	11	36	18	<20	<1
12.04.2023	ED/23/04/3-0174	13	15	44	26	<20	<1
15.04.2023	ED/23/04/4-0063	10	12	40	22	<20	<1
19.04.2023	ED/23/04/4-0122	8	11	51	28	<20	<1
21.04.2023	ED/23/04/5-0038	11	13	40	22	<20	<1
26.04.2023	ED/23/04/5-0118	8	11	48	25	<20	<1
29.04.2023	ED/23/05/1-0044	10	12	49	27	<20	<1
Limits for Industrial , Residential, Rural and other Areas		**80** **24 Hrs**	**80** **24 Hrs**	**100** **24 Hrs**	**60** **24 Hrs**	**400** **24 Hrs**	**5** **Annual**

Date of Sampling	Lab Code	Lead (Pb), $\mu g/m^3$	Nickel (Ni), ng/m^3	Arsenic (As), ng/m^3	Benzo(a) Pyrene (BaP), ng/m^3	Carbon Monoxide* (CO), mg/m^3	Ozone* (O_3), $\mu g/m^3$
01.04.2023	ED/23/04/2-0109	0.09	<0.5	<0.5	<0.5	0.14	22
05.04.2023	ED/23/04/2-0168	0.05	<0.5	<0.5	<0.5	0.19	23
08.04.2023	ED/23/04/3-0103	<0.05	<0.5	<0.5	<0.5	0.25	23
12.04.2023	ED/23/04/3-0174	0.12	<0.5	<0.5	<0.5	0.32	24
15.04.2023	ED/23/04/4-0063	0.08	<0.5	<0.5	<0.5	0.22	20
19.04.2023	ED/23/04/4-0122	0.16	<0.5	<0.5	<0.5	0.20	26
21.04.2023	ED/23/04/5-0038	0.08	<0.5	<0.5	<0.5	0.10	22
26.04.2023	ED/23/04/5-0118	0.12	<0.5	<0.5	<0.5	0.11	25
29.04.2023	ED/23/05/1-0044	0.05	<0.5	<0.5	<0.5	0.21	22
Limits for Industrial , Residential, Rural and other Areas		**1.0** **24 Hrs**	**20** **Annual**	**6** **Annual**	**1** **Annual**	**4** **1 Hr**	**180** **1 Hr**

Note : * Parameters monitored for period of 1 hr

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

ISO 45001:2018

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. 17

AMBIENT AIR QUALITY

Client	: Fomento Resources Pvt. Ltd.,
Project	: Block IV - Kalay Mineral Block Santona village Sanguem Taluka. South Goa Dist, Goa.,
Station at & Code	: A1 - Kalay Mineral Block Mine Office (Core zone)
Duration	: 24 Hrs
Issue Date	: 10.06.2023
Reference IS 5182	

Date of Sampling	Lab Code	Sulphur Dioxide (SO_2), $\mu g/m^3$	Nitrogen Dioxide (NO_2), $\mu g/m^3$	PM_{10}, ($\mu g/m^3$)	$PM_{2.5}$, ($\mu g/m^3$)	Ammonia (NH_3), $\mu g/m^3$	Benzene (C_6H_6), $\mu g/m^3$
03.05.2023	ED/23/05/1-0099	10	13	37	19	<20	<1
06.05.2023	ED/23/05/2-0315	11	16	40	25	<20	<1
10.05.2023	ED/23/05/2-0386	9	11	43	26	<20	<1
13.05.2023	ED/23/05/3-0295	10	13	51	33	<20	<1
17.05.2023	ED/23/05/3-0366	11	10	54	27	<20	<1
20.05.2023	ED/23/05/4-0354	7	14	49	26	<20	<1
24.05.2023	ED/23/05/4-0413	9	15	55	27	<20	<1
27.05.2023	ED/23/05/5-0135	6	16	51	26	<20	<1
31.05.2023	ED/23/06/1-0142	8	13	48	29	<20	<1
Limits for Industrial, Residential, Rural and other Areas		**80** **24 Hrs**	**80** **24 Hrs**	**100** **24 Hrs**	**60** **24 Hrs**	**400** **24 Hrs**	**5** **Annual**

Date of Sampling	Lab Code	Lead (Pb), $\mu g/m^3$	Nickel (Ni), ng/m^3	Arsenic (As), ng/m^3	Benzo(a) Pyrene (BaP), ng/m^3	Carbon Monoxide* (CO), mg/m^3	Ozone* (O_3), $\mu g/m^3$
03.05.2023	ED/23/05/1-0099	0.06	<0.5	<0.5	<0.5	0.22	24
06.05.2023	ED/23/05/2-0315	0.15	<0.5	<0.5	<0.5	0.16	22
10.05.2023	ED/23/05/2-0386	0.16	<0.5	<0.5	<0.5	0.36	26
13.05.2023	ED/23/05/3-0295	0.17	<0.5	<0.5	<0.5	0.18	24
17.05.2023	ED/23/05/3-0366	0.15	<0.5	<0.5	<0.5	0.18	23
20.05.2023	ED/23/05/4-0354	0.11	<0.5	<0.5	<0.5	0.24	20
24.05.2023	ED/23/05/4-0413	0.19	<0.5	<0.5	<0.5	0.06	21
27.05.2023	ED/23/05/5-0135	0.16	<0.5	<0.5	<0.5	0.13	23
31.05.2023	ED/23/06/1-0142	0.05	<0.5	<0.5	<0.5	0.18	20
Limits for Industrial, Residential, Rural and other Areas		**1.0** **24 Hrs**	**20** **Annual**	**6** **Annual**	**1** **Annual**	**4** **1 Hr**	**180** **1 Hr**
Note : * Parameters monitored for period of 1 hr							

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

ISO 45001:2018

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. 18

AMBIENT AIR QUALITY

Client	: Fomento Resources Pvt. Ltd.,
Project	: Block IV - Kalay Mineral Block Santona village Sanguem Taluka. South Goa Dist, Goa.,
Station at & Code	: A2 - Costi village (Near Chowgule Colony)
Duration	: 24 Hrs
Issue Date	: 10.06.2023
Reference	IS 5182

Date of Sampling	Lab Code	Sulphur Dioxide (SO_2), $\mu g/m^3$	Nitrogen Dioxide (NO_2), $\mu g/m^3$	PM_{10}, ($\mu g/m^3$)	$PM_{2.5}$, ($\mu g/m^3$)	Ammonia (NH_3), $\mu g/m^3$	Benzene (C_6H_6), $\mu g/m^3$
02.05.2023	ED/23/05/1-0089	13	13	48	30	<20	<1
05.05.2023	ED/23/05/2-0301	11	14	43	40	<20	<1
09.05.2023	ED/23/05/2-0372	9	14	46	24	<20	<1
12.05.2023	ED/23/05/3-0281	10	13	50	27	<20	<1
16.05.2023	ED/23/05/3-0352	6	10	57	29	<20	<1
19.05.2023	ED/23/05/4-0344	7	11	54	27	<20	<1
23.05.2023	ED/23/05/4-0403	9	16	51	26	<20	<1
26.05.2023	ED/23/05/5-0121	11	17	37	19	<20	<1
30.05.2023	ED/23/06/1-0128	7	11	40	22	<20	<1
Limits for Industrial, Residential, Rural and other Areas		**80 24 Hrs**	**80 24 Hrs**	**100 24 Hrs**	**60 24 Hrs**	**400 24 Hrs**	**5 Annual**

Date of Sampling	Lab Code	Lead (Pb), $\mu g/m^3$	Nickel (Ni), ng/m^3	Arsenic (As), ng/m^3	Benzo(a) Pyrene (BaP), ng/m^3	Carbon Monoxide* (CO), mg/m^3	Ozone* (O_3), $\mu g/m^3$
02.05.2023	ED/23/05/1-0089	0.19	<0.5	<0.5	<0.5	0.24	25
05.05.2023	ED/23/05/2-0301	0.06	<0.5	<0.5	<0.5	0.22	24
09.05.2023	ED/23/05/2-0372	0.08	<0.5	<0.5	<0.5	0.31	23
12.05.2023	ED/23/05/3-0281	0.15	<0.5	<0.5	<0.5	0.22	25
16.05.2023	ED/23/05/3-0352	0.08	<0.5	<0.5	<0.5	0.26	28
19.05.2023	ED/23/05/4-0344	0.05	<0.5	<0.5	<0.5	0.32	22
23.05.2023	ED/23/05/4-0403	0.16	<0.5	<0.5	<0.5	0.42	26
26.05.2023	ED/23/05/5-0121	0.11	<0.5	<0.5	<0.5	0.49	21
30.05.2023	ED/23/06/1-0128	0.18	<0.5	<0.5	<0.5	0.16	24
Limits for Industrial, Residential, Rural and other Areas		**1.0 24 Hrs**	**20 Annual**	**6 Annual**	**1 Annual**	**4 1 Hr**	**180 1 Hr**

Note : * Parameters monitored for period of 1 hr

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

ISO 45001:2018

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. 19

AMBIENT AIR QUALITY

Client : Fomento Resources Pvt. Ltd.,
Project : Block IV - Kalay Mineral Block
Santona village Sanguem Taluka. South Goa Dist, Goa.,
Station at & Code : A3 - Kalay village
Duration : 24 Hrs
Issue Date : 10.06.2023
Reference IS 5182

Date of Sampling	Lab Code	Sulphur Dioxide (SO_2), µg/m^3	Nitrogen Dioxide (NO_2), µg/m^3	PM_{10}, (µg/m^3)	$PM_{2.5}$, (µg/m^3)	Ammonia (NH_3), µg/m^3	Benzene (C_6H_6), µg/m^3
03.05.2023	ED/23/05/1-0100	9	11	38	21	<20	<1
06.05.2023	ED/23/05/2-0316	7	9	45	24	<20	<1
10.05.2023	ED/23/05/2-0387	8	10	40	25	<20	<1
13.05.2023	ED/23/05/3-0296	7	12	38	21	<20	<1
17.05.2023	ED/23/05/3-0367	12	18	35	15	<20	<1
20.05.2023	ED/23/05/4-0355	10	14	49	27	<20	<1
24.05.2023	ED/23/05/4-0414	7	13	38	20	<20	<1
27.05.2023	ED/23/05/5-0136	12	15	45	25	<20	<1
31.05.2023	ED/23/06/1-0143	8	12	39	20	<20	<1
Limits for Industrial, Residential, Rural and other Areas		**80 24 Hrs**	**80 24 Hrs**	**100 24 Hrs**	**60 24 Hrs**	**400 24 Hrs**	**5 Annual**

Date of Sampling	Lab Code	Lead (Pb), µg/m^3	Nickel (Ni), ng/m^3	Arsenic (As), ng/m^3	Benzo(a) Pyrene (BaP), ng/m^3	Carbon Monoxide* (CO), mg/m^3	Ozone* (O_3), µg/m^3
03.05.2023	ED/23/05/1-0100	0.08	<0.5	<0.5	<0.5	0.22	26
06.05.2023	ED/23/05/2-0316	0.07	<0.5	<0.5	<0.5	0.33	20
10.05.2023	ED/23/05/2-0387	0.06	<0.5	<0.5	<0.5	0.22	<20
13.05.2023	ED/23/05/3-0296	0.08	<0.5	<0.5	<0.5	0.25	25
17.05.2023	ED/23/05/3-0367	0.07	<0.5	<0.5	<0.5	0.16	26
20.05.2023	ED/23/05/4-0355	0.33	<0.5	<0.5	<0.5	0.20	20
24.05.2023	ED/23/05/4-0414	0.08	<0.5	<0.5	<0.5	0.22	22
27.05.2023	ED/23/05/5-0136	0.36	<0.5	<0.5	<0.5	0.17	27
31.05.2023	ED/23/06/1-0143	0.09	<0.5	<0.5	<0.5	0.16	22
Limits for Industrial, Residential, Rural and other Areas		**1.0 24 Hrs**	**20 Annual**	**6 Annual**	**1 Annual**	**4 1 Hr**	**180 1 Hr**

Note : * Parameters monitored for period of 1 hr

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

ISO 45001:2018

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. 20

AMBIENT AIR QUALITY

Client	: **Fomento Resources Pvt. Ltd.,**
Project	: **Block IV - Kalay Mineral Block Santona village Sanguem Taluka. South Goa Dist, Goa.,**
Station at & Code	: **A4 - Devonamol village**
Duration	: **24 Hrs**
Issue Date	: **10.06.2023**
Reference IS 5182	

Date of Sampling	Lab Code	Sulphur Dioxide (SO_2), µg/m^3	Nitrogen Dioxide (NO_2), µg/m^3	PM_{10}, (µg/m^3)	$PM_{2.5}$, (µg/m^3)	Ammonia (NH_3), µg/m^3	Benzene (C_6H_6), µg/m^3
03.05.2023	ED/23/05/1-0101	11	12	54	28	<20	<1
06.05.2023	ED/23/05/2-0317	10	12	46	18	<20	<1
10.05.2023	ED/23/05/2-0388	11	13	44	28	<20	<1
13.05.2023	ED/23/05/3-0297	9	11	35	19	<20	<1
17.05.2023	ED/23/05/3-0368	11	13	48	26	<20	<1
20.05.2023	ED/23/05/4-0356	7	11	45	25	<20	<1
24.05.2023	ED/23/05/4-0415	9	17	35	21	<20	<1
27.05.2023	ED/23/05/5-0137	13	15	50	26	<20	<1
31.05.2023	ED/23/06/1-0144	11	13	48	25	<20	<1
Limits for Industrial , Residential, Rural and other Areas		**80 24 Hrs**	**80 24 Hrs**	**100 24 Hrs**	**60 24 Hrs**	**400 24 Hrs**	**5 Annual**

Date of Sampling	Lab Code	Lead (Pb), µg/m^3	Nickel (Ni), ng/m^3	Arsenic (As), ng/m^3	Benzo(a) Pyrene (BaP), ng/m^3	Carbon Monoxide* (CO), mg/m^3	Ozone* (O_3), µg/m^3
03.05.2023	ED/23/05/1-0101	0.08	<0.5	<0.5	<0.5	0.23	25
06.05.2023	ED/23/05/2-0317	0.16	<0.5	<0.5	<0.5	0.31	25
10.05.2023	ED/23/05/2-0388	0.13	<0.5	<0.5	<0.5	0.22	23
13.05.2023	ED/23/05/3-0297	0.05	<0.5	<0.5	<0.5	0.16	26
17.05.2023	ED/23/05/3-0368	0.09	<0.5	<0.5	<0.5	0.22	24
20.05.2023	ED/23/05/4-0356	0.19	<0.5	<0.5	<0.5	0.25	23
24.05.2023	ED/23/05/4-0415	0.13	<0.5	<0.5	<0.5	0.36	26
27.05.2023	ED/23/05/5-0137	0.11	<0.5	<0.5	<0.5	0.22	21
31.05.2023	ED/23/06/1-0144	0.06	<0.5	<0.5	<0.5	0.16	25
Limits for Industrial , Residential, Rural and other Areas		**1.0 24 Hrs**	**20 Annual**	**6 Annual**	**1 Annual**	**4 1 Hr**	**180 1 Hr**

Note : * Parameters monitored for period of 1 hr

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

ISO 45001:2018

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. 21

AMBIENT AIR QUALITY

Client : Fomento Resources Pvt. Ltd.,
Project : Block IV - Kalay Mineral Block
Santona village Sanguem Taluka. South Goa Dist, Goa.,
Station at & Code : A5 - Cormonem village - Meditation Centre
Duration : 24 Hrs
Issue Date : 10.06.2023
Reference IS 5182

Date of Sampling	Lab Code	Sulphur Dioxide (SO_2), µg/m^3	Nitrogen Dioxide (NO_2), µg/m^3	PM_{10}, (µg/m^3)	$PM_{2.5}$, (µg/m^3)	Ammonia (NH_3), µg/m^3	Benzene (C_6H_6), µg/m^3
01.05.2023	ED/23/05/1-0064	10	15	43	25	<20	<1
04.05.2023	ED/23/05/1-0127	11	13	51	22	<20	<1
08.05.2023	ED/23/05/2-0343	10	15	30	16	<20	<1
11.05.2023	ED/23/05/2-0410	8	13	40	27	<20	<1
15.05.2023	ED/23/05/3-0323	11	14	46	28	<20	<1
18.05.2023	ED/23/05/3-0394	10	12	39	22	<20	<1
22.05.2023	ED/23/05/4-0378	9	15	48	28	<20	<1
25.05.2023	ED/23/05/4-0441	11	17	35	21	<20	<1
29.05.2023	ED/23/05/5-0163	7	12	30	18	<20	<1
Limits for Industrial, Residential, Rural and other Areas		**80 24 Hrs**	**80 24 Hrs**	**100 24 Hrs**	**60 24 Hrs**	**400 24 Hrs**	**5 Annual**

Date of Sampling	Lab Code	Lead (Pb), µg/m^3	Nickel (Ni), ng/m^3	Arsenic (As), ng/m^3	Benzo(a) Pyrene (BaP), ng/m^3	Carbon Monoxide* (CO), mg/m^3	Ozone* (O_3), µg/m^3
01.05.2023	ED/23/05/1-0064	0.15	<0.5	<0.5	<0.5	0.11	26
04.05.2023	ED/23/05/1-0127	0.35	<0.5	<0.5	<0.5	0.10	27
08.05.2023	ED/23/05/2-0343	0.26	<0.5	<0.5	<0.5	0.23	26
11.05.2023	ED/23/05/2-0410	0.25	<0.5	<0.5	<0.5	0.17	28
15.05.2023	ED/23/05/3-0323	0.33	<0.5	<0.5	<0.5	0.11	21
18.05.2023	ED/23/05/3-0394	0.21	<0.5	<0.5	<0.5	0.15	24
22.05.2023	ED/23/05/4-0378	0.19	<0.5	<0.5	<0.5	0.11	26
25.05.2023	ED/23/05/4-0441	0.28	<0.5	<0.5	<0.5	0.16	28
29.05.2023	ED/23/05/5-0163	0.08	<0.5	<0.5	<0.5	0.10	20
Limits for Industrial, Residential, Rural and other Areas		**1.0 24 Hrs**	**20 Annual**	**6 Annual**	**1 Annual**	**4 1 Hr**	**180 1 Hr**
Note : * Parameters monitored for period of 1 hr							

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

ISO 45001:2018

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. 22

AMBIENT AIR QUALITY

Client : Fomento Resources Pvt. Ltd.,
Project : Block IV - Kalay Mineral Block
Santona village Sanguem Taluka. South Goa Dist, Goa.,
Station at & Code : A6 - Bandoli village (Morcani)
Duration : 24 Hrs
Issue Date : 10.06.2023
Reference IS 5182

Date of Sampling	Lab Code	Sulphur Dioxide (SO_2), µg/m^3	Nitrogen Dioxide (NO_2), µg/m^3	PM_{10}, (µg/m^3)	$PM_{2.5}$, (µg/m^3)	Ammonia (NH_3), µg/m^3	Benzene (C_6H_6), µg/m^3
03.05.2023	ED/23/05/1-0102	10	12	49	27	<20	<1
06.05.2023	ED/23/05/2-0318	7	13	37	19	<20	<1
10.05.2023	ED/23/05/2-0389	10	17	29	20	<20	<1
13.05.2023	ED/23/05/3-0298	8	13	53	27	<20	<1
17.05.2023	ED/23/05/3-0369	12	15	40	22	<20	<1
20.05.2023	ED/23/05/4-0357	10	13	55	20	<20	<1
24.05.2023	ED/23/05/4-0416	8	15	38	23	<20	<1
27.05.2023	ED/23/05/5-0138	12	17	50	42	<20	<1
31.05.2023	ED/23/06/1-0145	7	9	38	27	<20	<1
Limits for Industrial , Residential, Rural and other Areas		**80 24 Hrs**	**80 24 Hrs**	**100 24 Hrs**	**60 24 Hrs**	**400 24 Hrs**	**5 Annual**

Date of Sampling	Lab Code	Lead (Pb), µg/m^3	Nickel (Ni), ng/m^3	Arsenic (As), ng/m^3	Benzo(a) Pyrene (BaP), ng/m^3	Carbon Monoxide* (CO), mg/m^3	Ozone* (O_3), µg/m^3
03.05.2023	ED/23/05/1-0102	0.16	<0.5	<0.5	<0.5	0.20	22
06.05.2023	ED/23/05/2-0318	0.27	<0.5	<0.5	<0.5	0.16	23
10.05.2023	ED/23/05/2-0389	0.19	<0.5	<0.5	<0.5	0.18	24
13.05.2023	ED/23/05/3-0298	0.25	<0.5	<0.5	<0.5	0.22	22
17.05.2023	ED/23/05/3-0369	0.14	<0.5	<0.5	<0.5	0.14	20
20.05.2023	ED/23/05/4-0357	0.19	<0.5	<0.5	<0.5	0.18	22
24.05.2023	ED/23/05/4-0416	0.25	<0.5	<0.5	<0.5	0.11	26
27.05.2023	ED/23/05/5-0138	0.16	<0.5	<0.5	<0.5	0.21	25
31.05.2023	ED/23/06/1-0145	0.09	<0.5	<0.5	<0.5	0.17	27
Limits for Industrial , Residential, Rural and other Areas		**1.0 24 Hrs**	**20 Annual**	**6 Annual**	**1 Annual**	**4 1 Hr**	**180 1 Hr**

Note : * Parameters monitored for period of 1 hr

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

ISO 45001:2018

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. 23

AMBIENT AIR QUALITY

Client : Fomento Resources Pvt. Ltd.,
Project : Block IV - Kalay Mineral Block
Santona village Sanguem Taluka. South Goa Dist, Goa.,
Station at & Code : A7 - Santona village (Ambeudok)
Duration : 24 Hrs
Issue Date : 10.06.2023
Reference IS 5182

Date of Sampling	Lab Code	Sulphur Dioxide (SO_2), µg/m^3	Nitrogen Dioxide (NO_2), µg/m^3	PM_{10}, (µg/m^3)	$PM_{2.5}$, (µg/m^3)	Ammonia (NH_3), µg/m^3	Benzene (C_6H_6), µg/m^3
02.05.2023	ED/23/05/1-0088	9	10	48	25	<20	<1
05.05.2023	ED/23/05/2-0300	11	13	53	27	<20	<1
09.05.2023	ED/23/05/2-0371	7	11	50	26	<20	<1
12.05.2023	ED/23/05/3-0280	9	10	55	30	<20	<1
16.05.2023	ED/23/05/3-0351	11	12	45	27	<20	<1
19.05.2023	ED/23/05/4-0343	7	9	40	28	<20	<1
23.05.2023	ED/23/05/4-0402	11	15	47	25	<20	<1
26.05.2023	ED/23/05/5-0120	9	11	36	18	<20	<1
30.05.2023	ED/23/06/1-0127	7	12	50	27	<20	<1
Limits for Industrial, Residential, Rural and other Areas		**80 24 Hrs**	**80 24 Hrs**	**100 24 Hrs**	**60 24 Hrs**	**400 24 Hrs**	**5 Annual**

Date of Sampling	Lab Code	Lead (Pb), µg/m^3	Nickel (Ni), ng/m^3	Arsenic (As), ng/m^3	Benzo(a) Pyrene (BaP), ng/m^3	Carbon Monoxide* (CO), mg/m^3	Ozone* (O_3), µg/m^3
02.05.2023	ED/23/05/1-0088	0.07	<0.5	<0.5	<0.5	0.15	23
05.05.2023	ED/23/05/2-0300	0.11	<0.5	<0.5	<0.5	0.15	21
09.05.2023	ED/23/05/2-0371	0.08	<0.5	<0.5	<0.5	0.13	25
12.05.2023	ED/23/05/3-0280	0.05	<0.5	<0.5	<0.5	0.06	20
16.05.2023	ED/23/05/3-0351	0.09	<0.5	<0.5	<0.5	0.11	22
19.05.2023	ED/23/05/4-0343	0.06	<0.5	<0.5	<0.5	0.05	26
23.05.2023	ED/23/05/4-0402	0.13	<0.5	<0.5	<0.5	0.07	21
26.05.2023	ED/23/05/5-0120	0.16	<0.5	<0.5	<0.5	0.06	20
30.05.2023	ED/23/06/1-0127	0.13	<0.5	<0.5	<0.5	0.15	22
Limits for Industrial, Residential, Rural and other Areas		**1.0 24 Hrs**	**20 Annual**	**6 Annual**	**1 Annual**	**4 1 Hr**	**180 1 Hr**

Note : * Parameters monitored for period of 1 hr

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

ISO 45001:2018

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. 24

AMBIENT AIR QUALITY

Client	: **Fomento Resources Pvt. Ltd.,**
Project	: **Block IV - Kalay Mineral Block Santona village Sanguem Taluka. South Goa Dist, Goa.,**
Station at & Code	: **A8 - Near SFIPL Plant Office**
Duration	: **24 Hrs**
Issue Date	: **10.06.2023**
Reference IS 5182	

Date of Sampling	Lab Code	Sulphur Dioxide (SO_2), $\mu g/m^3$	Nitrogen Dioxide (NO_2), $\mu g/m^3$	PM_{10}, ($\mu g/m^3$)	$PM_{2.5}$, ($\mu g/m^3$)	Ammonia (NH_3), $\mu g/m^3$	Benzene (C_6H_6), $\mu g/m^3$
03.05.2023	ED/23/05/1-0103	10	13	50	20	<20	<1
06.05.2023	ED/23/05/2-0319	8	15	48	20	<20	<1
10.05.2023	ED/23/05/2-0390	6	9	37	19	<20	<1
13.05.2023	ED/23/05/3-0299	10	11	49	27	<20	<1
17.05.2023	ED/23/05/3-0370	8	10	38	18	<20	<1
20.05.2023	ED/23/05/4-0358	9	8	48	26	<20	<1
24.05.2023	ED/23/05/4-0417	12	14	53	28	<20	<1
27.05.2023	ED/23/05/5-0139	11	15	37	19	<20	<1
31.05.2023	ED/23/06/1-0146	15	16	50	28	<20	<1
Limits for Industrial, Residential, Rural and other Areas		**80 24 Hrs**	**80 24 Hrs**	**100 24 Hrs**	**60 24 Hrs**	**400 24 Hrs**	**5 Annual**

Date of Sampling	Lab Code	Lead (Pb), $\mu g/m^3$	Nickel (Ni), ng/m^3	Arsenic (As), ng/m^3	Benzo(a) Pyrene (BaP), ng/m^3	Carbon Monoxide* (CO), mg/m^3	Ozone* (O_3), $\mu g/m^3$
03.05.2023	ED/23/05/1-0103	0.06	<0.5	<0.5	<0.5	0.24	26
06.05.2023	ED/23/05/2-0319	0.09	<0.5	<0.5	<0.5	0.15	22
10.05.2023	ED/23/05/2-0390	0.08	<0.5	<0.5	<0.5	0.22	24
13.05.2023	ED/23/05/3-0299	0.15	<0.5	<0.5	<0.5	0.30	26
17.05.2023	ED/23/05/3-0370	0.23	<0.5	<0.5	<0.5	0.15	28
20.05.2023	ED/23/05/4-0358	0.15	<0.5	<0.5	<0.5	0.11	20
24.05.2023	ED/23/05/4-0417	0.08	<0.5	<0.5	<0.5	0.25	23
27.05.2023	ED/23/05/5-0139	0.23	<0.5	<0.5	<0.5	0.12	22
31.05.2023	ED/23/06/1-0146	0.35	<0.5	<0.5	<0.5	0.10	24
Limits for Industrial, Residential, Rural and other Areas		**1.0 24 Hrs**	**20 Annual**	**6 Annual**	**1 Annual**	**4 1 Hr**	**180 1 Hr**
Note : * Parameters monitored for period of 1 hr							

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

ISO 45001:2018

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. 25

STATISTICAL AMBIENT AIR QUALITY REPORT

Client : Fomento Resources Pvt. Ltd.,

Cluster : Block IV - Kalay Mineral Block, Santona (v) Sanguem (T). South Goa Dist, Goa.,

Month : March to May, 2023

A 1 - Kalay Mineral Block Mine Office (Core zone)					A 2 - Costi village (Near Chowgule Colony)				A 3 - Kalay village			
	SO_2	NO_2	PM_{10}	$PM_{2.5}$	SO_2	NO_2	PM_{10}	$PM_{2.5}$	SO_2	NO_2	PM_{10}	$PM_{2.5}$
Min.	6	9	30	16	6	10	32	18	6	9	29	15
10%	7	10	35	18	7	10	36	19	7	9	35	19
25%	8	11	39	20	8	11	41	23	7	10	38	20
50%	9	12	44	26	10	12	46	26	9	11	40	22
75%	10	14	51	27	11	13	50	27	10	13	45	25
98%	13	16	55	31	13	17	56	35	13	17	51	29
Max.	15	16	55	33	13	17	57	40	13	18	51	29
Avg.	9	12	44	24	9	12	45	25	9	12	41	22
SD	2	2	7	4	2	2	7	4	2	2	6	4
No. of obs	26				26				26			

A 4 - Devonamol village					A 5 Cormonem village - Meditation Centre				A 6 - Bandoli village (Morcani)			
	SO_2	NO_2	PM_{10}	$PM_{2.5}$	SO_2	NO_2	PM_{10}	$PM_{2.5}$	SO_2	NO_2	PM_{10}	$PM_{2.5}$
Min.	6	9	30	16	6	9	26	15	6	9	29	15
10%	7	10	35	18	7	9	30	17	7	9	35	18
25%	9	11	36	18	8	10	34	19	7	10	37	19
50%	10	12	41	21	10	12	40	21	9	12	40	22
75%	11	13	46	25	11	14	43	25	10	13	47	26
98%	13	16	52	28	11	18	51	28	12	17	54	35
Max.	13	17	54	28	11	18	51	28	12	17	55	42
Avg.	10	12	41	22	9	12	39	22	9	12	42	23
SD	2	2	6	4	2	2	7	4	2	2	7	5
No. of obs	26				26				26			

A 7 - Santona village (Ambeudok)					A 8 - Near SFIPL Plant Office			
	SO_2	NO_2	PM_{10}	$PM_{2.5}$	SO_2	NO_2	PM_{10}	$PM_{2.5}$
Min.	7	9	30	18	6	8	35	18
10%	8	10	39	20	8	9	37	19
25%	9	11	40	22	8	11	40	20
50%	10	12	48	26	10	12	45	24
75%	11	13	51	27	11	13	50	27
98%	12	16	56	29	14	16	53	28
Max.	12	16	56	30	15	16	53	28
Avg.	10	12	46	25	10	12	45	24
SD	2	2	7	3	2	2	6	4
No. of obs	26				26			

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

ISO 45001:2018

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. 26

Free Slica (Quartz)

Name of the Client : Fomento Resources Pvt. Ltd.,
Name of the Project : Block IV - Kalay Mineral Block
Santona village Sanguem Taluka. South Goa Dist, Goa.,
Issue Date : 06.06.20223
Test Method Reference : NIOSH 7601

Sl No..	Location	Date of Sampling	Free Silica Content (%)	Free Silica Limits (%)
1	Kalay Mineral Block Mine Office (Core zone)	03.05.2023	ND	5
2	Costi village (Near Chowgule Colony)	05.05.2023	ND	5
3	Kalay village	10.05.2023	ND	5
4	Devonamol village	13.05.2023	ND	5
5	Cormonem village - Meditation Centre	08.05.2023	ND	5
6	Bandoli village (Morcani)	17.05.2023	ND	5
7	Santona village (Ambeudok)	19.05.2023	ND	5
8	Near SFIPL Plant Office	20.05.2023	ND	5

Note: ND-Not Detected, Detection Level : 0.0005%

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

ISO 45001:2018

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. 27

NOISE LEVEL DATA

Name of the Client : Fomento Resources Pvt. Ltd.,
Name of the Project : Block IV - Kalay Mineral Block
Santona village Sanguem Taluka. South Goa Dist, Goa.,
Sample Collected by : Environmental Laboratory Representative
Season : Summer, 2023
Issue Date : 06.06.2023

Code No.	Date of Monitoring	Monitoring stations	Area	Day			Night		
				L_{min}	L_{eq}	L_{max}	L_{min}	L_{eq}	L_{max}
N1	05.04.2023	Kalay Mineral Block Mine Office (Core zone)	Industrial areas	38.0	44.9	48.6	34.6	38.7	44.2
N2	13.04.2023	Cormonem village-Meditation Centre	Residential area	38.0	46.7	52.8	34.8	38.5	41.6
N3	14.04.2023	Santona village (Ambeudok)	Residential area	37.5	49.1	54.0	34.3	39.6	44.5
N4	15.04.2023	Near SFIPL Plant Office	Industrial areas	37.0	50.2	54.5	35.8	39.9	43.5
N5	21.04.2023	Mestri Bhat - Santona Village	Residential area	37.0	48.0	53.5	35.0	38.8	42.8
N6	24.04.2023	Costi Village (Near Chowgule Colony)	Residential area	36.0	45.2	49.0	34.0	38.0	42.5
N7	28.04.2023	Devonamol Village	Silent area	36.7	44.5	48.5	34.0	35.0	40.0
N8	27.04.2023	Bandoli village (Morcani)	Residential area	37.0	44.7	49.6	33.6	37.6	42.5

Permissible Limits of Ambient Noise Levels as per CPCB Guidelines

	Leq. Limit dB(A)	
	Day	Night
Industrial areas	75	70
Commerecial area	65	55
Residential area	55	45
Silence area	50	40

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

ISO 45001:2018

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No.28

Report No: ED00302355

Name of the Client	: Fomento Resources Pvt. Ltd.,
Project	: Block IV - Kalay Mineral Block Santona village Sanguem Taluka. South Goa Dist, Goa.,
Particulars of sample collected	: PW - Kalay Mineral Block Mine Pit water
Sample Collected by	: Environmental Laboratory Representative
Lab Code	: ED/23/05/5-030
Date of sampling	: 24.05.2023
Issue Date	: 10.06.2023
Ref	: Environmental (P) Rules, 1986 SCHEDULE I,- 01.01.2016

Sl. No.	Parameters	Results	General Standards For Effluent Discharge of Environmental Pollutants	Method of Testing
1	pH	7.05	6.0-9.0	IS 3025 (P-11) 2022
3	Chemical Oxygen Demand (COD) mg/l	41.6	250	IS 3025 (P-58) 2006 RA 2022
2	Biochemical Oxygen Demand mg/l, BOD_3 27^0 C	8	30	IS 3025 (P-44) 2014
4	Total Suspended Solids, mg/l	10	100	IS 3025 (P-17) 2022
5	Fixed Dissolved Solids (FDS) mg/l	53	2100	IS 3025(P-18) 2022
6	Temperature ° C	25	Shall not 5^0c above the receiving water temp	IS 3025 (P-9) 1984 RA 2022
7	Oil & Grease, mg/l	<1	10	IS 3025 (P-39) 2021
8	Ammonical Nitrogen, mg/l	0.34	50	IS 3025 (P-34) 1988 RA 2019
9	Total Kjedahl Nitrogen, mg/l	4.48	50	IS 3025 (P-34) 1988 RA 2019
10	Nitrate Nitrogen (as N), mg/l	0.17	10	IS 3025 (P-34) 1988 RA 2019
11	Phosphates (as P), mg/l	<0.05	5	IS 3025 (P-31) Sec 1 2022
12	Chlorides (as Cl), mg/l	11.6	1000	IS 3025 (P-32) 1988 RA 2019
13	Sulphates (as SO_4) mg/l	2	1000	IS 3025 (P-24) Sec 1 2022
14	Fluoride (as F), mg/l	0.2	2	ARHA 23rd Edition 4500F
15	Sulphide (as S), mg/l	<0.01	2	IS 3025 (P-29) 2022
16	Phenolic Compounds (as C_6H_5OH), mg/l	<0.001	1	IS 3025 (P-43) Sec 1 2022
17	Total Residual Chlorine, mg/l	<0.1	1	IS 3025 (P-26) 2021
18	Zinc (as Zn), mg/l	0.018	5	IS 3025 (P-2) 2019
19	Iron (as Fe), mg/l	0.075	3	IS 3025 (P-2) 2019
20	Copper (as Cu), mg/l	<0.005	3	IS 3025 (P-2) 2019
21	Trivalent Chromium (as Cr^{+3}), mg/l	<0.01	2	SOP/C/W-4
22	Manganese (as Mn), mg/l	0.01	2	IS 3025 (P-2) 2019
23	Nickel (as Ni), mg/l	<0.001	3	IS 3025 (P-2) 2019
24	Arsenic (as As), mg/l	<0.002	0.2	IS 3025 (P-2) 2019
25	Cyanide (as CN), mg/l	<0.01	0.2	IS 3025 (P-27) Sec 1 2021
26	Vanadium (as V), mg/l	<0.001	0.2	IS 3025 (P-2) 2019
27	Lead (as Pb), mg/l	<0.005	0.1	IS 3025 (P-2) 2019
28	Hexavalent Chromium (as Cr^{+6}), mg/l	<0.03	2	IS 3025 (P-52) 2014
29	Selenium (as Se), mg/l	<0.005	0.05	IS 3025 (P-2) 2019
30	Cadmium (as Cd), mg/l	<0.002	2	IS 3025 (P-2) 2019
31	Mercury (as Hg), mg/l	<0.0005	0.01	IS 3025 (P-2) 2019

""END OF REPORT""

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

(UNIT OF MINERAL ENGINEERING SERVICES)

ISO 45001:2018

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

Table No. 29

TEST REPORT

Name of the Client	: Fomento Resources Pvt. Ltd.,
Project	: Block IV - Kalay Mineral Block Santona village Sanguem Taluka. South Goa Dist, Goa.,
Sample Collected by	: Environmental Laboratory Representative
Date of sampling	: 26.05.2023
Issue Date	: 12.06.2023

Ref:IS : 2296, 1982 Class C Norms (Stream Water Standards)

Sl.No.	Parameters	Lab Code	ED/23/05/5-031	ED/23/05/5-032	ED/23/05/5-036	Limits For Stream Water Standards	Method of Testing
			Results				
			SW1	SW2	SW3		
1	Colour (Hazen Units), Max		5	5	5	300	IS:3025(P-4) 2021
2	pH		7.14	6.94	7.08	6.5 to 8.5	IS:3025(P-1) 2020
3	Dissolved Oxygen (as O_2), mg/l, Min		5.6	5.4	5.4	4	IS:3025(P-38)1989 RA 2019
4	Oil and grease, mg/l, Max		<0.1	<0.1	<0.1	0.1	IS:3025(P-39) 2021
5	Total Dissolved Solids (mg/l), Max		58	38	1680	1500	IS:3025(P-16) 2023
6	Nitrates (as NO_3),mg/l, Max		0.12	0.15	<0.1	50	IS:3025(P-34)1988 RA 2019
7	Anionic detergents (as MBAS),mg/l, Max		<0.1	<0.1	<0.1	1	IS:3025(P-68)
8	Copper (as Cu),mg/l, Max		0.025	0.013	0.061	1.5	IS:3025(P-2) 2019
9	Chloride (as Cl),mg/l, Max		11.6	9.6	840.0	600	IS:3025(P-32) 1988 RA 2019
10	Fluoride (as F),mg/l, Max		<0.1	0.2	0.2	1.5	APHA (A23rd Edition 4500F
11	Iron (as Fe),mg/l, Max		0.166	0.083	0.054	50	IS:3025(P-2) 2019
12	Phenolic compounds (as C_6H_5OH),mg/l, Max		<0.001	<0.001	<0.001	0.005	IS:3025(P-43) Sec1 2022
13	Selenium (as Se), mg/l, Max		<0.005	<0.005	<0.005	0.05	IS:3025(P-2) 2019
14	Sulphates as SO_4 (mg/l), Max		1.5	2.5	86.3	400	IS:3025(P-24) Sec1 2022
15	Zinc (as Zn),mg/l, Max		0.008	<0.005	0.015	15	IS:3025(P-2) 2019
16	Cadmium (as Cd), mg/l, Max		<0.001	<0.001	<0.001	0.01	IS:3025(P-2) 2019
17	Cyanides (as CN), mg/l, Max		<0.01	<0.01	<0.01	0.05	IS:3025(P-27) Sec1 2022
18	Lead (as Pb) mg/l, Max		<0.005	<0.005	<0.005	0.1	IS:3025(P-2) 2019
19	Arsenic as As (mg/l), Max		<0.002	<0.002	<0.002	0.2	IS:3025(P-2) 2019
20	Hexavalent Chromium (as Cr^{+6}), mg/l		<0.03	<0.03	<0.03	0.05	IS:3025(P-52) 2014
21	Total Coliform (mpn/100ml), Max		7	2	7	5000	IS:1622 : 2009
22	Biochemical Oxygen Demand (as O_2), mg/l		<3	<3	<3	3	IS:3025(P-44) 2014
23	Total Suspended Solids (mg/l)		10	12	14	-	IS:3025(P-17) 2023
24	Total Hardness (as $CaCO_3$),mg/l		40	28	288	-	IS:3025(P-21) 2014
25	Chemical Oxygen Demand (COD) mg/l		22	24	22	-	IS:3025(P-58) 2017

SAMPLE CODE :

SW1 - Kalay River up stream

SW2 - Kalay River down stream

SW3 - Zuvari River

BINU MANI
T.M. - Microbiology
Govt. Analyst / Authorised Signatory

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

(UNIT OF MINERAL ENGINEERING SERVICES)

ISO 45001:2018

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. 30

Name of the Client	: **Fomento Resources Pvt. Ltd.,**
Project	: **Block IV - Kalay Mineral Block Santona village Sanguem Taluka. South Goa Dist, Goa.,**
Sample Collected by	: **Environmental Laboratory Representative**
Date of sampling	: **26.05.2023**
Issue Date	: **12.06.2023**

Ref:IS : 2296, 1982 Class C Norms (Stream Water Standards)

Sl.No.	Parameters	Lab Code	ED/23/05/5-038	ED/23/05/5-035	Limits For Stream Water Standards	Method of Testing
			Results			
			SW4	SW5		
1	Colour (Hazen Units), Max		5	5	300	IS:3025(P-4) 2021
2	pH		7.10	7.25	6.5 to 8.5	IS:3025(P-1) 2020
3	Dissolved Oxygen (as O_2), mg/l, Min		5.6	5.2	4	IS:3025(P-38)1989 RA 2019
4	Oil and grease, mg/l, Max		<0.1	<0.1	0.1	IS:3025(P-39) 2021
5	Total Dissolved Solids (mg/l), Max		48	72	1500	IS:3025(P-16) 2023
6	Nitrates (as NO_3),mg/l, Max		0.13	0.2	50	IS:3025(P-34)1988 RA 2019
7	Anionic detergents (as MBAS),mg/l, Max		<0.1	<0.1	1	IS:3025(P-68)
8	Copper (as Cu),mg/l, Max		<0.005	<0.005	1.5	IS:3025(P-2) 2019
9	Chloride (as Cl),mg/l, Max		6.04	11.1	600	IS:3025(P-32) 1988 RA 2019
10	Fluoride (as F),mg/l, Max		<0.1	<0.1	1.5	APHA (A23rd Edition 4500F)
11	Iron (as Fe),mg/l, Max		0.097	0.090	50	IS:3025(P-2) 2019
12	Phenolic compounds (as C_6H_5OH),mg/l, Max		<0.001	<0.001	0.005	IS:3025(P-43) Sec1 2022
13	Selenium (as Se), mg/l, Max		<0.005	<0.005	0.05	IS:3025(P-2) 2019
14	Sulphates as SO_4 (mg/l), Max		4.1	4.4	400	IS:3025(P-24) Sec1 2022
15	Zinc (as Zn),mg/l, Max		<0.005	<0.005	15	IS:3025(P-2) 2019
16	Cadmium (as Cd), mg/l, Max		<0.002	<0.001	0.01	IS:3025(P-2) 2019
17	Cyanides (as CN), mg/l, Max		<0.01	<0.01	0.05	IS:3025(P-27) Sec1 2022
18	Lead (as Pb) mg/l, Max		<0.005	<0.005	0.1	IS:3025(P-2) 2019
19	Arsenic as As (mg/l), Max		<0.002	<0.002	0.2	IS:3025(P-2) 2019
20	Hexavalent Chromium (as Cr^{+6}), mg/l		<0.03	<0.03	0.05	IS:3025(P-52) 2014
21	Total Coliform (mpn/100ml), Max		<1	2	5000	IS:1622 : 2009
22	Biochemical Oxygen Demand (as O_2), mg/l		<3	<3	3	IS:3025(P-44) 2014
23	Total Suspended Solids (mg/l)		14	15	-	IS:3025(P-17) 2023
24	Total Hardness (as $CaCO_3$),mg/l		30	54	-	IS:3025(P-21) 2014
25	Chemical Oxygen Demand (COD) mg/l		20	26	-	IS:3025(P-58) 2017

SAMPLE CODE :
SW4 - Moisal Dam
SW5 - Dhudhsagar River

BINU MANI
T.M. - Microbiology
Govt. Analyst / Authorised Signatory

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

ISO 45001:2018

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. 31

Name of the Client	: **Fomento Resources Pvt. Ltd.,**
Project	: **Block IV - Kalay Mineral Block Santona village Sanguem Taluka. South Goa Dist, Goa.,**
Sample Collected by	: **Environmental Laboratory Representative**
Date of sampling	: **24.05.2023**
Date of Report	: **06.06.2023**

Ref : IS:10500-2012 Norms (Drinking Water Standards)

Sl. No.	Parameters	Lab Code	ED/23/06/1-0162	ED/23/05/4-0159	ED/23/05/4-0162	Desirable Limts	Permissible Limts	Method of Testing
			Results					
			GW1	GW2	GW3			
1	Colour (Hazen Units), Max		3	5	5	5	15	IS:3025 (P-4) 2021
2	Odour		Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	IS:3025 (P-5) 2018
3	pH		6.85	6.33	6.22	6.5 to 8.5	6.5 - 8.5	IS:3025 (P-11) 2022
4	Taste		Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	IS:3025 (P- 8) 1984 RA 2017
5	Turbidity,NTU, Max		<1.0	<0.1	0.9	1	5	IS:3025 (P-10) 1984 RA 2017
6	Electrical Conductvity (µmhos/cm)		60	72	61	-	-	IS 3025 (P-14)
8	Temperature ° C		25.0	25.0	25.0	-	-	IS 3025 (P-9)
7	Total Dissolved Solids,mg/l, Max		33.0	72.0	37.0	500	2000	IS:3025 (P-16) 1984 RA 2017
9	Aluminium (as Al), Max		<0.01	<0.01	<0.01	0.03	0.2	IS:3025 (P-55) 2003 RA 2019
10	Ammonia (as total Ammonia -N),mg/l, Max		<0.1	<0.1	<0.1	0.5	0.5	IS:3025 (P-34) 1988 RA 2019
11	Anionic Detergents (as MBAS),mg/l , Max		<0.1	<0.1	<0.1	1.0	1.0	Annex K of Is:13428 Amm 11 2022
12	Barium (as Ba), mg/l, Max		0.011	0.013	0.03	0.7	0.7	IS:15302 (P-2) 2019
13	Boron (as B), mg/l, Max		<0.1	<0.1	<0.1	0.5	2.4	IS:3025 (P-57) 2021
14	Calcium (as Ca),mg/l, Max		4.80	<2	3.20	75	200	IS:3025 (P-40) 1991 RA 2019
15	Copper (as Cu),mg/l, Max		<0.005	<0.005	<0.005	0.05	1.5	IS:3025 (P-2) 2019
16	Chloride as Cl (mg/l),mg/l, Max		10	16	10.6	250	1000	IS:3025 (P-32) 1988 RA 2019
17	Fluoride (as F),mg/l, Max		0.15	<0.1	<0.1	1.0	1.5	IS:3025 (P-60) 2008 RA 2019
18	Residual, Free Chlorine,mg/l, Max		<0.1	<0.1	<0.1	0.2	1.0	IS:3025 (P-26) 2021
19	Chloramines (as Cl_2), mg/l. Max		<0.1	<0.1	<0.1	4	4	IS:3025 (P-26) 2021
20	Iron (as Fe),mg/l, Max		<0.05	0.052	<1	1.0	1.0	IS:3025 (P-2) 2019
21	Magnesium (as Mg)mg/l, Max		2	<1.0	<1	30	100	IS:3025 (P-46) 1994 RA 2019
22	Manganese (as Mn),mg/l, Max		0.03	<0.001	0.009	0	0.3	IS:3025 (P-2) 2019
23	Mineral Oil,mg/l, Max		<0.5	<0.5	<0.5	1.0	1.0	Clause 6 of IS 3025 (part -39)2021
24	Nitrates (as NO_3),mg/l, Max		1.0	0.16	0.55	45	45	IS:3025 (P-34) 1988 RA 2019
25	Phenolics (as C_6H_5OH),mg/l, Max		<0.001	<0.001	<0.001	0.001	0.002	IS:3025 (P-43)Sec1 2022
26	Selenium (as Se),mg/l, Max		<0.005	<0.005	<0.005	0.01	0.01	IS:3025 (P-2) 2019
27	Silver (as Ag), mg/l. Max		<0.005	<0.005	<0.005	0.1	0.1	IS:3025 (P-2) 2019
28	Molybdenum (as Mo), mg/l		<0.001	0.01	<0.001	0.07	0.07	IS:3025 (P-2) 2019
29	Sulphates (as SO_4),mg/l, Max		2.5	2.57	3.28	200	600	IS:3025 (P-24) Sec1 2022
30	Sulphide (as H_2S) , mg/l, Max		<0.01	<0.01	<0.01	0.05	0.05	IS:3025 (P-29) 1986 RA 2019
31	Alkalinity (as $CaCO_3$) mg/l, Max		28	15	15	200	600	IS:3025 (P-23) 1986 RA 2019
32	Total Hardness (as $CaCO_3$),mg/l, Max		36	9.1	12.1	200	600	IS:3025 (P-21) 2009 RA 2019
33	Zinc (as Zn),mg/l, Max		<0.005	0.01	0.029	5	15	IS:3025 (P-2) 2019
34	Cadmium (as Cd),mg/l, Max		<0.001	<0.001	<0.001	0.003	0.003	IS:3025 (P-2) 2019
35	Cyanide (as CN),mg/l, Max		<0.01	<0.01	<0.01	0.05	0.05	IS:3025 (P-27) Sec1 2021
36	Lead (as Pb),mg/l, Max		<0.005	<0.005	<0.005	0.01	0.01	IS:3025 (P-2) 2019
37	Mercury (as Hg),mg/l, Max		<0.0005	<0.0005	<0.0005	0.001	0.001	USEPA 200.7 Rev 4.4
38	Nickel (as Ni),mg/l, Max		<0.001	<0.001	<0.001	0.02	0.02	IS:3025 (P-2) 2019
39	Total Arsenic (as As),mg/l Max		<0.002	<0.002	<0.002	0.01	0.01	IS:3025 (P-2) 2019
40	Sodium, mg/l, Max		3.2	12.4	8.5	-	-	IS:3025 (Part-45) 1993 RA2019
41	Potassium, mg/l, Max		<1	<1	1	-	-	IS:3025 (Part-45)
42	Hexavalent Chromium (as Cr^{+6}), mg/l Max		<0.03	<0.03	<0.03	--	--	IS:3025 (P-52) 2014
43	E-Coli (cfu/100ml)		Absent	Absent	Absent	--	--	IS:1622;1981
44	Total Coliform (/100ml)		<1	<1	<1	--	--	IS:1622:1981

SAMPLE CODE : GW1 - Within Kalay Mineral Block Open well, GW2 -Near SFIPL Plant Office Open well
GW3 - Santona Village (Ambeudok) Near Saibaba Temple Open well

BINU MANI
T.M. - Microbiology
Govt. Analyst / Authorised Signatory

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

ISO 45001:2018

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. 32

Name of the Client : Fomento Resources Pvt. Ltd.,
Project : Block IV - Kalay Mineral Block
Santona village Sanguem Taluka. South Goa Dist, Goa.,
Sample Collected by : Environmental Laboratory Representative
Date of sampling : 24.05.2023
Issue Date : 06.06.2023
Ref : IS:10500-2012 Norms (Drinking Water Standards)

Sl. No.	Parameters	Lab Code	ED/23/05/4-0149	ED/23/05/4-0147	ED/23/05/4-0146	Desirable Limts	Permissible Limts	Method of Testing
			Results					
			GW4	GW5	GW6			
1	Colour (Hazen Units), Max		5	5	5	5	15	IS:3025 (P-4) 2021
2	Odour		Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	IS:3025 (P-5) 2018
3	pH		6.26	5.75	6.08	6.5 to 8.5	6.5 - 8.5	IS:3025 (P-11) 2022
4	Taste		Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	IS:3025 (P- 8) 1984 RA 2017
5	Turbidity,NTU, Max		1.7	3.5	2.5	1	5	IS:3025 (P-10) 1984 RA 2017
6	Electrical Conductvity (µmhos/cm)		110	60	60	-	-	IS 3025 (P-14)
8	Temperature ° C		25.0	25.0	25.0	-	-	IS 3025 (P-9)
7	Total Dissolved Solids,mg/l, Max		58.0	35.0	36.0	500	2000	IS:3025 (P-16) 1984 RA 2017
9	Aluminium (as Al), Max		<0.01	<0.01	<0.01	0.03	0.2	IS:3025 (P-55) 2003 RA 2019
10	Ammonia (as total Ammonia -N),mg/l, Max		<0.1	<0.1	<0.1	0.5	0.5	IS:3025 (P-34) 1988 RA 2019
11	Anionic Detergents (as MBAS),mg/l , Max		<0.1	<0.1	<0.1	1.0	1.0	Annex K of Is:13428 Amm 11 2022
12	Barium (as Ba), mg/l, Max		0.038	0.036	0.022	0.7	0.7	IS:15302 (P-2) 2019
13	Boron (as B), mg/l, Max		<0.1	<0.1	<0.1	0.5	2.4	IS:3025 (P-57) 2021
14	Calcium (as Ca),mg/l, Max		8.20	4.80	3.60	75	200	IS:3025 (P-40) 1991 RA 2019
15	Copper (as Cu),mg/l, Max		<0.005	<0.005	0.009	0.05	1.5	IS:3025 (P-2) 2019
16	Chloride as Cl (mg/l),mg/l, Max		17.1	13.5	12.58	250	1000	IS:3025 (P-32) 1988 RA 2019
17	Fluoride (as F),mg/l, Max		<0.1	<0.1	<0.1	1.0	1.5	IS:3025 (P-60) 2008 RA 2019
18	Residual, Free Chlorine,mg/l, Max		<0.1	<0.1	<0.1	0.2	1.0	IS:3025 (P-26) 2021
19	Chloramines (as Cl_2), mg/l. Max		<0.1	<0.1	<0.1	4	4	IS:3025 (P-26) 2021
20	Iron (as Fe),mg/l, Max		0.038	0.114	0.055	1.0	1.0	IS:3025 (P-2) 2019
21	Magnesium (as Mg)mg/l, Max		4.86	2.4	2.2	30	100	IS:3025 (P-46) 1994 RA 2019
22	Manganese (as Mn),mg/l, Max		0.007	0.186	0.051	0	0.3	IS:3025 (P-2) 2019
23	Mineral Oil,mg/l, Max		<0.5	<0.5	<0.5	1.0	1.0	Clause 6 of IS 3025 (part -39)2021
24	Nitrates (as NO_3),mg/l, Max		0.38	<0.1	0.175	45	45	IS:3025 (P-34) 1988 RA 2019
25	Phenolics (as C_6H_5OH),mg/l, Max		<0.001	<0.001	<0.001	0.001	0.002	IS:3025 (P-43)Sec1 2022
26	Selenium (as Se),mg/l, Max		<0.005	<0.005	<0.005	0.01	0.01	IS:3025 (P-2) 2019
27	Silver (as Ag), mg/l. Max		<0.005	<0.005	<0.005	0.1	0.1	IS:3025 (P-2) 2019
28	Molybdenum (as Mo), mg/l		<0.001	<0.001	<0.001	0.07	0.07	IS:3025 (P-2) 2019
29	Sulphates (as SO_4),mg/l, Max		7.85	1.28	1.57	200	600	IS:3025 (P-24) Sec1 2022
30	Sulphide (as H_2S) , mg/l, Max		<0.01	<0.01	<0.01	0.05	0.05	IS:3025 (P-29) 1986 RA 2019
31	Alkalinity (as $CaCO_3$) mg/l, Max		20	15	15	200	600	IS:3025 (P-23) 1986 RA 2019
32	Total Hardness (as $CaCO_3$),mg/l, Max		40.8	22	18	200	600	IS:3025 (P-21) 2009 RA 2019
33	Zinc (as Zn),mg/l, Max		<0.005	0.032	0.027	5	15	IS:3025 (P-2) 2019
34	Cadmium (as Cd),mg/l, Max		<0.001	<0.001	<0.001	0.003	0.003	IS:3025 (P-2) 2019
35	Cyanide (as CN),mg/l, Max		<0.01	<0.01	<0.01	0.05	0.05	IS:3025 (P-27) Sec1 2021
36	Lead (as Pb),mg/l, Max		<0.005	<0.005	<0.005	0.01	0.01	IS:3025 (P-2) 2019
37	Mercury (as Hg),mg/l, Max		<0.0005	<0.0005	<0.0005	0.001	0.001	USEPA 200.7 Rev 4.4
38	Nickel (as Ni),mg/l, Max		<0.001	<0.001	<0.001	0.02	0.02	IS:3025 (P-2) 2019
39	Total Arsenic (as As),mg/l Max		<0.002	<0.002	<0.002	0.01	0.01	IS:3025 (P-2) 2019
40	Sodium, mg/l, Max		6.5	3.7	5.5	-	-	IS:3025 (Part-45) 1993 RA2019
41	Potassium, mg/l, Max		2	<1	<1	-	-	IS:3025 (Part-45)
42	Hexavalent Chromium (as Cr^{+6}), mg/l		<0.03	<0.03	<0.03	--	--	IS:3025 (P-52) 2014
43	E-Coli (cfu/100ml)		Absent	Absent	Absent	--	--	IS:1622;1981
44	Total Coliform (/100ml)		<1	<1	<1	--	--	IS:1622:1981

SAMPLE CODE : GW4 -Bandoli Village - Gavaliwada Open Well, GW5 - Costi Village (Near Chowgule colony) Open well
GW6 - Devonamol - Kalay Village Open Well

BINU MANI
T.M. - Microbiology
Govt. Analyst / Authorised Signatory

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

(UNIT OF MINERAL ENGINEERING SERVICES)

ISO 45001:2018

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. 33

Name of the Client : Fomento Resources Pvt. Ltd.,
Project : Block IV - Kalay Mineral Block
Santona village Sanguem Taluka. South Goa Dist, Goa.,
Sample Collected by : Environmental Laboratory Representative
Date of sampling : 24.05.2023
Issue Date : 06.06.2023
Ref : IS:10500-2012 Norms (Drinking Water Standards)

Sl. No.	Parameters	Lab Code	ED/23/05/4-0158	ED/23/05/4-0168	Desirable Limts	Permissible Limts	Method of Testing
			Results				
			GW7	GW8			
1	Colour (Hazen Units), Max		20	5	5	15	IS:3025 (P-4) 2021
2	Odour		Agreeable	Agreeable	Agreeable	Agreeable	IS:3025 (P-5) 2018
3	pH		5.52	6.67	6.5 to 8.5	6.5 - 8.5	IS:3025 (P-11) 2022
4	Taste		Agreeable	Agreeable	Agreeable	Agreeable	IS:3025 (P- 8) 1984 RA 2017
5	Turbidity,NTU, Max		2.0	<0.1	1	5	IS:3025 (P-10) 1984 RA 2017
6	Electrical Conductvity (µmhos/cm)		52	52	-	-	IS 3025 (P-14)
8	Temperature ° C		25.0	25.0	-	-	IS 3025 (P-9)
7	Total Dissolved Solids,mg/l, Max		32.0	32.0	500	2000	IS:3025 (P-16) 1984 RA 2017
9	Aluminium (as Al), Max		<0.01	<0.01	0.03	0.2	IS:3025 (P-55) 2003 RA 2019
10	Ammonia (as total Ammonia -N),mg/l, Max		<0.1	<0.1	0.5	0.5	IS:3025 (P-34) 1988 RA 2019
11	Anionic Detergents (as MBAS),mg/l , Max		<0.1	<0.1	1.0	1.0	Annex K of Is:13428 Amm 11 2022
12	Barium (as Ba), mg/l, Max		0.01	0.078	0.7	0.7	IS:15302 (P-2) 2019
13	Boron (as B), mg/l, Max		<0.1	<0.1	0.5	2.4	IS:3025 (P-57) 2021
14	Calcium (as Ca),mg/l, Max		<2	5.72	75	200	IS:3025 (P-40) 1991 RA 2019
15	Copper (as Cu),mg/l, Max		<0.005	<0.005	0.05	1.5	IS:3025 (P-2) 2019
16	Chloride as Cl (mg/l),mg/l, Max		16.0	7.04	250	1000	IS:3025 (P-32) 1988 RA 2019
17	Fluoride (as F),mg/l, Max		<0.1	<0.1	1.0	1.5	IS:3025 (P-60) 2008 RA 2019
18	Residual, Free Chlorine,mg/l, Max		<0.1	<0.1	0.2	1.0	IS:3025 (P-26) 2021
19	Chloramines (as Cl_2), mg/l. Max		<0.1	<0.1	4	4	IS:3025 (P-26) 2021
20	Iron (as Fe),mg/l, Max		0.085	0.033	1.0	1.0	IS:3025 (P-2) 2019
21	Magnesium (as Mg)mg/l, Max		<1	<1	30	100	IS:3025 (P-46) 1994 RA 2019
22	Manganese (as Mn),mg/l, Max		0.101	0.009	0.1	0.3	IS:3025 (P-2) 2019
23	Mineral Oil,mg/l, Max		<0.5	<0.5	1.0	1.0	Clause 6 of IS 3025 (part -39)2021
24	Nitrates (as NO_3),mg/l, Max		<0.1	0.22	45	45	IS:3025 (P-34) 1988 RA 2019
25	Phenolics (as C_6H_5OH),mg/l, Max		<0.001	<0.001	0.001	0.002	IS:3025 (P-43)Sec1 2022
26	Selenium (as Se),mg/l, Max		<0.005	<0.005	0.01	0.01	IS:3025 (P-2) 2019
27	Silver (as Ag), mg/l. Max		<0.005	<0.005	0.1	0.1	IS:3025 (P-2) 2019
28	Molybdenum (as Mo), mg/l		<0.001	<0.001	0.07	0.07	IS:3025 (P-2) 2019
29	Sulphates (as SO_4),mg/l, Max		1.28	<1	200	600	IS:3025 (P-24) Sec1 2022
30	Sulphide (as H_2S) , mg/l, Max		<0.01	<0.01	0.05	0.05	IS:3025 (P-29) 1986 RA 2019
31	Alkalinity (as $CaCO_3$) mg/l, Max		5	20	200	600	IS:3025 (P-23) 1986 RA 2019
32	Total Hardness (as $CaCO_3$),mg/l, Max		9.1	18.36	200	600	IS:3025 (P-21) 2009 RA 2019
33	Zinc (as Zn),mg/l, Max		<0.005	0.026	5	15	IS:3025 (P-2) 2019
34	Cadmium (as Cd),mg/l, Max		<0.001	<0.001	0.003	0.003	IS:3025 (P-2) 2019
35	Cyanide (as CN),mg/l, Max		<0.01	<0.01	0.05	0.05	IS:3025 (P-27) Sec1 2021
36	Lead (as Pb),mg/l, Max		<0.005	<0.005	0.01	0.01	IS:3025 (P-2) 2019
37	Mercury (as Hg),mg/l, Max		<0.0005	<0.0005	0.001	0.001	USEPA 200.7 Rev 4.4
38	Nickel (as Ni),mg/l, Max		<0.001	<0.001	0.02	0.02	IS:3025 (P-2) 2019
39	Total Arsenic (as As),mg/l Max		<0.002	<0.002	0.01	0.01	IS:3025 (P-2) 2019
40	Sodium, mg/l, Max		7.8	3.5	-	-	IS:3025 (Part-45) 1993 RA2019
41	Potassium, mg/l, Max		<1	1	-	-	IS:3025 (Part-45)
42	Hexavalent Chromium (as Cr^{+6}), mg/l Max		<0.03	<0.03	--	--	IS:3025 (P-52) 2014
43	E-Coli (cfu/100ml)		Absent	Absent	--	--	IS:1622;1981
44	Total Coliform (/100ml)		<1	<1	--	--	IS:1622:1981

SAMPLE CODE : GW7 - Savargal Village Open Well, GW8 - Kalsai village Open well

BINU MANI
T.M. - Microbiology
Govt. Analyst / Authorised Signatory

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

ISO 45001:2018

(UNIT OF MINERAL ENGINEERING SERVICES)

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. 34

GROUND WATER LEVEL

Name of the Client : Fomento Resources Pvt. Ltd.,
Project : Block IV - Kalay Mineral Block
Santona village Sanguem Taluka. South Goa Dist, Goa.,
Sample Collected by : Environmental Laboratory Representative

Code No.	Locations	Date of Samples	Depth (M)
GW1	Within Kalay Mineral Block Open well	24.05.2023	9.80
GW2	Near SFIPL Plant Office Open well	24.05.2023	5.80
GW3	Santona Village (Ambeudok) Near Saibaba Temple Open well	24.05.2023	11.0
GW4	Bandoli Village - Gavaliwada Open Well	24.05.2023	1.50
GW5	Costi Village (Near Chowgule colony) Open well	24.05.2023	5.50
GW6	Devonamol - Kalay Village Open well	24.05.2023	6.20
GW7	Savargal Village Open Well	24.05.2023	8.80
GW8	Kalsai village Open well	24.05.2023	6.40

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

(UNIT OF MINERAL ENGINEERING SERVICES)

ISO 45001:2018

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. 35

Name of the Client : M/s. Fomento Resources Pvt. Ltd.,
Cluster : Block IV - Kalay Mineral Block for Iron Ore
Santona village Sanguem Taluka. South Goa Dist, Goa.,
Date of samples : 18.05.2023
Date of Report : 10.06.2023

SL. No.	PARAMETERS	Unit	S1	S2	S3	S4	S5	-- Normal	-- High
Lab Code			ED/23/05/4-0459	ED/23/05/4-0460	ED/23/05/4-0461	ED/23/05/4-0462	ED/23/05/4-0463		
PHYSICAL PROPERTIES									
1	Colour	--	Red soil	Red soil	Red soil	Red soil	Red soil	--	--
2	Textural class	--	CLAY LOAM	CLAY LOAM	CLAY LOAM	CLAY LOAM	CLAY LOAM	--	--
3	Size Distribution								
	Sand	%	35.48	35.28	43.26	42.62	30.28	--	--
	Clay	%	36.5	35.62	34.28	35.48	34.62	--	--
	Silt	%	28.02	29.1	22.46	21.90	35.10	--	--
4	Moisture Content	%	11.25	10.73	9.82	9.28	9.48	--	--
5	Bulk Density	gm/cc	1.38	1.29	1.64	1.63	1.72	--	--
6	Porosity	%	48.12	51.50	38.35	38.72	35.34	--	--
7	Water holding capacity	%	31.63	32.48	33.2	31.63	22	--	--
8	pH	--	6.28	6.19	6.45	6.08	6.22	6.3	>8.3
9	EC	m.mohs/c	0.36	0.278	0.315	0.296	0.248	1.0 to 2.0	>2
Chemcial Properties									
10	Organic Carbon	%	1.1	1.32	1.13	1.05	1.21	0.5 to 0.75	>0.75
11	Nitrogen as N	Kg/Ha	160	200	190	160	270	280-560	>560
12	Phosphorous as P	Kg/Ha	15.8	14.6	18.6	15.6	17.5	9 to 22	>22
13	Potassium as K_2O	Kg/Ha	260	240	270	260	270	50 to 120	>120
14	Calcium as Ca^{++}	mg/kg	788	590	670	820	790	--	--
15	Magnesium as Mg^{++}	mg/kg	148	162	172	166	158	--	--
16	Sodium as Na_2O	mg/Kg	155	163	148	162	172	--	--
17	Chloride as Cl	mg/Kg	180	186	170	184	192	--	--
18	sodium absorption ratio	%	0.99	1.14	0.98	1.00	1.09	--	--
19	Salinity	ppt	0.33	0.34	0.31	0.33	0.35	--	--
20	Sulphate as SO_4	%	39	62	42	52	63	--	--
Micro- nutrients									
21	Boron (as B)	mg/Kg	0.26	0.15	0.19	0.22	0.27	--	--
22	Zinc (as Zn)	mg/Kg	0.34	0.22	0.29	0.48	0.44	--	--
23	Copper (as Cu)	mg/Kg	0.24	0.18	0.23	0.18	0.19	--	--
24	Iron (as Fe)	%	3.62	4.11	3.26	3.08	3.48	--	--

Sample Code :

S1 Dump Soil of Kalay Mineral Block
S2 Costi village Agriculture Land
S3 RF Near Devnamol village
S4 Santona village (Mestri Bhat) Agriculturel Land
S5 Cormonem village Agriculture Land

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

ENVIRONMENTAL LABORATORY

(UNIT OF MINERAL ENGINEERING SERVICES)

ISO 45001:2018

Recognised by BIS, FSSAI, ISO:45001:2018 Certified Laboratory

Recognised by MoEFCC(CPCB) under E(P) Act 1986 recognition valid upto 23.05.2025

TEST REPORT

Table No. 36

Name of the Client : Fomento Resources Pvt. Ltd.,
Cluster : Block IV - Kalay Mineral Block
Santona village Sanguem Taluka. South Goa Dist, Goa.,
Date of samples : 18.05.2023
Date of Report : 10.06.2023

SL. No.	PARAMETERS	Unit	S6	S7	-- Normal	-- High
	Lab Code		ED/23/05/4-0470	ED/23/05/4-0471		
PHYSICAL PROPERTIES						
1	Colour	--	Red soil	Red soil	--	--
2	Textural class	--	CLAY LOAM	CLAY LOAM	--	--
3	**Size Distribution**					
	Sand	%	41.62	42.63	--	--
	Clay	%	37.62	35.48	--	--
	Silt	%	20.76	21.89	--	--
4	Moisture Content	%	8.96	7.96	--	--
5	Bulk Density	gm/cc	1.30	1.37	--	--
6	Porosity	%	51.13	48.50	--	--
7	Water holding capacity	%	35.6	30.6	--	--
8	pH	--	6.15	5.99	6.3	>8.3
9	EC	m.mohs/c	0.315	0.363	1.0 to 2.0	>2
Chemcial Properties						
10	Organic Carbon	%	1.19	1.15	0.5 to 0.75	>0.75
11	Nitrogen as N	Kg/Ha	135	175	280-560	>560
12	Phosphorous as P	Kg/Ha	16.5	17.5	9 to 22	>22
13	Potassium as K_2O	Kg/Ha	280	260	50 to 120	>120
14	Calcium as Ca^{++}	mg/kg	890	696	--	--
15	Magnesium as Mg^{++}	mg/kg	168	170	--	--
16	Sodium as Na_2O	mg/Kg	148	162	--	--
17	Chloride as Cl	mg/Kg	170	186	--	--
18	sodium absorption ratio	%	0.89	1.06	--	--
19	Salinity	ppt	0.31	0.34	--	--
20	Sulphate as SO_4	%	48	63	--	--
Micro- nutrients						
21	Boron (as B)	mg/Kg	0.27	0.33	--	--
22	Zinc (as Zn)	mg/Kg	0.25	0.19	--	--
23	Copper (as Cu)	mg/Kg	0.16	0.22	--	--
24	Iron (as Fe)	%	4.18	4.72	--	--

Sample Code :
S6 Bandoli Village Agriculture Land
S7 Santona village (Ambeudok) Agriculture Land

ARSHIYA KOUSAR
Dy. T.M. - Chemical
Govt. Analyst / Authorised Signatory

948, 2nd Cross, St. Thomas Town Post, Kammanahalli, Bangalore - 560 084.
Phone : 080-25432969 Tel/fax : 25432968. E-mail : mesbng@gmail.com, www.envtest.in

Note : This report is subject to the terms and conditions mentioned overleaf.

FOMENTO RESOURCES

Annexure 8

Date: 05/03/2024

To,

The Chief Wildlife Warden,
Office of the Principal Chief Conservator of Forests,
"Goa Van Bhawan" Forest Department,
Altinho, Panaji Goa – 403001

05/3/2024
Office of the
Pr. Chief Conservator of Forests
Altinho, Panaji - Goa 403 001

Sub : Submission of Conservation Plan for listed Schedule-I species under Wildlife (Protection) Act, 1972 with respect to Block IV — Kalay Mineral Block of Fomento Resources Private Limited, for due Consultation.

Ref : 1) Block IV – Kalay Mineral Block having an area of 152.5073 ha., located at Santona Village of Sanguem Taluka, South Goa District, Goa.

2) Terms of Reference dated 08/01/2024 was issued by MoEF&CC) to conduct EIA study for Block IV — Kalay Mineral Block.

Sir/ Madam,

The undersigned would like to bring to your kind notice that Fomento Resources Private Limited has acquired Block IV — Kalay Mineral Block (Iron Ore) having an area of 152.5037 Ha. in auction conducted by Government of Goa through Directorate of Mines and Geology (DMG) on 12/12/2022.

The Govt. of Goa was pleased to issue us the Letter of Intent dated 13/01/2023 read with letter dated 13/03/2023 for the grant of Mining Lease for Iron Ore mineral, located at Santona Village of Sanguem Taluka South Goa District, Goa. A copy of Letter of Intent is enclosed herewith as **Annexure-1**.

FOMENTO RESOURCES PVT. LTD. FRPL GOA

The Letter of Intent dated 13/01/2023 prerequisites the Preferred Bidder to obtain various consents, approvals, permits, NOC's as may be required under applicable laws for commencement of mining operations.

In view of above requisite, we are in process of obtaining Environmental Clearance under Environment Protection Act, 1986 for Block IV — Kalay Mineral Block from the Ministry of Environment Forest and Climate

Change (MoEF & CC), New Delhi. Pursuant to our application for the grant of Environmental Clearance, MoEF&CC was pleased to grant Terms of References (TOR) to conduct EIA studies. A copy of TOR is enclosed herewith as **Annexure-2**.

Condition No. 5.2, under the heading '**5. Wildlife**' of the 'Standard Terms of Reference for (Mining of Minerals)' stipulated in the TOR dated 08/01/2024, directs us to prepare a Conservation Plan for listed Schedule-I species under Wildlife (Protection) Act 1972, in the event Schedule-I fauna species is found.

Stipulated TOR condition No. 5.2 is reproduced herein below:

"5.2. A detailed biological study of the area (Core Zone and buffer zone) 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 provision for their conservation should be prepared in consultation with State Forest/ Wildlife Department and details furnished. Necessary allocation of funds for implementing the same should be made as part of the project cost. Proof of its submission of conservation plan to the CWLW needs to be submitted"

Accordingly, study was undertaken by Mineral Engineering Services, a NABET Accredited Consultant to access the biodiversity of Mineral Block and its buffer area of 10km radius. Further, the detailed list of Flora and Fauna was prepared. The list of Flora & Fauna was authenticated by Dy. Conservator of Forest, South Goa Division. A copy of the authenticated letter dated 06/12/2023 and 13/02/2024 is enclosed herewith as **Annexure-3 Colly**.

Further please note, based on the primary field studies conducted for preparation of EIA/EMP within the study area, which constitutes Core Zone (Mining Lease Area) and Buffer zone (area of 10 Km radius from the boundary of the Mining Lease area), Schedule-I fauna species was found.

FOMENTO RESOURCES PVT. LTD. FRPL GOA

Accordingly, in compliance to the stipulated TOR condition no. 5.2 mentioned above, a Wildlife Conservation Plan for Schedule-I fauna species found in the study area has been prepared. We are submitting

herewith a copy of Wildlife Conservation Plan to your good office for your information and due consultation, enclosed herewith as **Annexure-4**.

Thanking You,
Yours faithfully,

For and on behalf of
Fomento Resources Private Limited

Sandeep Morajkar
(Authorized Representative)

FOMENTO RESOURCES PVT. LTD. FRPL GOA

Enclosures:

1) Terms of Reference dated 08/01/2024 issued by MoEF&CC to conduct EIA study for Block V — Kalay Mineral Block.

2) Authenticated list of Flora & Fauna in respect of Block IV — Kalay Mineral Block dated 06/12/2023 and 13/02/2024.

3) Wildlife Conservation Plan prepared with respect to Block IV – Kalay Mineral Block.

GOVERNMENT OF GOA
OFFICE OF THE EXECUTIVE ENGINEER
& GROUND WATER OFFICER,
WORKS DIVISION I
WATER RESOURCES DEPARTMENT
PORVORIM GOA

To,
M/S Fomento Resources Private Limited,
102, 1st Floor, Kamat Metropolis-I,
Behind Caculo Mall,
St. Inez, Panaji–Goa 403001.

Sub:- Issue NOC reg.... Renewal/Registration of Mine Pit with respect to Block – IV, Kalay Mineral Block situated at Village Santona, Taluka Sanguem District-South Goa.

Ref:- Your letter dated:-03/01/2024

Sir,

The application submitted vide letter dated. 03/01/2024 along with Hydrogeological and impact assessment of Ground Water, prepared by Shri. M.C. Reddy Consultant with NABET & CGWA accreditation and former Regional Director, CGWB is examined by the Ground Water Cell during its 131th meeting held on 19/03/2024.

The NOC/Registration is hereby issued as below with conditions.

FORM – III
[See Rule 3(6)(2)]

Certificate of Registration of an existing well/mine and permission for its continuous use in the Scheduled area under 5(4) of the Goa Ground Water Regulation Act, 2002 (Goa Act 1 of 2002).

*** Well be read as Mine**

Works Division I Water Resources Department जलसंपदा विभाग १,उदकी खात्यव Porvorim-Goa पर्वरी-गोवा

Registration Certificate

No. 3682 Date: 16/04/2024

1. Register Number of well/mine: **Block – IV, Kalay Mineral Block, Village Santona, Taluka Sanguem District-South Goa.**

2. Location of Mining Block,
   a) **Block – IV, Kalay Mineral Block, Village Santona, Taluka Sanguem District-South Goa.**

Survey No of Mining Block: **As per Annexure II - 7/1(P), 8/1(P), 8/2 (P), 15/1(P), 16/1(P), 24/1(P), 25/1(P), 25/2(P), 26(P), 29(P), 40/1, 40/2(P), 40/3(P), 40/5(P), 40/6(P), 40/7(P), 40/8(P), 40/9(P), 41/1(P).**

b) Name of Land: **Endigal**

b) Revenue village/Village Panchayat: **Santona.**

d) Taluka: **Sanguem.**

Type of well/tank: **Mining Pit (Opencast Mine)**

Details of well/mine
a) Diameter size of well/mining pits: One Pit 540 mts X 860 mts.
One Pit 350 mts X 850 mts.
b) Depth of well/tank/mining pits:
c) Year of construction: **Old Existing mining lease acquired by present applicant through e-auction.**
d) Year of commissioning: **2024-25.**
Name of occupant and address: - **Fomento Resources Private Ltd. 102, 1st Floor, Kamat Metropolis-I, Behind Caculo Mall, St. Inez, Panaji-Goa-403001.**

The device used for lifting the ground water Pump
Details of power supply
(a) Type of pump: **Centrifugal Pump**
(b) Horse power: **294; 151; 150; 112; 73; 99.**
(c) Pump capacity - **M3/Hr. 500; 400; 500; 500; 400; 140**
(d) E.D. Power supply connection number- **EE/Div.VII/TECH/HTC-25**

8. (a)Number of hours of pumping allowed per day: **12 Hours**
(b)The quantity of drawl of ground water allowed per day: **3360 Cum** as required for scientific operation of mine
(c)The total period of use permissible in each year Full year **(12 months)**

9. Validity period of registration: 2 (Two) year from date of issue **(06/06/2024 to 05/06/2026)**

This is subject to the following conditions
1. The certificate holder should not deviate in any way from specification regarding well, pump etc. mentioned above without approval of Ground Water Officer.

2. The drawl of ground water under this license should not interfere with the normal activities of the locality nor should it cause any traffic hazard.

3. The Ground Water Officer or any person duly authorized by him shall have the right to inspect the place with such assistance as may be necessary to satisfy itself or himself whether the condition of restrictions specified as complied.

4. Installation of Peizometers: The applicant should install Peizometers of type (One DWLR with Telemetry System) for monitoring the Ground Water Levels within the core area of mining lease for observation & monitoring. Slotted pipe is to be fitted against ground water potential.

5. Monitoring the Ground Water level in the buffer zone the established network of existing wells in the buffer zone (as per table 10 of the report), needs to be monitored on monthly basis and submitted to Ground Water Officer (WRD) and CGWB.

6. The project proponent needs to monitor the water quality of the mines seepage and mine discharge through NABL accredited/ Government approved laboratory on monthly basis to WRD and CGWB, Bangalore.

7. The applicant needs to ensure that the water available from the dewatering operations needs to be properly treated and quantity utilized for supply to irrigation/dust suppression/mining process.

8. The applicant needs to install digital water meter for measurement of the quantity of water abstraction, which will be chargeable as per the notification of Ground Water Act 2002.

9. Once the mining activities commence, year wise mine planning including excavation depth, area and mine seepage are to be submitted to WRD/CGWB every year.

10. All activities committed in the report on ground water recharge and rain water harvesting is to be implemented satisfactorily.

11. The NOC/permission/Ground Water clearance is valid for a period of 2 years and further renewal is subject to fulfilling the conditions stipulated in the NOC.

Place: **Porvorim**

Date: **16/04/2024**

Signature of the Ground Water Officer

Works Division I, Water Resources Department
जलसंपदा विभाग १, उदका साधन खाते
पर्वरी-गोवा
Porvorim-Goa

Government of Goa
Summary of the Mineral Block

(to be made available on the website of e-auction platform provider)
(As per GoI Notification No.1/15/2015-M.VI Dated: 02.07.2015)

Part A – GENERAL INFORMATION ABOUT MINERAL BLOCK

Sr. No.	Features	Details
1	**Location**	
	Mineral Block	**BLOCK IV- KALAY MINERAL BLOCK**
	Block Corner Points	As below
	Latitude-Longitude	Between Latitude 15° 17′ 43.1020″N to 15° 17′ 38.2925″ N to and Longitude 74° 9′ 36.9506″ E to 74° 9′ 40.0036″ E
	Latitude-Longitude of Corner Points as per DGPS	

POINT ID	LATITUDE	LONGITUDE	NORTHING	EASTING
BP 1	15° 17′ 43.1020″	74° 9′ 36.9506″	1691162.87479	409844.40791
BP 2	15° 18′ 2.6197″	74° 9′ 29.8008″	1691763.42390	409633.49239
BP 3	15° 18′ 8.7974″	74° 8′ 55.2583″	1691957.26383	408604.04653
BP 4	15° 17′ 40.1839″	74° 9′ 3.3467″	1691077.10693	408841.83170
BP 5	15° 17′ 30.9847″	74° 9′ 8.5955″	1690793.82945	408997.27328
BP 6	15° 17′ 1.6125″	74° 9′ 13.1548″	1689890.77419	409129.74092
BP 7	15° 17′ 12.4794″	74° 9′ 41.2969″	1690221.42929	409970.40182
BP 8	15° 17′ 13.0200″	74° 9′ 44.8333″	1690237.63266	410075.94036
BP 9	15° 17′ 38.2925″	74° 9′ 40.0036″	1691014.74070	409934.89037

	Villages	Santona
	Tehsil/Taluka	Sanguem
	District	South Goa
	State	Goa
2	**Area (hectares)**	179.1826 Ha.
	Mineralised Area in Ha.	82.5250 Ha.
	Non-Mineralised Area in Ha.	21.1800 Ha.
	Unexplored lease area	75.4776 Ha.
3	**Exploration**	
	Status (G1/G2/G3/G4 etc.)	General Exploration G2 Level (DMG lowered stage of exploration to G-2 after considering the data available)
	Exploration Agency	Erstwhile Lessee i.e. M/s. N. S. NARVEKAR
	Total Number of Boreholes with Meterage	234 Nos., 11392.1 m
	Borehole Spacing (Density)	50 X 50 m
4	**Quantity of Minerals (Grade-wise)**	
	Iron Ore	

	Total Geological Resources (Considered Indicated (332)	Lessee estimated total Geological resources after G-1 and G-2 exploration as on 29.09.2017 for +45 Fe% is 20.830 Million Tonnes or 20830000 tonnes (as per Mining Plan) with average grade of about 56.5 Fe%. As on 31.3.2018 total resource after removing production figure is 20.663 Million Tonnes or 20662966 tonnes with average grade of 56.5% (as per production data, the production for 6 months is 167034)
	For estimating quantity of resources for fine and lump ratio is taken as 27:73	Total available resource in the Block = 20662966 tonnes with average grade of 56.5% Fe. (falls under 55 to 58 Fe% as per IBM declared price range). Out of total resources, 3.932 million tonnes are blocked due to the 1 Km ESZ along the east of the block area. Hence the reduced resources are arrived at 16.731 million tonnes Lump ore = 4517370 tonnes Fine Ore = 12213630 tonnes
5	**Mineralised Zones**	
	Number of Mineral Zones	One. Ore body extends for a strike length 2000m with width ranging from 300 to 400m with an average thickness of ore body is 20 to 30m
	Trend (Dip and Strike)	Dip- E/W, Strike-NW-SE
	Total Thickness	-
6	**Accessibility**	
	Nearest Rail Head	Approx. 04 Kms to Kalay Railway Station
	Road	Approx. 100m to public road
	Airport	Approx. 78 Kms. to Mopa Airport Approx. 47 Kms. to Dabolim Airport
7	**Hydrography**	
	Local Surface Drainage Pattern (Channels)	Dendritic
	Rivers/Streams	Kalay River
8	**Climate**	
	Mean Annual Rainfall	Avg. Rainfall 4000mm/year
	Temperatures (November-December)	Temperature varies from 20^0C in winter season (November to February) to almost 36^0C in summer season (March to May)
	Temperatures (April-May)	
9	**Topography**	
	Topo Sheet Number	48 I/3
	Morphology of the Area	Hilly Terrain with gentle gradient

PART B – PARTICULARS OF STATUTORY LICENSE, PERMITS, PERMISSIONS, CONCESSIONS, APPROVALS AND CONSENTS RELATED TO MINING OPERATIONS

	Particulars	Details/Status
1.	Forest Clearance for leased area	To be obtained afresh by Successful Bidder/ not applicable/ if available, state govt. to provide details.
2.	Wild Life Clearance (sanctuary, reserve or special zone clearances)	To be obtained afresh by Successful Bidder/ not applicable/ if available, state govt. to provide details.
3	Environmental Clearance	To be obtained afresh by Successful Bidder/ not applicable/ if available, state govt. to provide details.
4	Consent to Establish	To be obtained afresh by Successful Bidder/ not applicable/ if available, state govt. to provide details.
5	Explosive Licence	To be obtained afresh by Successful Bidder/ not applicable/ if available, state govt. to provide details.
6	Permission for Mine Opening	To be obtained afresh by Successful Bidder/ not applicable/ if available, state govt. to provide details.
7	Permission of installation/ trial operation of equipment	To be obtained afresh by Successful Bidder/ not applicable/ if available, state govt. to provide details.
8	Ground Water Clearance (Centre/State)	To be obtained afresh by Successful Bidder/ not applicable/ if available, state govt. to provide details.
9	Railway Siding Approval	To be obtained afresh by Successful Bidder/ not applicable/ if available, state govt. to provide details.
10	Approval for diesel storage	To be obtained afresh by Successful Bidder/ not applicable/ if available, state govt. to provide details.
11	Power line from State Discom	To be obtained afresh by Successful Bidder/ not applicable/ if available, state govt. to provide details.
12	Clearances relating to work under an existing transmission line or shifting of the transmission line	To be obtained afresh by Successful Bidder/ not applicable/ if available, state govt. to provide details.
13	Gram Sabha consent	To be obtained afresh by Successful Bidder/ not applicable/ if available, state govt. to provide details.
14	Consent to Operate (CTO)	To be obtained afresh by Successful Bidder/ not applicable/ if available, state govt. to provide details.
15	Approval of Mine Plan from IBM	To be obtained afresh by Successful Bidder/ not applicable/ if available, state govt. to provide details.

16	Others (if any)	To be obtained afresh by Successful Bidder/ not applicable/ if available, state govt. to provide details.
PART-C – PARTICULARS OF LAND		
	Area	**Details**
1	Total Concession Area	179.1826 Ha.
2	Forest Land with Status	Not Applicable
3	Land Owned by the State Government	83.0714 Ha.
4	Land not owned by the State Government	96.1112 Ha.
5	Revenue Survey Details of the area	As per ANNEXURE B (source as per Approved Mining Plan)

(Source - Approved Mining Plan)

Annexure 11

Government of Goa
OFFICE OF THE DY. CONSERVATOR OF FORESTS
South Goa Division
Aquem, Margao – Goa, Pin 403 601.
Ph/Fax:- 0832-2750246/2751462 E mail: dcfsouth-forest.goa@nic.in/dcfsouthit@gmail.com

No.6/FCA/F & F/DCFS/TECH/2023-24/ 1420 Dated:- 06 /12/2023
Agrahayana, 1945 (Saka)

To,
Fomento Resources Private Limited,
102, 1st Floor, Kamat Metropolis,
St. Inez, Panaji- Goa.

Sub: Authentication list of Flora & Fauna within the study area (core zone & buffer zone i.e 10 Km radius of the periphery of the Mine Lease) of Block IV – Kalay Mineral Block, located at Santona Village of Sanguem Taluka.

Sir,

1) With reference to your letter dated 03/11/2023, please find enclosed herewith the list of Flora & Fauna / species present in (core and buffer zone i.e 10 Km radius) of the periphery of the Mine Lease of Block IV – Kalay Mineral Block, located at Santona Village of Sanguem Taluka w.r. to Fomento Resources Private Limited, St. Inez, Panaji- Goa, South Goa District, prepared by the authorized agency and authenticated by Forest Personnel for further necessary action.
2) It is to be noted that this letter pertains only to the list of Flora and Fauna in the said area and shall not be treated as NOC or approval for diversion or any matter relating to the land ownership or status of the applied area, for which appropriate permissions from competent authority shall be required as applicable.

6/12/'23
(Prem Kumar R., IFS)
Dy. Conservator of Forests,
South Goa Division,
Margao - Goa.

Encl: As Above.

MINERAL ENGINEERING SERVICES

Consulting Mining & Environmental Engineers, 25/XXV, Club Road, BALLARI - 583 103.
Phone : 08392 - 267421 / 268365, Mobile : 9448367421.
PAN No. ACBPR 9146B GST No. : 29ACBPR9146B1ZI

M.S. Raju M.Tech., M.I.E.,
Consultant

To

Fomento Resources Private Limited
1st Floor, 102, Kamat metropolis -1
Behind Caculo Mall, St. Inez
Panaji- Goa- 403001
Email : fomento@fomento.com
Phone no.: 08322441000

Date : 04.10.2023

Subject: List of Flora and Fauna identified in core and buffer zone of 10 km radius of the periphery of Block IV– Kalay Mineral Block of Fomento Resources Pvt Ltd.,

Sir,

We have carried out a detailed biological study in the core zone and buffer zone covering 10 km radius of the Block IV– Kalay Mineral Block of Fomento Resources Pvt Ltd., Goa.

We are attaching herewith the list of flora and fauna present within core and buffer zone of Block IV– Kalay Mineral Block as per the field survey conducted by our Ecology and Biodiversity (EB) expert Dr. Chetan H.C, duly Accredited by NABET (QCI) as FAE.

Request you to please get it authenticated from the State Forest Department, so as to use the authenticated list for the purpose of preparing Environment Impact Assessment report for obtaining Environment Clearance as per the Standard Terms of Reference (TOR) issued by MoEF&CC, Delhi.

Thanking you,

Yours faithfully
For Mineral Engineering Services

(M.S.Raju)
NABET Accredited consultant

Encl.: As above

Website : www.envtest.com E-mail : mesbly25@gmail.com mes_msraju@yahoo.co.uk
BANGALORE : 948, 2nd Cross, Kammanahalli Main Road, Behind Super Stores,
St. Thomas Town Post, Bangalore - 560 084. ☎ : 080-25432968, 080-25432969. Cell : 9742147954
GOA : 22/120/2, Bay View Colony, Near Ocean Heights, Donapaula, Goa - 403004. Cell : 9923453754

LIST OF FLORA & FAUNA IN CORE ZONE

FLORA : Total 24 species were recorded within core area, of which 6 species trees , 6 species shrubs , and 12 species herbs recorded

TREES: There are 6 species reported from core area

Trees growing in core area

Sl.No.	Species name	Family
1	*Acacia auriculiformis*	Mimosaceae
2	*Anacardium occidentale* L.	Anacardiaceae
3	*Canarium strictum* Roxb.	Burseraceae
4	*Cassia siamea* Lam.	Fabaceae
5	*Mecranga peltata* (Roxb.) Muell.	Euphorbiaceae
6	*Trema orientalis (L.) Bl.*	Ulmaceae

SHURBS: The shrub abundance recorded in core are 6 shrubs species

Shrubs growing in core area.

Sl.No.	Species name	Family
1	*Annona muricata L.*	Annonaceae
2	*Calotropis gigantean L.*	Asclepidiaceae
3	*Euphorbia totircornis L.*	Euphorbiaceae
4	*Helictris isora L.*	Malvaceae
5	*Lantana camara L.*	Verbenaceae
6	*Trema orientalis*	*Cannabaceae*

HERBS: 12 Species of herbs reported from core area,

List of Herbs and Climbers within the reserve forest and sanctuary and core area

Sl.No.	Species name	Family
1	*Alternathara sessilis*	Amaranthaceae
2	*Asparagus racemose*	Asparagaceae
3	*Bidens biternata*	Asteraceae
4	*Cassia tora*	Caesalpinaceae
5	*Cordia myxa*	Boraginaceae
6	*Cyperus difformis**	Cyperaceae
7	*Ocimum sanctum*	Lamiaceae
8	*Parthenium spp**	Asteraceae
9	*Sida acuta*	Malvaceae
10	*Smilax zeylanica**	Smilacaceae
11	*Stylosanthus sp.*	Fabaceae
12	*Urena lobate*	Malvaceae

*NOTE: * Invasive species*

Round Forester
Kirlapal - Round.

Range Forest Officer
Sanguem - Goa.

Mineral Engineering Services
(M.S.Raju)
NABET Consultant

FAUNA: Total 18 species were observed within the core area, of which 9 species are birds, 3 species of mammals and 4 species of reptiles

List of faunal species – Birds, Mammals and Reptiles in the core area

Sl. No.	Common name	Scientific name	Family	IUCN / WPA status
	BIRDS			
1	Common Iora	*Aegithina tiphia*	Irenidae	R/IV
2	Green Bee Eater	*Merops orientalis*	Meropidae	MR/IV
3	House Crow	*Corvus splendens*	Corvidae	R/IV
4	House Sparrow	*Passer domesticus*	Passeridae	R/IV
5	House Swift	*Apus affinis*	Apodidae	R/IV
6	Indian Robin	*Saxicoloides fulicata*	Turdinae	R/IV
7	Jungle Crow	*Corvus macrorhynchos*	Corvidae	R/IV
8	Jungle Myna	*Acridotheres fuscus*	Sturnidae	R/IV
9	Red-whiskered Bulbul	*Pycnonotus jocosus*	Pycnonotidae	R/IV
	MAMMALS			
13	Indian Hare	*Lepus nigricollis*	Leporidae	Lower risk/ IV
14	Rat	*Rattus rattus*	Muridae	Sch-V
15	Striped squirrel	*Funambulus palmarum*	Sciuridae	Sch- IV
	REPTILES			
15	Green Forest lizard	*Calotes calotes*	Agamidae	Common
16	Roux's Forest lizard	*Calotes rouxii*	Agamidae	Common
17	Garden lizard	*Calotes elloti*	Agamidae	Common
18	Russell's Viper	*Daboia russelii*	Viperidae	Schedule II

BUFFER AREA

FLORA DIVERSITY : Overall, 128, of which 89 species from the primary survey and 39 species from the report by Biodiversity Board. The results show that the buffer area recorded 89 tree species. Again we can see that exotic species Acacia auriculiformis and Anacardium occidentale have dominated in the core area. In addition, 39 species reported as secondary information from Biodiversity Board, Goa (https://gsbb.goa.gov.in/wp-content/uploads/2020/05/List-of-plants.pdf)

TREES: There are 89 species reported from core area

Trees growing in core and buffer area of 10-km radius.

Sl. No.	Species name	Family
1	*Acacia auriculiformis*	Mimosaceae
2	*Albizia odoratisima* Benth.	Mimosaceae
3	*Anacardium occidentale* L.	Anacardiaceae
4	*Anogeissus latifolia* (Roxb. ex DC.)	Combretaceae
5	*Ardisia solanacea Roxb.*	Myrsinaceae
6	*Areca catechu* L.	Arecaceae

Round Forester
Kirlapal - Round.

Range Forest Officer
Sanguem - Goa.

Mineral Engineering Services
(M.S.Raju)
NABET Consultant

7	*Artocarpus heterophyllus* Lam.	Moraceae
8	*Bauhinia malabarica* Roxb.	Fabaceae
9	*Bauhinia racemosa* Lam.	Fabaceae
10	*Bischofia javanica* Bl.	Phyllanthaceae
11	*Bombax malabaricum* DC.	Bombacaceae
12	*Bridelia retusa* Spreng.	Euphorbiaceae
13	*Buchnania lanzan*	Anacardiaceae
14	*Buchanania latifolia Roxb.*	Anacardiaceae
15	*Caesalpinia bonducella* (L.) Fleming	Caesalpinaceae
16	*Callicarpa tomentosa* (L.) Murr.	Verbinaceae
17	*Canthium dicocum* (Gaert.) T. & B.	Rubiaceae
18	*Canarium strictum* Roxb.	Burseraceae
19	*Careya arborea* Roxb.	Lecythidaceae
20	*Caryota urens* L. (Kithul) sap.	Arecaceae
21	*Cassia fistula L.*	Fabacaeae
22	*Casearia ovoidea Sleumer.*	Flacourtiaceae
23	*Cassia siamea* Lam.	Fabaceae
24	*Clerodendrum viscosum* Vent.	Euphorbiaceae
25	*Crotalaria retusa L.*	Fabaceae
26	*Dalbergia lanceolaria*	Fabacaeae
27	*Dalbergia latifolia* Roxb	Fabacaeae
28	*Dalbergia volubilis* Roxb.	Fabaceae
29	*Delonix regia* (Hk.) Raf.	Fabaceae
30	*Diospyros ebenum* Koenig.	Ebenaceae
31	*Diospyros montana Roxb.*	Ebenaceae
32	*Diospyros paniculata* Dalz.	Ebenaceae
33	*Emblica officinalis* Gaertn.	Euphorbiaceae
34	*Erythrina indica L.*	Fabacaeae
35	*Ficus arnottiana* (Miq.) Miq.	Moraceae
36	*Ficus microcarpa* L.f.	Moraceae
37	*Ficus virens L.*	Moraceae
38	*Gardenia tergida*	Rubiaceae
39	*Gliricidia sepium* (Jacq.) Kunth	Fabaceae
40	*Gmelina arborea* Roxb.	Verbenaceae
41	*Grewia robusta*	Malvaceae
42	*Grewia tilifolia* Vahl.	Malvaceae
43	*Hardwickia binata* Roxb.	Cesalpinaceae
44	*Holoptelea integrifolia* (Roxb.) Planch.	Ulmaceae
45	*Holigarna niger* Bourd.	Anacardiaceae
46	*Holarrhena pubescens* (Buch.-Ham.)	Apocynaceae
47	*Hopea acuminata* Merr.	Dipterocarpaceae
48	*Ixora brachiata* L.	Rubiaceae
49	*Lagerstroemia lanceolata* Clarke	Lythraceae
50	*Lannea coromandelica*	Anacardiceae
51	*Leucaena leucocephala* (Lam.) de Wit.	Mimosaceae
52	*Litsea glabrata*	Lauraceae

Mineral Engineering Services

(M.S.Raju)
NABET Consultant

Round Forester
Kirlapal - Round.

Range Forest Officer
Sanguem - Goa.

53	*Litsea zeylanica* Nees & T. Nees.	Lauraceae
54	*Maesa indica Roxb.*	Myrsinaceae
55	*Mallotus philippensis* (Lam.) Muell.	Euphorbiaceae
56	*Mangifera indica* L.	Anacardiaceae
57	*Mecranga peltata* (Roxb.) Muell.	Euphorbiaceae
58	*Melia composita Willd.*	Meliaceae
59	*Memecylon umbellatum Burm.*	Melastomataceae
60	*Mitragyna parviflora (Roxb.) Korth.*	Rubiaceae
61	*Murraya keenigii (Linn.) Spreng*	Rutaceae
62	*Musa paradisiaca Auct.*	Musaceae
63	*Myristica sp.*	Myristicaceae
64	*Nothopegia colebrookiana (Wight)*	Anacardiaceae
65	*Olea dioica Roxb.*	Oleaceae
66	*Peltophorum pterocarpum (DC.)*	Fabaceae
67	*Pogostemon cablin (Blanco) Benth.*	Lamiaceae
68	*Pongamia pinnata* (L.) Pierre	Fabiaceae
69	*Pterocarpus marsupium Roxb.*	Fabaceae
70	*Randia dumetorum L.*	Rubiaceae
71	*Randia malabarica Lam.*	Rubiaceae
72	*Samanea saman (Jacq.) Merr*	Cesalpinaceae
73	*Sapindus emarginatus L.*	Sapindaceae
74	*Saraca indica Auct.*	Cesalpinaceae
75	*Schleichera oleosa (Lour.) Oken*	Sapindaceae
76	*Scolopia crenulate*	Flacourtiaceae
77	*Spondias acuminata Roxb.*	Sapindaceae
78	*Sterospermum personatum (Hassk.)*	Bignoniaceae
79	*Strychnos nux vomica L.*	Loganiaceae
80	*Syzgium callophylum (L.) Alton*	Myrtaceae
81	*Syzgium cumini (L.) Skeels*	Myrtaceae
82	*Tectona grandis L.f.*	Verbinaceae
83	*Terminalia bellerica (Gaertn.) Roxb.*	Combretaceae
84	*Terminalia paniculata Roth* *	Combretaceae
85	*Terminalia tomentosa (DC.) W. & A.**	Combretaceae
86	*Trema orientalis (L.) Bl.*	Ulmaceae
87	*Vateria indica L.*	Cannabaceae
88	*Vitex altissima L.f*	Verbinaceae
89	*Ziziphus mauritiana Lam.*	Rhamnaceae

List of Secondary tree species documented by Biodiversity Board, Goa

Sl. No.	*Scientific Name* *	Common Name
1	*Aegle marmelos*	Bel
2	*Albizia lebbeck*	Siris
3	*Alstonia scholaris*	Santvin
4	*Annona murigata*	Palpanas
5	*Annona squamosa*	Sitaphal
6	*Anthocephalus cadamba*	Kadamb
7	*Artocarpus altilis*	Nirpanas

Round Forester
Kirlapal - Round.

Range Forest Officer
Sanguem - Goa.

Mineral Engineering Services
(M.S.Raju)
NABET Consultant

8	*Artocarpus heterocarpus*	Phanas
9	*Averrhoa carambola*	Karmal
10	*Averrhoea bilimbi*	Bimbal, bilimbi
11	*Azadirachta indica*	Neem
12	*Bauhinia variegate*	Kachnar
13	*Bombax ceiba*	Savar
14	*Butea monosperma*	Palas
15	*Cinnamomum zeylanicum*	Tikhi
16	*Cocos nucifera*	Mad
17	*Dalbergia sisso*	Shisam
18	*Ficus bengalensis*	Vad tree
19	*Ficus glomerata/racemosa*	Rumad
20	*Flacourtia jangomas*	Jagma
21	*Flacourtia montana*	Chafra
22	*Garcinia gummigutta*	Malabar tamarind
23	*Garcinia indica*	Bhirand
24	*Gmelina arborea*	Shivan
25	*Hardwickia binata*	Anjan
26	*Mesua ferrea*	Nagkesar
27	*Milingtonia hortensis*	Neem Chameli
28	*Millettia pinnata*	Karanjei
29	*Mimusops elengi*	Ovala
30	*Myristica fragrans*	Jaiphal
31	*Nothaphodytes nimmoniana*	Narkya, Ghaneri
32	*Peltophorum pterocarpum*	Copperpod tree
33	*Pouteria campechiana*	Egg fruit
34	*Psidium guajava*	Guava
35	*Sapinduslaurifolius/ mukorossi*	Ritho
36	*Saraca asoca*	Sita Ashok
37	*Stercularia urens*	Dhavorukh/ Arjun
38	*Syzyzium aqueum*	Zam
39	*Terminalia elliptica*	Madat

*Note: * Secondary information from Biodiversity Board, Goa, (https://gsbb.goa.gov.in/wp-content/uploads/2020/05/List-of-plants.pdf) and published literature*

SHRUBS: In buffer region recorded 42 shrubs species recorded. Overall, from this data we can interpret that the mining site possesses the less shrubs species and commonly overgrown exotic species such as *Lantana camara*, and *Chromolina odorata*, and less native species abundance, whereas the buffer area recorded higher number of native species

Round Forester
Kirlapal - Round.

Range Forest Officer
Sanguem - Goa.

Mineral Engineering Services
(M.S.Raju)
NABET Consultant

Shrubs growing in core and buffer area of 10-km radius.

Sl. No.	Species name	Family
1	*Abrus precatorius L.*	Ceasalpinaceae
2	*Acacia paniculata Willd.*	Mimosaceae
3	*Adathoda vasica L.*	Acanthaceae
4	*Amaranthus spinosus L.*	Amaranthaceae
5	*Annona muricata L.*	Annonaceae
6	*Antidesma menasu (Tul.) Müll.Arg*	Euphorbiaceae
7	*Aphanamixis polystachya (wall.)*	Rosaceae
8	*Apnomixis polystachia*	Rosaceae
9	*Bryneya species*	Euphorbiaceae
10	*Calotropis gigantean L.*	Asclepidiaceae
11	*Canthium parviflorum Lam.*	Rubiaceae
12	*Carissa carandas L.*	Apocynaceae
13	*Carissa congesta L.*	Apocynaceae
14	*Cassia hirsuta L.**	Ceasalpinaceae
15	*Chromolaena odorata (L.) K.R.*	Astraceae
16	*Croton lacciferus L.*	Euphorbiaceae
17	*Crotolaria virosa (Roxb.) Bake.*	Fabacaeae
18	*Dendrocalamus strictus*	Poaceae
19	*Euphorbia totircornis L.*	Euphorbiaceae
20	*Gossypium arboretum L.*	Malvaceae
21	*Helictris isora L.*	Malvaceae
22	*Hibiscus tiliaceus Wild.*	Malvaceae
23	*Ixora brachiata Roxb. ex DC*	Rubiaceae
24	*Ixora javanica DC, Prodr.*	Rubiaceae
25	*Jatropha gossypiifolia*	Euphorbiaceae
26	*Lantana camara L.*	Verbenaceae
27	*Leea indica (Burm.f.) Merr.*	Leaceae
28	*Niligirianthus barbatus (Nees)*	Acanthaceae
29	*Pandanus odoratissimus L.*	Pandanaceae
30	*Pavetta indica L.*	Rubiaceae
31	*Psychotria bisulcata Wight & Arn.*	Rubiaceae
32	*Ricinus communis L.*	Euphorbiaceae
33	*Rosa chinensis Jacq.*	Rosaceae
34	*Saprosma ceylanicum (Gardner)*	Rubiaceae
35	*Sida acuta N.L. Burman.*	Malvaceae
36	*Solanum indicum L.*	Solanaceae
37	*Techoma stans (L.) Juss. Ex Kunth.*	Bignoniaceae
38	*Tephrosia purpuria (L.) Pers.*	Fabaceae
39	*Vitex sp*	Verbenaceae
40	*Vitex nigundo L.*	Verbenaceae
41	*Ziziphus oenoplea Miller.*	Rhamnaceae
42	*Trema orientalis*	Cannabaceae

*Note: * Secondary information from forest working plan and published literature*

Round Forester
Kirlapal - Round.

Range Forest Officer
Sanguem - Goa.

Mineral Engineering Services
(M.S.Raju)
NABET Consultant

HERBS: Total 28 Species of herbs reported from the buffer

List of Herbs and Climbers within the reserve forest and sanctuary of buffer area

Sl. No.	Species name	Family
1	*Acrostichum aureum*	Pteridaceae
2	*Ageratum conyzoides*	Astraceae
3	*Alternathara sessilis*	Amaranthaceae
4	*Andropogon annulatus*	Poaceae
5	*Asparagus racemose*	Asparagaceae
6	*Atlantia species*	Rutaceae
7	*Bidens biternata*	Asteraceae
8	*Bidens comosa*	Asteraceae
9	*Borreria articulata*	Rubiaceae
10	*Cassia tora*	Caesalpinaceae
11	*Clematis gouriana*	Ranunculaceae
12	*Clerodendron inerme*	Lamiaceae
13	*Cordia myxa*	Boraginaceae
14	*Crotolaria virosa*	Fabacaeae
15	*Cymbopogon citratus*	Poaceae
16	*Cyperus difformis**	Cyperaceae
17	*Desmodium triflorum*	Fabaceae
18	*Ipomea cmuricata*	Convolvulaceae
19	*Ocimum sanctum*	Lamiaceae
20	*Parthenium spp**	Asteraceae
21	*Premna coriacea*	Verbenaceae
22	*Sida acuta*	Malvaceae
23	*Sida cordifolia*	Malvaceae
24	*Smilax zeylanica**	Smilacaceae
25	*Solanum indicum*	Solanaceae
26	*Spermacoce sp.*	Rubiaceae
27	*Stylosanthus sp.*	Fabaceae
28	*Urena lobate*	Malvaceae

***Note:** * Secondary information from Goa forest & Biodiversity deparment and published literature*

FARMLAND/ ROAD SIDE: Total 20 species recorded within the buffer area from the Avenue trees, farmlands/private lands and riparian river streams

Farmlands/road side species recorded within 10-km radius

Sl.No	*Species name*	Common name	Family	Habit
1	*Tamarindus indica*	Tamrind/imli	Cesalpinaceae	Tree
2	*Annona reticulata*	Ramphal	Annonaceae	Tree
3	*Bambusa* sp	Bamboo	Bambocaceae	Tree
4	*Bougainvillea spectabilis*	Bouganvilla	Nyctaginaceae	Tree
5	*Cassia fistula*	Amaltas	Fabaceae	Tree
6	*Dalbergia latifolia*	Shisam/ Shisoo	Fabaceae	Tree

Round Forester
Kirlapal - Round.

Range Forest Officer
Sanguem - Goa.

Mineral Engineering Services
(M.S.Raju)
NABET Consultant

7	*Delonix regia*	Gulmohar	Fabaceae	Tree
8	*Phyllanthus emblica*	Awala/.Avala	Phyllanthaceae	Tree
9	*Psidium guajava*	Peru/Gauva	Myrtaceae	Tree
10	*Samanea saman*	Rain tree	Fabaceae	Tree
11	*Sapindus mukorossi*	Ritha/Reetha	Sapindaceae	Tree
12	*Swetenia mahagoni*	Mohagony	Meliaceae	Tree
13	*Syzygium cumini*	Jamun	Myrtaceae	Tree
14	*Terminalia bellerica*	Ghoting/behada	Combretaceae	Tree
15	*Acacia auriculiformis*		Mimosaceae	Tree
16	*Garcinia indica*		Clusiaceae	Tree
17	*Pongamia pinnata*		Fabaceae	Tree
18	*Ficus benghalensis*		Moraceae	Tree
19	*Ficus religiosa*		Moraceae	Tree
20	*Ixora coccinea*		Rubiaceae	Shrub

DOMESTICATED / CULTIVATED SPECIES: Total 13 different crops and commercial species observed from the buffer area

Domesticated and cultivates species recorded 10-km buffer area

Sl. No.	Species name	Common name	Family	Habit
1	*Annona reticulata*	Ramphal	Annonaceae	Tree
2	*Phyllanthus emblica*	Awala/.Avala	Phyllanthaceae	Tree
3	*Psidium guajava*	Peru/Gauva	Myrtaceae	Tree
4	*Carica papaya*	Caricaceae	Caricaceae	Tree
5	*Musa paradisiaca*	Bannana	Musaceae	Tree
6	*Acacia auriculiformis*		Mimosaceae	Tree
7	*Anacardium occidentale*		Anacardiaceae	Tree
8	*Areca catechu*		Arecaceae	Tree
9	*Cocos nucifera*		Arecaceae	Tree
10	*Garcinia indica*		Clusiaceae	Tree
11	*Tamarindus indica*		Cesalpinaceae	Tree
12	*Oryza sativa*	Paddy	Poaceae	herb
13	Vegetable cultivation			herb

CONSERVATION THREAT STATUS: FLORA: The plant species recorded in the study area was grouped into three categories i.e endemic, rare, threatened and keystone species. Overall, 7 important species recorded within the study area. Within core/buffer area one IUCN rare and 4 were keystone species; two endemics to Western Ghats recorded in the buffer zone

Round Forester
Kirlapal - Round.

Range Forest Officer
Sanguem - Goa.

Mineral Engineering Services
(M.S.Raju)
NABET Consultant

Endemic, Keystone and Threatened species recorded in 10-km radius area

Sl. No.	Species	Family	Core/ buffer	Habitat	Status
1	*Artocarpus heterophyllus* Lam.	Moraceae	Buffer	Tree	Endemic
2	*Ficus arnottiana* (Miq.) Miq.	Moraceae	Core/ Buffer	Open	Keystone
3	*Ficus microcarpa* L. f.	Moraceae	Buffer	Open/ Rivulets	Keystone
4	*Ficus virens* L.	Moraceae	Core	Open	Keystone
5	*Holigarna nigra* Bourd.	Anacardiaceae	Buffer	Rivulets	Endemic
6	*Strychnos nux- vomica* L.	Loganiaceae	Core/buffer	Open	Rare
7	*Terminalia paniculata* Roth	Combretaceae	Core / Buffer	Open / Scrub forest	Endemic

FAUNAL DIVERSITY

FAUNA: Total 262 faunal species were reported by secondary and primary observation from the core and buffer area, of which 22 species of mammals; 24 species of reptiles, 17 species of amphibians and toads; 154 species of birds, 27 species of butterflies, and 18 species of crabs and fishes.

Total 22 species mammals were recorded within the 10 km radius, of which four arboreal mammals -Flying fox, Squirrel and macaque and remaining were ground dwellers. The Malabar giant squirrel encounter only within the Wildlife Sanctuaries (WLs).

Further one carnivore' Leopard, omnivore Mongoose, Indian muntjac, and Jackal hinted by rural communities. The most common species sighted by us and local communities are Indian hare, Rats, Wild boar.

As per IUCN status 10 species were under Least Concern, 1 Vulnerable and 2 were Data Deficit but Indian Wildlife Protection Act Schedule species under 9 were Schedule-I, 4 species of Schedule –II, 2- Schedule III, 3 are Schedule IV, and 2 are Schedule –V were recorded.

Round Forester
Kirlapal - Round.

Range Forest Officer
Sanguem - Goa.

Mineral Engineering Services
(M.S.Raju)
NABET Consultant

List of the mammal species recorded within 10-km radius.

Sl. No.	Local Name	Scientific name	Family	IUCN status/ WPA schedule
1	Common grey mongoose	*Herpestes edwardsii*	Herpestidae	LC / IV
2	Indian Hare	*Lepus nigricollis*	Leporidae	LC / IV
3	Flying fox bat*	*Pteropus Giganteus*	Pteropodidae	DD/V
4	Rat	*Rattus rattus*	Muridae	DD/V
5	Indian porcupine	*Hystrix indica*	Hystricidae	LC / IV
6	Wild boar	*Sus scrofa*	Suidae	LC / III
7	Malabar gain squirrel	*Ratufa indica*	Sciuridae	VU / II
8	Striped squirrel	*Funambulus palmarum*	Sciuridae	IV
9	Indian muntjac*	*Muntiacus muntjac*	Cervidae	LC/III
10	Small Indian civet*	*Viverricula indica*	Viverridae	LC / II
11	Bonnet macaque	*Macaca radiata*	Cercopithecidae	LC / II
12	Wild dog	*Cuon alpines*	Canidae	Sch-II
Schedule I Species				
13	Common leopard*	*Panthera pardus*	Felidae	LC / I
14	Leopard cat*	*Pronailurus bengalensis*	Felidae	LC / I
15	Wronghto's Gaint Mastiff Bat	*Otompos wronghtoni*	Molossidae	Sch-I
16	Slender Loris	*Loris lydekkerianus*	Lorisidae	Sch-I
17	Tiger	*Panthera tigris*	Felidae	Sch-I
18	Mouse Deer/ Indian Chevrotain	*Moschiola meminna*	Tragulidae	Sch-I
19	Four Horned Antelope	*Tetracerus quadricornis*	Bovidae	Sch-I
20	Gaur or Indian Bison	*Bos gaurus*	Bovidae	Sch-I
21	Indian Pangolin	*Manis crassicaudata*	Manidae	Sch-I
22	Sloth bear	*Melursus ursinus*	Ursidae	Sch-I

***Note** * Secondary information from the Bhagawan Mahavir WLs report from Goa forest department , Gazette Notification of Bhagwan wildlife Sanctuary dated 23.01.2015*

REPTILES: Total 24 reptile species were recorded within the buffer areas .out of 18 species of snakes and 5 species of lizards were recorded. Indian rock python, Krait, Cobra and King cobras identified has rare species under the IUCN status and most of them were common as per the IUCN status

As per the wildlife Protection act 4 Schedule I, 5 Schedule II, and 2 Schedule IV were recorded within the 10-km radius of the ML.

Round Forester
Kirlapal - Round.

Range Forest Officer
Sanguem - Goa.

Mineral Engineering Services
(M.S.Raju)
NABET Consultant

Checklist of Reptiles' reported from the Study Area.

Sl. No.	Common name	Scientific name	Family	IUCN status/ WPA schedule
1	Common Sand Boa*	*Gongylophis conicus*	Boidae	Common
2	Whitaker's Boa*	*Eryx whitakeri*	Boidae	Common
3	Montane trinket snake*	*Coelognathus helena monticollaris*	Colubridae	Common
4	Indian rat Snake*	*Ptyas muscosa*	Colubridae	Schedule II
5	Common Kukri Snake*	*Oligodon arnensis*	Colubridae	Common
6	Western Kukri Snake*	*Oligodon affinis*	Colubridae	uncommon
7	Checkered Keelback	*Xenochrophis piscator*	*Colubridae*	Schedule II
8	Striped Keelback*	*Amphiesma stolatum*	*Colubridae*	Common
9	Hill keelback	*Amphiesma monticola*	*Colubridae*	uncommon
10	Saw scaled Viper*	*Echis carinathus*	Viperidae	Schedule IV
11	Cobra	*Naja naja*	Elapidae	LC/ II
12	King cobra*	*Ophiophagus hannah*	Elapidae	VU/ II
13	Common krait*	*Bungarus caeruleus*	Elapidae	LC / IV
14	Ceylon Cat Snake*	*Boiga ceylonensis*	Colubridae	Common
15	Common Indian cat snake*	*Boiga trigonata*	Colubridae	Common
16	Russell's Viper	*Daboia russelii*	Viperidae	Schedule II
17	Bamboo Pit Viper*	*Trimeresurus gramineus*	Viperidae	Common
18	Green Forest lizard	*Calotes calotes*	*Agamidae*	Common
19	Common Indian monitor lizard	*Varanus bengalensis*	*Varanidae*	LC /II
20	Bark/Marbled Tree gecko	*Hemidactylus leschenaultia*	*Gekkonidae*	Common
	Schedule-I			
21	Indian Rock Python*	*Python molurus molurus*	Pythonidae	NT/ I
22	Marsh Crocodile	*Crocodylus palustris*	Crocodylidae	Sch-I
23	Indian Falpshell Turtle	*Lissemys punctata*	Trionychidae	Sch-I
24	Common Indian Monitor Lizard	*Varanus bengalensis*	Varanidae	Sch-I

***Note** * Secondary information from the Bhagawan Mahavir WLs report*

TOADS AND AMPHIBIANS : Total 17 species of frogs were recorded within the various habitat ranges from paddy field, scrub jungle, riparian forest, streams, and evergreen forest patches .The Jerdon's narrow mouthed frog and Bronzed frog are near threatened and one Konkan bush frog vulnerable under IUCN and the rest of all were under the least concern category. As per WPA 9 species were recorded under Schedule IV.

Round Forester
Kirlapal - Round.

Range Forest Officer
Sanguem - Goa.

Mineral Engineering Services
(M.S.Raju)
NABET Consultant

List of toads and amphibians reported within 10-km radius .

Sl. No.	Common name	Scientific name	Family	IUCN status / WPA schedule
1	Common Indian toad	*Bufo melanostictus*	Bufonidae	LC
2	Jerdon's narrow mouthed frog*	*Ramanella montana*	Microhylidae	NT
3	Konkan bush frog*	*Philautus bombayensis*	Rhacophoridae	VU
4	Marten's bush frog*	*Philautus leucorhinus*	Rhacophoridae	LC
5	Bamboo tree frog*	*Polypedates leucomystax*	Rhacophoridae	LC
6	Common tree frog*	*Polypedates maculatus*	Rhacophoridae	LC
7	Malabar gliding frog	*Rhacophorus malabaricus*	Rhacophoridae	LC
8	Skipper frog*	*Euphlyctis cyanophlyctis*	Ranidae	LC/IV
9	Jerdon's bull frog*	*Hoplobatrachus crassus*	Ranidae	LC/IV
10	Indian bull frog*	*Hoplobatrachus tigerinus*	Ranidae	LC/IV
11	Brown leaping frog	*Indirana semipalmata*	Ranidae	LC/IV
12	Paddyfield frog*	*Limnonectes limnocharis*	Ranidae	LC/IV
13	Hill cricket frog	*Limnonectes syhadrensis*	Ranidae	LC/IV
14	Fungoid frog	*Rana malabaricus*	Ranidae	LC/IV
15	Bronzed frog*	*Rana temporalis*	Ranidae	NT/IV
16	Indian burrowing frog	*Tomopterna breviceps*	Ranidae	LC/IV
17	Dobson's burrowing frog*	*Tomopterna dobsoni*	Dicroglossidae	LC

*Note: LC - Least concern, NT - near threaten, VU – Vulnerable, Wildlife Protection Act –Schedule - IV; * Secondary information from the Bhagawan Mahavir WLs report*

BIRDS : Total 154 species of birds were recorded within the habitat ranges from paddy field to evergreen forest. About 123 species were resident locally. Out of 2 were endemic to the Western Ghats, 7 species were locally migratory and 2 were vulnerable species. As per the Wildlife Protection Act , 4- species Schedule I and 124 species Schedule IV. About 21 species recorded migratory birds within these habitats and one threatened species recorded.

List of birds recorded within 10-km radius

Sl. No.	Common name	Scientific name	Family	IUCN status/ WPA schedule
	Schedule-I			
1	White-bellied Sea-Eagle	*Haliaeetus leucogaster*	Accipitridae	R/I
2	Indian Peafowl	*Pavo cristatus*	Phasianidae	R/I
3	Shikra	*Accipiter badius*	Accipitridae	R/I
4	Osprey	*Pandion haliaetus*	Pandionidae	Sch-I

Mineral Engineering Services

Round Forester
Kirlapal - Round.

Range Forest Officer
Sanguem - Goa.

(M.S.Raju)
NABET Consultant

	Other Schedule Species			
5	Little Grebe	*Tachybaptus ruficollis*	Podicipedidae	R/IV
6	Little Cormorant	*Phalacrocorax niger*	Phalacrocoracidae	R/IV
7	Indian Shag	*Phalacrocorax fuscicollis*	Phalacrocoracidae	R/IV
8	Great Cormorant	*Phalacrocorax carbo*	Phalacrocoracidae	M/IV
9	Darter	*Anhinga melanogaster*	Phalacrocoracidae	RV/IV
10	Little Egret	*Egretta garzetta*	Ardeidae	R/IV
11	Western Reef Egret	*Egretta gularis*	Ardeidae	RM/IV
12	Grey Heron	*Ardea cinerea*	Ardeidae	RM/IV
13	Purple Heron	*Ardea purpurea*	Ardeidae	R/IV
14	Large Egret	*Casmerodius albus*	Ardeidae	R/IV
15	Median Egret	*Mesophoyx intermedia*	Ardeidae	M/IV
16	Cattle Egret	*Bubulcus ibis*	Ardeidae	R/IV
17	Indian Pond-Heron	*Ardeola grayii*	Ardeidae	R/IV
18	Little Green Heron	*Butorides striatus*	Ardeidae	R/IV
19	Black-crowned Night Heron	*Nycticorax nycticorax*	Ardeidae	RM/IV
20	Malayan Night Heron*	*Gorsachius melanocephalus*	Ardeidae	M/IV
	Chestnut Bittern*	*Ixobrychus cinnamomeus*	Ardeidae	M/IV
21	Black Bittern	*Dupetor flavicollis*	Ardeidae	M/IV
22	Painted Stork*	*Mycteria leucocephala*	Cioniidae	M/IV
23	Lesser Whistling-Duck	*Dendrocygna javanica*	Anatidae	MR/IV
24	Cotton Teal	*Nettapus coromandelianus*	Anatidae	MR/IV
25	Spot-billed Duck*	*Anas poecilorhyncha*	Anatidae	M/IV
26	Oriental Honey-buzzard	*Pernis ptilorhyncus*	Accipitridae	T/IV
27	Black Kite*	*Milvus migrans*	Accipitridae	R/IV
28	Brahminy Kite	*Haliastur indus*	Accipitridae	R/IV
29	Long-billed Vulture	*Gyps indicus*	Accipitridae	CE/IV
30	Crested Serpent Eagle*	*Spilornis cheela*	Accipitridae	R/IV
31	Eurasian Marsh Harrier	*Circus aeruginosus*	Accipitridae	R/IV
32	Crested Goshawk	*Accipiter trivirgatus*	Accipitridae	MR/IV
33	Besra Sparrowhawk	*Accipiter virgatus*	Accipitridae	R/IV
34	Black Eagle*	*Ictinaetus malayensis*	Accipitridae	R/IV
35	Jungle Bush Quail*	*Perdicula asiatica*	Phasianidae	R/IV
36	Red Spurfowl*	*Galloperdix spadicea*	Phasianidae	R/IV
38	Grey Junglefowl	*Gallus sonneratii*	Phasianidae	R/IV
39	Common Buttonquail	*Turnix suscitator*	Turnicidae	R/IV
40	Blue-breasted Rail	*Gallirallus striatus*	Rallidae	R/IV
41	White-breasted Waterhen*	*Amaurornis phoenicurus*	Rallidae	R/IV
42	Purple Moorhen	*Porphyrio porphyrio*	Rallidae	RM/IV
43	Pheasant-tailed*	*Hydrophasianus chirurgus*	Jacanidae	R/IV
44	Bronze-winged Jacana	*Metopidius indicus*	Jacanidae	R/IV
45	Common Ringed Plover	*Charadrius hiaticula*	Charadriidae	M/IV
46	Little Ringed Plover	*Charadrius dubius*	Charadriidae	M/IV

Round Forester
Kirlapal - Round.

Range Forest Officer
Sanguem - Goa.

Mineral Engineering Services
(M.S.Raju)
NABET Consultant

47	Kentish Plover*	*Charadrius alexandrines*	Charadriidae	M/IV
48	Yellow-wattled Lapwing	*Vanellus malarbaricus*	Charadriidae	M/IV
49	Red-wattled Lapwing	*Vanellus indicus*	Charadriidae	R/IV
50	Eurasian Woodcock	*Scolopax rusticola*	Scolopacidae	R/IV
51	Nilgiri Wood Pigeon	*Columba elphinstonii*	Columbidae	RV/ IV
52	Spotted Dove	*Streptopelia chinensis*	Columbidae	R/IV
53	Emerald Dove*	*Chalcophaps indica*	Columbidae	R/IV
54	Green Imperial Pigeon	*Ducula aenea*	Columbidae	R/IV
55	Mountain Imperial-Pigeon	*Ducula badia*	Columbidae	R/IV
56	Indian Hanging-Parrot	*Parrot Loriculus vernalis*	Psittacidae	R/IV
57	Rose-ringed Parakeet	*Psittacula krameria*	Psittacidae	R/IV
58	Plum-headed Parakeet	*Psittacula cyanocephala*	Psittacidae	R/IV
59	Blue-winged Parakeet	*Psittacula columboides*	Psittacidae	RE/IV
60	Brainfever Bird	*Hierococcyx varius*	Cuculidae	R/IV
61	Indian Cuckoo	*Cuculus Micropterus*	Cuculidae	U/IV
62	Common Cuckoo	*Cuculus Micropterus*	Cuculidae	M/IV
63	Banded Bay Cuckoo	*Cacomantis sonneratii*	Cuculidae	RM/IV
64	Indian Plaintve Cuckoo	*Cacomantis passerinus*	Cuculidae	R/IV
65	Drongo Cuckoo	*Surniculus lugubris*	Cuculidae	R/IV
66	Asian Koel	*Eudynamys scolopacea*	Cuculidae	R/IV
67	Small Green-billed Malkoha	*Phaenicophaeus viridirostris*	Cuculidae	R/IV
68	Greater Coucal*	*Centropus sinensis*	Cuculidae	R/IV
69	Lesser Coucal *	*Centropus bengalensis*	Cuculidae	U/IV
70	Oriental Scops-Owl	*Otus sunia*	Strigidae	R/IV
71	Forest Eagle-Owl	*Bubo nipalensis*	Strigidae	U/IV
72	Ketupa zeylonensis	*Brown Fish-Owl*	Strigidae	R/IV
73	Brown Wood Owl	*Strix leptogrammica*	Strigidae	R/IV
74	Glaucidium radiatum	*Jungle Owlet*	Strigidae	R/IV
75	Spotted Owlet	*Athene brama*	Strigidae	R/IV
76	Indian Jungle Nightjar *	*Caprimulgus indicus*	Caprimulgidae	RM/IV
77	Indian Edible-nest Swiftlet	*Collocalia unicolor*	Apodidae	RM
78	White-rumped Needletail-Swift	*Zoonavena sylvatica*	Apodidae	M
79	Brown-backed Needletail-Swift	*Hirundapus giganteus*	Apodidae	M
80	Asian Palm Swift	*Cypsiurus balasiensis*	Apodidae	R
81	Alpine Swift	*Tachymarptis melba*	Apodidae	U
82	Pacific Swift	*Apus pacificus*	Apodidae	U
83	House Swift	*Apus affinis*	Apodidae	R
84	Crested Tree-swift	*Hemiprocne coronate*	Hemiprocnidae	R
85	Malabar Trogon*	*Harpactes fasciatus*	Trogonidae	R/IV
86	Small Blue Kingfisher	*Alcedo atthis*	Alcedinidae	R/IV

Round Forester
Kirlapal - Round.

Range Forest Officer
Sanguem - Goa.

Mineral Engineering Services
(M.S.Raju)
NABET Consultant

87	Oriental Dwarf Kingfisher	*Ceyx Erithacus*	Alcedinidae	R/IV
88	Stork-billed Kingfisher	*Halcyon capensis*	Alcedinidae	R/IV
89	White-breasted Kingfisher	*Halcyon smyrnensis*	Alcedinidae	R/IV
90	Black-capped Kingfisher	*Halcyon pileate*	Alcedinidae	R/IV
91	Collared Kingfisher *	*Todiramphus chloris*	Alcedinidae	R/IV
92	Blue-eared Kingfisher	*Alcedo meningting*	Alcedinidae	R/IV
93	Ceryle rudis *	*Lesser Pied Kingfisher*	Alcedinidae	R/IV
94	Blue-bearded Bee-eater	*Nyctyornis athertoni*	Meropidae	R
95	Small Bee-eater	*Merops orientalis*	Meropidae	R
96	Blue-tailed Bee-eater	*Merops philippinus*	Meropidae	M
97	Chestnut-headed Bee-eater*	*Merops leschenaultia*	Meropidae	R
98	Brown-headed Barbet	*Megalaima zeylanica*	Capitonidae	R/IV
99	Crimson-throated Barbet	*Megalaima rubricapilla*	Capitonidae	R/IV
100	Coppersmith Barbet	*Megalaima haemacephala*	Capitonidae	R/IV
101	Brown-capped Pygmy woodpecker	*Dendrocopos nanus*	Picidae	R/IV
102	Yellow-fronted Pied woodpecker	*Dendrocopos mahrattensis*	Picidae	R/IV
103	Wire-tailed Swallow	*Hirundo smithii*	Hirudinidae	R
104	Red-rumped Swallow	*Hirundo daurica*	Hirudinidae	R
105	Large Pied Wagtail*	*Motacilla maderaspatensis*	Motacillidae	R/IV
106	Yellow Wagtail	*Motacilla flava*	Motacillidae	M/IV
107	Paddyfield Pipit	*Anthus rufulus*	Motacillidae	R/IV
108	Large Cuckoo-shrike	*Coracina macei*	Campephagidae	R/IV
109	Small Minivet *	*Pericrocotus cinnamomeus*	Campephagidae	R/IV
110	Scarlet Minivet	*Pericrocotus flammeus*	Campephagidae	R/IV
111	Red-whiskered Bulbul	*Pycnonotus jocosus*	Pycnonotidae	R/IV
112	Red-vented Bulbul *	*Pycnonotus cafer*	Pycnonotidae	R/IV
113	White-browed Bulbul	*Pycnonotus luteolus*	Pycnonotidae	R/IV
114	Yellow-browed Bulbul	*Iole indica*	Pycnonotidae	R/IV
115	Common Iora	*Aegithina tiphia*	Irenidae	R/IV
116	Asian Fairy-Bluebird	*Irena puella*	Irenidae	R/IV
117	Jerdon's Chloropsis *	*Chloropsis cochinchinensis*	Irenidae	R/IV
118	Malabar Whistling Thrush	*Myophonus horsfieldii*	Turdinae	R
119	Orange-headed Thrush	*Zoothera citrinacyanotus*	Turdinae	R
120	Oriental Magpie-Robin	*Copsychus saularis*	Turdinae	R
121	White-rumped Shama	*Copsychus malabaricus*	Turdinae	R
122	Indian Robin	*Saxicoloides fulicata*	Turdinae	R
123	Pied Bushchat	*Saxicola caprata*	Turdinae	R
124	Spotted Babbler	*Pellorneum ruficeps*	Timaliinae	R/IV

Round Forester
Kirlapal - Round.

Range Forest Officer
Sanguem - Goa.

Mineral Engineering Services
(M.S.Raju)
NABET Consultant

125	Indian Scimitar Babbler	*Pomatorhinus horsfieldii*	Timaliinae	R/IV
126	Rufous-bellied Babbler*	*Dumetia hyperythra*	Timaliinae	R/IV
127	Black-headed Babbler	*Rhopocichla atriceps*	Timaliinae	R/IV
128	Yellow-eyed Babbler	*Chrysomma sinense*	Timaliinae	R/IV
129	Rufous Babbler	*Turdoides subrufus*	Timaliinae	RE/IV
130	Jungle Babbler	*Turdoides striatus*	Timaliinae	R/IV
131	Quaker Tit-Babbler	*Alcippe poioicephalA*	Timaliinae	R/IV
132	Streaked Fantail-Warbler	*Cisticola juncidis*	Sylviinae	R
133	Franklin's Prinia	*Prinia hodgsonii*	Sylviinae	R
134	Ashy Prinia	*Prinia socialis*	Sylviinae	R
135	Plain Prinia *	*Prinia inornate*	Sylviinae	R
136	Common Tailorbird	*Orthotomus sutorius*	Sylviinae	R
137	Tickell's Blue-Flycatcher	*Cyornis tickelliae*	Muscicapinae	R/IV
138	Tickell's Flowerpecker	*Dicaeum erythrorynchos*	Dicaeidae	R/IV
139	Plain Flowerpecker	*Dicaeum concolor*	Dicaeidae	R/IV
140	Purple-rumped Sunbird	*Nectarinia zeylonica*	Nectariniidae	R/IV
141	Black-headed Munia	*Lonchura malacca*	Estrildidae	MR/IV
142	House Sparrow	*Passer domesticus*	Passeridae	R
143	Yellow-thraoted Sparrow	*Petronia xanthocollis*	Passeridae	R
144	Common Myna	*Acridotheres tristis*	Sturnidae	R/IV
145	Jungle Myna	*Acridotheres fuscus*	Sturnidae	R/IV
146	Common Hill-Myna	*Gracula religiosa*	Sturnidae	R/IV
147	Black Drongo	*Dicrurus macrocercus*	Dicruridae	R/IV
148	Ashy Drongo	*Dicrurus leucophaeus*	Dicruridae	M/IV
149	Bronzed Drongo	*Dicrurus aeneus*	Dicruridae	R/IV
150	Greater Racket-tailed Drongo	*Dicrurus paradiseus*	Dicruridae	R/IV
151	Indian Treepie	*Dendrocitta vagabunda*	Corvidae	R/IV
152	White-bellied Tree Pie	*Dendrocitta leucogaster*	Corvidae	U/IV
153	House Crow	*Corvus splendens*	Corvidae	R/IV
154	Jungle Crow	*Corvus macrorhynchos*	Corvidae	R/IV

Note : M - Migratory, R - Resident, U - unclear, E - Endemic, CE - Critically endangered, NT - Near threatened, V - Vulnerable. WPA Schedule –I – IV, * Secondary information from the Bhagawan Mahavir WLs report.

BUTTERFLIES: Total 27 species of butterfly were recorded within various habitats such as Paddy field, degraded habitat, scrub forest, open grassland, evergreen forest, and near settlements . Out of 1 species were under schedule-I, 4 were Schedule-II and one in Schedule-IV, and 22 were common in these habitats.

Round Forester
Kirlapal - Round.

Range Forest Officer
Sanguem - Goa.

Mineral Engineering Services
(M.S.Raju)
NABET Consultant

List of butterfly species recorded within 10-km radius

Sl. No.	Common name	Scientific name	Family	IUCN status / WPA schedule
	Schedule -I			
1	Crimson rose	*Pachiopta hector* Linnaeus	Papilionidae	Schedule I
2	Danaid Eggfly	*Hypolimnasmisippus*	Nymphalidae	Sch-I
	Common Species			
3	Spot swordtail*	*Graphium nomius* Esper	Papilionidae	Common
4	Southern birdwing	*Troides minos* Cramer	Papilionidae	Schedule II
5	Red helan	*Princepes helenus helenus* Hampson	Papilionidae	
6	Malabar banded peacock*	*Papilio buddh* Westwood	Papilionidae	Schedule II
7	Lime butterfly	*Papilio demoleus* Linnaeus	Papilionidae	Common
8	Chocolate albatross	*Appias lyncida* Cramer	Pierinae	Schedule II
9	Common Jezebel	*Delias eucharis* Drury	Pierinae	Common
10	Common emigrant*	*Catopsilla pomona* Fabricius	Coliadinae	Common
11	Common grass Yellow	*Eurema hecabe contubernalis* Moore	Coliadinae	Common
12	Angled Sunbeam*	*Curetis dentata* Moore	Curetinae	Common
13	Common Silverline	*Spindasis vulcans fusca* Moore	Theclinae	Common
14	Angled pierrot*	*Caleta caleta decidia* Cromer	Polypmmatinae	Common
15	Pea Blue	*Lamipes boeticus* Linneaus	Polypmmatinae	Schedule II
16	Dark pierrot	*Tarueus Ananda*	Polypmmatinae	Schedule IV
17	Common four ring	*Ypthima hubenri hubenri* Fabricius	Polypmmatinae	Common
18	Common nawab*	*Polyura athamas athamas* Drury	Charaxinae	Common
19	Angled Castor*	*Ariadne ariadne pallidior* Frusthorfer	Nymphalinae	Common
20	Common castor	*Ariadne merione assama* Evans	Nymphalinae	Common
21	Lemon pansy *	*Precis lemonias lemonias* L	Nymphalinae	Common
22	Commander	*Moduza procis procis* Cramer	Nymphalinae	Common
23	Tree Nymph	*Idea malabarica* Moore	Danainae	Common
24	Common Indian Crow	*Euploea core* Cramer	Danainae	Common
25	Plain Tiger*	*Danaus (Anosia) chrysippus* L	Danainae	Common
26	Grass demon *	*Edaspes folcus* Cramer	Hesperiidae	Common
27	Common dart*	*Potanthus spp* Fabricius	Hesperiidae	Common

Note: * Secondary information from the Bhagawan Mahavir WLs report

AQUATIC SPECIES: CRAB/FISHES/INSECTS: Total 16 species of fishes were recorded within the regions and 2 species of crabs in the streams, rivers, and estuaries. The species *Thunnus albacares* under near threatened and *Thunnus obesus* are Vulnerable, and most of them were not being evaluated IUCN status.

Mineral Engineering Services

(M.S.Raju)
NABET Consultant

Round Forester
Kirlapal - Round.

Range Forest Officer
Sanguem - Goa.

List of fishes and crab species reported within 10-km radius

Sl. No.	Common name	Scientific name	Family	IUCN status/ WPA Schedule
1	Spangled emperor	*Lethrinus nebulosus*	Lethrinidae	Not evaluated
2	Mangrove red snapper	*Lutjanus argentimaculatus*	Lutjanidae	Not evaluated
3	Malabar blood snapper	*Lutjanus malabaricus*	Lutjanidae	Not evaluated
4	John's snapper	*Lutjanus johni*	Lutjanidae	Not evaluated
5	Yellowfin tuna	*Thunnus albacares*	Lutjanidae	Near Threatened
6	Bigeye tuna	*Thunnus obesus*	Lutjanidae	Vulnerable
7	Indian mackerel	*Rastrelliger kanagurta*	Lutjanidae	Data Deficient
8	Black marlin	*Makaira indica*	Lutjanidae	Data Deficient
9	Goatee croaker	*Dendrophysa russelli*	Sciaendae	Not evaluated
10	Blotched croaker	*Nibea maculate*	Sciaendae	Not evaluated
11	Indian oil-Sardinella	*Sardinella longiceps*	Sciaendae	Least Concern
12	Indian spiny turbot	*Psettodes erumei*	Psettodidae	Not evaluated
13	Malabar tonguesole	*Cynoglossus macrostomus*	Cynoglossidea	Not evaluated
14	Dorab wolf-herrings	*Chirocentrus dorab*	Chirocentridae	Not evaluated
15	Chacunda gizzard-shad	*Anodontostoma Chacunda*	Clupeidae	Not evaluated
16	Engraved catfish	*Arius caelatus*	Ariidae	Not evaluated
17	Christian crabs	*Charybdis cruciate*	Portunidae	Not evaluated
18	Blue swimming crab	*Portunus Pelagicus*	Portunidae	Not evaluated

*Note: * Secondary information from the Bhagawan Mahavir WLs report & Atkore, Vidyadhar PhD work on fish diversity and turnover across multiple spatial scales in the Western ghats*

Round Forester
Kirlapal - Round.

Range Forest Officer
Sanguem - Goa

Mineral Engineering Services
(M.S.Raju)
NABET Consultant

Government of Goa
OFFICE OF THE DY. CONSERVATOR OF FORESTS
South Goa Division
Aquem, Margao – Goa, Pin 403 601.
Ph/Fax:- 0832-2750246/2751462 E mail: dcfsouth-forest.goa@nic.in/dcfsouthit@gmail.com

No.6/FCA/F & F/DCFS/TECH/2023-24/ 1700 Dated:- 13/02/2024
Magha,24 1945(Saka)

To,
Fomento Resources Private Limited,
102, 1st Floor, Kamat Metropolis-I,
Behind Caculo Mall,
St. Inez, Panaji- Goa.

Sub: Authentication list of Scheduled I species around 10 Km radius and list of flora and fauna within core zone of Block IV – Kalay Mineral Block of Fomento Resources Private Limited located at Santona Village, Sanguem Taluka, South Goa District Goa.

Sir,

With reference to your dated 18/01/2024, find enclosed herewith the Authentication list of the Schedule I species around 10 Km radius and list of flora and fauna within core zone of Block IV- Kalay Mineral Block of Fomento Resources Private Limited Located at Santona village, Sanguem Taluka, South Goa District, Goa as per the Amended Gazette Notification of Wildlife (Protection) Amendment Act, 2022.

This is for information.

13/2/'24

Prem Kumar R., IFS
Dy. Conservator of Forests,
South Goa Division,
Margao - Goa.

Encl: As Above.

AUTHENTICATED LIST OF FLORA AND FAUNA IN CORE AND BUFFER ZONE OF BLOCK IV- KALAY MINERAL BLOCK OF FOMENTO RESOURCES PRIVATE LIMITED, SANGUEM TALUKA SOUTH GOA

List of the Schedule – I Wildlife species around 10-km radius of Block IV – Kalay Mineral Block

S. No.	Local Name	Scientific name	Family	IUCN / WPA Schedule
		MAMMALS		
1	Common grey mongoose	*Urva edwardsii*	Herpestidae	LC/I
2	Indian porcupine	*Hystrix indica*	Hystricidae	LC/I
3	Malabar gain squirrel	*Ratufa indica*	Sciuridae	VU/I
4	Small Indian civet	*Viverricula indica*	Viverridae	LC/I
5	Bonnet macaque	*Macaca radiata*	Cercopithecidae	LC/I
6	Wild dog	*Cuon alpines*	Canidae	EN/I
		REPTILES		
1	Russell's Viper	*Daboia russelii*	Viperidae	LC/I
2	Cobra	*Naja naja*	Elapidae	LC/I
3	King cobra	*Ophiophagus hannah*	Elapidae	VU/I
4	Green Forest lizard	*Calotes calotes*	*Agamidae*	LC/I
5	Checkered Keelback	*Fowlea piscator*	*Colubridae*	LC/I
6	Common Kukri Snake	*Oligodon arnensis*	Colubridae	LC/I
7	Whitaker's Boa	*Eryx whitakeri*	Boidae	NT/I
8	Common Indian monitor lizard	*Varanus bengalensis*	*Varanidae*	NT/I
		BIRDS		
1	Chestnut Bittern	*Ixobrychus cinnamomeus*	Ardeidae	LC/I
2	Cotton Teal	*Nettapus coromandelianus*	Anatidae	LC/I
3	Brahminy Kite	*Haliastur indus*	Accipitridae	LC/I
4	Long-billed Vulture	*Gyps indicus*	Accipitridae	CE/I
5	Crested Serpent Eagle	*Spilornis cheela*	Accipitridae	LC/I
6	Eurasian Marsh Harrier	*Circus aeruginosus*	Accipitridae	LC/I

Round Forester
Kirlapal - Round.

Range Forest Officer,
Sanguem-Goa.

7	Crested Goshawk	*Accipiter trivirgatus*	Accipitridae	LC/I
8	Besra Sparrowhawk	*Accipiter virgatus*	Accipitridae	LC/I
9	Black Eagle	*Ictinaetus malayensis*	Accipitridae	LC/I
10	Crested Tree-swift	*Hemiprocne coronate*	Hemiprocnidae	LC/I
11	Brown Wood Owl	*Strix leptogrammica*	Strigidae	LC/I
12	Common Hill-Myna	*Gracula religiosa*	Sturnidae	LC/I
13	Grey Junglefowl	*Gallus sonneratii*	Phasianidae	LC/I
14	Nilgiri Wood Pigeon	*Columba elphinstonii*	Columbidae	VU/I
15	Small Minivet	*Pericrocotus cinnamomeus*	Campephagidae	LC/I
16	Forest Eagle-Owl	*Bubo nipalensis*	Strigidae	LC/I

Note: The list of Fauna is as per Amended Gazette Notification of Wildlife (Protection) Amendment Act, 2022.

List of Flora within Block IV – Kalay Mineral Block

S. No.	Species name	Family	Common Name
	TREE		
1	*Casurina equisettifolia*	Casuarinaceae	Suru
2	*Alstonia scholaris*	Apocynaceae	Saten
3	*Bauhinia racemose*	Fabacaeae	Apto
4	*Artocarpus heterophyllus*	Moraceae	Phanas
5	*Bombox ceiba*	Bombacaceae	Sanwar
6	*Delonix regia*	Fabacaeae	Gulmohar
7	*Emblica officinalis*	Phyllanthaceae	Aonia
8	*Garcinia indica*	Clusiaceae	Kokum
9	*Gmelina arborea*	Lamiaceae	Shivan
10	*Leucaena leucocephala*	Fabacaeae	Subabul
11	*Mangifera indica*	Anacardiaceae	Mango
12	*Canthium dicoccum*	Rubiaceae	Ceylon boxwood
13	*Ziziphus mauritiana*	Rhamnaceae	Indian jujube
15	*Holigarna arnottiana*	Anacardiaceae	Black varnish tree
16	*Carryota urens*	Arecaceae	foxtail palm
17	*Grewia tiliifolia*	malvaceae	Dhaman
18	*Psidium guajava*	Myrtaceae	Guava

Round Forester
Kirlapal - Round.

Range Forest Officer,
Sanguem-Goa.

SHRUBS			
1	*Acacia paniculate*	Mimosaceae	sickle wattle
2	*Carissa congesta*	Apocynaceae	Karamda
3	*Ixora coccinea*	Rubiaceae	Jungel gerenium
4	*Ziziphus oenoplea*	Rhamnaceae	Jackal jujube
5	*Musaaanda glabrata*	Rubiaceae	Dhobi tree
6	*Getonia floribunda*	Combrataceae	Paper flower
7	Antidesma acidum	Euphotbiaceae	Black berry
8	*Breyania retusa*	Euphotbiaceae	Cup and soucer
HERBS AND CLIMBERS			
1	*Ipomea cmuricata*	Convolvulaceae	Bhingari
2	*Commelina odoreta*	Asteraceae	Slam weed
3	*Momordica diocia*	Cucurbitaceae	Spiny guard
4	*Dioscorea bulbifera*	Dioscoreaceae	air potato
5	*Impatiens balsmina*	Balsaminaceae	Spotted snapweed
6	*Impatiens minor*	Balsamaceae	lesser balsam
7	*Begonia crenata*	Begoniaceae	common begonia
8	*Curculigo orchioides*	Hycinthacieae	
9	*Curcuma sp.*	Zingiberaceae	wild ginger
10	*Commelina odoreta*	Asteraceae	Slam weed

Round Forester
Kirlapal - Round

Range Forest Officer,
Sanguem-Goa

Annexure 12

Government of Goa
Directorate of Mines & Geology
Institute Menezes Braganza, Panaji-Goa

Website:dmg.goa.gov.in **E-mail: dir-mine.goa@nic.in**

No.03/18/2023/Major/Mines | 1884 **Dated:** 31 **/08/2023**

To,
Fomento Resources Pvt. Ltd.,
1st Floor, 102, Kamat Metropolis-1,
Behind Caculo Mall, St. Inez,
Panaji, Goa.403001.

Subject: Clarification on queries raised in the Minutes of Agenda for 17th EAC Meeting of Expert Appraisal Committee (EAC) Non- Coal Mining Sector dated 11/07/2023 & 12/07/2023 and the subsequent query raised for EC/MOM/375984/6/2023 vide ADS dated 19/07/2023 with respect to our Block IV-Kalay Mineral Block.

Sir,

With reference to your letter dated 26/07/2023 on the above cited subject, I am directed to enclose herewith a copy of letter No. DCF(WP)/S-D/Vol-I/67/2023-2024/512 dated 24/08/2023 issued by the Dy. Conservator of Forests, Working Plan Division, Goa Van Bhavan, Altinho, Panaji,Goa clarifying and reiterating that the proposed Kalay mineral Block is falling outside the ESZ of Bhagwan Mahaveer Wildlife Sanctuary and National Park.

Further it is also informed by the Forest Department that the WGESA is handled by the Department of Environment, Goa being nodal department, so may seek requisite information regarding ESA as desired by EAC.

Yours faithfully

(Abhir Hede)
Dy. Director II

Encl: As stated.

Directorate of Mines & Geology
Inward No 5767
Dated 24/08/23
Signature

Government of Goa
Office of The Dy. Conservator of Forests
Working Plan Division
"Goa Van Bhavan"
Altinho Panaji Goa – 403 001

No: DCF(WP)/S-D/Vol-I/67/2023-2024/512 Dated 24/08/2023

To,
The Director
Directorate of Mining and Geology,
Institute Menezes Braganza, Panji, Goa.

Sub: Clarification on queries raised in the Minutes of Agenda for 17th EAC meeting of Expert Appraisal Committee (EAC) Non-Coal Mining Sector dated 11/07/2023 & 12/07/2023 and subsequent query raised for EC/MOM/375984/6/23 vide ADS dated 19/07/2023 with respect to our Block IV- Kalay Mineral block reg.

Ref: No: 03/18/2023/Major/Mines/1560 dated 31/07/2023.

Sir,

In reference to your letter cited above, the observation of EAC were perused. As per comments from ESZ Division, MoEF&CC "*one point (15^0 18' 08.7974'' N, 74^0 09' 44.8333'' E) is lying inside both the Eco Sensitive Zone (ESZ) of Bhagwan Mahaveer Wildlife Sanctuary and National Park (BMWLS&NP) and Western Ghats Eco Sensitive Area (WGESA). The distance estimated between boundary of the BMWLS & NP and referred point is approx. 0.07526 Km (less than 1 km). Further EAC observed that both the letters dated 05.05.2023 and 07.05.2023 does not mention about WGESA*".

The Kalay -IV mineral block consisting an area of 179.1826 ha including area falling within ESZ of BMWLS was auctioned and finalised to M/s Fomento Resources Pvt Ltd, Goa through your letter of intent in the month of January 2023.

As the mining is prohibited activity within ESZ, M/s Fomento Resources Pvt Ltd, Goa vide their letter dated 31.01.2023 requested to delete an area of 26.6753 ha which falls within the notified ESZ from the auctioned mineral block. The same has been accepted and approved by you vide your letter dated 13/03/2023.

Accordingly, on receipt of proposal with modified boundary of mineral block to ascertain status of project to ESZ of BMWLS&NP, was scrutinised by this office and it was informed to you that the proposed mineral block falls outside ESZ of BMWLS&NP vide this office letter No. DCF(WP)/S-D/Vol-I/67/2022-23/347 dated 05.05.2023.

The coordinate currently referred by EAC was further verified by plotting it on the map containing boundary coordinates of BMWLS&NP, Eco Sensitive Zone boundary of BMWLS& NP and Coordinates of original and modified Kalay- IV mineral block boundary at Santona village of Sanguem taluka.

The coordinates referred to by EAC though it is found to be falling inside ESZ of BMWLS&NP, but it is not falling within either the boundary coordinates of original Kalay mineral block bearing of Mining Lease Title of Concession numbers 62/51, 12/52, 40/51, and 40/50 or proposed modified mining area boundary bearing MLTC number 12/51 and 40/51. Map indicating the ESZ boundary, Mineral block area and EAC referred coordinate is enclosed as *Annexure A* for reference.

Therefore, it is to clarify and reiterate that the proposed Kalay mineral block is falling *outside* the ESZ of Bhagwan Mahaveer Wildlife Sanctuary and National Park.

Further it is to inform that the WGESA is handled by Department of Environment, Goa being nodal department, so may seek requisite information regarding ESA as desired by EAC.

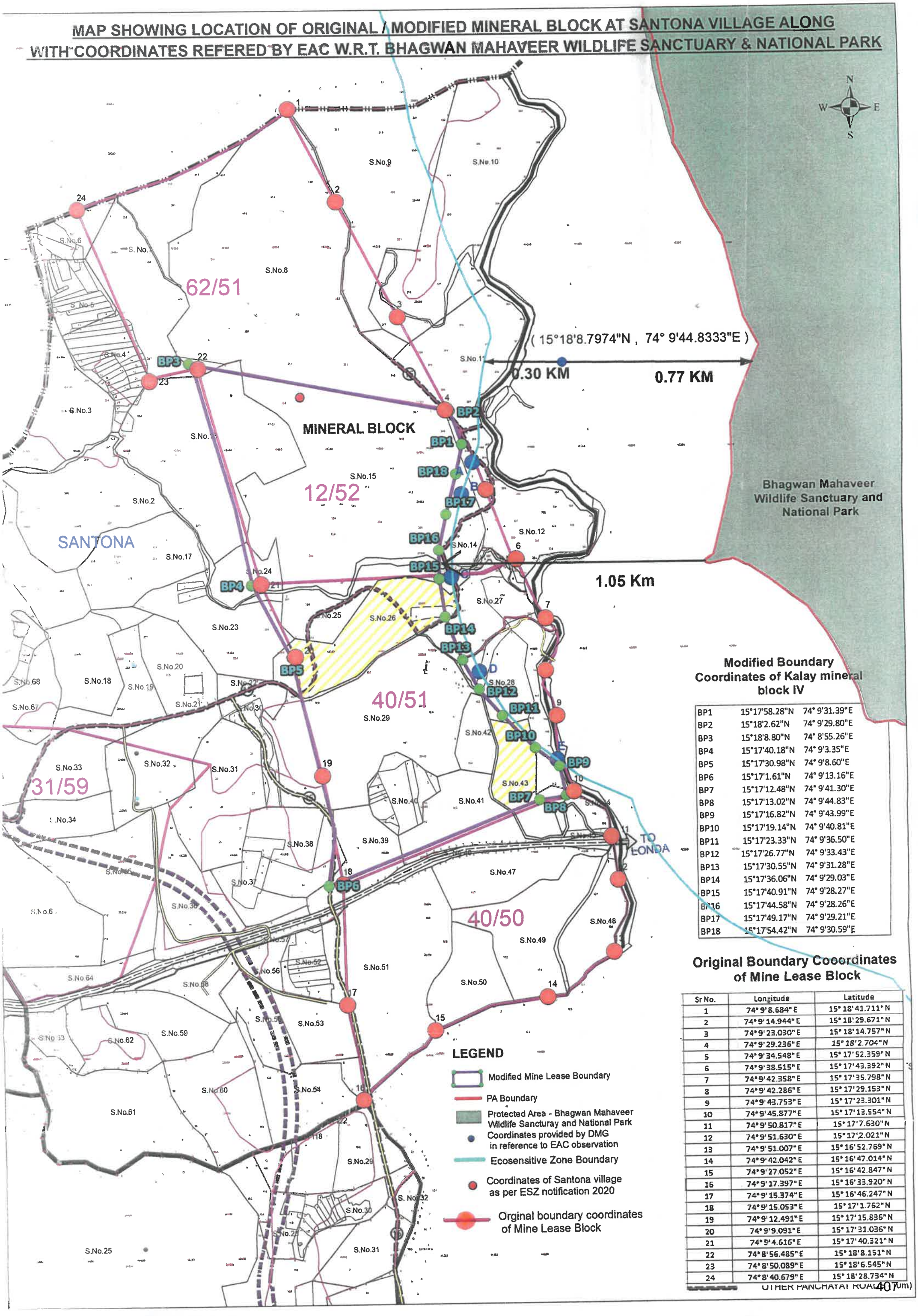
Encl: As above

Yours Sincerely

Dy. Conservator of Forests
Working Plan Division
Altinho, Panaji-Goa.

Copy to:
The Secretary (Environment & Climate Change), Government of Goa, Secretariate, Porvorim for information and needful action please.

MAP SHOWING LOCATION OF ORIGINAL / MODIFIED MINERAL BLOCK AT SANTONA VILLAGE ALONG WITH COORDINATES REFERED BY EAC W.R.T. BHAGWAN MAHAVEER WILDLIFE SANCTUARY & NATIONAL PARK



Modified Boundary Coordinates of Kalay mineral block IV

BP1	15°17'58.28"N	74° 9'31.39"E
BP2	15°18'2.62"N	74° 9'29.80"E
BP3	15°18'8.80"N	74° 8'55.26"E
BP4	15°17'40.18"N	74° 9'3.35"E
BP5	15°17'30.98"N	74° 9'8.60"E
BP6	15°17'1.61"N	74° 9'13.16"E
BP7	15°17'12.48"N	74° 9'41.30"E
BP8	15°17'13.02"N	74° 9'44.83"E
BP9	15°17'16.82"N	74° 9'43.99"E
BP10	15°17'19.14"N	74° 9'40.81"E
BP11	15°17'23.33"N	74° 9'36.50"E
BP12	15°17'26.77"N	74° 9'33.43"E
BP13	15°17'30.55"N	74° 9'31.28"E
BP14	15°17'36.06"N	74° 9'29.03"E
BP15	15°17'40.91"N	74° 9'28.27"E
BP16	15°17'44.58"N	74° 9'28.26"E
BP17	15°17'49.17"N	74° 9'29.21"E
BP18	15°17'54.42"N	74° 9'30.59"E

Original Boundary Cooordinates of Mine Lease Block

Sr No.	Longitude	Latitude
1	74° 9' 8.684" E	15° 18' 41.711" N
2	74° 9' 14.944" E	15° 18' 29.671" N
3	74° 9' 23.030" E	15° 18' 14.757" N
4	74° 9' 29.236" E	15° 18' 2.704" N
5	74° 9' 34.548" E	15° 17' 52.359" N
6	74° 9' 38.515" E	15° 17' 43.392" N
7	74° 9' 42.358" E	15° 17' 35.798" N
8	74° 9' 42.286" E	15° 17' 29.153" N
9	74° 9' 43.753" E	15° 17' 23.301" N
10	74° 9' 45.877" E	15° 17' 13.554" N
11	74° 9' 50.817" E	15° 17' 7.630" N
12	74° 9' 51.630" E	15° 17' 2.021" N
13	74° 9' 51.007" E	15° 16' 52.769" N
14	74° 9' 42.042" E	15° 16' 47.014" N
15	74° 9' 27.052" E	15° 16' 42.847" N
16	74° 9' 17.397" E	15° 16' 33.920" N
17	74° 9' 15.374" E	15° 16' 46.247" N
18	74° 9' 15.053" E	15° 17' 1.762" N
19	74° 9' 12.491" E	15° 17' 15.836" N
20	74° 9' 9.091" E	15° 17' 31.036" N
21	74° 9' 4.616" E	15° 17' 40.321" N
22	74° 8' 56.485" E	15° 18' 8.151" N
23	74° 8' 50.089" E	15° 18' 6.545" N
24	74° 8' 40.679" E	15° 18' 28.734" N

LEGEND

- Modified Mine Lease Boundary
- PA Boundary
- Protected Area - Bhagwan Mahaveer Wildlife Sancturay and National Park
- Coordinates provided by DMG in reference to EAC observation
- Ecosensitive Zone Boundary
- Coordinates of Santona village as per ESZ notification 2020
- Orginal boundary coordinates of Mine Lease Block
- OTHER PANCHAYAT ROAD (Kacha)

GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT, FORESTS & CLIMATE CHANGE
Regional Office (Southern Zone),
Kendriya Sadan, IVth Floor, E & F Wings, 17th Main Road,
IInd Block, Koramangala, Bengaluru - 560 034.
Tel.: 080-25635901 Fax : 080-25537184 E-mail : rosz.bng-mef@nic.in

Speed post

No.SPA/2(1)(ENV)(KAR)/RO(SZ)/RTI 327
Dated: 19.12.2023

To

Shri Sandip Vaman Morajkar
H.No.1734, Pajwada, Bicholim
Goa – 403504.

Sub: Application submitted under the provisions of Right to Information Act, 2005 –regarding.

* * * *

Sir,

I am to refer to your online RTI Application No.ROBAN/R/E/23/00067 dated 08/12/2023 and to inform that the information sought regarding site inspection on 05/10/2023 of M/s Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Limited for mining of Iron Ore with proposed production capacity of 0.75 MTPA, Waste: 3.0 MTPA in the mine lease area of 152.5073 Ha, located at Village Santona, Sanguem Taluka, South Goa District, Goa, as requested a copy is enclosed herewith for your reference.

In case you are not satisfied with the above information, you may file an appeal within 30 days from the date of issue of this letter before the Appellate Authority. The name and address of the Appellate Authority is Shri P. Subramanyam, IFS, Deputy Director General of Forests(C) and Appellate Authority, Ministry of Environment, Forest & Climate Change, Regional Office, Kendriya Sadan, 4th Floor, E&F Wings, 17th Main Road, II Block, Koramangala, Bangalore-560 034.

This disposes the RTI Application.

Yours faithfully,

Encl: as above

(Dr. R. Sridhar)
Scientist 'D' &
Central Public Information Officer

सत्यमेव जयते

भारत सरकार / GOVERNMENT OF INDIA
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय / MINISTRY OF ENVIRONMENT, FOREST AND CLIMATE CHANGE
क्षेत्रीय कार्यालय, बेंगलुरु /REGIONAL OFFICE, BENGALURU

4th Floor, E & F- Wings, Kendriya Sadan, 17th Main Road,
II Block, Koramangala, Bengaluru- 560 034

EP/12.8/KalayMineralBlock,Goa/2023 / 741 **25.10.2023**

To,
The Additional Director
& Member Secretary (EAC-Non-Coal Mining)
IA Division
Ministry of Environment, Forest & Climate Change
Indira Paryavaran Bhawan, Aliganj
Jorbagh Road, New Delhi-110003

Sub: Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Ltd for mining of Iron Ore with proposed production capacity of 0.75 MTPA, Waste: 3.0 MTPA in the mine lease area of of 152.5073 Ha, located at village Santona, Sangeum Taluka, South Goa District, Goa-TOR-REG.

Ref:
1. The Additional Director, IA Division, MoEF&CC letter dated 25.09.2023

Sir,

The undersigned is directed to refer to the subject matter. The Ministry vide email dated 25.09.2023 requested this office to carry out site inspection of the Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Ltd with representatives from State Forest Department and Department of Mining and Geology, Government of Goa. Accordingly, site inspection was carried out on 05.10.2023. Site inspection report is enclosed herewith.

Based on the observations made during site inspection, clarifications provided by State Forest Department and Environment Department, the committee states that the project site i.e. Block IV- Kalay Mineral Block area (Auction Block) of M/s Fomento Resources Private Limited located at village Santona, Sanguem Taluka, South Goa District Goa falls outside of ESZ of Bhagwan Mahaveer Wildlife Sanctuary and National Park and ESA of Western Ghats.

A. Suresh Kumar 25/10/23
(Suresh Kumar Adapa)
Scientist 'E'/Additional Director

Copy to:
1. The DCF, North Goa, Goa
2. The Dy. Director, DMG, Goa

A. Suresh Kumar 25/10/23
(Suresh Kumar Adapa)
Scientist 'E'/Additional Director

Site inspection report of Block IV - Kalay Mineral Block (Auction Block) of M/s Fomento Resources Private Limited for mining of Iron Ore with proposed production capacity of 0.75 MTPA, waste: 3.0 MTPA in the mine lease area of 152.5073 Ha, located at village Santona, Sanguem Taluka, South Goa District, Goa by M/s. Fomento Resources Private Limited

The Member Secretary, EAC (Non- Coal Mining), IA Division, MoEF&CC vide letter dated 25.09.2023 (enclosed as **Annexure-1**) informed that:

The Expert Appraisal Committee (EAC) for Non-Coal Mining projects in the 19th meeting held from 24th August to 25th August 2023, considered the proposal for mining of Iron Ore in Kalay Mineral Block (Auctioned Block) with lease area of 152.5073 ha. with production capacity 0.75 MTPA, Waste 3.0 MTPA. The EAC observed that:

"The ESZ division of the Ministry has informed that the project area falls partly within the ESZ boundary of Bhagwan Mahaveer Wildlife sanctuary, however the PA is still claiming that the project area is outside the ESZ area. Accordingly, the EAC was of view that Ministry's Regional Office (IRO), Bangalore and a Senior Officer from Forest Department, Government of Goa and a Senior Officer from Directorate of Mines and Geology, Government of Goa may be requested for a joint visit to the site for ground truthing and submit the report to the Ministry".

The Ministry vide email dated 25.09.2023 requested that RO, Bengaluru shall carry out the above site inspection with State Forest Department and Department of Mining & Geology (DMG), Government of Goa and submit its report.

The DMG, Government of Goa vide letter dated 01.09.2023, nominated Shri. Abir Hede, Dy. Director for the inspection. Copy of the letter is enclosed as **Annexure-2**.

The RO, Bengaluru vide email dated 25.09.2023 requested the State Forest Department to depute one officer for the site inspection. State Forest Department, Govt. of Goa vide letter dated 03.10.2023 nominated Shri. Jiss K. Varkey, DCF, North Goa Division to represent State Forest Department. Copies of letters/email are enclosed as **Annexure-3**.

Site inspection of proposed iron ore mine of M/s. Fomento Resources Private Limited located at village Santona, Taluka Sanguem of South Goa District of Goa was carried out on 05.10.2023. Following officers of MoEF&CC, State Forest Department and DMG, Govt. of Goa were present during site inspection:

1. Shri. Suresh Kumar Adapa, Scientist 'E', RO, MoEF&CC, Bengaluru, Govt of India
2. Shri. Jiss K. Varkey, DCF, North Goa Division, Govt. of Goa
3. Shri. Premkumar, DCF, South Goa Division, Govt. of Goa
4. Shri. Abir Hede, Dy. Director, DMG, Govt. of Goa

Following representative of M/s. Fomento Resources Private Limited accompanied the above team during site inspection:

1. Shri. Sandeep Morajkar, DGM (Mineral Resources)
2. Shri. Dharmendra Pawar, DGM (Mineral Resources)

3. Shri. Abhijit Pednekar, DGM(Geology)

Photographs of the site inspection are enclosed **Annexure-4.**

The committee perused the documents submitted by project proponent and observed following:

- The DMG, Government of Goa vide letter of intent no. DMG/25/Auction Cell/LOI-function/2023/2804 dated 13.01.2023 granted Block IV- Kalay Mineral Block for Iron Ore from 179.1826 ha. located at Santona Village in Sanguem Taluka of South Goa District to M/s. Fomento Resources Private Limited
- The project proponent vide letter dated 31.01.2023 requested the DMG to revise the lease area by deleting the area which was falling in Eco-Sensitive Zone (ESZ) of Bhagwan Mahaveer Wildlife Sanctuary and National Park.
- The DMG vide letter dated 13.03.2023 granted the revised mining lease for an area of 152.5073 ha., after deleting and deducting an area of 26.6753 ha., falling within Eco-Sensitive Zone (ESZ) of Bhagwan Mahaveer Wildlife Sanctuary and National Park. Copy of the letter is enclosed as **Annexure-5.**
- The State Forest Department vide letter dated 24.08.2023 clarified and reiterated that the proposed Kalay Mineral block is falling outside the ESZ of Bhagwan Mahaveer Wildlife Sanctuary and National Park. The nearest boundary of the project is located at a distance of over 1.05 kms from the protected area. Copy of the letter is enclosed as **Annexure-6.** The Department also advised the project proponent to seek clarification w.r.t. Western Ghats Eco Sensitive Area (WGESA) from Environment Department, Government of Goa, which is nodal department handling WGESA.
- The Director (Environment), Government of Goa vide letter dated 13.09.2023 clarified that Block-IV- Kalay Mineral Block of Fomento Resources Private Limited, Santona Village, Sanguem Goa is not a part of any Eco Sensitive Area of Western Ghats. Copy of the letter is enclosed as **Annexure-7.**

The committee inspected the boundary pillars (BP1, BP 9 to BP 18) that are located along eastern boundary and towards the ESZ of Bhagwan Mahaveer Wildlife Sanctuary and National Park. The coordinates of the boundary pillars along eastern boundary and towards the ESZ of Bhagwan Mahaveer Wildlife Sanctuary and National Park, collected during the site inspection with a handheld GPS are provided in the following table:

Sr. No.	Boundary Pillar No.	Coordinates (WGS 84)	
		Latitude	Longitude
1	BP-9 (GPS)	15°17'16.8" N	74°9'44.0" E
2	BP-10 (GPS)	15°17'19.2" N	74°9'40.7" E
3	BP-11 (GPS)	15°17'23.6" N	74°9'36.4" E
4	BP-12 (GPS)	15°17'26.8" N	74°9'33.4" E
5	BP-13 (GPS)	15°17'30.7" N	74°9'31.0" E
6	BP-14 (GPS)	15°17'36.2" N	74°9'28.8" E
7	BP-15 (GPS)	15°17'41.0" N	74°9'28.2" E
8	BP-16 (GPS)	15°17'44.7" N	74°9'28.0" E
9	BP-17 (GPS)	15°17'49.2" N	74°9'29.1" E

10	BP-18 (GPS)	15°17'54.4" N	74°9'30.4" E
11	BP-1 (GPS)	15°17'58.5" N	74°9'31.4" E

The Regional Office vide email dated 10.10.2023 requested the State Forest Department, Government of Goa for providing the coordinates of the ESZ boundary. The State Forest Department vide email dated 16.10.2023 provided the coordinates of boundary of ESZ of Bhagwan Mahaveer Wildlife Sanctuary and National Park. The coordinates provided are as follows:

Sr. No.	ESZ Points	Coordinate (WGS 84)	
		Latitude	Longitude
1	A	15°17'55.936" N	74°9'32.792" E
2	B	15°17'51.817" N	74°9'31.312" E
3	C	15°17'41.095" N	74°9'30.852" E
4	D	15°17'29.029" N	74°9'33.510" E
5	E	15°17'17.646" N	74°9'43.718" E

Copies of emails are enclosed as **Annexure-8.**

The coordinates collected during the site inspection along with the coordinates of ESZ of Bhagwan Mahaveer Wildlife Sanctuary are plotted in google earth map and same is enclosed as **Annexure-9**. As per the map, the project area falls outside of ESZ of Bhagwan Mahaveer Wildlife Sanctuary and National Park.

Conclusion:

Based on the observations made during site inspection, *clarifications provided by State Forest* Department and Environment Department, the committee states that the project site i.e. Block IV- Kalay Mineral Block area (Auction Block) of M/s Fomento Resources Private Limited located at village Santona, Sanguem Taluka, South Goa District, Goa falls outside of ESZ of Bhagwan Mahaveer Wildlife Sanctuary and National Park and ESA of Western Ghats.

Suresh Kumar Adapa
Scientist E/
Additional Director
RO, MoEF&CC, Bengaluru

Suresh Kumar Adapa
Scientist "E" / Additional Director (S)
Ministry of Environment, Forest & Climate Change
Integrated Regional Office
Kendriya Sadan, Koramangala
Bengaluru - 560034

20/10/2023

Jiss K. Varkey
DCF, North Goa Forest Division,
Government of Goa

Dy. Conservator of Forests
North Goa Division
Ponda - Goa

20/10/23

Abir Hede
Dy. Director, DMG,
Government of Goa

Deputy Director-II
Directorate of Mines & Geology
Government of Goa
Panaji-Goa

F. No. IA-J-11015/11/2023-IA-II(NCM)

Annexure-1

Government of India
Ministry of Environment, Forest and Climate Change
Impact Assessment Division
***

Indira Paryavaran Bhawan
3rd Floor, Vayu Wing,
Jor Bagh Road, Aliganj
New Delhi-110003.

Dated: 25th September, 2023

To

1. **The Deputy Director General of Forests (C),**
Ministry of Environment, Forest and Climate Change,
Regional Office, Kendriya Sadan,
4th Floor, E&F Wings, 17th Main Road,
Koramangala II Block, Bangalore – 560034, Karnataka.

2. **The Principal Chief Conservator of Forest,**
Office of the Principal Chief Conservator of Forest,
Goa Van Bhavan, Forest Department,
Altinho, Panaji – 403001, Goa.

3. **The Director,**
Directorate of Mines and Geology,
Government of Goa,
Ground Floor of Institute Menezes Braganza,
Panaji – 403001, Goa.

Sub: Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Limited for mining of Iron Ore with proposed production capacity of 0.75 MTPA, Waste: 3.0 MTPA in the mine lease area of 152.5073 Ha, located at Village Santona, Sanguem Taluka, South Goa District, Goa – [Proposal No: IA/GA/MIN/422578/2023] - Terms of Reference (ToR) regarding

Sir,

The proposal for Terms of Reference (ToR) for mining of Iron Ore in Kalay Mineral Block - Block IV (Auction Block) of M/s Fomento Resources Private Limited with proposed production capacity of 0.75 MTPA, Waste: 3.0 MTPA in the mine lease area of 152.5073 Ha, located at Village Santona, Sanguem Taluka, South Goa District, Goa was considered in the 19th EAC (Non-Coal Mining) meeting held during 24-25 August, 2023, wherein the EAC deferred the proposal.

2. It is to mention that during the EAC meeting, it is observed that the ESZ Division of the Ministry has informed that the project area falls partly within the ESZ boundary of Bhagwan Mahaveer Wildlife Sanctuary, however, the project proponent is still claiming that the project area is outside the ESZ of Bhagwan Mahaveer Wildlife Sanctuary and Western Ghats Eco-Sensitive Area (ESA). Accordingly, the EAC was of view that Ministry's Regional Office (IRO), Bangalore and a Senior Officer from Forest Department, Government of Goa and a Senior Officer from Directorate of Mines and Geology, Government of Goa may be requested for a joint visit to the site for ground truthing and submit the report to the Ministry. A copy of relevant

Cont...

minutes is enclosed. Project proponent is also requested to send the superimposition of KML file of the Project Area on the KML file of the sanctuary.

3. In this regard, it is requested to visit the mine site and furnish the report within 15 days for further necessary action.

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

Yours faithfully,

Pankaj Verma

(Pankaj Verma)
Scientist 'E'

Encl: As above

Copy to:

1. M/s Fomento Resources Pvt. Ltd., 1st Floor, 102, Kamat Metropolis-1, Behind Caculo Mall, St. Inez, Panaji - 403001, Goa.
2. Guard File.

xxi. The Project Proponent needs to submit the latest Certified Compliance Report (CCR) by the Ministry's Regional Office as per Ministry's OM dated 08.06.2022at the time of appraisal of EC.

xxii. The project proponent needs to submit the affidavit as per Ministry's O.M dated 30.05.2018 at the time of EC appraisal.

xxiii. The Project Proponent shall conduct drone survey of the mine lease area and buffer area and submit during the appraisal for EC.

1.4 Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Limited for mining of Iron Ore with proposed production capacity of 0.75 MTPA, Waste: 3.0 MTPA in the mine lease area of 152.5073 Ha, located at Village Santona, Sanguem Taluka, South Goa District, Goa - [F.No: IA-J-11015/11/2023-IA-II(NCM), Proposal No: IA/GA/MIN/422578/2023,EIA Consultant: M/s Mineral Engineering Services] -Terms of Reference (ToR)

The instant proposal is for mining of Iron Ore in Kalay Mineral Block - Block IV (Auction Block) of M/s Fomento Resources Private Limited with proposed production capacity of 0.75 MTPA, Waste: 3.0 MTPA in the mine lease area of 152.5073 Ha, located at Village Santona, Sanguem Taluka, South Goa District, Goa.

2. The details of the project as ascertained from the documents submitted by the Project Proponent and as revealed from the discussions held during the meeting are given as under:

i. The mine lease area is located between Latitude: 15°17'01.6125" N to 15°18' 08.7974" N and Longitude: 74°08'55.2583" E to 74°09'44.8333" E. The mine lease area falls under the Survey of India Toposheet No: D43C3and falls in Seismic Zone-II.

ii. The proposed project activity is listed at schedule no. 1(a) Mining of Minerals and instant proposal attracts the general conditions as the mine lease area is located within 5km radius of BhagwanMahavir Wildlife Sanctuary and falls under Category "A" and appraised at the Central level.

iii. The proposal was earlier considered in the 15thEAC (Non-Coal Mining) meeting held during 30-31 May, 2023 wherein the EAC deferred the proposal for want of requisite information. Then, the Project Proponent submitted the information on 22.06.2023 in Parivesh portal and accordingly the proposal was considered in the 17th EAC (Non-Coal Mining) meeting held during 11-12 July, 2023. After detailed deliberations made by the Project Proponent and the Consultant, the EAC again deferred the proposal and was of the view that the proposal may be considered only after obtaining the comments from the ESZ Division. The Project Proponent vide letter dated 26.07.2023 informed to the Ministry that the ESZ Division of Ministry by oversight has observed that, one of the point (15° 18'08.7974" N, 74°09'44.8333" E) of the project is lying inside both the ESZ boundary of BhagwanMahaveer Wildlife Sanctuary &

National Park and WGESA boundary as per the 5th draft notification of the WGESA dated 06.07.2022. The Project Proponent also requested to consider the proposal for grant of Terms of Reference or in an alternate to provide the personal hearing to explain the matter. The ESZ Division gave their comments on 27.07.2023 in the instant matter. Accordingly, the proposal was again reconsidered in the 19th EAC (Non-Coal Mining) meeting held during 24-25 August, 2023.

Based on observation of EAC in its EAC meeting held during 11-12 July, 2023 and compliance of observation of EAC are detailed below:

S. No	Observation of EAC in its meeting held during 11-12 July, 2023	Reply by Project Proponent
1	The EAC observed that both the letter dated 05.07.2023 and 07.07.2023 does not mention about the Western Ghats ESA. The EAC opined that the Ministry may again the refer the matter to the ESZ Division with reference to the letter issued by the Dy. Conservator of Forest dated 05.07.2023 and Directorate of Mines & Geology dated 07.07.2023 as submitted by the Project Proponent.	The ESZ Division gave their following comments on 27.07.2023 as given below: - i. The ESZ Division has informed that the Kalay mineral block falls partly within the ESZ boundary of Bhagwan Mahaveer Wildlife Sanctuary. And w.r.t. draft WGESA boundary, the ESZ Division has informed that the kml of kalay mineral block is outside the kml of draft WGESA boundary. ii. The ESZ Division has also informed that the Hon'ble Supreme Court by way of a clarification vide an Order dated 28.04.2023 in IA No. 3949 of 2016 in W.P (C) No. 202 of 1995: T.N GodavarmanThirumulpad Vs UoI&Ors. clarified that in specific terms that mining within 1.0 km from the boundary of the protected area shall be strictly prohibited. It also specified that even if the ESZ is less than 1.0 km, mining within 1.0 km from the boundary of the Protected Area, even beyond ESZ boundary shall be strictly prohibited.

3. Observation and Recommendation of the EAC: -

The EAC deliberated on the additional details submitted by the Project Proponent and the Consultant. The EAC noted the comments of the ESZ Division that the Kalay mineral block falls partly within the ESZ boundary of Bhagwan Mahaveer Wildlife Sanctuary and w.r.t. draft WGESA boundary, the kml of kalay mineral block is outside the kml of draft WGESA boundary.

The Project Proponent has informed the EAC that the Letter of Intent (LoI) was granted on 13.01.2023 over an area of 179.1826 ha comprised of an area which was forming part of the Eco-Sensitive Zone (ESZ) of Bhagwan Mahaveer Wild Life

Sanctuary & National Park. Then, the requisition letter was submitted to the Directorate of Mines and Geology, Government of Goa on 31.01.2023for deletion of area approximately 26.6753 ha falling within 1km from the boundary of Eco Sensitive Zone (ESZ) w.r.t Block IV – Kalay Mineral Block. Accordingly, the Directorate of Mines and Geology vide letter dated 13.03.2023 revised the area of Block IV – Kalay Mineral Block from 179.1826 ha to 152.5073 ha and the revised area was excluding the Eco Sensitive Zone (ESZ) area of 26.6753 ha. The Project Proponent also showed the DGPS Plan before and after deletion of the 26.6753 ha, authenticated map from the Deputy Conservator of Forest and map showing the distance of the ESZ of boundary of Eco Sensitive Zone (ESZ) from the mine lease area i.e. is 1.04 km and 1.12 km respectively. Further, the Project Proponent also informed the EAC that the Village Santona is not listed in the Western Ghats ESA as per notification dated 06.07.2022.

After derailed deliberations, the EAC observed that the ESZ division of the Ministry has confirmed that the project area falls partly within the ESZ boundary of Bhagwan Mahaveer Wildlife Sanctuary, however, the project proponent is still claiming that the project area is outside the ESZ of Bhagwan Mahaveer Wildlife Sanctuaryand Western Ghats Eco-Sensitive Area (ESA). Accordingly, the EAC was of view that Ministry's Regional Office (IRO), Bangalore and a Senior Officer from Forest Department, Government of Goa and a Senior Officer from Directorate of Mines and Geology, Government of Goa may be requested for a joint visit to the site for ground truthing and submit the report to the Ministry. Based on the discussions held, the EAC **deferred** the proposal.

1.5 Hutti Gold Mines (ML No: 2671) of M/s The Hutti Gold Mines Company Limited for expansion in production capacity from 0.6 MTPA to 0.9 MTPA (2000 TPD to 3000 TPD) and enhancement of processing plant capacity of 0.9 MTPA – 1.2 MTPA (3000 TPD to 4000 TPD) in the mine lease area of 528.35 ha, located at Hutti Village, Lingsugur Taluk, Raichur District, Karnataka - [File No: J-11015/13/2003-IA.II(M), Proposal No: IA/KA/MIN/436624/2023; EIA Consultant: M/s Hubert Enviro Care Systems] - Terms of Reference (Expansion)

The instant proposal is for Terms of Reference of M/s The Hutti Gold Mines Company Limited for expansion in production capacity from 0.6 MTPA to 0.9 MTPA (2000 TPD to 3000 TPD) and enhancement of processing plant capacity of 0.9 MTPA – 1.2 MTPA (3000 TPD to 4000 TPD) in the mine lease area of 528.35 ha, located at Hutti Village, Lingsugur Taluk, Raichur District, Karnataka.

2. The details of the project as ascertained from the documents submitted by the Project Proponent and as revealed from the discussions held during the meeting are given as under:

i. The mine lease area is located between Latitude: 16°12'29.55813"N to 16°11'57.54790"N and Longitude: 76°39'38.73430" E to 76°39'42.06560"E. The mine lease area falls under the Survey of India Toposheet No: 56 D/12.

Government of Goa
Directorate of Mines & Geology
Institute Menezes Braganza, Panaji-Goa

Website:dmg.goa.gov.in **E-mail: dir-mine.goa@nic.in**

No.03/18/2023/Major/Mines /1926 **Dated:** 01 /09/2023

To,
1. The Principal Chief Conservator of Forest,
Goa Van Bhavan,
Forest Department,
Altinho, Panaji,
Goa. 403001.
Email: dcfme-forest.goa@nic.in

2. The Dy. Director General of Forests (Central)
Ministry of Environment, Forest and Climate Change,
Integrated Regional Office,
Kendriya Sadan, IVth Floor, E&F Wing,
17th Main Road, II Block, Koramangala,
Banglore.560034.
Email:rosz.bng-mef@nic.in

Subject: Query raised dated 30/08/2023 for the proposal IA/GA/MIN/422578/2023 with respect to Block IV- Kalay Mineral Block in the 19th EAC Meeting of Expert Appraisal Commjttee (EAC) Non-Coal Mining Sector held on 24/08/2023.

Sir,

In order to expedite resumption of mining activity in the State, Government of Goa has so far auctioned 09 Iron Ore Mineral Blocks as per the Mineral Auction Rules, 2015. More mineral Blocks are proposed for auction shortly.

The Block - IV Kalay Mineral Block was won by Fomento Resources Pvt. Ltd. in the auction process. Letter of Intent (LOI) has been issued to the winning bidder. Accordingly, Fomento Resources Pvt. Ltd. have applied for TOR for getting Environmental Clearance from the Ministry of Environment, Forest and Climate Change.

In the 19th EAC Meeting of Expert Appraisal Committee (EAC) Non-Coal Mining Sector held on 24/08/2023 the EAC has given following directions:-

"After derailed deliberations, the EAC observed that the ESZ division of the Ministry has confirmed that the project area falls partly within the ESZ boundary of Bhagwan Mahaveer Wildlife Sanctuary, however, the project

proponent is still claiming that the project area is outside the ESZ of Bhagwan Mahaveer Wildlife Sanctuary and Western Ghats Eco-Sensitive Area (ESA). Accordingly, the EAC was of the view that Ministry's Regional Office (IRO), Bangalore and a Senior Officer from Forest Department, Government of Goa and a Senior Officer from Directorate of Mines and Geology, Government of Goa may be requested for a joint visit to the site for ground truthing and submit the report to the Ministry. Based on the discussions held, the EAC deferred the proposal".

In view of above, it is requested that a joint visit to the site for ground truthing may please be held at the earliest. For this purpose, Shri Abhir Hede, Dy. Director II (Contact No.9764214183) from this Directorate is nominated for the proposed visit and coordination with the nominated members from Forest Department and Ministry's Regional Office (IRO), Bangalore.

Therefore, you are kindly requested to nominate a Senior Officer from your Department for the proposed site visit as directed by EAC and it is suggested that the proposed site visit may be held preferably on or before 10th Sept. 2023 if possible, so as to expedite resumption of mining in the State.

An early response in this regard would be obliged.

Yours faithfully

Encl: EAC meeting minutes

(Dr. S. Shanbhouge)
Director

Copy to:

1. The Member Secretary
   IA-Division, Non-Coal Mining,
   Ministry of Environment, Forest and Climate Change,
   Government of India, Indira Paryavaran Bhavan,
   Jor Bhag Road, Aliganj, New Delhi.
   110003
   Email: Pankaj.verma@nic.in

2. Fomento Resources Pvt. Ltd.,
   1st Floor, 102, Kamat Metropolis-1,
   Behind Caculo Mall, St. Inez,
   Panaji, Goa.403001.

सत्यमेव जयते

Government of India
Ministry of Environment, Forest and Climate Change
IA Division
(Non-Coal Mining)
***

Minutes of AGENDA FOR 19th EAC MEETING OF THE EXPERT APPRAISAL COMMITTEE (NON-COAL MINING SECTOR), SCHEDULED TO BE HELD DURING 24 – 25 AUGUST, 2023 THROUGH VIDEO CONFERENCE. Expert Appraisal Committee meeting Non-Coal Mining held from 24/08/2023 to 25/08/2023

Date: 30/08/2023

MoM ID: EC/MOM/EAC/927221/8/2023

Agenda ID: EC/AGENDA/EAC/927221/8/2023

Meeting Venue: N/A

Meeting Mode: Virtual

Date & Time:

24/08/2023	10:30 AM	05:30 PM
25/08/2023	10:30 AM	05:30 PM

1. Opening remarks

The 19th meeting of the Re-constitution of Expert Appraisal Committee (EAC) for Environmental Appraisal of Mining Projects (Non-Coal) of the Ministry of Environment, Forest and Climate Change was held during 24-25 August, 2023 through video conference. The list of participants is annexed herewith. After login of the Committee Members through video conference link provided by NIC, discussion on each of the Agenda Items was taken up ad-seriatim.

2. Confirmation of the minutes of previous meeting

The minutes of the 18thEAC meeting held during 31stJuly & 1st August, 2023 were placed before the members of the EAC.

3. Details of proposals considered by the committee

Day 1 -24/08/2023

3.1. Agenda Item No 1:

3.1.1. Details of the proposal

Revalidation of EC under MoEF&CC Notification S.O 1530(E) dated 06th April, 2018 for Lakheri Limestone Mine (ML Area 1516.88 ha) with production capacity of 1.5 MTPA and waste/ topsoil 11.25 Lakhs CuM per annum (Maximum) with existing Wobbler and screening plant of 400 TPH at villages Gendoli Kala, GendoliKhurdh, Pholai, Gutha, Mahuwa, Dangaheri, Budel, Kankra, Chamavali, Uttarana, Lkaheri, Sakhoda, Nayagaon & Papadi, Tehsil: Indergarh&Kesoraipatan, District: Bundi, Rajasthan of M/s ACC Limited. by SANDEEP KUMAR located at BUNDI,RAJASTHAN

	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.

3.4. Agenda Item No 4:

3.4.1. Details of the proposal

Block IV – Kalay Mineral Block by FOMENTO RESOURCES PRIVATE LIMITED located at SOUTH GOA,GOA			
Proposal For		**Fresh ToR**	
Proposal No	**File No**	**Submission Date**	**Activity (Schedule Item)**
IA/GA/MIN/422578/2023	IA-J-11015/11/2023-IA-II(NCM)	24/04/2023	Mining of minerals (1(a))

3.4.2. Project Salient Features

1. The instant proposal is for mining of Iron Ore in Kalay Mineral Block - Block IV (Auction Block) of M/s Fomento Resources Private Limited with proposed production capacity of 0.75 MTPA, Waste: 3.0 MTPA in the mine lease area of 152.5073 Ha, located at Village Santona, Sanguem Taluka, South Goa District, Goa.

2. The details of the project as ascertained from the documents submitted by the Project Proponent and as revealed from the discussions held during the meeting are given as under:

i. The mine lease area is located between Latitude: 15°17'01.6125" N to 15°18' 08.7974" N and Longitude: 74°08'55.2583" E to 74°09'44.8333" E. The mine lease area falls under the Survey of India Toposheet No: D43C3and falls in Seismic Zone-II.

ii. The proposed project activity is listed at schedule no. 1(a) Mining of Minerals and instant proposal attracts the general conditions as the mine lease area is located within 5km radius of BhagwanMahavir Wildlife Sanctuary and falls under Category "A" and appraised at the Central level.

iii. The proposal was earlier considered in the 15thEAC (Non-Coal Mining) meeting held during 30-31 May, 2023 wherein the EAC deferred the proposal for want of requisite information. Then, the Project Proponent submitted the information on 22.06.2023 in Parivesh portal and accordingly the proposal was considered in the 17th EAC (Non-Coal Mining) meeting held during 11-12 July, 2023. After detailed deliberations made by the Project Proponent and the Consultant, the EAC again deferred the proposal and was of the view that the proposal may be considered only after obtaining the comments from the ESZ Division. The Project Proponent vide letter dated 26.07.2023 informed to the Ministry that the ESZ Division of Ministry by oversight has observed that, one of the point (15° 18'08.7974" N, 74°09'44.8333" E) of the project is lying inside both the ESZ boundary of BhagwanMahaveer Wildlife Sanctuary & National Park and WGESA boundary as per the 5th draft notification of the WGESA dated 06.07.2022. The Project Proponent also requested to consider the proposal for grant of Terms of Reference or in an alternate to provide the personal hearing to explain the matter. The ESZ Division gave their comments on 27.07.2023 in the instant matter. Accordingly, the proposal was again reconsidered in the 19th EAC (Non-Coal Mining) meeting held during 24-25 August, 2023.

Based on observation of EAC in its EAC meeting held during 11-12 July, 2023 and compliance of observation of EAC are detailed below:

S. No	Observation of EAC in its meeting held during 11-12 July, 2023	Reply by Project Proponent
1	The EAC observed that both the letter dated 05.07.2023 and 07.07.2023 does not mention about the Western Ghats	The ESZ Division gave their following comments on 27.07.2023 as given below: -

	ESA. The EAC opined that the Ministry may again the refer the matter to the ESZ Division with reference to the letter issued by the Dy. Conservator of Forest dated 05.07.2023 and Directorate of Mines & Geology dated 07.07.2023 as submitted by the Project Proponent.	1. The ESZ Division has informed that the Kalay mineral block falls partly within the ESZ boundary of Bhagwan Mahaveer Wildlife Sanctuary. And w.r.t. draft WGESA boundary, the ESZ Division has informed that the kml of kalay mineral block is outside the kml of draft WGESA boundary. 2. The ESZ Division has also informed that the Hon'ble Supreme Court by way of a clarification vide an Order dated 28.04.2023 in IA No. 3949 of 2016 in W.P (C) No. 202 of 1995: T.N GodavarmanThirumulpad Vs UoI&Ors. clarified that in specific terms that mining within 1.0 km from the boundary of the protected area shall be strictly prohibited. It also specified that even if the ESZ is less than 1.0 km, mining within 1.0 km from the boundary of the Protected Area, even beyond ESZ boundary shall be strictly prohibited.

3.4.3. Deliberations by the EAC in previous meetings

Date of EAC 1 :31/05/2023

Deliberations of EAC 1 :

The Project Proponent/Consultant presented the KML file to indicate the site features in the study area of 10 km radius. The Project Proponent has shown the boundary of the mine lease area and informed that there are three pits exist within the mine lease area. The Project Proponent has shown the two proposed transportation routes from Kalay Block to Sanvordem Jetty/Capxem Jetty via Ambeudoc Sanvordem Junction and another route from Kalay Block to Sanvordem Jetty/Capxem Jetty via Bandoli Sanvordem Junction. Bhagwan Mahavir Wildlife Sanctuary is located at a distance of 1.04 km, E from the boundary of the mine lease area. Santona Village is a not a part of ESA of Western Ghats. The EAC asked the Project Proponent whether letter has been obtained from the Forest Dept. in this regard. The Project Proponent informed the EAC that they are in the process of obtaining letter from the Forest Dept.

The Project Proponent also informed the EAC that the Dept. of Mining & Geology has informed that the revised area of 152.5073 Ha is excluding the Eco Sensitive Zone (ESZ) area of 26.6753 Ha. The EAC observed that the Final Notification on Bhagwan Mahaveer Wildlife Sanctuary and National Park, Goa was published vide S.O. 221(E) dated 23.01.2015. As per the Notification, the extent of Eco-sensitive Zone shall be one kilometre of land or the water body whichever is nearer to the boundary of the Bhagwan Mahaveer Wildlife Sanctuary and National Park in the State of Goa. The EAC also observed that the Village Santona is partially falling within the ESZ Boundary. The EAC opined that the Ministry may seek comments from the ESZ Division in the Ministry regarding whether the instant mine lease area falls within the ESZ/ESA or not.

Kalay River is located adjacent to the mine lease area on the eastern side. The transportation route passes through the village road. The width of the road is more than 12m. Tippers of 10 Tonnes of capacity will be utilized for transportation. Railway line is running parallely to the mine lease area at a distance of 75m. The EAC asked the Project Proponent whether it is possible to evacuate the material through railways. The Project Proponent informed the EAC that they will try to explore this option. Habitations exist within the mine lease area and do not fall in the proposed working area. In the next five years, the mining activity will not close to the habitation. The EAC opined that the habitations inside the mine lease area need to be shifted. The Project Proponent informed the EAC that one court case has been filed in Hon'ble High Court of Bombay at Goa vide Writ Petition 592 of 2022 to challenge the constitutionality of the tender documents of Phase I auction of Goa mines. As per the last order, Fomento Resources Private Limited is added as a party to the petition as it has acquired Block IV- Kalay Mineral Block in e-auction tendered vide NIT dated 30/09/2022. No stay on conducting the e-auction of Mineral Block granted and the Case is pending for disposal. Based on the above discussions, the EAC **deferred** the proposal for want of following additional information:-

i. The EAC opined that the Ministry may seek comments from the ESZ Division in the Ministry regarding whether the instant mine lease area falls within the ESZ of Bhagwan Mahaveer Wildlife Sanctuary and National Park / ESA of Western Ghats or not.

ii. The Project Proponent needs to submit the map demarcating the location of the mine lease area w.r.t ESA of Western Ghats and ESZ of Bhagwan Mahaveer Wildlife Sanctuary and National Park.

Date of EAC 2 :11/07/2023

Deliberations of EAC 2 :

Observation and Recommendation of the EAC:

The EAC deliberated on the additional details submitted by the Project Proponent and the Consultant. The EAC noted the comments from the ESZ Division that one of the point (15°18'08.7974" N, 74°09'44.8333" E) is lying inside both the ESZ of Bhagwan Mahaveer Wildlife Sanctuary and National Park, Goa and the WGESA boundary as per the 5th draft notification of the WGESA, dated 06.07.2022. The distance as estimated between the point location (15°18'08.7974" N, 74°09' 44.8333" E), and the Bhagwan Mahaveer NP & WLS, Goa is approx. 0.7526 km (less than 1 km).The Project Proponent informed the EAC that as per letter issued by the Dy. Conservator of Forest dated 05.07.2023 and Directorate of Mines & Geology dated 07.07.2023, the proposed Block-IV Kalay Mineral Block located at Santona Village Sanguem Taluka, South Goa District, Goa falls outside notified ESZ boundary of Bhagwan Mahavir Wildlife Sanctuary and National Park.

The EAC observed that both the letter dated 05.07.2023 and 07.07.2023 does not mention about the Western Ghats ESA. The EAC opined that the Ministry may again the refer the matter to the ESZ Division with reference to the letter issued by the Dy. Conservator of Forest dated 05.07.2023 and Directorate of Mines & Geology dated 07.07.2023 as submitted by the Project Proponent. Therefore, the EAC **deferred** the proposal and was of the view that the proposal may be considered only after obtaining the comments from the ESZ Division.

3.4.4. Deliberations by the EAC in current meetings

The EAC deliberated on the additional details submitted by the Project Proponent and the Consultant. The EAC noted the comments of the ESZ Division that the Kalay mineral block falls partly within the ESZ boundary of Bhagwan Mahaveer Wildlife Sanctuary and w.r.t. draft WGESA boundary, the kml of kalay mineral block is outside the kml of draft WGESA boundary.

The Project Proponent has informed the EAC that the Letter of Intent (LoI) was granted on 13.01.2023 over an area of 179.1826 ha comprised of an area which was forming part of the Eco-Sensitive Zone (ESZ) of Bhagwan Mahaveer Wild Life Sanctuary & National Park. Then, the requisition letter was submitted to the Directorate of Mines and Geology, Government of Goa on 31.01.2023for deletion of area approximately 26.6753 ha falling within 1km from the boundary of Eco Sensitive Zone (ESZ) w.r.t Block IV – Kalay Mineral Block. Accordingly, the Directorate of Mines and Geology vide letter dated 13.03.2023 revised the area of Block IV – Kalay Mineral Block from 179.1826 ha to 152.5073 ha and the revised area was excluding the Eco Sensitive Zone (ESZ) area of 26.6753 ha. The Project Proponent also showed the DGPS Plan before and after deletion of the 26.6753 ha, authenticated map from the Deputy Conservator of Forest and map showing the distance of the ESZ of boundary of Eco Sensitive Zone (ESZ) from the mine lease area i.e. is 1.04 km and 1.12 km respectively. Further, the Project Proponent also informed the EAC that the Village Santona is not listed in the Western Ghats ESA as per notification dated 06.07.2022.

After derailed deliberations, the EAC observed that the ESZ division of the Ministry has confirmed that the project area falls partly within the ESZ boundary of Bhagwan Mahaveer Wildlife Sanctuary, however, the project proponent is still claiming that the project area is outside the ESZ of Bhagwan Mahaveer Wildlife Sanctuaryand Western Ghats Eco-Sensitive Area (ESA). Accordingly, the EAC was of view that Ministry's Regional Office (IRO), Bangalore and a Senior Officer from Forest Department, Government of Goa and a Senior Officer from Directorate of Mines and Geology, Government of Goa may be requested for a joint visit to the site for ground truthing and submit the report to the Ministry. Based on the discussions held, the EAC **deferred** the proposal.

3.4.5. Recommendation of EAC

Deferred for ADS

3.5. Agenda Item No 5:

3.5.1. Details of the proposal

Enhancement of Ore production [2000-3000TPD] and Processing plant [3000-4000TPD] of Hutti Gold Mine (within the existing premises/Mining Lease Area, without additional land acquisition) by THE HUTTI GOLD MINES COMPANY LIMITED located at RAICHUR,KARNATAKA			
Proposal For		Fresh ToR	
Proposal No	**File No**	**Submission Date**	**Activity (Schedule Item)**
IA/KA/MIN/436624/2023	J-11015/13/2003.IA.II (M)	05/08/2023	Mining of minerals (1(a))

3.5.2. Project Salient Features

1. The instant proposal is for Terms of Reference of M/s The Hutti Gold Mines Company Limited for expansion in production capacity from 0.6 MTPA to 0.9 MTPA (2000 TPD to 3000 TPD) and enhancement of processing plant capacity of 0.9 MTPA – 1.2 MTPA (3000 TPD to 4000 TPD) in the mine lease area of 528.35 ha, located at Hutti Village, Lingsugur Taluk, Raichur District, Karnataka.
2. The details of the project as ascertained from the documents submitted by the Project Proponent and as revealed from the discussions held during the meeting are given as under:

i. The mine lease area is located between Latitude: 16°12'29.55813''N to 16°11'57.54790''N and Longitude: 76°39'38.73430" E to 76°39'42.06560"E. The mine lease area falls under the Survey of India Toposheet No: 56 D/12.

ii. The proposed project activity is listed at schedule no. 1(a) Mining of Minerals and 2(b) Mineral Beneficiation and falls under Category "A" as the mine lease area is greater than 250ha and appraised at the Central level.

Re: Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Limited-reg.

From : Dir Mines, Goa | dir-mine.goa@nic.in <dir-mine.goa@nic.in> Tue, Oct 03, 2023 12:24 PM
Subject : Re: Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Limited-reg.
To : Suresh Kumar Adapa <suresh.adapa@gov.in>

Sir,

I am directed to inform that the team of this Directorate will attend the joint inspection scheduled on 5th October 2023 in respect of Block IV.

Regards,
N. D'Silva,
Assistant Geologist,
Directorate of Mines & Geology,
Govt. of Goa.

From: "Suresh Kumar Adapa" <suresh.adapa@gov.in>
To: "Principal Chief Conservator Forest Dept Goa" <pccf-fore.goa@gov.in>
Cc: "Deputy Conservator of Forests Head Quarter" <dcfhq-forest.goa@nic.in>, "Dir Mines, Goa | dir-mine.goa@nic.in" <dir-mine.goa@nic.in>
Sent: Monday, September 25, 2023 4:06:35 PM
Subject: Fwd: Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Limited-reg.

From: "Suresh Kumar Adapa" <suresh.adapa@gov.in>
To: "pccf fore goa" <pccf_fore.goa@gov.in>
Cc: "dcfhq forest goa" <dcfhq_forest.goa@nic.in>, "dir mine goa" <dir_mine.goa@nic.in>, "Pankaj Verma" <pankaj.verma@nic.in>, "MoEF & CC IRO Bangalore" <rosz.bng-mef@nic.in>
Sent: Monday, September 25, 2023 3:44:51 PM
Subject: Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Limited-reg.

Sir,

This has reference to trailing mail. The EAC (Non Coal Mining) considered the subject proposal in the 19th meeting held from 24th to 25th August 2023 and observed that:

" **The ESZ division of the Ministry has confirmed that the project area falls partly within the ESZ boundary of Bhagwan Mahaveer Wildlife Sanctuary, however, the project proponent is still claiming that the project area is outside the ESZ of Bhagwan Mahaveer Wildlife Sanctuary and Western Ghats Eco Sensitive Area (ESA). Accordingly, the EAC was of view that Ministry's Regional Office (IRO), Bangalore and a Senior Officer from Forest Department, Government of Goa and a Senior Officer from Directorate of Mines and Geology, Government of Goa may be requested for a joint visit to the site for ground truthing and submit the report to the Ministry**."

In view of the above a joint inspection is planned on 5th October 2023 (tentatively). The nomination from the Directorate of Mines and Geology, Government of Goa was already received vide letter dated 01.09.2023.
The State Forest Department, Government of Goa is requested to depute a senior officer for the above inspection.

Suresh Kumar Adapa
Scientist 'E'/ Additional Director
Regional Office, MoEF&CC Bengaluru.

From: "MoEF & CC IRO Bangalore" <rosz.bng-mef@nic.in>
To: "Suresh Kumar Adapa" <suresh.adapa@gov.in>
Sent: Monday, September 25, 2023 1:14:12 PM
Subject: [PLEASE OPEN THE ATTACHMENT WITH CAUTION]Fwd: Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Limited for mining of Iron Ore with proposed production capacity of 0.75 MTPA, Waste: 3.0 MTPA in the mine lease area of 152.5073 Ha, located at Village Santona, Sanguem Taluka, South Goa District, Goa – [Proposal No: IA/GA/MIN/422578/2023] - Terms of Reference (ToR) regarding

---

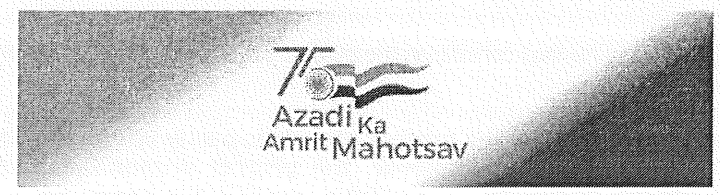
From: "Raj Kapoor" <rk.sarwan@gov.in>
To: "MoEF & CC IRO Bangalore" <rosz.bng-mef@nic.in>, "pccf fore goa" <pccf_fore.goa@gov.in>, "dcfhq forest goa" <dcfhq_forest.goa@nic.in>, "dir mine goa" <dir_mine.goa@nic.in>
Cc: morazkar@ilpl.biz, "Pankaj Verma" <pankaj.verma@nic.in>
Sent: Monday, September 25, 2023 12:09:29 PM
Subject: Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Limited for mining of Iron Ore with proposed production capacity of 0.75 MTPA, Waste: 3.0 MTPA in the mine lease area of 152.5073 Ha, located at Village Santona, Sanguem Taluka, South Goa District, Goa – [Proposal No: IA/GA/MIN/422578/2023] - Terms of Reference (ToR) regarding

Respected Sir

Please find the attachment ministry vide letter dated 25.09.2023.

--
सस्नेह / With Regards

राज कपूर / Raj Kapoor
सहायक अनुभाग अधिकारी / Assistant Section Officer
उद्योग-1 और गैर-कोयला खनन क्षेत्र (प्रभाव आकलन-II) / Industry-I and Non-Coal Mining Sector (Impact Assessment-II)
पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय / Ministry of Environment, Forest and Climate Change,
कमरा नंबर वी-329, तीसरी मंजिल, वायु विंग / Room No. V-329, 3rd Floor, Vayu Wing,
इंदिरा पर्यावरण भवन, जोरबाग रोड, अलीगंज / Indira Paryavaran Bhawan, Jorbagh Road, Aliganj,
नई दिल्ली - 110003 / New Delhi - 110003
Cont: 06377770646
09868757286
Email: rk.sarwan@gov.in, rajkapoorsarwan9@gmail.com





From : Suresh Kumar Adapa <suresh.adapa@gov.in> Mon, Sep 25, 2023 04:06 PM
Subject : Fwd: Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Limited-reg. 2 attachments
To : Principal Chief Conservator Forest Dept Goa <pccf-fore.goa@gov.in>
Cc : Deputy Conservator of Forests Head Quarter <dcfhq-forest.goa@nic.in>, Dir Mines, Goa | dir-mine.goa@nic.in <dir-mine.goa@nic.in>

From: "Suresh Kumar Adapa" <suresh.adapa@gov.in>
To: "pccf fore goa" <pccf_fore.goa@gov.in>
Cc: "dcfhq forest goa" <dcfhq_forest.goa@nic.in>, "dir mine goa" <dir_mine.goa@nic.in>, "Pankaj Verma" <pankaj.verma@nic.in>, "MoEF & CC IRO Bangalore" <rosz.bng-mef@nic.in>
Sent: Monday, September 25, 2023 3:44:51 PM
Subject: Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Limited-reg.

Sir,

This has reference to trailing mail. The EAC (Non Coal Mining) considered the subject proposal in the 19th meeting held from 24th to 25th August 2023 and observed that:

" **The ESZ division of the Ministry has confirmed that the project area falls partly within the ESZ boundary of Bhagwan Mahaveer Wildlife Sanctuary, however, the project proponent is still claiming that the project area is outside the ESZ of Bhagwan Mahaveer Wildlife Sanctuary and Western Ghats Eco Sensitive Area (ESA). Accordingly, the EAC was of view that Ministry's Regional Office (IRO), Bangalore and a Senior Officer from Forest Department, Government of Goa and a Senior Officer from Directorate of Mines and Geology, Government of Goa may be requested for a joint visit to the site for ground truthing and submit the report to the Ministry.**"

In view of the above a joint inspection is planned on 5th October 2023 (tentatively). The nomination from the Directorate of Mines and Geology, Government of Goa was already received vide letter dated 01.09.2023.
The State Forest Department, Government of Goa is requested to depute a senior officer for the above inspection.

Suresh Kumar Adapa
Scientist 'E'/ Additional Director
Regional Office, MoEF&CC Bengaluru.

From: "MoEF & CC IRO Bangalore" <rosz.bng-mef@nic.in>
To: "Suresh Kumar Adapa" <suresh.adapa@gov.in>
Sent: Monday, September 25, 2023 1:14:12 PM
Subject: [PLEASE OPEN THE ATTACHMENT WITH CAUTION]Fwd: Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Limited for mining of Iron Ore with proposed production capacity of 0.75 MTPA, Waste: 3.0 MTPA in the mine lease area of 152.5073 Ha, located at Village Santona, Sanguem Taluka, South Goa District, Goa – [Proposal No: IA/GA/MIN/422578/2023] - Terms of Reference (ToR) regarding

---

From: "Raj Kapoor" <rk.sarwan@gov.in>
To: "MoEF & CC IRO Bangalore" <rosz.bng-mef@nic.in>, "pccf fore goa" <pccf_fore.goa@gov.in>, "dcfhq forest goa" <dcfhq_forest.goa@nic.in>, "dir mine goa" <dir_mine.goa@nic.in>
Cc: morazkar@ilpl.biz, "Pankaj Verma" <pankaj.verma@nic.in>
Sent: Monday, September 25, 2023 12:09:29 PM
Subject: Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Limited for mining of Iron Ore with proposed production capacity of 0.75 MTPA, Waste: 3.0 MTPA in the mine lease area of 152.5073 Ha, located at Village Santona, Sanguem Taluka, South Goa District, Goa – [Proposal No: IA/GA/MIN/422578/2023] - Terms of Reference (ToR) regarding

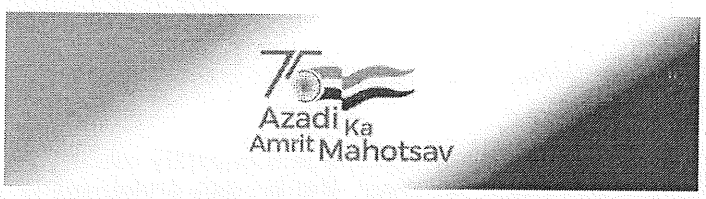
Respected Sir

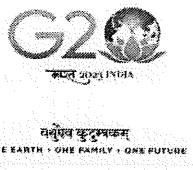
Please find the attachment ministry vide letter dated 25.09.2023.

--
सस्नेह / With Regards

राज कपूर / Raj Kapoor

सहायक अनुभाग अधिकारी / Assistant Section Officer
उद्योग-1 और गैर-कोयला खनन क्षेत्र (प्रभाव आकलन-II) / Industry-I and Non-Coal Mining Sector (Impact Assessment-II)
पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय / Ministry of Environment, Forest and Climate Change,
कमरा नंबर वी-329, तीसरी मंजिल, वायु विंग / Room No. V-329, 3rd Floor, Vayu Wing,
इंदिरा पर्यावरण भवन, जोरबाग रोड, अलीगंज / Indira Paryavaran Bhawan, Jorbagh Road, Aliganj,
नई दिल्ली - 110003 / New Delhi - 110003
Cont: 06377770646
09868757286
Email: rk.sarwan@gov.in, rajkapoorsarwan9@gmail.com





DMG Communication Query Raised in th 19th EAC Meet (4).pdf
747 KB

fomento-09252023115848.pdf
2 MB

From : Suresh Kumar Adapa <suresh.adapa@gov.in> Mon, Sep 25, 2023 03:44 PM
Subject : Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Limited-reg. 2 attachments
To : pccf fore goa <pccf_fore.goa@gov.in>
Cc : dcfhq forest goa <dcfhq_forest.goa@nic.in>, dir mine goa <dir_mine.goa@nic.in>, Pankaj Verma <pankaj.verma@nic.in>, MoEF & CC IRO Bangalore <rosz.bng-mef@nic.in>

Sir,

This has reference to trailing mail. The EAC (Non Coal Mining) considered the subject proposal in the 19th meeting held from 24th to 25th August 2023 and observed that:

" **The ESZ division of the Ministry has confirmed that the project area falls partly within the ESZ boundary of Bhagwan Mahaveer Wildlife Sanctuary, however, the project proponent is still claiming that the project area is outside the ESZ of Bhagwan Mahaveer Wildlife Sanctuary and Western Ghats Eco Sensitive Area (ESA). Accordingly, the EAC was of view that Ministry's Regional Office (IRO), Bangalore and a Senior Officer from Forest Department, Government of Goa and a Senior Officer from Directorate of Mines and Geology, Government of Goa may be requested for a joint visit to the site for ground truthing and submit the report to the Ministry**."

In view of the above a joint inspection is planned on 5th October 2023 (tentatively). The nomination from the Directorate of Mines and Geology, Government of Goa was already received vide letter dated 01.09.2023.

The State Forest Department, Government of Goa is requested to depute a senior officer for the above inspection.

Suresh Kumar Adapa
Scientist 'E'/ Additional Director
Regional Office, MoEF&CC Bengaluru.

From: "MoEF & CC IRO Bangalore" <rosz.bng-mef@nic.in>
To: "Suresh Kumar Adapa" <suresh.adapa@gov.in>

Sent: Monday, September 25, 2023 1:14:12 PM
Subject: [PLEASE OPEN THE ATTACHMENT WITH CAUTION]Fwd: Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Limited for mining of Iron Ore with proposed production capacity of 0.75 MTPA, Waste: 3.0 MTPA in the mine lease area of 152.5073 Ha, located at Village Santona, Sanguem Taluka, South Goa District, Goa – [Proposal No: IA/GA/MIN/422578/2023] - Terms of Reference (ToR) regarding

---

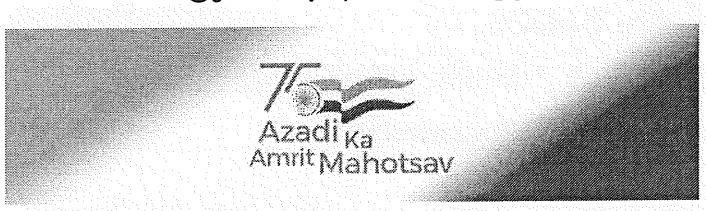
From: "Raj Kapoor" <rk.sarwan@gov.in>
To: "MoEF & CC IRO Bangalore" <rosz.bng-mef@nic.in>, "pccf fore goa" <pccf_fore.goa@gov.in>, "dcfhq forest goa" <dcfhq_forest.goa@nic.in>, "dir mine goa" <dir_mine.goa@nic.in>
Cc: morazkar@ilpl.biz, "Pankaj Verma" <pankaj.verma@nic.in>
Sent: Monday, September 25, 2023 12:09:29 PM
Subject: Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Limited for mining of Iron Ore with proposed production capacity of 0.75 MTPA, Waste: 3.0 MTPA in the mine lease area of 152.5073 Ha, located at Village Santona, Sanguem Taluka, South Goa District, Goa – [Proposal No: IA/GA/MIN/422578/2023] - Terms of Reference (ToR) regarding

Respected Sir

Please find the attachment ministry vide letter dated 25.09.2023.

--
सस्नेह / With Regards

राज कपूर / Raj Kapoor
सहायक अनुभाग अधिकारी / Assistant Section Officer
उद्योग-1 और गैर-कोयला खनन क्षेत्र (प्रभाव आकलन-II) / Industry-I and Non-Coal Mining Sector (Impact Assessment-II)
पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय / Ministry of Environment, Forest and Climate Change,
कमरा नंबर वी-329, तीसरी मंजिल, वायु विंग / Room No. V-329, 3rd Floor, Vayu Wing,
इंदिरा पर्यावरण भवन, जोरबाग रोड, अलीगंज / Indira Paryavaran Bhawan, Jorbagh Road, Aliganj,
नई दिल्ली - 110003 / New Delhi - 110003
Cont: 06377770646
09868757286
Email: rk.sarwan@gov.in, rajkapoorsarwan9@gmail.com





DMG Communication Query Raised in th 19th EAC Meet (4).pdf
747 KB

fomento-09252023115848.pdf
2 MB

Government of Goa
Office of Principal Chief Conservator of Forests
Forest Department
Goa Van Bhawan, Old IPHB Complex;
Altinho, Panaji Goa – 403 001

No.2-57-WL-ESZ-Vol.III-FD/23-24/3266 Dated: - 03.10.2023

To,
The Scientist 'E' / Additional Director,
Regional Office,
Ministry of Environment, Forests & Climate Change,
Bengaluru.

Sub:- Kalay Mineral Block – Block IV (Auction Block) of M/s Fomento Resources Private Limited – reg.

Sir,

With reference to your email dated 25/09/2023 on the above cited subject, it is to inform that the Dy. Conservator of Forests, North Goa Division, Ponda has been deputed for joint inspection which is planned on **5th October, 2023**. The contact details are as under:-

Name of the officer:-	Jiss K. Varkey, IFS
Designation:-	Dy. Conservator of Forests, North Goa Division
Contact No:-	08322312856 / 08322312095 / 7030069886
Email Id:-	**dcfnorth-forest.goa@nic.in**

Yours faithfully,

Santosh H. Fadte
Dy. Conservator of Forests
Planning & Statistics

Copy to:-

The Dy. Conservator of Forests, North Goa Division, Ponda – Goa alongwith enclosures for information and necessary action

Ph.No. 0832-2492527 Email: dcfps-forest.goa@nic.in

"Swach Bharat Nital Goem"
Towards Greener and Cleaner Goa

2263/FM 27/09/23 351 28/09/23

Email

Deputy Conservator of Forests Head Quarter 2081

Fwd: Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Limited-reg.

From : Suresh Kumar Adapa <suresh.adapa@gov.in> Mon, Sep 25, 2023 04:18 PM

Subject : Fwd: Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Limited-reg. 2 attachments

To : Principal Chief Conservator Forest Dept Goa <pccf-fore.goa@gov.in>

Cc : Deputy Conservator of Forests Head Quarter <dcfhq-forest.goa@nic.in>, Dir Mines, Goa | dir-mine.goa@nic.in <dir-mine.goa@nic.in>

Office of the P.C.C.F
Inward No. 7561
Book No. 06/23
Date 26/9/2023

From: "Suresh Kumar Adapa" <suresh.adapa@gov.in>
To: "pccf fore goa" <pccf_fore.goa@gov.in>
Cc: "dcfhq forest goa" <dcfhq_forest.goa@nic.in>, "dir mine goa" <dir_mine.goa@nic.in>, "Pankaj Verma" <pankaj.verma@nic.in>, "MoEF & CC IRO Bangalore" <rosz.bng-mef@nic.in>
Sent: Monday, September 25, 2023 3:44:51 PM
Subject: Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Limited-reg.

Sir,

This has reference to trailing mail. The EAC (Non Coal Mining) considered the subject proposal in the 19th meeting held from 24th to 25th August 2023 and observed that:

" **The ESZ division of the Ministry has confirmed that the project area falls partly within the ESZ boundary of Bhagwan Mahaveer Wildlife Sanctuary, however, the project proponent is still claiming that the project area is outside the ESZ of Bhagwan Mahaveer Wildlife Sanctuary and Western Ghats Eco Sensitive Area (ESA). Accordingly, the EAC was of view that Ministry's Regional Office (IRO), Bangalore and a Senior Officer from Forest Department, Government of Goa and a Senior Officer from Directorate of Mines and Geology, Government of Goa may be requested for a joint visit to the site for ground truthing and submit the report to the Ministry.**"

In view of the above a joint inspection is planned on 5th October 2023 (tentatively). The nomination from the Directorate of Mines and Geology, Government of Goa was already received vide letter dated 01.09.2023.
The State Forest Department, Government of Goa is requested to depute a senior officer for the above inspection.

Suresh Kumar Adapa
Scientist 'E'/ Additional Director
Regional Office, MoEF&CC Bengaluru.

Asaboosty
26/09
DCF(MRE) - Copy
DCF(PRJ)

15/9/23 WL

2071





वसुधैव कुटुम्बकम्
ONE EARTH · ONE FAMILY · ONE FUTURE

— **DMG Communication Query Raised in th 19th EAC Meet (4).pdf**
747 KB

— **fomento-09252023115848.pdf**
2 MB

2061

Government of Goa
Directorate of Mines & Geology
Institute Menezes Braganza, Panaji-Goa

Website:dmg.goa.gov.in **E-mail: dir-mine.goa@nic.in**

No.03/18/2023/Major/Mines /1926 **Dated:** 01 /09/2023

To,
1. The Principal Chief Conservator of Forest,
Goa Van Bhavan,
Forest Department,
Altinho, Panaji,
Goa. 403001.
Email: dcfme-forest.goa@nic.in

2. The Dy. Director General of Forests (Central)
Ministry of Environment, Forest and Climate Change,
Integrated Regional Office,
Kendriya Sadan, IVth Floor, E&F Wing,
17th Main Road, II Block, Koramangala,
Banglore.560034.
Email:rosz.bng-mef@nic.in

Subject: Query raised dated 30/08/2023 for the proposal IA/GA/MIN/422578/2023 with respect to Block IV- Kalay Mineral Block in the 19th EAC Meeting of Expert Appraisal Commjttee (EAC) Non-Coal Mining Sector held on 24/08/2023.

Sir,

In order to expedite resumption of mining activity in the State, Government of Goa has so far auctioned 09 Iron Ore Mineral Blocks as per the Mineral Auction Rules, 2015. More mineral Blocks are proposed for auction shortly.

The Block - IV Kalay Mineral Block was won by Fomento Resources Pvt. Ltd. in the auction process. Letter of Intent (LOI) has been issued to the winning bidder. Accordingly, Fomento Resources Pvt. Ltd. have applied for TOR for getting Environmental Clearance from the Ministry of Environment, Forest and Climate Change.

In the 19th EAC Meeting of Expert Appraisal Committee (EAC) Non-Coal Mining

proponent is still claiming that the project area is outside the ESZ of Bhagwan Mahaveer Wildlife Sanctuary and Western Ghats Eco-Sensitive Area (ESA). Accordingly, the EAC was of the view that Ministry's Regional Office (IRO), Bangalore and a Senior Officer from Forest Department, Government of Goa and a Senior Officer from Directorate of Mines and Geology, Government of Goa may be requested for a joint visit to the site for ground truthing and submit the report to the Ministry. Based on the discussions held, the EAC deferred the proposal".

In view of above, it is requested that a joint visit to the site for ground truthing may please be held at the earliest. For this purpose, Shri Abhir Hede, Dy. Director II (Contact No.9764214183) from this Directorate is nominated for the proposed visit and coordination with the nominated members from Forest Department and Ministry's Regional Office (IRO), Bangalore.

Therefore, you are kindly requested to nominate a Senior Officer from your Department for the proposed site visit as directed by EAC and it is suggested that the proposed site visit may be held preferably on or before 10th Sept. 2023 if possible, so as to expedite resumption of mining in the State.

An early response in this regard would be obliged.

Yours faithfully

Encl: EAC meeting minutes

(Dr. S. Shanhbhouge)
Director

Copy to:

1. The Member Secretary
   IA-Division, Non-Coal Mining,
   Ministry of Environment, Forest and Climate Change,
   Government of India, Indira Paryavaran Bhavan,
   Jor Bhag Road, Aliganj, New Delhi.
   110003
   Email: Pankaj.verma@nic.in

2. Fomento Resources Pvt. Ltd.,
   1st Floor, 102, Kamat Metropolis-1,

सत्यमेव जयते

Government of India
Ministry of Environment, Forest and Climate Change
IA Division
(Non-Coal Mining)
***

Minutes of AGENDA FOR 19th EAC MEETING OF THE EXPERT APPRAISAL COMMITTEE (NON-COAL MINING SECTOR), SCHEDULED TO BE HELD DURING 24 – 25 AUGUST, 2023 THROUGH VIDEO CONFERENCE. Expert Appraisal Committee meeting Non-Coal Mining held from 24/08/2023 to 25/08/2023

Date: 30/08/2023

MoM ID: EC/MOM/EAC/927221/8/2023

Agenda ID: EC/AGENDA/EAC/927221/8/2023

Meeting Venue: N/A

Meeting Mode: Virtual

Date & Time:

24/08/2023	10:30 AM	05:30 PM
25/08/2023	10:30 AM	05:30 PM

1. Opening remarks

The 19th meeting of the Re-constitution of Expert Appraisal Committee (EAC) for Environmental Appraisal of Mining Projects (Non-Coal) of the Ministry of Environment, Forest and Climate Change was held during 24-25 August, 2023 through video conference. The list of participants is annexed herewith. After login of the Committee Members through video conference link provided by NIC, discussion on each of the Agenda Items was taken up ad-seriatim.

2. Confirmation of the minutes of previous meeting

The minutes of the 18thEAC meeting held during 31stJuly & 1st August, 2023 were placed before the members of the EAC.

3. Details of proposals considered by the committee

Day 1 - 24/08/2023

	modifications arising out of the P.H. process) will entail conducting the PH again with the revised documentation. b) 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.

3.4. Agenda Item No 4:

3.4.1. Details of the proposal

Block IV – Kalay Mineral Block by **FOMENTO RESOURCES PRIVATE LIMITED** located at **SOUTH GOA,GOA**			
Proposal For		Fresh ToR	
Proposal No	**File No**	**Submission Date**	**Activity (Schedule Item)**
IA/GA/MIN/422578/2023	IA-J-11015/11/2023-IA-II(NCM)	24/04/2023	Mining of minerals (1(a))

3.4.2. Project Salient Features

1. The instant proposal is for mining of Iron Ore in Kalay Mineral Block - Block IV (Auction Block) of M/s Fomento Resources Private Limited with proposed production capacity of 0.75 MTPA, Waste: 3.0 MTPA in the mine lease area of 152.5073 Ha, located at Village Santona, Sanguem Taluka, South Goa District, Goa.

2. The details of the project as ascertained from the documents submitted by the Project Proponent and as revealed from the discussions held during the meeting are given as under:

i. The mine lease area is located between Latitude: 15°17'01.6125" N to 15°18' 08.7974" N and Longitude: 74°08'55.2583" E to 74°09'44.8333" E. The mine lease area falls under the Survey of India Toposheet No: D43C3and falls in Seismic Zone-II.

ii. The proposed project activity is listed at schedule no. 1(a) Mining of Minerals and instant proposal attracts the general conditions as the mine lease area is located within 5km radius of BhagwanMahavir Wildlife Sanctuary and falls under Category "A" and appraised at the Central level.

iii. The proposal was earlier considered in the 15thEAC (Non-Coal Mining) meeting held during 30-31 May, 2023 wherein the EAC deferred the proposal for want of requisite information. Then, the Project Proponent submitted the information on 22.06.2023 in Parivesh portal and accordingly the proposal was considered in the 17th EAC (Non-Coal Mining) meeting held during 11-12 July, 2023. After detailed deliberations made by the Project Proponent and the Consultant, the EAC again deferred the proposal and was of the view that the proposal may be considered only after obtaining the comments from the ESZ Division. The Project Proponent vide letter dated 26.07.2023 informed to the Ministry that the ESZ Division of Ministry by oversight has observed that, one of the point (15° 18'08.7974" N, 74°09'44.8333" E) of the project is lying inside both the ESZ boundary of BhagwanMahaveer Wildlife Sanctuary & National Park and WGESA boundary as per the 5th draft notification of the WGESA dated 06.07.2022. The Project Proponent also requested to consider the proposal for grant of Terms of Reference or in an alternate to provide the personal hearing to explain the matter. The ESZ Division gave their comments on 27.07.2023 in the instant matter. Accordingly, the proposal was again reconsidered in the 19th EAC (Non-Coal Mining) meeting held during 24-25 August, 2023.

Based on observation of EAC in its EAC meeting held during 11-12 July, 2023 and compliance of observation of EAC are detailed below:

S. No	Observation of EAC in its meeting held during 11-12 July, 2023	Reply by Project Proponent
1	The EAC observed that both the letter dated 05.07.2023 and 07.07.2023 does not mention about the Western Ghats	The ESZ Division gave their following comments on 27.07.2023 as given below: -

Deliberations of EAC 1 :

The Project Proponent/Consultant presented the KML file to indicate the site features in the study area of 10 km radius. The Project Proponent has shown the boundary of the mine lease area and informed that there are three pits exist within the mine lease area. The Project Proponent has shown the two proposed transportation routes from Kalay Block to Sanvordem Jetty/Capxem Jetty via Ambeudoc Sanvordem Junction and another route from Kalay Block to Sanvordem Jetty/Capxem Jetty via Bandoli Sanvordem Junction. Bhagwan Mahavir Wildlife Sanctuary is located at a distance of 1.04 km, E from the boundary of the mine lease area. Santona Village is a not a part of ESA of Western Ghats. The EAC asked the Project Proponent whether letter has been obtained from the Forest Dept. in this regard. The Project Proponent informed the EAC that they are in the process of obtaining letter from the Forest Dept.

The Project Proponent also informed the EAC that the Dept. of Mining & Geology has informed that the revised area of 152.5073 Ha is excluding the Eco Sensitive Zone (ESZ) area of 26.6753 Ha. The EAC observed that the Final Notification on Bhagwan Mahaveer Wildlife Sanctuary and National Park, Goa was published vide S.O. 221(E) dated 23.01.2015. As per the Notification, the extent of Eco-sensitive Zone shall be one kilometre of land or the water body whichever is nearer to the boundary of the Bhagwan Mahaveer Wildlife Sanctuary and National Park in the State of Goa. The EAC also observed that the Village Santona is partially falling within the ESZ Boundary. The EAC opined that the Ministry may seek comments from the ESZ Division in the Ministry regarding whether the instant mine lease area falls within the ESZ/ESA or not.

Kalay River is located adjacent to the mine lease area on the eastern side. The transportation route passes through the village road. The width of the road is more than 12m. Tippers of 10 Tonnes of capacity will be utilized for transportation. Railway line is running parallely to the mine lease area at a distance of 75m. The EAC asked the Project Proponent whether it is possible to evacuate the material through railways. The Project Proponent informed the EAC that they will try to explore this option. Habitations exist within the mine lease area and do not fall in the proposed working area. In the next five years, the mining activity will not close to the habitation. The EAC opined that the habitations inside the mine lease area need to be shifted. The Project Proponent informed the EAC that one court case has been filed in Hon'ble High Court of Bombay at Goa vide Writ Petition 592 of 2022 to challenge the constitutionality of the tender documents of Phase I auction of Goa mines. As per the last order, Fomento Resources Private Limited is added as a party to the petition as it has acquired Block IV- Kalay Mineral Block in e-auction tendered vide NIT dated 30/09/2022. No stay on conducting the e-auction of Mineral Block granted and the Case is pending for disposal. Based on the above discussions, the EAC **deferred** the proposal for want of following additional information:-

i. The EAC opined that the Ministry may seek comments from the ESZ Division in the Ministry regarding whether the instant mine lease area falls within the ESZ of Bhagwan Mahaveer Wildlife Sanctuary and National Park / ESA of Western Ghats or not.

ii. The Project Proponent needs to submit the map demarcating the location of the mine lease area w.r.t ESA of Western Ghats and ESZ of Bhagwan Mahaveer Wildlife Sanctuary and National Park.

Date of EAC 2 :11/07/2023

Deliberations of EAC 2 :

Observation and Recommendation of the EAC:

The EAC deliberated on the additional details submitted by the Project Proponent and the Consultant. The EAC noted the comments from the ESZ Division that one of the point (15°18'08.7974" N, 74°09'44.8333" E) is lying inside both the ESZ of Bhagwan Mahaveer Wildlife Sanctuary and National Park, Goa and the WGESA boundary as per the 5th draft notification of the WGESA, dated 06.07.2022. The distance as estimated between the point location (15°18'08.7974" N, 74°09' 44.8333" E), and the Bhagwan Mahaveer NP & WLS, Goa is approx. 0.7526 km (less than 1 km).The Project Proponent informed the EAC that as per letter issued by the Dy. Conservator of Forest dated 05.07.2023 and Directorate of Mines & Geology dated 07.07.2023, the proposed Block-IV Kalay Mineral Block located at Santona Village Sanguem Taluka, South Goa District, Goa falls outside notified ESZ boundary of Bhagwan Mahavir Wildlife Sanctuary and National Park.

The EAC observed that both the letter dated 05.07.2023 and 07.07.2023 does not mention about the Western Ghats ESA. The EAC opined that the Ministry may again the refer the matter to the ESZ Division with reference to the letter issued by the Dy. Conservator of Forest dated 05.07.2023 and Directorate of Mines & Geology dated 07.07.2023 as submitted by the Project Proponent. Therefore, the EAC **deferred** the proposal and was of the view that the proposal may be considered only after obtaining the comments from the ESZ Division.

3.4.4. Deliberations by the EAC in current meetings

	ESA. The EAC opined that the Ministry may again the refer the matter to the ESZ Division with reference to the letter issued by the Dy. Conservator of Forest dated 05.07.2023 and Directorate of Mines & Geology dated 07.07.2023 as submitted by the Project Proponent.	1. The ESZ Division has informed that the Kalay mineral block falls partly within the ESZ boundary of Bhagwan Mahaveer Wildlife Sanctuary. And w.r.t. draft WGESA boundary, the ESZ Division has informed that the kml of kalay mineral block is outside the kml of draft WGESA boundary. 2. The ESZ Division has also informed that the Hon'ble Supreme Court by way of a clarification vide an Order dated 28.04.2023 in IA No. 3949 of 2016 in W.P (C) No. 202 of 1995: T.N GodavarmanThirumulpad Vs UoI&Ors. clarified that in specific terms that mining within 1.0 km from the boundary of the protected area shall be strictly prohibited. It also specified that even if the ESZ is less than 1.0 km, mining within 1.0 km from the boundary of the Protected Area, even beyond ESZ boundary shall be strictly prohibited.

3.4.3. Deliberations by the EAC in previous meetings

Date of EAC 1 :31/05/2023

Deliberations of EAC 1 :

The Project Proponent/Consultant presented the KML file to indicate the site features in the study area of 10 km radius. The Project Proponent has shown the boundary of the mine lease area and informed that there are three pits exist within the mine lease area. The Project Proponent has shown the two proposed transportation routes from Kalay Block to Sanvordem Jetty/Capxem Jetty via Ambeudoc Sanvordem Junction and another route from Kalay Block to Sanvordem Jetty/Capxem Jetty via Bandoli Sanvordem Junction. Bhagwan Mahavir Wildlife Sanctuary is located at a distance of 1.04 km, E from the boundary of the mine lease area. Santona Village is a not a part of ESA of Western Ghats. The EAC asked the Project Proponent whether letter has been obtained from the Forest Dept. in this regard. The Project Proponent informed the EAC that they are in the process of obtaining letter from the Forest Dept.

The Project Proponent also informed the EAC that the Dept. of Mining & Geology has informed that the revised area of 152.5073 Ha is excluding the Eco Sensitive Zone (ESZ) area of 26.6753 Ha. The EAC observed that the Final Notification on Bhagwan Mahaveer Wildlife Sanctuary and National Park, Goa was published vide S.O. 221(E) dated 23.01.2015. As per the Notification, the extent of Eco-sensitive Zone shall be one kilometre of land or the water body whichever is nearer to the boundary of the Bhagwan Mahaveer Wildlife Sanctuary and National Park in the State of Goa. The EAC also observed that the Village Santona is partially falling within the ESZ Boundary. The EAC opined that the Ministry may seek comments from the ESZ Division in the Ministry regarding whether the instant mine lease area falls within the ESZ/ESA or not.

Kalay River is located adjacent to the mine lease area on the eastern side. The transportation route passes through the village road. The width of the road is more than 12m. Tippers of 10 Tonnes of capacity will be utilized for transportation. Railway line is running parallely to the mine lease area at a distance of 75m. The EAC asked the Project Proponent whether it is possible to evacuate the material through railways. The Project Proponent informed the EAC that they will try to explore this option. Habitations exist within the mine lease area and do not fall in the proposed working area. In the next five years, the mining activity will not close to the habitation. The EAC opined that the habitations inside the mine lease area need to be shifted. The Project Proponent informed the EAC that one court case has been filed in Hon'ble High Court of Bombay at Goa vide Writ Petition 592 of 2022 to challenge the constitutionality of the tender documents of Phase I auction of Goa mines. As per the last order, Fomento Resources Private Limited is added as a party to the petition as it has acquired Block IV- Kalay Mineral Block in e-auction tendered vide NIT dated 30/09/2022. No stay on conducting the e-auction of Mineral Block granted and the Case is pending for disposal. Based on the above discussions, the EAC **deferred** the proposal for want of following additional information:-

i. The EAC opined that the Ministry may seek comments from the ESZ Division in the Ministry regarding whether the instant mine lease area falls within the ESZ of Bhagwan Mahaveer Wildlife Sanctuary and National Park / ESA of Western Ghats or not.

ii. The Project Proponent needs to submit the map demarcating the location of the mine lease area w.r.t ESA of Western Ghats and ESZ of Bhagwan Mahaveer Wildlife Sanctuary and National Park.

Date of EAC 2 :11/07/2023

Deliberations of EAC 2 :

Observation and Recommendation of the EAC:

The EAC deliberated on the additional details submitted by the Project Proponent and the Consultant. The EAC noted the comments from the ESZ Division that one of the point (15°18'08.7974" N, 74°09'44.8333" E) is lying inside both the ESZ of Bhagwan Mahaveer Wildlife Sanctuary and National Park, Goa and the WGESA boundary as per the 5th draft notification of the WGESA, dated 06.07.2022. The distance as estimated between the point location (15°18'08.7974" N, 74°09' 44.8333" E), and the Bhagwan Mahaveer NP & WLS, Goa is approx. 0.7526 km (less than 1 km).The Project Proponent informed the EAC that as per letter issued by the Dy. Conservator of Forest dated 05.07.2023 and Directorate of Mines & Geology dated 07.07.2023, the proposed Block-IV Kalay Mineral Block located at Santona Village Sanguem Taluka, South Goa District, Goa falls outside notified ESZ boundary of Bhagwan Mahavir Wildlife Sanctuary and National Park.

The EAC observed that both the letter dated 05.07.2023 and 07.07.2023 does not mention about the Western Ghats ESA. The EAC opined that the Ministry may again the refer the matter to the ESZ Division with reference to the letter issued by the Dy. Conservator of Forest dated 05.07.2023 and Directorate of Mines & Geology dated 07.07.2023 as submitted by the Project Proponent. Therefore, the EAC **deferred** the proposal and was of the view that the proposal may be considered only after obtaining the comments from the ESZ Division.

3.4.4. Deliberations by the EAC in current meetings

The EAC deliberated on the additional details submitted by the Project Proponent and the Consultant. The EAC noted the comments of the ESZ Division that the Kalay mineral block falls partly within the ESZ boundary of Bhagwan Mahaveer Wildlife Sanctuary and w.r.t. draft WGESA boundary, the kml of kalay mineral block is outside the kml of draft WGESA boundary.

The Project Proponent has informed the EAC that the Letter of Intent (LoI) was granted on 13.01.2023 over an area of 179.1826 ha comprised of an area which was forming part of the Eco-Sensitive Zone (ESZ) of Bhagwan Mahaveer Wild Life Sanctuary & National Park. Then, the requisition letter was submitted to the Directorate of Mines and Geology, Government of Goa on 31.01.2023for deletion of area approximately 26.6753 ha falling within 1km from the boundary of Eco Sensitive Zone (ESZ) w.r.t Block IV – Kalay Mineral Block. Accordingly, the Directorate of Mines and Geology vide letter dated 13.03.2023 revised the area of Block IV – Kalay Mineral Block from 179.1826 ha to 152.5073 ha and the revised area was excluding the Eco Sensitive Zone (ESZ) area of 26.6753 ha. The Project Proponent also showed the DGPS Plan before and after deletion of the 26.6753 ha, authenticated map from the Depury Conservator of Forest and map showing the distance of the ESZ of boundary of Eco Sensitive Zone (ESZ) from the mine lease area i.e. is 1.04 km and 1.12 km respectively. Further, the Project Proponent also informed the EAC that the Village Santona is not listed in the Western Ghats ESA as per notification dated 06.07.2022.

After derailed deliberations, the EAC observed that the ESZ division of the Ministry has confirmed that the project area falls partly within the ESZ boundary of Bhagwan Mahaveer Wildlife Sanctuary, however, the project proponent is still claiming that the project area is outside the ESZ of Bhagwan Mahaveer Wildlife Sanctuaryand Western Ghats Eco-Sensitive Area (ESA). Accordingly, the EAC was of view that Ministry's Regional Office (IRO), Bangalore and a Senior Officer from Forest Department, Government of Goa and a Senior Officer from Directorate of Mines and Geology. Government of Goa may be requested for a joint visit to the site for ground truthing and submit the report to the Ministry. Based on the discussions held, the EAC **deferred** the proposal.

3.4.5. Recommendation of EAC

Deferred for ADS

3.5. Agenda Item No 5:

3.5.1. Details of the proposal

Enhancement of Ore production [2000-3000TPD] and Processing plant [3000-4000TPD] of Hutti Gold Mine (within the existing premises/Mining Lease Area, without additional land acquisition) by **THE HUTTI GOLD MINES COMPANY LIMITED** located at **RAICHUR,KARNATAKA**			
Proposal For		Fresh ToR	
Proposal No	**File No**	**Submission Date**	**Activity (Schedule Item)**
IA/KA/MIN/436624/2023	J-11015/13/2003.IA.II (M)	05/08/2023	Mining of minerals (1(a))

202/C

F. No. IA-J-11015/11/2023-IA-II(NCM)
Government of India
Ministry of Environment, Forest and Climate Change
Impact Assessment Division
***

Indira Paryavaran Bhawan
3rd Floor, Vayu Wing,
Jor Bagh Road, Aliganj
New Delhi-110003.

Dated: 25th September, 2023

To

1. **The Deputy Director General of Forests (C),**
Ministry of Environment, Forest and Climate Change,
Regional Office, Kendriya Sadan,
4th Floor, E&F Wings, 17th Main Road,
Koramangala II Block, Bangalore – 560034, Karnataka.

2. **The Principal Chief Conservator of Forest,**
Office of the Principal Chief Conservator of Forest,
Goa Van Bhavan, Forest Department,
Altinho, Panaji – 403001, Goa.

3. **The Director,**
Directorate of Mines and Geology,
Government of Goa,
Ground Floor of Institute Menezes Braganza,
Panaji – 403001, Goa.

Sub: Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Limited for mining of Iron Ore with proposed production capacity of 0.75 MTPA, Waste: 3.0 MTPA in the mine lease area of 152.5073 Ha, located at Village Santona, Sanguem Taluka, South Goa District, Goa – [Proposal No: IA/GA/MIN/422578/2023] - Terms of Reference (ToR) regarding

Sir,

The proposal for Terms of Reference (ToR) for mining of Iron Ore in Kalay Mineral Block - Block IV (Auction Block) of M/s Fomento Resources Private Limited with proposed production capacity of 0.75 MTPA, Waste: 3.0 MTPA in the mine lease area of 152.5073 Ha, located at Village Santona, Sanguem Taluka, South Goa District, Goa was considered in the 19th EAC (Non-Coal Mining) meeting held during 24-25 August, 2023, wherein the EAC deferred the proposal.

2. It is to mention that during the EAC meeting, it is observed that the ESZ Division of the Ministry has informed that the project area falls partly within the ESZ boundary of Bhagwan Mahaveer Wildlife Sanctuary, however, the project proponent is still claiming that the project area is outside the ESZ of Bhagwan Mahaveer Wildlife Sanctuary and Western Ghats Eco-Sensitive Area (ESA). Accordingly, the EAC was of view that Ministry's Regional Office (IRO), Bangalore and a Senior Officer from Forest Department, Government of Goa and a Senior Officer from Directorate of Mines and Geology, Government of Goa may be requested for a joint visit to the site for ground truthing and submit the report to the Ministry. A copy of relevant

Contd...

F. No. IA-J-11015/11/2023-IA-II(NCM)
Government of India
Ministry of Environment, Forest and Climate Change
Impact Assessment Division
***

202/C

Indira Paryavaran Bhawan
3rd Floor, Vayu Wing,
Jor Bagh Road, Aliganj
New Delhi-110003.

Dated: 25th September, 2023

To

1. **The Deputy Director General of Forests (C),**
Ministry of Environment, Forest and Climate Change,
Regional Office, Kendriya Sadan,
4th Floor, E&F Wings, 17th Main Road,
Koramangala II Block, Bangalore – 560034, Karnataka.

2. **The Principal Chief Conservator of Forest,**
Office of the Principal Chief Conservator of Forest,
Goa Van Bhavan, Forest Department,
Altinho, Panaji – 403001, Goa.

3. **The Director,**
Directorate of Mines and Geology,
Government of Goa,
Ground Floor of Institute Menezes Braganza,
Panaji – 403001, Goa.

Sub: Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Limited for mining of Iron Ore with proposed production capacity of 0.75 MTPA, Waste: 3.0 MTPA in the mine lease area of 152.5073 Ha, located at Village Santona, Sanguem Taluka, South Goa District, Goa – [Proposal No: IA/GA/MIN/422578/2023] - Terms of Reference (ToR) regarding

Sir,

The proposal for Terms of Reference (ToR) for mining of Iron Ore in Kalay Mineral Block - Block IV (Auction Block) of M/s Fomento Resources Private Limited with proposed production capacity of 0.75 MTPA, Waste: 3.0 MTPA in the mine lease area of 152.5073 Ha, located at Village Santona, Sanguem Taluka, South Goa District, Goa was considered in the 19th EAC (Non-Coal Mining) meeting held during 24-25 August, 2023, wherein the EAC deferred the proposal.

2. It is to mention that during the EAC meeting, it is observed that the ESZ Division of the Ministry has informed that the project area falls partly within the ESZ boundary of Bhagwan Mahaveer Wildlife Sanctuary, however, the project proponent is still claiming that the project area is outside the ESZ of Bhagwan Mahaveer Wildlife Sanctuary and Western Ghats Eco-Sensitive Area (ESA). Accordingly, the EAC was of view that Ministry's Regional Office (IRO), Bangalore and a Senior Officer from Forest Department, Government of Goa and a Senior Officer from Directorate of Mines and Geology, Government of Goa may be requested for a joint visit to the site for ground truthing and submit the report to the Ministry. A copy of relevant

— 1 —

Contd...

xxi. The Project Proponent needs to submit the latest Certified Compliance Report (CCR) by the Ministry's Regional Office as per Ministry's OM dated 08.06.2022at the time of appraisal of EC.

xxii. The project proponent needs to submit the affidavit as per Ministry's O.M dated 30.05.2018 at the time of EC appraisal.

xxiii. The Project Proponent shall conduct drone survey of the mine lease area and buffer area and submit during the appraisal for EC.

1.4 Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Limited for mining of Iron Ore with proposed production capacity of 0.75 MTPA, Waste: 3.0 MTPA in the mine lease area of 152.5073 Ha, located at Village Santona, Sanguem Taluka, South Goa District, Goa - [F.No: IA-J-11015/11/2023-IA-II(NCM), Proposal No: IA/GA/MIN/422578/2023,EIA Consultant: M/s Mineral Engineering Services] -Terms of Reference (ToR)

The instant proposal is for mining of Iron Ore in Kalay Mineral Block - Block IV (Auction Block) of M/s Fomento Resources Private Limited with proposed production capacity of 0.75 MTPA, Waste: 3.0 MTPA in the mine lease area of 152.5073 Ha, located at Village Santona, Sanguem Taluka, South Goa District, Goa.

2. The details of the project as ascertained from the documents submitted by the Project Proponent and as revealed from the discussions held during the meeting are given as under:

i. The mine lease area is located between Latitude: 15°17'01.6125" N to 15°18' 08.7974" N and Longitude: 74°08'55.2583" E to 74°09'44.8333" E. The mine lease area falls under the Survey of India Toposheet No: D43C3and falls in Seismic Zone-II.

ii. The proposed project activity is listed at schedule no. 1(a) Mining of Minerals and instant proposal attracts the general conditions as the mine lease area is located within 5km radius of BhagwanMahavir Wildlife Sanctuary and falls under Category "A" and appraised at the Central level.

iii. The proposal was earlier considered in the 15thEAC (Non-Coal Mining) meeting held during 30-31 May, 2023 wherein the EAC deferred the proposal for want of requisite information. Then, the Project Proponent submitted the information on 22.06.2023 in Parivesh portal and accordingly the proposal was considered in the 17th EAC (Non-Coal Mining) meeting held during 11-12 July, 2023. After detailed deliberations made by the Project Proponent and the Consultant, the EAC again deferred the proposal and was of the view that the proposal may be considered only after obtaining the comments from the ESZ Division. The Project Proponent vide letter dated 26.07.2023 informed to the Ministry that the ESZ Division of Ministry by oversight has observed that, one of the point (15° 18'08.7974" N, 74°09'44.8333" E) of the project is lying inside both the ESZ boundary of BhagwanMahaveer Wildlife Sanctuary &

National Park and WGESA boundary as per the 5th draft notification of the WGESA dated 06.07.2022. The Project Proponent also requested to consider the proposal for grant of Terms of Reference or in an alternate to provide the personal hearing to explain the matter. The ESZ Division gave their comments on 27.07.2023 in the instant matter. Accordingly, the proposal was again reconsidered in the 19th EAC (Non-Coal Mining) meeting held during 24-25 August, 2023.

Based on observation of EAC in its EAC meeting held during 11-12 July, 2023 and compliance of observation of EAC are detailed below:

S. No	Observation of EAC in its meeting held during 11-12 July, 2023	Reply by Project Proponent
1	The EAC observed that both the letter dated 05.07.2023 and 07.07.2023 does not mention about the Western Ghats ESA. The EAC opined that the Ministry may again the refer the matter to the ESZ Division with reference to the letter issued by the Dy. Conservator of Forest dated 05.07.2023 and Directorate of Mines & Geology dated 07.07.2023 as submitted by the Project Proponent.	The ESZ Division gave their following comments on 27.07.2023 as given below: - i. The ESZ Division has informed that the Kalay mineral block falls partly within the ESZ boundary of Bhagwan Mahaveer Wildlife Sanctuary. And w.r.t. draft WGESA boundary, the ESZ Division has informed that the kml of kalay mineral block is outside the kml of draft WGESA boundary. ii. The ESZ Division has also informed that the Hon'ble Supreme Court by way of a clarification vide an Order dated 28.04.2023 in IA No. 3949 of 2016 in W.P (C) No. 202 of 1995: T.N GodavarmanThirumulpad Vs UoI&Ors. clarified that in specific terms that mining within 1.0 km from the boundary of the protected area shall be strictly prohibited. It also specified that even if the ESZ is less than 1.0 km, mining within 1.0 km from the boundary of the Protected Area, even beyond ESZ boundary shall be strictly prohibited.

3. Observation and Recommendation of the EAC: -

The EAC deliberated on the additional details submitted by the Project Proponent and the Consultant. The EAC noted the comments of the ESZ Division that the Kalay mineral block falls partly within the ESZ boundary of Bhagwan Mahaveer Wildlife Sanctuary and w.r.t. draft WGESA boundary, the kml of kalay mineral block is outside the kml of draft WGESA boundary.

The Project Proponent has informed the EAC that the Letter of Intent (LoI) was granted on 13.01.2023 over an area of 179.1826 ha comprised of an area which was forming part of the Eco-Sensitive Zone (ESZ) of Bhagwan Mahaveer Wild Life

Sanctuary & National Park. Then, the requisition letter was submitted to the Directorate of Mines and Geology, Government of Goa on 31.01.2023for deletion of area approximately 26.6753 ha falling within 1km from the boundary of Eco Sensitive Zone (ESZ) w.r.t Block IV – Kalay Mineral Block. Accordingly, the Directorate of Mines and Geology vide letter dated 13.03.2023 revised the area of Block IV – Kalay Mineral Block from 179.1826 ha to 152.5073 ha and the revised area was excluding the Eco Sensitive Zone (ESZ) area of 26.6753 ha. The Project Proponent also showed the DGPS Plan before and after deletion of the 26.6753 ha, authenticated map from the Deputy Conservator of Forest and map showing the distance of the ESZ of boundary of Eco Sensitive Zone (ESZ) from the mine lease area i.e. is 1.04 km and 1.12 km respectively. Further, the Project Proponent also informed the EAC that the Village Santona is not listed in the Western Ghats ESA as per notification dated 06.07.2022.

After derailed deliberations, the EAC observed that the ESZ division of the Ministry has confirmed that the project area falls partly within the ESZ boundary of Bhagwan Mahaveer Wildlife Sanctuary, however, the project proponent is still claiming that the project area is outside the ESZ of Bhagwan Mahaveer Wildlife Sanctuaryand Western Ghats Eco-Sensitive Area (ESA). Accordingly, the EAC was of view that Ministry's Regional Office (IRO), Bangalore and a Senior Officer from Forest Department, Government of Goa and a Senior Officer from Directorate of Mines and Geology, Government of Goa may be requested for a joint visit to the site for ground truthing and submit the report to the Ministry. Based on the discussions held, the EAC **deferred** the proposal.

1.5 Hutti Gold Mines (ML No: 2671) of M/s The Hutti Gold Mines Company Limited for expansion in production capacity from 0.6 MTPA to 0.9 MTPA (2000 TPD to 3000 TPD) and enhancement of processing plant capacity of 0.9 MTPA – 1.2 MTPA (3000 TPD to 4000 TPD) in the mine lease area of 528.35 ha, located at Hutti Village, Lingsugur Taluk, Raichur District, Karnataka - [File No: J-11015/13/2003-IA.II(M), Proposal No: IA/KA/MIN/436624/2023; EIA Consultant: M/s Hubert Enviro Care Systems] - Terms of Reference (Expansion)

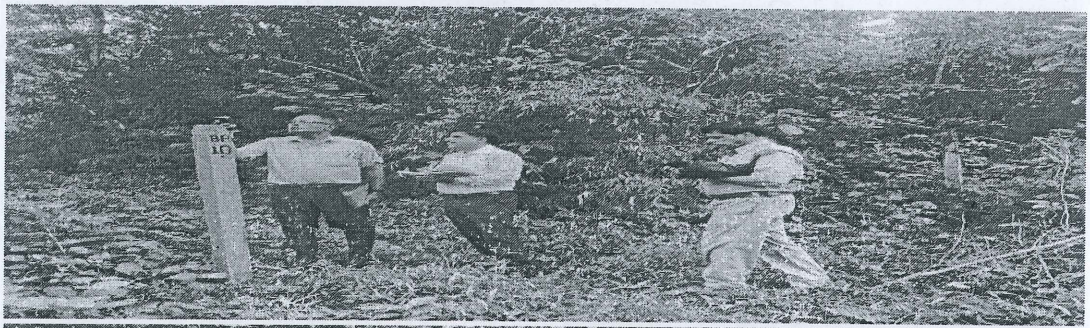
The instant proposal is for Terms of Reference of M/s The Hutti Gold Mines Company Limited for expansion in production capacity from 0.6 MTPA to 0.9 MTPA (2000 TPD to 3000 TPD) and enhancement of processing plant capacity of 0.9 MTPA – 1.2 MTPA (3000 TPD to 4000 TPD) in the mine lease area of 528.35 ha, located at Hutti Village, Lingsugur Taluk, Raichur District, Karnataka.

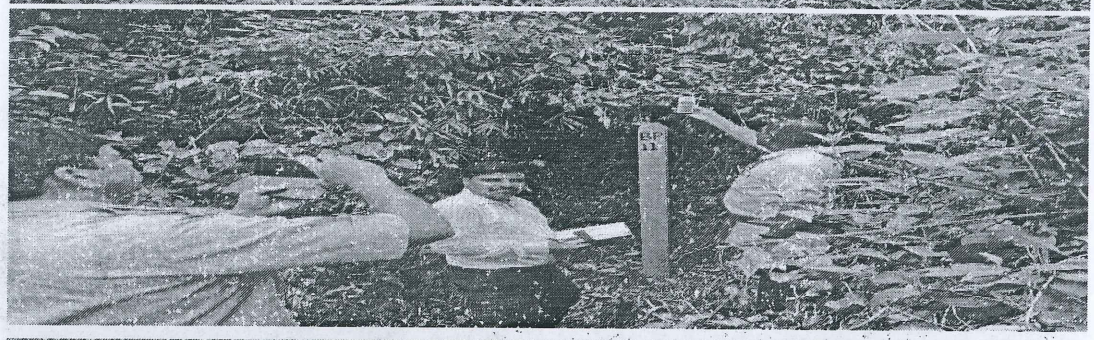
2. The details of the project as ascertained from the documents submitted by the Project Proponent and as revealed from the discussions held during the meeting are given as under:

i. The mine lease area is located between Latitude: 16°12'29.55813"N to 16°11'57.54790"N and Longitude: 76°39'38.73430" E to 76°39'42.06560"E. The mine lease area falls under the Survey of India Toposheet No: 56 D/12.

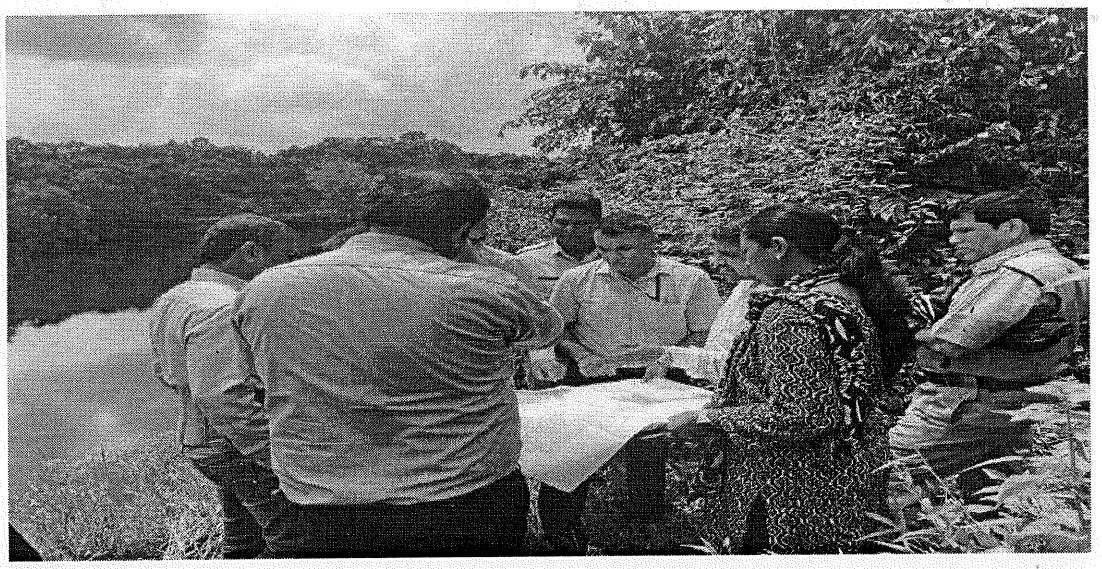
Annexure-4

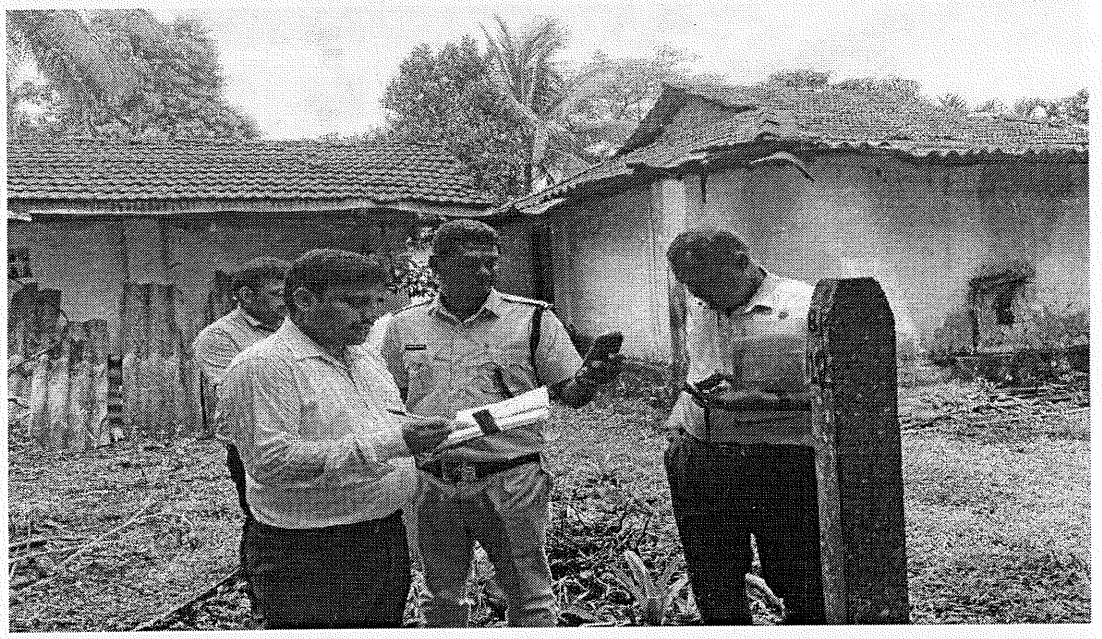
Photographs of Site Inspection

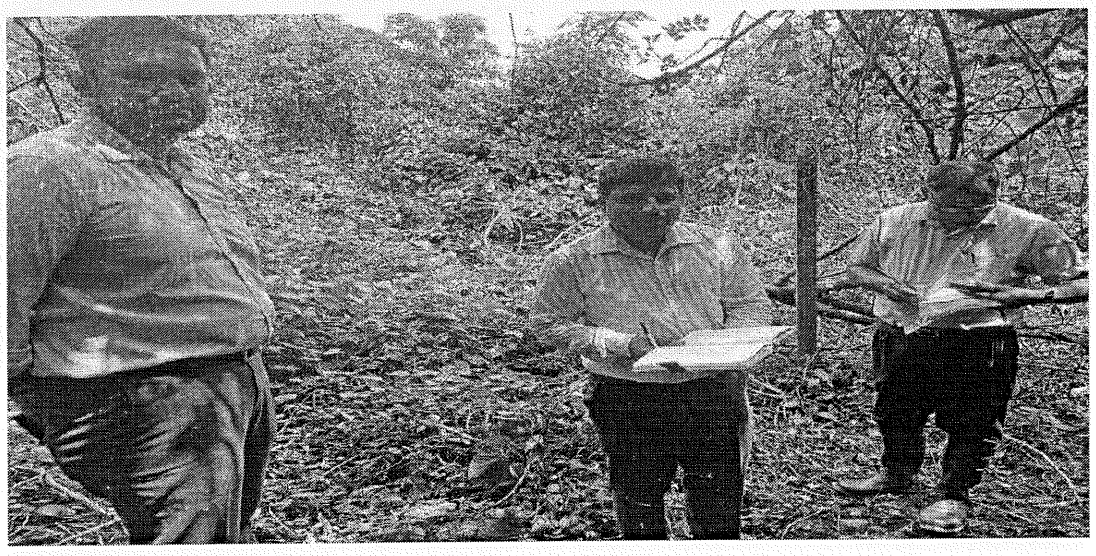








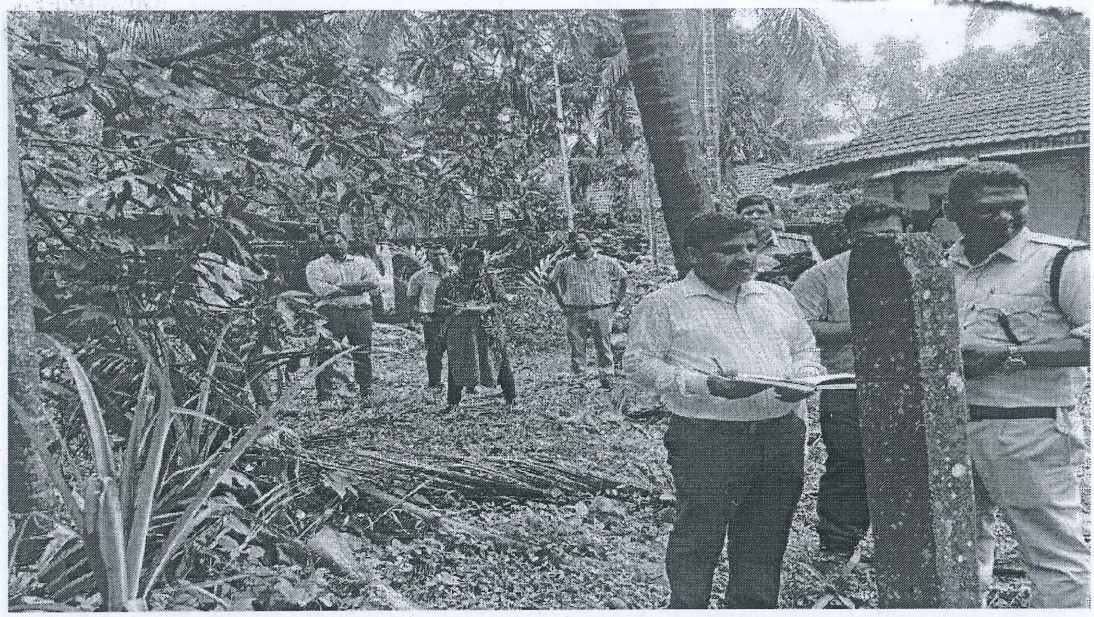









BF
11



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/25/Auction Cell/LOI-function/2023/2804 Date:13/01/2023

Letter of Intent for Block IV- Kalay Mineral Block

To,
Fomento Resources Private Limited,
1st Floor, 102, Kamat Metropolis-1,
Behind Caculo Mall, St. Inez,
Panaji, Goa 403001.

***Sub**: Letter of intent with reference to e-auction dated December 21, 2022 for grant of a mining lease for Block IV- Kalay Mineral Block for Iron Ore mineral in Santona village, Sanguem Taluka, South Goa District on 179.1826 Hectare Area.*

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 September 30, 2022 to commence the auction process for grant of mining lease for **Block IV- Kalay Mineral Block** located in North Goa. The e-auction process was conducted in accordance with the tender document for the said mineral block and **Fomento Resources Private Limited** was declared as the 'Preferred Bidder' under Rule 9(9)(iii) of Auction Rules, having quoted a Final Price Offer of **86.40% (Eighty six point four zero percent).**

1.2 As required under Rule 10(1) of the Auction Rules and the tender document for the said mineral block, **Fomento Resources Private Limited** has made payment of the first instalment, being 20%

(twenty per cent) of the upfront payment of Rs. 5,54,91,122 (Rupees Five Crore Fifty Four Lakh Ninety One Thousand One Hundred Twenty Two) through e-Challan (e-Challan No. 202300001651) dated January 2, 2023, 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 **Block IV- Kalay Mineral Block** for Iron Ore in Santona village, Sanguem Taluka, South Goa District on 179.1826 Hectare Area to **Fomento Resources Private 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 **Fomento Resources Private 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.

DIRECTORATE OF MINES & GEOLOGY GOVT. OF GOA

Fomento Resources Private 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 **Fomento Resources Private 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":

Fomento Resources Private 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; and

(b) Signing of the Mine Development and Production Agreement

Fomento Resources Private 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, **Fomento Resources Private 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. The State Government reserves the 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 dumps presently located within the Mineral Block. Provided that such right shall be exercised by the State Government no later than 12 (twelve) months from the date of issuance of this Letter of Intent. It is clarified that the Successful Bidder shall, in accordance with Applicable Law, be entitled to dispose of only such part of the dumps in respect of which the State Government does not exercise the aforesaid right.

4. Validity

4.1. This Letter of Intent shall be valid only if **Fomento Resources Private 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 **Fomento Resources Private 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

DIRECTORATE OF MINES & GEOLOGY GOVT. OF GOA

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.

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 **January 27, 2023.**

(Dr. S. Shanbhogue)
Director



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.03/18/2023/Major/Mines/ 3286 Date:13/03/2023

To,
Fomento Resources Private Limited,
1st Floor, 102, Kamat Metropolis-1,
Behind Caculo Mall, St. Inez,
Panaji, Goa 403001.

***Sub**: Request for deletion of area falling under Eco Sensitive Zone (ESZ) with respect to Block IV- Kalay Mineral Block for Iron Ore mineral in Santona village, Sanguem Taluka, South Goa.*

Sir,

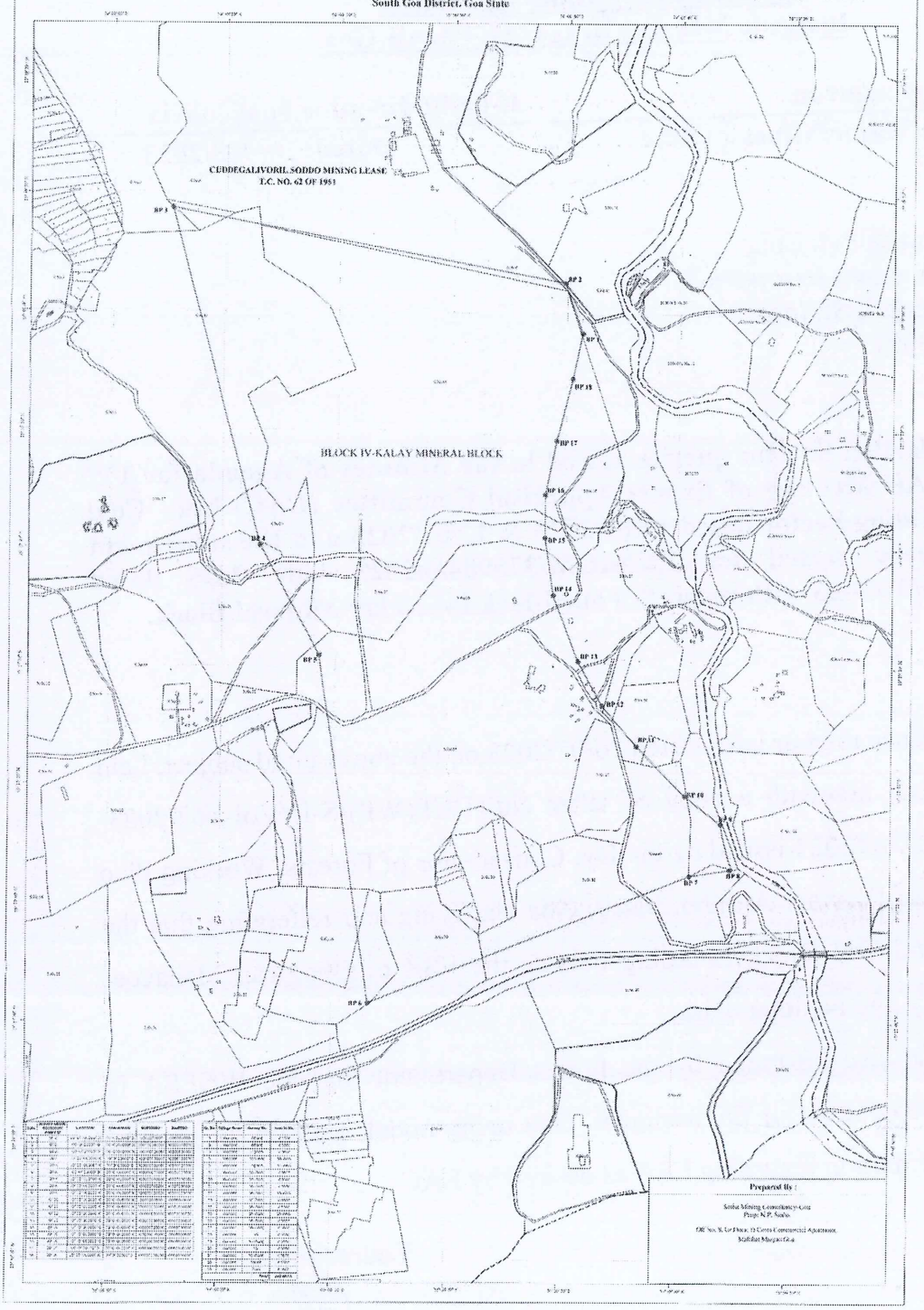
With reference to your letter dated 31.01.2023 on the subject cited above, approval of the Government is hereby conveyed to revise the area of Block IV- Kalay Mineral Block for Iron Ore from 179.1826Ha to 152.5073Ha. allotted to you vide Letter of Intent (LOI) No. DMG/25/Auction Cell/LOI-function/2023/2804, dated 13.01.2023. This revised area is excluding the Eco Sensitive Zone (ESZ) area of 26.6753Ha.

A copy of the plan giving the revised area of Block IV- Kalay Mineral Block for Iron Ore is enclosed for reference.

(Dr. S. Shanbhogue)
Director

Encl: As stated.

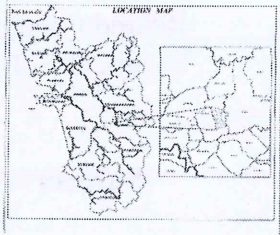
Plan Showing Mining Lease Boundary of BLOCK IV-KALAY MINERAL BLOCK, on Georeferenced and Vectorised Cadastral Map, situated in Santona Village of Sanguem Taluka, South Goa District, Goa State



SCALE 1 : 3960

0 50 100 200 300 400 500 Meters

LOCATION MAP



KKT PLAN



DATUM : WGS 84
PROJECTION : UTM_Zone_43 N

LEGEND

- DGPS POINT OF LEASE BOUNDARY
- BOUNDARY AS PER DGPS SURVEY
- SURVEY NUMBER BOUNDARY
- SUB DIVISION OF THE SURVEY NUMBER
- VILLAGE BOUNDARY

CERTIFICATE

This is to certify that the Mining Lease Boundary Pillars have been verified along with officials of Directorate of Mines and Geology, Goa (DMG) on 19.07.2021 based on the survey data of Mining Lease boundary pillars which were surveyed by Sneha Mining Consultancy Goa by using DGPS (Differential Global Positioning System) on 09-11-2022

Sd/-
R.M.Salvapawad
(Surveyor)

CERTIFICATE BY ACCREDITED AGENCY

This is to certify that the Mining Lease Boundary Pillars have been Surveyed by using DGPS (Differential Global Positioning System). The Survey was conducted as per Directorate of Mines and Geology, Goa (DMG) Letter No.DMG/IBM/Auction Cell/Misc/2015/5969 dated 10-11-2022.

For Sneha Mining Consultancy - Goa

Sd/-
(Mr. N.P. Sinari)

DIRECTORATE OF MINES AND GEOLOGY - PANAJI - GOA

Checked and verified by

Assistant Director of Geology,
Directorate of Mines & Geology,
Government of Goa,
Panaji - Goa.

Assistant Director of Mines & Geology,
Directorate of Mines & Geology,
Government of Goa,
Panaji - Goa.

Annexure 6

Government of Goa
Directorate of Mines & Geology
Institute Menezes Braganza, Panaji-Goa

Website:dmg.goa.gov.in **E-mail: dir-mine.goa@nic.in**

No.03/18/2023/Major/Mines | 1884 **Dated:** 31 **/08/2023**

To,
Fomento Resources Pvt. Ltd.,
1st Floor, 102, Kamat Metropolis-1,
Behind Caculo Mall, St. Inez,
Panaji, Goa.403001.

Subject: Clarification on queries raised in the Minutes of Agenda for 17th EAC Meeting of Expert Appraisal Committee (EAC) Non- Coal Mining Sector dated 11/07/2023 & 12/07/2023 and the subsequent query raised for EC/MOM/375984/6/2023 vide ADS dated 19/07/2023 with respect to our Block IV-Kalay Mineral Block.

Sir,

With reference to your letter dated 26/07/2023 on the above cited subject, I am directed to enclose herewith a copy of letter No. DCF(WP)/S-D/Vol-I/67/2023-2024/512 dated 24/08/2023 issued by the Dy. Conservator of Forests, Working Plan Division, Goa Van Bhavan, Altinho, Panaji,Goa clarifying and reiterating that the proposed Kalay mineral Block is falling outside the ESZ of Bhagwan Mahaveer Wildlife Sanctuary and National Park.

Further it is also informed by the Forest Department that the WGESA is handled by the Department of Environment, Goa being nodal department, so may seek requisite information regarding ESA as desired by EAC.

Yours faithfully

(Abhir Hede)
Dy. Director II

Encl: As stated.

Directorate of Mines & Geology
Inward-No 5767
Dated 24/08/23
Signature

Government of Goa
Office of The Dy. Conservator of Forests
Working Plan Division
"Goa Van Bhavan"
Altinho Panaji Goa – 403 001

No: DCF(WP)/S-D/Vol-I/67/2023-2024/512 Dated 24/08/2023

To,
The Director
Directorate of Mining and Geology,
Institute Menezes Braganza, Panji, Goa.

Sub: Clarification on queries raised in the Minutes of Agenda for 17th EAC meeting of Expert Appraisal Committee (EAC) Non-Coal Mining Sector dated 11/07/2023 & 12/07/2023 and subsequent query raised for EC/MOM/375984/6/23 vide ADS dated 19/07/2023 with respect to our Block IV- Kalay Mineral block reg.

Ref: No: 03/18/2023/Major/Mines/1560 dated 31/07/2023.

Sir,

In reference to your letter cited above, the observation of EAC were perused. As per comments from ESZ Division, MoEF&CC "*one point (15^0 18' 08.7974'' N, 74^0 09' 44.8333'' E) is lying inside both the Eco Sensitive Zone (ESZ) of Bhagwan Mahaveer Wildlife Sanctuary and National Park (BMWLS&NP) and Western Ghats Eco Sensitive Area (WGESA). The distance estimated between boundary of the BMWLS & NP and referred point is approx. 0.07526 Km (less than 1 km). Further EAC observed that both the letters dated 05.05.2023 and 07.05.2023 does not mention about WGESA*".

The Kalay -IV mineral block consisting an area of 179.1826 ha including area falling within ESZ of BMWLS was auctioned and finalised to M/s Fomento Resources Pvt Ltd, Goa through your letter of intent in the month of January 2023.

As the mining is prohibited activity within ESZ, M/s Fomento Resources Pvt Ltd, Goa vide their letter dated 31.01.2023 requested to delete an area of 26.6753 ha which falls within the notified ESZ from the auctioned mineral block. The same has been accepted and approved by you vide your letter dated 13/03/2023.

Accordingly, on receipt of proposal with modified boundary of mineral block to ascertain status of project to ESZ of BMWLS&NP, was scrutinised by this office and it was informed to you that the proposed mineral block falls outside ESZ of BMWLS&NP vide this office letter No. DCF(WP)/S-D/Vol-I/67/2022-23/347 dated 05.05.2023.

The coordinate currently referred by EAC was further verified by plotting it on the map containing boundary coordinates of BMWLS&NP, Eco Sensitive Zone boundary of BMWLS& NP and Coordinates of original and modified Kalay- IV mineral block boundary at Santona village of Sanguem taluka.

The coordinates referred to by EAC though it is found to be falling inside ESZ of BMWLS&NP, but it is not falling within either the boundary coordinates of original Kalay mineral block bearing of Mining Lease Title of Concession numbers 62/51, 12/52, 40/51, and 40/50 or proposed modified mining area boundary bearing MLTC number 12/51 and 40/51. Map indicating the ESZ boundary, Mineral block area and EAC referred coordinate is enclosed as *Annexure A* for reference.

Therefore, it is to clarify and reiterate that the proposed Kalay mineral block is falling *outside* the ESZ of Bhagwan Mahaveer Wildlife Sanctuary and National Park.

Further it is to inform that the WGESA is handled by Department of Environment, Goa being nodal department, so may seek requisite information regarding ESA as desired by EAC.

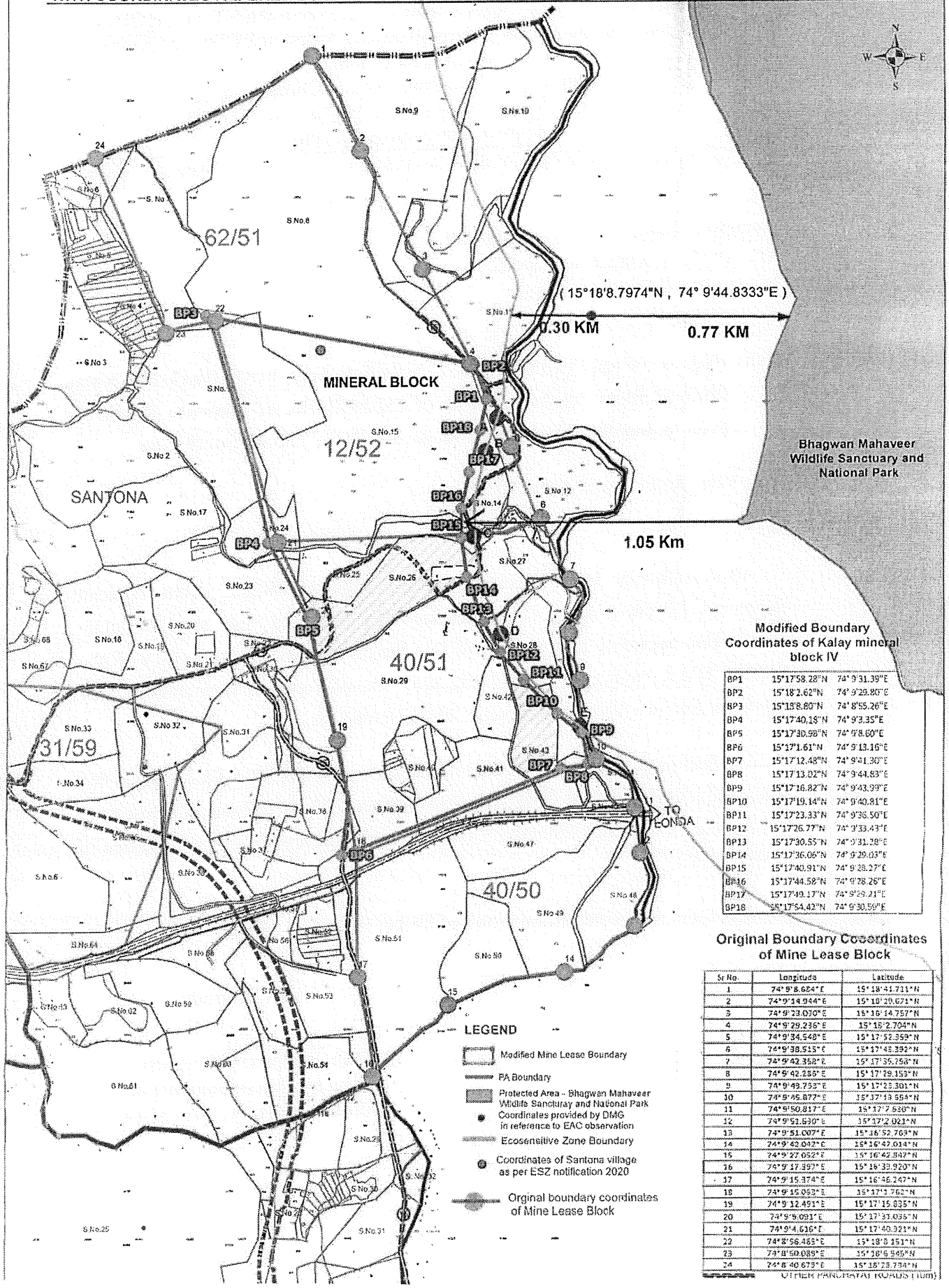
Encl: As above

Yours Sincerely

Dy. Conservator of Forests
Working Plan Division
Altinho, Panaji-Goa.

Copy to:
The Secretary (Environment & Climate Change), Government of Goa, Secretariate, Porvorim for information and needful action please.

MAP SHOWING LOCATION OF ORIGINAL / MODIFIED MINL... ...CK AT SANTONA VILLAGE ALONG WITH COORDINATES REFERED BY EAC W.R.T. BHAGWAN MAHAVEER WILDLIFE SANCTUARY & NATIONAL PARK



Modified Boundary Coordinates of Kalay mineral block IV

BP1	15°17'58.28"N	74° 9'31.39"E
BP2	15°18'2.62"N	74° 9'29.80"E
BP3	15°18'8.80"N	74° 8'55.26"E
BP4	15°17'40.18"N	74° 9'3.35"E
BP5	15°17'30.98"N	74° 9'8.60"E
BP6	15°17'1.61"N	74° 9'13.16"E
BP7	15°17'12.48"N	74° 9'41.30"E
BP8	15°17'13.02"N	74° 9'44.83"E
BP9	15°17'16.82"N	74° 9'43.99"E
BP10	15°17'19.14"N	74° 9'40.81"E
BP11	15°17'23.33"N	74° 9'36.50"E
BP12	15°17'26.77"N	74° 9'33.43"E
BP13	15°17'30.55"N	74° 9'31.28"E
BP14	15°17'36.06"N	74° 9'29.03"E
BP15	15°17'40.91"N	74° 9'28.27"E
BP16	15°17'44.58"N	74° 9'28.26"E
BP17	15°17'49.17"N	74° 9'29.21"E
BP18	15°17'54.42"N	74° 9'30.59"E

Original Boundary Coordinates of Mine Lease Block

Sr No.	Longitude	Latitude
1	74°9'8.624"E	15°18'41.711"N
2	74°9'14.944"E	15°18'20.671"N
3	74°9'23.030"E	15°18'14.757"N
4	74°9'29.236"E	15°18'2.704"N
5	74°9'34.548"E	15°17'52.359"N
6	74°9'38.515"E	15°17'43.392"N
7	74°9'42.358"E	15°17'35.758"N
8	74°9'42.286"E	15°17'29.153"N
9	74°9'48.753"E	15°17'25.301"N
10	74°9'45.877"E	15°17'13.554"N
11	74°9'50.817"E	15°17'7.630"N
12	74°9'51.630"E	15°17'2.021"N
13	74°9'51.007"E	15°16'52.769"N
14	74°9'42.042"E	15°16'47.014"N
15	74°9'27.052"E	15°16'42.842"N
16	74°9'17.397"E	15°16'39.920"N
17	74°9'15.374"E	15°16'46.247"N
18	74°9'15.052"E	15°17'1.762"N
19	74°9'12.491"E	15°17'15.035"N
20	74°9'9.091"E	15°17'33.036"N
21	74°9'4.616"E	15°17'40.321"N
22	74°8'56.465"E	15°18'8.151"N
23	74°8'50.089"E	15°18'6.565"N
24	74°8'40.673"E	15°18'28.734"N

GOA STATE ENVIRONMENT IMPACT ASSESSMENT AUTHORITY
Constituted by the Ministry of Environment, Forest and Climate Change,
Government of India
C/o Department of Environment and Climate Change
4th Floor, Dempo Towers, Patto Panaji Goa - 403001.
e-mail: goaseac@gmail.com

No. 122/3/2023-24/GSEIAA/Project -Prop/157 Date: 13/ 09/2023

To,

Fomento Resources Private Limited,
102, 1st Floor, Kamat Metropolis - I,
Behind Caculo Mall, St. Inez,
Panaji North Goa

Sub: Regarding applicability of Eco Sensitive Area w.r.t. Block-IV- Kalay Mineral Block having an area of 152.5073 Ha. of Fomento Resources Private, located at Santona Village, Sanguem Taluka South Goa

Ref: Your letter dated 17/05/2023

sir,

This Authority is in receipt of letter dated 17/05/2023 from Fomento Resources Private Limited. The Authority has examined your request seeking clarification regarding applicability of Eco Sensitive Area w.r.t. Block-IV- Kalay Mineral Block having an area of 152.5073 Ha. of Fomento Resources Private, located at Santona Village, Sanguem Taluka South Goa.

The Authority on perusal of Draft notification issued by MoEF&CC dated 06th July 2022 it is clarify that Block-IV- Kalay Mineral Block of Fomento Resources Private, Santona Village Sanguem Goa is not a part of any Eco Sensitive Area of western ghats.

This is for your kind information and further necessary action.

Yours faithfully

(Dr. Sneha S. Gitte, IAS)
Director (Environment) &
Member Secretary, Goa-SEIAA

Email **Suresh Kumar Adapa**

Re: Coordinates of ESZ boundary of Bhagwan Mahaveer Wildlife Sanctuary-reg.

From : DCF Working Plan <dcfwp-forest.goa@nic.in> Mon, Oct 16, 2023 06:05 PM
Subject : Re: Coordinates of ESZ boundary of Bhagwan Mahaveer Wildlife Sanctuary-reg.
To : Suresh Kumar Adapa <suresh.adapa@gov.in>

Dear Dr Suresh

As requested in your trailing mail, kindly find the coordinates of the points A,B,C, D & E shown in ESZ boundary map of BMWLS, furnished below for your onward action,

Point No.	Longitude	Latitude
A	74° 9' 32.792" E	15° 17' 55.936" N
B	74° 9' 31.312" E	15° 17' 51.817" N
C	74° 9' 29.852" E	15° 17' 41.095" N
D	74° 9' 33.510" E	15° 17' 29.029" N
E	74° 9' 43.718" E	15° 17' 17.646" N

From : Suresh Kumar Adapa <suresh.adapa@gov.in> Mon, Oct 16, 2023 11:43 AM
Subject : Re: Coordinates of ESZ boundary of Bhagwan Mahaveer Wildlife Sanctuary-reg. 2 attachments
To : DCF Working Plan <dcfwp-forest.goa@nic.in>
Cc : Dy Conservator of Forest P and S <dcfps-forest.goa@nic.in>, Dy Conservator of Forest North Goa Ponda <dcfnorth-forest.goa@nic.in>, Dir Mines, Goa | dir-mine.goa@nic.in <dir-mine.goa@nic.in>, Pankaj Verma <Pankaj.verma@nic.in>

Sir,

This has reference to trailing mail. This office requested the coordinates of the A,B,C, D & E points of highlighted ESZ boundary line as highlighted in the attached map. As the joint committee (with members from MoEF&CC, Goa State Forest Department and DMG Goa) report is to be submitted to Ministry in timebound manner, it is once again humbly requested to provide the coordinates at the earliest.

Suresh Kumar Adapa
Scientist 'E'/Additional Director
Regional Office MoEF&CC Bengaluru.

From: "Suresh Kumar Adapa" <suresh.adapa@gov.in>
To: "DCF Working Plan" <dcfwp-forest.goa@nic.in>
Cc: "Dy Conservator of Forest P and S" <dcfps-forest.goa@nic.in>, "Dy Conservator of Forest North Goa Ponda" <dcfnorth-forest.goa@nic.in>, "Dir Mines, Goa | dir-mine.goa@nic.in" <dir-mine.goa@nic.in>
Sent: Tuesday, October 10, 2023 12:03:42 PM
Subject: Coordinates of ESZ boundary of Bhagwan Mahaveer Wildlife Sanctuary-reg.

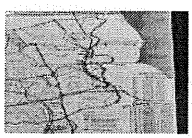
Sir,

The committee constituted for the inspection of Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Ltd carried out the inspection of the site on 05.10.2023. The coordinates of the boundary pillars (BP1 and BP9 to BP18) located towards ESZ boundary were collected during the site inspection. In order to verify the locations of the coordinates(collected during site inspection) w.r.t. ESZ boundary of Bhagawan Mahaveer Wild Life

Sanctuary, the coordinates of the ESZ boundary highlighted in blue color in the attached map are required. It is humbly requested to provide the same at the earliest.

Suresh Kumar Adapa
Scientist 'E'/ Additional Director
Regional Office, MoEF&CC, Bengaluru

Letter_from_DMG_to_FRPL (1).pdf
665 KB



Map of Kalay Lease Area w.r.t. ESZ boundary.jpeg
192 KB

From : Suresh Kumar Adapa <suresh.adapa@gov.in> Wed, Oct 11, 2023 11:38 AM
Subject : Fwd: Coordinates of ESZ boundary of Bhagwan Mahaveer Wildlife Sanctuary-reg. 2 attachments
To : Deputy Conservator of Forests South Goa <dcfsouth-forest.goa@nic.in>

Sir,

Kindly see the trailing mail. It is requested to kindly provide the coordinates of ESZ boundary so that report can be finalized and submitted to Ministry.

Suresh Kumar Adapa
Scientist 'E'/ Additional Director
Regional Office, MoEF&CC Bengaluru.

From: "Suresh Kumar Adapa" <suresh.adapa@gov.in>
To: "DCF Working Plan" <dcfwp-forest.goa@nic.in>
Cc: "Dy Conservator of Forest P and S" <dcfps-forest.goa@nic.in>, "Dy Conservator of Forest North Goa Ponda" <dcfnorth-forest.goa@nic.in>, "Dir Mines, Goa | dir-mine.goa@nic.in" <dir-mine.goa@nic.in>
Sent: Tuesday, October 10, 2023 12:03:42 PM
Subject: Coordinates of ESZ boundary of Bhagwan Mahaveer Wildlife Sanctuary-reg.

Sir,

The committee constituted for the inspection of Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Ltd carried out the inspection of the site on 05.10.2023. The coordinates of the boundary pillars (BP1 and BP9 to BP18) located towards ESZ boundary were collected during the site inspection. In order to verify the locations of the coordinates(collected during site inspection) w.r.t. ESZ boundary of Bhagawan Mahaveer Wild Life Sanctuary, the coordinates of the ESZ boundary highlighted in blue color in the attached map are required. It is humbly requested to provide the same at the earliest.

Suresh Kumar Adapa
Scientist 'E'/ Additional Director
Regional Office, MoEF&CC, Bengaluru

Letter_from_DMG_to_FRPL (1).pdf
665 KB



Map of Kalay Lease Area w.r.t. ESZ boundary.jpeg
192 KB

From : Suresh Kumar Adapa <suresh.adapa@gov.in> Tue, Oct 10, 2023 12:03 PM

Subject : Coordinates of ESZ boundary of Bhagwan Mahaveer Wildlife Sanctuary-reg. 2 attachments

To : DCF Working Plan <dcfwp-forest.goa@nic.in>

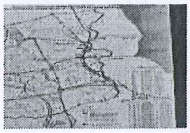
Cc : Dy Conservator of Forest P and S <dcfps-forest.goa@nic.in>, Dy Conservator of Forest North Goa Ponda <dcfnorth-forest.goa@nic.in>, Dir Mines, Goa | dir-mine.goa@nic.in <dir-mine.goa@nic.in>

Sir,

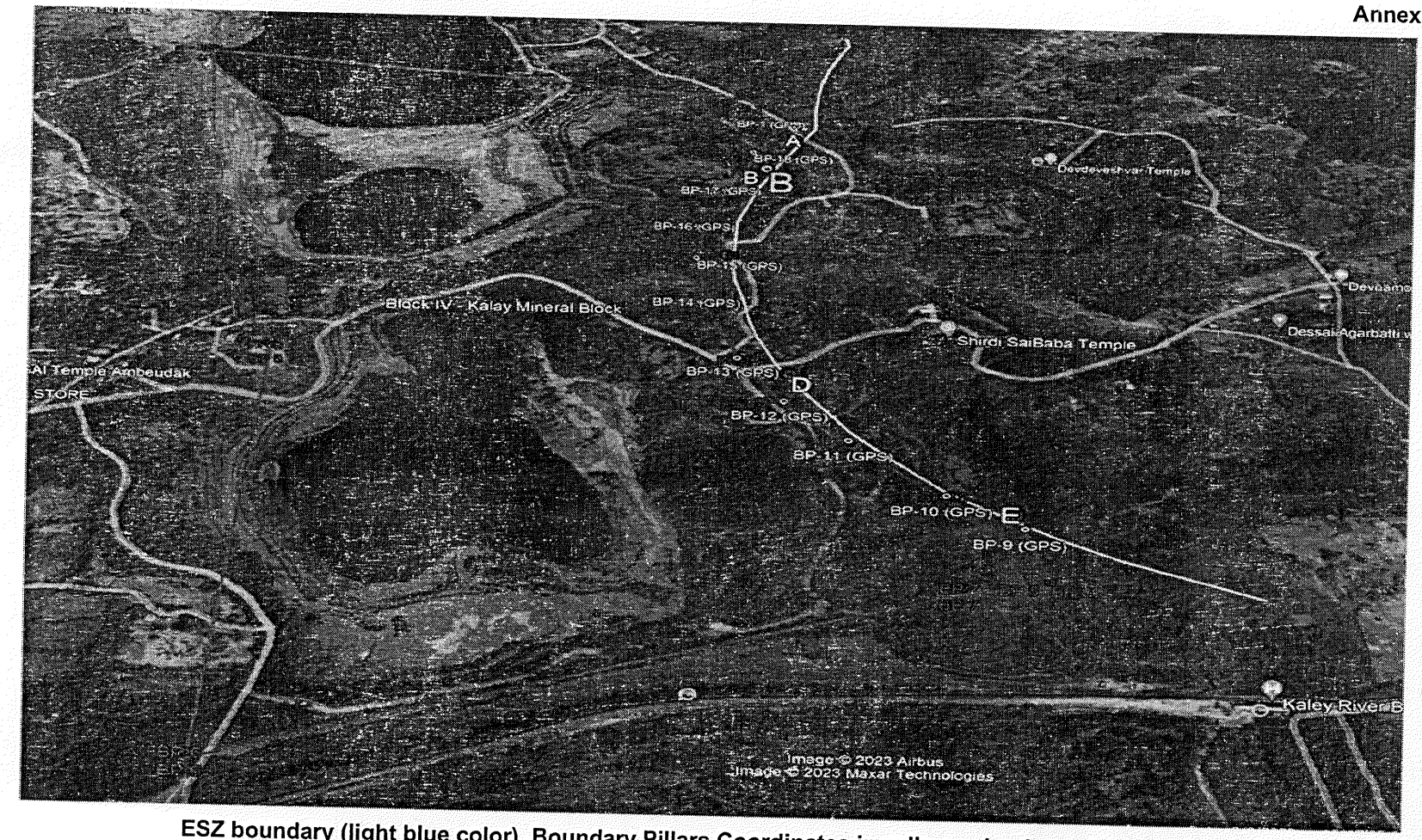
The committee constituted for the inspection of Kalay Mineral Block- Block IV (Auction Block) of M/s Fomento Resources Private Ltd carried out the inspection of the site on 05.10.2023. The coordinates of the boundary pillars (BP1 and BP9 to BP18) located towards ESZ boundary were collected during the site inspection. In order to verify the locations of the coordinates(collected during site inspection) w.r.t. ESZ boundary of Bhagawan Mahaveer Wild Life Sanctuary, the coordinates of the ESZ boundary highlighted in blue color in the attached map are required. It is humbly requested to provide the same at the earliest.

Suresh Kumar Adapa
Scientist 'E'/ Additional Director
Regional Office, MoEF&CC, Bengaluru

Letter_from_DMG_to_FRPL (1).pdf
665 KB



Map of Kalay Lease Area w.r.t. ESZ boundary.jpeg
192 KB



ESZ boundary (light blue color), Boundary Pillars Coordinates in yellow color, Lease boundary in red color

GOA STATE ENVIRONMENT IMPACT ASSESSMENT AUTHORITY
Constituted by the Ministry of Environment, Forest and Climate Change,
Government of India
C/o Department of Environment and Climate Change
4th Floor, Dempo Towers, Patto Panaji Goa - 403001.
e-mail: goaseac@gmail.com

No. 122/3/2023-24/GSEIAA/Project -Prop/157 Date: 13/ 09/2023

To,
Fomento Resources Private Limited,
102, 1st Floor, Kamat Metropolis - I,
Behind Caculo Mall, St. Inez,
Panaji North Goa

Sub: Regarding applicability of Eco Sensitive Area w.r.t. Block-IV- Kalay Mineral Block having an area of 152.5073 Ha. of Fomento Resources Private, located at Santona Village, Sanguem Taluka South Goa

Ref: Your letter dated 17/05/2023

sir,

This Authority is in receipt of letter dated 17/05/2023 from Fomento Resources Private Limited. The Authority has examined your request seeking clarification regarding applicability of Eco Sensitive Area w.r.t. Block-IV- Kalay Mineral Block having an area of 152.5073 Ha. of Fomento Resources Private, located at Santona Village, Sanguem Taluka South Goa.

The Authority on perusal of Draft notification issued by MoEF&CC dated 06th July 2022 it is clarify that Block-IV- Kalay Mineral Block of Fomento Resources Private, Santona Village Sanguem Goa is not a part of any Eco Sensitive Area of western ghats.

This is for your kind information and further necessary action.

Yours faithfully

(Dr. Sneha S. Gitte, IAS)
Director (Environment) &
Member Secretary, Goa-SEIAA

Annexure 15

Name of Project: **Block IV – Kalay Mineral Block**

Address: **Santona Village, Sanguem Taluka, South Goa District, Goa**

Specific terms of Reference (Mining of Minerals)

4.1 –Road transportation

1. A Map showing transportation route of the mineral via SH-7, from mine lease to destination on Google earth image is enclosed herewith as **Exhibit A**.

2. Impact of details of habitation at a distance of 100m from the centre on both sides of the road is enclosed herewith as **Exhibit B.**

3. Details of no. of trips per day to and fro, capacity of the trucks to be deployed, and the dimensions of the road, existing and additional traffic load to the National Highway (NH) and the carrying capacity of the road is enclosed herewith as **Exhibit C.**

4. SOP for transportation has been framed and is enclosed herewith as **Exhibit D**.

Exhibit A

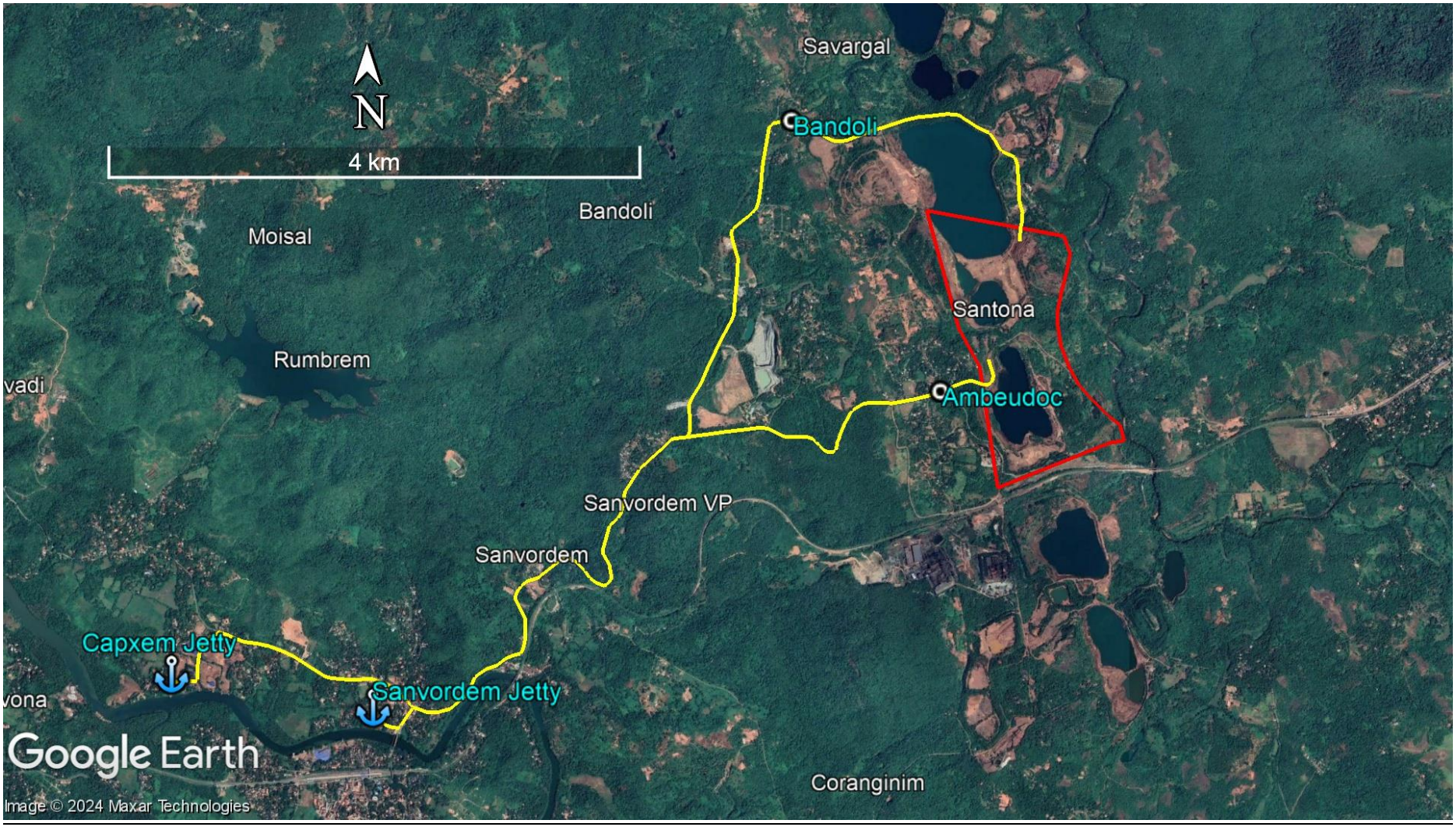
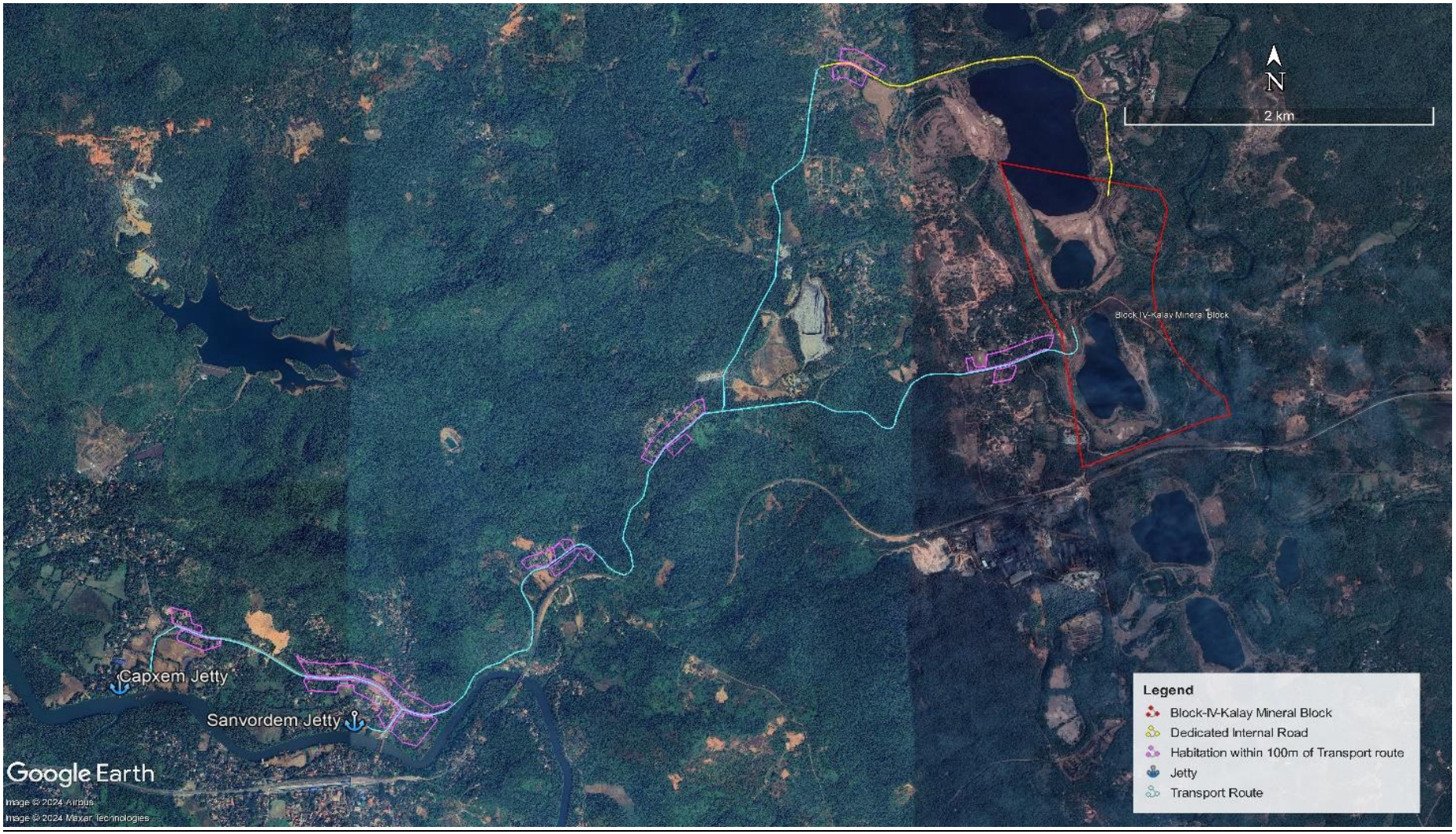

N
4 km
Savargal
Bandoli
Bandoli
Moisal
Santona
Rumbrem
vadi
Ambeudoc
Sanvordem VP
Sanvordem
Capxem Jetty
Sanvordem Jetty
vona
Google Earth
Image © 2024 Maxar Technologies
Coranginim

Exhibit B


N
2 km
Block IV-Kalay Mineral Block
Capxem Jetty
Sanvordem Jetty
Google Earth
Image © 2024 Airbus
Image © 2024 Maxar Technologies
Legend
Block-IV-Kalay Mineral Block
Dedicated Internal Road
Habitation within 100m of Transport route
Jetty
Transport Route

Exhbit C

Traffic load and effective distance between two trucks

Considering the production capacity of 0.75 MTPA, transportation details with respect to no. of trips per day to and fro, capacity of the trucks to be deployed, and the dimensions of the road, existing and additional traffic load and the carrying capacity of the road is provided below.

The total number of Ore transport trips per day (to and fro) is calculated as shown in the below table.

Quantity of Ore Transported Tonnes per annum	No. of Transportation days per annum	Tonnes per Day	Total Trips per day	Total Trips per day (to and fro)	Mode of Transport
7,50,000	200	3750	358	716	Road

The total distance of transportation route from Mineral Block to Jetty is a about 14 km.

The total transportation route constitutes dedicated road corridor of 2.5 km and Public road (SH-7) of 11.5 km details of which are given below:

S. No.	Existing Road	Distance (km)	Width (m)
1	Dedicated road corridor	2.5	8-10
2	Public Road (SH-7)	11.5	10

Carrying capacity of trucks and Additional traffic load:

Capacity of truck is 10.5 tonnes as per directives of Department of Mines & Geology, Govt. of Goa

- Average handling per day - 3750 tonnes
- Transportation timings – from 6.00 am to 7.00 am, 8.00 am to 12.45pm, and from 2.00 pm to 5. 45 pm. Effective transportation time is - 9.30 hrs
- Per Hour Handling - 395 tonnes
- Number of vehicles per hour (One way): 38
- Number of vehicles per hour (to and fro): 76 vehicles
- The speed of vehicle is 30 KMPH, the lead distance is 11.5 Km

- The time taken for 11.5 km is 23 minutes for each truck and loading time is 1min, weighment time at both source location is 2min, Tarpaulin tying and untying time is 2min, unloading time 1min and waiting time 10 minutes.
- Truck length is = 4.58 m
- Effective distance from truck to truck is 10 m both side = 20m
- Each vehicle occupies a min. distance of 24.58 m =~ 25m
- The length of road is 11.5 km = 11500 m
- Number of trucks which can travel on this road for one side = 11500/25 = 460, However, we would be plying (additional) only 76 trucks/ hour (To and fro) hence effective distance between two vehicles will be about 151 m.
- Transportation of minerals through National Highway is not involved.

Measures for transportation as given below:

- SH – 7 road is hot mixed and well maintained. Thick vegetation is existing on both sides of the major portion of this road.
- 1000 m dedicated road is tarred connecting to SH-7.
- Entire dedicated transportation route is surrounded by thick green belt.
- Transportation trucks will be loaded with prescribed capacity and covered with tarpaulin before leaving mines premises.
- Overloading of the material will be avoided.
- Regular water sprinkling by water tanker on haul road and Loading points will be carried out.
- Manual and mechanised machines for road sweeping for road cleaning.
- Green nets will be erected along the road at Bandoli habitation to prevent pollution.

Exhibit D

Safe Operating Procedures for Transportation Trucks engaged at Block IV- Kalay Mineral Block of Fomento Resources Private Limited

The Safe Operating Procedures (SOPs) outlined herein below are applicable for transportation trucks engaged at Block IV-Kalay Mineral Block.

Truck drivers shall observe these SOPs and other specific instructions given by Mines Manager / Transportation In-charge /Mine Officials:

A. Procedures:

1) Trucks shall not be engaged for transportation unless authorized by the Mines Manager.
2) A person shall neither drive nor operate truck unless authorized to do so by the Mines Manager.
3) The truck driver shall have valid driving licence.
4) Mechanical and general condition of the Vehicle shall be in good and safe working order.
5) The truck drivers shall undergo Initial Medical Examination, followed by Periodical Medical Examination once in a five years below the age of 45 and once in three years for persons above 45 years of age. The truck driver shall be medically fit to drive the truck.
6) The truck driver shall undergo eye refraction test at least once in a year.
7) A record of the truck driver along with ID proof and Driving licence are to be maintained in the office.
8) Valid photo identity card shall be issued to the all truck drivers giving information on details of the mine engaged in, address, medical examination, vocational training, driving licence no. and its validity, contact no., etc.
9) The security personal shall allow entry of truck drivers into the mines only after checking his identity card at the main mine gate.

B. Intoxication

1) Every truck driver shall be checked for intoxication using Alcometer during his entry in to the mine.
2) No driver shall be allowed to drive a vehicle in a state of intoxication.
3) If any driver is found to be in a state of intoxication, he shall be not allowed to drive the truck for that day.
4) Any habitual offenders shall be warned and eventually prohibited from engaging in transportation activities.

C. Other procedures to be followed:

1) Mines Manager/Transport in-charge shall give periodical safety briefings to all the truck drivers. Educating the drivers on the road safety matters /personnel safety and right of way.

5) Truck drivers shall not drive the trucks at speeds exceeding 40 Km per hour on public road and exceeding 25 Km per hour within the mines. Over-speeding of truck shall be monitored through GPS/VTS.
6) Security guards shall be posted at strategic locations such as near schools and public places to control the speed of the ore transport tucks and also to prevent them from overtaking.
7) Patrolling of the transport road/ surprise checks by officer in-charge of transport to track the offenders. Offenders shall be warned and educated, while stern actions shall be taken against habitual offenders.
8) Information shall be gathered on driving habit of the drivers from security guards and other reliable sources in an event of traffic blockade on road and taking appropriate action.
9) Removal of tinted filming on the wind screens and side glasses so as to have clear vision.
10) Cutting the bushes/branches and placing the blind view mirrors wherever required along the transport road
11) Giving right of way to pedestrians / two wheelers / light motor vehicles.
12) Act as god in case of accidents by informing the ambulance services (108) or taking them to the doctors.
13) Road worthiness of the trucks to be monitored by the transport in-charge.
14) Keeping vigilance on the trucks which are tampering the GPS/VTS and informing the Mega Soft for blockage of the truck and booking an offense.
15) Prior intimation to be given to the Mega Soft about the stoppage of the transport other than Sundays/public holidays in order to track on the speed limits.
16) Do and Don'ts to be given to the truck drivers in their languages for strict implementation.

D. <u>Mechanical condition of the Vehicle:</u>

1) Truck/Vehicle should be mechanically sound and in healthy condition.
2) Truck should have proper horn/audio- visual alarm (AVA's) and side indicators in good working condition. Truck also should have proper rear view mirrors, blind view mirrors.
3) Truck should not have tinted filming on the screens.
4) Truck should have proper breaking system.
5) Truck should have proper tailgate locking arrangement

E. <u>Do and Don't for the truck drivers:</u>

- Should have a valid licence
- Should at least daily examine the truck to ensure it is in safe working order
- Should drive a vehicle/truck for which he is being allotted
- Should not allow any other person to drive the vehicle/truck
- Should not take any passengers in the truck.

- Should not over take other vehicles
- Should not drive the vehicle above 40 km per hour speed
- Should strictly obey the instructions by the mine officials
- Should drive very carefully while reversing and ensure that nobody is present behind the vehicle
- Should have right of way and should give right of way and follow the lane discipline
- Should never be under intoxication whilst on driving
- Should give way to the light vehicles , two wheelers and pedestrians
- Utmost care should be taken while approaching schools, temples, junctions ,blind corners and narrow roads and public places
- Should have parking sense, and truck should be parked at the designated places only
- Should always carry the photo identity card
- Should see that tarpaulin fastened properly and ensure that no spillage from the truck tail gate
- Should blow the horn at blind corners/indicators before turning wherever required
- Should not leave vehicle un attended un less it is parked safely and properly
- Should not sit under the trucks, in front ,back while in waiting for the trip, always should remain in the vehicle only
- Should not give vehicle to the other persons to drive being taken out from the mine
- Should maintain sufficient gap/distance between the trucks
- Should not become the cause for blocking the road/disturbing public
- Should not raise the cargo box under the electrical lines
- Should not allow anybody to travel on the free board, on the doors
- Should help the injured in case accidents to the reach of hospital
- Should inform to the mine official about the incidents/blockages on the transport roads immediately
- Should give way to the emergency vehicles such as ambulances, fire tender, police vehicles
- Driver should follow the general discipline at all the time whilst on the duty
- Truck should not be driven when it requires mechanical attention/repairs
- Should adhere the road signs, traffic signals
- Should always keep in mind that public also has right of way on the roads
- Should also follow Traffic Rules & Procedures given / displayed at mine to maintain safety within the mine.

Annexure 16

Name of Project: **Block IV – Kalay Mineral Block**

Address: **Santona Village, Sanguem Taluka, South Goa District, Goa**

Specific terms of Reference (Mining of Minerals)

10.1 – Employment

The employment based skill development plan for the local people is enclosed as **Exhibit A**.

Exhibit A

Proposed Employment Based Skill Development Plan for Local People

The proposed project will generate employment for around 327 people which includes direct and indirect employment during its operation. Additionally, it will benefit about 1250 persons from nearby villages by way of allied business activities such as engagement of trucks for transportation of ore, small eateries, garages and workshops, tea stalls, environmental protective works, etc.

The category wise employment is detailed below:-

S. No.	Category	No. of Persons
1	Officers/Managerial Staff	19
2	Supervisor	6
3	HEMM Operator	32
4	Pump Operator	6
5	Truck Operator	50
6	Weighbridge Operator	8
7	Labour	6
8	Truck Driver	200
	TOTAL	**327**

Proposed Employment based Skill Development Plan:

The management will ensure that the local people are benefitted from the operations of the Project. Emphasis will be given on imparting trade based vocational training to the local people and such trained local people will be engaged in employment in various category of operations.

Sr. No.	Category	Year of operation					Proposed Training Details
		1st	2nd	3rd	4th	5th	
1	Supervisor	4	2	-	-	-	Will be trained in-house for basic computer operations & supervision of HEMM under managerial supervision. Additionally, vocational training will be provided during the first year. Thereafter, refresher training will be provided every 5 years at Goa Group Vocational Training Centre.

2	HEMM Operator	10	10	6	6	-	The persons holding Heavy Motor Driving Licence will be provided in-house training under guidance of Qualified Engineers & Operators to operate HEMM and will be upgraded to HEMM Operators. Additionally, vocational training will be provided during the first year. Thereafter, refresher training will be provided every 5 years at Goa Group Vocational Training Centre.
3	Pump Operator	3	3	-	-	-	The persons with ITI certificate or 10th passed will be provided in-house training under guidance of Qualified Engineers to operate and maintain pumps. Additionally, vocational training will be provided during the first year. Thereafter, refresher training will be provided every 5 years at Goa Group Vocational Training Centre.
4	Truck Operator	15	15	10	10	-	Persons holding licence for driving heavy vehicle will be tested for his driving skills. Suitable people will be trained to operate trucks of higher capacities. Upon completion of training will be engaged as truck operators. Additionally, vocational training will be provided during the first year. Thereafter, refresher training will be provided every 5 years at Goa Group Vocational Training Centre.
5	Weighbridge Operator	4	4	-	-	-	Will be trained in house for basic computer operations & to operate weighbridges. Additionally,

							vocational training will be provided during the first year. Thereafter, refresher training will be provided every 5 years at Goa Group Vocational Training Centre.
6	Labour	3	3	-	-	-	Will be engaged and imparted in house training. They will be further upgraded as per their skills.
8	Truck Drivers	50	50	75	25	-	Selection & preference will be given to the local persons having Heavy Motor Vehicle Driving licence. These selected drivers will be imparted in house training, on the job briefing will be given by the Management. The skill will be further enhanced through training on simulator. Additionally, vocational training will be provided during the first year. Thereafter, refresher training will be provided every 5 years at Goa Group Vocational Training Centre.
	TOTAL	**89**	**87**	**91**	**41**	**-**	

Annexure 17

Name of Project: **Block IV – Kalay Mineral Block**

Address: **Santona Village, Sanguem Taluka, South Goa District, Goa**

Specific terms of Reference (Mining of Minerals)

12.1 – Railway Line

1. A map demarcating the exact distance of the railway line and railway boundary from the mine lease area is enclosed as **Exhibit A**.

2. Details of the trains passing and their frequency obtained from Dy. Station Manager, Sanvordem/Curchorem, South Western Railway is enclosed as **Exhibit B**.

3. Measures taken to protect the railway line from the mining activity is enclosed as **Exhibit C**.

Exhibit A

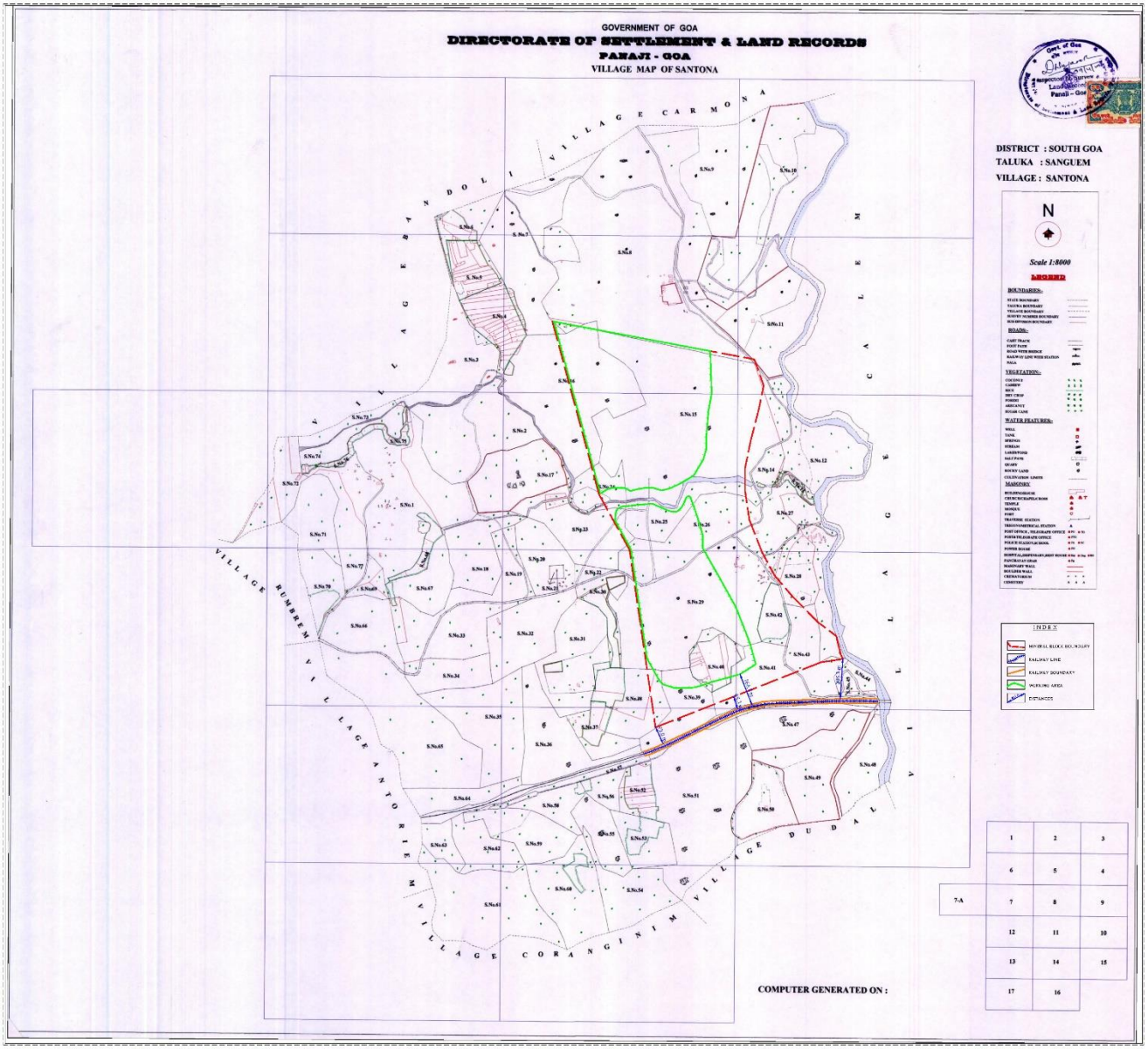

GOVERNMENT OF GOA
DIRECTORATE OF SETTLEMENT & LAND RECORDS
PANAJI - GOA
VILLAGE MAP OF SANTONA
DISTRICT : SOUTH GOA
TALUKA : SANGUEM
VILLAGE : SANTONA
N
Scale 1:8000
INDEX
BOUNDARIES:
ROADS:
VEGETATION:
WATER FEATURES:
MASONRY:
INDEX
VILLAGE CARMONA
VILLAGE RUMBREM
VILLAGE ANTORIM
VILLAGE CORANGINIM
VILLAGE DUDAVI
COMPUTER GENERATED ON :

Exhibit B

Date:-10.01.2024

To,
Fomento Resources Private Limited,
102, 1st floor, Kamat Metropolis-1
Behind Caculo Mall, St. Inez,
Panjim, North Goa,403001

Subject: Details of Train (Goods train ,Passenger train & Mail train) passing through Curchorem/Sanvordem railway station along with time.

Ref :- Your letter dated:- 02.01.2024 on the above cited subject

Dear Sir,
With reference to your letter above referred dated 02.01.2023, requesting to provide details of daily train frequency , below is the train frequency passing through the Sanvordem/Curchorem railway station and further passing through the Kalay Railway station towards up and down direction is as under:-

Sr. No	Type of Trains (Up/Dn approx.)	Frequency (No)
1	Goods train daily frequency	50
2	Daily mail train/Passenger train frequency	12
3	Weekly train frequency	06
Approx. daily train frequency		**68**

Thanking You,

Dy. Station Manager
(Sanvordem/Curchorem
South Western Railway)

Exhibit C

Measures taken to protect the railway line from the mining activity:

1) Entire mining operations will be carried out in accordance with approved Mining Plan.
2) No mining operations will be carried out at any point within a distance of fifty meters from the railway line, except with approval in writing from the concerned authorities.
3) The said fifty meters shall be measured from the outer edge of the mine pit (Ultimate Pit limit).
4) During Monsoon, as far as possible, water from the catchment area falling within 50 meters from the railway line, within the Mineral Block, will be channelized to the mine pit.
5) Security persons shall be deployed to prohibit any unauthorized entry in the area.
6) Additionally, persons employed at Mines will be briefed regarding importance of self-discipline and the safety measures.
7) Cautionary sign boards will be displayed at suitable distances, fifty meter from the railway line as a precautionary measure.

Annexure 18

ECOLOGY RESTORATION PLAN

Introduction:

The mining sector is an important sector and is related to the development of a country. But mining brings deterioration of environmental entities along with it. Post the mining process, the lands get degraded which if left as such will take many decades to reach the climax stage of ecological succession.

The proposed project, 'Block IV – Kalay Mineral Block' is an e - auctioned Mineral Block for grant of mining lease over an area of 152.5073 Ha. Presently based on the Mineral Reserves/ Resources and production capacity of 0.75 million tonnes, the life of the mine is estimated to be about 24 years, from the commencement of mining operation. However, based on the results of the proposed exploration, the life of the mine may enhance.

The Ecology Restoration activity at out Block IV – Kalay Mineral Block will be carried out concurrently with mining operations. Mining operations will be carried out in accordance with the Approved Mining Plan along with Progressive Mine Closure Plan. At the end of life of the mine, the entire block area will be restored by carrying out scientific and systematic ecology-restoration of the mines.

Land Reclamation:

Mining operation will result in a change in land use of the area by formation of pits, dumps and other mining features. The restoration of the degraded mined areas is essential to re-establish the ecological balance so that a self-sustaining ecosystem can be maintained.

At the conceptual stage an area of about 99.46 Ha. will be degraded due to mining pits, about 21.22 Ha for dumping and about 14.36 Ha. for other utility services such as

roads, infrastructure, etc.

The total area of 99.46 Ha. degraded by mining pits will be reclaimed. About 29.07 Ha. of the total pit area will be reclaimed as finalized / stabilized benches, 26.26 Ha. will be reclaimed by Backfilling and 44.14 Ha. will be maintained as water reservoir.

The total area of 21.22 Ha. that will be utilized by dump will be reclaimed by properly levelling / finalizing of dumps and subsequently rehabilitating with plantation. Area under roads, infrastructure and other utilities used by the project proponent will be well maintained.

The following measures will be taken up to mitigate land degradation-

- Sustainable, safe and scientific method of mining will be adopted for wining of ore. In the interest of this, a Slope stability study has been carried out through a reputed institute viz. "National Institute of Technology Karnataka" Suratkal (NITK). Recommendations suggested by the Institute in the study report will be followed.
- Mine reclamation by backfilling will be adopted in mineral exhausted mine pits.
- The stabilized and reclaimed mine benches will be provided with garland drains and erosion control measures to channelize incident rainwater into the mine pit / water reservoir.
- Waste will be disposed at earmarked place. The waste dumps will be terraced and will be provided with garland drains at the toe of the dumps, retention walls and series of settling ponds at strategic locations to avoid the silt/sediment runoff from the waste dumps during monsoon.
- The matured portion of the waste dumps will be stabilized by geo-textile wherever feasible and will be progressively planted and rehabilitated with suitable native species.

Land Rehabilitation by Plantation:

The challenging task in ecology restoration is the soil restoration which can be carried out through the plantation. Plantation with native species has been the oldest yet an effective process for restoration and rehabilitation of the degraded lands. . Plantation of saplings at our mine will comprise of mixed native species indigenous to the State of Goa with preference given to fruit bearing species such as cashew, mango, jamun, avla, etc. This will also attracts birds and generate revenue for the local habitants. Plantation improves soil conditions making it favorable for species colonization and ecosystem development by increasing soil organic matter and nutrients. Plantation will be carried out as per CPCB guidelines "Guidelines for Developing Greenbelts" in consultation with the state forest and agriculture departments.

Progressive method of plantation will be followed initiating with plantation of grass seeds/ seedlings to stabilize the soil followed by drought hardy plants, with fast growth rate, having glabrous/ pendulous leaves, will be selected for plantation. Pits of size 60cm x 60cm will be dug at 1.5m interval and filled with a mixture of top soil, organic manure and phosphate fertilizer and covered with a layer of soil held with coir net blanket. Care and maintenance will be done for maximum survival of saplings.

a) Plantation along mining lease boundary

Kalay Mineral Block is already having a 7.5m wide green belt all along its eastern and Southern boundary and partly on its western boundary. As the Mineral Block shares a common boundary with adjoining mine towards the North, there is no green belt on its northern boundary. Wherever there is less density of vegetation, plantation by gap filling will be carried out. At the conceptual stage, the 7.5m wide green belt will be well maintained.

b) Plantation around office building, Nalla & road

Avenue plantation already exists around the built-up areas and in open spaces around the office premises. Thick Plantation also exists on either sides all along the village road and the seasonal nalla.

c) Plantation on dump slopes

The matured portion of the waste dumps will be terraced at suitable intervals and the slopes of the waste dumps will be stabilized by covering with lateritic/soil material.Geo-textile will be laid wherever feasible and seeds of grass and small scrubs of local varieties will be sprinkled on the soil covering the dump slope. The waste dumps will be progressively planted and rehabilitated with suitable native species. At the end of conceptual period, all the waste dumps will be stabilized and rehabilitated with plantation.

d) Plantation on Backfilled areas

Rehabilitation of backfilled areas will be taken up as mining progresses and the pit is exhausted of mineral. At the conceptual stage about 26.26 Ha. of the mining pit area will be reclaimed and rehabilitated by plantation. After backfilling and levelling, a layer of lateritic/soil material will be spread over the backfilled area followed by plantation.

As per the Approved Mining Plan, green belt development for the 5 year plan period is given below in **Table 1.**

Table 1: Green belt planning during mining plan period

Year	Green Belt Location(s)	Area Proposed to be Covered (Ha)	Number of Plants Proposed	Estimated Expenditure (INR)

1	Dump1	0.60	1500	150000
2	Dump1	0.60	1500	150000
3	Dump1	0.60	1500	150000
4	Dump1 & Along Eastern Block Boundary	0.50	1500	150000
5	Dump1 & Along Eastern Block Boundary	0.50	1500	150000

Potential species suggested for green belt development is listed below in **Table 3.**

Table 3: List of species suggested for future green belt development

S. No.	Botanical Name	Family	Common Name	S/ T	Habitat	Height
Shrubs - < 5m (1st tier of Plantation)						
1	*Citrus limon*	Rutaceae	Lemon	T	Shrub	3m
2	*Duranta repens*	Verenaceae	Golden Dew Drop	T	Shrub	3m
3	*Hibiscus rosa sinensis*	Malvaceae	China Rose/ DasavaLa	T	Shrub	3m
4	*Nerium indicum*	Apocynaceae	Oleander/Chandaatha	T	Shrub	5m
Trees 5 - 10m (2nd tier of Plantation)						
5	*Acacia nilotica*	Mimoseae	Gum Arabic/ Babli	T	Tree	8m
6	*Bauhinia varigata*	Caesalpinaceae	Kachnar/ Arisinantige	T	Tree	5m
7	*Annona squamosa*	Annonaceae	Setha palla	T	Tree	6m
8	*Butea monosperma*	Fabaceae	Flame of the Forest/ Muttuga	T	Tree	10m
9	*Gardenia jasminoides*	Rubiaceae	Cape jasmine/ Suvasane Malle	T	Tree	5m
10	*Moringa oleifera*	Moringaceae	Drumstick Tree/Guggala	S	Tree	10m
11	*Pithecellobium dulce*	Mimosaceae	Manilla Tamarind/Seeme hunase	T	Tree	8m
12	*Thevetia peruviana*	Apocynaceae	Mexican oleander	T	Shrub	6m
13	*Phyllanthus emblica*	Phyllanthaceae	Ambla	T	Shrub	7m
Trees >10m (3rd tier of Plantation)						
14	*Aegle marmelos*	Rutaceae	Maredu / Bilva	T	Tree	12m

15	*Albizia lebbeck*	Mimoseae	Siris tree	T	Tree	20m
16	*Albizia procera*	Mimoseae	White siris/Belari	T	Tree	20m
17	*Alstona scholaris*	Apocynaceae	Devil Tree/ Aelele Haale	T	Tree	15m
18	*Azadirachta indica*	Meliaceae	Neem/ Turakabevu	T	Tree	20m
19	*Bambusa vulgaris*	Poaceae	Yellow Bamboo	T	Perennial grass	15m
20	*Cassia fistula*	Caesalpinaceae	Golden Shower/ Kakke	T	Tree	12m
21	*Delonix regia*	Caesalpinaceae	Flame Tree/ Kempu torai	T	Tree	15m
22	*Ficus benghalensis*	Moraceae	Banyan tree/ Aaladamara	T	Tree	20m
23	*Ficus religiosa*	Moraceae	Peepal/ Arali	T	Tree	20m
24	*Mangifera indica*	Anacardiaceae	Mango/ Mavinamara	S	Tree	15m
25	*Polythia longifolia*	Anonaceae	Ashok/Ubbina	S	Tree	15m
26	*Wrightia tinctoria*	Apocynaceae	Alae mara	T	Tree	12 m
27	*Hardwickia binata*	Fabaceae	Small leaves	T	Shrub	6m
28	*Syzygium cumini*	Myrtaceae	Neredu/ Neereedu	T	Tree	20m
29	*Tectona grandis*	Verbenaceae	Teak	T	Tree	20m

e) Post-Plantation Care

Post-plantation care will be an integral part of plantation management. Dedicated manpower will be engaged in the mine for post-plantation care, the activities of which include, regular watering, de-weeding, manuring, providing protective measures to protect planted saplings, etc. Diseased and dead plants shall be replaced by fresh saplings. Regular monitoring of the survival rate and remedial action will be done in an organized and planned manner. Thus, the ecological integrity and self-sustainability of the degraded mined land will be restored with the help of Plantation.

Water Reservoir:

A part of the mined out pits will be partially backfilled and retained as a water reservoir. Garland drains & erosion control measures will be provided to channelize the rainwater incident on benches, backfilled area and waste dumps into these water reservoirs. The water reservoirs will act as groundwater recharge pits. Our company in collaboration with the state fishery department may develop pisciculture in these

water reservoirs for the benefit of the local community.

Sustainable and Systematic Ecology Restoration Practices:

The company will adopt the following practices for carrying out scientific sustainable mining and systematic eco-restoration of the mines during the conceptual period:

1. Use of the latest software for mine planning.
2. Planning concurrent mining and mine reclamation activities in mineral exhausted pits.
3. Associating with various research institutes like NEERI, ICAR, ICFRE and consultants for mine reclamation projects as and when required.
4. Associating with various technical departments of state government like Forest department, Agriculture department, Fisheries department, Water Resource department etc.
5. Identifying all the stakeholders and engaging with them in a structured manner throughout the life of the mine. This will help to identify the issues, concerns of the stakeholders and satisfy them in a systematic manner. It will also help to take inputs from the stakeholders in eco-restoration of the mines.
6. Regular Biodiversity Assessment to help the company to achieve a No Net Loss with respect to biodiversity.
7. Converting of mining pits into water reservoirs, ponds, pisciculture, fishing, etc. based on the requirement of the local people.
8. Developing theme-based gardens like medicinal gardens, horticulture gardens, spice gardens.
9. Converting the mining infrastructure like office buildings, workshops, etc. into public utility infrastructure.

Conclusion:

The aim of the Ecology restoration would be to create a positive landscape which will

be ecologically rich and economically vibrant for the community even after the mining operations closes. At the end of conceptual stage, about 89.97 ha. of land will be brought under plantation, about 44.96 Ha. under water bodies and about 17.58 Ha. will remain under infrastructure and unused virgin area.

Ecology restoration will scientifically developed vast tracts of green belts, water bodies and other infrastructures which will transform the area into aesthetically appealing region in the benefit of the community. In a long term vision, Ecology restoration will support livelihoods, restore land and increase biodiversity.

Name of Project: **Block IV – Kalay Mineral Block**

Address: **Santona Village, Sanguem Taluka, South Goa District, Goa**

Specific terms of Reference (Mining of Minerals)
2.1 – Sequence of Mining

PP needs to submit year wise sequence of mining operation and plan for backfilling.

Reply:

The mining operation in Block IV - Kalay Mineral Block will be carried out in accordance with the approved mining plan, wherein, year-wise sequence of mining operation for the first 5 years has been depicted. The maximum production planned is 0.75 million tonnes per annum of Iron ore. Year-Wise Development & Production Plan are enclosed as **Exhibit 1,2,3,4 & 5.**

As the Total Mineral Reserves / Resources is estimated to a tune of about 16.731 million tonnes and production capacity is 0.75 million tonnes per annum, the expected life of the mine will be 24 years from the date of commencement of mining operations.

In a span of 24 years there will be 5 block plan periods consisting of detailed year-wise review of mining plan for 5 years each. Based on the life of the mine, sequence of mining operations for first five year plan period is given in table below:

Block Period	Year	Sequence of Mining					
		ROM (Tonnes)	Waste (tonnes)	Location	Pit ID	Bench (m RL)	Direction
1st – 5 years	1	350000	1432000		Pit-1 & Pit-3	77 to 35	West
	2	500000	2128000		Pit-1 & Pit-3	47 to 23	West & East
	3	750000	2303000		Pit-1 & Pit-3	89 to 11	West & East
	4	750000	2384000		Pit-1 & Pit-3	47 to 5	West & East
	5	750000	1180000		Pit-1 & Pit-3	29 to -7	West & East

Further, about 33.56 Ha of area under G3 level of exploration is proposed for exploration. Based on the results of the proposed exploration the life of the mine may vary.

Plan of Backfilling:

As per the approved mining plan, during the first 5 year mining plan period no backfilling will be carried out. Waste will be temporarily stacked/ dumped in Pit-1, Pit-3 & on dump 6 & 6A. Further, as mining progresses, the waste that was stacked/ dumped in pits will be re-handled. Backfilling will be carried out in exhausted pits from the third 5 year mining plan period onwards.

At the end of the conceptual period part of the exhausted pit will be backfilled and part will remain as water reservoir. The land use at the end of conceptual period is given in table below. :

Land-use at the end of conceptual period:

Sr. No.	Particulars	Area (Ha.)
1.	Pit Reclaimed	29.0675
2.	Pit Backfilled	26.2555
3.	Water Reservoir	44.1356
4.	Rehabilitated Waste Dump	21.2162
5.	Green Belt	3.0288
6.	Other Utility Services	14.363
7.	Unused	14.4407
	TOTAL	**152.5073**

A copy of Conceptual Plan showing the plan for backfilling is enclosed as **Exhibit 6.**

E 408600 E 408800 E 409000 E 409200 E 409400 E 409600 E 409800 E 410000 E 410200

N1692000 N1691800 N1691600 N1691400 N1691200 N1691000 N1690800 N1690600 N1690400 N1690200 N1690000 N1689800

N

BP 3 M-2' M-1' M0' M1' M2' M3' M4' M5' M6' M7' M8' M9' M10' M11' BP 2 M12' BP 1 BP 18 BP 17 P2' P3' BP 16 P4' P5' BP 15 P6' P7' P8' BP 14 P9' P10' P11' BP 13 P12' P13' P14' P15' BP 12 P16' P17' BP 11 P18' P19' P20' BP 10 P21' P22' BP 9 P23' P24' BP 8 BP 7 P25' BP 6 P21 P22 P23 P24 P25 BP 5 P4 P3 P2 BP 4 M12 M11 M10 M9 M8 M7 M6 M5 M4 M3 M2 M1 M0 M-1 M-2

PIT NO. 3

IDEA TOWER

PIPELINE

DUMP - 1

DUMP - 2

DUMP - 3

DUMP - 4

DUMP - 5

DUMP - 6

DUMP - 7

DUMP - 8

DUMP - 9

PIT NO. 1

PIT NO. 2

WATER LOGGED AREA

WATER LOGGED AREA

WATER LOGGED AREA

REF LINE 40 L

REF LINE

REF LINE

WEIGHBRIDGE

WELL

T.O.C.

PROPOSALS FOR THE 1st YEAR

- EXCAVATION
- TEMPORARY DUMPING
- DUMPING
- BUND
- MINERAL STACK AREA
- PLANTATION
- GARLAND DRAINS
- SETTLING POND
- HAUL ROAD

- EXISTING SETTLING POND
- ULTIMATE STRIPPING LIMIT FOR MINEABLE PROVED RESERVE (UNFC CODE 111)
- SAFETY BARRIER FROM NALLAH, HIGH TENSION POWER LINE, VILLAGE ROAD

I N D E X

- MINERAL BLOCK BOUNDARY
- BENCHES
- EXISTING DUMP/ BACKFILLING
- BOREHOLE (NSN S-38 / 68.5)
- CONTOUR (60)
- ROADS
- HIGH TENSION POWER LINE
- LOW TENSION POWER LINE
- RUBBLE WALL
- STRUCTURES
- NALLAH
- 7.5 m STATUTORY BARRIER

SCALE - 1 : 2000

20 0 20 40 60 80 100 200 300 400 500

PLATE No. 5A

FOMENTO RESOURCES PRIVATE LIMITED

BLOCK IV - KALAY MINERAL BLOCK

AREA - 152.5073 Ha.

VILLAGE - SANTONA TALUKA - SANGUEM

PURPOSE OF THE PLAN: 1st YEAR PRODUCTION & DEVELOPMENT PLAN

DATE	SCALE	Certified that the Plan is prepared based on the Geo-referenced Cadastral DGPS Plan authenticated by the State Government and is correct to the best of our knowledge
	1 : 2000	Roshel Fernandes, Qualified Person — Amit Ashok Ghogale, Qualified Person

E 408600 E 408800 E 409000 E 409200 E 409400 E 409600 E 409800 E 410000 E 410200

N1692000 N1691800 N1691600 N1691400 N1691200 N1691000 N1690800 N1690600 N1690400 N1690200 N1690000 N1689800

N

BP 3 M-2' M-1' M0' M1' M2' M3' M4' M5' M6' M7' M8' M9' M10' M11' BP 2 M12' BP 1 BP 18 BP 17 P2' P3' BP 16 P4' P5' BP 15 P6' P7' P8' BP 14 P9' P10' P11' BP 13 P12' P13' P14' BP 12 P15' P16' P17' BP 11 P18' P19' P20' BP 10 P21' P22' P23' BP 9 P24' BP 8 BP 7 P25' BP 6 P21 P20 P19 P18 P17 P16 P15 P14 P13 P12 P11 P10 P9 P8 P7 P6 P5 P4 BP 5 P3 P2 BP 4 M12 M11 M10 M9 M8 M7 M6 M5 M4 M3 M2 M1 M0 M-1 M-2

PIT NO. 3

PIPELINE

IDEA TOWER

DUMP - 1

DUMP - 3

REF LINE

40 L

WATER LOGGED AREA

DUMP - 2

REF LINE

WATER LOGGED AREA

WEIGHBRIDGE

WATER LOGGED AREA

PIT NO. 1

DUMP - 6

DUMP - 8

PIT NO. 2

DUMP - 4

DUMP - 7

60 L

REF LINE

DUMP - 9

WELL

PROPOSALS FOR THE 2nd YEAR

- EXCAVATION
- TEMPORARY DUMPING
- BUND
- LATERITE RUBBLE WALL
- SETTLING POND
- MINERAL STACK AREA
- PLANTATION
- GARLAND DRAINS
- HAUL ROAD

PROPOSALS AT THE END OF 1st YEAR

- EXCAVATION
- TEMPORARY DUMPING
- DUMPING
- BUND
- PLANTATION
- GARLAND DRAINS
- SETTLING POND

- EXISTING SETTLING POND
- ULTIMATE STRIPPING LIMIT FOR MINEABLE PROVED RESERVE (UNFC CODE 111)
- SAFETY BARRIER FROM NALLAH, HIGH TENSION POWER LINE, VILLAGE ROAD

I N D E X

- MINERAL BLOCK BOUNDARY
- BENCHES
- EXISTING DUMP/ BACKFILLING
- BOREHOLE (NSN S-38 / 68.5)
- CONTOUR (60)
- ROADS
- HIGH TENSION POWER LINE
- LOW TENSION POWER LINE
- RUBBLE WALL
- STRUCTURES
- NALLAH
- 7.5 m STATUTORY BARRIER

SCALE - 1 : 2000

20 0 20 40 60 80 100 200 300 400 500

PLATE No. 5B

FOMENTO RESOURCES PRIVATE LIMITED

BLOCK IV - KALAY MINERAL BLOCK

AREA - 152.5073 Ha.

VILLAGE - SANTONA TALUKA - SANGUEM

PURPOSE OF THE PLAN: 2nd YEAR PRODUCTION & DEVELOPMENT PLAN

DATE	SCALE	
	1 : 2000	Certified that the Plan is prepared based on the Geo-referenced Cadastral DGPS Plan authenticated by the State Government and is correct to the best of our knowledge

Roshel Fernandes
Qualified Person

Amit Ashok Ghogale
Qualified Person

E 408600 E 408800 E 409000 E 409200 E 409400 E 409600 E 409800 E 410000 E 410200

N1692000 N1691800 N1691600 N1691400 N1691200 N1691000 N1690800 N1690600 N1690400 N1690200 N1690000 N1689800

N

BP 3 BP 2 BP 1 BP 18 BP 17 BP 16 BP 15 BP 14 BP 13 BP 12 BP 11 BP 10 BP 9 BP 8 BP 7 BP 6 BP 5 BP 4

M-2' M-1' M0' M1' M2' M3' M4' M5' M6' M7' M8' M9' M10' M11' M12'

M-2 M-1 M0 M1 M2 M3 M4 M5 M6 M7 M8 M9 M10 M11 M12

P2' P3' P4' P5' P6' P7' P8' P9' P10' P11' P12' P13' P14' P15' P16' P17' P18' P19' P20' P21' P22' P23' P24' P25'

P2 P3 P4 P5 P6 P7 P8 P9 P10 P11 P12 P13 P14 P15 P16 P17 P18 P19 P20 P21 P22 P23 P24

PIT NO. 3

PIT NO. 1

PIT NO. 2

DUMP - 1

DUMP - 2

DUMP - 3

DUMP - 4

DUMP - 6

DUMP - 7

DUMP - 8

DUMP - 9

IDEA TOWER

PIPELINE

WATER LOGGED AREA

WEIGHBRIDGE

WELL

REF LINE

40 L

60 L

30 L

50 L

PROPOSALS FOR THE 3rd YEAR	PROPOSALS AT THE END OF 2nd YEAR
EXCAVATION	EXCAVATION
TEMPORARY DUMPING	TEMPORARY DUMPING
DUMPING	DUMPING
BUND	BUND
MINERAL STACK AREA	LATERITE RUBBLE WALL
PLANTATION	PLANTATION
GARLAND DRAINS	GARLAND DRAINS
HAUL ROAD	SETTLING POND

EXISTING SETTLING POND

ULTIMATE STRIPPING LIMIT FOR MINEABLE PROVED RESERVE (UNFC CODE 111)

SAFETY BARRIER FROM NALLAH, HIGH TENSION POWER LINE, VILLAGE ROAD

I N D E X

- MINERAL BLOCK BOUNDARY
- BENCHES
- EXISTING DUMP/ BACKFILLING
- BOREHOLE (NSN S-38 / 68.5)
- CONTOUR (60)
- ROADS
- HIGH TENSION POWER LINE
- LOW TENSION POWER LINE
- RUBBLE WALL
- STRUCTURES
- NALLAH
- 7.5 m STATUTORY BARRIER

SCALE - 1 : 2000

20 0 20 40 60 80 100 200 300 400 500

PLATE No. 5C

FOMENTO RESOURCES PRIVATE LIMITED

BLOCK IV - KALAY MINERAL BLOCK

AREA - 152.5073 Ha.

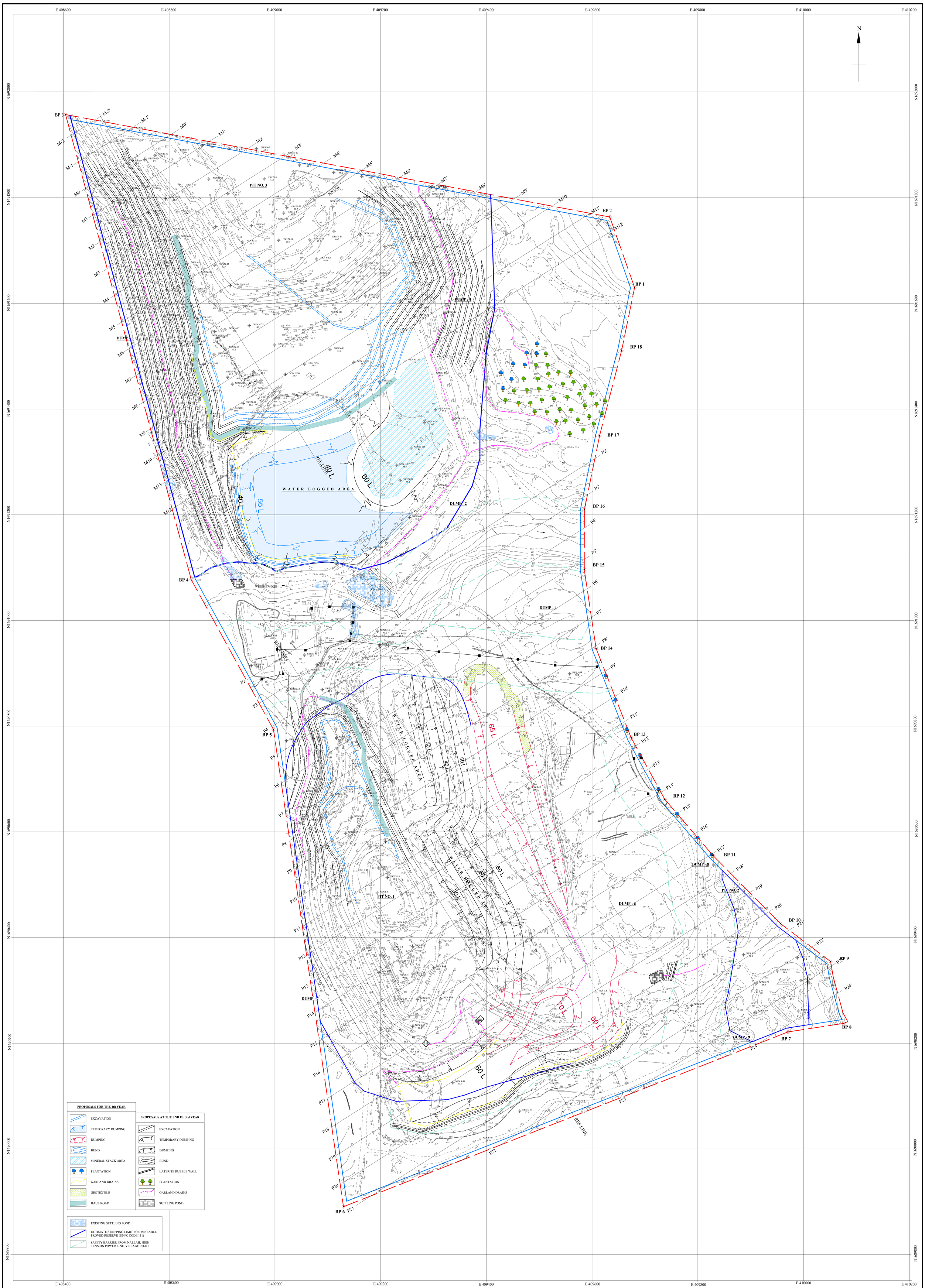
VILLAGE - SANTONA TALUKA - SANGUEM

PURPOSE OF THE PLAN: 3rd YEAR PRODUCTION & DEVELOPMENT PLAN

DATE	SCALE	
	1 : 2000	Certified that the Plan is prepared based on the Geo-referenced Cadastral DGPS Plan authenticated by the State Government and is correct to the best of our knowledge

Roshel Fernandes
Qualified Person

Amit Ashok Ghogale
Qualified Person



PROPOSALS FOR THE 4th YEAR

- EXCAVATION
- TEMPORARY DUMPING
- DUMPING
- BUND
- MINERAL STACK AREA
- PLANTATION
- GARLAND DRAINS
- GEOTEXTILE
- HAUL ROAD

PROPOSALS AT THE END OF 3rd YEAR

- EXCAVATION
- TEMPORARY DUMPING
- DUMPING
- BUND
- LATERITE RUBBLE WALL
- PLANTATION
- GARLAND DRAINS
- SETTLING POND

- EXISTING SETTLING POND
- ULTIMATE STRIPPING LIMIT FOR MINEABLE PROVED RESERVE (UNFC CODE 111)
- SAFETY BARRIER FROM NALLAH, HIGH TENSION POWER LINE, VILLAGE ROAD

I N D E X

- MINERAL BLOCK BOUNDARY
- BENCHES
- EXISTING DUMP/ BACKFILLING
- BOREHOLE (NSN S-38, 68.5)
- CONTOUR (60)
- ROADS
- HIGH TENSION POWER LINE
- LOW TENSION POWER LINE
- RUBBLE WALL
- STRUCTURES
- NALLAH
- 7.5 m STATUTORY BARRIER

SCALE - 1 : 2000

20 0 20 40 60 80 100 200 300 400 500

PLATE No. 5D

FOMENTO RESOURCES PRIVATE LIMITED

BLOCK IV - KALAY MINERAL BLOCK

AREA - 152.5073 Ha.

VILLAGE - SANTONA TALUKA - SANGUEM

PURPOSE OF THE PLAN: 4th YEAR PRODUCTION & DEVELOPMENT PLAN

DATE	SCALE	
	1 : 2000	Certified that the Plan is prepared based on the Geo-referenced Cadastral DGPS Plan authenticated by the State Government and is correct to the best of our knowledge

Roshel Fernandes
Qualified Person

Amit Ashok Ghogale
Qualified Person

E 408600 E 408800 E 409000 E 409200 E 409400 E 409600 E 409800 E 410000 E 410200

N1692000 N1691800 N1691600 N1691400 N1691200 N1691000 N1690800 N1690600 N1690400 N1690200 N1690000 N1689800

N

BP 3 M-2' M-1' M0' M1' M2' M3' M4' M5' M6' M7' M8' M9' M10' M11' BP 2 M12' BP 1 BP 18 BP 17 P2' P3' BP 16 P4' P5' BP 15 P6' P7' P8' BP 14 P9' P10' P11' BP 13 P12' P13' P14' BP 12 P15' P16' P17' BP 11 P18' P19' P20' BP 10 P21' P22' BP 9 P23' P24' BP 8 BP 7 P25' BP 6 P21 P22 P23 P2 P3 P4 BP 5 P5 P6 P7 P8 P9 P10 P11 P12 P13 P14 P15 P16 P17 P18 P19 P20 BP 4 M-2 M-1 M0 M1 M2 M3 M4 M5 M6 M7 M8 M9 M10 M11 M12

PIT NO. 3

IDEA TOWER

PIPELINE

DUMP - 1

DUMP - 3

WATER LOGGED AREA

40 L

60 L

55 L

RET. LINE

DUMP - 2

WEIGHBRIDGE

49.0

WATER LOGGED AREA

30 L

40 L

50 L

65 L

60 L

70 L

WELL

DUMP - 8

DUMP - 6

PIT NO. 2

PIT NO. 1

DUMP - 7

DUMP - 4

DUMP - 9

RET. LINE

PROPOSALS FOR THE 5th YEAR

- EXCAVATION
- DUMPING
- BUND
- MINERAL STACK AREA
- PLANTATION
- GARLAND DRAINS
- GEOTEXTILE
- HAUL ROAD

PROPOSALS AT THE END OF 4th YEAR

- EXCAVATION
- TEMPORARY DUMPING
- DUMPING
- BUND
- LATERITE RUBBLE WALL
- PLANTATION
- GARLAND DRAINS
- SETTLING POND
- GEOTEXTILE

- EXISTING SETTLING POND
- ULTIMATE STRIPPING LIMIT FOR MINEABLE PROVED RESERVE (UNFC CODE 111)
- SAFETY BARRIER FROM NALLAH, HIGH TENSION POWER LINE, VILLAGE ROAD

I N D E X

- MINERAL BLOCK BOUNDARY
- BENCHES
- EXISTING DUMP/ BACKFILLING
- BOREHOLE (NSN S-38 / 68.5)
- CONTOUR (60)
- ROADS
- HIGH TENSION POWER LINE
- LOW TENSION POWER LINE
- RUBBLE WALL
- STRUCTURES
- NALLAH
- 7.5 m STATUTORY BARRIER

SCALE - 1 : 2000

20 0 20 40 60 80 100 200 300 400 500

PLATE No. 5E

FOMENTO RESOURCES PRIVATE LIMITED

BLOCK IV - KALAY MINERAL BLOCK

AREA - 152.5073 Ha.

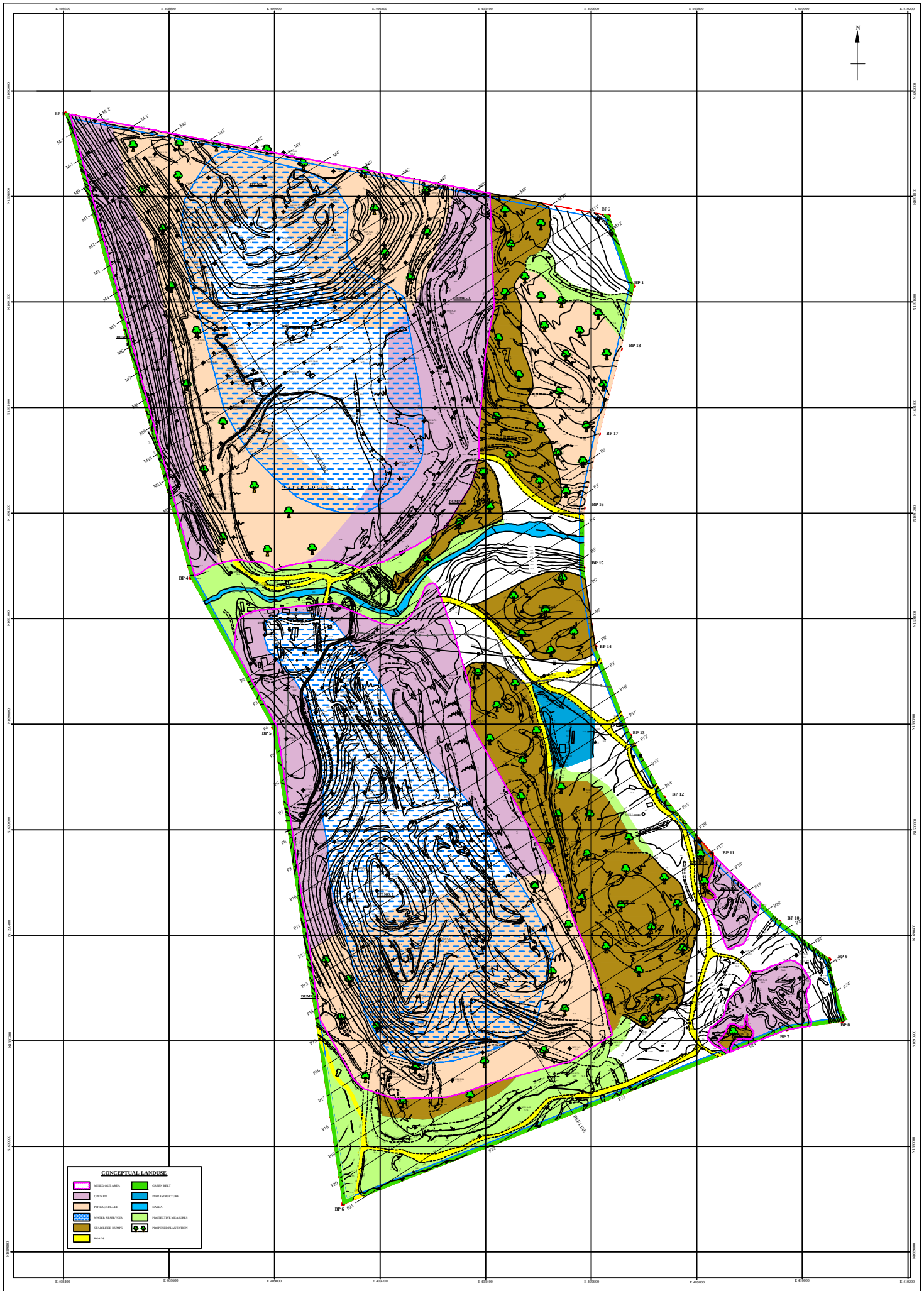
VILLAGE - SANTONA TALUKA - SANGUEM

PURPOSE OF THE PLAN: 5th YEAR PRODUCTION & DEVELOPMENT PLAN

DATE	SCALE	
	1 : 2000	Certified that the Plan is prepared based on the Geo-referenced Cadastral DGPS Plan authenticated by the State Government and is correct to the best of our knowledge

Roshel Fernandes
Qualified Person

Amit Ashok Ghogale
Qualified Person



I N D E X

- MINERAL BLOCK BOUNDARY
- BENCHES
- EXISTING DUMP/ BACKFILLING
- BOREHOLE
- CONTOUR
- ROADS
- HIGH TENSION POWER LINE
- LOW TENSION POWER LINE
- RUBBLE WALL
- STRUCTURES
- NALLAH
- T.I.m STATUTORY BARRIER

SCALE - 1: 2000

FOMENTO RESOURCES PRIVATE LIMITED	
BLOCK IV - KALAY MINERAL BLOCK	
AREA - 152.5073 Ha.	
VILLAGE - SANTONA	TALUKA - SANGUEM
PURPOSE OF THE PLAN: CONCEPTUAL PLAN	
DATE	SCALE: 1 : 2000

Certified that the Plan is prepared based on the Geo-referenced Cadastral DGPS Plan authenticated by the State Government and is correct to the best of our knowledge

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-(177)-2024-25-FD/ 1088 Dated: 18/06/2024.
19

To
The Director
Fomento Resources Pvt. Ltd.,
102, 1st Floor, Kamat Metropolis-I,
Behind Caculo Mall, St. Inej,
Panaji-Goa, 403001

Sub:- Application submitted under Van (Sarashan Evam Samvardhan) Adhiniyam, 2023 for diversion of 18.221 ha. of forest land in Block-IV-Kalay Mining Block in Sy. No. 26 (p) & 43 (p) of Santona village of Sanguem taluka, South Goa Division & District in favour of Fomento Resources Pvt. Ltd.,

Ref: 1. Online proposal no. FP/GA/MIN/QRY/472990/2024 dated 15.05.2024.

2. This office letter no. 6-13(177)-2024-25-FD/973 dated 11.06.2024

Sir,

With reference to the above-mentioned subject, I am directed to inform that as per the point no. 2 of Minutes of Meeting of PSC-I held on 03.06.2024 under the chairmanship APCCF / Nodal Officer, FCA, 1980 and upon verification by field functionaries, forest area with respect to Survey no. 26/1(p), 43/1(p), 27(p) & 28/(p), with details, is tabulated below:

Sr. No.	Survey Nos.	Area in Ha.	Remarks
1.	27(p)	0.9959	Prospective Private Forests
2.	28(p)	1.9161	
3.	26/1(p)	13.4539	Unclassed Forests
4.	43/1(p)	4.7671	
TOTAL AREA		**21.133**	

You are advised to take necessary action as per the minutes recorded during PSC-I held on 03.06.2024.

Yours faithfully,

14/6/2024

Dy. Conservator of Forest
Monitoring & Evaluation/Link officer

Copy for information to:

1. The Directorate of Mines & Geology, Institute Menezes Braganza Hall, Panaji-Goa, w.r.t. letter dated 31.10.2023.
2. The Dy. Conservator of Forests, Working Plan Division, O/o. PCCF (Goa)
3. The Dy. Conservator of Forests, South Goa Division, Margao-Goa
4. The Chief Conservator of Forests (Dev.), O/o. PCCF (Goa) Panaji.
5. The Additional Principal Chief Conservator of Forests / Nodal Officer, (FCA) Chairperson, PSC, O/o. PCCF (Goa), Panaji.

"Swachh Bharat, Swachh Goa"
"Clean India,Clean Goa"

FOMENTO RESOURCES

Date: 24/10/2024

To

District Collector,

Government of Goa,

4th Floor, Matanhy Saldana Complex,

South Goa, Margao, Goa.

Annexure 21

Sub: Implementation status of recognition of forest rights under the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 with respect to Survey nos. 26/1(P), 27/1(P), 28/3(P), 28/4(P), 28/5(P), 28/6 (P) and 43/1(P) within Block IV – Kalay Mineral Block, located at Santona Village, Sanguem Taluka, South Goa District, Goa.

Ref:

1. Terms of Reference (ToR) identification no. TO23B0000GA5122365N dated 08/01/2024.
2. Our FCA application bearing proposal no. FP/GA/MIN/QRY/472990/2024 dated 15/05/2024.

Sir,

1. We are the Preferred Bidders for Block IV – Kalay Mineral Block, located at Santona Village, Sanguem Taluka, South Goa District, Goa. The Letter of Intent (LOI) was granted by Director of Mines of Geology, Government of Goa, on 13/01/2023 read with letter dated 13/03/2023 for grant of Mining Lease for Block IV - Kalay Mineral Block (Block IV) for Iron Ore mineral located at Santona Village of Sanguem Taluka, South Goa for area of 152.5073 Ha. A copy of Letter of Intent dated 13/01/2023 along with letter dated 13/03/2023 is enclosed as **Annexure 1**.

FOMENTO RESOURCES PVT. LTD. FRPL GOA

Collectorate of South Goa Margao
Date: 24/10/24
Inward No.: 24044
Section:

2. Further, we wish to inform you that we are in the process of obtaining prior Environmental Clearance (EC) for the subject Mineral Block IV. Pursuant to our EC application dated 24/04/2023, Ministry of Environment, Forest & Climate Change, Government of India has granted us Terms of Reference (ToR) dated 08/01/2024 for grant of EC. A copy of the ToR is enclosed as **Annexure 2** for your ready reference.

3. As required, under condition no. 2.1 of ToR dated 08/01/2024 and subsequent to our communication dated 16/05/2024, the Office of the Principal Chief Conservator of Forest, Panaji, Goa, vide its letter No. 6-13-(177)-2024-25-FD/1088 dated 19/06/2024, informed that Block IV - Kalay Mineral Block includes Unclassed Forest area of 18.2210 Ha. comprising of Survey nos. 26/1(P) and 43/1(P) and Prospective Private Forest area of 2.901 Ha. comprising of Survey nos. 27/1(P), 28/3(P), 28/4(P), 28/5(P) and 28/6 (P) within the Mineral Block area of 152.5073 Ha. A copy of letter dated 19/06/2024 is enclosed as **Annexure 3**.

4. The copies of Form I&XIV with respect to Survey nos. 26/1(P), 27/1(P), 28/3(P), 28/4(P), 28/5(P), 28/6 (P) and 43/1(P) within Block IV – Kalay Mineral Block, located at Santona Village, Sanguem Taluka, South Goa District, Goa, are enclosed herewith as **Annexure 4** and Survey Plan showing mining lease boundary of Block IV – Kalay Mineral Block demarcating forest area is enclosed as **Annexure 5** for your kind perusal.

5. Further, the condition 2.3 at page 8 of 13 of Standard Terms of reference (Mining of Minerals) mandates the applicant to indicate Implementation status of recognition of forest rights under the Scheduled Tribes and other Traditional Forest Dwellers

FOMENTO RESOURCES PVT. LTD. FRPL GOA

(Recognition of Forest Rights) Act, 2006. The condition 2.3 is reproduce herein below for your ready reference.

> *".....2.3 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."*

6. In view of above, we kindly request your good office to provide us the implementation status of recognition of forest rights under the Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006 with respect to Survey nos. 26/1(P), 27/1(P), 28/3(P), 28/4(P), 28/5(P), 28/6 (P) and 43/1(P) within Block IV – Kalay Mineral Block, located at Santona Village, Sanguem Taluka, South Goa District, Goa.

Thanking you
Yours faithfully
For and on behalf of Fomento Resources Private Limited



Sandeep Morajkar
Authorised Representative

Encl: As above

Appendix

WILD LIFE CONSERVATION PLAN

of

Block IV – Kalay Mineral Block

Area : 152.5073 Ha
located in Santona Village,
Sanguem Taluka,
South Goa District, Goa

PROPONENT

Fomento Resources Private Limited,
1st Floor, 102, Kamat metropolis -1,
Behind Caculo Mall, St. Inez
Goa- 403001

Feb-2024

EIA Consultant
MINERAL ENGINEERING SERVICES
25/XXV, Club Road, BALLARI-583103, Karnataka
email : mes_msraju@yahoo.co.uk
Tel: 08392-267421/9448367421

Contents

Chapter No	Particulars	Page No.
1	Introduction	2
2	Project and Impact area	7
3	Probable impacts of the project on flora & fauna	37
4	Mitigation Measures required	43
5	Animal Passage Plan	54
6	Financial Implications and monitoring	56
7	**Maps**	
	Key Plan	Map - 1
	Land use Plan	Map - 2

CHAPTER -1
INTRODUCTION

1.0 INTRODUCTION

Block IV – Kalay Mineral Block, having an area of 152.5073 Ha is located in Santona Village, Sanguem Taluka, South Goa District, Goa State.

Government of Goa, through Directorate of Mines and Geology (DMG), issued Notice Inviting Tender (NIT) on 30/09/2022 in accordance with the Mineral (Auction) Rules, 2015. As per the said NIT, the auction process for Block IV – Kalay Mineral Block for Iron Ore mineral was conducted. Upon conclusion of the aforesaid auction, DMG, Govt. of Goa, declared Fomento Resources Private Limited as Preferred Bidder on 22/12/2022. Pursuant to the declaration as Preferred Bidder, DMG was pleased to issue the Letter of Intent (LOI) dated 13/01/2023 for an area of 179.1826 Ha. Further, vide letter dated 13/03/2023, DMG, Govt. of Goa revised the area of the Block from 179.1826 Ha to 152.5073 Ha., excluding the Eco Sensitive Zone (ESZ) w.r.t. Bhagwan Mahaveer Wildlife Sanctuary and National Park for the grant of Mining Lease for Block IV - Kalay Mineral Block for Iron Ore Mineral. The Mining Lease will be valid for a period of 50 years from the date of registration of Mining Lease Deed.

Fomento Resources Private Limited intends to obtain prior Environmental Clearance from MoEF&CC for the production of 0.75 MPTA of Iron Ore from Block IV - Kalay Mineral Block.

1.1 PROJECT & PROJECT PROPONENT

1.1.1 PROJECT

Block IV-Kalay Mineral Block is an Iron Ore Mine having an area of 152.5073 Ha, located at Santona Village, Sanguem Taluka, South Goa District, Goa State.

The Govt. of Goa through Directorate of Mine and Geology (DMG), issued Notice Inviting Tender (NIT) on 30/09/2022 in accordance with Mineral (Auction) Rules, 2015. As per the Said NIT, the auction process for Block IV - Kalay Mineral Block for Iron Ore Mineral was conducted. Upon conclusion of the aforesaid auction, DMG declared Fomento Resources Private Limited as Preferred Bidder for Block IV - Kalay Mineral Block on 22/12/2022.

Furtherance to the issuance of LOI dated 13/01/2023 read with letter dated 13/03/2023, the Project Proponent is in the process of obtaining various Consents, Approvals, Permits, NOC's as required under applicable laws for commencement of mining operations, which will further culminate into signing of Mine Development Production Agreement (MDPA) and subsequently execution of Mining Lease Deed.

1.1.2 PROJECT PROPONENT & ADDRESS

Fomento Resources Private Limited is the project proponent; details are provided herein below:

Registered Address: Fomento Resources Private Limited
1st Floor, 102, Kamat metropolis -1
Behind Caculo Mall, St. Inez
Panaji- Goa- 403001
Email : fomento@fomento.com
Phone no. : 08322441000

1.2 LOCATION OF THE PROJECT

The proposed project is located in Santona Village, Sanguem Taluka, South Goa District, Goa State. The boundary pillars of the mining lease are given in the below table. The project falling in the Survey of India Toposheet No. D43C3 (48 I/3). This mining lease lies in Toposheet number 48 E/14 as shown in Map-1.

Boundary co-ordinates of the Mining Lease as per DGPS plan

Mineral Block Boundary Pillar Nos.	Co-ordinates (Datum: WGS84)	
	Latitude (Northing)	Longitude (Easting)
BP-1	15° 17′ 58.2803″	74° 09′ 31.3905″
BP-2	15° 18′ 02.6197″	74° 09′ 29.8008″
BP-3	15° 18′ 08.7974″	74° 08′ 55.2583″
BP-4	15° 17′ 40.1839″	74° 09′ 03.3467″
BP-5	15° 17′ 30.9847″	74° 09′ 08.5955″
BP-6	15° 17′ 01.6125″	74° 09′ 13.1548″
BP-7	15° 17′ 12.4794″	74° 09′ 41.2969″
BP-8	15° 17′ 13.0200″	74° 09′ 44.8333″
BP-9	15° 17′ 16.8213″	74° 09′ 43.9885″
BP-10	15° 17′ 19.1419″	74° 09′ 40.8072″
BP-11	15° 17′ 23.3295″	74° 09′ 36.4971″
BP-12	15° 17′ 26.7696″	74° 09′ 33.4331″
BP-13	15° 17′ 30.5546″	74° 09′ 31.2826″
BP-14	15° 17′ 36.0551″	74° 09′ 29.0348″
BP-15	15° 17′ 40.9091″	74° 09′ 28.2686″

Mineral Block Boundary Pillar Nos.	Co-ordinates (Datum: WGS84)	
	Latitude (Northing)	Longitude (Easting)
BP-16	15° 17′ 44.5813″	74° 09′ 28.2599″
BP-17	15° 17′ 49.1710″	74° 09′ 29.2119″
BP-18	15° 17′ 54.4169″	74° 09′ 30.5870″

The Mineral Block is located 1.27 Km from State Highway Road No. SH-7 viz. the Sanvordem-Dabal-Dharbandora road. National Highway NH748 connecting the States of Karnataka and Goa runs on the North-North East side of the Mining Lease at an aerial distance of approximately 7.0 Km. Jetties are accessible via State Highway SH-7 and gives access to the major waterway joining Zuari River in the upstream and opening in to the Arabian Sea at the downstream

1.3 PROPOSED LAND USE PATTERN

The land use map of the study area is given vide Map-2.

Table 1.1: Existing Land Use on the Minerla Block

Pre Mining Use	**AREA** (Ha)
Land under Public Infrastructure / Utilities (water bodies, roads, railways, electric lines, telephone lines etc.)	2.6314
Degraded by Pits & Excavation	79.4997
Degraded by Dumps & Material Stacking	28.6610
Covered under Mine Infrastructure (plants, shades, buildings etc.)	4.8326
Others	36.8826
Total	**152.5073**

Table.1.2: Land Use at the Conceptual Stage

Post Mining Use (Conceptual)	**AREA** (Ha)
Degradation by Excavation	99.4586
Degradation by Dumps & Material Stacking	21.2162
Covered under Plants, Shades & Buildings	1.1398
Covered by Roads & Approaches	2.8234
Others	27.8693
Total	**152.5073**

1.4 STATUTORY CLEARANCE

Status of Forest Clearance

The tender document, Geological Report and summary of Mineral Block issued by Govt. of Goa, has mentioned that forest land is not ivolved in this Project.The Project Proponent has communicated to the forest dept., Govt. of Goa and reply is awaited.

1.5 ENVIRONMENTAL SENSITIVITY

Table 1.4: Environmental Sensitivity

Particulars	Details	Distance and direction
Sanctuary/ National Park / Tiger Reserve/ Elephant / any other Reserve Forest	Bhagwan Mahaveer Wildlife Sanctuary & National Park Bondla Wildlife sanctuary Madei Wildlife Sanctuary	 1.04 Km 12 Km 17 km
Biosphere Reserve	None	-
Habitat for Migratory Birds	Nanda Lake	7 km
Water Bodies	Seasonal Nalla Flows W-E across the Mineral Block. Kalay River runs along Eastern Boundary of the Mineral Block from S-N.	Seasonal Nalla – within lease Kalay River - 0.005 km
Defence Installation	None	-
Nearest airport	Dabolim Airport	49 km
Nearest Railway Station	Kalay Railway Station	4 km
Nearest Highway	State Highway (SH7)	2 km
Seismic Zone	III	
Nearest Habitat	Within the lease	Min Buffer of 50mts shall be provided and no drilling and blasting shall be carried out.
Archaeological monuments	--	--
Protected Monuments	Shigao Caves	5.3 km
Places of worship	Place of worship -Ambeudak temple	0.3 km from western boundry
Public utilities	None	
Coastal Regulation Zone (CRZ)	Not Applicable	--
Distance from the HFL of the river in m	Kalay River	5 m from eastern Boundary. There is enough elevation difference.

CHAPTER -2
PROJECT & IMPACT AREA

2.0 PROJECT & IMPACT AREA

2.1 DESCRIPTION OF STUDY AREA (CORE AND BUFFER AREA)

The study area includes Mineral Block area which is core Zone and Buffer Zone of 10 km radius (from the boundary of Mineral Block) has been considered for assessing the data. The study area covering 10 km radius of the Mineral Block falls in Toposheet Number D43C3 (48 I/3) of Survey of India.

There are 51 villages in the buffer zone. These villages are in Sanguem, Dharbandora, Ponda, Quepem & Salcete talukas of of Goa State. The total population of these villages is 113340 according to census 2011. As per Census 2011 villages Antoriem and Salaulim are uninhabited.

Table 2.1: Population in buffer zone villages, 2011 Census.

Sl No.	Name	No House Hold	Total Population	Total Male	Total Female
1	Colem	995	4195	2092	2103
2	Sigao	405	1724	879	845
3	Sangod	236	1083	557	526
4	Cormonem	152	645	358	287
5	Codli	884	3801	1955	1846
6	Camarconda	173	793	395	398
7	Moissal	2	8	5	3
8	Bandoli	231	1060	512	548
9	Rumbrem	131	646	300	346
10	Santona	343	1403	739	664
11	Calem	574	2683	1316	1367
12	Maulinguem	72	354	178	176
13	Dudal	97	446	229	217
14	Costi	196	881	503	378
15	Coranginim	9	32	14	18
16	Comproi	150	620	301	319
17	Muguli	119	508	225	283
18	Uguem	608	2557	1248	1309
19	Sanguem (M Cl)	1545	6444	3162	3282
20	Sanvordem (CT)	1187	5103	2552	2551
21	Assolda	309	1257	634	623
22	Bati	438	1933	959	974
23	Chandor	184	707	307	400
24	Conxem	39	186	94	92
25	Cotarli	258	1121	563	558
26	Curchorem-Cacora (M Cl)	5667	22730	11601	11129
27	Darbandora	672	2991	1493	1498

28	Dongurli	339	1534	753	781
29	Guirdolim	909	3622	1736	1886
30	Macasana	503	1972	880	1092
31	Molcopona	93	457	224	233
32	Molcarnem	347	1507	707	800
33	Molem	383	1715	883	832
34	Nagvem	100	475	238	237
35	Nirancal	406	1772	880	892
36	Odar	143	569	284	285
37	Oxel	633	2794	1329	1465
38	Patiem	60	292	158	134
39	Ponchavadi	931	4295	2140	2155
40	Sancordem	273	1233	624	609
41	Siroda	3197	14041	6886	7155
42	Sirvoi	281	1129	559	570
43	Tudou	9	35	17	18
44	Undorna	53	176	93	83
45	Xeldem (CT)	1815	7434	3693	3741
46	Xelpem	66	255	122	133
47	Xelvona	418	1725	870	855
48	Xic-Xelvona	28	125	67	58
49	Zanodem	61	272	138	134
	Total	26724	113340	56452	56888

2.2 EMPLOYMENT

The major employment in this part of the district is Agriculture, small businesses, animal husbandry and some of the people are also employed as workers in the Mines and nearby Industries.

2.3 CROPPING PATTERN

Agriculture in the area mostly depends on rains. The major crop is Cashew, betel nuts, Mangoes, Paddy etc. are grown to some extent. Some people also grow vegetables which find a ready market.

2.4 PHYSIOGRAPHY, NATURAL DRAINAGE LINES, WATER SOURCE

The 10km buffer zone study area comprises of the stretched low lying plains, hills and valleys along with the deeply dissecting high Western Ghats with denudational hills. Many first order streams originate from the hill top downwards forming a dendritic drainage pattern. The topography of the area is undulating & hilly with gentle gradient of 10 to 20 degrees towards east.

The highest level is 102 m AMSL towards North East of lease on Dump no. 1 and lowest level is -0.5 m AMSL towards North of lease in pit no.3. There is a seasonal nalla flowing across the block from west to east and joins river Kalay flowing towards the eastern side of the block boundary.

Drainage: The main drainage for this mineral block is the Kalay River flowing from South to North towards the eastern side of the block.

The catchment area of Kalay River is all high ground towards eastern side of the block to a distance of 5 to 6 kms from the Kalay River.

Also a second order seasonal nalla flows from the north west of block towards south and passes across the block from west to east, ultimately joining to the Kalay River in the eastern side of the block. The catchment area for the seasonal nalla is all high ground towards west of the lease to a distance of 300 to 600 meters from the nalla.

Distance & Direction of River/ Stream/Nallah within the 10km radius

Name of the River/Stream/Nallah	Distance from Project Site (Km)	Direction from Project Site
Kalay River	0.005	East
Doodhsagar River	4.0	North – North East
Zuari River	3.79	South West

Distance & Direction of Reservoir within the 10km radius

Name of the Reservoir	Distance from Project Site (Km)	Direction from Project Site
Salaulim	7.83	South
Moisal	4.32	East

2.5 *GEOLOGY*

The main Iron Ore deposit where this mine is located is called as Codli-Kirlapal-Costi deposit. The general succession of the strata from top to bottom is as follows. Laterite (about 15m - 20m), Altered Dyke (Intrusive) Ferrugenous/Phyllitic/Limonitic Clay (10m- 15m), Iron Ore body (20m - 30m), Siliceous Manganiferous Clay & Weathered BHQ (forms foot wall). Most of the lease area is broken up by mining and allied activities.

The remaining area is mostly covered with a capping of laterite. Based on the exposed rocks formation and the available borehole data, the ore body and the associated rocks are folded.

Structurally ore body and associated formations appears to be subjected to folding with dips towards both Easterly and Westerly direction. The ore body has a general strike direction as N 10°-20° W to S 10°-20° E and folded into anticlines and synclines with amount of dip varying from 10°-40°. The synclinal portions are preserved whereas anticlinal portions are eroded. The ore body is plunging towards south with an average angle of 5° to 10°. The total length of Ore body is about 2000m and width varies from of 300m to 400m. The thickness of the ore body is 20m to 30m. Due to igneous activity, a number of weathered and altered sills & dykes exist in the form of clays along and across the ore body

2.6 CLIMATE

Sub-tropical climate prevails over the study area. May is the hottest month where the mean daily temperature increases to 30^0C. January is the coolest month with mean daily temperature is about 23^0C. The temperature is highest (around 33^oC) in pre–monsoon months of April & May and again in post-monsoonon months of November & January. Due to its proximity to the Arabian Sea, humidity throughout the year is more than 60% with range from 80 to 90% during the monsoon period.

As a result of geographic influence, rainfall increases towards the Western Ghats, with an average annual rainfall of about 3959 mm.

Over 90% of the annual rainfall occurs during monsoon months of June to September of Sub-tropical climate prevails over the study area.

The average annual rainfall recorded was is 395.9 cm in Santona village of Sanguem taluka of South Goa District.

2.7 FLORA & FAUNA

2.7.1 STUDY REGION

The biodiversity study was undertaken to assess the biodiversity of Mineral Block Area and its buffer area of 10 Km radius with the following objectives.

1. Collection and synthesis of secondary information on the status of biodiversity in study region
2. Field survey to assess the status of flora and fauna component in core and buffer areas of project site
3. Identification and listing of flora and fauna which are important as per the Wildlife (protection) Act 1972.

2.7.2 APPROACH

A participatory and consultative approach was followed in executing the assignment on Ecology & Biodiversity assessment of the mining lease and 10-km buffer region. Further enquiries were made with forest officials, revenue department and local villagers. Literature survey included a review of the forest working plan, Census hand book, Gazetteer and other records related to the ecology of the region.

A team comprising flora and fauna specialist from Mineral Engineering Services along with Mr. M.S. Raju (EIA coordinator) have visited the Block-VI Kalay Mineral Block Iron Ore Mine and 5-km buffer area during 6th to 9th April 2023.

Mining officers have highlighted the mining history, shown us the mine lease boundary, and they have further explained to us about the future afforestation works to be undertaken in the region and the prior afforestation as recommended in the TOR. They have shown us the surrounding land use, villages and agro biodiversity area such as Mango and Cashew and orchards falling within the 10Km radius area of project.

2.7.3 FLORA STUDIES

Forest Types: Forest types were closely observed on the ground and identified using Champion & Sheth (1978), forest classification of India. The forest types are based on the composition of the forests and the dominant species found in them.

The identified forest types have been verified, and confirmed from forest working plan for the south Goa Forest Division with specific emphasis on Ponda and Mollem forest ranges, published and other authenticated sources.

Quartile Approach: In order to provide representative ecological status 10-km buffer has been divided into four quartiles for biodiversity sampling, i.e., NE (Q-1), NW (Q-2) SW (Q-3) and SE (Q-4) is given in Fig. 3.1.

Each of the quartiles have been examined for representative flora on randomly sampled quadrats for trees (25x25-m), shrubs (10x10-m) and herbs (2x2-m) depending upon prevailing geographical conditions and bio-diversity aspects of study area.

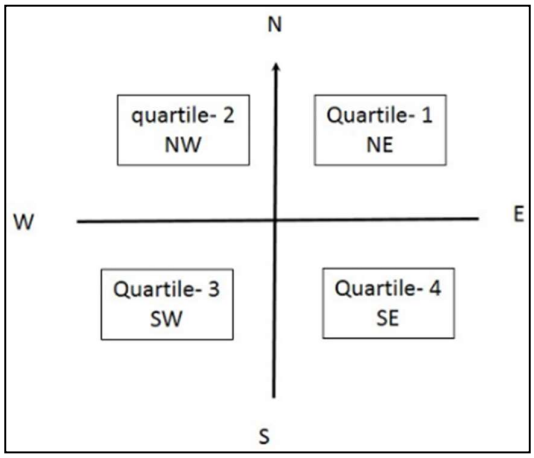


Figure. 2.1. Schematic diagram shown 10- km radius buffer area representation under four quartiles for ecology and biodiversity sampling.

Phyto-sociological parameters, viz., Abundance, Density, Frequency (%) were measured as given below. A total of 10 quadrats were laid down randomly within core area and 40 quadrats were laid down within four quartiles randomly (10/quartile) in buffer area each quadrat trees, shrubs, and herbs as per the Fig.2.1

Quadrats method: Quadrats of 25 × 25-m were laid down randomly within core and 10-km buffer area; each quadrat was laid to assess the trees (>5 cm GBH) and one, 10 × 10-m sub-quadrat nested within the quadrat for shrubs, and two, plots 2 × 2-m for herbs, climbers & grass is given in **Fig. 2.2**.

The quadrats were laid randomly to cover the area to maximize the sampling efforts and minimize the species homogeneity, such as small stream area, trees in agricultural bunds, tank bunds, farm forestry plantations, wildlife areas, natural forest area, avenue plantations, house backyards, etc.

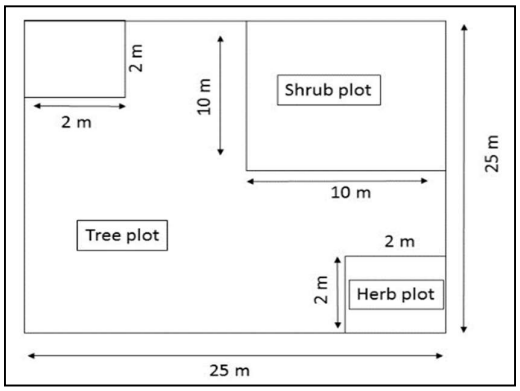


Figure.2.2. Schematic representation of quadrats for trees, shrubs, herbs & grass.

Following formulae was used for calculating the frequency (%), abundance and density of the floral species

$$\%\ \text{Frequency of species A} = \frac{\text{Number of quadrats of occurrence of species A}}{\text{Total number of quadrats studied}} \times 100$$

$$\text{Abundance of species A} = \frac{\text{Number of individuals of species A in total quadrats studied}}{\text{Number of quadrats of occurrence of species A}}$$

$$\text{Density of species A} = \frac{\text{Number of individuals of species A in total quadrats studied}}{\text{Total area studied}}$$

Biodiversity Analysis using index: Species diversity will be calculated by using Shannon and Wiener (1963) formula as follows:

$$H' = -\sum_{i=1}^{R} p_i \ln p_i$$

Whereas H' is Shannon index of general diversity, p_i is often the proportion of individuals belonging to the ith species in the dataset of interest.

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 (*see* http://www.iucnredlist.org/static/categories_criteria_3_1).

A keystone species : 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.

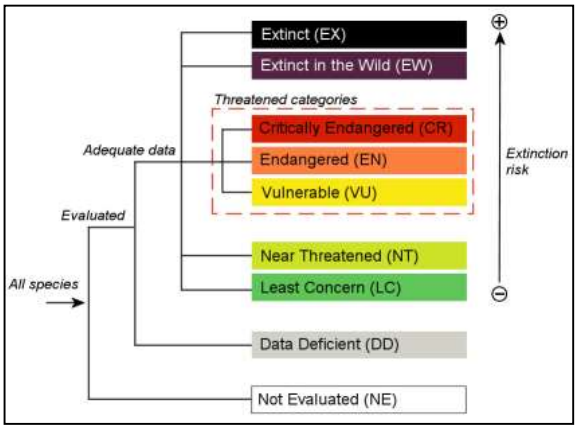


Figure 2.3. IUCN categories showing threatened species categories

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 (Fig. 2.3).

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., are *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*).

2.7.4 FAUNAL DIVERSITY

Mammals: Mammals were observed using indirect methods such as faucal matter (i.e., scat) and pug mark by establishing 10 × 100-m linear transects depending on the habitat (i.e., existing wildlife game routes/forest trails used). We have also documented few mammals by direct sighting.

Birds: We have used point count method for bird documentation as per standard method by Sutherland (1996), which involved 10-minute observation in each point during early morning hours (6.00 to 10.00 AM). We have enumerated 20 point-counts in each quartile, which constitute a total of 80 points-counts (20 × 4) within 10-km radius area.

Butterfly: The butterfly was enumerated by two linear transects, of 10 × 100 m were laid at each quartile at an interval of 1 km. Further, reptiles and fishes documented in existing literature and secondary information in consultation with local people and wildlife experts were recorded. Apart from field observation, consultations were held with knowledgeable persons of the villages, and frontline forest department officials to validate the field observation and information cited in the literature.

To know the endemic or conservation status of the fauna, Schedule 1 of the Wildlife Preservation Act (1972) has been screened

2.7.5 OBSERVATIONS AND DISCUSSIONS

2.7.5.1 OVERVIEW OF PROJECT AREAS

The forest of the region was categorised as Southern moist deciduous mixed forests and Southern secondary moist mixed deciduous forests (Champion & Seth, 1968), in *'A revised survey of the forest types of India'*.

The region presents a wide range of altitudes, aspects, slopes, drainage, and spills giving rise to a variety of locality factors reflected in the occurrence of number of forest types from tropical semi-evergreen to mangrove forests. These types are broadly differentiated and described here as per recognized and revised forest classification of Champion & Seth.

- 1A/C4 West Coast Tropical Ever Green Forest
- 2A/C2 Southern Moist Deciduous Forest
- 3B/C2 Southern Moist Mixed Deciduous Forest

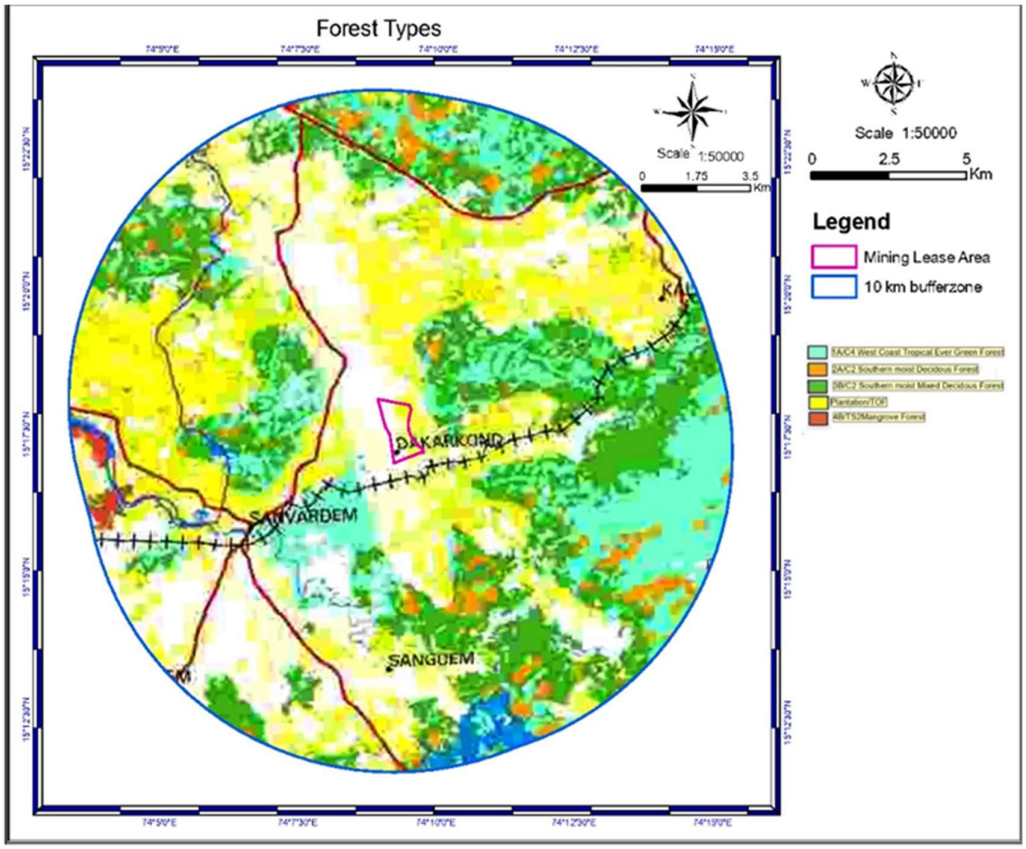


Fig. 1.0: Forest Types

These forest types have essentially a deciduous vegetation over a period of the year. However, few evergreen species occur sporadically due to favourable soil and moisture conditions along the rivulet and depressions.

2.7.5.2 CORE ZONE

FLORA: Total 45 species were recorded within core area, of which 21 species trees , 11 species shrubs and 13 species herbs recorded (Table 2.1)

Table 2.1: Flora species recorded within core zone

S. No	Species name	Family	Common Name
		TREE	
1	*Anacardium occidentale*	Anacardiaceae	Cashew
2	*Acacia auriculiformis* *	Fabaceae	Acacia
3	*Casurina equisettifolia*	Casuarinaceae	Suru
4	*Alstonia scholaris*	Apocynaceae	Saten
5	*Bauhinia racemose*	Fabacaeae	Apto
6	*Artocarpus heterophyllus*	Moraceae	Phanas
7	*Bombox ceiba*	Bombacaceae	Sanwar
8	*Delonix regia*	Fabacaeae	Gulmohar
9	*Emblica officinalis*	Phyllanthaceae	Aonia
10	*Garcinia indica*	Clusiaceae	Kokum
11	*Gmelina arborea*	Lamiaceae	Shivan
12	*Leucaena leucocephala*	Fabacaeae	Subabul
13	*Mangifera indica*	Anacardiaceae	Mango
14	*Trema orientalis*	Cannabaceae	Charcoal tree
15	*Canthium dicoccum*	Rubiaceae	Ceylon boxwood
16	*Ziziphus mauritiana*	Rhamnaceae	Indian jujube
17	*Holigarna arnottiana*	Anacardiaceae	Black varnish tree
18	*Carryota urens*	Arecaceae	foxtail palm
19	*Grewia tiliifolia*	malvaceae	Dhman
20	*Macaranga peltata*	Euphorbiaceae	Chandada
21	*Psidium guajava*	Myrtaceae	Guava
		SHRUBS	
22	*Acacia paniculate*	Mimosaceae	sickle wattle
23	*Calotropis gigantean*	Asclepidiaceae	crown flower
24	*Carissa congesta*	Apocynaceae	Karamda
25	*Helictris isora*	Malvaceae	Marodphali
26	*Lantana camara**	Verbenaceae	Lantana
27	*Ixora coccinea*	Rubiaceae	Jungel gerenium
28	*Ziziphus oenoplea*	Rhamnaceae	Jackal jujube
29	*Musaaanda glabrata*	Rubiaceae	Dhobi tree
30	*Getonia floribunda*	Combrataceae	Paper flower
31	Antidesma acidum	Euphotbiaceae	Black berry
32	*Breyania retusa*	Euphotbiaceae	Cup and soucer
		HERBS AND CLIMBERS	
33	*Asparagus racemosa*	Asparagaceae	Satavar
34	*Bidens biternata*	Asteraceae	Chirchitta
35	*Ipomea cmuricata*	Convolvulaceae	Bhingari
36	*Ocimum sanctum*	Lamiaceae	Tulsi
37	*Commelina odoreta*	Asteraceae	Slam weed
38	*Smilax zeylanica*	Smilacaceae	Kumarika

39	*Momordica diocia*	Cucurbitaceae	Spiny guard
40	*Dioscorea bulbifera*	Dioscoreaceae	air potato
41	*Impatiens balsmina*	Balsaminaceae	Spotted snapweed
42	*Impatiens minor*	Balsamaceae	lesser balsam
43	*Begonia crenata*	Begoniaceae	common begonia
44	Curculigo orchioides	Hycinthacieae	
45	*Curcuma sp.*	Zingiberaceae	wild ginger

NOTE: * Invasive species

FAUNA: Total 16 species were observed within the core area, of which 9 species are birds, 3 species of mammals and 4 species of reptiles **(Table 2.2).**

Table 2.2: List of faunal species within core zone

Sl. No.	Common name	Scientific name	Family	IUCN / WPA status
	BIRDS			
1	Common Iora	*Aegithina tiphia*	Irenidae	LC/II
2	Green Bee Eater	*Merops orientalis*	Meropidae	LC/II
3	House Crow	*Corvus splendens*	Corvidae	LC/II
4	House Sparrow	*Passer domesticus*	Passeridae	LC/II
5	House Swift	*Apus affinis*	Apodidae	LC/II
6	Indian Robin	*Saxicoloides fulicata*	Turdinae	LC/IV
7	Jungle Crow	*Corvus macrorhynchos*	Corvidae	LC/II
8	Jungle Myna	*Acridotheres fuscus*	Sturnidae	LC/II
9	Red-whiskered Bulbul	*Pycnonotus jocosus*	Pycnonotidae	LC/II
	MAMMALS			
10	Indian Hare	*Lepus nigricollis*	Leporidae	LC/II
11	Rat	*Rattus rattus*	Muridae	LC/IV
12	Striped squirrel	*Funambulus palmarum*	Sciuridae	LC/IV
	REPTILES			
13	Green Forest lizard	*Calotes calotes*	Agamidae	LC/IV
14	Roux's Forest lizard	*Calotes rouxii*	Agamidae	LC/IV
15	Garden lizard	*Calotes elloti*	Agamidae	LC/IV
16	Russell's Viper	*Daboia russelii*	Viperidae	Schedule I

2.7.5.3 BUFFER ZONE

Overview of buffer area (10-km radius) in all 4 directional quartiles - eco-sensitive areas, plantations and development activities so on (Table 2.3).

Table 2.3: General description of landscape within 10 km radius from core area (all 4 directions of North, East, West and South).

Quartiles	Trees/ Shrubs	Species richness	Density/ha	Species diversity (H')	Habitat Characteristics **
Quartile 1 North-East	Trees	42	1834	2.37	Bhagavan Mahavir WLs; Reserve Forest Open mixed forest Main Power line; Dudhsagar River
	Shrubs	13	4710	2.14	
	Herbs	10	86500	2.16	
Quartile 2 North-West	Trees	35	1714	2.78	Dense Forest; Cashew mixed forest RF, Zuari River, Mahadayi River Udnai Nadi. CARMONEM RF Comarconda RF
	Shrubs	9	2120	1.84	
	Herbs	9	2050	2.36	
Quartile 3 South-West	Trees	54	234	1.87	Reserve Forest; Zuvari River; South Central Railway Track; Zuari River.
	Shrubs	8	1220	1.84	
	Herbs	10	2500	1.36	
Quartile 4 South-East	Trees	44	734	2.17	Solaulim dam reservoir, Reserve Forest , Bhagavan Mahveer WLS, Netravali WLS, Ugem Nadi, Salauli dam back water, Gouli Nadi
	Shrubs	11	3820	2.64	
	Herbs	9	11500	2.06	

Detailed Eco-Sensitive Areas

Table 2.4 Ecologically Important habitat from the core area boundary

Sl. No	Quartile	Importance ecosystem	Direction	Distance from Lease Area
1	Q1	Bhagavan mahveer WLS	E	1.04
2		Dudsagar River	N	4.00
3		Kalay River	E	0.12
4		Dongarwada RF	N	8.80
5	Q2	Mahadayi River	N	4.30
6		Udnai Nadi	NW	8.80
7		CARMONEM RF	N	0.75
8		Comarconda RF	W	3.43
9	Q3	Barazona Dongor RF	SW	0.80
10		Moisal dam	W	4.80
11		Guddemal RF	SW	0.88
12		Zuvari River	SW	3.80
13		Ambeudhok RF	SW	0.18
14		Kushavathi River	SSW	9.00
15		Odsorvo RF	SW	0.80
16	Q4	Netravali WLS	SE	9.34
17		Ugem Nadi	SE	6.10
18		Salauli dam	SE	7.90
19		Gouli Nadi	S	7.20

FLORA DIVERSITY

TREE: Overall, 128, of which 89 species from the primary survey and 39 species from the report by Biodiversity Board. The results show that the buffer area recorded 89 tree species compared to 7 species of the core area.

Again we can see that exotic species Acacia auriculiformis and Anacardium occidentale have dominated in the core area. In addition, 39 species reported as secondary information from Biodiversity Board, Goa (https://gsbb.goa.gov.in/wp-content/uploads/2020/05/List-of-plants.pdf)

Table 2.5: Trees growing in core and buffer area of 10-km radius.

Sl. No.	Species name	Family	Frequency %	Abundance	Density
1	*Acacia auriculiformis*	Mimosaceae	21	1.7	5.7
2	*Albizia odoratisima* Benth.	Mimosaceae	21	3.0	10.3
3	*Anacardium occidentale* L.	Anacardiaceae	21	3.0	10.3
4	*Anogeissus latifolia* (Roxb. ex DC.)	Combretaceae	29	2.8	12.6
5	*Ardisia solanacea Roxb.*	Myrsinaceae	29	2.5	11.4
6	*Areca catechu* L.	Arecaceae	29	2.0	9.1
7	*Artocarpus heterophyllus* Lam.	Moraceae	29	2.5	11.4
8	*Bauhinia malabarica* Roxb.	Fabaceae	29	3.8	17.1
9	*Bauhinia racemosa* Lam.	Fabaceae	29	2.3	10.3
10	*Bischofia javanica* Bl.	Phyllanthaceae	29	4.0	18.3
11	*Bombax malabaricum* DC.	Bombacaceae	14	3.0	6.9
12	*Bridelia retusa* Spreng.	Euphorbiaceae	14	2.5	5.7
13	*Buchnania lanzan*	Anacardiaceae	14	3.0	6.9
14	*Buchanania latifolia Roxb.*	Anacardiaceae	14	2.5	5.7
15	*Caesalpinia bonducella* (L.) Fleming	Caesalpinaceae	14	3.0	6.9
16	*Callicarpa tomentosa* (L.) Murr.	Verbinaceae	14	2.0	4.6
17	*Canthium dicocum* (Gaert.) T. & B.	Rubiaceae	29	3.0	13.7
18	*Canarium strictum* Roxb.	Burseraceae	29	2.3	10.3
19	*Careya arborea* Roxb.	Lecythidaceae	29	3.5	16.0
20	*Caryota urens* L. (Kithul) sap.	Arecaceae	29	3.5	16.0
21	*Cassia fistula L.*	Fabacaeae	29	2.5	11.4
22	*Casearia ovoidea Sleumer.*	Flacourtiaceae	29	2.8	12.6
23	*Cassia siamea* Lam.	Fabaceae	21	3.7	12.6
24	*Clerodendrum viscosum* Vent.	Euphorbiaceae	21	3.0	10.3
25	*Crotalaria retusa L.*	Fabaceae	21	4.0	13.7
26	*Dalbergia lanceolaria*	Fabacaeae	21	2.0	6.9
27	*Dalbergia latifolia* Roxb	Fabacaeae	21	2.7	9.1
28	*Dalbergia volubilis* Roxb.	Fabaceae	21	2.7	9.1
29	*Delonix regia* (Hk.) Raf.	Fabaceae	21	2.7	9.1
30	*Diospyros ebenum* Koenig.	Ebenaceae	21	1.0	3.4
31	*Diospyros montana Roxb.*	Ebenaceae	21	3.7	12.6
32	*Diospyros paniculata* Dalz.	Ebenaceae	21	2.0	6.9
33	*Emblica officinalis* Gaertn.	Euphorbiaceae	21	2.3	8.0

34	*Erythrina indica L.*	Fabacaeae	21	4.0	13.7
35	*Ficus arnottiana* (Miq.) Miq.	Moraceae	21	2.0	6.9
36	*Ficus microcarpa* L.f.	Moraceae	21	2.7	9.1
37	*Ficus virens L.*	Moraceae	21	3.0	10.3
38	*Gardenia tergida*	Rubiaceae	14	3.0	6.9
39	*Gliricidia sepium* (Jacq.) Kunth	Fabaceae	14	2.5	5.7
40	*Gmelina arborea* Roxb.	Verbenaceae	14	3.5	8.0
41	*Grewia robusta*	Malvaceae	14	3.0	6.9
42	*Grewia tilifolia* Vahl.	Malvaceae	14	3.0	6.9
43	*Hardwickia binata* Roxb.	Cesalpinaceae	14	2.5	5.7
44	*Holoptelea integrifolia* (Roxb.) Planch.	Ulmaceae	14	3.0	6.9
45	*Holigarna niger* Bourd.	Anacardiaceae	14	3.0	6.9
46	*Holarrhena pubescens* (Buch.-Ham.)	Apocynaceae	14	3.5	8.0
47	*Hopea acuminata* Merr.	Dipterocarpaceae	14	1.5	3.4
48	*Ixora brachiata* L.	Rubiaceae	14	3.5	8.0
49	*Lagerstroemia lanceolata* Clarke	Lythraceae	14	2.0	4.6
50	*Lannea coromandelica*	Anacardiceae	14	1.0	2.3
51	*Leucaena leucocephala* (Lam.) de Wit.	Mimosaceae	14	2.0	4.6
52	*Litsea glabrata*	Lauraceae	14	5.0	11.4
53	*Litsea zeylanica* Nees & T. Nees.	Lauraceae	14	2.5	5.7
54	*Maesa indica Roxb.*	Myrsinaceae	14	3.5	8.0
55	*Mallotus philippensis* (Lam.) Muell.	Euphorbiaceae	14	2.5	5.7
56	*Mangifera indica* L.	Anacardiaceae	14	3.0	6.9
57	*Mecranga peltata* (Roxb.) Muell.	Euphorbiaceae	14	3.5	8.0
58	*Melia composita Willd.*	Meliaceae	14	1.0	2.3
59	*Memecylon umbellatum Burm.*	Melastomataceae	14	3.0	6.9
60	*Mitragyna parviflora (Roxb.) Korth.*	Rubiaceae	14	2.0	4.6
61	*Murraya keenigii (Linn.) Spreng*	Rutaceae	14	3.0	6.9
62	*Musa paradisiaca Auct.*	Musaceae	14	3.5	8.0
63	*Myristica sp.*	Myristicaceae	14	3.0	6.9
64	*Nothopegia colebrookiana (Wight)*	Anacardiaceae	14	3.5	8.0
65	*Olea dioica Roxb.*	Oleaceae	14	4.0	9.1
66	*Peltophorum pterocarpum (DC.)*	Fabaceae	14	3.5	8.0
67	*Pogostemon cablin (Blanco) Benth.*	Lamiaceae	14	2.0	4.6
68	*Pongamia pinnata* (L.) Pierre	Fabiaceae	14	1.5	3.4
69	*Pterocarpus marsupium Roxb.*	Fabaceae	14	3.5	8.0
70	*Randia dumetorum L.*	Rubiaceae	14	3.5	8.0
71	*Randia malabarica Lam.*	Rubiaceae	14	3.0	6.9
72	*Samanea saman (Jacq.) Merr*	Cesalpinaceae	14	4.5	10.3
73	*Sapindus emarginatus L.*	Sapindaceae	14	2.5	5.7
74	*Saraca indica Auct.*	Cesalpinaceae	14	1.5	3.4
75	*Schleichera oleosa (Lour.) Oken*	Sapindaceae	14	3.0	6.9
76	*Scolopia crenulate*	Flacourtiaceae	14	2.5	5.7
77	*Spondias acuminata Roxb.*	Sapindaceae	14	4.0	9.1
78	*Sterospermum personatum (Hassk.)*	Bignoniaceae	14	2.5	5.7
79	*Strychnos nux vomica L.*	Loganiaceae	14	4.0	9.1
80	*Syzgium callophylum (L.) Alton*	Myrtaceae	14	1.0	2.3
81	*Syzgium cumini (L.) Skeels*	Myrtaceae	14	4.0	9.1
82	*Tectona grandis L.f.*	Verbinaceae	14	3.0	6.9
83	*Terminalia bellerica (Gaertn.) Roxb.*	Combretaceae	14	4.5	10.3

84	*Terminalia paniculata Roth* *	Combretaceae	14	2.5	5.7
85	*Terminalia tomentosa (DC.) W. & A.**	Combretaceae	14	3.0	6.9
86	*Trema orientalis (L.) Bl.*	Ulmaceae	14	4.0	9.1
87	*Vateria indica L.*	Cannabaceae	14	1.5	3.4
88	*Vitex altissima L.f*	Verbinaceae	14	2.5	5.7
89	*Ziziphus mauritiana Lam.*	Rhamnaceae	14	4.5	10.3

Table 2.6: List of Secondary tree species documented by Biodiversity Board, Goa

Sl. No.	Scientific Name *	Common Name
1	*Aegle marmelos*	Bel
2	*Albizia lebbeck*	Siris
3	*Alstonia scholaris*	Santvin
4	*Annona murigata*	Palpanas
5	*Annona squamosa*	Sitaphal
6	*Anthocephalus cadamba*	Kadamb
7	*Artocarpus altilis*	Nirpanas
8	*Artocarpus heterocarpus*	Phanas
9	*Averrhoa carambola*	Karmal
10	*Averrhoea bilimbi*	Bimbal, bilimbi
11	*Azadirachta indica*	Neem
12	*Bauhinia variegate*	Kachnar
13	*Bombax ceiba*	Savar
14	*Butea monosperma*	Palas
15	*Cinnamomum zeylanicum*	Tikhi
16	*Cocos nucifera*	Mad
17	*Dalbergia sisso*	Shisam
18	*Ficus bengalensis*	Vad tree
19	*Ficus glomerata/racemosa*	Rumad
20	*Flacourtia jangomas*	Jagma
21	*Flacourtia montana*	Chafra
22	*Garcinia gummigutta*	Malabar tamarind
23	*Garcinia indica*	Bhirand
24	*Gmelina arborea*	Shivan
25	*Hardwickia binata*	Anjan
26	*Mesua ferrea*	Nagkesar
27	*Milingtonia hortensis*	Neem Chameli
28	*Millettia pinnata*	Karanjei
29	*Mimusops elengi*	Ovala
30	*Myristica fragrans*	Jaiphal
31	*Nothaphodytes nimmoniana*	Narkya, Ghaneri
32	*Peltophorum pterocarpum*	Copperpod tree
33	*Pouteria campechiana*	Egg fruit
34	*Psidium guajava*	Guava
35	*Sapinduslaurifolius/ mukorossi*	Ritho
36	*Saraca asoca*	Sita Ashok
37	*Stercularia urens*	Dhavorukh/ Arjun
38	*Syzyzium aqueum*	Zam
39	*Terminalia elliptica*	Madat

Note: ** Secondary information from Biodiversity Board, Goa, (https://gsbb.goa.gov.in/wp-content/uploads/2020/05/List-of-plants.pdf) and published literature*

SHRUBS: In buffer region recorded 42 shrubs species recorded. Overall, from this data we can interpret that the mining site possesses the less shrubs species and commonly overgrown exotic species such as *Lantana camara,* and *Chromolina odorata,* and less native species abundance, whereas the buffer area recorded higher number of native species .

Table 2.7. Shrubs growing in core and buffer zone

S. No.	Species name	Family	Frequency %	Abundance	Density
1	*Abrus precatorius L.*	Ceasalpinaceae	21	1.7	35.7
2	*Acacia paniculata Willd.*	Mimosaceae	21	2.7	57.1
3	*Adathoda vasica L.*	Acanthaceae	7	1.0	7.1
4	*Amaranthus spinosus L.*	Amaranthaceae	21	1.7	35.7
5	*Annona muricata L.*	Annonaceae	14	1.5	21.4
6	*Antidesma menasu (Tul. Müll.Arg*	Euphorbiaceae	7	3.0	21.4
7	*Aphanamixis polystachya (wall.)*	Rosaceae	7	4.0	28.6
8	*Apnomixis polystachia*	Rosaceae	14	1.0	14.3
9	*Bryneya species*	Euphorbiaceae	7	1.0	7.1
10	*Calotropis gigantean L.*	Asclepidiaceae	14	1.5	21.4
11	*Canthium parviflorum Lam.*	Rubiaceae	14	2.5	35.7
12	*Carissa carandas L.*	Apocynaceae	14	2.0	28.6
13	*Carissa congesta L.*	Apocynaceae	21	2.0	42.9
14	*Cassia hirsuta L.**	Ceasalpinaceae	21	2.3	50.0
15	*Chromolaena odorata (L.) K.R.*	Astraceae	21	2.3	50.0
16	*Croton lacciferus L.*	Euphorbiaceae	29	2.0	57.1
17	*Crotolaria virosa (Roxb.) Bake.*	Fabacaeae	21	1.3	28.6
18	*Dendrocalamus strictus*	Poaceae	29	1.3	35.7
19	*Euphorbia totircornis L.*	Euphorbiaceae	7	1.0	7.1
20	*Gossypium arboretum L.*	Malvaceae	7	4.0	28.6
21	*Helictris isora L.*	Malvaceae	29	2.8	78.6
22	*Hibiscus tiliaceus Wild.*	Malvaceae	7	1.0	7.1
23	*Ixora brachiata Roxb. ex DC*	Rubiaceae	21	1.7	35.7
24	*Ixora javanica DC, Prodr.*	Rubiaceae	7	1.0	7.1
25	*Jatropha gossypiifolia*	Euphorbiaceae	21	2.0	42.9
26	*Lantana camara L.*	Verbenaceae	29	2.0	57.1
27	*Leea indica (Burm.f.) Merr.*	Leaceae	29	2.5	71.4
28	*Niligirianthus barbatus (Nees)*	Acanthaceae	7	1.0	7.1
29	*Pandanus odoratissimus L.*	Pandanaceae	7	1.0	7.1
30	*Pavetta indica L.*	Rubiaceae	7	1.0	7.1
31	*Psychotria bisulcata Wight &Arn.*	Rubiaceae	7	1.0	7.1
32	*Ricinus communis L.*	Euphorbiaceae	7	3.0	21.4
33	*Rosa chinensis Jacq.*	Rosaceae	29	1.8	50.0
34	*Saprosma ceylanicum (Gardner)*	Rubiaceae	7	1.0	7.1
35	*Sida acuta N.L. Burman.*	Malvaceae	29	2.3	64.3
36	*Solanum indicum L.*	Solanaceae	29	1.8	50.0
37	*Techoma stans (L.) Juss. Ex Kunth.*	Bignoniaceae	7	4.0	28.6

38	*Tephrosia purpuria (L.) Pers.*	Fabaceae	21	1.3	28.6
39	*Vitex sp*	Verbenaceae	14	1.0	14.3
40	*Vitex nigundo L.*	Verbenaceae	7	3.0	21.4
41	*Ziziphus oenoplea Miller.*	Rhamnaceae	21	2.3	50.0
42	*Trema orientalis*	Cannabaceae	14	1.5	32.0

***Note*: *** *Secondary information from forest working plan and published literature*

HERBS: Total 28 Species of herbs reported from the buffer

Table 2.8. List of Herbs and Climbers within the reserve forest and sanctuary of buffer area

S. No.	Species name	Family	Frequency %	Abundance	Density
1	*Acrostichum aureum*	Pteridaceae	25	4.7	2946
2	*Ageratum conyzoides*	Astraceae	4	1.0	89
3	*Alternathara sessilis*	Amaranthaceae	18	5.8	2589
4	*Andropogon annulatus*	Poaceae	7	4.5	804
5	*Asparagus racemose*	Asparagaceae	11	3.3	893
6	*Atlantia species*	Rutaceae	29	3.4	2411
7	*Bidens biternata*	Asteraceae	7	2.5	446
8	*Bidens comosa*	Asteraceae	4	6.0	536
9	*Borreria articulata*	Rubiaceae	39	3.7	3661
10	*Cassia tora*	Caesalpinaceae	7	1.5	268
11	*Clematis gouriana*	Ranunculaceae	29	4.9	3482
12	*Clerodendron inerme*	Lamiaceae	22	4.2	1429
13	*Cordia myxa*	Boraginaceae	39	2.9	2857
14	*Crotolaria virosa*	Fabacaeae	14	2.0	714
15	*Cymbopogon citratus*	Poaceae	36	2.6	2321
16	*Cyperus difformis**	Cyperaceae	21	3.0	1607
17	*Desmodium triflorum*	Fabaceae	39	3.5	3393
18	*Ipomea cmuricata*	Convolvulaceae	14	4.3	1518
19	*Ocimum sanctum*	Lamiaceae	32	3.1	2500
20	*Parthenium spp**	Asteraceae	7	3.0	536
21	*Premna coriacea*	Verbenaceae	7	2.5	446
22	*Sida acuta*	Malvaceae	29	4.9	3482
23	*Sida cordifolia*	Malvaceae	36	4.8	4286
24	*Smilax zeylanica**	Smilacaceae	7	8.5	1518
25	*Solanum indicum*	Solanaceae	14	2.0	714
26	*Spermacoce sp.*	Rubiaceae	36	3.0	2679
27	*Stylosanthus sp.*	Fabaceae	39	3.3	3214
28	*Urena lobate*	Malvaceae	36	3.8	3393

Note: ** Secondary information from Goa forest & Biodiversity deparment and published literature*

***FARMLAND/ ROAD SIDE*:** Total 20 species recorded within the buffer area from the Avenue trees, farmlands/private lands and riparian river streams

Table 2.9: Farmlands/road side species recorded within buffer zone

Sl. No	*Species name*	Common name	Family	Habit
1	*Tamarindus indica*	Tamrind/imli	Cesalpinaceae	Tree
2	*Annona reticulata*	Ramphal	Annonaceae	Tree
3	*Bambusa* sp	Bamboo	Bambocaceae	Tree
4	*Bougainvillea spectabilis*	Bouganvilla	Nyctaginaceae	Tree
5	*Cassia fistula*	Amaltas	Fabaceae	Tree
6	*Dalbergia latifolia*	Shisam/ Shisoo	Fabaceae	Tree
7	*Delonix regia*	Gulmohar	Fabaceae	Tree
8	*Phyllanthus emblica*	Awala/.Avala	Phyllanthaceae	Tree
9	*Psidium guajava*	Peru/Gauva	Myrtaceae	Tree
10	*Samanea saman*	Rain tree	Fabaceae	Tree
11	*Sapindus mukorossi*	Ritha/Reetha	Sapindaceae	Tree
12	*Swetenia mahagoni*	Mohagony	Meliaceae	Tree
13	*Syzygium cumini*	Jamun	Myrtaceae	Tree
14	*Terminalia bellerica*	Ghoting/behada	Combretaceae	Tree
15	*Acacia auriculiformis*		Mimosaceae	Tree
16	*Garcinia indica*		Clusiaceae	Tree
17	*Pongamia pinnata*		Fabaceae	Tree
18	*Ficus benghalensis*		Moraceae	Tree
19	*Ficus religiosa*		Moraceae	Tree
20	*Ixora coccinea*		Rubiaceae	Shrub

DOMESTICATED / CULTIVATED SPECIES: Total of 13 different crops and commercial species observed from the buffer area

Table 2.30: Domesticated and cultivates species recorded within buffer zone

S. No.	Species name	Common name	Family	Habit
1	*Annona reticulata*	Ramphal	Annonaceae	Tree
2	*Phyllanthus emblica*	Awala/.Avala	Phyllanthaceae	Tree
3	*Psidium guajava*	Peru/Gauva	Myrtaceae	Tree
4	*Carica papaya*	Caricaceae	Caricaceae	Tree
5	*Musa paradisiaca*	Bannana	Musaceae	Tree
6	*Acacia auriculiformis*		Mimosaceae	Tree
7	*Anacardium occidentale*		Anacardiaceae	Tree
8	*Areca catechu*		Arecaceae	Tree
9	*Cocos nucifera*		Arecaceae	Tree
10	*Garcinia indica*		Clusiaceae	Tree
11	*Tamarindus indica*		Cesalpinaceae	Tree
12	*Oryza sativa*	Paddy	Poaceae	herb
13	Vegetable cultivation			herb

2.7.5.4 CONSERVATION THREAT STATUS

***FLORA*:** The plant species recorded in the study area was grouped into three categories i.e., endemic, rare, threatened and keystone species were given in below Table 2.31. Overall, 7 important species recorded within the study area. Within core/buffer area one IUCN rare and 4 were keystone species; two endemics to Western Ghats recorded in the buffer Zone.

Table 2.31. Endemic, Keystone and Threatened species recorded in 10-km radius area

Sl. No.	Species	Family	Core/ buffer	Habitat	Status
1	*Artocarpus heterophyllus* Lam.	Moraceae	Buffer	Tree	Endemic
2	*Ficus arnottiana* (Miq.) Miq.	Moraceae	Core/ Buffer	Open	Keystone
3	*Ficus microcarpa* L. f.	Moraceae	Buffer	Open/ Rivulets	Keystone
4	*Ficus virens* L.	Moraceae	Core	Open	Keystone
5	*Holigarna nigra* Bourd.	Anacardiaceae	Buffer	Rivulets	Endemic
6	*Strychnos nux- vomica* L.	Loganiaceae	Core/buffer	Open	Rare
7	*Terminalia paniculata* Roth	Combretaceae	Core / Buffer	Open / Scrub forest	Endemic

***FAUNA*:** Total 262 faunal species were reported by secondary and primary observation from the core and buffer area, of which 22 species of mammals; 24 species of reptiles, 17 species of amphibians and toads; 154 species of birds, 27 species of butterflies, and 18 species of crabs and fishes.

Total 22 species mammals were recorded within the 10 km radius; of which four arboreal mammals such as Flying fox, Squirrel, macaque, Wronghto's Gaint Mastiff Bat and remaining were ground dwellers. The Malabar giant squirrel encounter only within the Wildlife Sanctuaries (WLs). Further one carnivore Leopard, omnivore Mongoose, Indian muntjac, and Jackal as hinted by rural communities. The most common species sighted by us and local communities are Indian hare, Rats, Wild boar. As per IUCN status 9 species were under Least Concern, 1 Vulnerable and 2 were Data Deficit but Indian Wildlife Protection Act Schedule species under 10 were Schedule-I, 4 species of Schedule –II, 2- Schedule III, 3 are Schedule IV, and 2 are Schedule –V were recorded.

Table 2.32. List of the mammal species recorded within 10-km radius.

S. No.	Local Name	Scientific name	Family	IUCN / WPA 1972 &Amnd. 2022
1	Common grey mongoose	*Urva edwardsii*	Herpestidae	LC/I
2	Indian porcupine	*Hystrix indica*	Hystricidae	LC/I
3	Malabar gain squirrel	*Ratufa indica*	Sciuridae	VU/I
4	Common leopard*	*Panthera pardus*	Felidae	VU/I
5	Leopard cat*	*Pronailurus bengalensis*	Felidae	LC/I
6	Wronghto's Gaint Mastiff Bat	*Otomops wroughtoni*	Molossidae	LC/I
7	Slender Loris	*Loris lydekkerianus*	Lorisidae	NT/I
8	Tiger	*Panthera tigris*	Felidae	EN/I
9	Mouse Deer	*Moschiola indica*	Tragulidae	LC/I
10	Four Horned Antelope	*Tetracerus quadricornis*	Bovidae	VU/I
11	Gaur or Indian Bison	*Bos gaurus*	Bovidae	VU/I
12	Indian Pangolin*	*Manis crassicaudata*	Manidae	EN/I
13	Sloth bear*	*Melursus ursinus*	Ursidae	VU/I
14	Small Indian civet*	*Viverricula indica*	Viverridae	LC/I
15	Bonnet macaque	*Macaca radiata*	Cercopithecidae	LC/I
16	Wild dog	*Cuon alpines*	Canidae	EN/I
17	Indian Hare	*Lepus nigricollis*	Leporidae	LC/II
18	Flying fox bat*	*Pteropus Giganteus*	Pteropodidae	LC/II
19	Rat	*Rattus rattus*	Muridae	LC/IV
20	Wild boar	*Sus scrofa*	Suidae	LC/II
21	Striped squirrel	*Funambulus palmarum*	Sciuridae	LC/IV
22	Indian muntjac*	*Muntiacus muntjac*	Cervidae	LC/IV

***Note** * Secondary information from the Bhagawan Mahavir WLs report from Goa forest department , Gazette Notification of Bhagwan wildlife Sanctuary dated 23.01.2015.*

REPTILES: Total 24 reptile species were recorded within the buffer areas (Table 3.32), out of 18 species of snakes and 5 species of lizards were recorded. Indian rock python, Krait, Cobra and King cobras identified has rare species under the IUCN status and most of them were common as per the IUCN status

As per the wildlife Protection act 4 Schedule I, 5 Schedule II, and 2 Schedule IV were recorded within the 10-km radius of the ML.

Table 2.33. list of Reptiles' reported from the Study Area.

S. No.	Common name	Scientific name	Family	IUCN / WPA 1972 &Amnd. 2022
1	Indian Rock Python*	*Python molurus molurus*	Pythonidae	NT/I
2	Marsh Crocodile	*Crocodylus palustris*	Crocodylidae	VU/I
3	Indian Falpshell Turtle	*Lissemys punctata*	Trionychidae	VU/I
4	Common Indian Monitor Lizard	*Varanus bengalensis*	Varanidae	NT/I
5	Russell's Viper	*Daboia russelii*	Viperidae	LC/I
6	Cobra	*Naja naja*	Elapidae	LC/I
7	King cobra*	*Ophiophagus hannah*	Elapidae	VU/I
8	Green Forest lizard	*Calotes calotes*	*Agamidae*	LC/I
9	Checkered Keelback	*Fowlea piscator*	*Colubridae*	LC/I
10	Common Kukri Snake*	*Oligodon arnensis*	Colubridae	LC/I
11	Whitaker's Boa*	*Eryx whitakeri*	Boidae	NT/I
12	Common Indian monitor lizard	*Varanus bengalensis*	*Varanidae*	NT/I
13	Common Sand Boa*	*Gongylophis conicus*	Boidae	LC/IV
14	Montane trinket snake*	*Coelognathus helena monticollaris*	Colubridae	LC/IV
15	Indian rat Snake*	*Ptyas muscosa*	Colubridae	LC/IV
16	Western Kukri Snake*	*Oligodon affinis*	Colubridae	LC/IV
17	Striped Keelback*	*Amphiesma stolatum*	*Colubridae*	LC/IV
18	Hill keelback	*Amphiesma monticola*	*Colubridae*	LC/IV
19	Saw scaled Viper*	*Echis carinathus*	Viperidae	LC/IV
20	Common krait*	*Bungarus caeruleus*	Elapidae	LC/IV
21	Ceylon Cat Snake*	*Boiga ceylonensis*	Colubridae	LC/IV
22	Common Indian cat snake*	*Boiga trigonata*	Colubridae	LC/IV
23	Bamboo Pit Viper*	*Trimeresurus gramineus*	Viperidae	LC/IV
24	Bark/Marbled Tree gecko	*Hemidactylus leschenaultia*	*Gekkonidae*	LC/IV

***Note** * Secondary information from the Bhagawan Mahavir WLs report*

***TOADS AND AMPHIBIANS*:** Total 17 species of frogs were recorded within the various habitat ranges from paddy field, scrub jungle, riparian forest, streams, and evergreen forest patches. The Jerdon's narrow mouthed frog and Bronzed frog are near threatened and one Konkan bush frog vulnerable under IUCN and the rest of all were under the least concern category. As per WPA 9 species were recorded under Schedule IV.

Table 2.34: List of toads and amphibians reported within buffer zone

S. No.	Common name	Scientific name	Family	IUCN / WPA 1972 &Amnd. 2022
1	Common Indian toad	*Bufo melanostictus*	Bufonidae	LC/IV
2	Jerdon's narrow mouthed frog*	*Ramanella montana*	Microhylidae	LC/IV
3	Konkan bush frog*	*Philautus bombayensis*	Rhacophoridae	LC/IV
4	Marten's bush frog*	*Philautus leucorhinus*	Rhacophoridae	LC/IV
5	Bamboo tree frog*	*Polypedates leucomystax*	Rhacophoridae	LC/IV
6	Common tree frog*	*Polypedates maculatus*	Rhacophoridae	LC/IV
7	Malabar gliding frog	*Rhacophorus malabaricus*	Rhacophoridae	LC/IV
8	Skipper frog*	*Euphlyctis cyanophlyctis*	Ranidae	LC/II
9	Jerdon's bull frog*	*Hoplobatrachus crassus*	Ranidae	LC/IV
10	Indian bull frog*	*Hoplobatrachus tigerinus*	Ranidae	LC/II
11	Brown leaping frog	*Indirana semipalmata*	Ranidae	LC/IV
12	Paddyfield frog*	*Limnonectes limnocharis*	Ranidae	LC/IV
13	Hill cricket frog	*Limnonectes syhadrensis*	Ranidae	LC/IV
14	Fungoid frog	*Rana malabaricus*	Ranidae	LC/IV
15	Bronzed frog*	*Rana temporalis*	Ranidae	LC/IV
16	Indian burrowing frog	*Tomopterna breviceps*	Ranidae	LC/IV
17	Dobson's burrowing frog*	*Tomopterna dobsoni*	Dicroglossidae	LC/IV

Note: *LC - Least concern, NT - near threaten, VU – Vulnerable, Wildlife Protection Act –Schedule - IV;* * Secondary information from the Bhagawan Mahavir WLs report

BIRDS : Total 154 species of birds were recorded within the habitat ranges from paddy field to evergreen forest .About 123 species were resident locally. Out of 2 were endemic to the Western Ghats, 7 species were locally migratory and 2 were vulnerable species. As per the Wildlife Protection Act , 4- species Schedule I and 124 species Schedule IV. About 21 species recorded migratory birds within these habitats and one threatened species recorded.

Table 2.35. List of birds recorded within buffer zone

S. No	Common name	Scientific name	Family	IUCN / WPA 1972 &Amnd. 2022
1	White-bellied Sea-Eagle	*Haliaeetus leucogaster*	Accipitridae	LC/I
2	Indian Peafowl	*Pavo cristatus*	Phasianidae	LC/I
3	Shikra	*Accipiter badius*	Accipitridae	LC/I
4	Osprey	*Pandion haliaetus*	Pandionidae	LC/I
5	Chestnut Bittern*	*Ixobrychus cinnamomeus*	Ardeidae	LC/I
6	Cotton Teal	*Nettapus coromandelianus*	Anatidae	LC/I
7	Brahminy Kite	*Haliastur indus*	Accipitridae	LC/I
8	Long-billed Vulture	*Gyps indicus*	Accipitridae	CR/I

9	Crested Serpent Eagle*	*Spilornis cheela*	Accipitridae	LC/I
10	Eurasian Marsh Harrier	*Circus aeruginosus*	Accipitridae	LC/I
11	Crested Goshawk	*Accipiter trivirgatus*	Accipitridae	LC/I
12	Besra Sparrowhawk	*Accipiter virgatus*	Accipitridae	LC/I
13	Black Eagle*	*Ictinaetus malayensis*	Accipitridae	LC/I
14	Crested Tree-swift	*Hemiprocne coronate*	Hemiprocnidae	LC/I
15	Brown Wood Owl	*Strix leptogrammica*	Strigidae	LC/I
16	Common Hill-Myna	*Gracula religiosa*	Sturnidae	LC/I
17	Grey Junglefowl	*Gallus sonneratii*	Phasianidae	LC/I
18	Nilgiri Wood Pigeon	*Columba elphinstonii*	Columbidae	VU/I
19	Small Minivet *	*Pericrocotus cinnamomeus*	Campephagidae	LC/I
20	Forest Eagle-Owl	*Bubo nipalensis*	Strigidae	LC/I
21	Little Grebe	*Tachybaptus ruficollis*	Podicipedidae	LC/II
22	Little Cormorant	*Phalacrocorax niger*	Phalacrocoracidae	LC/II
23	Indian Shag	*Phalacrocorax fuscicollis*	Phalacrocoracidae	LC/II
24	Great Cormorant	*Phalacrocorax carbo*	Phalacrocoracidae	LC/IV
25	Darter	*Anhinga melanogaster*	Phalacrocoracidae	LC/II
26	Little Egret	*Egretta garzetta*	Ardeidae	LC/II
27	Western Reef Egret	*Egretta gularis*	Ardeidae	LC/II
28	Grey Heron	*Ardea cinerea*	Ardeidae	LC/II
29	Purple Heron	*Ardea purpurea*	Ardeidae	LC/II
30	Large Egret	*Casmerodius albus*	Ardeidae	LC/II
31	Median Egret	*Mesophoyx intermedia*	Ardeidae	LC/II
32	Cattle Egret	*Bubulcus ibis*	Ardeidae	LC/II
33	Indian Pond-Heron	*Ardeola grayii*	Ardeidae	LC/II
34	Little Green Heron	*Butorides striatus*	Ardeidae	LC/IV
35	Black-crowned Night Heron	*Nycticorax nycticorax*	Ardeidae	LC/II
36	Malayan Night Heron*	*Gorsachius melanocephalus*	Ardeidae	LC/II
37	Black Bittern	*Dupetor flavicollis*	Ardeidae	LC/IV
38	Painted Stork*	*Mycteria leucocephala*	Cioniidae	LC/II
39	Lesser Whistling-Duck	*Dendrocygna javanica*	Anatidae	LC/II
40	Spot-billed Duck*	*Anas poecilorhyncha*	Anatidae	LC/II
41	Oriental Honey-buzzard	*Pernis ptilorhyncus*	Accipitridae	LC/II
42	Black Kite*	*Milvus migrans*	Accipitridae	LC/II
43	Jungle Bush Quail*	*Perdicula asiatica*	Phasianidae	LC/II
44	Red Spurfowl*	*Galloperdix spadicea*	Phasianidae	LC/II
45	Common Buttonquail	*Turnix suscitator*	Turnicidae	LC/II
46	Blue-breasted Rail	*Gallirallus striatus*	Rallidae	LC/IV
47	White-breasted Waterhen*	*Amaurornis phoenicurus*	Rallidae	LC/II
48	Purple Moorhen	*Porphyrio porphyrio*	Rallidae	LC/IV
49	Pheasant-tailed*	*Hydrophasianus chirurgus*	Jacanidae	LC/II
50	Bronze-winged Jacana	*Metopidius indicus*	Jacanidae	LC/II
51	Common Ringed Plover	*Charadrius hiaticula*	Charadriidae	LC/II
52	Little Ringed Plover	*Charadrius dubius*	Charadriidae	LC/II
53	Kentish Plover*	*Charadrius alexandrines*	Charadriidae	LC/II
54	Yellow-wattled Lapwing	*Vanellus malarbaricus*	Charadriidae	LC/IV
55	Red-wattled Lapwing	*Vanellus indicus*	Charadriidae	LC/II
56	Eurasian Woodcock	*Scolopax rusticola*	Scolopacidae	LC/II
57	Spotted Dove	*Streptopelia chinensis*	Columbidae	LC/II
58	Emerald Dove*	*Chalcophaps indica*	Columbidae	LC/II

59	Green Imperial Pigeon	*Ducula aenea*	Columbidae	LC/II
60	Mountain Imperial-Pigeon	*Ducula badia*	Columbidae	LC/II
61	Indian Hanging-Parrot	*Parrot Loriculus vernalis*	Psittacidae	LC/IV
62	Rose-ringed Parakeet	*Psittacula krameria*	Psittacidae	LC/II
63	Plum-headed Parakeet	*Psittacula cyanocephala*	Psittacidae	LC/II
64	Blue-winged Parakeet	*Psittacula columboides*	Psittacidae	LC/II
65	Brainfever Bird	*Hierococcyx varius*	Cuculidae	LC/II
66	Indian Cuckoo	*Cuculus Micropterus*	Cuculidae	LC/II
67	Common Cuckoo	*Cuculus Micropterus*	Cuculidae	LC/II
68	Banded Bay Cuckoo	*Cacomantis sonneratii*	Cuculidae	LC/II
69	Indian Plaintve Cuckoo	*Cacomantis passerinus*	Cuculidae	LC/II
70	Drongo Cuckoo	*Surniculus lugubris*	Cuculidae	LC/II
71	Asian Koel	*Eudynamys scolopacea*	Cuculidae	LC/II
72	Small Green-billed Malkoha	*Phaenicophaeus viridirostris*	Cuculidae	LC/II
73	Greater Coucal*	*Centropus sinensis*	Cuculidae	LC/II
74	Lesser Coucal *	*Centropus bengalensis*	Cuculidae	LC/II
75	Oriental Scops-Owl	*Otus sunia*	Strigidae	LC/II
76	Ketupa zeylonensis	*Brown Fish-Owl*	Strigidae	LC/IV
77	Glaucidium radiatum	*Jungle Owlet*	Strigidae	LC/IV
78	Spotted Owlet	*Athene brama*	Strigidae	LC/II
79	Indian Jungle Nightjar *	*Caprimulgus indicus*	Caprimulgidae	LC/II
80	Indian Edible-nest Swiftlet	*Collocalia unicolor*	Apodidae	LC/IV
81	White-rumped Needletail-Swift	*Zoonavena sylvatica*	Apodidae	LC/II
82	Brown-backed Needletail-Swift	*Hirundapus giganteus*	Apodidae	LC/II
83	Asian Palm Swift	*Cypsiurus balasiensis*	Apodidae	LC/II
84	Alpine Swift	*Tachymarptis melba*	Apodidae	LC/II
85	Pacific Swift	*Apus pacificus*	Apodidae	LC/II
86	House Swift	*Apus affinis*	Apodidae	LC/II
87	Malabar Trogon*	*Harpactes fasciatus*	Trogonidae	LC/II
88	Small Blue Kingfisher	*Alcedo atthis*	Alcedinidae	LC/II
89	Oriental Dwarf Kingfisher	*Ceyx Erithacus*	Alcedinidae	LC/II
90	Stork-billed Kingfisher	*Halcyon capensis*	Alcedinidae	LC/IV
91	White-breasted Kingfisher	*Halcyon smyrnensis*	Alcedinidae	LC/IV
92	Black-capped Kingfisher	*Halcyon pileate*	Alcedinidae	LC/II
93	Collared Kingfisher *	*Todiramphus chloris*	Alcedinidae	LC/II
94	Blue-eared Kingfisher	*Alcedo meningting*	Alcedinidae	LC/II
95	Ceryle rudis *	*Lesser Pied Kingfisher*	Alcedinidae	LC/IV
96	Blue-bearded Bee-eater	*Nyctyornis athertoni*	Meropidae	LC/II
97	Small Bee-eater	*Merops orientalis*	Meropidae	LC/II
98	Blue-tailed Bee-eater	*Merops philippinus*	Meropidae	LC/II
99	Chestnut-headed Bee-eater*	*Merops leschenaultia*	Meropidae	LC/II
100	Brown-headed Barbet	*Megalaima zeylanica*	Capitonidae	LC/II
101	Crimson-throated Barbet	*Megalaima rubricapilla*	Capitonidae	LC/IV
102	Coppersmith Barbet	*Megalaima haemacephala*	Capitonidae	LC/II
103	Brown-capped Pygmy woodpecker	*Dendrocopos nanus*	Picidae	LC/IV
104	Yellow-fronted Pied woodpecker	*Dendrocopos mahrattensis*	Picidae	LC/IV
105	Wire-tailed Swallow	*Hirundo smithii*	Hirudinidae	LC/II
106	Red-rumped Swallow	*Hirundo daurica*	Hirudinidae	LC/IV
107	Large Pied Wagtail*	*Motacilla maderaspatensis*	Motacillidae	LC/II
108	Yellow Wagtail	*Motacilla flava*	Motacillidae	LC/IV

109	Paddyfield Pipit	*Anthus rufulus*	Motacillidae	LC/II
110	Large Cuckoo-shrike	*Coracina macei*	Campephagidae	LC/II
111	Scarlet Minivet	*Pericrocotus flammeus*	Campephagidae	LC/II
112	Red-whiskered Bulbul	*Pycnonotus jocosus*	Pycnonotidae	LC/II
113	Red-vented Bulbul *	*Pycnonotus cafer*	Pycnonotidae	LC/II
114	White-browed Bulbul	*Pycnonotus luteolus*	Pycnonotidae	LC/II
115	Yellow-browed Bulbul	*Iole indica*	Pycnonotidae	LC/IV
116	Common Iora	*Aegithina tiphia*	Irenidae	LC/II
117	Asian Fairy-Bluebird	*Irena puella*	Irenidae	LC/IV
118	Jerdon's Chloropsis *	*Chloropsis cochinchinensis*	Irenidae	LC/II
119	Malabar Whistling Thrush	*Myophonus horsfieldii*	Turdinae	LC/II
120	Orange-headed Thrush	*Zoothera citrinacyanotus*	Turdinae	LC/II
121	Oriental Magpie-Robin	*Copsychus saularis*	Turdinae	LC/II
122	White-rumped Shama	*Copsychus malabaricus*	Turdinae	LC/IV
123	Indian Robin	*Saxicoloides fulicata*	Turdinae	LC/IV
124	Pied Bushchat	*Saxicola caprata*	Turdinae	LC/II
125	Spotted Babbler	*Pellorneum ruficeps*	Timaliinae	LC/II
126	Indian Scimitar Babbler	*Pomatorhinus horsfieldii*	Timaliinae	LC/II
127	Rufous-bellied Babbler*	*Dumetia hyperythra*	Timaliinae	LC/IV
128	Black-headed Babbler	*Rhopocichla atriceps*	Timaliinae	LC/IV
129	Yellow-eyed Babbler	*Chrysomma sinense*	Timaliinae	LC/IV
130	Rufous Babbler	*Turdoides subrufus*	Timaliinae	LC/IV
131	Jungle Babbler	*Turdoides striatus*	Timaliinae	LC/II
132	Quaker Tit-Babbler	*Alcippe poioicephalA*	Timaliinae	LC/II
133	Streaked Fantail-Warbler	*Cisticola juncidis*	Sylviinae	LC/II
134	Franklin's Prinia	*Prinia hodgsonii*	Sylviinae	LC/II
135	Ashy Prinia	*Prinia socialis*	Sylviinae	LC/II
136	Plain Prinia *	*Prinia inornate*	Sylviinae	LC/II
137	Common Tailorbird	*Orthotomus sutorius*	Sylviinae	LC/II
138	Tickell's Blue-Flycatcher	*Cyornis tickelliae*	Muscicapinae	LC/II
139	Tickell's Flowerpecker	*Dicaeum erythrorynchos*	Dicaeidae	LC/II
140	Plain Flowerpecker	*Dicaeum concolor*	Dicaeidae	LC/II
141	Purple-rumped Sunbird	*Nectarinia zeylonica*	Nectariniidae	LC/IV
142	Black-headed Munia	*Lonchura malacca*	Estrildidae	LC/II
143	House Sparrow	*Passer domesticus*	Passeridae	LC/II
144	Yellow-thraoted Sparrow	*Petronia xanthocollis*	Passeridae	LC/IV
145	Common Myna	*Acridotheres tristis*	Sturnidae	LC/II
146	Jungle Myna	*Acridotheres fuscus*	Sturnidae	LC/II
147	Black Drongo	*Dicrurus macrocercus*	Dicruridae	LC/II
148	Ashy Drongo	*Dicrurus leucophaeus*	Dicruridae	LC/II
149	Bronzed Drongo	*Dicrurus aeneus*	Dicruridae	LC/II
150	Greater Racket-tailed Drongo	*Dicrurus paradiseus*	Dicruridae	LC/II
151	Indian Treepie	*Dendrocitta vagabunda*	Corvidae	LC/II
152	White-bellied Tree Pie	*Dendrocitta leucogaster*	Corvidae	LC/II
153	House Crow	*Corvus splendens*	Corvidae	LC/II
154	Jungle Crow	*Corvus macrorhynchos*	Corvidae	LC/II

Note : *M - Migratory, R - Resident, U - unclear, E - Endemic, CE - Critically endangered, NT - Near threatened, V - Vulnerable. WPA Schedule –I – IV,* * Secondary information from the Bhagawan Mahavir WLs report.

BUTTERFLIES: Total 27 species of butterfly were recorded within various habitats such as Paddy field, degraded habitat, scrub forest, open grassland, evergreen forest, and near settlements . Out of 27 species there are 2 species were under Schedule-I, 4 were Schedule-II and one in Schedule-IV, and 22 were common in these habitats.

Table 2.37. List of butterfly species recorded within buffer zone

S. No.	Common name	Scientific name	Family	IUCN / WPA 1972 &Amnd. 2022
1	Crimson rose	*Pachiopta hector Linnaeus*	Papilionidae	LC/II
2	Danaid Eggfly	*Hypolimnas misippus*	Nymphalidae	LC/II
3	Spot swordtail*	*Graphium nomius Esper*	Papilionidae	LC/IV
4	Southern birdwing	*Troides minos Cramer*	Papilionidae	LC/II
5	Red helan	*Princepes helenus helenus Hampson*	Papilionidae	LC/IV
6	Malabar banded peacock*	*Papilio buddh Westwood*	Papilionidae	LC/II
7	Lime butterfly	*Papilio demoleus Linnaeus*	Papilionidae	LC/IV
8	Chocolate albatross	*Appias lyncida Cramer*	Pierinae	LC/II
9	Common Jezebel	*Delias eucharis Drury*	Pierinae	LC/IV
10	Common emigrant*	*Catopsilla pomona Fabricius*	Coliadinae	LC/IV
11	Common grass Yellow	*Eurema hecabe contubernalis Moore*	Coliadinae	LC/IV
12	Angled Sunbeam*	*Curetis dentata Moore*	Curetinae	LC/IV
13	Common Silverline	*Spindasis vulcans fusca Moore*	Theclinae	LC/IV
14	Angled pierrot*	*Caleta caleta decidia Cromer*	Polypmmatinae	LC/IV
15	Pea Blue	*Lamipes boeticus*	Polypmmatinae	LC/IV
16	Dark pierrot	*Tarueus Ananda*	Polypmmatinae	LC/IV
17	Common four ring	*Ypthima hubenri hubenri Fabricius*	Polypmmatinae	LC/IV
18	Common nawab*	*Polyura athamas athamas Drury*	Charaxinae	LC/II
19	Angled Castor*	*Ariadne ariadne pallidior Frusthorfer*	Nymphalinae	LC/IV
20	Common castor	*Ariadne merione assama Evans*	Nymphalinae	LC/IV
21	Lemon pansy *	*Precis lemonias lemonias L*	Nymphalinae	LC/IV
22	Commander	*Moduza procis procis Cramer*	Nymphalinae	LC/IV
23	Tree Nymph	*Idea malabarica Moore*	Danainae	LC/II
24	Common Indian Crow	*Euploea core Cramer*	Danainae	LC/IV
25	Plain Tiger*	*Danaus (Anosia) chrysippus L*	Danainae	LC/IV
26	Grass demon *	*Edaspes folcus Cramer*	Hesperiidae	LC/IV
27	Common dart*	*Potanthus spp Fabricius*	Hesperiidae	LC/IV

Note: * Secondary information from the Bhagawan Mahavir WLs report

AQUATIC SPECIES (CRAB/FISHES): Total 16 species of fishes were recorded within the regions and 2 species of crabs in the streams, rivers, and estuaries. The species *Thunnus albacares* under near threatened and *Thunnus obesus* are Vulnerable, and most of them were not being evaluated IUCN status

Table 2.38. List of fishes and crab species reported within buffer zone

S. No.	Common name	Scientific name	Family	IUCN status/ WPA Schedule
1	Spangled emperor	*Lethrinus nebulosus*	Lethrinidae	Not evaluated
2	Mangrove red snapper	*Lutjanus argentimaculatus*	Lutjanidae	Not evaluated
3	Malabar blood snapper	*Lutjanus malabaricus*	Lutjanidae	Not evaluated
4	John's snapper	*Lutjanus johni*	Lutjanidae	Not evaluated
5	Yellowfin tuna	*Thunnus albacares*	Lutjanidae	Near Threatened
6	Bigeye tuna	*Thunnus obesus*	Lutjanidae	Vulnerable
7	Indian mackerel	*Rastrelliger kanagurta*	Lutjanidae	Data Deficient
8	Black marlin	*Makaira indica*	Lutjanidae	Data Deficient
9	Goatee croaker	*Dendrophysa russelli*	Sciaendae	Not evaluated
10	Blotched croaker	*Nibea maculate*	Sciaendae	Not evaluated
11	Indian oil-Sardinella	*Sardinella longiceps*	Sciaendae	Least Concern
12	Indian spiny turbot	*Psettodes erumei*	Psettodidae	Not evaluated
13	Malabar tonguesole	*Cynoglossus macrostomus*	Cynoglossidea	Not evaluated
14	Dorab wolf-herrings	*Chirocentrus dorab*	Chirocentridae	Not evaluated
15	Chacunda gizzard-shad	*Anodontostoma Chacunda*	Clupeidae	Not evaluated
16	Engraved catfish	*Arius caelatus*	Ariidae	Not evaluated
17	Christian crabs	*Charybdis cruciate*	Portunidae	Not evaluated
18	Blue swimming crab	*Portunus Pelagicus*	Portunidae	Not evaluated

Note: ** Secondary information from the Bhagawan Mahavir WLs report & Atkore, Vidyadhar PhD work on fish diversity and turnover across multiple spatial scales in the Western ghats*

Wildlife management is complex and need to be considered multifaceted factors such as food-web, resources competitions, anthropogenic, forest fragmentation, and sociological issues such community livelihoods, culture, ethics and forest dependency etc. Total of 48 species of fauna falls within the category of Wildlife Protection Act 1972 under Schedule I. The details of each species ecology and conservation issues given below.

Table 2.38: List of Scheduled I Wildlife species

S. No.	Local Name	Scientific name	Family	WPA-Schedule
	Mammals			
1	Common grey mongoose	*Urva edwardsii*	Herpestidae	LC/I
2	Indian porcupine	*Hystrix indica*	Hystricidae	LC/I
3	Malabar gain squirrel	*Ratufa indica*	Sciuridae	VU/I
4	Common leopard*	*Panthera pardus*	Felidae	VU/I
5	Leopard cat*	*Pronailurus bengalensis*	Felidae	LC/I

6	Wronghto's Gaint Mastiff Bat	*Otomops wroughtoni*	Molossidae	LC/I
7	Slender Loris	*Loris lydekkerianus*	Lorisidae	NT/I
8	Tiger	*Panthera tigris*	Felidae	EN/I
9	Mouse Deer	*Moschiola indica*	Tragulidae	LC/I
10	Four Horned Antelope	*Tetracerus quadricornis*	Bovidae	VU/I
11	Gaur or Indian Bison	*Bos gaurus*	Bovidae	VU/I
12	Indian Pangolin*	*Manis crassicaudata*	Manidae	EN/I
13	Sloth bear*	*Melursus ursinus*	Ursidae	VU/I
14	Small Indian civet*	*Viverricula indica*	Viverridae	LC/I
15	Bonnet macaque	*Macaca radiata*	Cercopithecidae	LC/I
16	Wild dog	*Cuon alpines*	Canidae	EN/I
	Birds			
17	White-bellied Sea-Eagle	*Haliaeetus leucogaster*	Accipitridae	LC/I
18	Indian Peafowl	*Pavo cristatus*	Phasianidae	LC/I
19	Shikra	*Accipiter badius*	Accipitridae	LC/I
20	Osprey	*Pandion haliaetus*	Pandionidae	LC/I
21	Chestnut Bittern*	*Ixobrychus cinnamomeus*	Ardeidae	LC/I
22	Cotton Teal	*Nettapus coromandelianus*	Anatidae	LC/I
23	Brahminy Kite	*Haliastur indus*	Accipitridae	LC/I
24	Long-billed Vulture	*Gyps indicus*	Accipitridae	CR/I
25	Crested Serpent Eagle*	*Spilornis cheela*	Accipitridae	LC/I
26	Eurasian Marsh Harrier	*Circus aeruginosus*	Accipitridae	LC/I
27	Crested Goshawk	*Accipiter trivirgatus*	Accipitridae	LC/I
28	Besra Sparrowhawk	*Accipiter virgatus*	Accipitridae	LC/I
29	Black Eagle*	*Ictinaetus malayensis*	Accipitridae	LC/I
30	Crested Tree-swift	*Hemiprocne coronate*	Hemiprocnidae	LC/I
31	Brown Wood Owl	*Strix leptogrammica*	Strigidae	LC/I
32	Common Hill-Myna	*Gracula religiosa*	Sturnidae	LC/I
33	Grey Junglefowl	*Gallus sonneratii*	Phasianidae	LC/I
34	Nilgiri Wood Pigeon	*Columba elphinstonii*	Columbidae	VU/I
35	Small Minivet *	*Pericrocotus cinnamomeus*	Campephagidae	LC/I
36	Forest Eagle-Owl	*Bubo nipalensis*	Strigidae	LC/I
	Reptiles			
37	Indian Rock Python*	*Python molurus molurus*	Pythonidae	NT/I
38	Marsh Crocodile	*Crocodylus palustris*	Crocodylidae	VU/I
39	Indian Falpshell Turtle	*Lissemys punctata*	Trionychidae	VU/I
40	Common Indian Monitor Lizard	*Varanus bengalensis*	Varanidae	NT/I
41	Russell's Viper	*Daboia russelii*	Viperidae	LC/I
42	Cobra	*Naja naja*	Elapidae	LC/I

43	King cobra*	*Ophiophagus hannah*	Elapidae	VU/I
44	Green Forest lizard	*Calotes calotes*	*Agamidae*	LC/I
45	Checkered Keelback	*Fowlea piscator*	*Colubridae*	LC/I
46	Common Kukri Snake*	*Oligodon arnensis*	Colubridae	LC/I
47	Whitaker's Boa*	*Eryx whitakeri*	Boidae	NT/I
48	Common Indian monitor lizard	*Varanus bengalensis*	*Varanidae*	NT/I

CHAPTER -3
PROBABLE IMPACTS OF THE PROJECT ON FLORA & FAUNA

3.0 PROBABLE IMPACTS OF THE PROJECT ON FLORA AND FAUNA

3.1 IMPACT

The Environmental Impacts can be broadly categorized into Primary and Secondary Impacts. If the impact is directly due to the Project Activity, it is termed as Primary Impact. In case, the impacts are indirectly induced, then it is called Secondary Impact. The project can create impact in two phases. One is during the construction phase, which are temporary and short term in nature, while the impacts created during the operation phase can have long term impacts.

Consturction Stage : No construction is involved in the Mineral Block

Operation Stage:

3.1.1 IMPACT ON AIR

Activities at Operation stage will be permanent in nature and will continue till the end of the mine lease. The impacts which are perceived during this phase will be due to the following activities.

Area Sources: The total mine area with all mining activities like operation of equipment/machinery, active mine pit, mineral stock yard and waste dump locations and haul roads constitute the area source, which lead to increase in air pollution in and around mine lease area.

Mining: Overburden and ore benches would be developed in scientific and sustainable open cast method using hydraulic excavator along with matching dumpers.

Dozing: Dozing is envisaged during mining operations. The dozing activity is likely to contribute to air pollution in the form of PM, SO_2, NO_2 and hydrocarbons due to use of diesel operated machines.

Loading & unloading of waste/ore: The loading of Waste/Ore is proposed by excavators. These activities are likely to contribute air pollution in the form of dust/ particulate matter during discharge of material from bucket and gaseous pollutant like SO2, NO2 and hydrocarbons due to combustion of diesel in the loading machinery. The generated waste/ore will be transported by dumpers, tippers and unloaded at the designated locations i.e. at dump site.

During unloading operation at the dump site of the waste/Ore, air pollution in the form of dust (PM) and gaseous pollutants namely SO2, NO2 and hydrocarbons due to consumption of diesel in dumper is anticipated.

Line Sources: These are normally mobile sources, which emit pollutants in the area through which they pass. The following are the sources of air pollution falling under this category.

Transportation: Surface transport consists of transport of overburden and iron ore. Overburden will be transported by dumpers to respective waste dumps. Haul roads have been provided for movement of dumpers. Transportation also includes movement of service vehicles in the mine lease area.

The traffic on the haul roads is likely to contribute towards increase in dust and gaseous pollutants concentration in the mining area. However, this is more of a localized phenomenon within the mining areas that have limited human exposure.

3.1.2 IMPACT ON SOIL

The area proposed for the mining is more or less covered by hard laterite, the occurrence of the topsoil very sparse and that too in patches beneath the tree growth.

3.1.3 IMPACT ON VEGETATION

There exist orchards and shrub growth within the Mining Lease area. A detailed biological study has been carried out. Tree enumeration has been carried out.

3.1.4 IMPACT ON WATER REGIME

Surface Water : There are one seasonal nallah existing in the mineral block and one river which is adjacent to the ML area i.e., the Kalay River flowing from South to North towards the eastern side of the block.

Also a second order seasonal nalla flows from the north west of block towards south and passes across the block from west to east, ultimately joining to the Kalay River in the eastern side of the block. The study area drainage pattern is dendritic and sub dendritic

Ground Water : Impact on Core and buffer zone due to Discharge of effluent/waste water from Mine. Intersection of water table as the ground level in the mine is about 10M BGL.

3.1.5 IMPACT OF NOISE

During the mine operation phase, noise will be generated from all sources. With increasing distance from the source, the noise level decreases due to wave divergence. Additional decrease also occurs due to atmospheric effects and interaction with objects in the transmission paths.

Machinery / equipment proposed to be deployed in mining complex are used as input as noise generating sources.

Probable increase in the vehicular traffic

Transportation of Iron Ore and raw material by road. The road traffic to and from the proposed mine during operation phase would not be so intensive.

3.2 NATURE OF THREAT TO THE FLORA AND FAUNA ON ACCOUNT OF PROJECT IMPLEMENTATION

Identification of all potential environmental impacts due to a project is an essential step of Environmental Impact Assessment. Mining activities are normally carried out over a long period of about 50 years. This also encourages downstream industrial development in the area, which adds to environmental degradation. Positive impacts on the socio-economic environment are expected to create employment opportunities and development of infrastructure such as roads, school, hospitals etc.

The impact on biodiversity would be high if the project is located close to a sensitive area. The impact on biodiversity is difficult to quantify because of its diverse and dynamic characteristics.

Identification of all potential environmental impacts due to a project is an essential step of Environmental Impact Assessment. In generally Mining are normally carried out over a long period till the ore get exhausted. This is important to predict downstream of the industrial development to find the suitable mitigation measures.

The impact on biodiversity would be high if the project is located close to a sensitive area. So, impact of biological environment was assessed based on the ground observation and distance from the project. Where Impact level ranges as follows :- 1 – Highest Impact, 2 to 4 – Higher Impact, 5 to 7 – Moderate to high impact; 8 to 10 moderate to less impact on Bio diversity)

Significance of Impact on Biological Environment (Score 1 higher impact and 10 – least impact on biodiversity, where Impact level ranges as follows:- 1 – Highest Impact, 2 to 4 – Higher Impact, 5 to 7 – Moderate to high impact; 8 to 10 moderate to less impact on Biodiveristy)

Table 3.1: Significance of Impact on Biological Environment (Score 1 higher impact and 10 – least impact on biodiversity)

Issues	Observations
Proximity to national park / wildlife sanctuary/ reserve forest/mangroves/ coastline/estuary/sea	Bhagwan Mahavir WLS is 1.04 km from the core zone (East direction) **Eco-sensitive scale range - 1**
	The 1st, 2nd & 3rd order streams, Dudsagar River – 3.5 km, Kalay River – 0.005 km. **Eco-sensitive scale range - 1**
	Zuari River flows at a distance of 3.8 km. **Ecosensitive Scale range- 3**
Activities of the project affects the breeding/nesting sites of birds and animals	Migratory bird species may be affected due to the noise and dust from the vehicles etc. Further Yellow wattled lapwing and Red-wattled lapwings (Resident) which prefer the ground for their nesting, which may affect only closer to the core areas. **Eco-sensitive scale ranges - 8-10**
	The reptiles, may be affected due to the excavation of the core area .**Eco-sensitive scale ranges - 8-10**
	Fishes and crabs may be affected due to nearby mining due to human settlements and layouts which get nutritional demands of peoples .**Eco-sensitive scale ranges - 8-10**
Located near an area populated by rare or endangered species	Rare plant species *Strychnos nux vomica,* reported in buffer zone and not in core zone, **Eco-sensitive scale ranges - 10**
	Amongst the fauna species**,** very few species were migratory, while, many of them were local species.**Eco-sensitive scale ranges - 8**
	Many schedule Butterfly species can be enhanced within the ML area by planting a species that provides larval food plants. **Eco-sensitive scale ranges - 8**
Proposed project restricts access to waterholes for wildlife.	Kalay river exists on the eastern side of the Mineral Block, which forms a natural barrier. Thus there is no crossing over of wild

	animals from wildlife sanctuary located at the Eastern side of the Kalay river towards the Mineral Block. **Eco-sensitive scale ranges - 8**
The proposed mining project impacts surface water quality that also provide water to wildlife	No such water is effectively used for wildlife. Rainwater harvested in mine pits is utilized within the mine for dust suppression, green belt development, etc. and is also utilized for useful gains downstream such as agriculture, horticulture, etc. **Eco-sensitive scale ranges - 8**
Proposed mining project increase siltation that would affect nearby Biodiversity area.	Environmental protective measures such as retention walls, trenches, settling ponds will facilitate sedimentation of any sediment runoff within the Mineral Block. Such measures will prevent siltation of nearby rivers and Biodiversity area. **Eco-sensitive scale ranges - 8**
Risk of fall/slip or cause death to wild animals due to project activities	Kalay river exists on the eastern side of the Mineral Block, which forms a natural barrier. Thus there is no crossing over of wild animals from wildlife sanctuary located at the Eastern side of the Kalay river towards the Mineral Block. Further, the proposed Mineral Block area will be fenced, preventing any such deaths to wild animals. In case of any such incidence; assistance will be taken from veterinary doctor and wildlife expert. **Eco-sensitive scale ranges - 8**
The project releases effluents into a water body that also supplies water to wildlife	Industrial effluents will not be generated from the mining activity. Waste water from workshop and wheel washing system will be recycled and reused. No such effluents will be released from the project area. **Eco-sensitive scale ranges – 9**
Mining projects affect the forest-based livelihood/ any specific forest product on which local livelihood depended	The proposed mine does not have any timber based or any forest product on which the local livelihood depend.
Project likely to affect migration routes	No such wildlife corridors exists within the Mineral block area.
Project likely to affect flora of an area, which have medicinal value.	No such significantly important medicinal value species exists within the Mineral Block.
Forestland is to be diverted, has carbon-high sequestration	The proposed project doesn't require conversion of forest to non-forest land.
The project likely to affect wetlands, fish breeding grounds, marine ecology	Clean water will be discharged after treating from the Mineral Block. Wetlands (Nanda lake) is at a distance of 7 Km from the project boundary. Hence, wetlands, fish breeding grounds, marine ecology from the proposed project. **Eco-sensitive scale ranges - 9**

CHAPTER -4
MITIGATION MEASURES REQUIRED

4.0 MITIGATIVE MEASURES AND EMP MANAGEMENT

4.1 PROJECT AREA

It has been provided in the Environment Impact Assessment and Environmental Management Plan of the total area that will be planted with indigenous species and maintained as green belt. Hence no further steps are required.

4.2 CONTROL OF WATER POLLUTION

There is no perennial water course within ML, which can get polluted. The wastes or the ore do not contain any leachable toxic elements or heavy metals. Thus no leachate water is generated either from the waste dump or from the pit workings.

Stacking of waste: Laterite wall at the foot of the dump shall be maintained that arrests silt runoff. Garland drain around the waste dump shall be constructed and maintained with dimensions 1m bottom width, 1m top width and 1.5m deep to divert water to mine pit and settling pond for arresting the suspended solids. Covering slopes of the dumps with lateritic material, coir mat and planting grasses, legumes and bush variety of species to prevent erosion. Construction of Check Dams, strategic locations, to arrest suspended solids.

Proposed rain water harvesting measures: The collected rainwater in the Mine Pit will be utilized for dust suppression and greenbelt development. Harvested rainwater will also facilitate ground water recharge.

4.3 CONTROL OF AIR POLLUTION

Drilling & Blasting: No drilling & Blasting

Loading & unloading : Dust suppression by water sprinking over the areas, proper maintenance of machinery & equipment as per manufactures specification, avoiding overloading of trucks

Haul Road: Dust suppression by water sprinking on mine haul roads, speed restriction, proper maintenance of roads, proper maintenance of machinery & equipment as per manufactures specification.

Mining area: 7.5m 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.

High canopy plantation (local species like Cashew, Alva, Arjuna, etc.) shall be carried out to reduce dust emission.

Transportation: No overloading of trucks, speed restriction, covering of carriers of tipper trucks before ore transportation, proper maintenance of machinery & equipment as per manufactures specification, PUC for transport vehicle.

Waste & topsoil handling: Stabilization of waste dumps by covering with geo-textiles, plantation with initial reclamation crops of grasses and mulches, afforestation with shrub and tree species

DG Set: No generator is in operation

4.4 CONTROL OF NOISE POLLUTION

Following noise management measures will be adopted to control noise levels

- Drilling and blasting operations is not proposed.
- Reduction of noise level at source will be achieved by proper maintenance of machinery and equipment. Interruption of noise path from the source to the receiver will be achieved by the development of greenbelts.
- Provision of acoustic cabins for operators operating HEMM
- Vehicular traffic within the mine is restricted by reducing the number of trips, using heavy duty dumpers within the ML.
- Selection of new low-noise equipment from the manufactures
- Green belt developed acts as an acoustic barrier

Use of Protective equipment- Administrative Control

As part of a hearing protection PP shall consider:

- The need for hearing protectors
- Defining hearing protector areas
- Selection of hearing protectors
- Issuing of hearing protection equipment to individuals

- Cleaning, maintenance and replacement of hearing protectors
- Training and education of people wearing hearing protectors.
- Provision of job rotation in noisy areas that will reduce personal exposure
- Setting targets for noise levels in existing work areas
- Training on noise impact and consequences
- Including Noise aspects in work agreements with contractors

4.5 CONTROL OF TRAFFIC DENSITY

The following steps will be taken to reduce pollution level:

- Attempt to be made to use high capacity dumpers to reduce traffic density
- Regular maintenance of vehicles shall limit the pollution.
- The present road conditions are good for proposed movement of traffic. However, take necessary steps to upgrade and maintain the road condition and traffic movements during the normal course of operation.

4.6 MEASURES TO MAINTAIN ECOLOGY

- A planned 5-year Afforestation scheme shall be developed
- The species proposed to be planted shall be selected based on the criteria prescribed by CPCB as "Guidelines for Developing Greenbelts".
- Local species shall be preferred; As this aspect has been provided in the Environment Management Plan, no separate provision for plantation is made.
- Dust suppression shall be done by regular water sprinkling to minimize the impact.
- Green belt area: Plantation will be carried out over the backfilled area after stabilization is completed.

4.7 WILDLIFE CONSERVATION AND MANAGEMENT MEASURES

Wildlife conservation and management is complex and need to be considered multifaceted factors such as food-web, resources competitions, anthropogenic, forest fragmentation, and sociological issues such community livelihoods, culture, ethics and forest dependency so on.

Total of 48 species of fauna falls within the category of Wildlife Protection Act 1972 under Schedule I. The details of each species ecology and conservation issues given below.

Table 4.1: List of Scheduled I Wildlife species

S. No.	Local Name	Scientific name	Family	WPA-Schedule
	Mammals			
1	Common grey mongoose	*Urva edwardsii*	Herpestidae	LC/I
2	Indian porcupine	*Hystrix indica*	Hystricidae	LC/I
3	Malabar gain squirrel	*Ratufa indica*	Sciuridae	VU/I
4	Common leopard*	*Panthera pardus*	Felidae	VU/I
5	Leopard cat*	*Pronailurus bengalensis*	Felidae	LC/I
6	Wronghto's Gaint Mastiff Bat	*Otomops wroughtoni*	Molossidae	LC/I
7	Slender Loris	*Loris lydekkerianus*	Lorisidae	NT/I
8	Tiger	*Panthera tigris*	Felidae	EN/I
9	Mouse Deer	*Moschiola indica*	Tragulidae	LC/I
10	Four Horned Antelope	*Tetracerus quadricornis*	Bovidae	VU/I
11	Gaur or Indian Bison	*Bos gaurus*	Bovidae	VU/I
12	Indian Pangolin*	*Manis crassicaudata*	Manidae	EN/I
13	Sloth bear*	*Melursus ursinus*	Ursidae	VU/I
14	Small Indian civet*	*Viverricula indica*	Viverridae	LC/I
15	Bonnet macaque	*Macaca radiata*	Cercopithecidae	LC/I
16	Wild dog	*Cuon alpines*	Canidae	EN/I
	Birds			
17	White-bellied Sea-Eagle	*Haliaeetus leucogaster*	Accipitridae	LC/I
18	Indian Peafowl	*Pavo cristatus*	Phasianidae	LC/I
19	Shikra	*Accipiter badius*	Accipitridae	LC/I
20	Osprey	*Pandion haliaetus*	Pandionidae	LC/I
21	Chestnut Bittern*	*Ixobrychus cinnamomeus*	Ardeidae	LC/I
22	Cotton Teal	*Nettapus coromandelianus*	Anatidae	LC/I
23	Brahminy Kite	*Haliastur indus*	Accipitridae	LC/I
24	Long-billed Vulture	*Gyps indicus*	Accipitridae	CR/I
25	Crested Serpent Eagle*	*Spilornis cheela*	Accipitridae	LC/I
26	Eurasian Marsh Harrier	*Circus aeruginosus*	Accipitridae	LC/I
27	Crested Goshawk	*Accipiter trivirgatus*	Accipitridae	LC/I
28	Besra Sparrowhawk	*Accipiter virgatus*	Accipitridae	LC/I
29	Black Eagle*	*Ictinaetus malayensis*	Accipitridae	LC/I
30	Crested Tree-swift	*Hemiprocne coronate*	Hemiprocnidae	LC/I
31	Brown Wood Owl	*Strix leptogrammica*	Strigidae	LC/I

32	Common Hill-Myna	*Gracula religiosa*	Sturnidae	LC/I
33	Grey Junglefowl	*Gallus sonneratii*	Phasianidae	LC/I
34	Nilgiri Wood Pigeon	*Columba elphinstonii*	Columbidae	VU/I
35	Small Minivet *	*Pericrocotus cinnamomeus*	Campephagidae	LC/I
36	Forest Eagle-Owl	*Bubo nipalensis*	Strigidae	LC/I
	Reptiles			
37	Indian Rock Python*	*Python molurus molurus*	Pythonidae	NT/I
38	Marsh Crocodile	*Crocodylus palustris*	Crocodylidae	VU/I
39	Indian Falpshell Turtle	*Lissemys punctata*	Trionychidae	VU/I
40	Common Indian Monitor Lizard	*Varanus bengalensis*	Varanidae	NT/I
41	Russell's Viper	*Daboia russelii*	Viperidae	LC/I
42	Cobra	*Naja naja*	Elapidae	LC/I
43	King cobra*	*Ophiophagus hannah*	Elapidae	VU/I
44	Green Forest lizard	*Calotes calotes*	*Agamidae*	LC/I
45	Checkered Keelback	*Fowlea piscator*	*Colubridae*	LC/I
46	Common Kukri Snake*	*Oligodon arnensis*	Colubridae	LC/I
47	Whitaker's Boa*	*Eryx whitakeri*	Boidae	NT/I
48	Common Indian monitor lizard	*Varanus bengalensis*	*Varanidae*	NT/I

*Note * Secondary sources (literature, field guide and Forest working plan*

CONSERVATION MEASURE IN CONTEXT OF SCHEDULE I SPECIES WITHIN THE MINE BUFFER AREA

1. Conduct extensive census and surveys periodically, to assess changes in populations and habitats.
2. Identify critical habitats and migration routes within the 10 km buffer zone, including Reserve Forests, riparian habitats, and mangrove vegetation, implementing restoration plans.
3. Implement protective measures in the core area, restricting mining impacts during operations. Ban high beam lights and night operations to ensure the safety of nocturnal wildlife.
4. Develop a green belt around the mine lease area and transportation roads, minimizing disturbance and ensuring habitat connectivity.

5. Engage local communities in conservation awareness, monitoring, and provide employment opportunities to aid in ecology and biodiversity conservation.
6. Establish a robust monitoring system in collaboration with local forest departments, conducting wildlife censuses and tracking species status.
7. Ensure compliance with regulations and adapt strategies for continual improvement.

The forest department has to carry out conservation of wildlife in the protected and forest areas. The Project Proponent will support the department by allocating and providing funds for implementation of scheme for conservation of wildlife.

MITIGATIVE MEASURES FOR CONSERVATION OF WILDLIFE:

The forest department is responsible for conservation of wildlife in the protected areas and the project proponent can only 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 of mineral block would be responsibility of the project proponent and will be carried out as per requirement.

(i) Water holes for habitat improvement:

Animals and birds need a regular water source for their daily consumption.

During hot summer wild animals and birds stray outside forest in search of water source for quenching thirst. It is therefore proposed to construct water holes/check-dams 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 shall be cleaned at regular intervals to remove leaf litter, de-silting and refilling water. Shade should be provided around water holes for animal resting during summer season.

Fruit bearing trees shall be grown around water holes to nesting and food for birds and shade for wild animals. Project proponent will provide some funds to forest department to undertake water holes.

(ii) 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.

i) Use of well-maintained loading machines with sharp bucket teeth

ii) Well maintained roads. No over speeding of vehicles

(iii) Air Quality:

The ambient air quality in the buffer zone shall be maintained within the CPCB limits in respect of PM_{10}, SO_2, NO_2 and CO emissions. For this the following steps are proposed.

i) Regular sprinkling of water on roads for dus suppression

ii) No overloading to avoid spillage, trucks covered with tarpaulins.

iii) Creation of green belt around the mine area and avenue plantation with thick foliage to arrest dust.

(iv) Green Belt Development

- The project shall develop and maintain green belt to mitigate the effects of air and noise pollution from the project activity.
- The species proposed to be planted shall be selected based on the criteria prescribed by CPCB as "Guidelines for Developing Greenbelts" and also in consultation with local forest department.

Table.4.1. Green belt planning next 5 years

Year	Green Belt Location (s)	Area Proposed to be Covered (Ha)	Number of saplings Proposed
Year1	Dump1	0.60	1500
Year2	Dump1	0.60	1500
Year3	Dump1	0.60	1500
Year4	Dump1 & Along Eastern Block Boundary	0.50	1500
Year5	Dump1 & Along Eastern Block Boundary	0.50	1500

Table 4.2 List of Species suggested for future Greenbelt development

S.No	Botanical Name	Family	Common Name	S/ T	Habitat	Height
Shrubs - < 5m (1st tier of Plantation)						
1	*Citrus limon*	Rutaceae	Lemon	T	Shrub	3m
2	*Duranta repens*	Verenaceae	Golden Dew Drop	T	Shrub	3m
3	*Hibiscus rosa sinensis*	Malvaceae	China Rose/ DasavaLa	T	Shrub	3m
4	*Nerium indicum*	Apocynaceae	Oleander/Chandaatha	T	Shrub	5m
Trees 5 - 10m (2nd tier of Plantation)						
5	*Acacia nilotica*	Mimoseae	Gum Arabic/ Babli	T	Tree	8m
6	*Bauhinia varigata*	Caesalpinaceae	Kachnar/ Arisinantige	T	Tree	5m
7	*Annona squamosa*	Annonaceae	Setha palla	T	Tree	6m
8	*Butea monosperma*	Fabaceae	Flame of the Forest/ Muttuga	T	Tree	10m
9	*Gardenia jasminoides*	Rubiaceae	Cape jasmine/ Suvasane Malle	T	Tree	5m
10	*Moringa oleifera*	Moringaceae	Drumstick Tree/Guggala	S	Tree	10m
11	*Pithecellobium dulce*	Mimosaceae	Manilla Tamarind/Seeme hunase	T	Tree	8m
12	*Thevetia peruviana*	Apocynaceae	Mexican oleander	T	Shrub	6m
13	*Phyllanthus emblica*	Phyllanthaceae	Ambla	T	Shrub	7m
Trees >10m (3rd tier of Plantation)						
14	*Aegle marmelos*	Rutaceae	Maredu / Bilva	T	Tree	12m
15	*Albizia lebbeck*	Mimoseae	Siris tree	T	Tree	20m
16	*Albizia procera*	Mimoseae	White siris/Belari	T	Tree	20m
17	*Alstona scholaris*	Apocynaceae	Devil Tree/ Aelele Haale	T	Tree	15m
18	*Azadirachta indica*	Meliaceae	Neem/ Turakabevu	T	Tree	20m
19	*Bambusa vulgaris*	Poaceae	Yellow Bamboo	T	Perennial grass	15m
20	*Cassia fistula*	Caesalpinaceae	Golden Shower/ Kakke	T	Tree	12m
21	*Delonix regia*	Caesalpinaceae	Flame Tree/ Kempu torai	T	Tree	15m
22	*Ficus benghalensis*	Moraceae	Banyan tree/ Aaladamara	T	Tree	20m
23	*Ficus religiosa*	Moraceae	Peepal/ Arali	T	Tree	20m
24	*Mangifera indica*	Anacardiaceae	Mango/ Mavinamara	S	Tree	15m
25	*Polythia longifolia*	Anonaceae	Ashok/Ubbina	S	Tree	15m
26	*Wrightia tinctoria*	Apocynaceae	Alae mara	T	Tree	12 m
27	*Hardwickia binata*	Fabaceae	Small leaves	T	Shrub	6m
28	*Syzygium cumini*	Myrtaceae	Neredu/ Neereedu	T	Tree	20m
29	*Tectona grandis*	Verbenaceae	Teak	T	Tree	20m

(*v*) ***Salt licks***: As natural salt is very scarce in the area and salt is a very essential requirement for the wild animals particularly the herbivores, such salt licks may be created artificially and maintained for use of wild animals near the water hole and grass land. Clay soil will be mixed with salt mixture in 3 : 1 ratio. Salt mixture will be prepared by mixing of 95 kg common salt, 3 kg rock salt and 2 kg trace mineral mixture.

(vi) Training staff and Awareness activity:

All the mine workers and staff shall be trained in conservation of wildlife and develop a liking for wildlife conservation by celebrating Environment Day involving local village people and school students. The drivers shall be trained to give way for wildlife with the support of local forest department.

The villagers are also made aware of wildlife conservation by conducting meetings using pamphlets, audio and video means. Importance of plants and wildlife will be informed through conducting quiz, drawing, painting competitions and essay writing for students.

Prizes shall be distributed to the winners; Women participation in conserving the forest plants shall be rewarded.

Villagers are awarded for protecting and preventing wood theft and tree cutting helping Forest Dept. Guards in catching Poachers. Conservation activities for protection of flora & fauna shall be implemented in consultation of Forest Department officials.

(vii) Awareness programmes:

Forest department carries a lot of awareness programmes in the 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.

(viii) Prevention of man and animal conflict:

The project proponent will support the forest department in strengthening the fencing in the protected areas thus prevent man and animal conflict.

CHAPTER -5
ANIMAL PASSAGE PLAN

5.0 ANIMAL PASSAGE PLAN

Not applicable

The proposed project is an open cast mining its not a linear project

CHAPTER -6 FINANCIAL IMPLICATIONS AND MONITORING

6.0 FINANCIAL IMPLICATIONS AND MONITORING

Fund for wildlife conservation:

Detailed cost estimates and design are providing site specific activity plan. However, based on the studies a total of Rs 12.5 lakhs are earmarked for implementation of wildlife conservation plan for 5 years period.

The budgetary allocation is as given in the **Table 6.1**.

Table 6.1: Budget Layout for Implementation of Wildlife Management & Mitigation Plan

Rs. In lakhs

Sl. No.	Particulars	1st Year	2nd Year	3rd Year	4th Year	5th Year
1	Construction of water holes and maintenance	1.0	1.0	1.0	1.0	1.0
2	Fruit bearing and shade giving trees around water holes	0.75	0.75	0.75	0.75	0.75
3	Erection of watch towers	0.5	0.5	0.5	0.5	0.5
4	Provision of salt licks	0.25	0.25	0.25	0.25	0.25
	Total	**2.50**	**2.50**	**2.50**	**2.50**	**2.50**

The following suggestions are encouraged to be followed for maintaining the human-animal co-existence.

- Habitat management must be adopted by planting suitable fodder species to enable herbivores to thrive upon.
- 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) are not killed.

- Rock fill dams and check dams shall be constructed in the forest area of buffer zone to prevent the soil erosion. This will enable the storage of sufficient quantity of filtered water in the area and will act as water holes for the fauna.
- 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.
- Awareness campaign amongst the local people/schools children as well as project staff shall be carried out regarding the importance of regional biodiversity and the 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.
- People should be trained with forest fire fighting measures and equipped with necessary equipment like rakes, shovels, billhook, bucket, etc.

From our field investigation and secondary literature review, we can safely conclude as follows:

- The Mine area is located at the distance of a 1.04 km from the Bhagwan Wildlife Sanctuary, hence, there is very less chance of threat to the sanctuary and mangrove ecosystem, however, mine management could work with downstream riparian and mangrove forest and assist ecologically restoration as per the EMP suggested species.
- The Mine area is already degraded and been away from community settlement usage; hence, there is not much additional impact or social ecological constraints,
- In case of flora and fauna of the conservation as per suggested EMP, greenbelt all along the mine area and roadside both core and buffer area to be executed along with local forest department.

- The proposed biodiversity management plan will be implemented as per the standard guidelines prescribed by regulatory authorities.

Budget allocations and time bound interventions will be monitored by local authority to ensure biodiversity conservation and not to damage existing ecosystem habitats

Prepared By : Dr. Chetan H C
Ecology & Biodiversity- FAE(NABET)

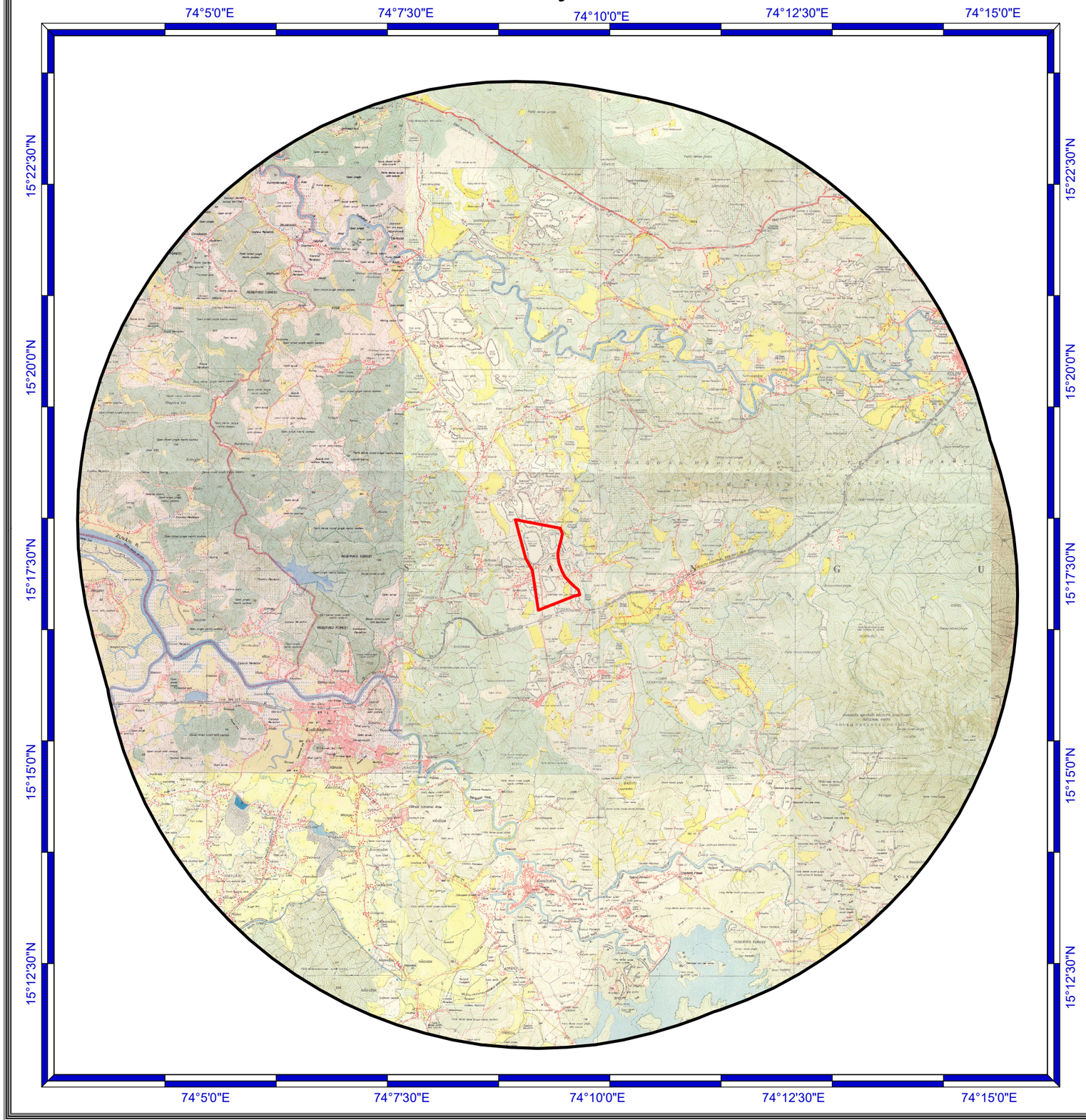
(M.S.RAJU)
NABET CONSULTANT

Place: Ballari

Date: 28.02.2024

MINERAL ENGG SERVICES BELLARY.

Key Plan





Scale 1:50,000

0 2.5 5 Km

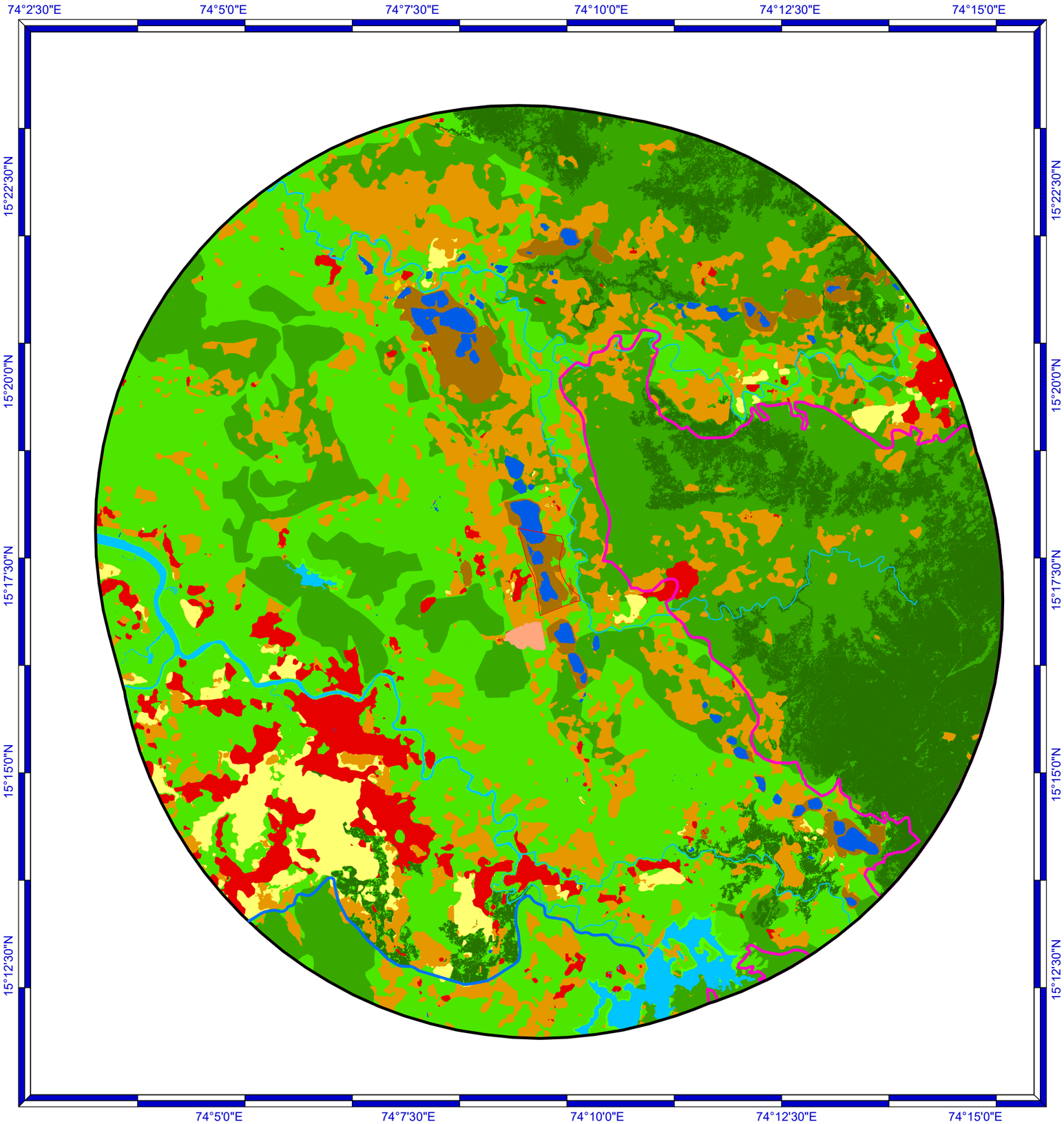
Legend

- Mineral Block
- 10 km bufferzone

Map-1

BLOCK IV- KALAY MINERAL BLOCK **Located at Santona Village, Sanguem taluka, South -Goa District, Goa**		
Fomento Resources Private Ltd.,		
Scale	1:50,000	
Topo Sheets No.	New	Old
	D43C3, D43C7 & D43C4	48I/3, 48I/7 & 48I/4
Map Prepared By	**Mineral Engineering Services 25/XXV Club Road, Ballari -583103**	

Land Use and Land Cover



N
W E
S

Scale 1:50,000

0 2.5 5 Km

Legend

- Mineral Block
- 10 Km Bufferzone
- Rivers
- Wildlife sanctuary Boundary
- canal
- Dense Reserve Forest
- Reserve Forest
- Vegetation
- Agricultural Land
- Water Bodies
- Mine Broken up Area
- Mine Pit Water
- Barren/Grass Land
- Settlements
- Industry

Sl.No	Descripition	Area_Ha	%
1	Dense Reserve Forest	5227.0	13.99
2	Reserve Forest	12617.0	33.78
3	Vegetation	8416.0	22.53
4	Settlements	1714.3	4.59
5	Water Bodies	772.0	2.07
6	Broken up Area & Pit Water Bodies	1448.0	3.88
7	Agricultural Land	1304.8	3.49
8	Barren/Grass Land	5810.2	15.55
9	Industry	46.7	0.13
Total		37356.0	100.0

Block IV – Kalay Mineral Block

Located at Santona Village, Sanguem taluka,
South Goa District, Goa

Fomento Resources Private Ltd.,

Title	Land Use Land Cover
Scale	1:50,000
Data Used	IRS-R2, Mx
Resolution	5m
Date of Pass	01.04.2023 & 08.03.2023
Map Prepared By	Mineral Engineering Service 25/XXV Club Road, Ballari -583103

Map-2

HYDROGEOLOGICAL AND IMPACT ASSESSMENT STUDIES

IN AND AROUND

BLOCK IV – KALAY MINERAL BLOCK

LOCATED AT

SANTONA VILLAGE, SANGUEM TALUKA,
SOUTH GOA DISTRICT, GOA STATE.

REPORT PREPARED BY

M.C. REDDY

Formerly Regional Director,

Accredited Consultant of Central Ground Water Authority for Mining Projects & NABET

SEPTEMBER 2023

M.C.REDDY
Former Regional Director
Central Ground Water Board
Ministry of Water Resources
Govt. of India

Phone: 08048521486
Mobile: 9448864873
e: mcreddycgwb@yahoo.co.in
PAN No. AERPK1910J

06-09-2023

DECLARATION

I, M. C. Reddy, Former Regional Director, Central Ground Water Board and Accredited Consultant of Central Ground Water Authority for mining projects & NABET (HG & GEO) declare that I have carried out Hydrogeological Surveys and prepared a report on "HYDROGEOLOGICAL AND IMPACT ASSESSMENT STUDIES IN AND AROUND THE IRON ORE MINE, BLOCK IV – KALAY MINERAL BLOCK, SANTONA VILLAGE, SANGUEM TALUKA, SOUTH GOA DISTRICT, Goa", and submitted to the Lessee M/s. Fomento Resources Pvt. Ltd. in September, 2023

(M.C. Reddy)

Date: 06-09-2023

CONTENTS

Chapter No		Description	Page No.
1.0	**INTRODUCTION**		1
	1.1	Location Details	1
	1.2	Mining Lease Boundary Co-ordinates	5
	1.3	Details of the Project	6
	1.4	Lessee / Project Proponent Details	6
	1.5	Mining Method	7
	1.6	Layout of Mine Workings	8
2.0	OBJECTIVE OF STUDY		9
	2.1	Scope of the Study	9
	2.2	Methodology	10
3.0	GEOMORPHOLOGY, PHYSIOGRAPHY AND DRAINAGE		13
	3.1	Geomorphology	13
	3.2	Land Use and Land Cover	14
	3.3	Physiography	14
	3.4	Drainage	14
	3.5	Soil Characteristics	16
4.0	HYDROMETEOROLOGY		17
	4.1	Climate and Temperature	17
	4.2	Relative Humidity	17
	4.3	Actual Rainfall Analysis	19
	4.3.1	Behavior of Monthly Rainfall	19
	4.3.2	Behavior of Annual Rainfall	22
5.0	GROUND WATER CONDITIONS & QUALITY		23
	5.1	Brief Geology of the Area	23
	5.1.1	Regional Geology of the Area:	23
	5.1.2	Local Geology of the Mineral Block	24
	5.2	Hydrogeology	26
	5.3	Aquifer Description	26
	5.4	Aquifer Performance Test	26
	5.5	Ground Water Flow and Aquifer Interaction	29
	5.6	Depth to Water Level	36
	5.7	Water Table Elevation	36
	5.8	Yield of bore wells	37
	5.9	Bore wells in the core area	38
	5.10	Ground water table at Santona Village	38
	5.11	Ground water level trend analysis	38
	5.12	Water level trend analysis and 5 years projected water level	52
	5.13	Details Of Piezometer Already Constructed For Monitoring Water Levels And Water Quality	54
	5.14	The sub surface geological formation and hydrogeological scenario of deeper semi confined to confined aquifers around the mining block	54
6.0	GROUND WATER RESOURCES		63
7.0	WATER QUALITY		65

Chapter No		Description	Page No.
	7.1	Electrical Conductivity	65
	7.2	Chlorides	66
	7.3	Nitrates	67
	7.4	Fluorides	68
	7.5	BIS Standards	68
	7.6	Observation Wells for monitoring ground water levels in the study area	73
	7.7	Bore wells	74
	7.8	Water Budget	74
	7.9	Projected Water Requirements and utilization plan	75
	7.10	Source Water for Mining	76
8.0	IMPACT ON GROUND WATER RESOURCES		77
	8.1	Impact on ground water sources	77
	8.1.1	Impact on Ground Water	77
	8.2	Dependency on source of water	77
	8.3	Ground water users	77
9.0	PROPOSED MEASURE FOR DISPOSAL OF WASTE WATER BY INDUSTRIES DRAWING SALINE WATER		78
	9.1	Existing Ground Water Recharge Measures	78
	9.2	Proposed Ground Water Recharging Measures / Artificial Recharge of Ground Water	78
	9.3	Water Utilisation Chart	81
10.0	CONCLUSION		82
11.0	REFERENCES		84

FIGURES

FIGURE	PARTICULARS	PAGE
Fig.1	Monthly Mean Minimum & Maximum Temperature (°C)	18
Fig.2	Monthly Mean relative Humidity (%)	18
Fig.3	Month-wise Rainfall for 10 year period (1991-2021) at Santona Village	20
Fig.4	Annual distribution of rainfall at Santona Village	22
Fig.5	Monthly distribution of rainfall at Santona Village	22
Fig.6a	Plot of time Vs draw down for Santona dug well	28
Fig.6b	Plot of Rdd Vs time for Santona dug well	29
Fig.7a to 7x	Hydrographs regarding details of water levels and trend analysis for 10 years period	40-51
Fig. 8	Synoptic view of Piezometer	52
Fig.9 to Fig.22	Suitability of water with reference to the BIS standards vis-à-vis desirable limits and maximum permissible limits in respect of phreatic and deep aquifers	69-73
Fig.23	Settling pond used for water storage and groundwater recharge	78
Fig.24	Series of the silt retention tanks	79
Fig.25	Trenches and drainages	79
Fig.26	Flow Chart showing water Utilization	81

TABLES

TABLE	PARTICULARS	PAGE
Table 1	Mining Lease Boundary coordinates of the Project	5
Table 2	Particulars of Land use for the project area – Roof area of the buildings, Roads and Paved area, green area and open area	7
Table 3	Approved mining plan-level m RL at the end of Plan Period – Top and Bottom year wise, working depths	7
Table 4	Statistical Analysis of Sanguem Taluka	19
Table 5	Monthly Rainfall at Santona Village, Sanguem Taluka	19
Table 6	Monthly rainfall data recorded at Santona Village (2013-2022)	21
Table 7	Aquifer Performance Test for Santona dug well	27
Table 8	Details of open wells inventoried for water level in study area of Block IV – Kalay Mineral Block	30
Table 9	Details of water quality of wells in study area of Block IV – Kalay Mineral Block	32-35
Table 10	Details of bore wells in the 10 kms radius of Kalay mine	37
Table 11	Ground water trend analysis attempted for the 10 years period	39
Table 12	Ground water regime is also projected for after five years	53
Table 13	Ground Water Resources of Goa	64
Table 14	Established Network of existing wells in and around the Project for monitoring Water Levels	74
Table 15	Established Network of existing wells in and around the Project for monitoring Water Quality	74

ANNEXURES

TABLE	PARTICULARS
Annexure 1	Letter of Intent (LOI) for the Grant of Mining Lease for Block IV- Kalay Mineral Block bearing No. DMG/25/Auction Cell/L01-function/2023/2804 dated 13/01/2023 read with letter dated 13/03/2023.
Annexure 2	Lab results details of the water quality analysis carried out.

PLATES

PLATES	PARTICULARS
Plate 1	Location Plan
Plate 2	Lease boundary superimposed on Toposheet
Plate 3	Site Plan
Plate 4	Google Image
Plate 5	Geomorphology
Plate 6	Land Use Land Cover
Plate 7	Drainage Map
Plate 8	Geology of the project Area
Plate 9	Location plan showing groundwater monitoring locations
Plate 10	Map showing depth to water level of observation open wells around the project
Plate 11	Water table elevation of the study area around the project
Plate 12	Distribution of Electrical Conductivity
Plate 13	Distribution of Chlorides
Plate 14	Distribution of Nitrates

Plate 15	Distribution of Flouride

HYDROGEOLOGICAL AND IMPACT ASSESSMENT STUDIES IN AND AROUND 'BLOCK IV – KALAY MINERAL BLOCK' LOCATED AT SANTONA VILLAGE, SANGUEM TALUKA, SOUTH GOA DISTRICT, GOA.

1.0 INTRODUCTION

'Block IV – Kalay Mineral Block' located at Santona Village, Sanguem Taluka, South Goa District, Goa, over an area of **152.5073 Ha.** was granted by the Government of Goa for the grant of Mining Lease in accordance with the Mineral (Auction) Rules, 2015, to **Fomento Resources Private Limited.**

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 September 30, 2022 to commence the auction process for grant of mining lease for Block IV- Kalay Mineral Block, located in South Goa.

The e-auction process was conducted in accordance with the tender document for the said mineral block and Fomento Resources Private Limited was declared as the 'Preferred Bidder' under Rule (9)(iii) of Auction Rules. Subsequently, Letter of Intent (LOI) for the Grant of Mining Lease for Block IV- Kalay Mineral Block was issued to Fomento Resources Private Limited vide letter bearing No. DMG/25/Auction Cell/L0I-function/2023/2804 dated 13/01/2023 read with letter dated 13/03/2023 and. Copy of the same is enclosed as **Annexure -1**

1.1 Location Details

Block IV – Kalay Mineral Block is located in the Santona Village, Sanguem Taluka, South Goa District of Goa State. The block area falls under Survey of India Toposheet No. 48I/3. The entire block area is Non-Forest land having Government of Goa as well as Private ownership. Most of the Block area is broken up by mining pit, waste dumps and other mining allied activities, while about 15% remains untouched by mining activities.

The area is approachable from the Sanvordem-Dharbandora State Highway (SH-7) by village road to Ambeadoc village. The SH-7 is at an aerial distance of 1.27 km from the block boundary. The nearest railway station is Kalay railway station at an aerial distance of about 2.5 Kms. The nearest port is Marmugao port located at an aerial distance of about 40.5 km from the Block. Bhagwan Mahavir Wildlife Sanctuary is at a distance of 1.04 Km from the block boundary. Location map of the project core and buffer area is shown in **Plate-1**. Mining Lease Boundary superimposed on toposheet of 1:50,000 scale, is enclosed as Key Plan in **Plate-2,** Site Plan as **Plate-3** and Google Plan of the project area as **Plate-4.**

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

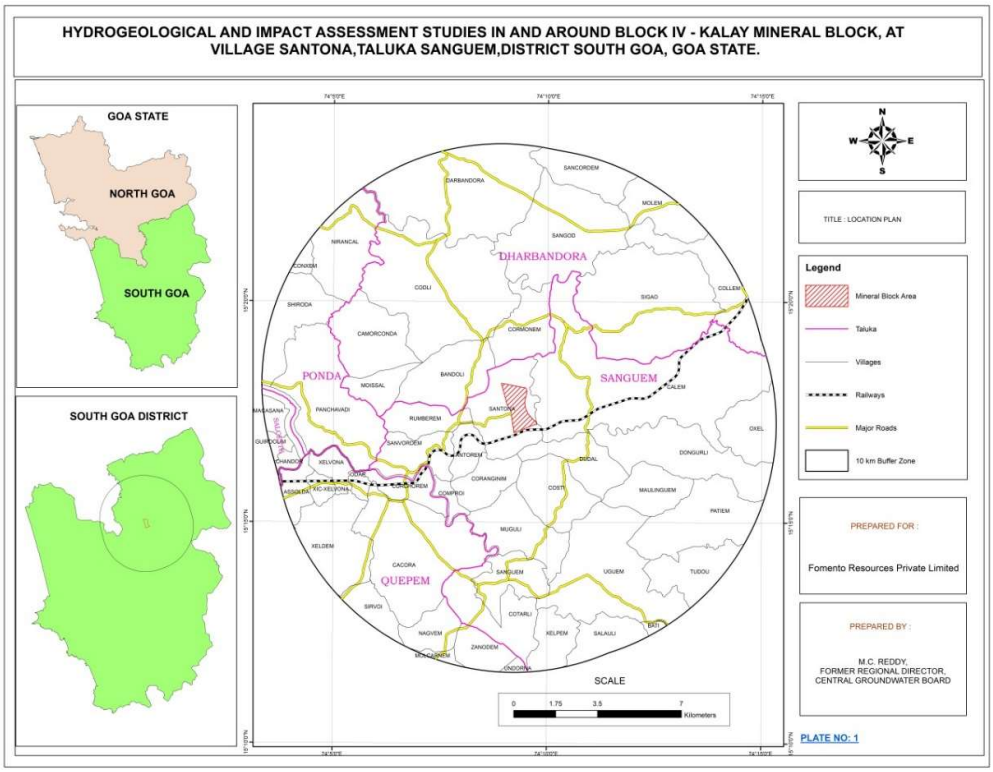


Plate-1 Location

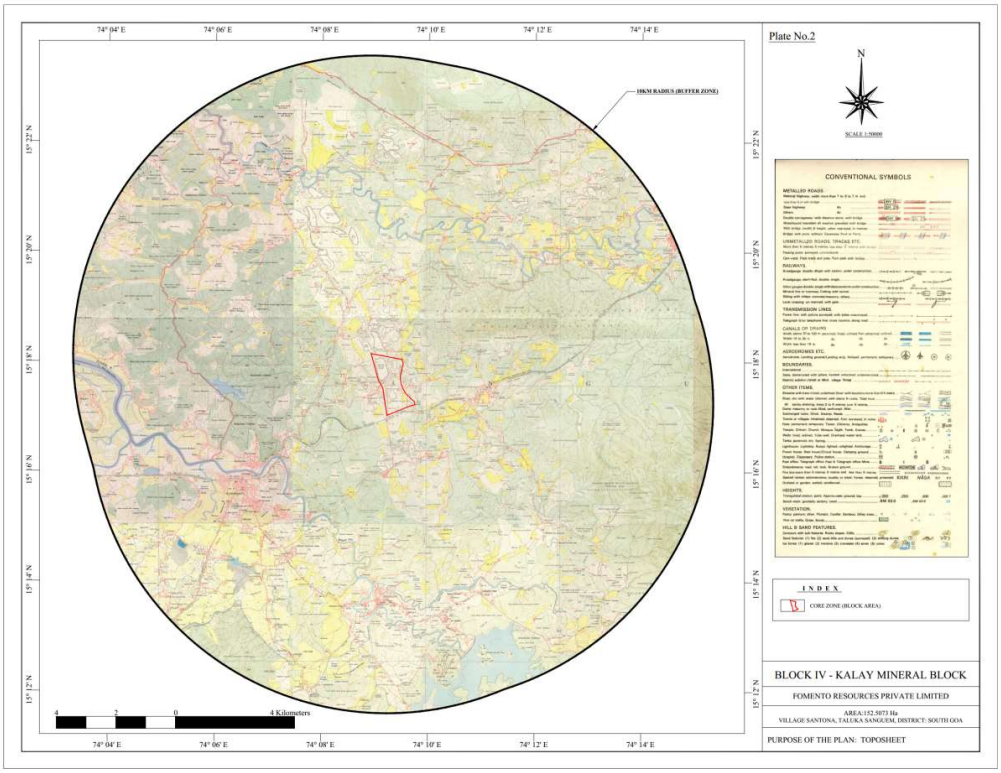


Plate-2 Lease boundary superimposed on Toposheet

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

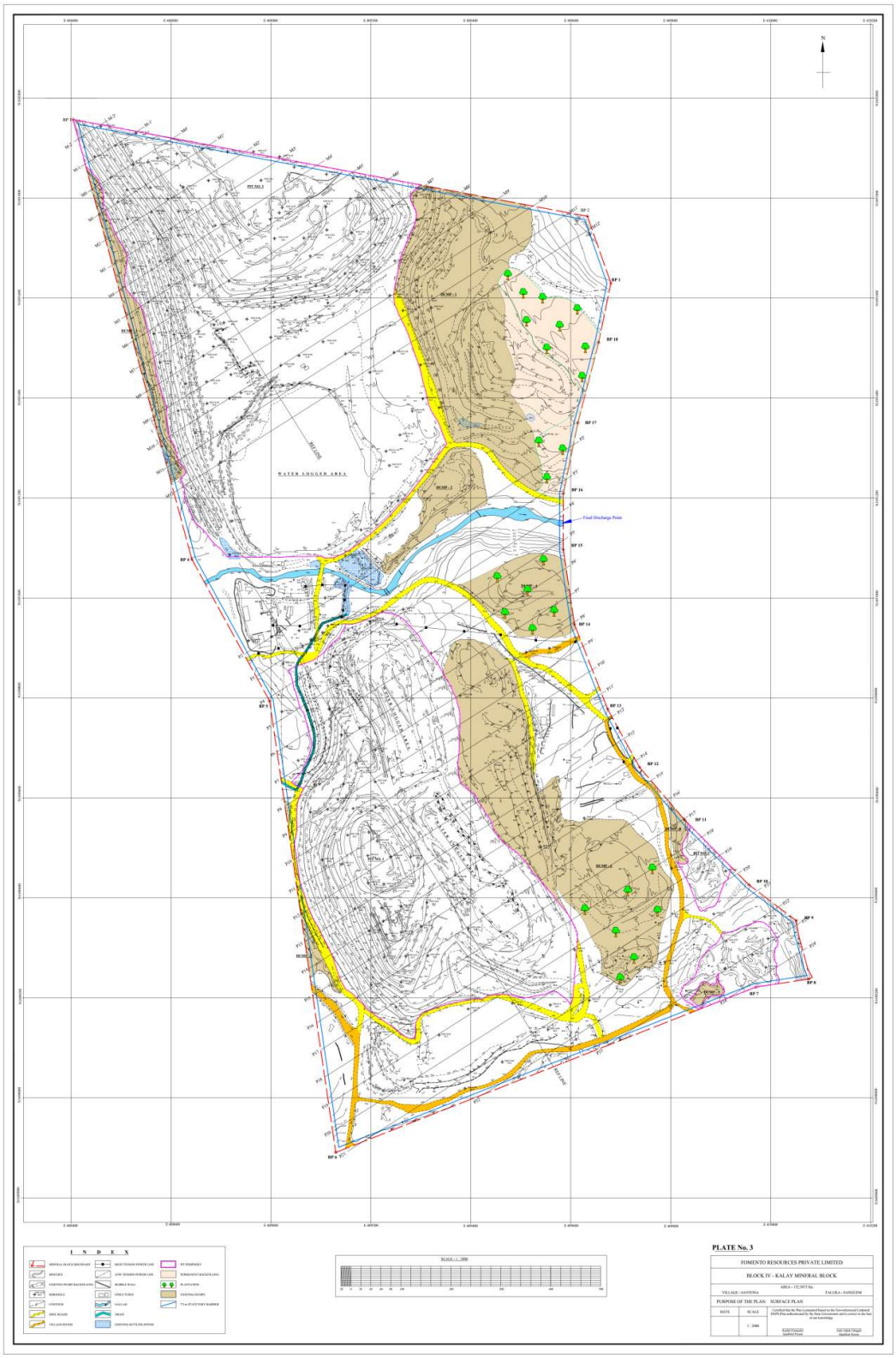


Plate-3 Site Plan

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in



Plate-4 Google Image

1.2 Mining Lease Boundary coordinates

DGPS Co-ordinates of the Mining Lease boundary pillars is shown below in **Table-1**.

Table-1. Mining Lease Boundary coordinates of the Project

Pillar No.	Pillar Latitude *(dd:mm:ss.ss)*	Pillar Longitude *(dd:mm:ss.ss)*	NORTHING	EASTING
BP 1	15° 17′ 58.2803″	74° 09′ 31.3905″	1691629.9007	409680.3863
BP 2	15° 18′ 02.6197″	74° 09′ 29.8008″	1691763.42390	409633.49239
BP 3	15° 18′ 08.7974″	74° 08′ 55.2583″	1691957.26383	408604.04653
BP 4	15° 17′ 40.1839″	74° 09′ 03.3467″	1691077.10693	408841.83170
BP 5	15° 17′ 30.9847″	74° 09′ 08.5955″	1690793.82945	408997.27328
BP 6	15° 17′ 01.6125″	74° 09′ 13.1548″	1689890.77419	409129.74092
BP 7	15° 17′ 12.4794″	74° 09′ 41.2969″	1690221.42929	409970.40182
BP 8	15° 17′ 13.0200″	74° 09′ 44.8333″	1690237.63266	410075.94036
BP 9	15° 17′ 16.8213″	74° 09′ 43.9885″	1690354.53420	410051.19470
BP 10	15° 17′ 19.1419″	74° 09′ 40.8072″	1690426.2050	409956.5872
BP 11	15° 17′ 23.3295″	74° 09′ 36.4971″	1690555.37540	409828.53230
BP 12	15° 17′ 26.7696″	74° 09′ 33.4331″	1690661.43320	409737.55770

BP 13	15° 17′ 30.5546″	74° 09′ 31.2826″	1690777.98410	409673.86810
BP 14	15° 17′ 36.0551″	74° 09′ 29.0348″	1690947.25690	409607.48350
BP 15	15° 17′ 40.9091″	74° 09′ 28.2686″	1691096.49390	409585.20930
BP 16	15° 17′ 44.5813″	74° 09′ 28.2599″	1691209.33190	409585.38810
BP 17	15° 17′ 49.1710″	74° 09′ 29.2119″	1691350.25070	409614.32540
BP 18	15° 17′ 54.4169″	74° 09′ 30.5870″	1691511.28230	409655.96260

1.3 Details of the Project

Block IV -Kalay Mineral Block, having an area of 152.5073 Ha. situated at Santona Village, Sanguem Taluka, South Goa District of Goa State was granted by the Government of Goa for the grant of Mining Lease in accordance with the Mineral (Auction) Rules, 2015, to Fomento Resources Private Limited.

This Mineral block of iron ore deposit is located on the Codli-Kirlapal-Costi deposit. The total length of Ore body is about 2000 mtrs. and width varies from 300 to 400 mtrs. The average thickness of the ore body is 20 to 30 mtrs. The Total Reserves & Resources are 16.731 million tonnes and yearly production proposed @ 0.75million tonnes per year.

1.4 Project Proponent Details

Project Proponent: Fomento Resources Pvt. Ltd. (Preferred Bidder)
Address: 102, 1st Floor, Kamat Metropolis-I,
Behind Caculo Mall,
St. Inez, Panaji,
North Goa, 403001.
Email: fomento@fomento.com

Date of grant of lease, expiry –

Fomento Resources Private Limited was declared as the 'Preferred Bidder' under Rule (9)(iii) of Auction Rules and a Letter of Intent (LOI) for Block IV- Kalay Mineral Block over an area of 152.5073 Ha. was issued to Fomento Resources Private Limited vide letter bearing No. DMG/25/Auction Cell/L0I-function/2023/2804 dated 13/01/2023 read with letter dated 13/03/2023.

The Mining Lease will be valid for a period of 50 years from the date of registration of Mining Lease Deed.

Table-2 Particulars of Land use for the project area – Roof area of the buildings, Roads and Paved area, green area and open area

Particulars	Present Land use (Area in Ha.)
Area under mining	74.3004
Pit Reclaimed	2.0843
Pit Reclaimed & Rehabilitated	3.1150
Overburden/Waste Dumping	23.0618
Dump Rehabilitated	5.5992
Infrastructure	4.8326
Road	4.9058
Drains	0.1767
Nalla	0.8255
Protective measures	6.3878
Other Mining Utilities	3.3491
Unused	23.8691
Total	**152.5073**

Table-3: Year wise working depths, as per Approved Mining Plan

Sr. No	Year	Pit ID	Top Bench (m RL)	Bottom Bench (m RL)
1	1st	Pit-1	65	53
2		Pit-3	77	35
3	2nd	Pit-1	59	35
4		Pit-3	41	17
5	3rd	Pit-1	41	29
6		Pit-3	89	11
7	4th	Pit-1	35	23
8		Pit-3	41	-1
9	5th	Pit-1	29	17
10		Pit-3	11	-7

Proposed mining: The proposed production capacity of the project is 0.75 MTPA of Iron Ore. Mode of mining will be opencast mechanized, engaging Heavy earth moving machinery i.e. a combination of Excavator, loaders, Ripper Dozer and Trucks/ dumpers. The project will not engage drilling and blasting methods in the Mineral Block. ROM will be directly transported out of the mineral block by road. However, if the market requirement demands, ROM screening and sizing will be carried out within the block area.

1.5 Mining Method

Opencast Mining Method will be practiced using Heavy Earth Moving Machinery such as Ripper & dozers, excavators, wheel Loaders, dumpers, etc. Hard material will be broken using Ripper Dozer. Excavators with bucket capacity of 1.2 to 2.5

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

cu.m. will be deployed in the mines for digging/ excavation. Tippers and dumpers will be engaged for transporting the excavated material within the mine. Wheel loaders with bucket capacity of 1.2 to 2.46 cum. will be used for loading/dozing and other miscellaneous works. Hydraulic rock breakers will be used for secondary breaking of hard material. Water tankers with capacities of 8000-10,000 liters will be used for dust suppression on the haul roads within the mining lease. Mine will be worked under the supervision of technically qualified professionals like Mines Manager, Asst. Mines Managers, Mining Engineers, etc., having relevant qualification and vast experience in their respective fields.

In general, mining and mine development related activities are being carried out since early 1950s in the State of Goa. Natural resources in the area need to be continuously monitored for the dynamic changes in the water and land environment caused by mining activities in Goa.

1.6 Layout of Mine Workings

Open cast mining will be carried out by forming systemetic benches of 6m height and 8m width in waste rock and ore body. The haul road gradient will be maintained at 1:16. Overall pit slope will be maintained at 30 degrees. The width of the haulage road will be maintained as required under statutes. Safety bunds will be maintained along the main haulage roads.

In order to maintain sustainable mining environment, lessee requires to effectively implement dust suppression and green area development. The mine pit area will act as storage pits to receive rainwater which comes from direct precipitation and also contribution from surface runoff during monsoon. Rainwater conservation will be given highest priority. An application has been already submitted to Water Resource Department (WRD), South Goa for registration of Mining Pit and registration certificate obtained from WRD south Goa. Water requirement will be 300m^3 / day, which will be met from the harvested rainwater in the mine lease area and also from nearby surface water bodies through local contractors. The proponent does not propose to have any ground water structure within the Mining Lease for the drawl of ground water. In order to study the hydrogeological changes, the following scope and objectives are set in.

2.0 OBJECTIVE OF THE STUDY

The objective of the study is to fulfill the requirements of conditions stipulated in Standard Terms of Reference for conducting Environment Impact Assessment Study for Non-Coal mining Projects and Information to be included in EIA/ EMP Report. Subsequent to site visit and after several discussions with the management, review of pertinent reports and maps of the mine area, various ground water and surface water sources, the following objectives were summed up for detailed study to fulfill the stipulated requirements.

i. Based on actual monitored data, it should be established whether working will intersect ground water. Necessary data and documentation in this regard may be provided.
ii. In case the working will intersect ground water table, a detailed hydrogeological study should be undertaken and report furnished. The report inter-alia shall include aquifers present and impact of mining activities on these aquifers.
iii. Information on site elevation, working depth and ground water table should be provided both in AMSL and bgl (below ground level). A schematic diagram may also be provided for the same.
iv. The water requirements of the project, its availability and source should be provided. A detailed water balance should also be provided. Fresh water requirement for the Project should be indicated.
v. 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.
vi. 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.

2.1 Scope of the study

The studies are concentrated within the study area comprising of the mining lease (Core area) and an area of 10 km radius from the mine lease boundary (Buffer area) on the following aspects:

i. Collection, preparation and presentation of the historical data on ground water available from different agencies.
ii. Monitoring of ground water levels and quality from select wells in Core and Buffer area.
iii. Conducting aquifer test to evaluate the aquifer conditions in the area.
iv. Preparation of ground water level and quality regime maps for the area – depth to water level (with reference to GL), water table elevation (with reference to AMSL), water quality with reference to Bureau of Indian Standards (BIS).
v. Study on change of ground water level and quality over space

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

vi. Impact assessment of mining activities on ground water quantity and quality.
vii. Plan for Augmentation of Recharge to Ground Water through various conservation measures. Implementing Rainwater Harvesting through Rainfall Run-off management and Roof Top Rainwater Harvesting.
viii. Preparation of water budget for the project

2.2 Methodology

Historical real time data and pertinent reports on groundwater available with Central and state agencies connected with Ground Water development and management were collected and discussions held with the representatives of the Lessee, forms the base for the study. To prepare a mitigation plan it becomes essential to evaluate the exact hydro-geological conditions and aquifer parameters. To achieve the aims, geology of the area and surface conditions has to be interpreted based on the exploratory data and geological studies made by different agencies.

Intensive well inventory represented by phreatic aquifers of the area have to be undertaken to measure the status of the water level and impact of ground water development in the study area. The water samples are to be collected and analyzed to establish the water quality regime. The seasonal fluctuation of water level in response to groundwater recharge due to rainfall have to be estimated based on local information, field observations and secondary data.

To evaluate the aquifer characteristics, aquifer performance test on the existing dug well in the project study area is to be conducted at constant pumping rate. The data will be analyzed using standard analytical technique suited to field conditions of testing site.

The groundwater resources of the study area estimated based on the norms of the Ground Water Estimation Committee, Govt. of Goa and Govt. of India, will be the guiding factor for development of resources. The ground water flow regime estimated using network and Piezometer data, will be an indicator for the impact of ground water development in the area, vis-à-vis to decipher ”SAFE“, “SEMI CRITICAL“, “CRITICAL“, “OVER-EXPLOITED” and “WATER LOGGED” based on stage of development and long-term water level trend. The detailed explanation of the above categorization and remedial measures are as below:

Status (state wise) of ground water development of the area as defined by the Central Ground Water Authority.

a. Safe (Stage of development < 70 %)

i. Areas where stage of ground water development is less than 70 % and there is no significant long-term decline of pre-monsoon or post-monsoon water level trend. Such areas have potential for ground water development.

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

ii. To be brought under the purview if quantity of abstraction exceeds 10000 m^3/ day in hard rock areas and 2000 m^3/ day in alluvial areas. RWH (Rain Water Harvesting) to be adopted.

b. Semi Critical (Stage of development 70 - 90 %)

Areas where stage of ground water development is 70 – 90 % and water table during either pre or post-monsoon shows a significant long term declining water level trend. Caution may be exercised in future ground water development in such areas and if necessary, the density of network monitoring in such areas are to be increased to have better data based on the long-term behavior of water table.

i. Efficient utilization of recycle and reuse of water should be mandatory; Water audit to be adopted.
ii. Withdrawal may be permitted subject to undertaking of recharge measures at least 50 % recharge compared to withdrawal quantity may be made mandatory.

c. Critical (Stage of development 90 - 100 %)

i. Areas where stage of ground water development is more than 90 % and long-term water level trend during pre-monsoon or post-monsoon shows a falling trend.
ii. Areas where stage of ground water development is less than or equal to 100% and water table trend during pre-monsoon or post-monsoon shows a significant long term falling trend. There is very marginal scope for future ground water development in critical areas.

Following measures are to be adopted in these areas:

- ❖ Density of observation wells for monitoring may be increased
- ❖ Water conservation measures may be adopted
- ❖ Micro level ground water studies may be carried out to reassess ground water resources more precisely.

iii. Efficient utilization of recycle and reuse of water should be mandatory Water audit to be adopted.

Withdrawal may be permitted subject to quantum of recharge should be equal or more than the proposed withdrawal.

d. Over-Exploited (Stage of development 100 – 200 % & 200 – 300 %)

i. Areas where stage of ground water development is more than 100 % and long term water table trend during pre-monsoon or post-monsoon show a significant declining trend and categorized as over exploited areas. There is no scope for future ground water development in over exploited areas indicates alarming situations. All three measures as suggested in case of critical areas may be adopted in over exploited areas also.
ii. Efficient utilization of recycle and reuse of water should be mandatory. Water audit to be adopted, withdrawal may be permitted up to 60% of proposed recharge.

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

e. Water Logged areas

Where water levels are shallow i.e., 2 m. from ground level in post – monsoon period and 3 m. from ground level in pre – monsoon period resulting in salinization and fertile land is lost. In such cases extraction of ground water is encouraged by recommending change of cropping pattern so that water level will be lowered and prevent salinization of fertile land. This phenomenon is commonly seen near canal command areas.

Surface run-off management in respect of the monsoon period forms the source water for augmentation of recharge to ground water body and various conservation structures are to be designed for the project area taking into consideration the rainfall and site conditions.

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

3.0 GEOMORPHOLOGY, PHYSIOGRAPHY & DRAINAGE

3.1 Geomorphology

Geomorphologically, the state is divided into four morphological units namely;

1. The coastal plains with dominant marine land forms on the west,
2. Vast etch plain,
3. Low dissected denudational hills with valleys
4. Deeply dissected high Western Ghats with denudational hills rising to a maximum of 832m amsl and occurring all along the eastern part of the state.

The 10km buffer zone study area comprises of the stretched low lying plains, hills and valleys along with the deeply dissecting high Western Ghats with denudational hills. Many first order streams originate from the hill top downwards forming a dendritic drainage pattern. Geomorphology of the area is shown in **Plate-5.**

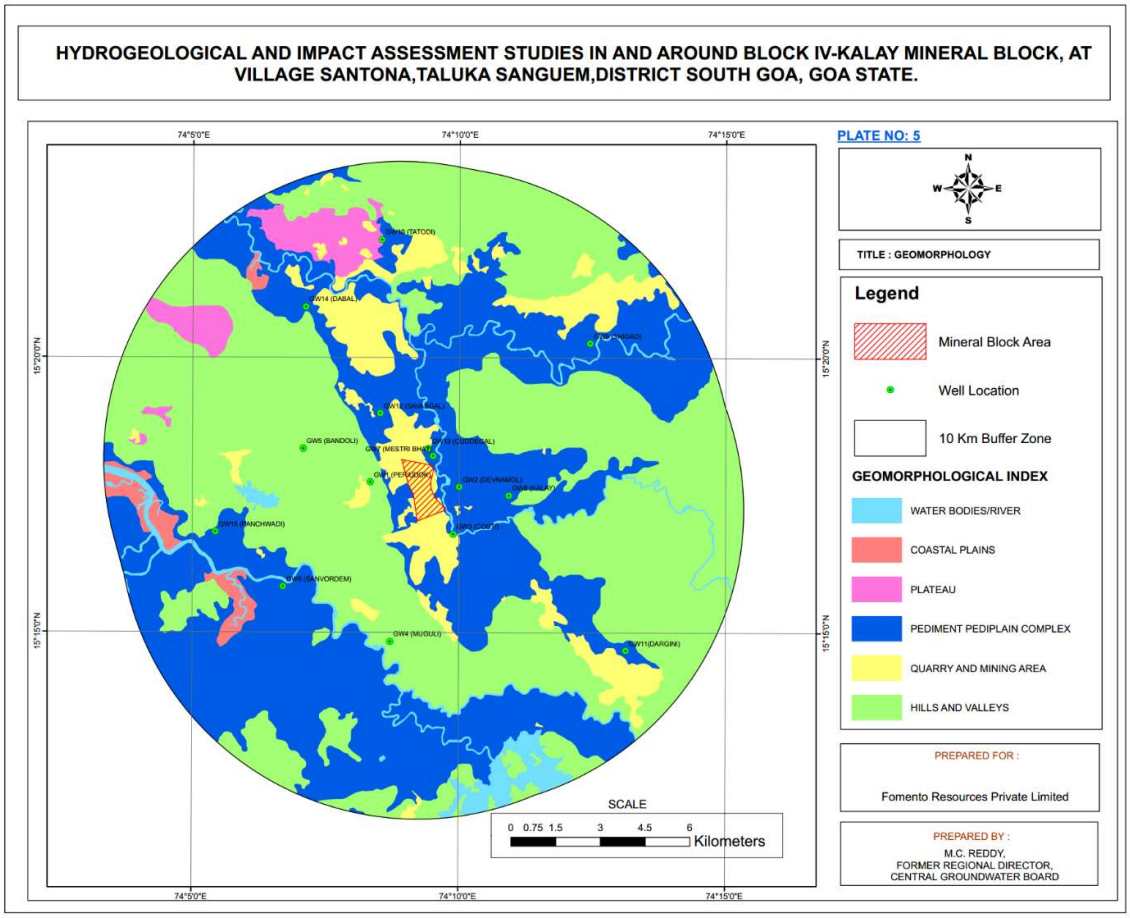


Plate-5 Geomorphology

3.2 Land Use Land Cover (LULC)

Land Use Land Cover of the core and buffer area is presented in **Plate-6.** Core area is essentially falling under the mine broken-up area and mine pit. A seasonal drainage passes across from west to east of the project boundary. The remaining land constitutes of Barren/grassland, vegetation, etc.

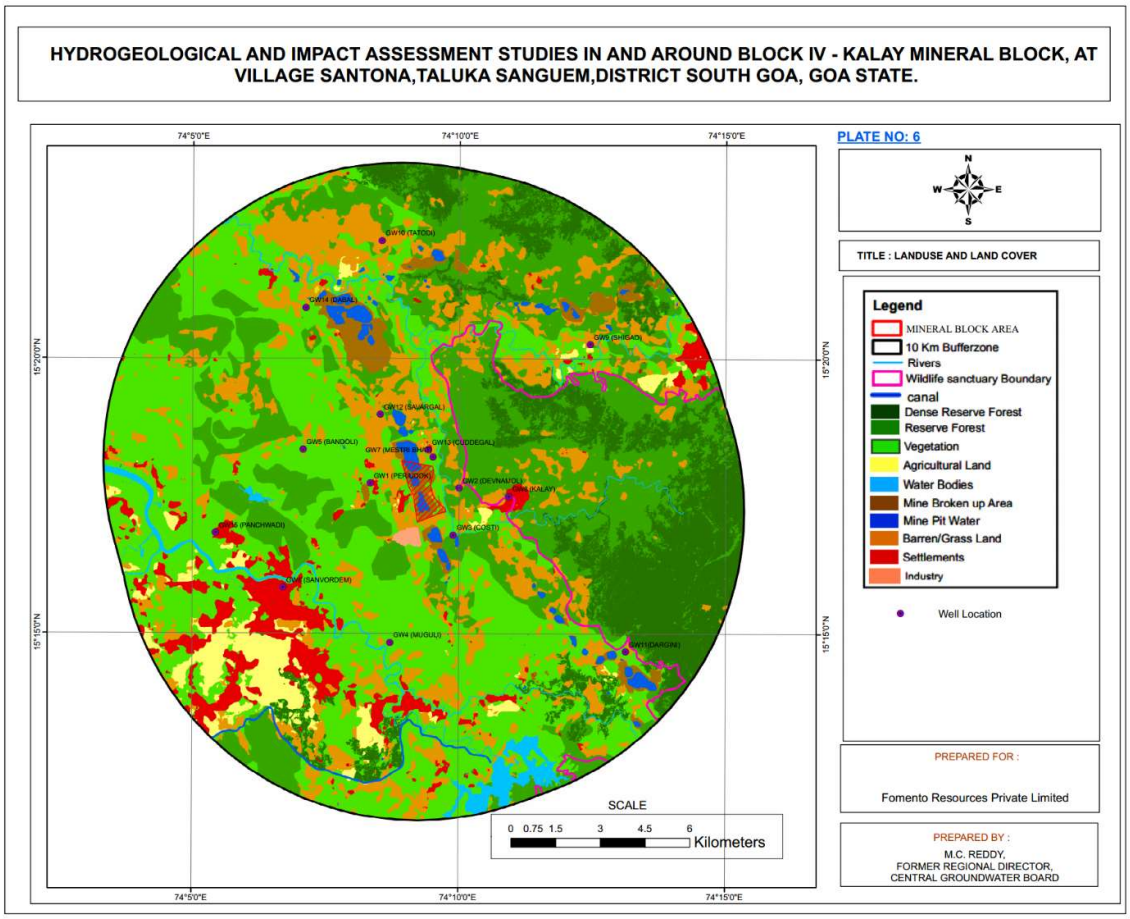


Plate-6 Land Use Land Cover

3.3 Physiography

The topography of the area is undulating & hilly with gentle gradient of 10 to 20 degrees. The highest level is 102 m MSL towards North East of lease on Dump no. 1 and lowest level is -0.5 m MSL towards North of lease in pit no.3. There is a seasonal nalla flowing across the block from west to east and joins river Kalay flowing towards the eastern side of the block boundary.

3.4 Drainage

Regionally, dendritic drainage is observed in the 10km buffer with many first order streams originating from the hill top downwards flowing into major rivers. The

study area comprises of the rivers such as Uguem River, Sanguem River and Khushavati river flowing into Zuari River and Dhudsagar River, Kalay River flowing into the Mahadayi River. The main drainage for this mineral block is the Kalay River flowing from South to North towards the eastern side of the block. The catchment area of Kalay River is all high ground towards eastern of the block to a distance of 5 to 6 kms from the Kalay River. Also a second order seasonal nalla flows from the north west of block towards due south and passes across the block from west to east, ultimately joining to the Kalay River in the eastern side of the block. The catchment area for the seasonal nalla is all high ground towards west of the lease to a distance of 300 to 600 meters from the nalla. Drainage of the study area is shown in **Plate-7.**

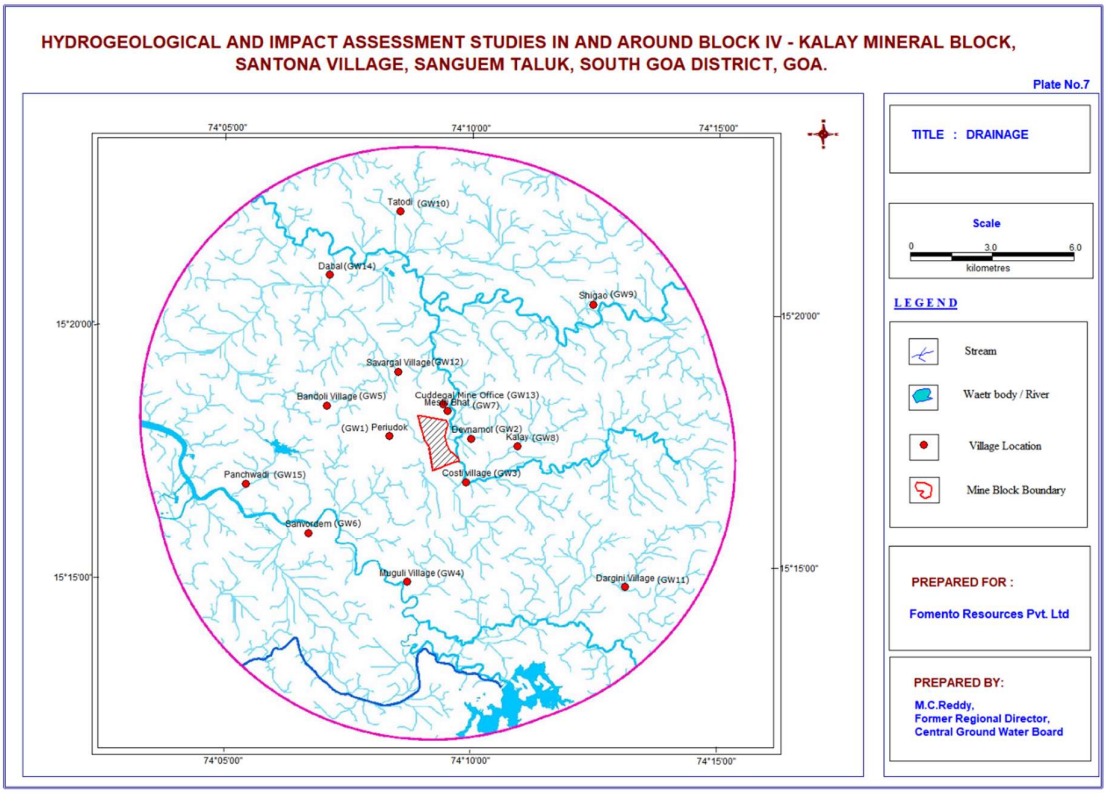


Plate-7 Drainage

Distance & Direction of River/ Stream/Nalla within the 10km radius

Name of the River / Stream / Nala	Distance from Project Site (Km)	Direction from Project Site
Uguem River	5.6	South
Sanguem River	5.71	South
Khushavati river	8.63	West
Zuari River	3.8	South west
Dhudsagar River	4.0	North
Kalay River	0.005	East

Mahadayi River	4.3	North

Distance & Direction of Reservoir within the 10km radius

Name of the Reservoir	**Distance from Project Site (Km)**	**Direction from Project Site**
Salaulim	7.83	South
Moisal	4.23	West

3.5 Soil Characteristics

Soils of the district can be classified into 4 types namely (i) Laterite soil (ii) Saline soil and (iii) Marshy soil and (iv) Alluvial soil.
The soil types observed within the buffer area are as follows:

1. Lateritic soil is the major soil type in the district. It is highly porous & permeable, slightly acidic with low pH values, low in organic matter, Calcium and Phosphorus.
2. Saline soil in the district occurs in the flood plains of Quepem taluka.
3. Marshy area occurs to a large extent in Salcette Taluka and towards western part of Cancona Taluka.
4. Alluvial soil occurs as a thin strip along the coastal line towards the western part of Salcette Taluka and also a limited exposure in Cancona Taluka.

The dominant soil type observed in the mining lease is of lateritic type.

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

4.0 HYDROMETEOROLOGY

Due to maritime influence, the diurnal range of temperature during the day is not large. The diurnal range is the least being 4 to 6° C during monsoon season and increases to the maximum of 10 to 20°C during December & January. May is the hottest month where the mean daily temperature increases to 30°C. January is the coolest with mean daily temperature of about 23°C. It is noted that the day temperature is the lowest in monsoon months of July and August and not in the cool winter months of December and January. The temperature is highest (around 33°C) in pre – monsoon months of April & May and again in post monsoon months of November & January. Due to proximity to the Arabian Sea, humidity throughout the year is more than 60% with range from 80 to 90% during monsoon period. As a result of orographic influence, rainfall increases towards the Western Ghat, with average annual rainfall 2875 mm (in Salcete taluk) & 2466 mm (Marmugao taluk) respectively to 3825 mm (in Sanguem taluk). Over 90% of annual rainfall occurs during monsoon months of June to September. About 32% of the annual rainfall is received during July.

4.1 Climate & Temperature

i. Climate

The climate of the area is tropical and is largely influenced by the Arabian Sea. The area experiences three seasons viz. Summer (March to May), Monsoon season (June to October) and Winter (November to February). Average rainfall of about 4000mm is observed during the monsoon season in the area. The temperature varies from a minimum of about 16°C during Winter season to a maximum of 36°C during Summer season. Relative humidity has been observed between 60% to 100% during the year. Average wind velocity has been observed around 0.3 Km/hr with the predominant wind direction being in the SW-NE.

ii. Temperature

The study area experiences hot summer and mild winter. November to February is generally the pleasant climate and in December the mean temperature is lowest. The mean maximum temperature is around 33.2°C during May. The average monthly low temperature is around 28.2°C during May, which decreases to around 24.8°C during August. Graph showing monthly minimum and maximum temperature is given in **Fig.1.** Statistical analysis is shown in **Table-4.**

4.2 Relative Humidity

Relative Humidity is around 90% during rainy season. It ranges from 60% during January and December to attain maximum 93% during July. Its graphical representation is shown in **Fig.2.**

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

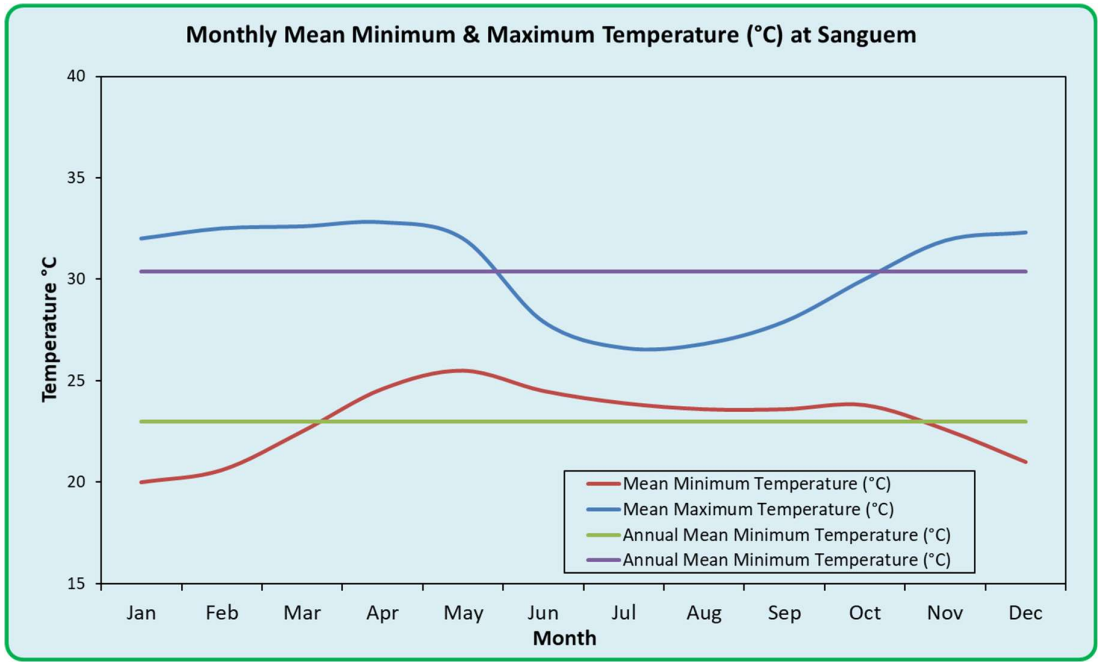


Fig.1

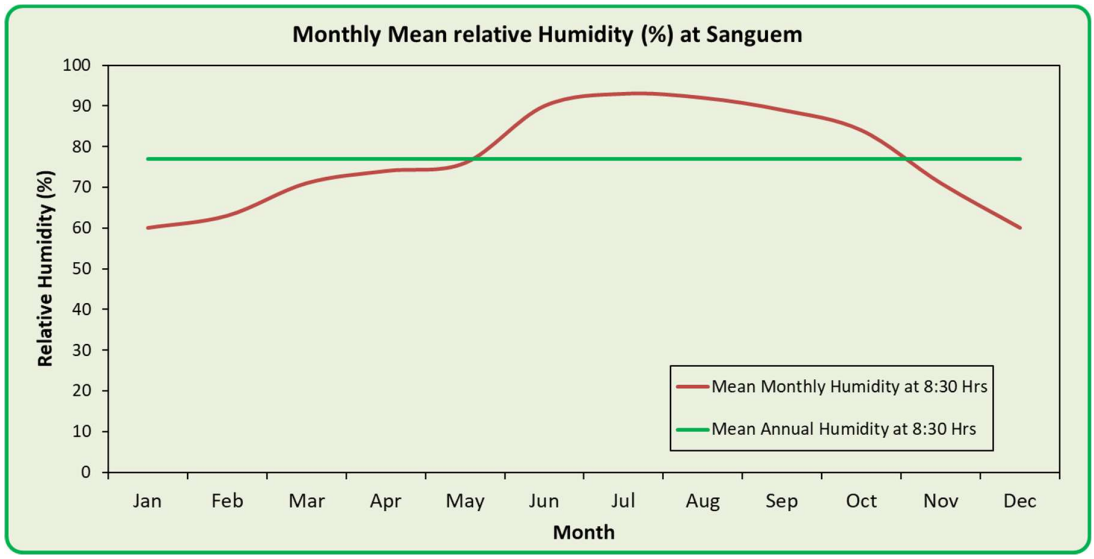


Fig.2

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

Table-4 Statistical Analysis of Sanguem Taluka

	January	February	March	April	May	June	July	August	September	October	November	December
Avg. Temperature °C (°F)	25.5 °C	26 °C	26.9 °C	28 °C	28.2 °C	25.8 °C	24.9 °C	24.8 °C	25.3 °C	26.4 °C	26.7 °C	26 °C
Min. Temperature °C (°F)	20 °C	20.6 °C	22.5 °C	24.6 °C	25.5 °C	24.5 °C	23.9 °C	23.6 °C	23.6 °C	23.8 °C	22.6 °C	21 °C
Max. Temperature °C (°F)	32 °C	32.5 °C	32.6 °C	32.8 °C	32 °C	27.9 °C	26.6 °C	26.8 °C	27.9 °C	30 °C	31.9 °C	32.3 °C
Precipitation / Rainfall mm (in)	2	1	17	27	104	680	1006	692	322	214	48	10
Humidity(%)	60%	63%	71%	74%	76%	90%	93%	92%	89%	84%	71%	60%
Rainy days (d)	0	0	2	5	9	20	22	22	19	14	5	1
avg. Sun hours (hours)	9.9	10	9.6	8.6	7.3	3.6	2.8	3.2	4.7	7.3	9.5	9.8

Source: https://en.climate-data.org/asia/india/goa/sanguem-796290/

4.3 Actual Rainfall Analysis

Month-wise rainfall data collected at Santona Village, Sanguem Taluka during 10 year period (1991-2021) is compiled and presented below in **Table 5** and its graphical representation is shown as **Fig. 3** (Source: https://https://en.climate-data.org/asia/india/goa/sanguem-796290/).

4.3.1 Behavior of Monthly rainfall:

In general, the area experiences rainfall during the months May to October only and remaining months it is almost nil. Normal Monthly rainy days ranges from Almost 0 days during January and February to 22 days during July and August. Negligible amount of rainfall occurs during January, February, March, April, November and December months. Bulk i.e., 96% of the annual rainfall occurs during monsoon months i.e from June to September months only. The monthly normal rainfall for this period is presented in **Table-5** and the same is shown in Fig. 3. Monthly Rainfall data of Kalay Block is presented in **Table-6**

Table-5: Monthly Rainfall at Santona Village, Sanguem Taluka

Normal Rainfall (mm) & Normal Rainy days at Sanguem Taluka, South Goa District, Goa (1991-2021)		
Month	**Rainfall (mm)**	**Rainy days (d)**
January	2	0
February	1	0

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

March	17	2
April	27	5
May	104	9
June	680	20
July	1006	22
August	692	22
September	322	19
October	214	14
November	48	5
December	10	1
Total	**3123**	**119**

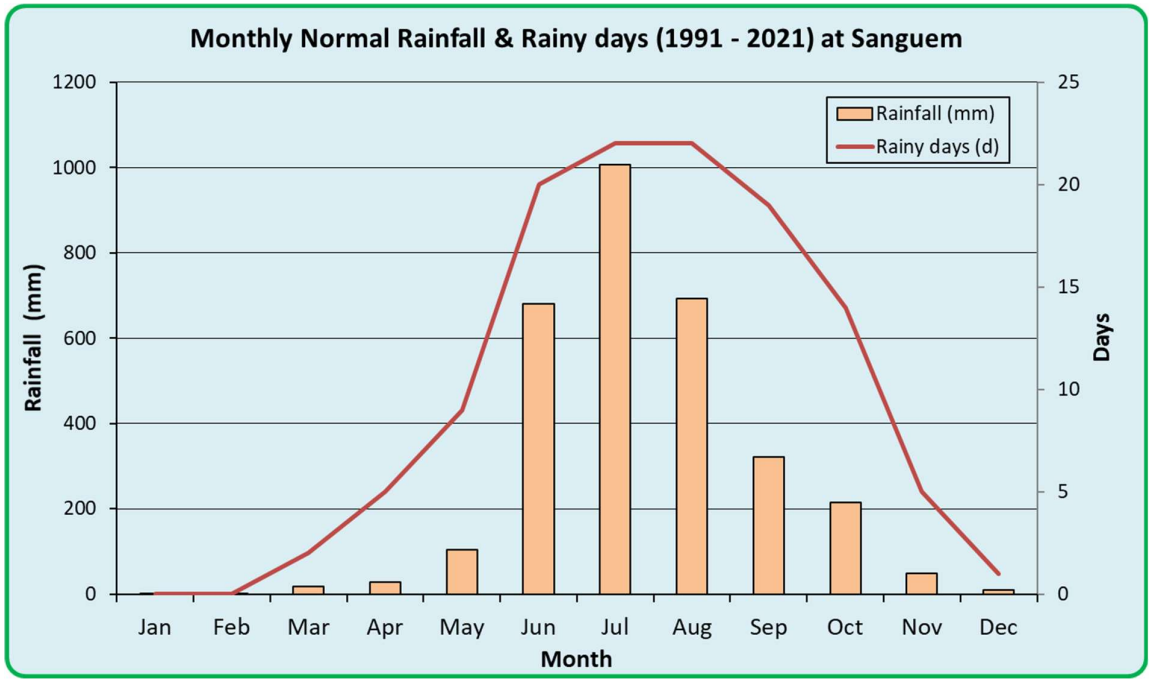


Fig 3: Month-wise Rainfall for 30 year period (1991-2021) at Sanguem Taluka

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

Table-6 Monthly rainfall data recorded at Santona Village (2013-2022)

Monthly rainfall data for the last 10 years at Block IV – Kalay Mineral Block											
Month	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**Average**
January	0	0	4.8	0	0	0	0	0	27.6	0	3.24
February	0	0	0	0	0	0	0	0	16.2	0	1.62
March	0	0	29	0	0	0	0	0	0	0	2.9
April	0	0	1.4	0	1.4	2.8	1.2	9.2	46.4	84	14.64
May	70.4	80.4	55.1	53.3	97.6	214.6	0	83.4	335.1	110	109.99
June	1255.4	650.3	796.2	944.4	934.22	900.1	790	819.6	1046.9	595.2	873.232
July	2129.03	1584	967.2	886.8	1035.94	1169	1808.8	1142.6	1412.82	1600	1373.619
August	723	1302.1	645.5	644.8	596	746	1702.4	1507.8	398	451	871.66
September	421.2	498.66	304.9	455	382.8	122	823	808.32	485.1	403.2	470.418
October	240.2	206.7	139.2	70.2	153.9	96.8	610.8	229	253.3	256	225.61
November	33.2	0	40.4	0	0.4	0	30.8	0	226.2	8.4	33.94
December	0	49.4	0	0	13	0	0	28.2	33.4	9.2	13.32
Total	**4872.43**	**4371.56**	**2983.7**	**3054.5**	**3215.26**	**3251.3**	**5767**	**4628.12**	**4281.02**	**3517**	**3994.189**

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects. mcreddycgwb@yahoo.co.in

4.3.2 Behavior of Annual rainfall

The annual rainfall is studied for the period 2013 to 2022 at Block IV –Kalay Mineral Block Iron Ore Mine, Santona Village. It ranges from 2983mm during 2015 to 5767 mm during 2019. The average annual rainfall for this period works out to be 3994 mm. The distribution of annual rainfall is presented in the **Fig 4** and monthly rainfall is presented in **Fig 5.**

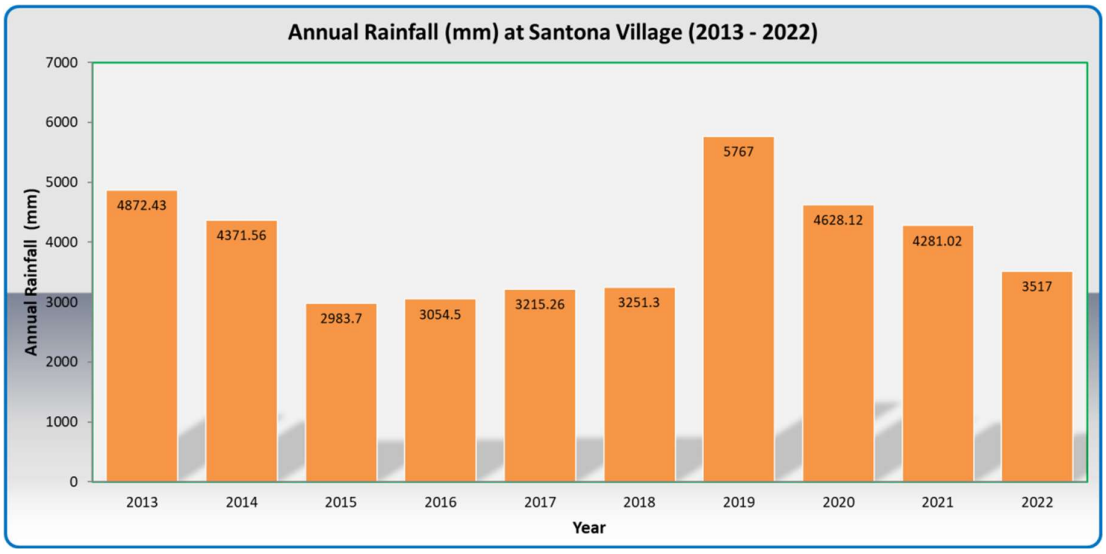


Fig.4 : Annual distribution of rainfall at Santona Village

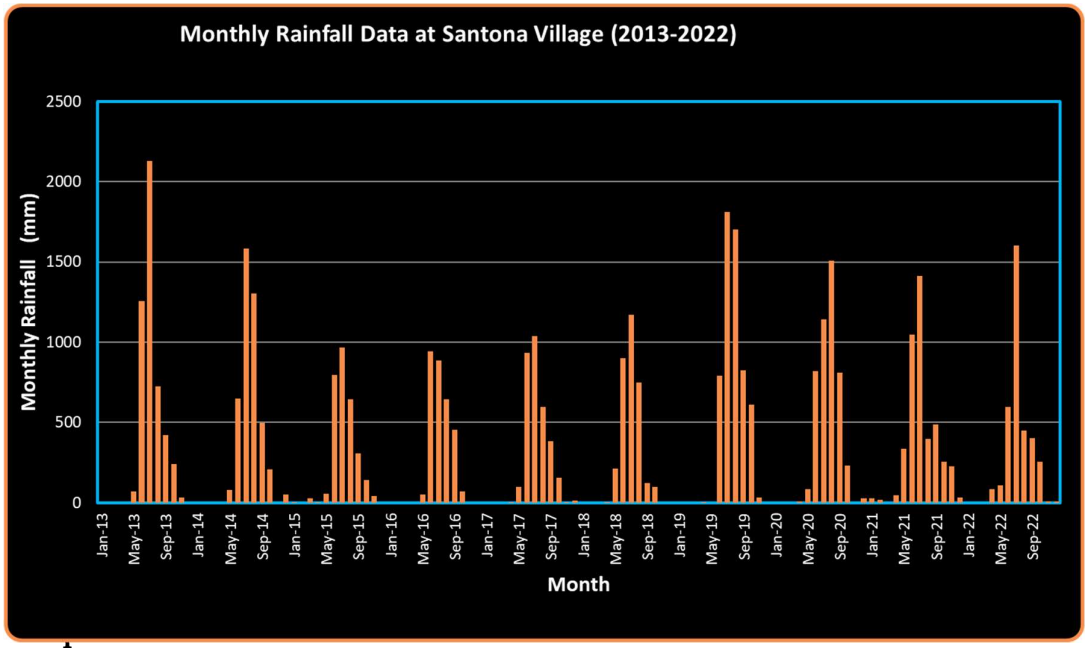


Fig.5: Monthly distribution of rainfall at Santona Village

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

5.0 GROUND WATER CONDITIONS & QUALITY

5.1 Brief Geology of the Area

5.1.1 Regional Geology of the Area:

Goa is dominantly covered by rocks of the Goa Group of rocks belonging to Dharwar Super Group of the Archaean to Proterozoic age except for a narrow strip along the northeastern corner occupied by the Deccan Trap of Upper Cretaceous to Lower Eocene age. The Iron ore formations of Goa belong to Dharwar super group of the Archaean-Proterozoic age. The Goa Group consists of assemblage of rocks and is divided into four Formations that in the order of superposition are Barcem Formation, Sanvordem Formation, Bicholim Formation and Vageri Formation. Barcem Formation includes essentially metavolcanic rocks with minor meta-sedimentaries. Geology of the area is shown in **Plate-8.**

All the formations are very important and from commercial point of view, it contains all the iron and manganese ore deposits of Goa, which is the backbone of Goa's economy. The Goa Group of rocks is disposed in a NW-SE direction in the northern, central, eastern and southern parts of Goa and in E-W direction in the South Goa. The rocks have been subjected to at least three generations of folding. The intensity of different generations of folding and degree of expression of their effect are however observed to vary widely from place to place. The stratigraphic succession of the rocks of Goa region is given below:

Recent to sub recent	Sea Sand and Laterite
Deccan Trap	Basalts
Basic Intrusive	Dolerite, Gabbro
Acid Intrusive	Pegmatite, vein quartz, Porphyritic Granite, Hornblende Granite, Felspathic Gneiss, Granite Gneiss
Vageri Formation	Meta-basalt, Meta-greywacke
Bicholim Formation	Banded Ferruginous Quartzite, Manganiferous Chert Breccia with Pink Ferruginous Phyllite, Limestone, Pink Ferruginous Phyllite, Qzt-Chlorite-Amphibole Schist
Sanvordem Formation	Argillite, Quartzite, Tilloid, Metagreywacke
Barcem Formation	Metagabbro, Peridotite, Talc-Chlorite Schist, Variegate Phyllite, Quartz-Chlorite Schist, Quartzite, Quartz-Sericite Schist, Red Phyllite Quartz Porphyry, Massive, Schistose & Vesicular Metabasalt

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

5.1.2 Local Geology of the Mineral Block

The main iron ore deposit where this block is located is called as Codli-Kirlapal-Costi deposit. The general succession of the strata from top to bottom is as follows.

- Laterite (about 15 – 20 m)
- Altered Dyke (Intrusive)
- Ferruginous/Phyllitic/Limonitic Clay (10 – 15 m)
- Iron Ore body (20 - 30 m)
- Siliceous Manganiferous Clay & Weathered BHQ (forms foot wall)

Most of the total lease area is broken up by mining and allied activities. The remaining area is mostly covered with a capping of laterite. Based on the exposed rocks formation and the available borehole data, the ore body and the associated rocks are folded.

Structurally ore body and associated formations appears to be subjected to folding. The ore body has a general strike direction as N 10°~20° W to S 10°~20° E and folded into anticlines and synclines with both easterly and westerly dips and amount of dip varying from 10°~40°. The synclinal portions are preserved whereas anticlinal portions are eroded. The ore body is plunging towards south with an average angle of 5° to 10°. The total length of Ore body is about 2000 m. and width varies from of 300 to 400 m. The average thickness of the ore body is 20 to 30 m. Due to igneous activity, a number of weathered and altered sills & dykes exist in the form of clays along and across the ore body.

The Iron ore deposit is a bedded stratiform & tabular deposit of regular habit. The Iron ore body tends to be lumpy at surface and powdery at depth. As per the Geological Report obtained from Directorate of mines & Geology, Goa, the Iron ore is hard to powdery in nature having a ratio of 73% Fines and 27% Lumps. However, the ratio may vary between 75 to 70% Fines to 25 to 30% Lumps.

Most of the lease area is covered by laterite. The laterite at places appears to be very hard and compact. some places, the laterite is having hard lumpy ore pieces. The chemical composition of the laterite ranges from 20 to 38% Fe and alumina ranging from 2 to 30% Al_2O_3.

Ferruginous/Phyllitic Clay is exposed at very small place. It is very fined grained and soft. The chemical composition of clay ranges from Fe 28 to 30% and Al_2O_3 from 10 to 25%.

The Iron ore body is generally found below the laterite capping. The total thickness of the ore body is about 20 to 30 meters. Out of which the top portion of the ore body is lateritized and the grade is +45% Fe. The lower part of the ore body is softer and has a grade of +45% Fe. As per the Geological Report provided by the Directorate of Mines & Geology, Goa the average grade of in-situ ROM is about

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

56.5% Fe. Considering the Geological structure of the Ore body and the intercalations/intrusions of the clays within the ore body and the dilution factor prevalent in Goan Iron ore deposits, the dilution factor applied during the course of mining/extraction of ROM is about 1.4 to 2.0 Fe unit (an average of 1.7%). Hence the average grade of the ROM recovered will be about 54.8% Fe.

Weathered BHQ/Manganiferous Clay/Siliceous Manganiferous Clay forms the footwall. It is exposed mainly in the central part of the pit. It is soft and at some places where banded hematite quartzite is exposed, it is little hard.

There are numerous dyke intrusion within the ore body. The main dyke is not yet exposed but in some boreholes towards south west, the main dyke is encountered. Dyke exposed is fully weathered can be differentiated by pinkish brown colour. It is very soft like clay and can be excavated with any excavator. The chemical composition of the dyke is 15 to 30% Fe and 15 to 25% Al_2O_3.

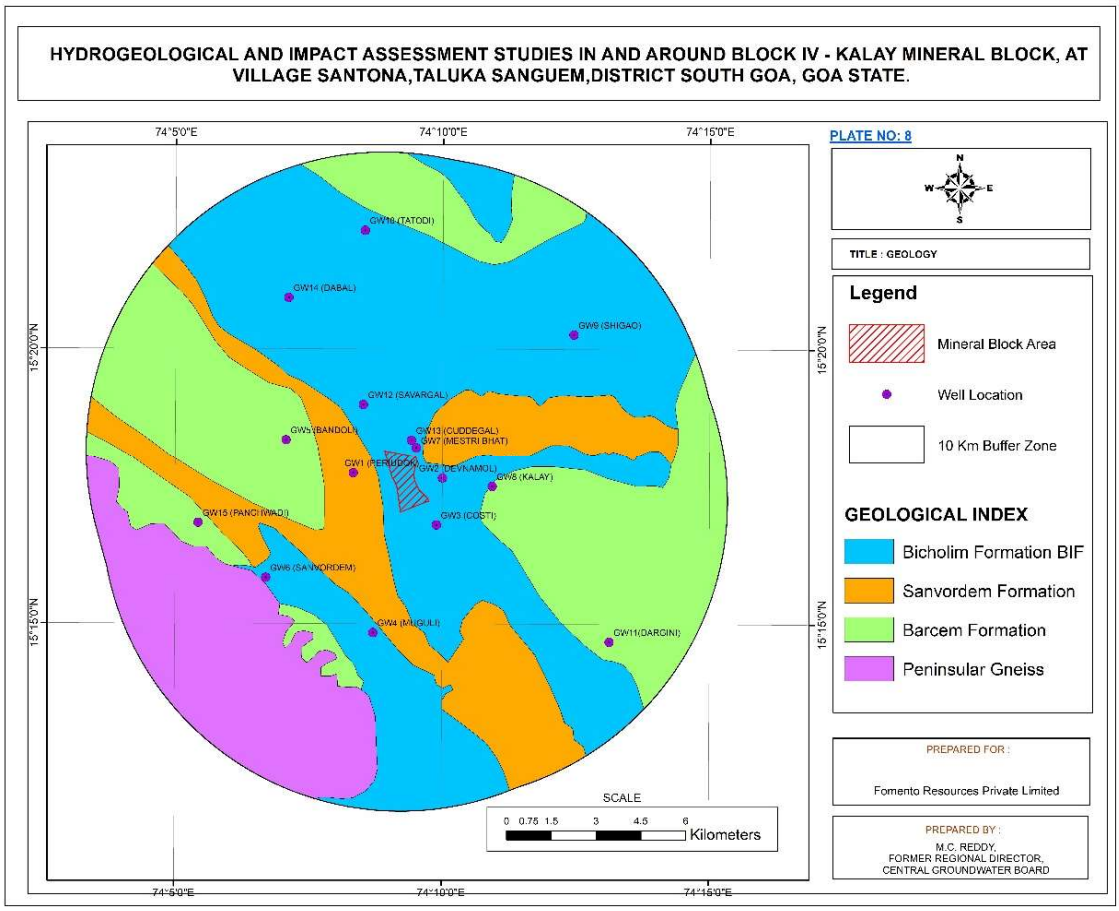


Plate 8: Geology of the Project area

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

5.2 Hydrogeology

In Goa, about 95% of the area is occupied by hard rock granite, granitic gneiss, meta-volcanics, meta-sedimentaries, basalts and laterites. In these hard rock aquifers, the water storage and yielding capacities measured in terms of specific yield and Storativity are on lower side as compared to soft aquifers. The ground water occurrence and movement are controlled by the degree of weathering, fracturing and geomorphological set up in the state. The aquifer system as per lithology is quite varied with 9 major aquifers owing to the presence of different geological formations.

Laterites are the most important water bearing formation covering over 60 percent of the area. Metavolcanics formation spreads in parts of Sanguem, Quepem and Cancona talukas of South Goa district. The water bearing properties of metabasalt and metagreywacks and the associated rocks of pre-Cambrian age are also dependent on fracturing, jointing and foliation present in the rocks.

5.3 Aquifer description

The data generated from ground water monitoring wells, microlevel hydrogeological inventories, exploratory and observation wells, various thematic layers was utilized to decipher the aquifer disposition of the area. If we consider the vertical distribution of aquifer, two types of aquifer system are observed i.e., Aquifer-I which is shallow phreatic aquifer and Aquifer-II which constitutes the deep fractured aquifer.

Aquifer-I comprises of Laterite, Alluvium, weathered meta volcanic and weathered meta sedimentaries, generally occurs in depth ranges of 9-42 m bgl. Aquifer-II comprises of fractured meta-sedimentaries, Granite gneiss and schistose rock. Depth of occurrence of aquifer ranges from 25 to 180 m bgl. The higher fractured aquifer thickness of 9 to 16 m is observed isolated patches in the central western parts near Sacordem, Kalay. The perusal of the map for fractured aquifer thickness indicates that it ranges from 0.10 to 16 m, however aquifer thickness of 2-5 m is observed in many parts of the state.

Hydrogeological surveys carried out in parts of Sangem Taluks of South Goa District show rise in water level in Phreatic aquifer. The fluctuations are less near the drainage system and topographic lows and higher in the topographic highs and hilly areas. Change in ground water scenario over a decade shows rise in water level in respect of three wells monitored in Sanguem Taluk of South Goa.

5.4 Aquifer Performance Test

Aquifer performance test was conducted on one dug well located at Santona village which is within the block area. The discharge of the dug well is 40 m^3 / hour sustaining pumping for more than 10 hours per day. The draw down

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

recorded in the open well is 3.98 m. The details of the test are given in Table. 7 and the plots are shown in Fig.6a and 6b.

Table. 7 Aquifer Performance Test for Santona dug well

Location :	Latitude: 15°17′ 36.17″ N Longitude: 74° 09′ 09.94″ E
Owner :	M/s. N. S. Narvekar
Located within the Block Boundary	
Taluk :	Sanguem
District :	South Goa
State :	Goa
Depth of well :	11.2 m. (Dug Well)
Diameter :	3.0 m (inner), 3.8 (outer)
Pump :	5 HP Pump
Discharge :	40 m^3 / hr.
Measuring Point :	0.95 m. agl
SWL :	4.77 m. bgl.
Date Of Test :	27-02-2023

Date	Time in hrs.	Time in min. since pump started	Time in min. since pump stopped	Pumping water level m.bmp.	Draw Down m.	Remarks
1	**2**	**3**	**4**	**5**	**6**	**7**
27-02-2023	11:15	-	-	4.77	-	Pump Start
	11:20	00:05	-	5.02	0.25	
	11:25	00:10	-	5.23	0.46	
	11:30	00:15	-	5.4	0.63	
	11:40	00:25	-	5.71	0.94	
	11:50	00:35	-	5.98	1.21	
	12:00	00:45	-	6.2	1.43	
	12:15	01:00	-	6.52	1.75	
	12:30	01:15	-	6.85	2.08	

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

	13:00	01:45	-	7.48	2.71	
	13:30	02:15	-	8.71	3.94	
	14:40	03:25	-	8.75	3.98	Pump Stopped
	14:45		00:05	8.25	3.48	
	14:50		00:10	8	3.23	
	14:55		00:15	7.73	2.96	
	15:05		00:25	7.19	2.42	
	15:15		00:35	6.71	1.94	
	15:30		00:50	6	1.23	
	15:45		01:05	5.45	0.68	
	16:00		01:20	5.15	0.38	
	16:30		01:50	4.89	0.12	
	17:00		02:20	4.84	0.07	
	17:30		02:50	4.76	-	

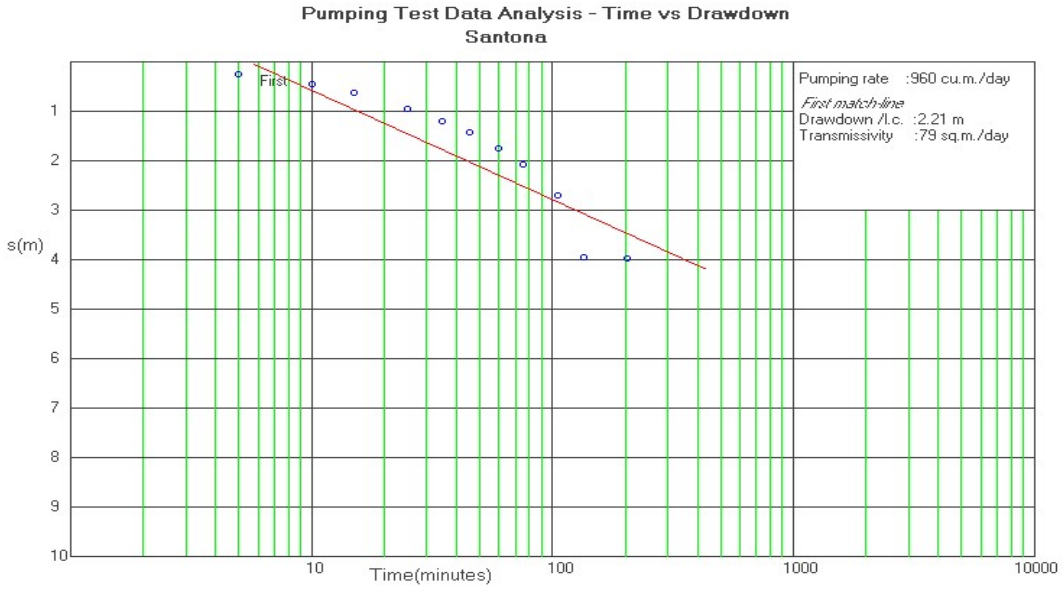


Fig.6 a. Plot of time Vs draw down for Santona dug well

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

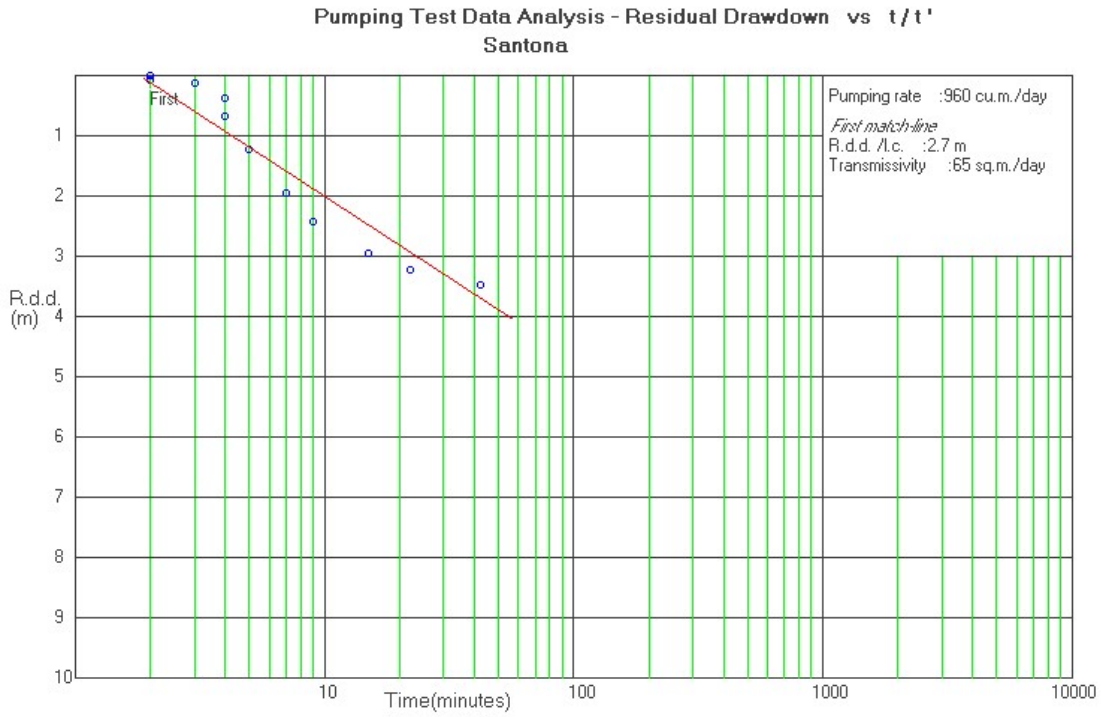


Fig. 6 b. Plot of Rdd Vs time for Santona dug well

5.5 Ground water flow and aquifer interaction

Hydrogeological surveys were carried out in Mineral Block Area (core area) and in area falling within 10 Km from Kalay Mineral Block boundary (buffer area) during May 2023 to evaluate the groundwater regime. The core and buffer area forms a part of Sanguem taluks of South Goa district. Water levels were monitored in 15 villages tapping mostly shallow aquifers to delineate the ground water regime in the study area. The location and details of the abstraction structures in the core and buffer area in parts of Sanguem taluks of South Goa District are shown in **Plate-9**. The location details, coordinates, elevation and water levels of the abstraction structures in core and buffer area is given in **Table-8.** The abstraction structures inventoried are essentially open wells tapping phreatic aquifers. Well density with respect to the unit area as an index to assess the ground water development, vis-à-vis the potential of the area show the density of the wells as observed during the present hydrogeological surveys indicate the area falls in less than 2 bore well / km. Water samples were collected from 15 shallow aquifer wells in buffer area. The details of the water quality analysis carried out are presented in **Table-9** and the lab results are presented as **Annexure-2.**

Table-8: DETAILS OF OPEN WELLS INVENTORIED FOR WATER LEVEL IN STUDY AREA OF THE IRON ORE MINE, BLOCK IV – KALAY MINERAL BLOCK

S. No.	Location	Co-ordinates						Elevation (m)	Water level (m)
		Latitude (N)			Longitude (E)				
		D	M	S	D	M	S		
1	GW1 - Periudok	15	17	44.1	74	8	20.1	30	6.4
2	GW2 - Devnamol	15	17	39	74	10	0.2	44	6.2
3	GW3 - Costi village	15	16	47.7	74	9	53.6	51	5.5
4	GW4 - Muguli Village	15	14	50.31	74	8	42.76	18	5
5	GW5 - Bandoli Village	15	18	20.8	74	7	4.4	94	1.5
6	GW6 - Sanvordem	15	15	50	74	6	42.2	6	1.5
7	GW7 - Mestri Bhat	15	18	12.5	74	9	30.7	40	6
8	GW8 - Kalay	15	17	29.8	74	10	56.1	53	6.5
9	GW9 - Shigao	15	20	15.88	74	12	27.34	60	7.2
10	GW10 - Tatodi	15	22	9.02	74	8	32.61	73	13.7
11	GW11 - Dargini Village	15	14	40.64	74	13	7.94	41	7
12	GW12 - Savargal Village	15	18	59.3	74	8	31.22	51	8.8
13	GW13 - Cudeggal	15	18	20.64	74	9	25.29	34	5.8
14	GW14 - Dabal	15	20	55.63	74	7	7.09	30	6.4
15	GW15 - Panchwadi	15	16	49.69	74	5	26	20	8.1

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects. mcreddycgwb@yahoo.co.in

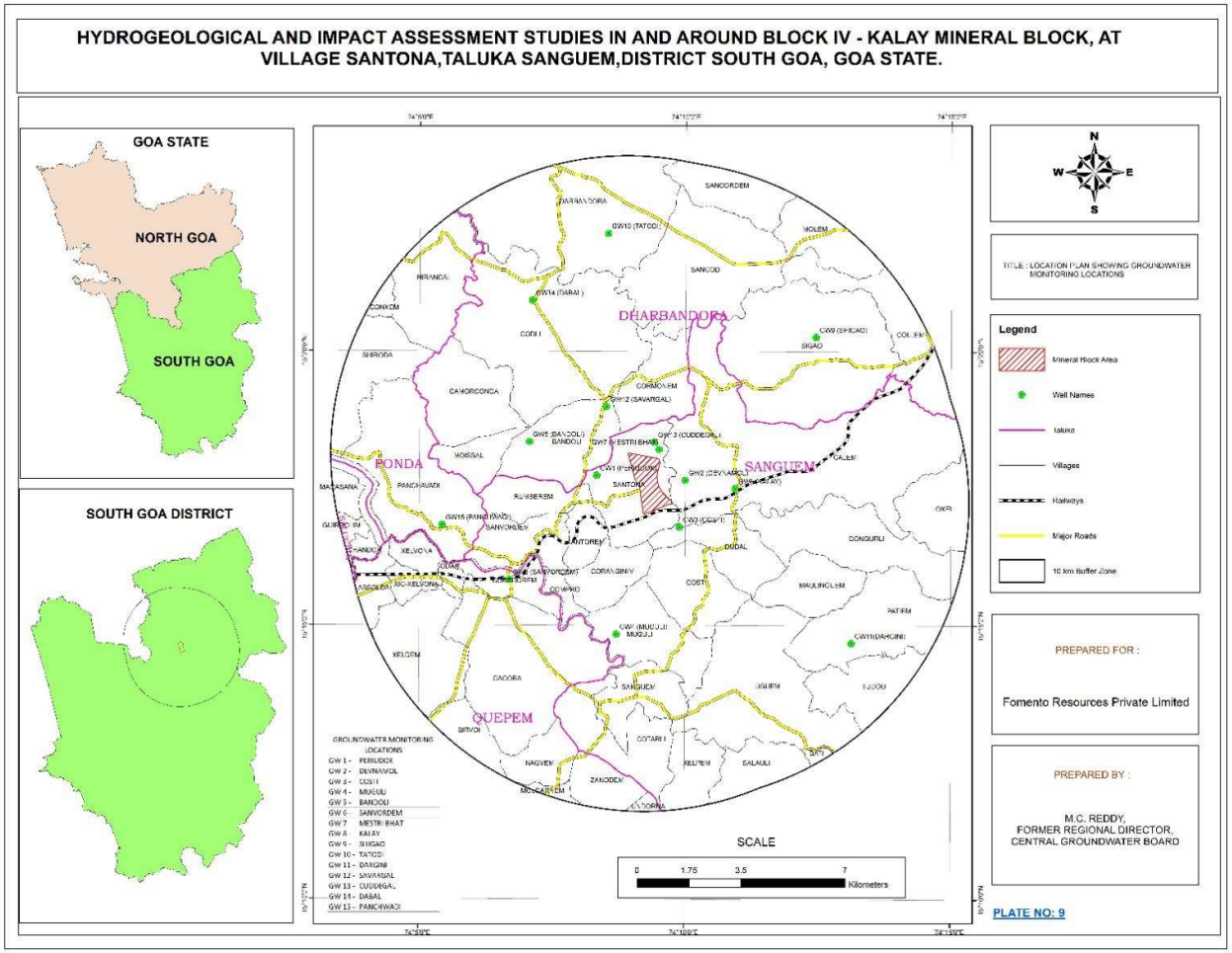


Plate No -9: Location plan showing groundwater monitoring locations

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects. mcreddycgwb@yahoo.co.in

Table-9 DETAILS OF WATER QUALITY OF WELLS IN STUDY AREA OF THE IRON ORE MINE, BLOCK IV – KALAY MINERAL BLOCK

Sl. No.	Test Parameters	GW1 (Periudok)	GW2 (Devnamol)	GW3 (Costi Village)	GW4 (Muguli Village)	GW5 (Bandoli Village)	GW6 (Sanvordem)	GW7 (Mestri Bhat)	GW8 (Kalay)
1	Color, Hazen Units	5	5	5	15	5	5	5	10
2	Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3	pH	5.94	6.08	5.75	6.22	6.26	6.69	5.51	5.87
4	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
5	Turbidity as NTU	4.4	2.5	3.5	5.8	1.7	13.7	<0.1	19.5
6	Conductivity, µmhos/cm	53	60	60	63	109.8	210	50	53.6
7	Total Dissolved Solids, mg/l	33	36	35	37	58	118	30	30
8	Temperature, °C	25	25	25	25	25	25	25	25
9	Aluminium as Al, mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
10	Ammonia (as total ammonia-N) mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
11	Anionic Detergents as MBAS, mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
12	Barium as Ba mg/l	0.036	0.022	0.036	<0.005	0.038	0.134	0.017	0.011
13	Boron as B, mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
14	Calcium as Ca, mg/l	4	3.6	4.8	4.08	8.2	23.7	<2	2.4
15	Copper as Cu, mg/l	<0.005	0.009	<0.005	<0.005	<0.005	<0.005	<0.005	0.026
16	Chloride as Cl, mg/l	12	12.58	13.5	8.55	17.1	27.1	14	11
17	Fluoride as F, mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
18	Residual Free Chlorine, mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
19	Chloramines as Cl2,mg/I	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
20	Iron as Fe, mg/l	0.082	0.055	0.114	<0.005	0.038	0.131	0.105	0.441
21	Magnesuim as Mg, mg/l	2.4	2.2	2.4	2.97	4.86	5.83	1.4	<1
22	Manganese as Mn, mg/l	0.007	0.051	0.186	<0.001	0.007	<0.001	0.029	0.171
23	Mineral Oil, mg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5

24	Nitrate as N03, mg/l	<0.1	0.175	<0.1	<0.1	0.38	0.17	<0.1	<0.1
25	Phenolic Compounds as C6H50H. mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
26	Selenium as Se, mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
27	Silver as Ag, mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
28	Molybdenum as Mo, mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
29	Sulphate as SO4, mg/l	1.71	1.57	1.28	<1.0	7.85	13.71	1.42	<1
30	Sulphide as H2S, mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
31	Total Alkalinity as CaCO3, mg/l	15	15	15	25	20	60	5	10
32	Total Hardness as CaCO3. mg/l	20	18	22	22.44	40.8	83.64	10.2	10.2
33	Zinc as Zn, mg/l	0.017	0.027	0.032	<0.005	0.009	<0.005	0.013	0.026
34	Cadmium as Cd, mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
35	Cyanide as CN, mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
36	Lead as Pb, mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
37	Mercury as Hg, mg/l	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
38	Nickel as Ni, mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
39	Total Arsenic as As, mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
40	Sodium as Na mg/l	3	5.5	3.7	4.2	6.5	10	6.8	7.6
41	Potassium as K mg/l	1	1	<1	<1	2	1	1	<1
42	Hexavalent Chromium as Cr+6, mg/l	<0.03	<0.001	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03
43	Escherichia coli/100ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent	Absent
44	Total Coliforms/100ml	<1	<1	<1	<1	<1	<1	<1	<1

Table-9: DETAILS OF WATER QUALITY OF WELLS IN STUDY AREA OF THE IRON ORE MINE, BLOCK IV – KALAY MINERAL BLOCK (cont….)

Sl. No.	Test Parameters	GW9 (Shigao)	GW10 (Tatodi)	GW11 (Dargini Village)	GW12 (Savargal Village)	GW13 (Cuddegal)	GW14 (Dabal)	GW15 (Panchwadi)
1	Color, Hazen Units	5	120	10	20	5	20	15
2	Odour	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
3	pH	5.9	5.98	5.66	5.52	6.33	7.69	7.72
4	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
5	Turbidity as NTU	2	28.5	0.7	2	<0.1	3.9	2.2
6	Conductivity,µmhos/cm	41.4	57.6	56	52	72	158	80
7	Total Dissolved Solids, mg/l	28	40	35	32	44	92	49
8	Temperature, °C	25	25	25	25	25	25	25
9	Aluminium as Al, mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
10	Ammonia (as total ammonia-N) mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
11	Anionic Detergents as MBAS, mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
12	Barium as Ba mg/l	0.021	0.026	0.01	0.01	0.013	0.034	0.032
13	Boron as B, mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
14	Calcium as Ca, mg/l	2.4	4	2.4	<2	<2	15.5	4
15	Copper as Cu, mg/l	<0.005	0.06	<0.005	<0.005	<0.005	0.148	<0.005
16	Chloride as Cl, mg/l	11.5	11	13.5	16	16	12.5	13.5
17	Fluoride as F, mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
18	Residual Free Chlorine, mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
19	Chloramines as Cl2,mg/I	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
20	Iron as Fe, mg/l	0.069	0.115	0.06	0.085	0.052	0.076	0.143
21	Magnesuim as Mg, mg/l	<1	<1	<1	<1	<1	7.4	1.9

22	Manganese as Mn, mg/l	0.011	0.212	0.06	0.101	<0.001	0.029	0.007
23	Mineral Oil, mg/l	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
24	Nitrate as N03, mg/l	0.12	<0.1	<0.1	<0.1	0.16	0.25	<0.1
25	Phenolic Compounds as C6H50H. mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
26	Selenium as Se, mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
27	Silver as Ag, mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
28	Molybdenum as Mo, mg/l	<0.001	0.016	<0.001	<0.001	0.006	<0.001	<0.001
29	Sulphate as SO4, mg/l	1.28	3.71	2.28	1.28	2.57	1.28	9.14
30	Sulphide as H2S, mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
31	Total Alkalinity as CaCO3, mg/l	10	20	10	5	15	75	15
32	Total Hardness as CaCO3. mg/l	10.2	14.3	10	9.1	9.1	69.36	17.8
33	Zinc as Zn, mg/l	0.023	0.012	0.014	<0.005	0.01	0.013	<0.005
34	Cadmium as Cd, mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
35	Cyanide as CN,mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
36	Lead as Pb, mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
37	Mercury as Hg, mg/l	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
38	Nickel as Ni, mg/l	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
39	Total Arsenic as As, mg/l	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
40	Sodium as Na mg/l	4.8	<1	8.3	7.8	12.4	4.4	10.2
41	Potassium as K mg/l	<1	<1	1	<1	<1	5	<1
42	Hexavalent Chromium as Cr+6, mg/l	<0.03	<0.03	<0.001	<0.03	<0.03	<0.03	<0.03
43	Escherichia coli/100ml	Absent	Absent	Absent	Absent	Absent	Absent	Absent
44	Total Coliforms/100ml	<1	<1	<1	<1	<1	<1	<1

5.6 Depth to water level

Water levels based on the abstraction structures inventoried in the study area is shown in depth to water level map prepared for the shallow aquifers in **Plate-10**. Depth to water level varied from less than 2 m bgl to more than 14 m bgl. Shallow water levels of less than 4 m bgl is found to occur in and around Bandoli and Sanvordem; 4-6 m bgl in and around Costi, Muguli, Mestri Bhat and Cudeggel Mine; Water levels between 6 and 10 m bgl is noted occurring in and around Periudok, Devnamol, Kalay, Shigao, Dargini, Savargal, Dabal and Panchwadi. Water levels of more than 10 m bgl is found to occur in and around Tatodi.

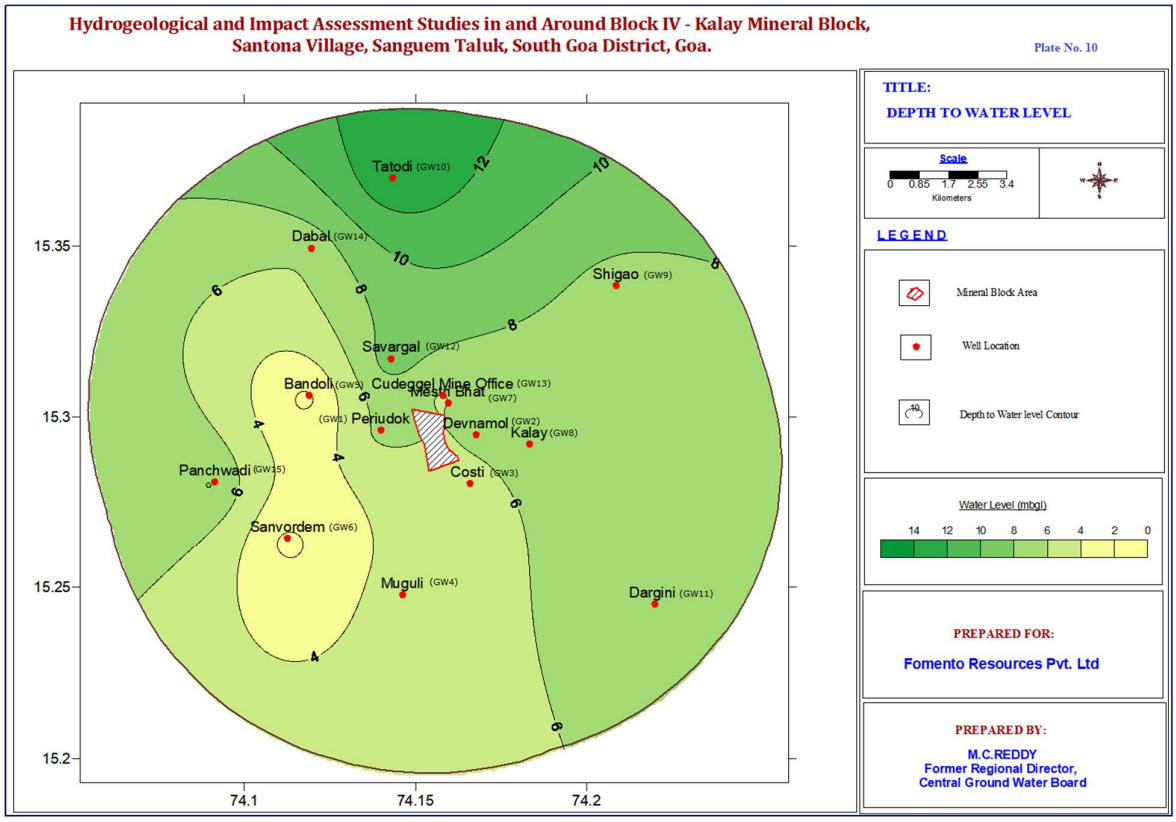


Plate-10: Depth to Water Level

5.7 Water Table Elevation

Water table elevation for the study area tapping shallow aquifer is shown in **Plate-11**. Water table elevation is in the range of less than 4 m. above mean sea level (amsl) to more than 80 m amsl. The water table elevation is less than 5 m amsl in and around Sanvordem; between 5 and 15 m amsl in and around Muguli and Panchwadi; Water table elevation is between 15 and 40 m amsl in and around Dabal , Dargini, Periudok, Cudeggel Mine, Mestri Bhat and Devnamol; between 40 to 60 m amsl in and around Costi, Kalay, Shigao, Tatodi, Savargal, Padi and Cordem; Water table elevation is more than 80 m amsl in and around Bandoli. Ground water flow direction is following the topography.

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

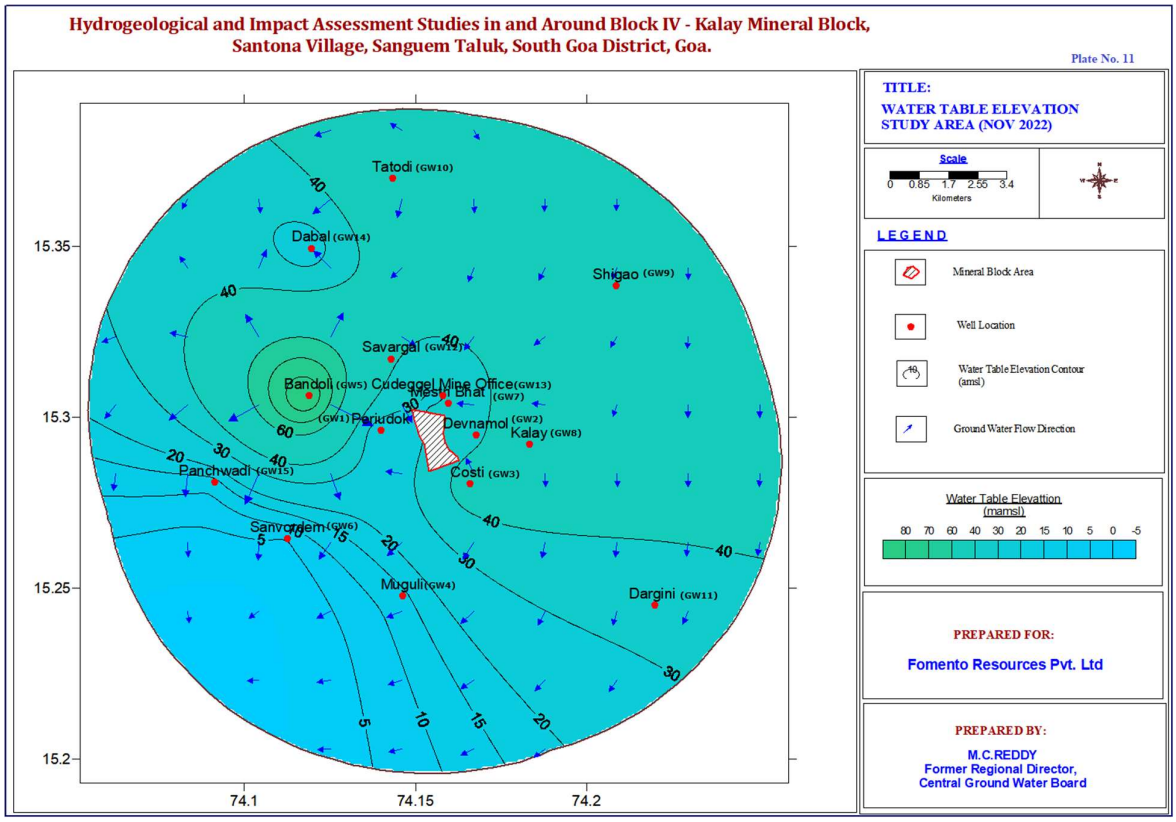


Plate-11: Water Table Elevetion

5.8 Yield of bore wells

Bore wells are not common in the study area. Based on the information gathered during the hydrogeological survey bore wells are mostly confined to few villages and that too are fitted with hand pumps for domestic use. The details of the depth drilled reported is given in **Table- 10** in respect of Sanguem Taluka.

Table-10: Details of bore wells in the 10 kms radius of Block IV - Kalay Mineral Block.

Bore	Township	Longitude	Latitude	Elevation	Total depth	Casing
Kalay	Sanguem	74.180787	15.287988	51	68	37
Kirlapal	Sanguem	74.126629	15.327449	52	60	34
Sanguem	Sanguem	74.157868	15.223713	32.5	200	2
Bandoli	Sanguem	74.137573	15.300324	95	48.2	23
Ambe Udak	Sanguem	74.13600	15.29300	67.4	58.84	34

5.9 Bore wells in the Core area

There are two piezometers in the project area. These two Piezometers will be utilized for monitoring of water levels on a monthly basis. One of the piezometer will be installed with a Telemetry system of monitoring.

5.10 Ground water table at Santona Village

Based on the monitored data in buffer area of Block IV – Kalay Mineral Block, it is observed that the water levels in Phreatic aquifer is mostly shallow. Kalay mineral block is located on a plain region having an elevation of about 53 m amsl. The ground water abstraction structures are located at the elevation of 20 m amsl to 94 m amsl, average elevation. The details of elevation of the ground level is given in **Table- 8.**

5.11 Ground water level trend analysis

In all 5 National Hydrograph stations maintained by Central Ground Water Board in South Goa is considered for the analysis. Long term trends for Pre-monsoon, Post monsoon and all seasons were attempted. Rise in water level is recorded at two hydrograph stations and fall in water levels were recorded at three hydrograph stations. Details of water levels for trend analysis attempted for the 10 years period is given in **Table-11** and the hydrographs are presented in **Fig. 7a – Fig. 7x**.

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

Table-11: Ground water trend analysis attempted for the 10 years period

Water Level data of Central Ground Water Board (within 10 km Radius), Sanguem and Dharbandora Taluka, South Goa District, Goa

State	Year	Station	Latitude	Longitude	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Goa	2011	Bolkharnem(48I3A2)	15.42964	74.192351	5.62	-	-	-	6.84	-	-	3.34	-	-	5.34	-
Goa	2012	Bolkharnem(48I3A2)	15.42964	74.192351	-	-	-	-	7.01	-	-	4.11	-	-	5.23	-
Goa	2013	Bolkharnem(48I3A2)	15.42964	74.192351	5.78	-	-	-	6.93	-	-	3.98	-	-	5.29	-
Goa	2014	Bolkharnem(48I3A2)	15.42964	74.192351	5.7	-	-	-	6.77	-	-	4.58	-	-	1.26	-
Goa	2015	Bolkharnem(48I3A2)	15.42964	74.192351	5.92	-	-	-	6.66	-	-	4.76	-	-	4.97	-
Goa	2016	Bolkharnem(48I3A2)	15.42964	74.192351	6.18	-	-	-	6.88	-	-	2.94	-	-	5.25	-
Goa	2017	Bolkharnem(48I3A2)	15.42964	74.192351	6.05	-	-	-	6.28	-	-	4.16	-	-	5.28	-
Goa	2018	Bolkharnem(48I3A2)	15.42964	74.192351	5.94	-	-	-	6.74	-	-	4.14	-	-	5.35	-
Goa	2019	Bolkharnem(48I3A2)	15.42964	74.192351	6.18	-	-	-	7.19	-	-	-	-	-	5.08	-
Goa	2020	Bolkharnem(48I3A2)	15.42964	74.192351	5.97	-	-	-	-	-	-	-	-	-	5.25	-
Goa	2021	Bolkharnem(48I3A2)	15.42964	74.192351	5.98	-	-	-	-	-	-	5.41	-	-	5.1	-
Goa	2022	Bolkharnem(48I3A2)	15.42964	74.192351	6.98	-	-	-	4.5	-	-	4.34	-	-	5.61	-
Goa	2023	Bolkharnem(48I3A2)	15.42964	74.192351	7	-	-	-	7.84	-	-	-	-	-	-	-
Goa	2011	Deulwada Kolamba(48I4A7)	15.149886	74.130746	2.42	-	-	-	3	-	-	1.11	-	-	2.33	-
Goa	2012	Deulwada Kolamba(48I4A7)	15.149886	74.130746	2.66	-	-	-	3.24	-	-	2.18	-	-	2.67	-
Goa	2013	Deulwada Kolamba(48I4A7)	15.149886	74.130746	2.34	-	-	-	3.21	-	-	1.91	-	-	2.92	-
Goa	2014	Deulwada Kolamba(48I4A7)	15.149886	74.130746	2.39	-	-	-	2.31	-	-	1.91	-	-	2.71	-
Goa	2015	Deulwada Kolamba(48I4A7)	15.149886	74.130746	2.27	-	-	-	2.67	-	-	1.85	-	-	2.31	-
Goa	2016	Deulwada Kolamba(48I4A7)	15.149886	74.130746	2.57	-	-	-	3	-	-	1.93	-	-	-	-
Goa	2017	Deulwada Kolamba(48I4A7)	15.149886	74.130746	2.6	-	-	-	2.41	-	-	1.63	-	-	2.64	-
Goa	2018	Deulwada Kolamba(48I4A7)	15.149886	74.130746	2.61	-	-	-	2.51	-	-	1.88	-	-	2.87	-
Goa	2019	Deulwada Kolamba(48I4A7)	15.149886	74.130746	2.49	-	-	-	3.08	-	-	-	-	-	2.31	-
Goa	2020	Deulwada Kolamba(48I4A7)	15.149886	74.130746	2.61	-	-	-	-	-	-	-	-	-	2.11	-
Goa	2021	Deulwada Kolamba(48I4A7)	15.149886	74.130746	2.49	-	-	-	-	-	-	2.6	-	-	3.48	-
Goa	2022	Deulwada Kolamba(48I4A7)	15.149886	74.130746	3.7	-	-	-	4.1	-	-	2.64	-	-	3.7	-
Goa	2023	Deulwada Kolamba(48I4A7)	15.149886	74.130746	3.42	-	-	-	4.26	-	-	-	-	-	-	-
Goa	2011	Molem(48I3A5)	15.377056	74.229658	10.1	-	-	-	13.7	-	-	0.76	-	-	7.59	-
Goa	2012	Molem(48I3A5)	15.377056	74.229658	10.5	-	-	-	14	-	-	1.15	-	-	7.69	-
Goa	2013	Molem(48I3A5)	15.377056	74.229658	11.1	-	-	-	13.8	-	-	0.9	-	-	7.08	-
Goa	2014	Molem(48I3A5)	15.377056	74.229658	10.4	-	-	-	13.8	-	-	1	-	-	4.72	-
Goa	2015	Molem(48I3A5)	15.377056	74.229658	10.3	-	-	-	13.8	-	-	3.28	-	-	7.07	-
Goa	2016	Molem(48I3A5)	15.377056	74.229658	10.7	-	-	-	14.2	-	-	1.75	-	-	10.05	-
Goa	2017	Molem(48I3A5)	15.377056	74.229658	10.5	-	-	-	-	-	-	1.75	-	-	4	-
Goa	2018	Molem(48I3A5)	15.377056	74.229658	10.4	-	-	-	13.8	-	-	0.42	-	-	8.66	-
Goa	2019	Molem(48I3A5)	15.377056	74.229658	11.2	-	-	-	-	-	-	-	-	-	3.9	-
Goa	2020	Molem(48I3A5)	15.377056	74.229658	10.2	-	-	-	-	-	-	-	-	-	7.24	-
Goa	2021	Molem(48I3A5)	15.377056	74.229658	10.4	-	-	-	-	-	-	1.9	-	-	8	-
Goa	2022	Molem(48I3A5)	15.377056	74.229658	11.7	-	-	-	14.9	-	-	2	-	-	5.52	-
Goa	2023	Molem(48I3A5)	15.377056	74.229658	4.38	-	-	-	15.7	-	-	-	-	-	-	-
Goa	2011	Netrolim(48I4A9)	15.09065	74.216706	9.68	-	-	-	10.1	-	-	8.84	-	-	9.8	-
Goa	2012	Netrolim(48I4A9)	15.09065	74.216706	10.6	-	-	-	10.6	-	-	9.66	-	-	10.5	-
Goa	2013	Netrolim(48I4A9)	15.09065	74.216706	10.1	-	-	-	10.2	-	-	-	-	-	10.44	-
Goa	2014	Netrolim(48I4A9)	15.09065	74.216706	9.3	-	-	-	10.1	-	-	9.21	-	-	10.45	-
Goa	2015	Netrolim(48I4A9)	15.09065	74.216706	9.74	-	-	-	10.5	-	-	9.04	-	-	11	-
Goa	2016	Netrolim(48I4A9)	15.09065	74.216706	10.1	-	-	-	9.74	-	-	8.92	-	-	10.14	-
Goa	2017	Netrolim(48I4A9)	15.09065	74.216706	8.79	-	-	-	8.2	-	-	8.01	-	-	8.94	-
Goa	2018	Netrolim(48I4A9)	15.09065	74.216706	8.13	-	-	-	10.4	-	-	9.18	-	-	10.64	-
Goa	2019	Netrolim(48I4A9)	15.09065	74.216706	9.54	-	-	-	10.8	-	-	-	-	-	10.24	-
Goa	2020	Netrolim(48I4A9)	15.09065	74.216706	8.43	-	-	-	-	-	-	-	-	-	9.32	-
Goa	2021	Netrolim(48I4A9)	15.09065	74.216706	9.54	-	-	-	-	-	-	9.15	-	-	11.32	-
Goa	2022	Netrolim(48I4A9)	15.09065	74.216706	11	-	-	-	11.6	-	-	8.92	-	-	11.18	-
Goa	2023	Netrolim(48I4A9)	15.09065	74.216706	11.5	-	-	-	9.15	-	-	-	-	-	-	-
Goa	2013	Collem(PzGoal018)	15.334	74.244	-	-	-	-	6.7	-	-	1.5	-	-	-	-
Goa	2014	Collem(PzGoal018)	15.334	74.244	-	-	-	-	5.9	-	-	2.7	-	-	4.9	-
Goa	2015	Collem(PzGoal018)	15.334	74.244	5.7	-	-	-	6.2	-	-	4.7	-	-	5.2	-
Goa	2016	Collem(PzGoal018)	15.334	74.244	6.3	-	-	-	-	-	-	-	-	-	6.3	-
Goa	2017	Collem(PzGoal018)	15.334	74.244	5.7	-	-	-	5.8	-	-	-	-	-	4.8	-
Goa	2018	Collem(PzGoal018)	15.334	74.244	5.7	-	-	-	5.7	-	-	1.4	-	-	5.8	-
Goa	2019	Collem(PzGoal018)	15.334	74.244	-	-	-	-	7.1	-	-	-	-	-	4.4	-
Goa	2020	Collem(PzGoal018)	15.334	74.244	5.2	-	-	-	-	-	-	-	-	-	5.4	-
Goa	2021	Collem(PzGoal018)	15.334	74.244	5.6	-	-	-	-	-	-	2.49	-	-	6.21	-
Goa	2022	Collem(PzGoal018)	15.334	74.244	6.55	-	-	-	6.4	-	-	-	-	-	5.82	-
Goa	2023	Collem(PzGoal018)	15.334	74.244	8.93	-	-	-	6.95	-	-	-	-	-	-	-
Goa	2013	Molem(PzGoal021)	15.376	74.23	-	-	-	-	9.9	-	-	0.8	-	-	-	-
Goa	2014	Molem(PzGoal021)	15.376	74.23	-	-	-	-	8.8	-	-	-	-	-	2.1	-
Goa	2015	Molem(PzGoal021)	15.376	74.23	6.2	-	-	-	9.3	-	-	1.5	-	-	-	-
Goa	2016	Molem(PzGoal021)	15.376	74.23	7.8	-	-	-	9.3	-	-	1.3	-	-	4.1	-
Goa	2017	Molem(PzGoal021)	15.376	74.23	6.7	-	-	-	8.3	-	-	0.9	-	-	2.3	-
Goa	2018	Molem(PzGoal021)	15.376	74.23	-	-	-	-	-	-	-	0.7	-	-	5.3	-
Goa	2019	Molem(PzGoal021)	15.376	74.23	-	-	-	-	10.6	-	-	-	-	-	1.6	-
Goa	2020	Molem(PzGoal021)	15.376	74.23	6.5	-	-	-	-	-	-	-	-	-	4.5	-
Goa	2021	Molem(PzGoal021)	15.376	74.23	6.8	-	-	-	-	-	-	1.41	-	-	4.71	-
Goa	2022	Molem(PzGoal021)	15.376	74.23	7.73	-	-	-	9.52	-	-	0.95	-	-	2.52	-
Goa	2023	Molem(PzGoal021)	15.376	74.23	4.28	-	-	-	9.9	-	-	-	-	-	-	-
Goa	2013	Meidawada(PzGoal019)	15.2054	74.1548	-	-	-	-	11.9	-	-	4.2	-	-	-	-
Goa	2014	Meidawada(PzGoal019)	15.2054	74.1548	-	-	-	-	11.3	-	-	-	-	-	9.4	-
Goa	2015	Meidawada(PzGoal019)	15.2054	74.1548	11	-	-	-	13.1	-	-	7.6	-	-	10.1	-
Goa	2016	Meidawada(PzGoal019)	15.2054	74.1548	10.8	-	-	-	-	-	-	6.6	-	-	10.2	-
Goa	2017	Meidawada(PzGoal019)	15.2054	74.1548	10.9	-	-	-	11	-	-	4.8	-	-	10.1	-
Goa	2018	Meidawada(PzGoal019)	15.2054	74.1548	10.8	-	-	-	11	-	-	3.8	-	-	10.8	-
Goa	2019	Meidawada(PzGoal019)	15.2054	74.1548	-	-	-	-	12.1	-	-	-	-	-	8.6	-
Goa	2020	Meidawada(PzGoal019)	15.2054	74.1548	10.7	-	-	-	-	-	-	-	-	-	10.3	-
Goa	2021	Meidawada(PzGoal019)	15.2054	74.1548	10.7	-	-	-	-	-	-	5.24	-	-	10.68	-
Goa	2022	Meidawada(PzGoal019)	15.2054	74.1548	11.5	-	-	-	-	-	-	6.29	-	-	10.06	-
Goa	2023	Meidawada(PzGoal019)	15.2054	74.1548	11	-	-	-	11.3	-	-	-	-	-	-	-
Goa	2013	Kalay(PzGoal049)	15.29022	74.18353	-	-	-	-	5.5	-	-	2.6	-	-	3	-
Goa	2014	Kalay(PzGoal049)	15.29022	74.18353	-	-	-	-	4.8	-	-	2.4	-	-	3	-
Goa	2015	Kalay(PzGoal049)	15.29022	74.18353	2.7	-	-	-	5.3	-	-	3.3	-	-	-	-
Goa	2016	Kalay(PzGoal049)	15.29022	74.18353	3.2	-	-	-	5	-	-	-	-	-	3.2	-
Goa	2017	Kalay(PzGoal049)	15.29022	74.18353	4	-	-	-	3.8	-	-	2.7	-	-	3.3	-
Goa	2018	Kalay(PzGoal049)	15.29022	74.18353	3.2	-	-	-	4.7	-	-	2.1	-	-	4	-
Goa	2019	Kalay(PzGoal049)	15.29022	74.18353	-	-	-	-	5.9	-	-	-	-	-	2.8	-
Goa	2020	Kalay(PzGoal049)	15.29022	74.18353	2.9	-	-	-	-	-	-	-	-	-	-	-
Goa	2021	Kalay(PzGoal049)	15.29022	74.18353	-	-	-	-	-	-	-	-	-	-	-	-
Goa	2022	Kalay(PzGoal049)	15.29022	74.18353	-	-	-	-	-	-	-	-	-	-	Closed	-
Goa	2023	Kalay(PzGoal049)	15.29022	74.18353	Nil											

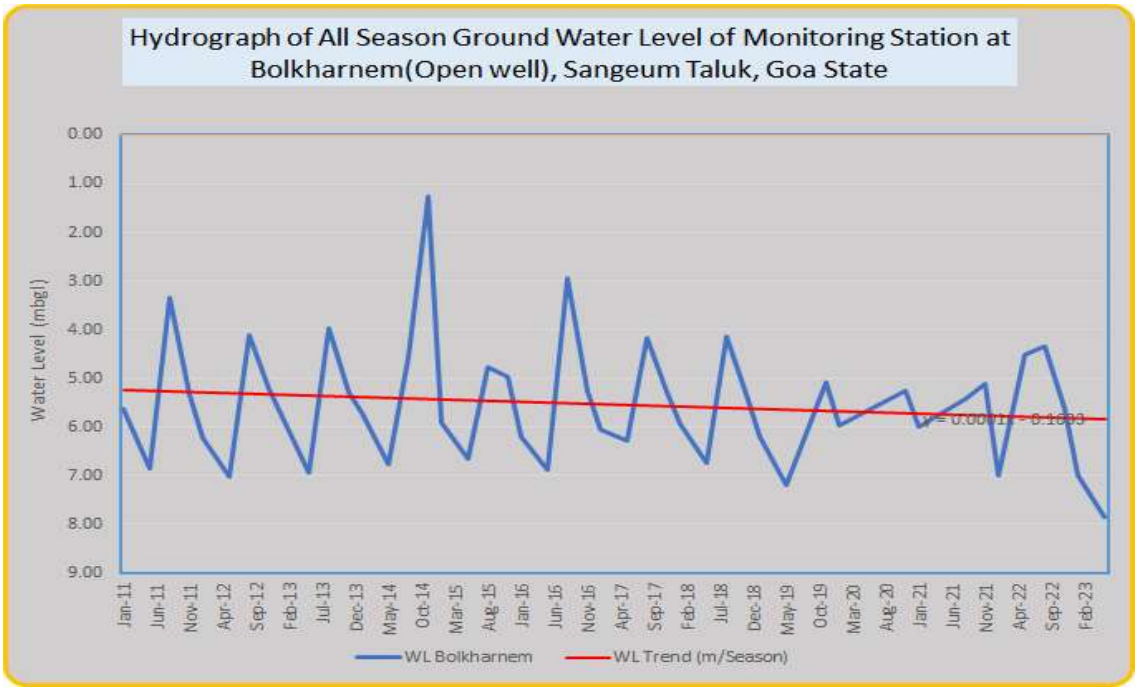


Fig.7a

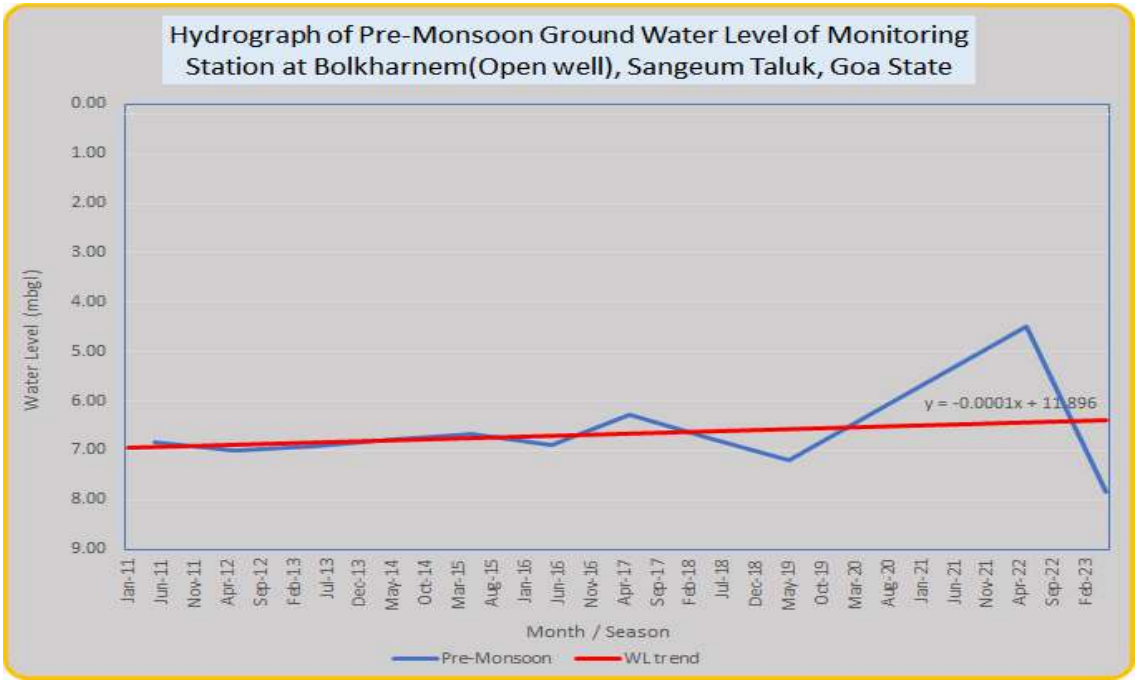


Fig.7b

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

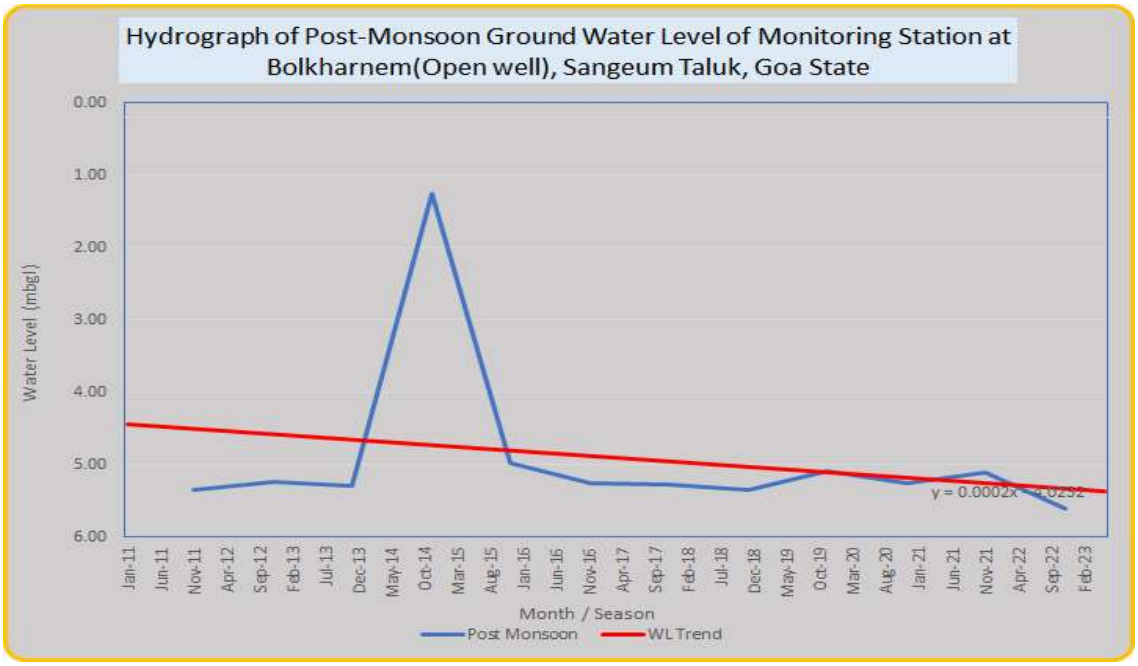


Fig.7c

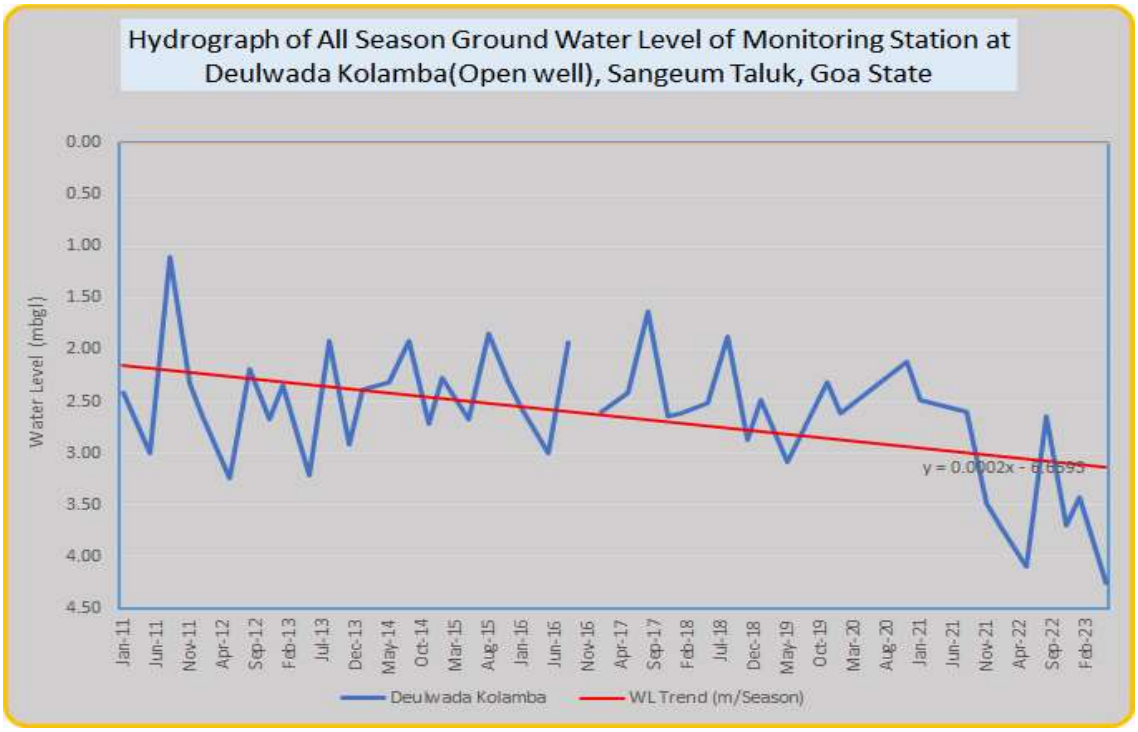


Fig.7d

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

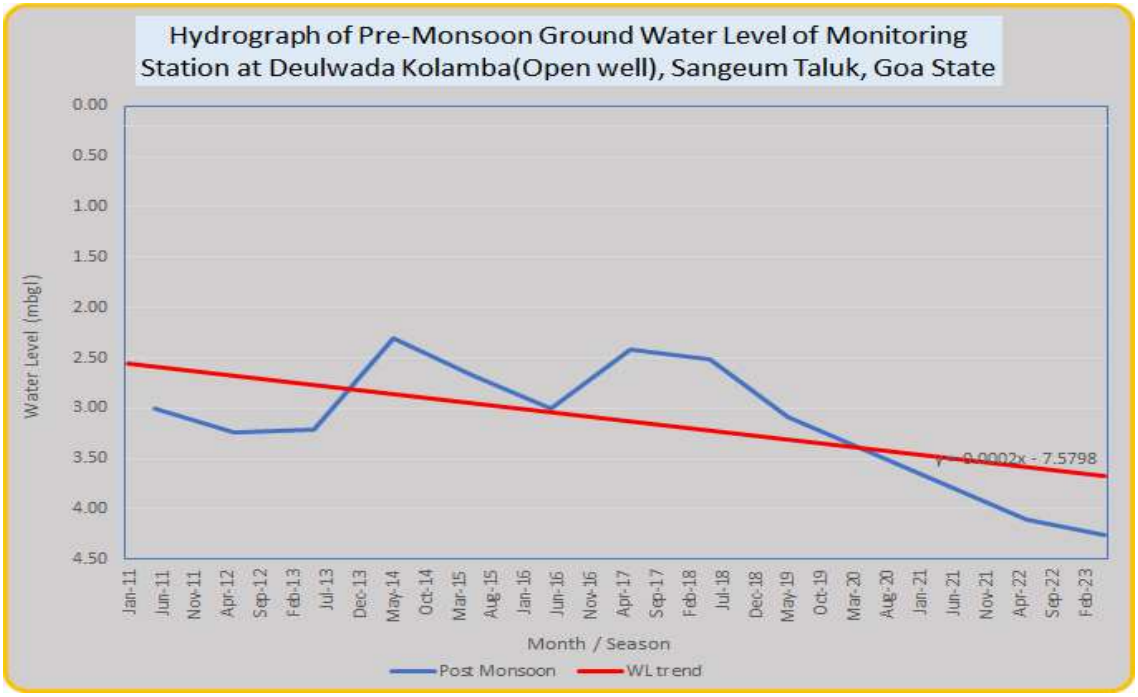


Fig.7e

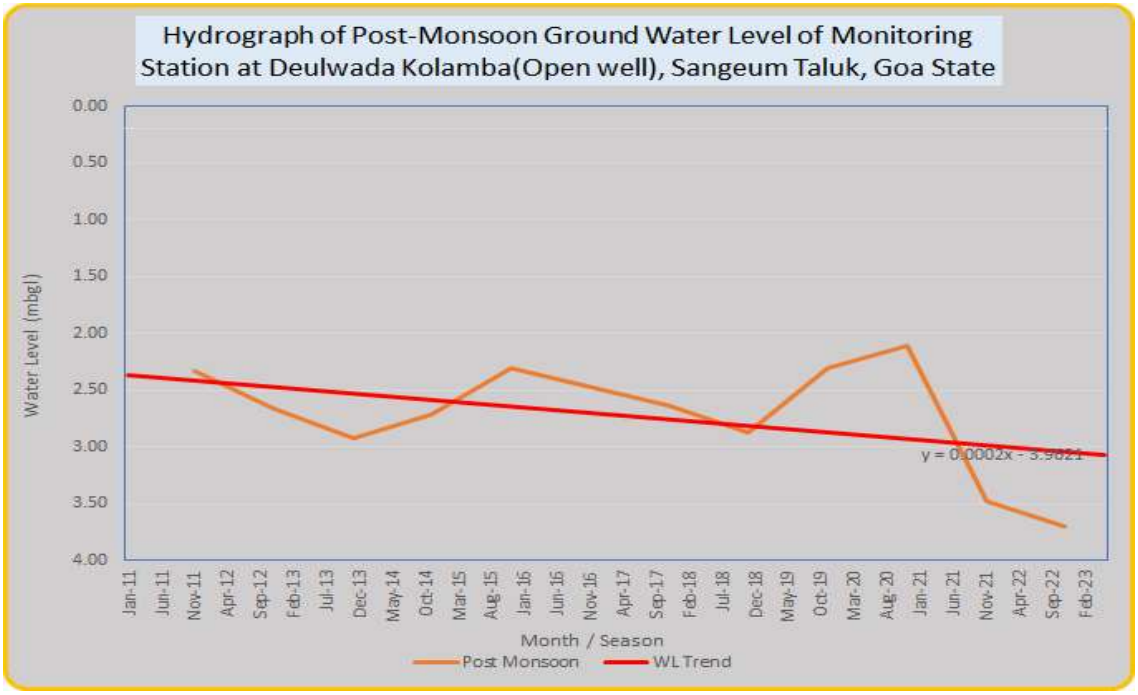


Fig.7f

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

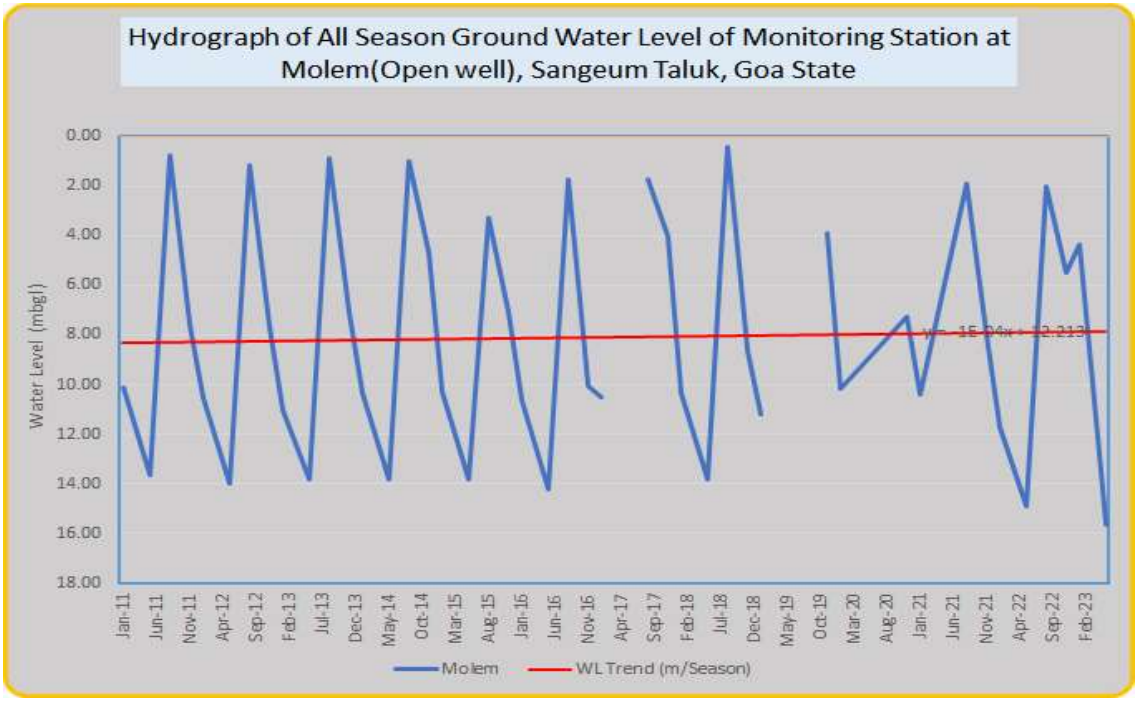


Fig.7g

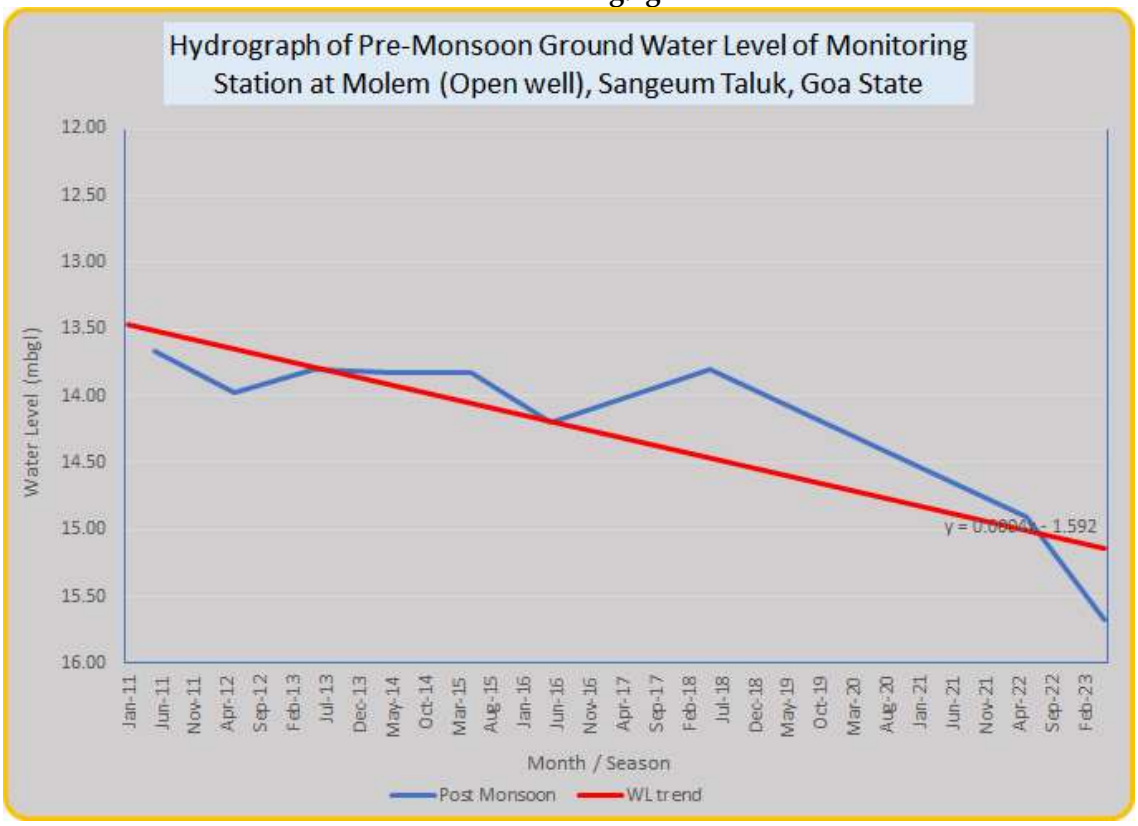


Fig.7h

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

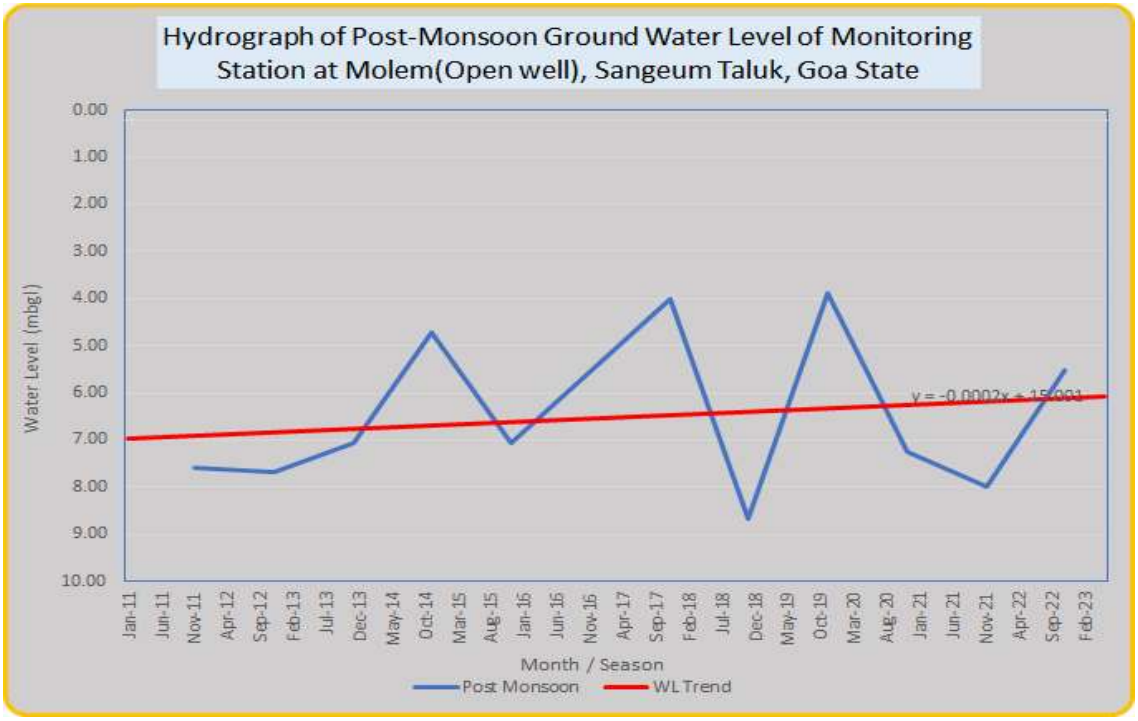


Fig.7i

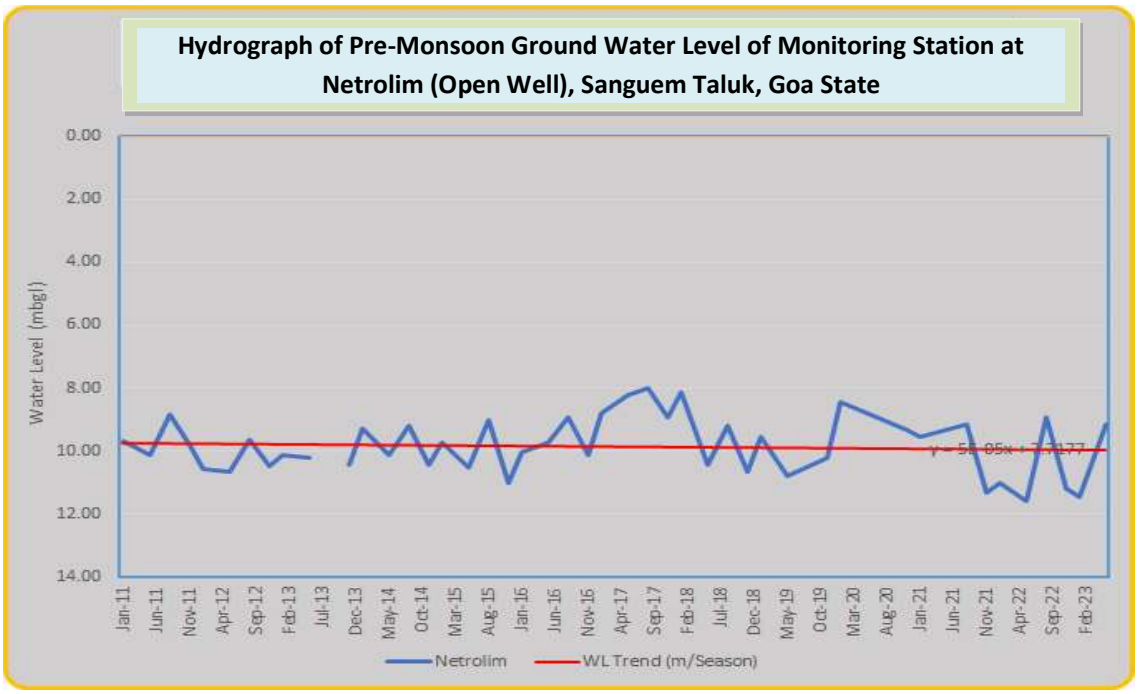


Fig.7j

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

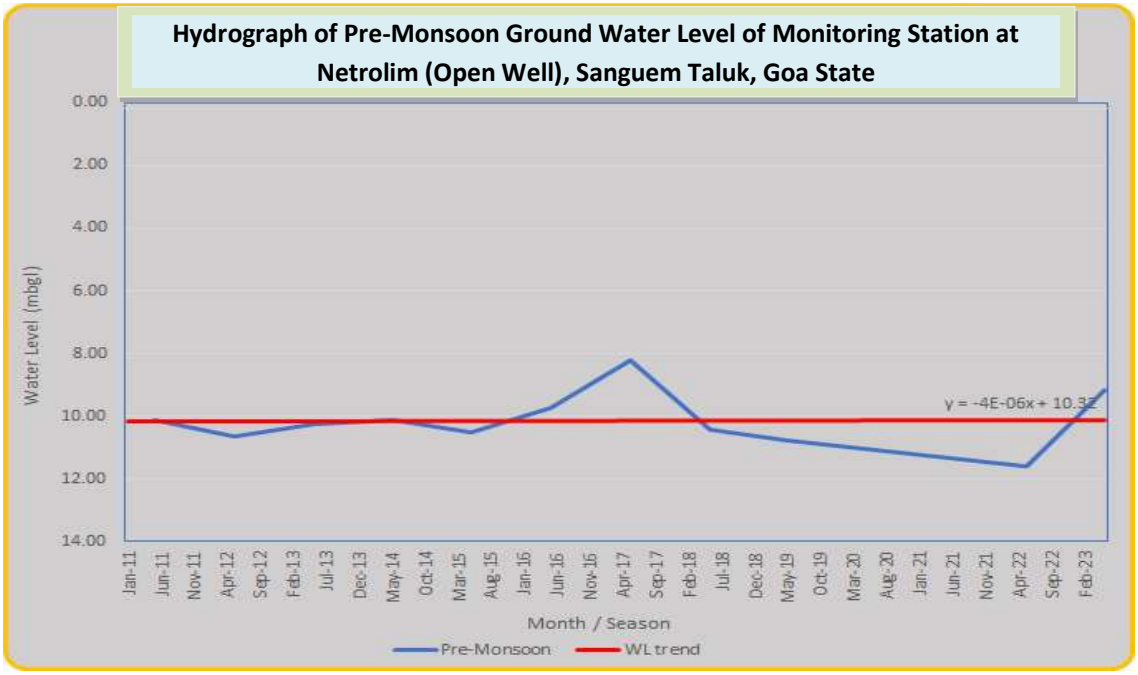


Fig.7k

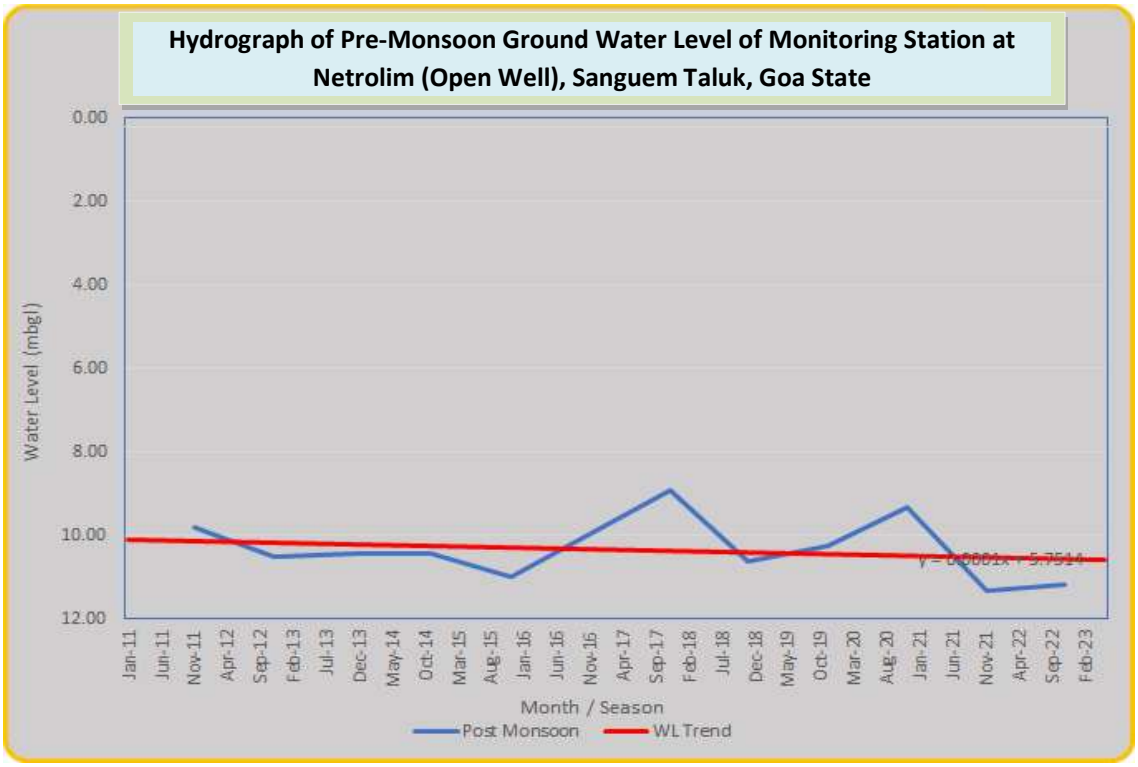


Fig.7l

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

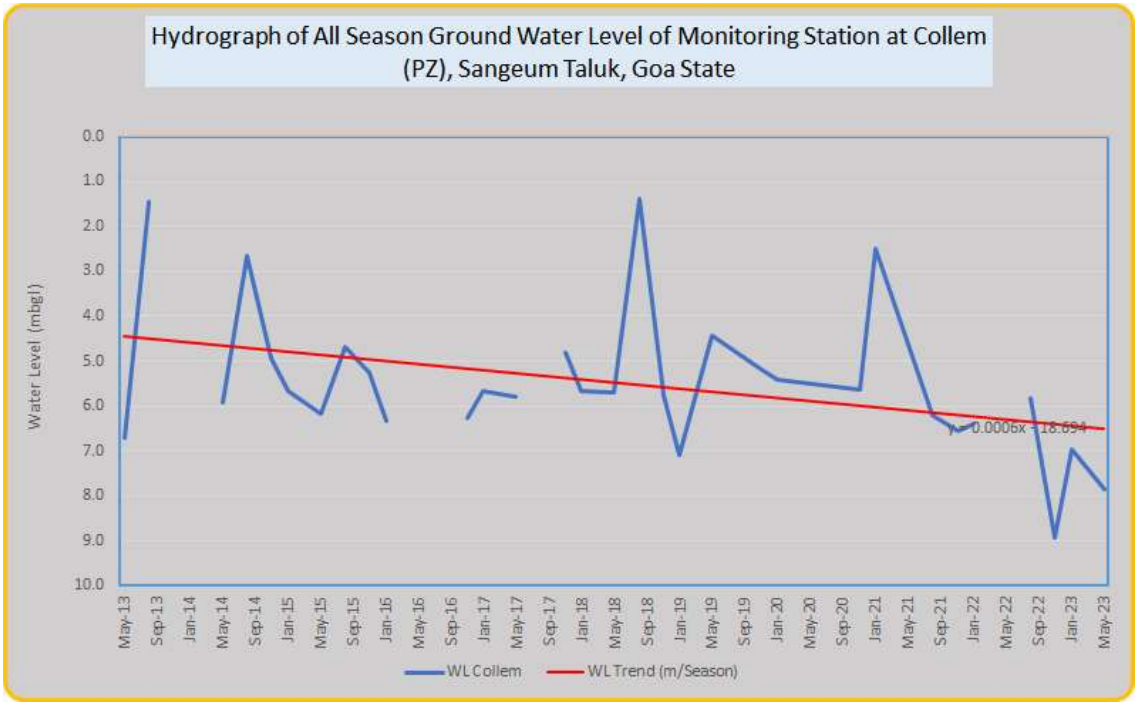


Fig.7m

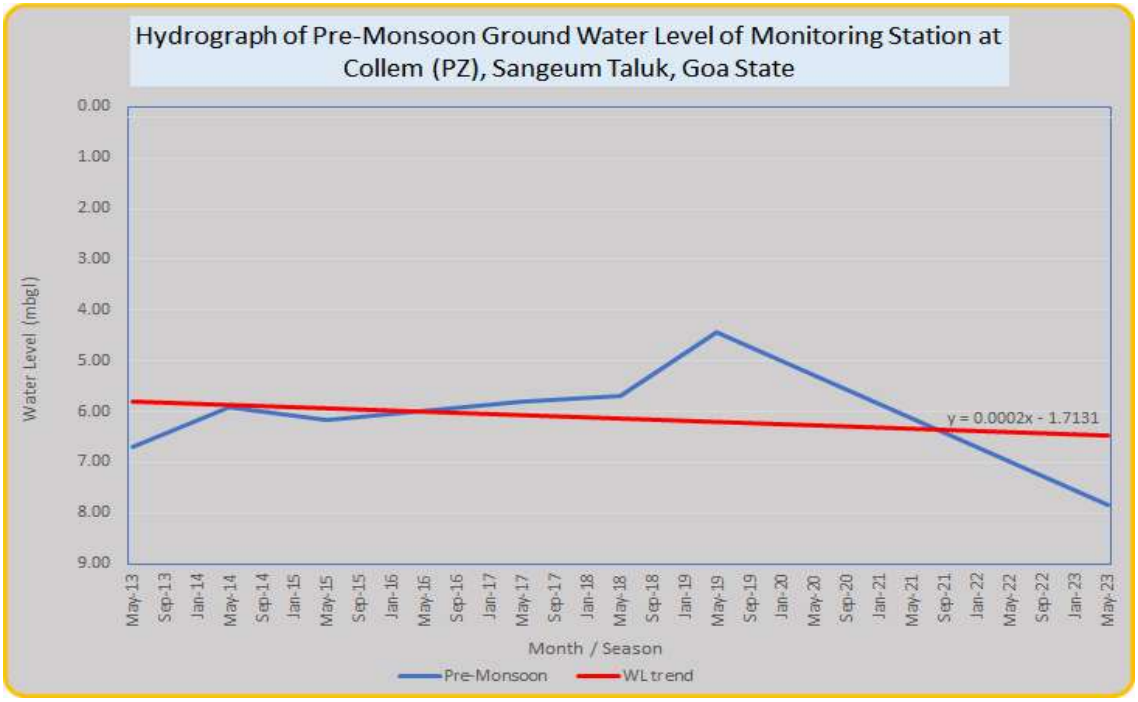


Fig.7n

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

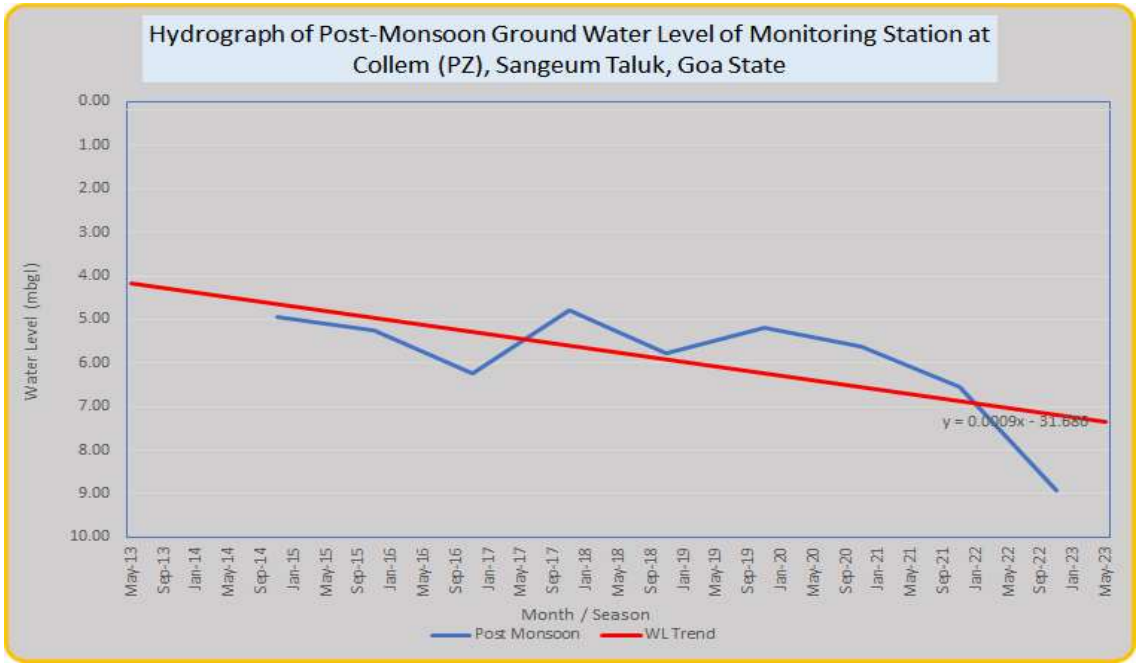


Fig.7o

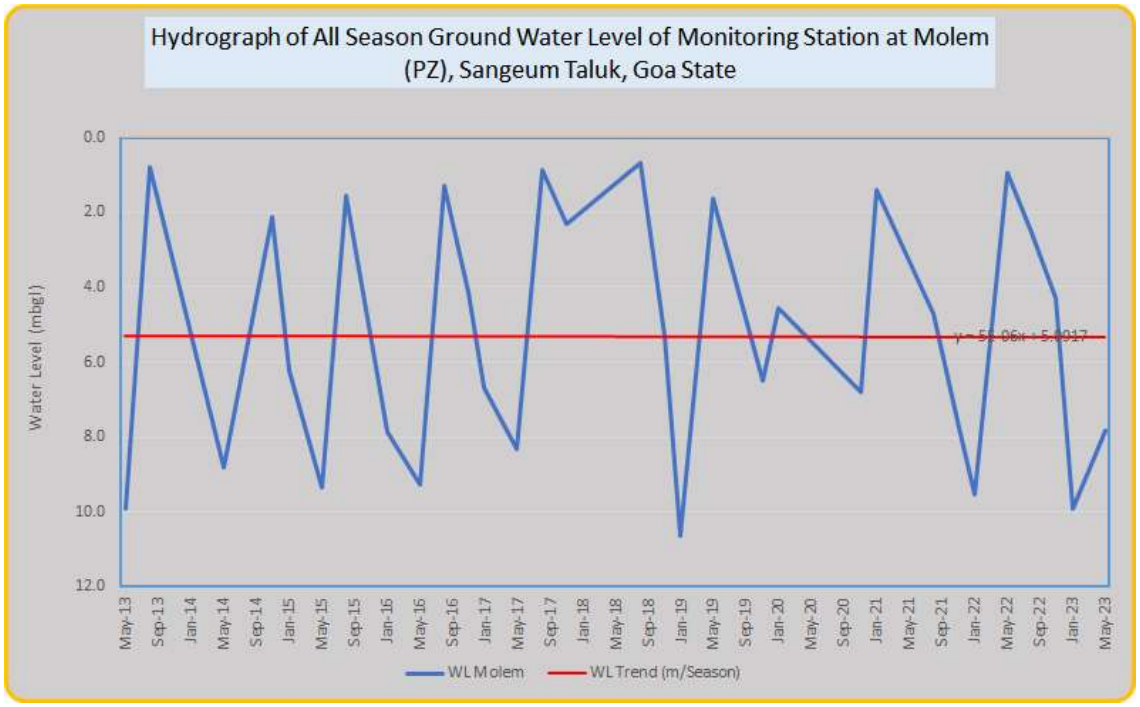


Fig.7p

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

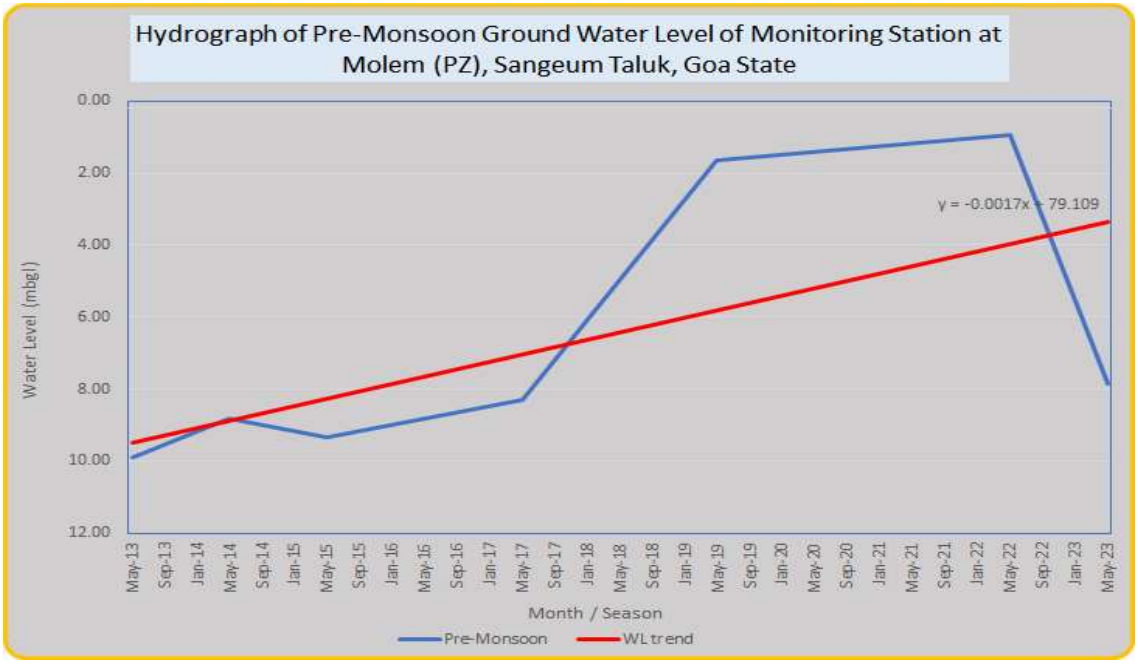


Fig.7q

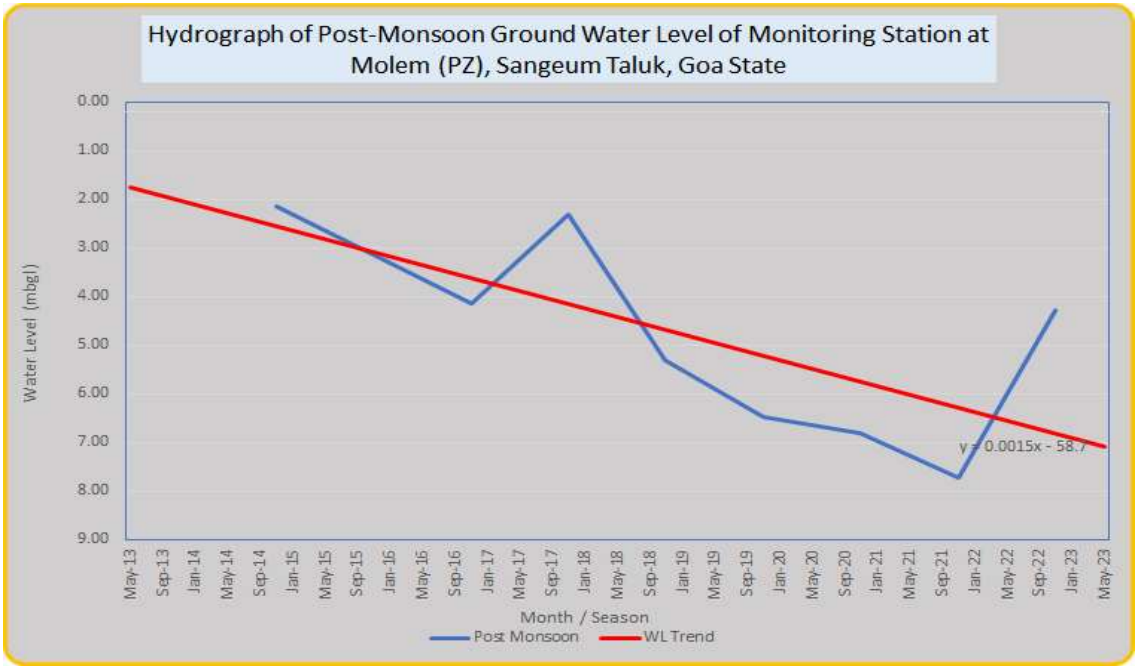


Fig.7r

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

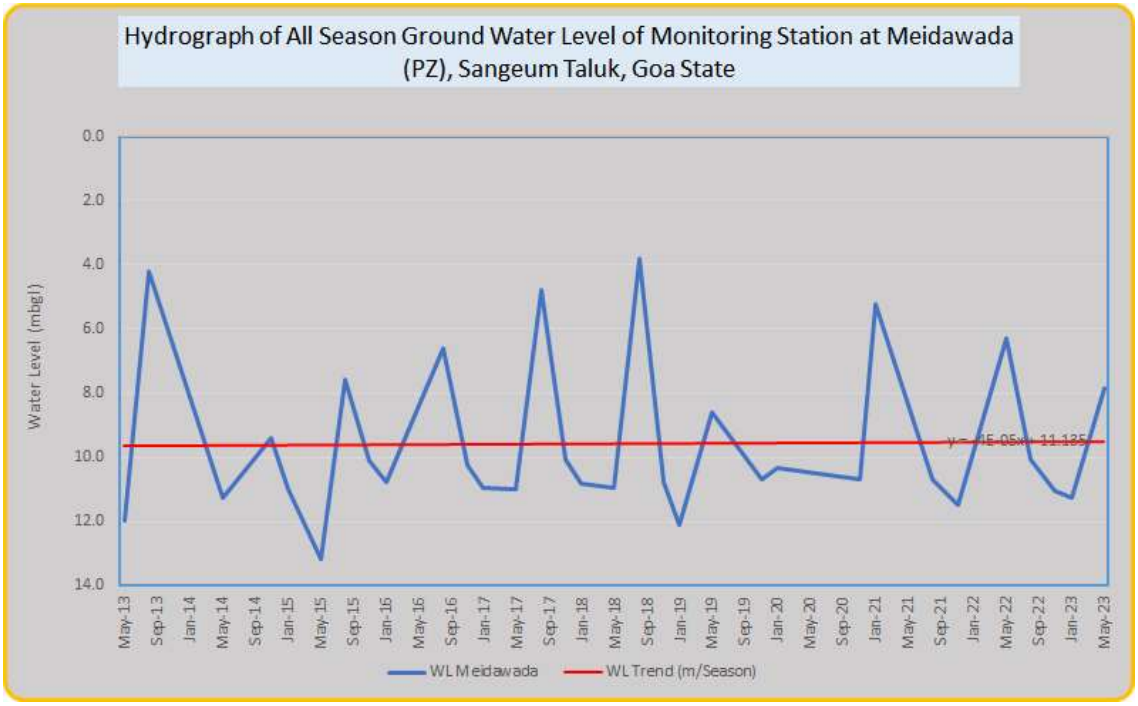


Fig.7s

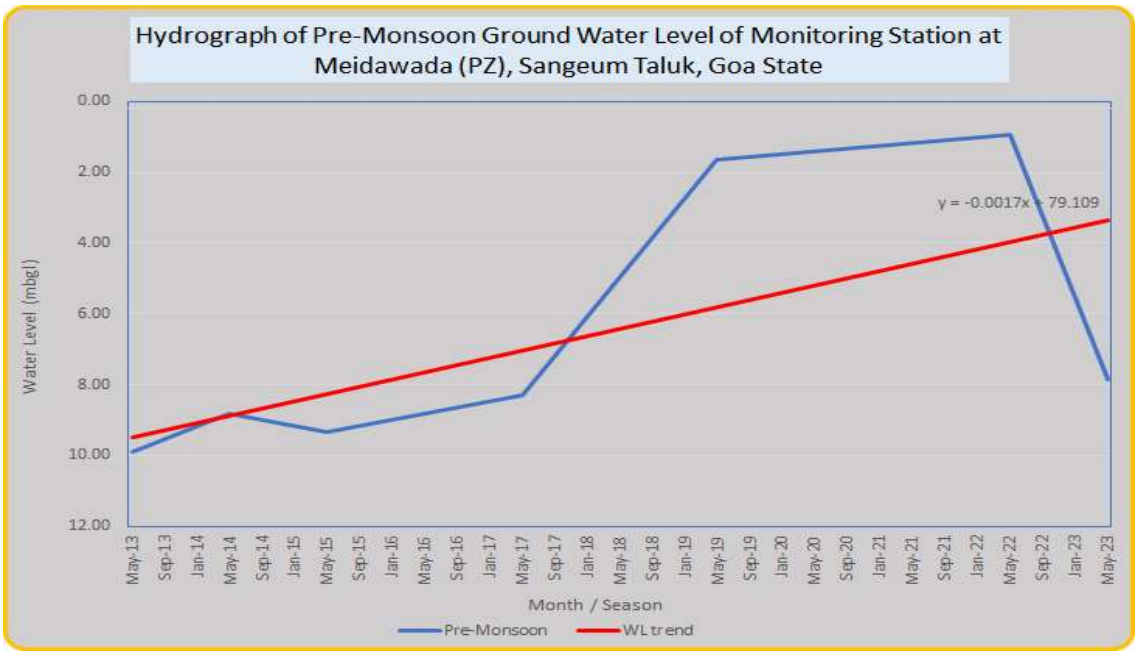


Fig.7t

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

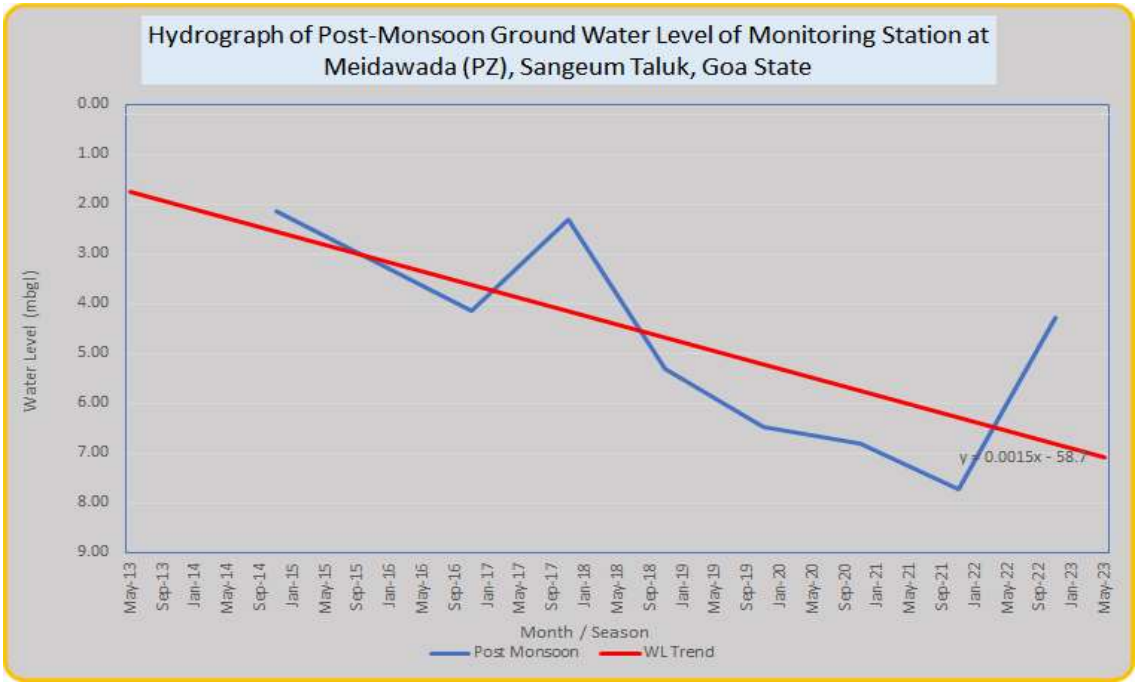


Fig.7u

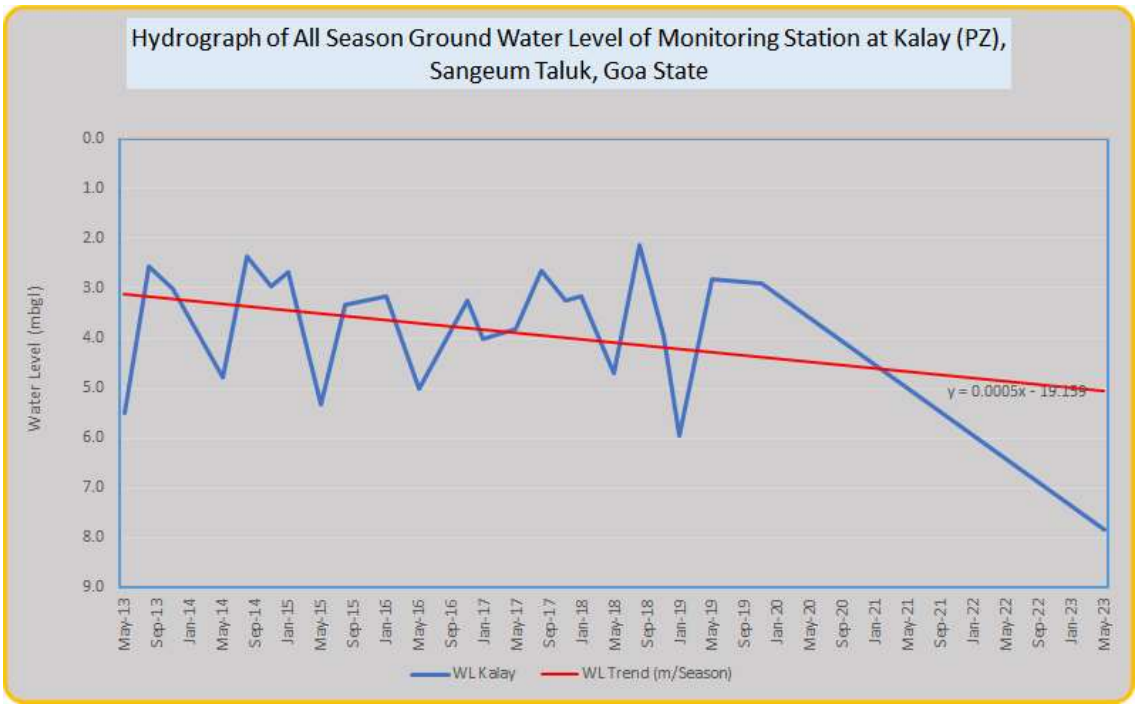


Fig.7v

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

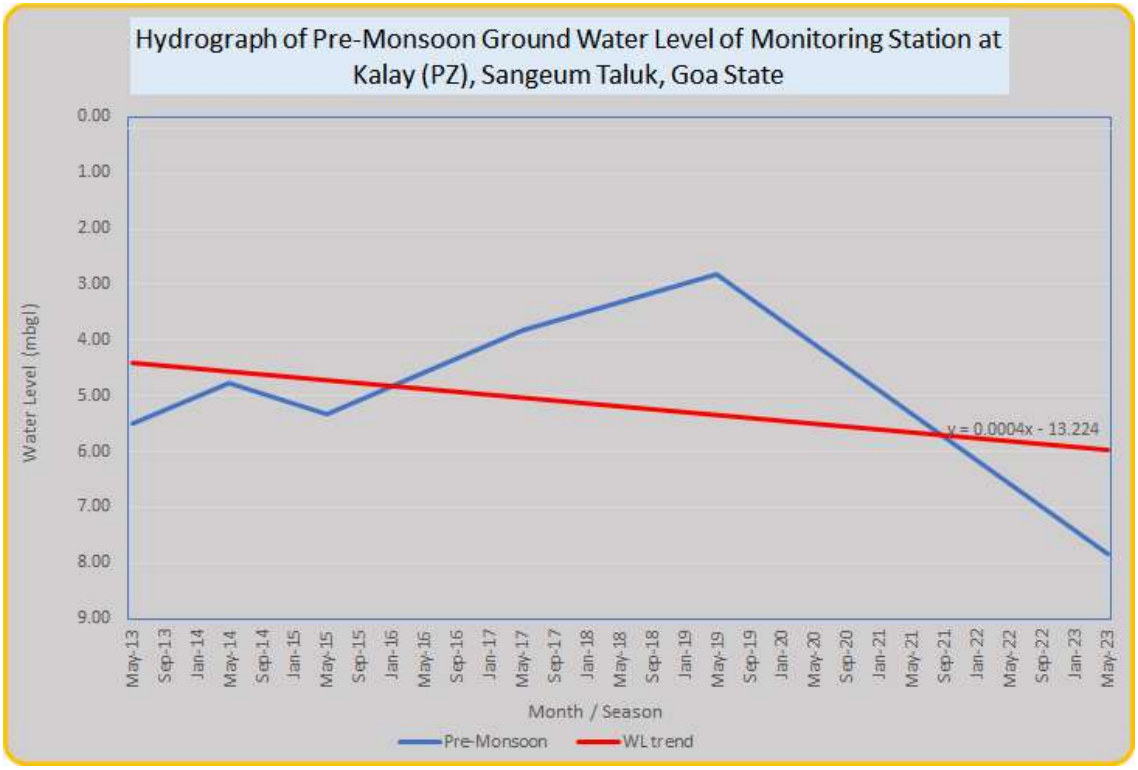


Fig.7w

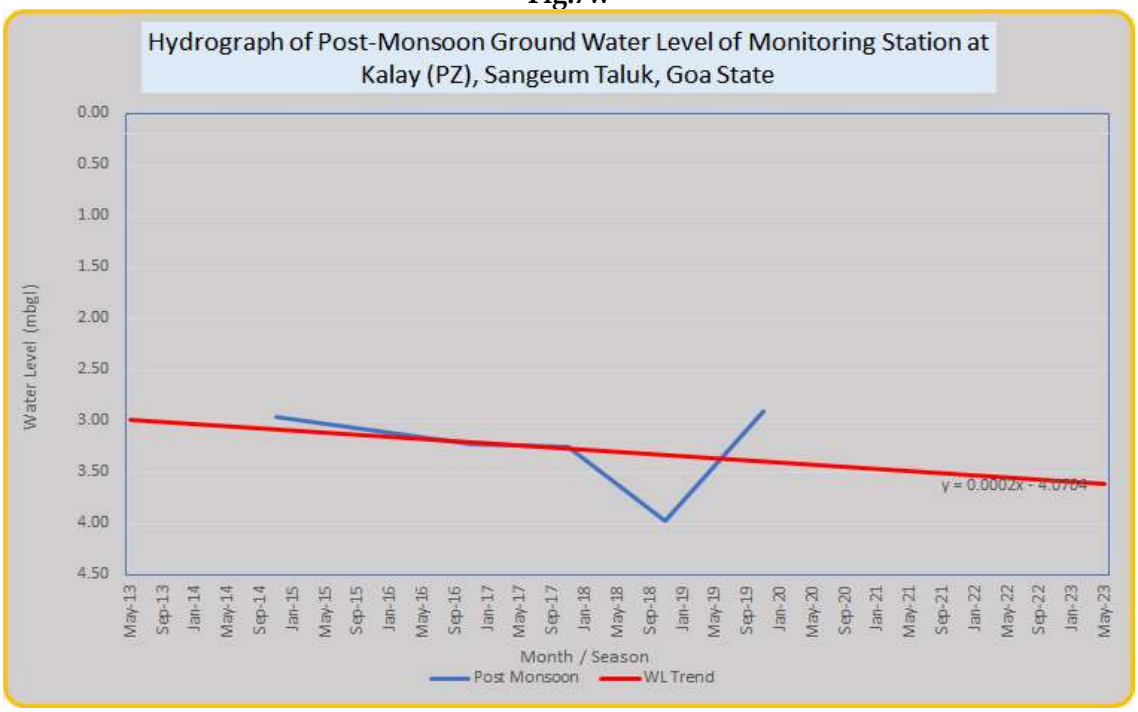


Fig.7x

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

5.12 Water level trend analysis and 5 years projected water level

Water level trend analysis is carried out on data collected from 8 Ground water monitoring stations of Central Ground Water Board (CGWB). The data available with these observation wells is from January 2011 to May 2023 i.e. for 13 years and considered to be long enough to carry out trend analysis. Four wells are monitoring the shallow aquifers (Open wells) and Four wells monitoring the Deeper aquifers (Piezometers) of Sangeum taluk, which are considered to extrapolate the trend analysis results to the study area. Trend analysis is calculated for pre-monsoon and post-monsoon water level using 'linear regression' method is applied using 'Microsoft Excel trend analysis tool'. Based on current water level trend, the ground water regime is also projected for after five years and presented in **Table - 12** and upon which, following observations are also made.



Fig. 8: Piezometer

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

Table-12: Ground water regime is also projected for after five years

Stationwise Ground water level Trend Analysis (2011- 2023) of CGWB, SangeumTaluk, South Goa district, Goa state				
Station	Ground water level Trend (m/ Year)		Projected DTW after 5 years based on present trend	
	Pre-Monsoon	Post-monsoon	Pre-Monsoon	Post-monsoon
Bolkharnem (DW)	0.04	-0.08	6.31	5.88
Deulwada Kolamba(DW)	-0.09	-0.06	4.16	3.51
Molem(DW)	-0.13	0.08	15.85	5.62
Netrolim(DW)	0.03	-0.05	9.65	10.83
Collem (PZ)	-0.04	-0.25	6.49	8.57
Molem(PZ)	0.46	-0.42	1.19	9.28
Meidawada(PZ)	0.46	-0.17	4.19	11.85
Kalay(PZ)	-0.12	-0.05	6.58	3.83

1. The Pre-monsoon Water level trend in four stations are rising, and four stations are falling.
    a. The rising trend in the shallow aquifers is observed in Bolkharnem and Netrolim in the range of 0.03 to 0.04 m/year. Whereas rising trend in the deeper aquifers is observed in Molem and Meidawada in the range of 0.46 m/year.
    b. The Declining trend in the shallow aquifers is observed Deulwada Kolamba and Molem in the range of 0.09 to 0.13 m/year. The Declining trend in the deeper aquifers is observed in and Collem and Kalay in the range of 0.04 m/year to 0.12.
2. The post-monsoon season water level in all the eight stations of both shallow and deeper aquifers in the taluk is exhibiting declining trend which is a common phenomenon in the lateritic formations.
3. The water level trend of these eight wells is projected for five years based on the present water level trend and following observations are made.
    a. The projected water level of shallow aquifer zone ranges from 4.16 to 15.85 m
    b. The pre-monsoon projected water level of shallow aquifers continue to rise in Bolkharnem and Netrolim (6 to 9 m/year) and showing declining Deulwada Kolamba and Molem in the range of 9 to 15 m/year
    c. The post-monsoon projected water level of shallow aquifers continues to rise in Molem and Netrolim (5 to 10 m/year) and showing declining Deulwada Kolamba and Bolkharnem in the range of 4 to 6 m/year.
    d. The pre-monsoon projected water level of Deeper aquifers continue to rise in Molem and Meidawada in the range of 1 to 4 m/year and showing declining Collem and Kalay in the range of 6 m/year.
    e. The post-monsoon projected water level of Deeper aquifers continues to decline in all the four stations Collem, Molem, Meidawada and Kalay in the range of 3.83 to 11.85 m/year.

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

5.13 Details Of Piezometer Already Constructed For Monitoring Water Levels And Water Quality

a. Piezometer

There are two piezometers in the project area. These two Piezometers will be used for monitoring of water levels on a monthly basis**.**

5.14 The Sub Surface Geological Formation And Hydrogeological Scenario Of Deeper Semi Confined To Confined Aquifers Around The Mining Block

The proposed mining activities are at deeper levels. Hence, the aquifer disposition and lithological configurations where the maximum mining activities are taking place is of utmost importance to assess the impact of mining on ground water regime. To know the sub surface configuration of geological setting and aquifer characteristics of the area around the mining blocks, the basic data report of the exploratory bore hole/piezometers at Kalay constructed by CGWB is examined. Kalay village lies 150 17'20" and longitude 74011'10" falling in Survey of India toposheet number 48I/3.The site is located in the premises of Panchayat office, Kalay.

GENERAL FEATURES

The bore well at Kalay was drilled under the Hydrology Project-II in Sanguem taluk of South Goa district for monitoring the groundwater level. Kalay village is located North of Sanguem at a distance of about 12 kms on Molem road. The village lies at the latitude 150 17'20" and longitude 74011'10" falling in Survey of India toposheet number 48I/3.The site is located in the premises of Panchayat office, Kalay.

GEOLOGICAL DATA

The area is underlain by Bicholim formation of Goa Super Group. The Bicholim formation overlies the Savardem formation conformably and it includes quartz-chlorite-amphibole schist, ferruginous pink phyllite, manganiferous chert breccias and banded ferruginous quartzite. The quartz-chlorite-amphibole schist is light to dark green in color, fine to medium grained, schistose and contains quartz, chlorite and magnetite. These rocks covered by a mantle of laterite. The ground water occurs in laterite, weathered zones, jointed and fractured.

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

LITHOLOGY

During the drilling, the drill cutting samples were collected after every meter of drilling. The samples collected were dried and stored in labeled sample bags and were examined for the preparation of lithological log and presented below

Lithological log of Kalay bore well

Sr.No.	Depth (m)	Lithology
1	0-12	Lateritic soil
2	12-21	Lateritic gravel reddish brown colour, size 2-3mm
3	21-24	Lateritic **Clay** reddish brown in colour mixed with quartz
4	24-30	Lateritic gravel white in colour, gravel size 1-2mm with quartz
5	30-36	Manganiferrous **clay** associated with quartz black colour
6	36-41	Chert breccias, black colour, medium to fine grained, hard and compact associated with quartz

WELL CONSTRUCTION

The well assembly was recommended on the basis of litholog and the detail well assembly is given in below.

Details of well assembly of bore well at Kalay, South Goa district

Depth (m)		**Length of pipe (m)**	**Diameter (inches)**	**Description**
From	**To**			
0	0.60 agl	0.6	4	Blank PVC pipe
0	9.40 bgl	9.40	4	Blank PVC pipe
9.40	12.40 bgl	3.0	4	Slotted PVC pipe
12.40	24.40 bgl	12.0	4	Blank PVC pipe
24.40	30.40 bgl	6.0	4	Slotted PVC pipe
30.40	36.40bgl	6.0	4	Blank PVC pipe
36.40	39.40bgl	3.0	4	Slotted PVC pipe
39.40	40.40bgl	1.0	4	Blank PVC pipe& Bail Plug

HYDROGEOLOGICAL DATA

1. Static Water Level:
Depth to Water of bore well was 11.40 mbgl
2. Discharge: The discharge during development was 0.41 lps.

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

WELL HYDRAULICS

No Pumping test was conducted in the piezometer at the time of constructionbecause the ground water potential is negligible as evidenced from the low drilling discharge of 0.41 lps.

A perusal of the lithology and the well assembly clearly shows that out of 41 meter zone drilled, the well-constructed portion by providing slotted pipe is only 12 meter and the remaining thickness of 29 m of formation is made of impermeable loose clayey materials devoid of aquifer and they act as aquicludes . Even the 12 m aquifer zone tapped yields only 0.41 liter per second(LPS), which clearly shows that Aquifer is less potential and mining does not result in any adverse impact on the ground water regime. Chemical Quality of deeper aquifer

		Concentration in mg/l												
pH	EC µS/cm at 25°	TDS	C03 - -	HC03	Cl^-	NO_3	SO_4	F -	Ca^{++}	Mg ++	TH	Na^+	K^+	
7.7	1870	1197	0	61	540	6	106	0.19	24	60	310	276	7.3	

Long term trend in Ground water level

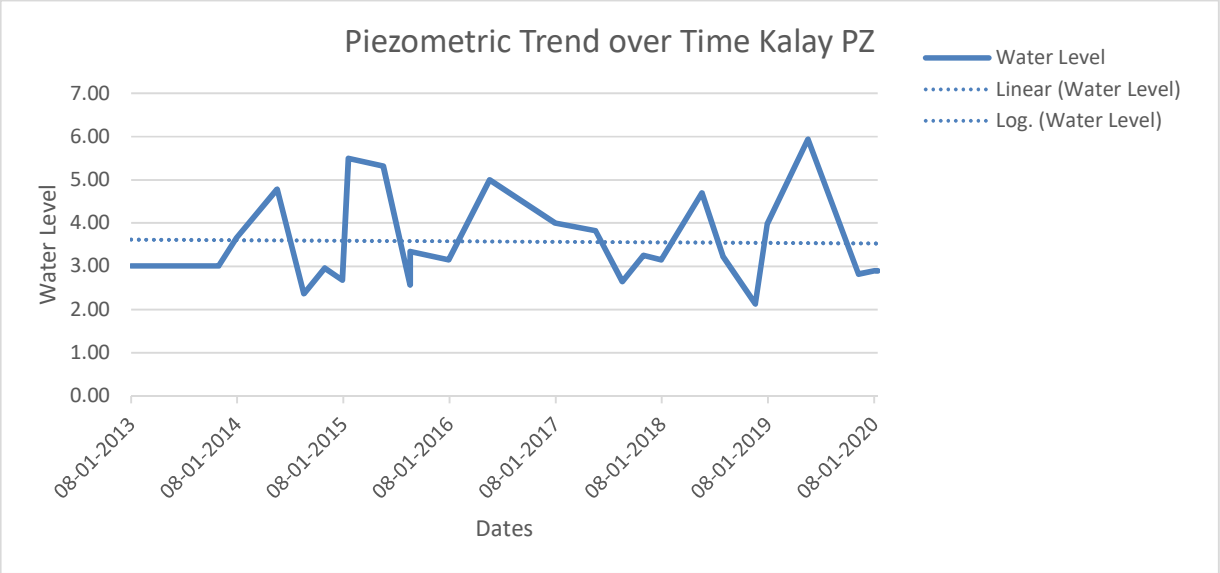
To know the long term trend in Ground water level (Piezomtric surface) of the deeper aquifer, the water level monitored from the piezometer at Kalay by CGWB is collected for a decade and presented below.

District	Tahsil / Taluk	Village	Latitude	Longitude	Date	Depth to Water Level(mbgl)
South Goa	Sangeum	Kalay	15.1724	75.112	08-01-2013	3.01
South Goa	Sangeum	Kalay	15.1724	75.112	05-11-2013	3.01
South Goa	Sangeum	Kalay	15.1724	75.112	05-01-2014	3.66
South Goa	Sangeum	Kalay	15.1724	75.112	25-05-2014	4.78
South Goa	Sangeum	Kalay	15.1724	75.112	25-08-2014	2.37
South Goa	Sangeum	Kalay	15.1724	75.112	05-11-2014	2.96

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

South Goa	Sangeum	Kalay	15.1724	75.112	25-01-2015	5.50
South Goa	Sangeum	Kalay	15.1724	75.112	25-08-2015	2.57
South Goa	Sangeum	Kalay	15.1724	75.112	05-01-2015	2.68
South Goa	Sangeum	Kalay	15.1724	75.112	25-05-2015	5.32
South Goa	Sangeum	Kalay	15.1724	75.112	25-08-2015	3.34
South Goa	Sangeum	Kalay	15.1724	75.112	05-01-2016	3.15
South Goa	Sangeum	Kalay	15.1724	75.112	25-05-2016	5.00
South Goa	Sangeum	Kalay	15.1724	75.112	05-01-2017	4.00
South Goa	Sangeum	Kalay	15.1724	75.112	25-05-2017	3.82
South Goa	Sangeum	Kalay	15.1724	75.112	25-08-2017	2.65
South Goa	Sangeum	Kalay	15.1724	75.112	05-11-2017	3.25
South Goa	Sangeum	Kalay	15.1724	75.112	05-01-2018	3.15
South Goa	Sangeum	Kalay	15.1724	75.112	25-05-2018	4.70
South Goa	Sangeum	Kalay	15.1724	75.112	05-08-2018	3.23
South Goa	Sangeum	Kalay	15.1724	75.112	25-11-2018	2.13
South Goa	Sangeum	Kalay	15.1724	75.112	05-01-2019	3.97
South Goa	Sangeum	Kalay	15.1724	75.112	25-05-2019	5.94
South Goa	Sangeum	Kalay	15.1724	75.112	20-01-2020	2.90
South Goa	Sangeum	Kalay	15.1724	75.112	15-11-2019	2.82
South Goa	Sangeum	Kalay	15.1724	75.112	10-01-2020	2.90

The piezometric surface trend over a decade is plotted and graph is presented below. A perusal of the trend shows that steady state trend with slight rising trend is noticed. Absence of falling trend is also indicates that the mining will not cause any deteriorating effects on ground water regime.



Pumping test

To know the aquifer characteristic, pumping test is conducted in a bore well at Santona outside the core area. The salient details of the borewell conducted pumping test along with the pump test data (Time versus draw down data are furnished below

PUMPING TEST DATA SHEET	
Well type	bore well
Site Name with Coordinates	Santona,Sanguem, Latitude 15.27853,Longitude 74.15435
Location Details	survey No 53/1
District and State	South Goa& Goa
Depth of pump	53mtrs
Diameter of Well in mm/dia of discharge pipe	0.15mtrs
Distance from the observation wells	No Observation Well
Capacity of the pump	3Hp
Discharge	4 lps

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

Measuring Point (m)	0.55MAGL			
SWL in m below measuring point	19.32 mtrs			
SWL in m belowGL	18.77 mtrs			
Clock Time (HH/MM) 10.01.24	Time Since Pump Started (min)	Water Level (m bmp)	Water Level (m bgl)	Drawdown (m)
8.00 Am	1	22.81	22.26	3.49
	2	22.9	22.35	3.58
	3	24	23.4	4.63
	4	24.6	24.05	5.28
	5	24.9	24.39	5.62
	6	25.5	24.9	6.13
	7	25.7	25.15	6.38
	8	26	25.48	6.71
	9	26.3	25.75	6.98
	10	26.5	25.9	7.18
	12	26.9	26.35	7.58
	14	27.2	26.6	7.83
	16	27.5	26.9	8.13
	18	27.7	27.1	8.33
	20	27.9	27.35	8.58
	25	28.3	27.77	9
	30	28.70	28.15	9.38
	35	29.08	28.53	9.76
	40	29.45	28.90	10.13
	45	29.83	29.28	10.51
	50	30.28	29.73	10.96
	55	30.63	30.08	11.31
	60	31.10	30.55	11.78
	65	31.45	30.90	12.13

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

	70	31.78	31.23	12.46
	75	32.10	31.55	12.78
	80	32.55	32.00	13.23
	85	32.88	32.33	13.56
	90	33.16	32.61	13.84
	95	33.40	32.85	14.08
	100	33.58	33.03	14.26
	110	33.95	33.40	14.63
	120	34.08	33.53	14.76
	130	34.55	34.00	15.23
	140	34.96	34.41	15.64
	150	35.35	34.80	16.03
	160	35.68	35.13	16.36
	170	35.95	35.40	16.63
	180	36.15	35.60	16.83
	190	36.30	35.75	16.98
	200	36.57	36.02	17.25
	220	36.95	36.40	17.63
	240	37.34	36.79	18.02
	260	37.70	37.15	18.38
	280	38.00	37.45	18.68
	300	38.30	37.75	18.98
	330	38.58	38.03	19.26
	360	38.85	38.30	19.53
	390	39.10	38.55	19.78
	420	39.30	38.75	19.98
	450	39.48	38.93	20.16
	480	39.63	39.08	20.31
4.00 Pm	510	39.75	39.20	20.43

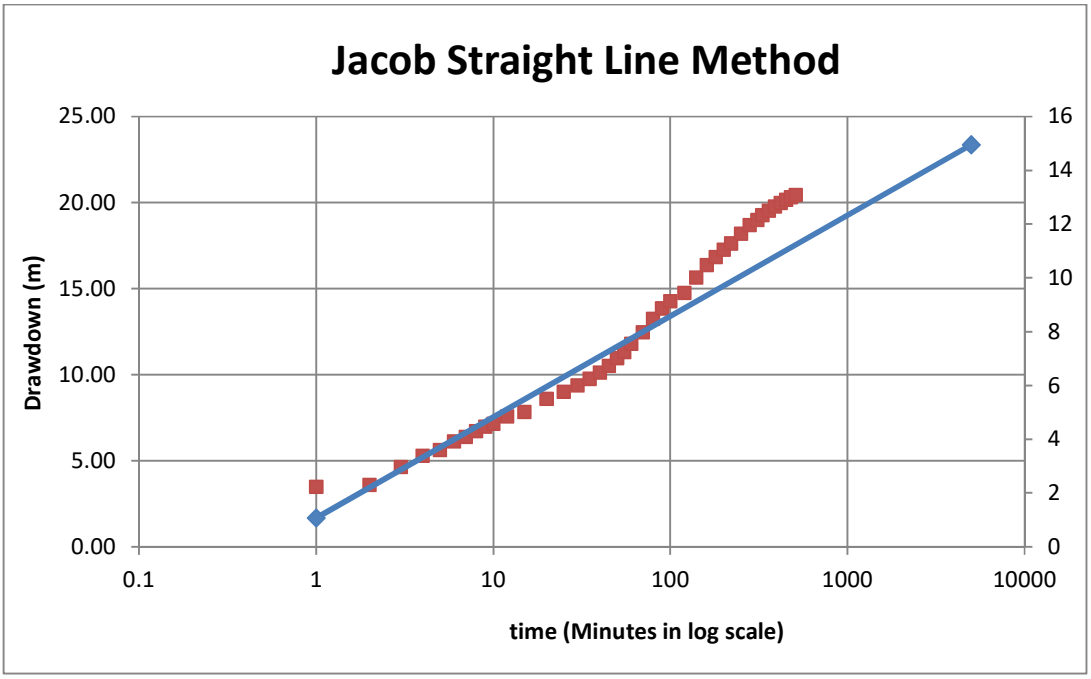
PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

RECUPERATION TEST DATA SHEET						
Time Since Pump Stopped (min) (t)	Time Since Stopping of Pumping (min) (t')	Water Level (m bmp)	Water Level (m bgl)	Recovery (m)	Residual Drawdown s'(RDD) (m)	t/t'
4.00 Pm	1	32.30	31.75	7.45	12.98	511
	2	30.50	29.95	9.25	11.18	256
	3	29.25	28.7	10.50	9.93	171
	4	27.92	27.37	11.83	8.6	129
	5	27.00	26.45	12.75	7.68	103
	6	26.20	25.65	13.55	6.88	86
	7	25.70	25.15	14.05	6.38	73.9
	8	25.12	24.57	14.63	5.8	64.8
	9	24.69	24.14	15.06	5.37	56.6
	10	24.37	23.82	15.38	5.05	51
	12	23.82	23.27	15.93	4.5	42.6
	14	23.28	22.73	16.47	3.96	36.7
	16	22.86	22.31	16.89	3.54	32.3
	18	22.40	21.85	17.35	3.08	28.8
	20	22.19	21.64	17.56	2.87	26
	25	21.65	21.1	18.10	2.33	21
	30	21.05	20.5	18.70	1.73	17.7
	35	20.68	20.13	19.07	1.36	15.3
	40	20.35	19.8	19.40	1.03	13.5
	45	20.02	19.47	19.73	0.7	12.1
	50	19.80	19.25	19.95	0.48	11
	55	19.55	19	20.20	0.23	10.1
	60	19.40	18.85	20.35	0.18	9.33
	65	19.24	18.69	20.51	0.13	8.69
	70	19.04	18.49	20.71	0.08	8.14
	75	18.91	18.36	20.84	0.05	7.66
	80	18.79	18.24	20.96	0.03	7.25
5.25 Pm	85	19.34		20.41	0.02	6.88

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

Pumping test analysis

The time draw down data of pump test is analyzed as per the Jacob straight-line method. Delata S value obtained is 3.75-.The discharge rate is 345 m3/day



Data		
Q Discharge	345	m3/day
r	0	m

Δs	3.753072	d'less
t_0	0.51862	Minutes
t_0	0.00036	days
T	16.84364	m2/day
S	NA	d'less

The transmissivity obtained as per Jacob straight line method is 16.84m2/day, which is low due the less potential aquifer and its low hydraulic conductivity. This also supports the fact that the impact of mining will not have any detrimental effect to the ground water regime. Storage coefficient is not calculated since there is no observation bore well.

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

6.0 GROUND WATER RESOURCES

The ground water resources for the study area were assessed as per the methodology adopted by the Ground Water Estimation Committee 97 methodology (GEC97) for the year 2020. The resources were calculated by infiltration method due to non-availability of long-term water level data and fluctuation in the area. The rain fall recharge was calculated by Rainfall Infiltration method. Domestic water requirement has been estimated based on population as per census, by taking the average per capita consumption as 60 liter per day by considering 100 % dependence of total population on ground water. The ground water draft for irrigation was calculated from number of ground water abstraction structures and unit draft.

Water Resources Department, Government of Goa in association with Central Ground Water Board has been making all efforts to assess the quality of ground water estimation since last ten years. Of late, the ground water has gained more importance due to scarcity of surface water and frequent fluctuations in supply of water to the various consumers. Keeping this in view, the Government of Goa has enacted Goa Ground Water Regulation Act 2002. The attempt has been made by the Department of Water Resources, Government of Goa and Central Ground Water Board, South Western Region, Bangalore to assess the resources of State of Goa as per the Ground Water Estimation Methodology 2015 on administrative unit basis. The Annual Extractable Ground Water Resources as on March 2020 in the state of Goa is 32169.66 HAM and stage of ground water extractions is 23.48%.

Groundwater resources were estimated considering taluk as unit of assessment for the base year 2020. There are 12 taluks. The taluks were divided into sub units of command, non-command, poor quality and hilly areas of more than 20% are supposed to have very quick run off and contribute little recharge to the ground water. Similarly the areas having massive rock exposures are also not suitable for augmenting recharge to ground water. Hence such areas are excluded from recharge calculations. The resources were estimated by water table fluctuation method.

The recharge to ground water is computed separately for monsoon and non-monsoon months. The recharge was computed by water table fluctuation method and rainfall infiltration method. The percentage difference was calculated and normalisation was also done.

The Annual Extractable Ground Water Resources as on March 2020 for the state of Goa is 32169.66 HAM, while the existing ground water extraction for all uses is 7554.75 HAM, and the net available resource for future irrigation development is 24190.33 HAM.

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

The average stage of ground water development in North Goa district is 24.26% with Bicholim taluk recording the lowest stage of development of 13.01%, while Bardez taluk recording the highest stage of development of 32.81%.

In respect of south Goa district, the average stage of development is 21.49% with Cancona taluk recording the lowest stage of development of 8%, while Marmagao taluk has recorded the highest stage of development of 40.07%. The overall stage of ground water development in the state of Goa is 23.48% and all the taluks are falling under safe category.

The salient features of the groundwater resources of the state during 2020 as compared to that in 2017 is presented in **Table-13**

Table-13 Ground Water Resources of Goa.

Particulars	As on 2017	As on 2020
Annual Extractable Ground Water Resources (HAM)	**16033**	**32169.66**
Existing Ground water Extraction for Irrigation (HAM)	**2058**	**2425.14**
Existing Ground water Extraction for domestic and Industrial water supply (HAM)	**3314**	**5129.58**
Existing Ground water Extraction for all uses (HAM)	**5371**	**7554.75**
Provision for domestic and industrial requirement supply for 2025	**3669**	**5168.79**
Net annual ground water availability for future irrigation development (HAM)	**6993**	**24190.33**
Stage of Ground water Extraction (%)	**34**	**23.48**
Category	**Safe**	**Safe**

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

7.0 WATER QUALITY

Water samples were collected from fifteen abstraction structures representing the shallow aquifers (Open wells) in buffer area. The water samples collected were analyzed at Accredited Laboratory. The details of the various constituents prevailing in the area are given in **Table-9**. Water quality in general is safe and potable in all the sites and is within the maximum permissible limits of the Bureau of Indian Standards (BIS). Fluoride, Nitrate, Total dissolved solids, Chloride and Iron are within the maximum permissible limits as per BIS. Electrical conductivity, Chlorides, Nitrate and Flouride distribution in the study area is shown in **Plate-12, Plate-13, Plate-14** and **Plate-15.**

7.1 Electrical conductivity (EC)

Distribution of Electrical Conductivity in the core and buffer area ranges from 41 to 210 micro mhos/cm, which are within the fresh water standards and is potable in all the sites. Electrical Conductance distribution is shown in **Plate 12**.

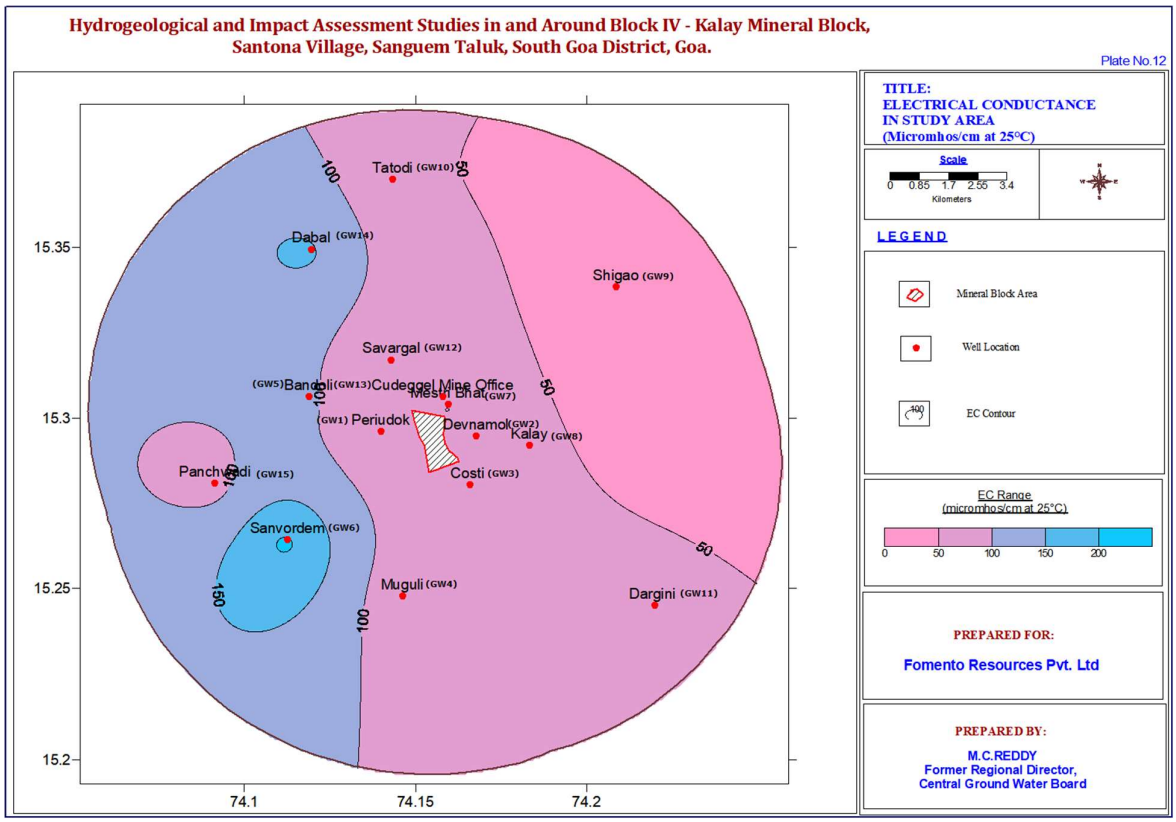


Plate-12 Electrical Conuctance

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

7.2 Chlorides

Chloride distribution in the study area and ranges from 8.5 ppm to 27 ppm and is within the permissible limits prescribed by BIS Standards for drinking water. Chlorides in the Project area and 10 kms radius is shown in **Plate 13.**

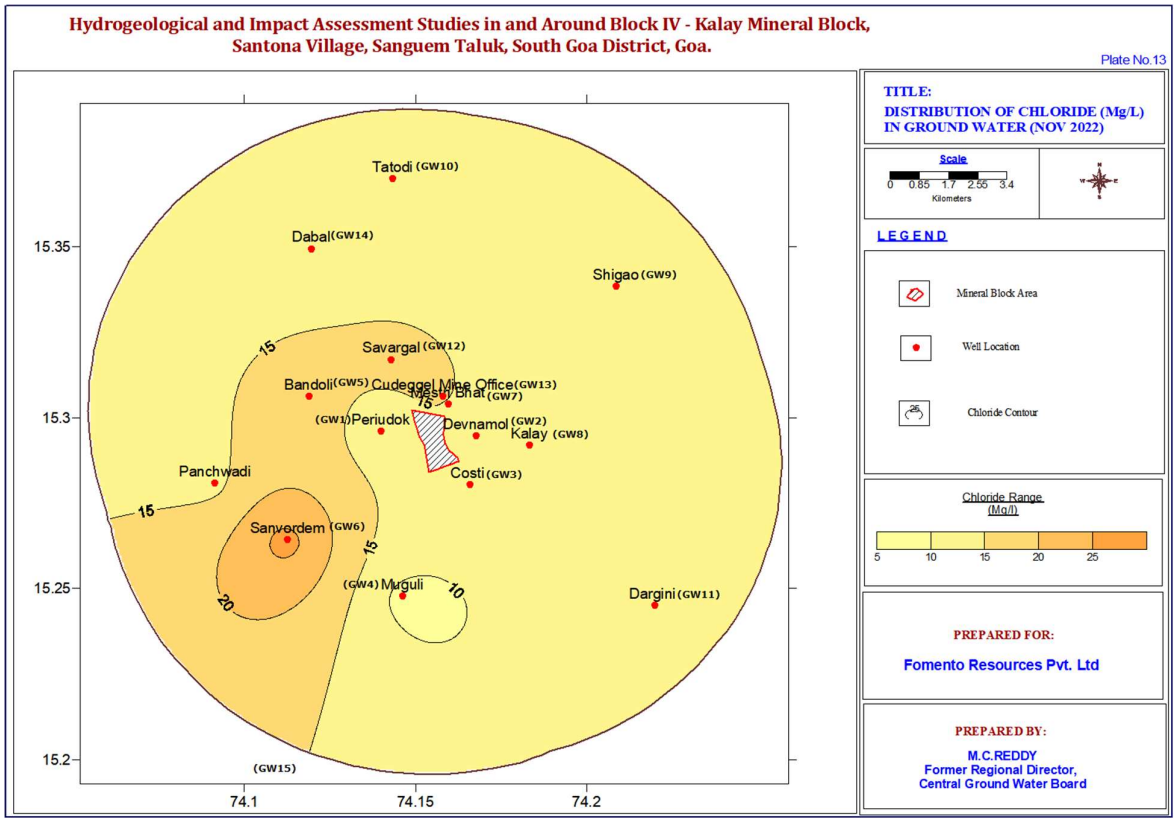


Plate-13: Distribution of Chloride

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

7.3 Nitrates

Nitrate distribution in the study area and ranges from <0.1 mg/l to 0.38 mg/l and is within the permissible limits prescribed by BIS Standards for drinking water. Nitrates in the Project area and 10 kms radius is shown in **Plate 14.**

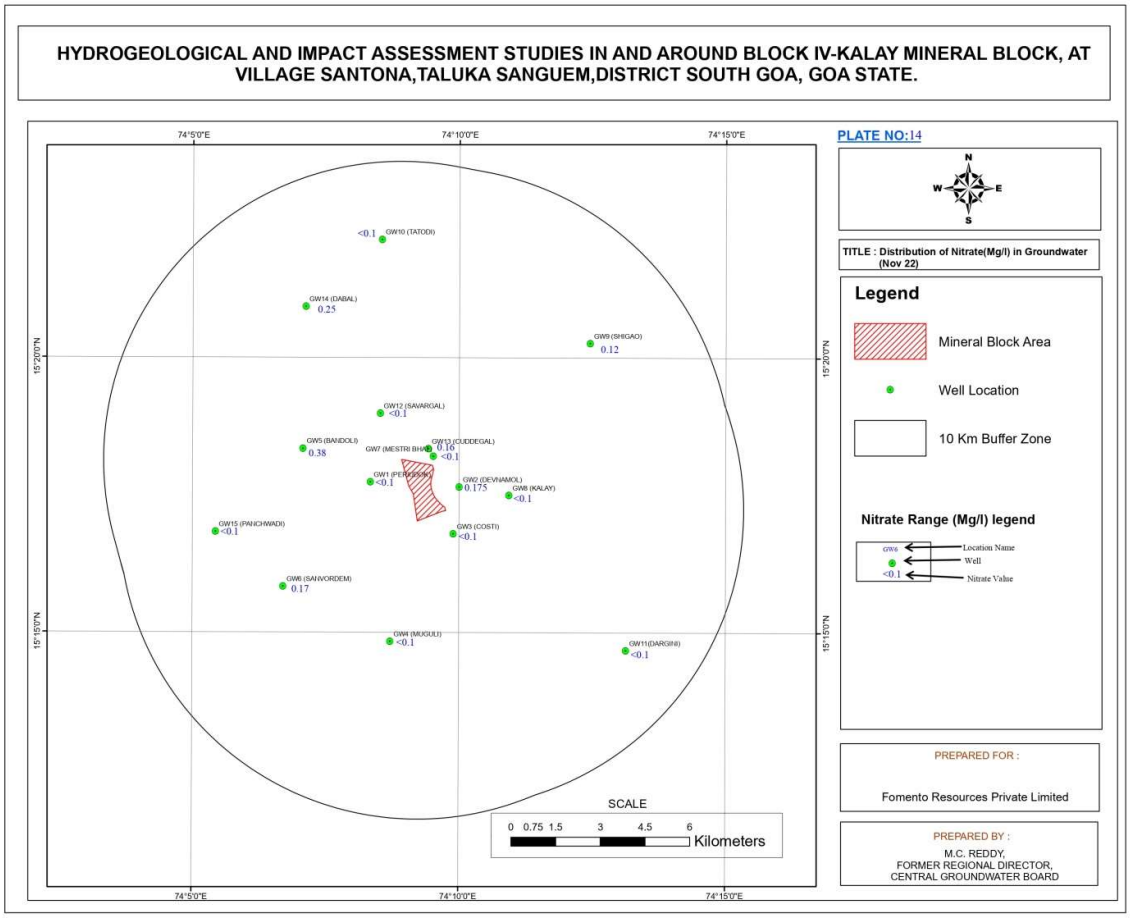


Plate-14: Distribution of Nitrate

7.4 Fluorides

Fluoride distribution in the study area was found to be less than 0.1 mg/l and is within the permissible limits prescribed by BIS Standards for drinking water. Fluoride in the Project area and 10 kms radius is shown in **Plate 15**.

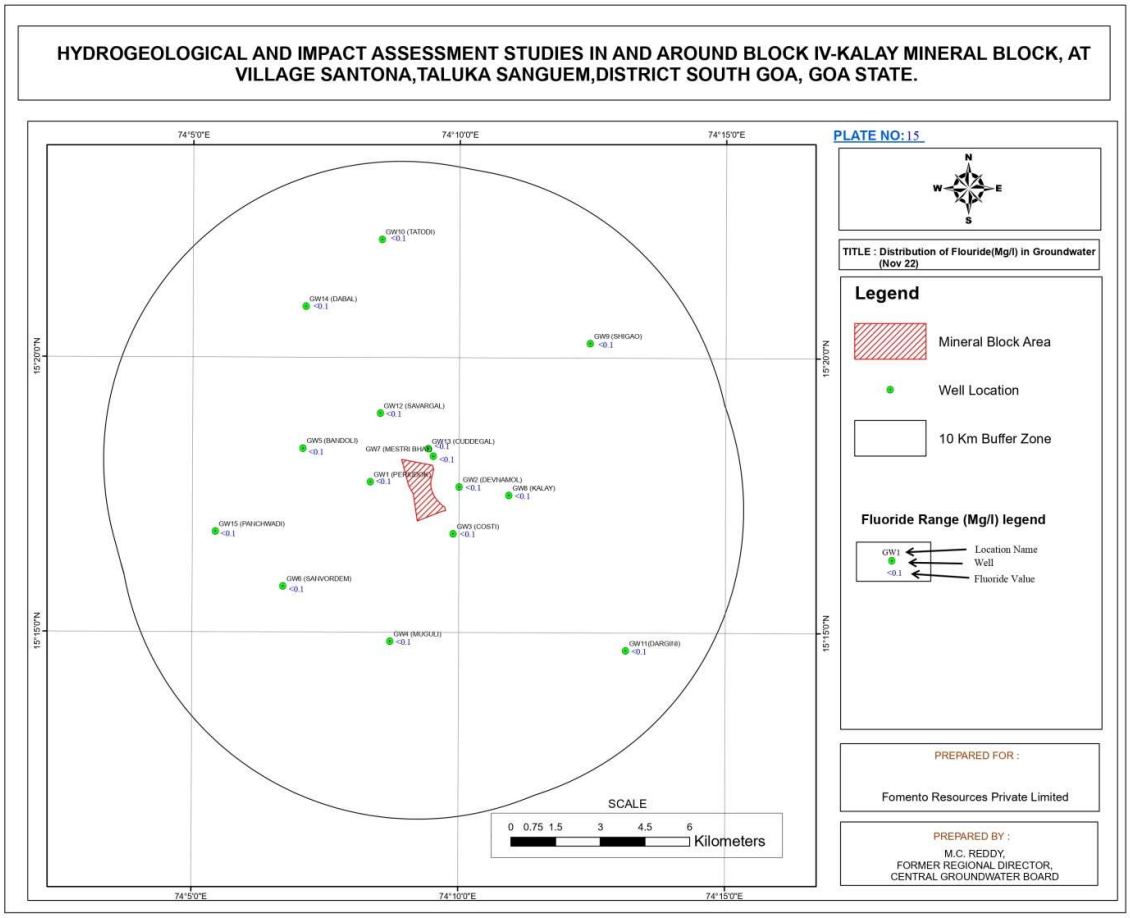


Plate-15: Distribution of Fluoride

7.5 BIS Standards

The suitability of water with reference to the BIS standards vis-à-vis desirable limits and maximum permissible limits in respect of phreatic and deep aquifers are shown in **Fig. 9 to Fig 22**.

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

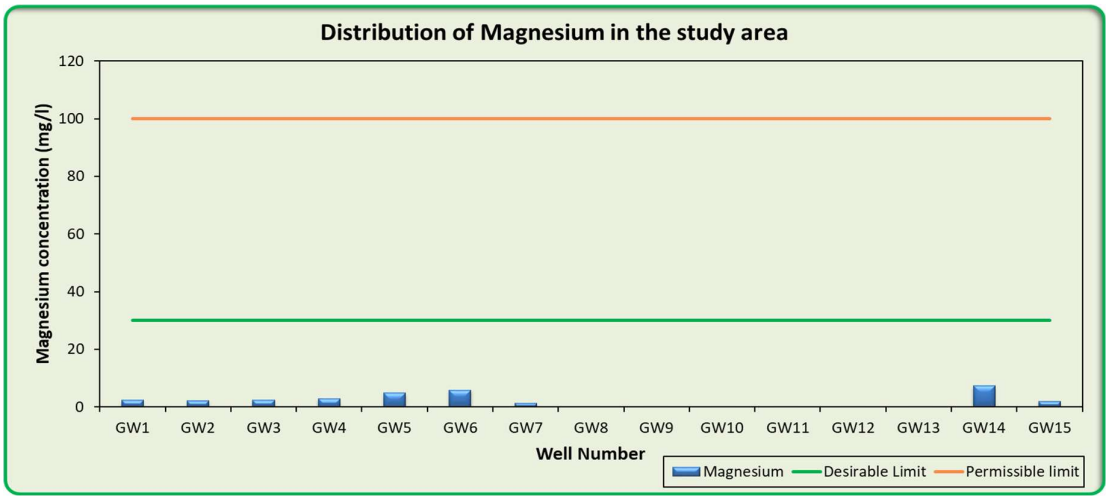


Fig. 9

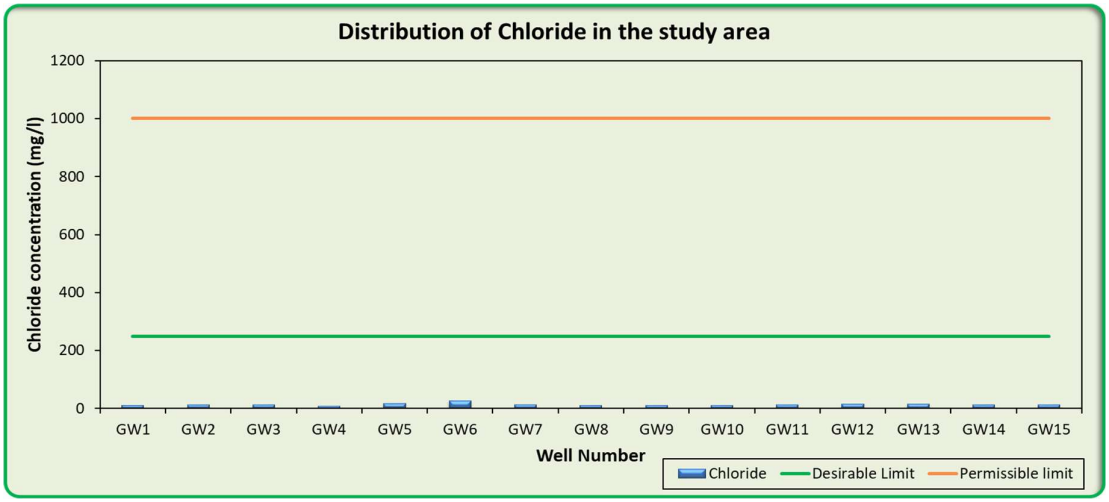


Fig. 10

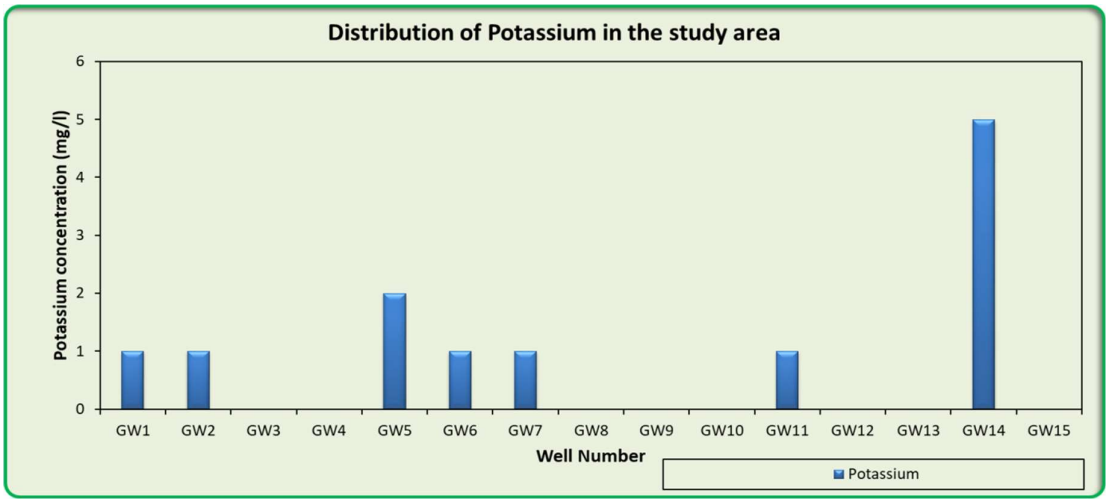


Fig. 11

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

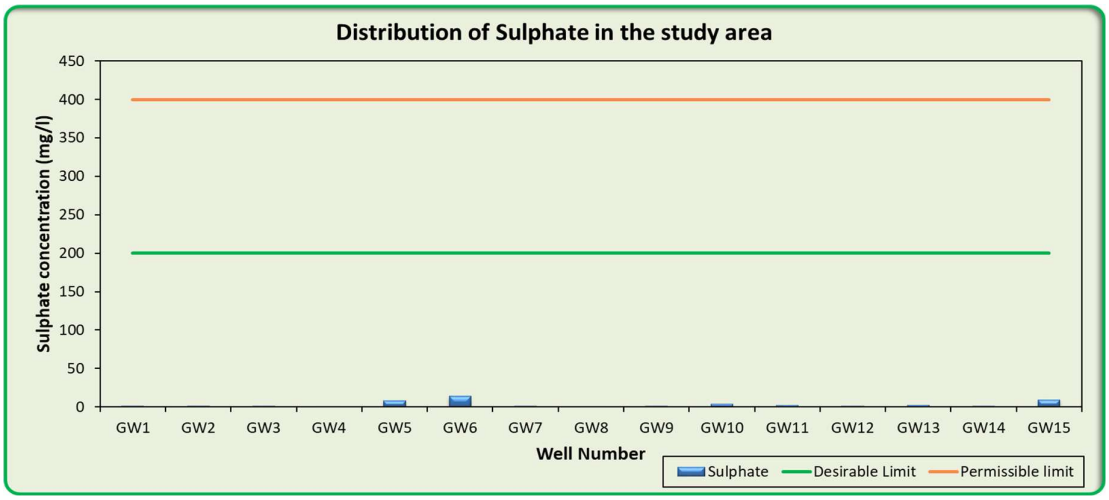


Fig. 12

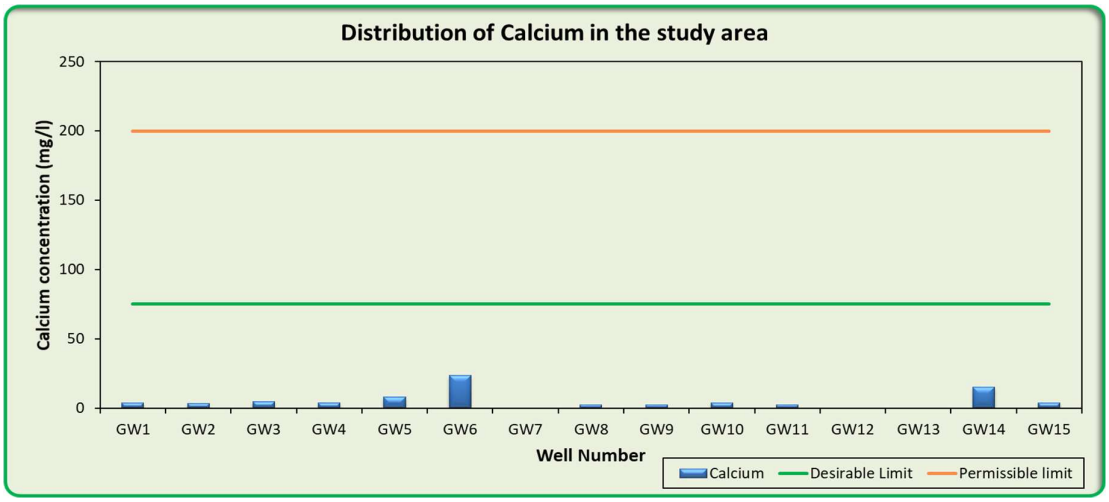


Fig. 13

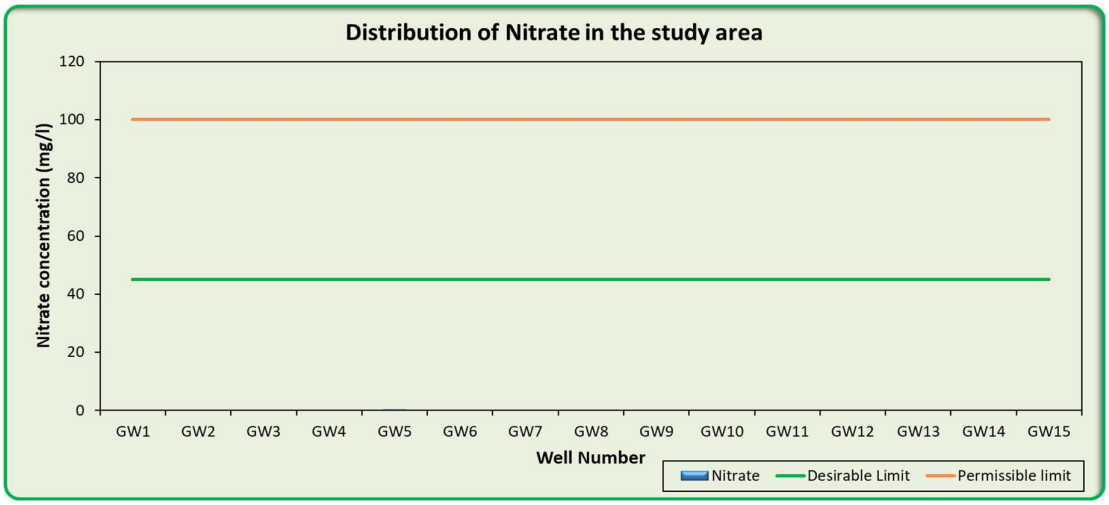


Fig. 14

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

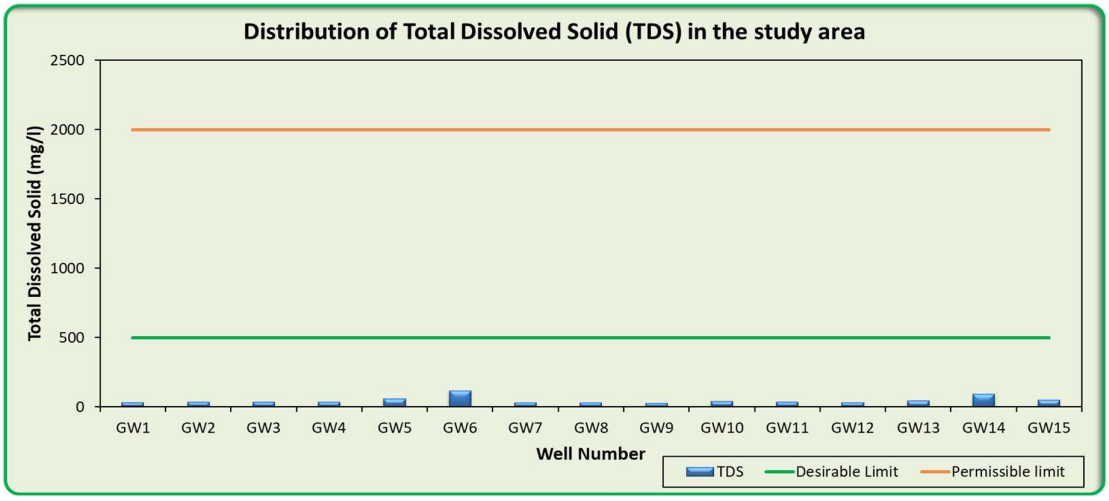


Fig. 15

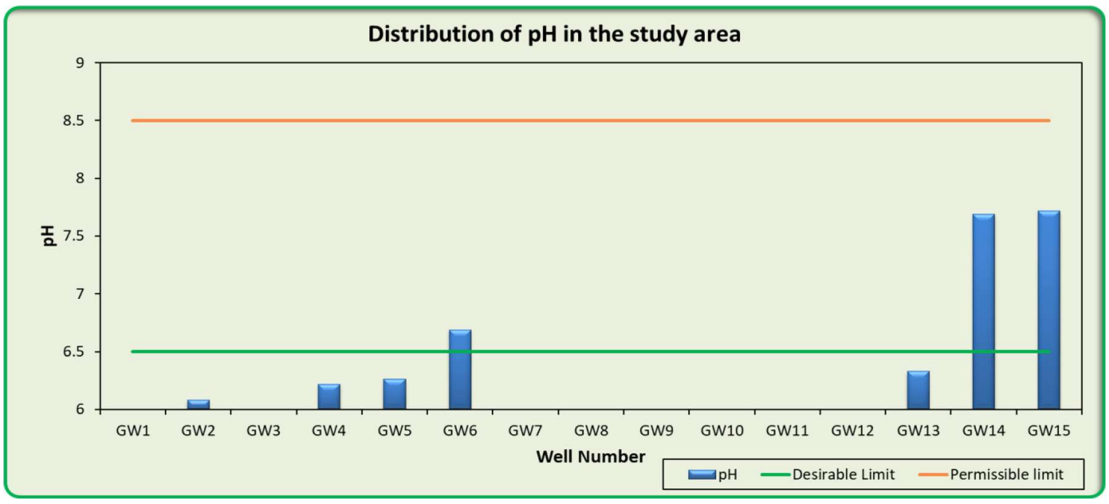


Fig. 16

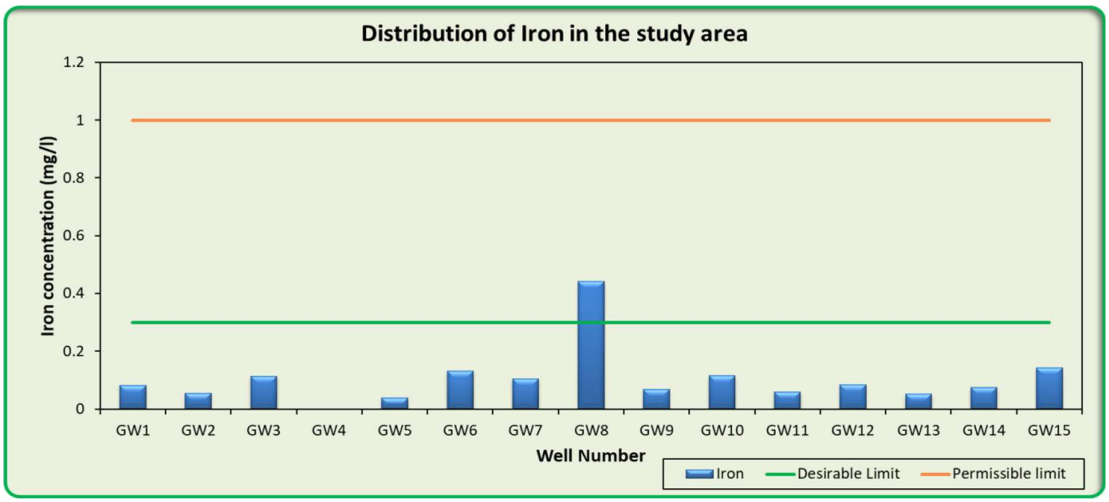


Fig. 17

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

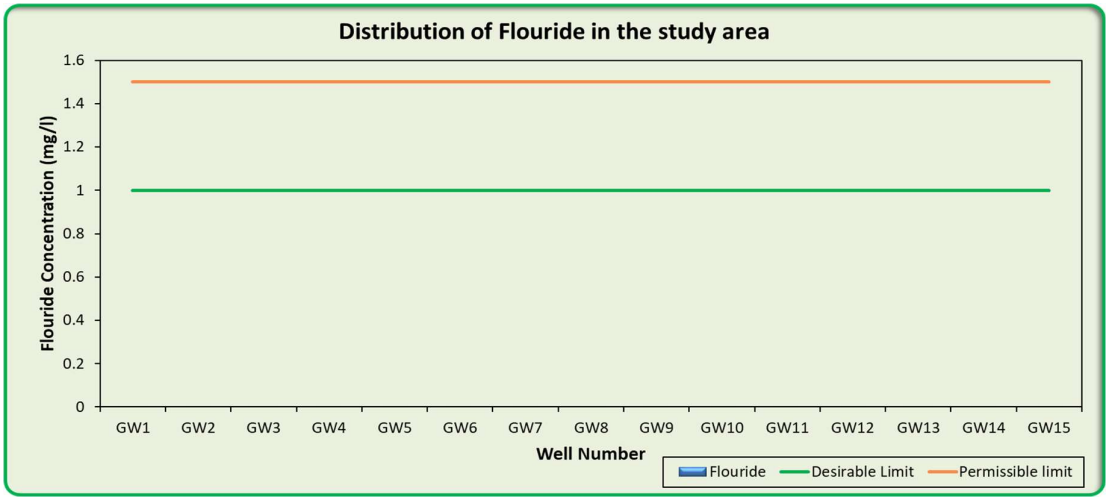


Fig. 18

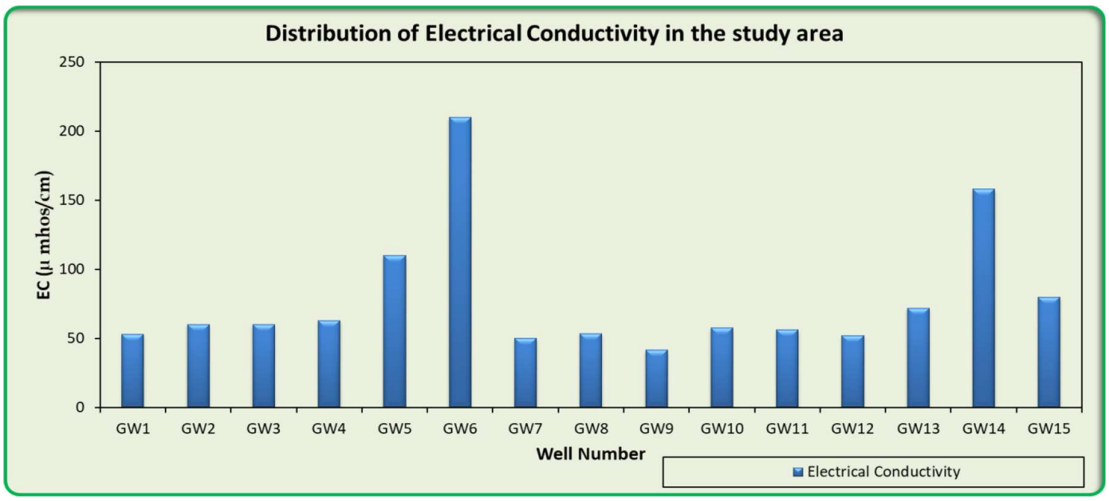


Fig. 19

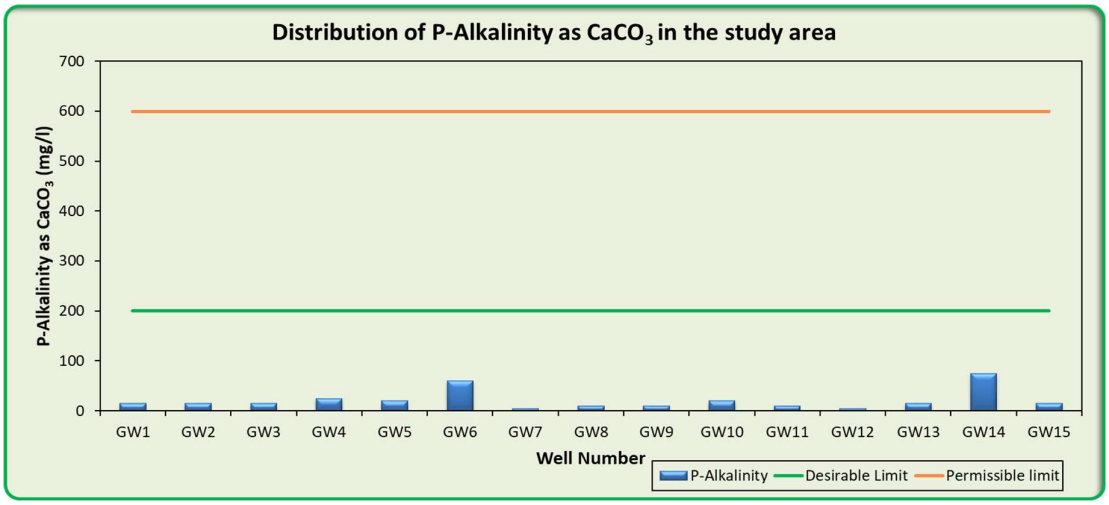


Fig. 20

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

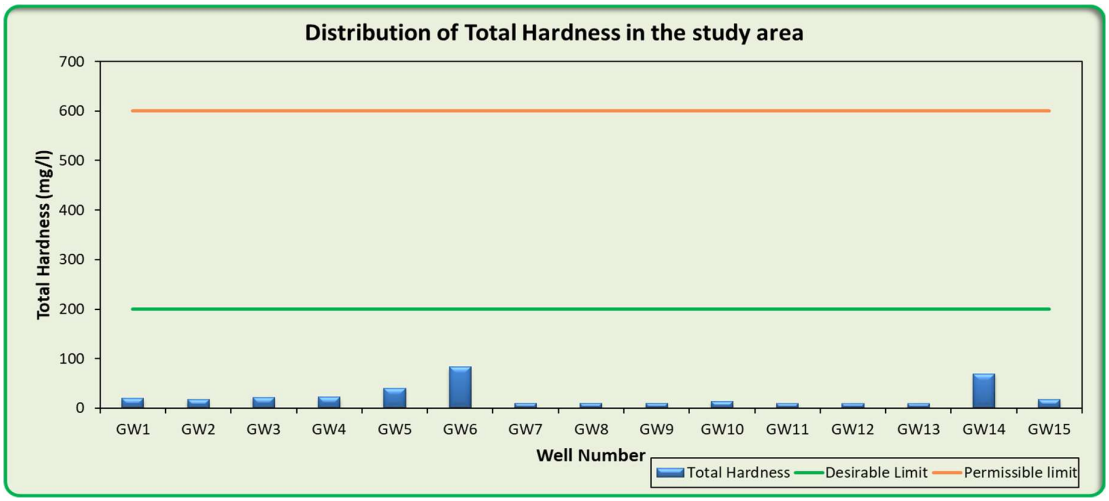


Fig. 21

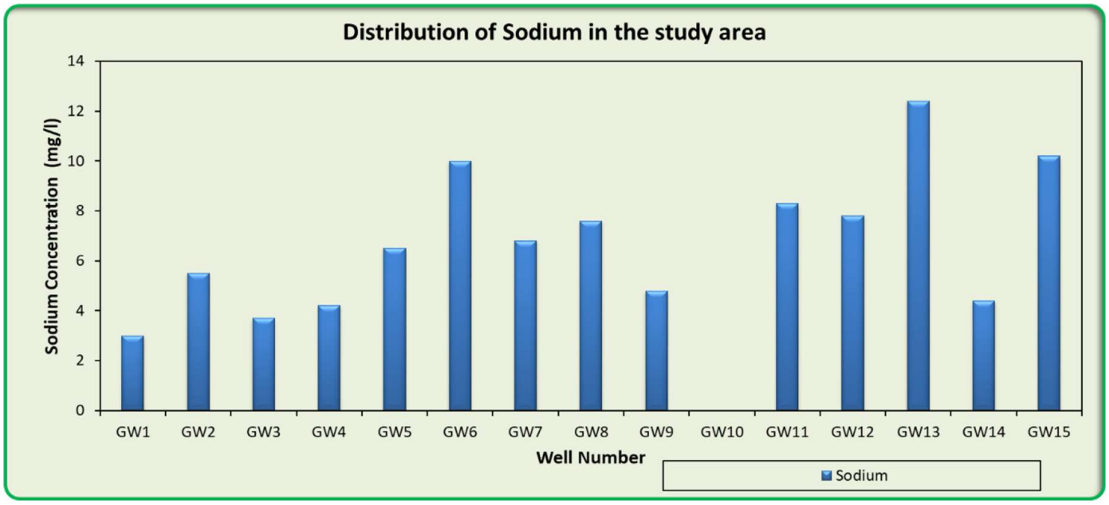


Fig. 22

7.6 Observation Wells for monitoring ground water levels in the study area

Based on the inventory of abstraction structures, established nine network of existing open wells in Core and Buffer area for monitoring water levels on monthly basis, details of the well location are given in **Table-14** and details of the well location for water quality are given in **Table-15.** Water quality monitoring should be once in a year i.e., during Pre-monsoon, (first week of May).

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

Table - 14: Established Network of existing wells in and around the Project for monitoring Water Levels.

Sr. No.	Location	Co-ordinates					
		Latitude (N)			Longitude (E)		
		D	M	S	D	M	S
1	GW4 - Muguli Village	15	14	50.31	74	8	42.76
2	GW8 - Kalay	15	17	29.8	74	10	56.1
3	GW10 - Tatodi	15	22	9.02	74	8	32.61
4	GW11 - Dargini Village	15	14	40.64	74	13	7.94
5	GW12 - Savargal Village	15	18	59.3	74	8	31.22
6	GW13 - Cudeggal	15	18	20.64	74	9	25.29
7	GW14 - Dabal	15	20	55.63	74	7	7.09
8	GW15 - Panchwadi	15	16	49.69	74	5	26

Table - 15: Established Network of existing wells in and around the Project for monitoring Water Quality.

Sr. No.	Location	Co-ordinates					
		Latitude (N)			Longitude (E)		
		D	M	S	D	M	S
1	GW4 - Muguli Village	15	14	50.31	74	8	42.76
2	GW8 - Kalay	15	17	29.8	74	10	56.1
3	GW10 - Tatodi	15	22	9.02	74	8	32.61
4	GW13 - Cudeggal	15	18	20.64	74	9	25.29
5	GW15 - Panchwadi	15	16	49.69	74	5	26
6	GW10 - Tatodi	15	22	9.02	74	8	32.61

7.7 Bore wells

The project proponent does not propose to construct any borewell within the Mining Lease for ground water withdrawal. The water requirements are to be met from the harvested rainwater from the mine pits in the mineral block area and nearby surface water bodies through local contractors.

7.8 Water Budget

The water requirement for Block IV - Kalay mineral block is about 300 m3/day, intends to collect from the rainwater harvesting pits within the mineral block area and nearby surface water bodies. The water requirements are essentially for various activities such as green belt, dust suppression and mine maintenance. The project proponent plans to conserve rain water through Roof Top Rainwater harvesting and Rainfall Run-off management for the water requirements of the mine and recharge ground water body by constructing various conservation structures. As per Ground Estimation Committee (GEC) norms of year 2020,

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

Ground Water Department, Government of Goa and Central Ground Water Board, Government of India has categorized Block IV – Kalay Mineral Block Iron ore mine, Santona, Sanguem Taluk, South Goa as "SAFE" category in ground water development. The details of the water requirements and utilization plan are given below.

7.9 Projected Water Requirements and utilization plan

I. Water Requirement:

Groundwater: Nil

Other Sources: as shown below:

Sr. No.	Particulars	Source	Quantity (m3/day)
1	Dust suppression, green belt and other mining activities	Rain and storm water harvested in mine pit	292
2	Domestic use	Nearby surface water bodies through local contractors	8
	Total		**300**

II. Rainfall Run-off Management (Proposed)

Total Mining Lease area	: 15,25,073 sq m
Vegetated / Green area	: 4,57,522 sq m
Open area (Broken up area)	: 1067551 sq m
Avg. rainfall of the study area	: 3,994 mm
Percentage of RTRW recovery	: 10
RWH (Green area)	: 1,82,734 m ^{3} / annum
	: 501 m ^{3} / day
RWH (Open area)	: 4,26,380 m ^{3} / annum
	: 1,168 m ^{3} / day
Total available water (A)	**: 1,669 m ^{3} / day**

III. Use of Water

A.	
B. Dust suppression & Green belt	: 232 m3/d
C. Domestic	: 8 m3/d
D. Workshop	: 10m3/d
E. Wheel washing system	: 50 m3/d
Total utilized for Mining Operations	: 300 m3/d

IV. Recharge to groundwater : 1,574 m ^{3} / day

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

V. Total Recharge to Ground Water

A.	Return flow from applied greenbelt & Return flow from dust suppression	: 5 m^3 / day
B.	Water available for recharge to ground water body	: 1,574 m^3 / day
	Total	: **1,579 m^3 / day**

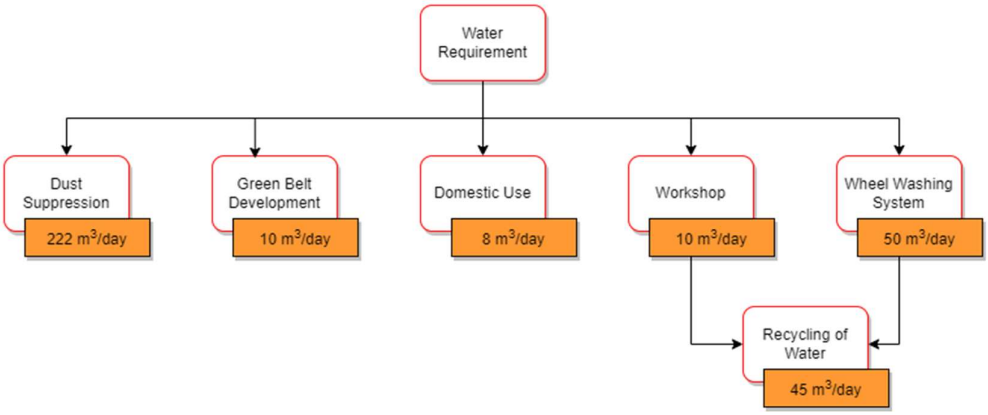
VI. Proposed to withdraw ground water : Nil

7.10 Source Water for Mining

There is no proposal to establish any ground water structure in the mineral block area for the drawl of groundwater, thus, the ground water withdrawal in the core area will be nil. Existing Rainwater Harvesting in the mine pit will be pumped out for utilizing various gainful purposes. The mineral block consists of 3 mining pits of which two are presently waterlogged. To carry out mining operations, harvested Rainwater of the pit will be utilised at a rate of 15,000 m3/day (accumulated water in the pit and harvested runoff water).

The pumped water will be utilised for mining & allied activities and for the development of the surrounding villages, agriculture and recharge to the ground water body.

Water requirement Chart is shown herein below.



Besides the above also implement Rainwater harvesting and recharge to the ground water body through conservation structures like Check dams, Gulley plugs, Toe wall, Garland drains, Trenches, and Percolation tanks is proposed for the area is a continuous process. Every year the conservation structures will be well maintained. Withdrawal of accumulated rainwater in the mine pit for Kalay Mineral Block Iron Ore Mine will not create any impact on Ground Water body in the core and buffer area. As per the Ground Water Resources estimated in 2020, the stage of Ground Water Development of the Taluka is less than 17% in the year 2020 GW resource estimates by Government of Goa (GW Department, Goa) and Government of India (CGWB). Mining operations will not create any impact within the 10 kms radius of the mine.

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

8.0 IMPACT ON GROUND WATER SOURCES

8.1 Impact on ground water sources

The ground water extraction in the project area is nil and hence no adverse impact is created due to the mining activities.

8.1.1 Impact on Ground Water

The ground water extraction in the project area is nil and hence no adverse impact will be created due to the mining activities in the core area as well as in the surrounding 10 kms radius buffer area. The Lessee proposes to actively implement rainwater harvesting activities to recharge the ground water body through the percolation tanks and other conservation structures. There are no major rivers/streams in the project site. No adverse impact on the groundwater will be observed due to drawl of harvested rainwater from the Mine pit in the core area. The core and buffer area of Kalay Mineral Block Mine is declared as **SAFE** in respect of ground water development and management by Government of Goa (WRD) and Government of India (CGWB). The water Quality Analysis from the accredited laboratory has shown all the parameters are well within the maximum permissible limits of the BIS for drinking water.

Since the proposed mining activities are at deeper level, the Lithological variations and aquifer configurations at deeper levels are thoroughly investigated and detailed in page No. 54 **(The sub surface geological formation and hydrogeological scenario of deeper semi confined to confined aquifers around the mining block)** which clearly establish that the aquifer potential/yield of bore wells/Transmissivity are very less and deeper geological formation are dominated by clayey formations which are impermeable and **aquicludes** which scientifically prove that mining activities will not have any adverse impact on ground water regime.

8.2 Dependency on source of water

Villages located in the buffer area are dependent on availability of surface water supply through Water tankers for the household chores and Ground water for domestic use from open wells or PWD water supply schemes. The agriculture is dependent on monsoon for the seasonal crops like Rice etc.

8.3 Ground water users

Ground water in the buffer area is mainly used for domestic purpose and to a lesser extent for irrigation through bore wells.

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

9.0 PROPOSED MEASURE FOR DISPOSAL OF WASTE WATER BY INDUSTRIES DRAWING SALINE WATER

The Mining project is not extracting any saline water and hence no measures are in practice.

9.1 Existing Ground Water Recharge Measures

The proposed project is planning to implement various conservation measures to recharge ground water body and to meet the water requirement besides the existing ones. The proposal to implement rainwater conservation in Block IV - Kalay Mineral Block area is as follows:

i. The surface rainwater within mining lease (broken up area) is proposed to be collected in mining pit through a network of trenches. The collected water in the mine pit will act as water harvesting measure thereby recharging the groundwater table through percolation.
ii. The overburden dumps will be terraced and the rain water shall be channelized through garland drains and trenches into the mine pit.



Fig. 23: Synoptic view of a Mine Pit

9.2 Proposed Ground Water Recharging Measures / Artificial Recharge of Ground Water.

Rainwater harvesting in the Mining Lease area is one of the main conservations of water for direct use / recharge to the ground water body. The structures planned for the project is given below:

A. Recharge Pits

To strengthen the recharge to ground water body, the best practiced conservation method is construction a recharge pits. The surface runoff water will be diverted in

the mining pit and settling ponds through trenches and garland drains.



Fig. 24: Series of the silt retention tanks

B. Recharge Trenches

Based on the survey 2 m contour data for the mine lease area land, separation of steep slope areas will be demarcated to locate the sites for Recharge trench sites. Initially about 5 trenches are planned to construct in the first phase. Recharge trenches are simple and effective ground water recharge structures over a wide area. These trenches may be constructed across the slope of the ground surface. These trenches help in slowing down and retaining the sheet-flow of rain water and enhance recharge. The trenches can be continuous or discontinuous. Recharge trenches of dimensions 20m (L) x 1m (W) x 1m (D) will be dug and filled with 40 mm gravel, 20mm gravel and coarse sand so as to arrest the flow of run-off rainwater and capture for recharge to the ground water body. The design is as follows:



Fig. 25: Schematic view of Recharge Trenches

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

These trenches are effective structures

- in conserving sheet-flow of rain water falling in the project premises
- in enhancing the process of recharging ground water
- conserving soil profile
- avoid formation of new gullies and protect the existing ground surface profile

It is an effective long term environment protective measure and simultaneously enhancing the natural resource. The entire stretch of the trenches become a wide spatial recharge zone.

9.3 Water Utilisation Chart

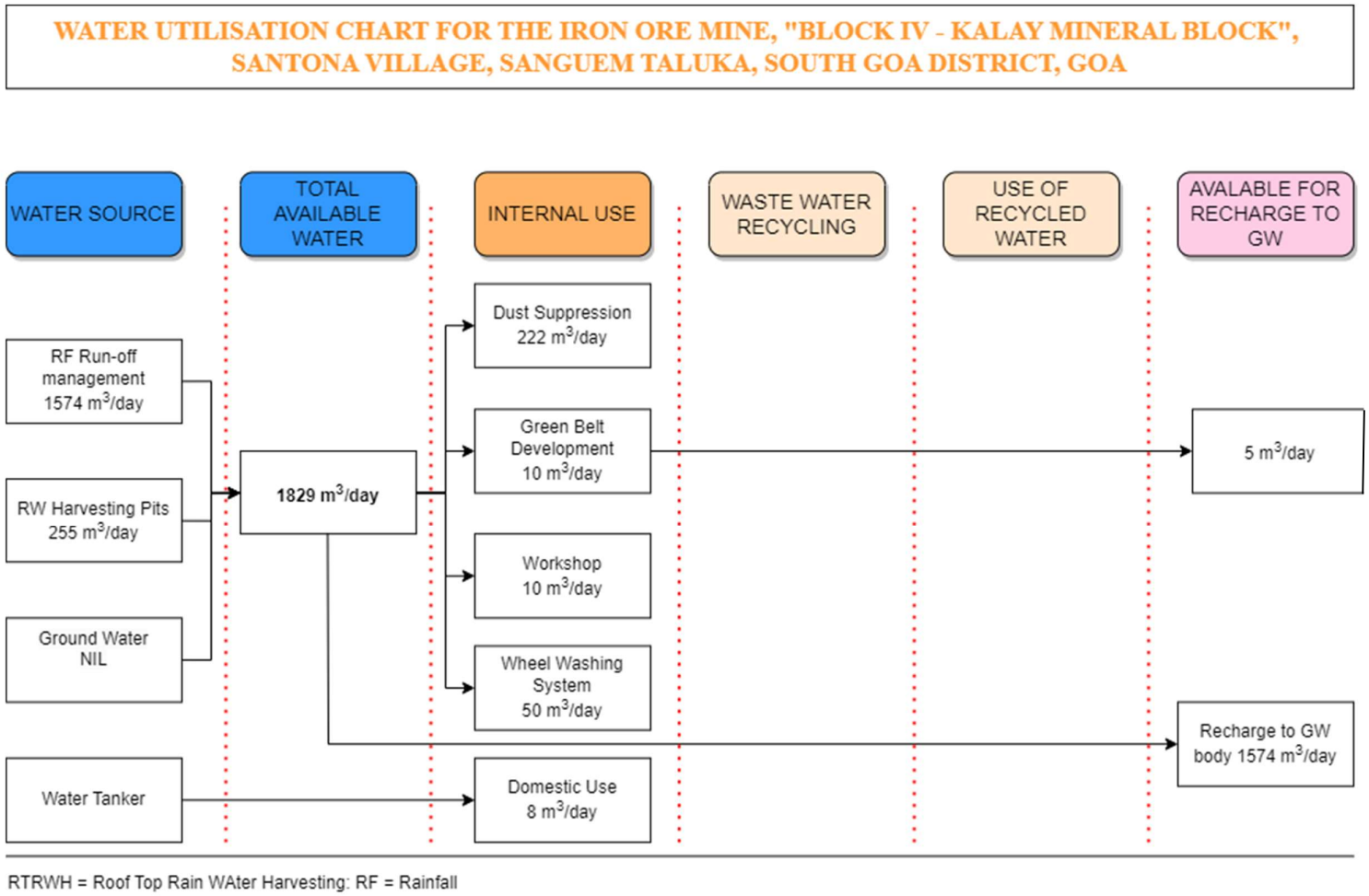


Fig.26 Flow Chart showing water Utilization

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects. mcreddycgwb@yahoo.co.in

10.0 CONCLUSION

i. Stage of Ground Water development in Sanguem Taluka is 16.97% and categorised as SAFE in ground water development and management point of view.

ii. Water quality in general is safe and potable in all the sites and is within the maximum permissible limits of the Bureau of Indian Standards (BIS).

iii. Depth to water level varied from less than 2 m bgl to more than 14 m bgl.

iv. The water requirement for the mine is 300 m3/day.

v. Annual average rainfall received in the area is about 4000 mm. Rainwater from the project area will be channelized into the mining pits and settling ponds.

vi. Treatment facilities for contaminated water: The pollutants present in the waste water will be reduced to acceptable levels by adoption of the following schemes.

- Removal of oil and grease from the contaminated water by means of oil traps and skimming devices.

vii. The main iron ore deposit is called as Codli-Kirlapal-Costi deposit. The general succession of the strata observed in the mineral block from top to bottom is Laterite (about 15 – 20 m), Altered Dyke (Intrusive), Ferruginous/Phyllitic/ Limonitic Clay (10 – 15 m), Iron Ore body (20 - 30 m) and Siliceous Manganiferous Clay & Weathered BHQ (forms foot wall).

viii. Laterites are the most important water bearing formation covering over 60 percent of the area. Metavolcanics formation spreads in parts of Sanguem, Quepem and Cancona talukas of South Goa district. The water bearing properties of metabasalt and metagreywacks and the associated rocks of pre-Cambrian age are also dependent on fracturing, jointing and foliation present in the rocks.

ix. Two types of aquifer system are observed i.e., Aquifer-I which is shallow phreatic aquifer and Aquifer-II which constitutes the deep fractured aquifer. Aquifer-I comprises of Laterite, Alluvium, weathered meta volcanic and weathered meta sedimentaries, generally occurs in depth ranges of 9-42 m bgl.

PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

Aquifer-II comprises of fractured meta-sedimentaries, Granite gneiss and schistose rock. Depth of occurrence of aquifer ranges from 25 to 180 m bgl.

x. The higher fractured aquifer thickness of 9 to 16 m is observed isolated patches in the central western parts near Sacordem, Kalay.

xi. Fractured aquifer thickness indicates that it ranges from 0.10 to 16 m, however aquifer thickness of 2-5 m is observed in many parts of the state.

xii. The discharge of the bore well tested in the lease area is 14.38 m^3/ hr. Transmissivity estimated as 16.84 m^2/ day for draw down of 20.43 m.

xiii. Since the proposed mining activities are at deeper level, the Lithological variations and aquifer configurations at deeper levels are thoroughly investigated and detailed in page No. 54 **(The sub surface geological formation and hydrogeological scenario of deeper semi confined to confined aquifers around the mining block)** which clearly establish that the aquifer potential/yield of bore wells/Transmissivity are very less and deeper geological formation are dominated by clayey formations which are impermeable and **aquicludes** which scientifically prove that mining activities will not have any adverse impact on ground water regime.

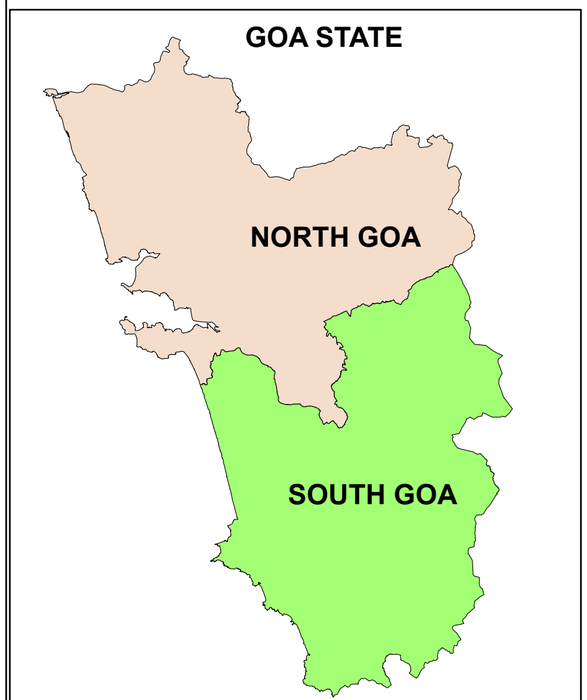
xiv. Block IV –Kalay Mineral Block is situated on a Plain region at an elevation of about 18 - 94 m amsl and does not have any surface water bodies. It was observed from the studies carried out on the open wells, that water levels in Phreatic aquifer is mostly shallow where the ground water abstraction structures are located at an elevation of 18 m to 94 amsl. The aquifer at deeper mining level is less potential and made of clayey intercalations and mostly aquicludes. The piezometric surface of deeper semiconfined aquifer shows steady state to rising trend and not showing falling trend. Mining activity will not have any negative impact on ground water regime.

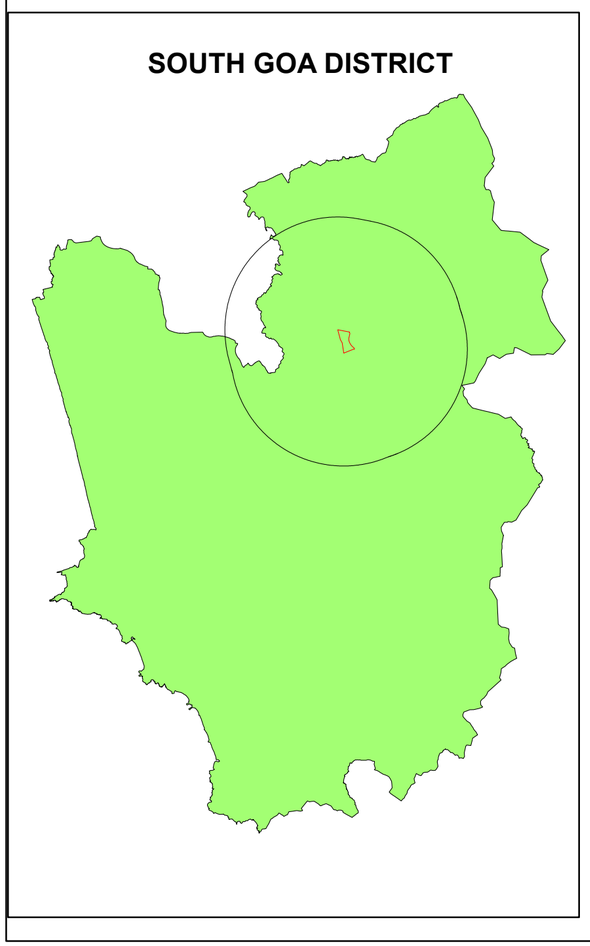
PREPARED BY: M. C. Reddy, Former Regional Director, Central Ground Water Board,
Accredited for NABET for Geology & Hydrogeology and CGWA for Mining Projects.
mcreddycgwb@yahoo.co.in

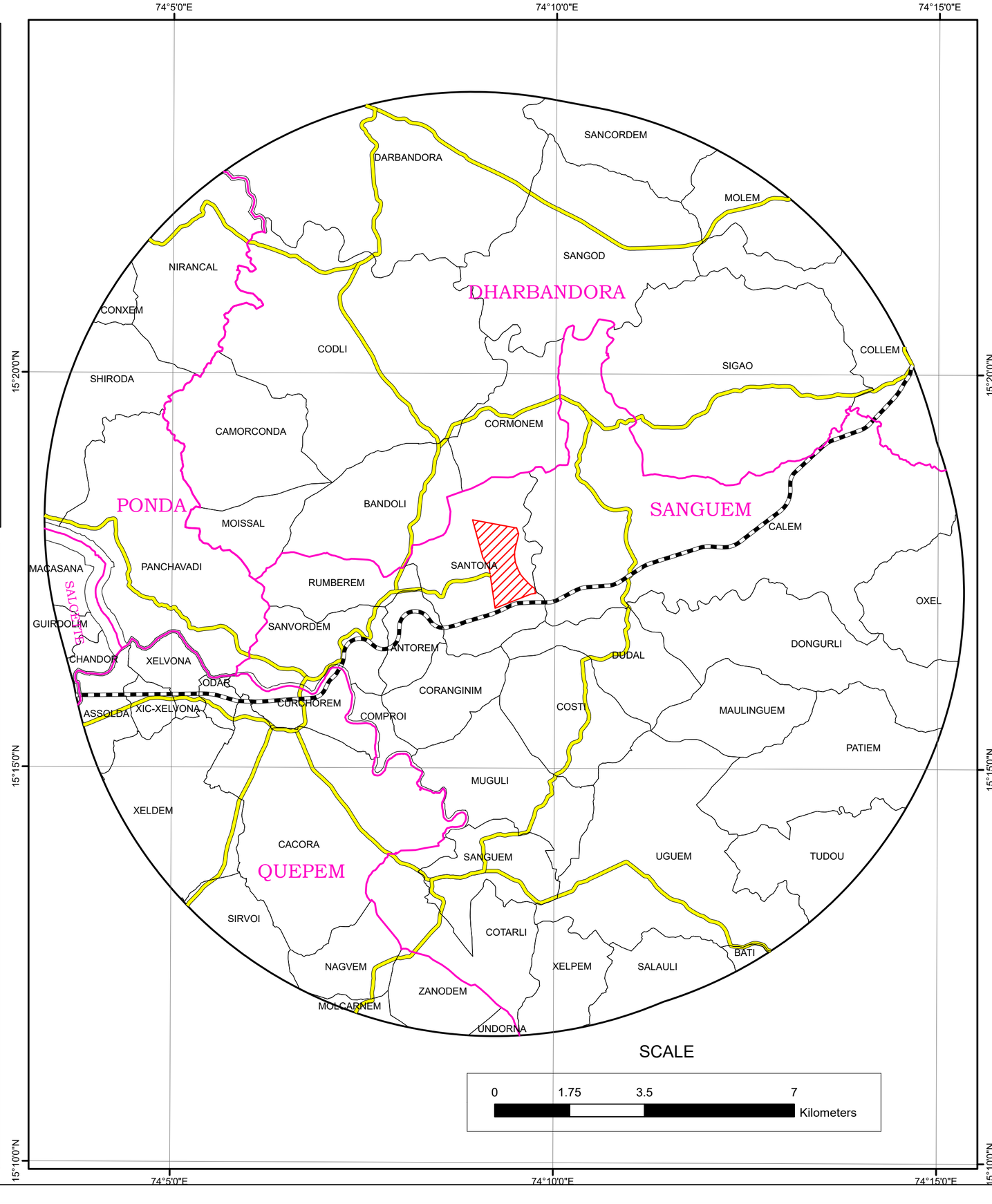
11.0 REFERENCES

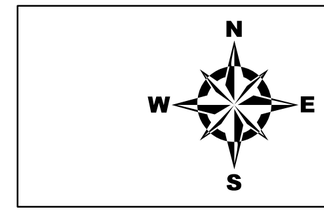
1. Ground Water Resource and Development Potential of Goa
2. South Goa District at a glance, Government of Maharashtra
3. Rainfall data: Source: https://en.climate-data.org/asia/india/goa/quepem-718390/
4. Piezometer Data from Ground Water Resources of Goa
5. Directorate of Economic and Statistics, Planning Programme Monitoring and Statistics Department
6. National Hydrographs from Central Ground Water Board
7. Central Ground Water Board, Central Region, "Water Year"
8. Karanth, K.R., Ground Water Assessment, Development and Management
9. Central Ground Water Board, 1994 "Manual on Artificial Recharge of Ground Water".
10. Central Ground Water Board, 2023 "Proceeding Volume – National Aquifer Mapping and Management (NAQUIM) Programme".
11. Basic data report of piezometer at Kalay, Sanguem Taluk, South Goa. July 2013.
12. Central Ground water board, SWR: Ground water year book of Goa 2022.

HYDROGEOLOGICAL AND IMPACT ASSESSMENT STUDIES IN AND AROUND BLOCK IV - KALAY MINERAL BLOCK, AT VILLAGE SANTONA,TALUKA SANGUEM,DISTRICT SOUTH GOA, GOA STATE.









TITLE : LOCATION PLAN

Legend

- Mineral Block Area
- Taluka
- Villages
- Railways
- Major Roads
- 10 km Buffer Zone

PREPARED FOR :

Fomento Resources Private Limited

PREPARED BY :

M.C. REDDY,
FORMER REGIONAL DIRECTOR,
CENTRAL GROUNDWATER BOARD

PLATE NO: 1

659

74° 04' E | 74° 06' E | 74° 08' E | 74° 10' E | 74° 12' E | 74° 14' E

15° 22' N
15° 20' N
15° 18' N
15° 16' N
15° 14' N
15° 12' N

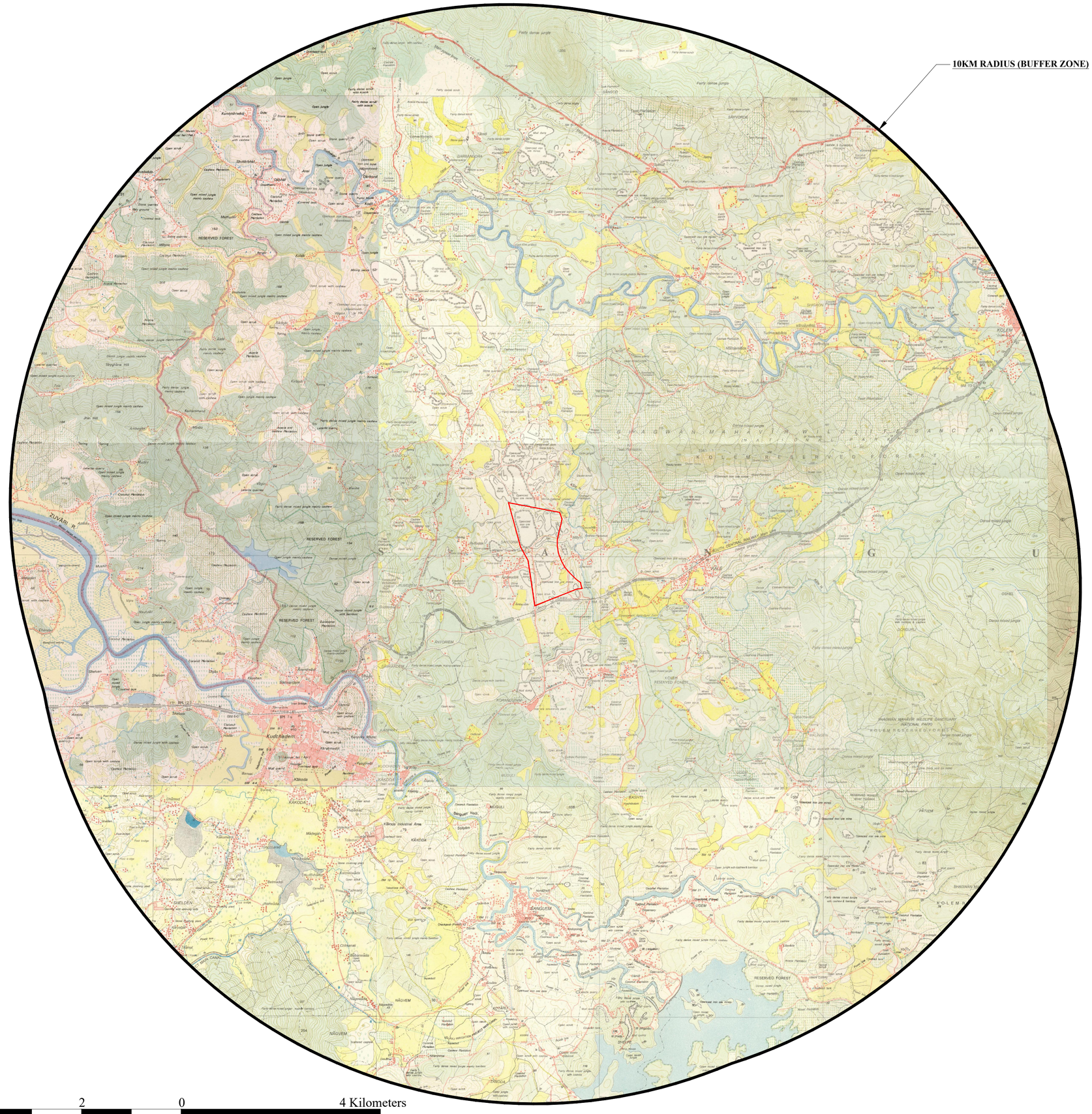


Plate No.2

N

SCALE 1:50000

CONVENTIONAL SYMBOLS

METALLED ROADS.
National Highway: width more than 7 m; 6 to 7 m and less than 6 m with bridge
State Highway: do
Others: do
Double carriageway: with distance stone; with bridge
Waterbound macadam all weather gravelled with bridge
With bridge (width & height, when restricted, in metres)
Bridge: with piers; without. Causeway. Ford or Ferry.

UNMETALLED ROADS, TRACKS ETC.
More than 6 metres; 6 metres; less than 6 metres with bridge
Passing point: surveyed; conventional
Cart-track. Pack-track and pass. Foot-path with bridge

RAILWAYS.
Broadgauge: double; single with station; under construction
Broadgauge, electrified: double; single.
Other gauges: double; single with distance stone; under construction
Mineral line or tramway. Cutting with tunnel.
Siding with ramps: concrete/masonry; others
Level crossing: un-manned; with gate

TRANSMISSION LINES.
Power line: with pylons surveyed; with poles unsurveyed
Telegraph &/or telephone line: cross country; along road.

CANALS OR DRAINS
Width above 30 to 100 m perennial; lined; unlined, non-perennial; unlined.
Width 16 to 30 m do do do
Width less than 16 m do do do

AERODROMES ETC.
Aerodrome. Landing ground/Landing strip. Helipad: permanent; temporary.

BOUNDARIES.
International
State, demarcated with pillars; located unlocated; undemarcated.
District; subdivn./tahsil or taluk. village forest

OTHER ITEMS.
Streams: with track in bed; undefined. River with boulders more than 0·4 metre.
River; dry with water channel, with islans & rocks. Tidal river.
do banks: shelving; steep 3 to 6 metres; over 6 metres.
Dams: masonry or rock-filled; earthwork. Weir.
Submerged rocks. Shoal. Swamp. Reeds.
Towns or villages: inhabited; deserted. Fort; surveyed; in ruins.
Huts: permanent; temporary. Tower. Chimney. Antiquities.
Temple. Chhatri. Church. Mosque. Idgah. Tomb. Graves.
Wells: lined; unlined. Tube-well. Overhead water tank.
Tanks: perennial; dry. Spring.
Lighthouse. Lightship. Buoys: lighted; unlighted. Anchorage.
Power house. Rest-house/Circuit house. Camping ground.
Hospital. Dispensary. Police station.
Post office. Telegraph office. Post & Telegraph office. Mine
Embankments: road; rail; tank. Broken ground.
Fire line: more than 6 metres; 6 metres and less than 6 metres
Spaced names: administrative; locality or tribal. Forest, reserved; protected. KIKRI NÃGA RF PF
Orchard or garden: walled; wirefenced.

HEIGHTS.
Triangulated: station; point. Approximate: ground; top. △200 ·200 ·200 ·200 T
Bench-mark: geodetic; tertiary; canal. ·BM 63·3 ·BM 63·3 63

VEGETATION.
Palms: palmyra; other. Plantain. Conifer. Bamboo. Other trees.
Vine on trellis. Grass. Scrub.

HILL & SAND FEATURES.
Contours with sub-features. Rocky slopes. Cliffs.
Sand features: (1) flat (2) sand-hills and dunes (surveyed) (3) shifting dunes.
Ice forms: (1) glacier (2) moraine (3) crevasses (4) scree (5) snow.

INDEX

CORE ZONE (BLOCK AREA)

BLOCK IV - KALAY MINERAL BLOCK

FOMENTO RESOURCES PRIVATE LIMITED

AREA:152.5073 Ha
VILLAGE SANTONA, TALUKA SANGUEM, DISTRICT: SOUTH GOA

PURPOSE OF THE PLAN: TOPOSHEET

E 408600 E 408800 E 409000 E 409200 E 409400 E 409600 E 409800 E 410000 E 410200

N1692000 N1691800 N1691600 N1691400 N1691200 N1691000 N1690800 N1690600 N1690400 N1690200 N1690000 N1689800

N

BP 3 M-2' M-1' M0' M1' M2' M3' M4' M5' M6' M7' M8' M9' M10' M11' BP 2 M12' BP 1 BP 18 BP 17 P2' P3' BP 16 P4' Final Discharge Point P5' BP 15 P6' P7' P8' BP 14 P9' P10' P11' BP 13 P12' P13' P14' BP 12 P15' P16' P17' BP 11 P18' P19' P20' BP 10 P21' P22' BP 9 P23' P24' BP 8 BP 7 BP 6 P21 P20 P19 P18 P17 P16 P15 P14 P13 P12 P11 P10 P9 P8 P7 P6 P5 BP 5 P4 P3 P2 BP 4 M12 M11 M10 M9 M8 M7 M6 M5 M4 M3 M2 M1 M0 M-1 M-2 BP 3

PIT NO. 3

PIPELINE

DUMP - 1

DUMP - 3

DUMP - 2

WATER LOGGED AREA

REF LINE

WEIGHBRIDGE

WATER LOGGED AREA

PIT NO. 1

DUMP - 7

DUMP - 8

DUMP - 6

PIT NO. 2

DUMP - 4

DUMP - 9

WELL

REF LINE

REF LINE

I N D E X

- MINERAL BLOCK BOUNDARY
- BENCHES
- EXISTING DUMP/ BACKFILLING
- NSN S-38 68.5 BOREHOLE
- 60 CONTOUR
- MINE ROADS
- VILLAGE ROADS
- HIGH TENSION POWER LINE
- LOW TENSION POWER LINE
- RUBBLE WALL
- STRUCTURES
- NALLAH
- DRAIN
- EXISTING SETTLING PONDS
- PIT PERIPHERY
- PERMANENT BACKFILLING
- PLANTATION
- EXISTING DUMPS
- 7.5 m STATUTORY BARRIER

SCALE - 1 : 2000

20 0 20 40 60 80 100 200 300 400 500

PLATE No. 3

FOMENTO RESOURCES PRIVATE LIMITED

BLOCK IV - KALAY MINERAL BLOCK

AREA - 152.5073 Ha.

VILLAGE - SANTONA TALUKA - SANGUEM

PURPOSE OF THE PLAN: SURFACE PLAN

DATE	SCALE	
	1 : 2000	Certified that the Plan is prepared based on the Geo-referenced Cadastral DGPS Plan authenticated by the State Government and is correct to the best of our knowledge

Roshel Fernandes
Qualified Person

Amit Ashok Ghogale
Qualified Person


Block IV - Kalay Mineral Block
BP-3
BP-2
BP-1
BP-18
BP-17
BP-16
BP-15
BP-14
BP-13
BP-12
BP-11
BP-10
BP-9
BP-8
BP-7
BP-6
BP-5
BP-4
N
800 m
Santona
Devdeveshvar Temple
Shirdi SaiBaba Temple
Our lady of help chapel
live chicken
Government Primary School
Kaley River Bridge
Goenchi Gariana News
Google Earth
Image © 2023 Airbus

HYDROGEOLOGICAL AND IMPACT ASSESSMENT STUDIES IN AND AROUND BLOCK IV-KALAY MINERAL BLOCK, AT VILLAGE SANTONA,TALUKA SANGUEM,DISTRICT SOUTH GOA, GOA STATE.

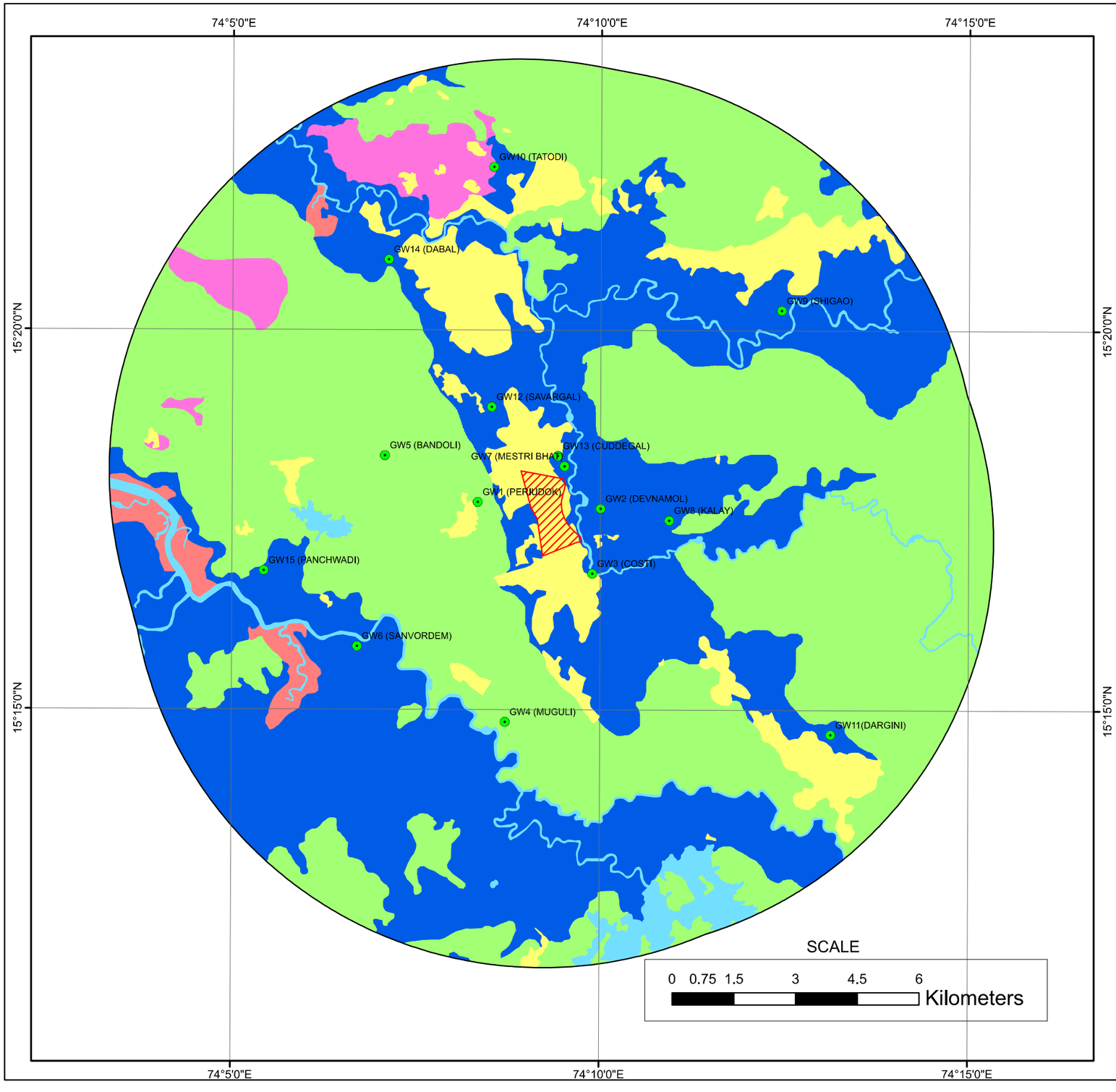


PLATE NO: 5

N
W E
S

TITLE : GEOMORPHOLOGY

Legend

- Mineral Block Area
- Well Location
- 10 Km Buffer Zone

GEOMORPHOLOGICAL INDEX

- WATER BODIES/RIVER
- COASTAL PLAINS
- PLATEAU
- PEDIMENT PEDIPLAIN COMPLEX
- QUARRY AND MINING AREA
- HILLS AND VALLEYS

PREPARED FOR :

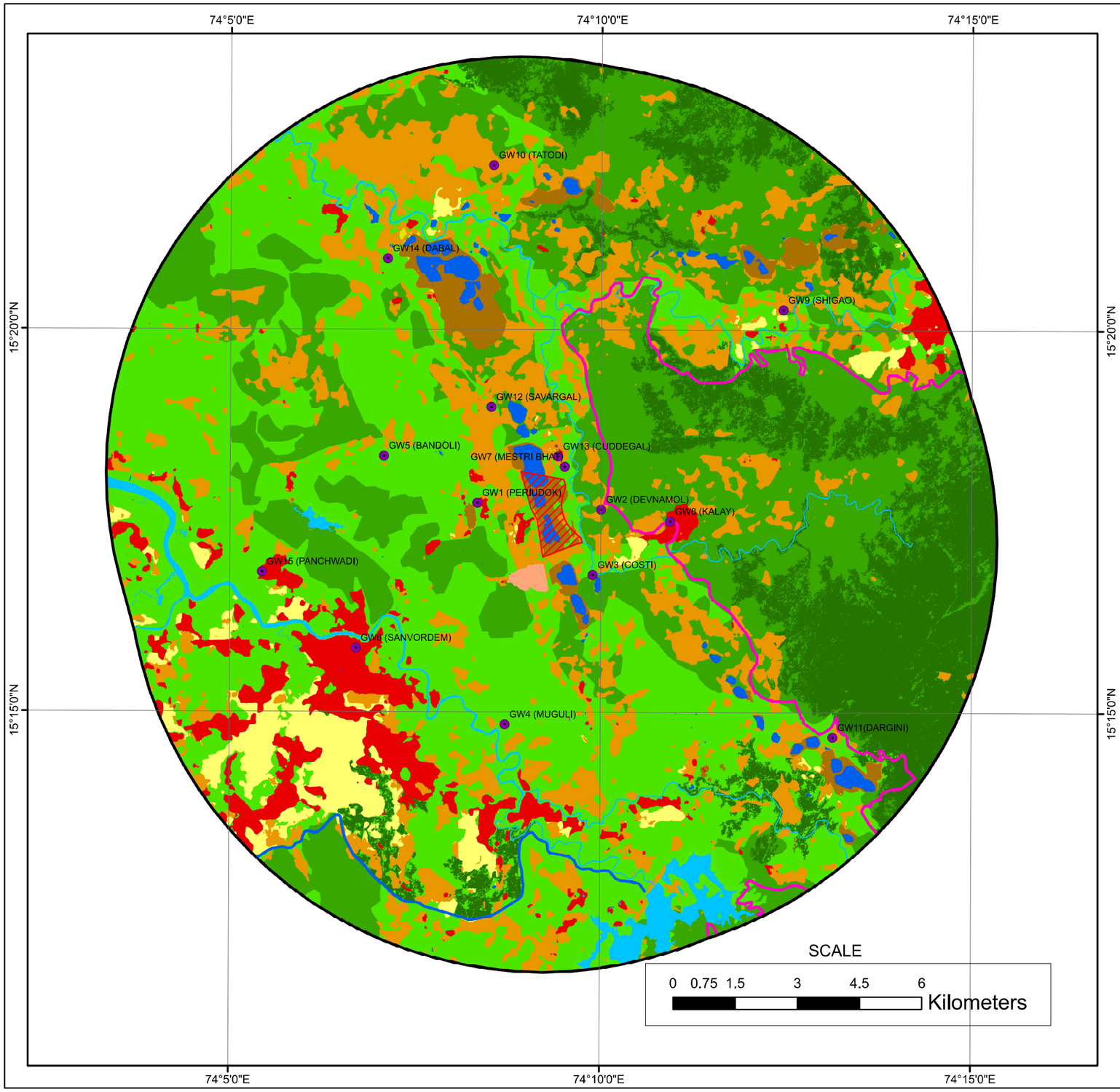
Fomento Resources Private Limited

PREPARED BY :

M.C. REDDY,
FORMER REGIONAL DIRECTOR,
CENTRAL GROUNDWATER BOARD

HYDROGEOLOGICAL AND IMPACT ASSESSMENT STUDIES IN AND AROUND BLOCK IV - KALAY MINERAL BLOCK, AT VILLAGE SANTONA,TALUKA SANGUEM,DISTRICT SOUTH GOA, GOA STATE.

PLATE NO: 6



N
W E
S

TITLE : LANDUSE AND LAND COVER

Legend

- MINERAL BLOCK AREA
- 10 Km Bufferzone
- Rivers
- Wildlife sanctuary Boundary
- canal
- Dense Reserve Forest
- Reserve Forest
- Vegetation
- Agricultural Land
- Water Bodies
- Mine Broken up Area
- Mine Pit Water
- Barren/Grass Land
- Settlements
- Industry

Well Location

PREPARED FOR :

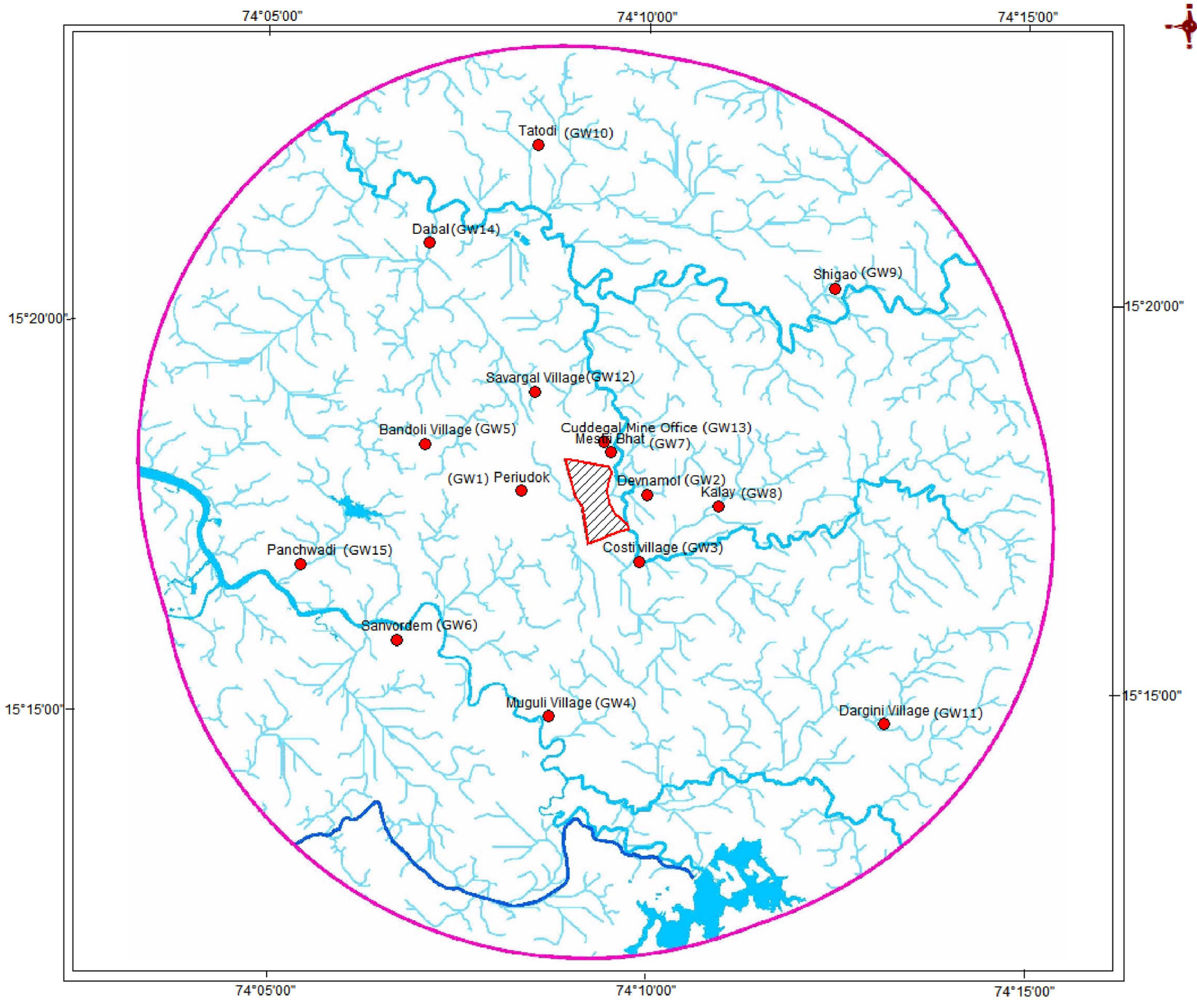
Fomento Resources Private Limited

PREPARED BY :

M.C. REDDY,
FORMER REGIONAL DIRECTOR,
CENTRAL GROUNDWATER BOARD

HYDROGEOLOGICAL AND IMPACT ASSESSMENT STUDIES IN AND AROUND BLOCK IV - KALAY MINERAL BLOCK, SANTONA VILLAGE, SANGUEM TALUK, SOUTH GOA DISTRICT, GOA.

Plate No.7



TITLE : DRAINAGE

Scale

0 3.0 6.0

kilometres

LEGEND

- Stream
- Waetr body / River
- Village Location
- Mine Block Boundary

PREPARED FOR :

Fomento Resources Pvt. Ltd

PREPARED BY:

M.C.Reddy,
Former Regional Director,
Central Ground Water Board

HYDROGEOLOGICAL AND IMPACT ASSESSMENT STUDIES IN AND AROUND BLOCK IV - KALAY MINERAL BLOCK, AT VILLAGE SANTONA,TALUKA SANGUEM,DISTRICT SOUTH GOA, GOA STATE.

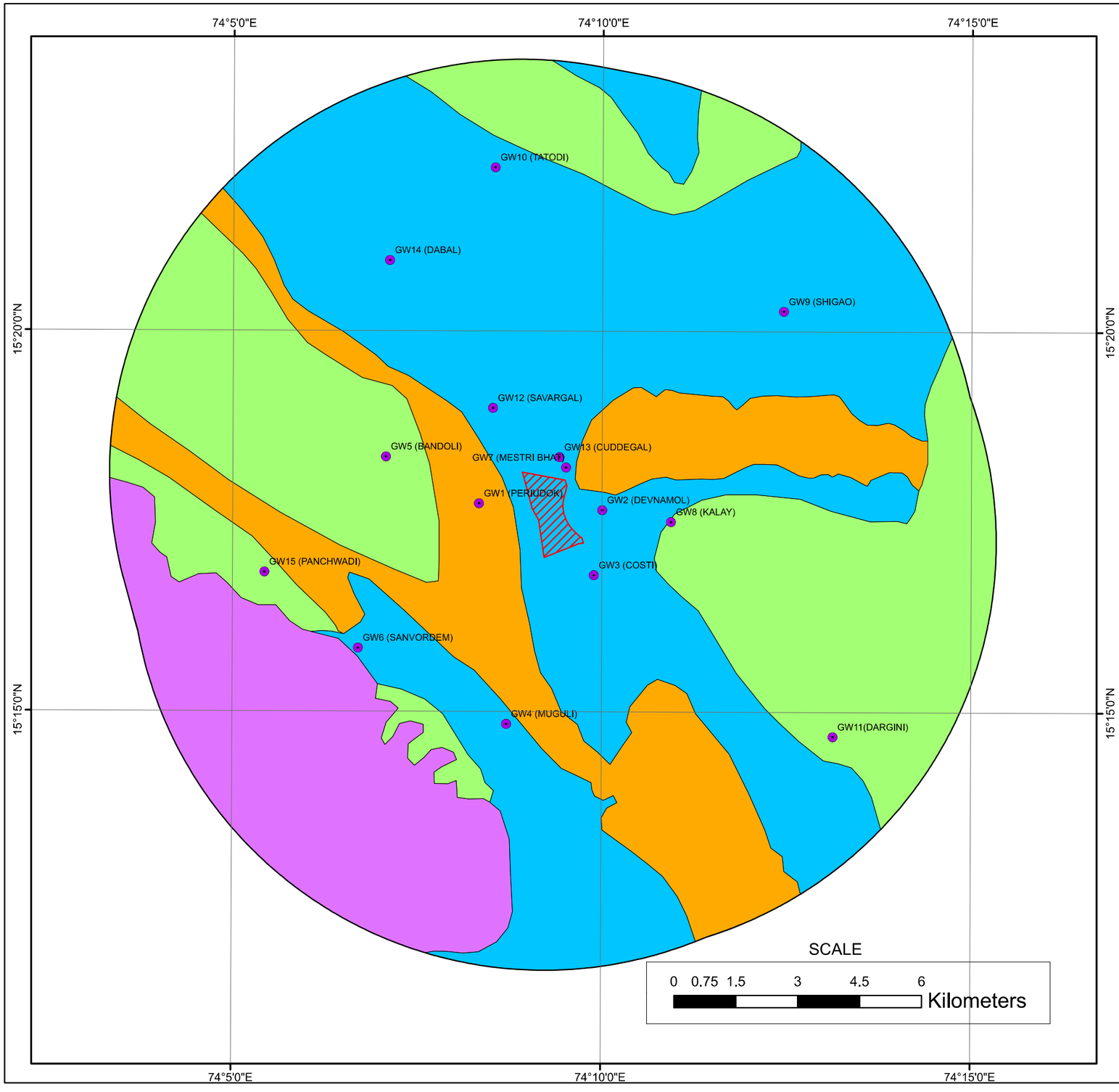


PLATE NO: 8

N
W E
S

TITLE : GEOLOGY

Legend

- Mineral Block Area
- Well Location
- 10 Km Buffer Zone

GEOLOGICAL INDEX

- Bicholim Formation BIF
- Sanvordem Formation
- Barcem Formation
- Peninsular Gneiss

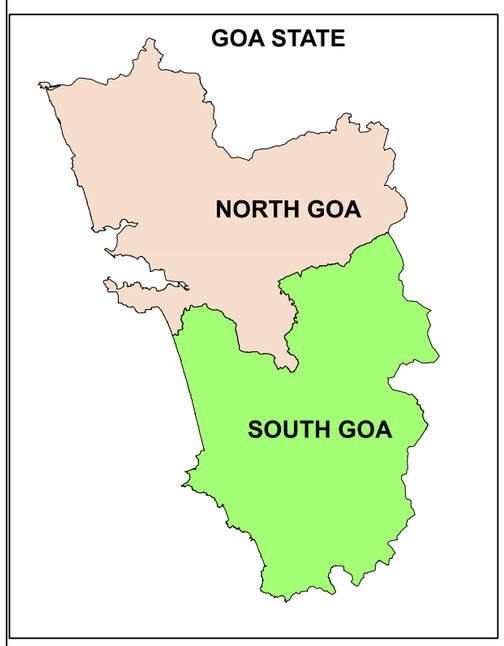
PREPARED FOR :

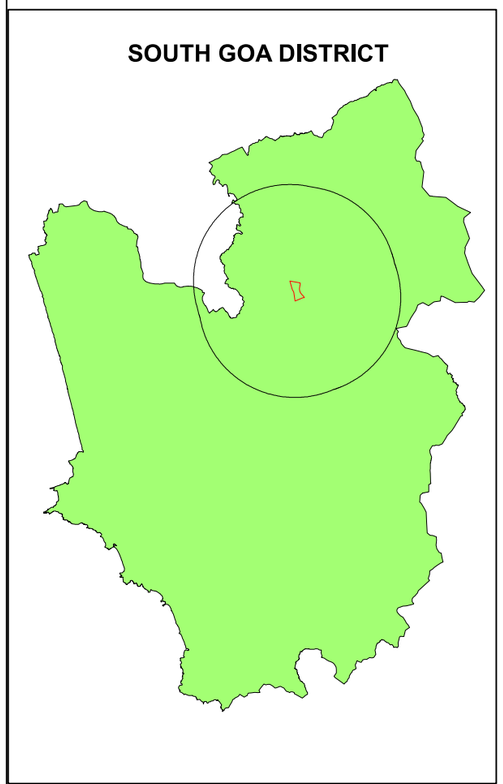
Fomento Resources Private Limited

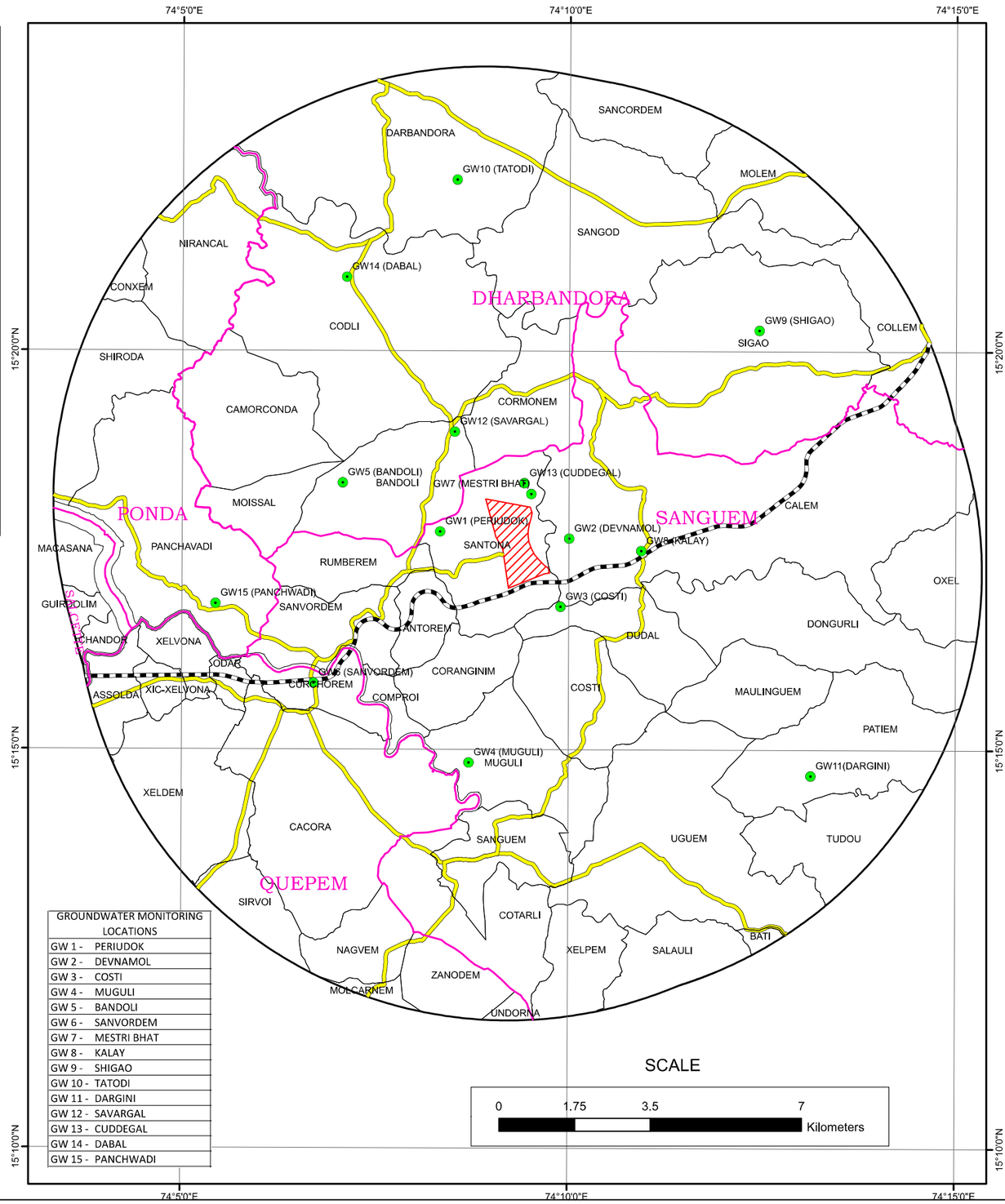
PREPARED BY :

M.C. REDDY,
FORMER REGIONAL DIRECTOR,
CENTRAL GROUNDWATER BOARD

HYDROGEOLOGICAL AND IMPACT ASSESSMENT STUDIES IN AND AROUND BLOCK IV - KALAY MINERAL BLOCK, AT VILLAGE SANTONA,TALUKA SANGUEM,DISTRICT SOUTH GOA, GOA STATE.







GROUNDWATER MONITORING LOCATIONS	
GW 1 -	PERIUDOK
GW 2 -	DEVNAMOL
GW 3 -	COSTI
GW 4 -	MUGULI
GW 5 -	BANDOLI
GW 6 -	SANVORDEM
GW 7 -	MESTRI BHAT
GW 8 -	KALAY
GW 9 -	SHIGAO
GW 10 -	TATODI
GW 11 -	DARGINI
GW 12 -	SAVARGAL
GW 13 -	CUDDEGAL
GW 14 -	DABAL
GW 15 -	PANCHWADI

N
W
E
S

TITLE : LOCATION PLAN SHOWING GROUNDWATER MONITORING LOCATIONS

Legend

- Mineral Block Area
- Well Names
- Taluka
- Villages
- Railways
- Major Roads
- 10 km Buffer Zone

PREPARED FOR :

Fomento Resources Private Limited

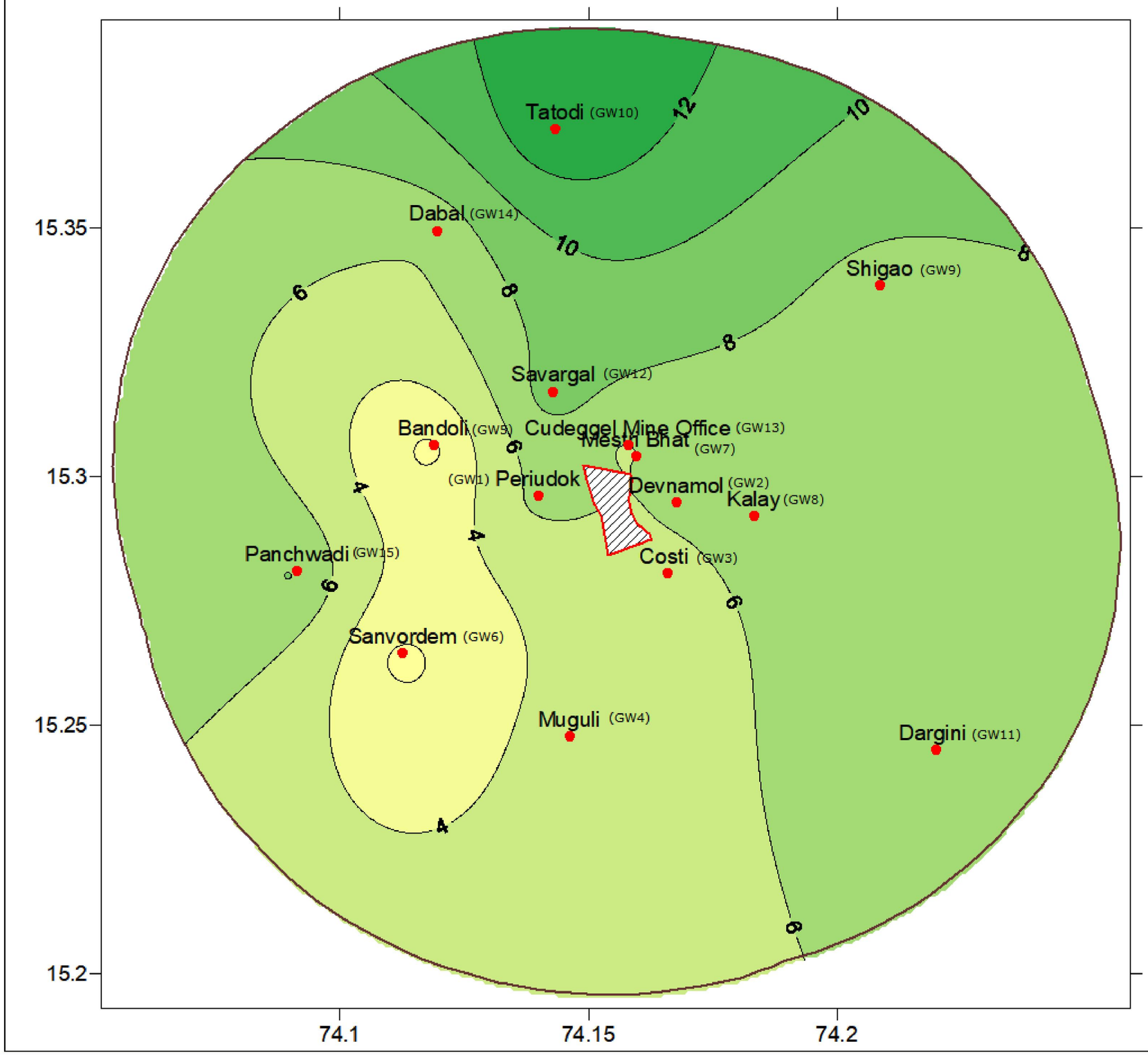
PREPARED BY :

M.C. REDDY,
FORMER REGIONAL DIRECTOR,
CENTRAL GROUNDWATER BOARD

PLATE NO: 9

Hydrogeological and Impact Assessment Studies in and Around Block IV - Kalay Mineral Block, Santona Village, Sanguem Taluk, South Goa District, Goa.

Plate No. 10



TITLE:

DEPTH TO WATER LEVEL

Scale

0 0.85 1.7 2.55 3.4

Kilometers

N

W E

S

LEGEND

Mineral Block Area

Well Location

10 Depth to Water level Contour

Water Level (mbgl)

14 12 10 8 6 4 2 0

PREPARED FOR:

Fomento Resources Pvt. Ltd

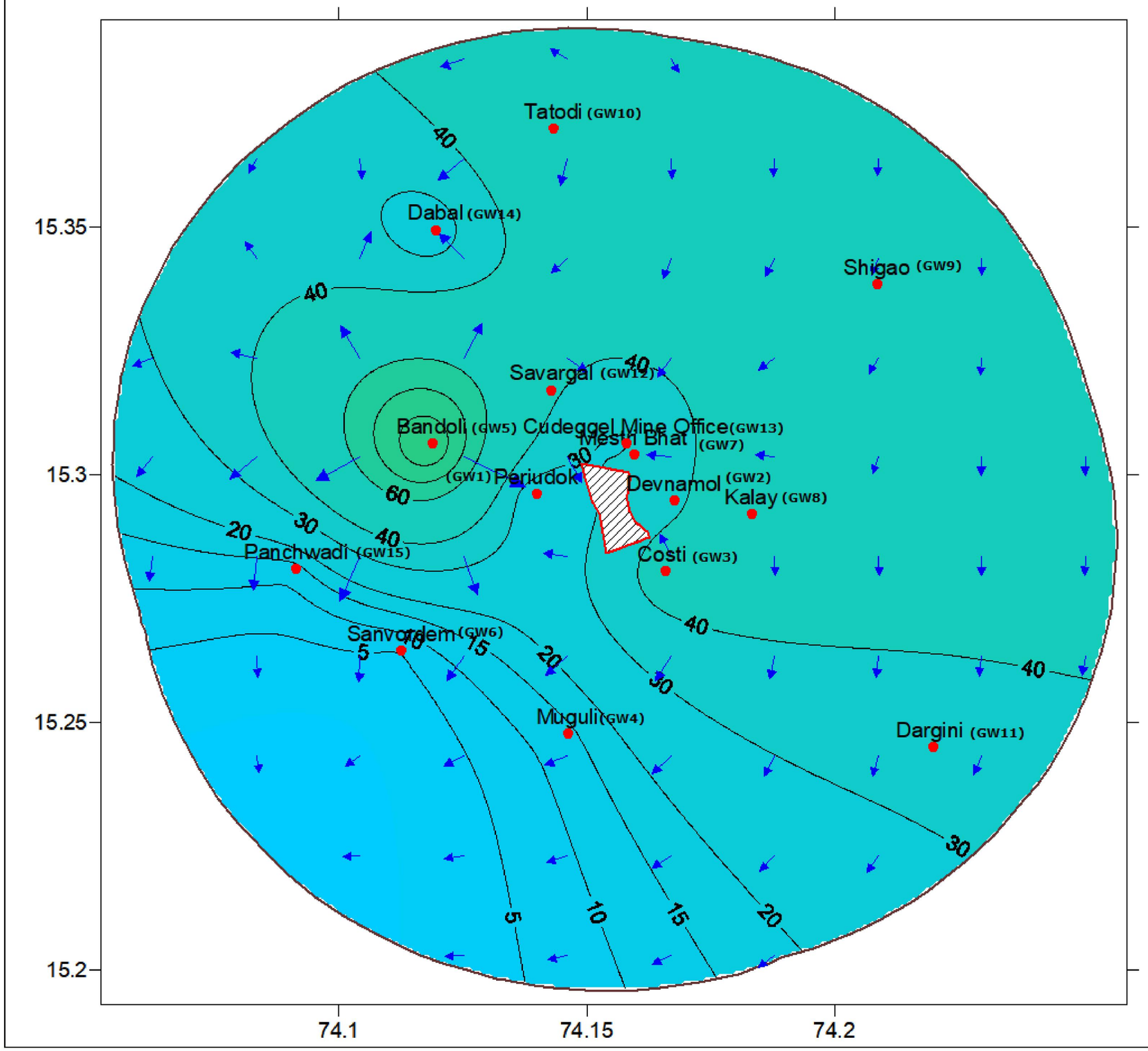
PREPARED BY:

M.C.REDDY
Former Regional Director,
Central Ground Water Board

668

Hydrogeological and Impact Assessment Studies in and Around Block IV - Kalay Mineral Block, Santona Village, Sanguem Taluk, South Goa District, Goa.

Plate No. 11



TITLE:

WATER TABLE ELEVATION STUDY AREA (NOV 2022)

Scale

0 0.85 1.7 2.55 3.4

Kilometers

N W E S

LEGEND

- Mineral Block Area
- Well Location
- 40 — Water Table Elevation Contour (amsl)
- Ground Water Flow Direction

Water Table Elevattion (mamsl)

80 70 60 40 30 20 15 10 5 0 -5

PREPARED FOR:

Fomento Resources Pvt. Ltd

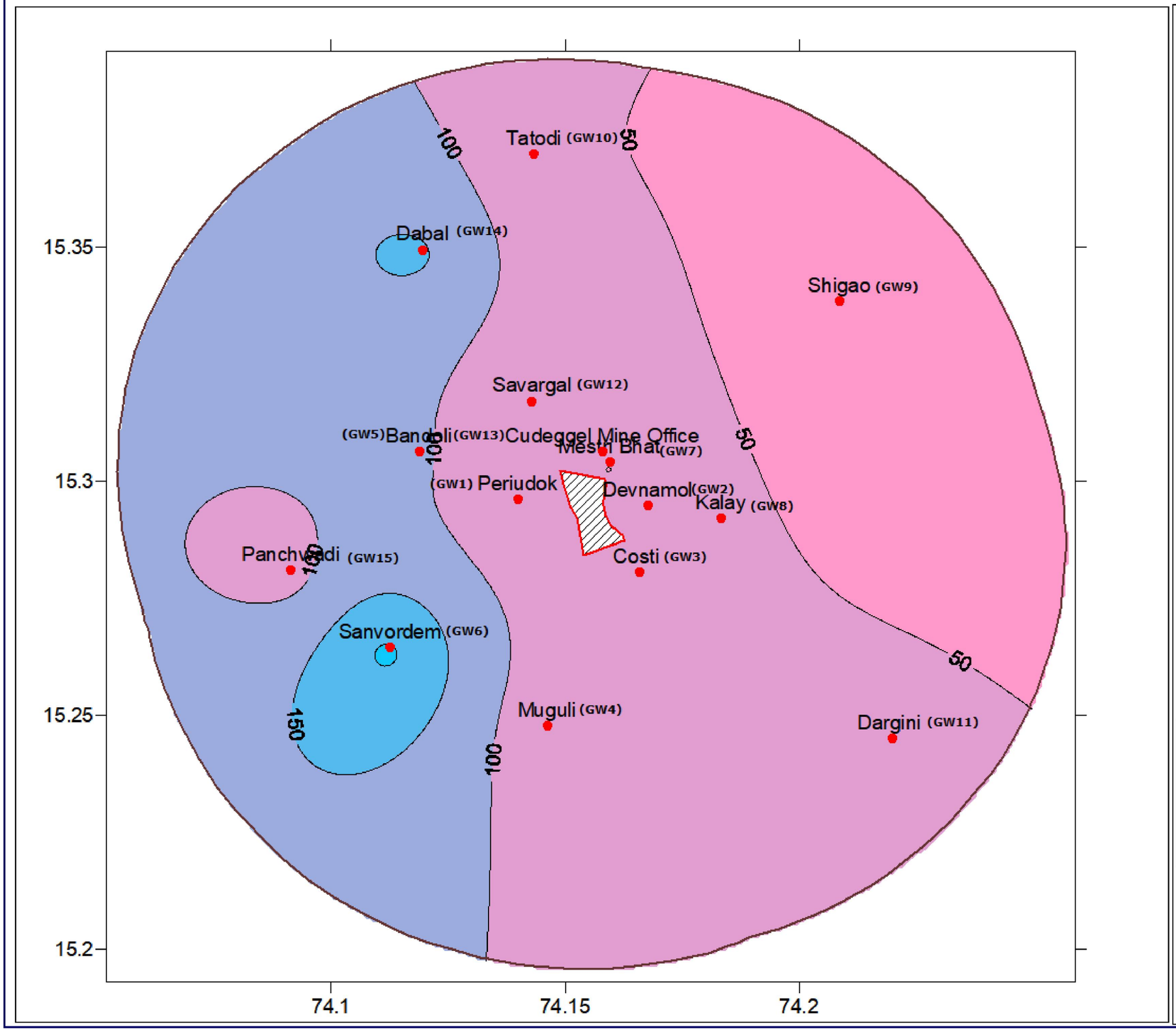
PREPARED BY:

M.C.REDDY
Former Regional Director,
Central Ground Water Board

669

Hydrogeological and Impact Assessment Studies in and Around Block IV - Kalay Mineral Block, Santona Village, Sanguem Taluk, South Goa District, Goa.

Plate No.12



TITLE:
ELECTRICAL CONDUCTANCE IN STUDY AREA (Micromhos/cm at 25°C)

Scale

0 0.85 1.7 2.55 3.4

Kilometers

N W E S

LEGEND

- Mineral Block Area
- Well Location
- 100 EC Contour

EC Range (micromhos/cm at 25°C)

0 50 100 150 200

PREPARED FOR:

Fomento Resources Pvt. Ltd

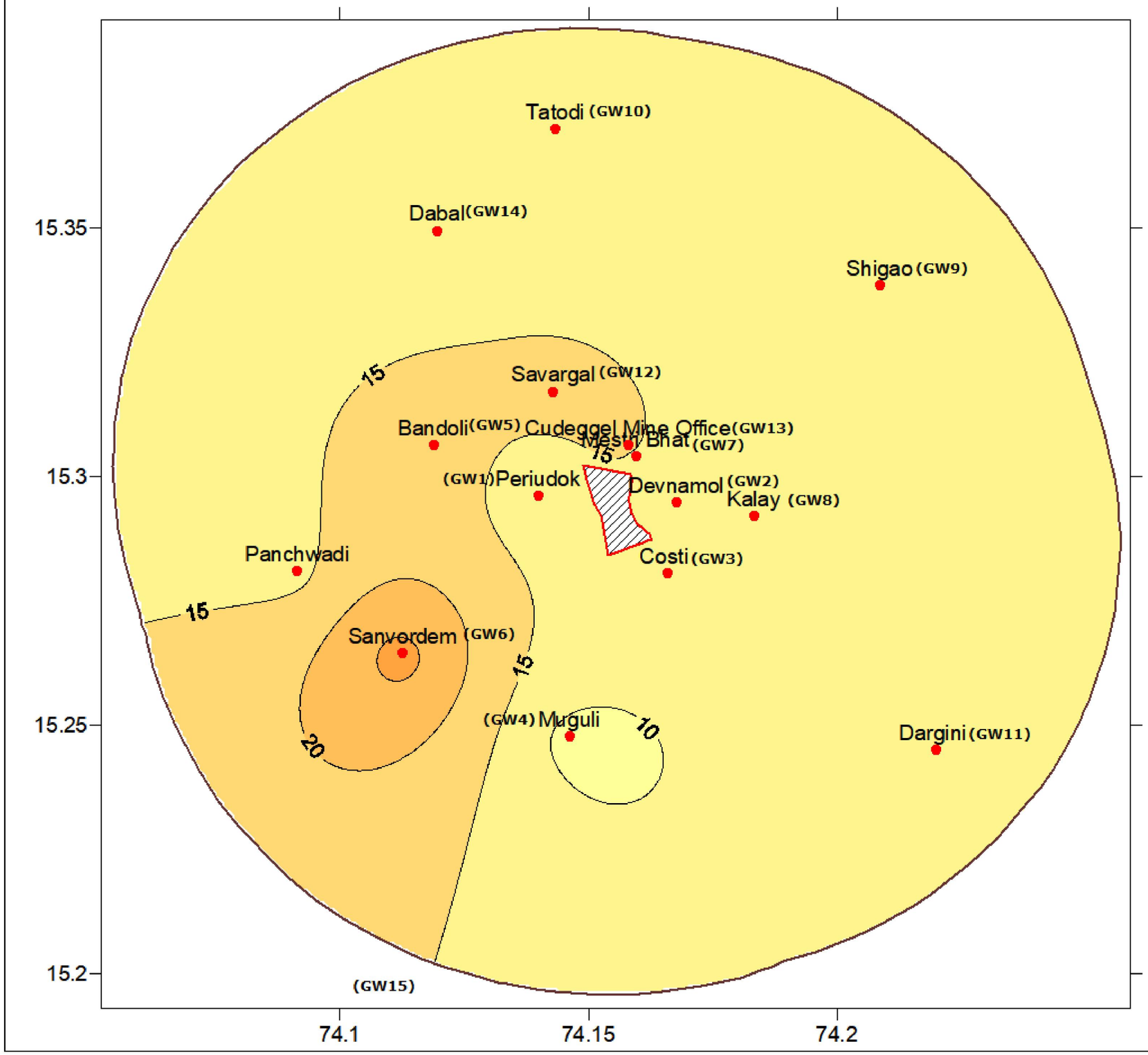
PREPARED BY:

M.C.REDDY
Former Regional Director,
Central Ground Water Board

670

Hydrogeological and Impact Assessment Studies in and Around Block IV - Kalay Mineral Block, Santona Village, Sanguem Taluk, South Goa District, Goa.

Plate No.13



TITLE:

DISTRIBUTION OF CHLORIDE (Mg/L) IN GROUND WATER (NOV 2022)

Scale

0 0.85 1.7 2.55 3.4

Kilometers

N W E S

LEGEND

Mineral Block Area

Well Location

25 Chloride Contour

Chloride Range (Mg/l)

5 10 15 20 25

PREPARED FOR:

Fomento Resources Pvt. Ltd

PREPARED BY:

M.C.REDDY
Former Regional Director,
Central Ground Water Board

671

HYDROGEOLOGICAL AND IMPACT ASSESSMENT STUDIES IN AND AROUND BLOCK IV-KALAY MINERAL BLOCK, AT VILLAGE SANTONA,TALUKA SANGUEM,DISTRICT SOUTH GOA, GOA STATE.

PLATE NO:14



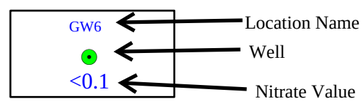


TITLE : Distribution of Nitrate(Mg/l) in Groundwater (Nov 22)

Legend

- Mineral Block Area
- Well Location
- 10 Km Buffer Zone

Nitrate Range (Mg/l) legend



PREPARED FOR :

Fomento Resources Private Limited

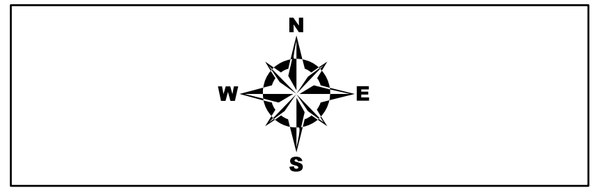
PREPARED BY :

M.C. REDDY,
FORMER REGIONAL DIRECTOR,
CENTRAL GROUNDWATER BOARD

HYDROGEOLOGICAL AND IMPACT ASSESSMENT STUDIES IN AND AROUND BLOCK IV-KALAY MINERAL BLOCK, AT VILLAGE SANTONA,TALUKA SANGUEM,DISTRICT SOUTH GOA, GOA STATE.

PLATE NO: 15





TITLE : Distribution of Flouride(Mg/l) in Groundwater (Nov 22)

Legend

- Mineral Block Area
- Well Location
- 10 Km Buffer Zone

Fluoride Range (Mg/l) legend

GW1 — Location Name
Well
<0.1 — Fluoride Value

PREPARED FOR :

Fomento Resources Private Limited

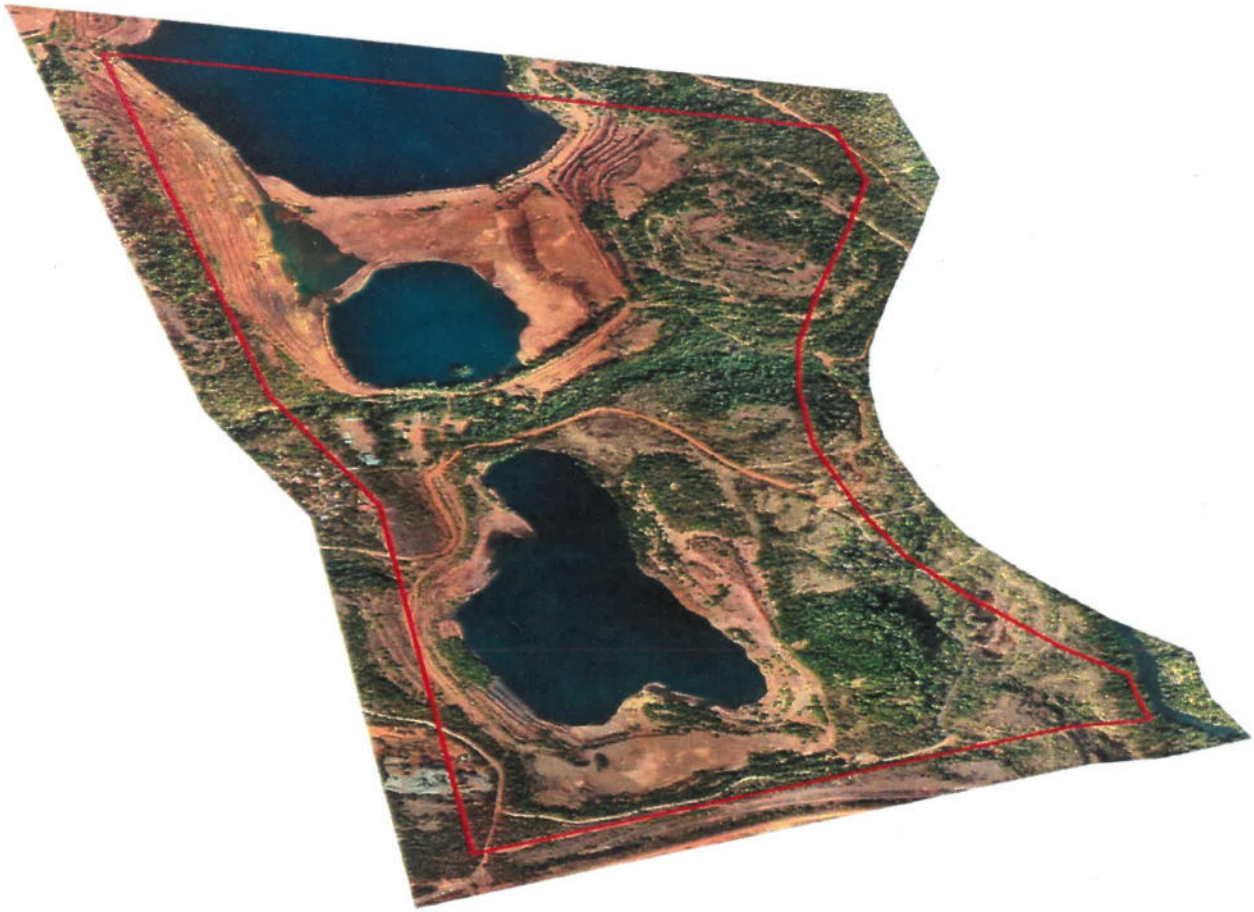
PREPARED BY :

M.C. REDDY,
FORMER REGIONAL DIRECTOR,
CENTRAL GROUNDWATER BOARD

Final Report

on

Slope Stability Study of the Block IV- Kalay Mineral Block of Fomento Resources Private Limited for Safe Workings and Optimum Design situated at Santona Village, Sanguem Taluk, South Goa District, Goa State



Submitted

June, 2023

_By

Dr. Sandi Kumar Reddy

Assistant Professor

DrSANDIKyMADDY
Department of Mining Engineering
National Institute of Technology Karnataka,Surathkal
Srinwasnagar - 575 025, Mangalore, Karnataka

Department of Mining Engineering

NATIONAL INSTITUTE OF TECHNOLOGY KARNATAKA, SURATHKAL

(Govt, of India)

P.O: Srinivasnagar – 575025, Mangalore, INDIA

Phone: 0824-2473375, Fax: 0824-2474033

CONTENTS

Sl.No.	Title	Page No.
1.0	INTRODUCTION	1
2.0	OBJECTIVES	2
3.0	FIELD INVESTIGATIONS	3
	3.1 Geology	3
	3.2 Kinamatic Analysis	17
4.0	MINING METHOD	19
5.0	ROCK TESTING	19
	5.1 Physico-Mechanical Properties	19
6.0	SLOPE STABILITY	23
	6.1 Slope Analysis	23
7.0	OVERALL PIT SLOPE	56
8.0	DRAINAGE	67
9.0	CONCLUSIONS & RECOMMENDATIONS	68
ACKNOWLEDGEMENTS		69
DISCLAIMER		69

Dr. SANDI KUMAR REDDY
Assistant Professor
Department of Mining Engineering
National Institute of Technology Karnataka,Surathkal
Srinivasnagar - 575 025, Mangalore, Karnataka

SUMMARY

Fomento Resources Private Limited proposes to start a new iron ore mining project known as Block IV- Kalay Mineral Block for Iron ore Mineral, allotted vide e-auction dated 21-12-2022, situated at Santona Village, Sanguem Taluk, South Goa district of Goa. The total Reserves & Resources of 16.731 Million Tonnes of Iron ore is estimated within the Mining Lease area of 152.5073 Ha. A Fully mechanized Open Cast Mining method is proposed without drilling and blasting.

Future proposed workings of Block IV- Kalay Mineral Block require scientific studies to optimize the bench parameters and final/ultimate pit slope for the stability of safe working conditions and also for the purpose of Environment Impact Assessment (EIA) approval. Because of this, the mine management approached the National Institute of Technology Karnataka Surathkal (NITK) to carry out 'Slope stability studies for safe workings and optimum design of Block IV- Kalay Mineral Block'. In this regard, The NITK team conducted detailed field investigations during the first week of March 2023. This report incorporates the details of investigations, recommendations for safe workings and optimum design related to Block IV- Kalay Mineral Block.

Based on investigations carried out by NITK and the data provided by the mine management, a detailed study was carried out, and the following conclusions and recommendations were made.

- The laterite, weathered/siliceous BHQ and Iron Ore found in the lease is classified as sandy material, and Ferruginous/Limonitic/Phyllitic soil, Siliceous manganiferrous soil and Mangniferrous soil is classified as clay material. The lateritic soils are highly porous and permeable. These soils become soft when wet, and they become strong after drying.
- It is recommended that the ultimate pit slope angle for different sections in the mine as given in Table-3.
- In general, for the whole mine it is recommended that the ultimate pit slope angle for any section is 30^0.However, monitoring shall be carried out while approaching the ultimate pit limits to ensure safety and understanding of the slope movements.
- The recommended bench dimensions are a maximum of 6m height by 8m width with an individual bench slope of 63^0 for the mine. However, if any weak material encounters

during excavation, the individual benches in weak material need to be stabilized, and bench parameters need to be adjusted accordingly within above mentioned recommendations.

- The benches need to be properly sloped, and no undercutting is permitted to prevent danger from falling off sides. Whenever any geological weakness like faults, folds and weathered/loose material etc., are encountered during the extraction process, the same shall be treated before proceeding with the further operation.
- Local wedges forming at the face of the workings in the mine need to be supported.
- Proper drainage system to be made in the entire pit area to minimise the influence of water on the stability of slopes.
- During mining operations, the working area pit slope should be less than the ultimate or final pit slope and the bench width should be maintained at 8m. Unavoidable small-scale bench failures can be arrested on these wide benches, and large-scale slope failures can be avoided. The wider bench will arrest the local bench failures, and there will not be any operational problems. Ultimately the overall pit slope should be maintained at 30^0 angle with 6m bench height and 8m bench width.
- It may be noted that a few small-scale failures may cause a big failure. If two or three benches are steeper at any level in any part/ depth of the pit, it may initiate failure. Although the overall slope angle may be pretty low, the steeper slope angle of the three benches may increase the stress at the toe of the steeper part of the slope, which may cause failure. Two or three such small failures may cause a big failure. So, benching should be appropriately done from top to bottom.
- It is recommended that an updated geological mapping, and design need to be checked every five years to optimise the workings and safe workings in the mine.
- It is recommended slope and water pressure monitoring of the pit benches need to be carried out and monitoring data need to be submitting to regulatory bodies.

Dr. SANDI KUMAR REDDY
Assistant Professor
Department of Mining Engineering
National Institute of Technology Karnataka, Surathkal
Srinivasnagar - 575 025, Mangalore, Karnataka

1.0 INTRODUCTION

Fomento Resources Private Limited proposes to start a new iron ore mining project known as Block IV- Kalay Mineral Block for Iron ore Mineral, allotted vide e-auction dated 21-12-2022, situated at Santona Village, Sanguem Taluk, South Goa district of Goa. A plan boundary view of the mining lease area as shown in Figure 1 (Table 1). The total Reserves & Resources of 16.731 Million Tonnes of Iron ore is estimated within the Mining Lease area of 152.5073 Ha. A Fully mechanized Open Cast Mining method is proposed without drilling and blasting.



Figure 1. A plan view of the Block IV- Kalay Mineral Block

Table-1. DGPS Co-ordinates of the Mining Lease boundary

Boundary Pillar No.	Latitude (N)	Longitude (E)
BP 1	15° 17′ 58.2803″	74° 09′ 31.3905″
BP 2	15° 18′ 02.6197″	74° 09′ 29.8008″
BP 3	15° 18′ 08.7974″	74° 08′ 55.2583″
BP 4	15° 17′ 40.1839″	74° 09′ 03.3467″
BP 5	15° 17′ 30.9847″	74° 09′ 08.5955″
BP 6	15° 17′ 01.6125″	74° 09′ 13.1548″
BP 7	15° 17′ 12.4794″	74° 09′ 41.2969″
BP 8	15° 17′ 13.0200″	74° 09′ 44.8333″
BP 9	15° 17′ 16.8213″	74° 09′ 43.9885″
BP 10	15° 17′ 19.1419″	74° 09′ 40.8072″
BP 11	15° 17′ 23.3295″	74° 09′ 36.4971″
BP 12	15° 17′ 26.7696″	74° 09′ 33.4331″
BP 13	15° 17′ 30.5546″	74° 09′ 31.2826″
BP 14	15° 17′ 36.0551″	74° 09′ 29.0348″
BP 15	15° 17′ 40.9091″	74° 09′ 28.2686″
BP 16	15° 17′ 44.5813″	74° 09′ 28.2599″
BP 17	15° 17′ 49.1710″	74° 09′ 29.2119″
BP 18	15° 17′ 54.4169″	74° 09′ 30.5870″

Future proposed workings of Block IV- Kalay Mineral Block require scientific studies to optimize the bench parameters and final/ultimate pit slope for the stability of safe working conditions and also for the purpose of Environment Impact Assessment (EIA) approval. Because of this, the mine management approached the National Institute of Technology Karnataka Surathkal (NITK) to carry out 'Slope stability studies for safe workings and optimum design of Block IV- Kalay Mineral Block'. In this regard, The NITK team conducted detailed field investigations during the first week of March 2023. This report incorporates the details of investigations, recommendations for safe workings and optimum design related to Block IV- Kalay Mineral Block.

2.0 SCOPE OF WORK

The scope of work for the studies related to this project is as given below:

- To assess the slope stability conditions in the Mining Lease area based on the mining area, topography, rock properties, Hydrology, Geological Setup, and other Geo-mining conditions; and predict the type of slope failure.
- To determine geotechnical parameters relevant to slope stability analysis in the field

and laboratory.

- To study the stability of individual benches of different lithology and proposed overall pit slope. It is proposed to carry out modelling studies using limit equilibrium-based modelling software. Various models will be developed incorporating geotechnical and mining parameters with different bench configurations for the ultimate pit depth.
- Recommend suitable individual bench and overall pit slope configurations under given geo-mining conditions in the Block IV- Kalay Mineral Block.

3.0 FIELD INVESTIGATIONS

3.1 Geology

Topographically, the Mining Lease area is located on undulating terrain and at few places predominantly covered with climbers, bushes and Accacia plants. The highest elevation of the lease area is 102m MSL, and the lowest is -0.5m MSL. The entire area is covered with three old working pits and nine dumps. Generally, the litho units observed from the surface studies and the exploration data are the top capping of Laterite, followed by lateritic lumpy Iron ore, Iron ore, Phyllitic & Manganese clays, Silicious ore & clay and weathered BHQ (Figure 2).

Regional Geology

Goa is dominantly covered by rocks of the Goa Group of rocks belonging to Dharwar Super Group of the Archaean to Proterozoic age except for a narrow strip along the northeastern corner occupied by the Deccan Trap of Upper Cretaceous to Lower Eocene age. The Iron ore formations of Goa belong to Dharwar super group of the Archaean-Proterozoic age. The Goa Group consists of assemblage of rocks and is divided into four Formations that in the order of superposition are Barcem Formation, Sanvordem Formation, Bicholim Formation and Vageri Formation. Barcem Formation includes essentially metavolcanic rocks with minor meta-sedimentaries.

All the formations are very important and from a commercial point of view, it contains all the iron and manganese ore deposits of Goa, which is the backbone of Goa's economy. The Goa Group of rocks is disposed in a NW-SE direction in the northern, central, eastern and southern parts of Goa and in E-W direction in the South Goa. The rocks have been subjected to at least three generations of folding. The intensity of different generations of folding and degree of expression of their effect are however observed to vary widely from place to place. The stratigraphic succession of the rocks of Goa region is given below:

Table 1: Stratigraphic succession of the lease area

Recent to sub recent	Sea Sand and Laterite
Deccan Trap	Basalts
Basic Intrusive	Dolerite, Gabbro
Acid Intrusive	Pegmatite, Vein Quartz, Porphyritic Granite, Hornblende Granite, Felspathic Gneiss, Granite Gneiss
Vageri Formation	Meta-basalt, Meta-greywacke
Bicholim Formation	Banded Ferruginous Quartzite, Manganiferous Chert Breccia with Pink Ferruginous Phyllite, Limestone, Pink Ferruginous Phyllite, Qzt-Chlorite-Amphibole Schist
Sanvordem Formation	Argillite, Quartzite, Tilloid, Metagreywacke
Barcem Formation	Metagabbro, Peridotite, Talc-Chlorite Schist, Variegate Phyllite, Quartz-Chlorite Schist, Quartzite, Quartz-Sericite Schist, Red Phyllite Quartz Porphyry, Massive, Schistose & Vesicular Metabasalt

Geology of the Mineral Block

The main iron ore deposit where this block is located is called as Codli-Kirlapal-Costi deposit. The general succession of the strata from top to bottom is as follows.

Laterite (about 15 – 20 m)

Altered Dyke (Intrusive)

Ferrugenous/Phyllitic/Limonitic Clay (10 – 15 m)

Iron Ore body (20 - 30 m)

Siliceous Manganiferous Clay & Weathered BHQ (forms foot wall)

Most of the total lease area is broken up by mining and allied activities. The remaining area is mostly covered with a capping of laterite. Based on the exposed rocks formation and the available borehole data, the ore body and the associated rocks are folded.

Structurally ore body and associated formations appears to be subjected to folding. The ore body has a general strike direction as N 10°~20° W to S 10°~20° E and folded into anticlines and synclines with both easterly and westerly dips and amount of dip varying from 10°~40°. The synclinal portions are preserved whereas anticlinal portions are eroded. The ore body is plunging towards the South with an average angle of 5° to 10°. The total length of the Ore body is about 2000 m. and width varies from 300 to 400 m. The average thickness of the ore body is

20 to 30 m. Due to igneous activity, a number of weathered and altered sills & dykes exist in the form of clays along and across the ore body.

The Iron ore deposit is a bedded stratiform & tabular deposit of regular habit. The Iron ore body tends to be lumpy at surface and powdery at depth. As per the Geological Report obtained from Directorate of mines & Geology, Goa, the Iron ore is hard to powdery in nature having a ratio of 73% Fines and 27% Lumps. However, the ratio may vary between 75 to 70% Fines to 25 to 30% Lumps.

Mineralogy:

Most of the lease area is covered by laterite. The laterite at places appears to be very hard and compact. At places, the laterite is having hard lumpy ore pieces. The chemical composition of the laterite ranges from 20 to 38% Fe and alumina ranging from 2 to 30% Al_2O_3.

Ferruginous/Phyllitic Clay is exposed at very small places. It is very fine grained and soft. The chemical composition of clay ranges from Fe 28 to 30% and Al_2O_3 from 10 to 25%.

The Iron ore body is generally found below the laterite capping. The total thickness of the ore body is about 20 to 30 meters. Out of which the top portion of the ore body is lateritized and the grade is +45% Fe. The lower part of the ore body is softer and has a grade of +45% Fe. As per the Geological Report provided by the Directorate of Mines & Geology, Goa the average grade of in-situ ROM is about 56.5% Fe. Considering the Geological structure of the Ore body and the intercalations/intrusions of the clays within the ore body and the dilution factor prevalent in Goan Iron ore deposits, the dilution factor applied during the course of mining/extraction of ROM is about 1.4 to 2.0 Fe unit (an average of 1.7%). Hence the average grade of the ROM recovered will be about 54.8% Fe.

Weathered BHQ/Manganiferous Clay/Siliceous Manganiferous Clay forms the footwall. It is exposed mainly in the central part of the pit. It is soft and at some places where banded hematite quartzite is exposed, it is a little hard.

There are numerous dyke intrusion within the ore body. The main dyke is not yet exposed but in some boreholes towards south west, the main dyke is encountered. Dyke exposed is fully weathered and can be differentiated by pinkish brown colour. It is very soft like clay and can be excavated with any excavator. The chemical composition of the dyke is 15 to 30% Fe and 15 to 25% Al_2O_3.

The samples of the rock/soil collected during geological mapping from the Mining Lease area is carried by NITK Laboratory so that they can be tested in the laboratory to determine the

strength properties of the rock/soil is essential in determining design strength values for stability analysis (Figure 3).

The geological plan of the Mining Lease area is shown in Figure 4, and the geological sections of the Mining Lease area is shown in Figures 5 (a-m). It is also observed that old pits are water logged approximately a quantity of 7.2 million cubic meters in the Mine Lease area ut po a water level of 38.8mRL.



(a)



(b)

Figure 2 (a &b). A view of the Mine Lease area



(a)









(b)



(c)

Figure 3 (a, b & c). A view of the field testing & sample collection in the lease area

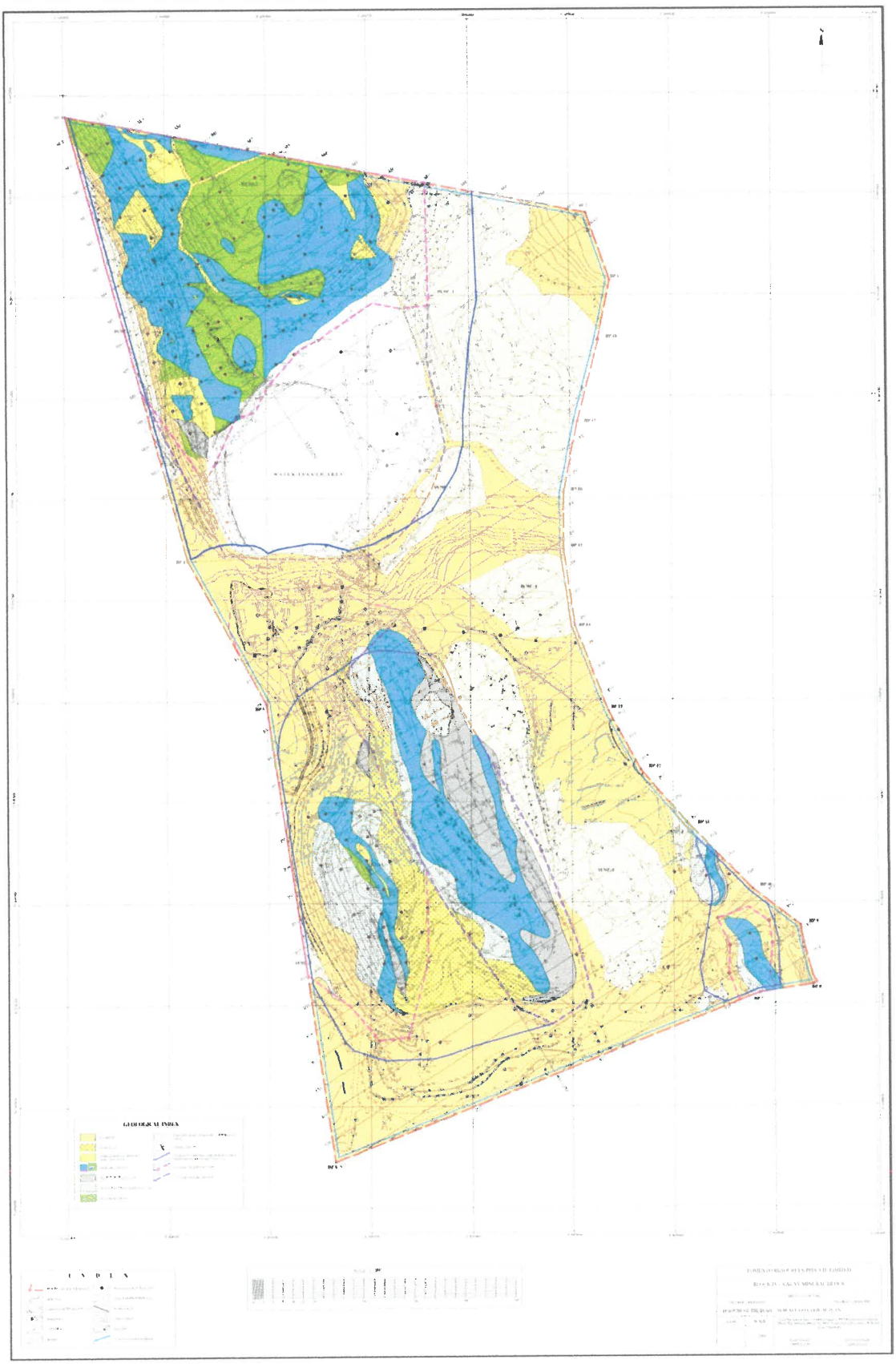
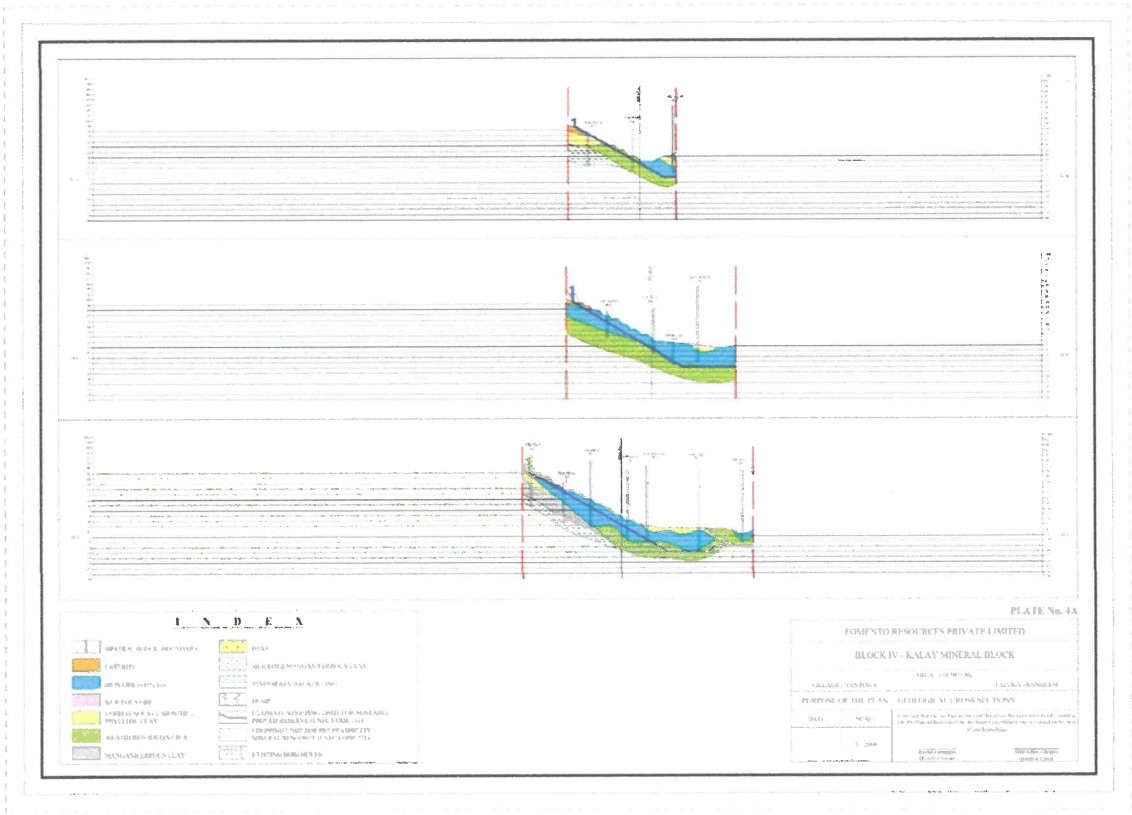
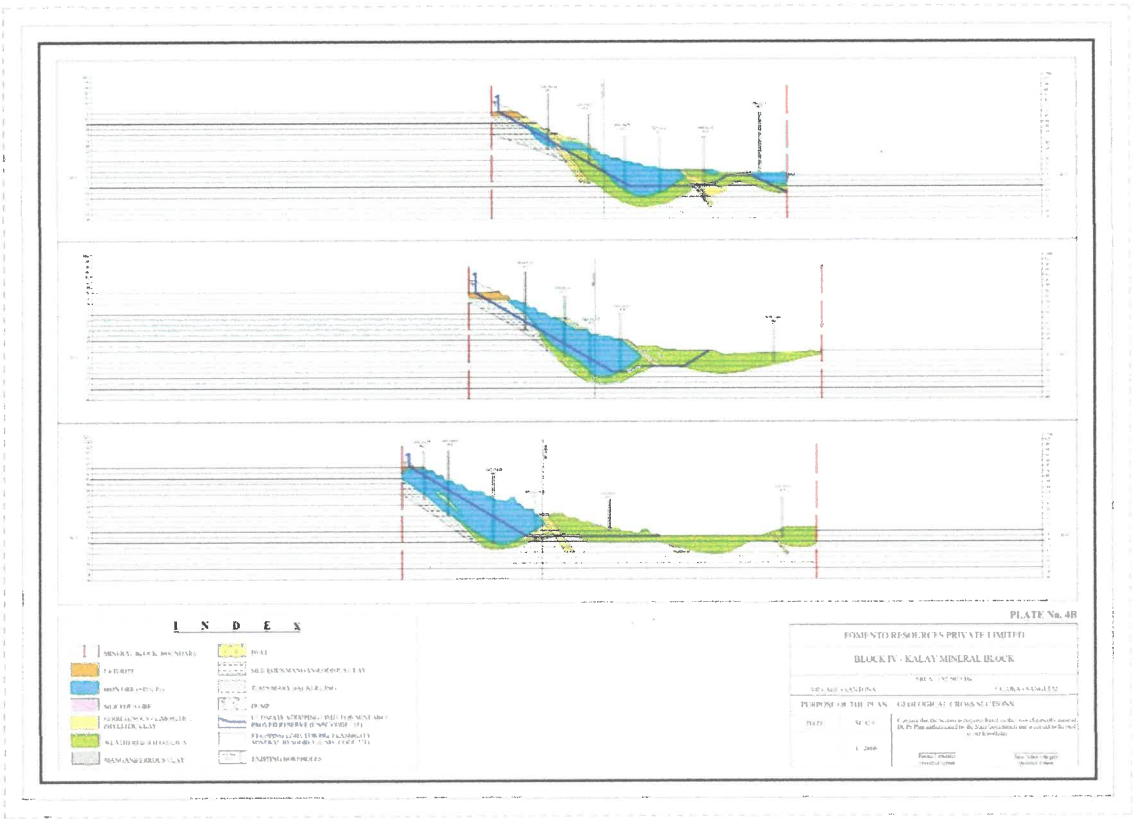


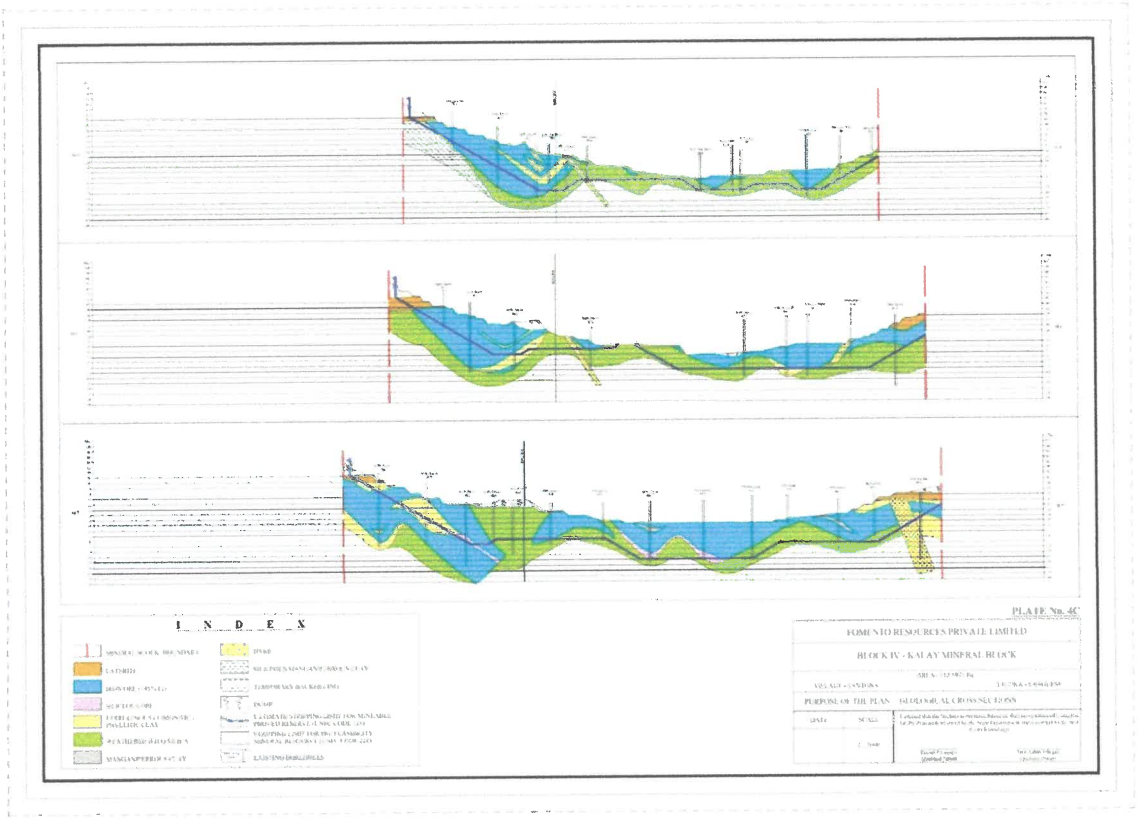
Figure 4. A Plan view of the geology of the Mining Lease area


I N D E X
PLATE No. 4A
FOMENTO RESOURCES PRIVATE LIMITED
BLOCK IV - KALAY MINERAL BLOCK

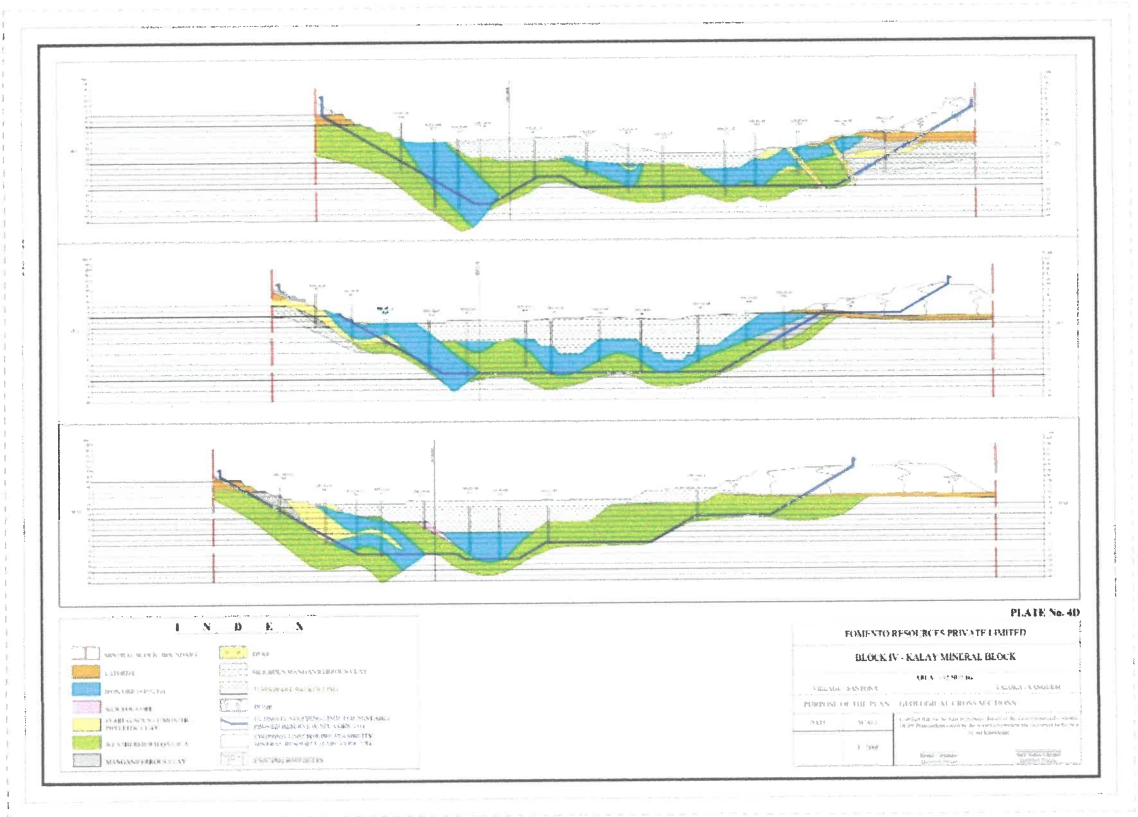
(a)


I N D E X
PLATE No. 4B
FOMENTO RESOURCES PRIVATE LIMITED
BLOCK IV - KALAY MINERAL BLOCK

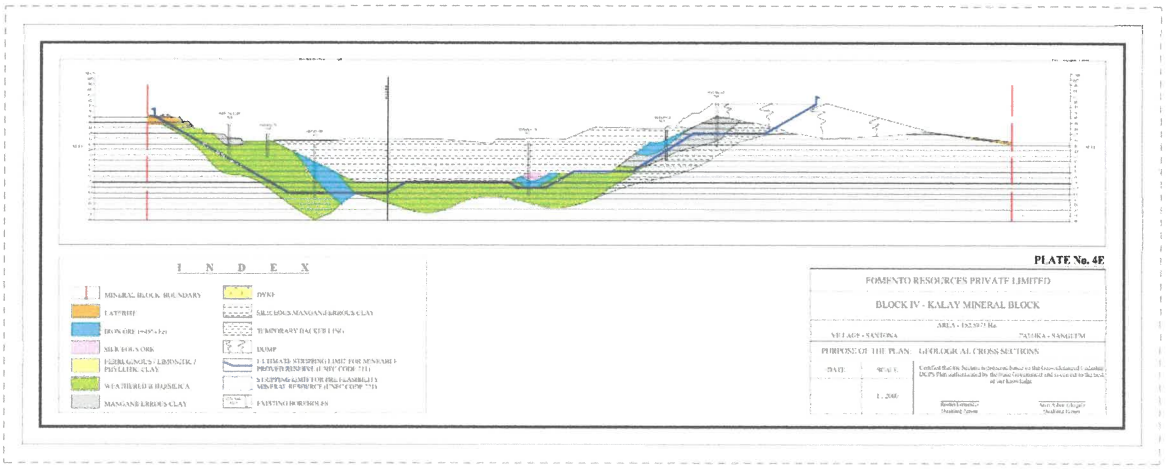
(b)


I N D E X
PLATE No. 4C
FOMENTO RESOURCES PRIVATE LIMITED
BLOCK IV - KALAY MINERAL BLOCK

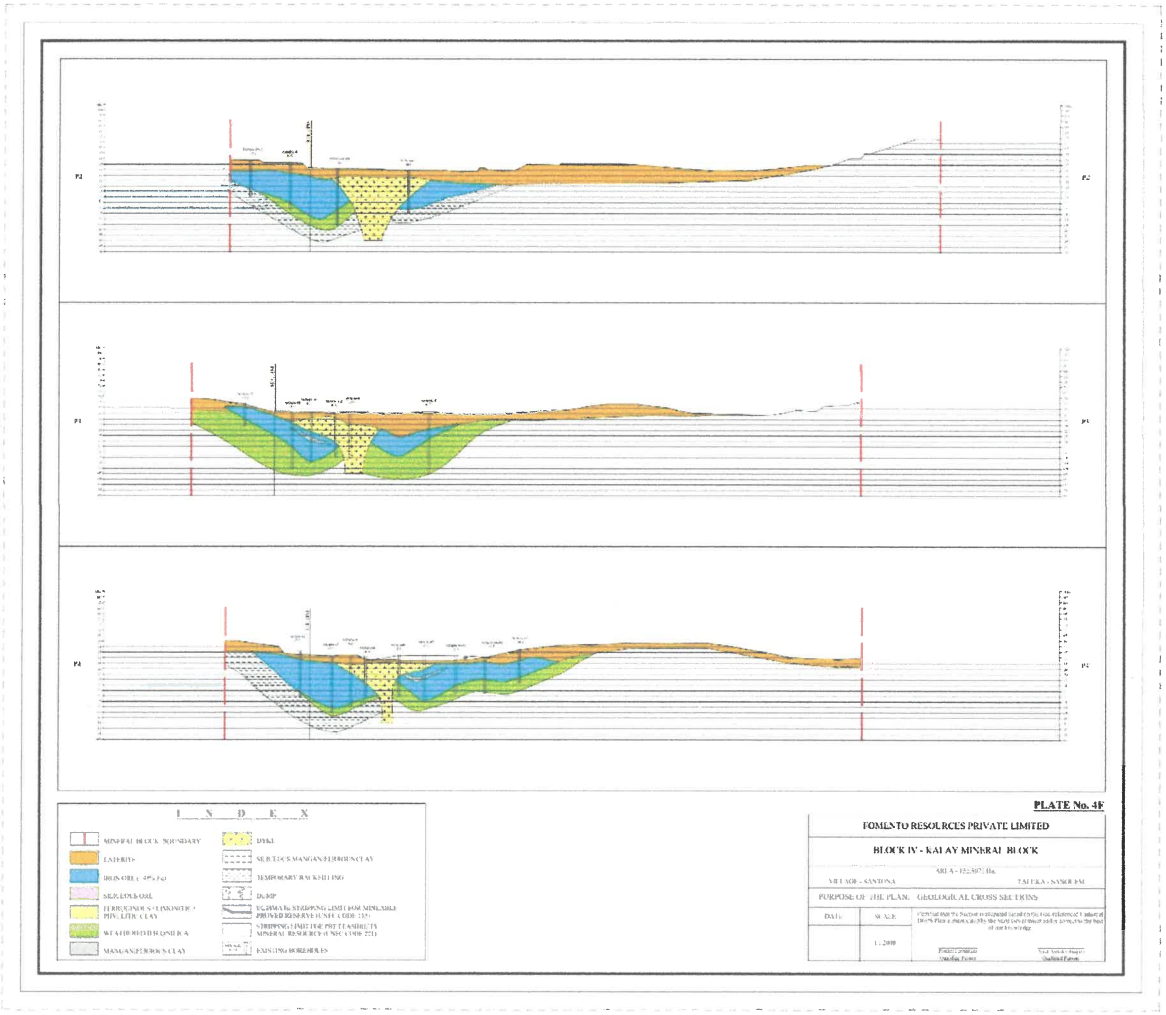
(c)


I N D E X
PLATE No. 4D
FOMENTO RESOURCES PRIVATE LIMITED
BLOCK IV - KALAY MINERAL BLOCK

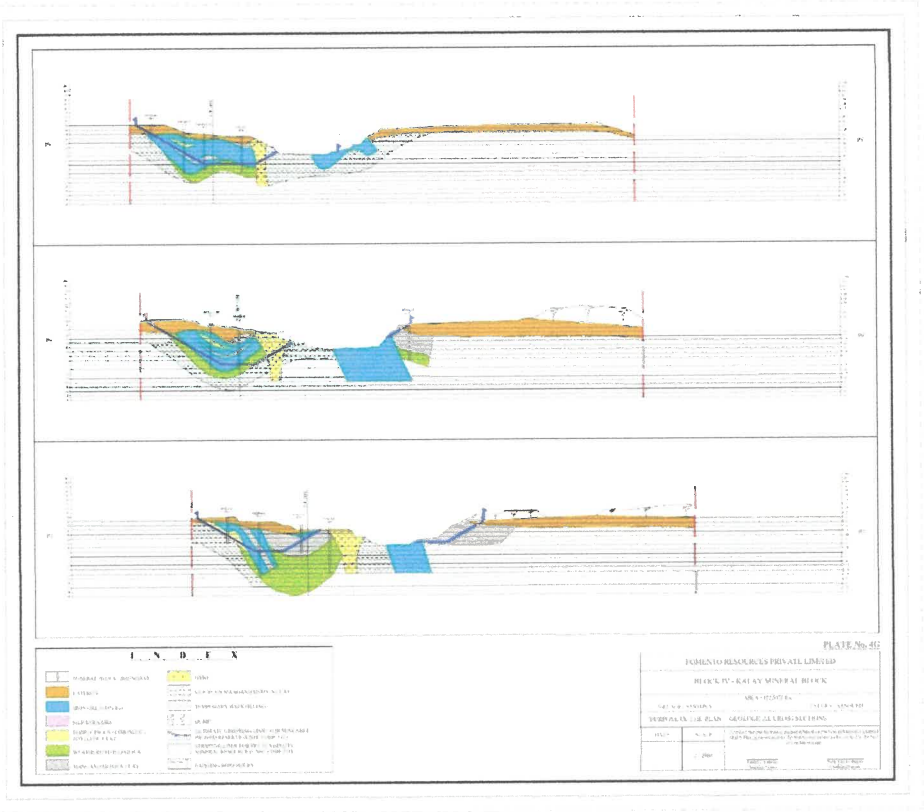
(d)


PLATE No. 4E
FOMENTO RESOURCES PRIVATE LIMITED
BLOCK IV - KALAY MINERAL BLOCK
GEOLOGICAL CROSS SECTIONS

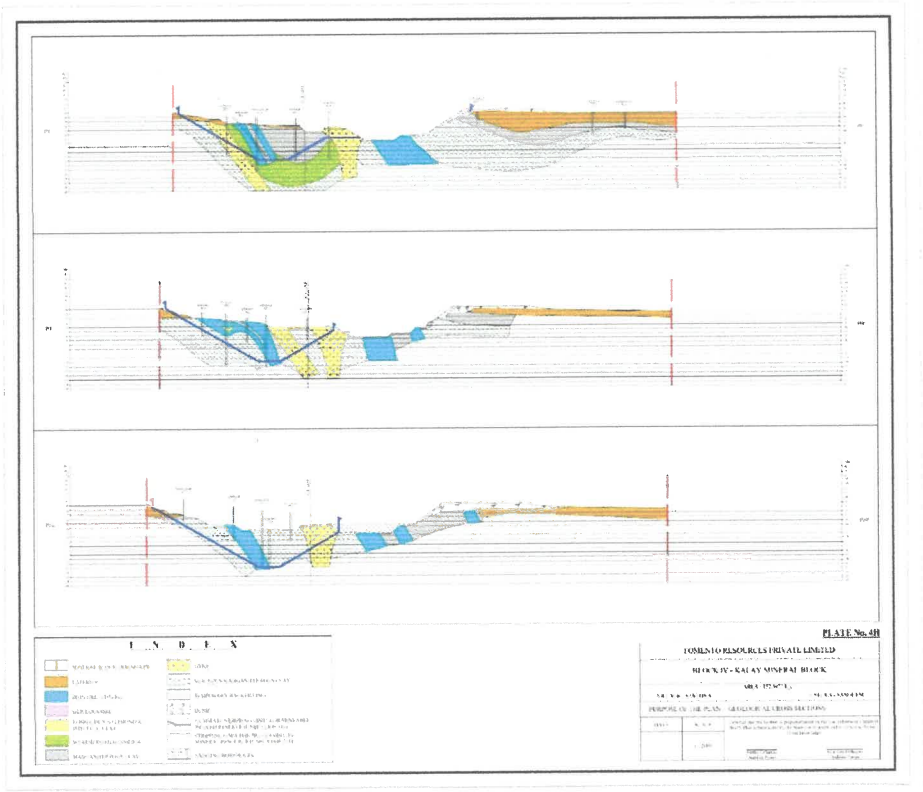
(e)


PLATE No. 4F
FOMENTO RESOURCES PRIVATE LIMITED
BLOCK IV - KALAY MINERAL BLOCK
GEOLOGICAL CROSS SECTIONS

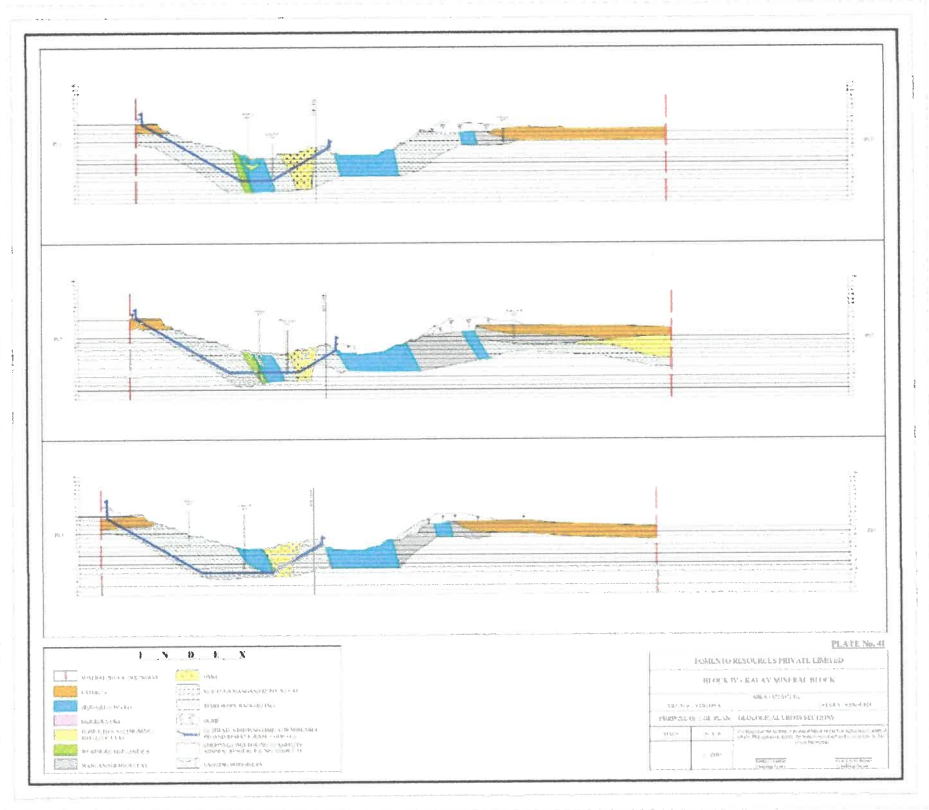
(f)


I N D E X
PLATE No. 4G
TORONTO RESOURCES PRIVATE LIMITED
BLOCK IV - KALAY MINERAL BLOCK

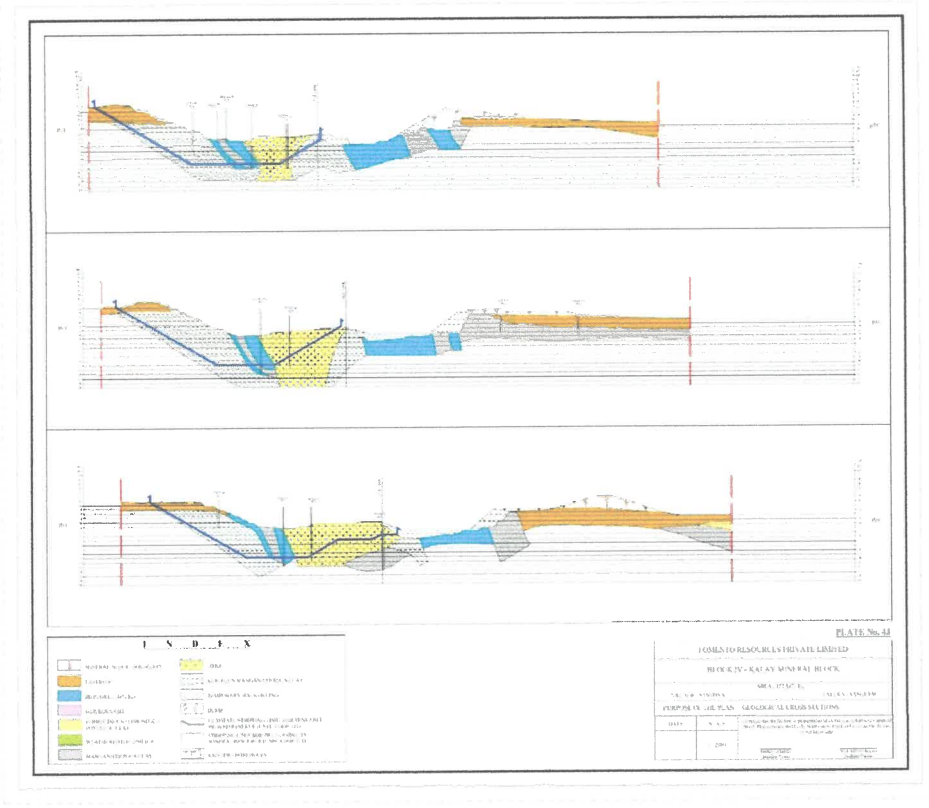
(g)


I N D E X
PLATE No. 4H
TORONTO RESOURCES PRIVATE LIMITED
BLOCK IV - KALAY MINERAL BLOCK

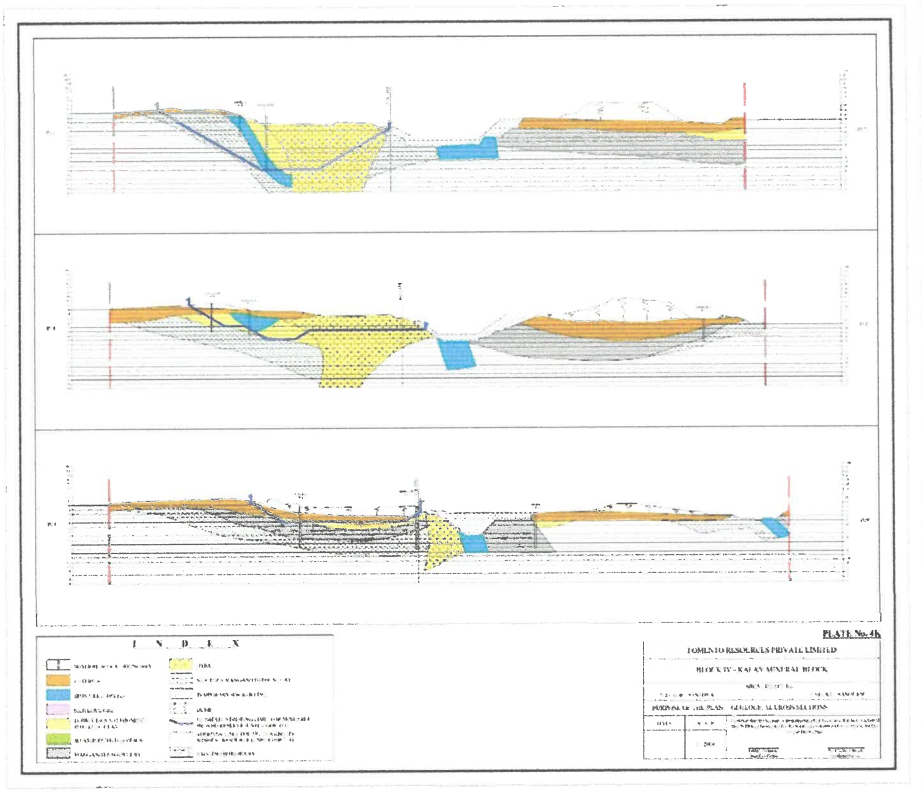
(h)


PLATE No. 41
FOMENTO RESOURCES PRIVATE LIMITED
BLOCK IV - KALAY MINERAL BLOCK

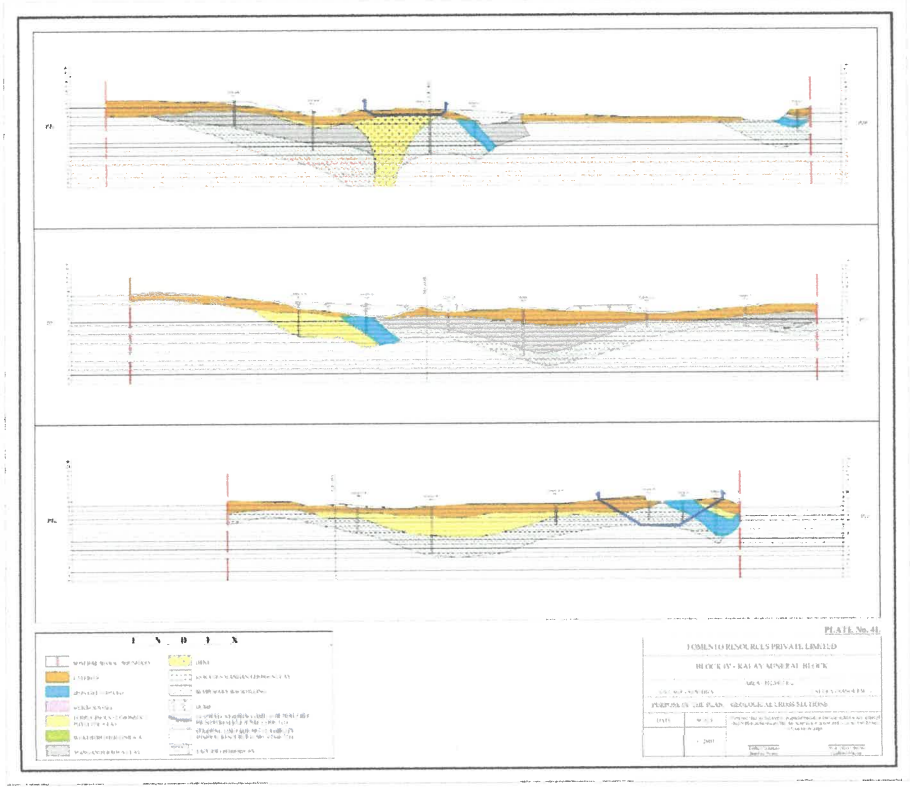
(i)


PLATE No. 42
FOMENTO RESOURCES PRIVATE LIMITED
BLOCK IV - KALAY MINERAL BLOCK

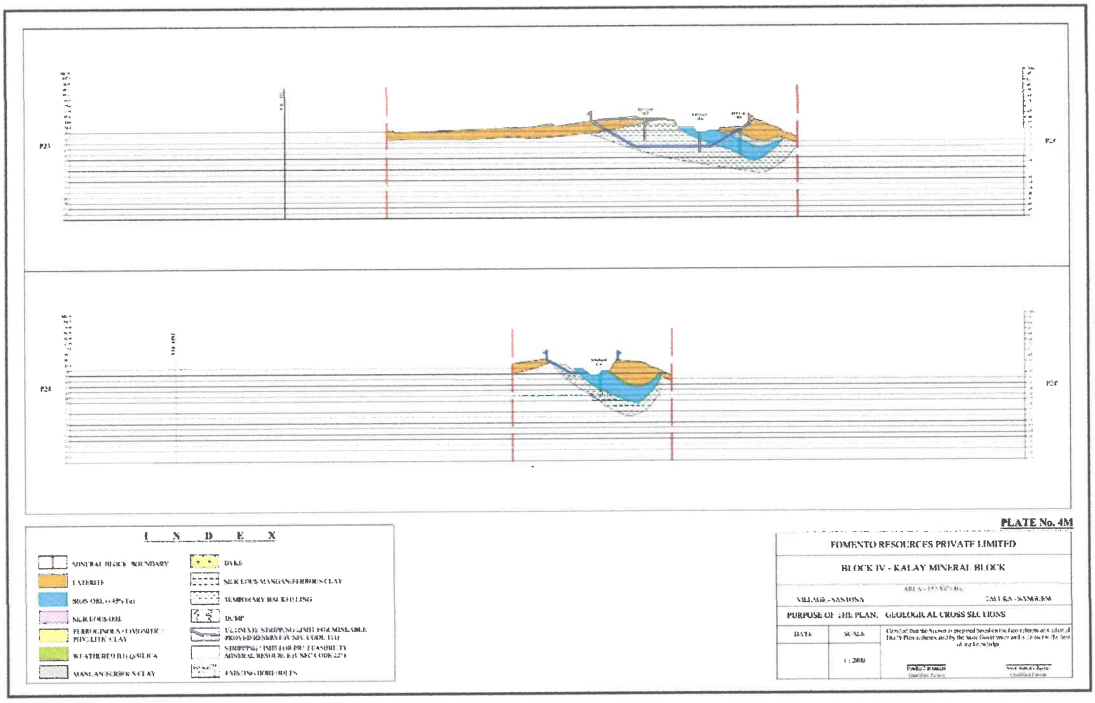
(j)


PLATE No. 4k
TOMEN TO RESOURCES PRIVATE LIMITED
BLOCK IV - KALAY MINERAL BLOCK

(k)


PLATE No. 4l
TOMEN TO RESOURCES PRIVATE LIMITED
BLOCK IV - KALAY MINERAL BLOCK

(l)

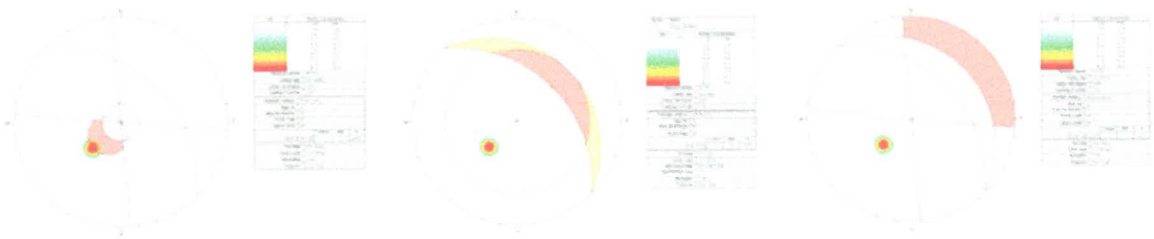


(m)

Figure 5 (a to m). A geological sectional view at different sections of the Mining Lease area

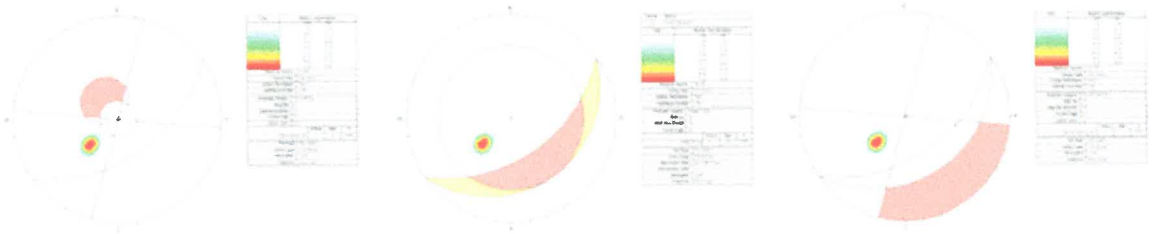
2.0 Kinematic analysis

Kinematic analysis has been performed to illustrate the potential for various modes of rock /soil slope failures, namely, planar, wedge and toppling failures that occur due to the presence of unfavourably oriented discontinuities using statistical stability code Dips 6.0 (Rocscience 2014). Kinematic analysis was conducted using the internal friction angle of rock and the relative orientation of slopes and discontinuities, which were measured to identify any possible structurally controlled failure at locations under investigation (Figures 6 to 11). The study reveals that structurally controlled failure will not occur in these slopes of the Mine Lease as there are no critical areas in the Mining Lease area.



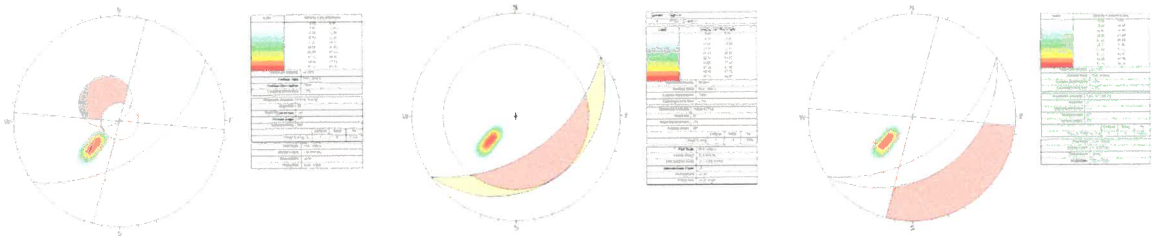
(a) (b) (c)

Figure 6. Sliding chances (Planar, Wedge & Toppling) of the slope section M-1



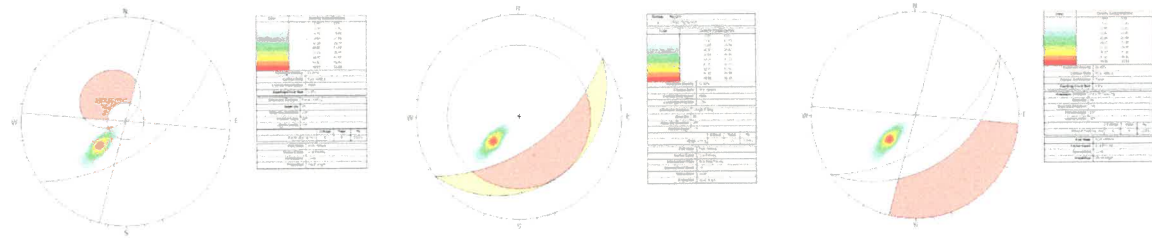
(a) (b) (c)

Figure 7. Sliding chances (Planar, Wedge & Toppling) of the slope section M2



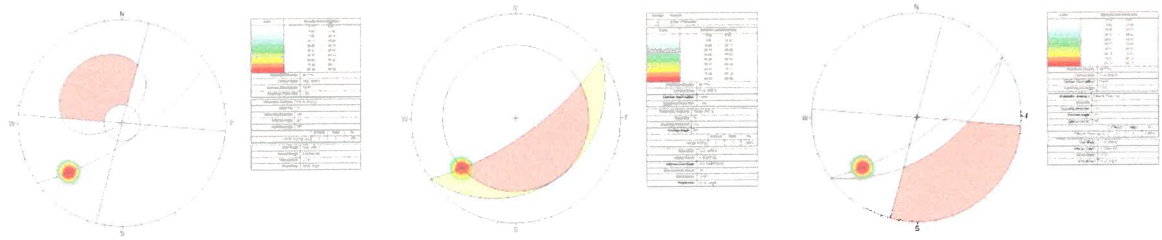
(a) (b) (c)

Figure 8. Sliding chances (Planar, Wedge & Toppling) of the slope section M5



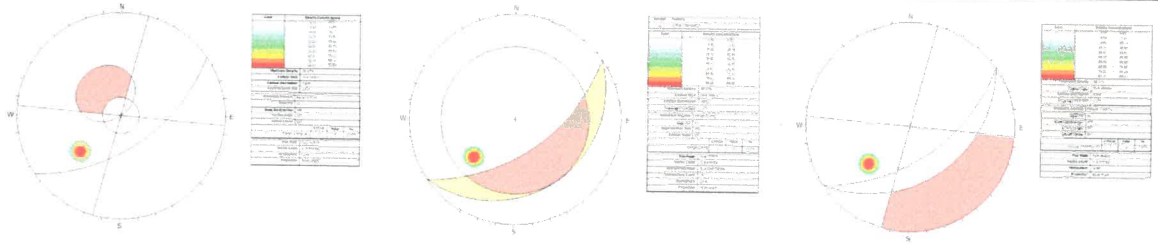
(a) (b) (c)

Figure 9. Sliding chances (Planar, Wedge & Toppling) of the slope section M8



(a) (b) (c)

Figure 10. Sliding chances (Planar, Wedge & Toppling) of the slope section P11



(a) (b) (c)

Figure 11. Sliding chances (Planar, Wedge & Toppling) of the slope section P14

4.0MINING METHOD

Fully mechanized Open Cast Mining method is proposed. It involves overburden/waste removal and ore extraction using heavy earth-moving machinery. For the systematic working of open cast mines, the main development work will be forming systematic benching. The bench height of 6m and width of 8m will be maintained. Mining will be done with the help of heavy earth-moving machinery such as excavators and dumpers. There will be no drilling and blasting. The annual production of iron ore is about 0.75 Million Tonnes. The iron ore produced will be sold to local buyers/ for onward export.

5.0 ROCK TESTING

5.1 Physico-Mechanical Properties

To determine the physico-mechanical properties of the rock/soil, samples were collected from the site. As per the American Society of Testing and Materials (ASTM) and ISRM Standards, the samples were prepared from the collected samples and were tested at the NITK laboratory.

The samples are used to conduct different tests as per the IS standards. The grain size analysis tests were conducted as per IS:2720 (Part 4)–1985. A specific gravity test of the sample was conducted as per IS:2720 (Part. III) Sect/2-1980 of Fine, Medium & Coarse-Grained Soil. Free swell index tests were conducted on all ten samples as per IS:2720 (Part40)–1977—Methods of test for soils: Determination of free swell index of soils. Direct shear tests were conducted as per IS:2720 (Part 13)-1986—Direct shear test. Based on the results, soil can be classified as silty clay (Figures 12-15). The laterite, weathered/siliceous BHQ and Iron Ore found in the lease is classified as sandy material, and Ferruginous/Limonitic/Phyllitic soil, Siliceous manganiferrous soil and Mangniferrous soil is classified as clay material. The lateritic soils are highly porous and permeable. These soils become soft when wet, and they become strong after drying. The observed values of various geotechnical properties are given inTable-2.



Figure 12. Different samples from the Mine Lease area



Figure 13. Specific Gravity testing of the different samples



Figure 14.Uniaxial compression testing of the different rock samples

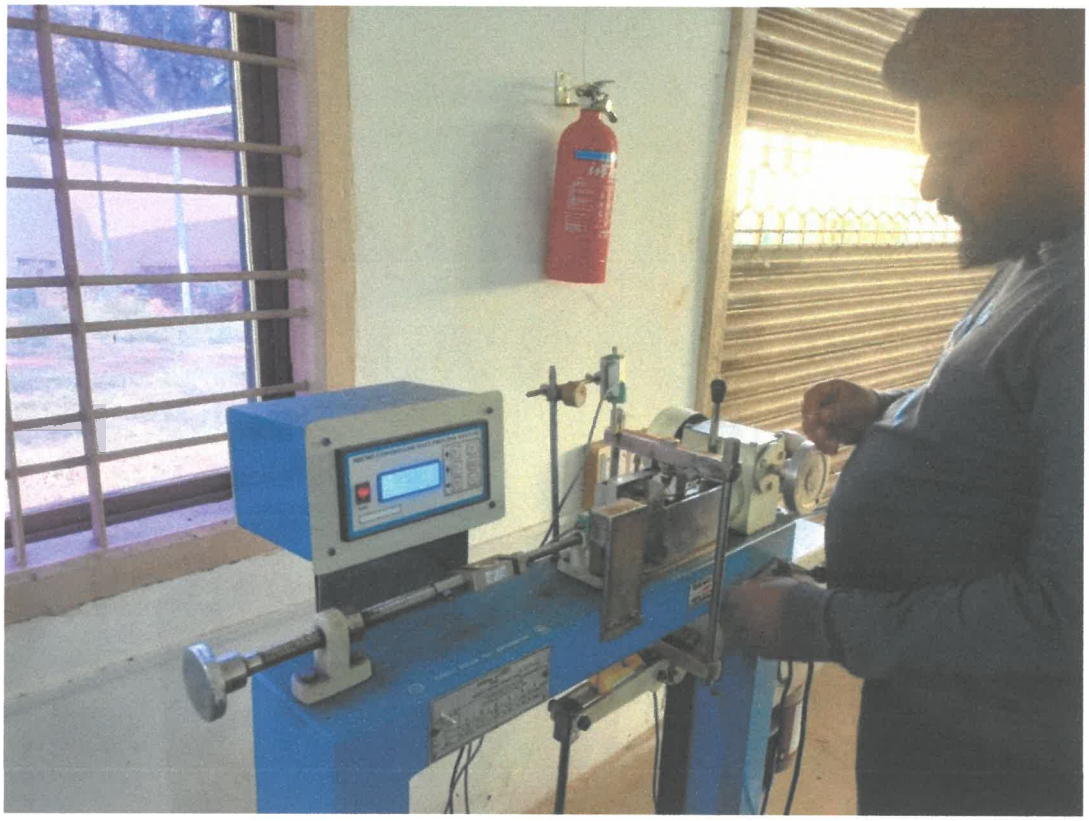


Figure 15. Direct shear testing of the different soil samples

Table-2. Details of physico-mechanical properties of Mine Lease area

Sl. No.	Material Type	Number of samples	Bulk density (t/m^3)	Moisture (%)	Compressive Strength (MPa)	Cohesion (KPa)	Friction Angle (Deg.)
1	Laterite (Hard)	5	2.7	5-8	5-10	280	30-40
2	Laterite	5	2.5	5	2-5	65-188	50-60
3	Ferruginous / Limonitic/ Phyllitic Clay	5	1.87	8-10	-	50-100	25-35
4	Siliceous Manganiferrous clay	5	2.0	8-12	-	50-100	25-35
5	Manganiferrous Clay	5	1.77	10-15	1-2	50-100	25-35
6	Iron Ore (+45% Fe)	5	2.83	1-2	-	220	25-30

6.0 SLOPE STABILITY

6.1 Slope Analysis

Slope stability of a pit is important for three principle reasons. Firstly, operations carried out to excavate and extract Iron Ore minerals need to be safe; Secondly, slopes need to be suitable for their intended future use; Thirdly, slopes need to fit in to the local landscape.

The factors that may affect the stability of slopes is summarized as follows:

i. Geological structures include bedding planes, joints and faults (naturally occurring cracks).
ii. The physico-mechanical properties of the rocks and soils.
iii. Ground water conditions because of water pressure behind a slope will create instability.
iv. Operational controls include the height of benches, width of benches, whether the bench slope are angled or vertical, overall pit slope, and the excavation methods used.

These factors will determine whether ground movements are likely to occur and their size (in three dimensions). To assess the stability of a slope, it is necessary to consider how any ground movement might occur. For example, is there the risk of a block sliding down an angled bedding plane or toppling forward due to joint cracks? The presence of water in a bank of soil may cause a landslip.

Once ground conditions are understood, it is usually possible to design slopes using appropriate benches dimensions, slope angles, or drainage, to avoid large-scale movements. Monitoring should still be carried out on any artificial slope, where rock falls may remain a hazard and requires long-term management(rockfall protection measures).

Slope stability analysis is carried out under the following cases

Case-1: Individual bench of different formation/Litho unit

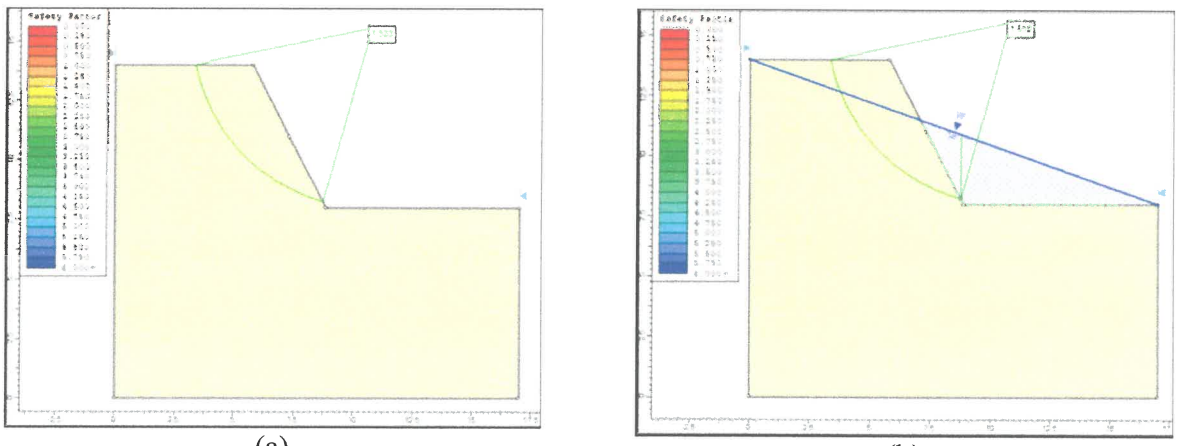
Case-2: Existing overall pit section configuration

Case-3: Proposed overall pit section configuration

These proposed slope sections of the pit were studied using the limit-equilibrium analysis with the SLIDE 6.0 software. In the limit equilibrium analysis, two conditions, namely, dry and saturated slopes, are considered to estimate the safety factor of 1.50.

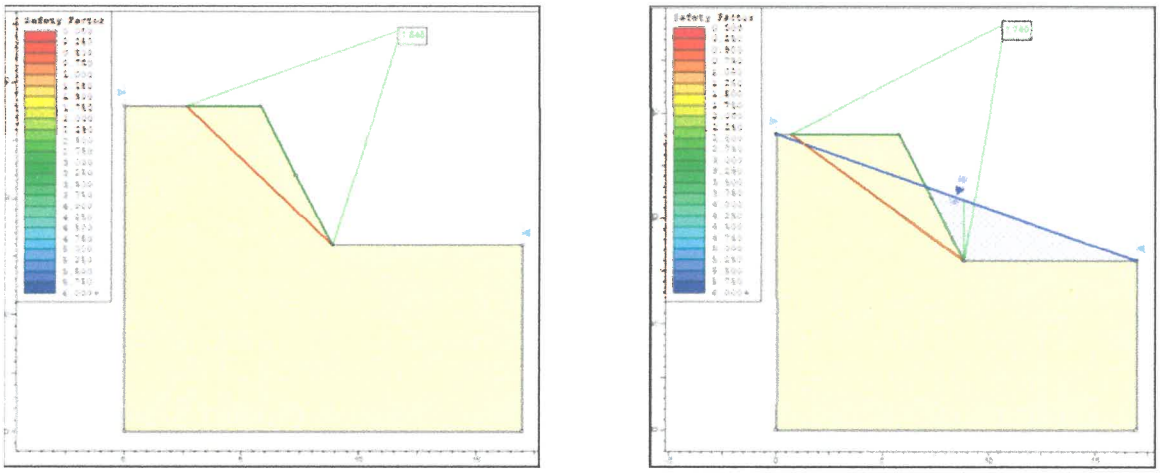
Case-1: Individual bench of different formation

The model created for existing bench (6m height and 8m width) of laterite and laterite with lumpy Iron ore under circular failure with dry and saturated conditions resulted in the least FOS of 1.533 and 1.510 (Figure 16 a & b), respectively. Non-circular failure with dry and saturated conditions resulted in the least FOS of 1.848 and 1.740 (Figure17 a&b) respectively. This indicates that the bench is in stable condition for an individual bench slope with 63^0 and a maximum bench height of 6m, and a minimum width of 8m.



(a) (b)

Figure16 (a & b). Analysis of laterite, MN clay, iron ore, weathered BHQ, Limonitic clay, Siliceous Clay, lumpy ore and Siliceous ore bench in dry & saturated conditions in circular Failure



(a) (b)

Figures 17 (a & b). Analysis of laterite, MN clay, iron ore, weathered BHQ, Limonitic clay, Siliceous Clay, lumpy ore and Siliceous ore bench in dry & saturated conditions in non-circular failure

However, if any weak material encounters during excavation, the individual benches in weak material needs to be stablilize, and bench parameters need to be adjusted accordingly with in above mentioned recommendations.

Case-2: Existing overall pit section configuration

For the critical sections (M-1, M2, M5, M8, M11, P2, P5, P8, P11, P14, P17, P22&P24) of the Mining Lease area, the limit equilibrium analysis was carried out using SLIDE 6.0 software. In this analysis, elevation is taken on the y-axis, and the safety factors are estimated for each section under dry and saturated conditions. The numerical analysis is considering the field and laboratory observation of the rock/soil mass in the Mining Lease area. A sensitive analysis is carried out to determine the behaviour of rock mass in different conditions (i.e. Change in the geology of the rock mass and mining conditions).

In the existing critical section-M-1 towards the East-West direction of the mine, the slope analysis shows that the safety factor under circular failure with dry and saturated conditions are 3.012 and 2.576 respectively (Figures 18 & 19). Based on the proposed analysis for the critical section-M-1 towards the East-West direction of the mine pit for 60m depth, the slope analysis shows the factor of safety under circular failure with dry and saturated conditions are 2.229 and 2.149 respectively (Figures 20&21) and noncircular failure conditions are1.777 and1.908, respectively (Figures 22&23).

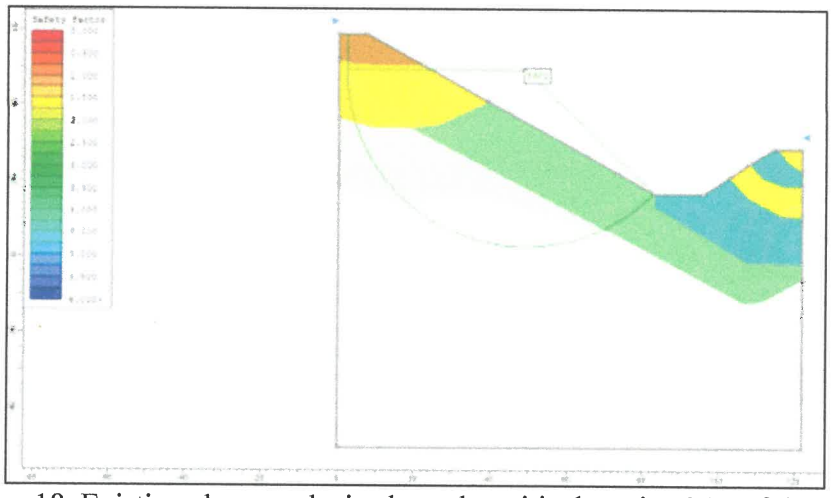


Figure 18. Existing slope analysis along the critical section-M-1of the mine under circular failure with dry condition

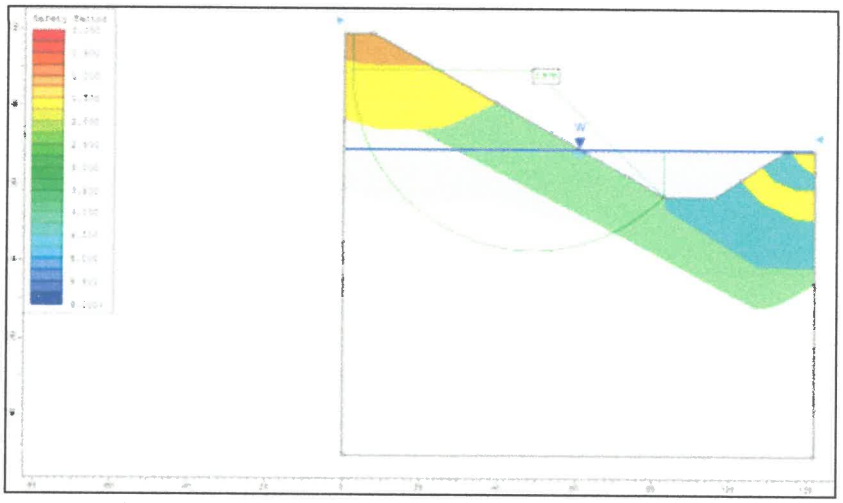


Figure 19. Existing slope analysis along the critical section-M-1of the mine under circular failure with saturated condition

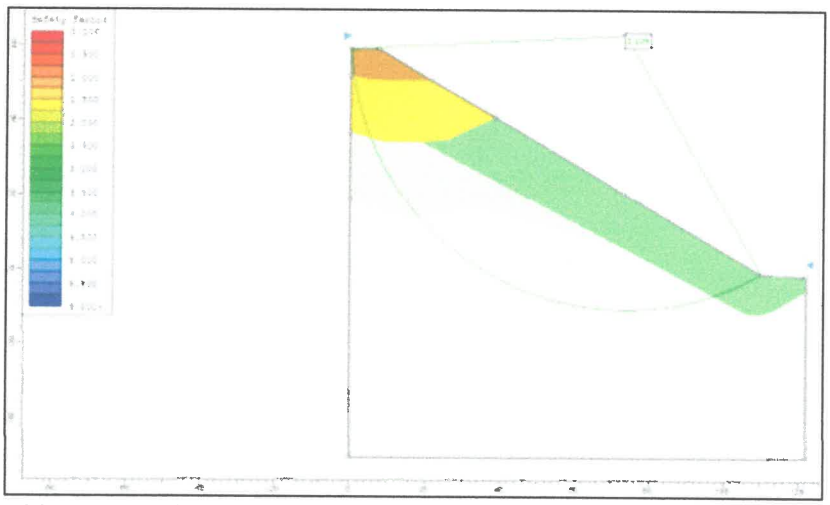


Figure 20. Proposed slope analysis along the critical section -M-1 of the mine under circular failure with dry condition

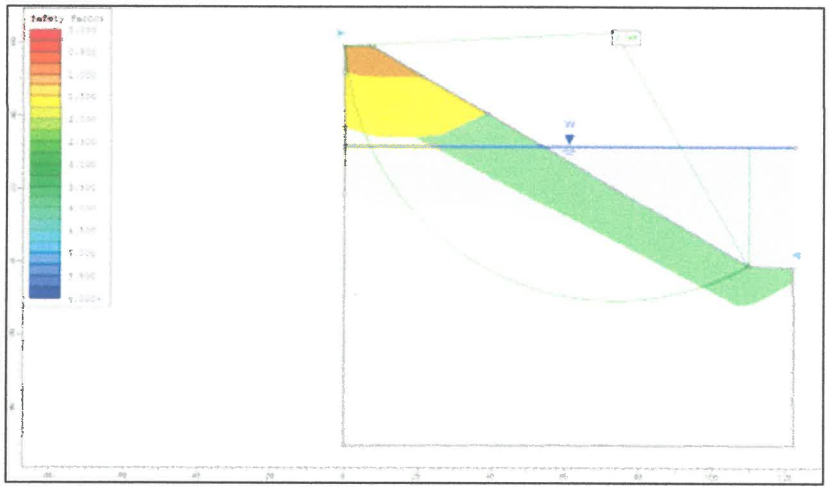


Figure 21. Proposed slope analysis along the critical section-M-1 of the mine under circular failure with saturated condition

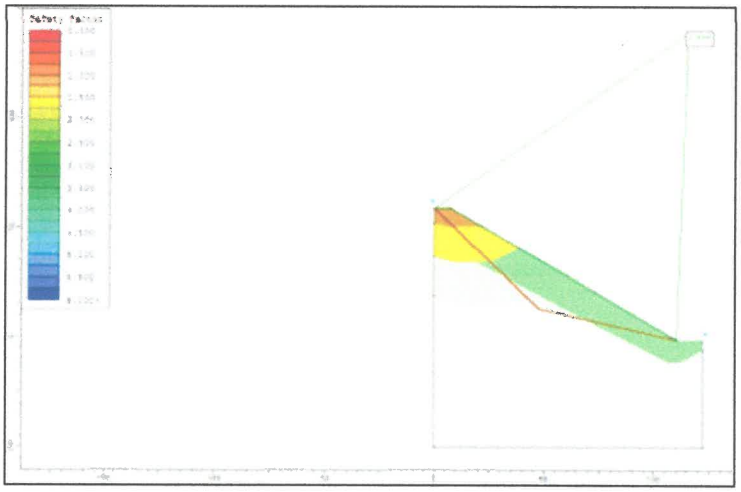


Figure 22. Proposed slope analysis along the critical section-M-1 of the mine under noncircular failure with dry condition

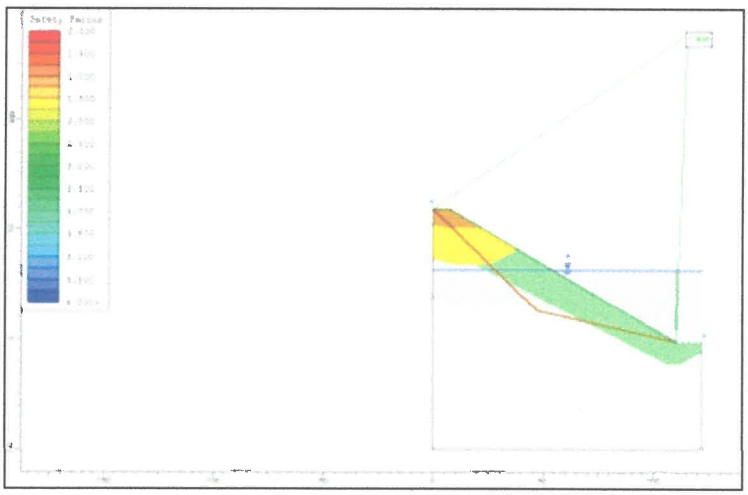


Figure 23. Proposed slope analysis along the critical section-M-1 of the mine under noncircular failure with saturated condition

In the existing critical section-M2 towards the East-West direction of the mine, the slope analysis shows that the safety factor under circular failure with dry and saturated conditions are 1.748 and 1.666 respectively (Figures 24 & 25). Based on the proposed analysis for the critical section-M2 towards the East-West direction of the mine pit for 84m depth, the slope analysis shows the factor of safety under circular failure with dry and saturated conditions are 1.694 and 1.614 respectively (Figures 26& 27) and noncircular failure conditions are 1.62 and 1.629, respectively (Figures 28&29).

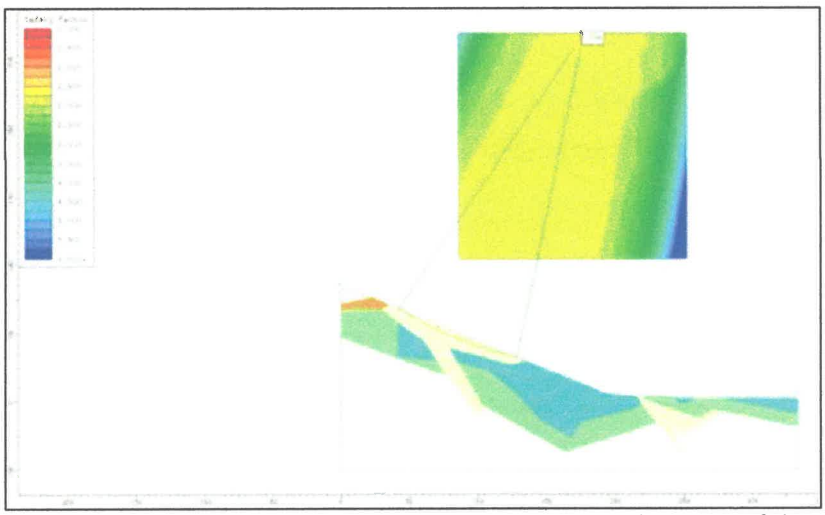


Figure 24. Existing slope analysis along the critical section-M2 of the mine under circular failure with dry condition

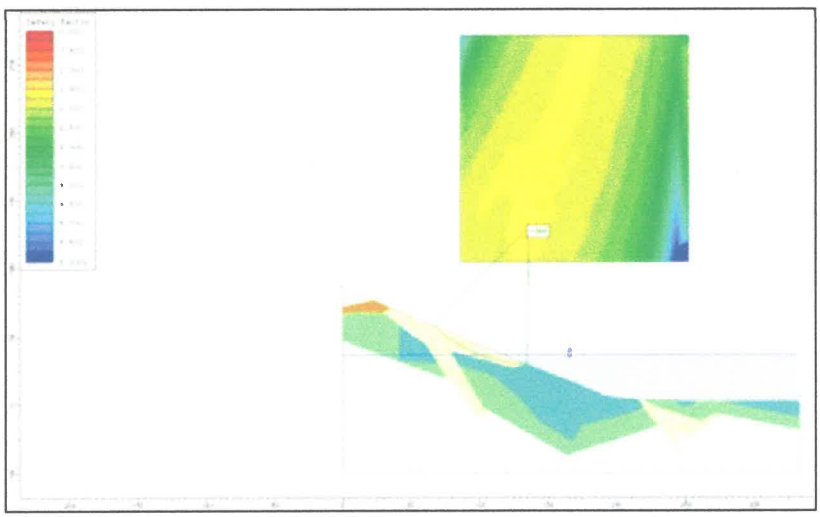


Figure 25. Existing slope analysis along the critical section-M2 of the mine under circular failure with saturated condition

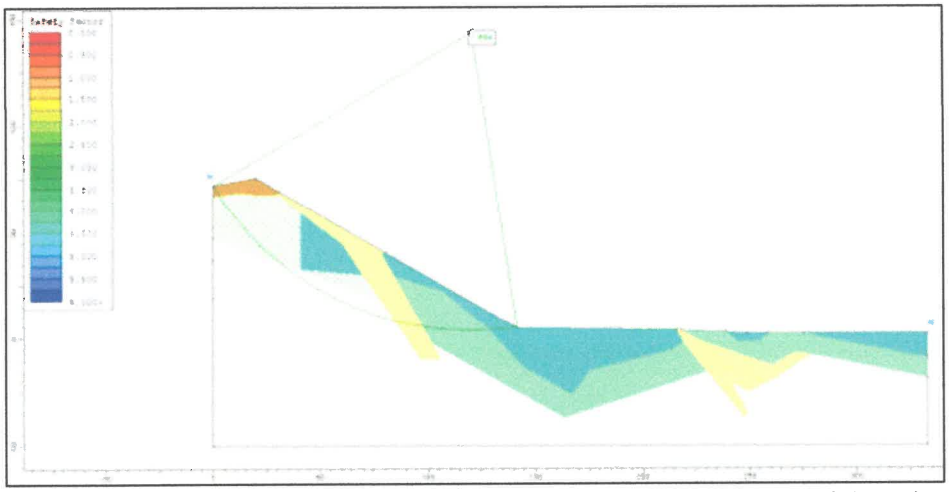


Figure 26. Proposed slope analysis along the critical section-M2 of the mine under circular failure with dry condition

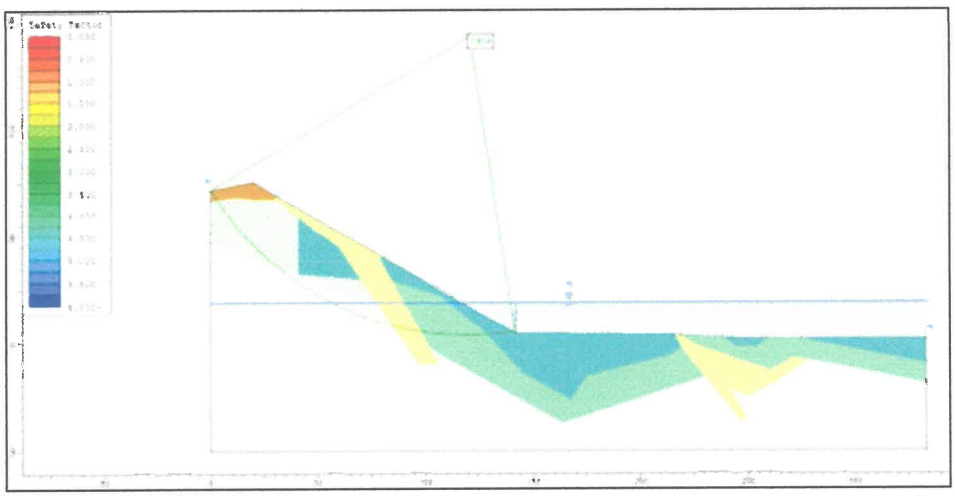


Figure 27. Proposed slope analysis along the critical section-M2 of the mine under circular failure with saturated condition

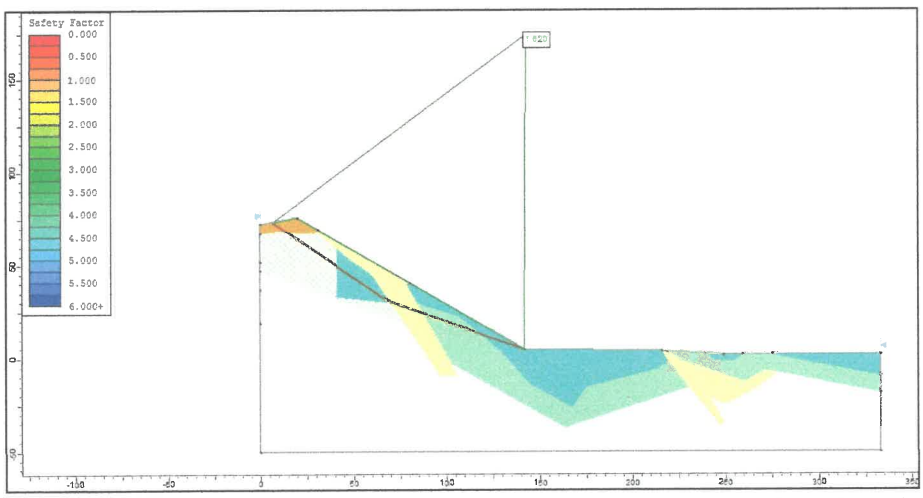


Figure 28. Proposed slope analysis along the critical section-M2 of the mine under noncircular failure with dry condition

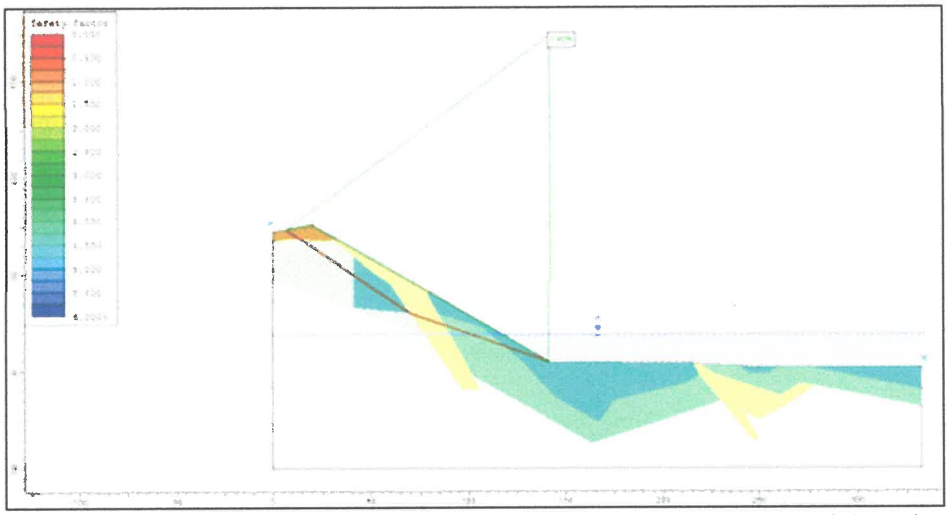


Figure 29. Proposed slope analysis along the critical section-M2 of the mine under noncircular failure with saturated condition

In the existing critical section-M5 towards the East-West direction of the mine, the slope analysis shows that the safety factor under circular failure with dry and saturated conditions are 1.835 and 1.67 (Figures 30&31). Based on the proposed analysis for the critical section-M5 towards the East-West direction of the mine pit for 85m depth, the slope analysis shows the factor of safety under circular failure with dry and saturated conditions are 1.514 and 1.559 respectively (Figures 32&33) and noncircular failure conditions are 1.576 and 1.556, respectively (Figures 34&35).

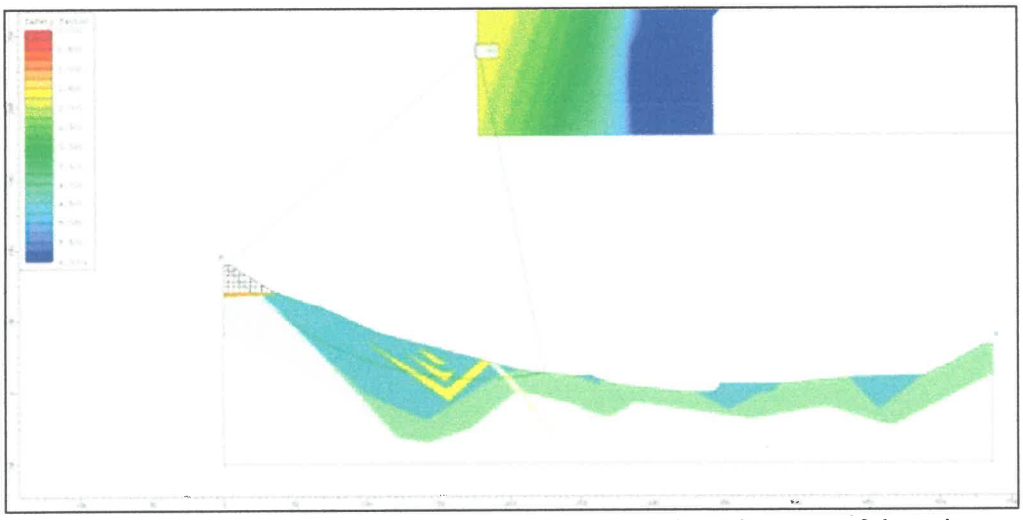


Figure 30. Existing slope analysis along the critical section-M5 of the mine under circular failure with dry condition

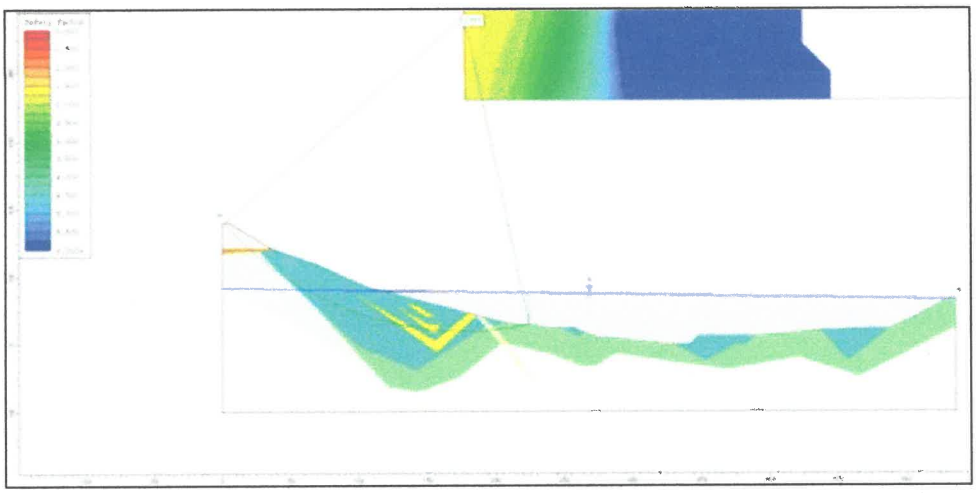


Figure 31. Existing slope analysis along the critical section-M5 of the mine under circular failure with saturated condition

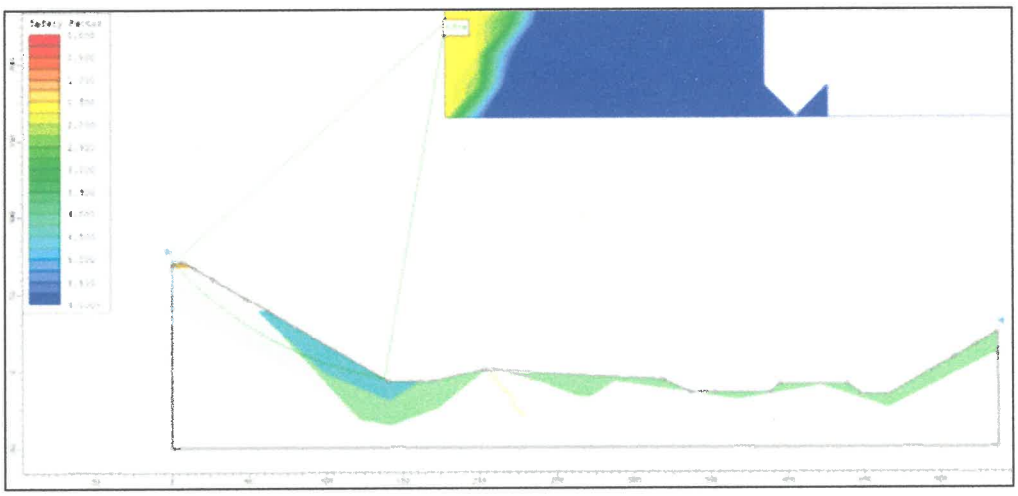


Figure 32. Proposed slope analysis along the critical section-M5 of the mine under circular failure with dry condition

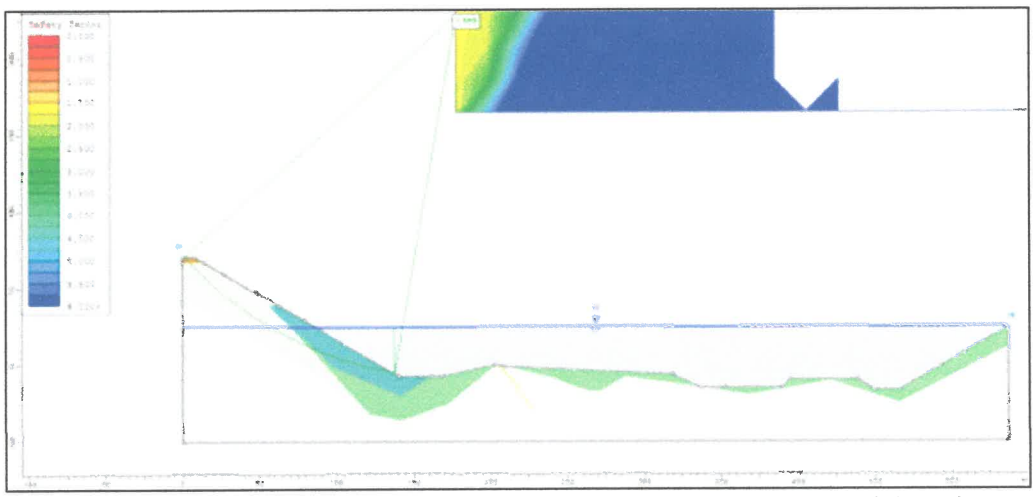


Figure 33. Proposed slope analysis along the critical section-M5 of the mine under circular failure with saturated condition

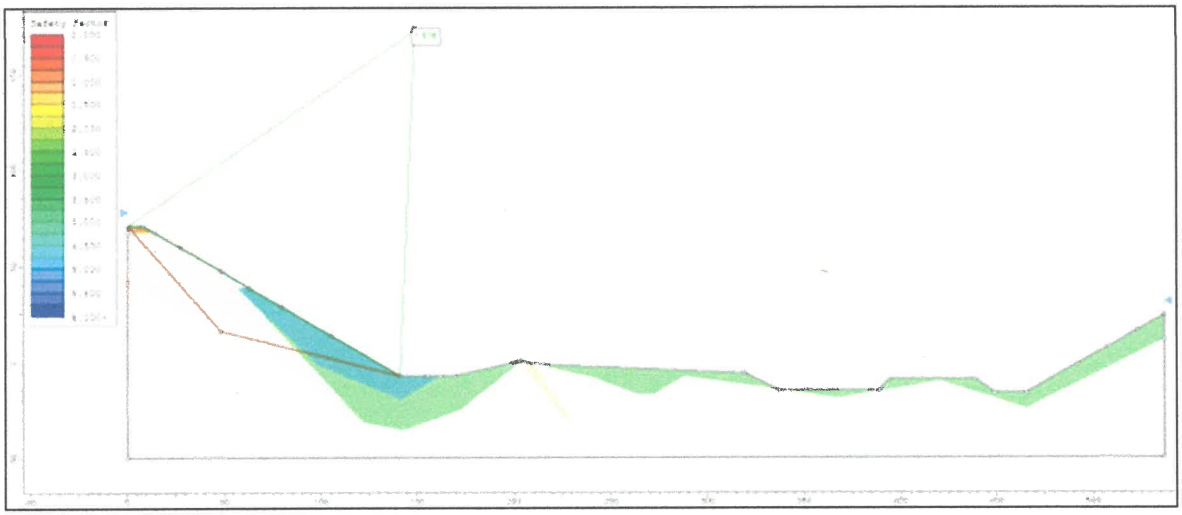


Figure 34. Proposed slope analysis along the critical section-M5 of the mine under noncircular failure with dry condition

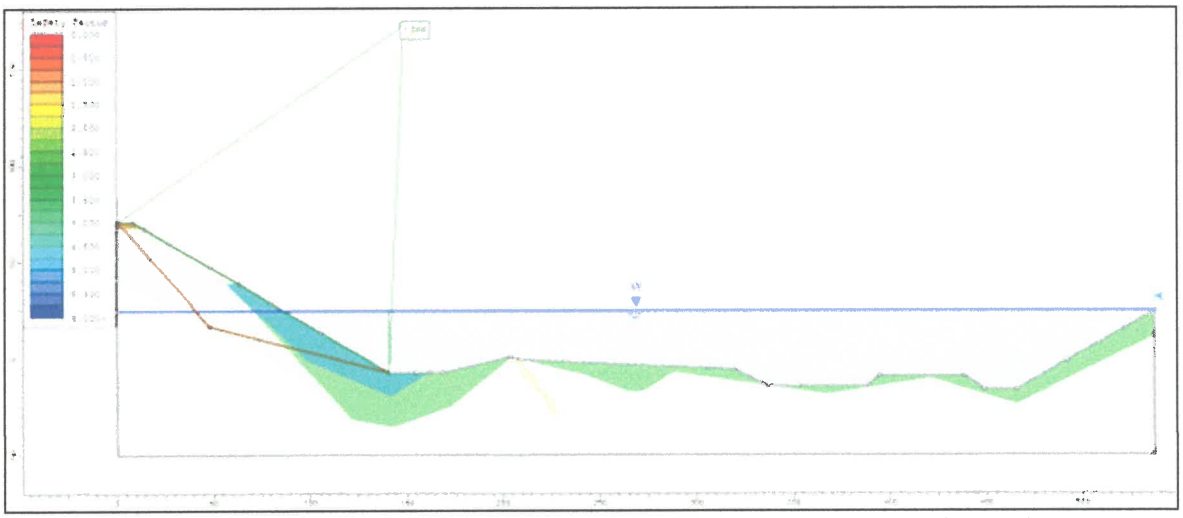


Figure 35. Proposed slope analysis along the critical section-M5 of the mine under noncircular failure with saturated condition

In the existing critical section-M8 towards the East-West direction of the mine, the slope analysis shows that the safety factor under circular failure with dry and saturated conditions are 2.523 and 2.282 both (Figures 36&37). Based on the proposed analysis for the critical section-12 towards the North-West direction of the mine pit for 103m depth, the slope analysis shows the factor of safety under circular failure with dry and saturated conditions are 1.547 and 1.55 respectively (Figures 38&39) and noncircular failure conditions are 1.514 and 1.575, respectively (Figures 40&41).

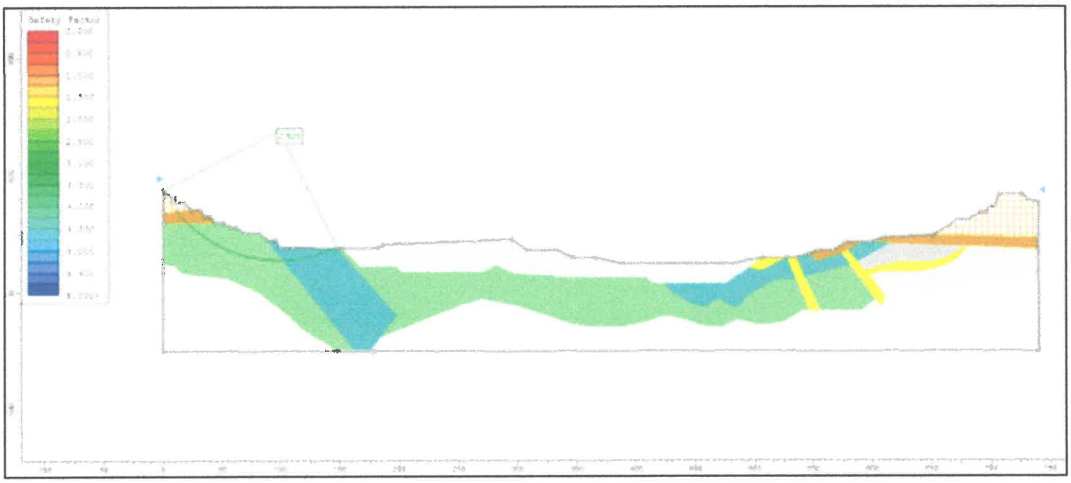


Figure 36. Existing slope analysis along the critical section-M8 of the mine under circular failure with dry condition

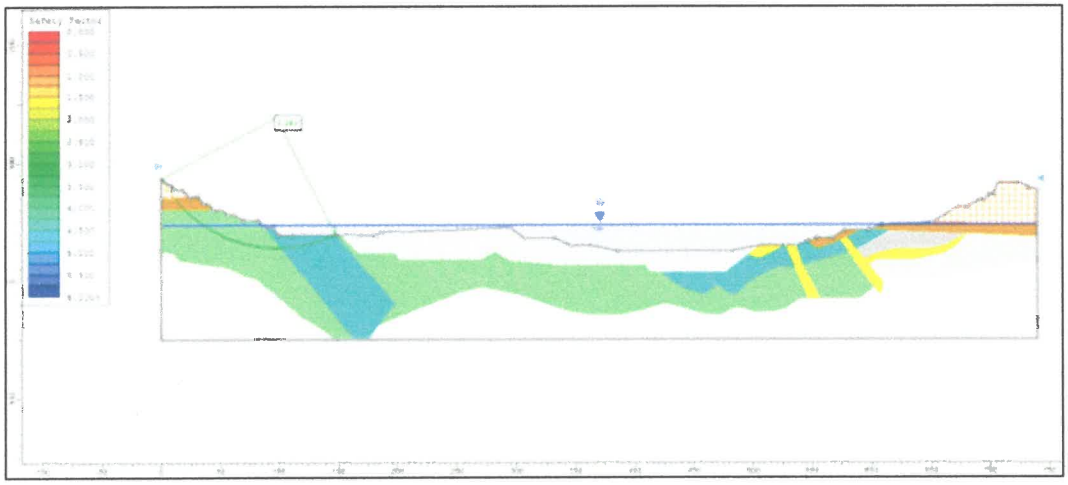


Figure 37. Existing slope analysis along the critical section-M8 of the mine under circular failure with saturated condition

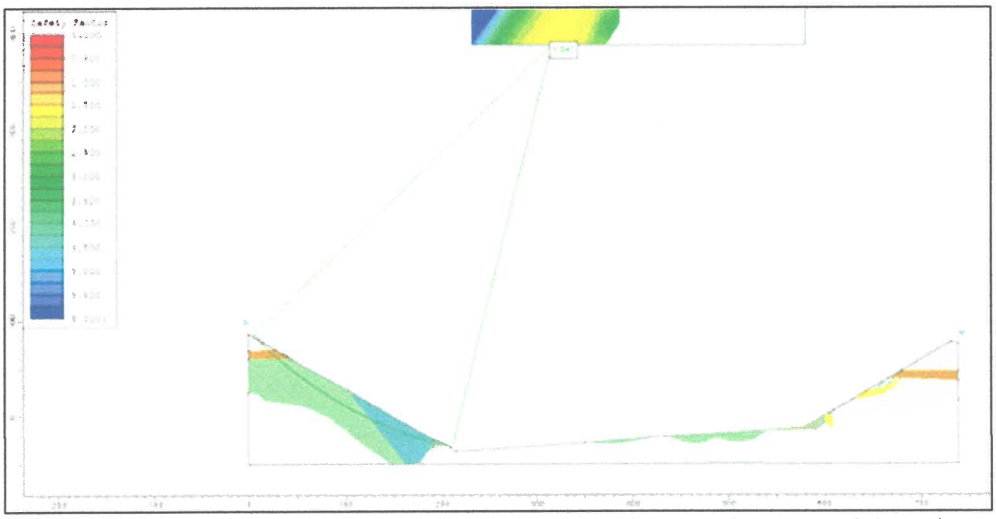


Figure 38. Proposed slope analysis along the critical section-M8 of the mine under circular failure with dry condition

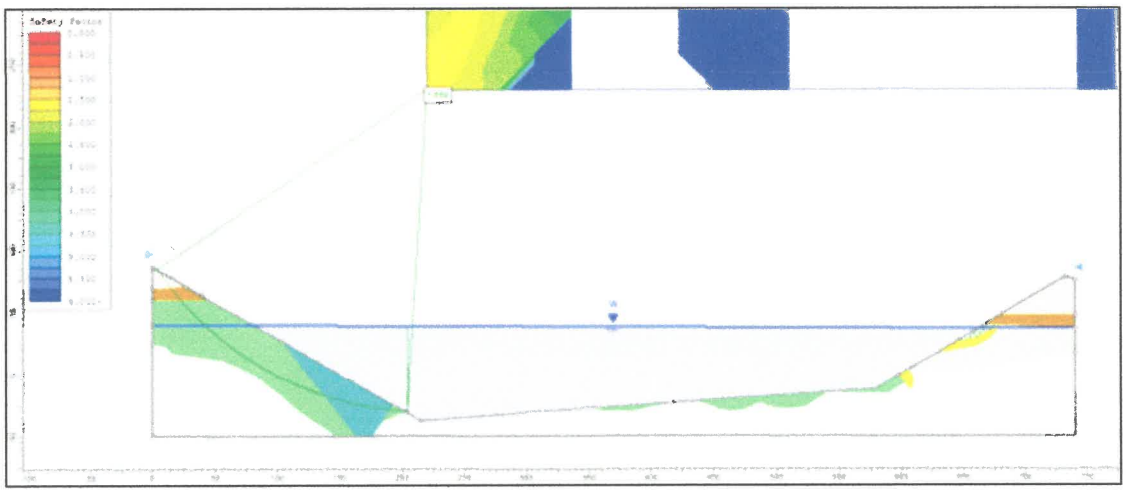


Figure 39. Proposed slope analysis along the critical section-M8 of the mine under circular failure with saturated condition

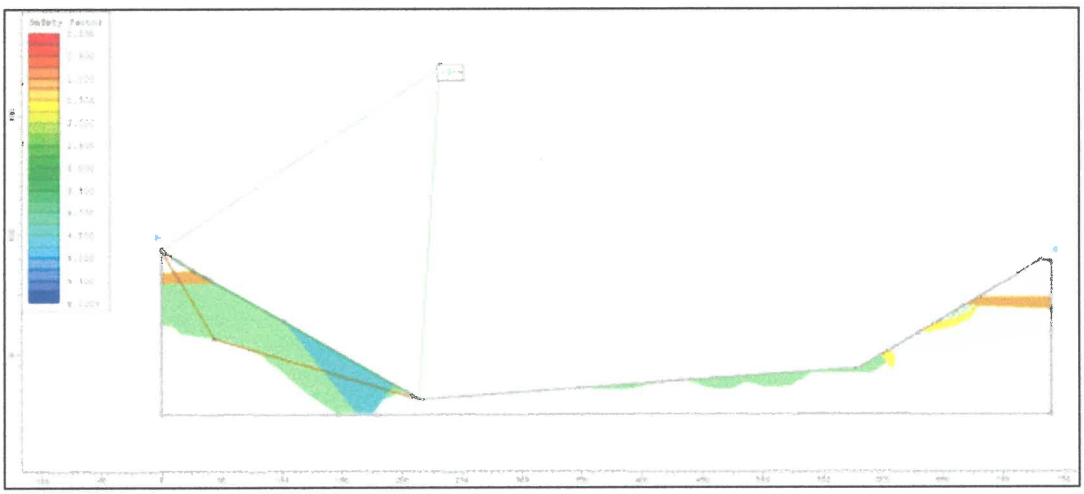


Figure 40. Proposed slope analysis along the critical section-M8 of the mine under noncircular failure with dry condition

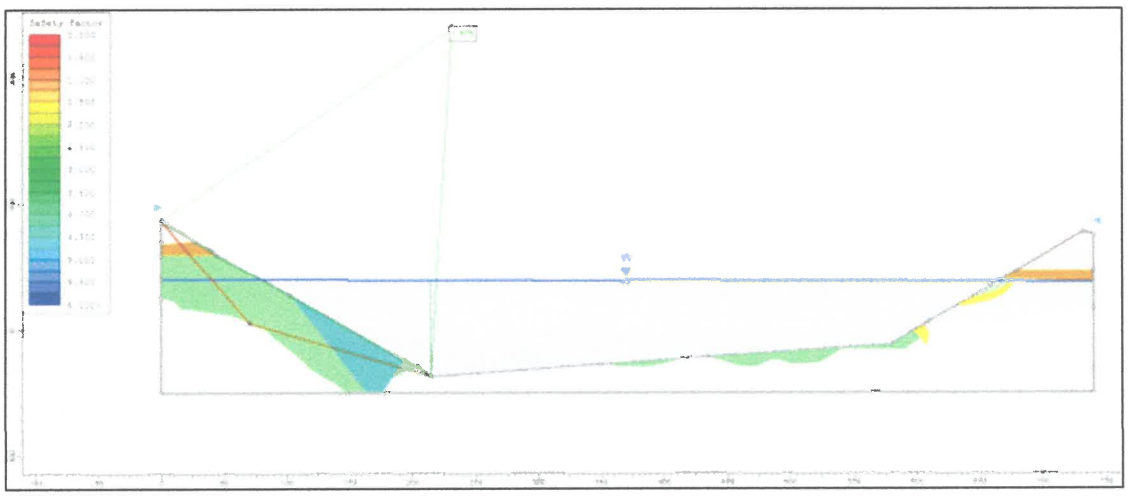


Figure 41. Proposed slope analysis along the critical section-M8 of the mine under noncircular failure with saturated condition

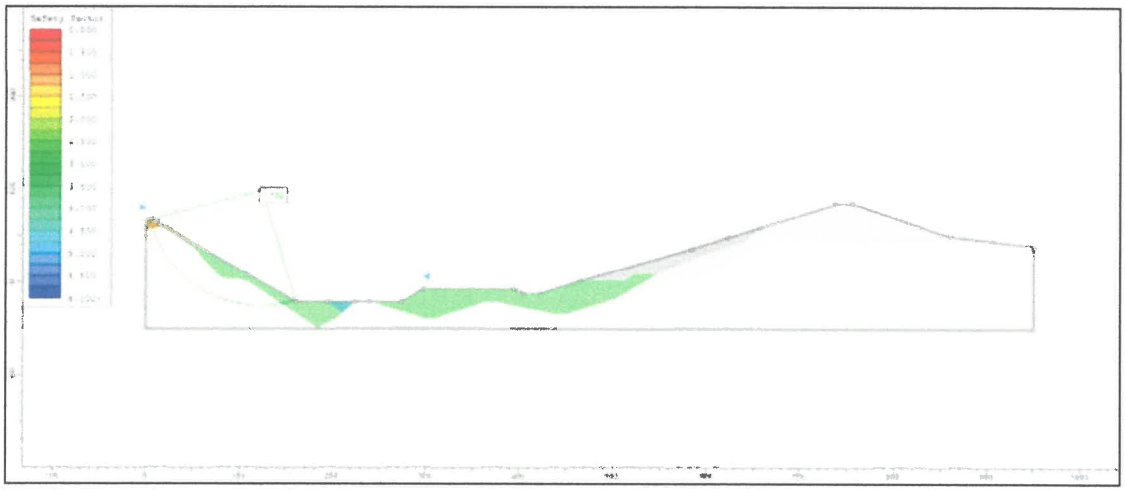


Figure 44. Proposed slope analysis along the critical section-M11 of the mine under circular failure with dry condition

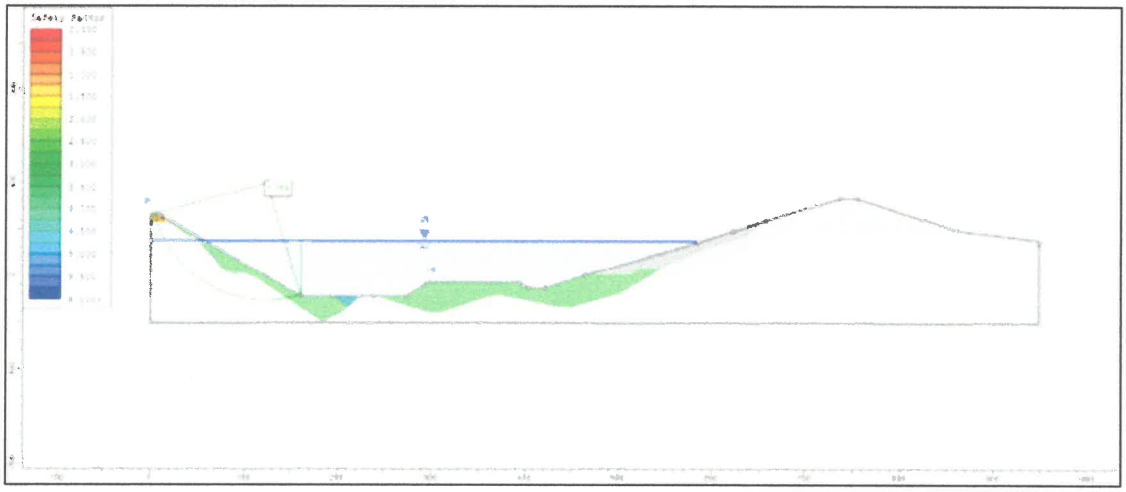


Figure 45. Proposed slope analysis along the critical section-M11 of the mine under circular failure with saturated condition

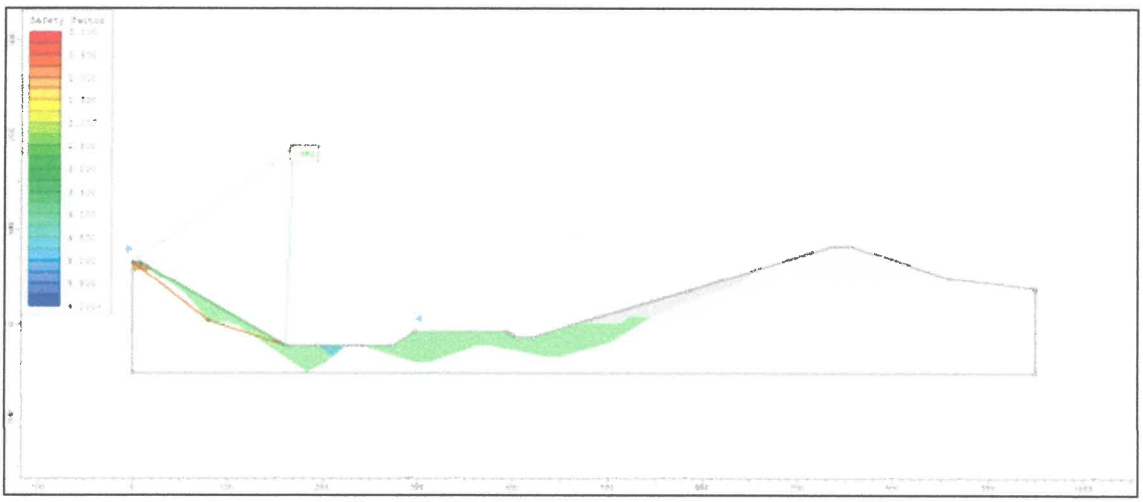


Figure 46. Proposed slope analysis along the critical section-M11 of the mine under noncircular failure with dry condition

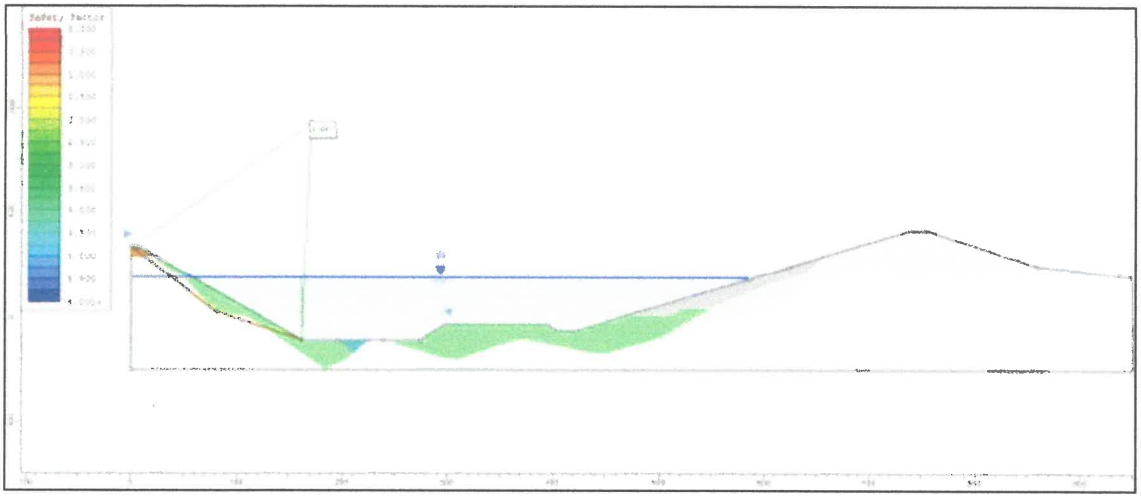


Figure 47. Proposed slope analysis along the critical section-M11 of the mine under noncircular failure with saturated condition

Further, In the existing critical section-P2 towards the East-North direction of the mine, the slope analysis shows that the factor of safety under circular failure with dry and saturated conditions is 9.951 and 8.219 (Figures 48&49). Based on the proposed analysis for the critical section-P2 towards the East-North direction of the mine pit for 65m depth, the slope analysis shows the factor of safety under circular failure with dry and saturated conditions are 2.129 and 2.106(Figures 50&51), and noncircular failure conditions are 1.594 and 1.537(Figures 52&53).

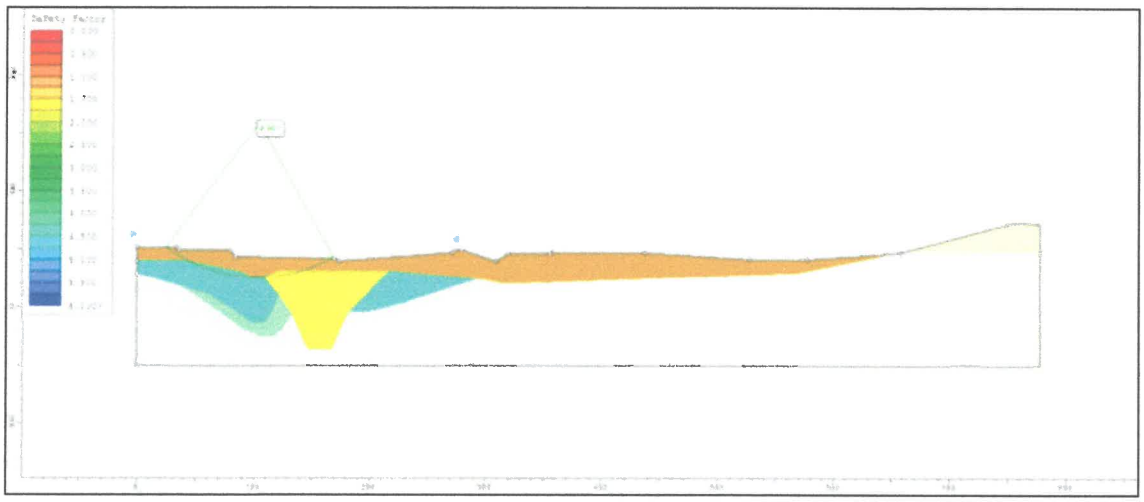


Figure 48. Existing slope analysis along the critical section-P2 of the mine under circular failure with dry condition

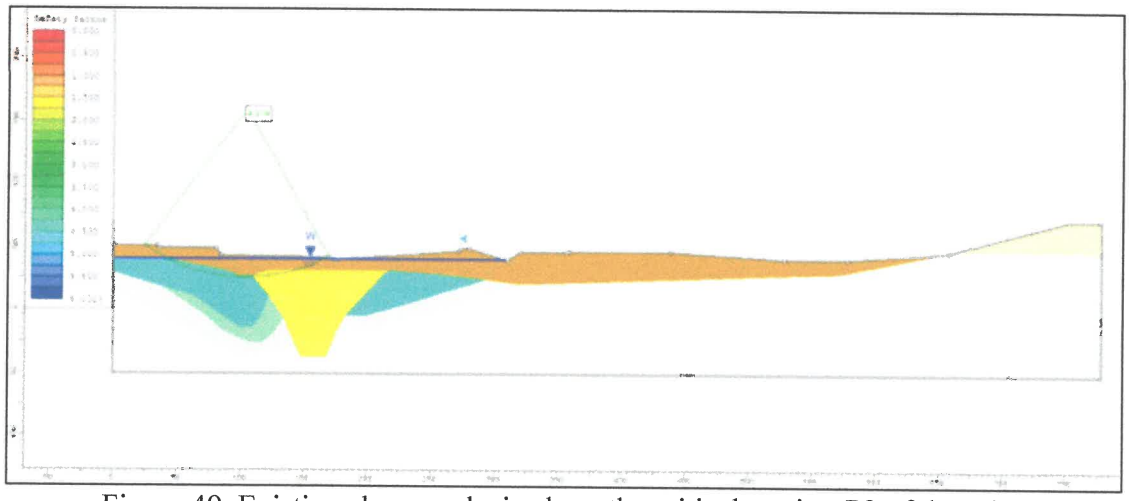


Figure 49. Existing slope analysis along the critical section-P2 of the mine under circular failure with saturated condition

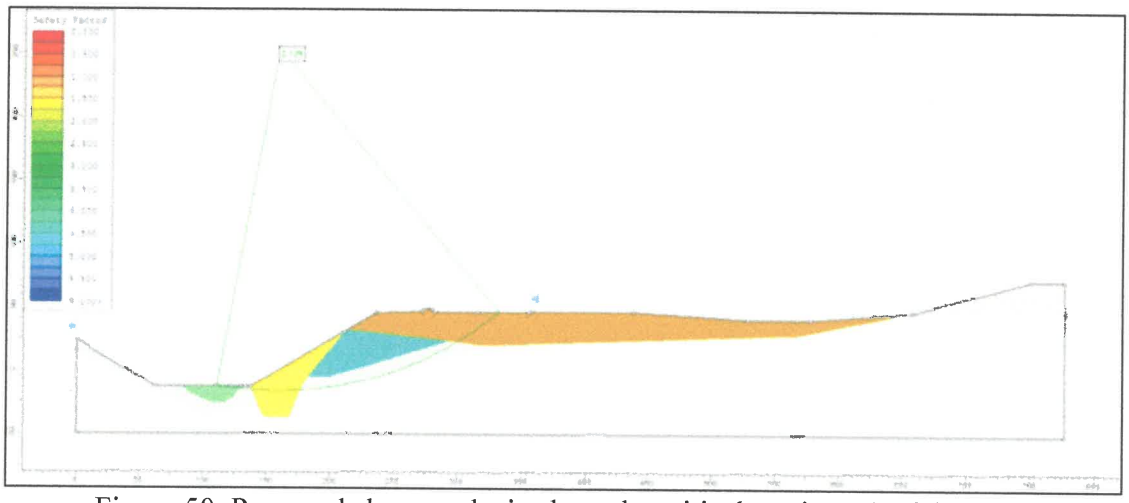


Figure 50. Proposed slope analysis along the critical section-P2 of the mine under circular failure with dry condition

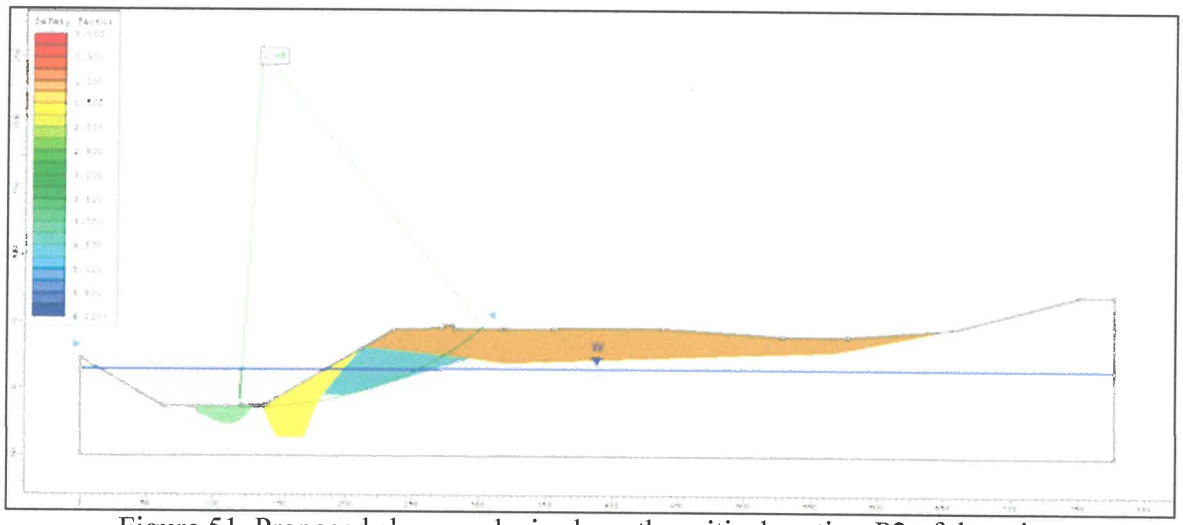


Figure 51. Proposed slope analysis along the critical section-P2 of the mine under circular failure with saturated condition

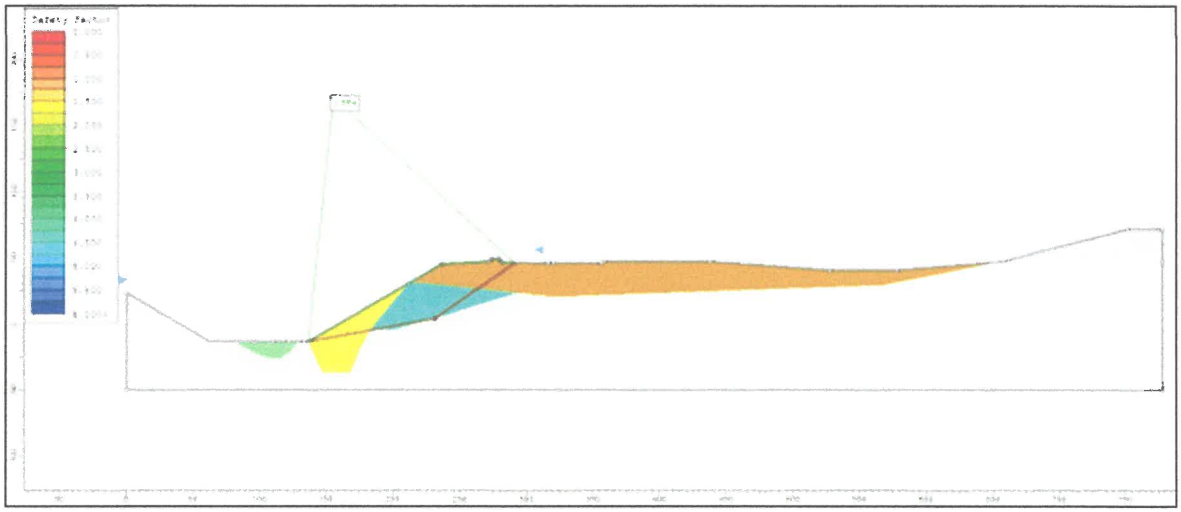


Figure 52. Proposed slope analysis along the critical section-P2 of the mine under noncircular failure with dry condition

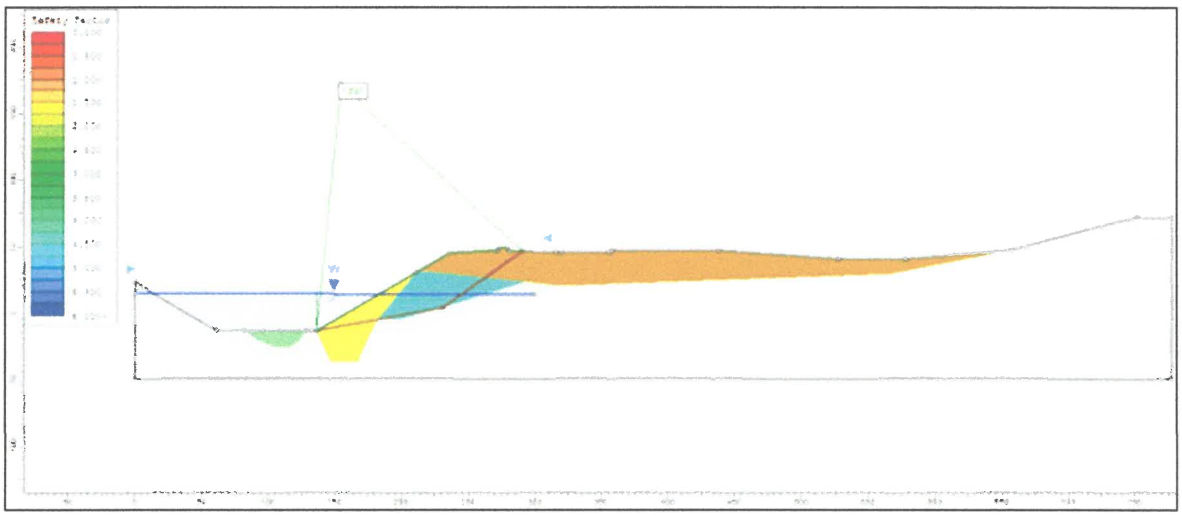


Figure 53. Proposed slope analysis along the critical section -P2 of the mine under noncircular failure with saturated condition

Further, In the existing critical section-P5 towards the East-North direction of the mine, the slope analysis shows that the factor of safety under circular failure with dry and saturated conditions is 3.623 and 3.426 (Figures 54 & 55). Based on the proposed analysis for the critical section-P5 towards the East-North direction of the mine pit for 66m depth, the slope analysis shows the factor of safety under circular failure with dry and saturated conditions are 2.166 and 2.074(Figures 56& 57), and noncircular failure conditions are 2.858 and 3.019(Figures 58&59).

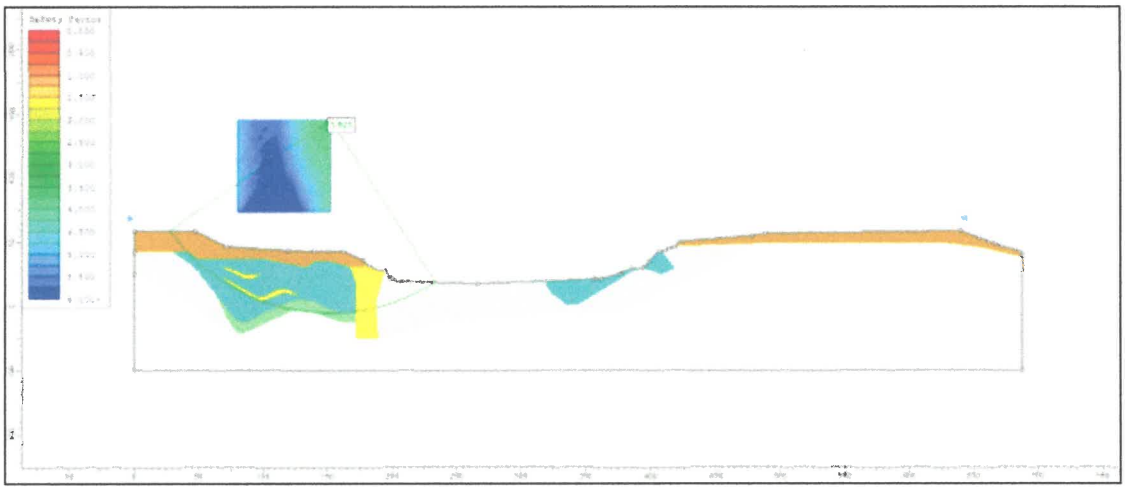


Figure 54. Existing slope analysis along the critical section-P5 of the mine under circular failure with dry condition

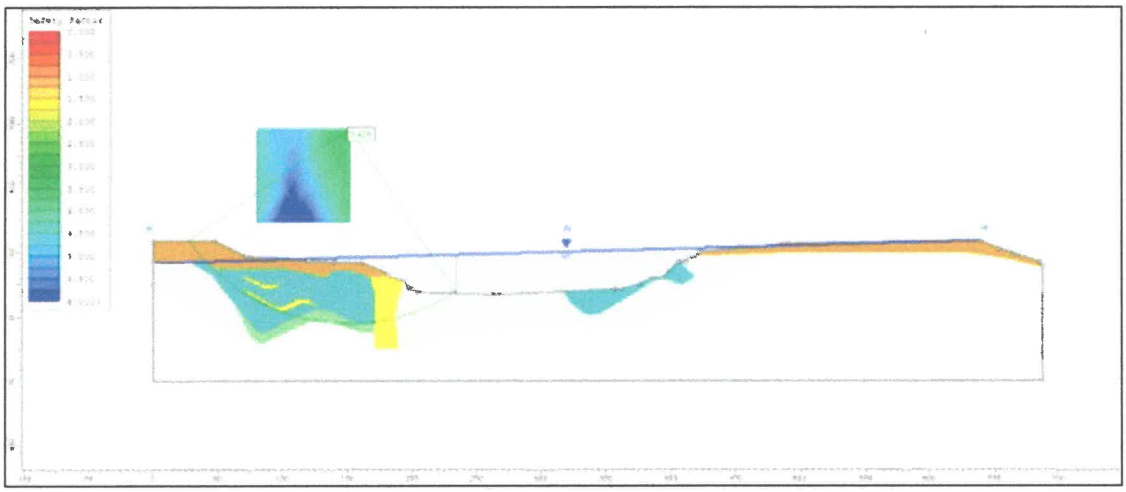


Figure 55. Existing slope analysis along the critical section-P5 of the mine under circular failure with saturated condition

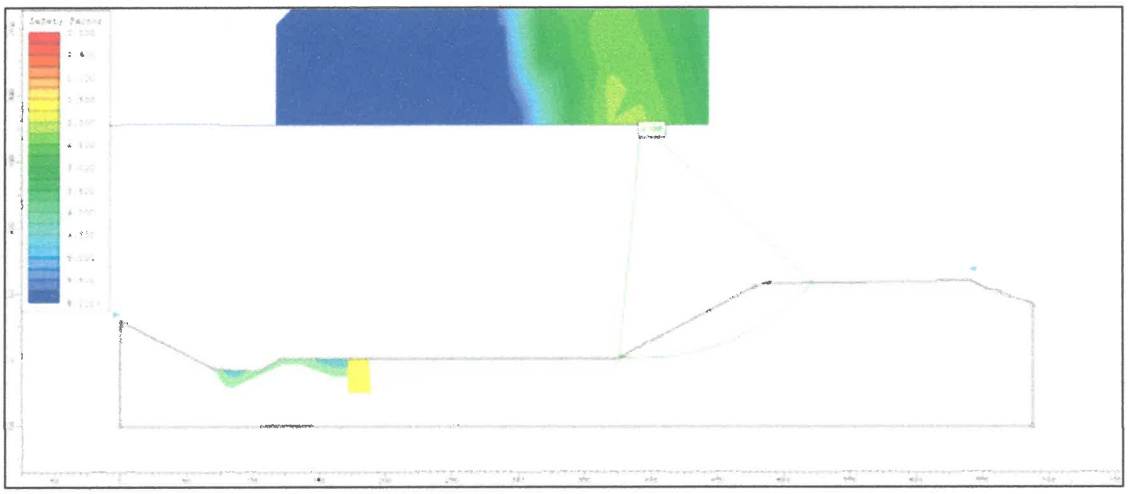


Figure 56. Proposed slope analysis along the critical section-P5 of the mine under circular failure with dry condition

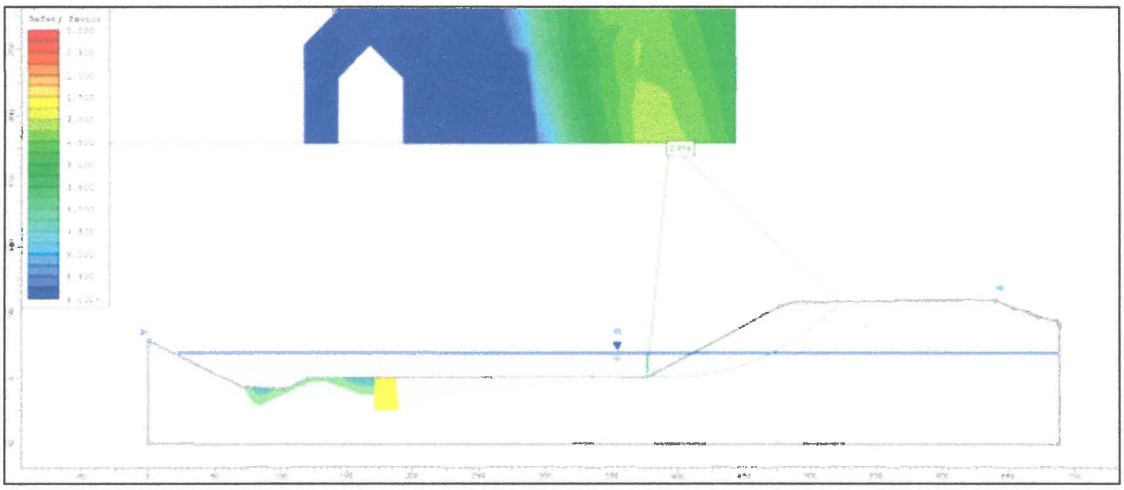


Figure 57. Proposed slope analysis along the critical section-P5 of the mine under circular failure with saturated condition

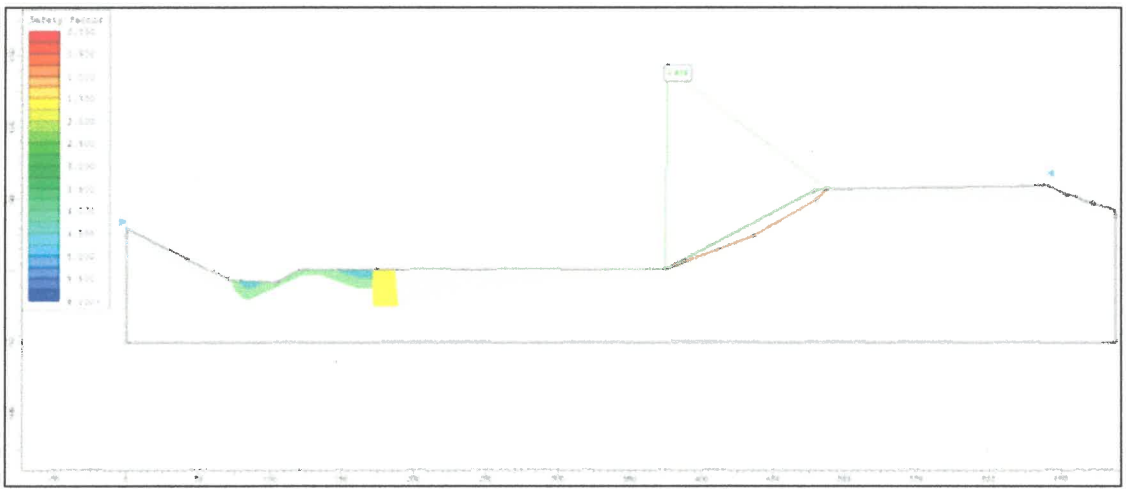


Figure 58. Proposed slope analysis along the critical section-P5 of the mine under noncircular failure with dry condition

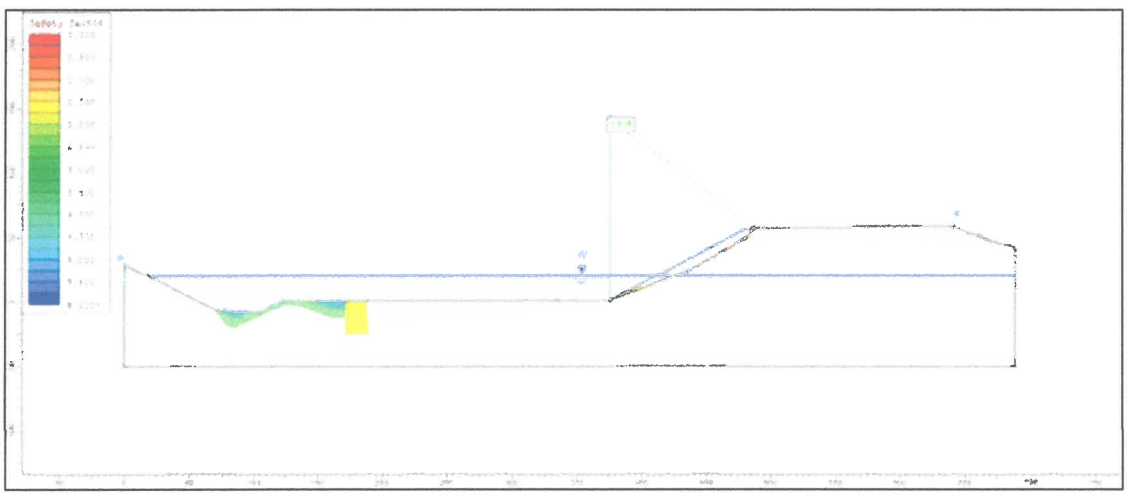


Figure 59. Proposed slope analysis along the critical section –P5 of the mine under noncircular failure with saturated condition

Further, In the existing critical section-P8 towards the East-North direction of the mine, the slope analysis shows that the factor of safety under circular failure with dry and saturated conditions is 2.359 and 2.152 (Figures 60 & 61). Based on the proposed analysis for the critical section-P8 towards the East-North direction of the mine pit for 66m depth, the slope analysis shows the factor of safety under circular failure with dry and saturated conditions are 2.101 and 2.068(Figures 62&63), and noncircular failure conditions are 2.442 and 2.829(Figures 64&65).

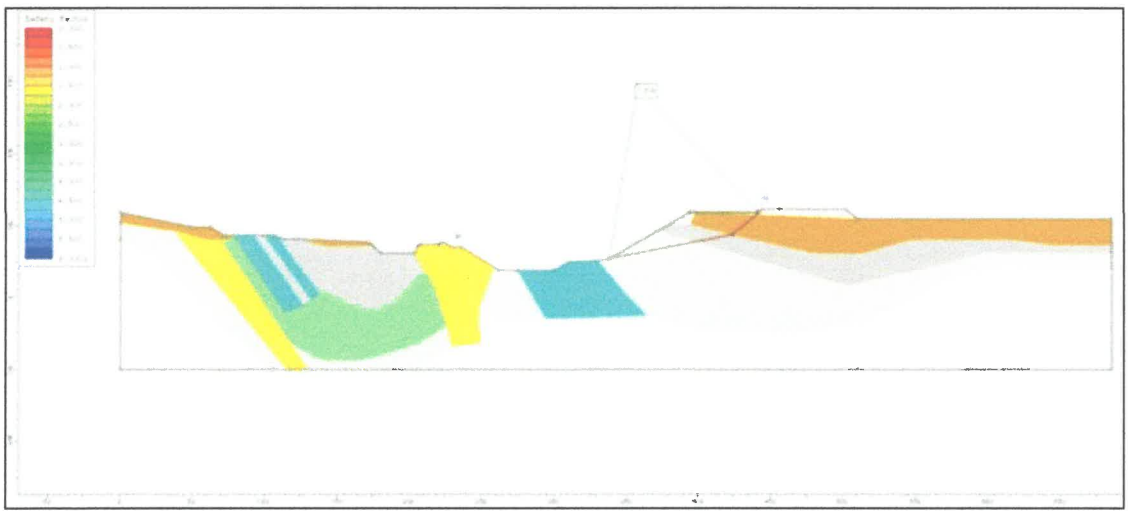


Figure 60. Existing slope analysis along the critical section-P8 of the mine under circular failure with dry condition

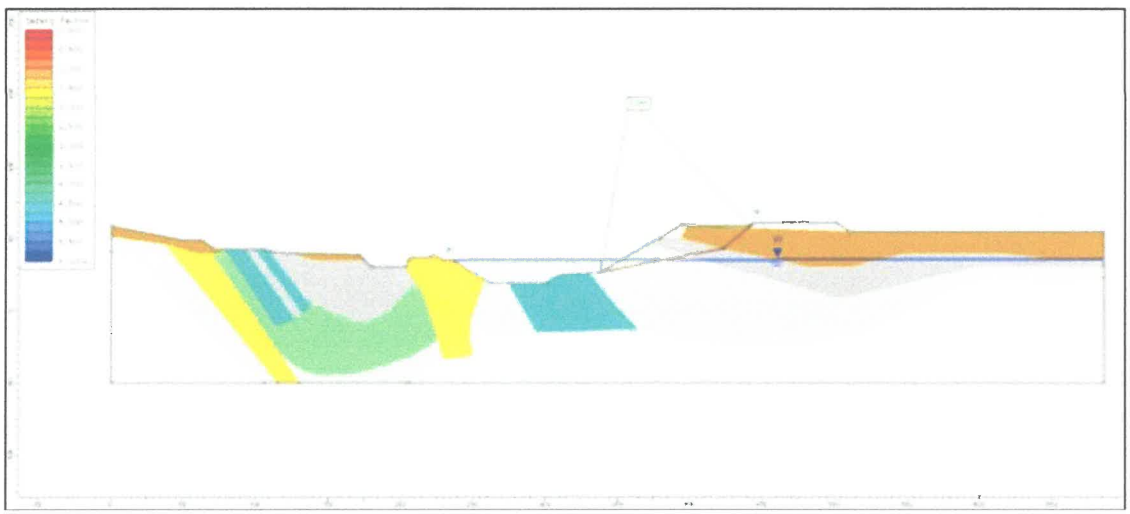


Figure 61. Existing slope analysis along the critical section-P8 of the mine under circular failure with saturated condition

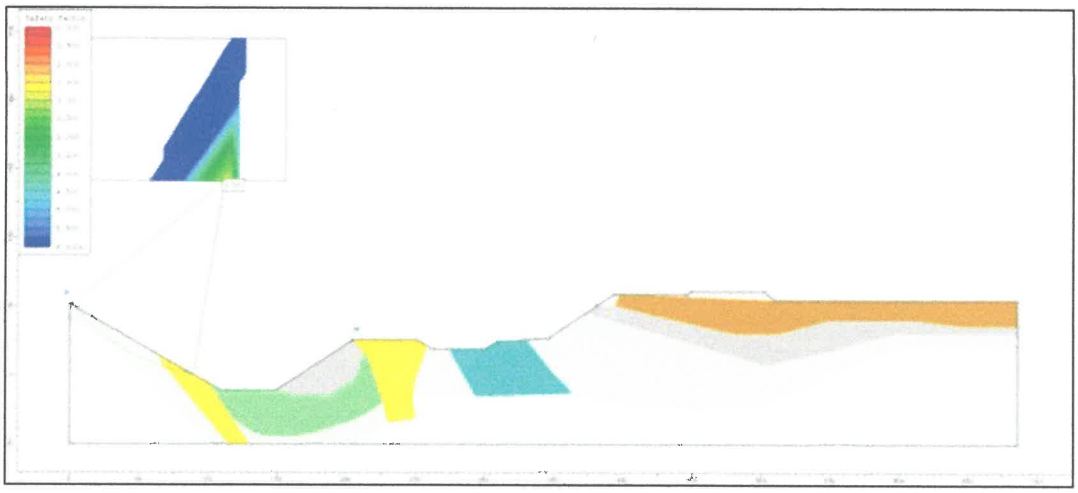


Figure 62. Proposed slope analysis along the critical section-P8 of the mine under circular failure with dry condition

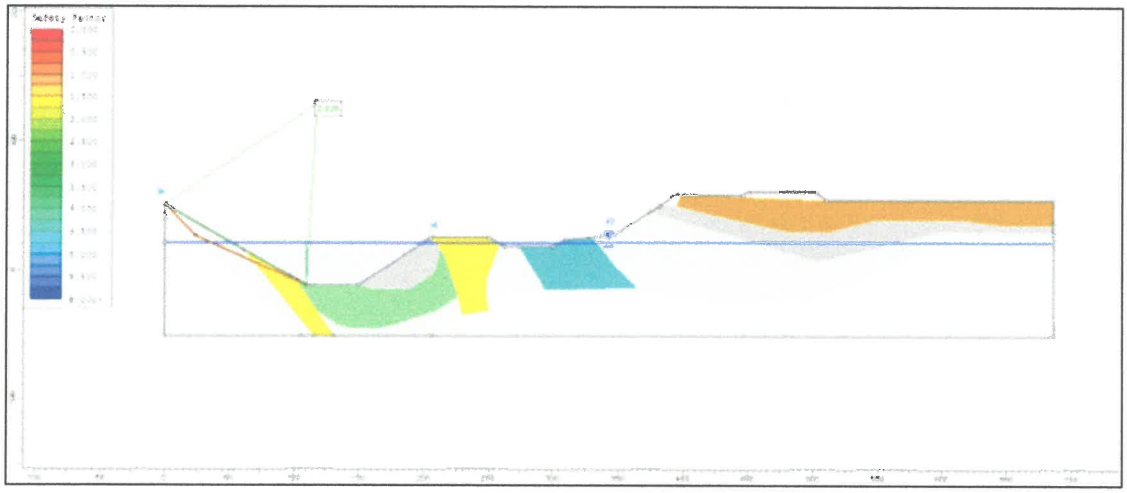


Figure 63. Proposed slope analysis along the critical section-P8 of the mine under circular failure with saturated condition

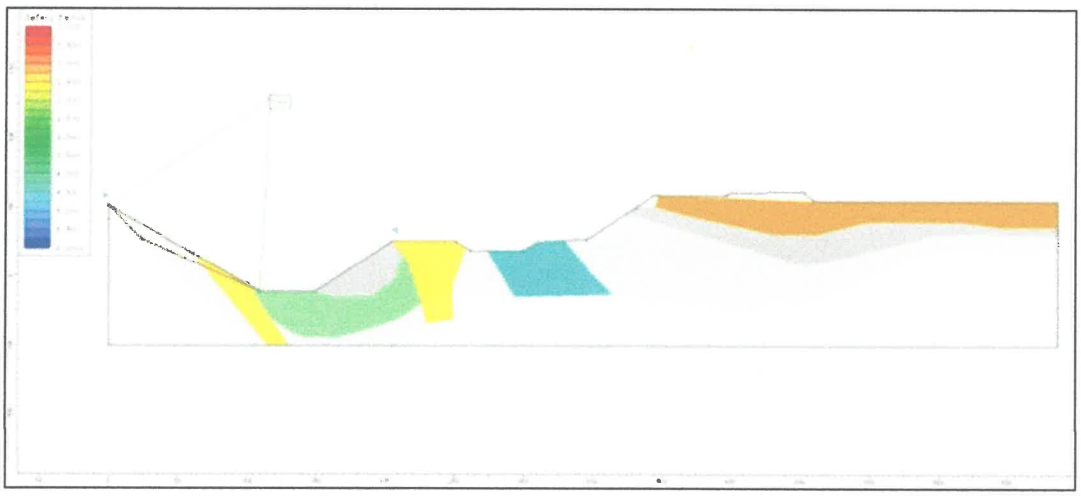


Figure 64. Proposed slope analysis along the critical section-P8 of the mine under noncircular failure with dry condition

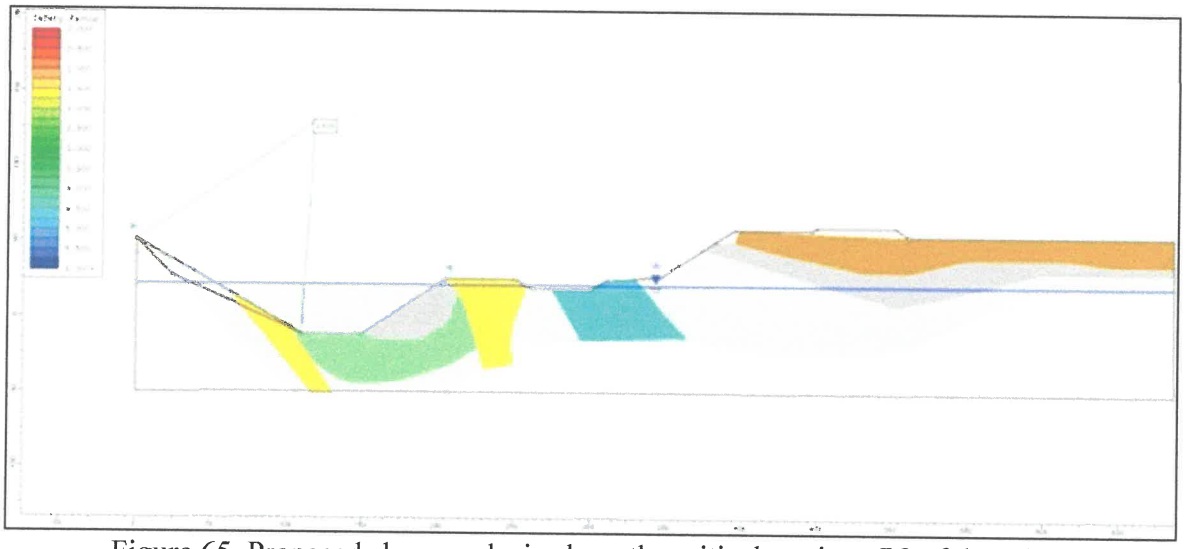


Figure 65. Proposed slope analysis along the critical section –P8 of the mine under noncircular failure with saturated condition

Further, In the existing critical section-P11 towards the East-North direction of the mine, the slope analysis shows that the factor of safety under circular failure with dry and saturated conditions is 2.375 both (Figures 66& 67). Based on the proposed analysis for the critical section-P11 towards the East-North direction of the mine pit for 78m depth, the slope analysis shows the factor of safety under circular failure with dry and saturated conditions are 1.818 and 1.755(Figures 68&69), and noncircular failure conditions are 1.741 and 1.863(Figures 70&71).

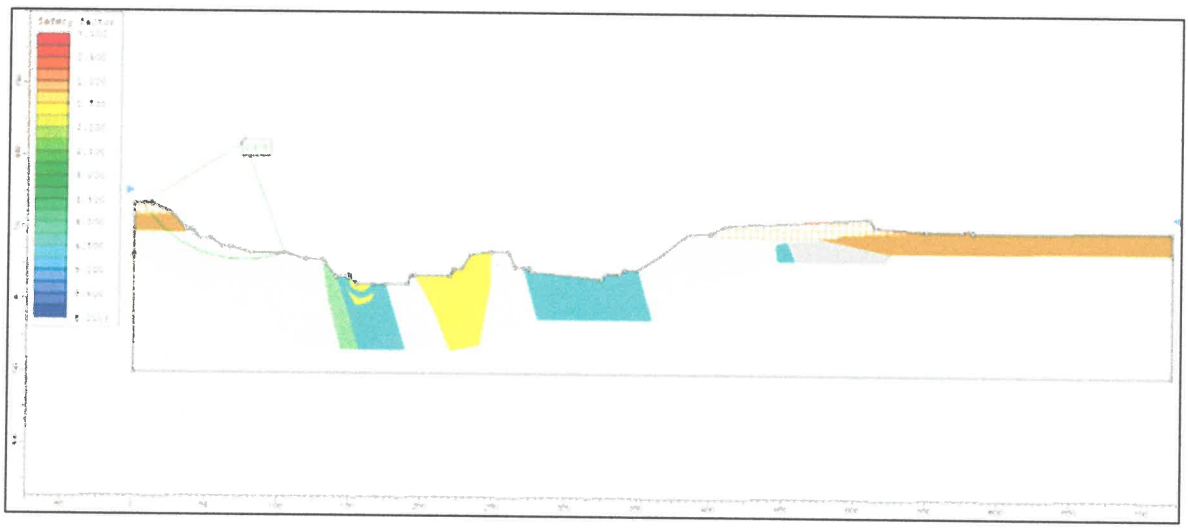


Figure 66. Existing slope analysis along the critical section-P11of the mine under circular failure with dry condition

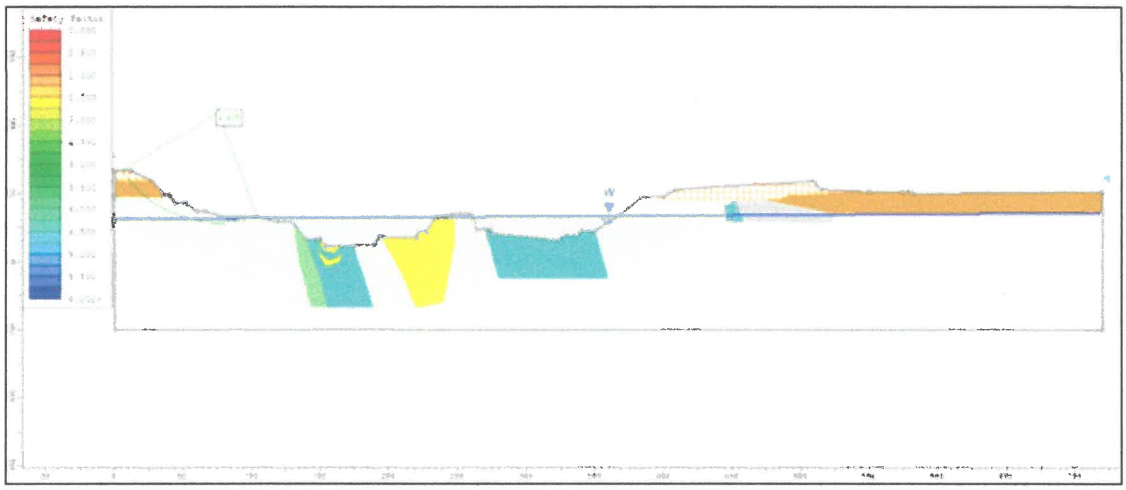


Figure 67. Existing slope analysis along the critical section-P11 of the mine under circular failure with saturated condition

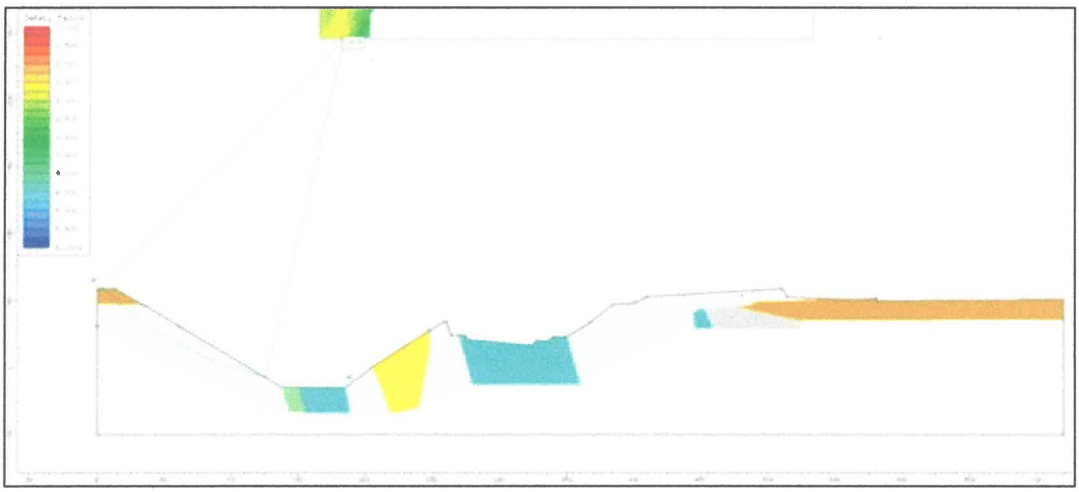


Figure 68. Proposed slope analysis along the critical section-P11 of the mine under circular failure with dry condition

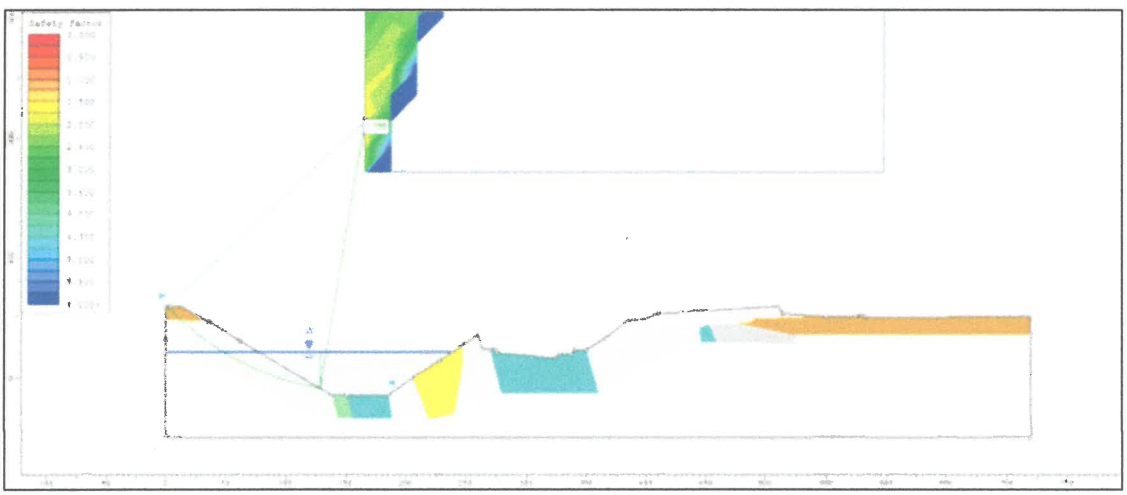


Figure 69. Proposed slope analysis along the critical section-P11 of the mine under circular failure with saturated condition

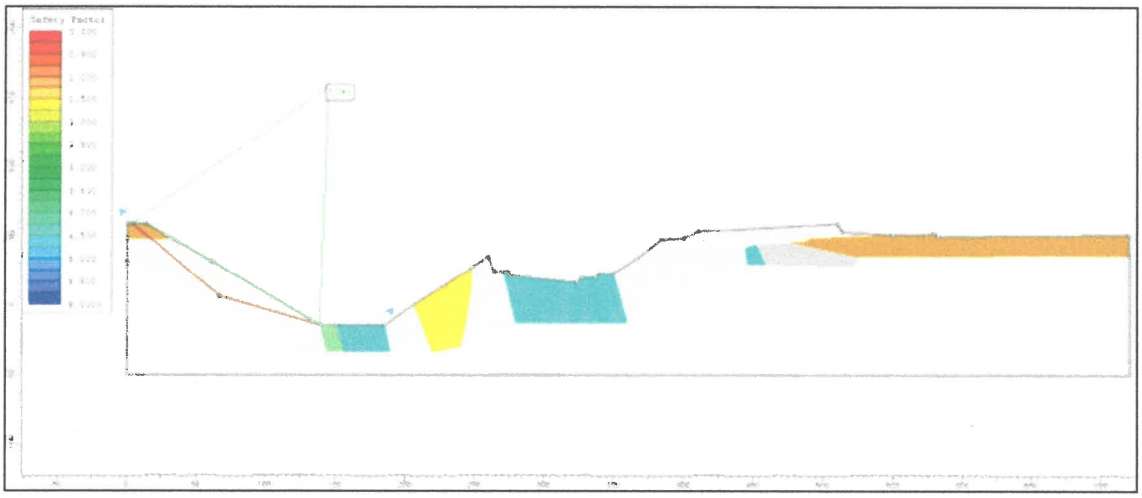


Figure 70. Proposed slope analysis along the critical section-P11 of the mine
under noncircular failure with dry condition

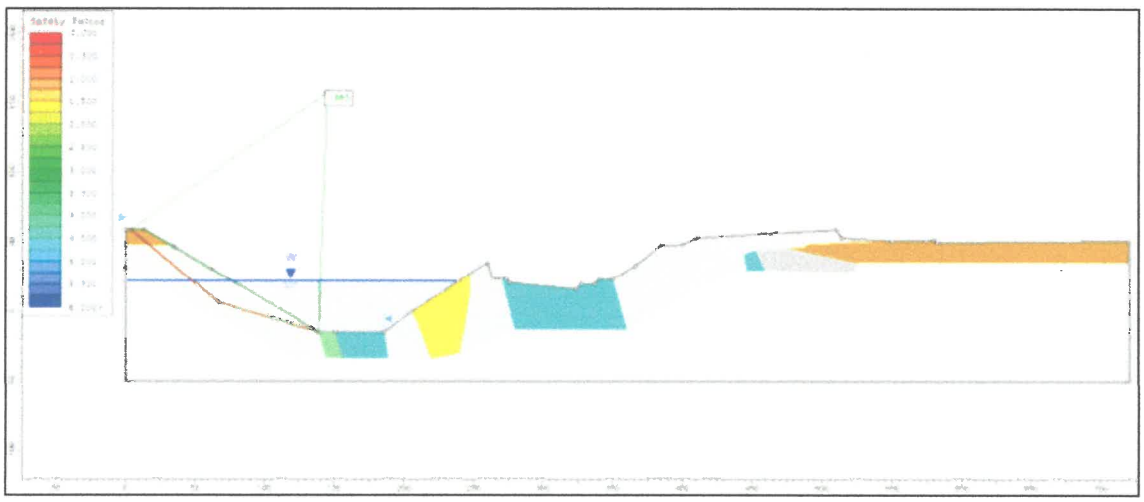


Figure 71. Proposed slope analysis along the critical section –P11 of the mine
under noncircular failure with saturated condition

Further, In the existing critical section-P14 towards the East-North direction of the mine, the slope analysis shows that the factor of safety under circular failure with dry and saturated conditions is 2.125 both (Figures 72 & 73). Based on the proposed analysis for the critical section-P14 towards the East -North direction of the mine pit for 81m depth, the slope analysis shows the factor of safety under circular failure with dry and saturated conditions are 1.917 and 1.809(Figures 74 & 75), and noncircular failure conditions are 1.934 and 2.114(Figures 76 & 77).

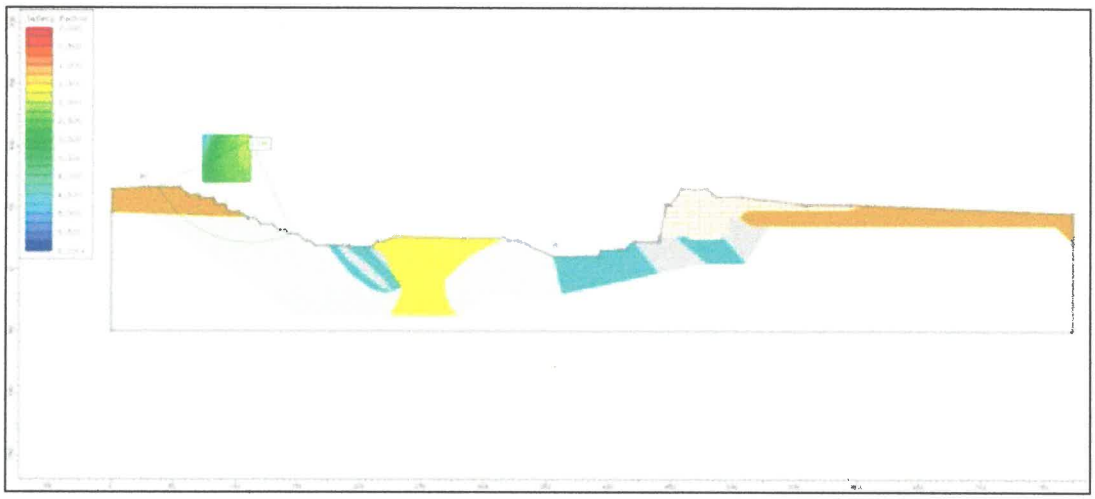


Figure 72. Existing slope analysis along the critical section-P14 of the mine under circular failure with dry condition

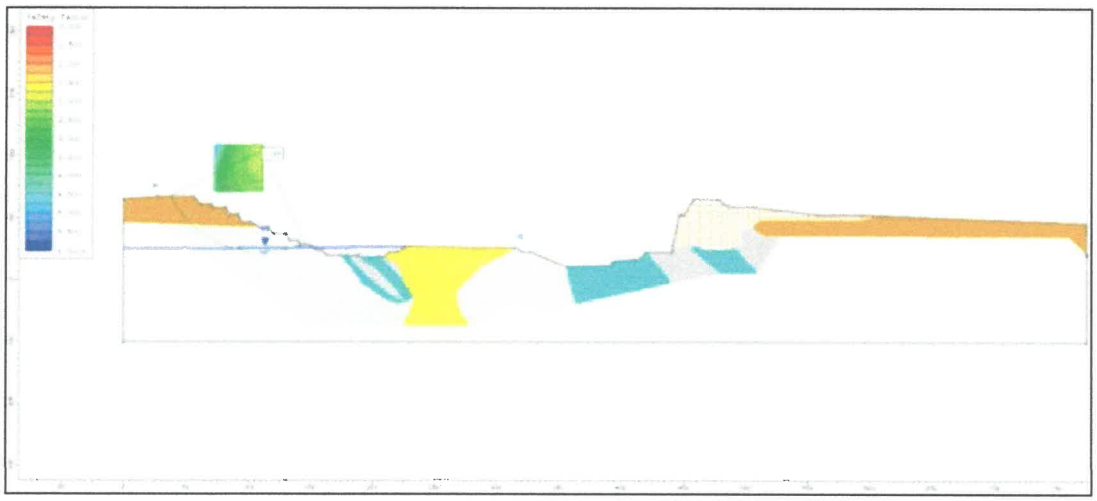


Figure 73. Existing slope analysis along the critical section-P14 of the mine under circular failure with saturated condition

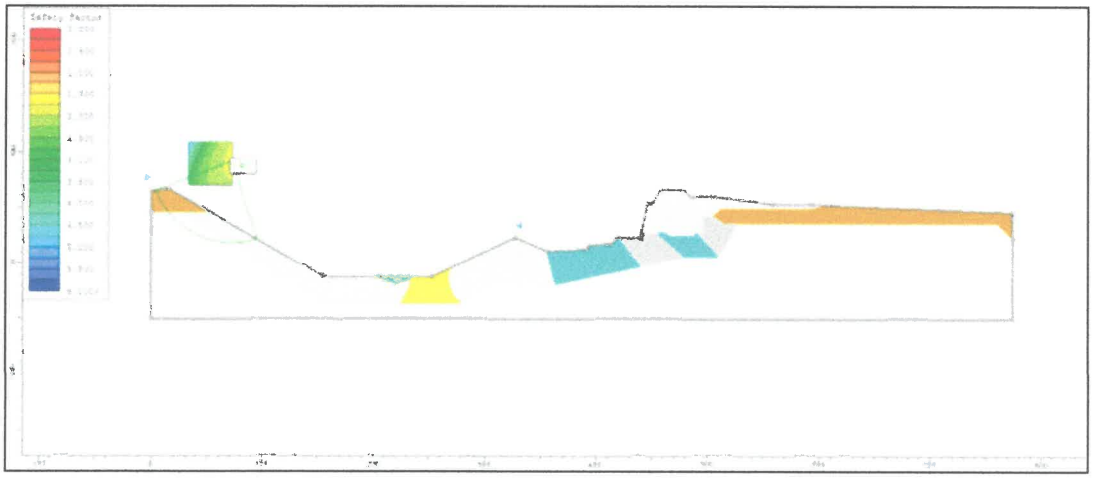


Figure 74. Proposed slope analysis along the critical section-P14 of the mine under circular failure with dry condition

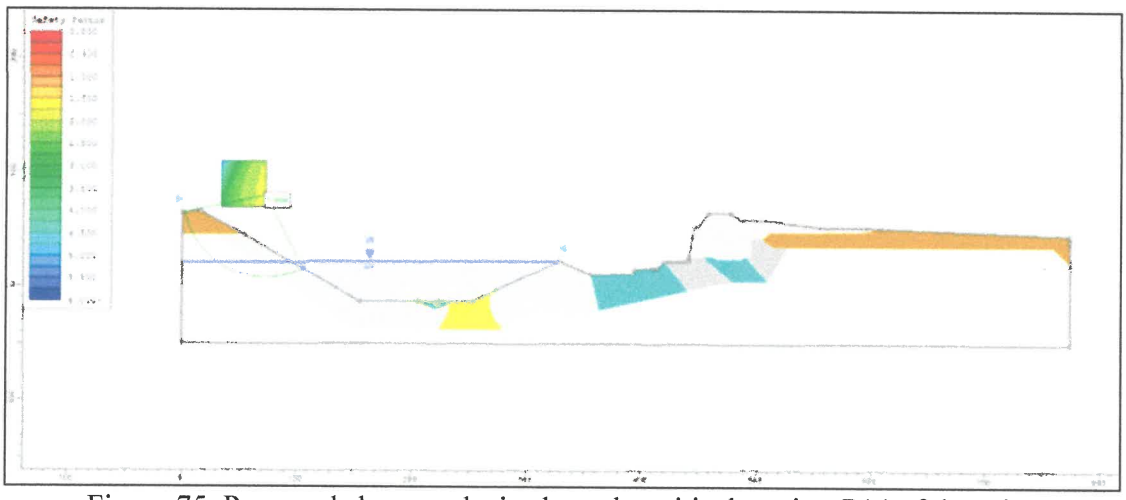


Figure 75. Proposed slope analysis along the critical section-P14 of the mine under circular failure with saturated condition

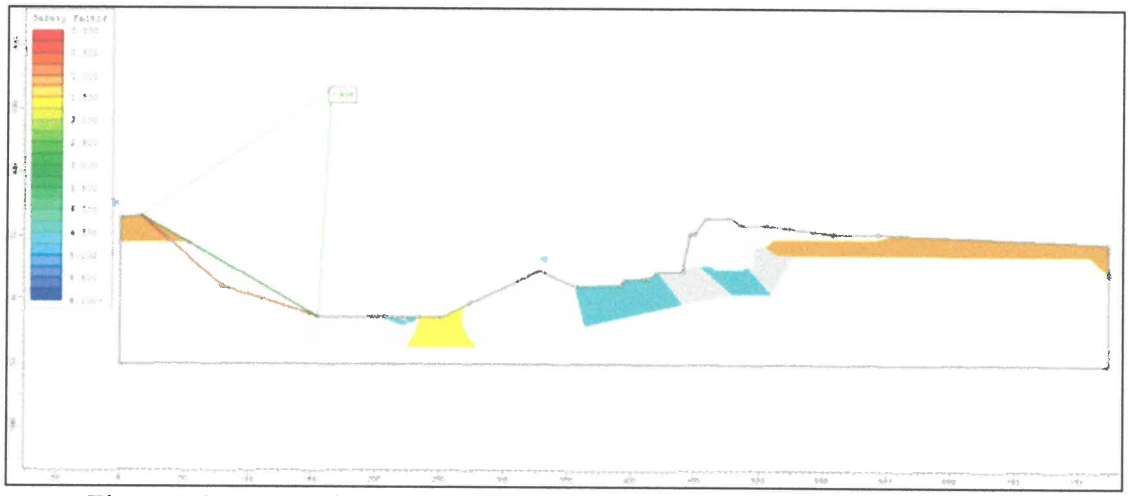


Figure 76. Proposed slope analysis along the critical section-P14 of the mine under noncircular failure with dry condition

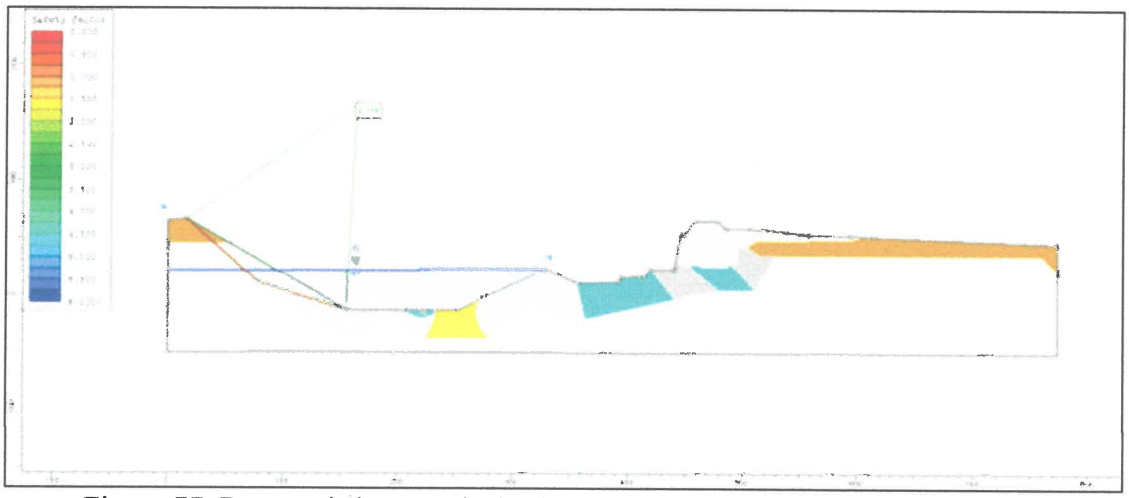


Figure 77. Proposed slope analysis along the critical section –P14of the mine under noncircular failure with saturated condition

Further, In the existing critical section-P17 towards the East-North direction of the mine, the slope analysis shows that the factor of safety under circular failure with dry and saturated conditions is 4.248 and 4.197 (Figures 78 & 79). Based on the proposed analysis for the critical section-P17 towards the East -North direction of the mine pit for 83m depth, the slope analysis shows the factor of safety under circular failure with dry and saturated conditions are 1.844 and 1.852 (Figures 80 & 81), and noncircular failure conditions are 1.912 and 1.895 (Figures 82 & 83).



Figure 78. Existing slope analysis along the critical section-P17 of the mine under circular failure with dry condition

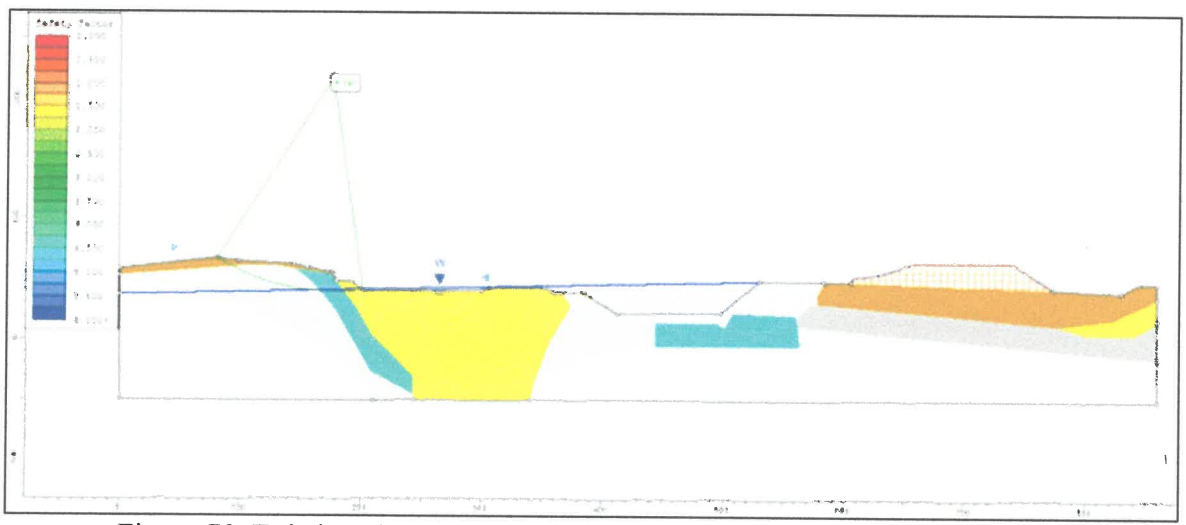


Figure 79. Existing slope analysis along the critical section-P17 of the mine under circular failure with saturated condition

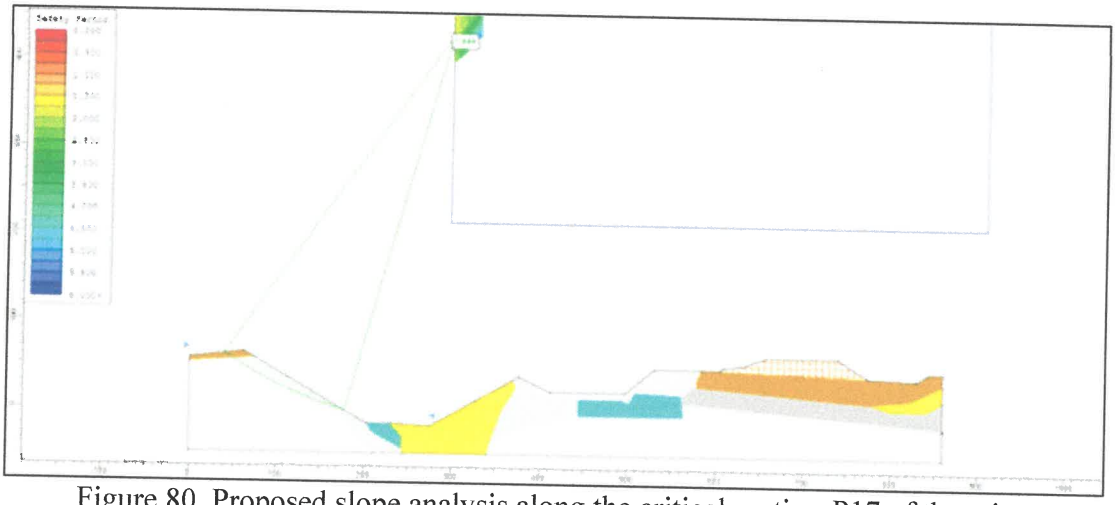


Figure 80. Proposed slope analysis along the critical section-P17 of the mine under circular failure with dry condition

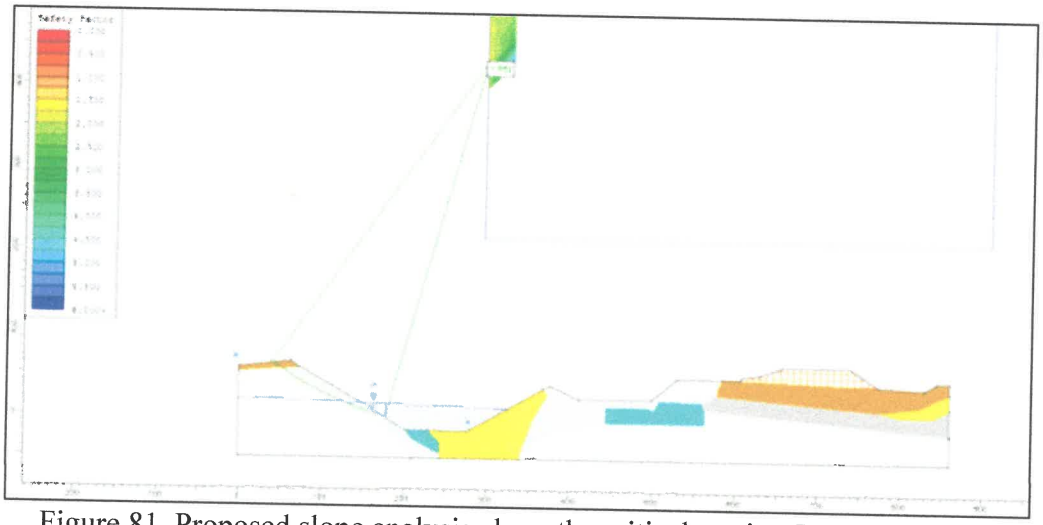


Figure 81. Proposed slope analysis along the critical section-P17 of the mine under circular failure with saturated condition

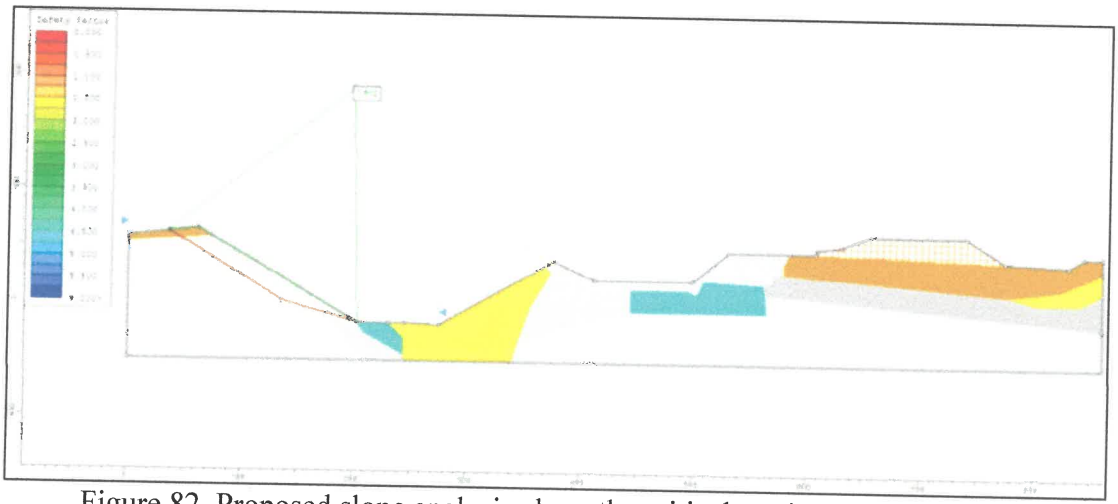


Figure 82. Proposed slope analysis along the critical section-P17of the mine

under noncircular failure with dry condition

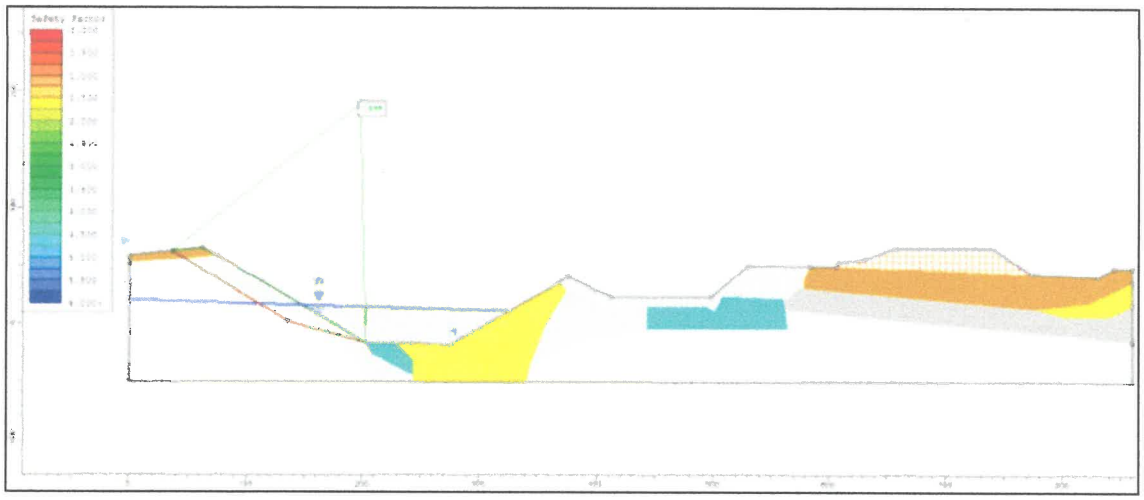


Figure 83. Proposed slope analysis along the critical section –P17of the mine under noncircular failure with saturated condition

Further, In the existing critical section-P22 towards the East-North direction of the mine, the slope analysis shows that the factor of safety under circular failure with dry and saturated conditions is 7.217 and 9.756(Figures 84& 85). Based on the proposed analysis for the critical section-P22 towards the East -North direction of the mine pit for 36m depth, the slope analysis shows the factor of safety under circular failure with dry and saturated conditions are 2.503 and 2.494 (Figures 86& 87), and noncircular failure conditions are 2.565 and 2.607 (Figures 88&89).

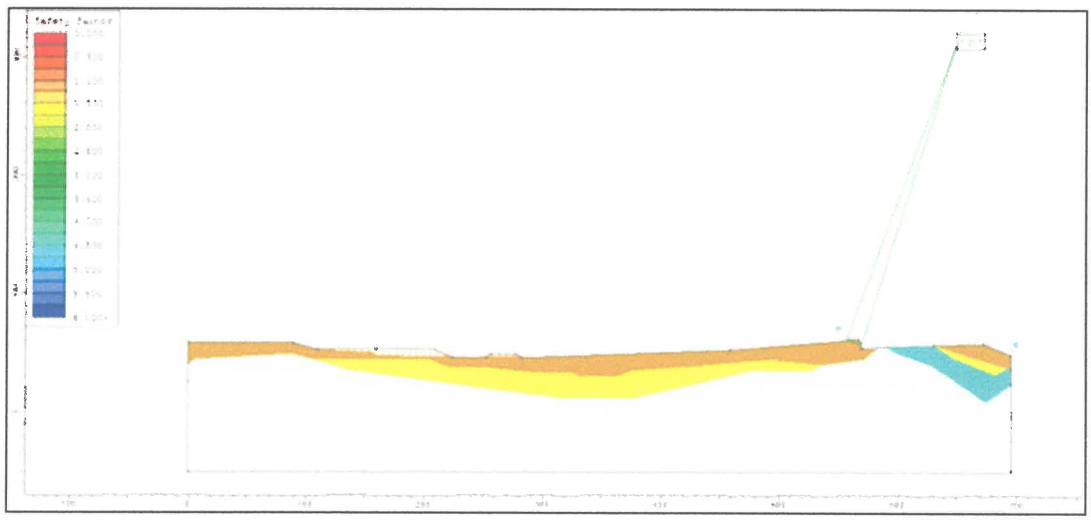


Figure 84. Existing slope analysis along the critical section-P22 of the mine under circular failure with dry condition

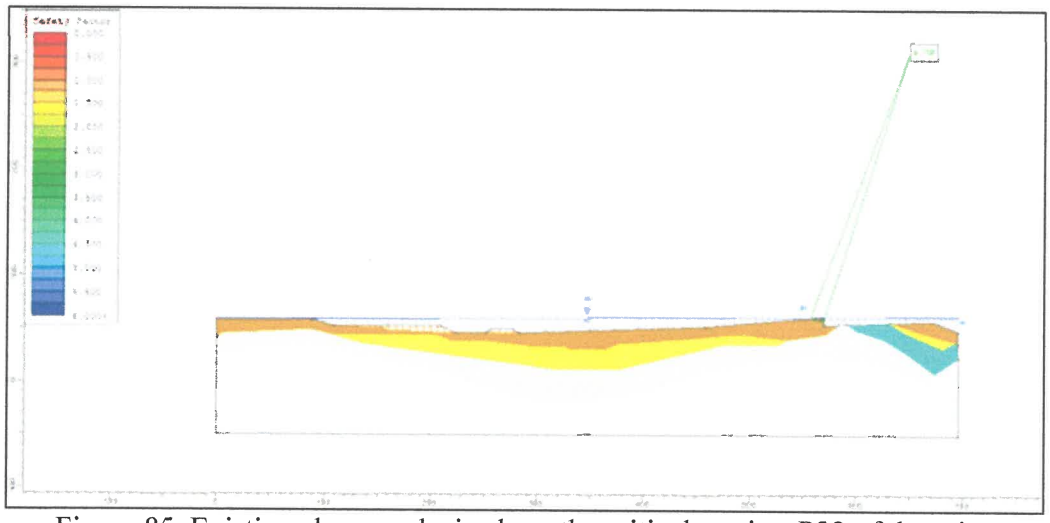


Figure 85. Existing slope analysis along the critical section-P22 of the mine under circular failure with saturated condition

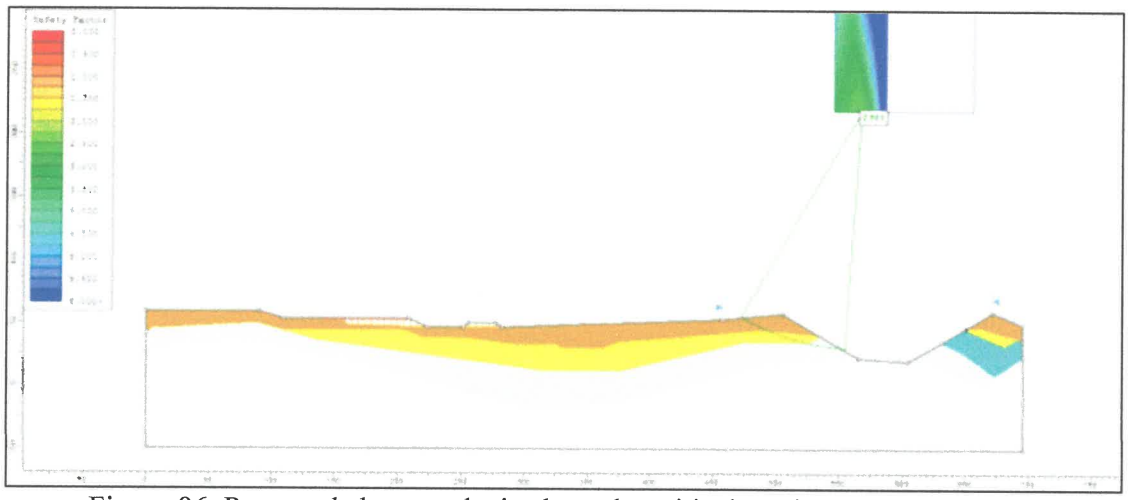


Figure 86. Proposed slope analysis along the critical section-P22 of the mine under circular failure with dry condition

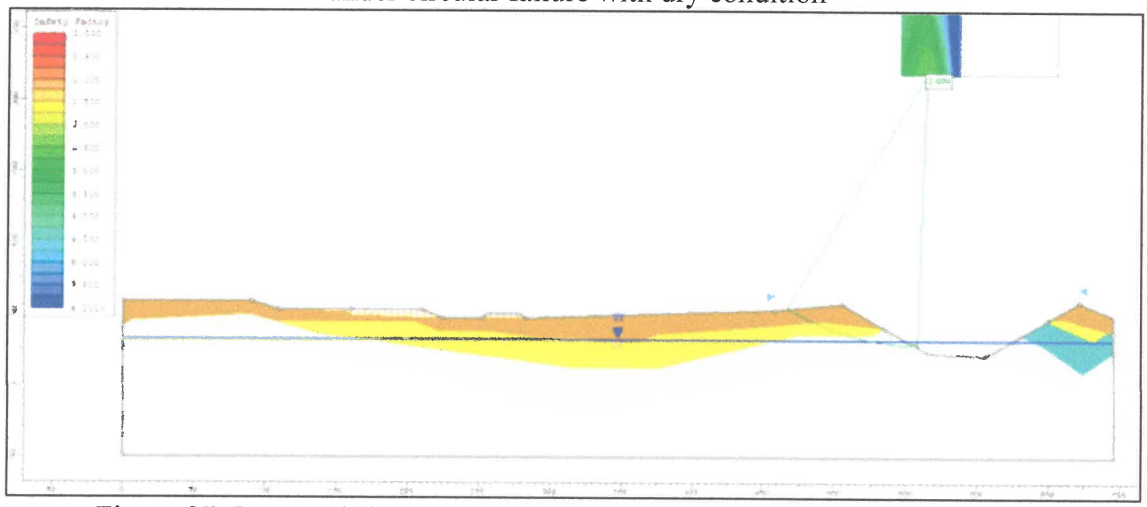


Figure 87. Proposed slope analysis along the critical section-P22 of the mine

under circular failure with saturated condition

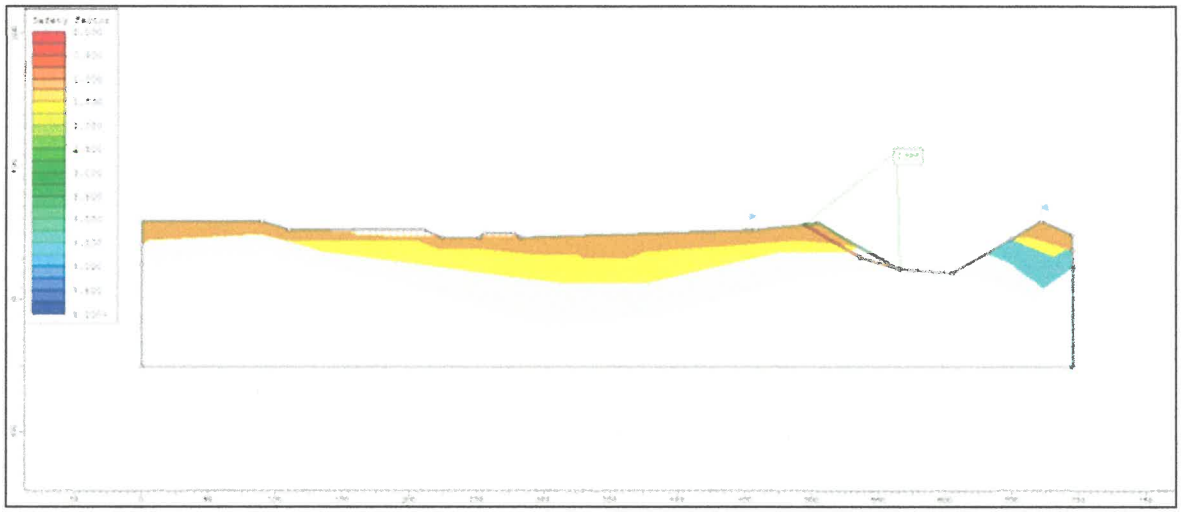


Figure 88. Proposed slope analysis along the critical section-P22 of the mine under noncircular failure with dry condition

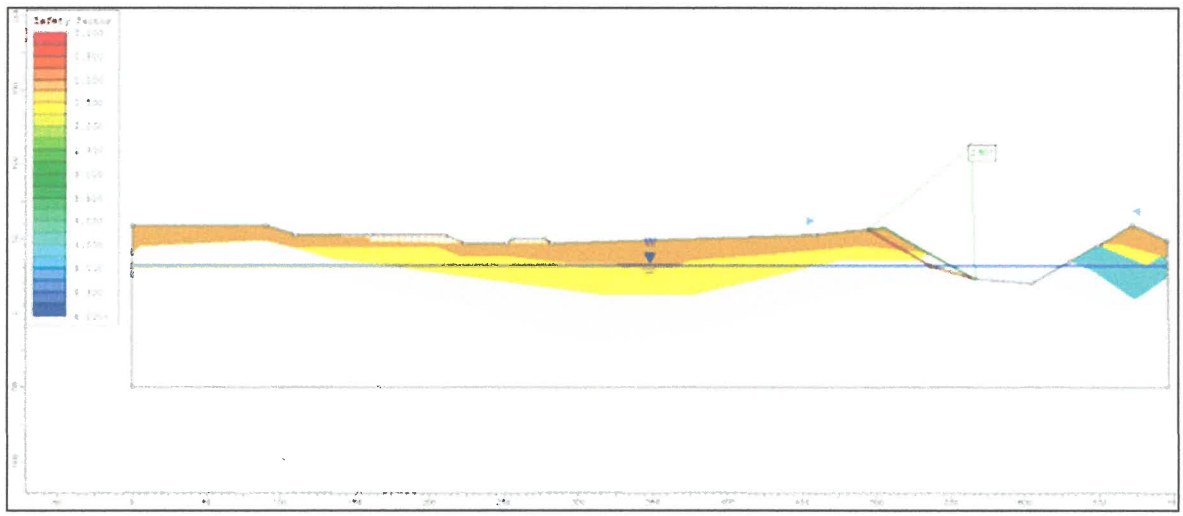


Figure 89. Proposed slope analysis along the critical section –P22of the mine under noncircular failure with saturated condition

Further, In the existing critical section-P24 towards the East-North direction of the mine, the slope analysis shows that the factor of safety under circular failure with dry and saturated conditions is 4.197 and 4.27 (Figures 90 & 91). Based on the proposed analysis for the critical section-P24 towards the East -North direction of the mine pit for 17m depth, the slope analysis shows the factor of safety under circular failure with dry and saturated conditions are 2.697 and 2.843 (Figures 92&93), and noncircular failure conditions are 3.064 and 3.134 (Figures 94& 95).

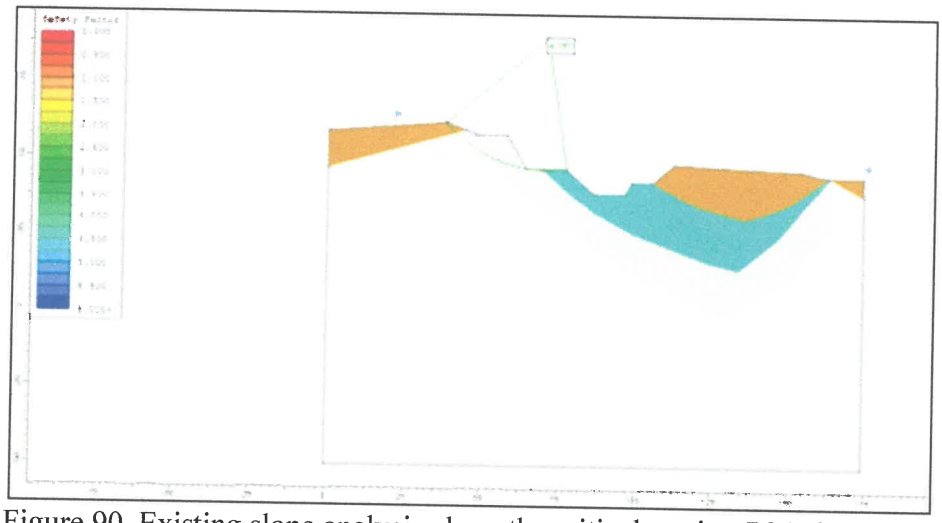


Figure 90. Existing slope analysis along the critical section-P24of the mine under circular failure with dry condition

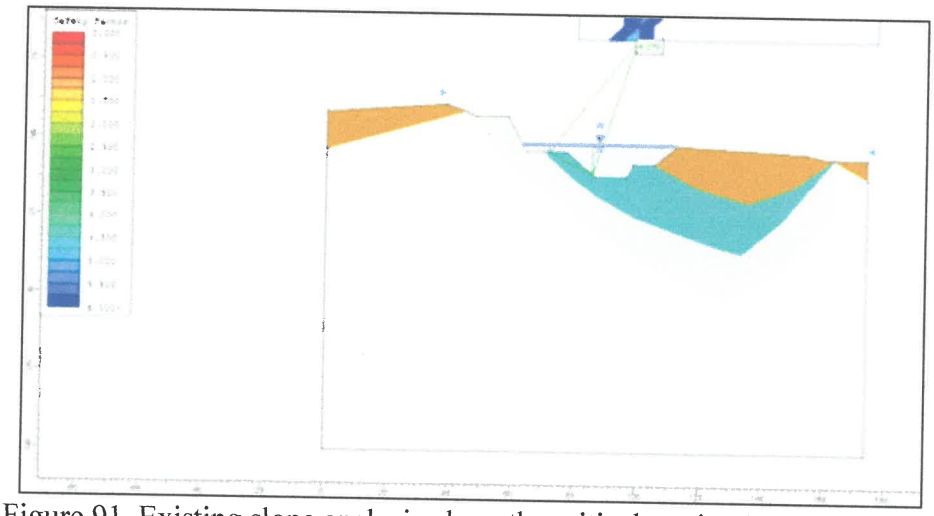


Figure 91. Existing slope analysis along the critical section-P24of the mine under circular failure with saturated condition

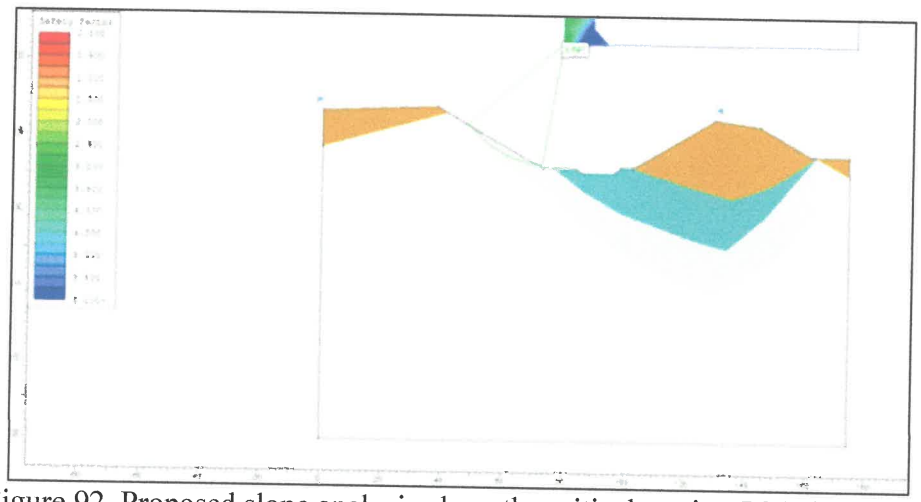


Figure 92. Proposed slope analysis along the critical section-P24of the mine under circular failure with dry condition

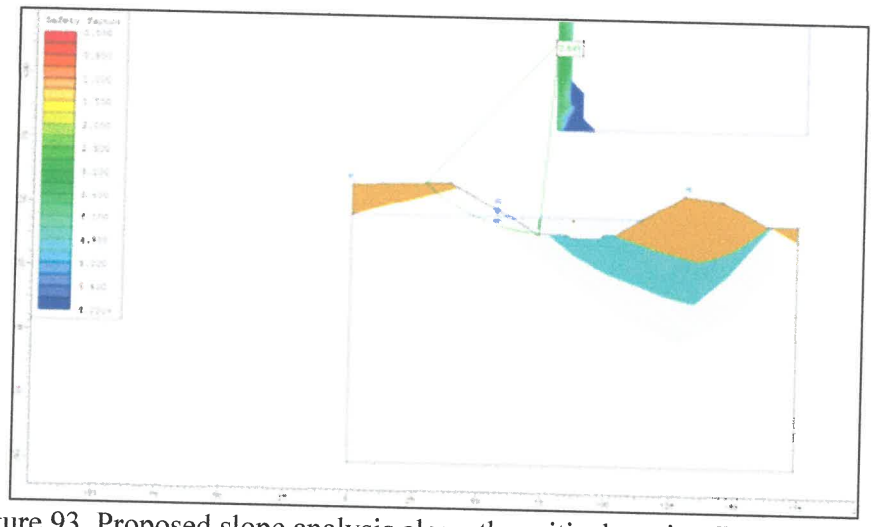


Figure 93. Proposed slope analysis along the critical section-P24of the mine under circular failure with saturated condition

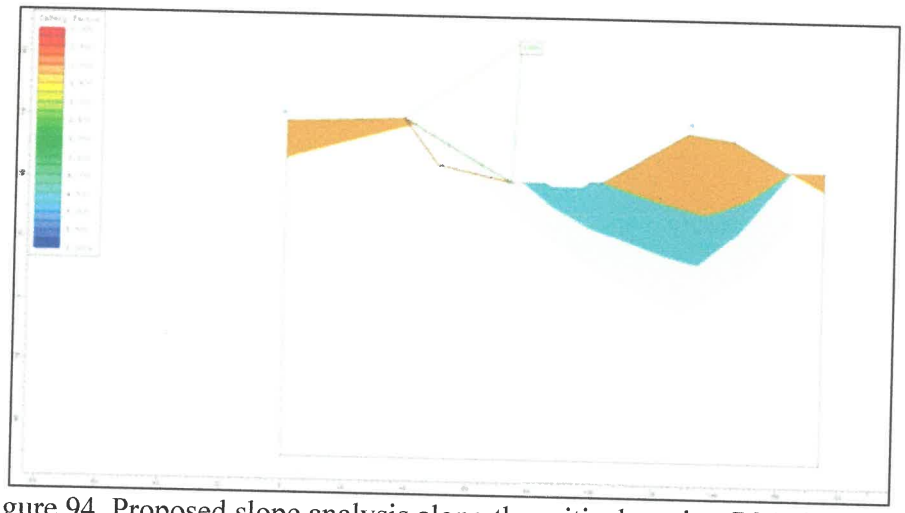


Figure 94. Proposed slope analysis along the critical section-P24of the mine under noncircular failure with dry condition

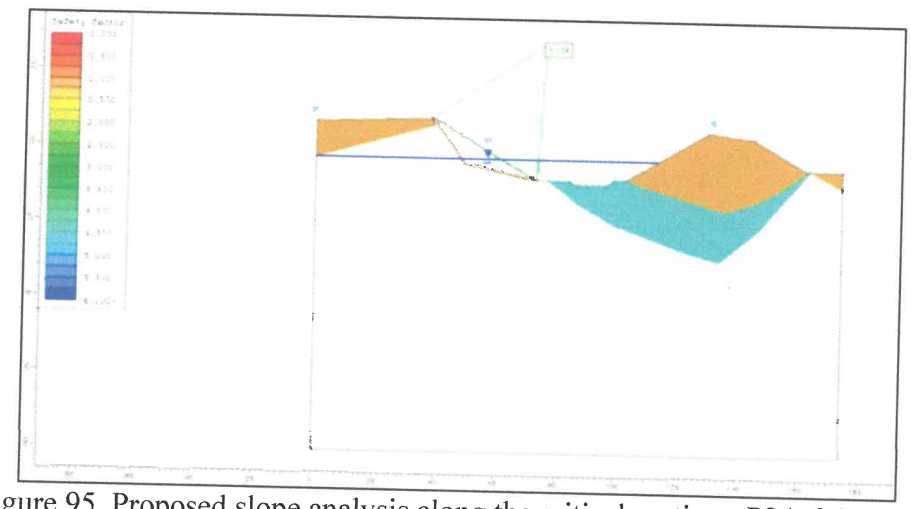


Figure 95. Proposed slope analysis along the critical section –P24of the mine under noncircular failure with saturated condition

7.0 OVERALL PIT SLOPE

The ultimate pit slope angle for the existing mine lease for section-M-1, M2, M5, M8, M11, P2, P5, P8, P11, P14, P17, P22& P24 is29^0, 27^0, 25^0, 24^0, 21^0, 9^0, 14^0, 8^0, 24^0, 24^0, 9^0, 5^0&21^0respectively (Figures 96-108). Based on the analysis done for the critical sections of the mine, it is recommended that the ultimate pit slope angle for proposed mine operations for section-M-1 is 30^0 for a depth of 60m (59 MSL to -1 MSL); section-M2 is $30^0$for a depth of 84m (83 MSL to -1 MSL); section-M5 is 30^0 for a depth of 85m (72 MSL to -13 MSL);section-M8 is 30^0 for a depth of 103m (72 MSL to -31 MSL); section-M11 is 30^0 for a depth of 84m (65 MSL to -19 MSL); section-P2 is 30^0 for a depth of 65m (52 MSL to -13 MSL);section-P5 is 30^0 for a depth of 66m (59 MSL to -7 MSL);section-P8 is 30^0 for a depth of 66m (59 MSL to -7 MSL);section-P11 is 30^0 for a depth of 78m (59 MSL to -19 MSL);section-P14 is 30^0 for a depth of 81m (68 MSL to -13 MSL);section-P17 is 30^0 for a depth of 83m (64 MSL to -19 MSL);section-P22 is 30^0 for a depth of 36m (59 MSL to 23 MSL);section-P24 is 30^0 for a depth of 17m (62 MSL to 45 MSL)(Figures 109-121) (Table-3). Generally, the whole quarry is recommended that the ultimate pit slope angle for all sections is 30^0 only. The benches in the mine should be maintained at a maximum 6m height by 8m width with 63^0 slopes. However, monitoring shall be carried out while approaching the ultimate pit limits to ensure safety and understanding of the slope movements.

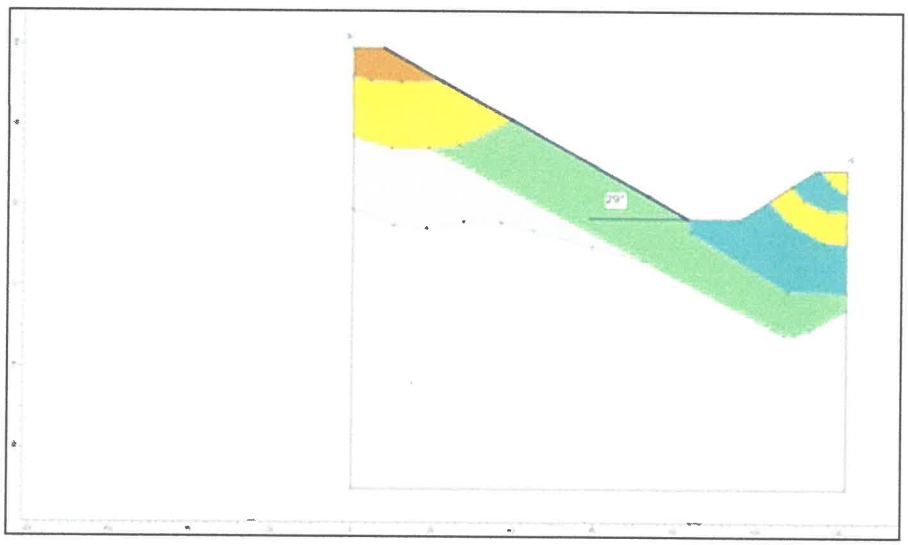


Figure 96.Shows existing configuration (Section-M-1) ultimate pit limits of mine

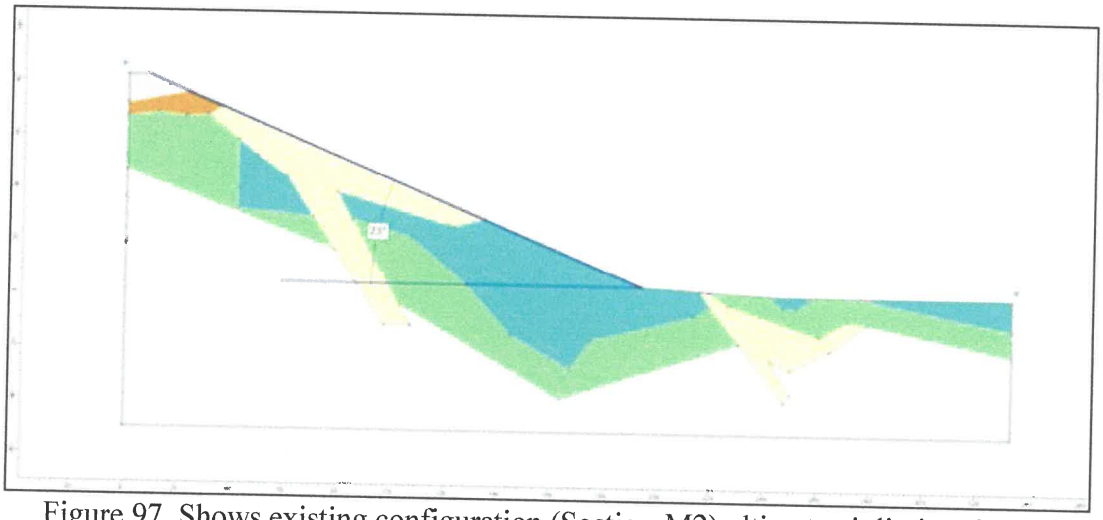


Figure 97. Shows existing configuration (Section-M2) ultimate pit limits of mine

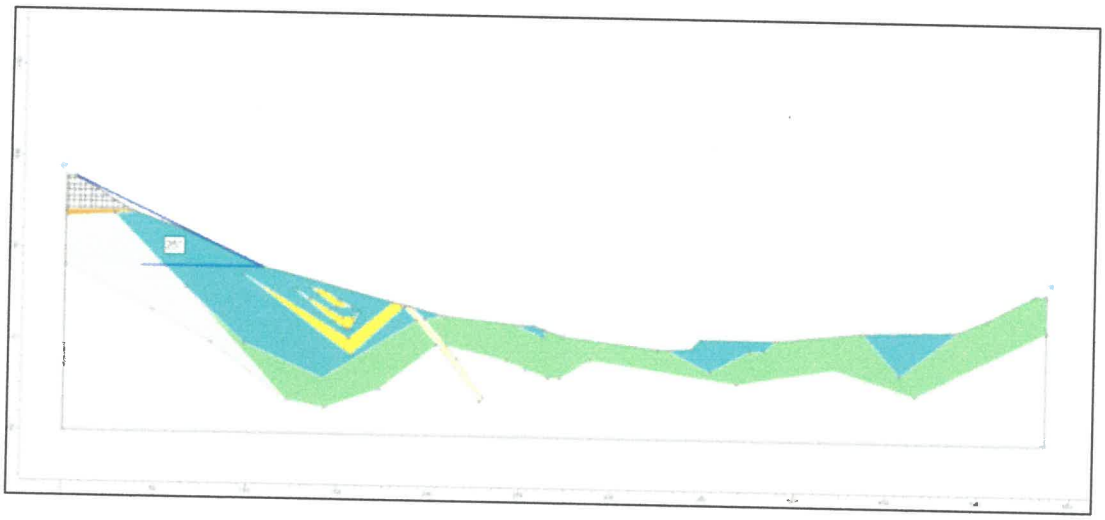


Figure 98. Shows existing configuration (Section-M5) ultimate pit limits of mine

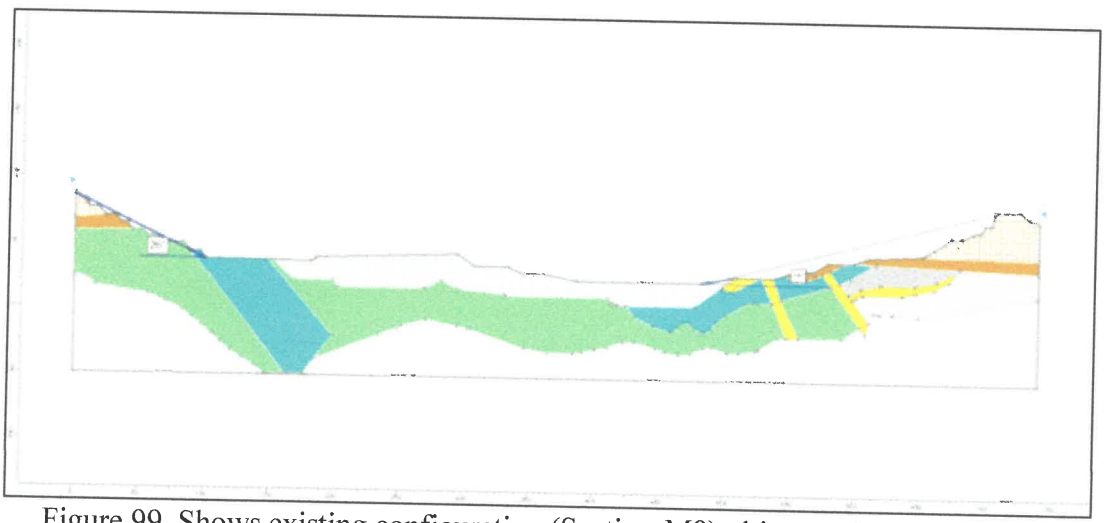


Figure 99. Shows existing configuration (Section-M8) ultimate pit limits of mine

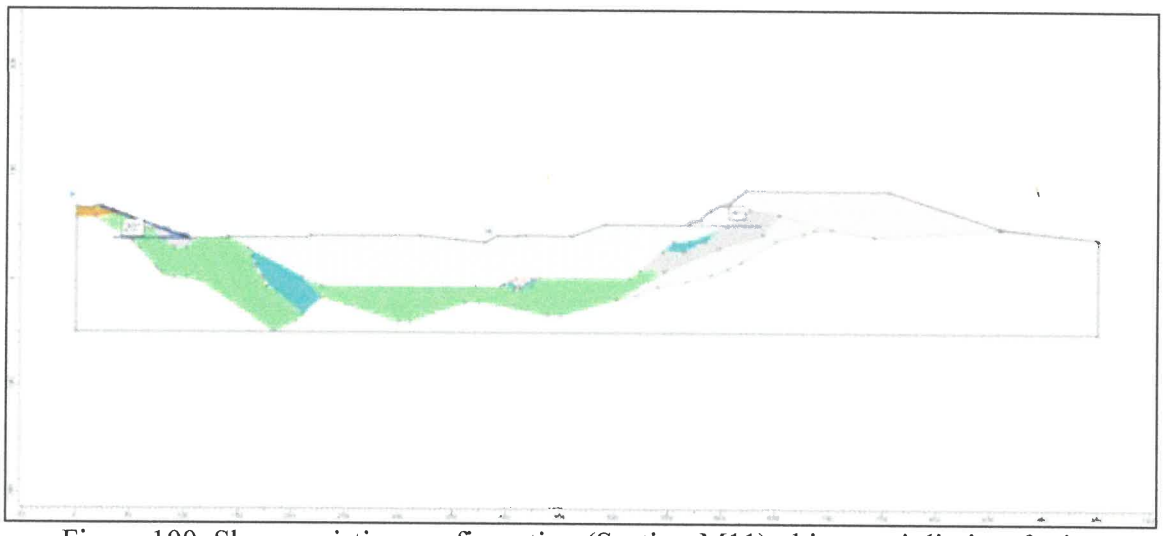


Figure 100. Shows existing configuration (Section-M11) ultimate pit limits of mine

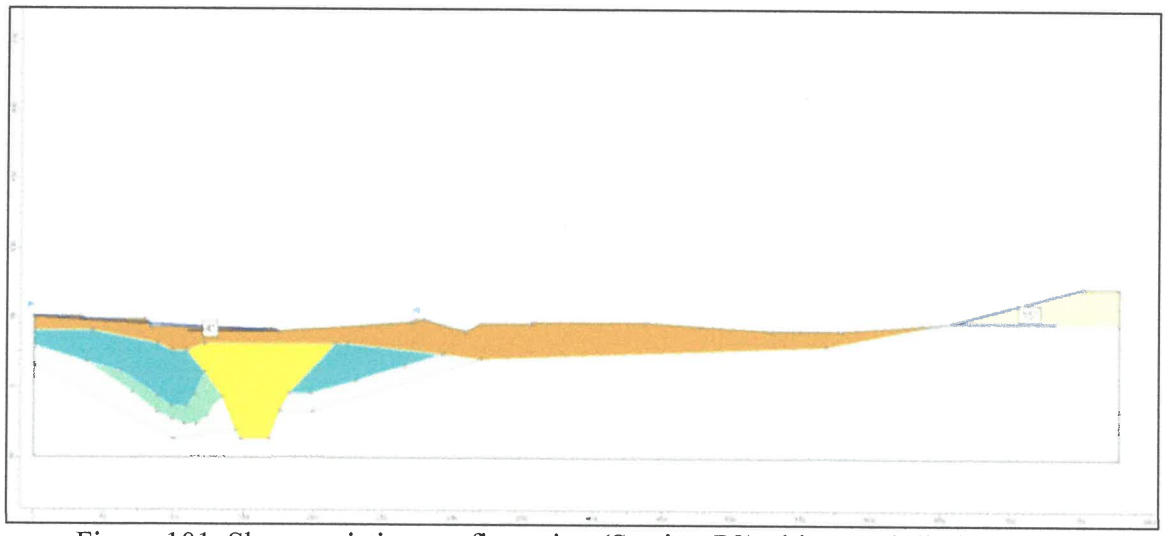


Figure 101. Shows existing configuration (Section-P2) ultimate pit limits of mine

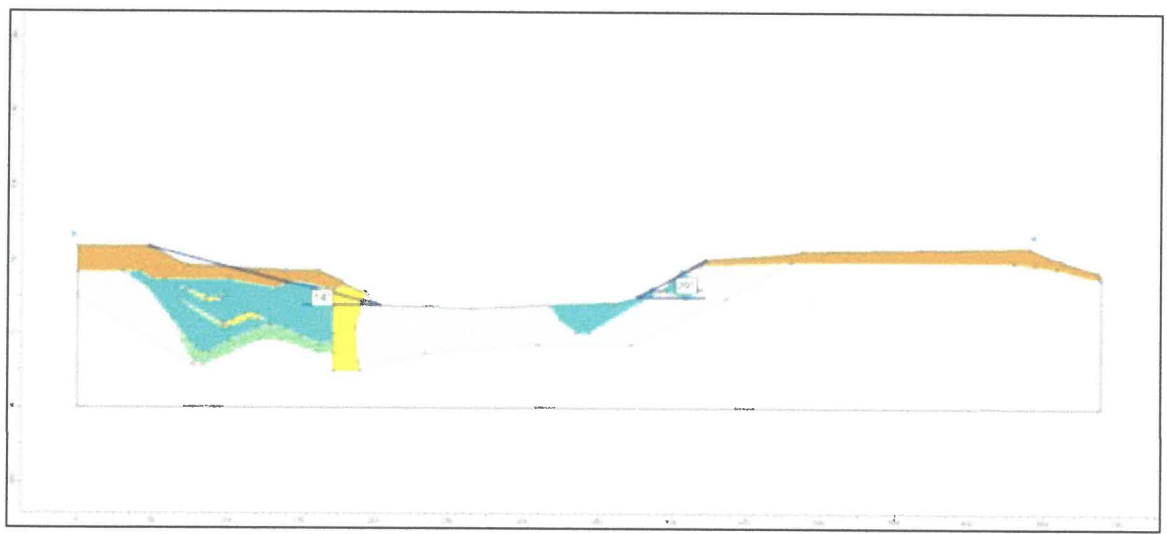


Figure 102.Shows existing configuration (Section-P5) ultimate pit limits of mine

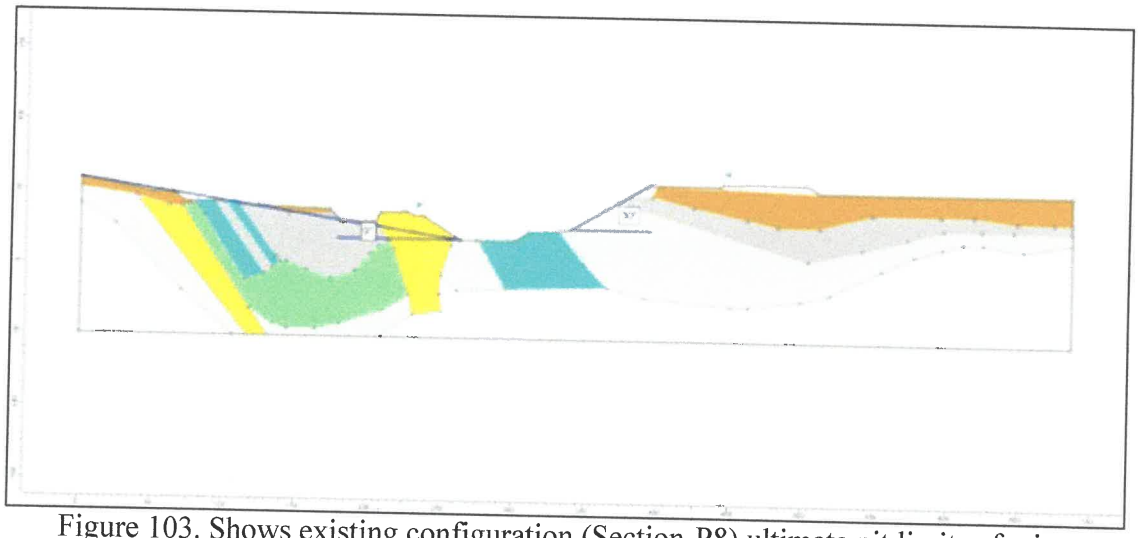


Figure 103. Shows existing configuration (Section-P8) ultimate pit limits of mine

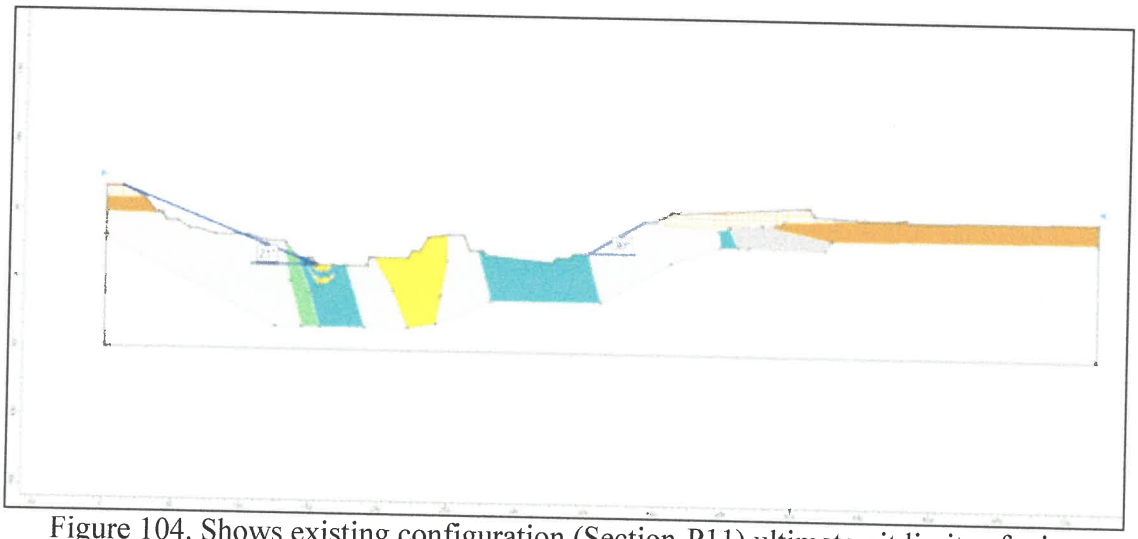


Figure 104. Shows existing configuration (Section-P11) ultimate pit limits of mine

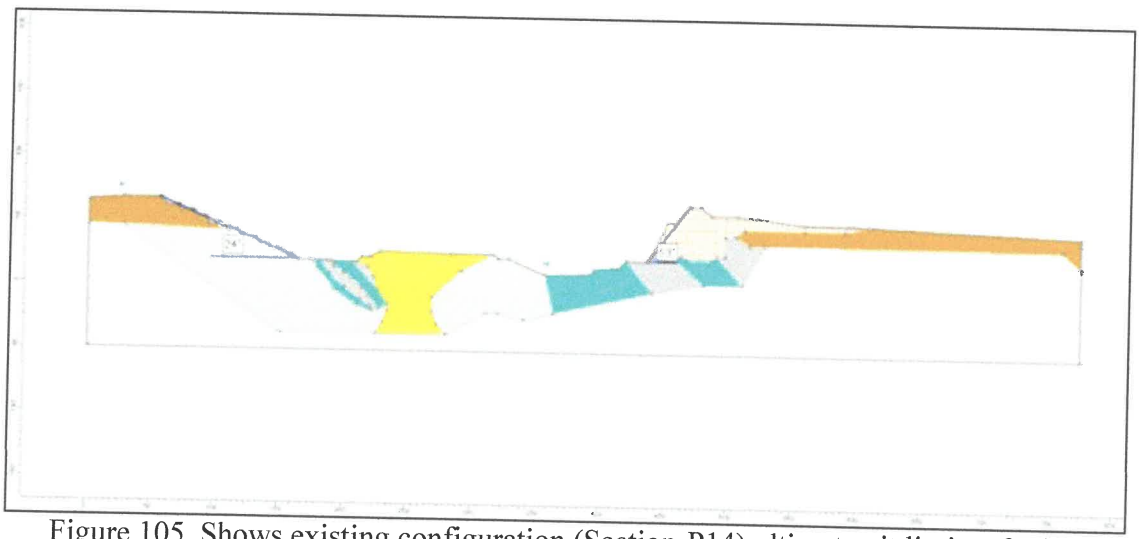


Figure 105. Shows existing configuration (Section-P14) ultimate pit limits of mine

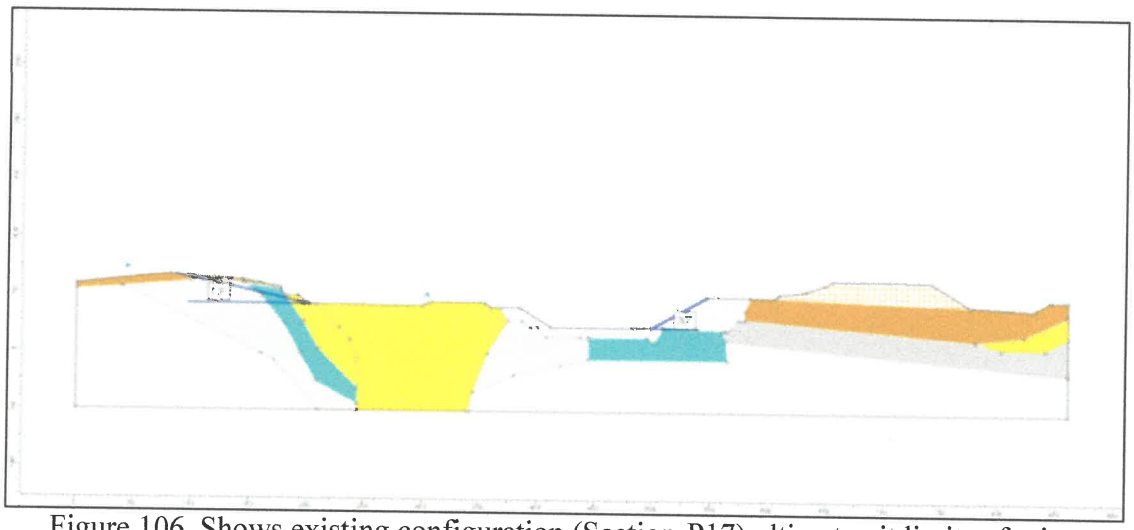


Figure 106. Shows existing configuration (Section-P17) ultimate pit limits of mine

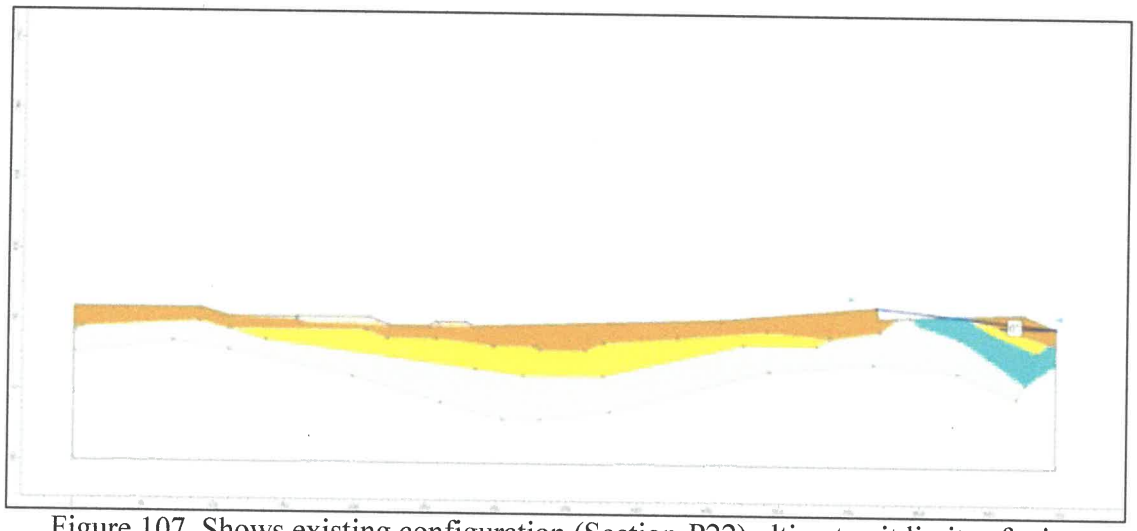


Figure 107. Shows existing configuration (Section-P22) ultimate pit limits of mine

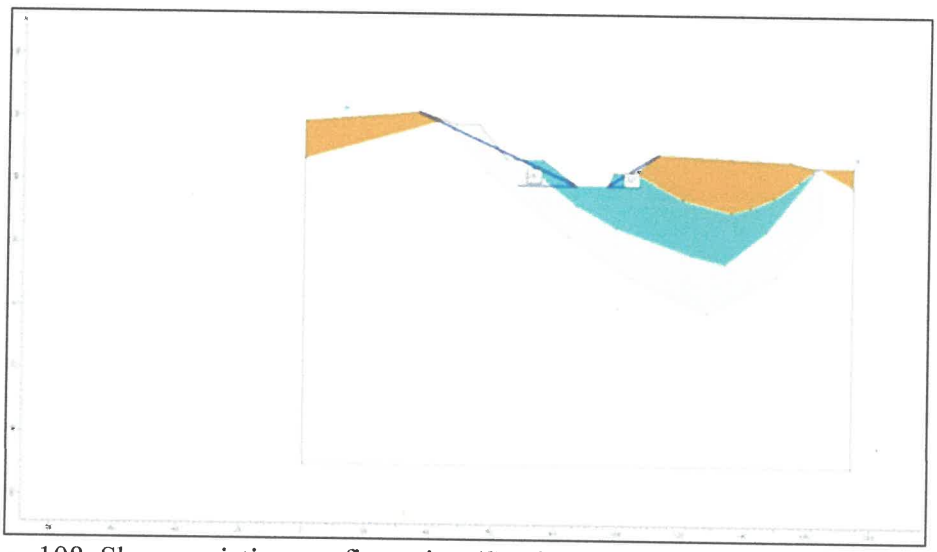


Figure 108. Shows existing configuration (Section-P22) ultimate pit limits of mine

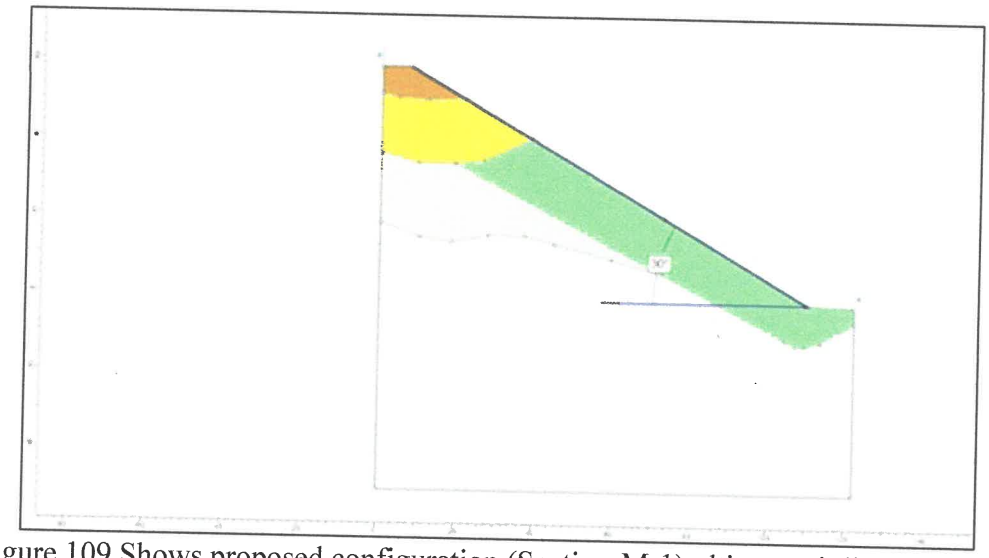


Figure 109.Shows proposed configuration (Section-M-1) ultimate pit limits of mine

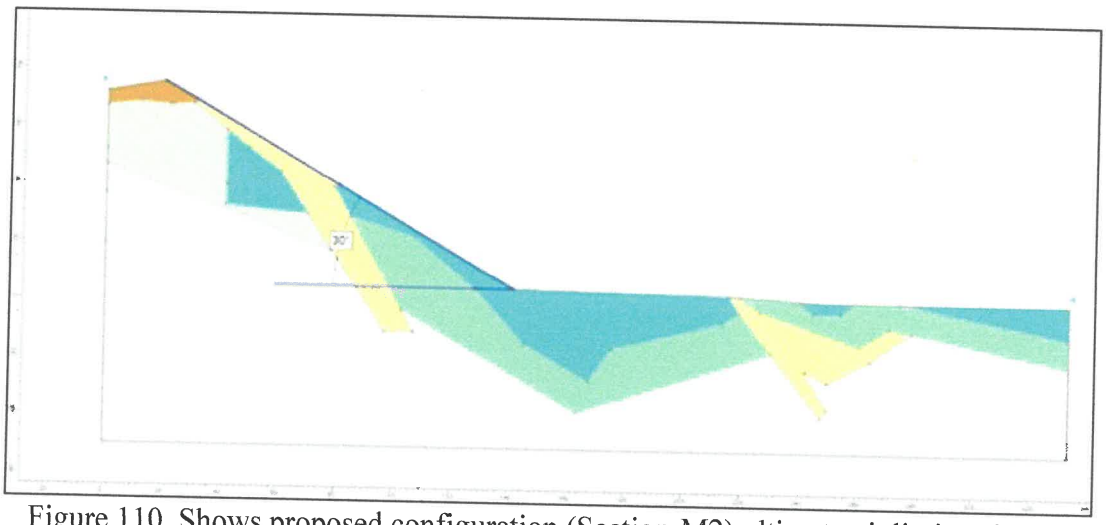


Figure 110. Shows proposed configuration (Section-M2) ultimate pit limits of mine

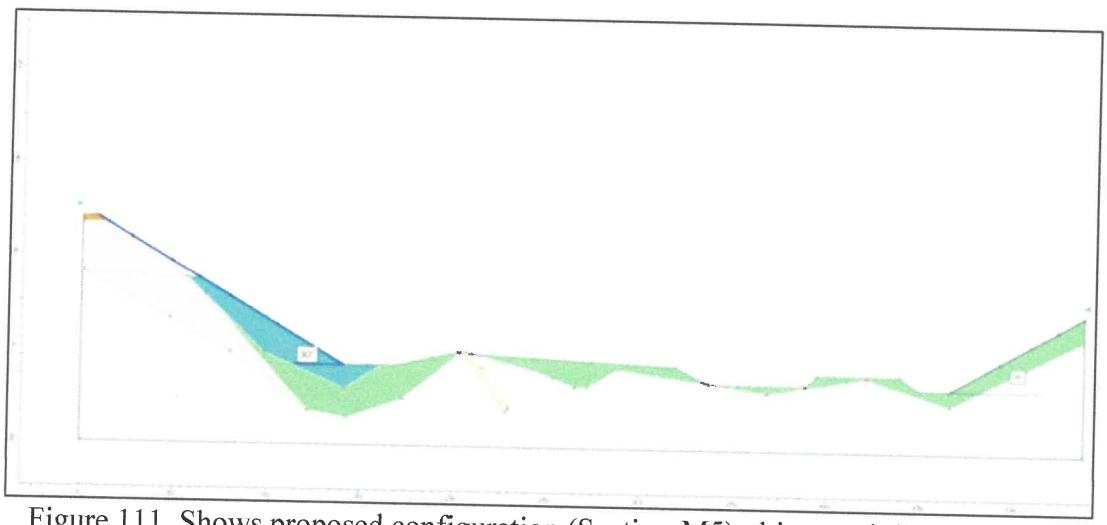


Figure 111. Shows proposed configuration (Section-M5) ultimate pit limits of mine

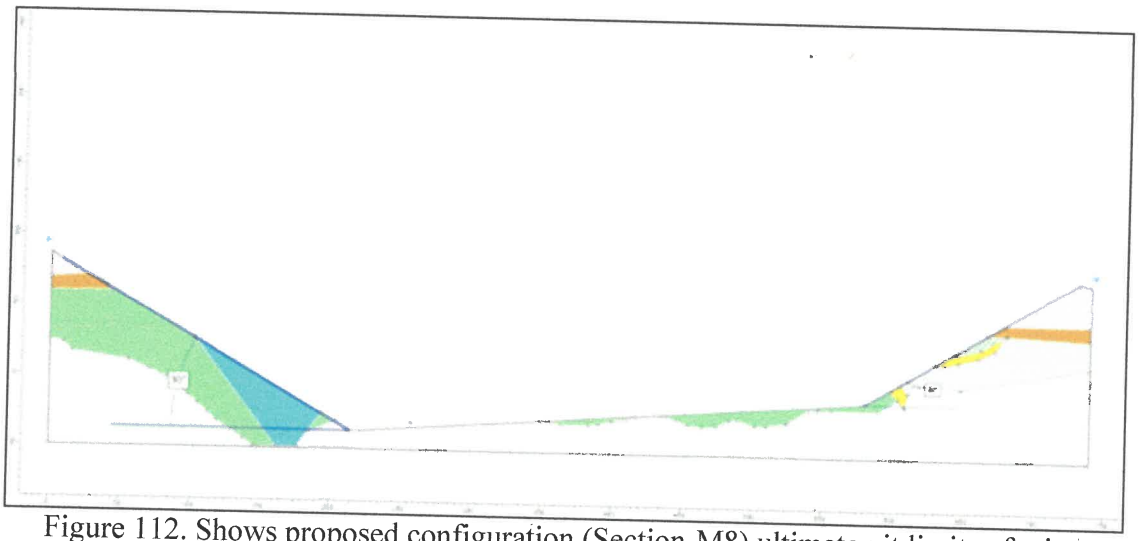


Figure 112. Shows proposed configuration (Section-M8) ultimate pit limits of mine

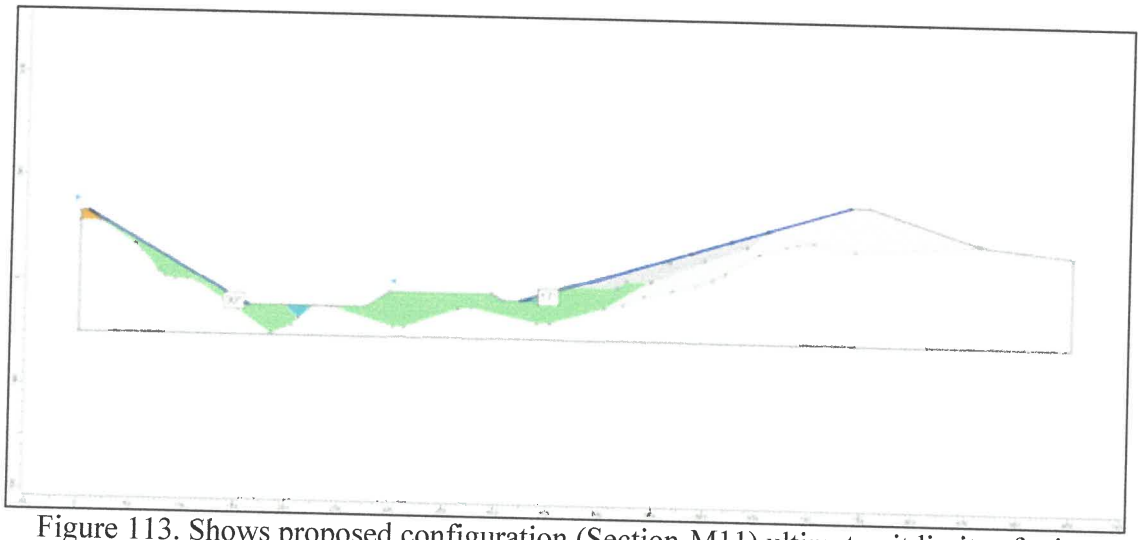


Figure 113. Shows proposed configuration (Section-M11) ultimate pit limits of mine

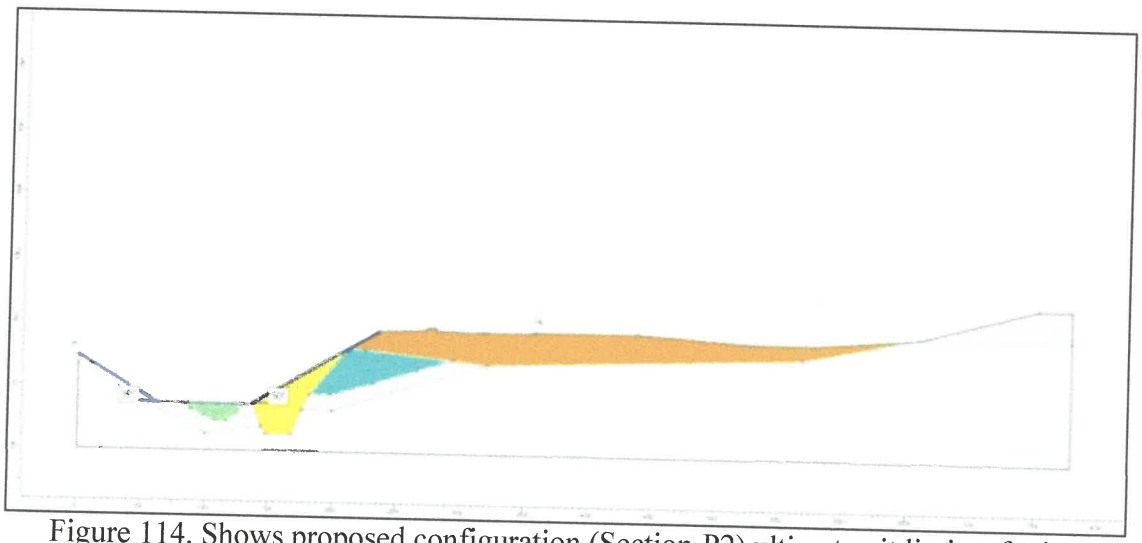


Figure 114. Shows proposed configuration (Section-P2) ultimate pit limits of mine

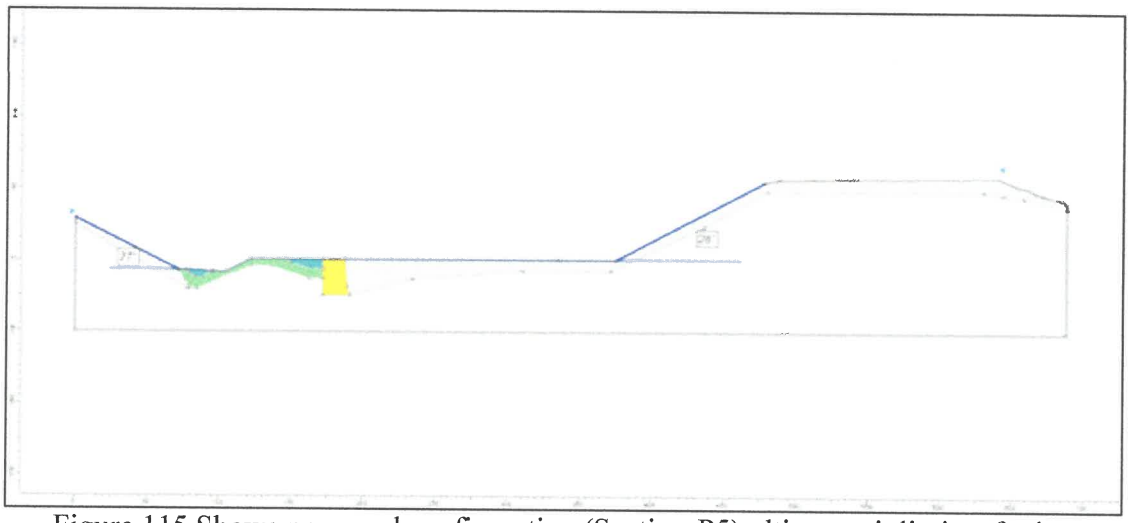


Figure 115.Shows proposed configuration (Section-P5) ultimate pit limits of mine

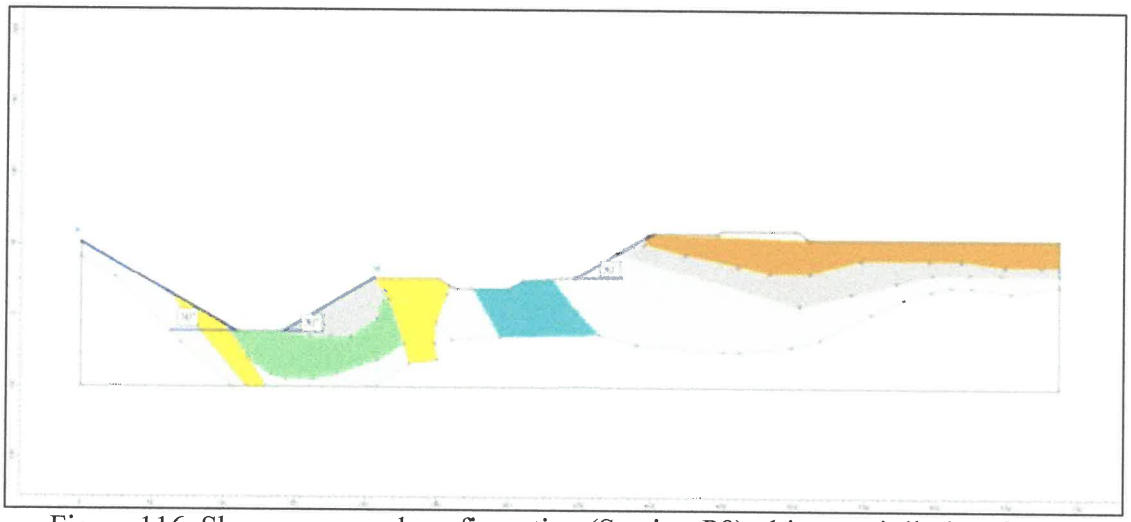


Figure 116. Shows proposed configuration (Section-P8) ultimate pit limits of mine

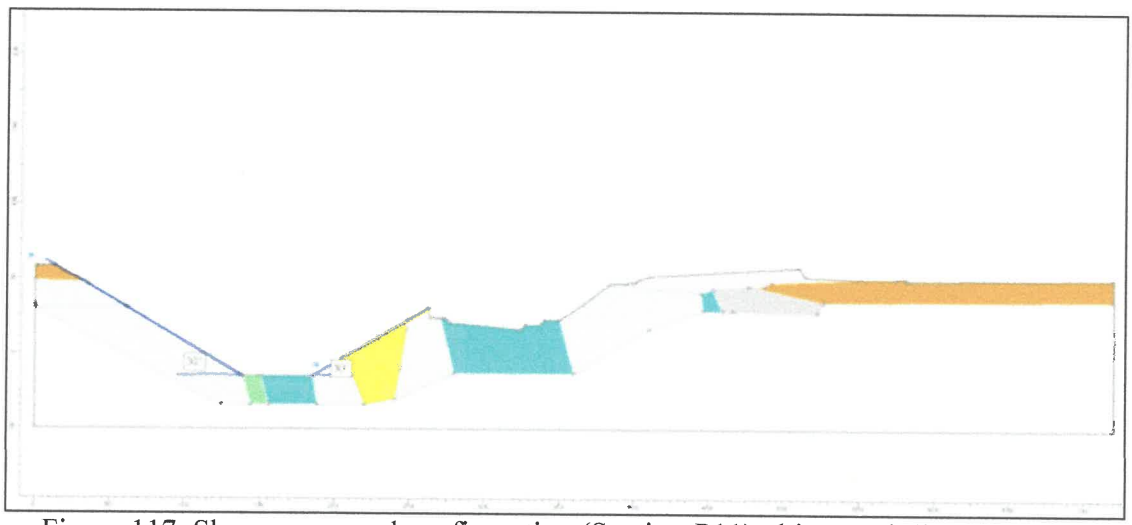


Figure 117. Shows proposed configuration (Section-P11) ultimate pit limits of mine

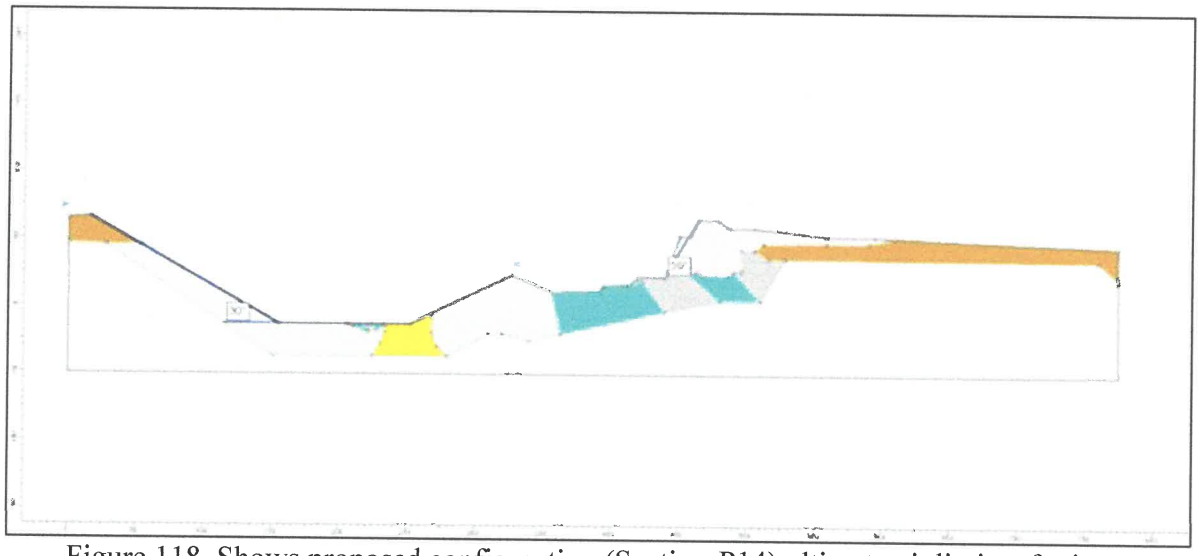


Figure 118. Shows proposed configuration (Section-P14) ultimate pit limits of mine

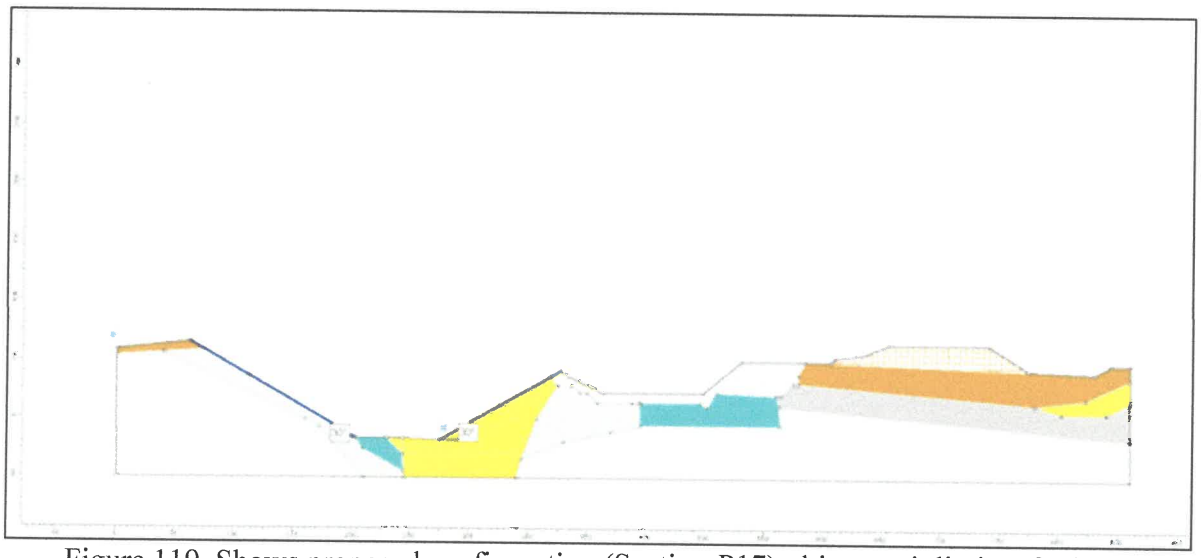


Figure 119. Shows proposed configuration (Section-P17) ultimate pit limits of mine

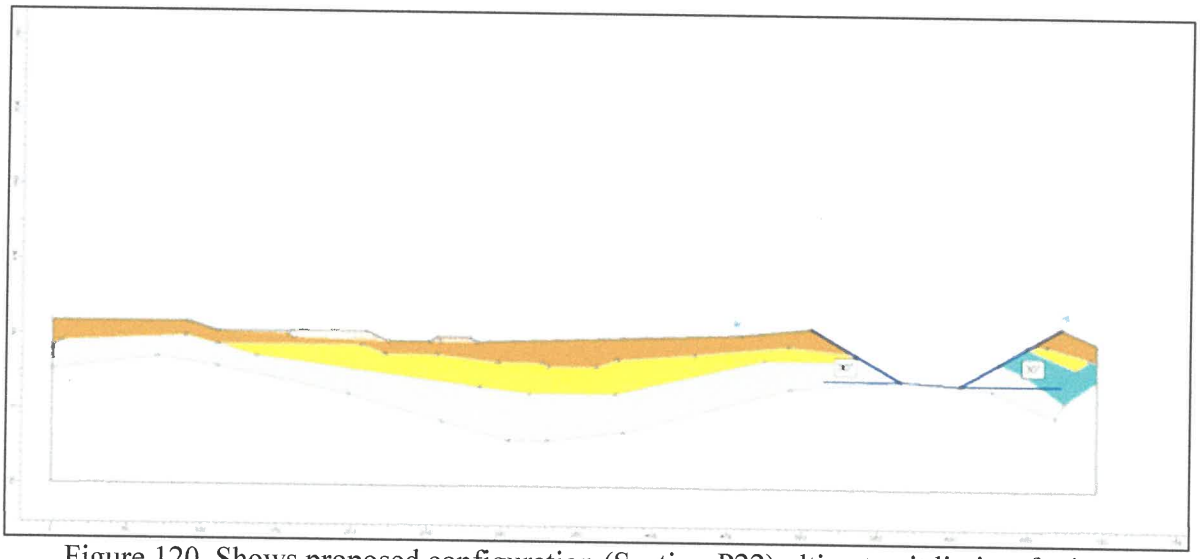


Figure 120. Shows proposed configuration (Section-P22) ultimate pit limits of mine

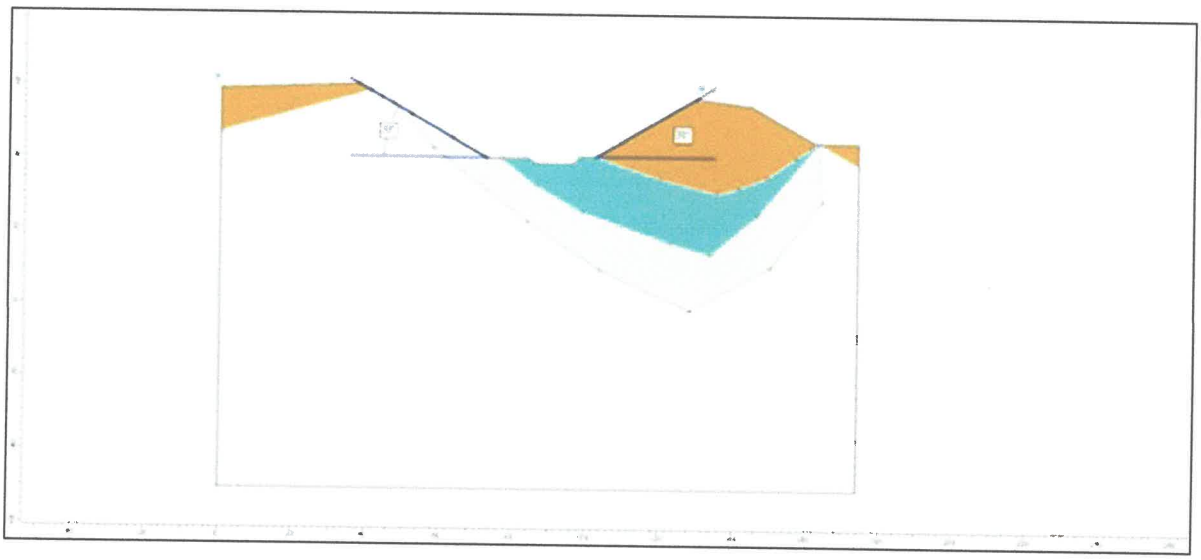


Figure 121. Shows proposed configuration (Section-P24) ultimate pit limits of mine

Table-3. The recommended ultimate pit slope angle for different sections in the mine

Particulars	Circular		Non-Circular		Depth		Ultimate/Final Slope Angle	
	Dry	Saturated	Dry	Saturated	Existing	Projected	Existing	Projected
Section-M-1 (Existing)	3.012	2.576	2.366	2.417	42		29	
Section-M-1 (Projected)	2.229	2.149	1.777	1.908		60		
Section-M2 (Existing)	1.748	1.666	2.073	2.136	78		27	
Section-M2 (Projected)	1.694	1.614	1.62	1.629		84		
Section-M5 (Existing)	1.835	1.67	1.928	1.767	89		25	
Section-M5 (Projected)	1.514	1.559	1.576	1.556		85		
Section-M8 (Existing)	2.523	2.282	2.456	2.479	57		24	
Section-M8 (Projected)	1.547	1.55	1.514	1.575		103		
Section-M11 (Existing)	3.04	2.797	5.423	4.814	27		21	
Section-M11 (Projected)	1.732	1.753	1.952	2.327		84		
Section-P2 (Existing)	9.951	8.219	27.83	33.79	11		9	
Section-P2 (Projected)	2.129	2.106	1.594	1.537		65		
Section-P5 (Existing)	3.623	3.426	5.608	5.132	42		14	
Section-P5 (Projected)	2.166	2.074	2.858	3.019		66		30
Section-P8 (Existing)	2.359	2.152	2.939	2.955	38		8	
Section-P8 (Projected)	2.101	2.068	2.442	2.829		66		
Section-P11 (Existing)	2.375	2.375	2.546	2.546	55		24	
Section-P11 (Projected)	1.818	1.755	1.741	1.863		78		
Section-P14 (Existing)	2.125	2.125	2.381	2.441	49		24	
Section-P14 (Projected)	1.917	1.809	1.934	2.114		81		
Section-P17 (Existing)	4.248	4.197	4.46	4.461	41		9	
Section-P17 (Projected)	1.844	1.852	1.912	1.895		83		
Section-P22(Existing)	7.217	9.756	4.708	6.277	4		5	
Section-P22 (Projected)	2.503	2.494	2.565	2.607		36		
Section-P24 (Existing)	4.197	4.27	3.312	3.365	17		21	
Section-P24 (Projected)	2.697	2.843	3.064	3.134		17		

This recommendation is made on the fact that no significant geological weaknesses like faults, folds and joints etc. are present. If such weakness or faults are encountered during the extraction process, the same shall be treated before proceeding with the further operation. However, updated geological mapping and design need to be checked once every five years to optimise the workings and maintain safe working conditions in the mine.

This arrangement shall provide stable benches, an increased number of working faces for optimum production and easy manoeuvrability of men and machinery. A ramp with a gradient of 1 in 10 is advisable for safe haul roads. The overburden material of soil/weathered rock in the mine needs to be removed or strengthened to increase the pit's stability and avoid free fall materials in the pit.

8.0 DRAINAGE

The mine is waterlogged in the three pits. Water accumulated in the mining pit will be allowed to settle for suspended solids before being pumped out. The pumped-out water will be made to pass through settling ponds where it will be treated with lime and flocculants for faster settling of solid suspended particles. The overflow from the settling ponds will then be discharged into the seasonal nallah. Thus, clear water will be discharged from the mineral block into the natural water course outside the block area. The quality of the mine pit water and discharged water is proposed to be regularly monitored.

The mine pit must be provided with a very effective garland drain/ bund depending upon the topography of the area. The drains should be clear of soil debris and compelling for the free flow of water. The discontinuance of the pre-monsoon preparation at any location will jeopardise maintaining the designed slopes.

The drain should be kept effective. The top ground surface should be levelled appropriately for quick rainwater run-off. There should not be any water stagnation.

The benches should be provided with bench drains to collect the rainwater. The flowing rainwater should not be allowed to flow down to lower benches in an uncontrolled manner. The slope of the upper surface/benches should be well-graded so that the rainwater goes away from the bench face. The water should be channelized trough garland drains/trenches into the mine

pit. During monsoon, rainwater/stormwater from the broken-up area should be diverted to the mine pit through well-maintained drains/trenches. The water should not be allowed to enter the mine pit from many channels or be left uncontrolled. The drains/trenches should be maintained in properly with intermediate settling ponds and regular checking of the drains to be done to avoid any soil/clays/material erosion/ failure of drains. Rainwater/stormwater should be channelized by guiding the flow of water in proposed designated channels/trenches.

The influence of water is alarming, and hence every attempt should be made to maintain a good drainage pattern within the Mining Lease. A proper gradient helps for quick run-off of water.

9.0 CONCLUSIONS & RECOMMENDATIONS

Based on investigations carried out by NITK and the data provided by the mine management, a detailed study was carried out, and the following conclusions and recommendations were made.

- The laterite, weathered/siliceous BHQ and Iron Ore found in the lease is classified as sandy material, and Ferruginous/Limonitic/Phyllitic soil, Siliceous manganiferrous soil and Mangniferrous soil is classified as clay material. The lateritic soils are highly porous and permeable. These soils become soft when wet, and they become strong after drying.
- It is recommended that the ultimate pit slope angle for different sections in the mine as given in Table-3.
- In general, for the whole mine it is recommended that the ultimate pit slope angle for any section is 30^0.However, monitoring shall be carried out while approaching the ultimate pit limits to ensure safety and understanding of the slope movements.
- The recommended bench dimensions are a maximum of 6m height by 8m width with an individual bench slope of 63^0 for the mine. However, if any weak material encounters during excavation, the individual benches in weak material need to be stabilized, and bench parameters need to be adjusted accordingly within above mentioned recommendations.
- The benches need to be properly sloped, and no undercutting is permitted to prevent danger from falling off sides. Whenever any geological weakness like faults, folds and weathered/loose material etc., are encountered during the extraction process, the same shall be treated before proceeding with the further operation.
- Local wedges forming at the face of the workings in the mine need to be supported.
- Proper drainage system to be made in the entire pit area to minimise the influence of water on the stability of slopes.

- During mining operations, the working area pit slope should be less than the ultimate or final pit slope and the bench width should be maintained at 8m. Unavoidable small-scale bench failures can be arrested on these wide benches, and large-scale slope failures can be avoided. The wider bench will arrest the local bench failures, and there will not be any operational problems. Ultimately the overall pit slope should be maintained at 30^0 angle with 6m bench height and 8m bench width.
- It may be noted that a few small-scale failures may cause a big failure. If two or three benches are steeper at any level in any part/ depth of the pit, it may initiate failure. Although the overall slope angle may be pretty low, the steeper slope angle of the three benches may increase the stress at the toe of the steeper part of the slope, which may cause failure. Two or three such small failures may cause a big failure. So, benching should be appropriately done from top to bottom.
- It is recommended that an updated geological mapping, and design need to be checked every five years to optimise the workings and safe workings in the mine.
- It is recommended slope and water pressure monitoring of the pit benches need to be carried out and monitoring data need to be submitting to regulatory bodies.

ACKNOWLEDGMENTS

We are pleased to express our sincere gratitude to the management of M/s Fomento Resources Pvt. Ltd. for sponsoring the work to NITK Surathkal. We also thank those who have directly and indirectly co-operated in completing the field investigations.

DISCLAIMER

This investigation report is classified as "Restricted Circulation" and is meant for the internal use of M/s Fomento Resources Pvt. Ltd. authority only. Standard conditions of restricted circulation are as under:

- This report shall not be used in parts or for other purposes than the report deals with.
- This report shall not be given to a third party without the consent of NITK, Surathkal.
- This report shall not be copied, in parts or in whole.

Further, this report, in full or part, can neither be quoted nor published anywhere by anybody other than the investigators. NITK Surathkal reserves the right to publish the results of the present study.

The study is based on the information provided at the site by the M/s Fomento Resources Private Limited management. NITK Surathkal is not responsible for its authenticity. Some

assumptions had to be made during the analysis. There may be hidden slips and geological surprises within the rock mass which could not be anticipated or presumed during data interpretation. These results present the state of affairs as of the day of investigation. Day-to-day activities at the project site are not under the control of NITK Surathkal, nor is it possible to have any such control. Therefore, NITK Surathkal cannot be held responsible for the further deterioration of site conditions.

In view of the above, the authors of this report, the investigators and NITK Surathkal in general assume no responsibility for any untoward incident which might occur due to the deficiency/deviation in implementation of the recommendations of the report, nor do we assume any liability in respect of any consequential financial claims, damages or losses arising out of the use of the results/recommendations of the present study.

This report is only for guidance to the project authorities, and the management has to decide on all other safety and operational aspects at the site. It is the responsibility of the management to take all additional safety measures as necessary.

(Dr Sandi Kumar Reddy)

Dr. SANDI KUMAR REDDY
Assistant Professor
Department of Mining Engineering
National Institute of Technology Karnataka,Surathkal
Srinivasnagar - 575 025, Mangalore, Karnataka

Gov«rnm«nt of Go®
Goa College of Engineering,
Farmagudi - Go®
गोवा aifWfWI महाविद्यालय,
फार्मागुडी – गोवा

REPORT ON

THE ENGINEERING DESIGN FOR GARLAND DRAINS, SETTLING TANKS, CHECK DAMS AND THEIR EFFICACY

BLOCK-IV KALAY MINERAL BLOCK- SANTONA VILLAGE-SANGUEM- GOA FOR IRON ORE



PREPARED AND DESIGNED BY

DR. K G GUPTHA

PROFESSOR AND HEAD, CIVIL ENGINEERING DEPARTMENT

DR. PURNANAND P SAVOIKAR

PROFESSOR IN CIVIL ENGINEERING

GOA COLLEGE OF ENGINEERING- FARMAGUDI-GOA

SUBMITTED TO

FOMENTO RESOURCES PRIVATE LIMITED

MARCH-2024

CONTENTS

No.	DESCRIPTION	PAGE NO
	ABSTRACT	1
I	INTRODUCTION	2
	1.1 General	2
	1.2 Scope of Work	3
	1.3 Study Area	4
	1.3.1. Project Location and Configuration	4
II	GEOMORPHOLOGY, PHYSIOGRAPHY & DRAINAGE	10
	2.1 Geomorphology	10
	2.2 Physiography	10
	2.3 Drainage	12
	2.4 Land Use & Land Cover (LULC)	14
	2.5 Digital Elevation Model	14
III	GEOLOGY	17
	3.1 Regional Geology	17
	3.2 Geology of the Mineral Block	18
	3.3 Soil Characteristics	19
IV	CLIMATE	20
	4.1 Hydrometeorology in General	20
	4.2 Climatic Details of South Goa	20
	4.3 Rainfall	20
	4.3.1. Behavior of Monthly Rainfall	21
	4.3.2. Behavior of Annual Rainfall	23
	4.4 Temperature	24
	4.5 Humidity	25
	4.6 Hydro-Geological Information	25
	4.7 Aquifer Description	26
	4.8 Surface Water Quality Analysis	26

Dr. K.G. GUPTHA (Ph.D,IIT Bombay)
Professor & Head, Civil Engg.
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.
E-mail: kgg@gec.ac.in M: 9422061953

Dr. Purnanand P. Savoikar
Ph. D. (IITB)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

No.	DESCRIPTION	PAGE NO
V	METHODOLOGY ADOPTED	27
	5.1 General	27
	5.2 Results and Discussions	28
	5.2.1. General	28
	5.2.2. Description of Mining Pit, Garland Drains, Settling Tanks etc	33
	5.2.3. Time of Concentration (Tc)	35
	5.2.4. Theory behind the Process Adopted	37
	5.2.5. Silt Load, Settling Velocity of Silt, etc.,	39
	5.2.6. Design Analysis and Calculations	41
	a. Runoff Calculations	41
	b. Estimation of Silt Load	43
	5.3 Recommendations	47
	a. Garland Drains	47
	b. Velocity Dropping Arrangement	48
	c. Image Of A Bund	48
VI	CONCLUSIONS	49
	ANNEXURE A	51
	ANNEXURE B	54

LIST OF FIGURES

FIGURE No.	DESCRIPTION	PAGE NO
1	Location Map	5
2	Mineral Block Superimposed on Toposheet	6
3	Surface Plan	8
4	Mineral Block Superimposed on Google Earth image	9
5	Mineral Block Superimposed on Geomorphology Map	11
6	Drainage Basin Map	13
7	Land use and Land Cover of the Study area	15
8	Digital Elevation Map	16
9	Average Month-wise Rainfall for a 30-year period Santona Village, Sanguem Taluka	22
10	Monthly distribution of rainfall at Santona Village	23
11	Annual distribution of rainfall at Santona Village	24
12	Monthly Mean Minimum and Maximum temperatures at Sanguem Village	24
13	Monthly Mean Relative Humidity (%) at Sanguem Taluka	25
14	Surface plan showing the existing pits, settling ponds & Trenches	31
15	Enlarged plan of the settling ponds & trenches	32
16	Flow diagram and the corresponding channelization of stormwater into the settling ponds	33
17	Typical Swale	39
	Plates as Annexure B	54

Dr. K.G. GUPTHA (Ph.D,IIT Bombay)
Professor & Head, Civil Engg.
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.

Dr. Purmanand P. Savoikar
Ph. D. (IITB)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

LIST OF FIGURES

TABLE No.	DESCRIPTION	PAGE NO
1	DGPS Co-ordinates of Mineral Block boundary	7
2	Distance & Direction of River/ Stream/Nalla within the 10km radius	12
3	The Stratigraphic Succession of the Goa Group	18
4	Average monthly Rainfall at Santona (1991-2021) at Sanguem Taluka	21
5	Monthly rainfall data recorded at Santona Village (2019-2023)	22
6	Existing Mine Pits & Sedimentation Tanks/ Ponds with Their Holding Capacities	29
7	Settling Pond and the Corresponding Catchment Area	30
8	Retention time of Particles	42
	Annexure A (Yearwise Rainfall Data)	51

ABSTRACT

This document outlines the introduction and scope of a detailed study conducted for the Kalay Mineral Block, Block IV, situated in Santona Village, Sanguem Taluka, South Goa District, Goa State. The project, owned by Fomento Resources Private Limited, involves mining operations for an area of 152.5073 hectares, with a proposed annual production of 0.75 million tonnes of Iron Ore. The study, mandated by the Ministry of Environment Forest and Climate Change (MoEF & CC), focuses on meeting specific conditions outlined in the Terms of Reference (ToR) for the Environmental Impact Assessment (EIA) process.

The scope of the work includes a thorough examination of engineering designs for garland drains, settling tanks, and check dams within the project site. It also involves sediment analysis, with a focus on per-day silt load, settling velocity, and retention time, correlated with annual rainfall patterns. Additionally, the study establishes a monitoring framework for turbidity in the siltation tank overflow and drains, ensuring compliance with environmental standards.

The study evaluates the likelihood of river water seepage into the mine pit and proposes preventive measures. The document concludes with the preparation of a comprehensive project report, aligning with legal standards and emphasizing transparency and accountability.

The study area encompasses the Kalay Mineral Block and its buffer zone within a 10 km radius, with accessibility facilitated through a village road connected to the Sanvordem-Dharbandora State Highway. The abstract provides an overview of the project, its objectives, and the comprehensive approach taken to assess environmental, engineering, and geological aspects for sustainable mining operations and stormwater management in particular.

Dr. K.G. GUPTHA (Ph.D,IIT Bombay)
Professor & Head, Civil Engg.
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.
E-mail: kgg@gec.ac.in M:

Dr. Purnanand P. Savoikar
Ph. D. (IITB)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

I. INTRODUCTION

1.1. General

The Project, Block IV – Kalay Mineral Block, having an area of 152.5073 ha, of Fomento Resources Private Limited, is situated at Santona Village, Sanguem Taluka, South Goa District, Goa State. The Mineral Block is granted vide Letter of Intent (LOI) bearing No. DMG/25/Auction Cell/LOI-function/2023/2804 dated 13/01/2023, read with Letter dated 13/03/2023, bearing No. 03/18/2023/Major/Mines/3286, subsequent to e-auction process carried out by the State Government of Goa through Directorate of Mines and Geology. The total Reserves and Resources of the Project are 16.731 Million Tonnes and the proposed production is 0.75 Million Tonnes Per Annum of Iron Ore. The Project Proponent proposes to commence the mining operation after obtaining all the necessary permissions and after the execution of the Mining Lease Deed.

Ministry of Environment Forest and Climate Change (MoEF & CC) has granted Terms of Reference (ToR) to Fomento Resources Private Limited by the vide ToR Identification No. TO23B0000GA5122365N dated 08/01/2024, to undertake a detailed EIA/EMP study subject to the conditions stipulated therein.

In order to comply with the two conditions stipulated in the TOR, the Project Proponent approached the Department of Civil Engineering, Goa Engineering College, Farmagudi, Goa, to carry out a systematic and scientific study in view of the stipulated TOR conditions mentioned below.

A. The Project Proponent needs to submit a detailed report on the engineering design for the garland drain, settling tank, and check dams and their efficacy through the recognized institution. The study should also include the per day silt load, settling velocity of the silt, and retention time required based on the annual rainfall with a provision to monitor the turbidity of the overflow from the siltation tank as well as monitoring of the turbidity into the drains.

B. The Project Proponent needs to explore the likelihood of river water entering into the mine pit below the RL of the HFL and the measures that are required to be taken for the prevention of seepage and in the event of seepage to drain out the water through settling

tank. PP also needs to submit the measures to be taken for the protection of the river in the vicinity of the mine lease area due to mining activity.

Site visit for field investigation at the Project site was carried out along with the representatives of Fomento Resources Private Limited on December 26, 2023, and January 31, 2024. During the visit, it was observed that the Project is situated in close proximity to River Kalay existing towards the Eastern side of the Mineral Block boundary. River Kalay exists at about 0.005 km flowing in the South to North direction. Further, a seasonal drainage exists within the Mineral Block flowing from in West to the East direction across the Mineral Block, ultimately joining the Kalay River. The details of the above as in ToR are further defined in the scope of the work as follows

1.2. Scope of Work

In alignment with the Terms of Reference (ToR) conditions and guided by the information provided by the Company's representatives, the study was designed to achieve the following objectives:

1. **Engineering Design Examination:** Conduct an in-depth analysis of the engineering design aspects of garland drains, settling tanks, and check dams within the project site. This involves a meticulous assessment of their effectiveness in countering erosion and sedimentation, ensuring compliance with engineering standards and regulatory requirements.
2. **Sediment Analysis:** Investigate and deliver a comprehensive report on the per-day silt load, settling velocity of the silt, and the required retention time. Emphasis is placed on establishing correlations with annual rainfall patterns, aiming for a scientific understanding that informs robust sediment management strategies.
3. **Turbidity Monitoring Framework:** Establish a monitoring framework for evaluating the turbidity of overflow from the siltation tank and the turbidity entering the drains. Ensure strict adherence to environmental regulations and standards, guaranteeing project operations remain within permissible turbidity limits.
4. **Environmental Impact Assessment:** Undertake a comprehensive study covering waste dumps and the entire 152.5073-hectare mining lease area. Assess and address potential environmental impacts, ensuring compliance with legal requirements governing mining operations within the specified region.
5. **Seepage Assessment:** Evaluate the likelihood of seepage from Kalay River into Block IV – Kalay Mineral Block. Conduct a scientific assessment considering hydrological and

Dr. K.G. GUPTHA (Ph.D,IIT Bombay)
Professor & Head, Civil Engg
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.
E-mail: kgg@gec.ac.in M: 9422061953

Dr. Purnanand P. Savoikar
Ph. D. (IITB)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

geological factors, ensuring strict compliance with environmental regulations to prevent adverse effects on the surrounding ecosystem.

6. **River Water Ingress Analysis:** Assess the potential entry of river water into the mine pit below the Reduced Level (RL) of the High Flood Level (HFL). Propose preventive measures against seepage and, in the event of seepage, outline strategies for draining out water through settling tanks.
7. **Comprehensive Project Report:** Prepare a detailed Project Report encompassing all relevant details in accordance with legal and regulatory requirements. This includes presenting findings, engineering designs, environmental impact assessments, and proposed mitigation measures. Strive for alignment with legal standards, ensuring transparency and accountability in project documentation.

1.3. Study Area

1.3.1. Project location and configuration

The Kalay Mineral Block, designated as Block IV and spanning an area of 152.5073 hectares, is strategically positioned in Santona Village, Sanguem Taluka, South Goa District, Goa State. This locale is precisely identified on Survey of India Toposheet No. 48I/3. The geographic context of the project is visually represented in **Fig. 1**, showcasing the location plan.

The spatial layout of the Project area extends across the core zone (Mineral Block Area) and the buffer zone (an area within a 10 km radius from the Mineral Block boundary), as depicted in the Toposheet presented in **Fig. 2.** The combined core and buffer zones constitute the comprehensive study area.

Accessibility to the Project is facilitated through a village road branching off the Sanvordem-Dharbandora State Highway (SH-7), navigable via Ambeudoc village. The State Highway, SH-7, is situated at an approximate aerial distance of 1.27 km from the boundary of the Mineral Block, ensuring efficient connectivity to the project site.

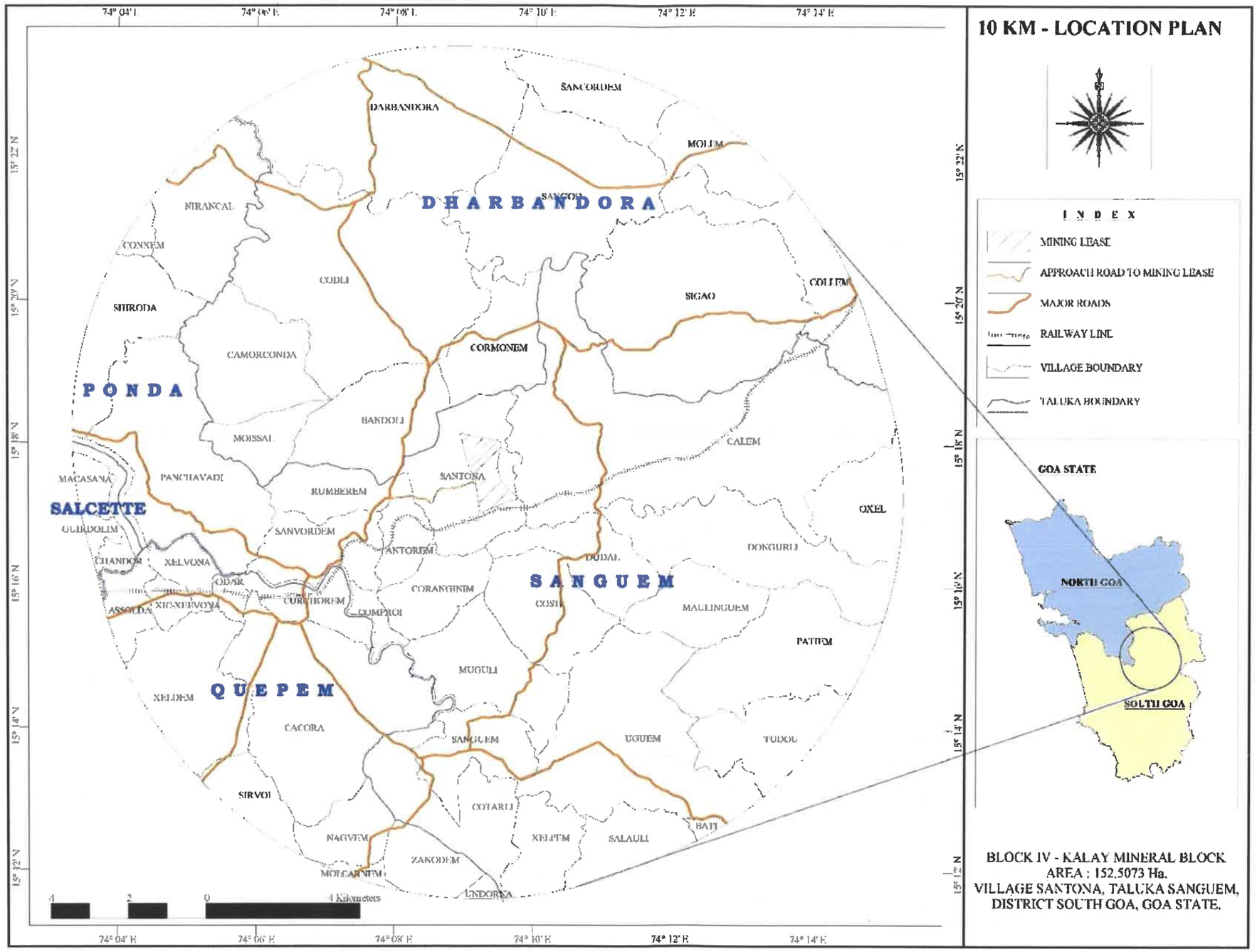


Fig. 1: Location Map

Dr. K.G. GUPTHA (Ph.D,IIT Bombay)
Professor & Head, Civil Engg.
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.
E-mail: kgg@gec.ac.in M: 9423061952

Dr. Purnanand P. Savoikar
Ph. D. (IITB)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

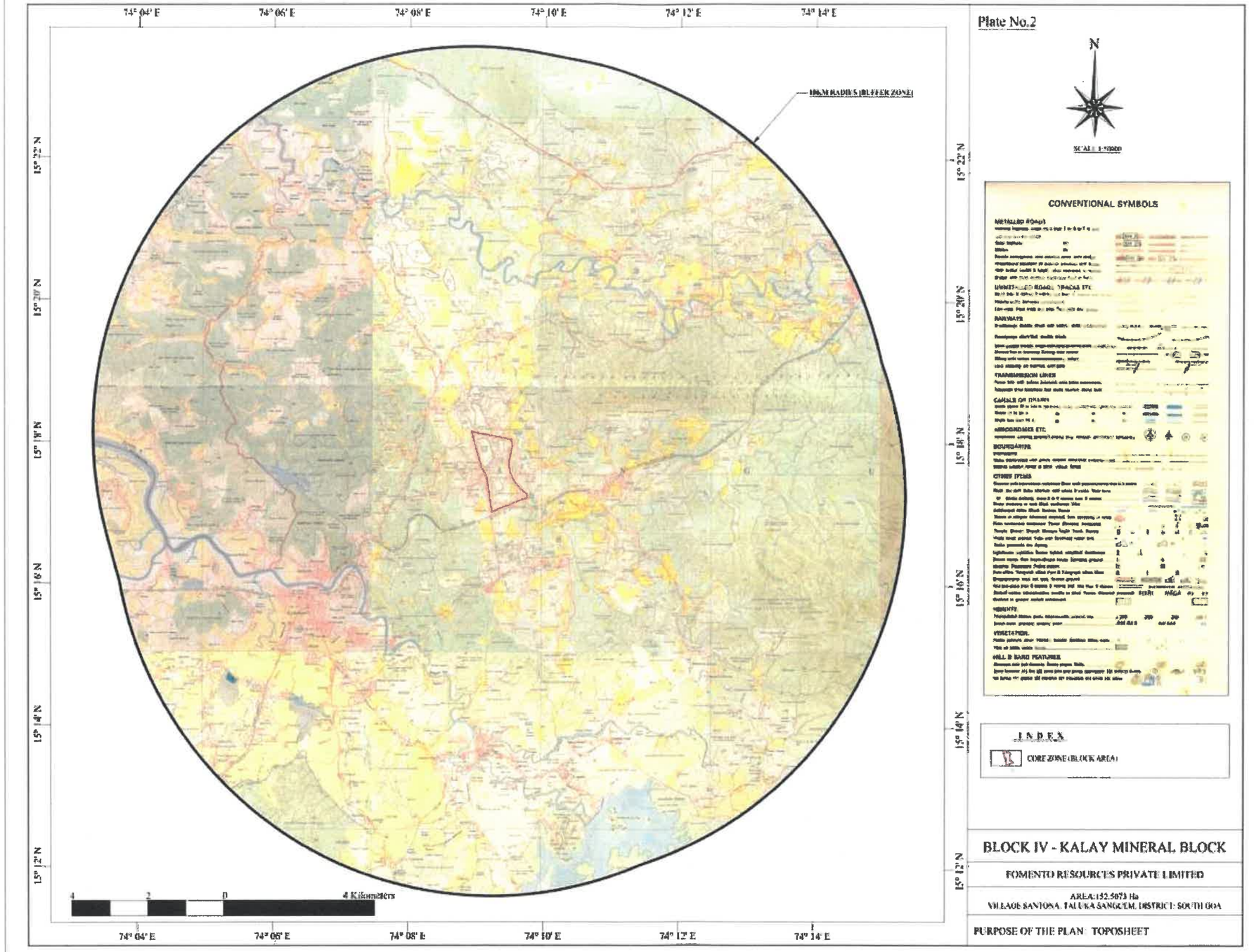


Fig. 2: Mineral Block Superimposed on Toposheet

Dr. K.G. GUPTHA (Ph.D,IIT Bombay)
Professor & Head, Civil Engg.
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.
E-mail: kgg@gec.ac.in M: 9422061953

Dr. Purnanand P. Savoikar
Ph. D. (IITB)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

DGPS coordinates of the Mineral Block boundary pillars are shown below in **Table 1.** The surface plan of the Mineral Block and Google Earth image Mineral Block superimposed with the Mineral Block boundary are shown in **Fig. 3 & 4** respectively.

Table 1: DGPS Co-ordinates of Mineral Block boundary

Pillar No.	Pillar Latitude (N) *(dd:mm:ss.ss)*	Pillar Longitude (E) *(dd:mm:ss.ss)*
BP 1	15° 17′ 58.2803″	74° 09′ 31.3905″
BP 2	15° 18′ 02.6197″	74° 09′ 29.8008″
BP 3	15° 18′ 08.7974″	74° 08′ 55.2583″
BP 4	15° 17′ 40.1839″	74° 09′ 03.3467″
BP 5	15° 17′ 30.9847″	74° 09′ 08.5955″
BP 6	15° 17′ 01.6125″	74° 09′ 13.1548″
BP 7	15° 17′ 12.4794″	74° 09′ 41.2969″
BP 8	15° 17′ 13.0200″	74° 09′ 44.8333″
BP 9	15° 17′ 16.8213″	74° 09′ 43.9885″
BP 10	15° 17′ 19.1419″	74° 09′ 40.8072″
BP 11	15° 17′ 23.3295″	74° 09′ 36.4971″
BP 12	15° 17′ 26.7696″	74° 09′ 33.4331″
BP 13	15° 17′ 30.5546″	74° 09′ 31.2826″
BP 14	15° 17′ 36.0551″	74° 09′ 29.0348″
BP 15	15° 17′ 40.9091″	74° 09′ 28.2686″
BP 16	15° 17′ 44.5813″	74° 09′ 28.2599″
BP 17	15° 17′ 49.1710″	74° 09′ 29.2119″
BP 18	15° 17′ 54.4169″	74° 09′ 30.5870″

Datum: WGS84

Dr. K.G. GUPTHA (Ph.D,IIT Bombay)
Professor & Head, Civil Engg.
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.
E-mail: kgg@gec.ac.in M: 9422061953

Dr. Purnanand P. Savoikar
Ph. D. (IITB)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

Dr. K.G. GUPTHA (Ph.D,IIT Bombay)
Professor & Head, Civil Engg.
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.
E-mail: kgg@gec.ac.in M: 9422051953

Dr. Purnanand P. Savoikar
Ph. D. (IITB)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

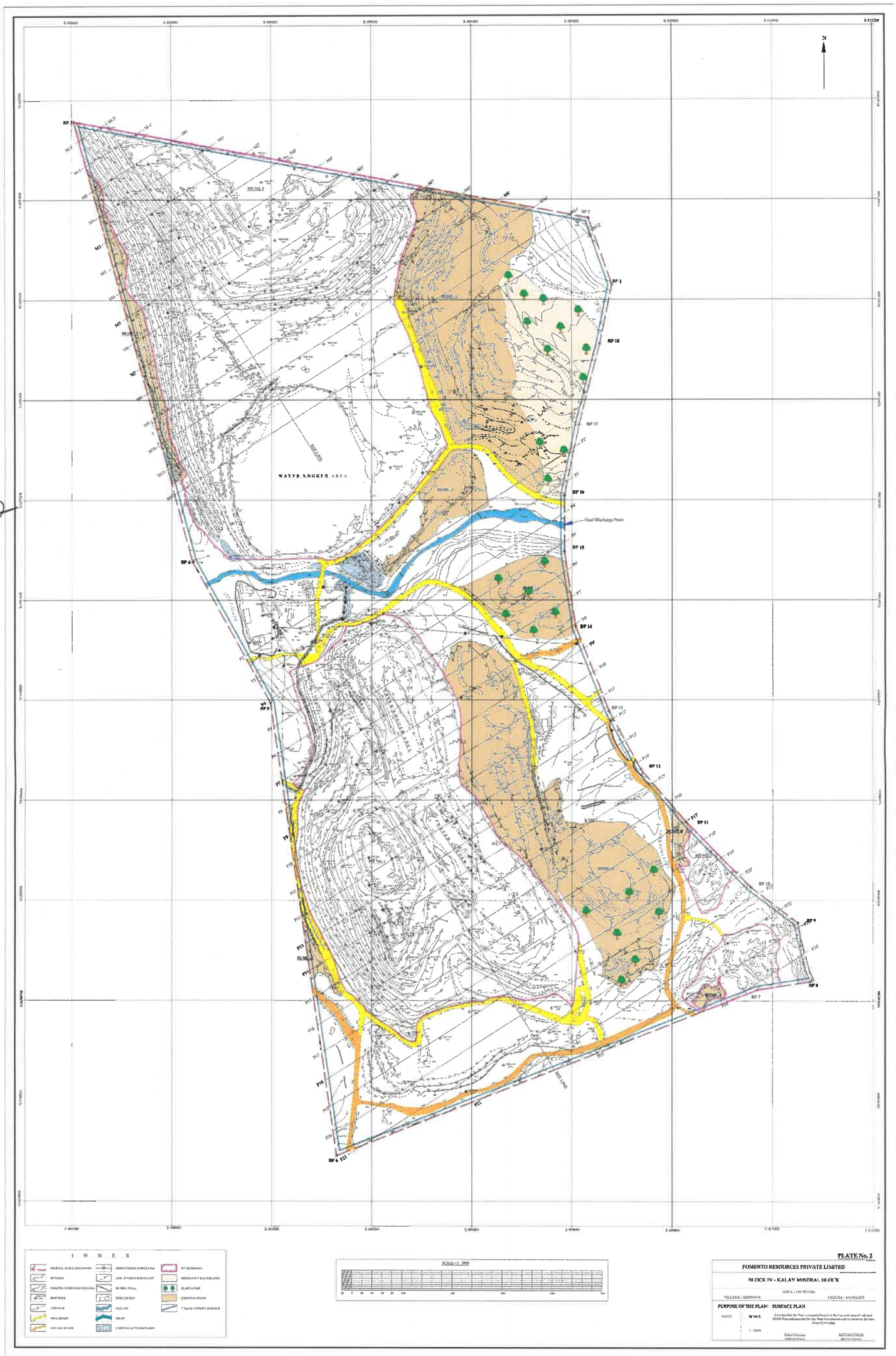


Fig.3: Surface Plan



Fig. 4: Mineral Block Superimposed on Google Earth image.

Dr. K.G. GUPTHA (Ph.D,IIT Bombay)
Professor & Head, Civil Engg.
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.
E-mail: kgg@gec.ac.in M: 9422061953

Dr. Purnanand P. Savoikar
Ph. D. (IIT B)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

II. GEOMORPHOLOGY, PHYSIOGRAPHY & DRAINAGE

2.1 Geomorphology

Geo-morphologically, the state is divided into four morphological units-

1. The coastal plains with dominant marine landforms on the west,
2. Vast etch plain,
3. Low dissected denudational hills with valleys,
4. Deeply dissected high Western Ghats with denudational hills rising to a maximum of 832m amsl and occurring all along the eastern part of the state.

The 10km buffer zone comprises the stretched low-lying plains, hills, and valleys along with the deeply dissecting high Western Ghats with denudational hills. Many first-order streams originate from the hilltop downwards forming a dendritic drainage pattern. The geomorphology of the area is shown in **Fig. 5**.

2.2 Physiography

The 10km buffer zone of the study area comprises the stretched low-lying plains, hills, and valleys along with the deeply dissecting high Western Ghats with denudational hills. Many first-order streams originate from the hill top downwards forming a dendritic drainage pattern.

The topography of the area is undulating & hilly with a gentle gradient of 10 to 20 degrees towards the East. The highest level is 102 m MSL towards the North East of the lease on Dump no. 1 and the lowest level is -0.5 m MSL towards the North of the lease in pit no.3. There is a seasonal drain/nalla flowing across the block from west to east and joins river Kalay River flowing towards the eastern side of the block boundary.

Dr. K.G. GUPTHA (Ph.D,IIT Bombay)
Professor & Head, Civil Engg.
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.
E-mail: kgg@gec.ac.in M: 9422061953

Dr. Purnanand P. Savoikar
Ph. D. (IITB)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

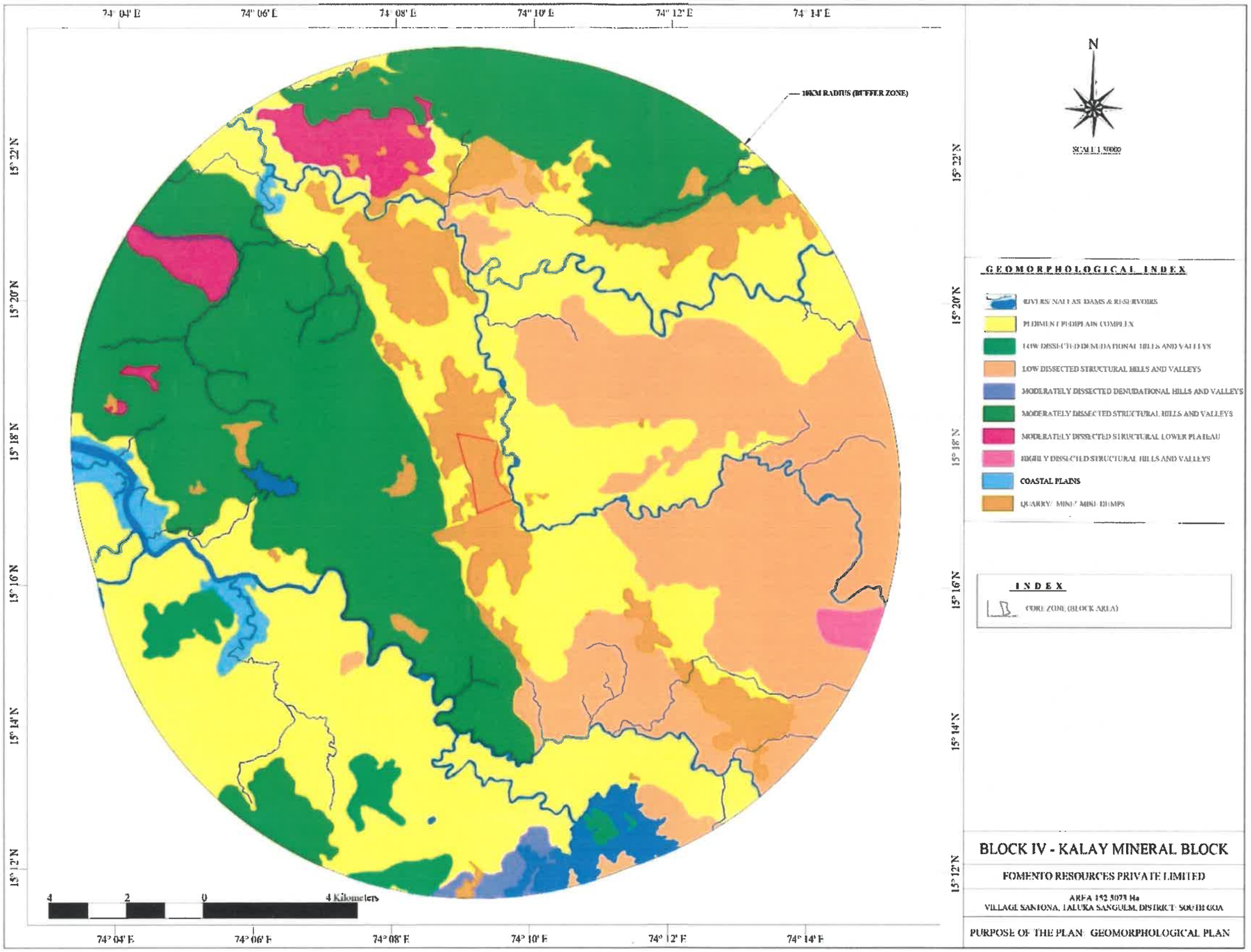


Fig 5: Mineral Block Superimposed on Geomorphology Map

Dr. K.G. GUPTHA (Ph.D,IIT Bombay)
Professor & Head, Civil Engg.
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.
E-mail: kgg@gec.ac.in M: 9422061953

Dr. Purnanand P. Savoikar
Ph.D (IISc)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

2.3 Drainage

The regional drainage system in the 10km buffer zone is notably dendritic, marked by first-order streams originating from hilltops. These streams contribute to major river systems such as the Uguem River, Sanguem River, Khushavati River, Dhudsagar River, Kalay River, and Mahadayi River. The distance and direction of River/ Stream/Nalla within the study area is presented in **Table 2**. The primary drainage focal point for the mineral block is the Kalay River flowing from south to north. A basin map showing the drainage pattern of the study area is shown in **Fig. 6**. Also a second-order seasonal drain/ nalla flows from the northwest of the block towards due south and passes across the block from west to east, ultimately joining to the Kalay River existing on the eastern side of the block.

Table 2: Distance & Direction of River/ Stream/Nalla within the 10km radius

Name of the River /Stream / Nala	Distance from Project Site (Km)	Direction from Project Site
Uguem River	5.6	South
Sanguem River	5.71	South
Khushavati river	8.63	West
Zuari River	3.8	Southwest
Dhudsagar River	4.0	North
Kalay River	0.005	East
Mahadayi River	4.3	North
Salaulim	7.83	South
Moisal	4.23	West

Dr. K.G. GOVEKAR (Ph.D,IIT bombay)
Professor & Head, Civil Engg.
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.

Dr. Purnanand P. Savoikar
Ph. D. (IITB)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

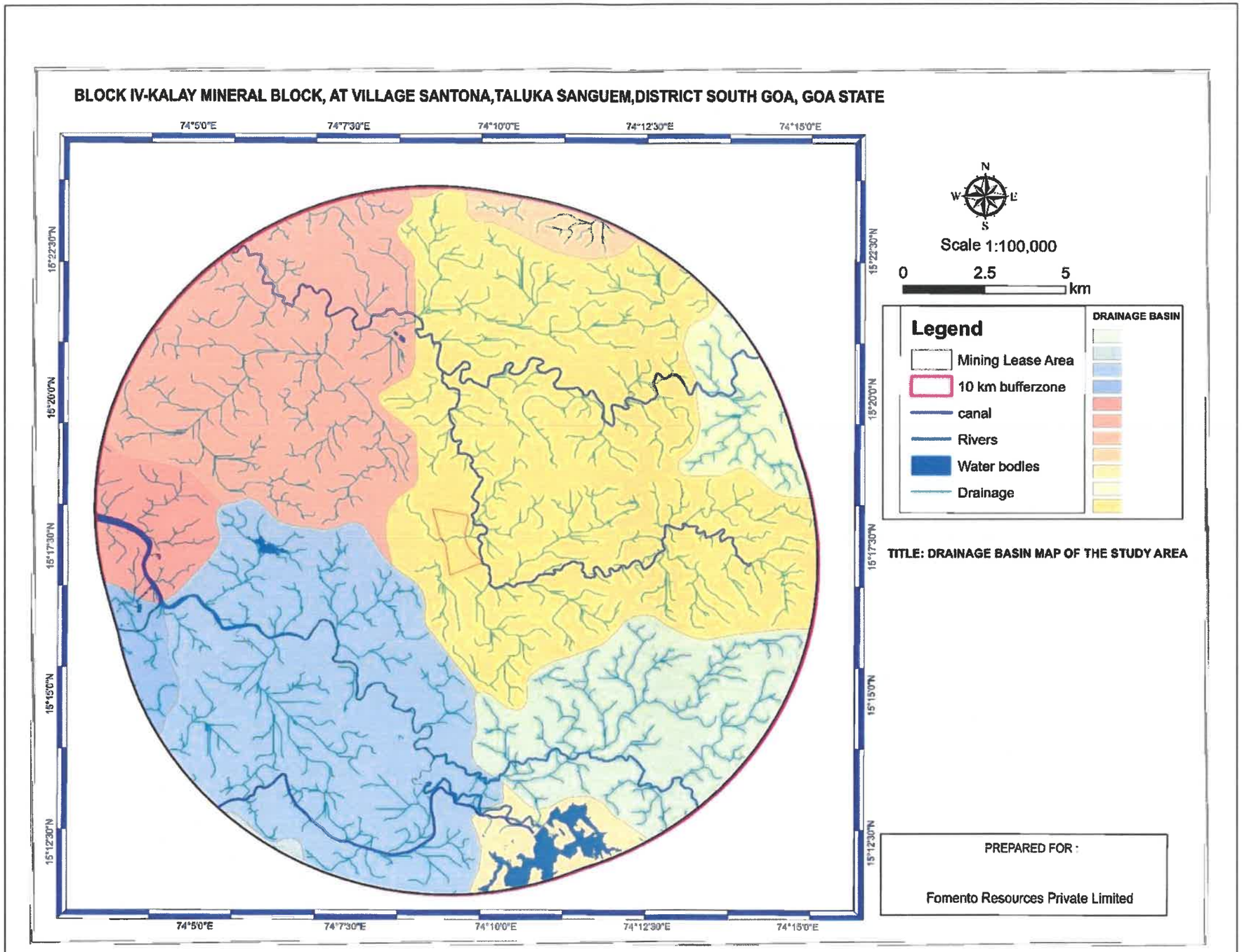


Fig. 6: Drainage Basin Map

Dr. K.G. GUPTHA (Ph.D,IIT Bombay)
Professor & Head, Civil Engg.
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.
E-mail: kgg@gec.ac.in M: 9422061953

Dr. Purnanand P. Savoikar
Ph. D. (IITB)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

2.4 Land Use & Land Cover (LULC)

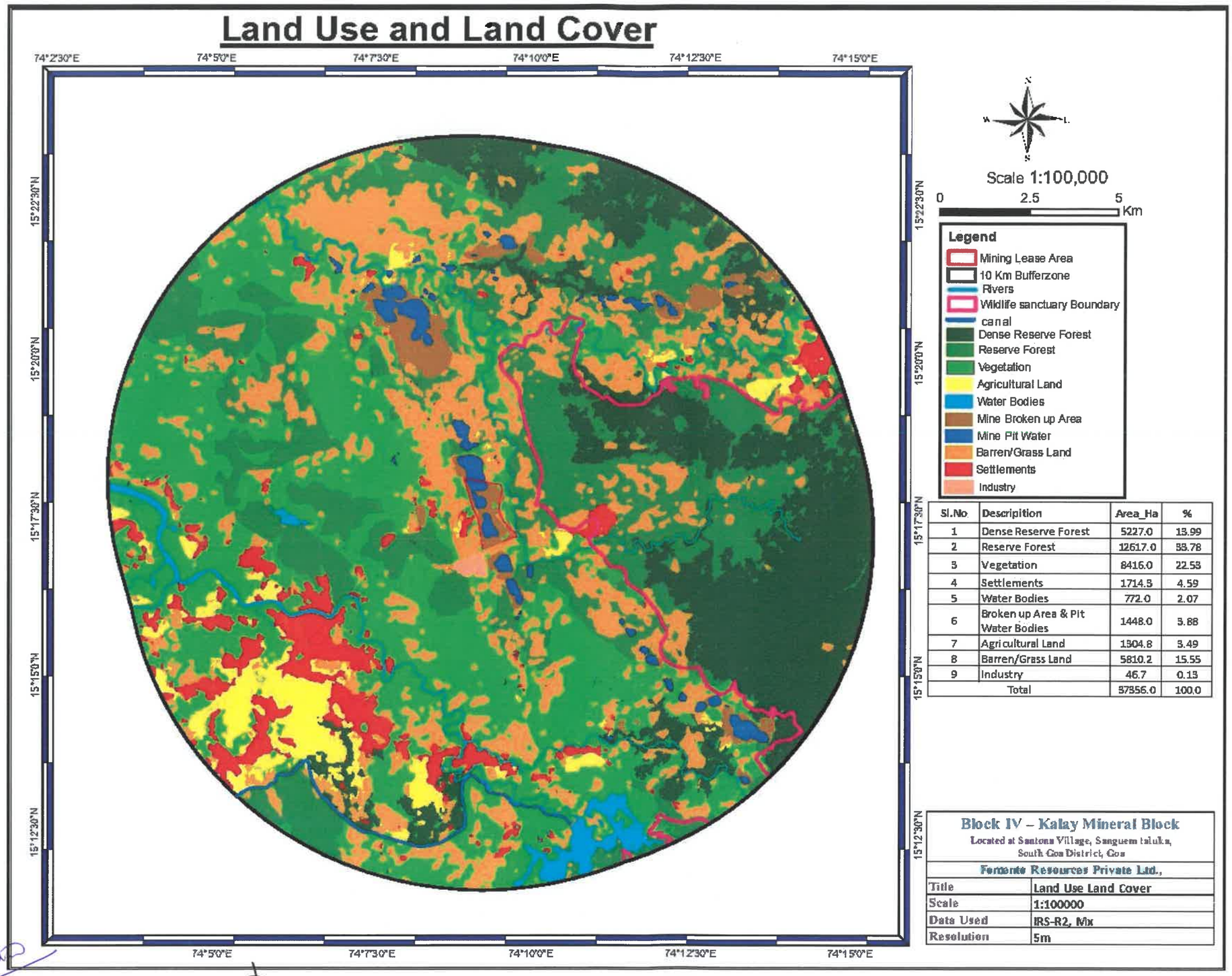
Land use land cover analysis, delineates the core and buffer area's characteristics. The core area primarily comprises mine-broken terrain and pits, accentuated by a seasonal drainage course. The residual land cover includes barren/grassland and vegetation. This delineation provides a foundation for understanding land utilization patterns within the mining lease area. Mineral Block superimposed on LULC map of the study area is shown in **Fig. 7**.

2.5 Digital Elevation Model

As per the Digital Elevation Model, the 10km study area from the mineral block boundary consists of undulation topography. The elevation within the buffer zone of the study area ranges from 640 m to 0 m above mean sea level (amsl). The highest elevation is towards the southeastern region while the minimum elevation is towards the south western and south portion of the study area. As observed in the field, the highest and lowest elevation of the mineral block area ranges from 102 m amsl to -0.5 m amsl. The Digital Elevation Model Map is shown in **Fig. 8**.

Dr. K.G. GUPTHA (Ph.D,IIT Bombay)
Professor & Head, Civil Engg.
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.
E-mail: kgg@gec.ac.in M: 9422061953

Dr. Purnanand P. Savoikar
Ph. D. (IITB)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi, Ponda Goa 403401



Sl.No	Descripition	Area_Ha	%
1	Dense Reserve Forest	5227.0	13.99
2	Reserve Forest	12617.0	33.78
3	Vegetation	8416.0	22.53
4	Settlements	1714.3	4.59
5	Water Bodies	772.0	2.07
6	Broken up Area & Pit Water Bodies	1448.0	3.88
7	Agricultural Land	1304.8	3.49
8	Barren/Grass Land	5810.2	15.55
9	Industry	46.7	0.13
Total		37356.0	100.0

Fig. 7: LULC Map

Dr. K.G. GUPTHA (Ph.D,IIT Bombay)
Professor & Head, Civil Engg.
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.
E-mail: kgg@gec.ac.in M: 9422061953

Dr. Purnanand P. Savoikar
Ph. D (IITB)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

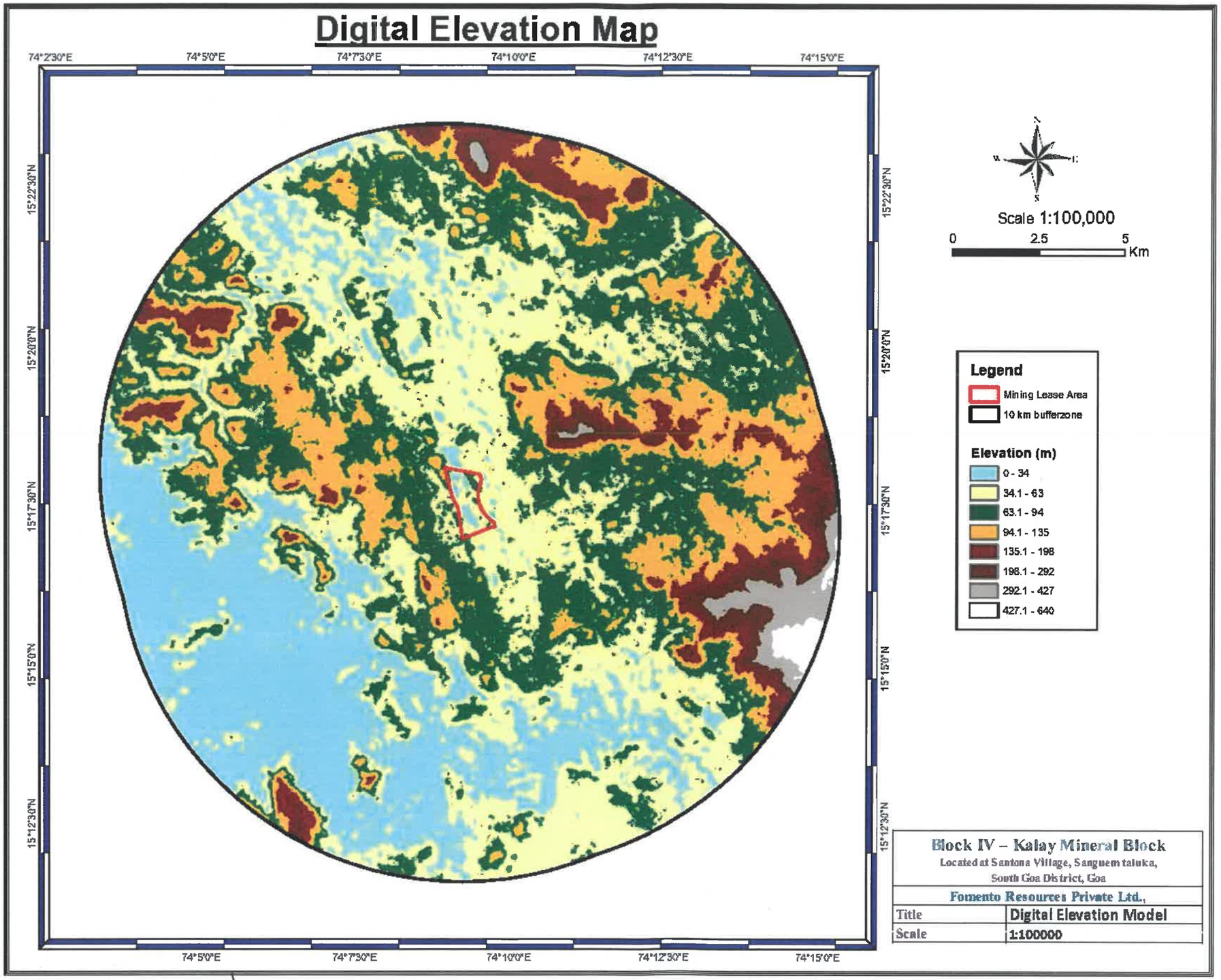


Fig. 8: Digital Elevation Map

Dr. K.G. GURTHA (Ph.D,IIT Bombay)
Professor & Head, Civil Engg.
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.
E-mail: kgg@gec.ac.in M: 9422061952

Dr. Pramanand P. Savoikar (IIT)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

III. GEOLOGY

3.1 Regional Geology

The geological composition of Goa is predominantly characterized by the Goa Group, a part of the Dharwad Super Group, spanning the Archaean to Proterozoic age. However, a narrow strip in the northeastern sector is occupied by the Deccan Trap, dated from Upper Cretaceous to Lower Eocene. The Iron ore formations within Goa belong to the Archaean-Proterozoic age of the Dharwad super group. The Goa Group comprises four formations in ascending order: Barcem Formation, Sanvordem Formation, Bicholim Formation, and Vageri Formation. The disposition of these rocks exhibits an NW-SE orientation in northern, central, eastern, and southern Goa, while in South Goa, it aligns in an E-W direction. The rocks have undergone at least three generations of folding, with varying degrees of intensity and expression observed across different locations. The Bicholim formation is very important from the commercial point of view, as it contains all the iron and manganese ore deposits of the study region, being the treasure house and backbone of Goa's economy.

The Bicholim formation overlies the Sanvordem formation in conformity and it includes quartz-sericite schist and phyllite with BIF rock formations (Gokul et al., 1985). The formation extends in a general NW-SE portion of the watersheds. The banded iron formation (BIF) consists of two sub-facies - the haematite sub-facies and the magnetite sub-facies, both of which show an inter-digitated relationship. The hematite sub-facies predominate in the north western and central parts (from Advalpal to Dharbandora) of the State whereas the magnetite sub-facies are largely confined to the central and the south eastern part.

Dr. K.G. GUPTHA (Ph.D,IIT Bombay)
Professor & Head, Civil Engg.
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.
E-mail: kgg@gec.ac.in M: 9422061959

Dr. Purnanand P. Savoikar
Ph. D. (IITB)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi, Ponda Goa 403401

Table 3: The Stratigraphic Succession of the Goa Group

Recent to sub recent	Sea Sand and Laterite
Deccan Trap	Basalts
Basic Intrusive	Dolerite, Gabbro
Acid Intrusive	Pegmatite, vein quartz, Porphyritic Granite, Hornblende Granite, Felspathic Gneiss, Granite Gneiss
Vageri Formation	Meta-basalt, Meta-greywacke
Bicholim Formation	Banded Ferruginous Quartzite, Manganiferous Chert Breccia with Pink Ferruginous Phyllite, Limestone, Pink Ferruginous Phyllite, Qzt-Chlorite-Amphibole Schist
Sanvordem Formation	Argillite, Quartzite, Tilloid, Metagreywacke
Barcem Formation	Metagabbro, Peridotite, Talc-Chlorite Schist, Variegate Phyllite, Quartz-Chlorite Schist, Quartzite, Quartz-Sericite Schist, Red Phyllite Quartz Porphyry, Massive, Schistose & Vesicular Metabasalt

3.2 Geology of the Mineral Block

The mineral block, part of the Codli-Kirlapal-Costi deposit, showcases a stratigraphic succession from top to bottom:

1. Laterite (15 – 20 m): Predominant capping layer.
2. Altered Dyke (Intrusive): Intrusive igneous feature.
3. Ferruginous/Phyllitic/Limonitic Clay (10 – 15 m): Comprising altered clay formations.
4. Iron Ore Body (20 - 30 m): Main iron ore deposit.
5. Siliceous Manganiferous Clay & Weathered BHQ: Forms footwall.

The majority of the lease area is impacted by mining activities, while the remaining portion is covered with laterite. Exposed rocks and borehole data indicate the folding of the ore body and associated rocks. Structurally, the ore body exhibits folding, presenting anticlines and synclines with easterly and westerly dips ranging from 10° to 40°. The ore body plunges southward at an average angle of 5° to 10°. The preserved synclinal portions contrast with eroded anticlinal sections. The ore body is approximately 2000 m in length, 300 to 400 m in width, and 20 to 30 m in average thickness. Igneous activity has resulted in the presence of weathered and altered sills and dykes in the form of clays along and across the ore body.

The iron ore deposit is strati form and tabular, exhibiting a regular habit. Surface characteristics include a lumpy texture, transitioning to a powdery consistency at depth. According to the Geological Report from the Directorate of Mines & Geology, Goa, the iron ore displays a hardness ranging from hard to powdery, with a fines-to-lumps ratio typically around 73% fines and 27% lumps, subject to variations between 75-70% fines and 25-30% lumps.

3.3 Soil Characteristics

The soil classification within the district reveals four primary types: lateritic soil, saline soil, marshy soil, and alluvial soil. Within the mining lease area, the dominant soil type aligns with lateritic classification, characterized by high porosity and permeability, slightly acidic pH values, and low organic matter, calcium, and phosphorus content.

Dr. K.G. GUPTHA (Ph.D,IIT Bombay)
Professor & Head, Civil Engg.
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.
E-mail: kgg@gec.ac.in M: 9422063953

Dr. Purnanand P. Savoikar
Ph. D. (IITB)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

IV. CLIMATE

4.1 Hydrometeorology in general

A detailed exploration of climatic parameters in South Goa reveals a tropical climate with nuanced variations. The district experiences a significant annual rainfall ranging from 2701 mm to 4100 mm, with monsoon months contributing around 90% of the total rainfall. Temperature variations exhibit distinct seasonal patterns, with the coolest temperatures observed in January and the hottest in May. Relative humidity remains notably high, especially during the monsoon season, and prevailing winds demonstrate a directional shift based on seasonal influences.

4.2 Climatic details of South Goa (Extracted from IMD-Goa)

State of Goa is part of the west coast region of India. Geographically the district has mainly three natural divisions namely Low land, the plateaus, and the Mountain region. South Goa district of Goa state covers the entire southern part of Goa. The Arabian Sea is to the west of the district, the North Goa district is to the North, and Uttar Kannada district of Karnataka in the East and South, Sahyadri mountains are to the east of South Goa. The climate of South Goa is generally hot as it lies within the tropics. Generally, the year may be divided into four seasons. The period from March to May is of pre-monsoon season followed by the southwest monsoon from June to September. The rainfall is more in the mountainous region than in the coastal region. The period from October to December constitutes the post-monsoon season or transition period between the monsoon and winter season. The period from January to February is the winter or cold season.

4.3 Rainfall

Records of rainfall in the district are available for seven rain gauge stations for the period 10 years ranging from 2013-14 to 2022-23 years. The details of rainfall for these stations and the district as a whole are annexed as Annexure-A The average annual rainfall in the district is 3394.2 mm. Rainfall varies from place to place due to topographic variation in the district. However, rainfall increases towards the northern part of the district. Months from June to September comprises of southwest monsoon season, is a chief rain-bearing period which constitutes about 90% of the annual

rainfall. July is the rainiest month in the year with an average rainfall of about 1128.0 mm. During the period of October to February the district receives only about 6% of the annual rainfall.

During the period 1961- 2010, the highest annual rainfall occurred in the year 1961 when it amounted to 138% of the normal. However, the lowest annual rainfall was 48% of the normal occurred in 1972. In this period there were 15 years in which the rainfall was less than 80% of the normal and such a low rainfall occurred in two consecutive years twice and three consecutive years once. On average, there are about 103 rainy days (i.e. days with rainfall of 2.5 mm or more) in a year in the district.

4.3.1 Behaviour of Monthly Rainfall

Average month-wise rainfall data collected at Sanguem Taluka during 30 years (1991-2021) is compiled and presented below in **Table 4** and its graphical representation is shown in **Fig. 9** (Source: https://https://en.climate- data.org/asia/india/goa/sanguem-796290/).

Table 4: Average monthly Rainfall at Santona (1991-2021) at Sanguem Taluka

Normal Rainfall (mm) & Normal Rainy days at Sanguem Taluka, South Goa District, Goa (1991-2021)		
Month	**Rainfall (mm)**	**Rainy days(d)**
January	2	0
February	1	0
March	17	2
April	27	5
May	104	9
June	680	20
July	1006	22
August	692	22
September	322	19
October	214	14
November	48	5
December	10	1
Total	**3123**	**119**

Dr. K. G. GUPTHA (IIT Bombay)
Professor & Head, Civil Engg.
Govt. of Goa

Dr. Purnanand D. Savoikar
Ph. D. (IITB)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

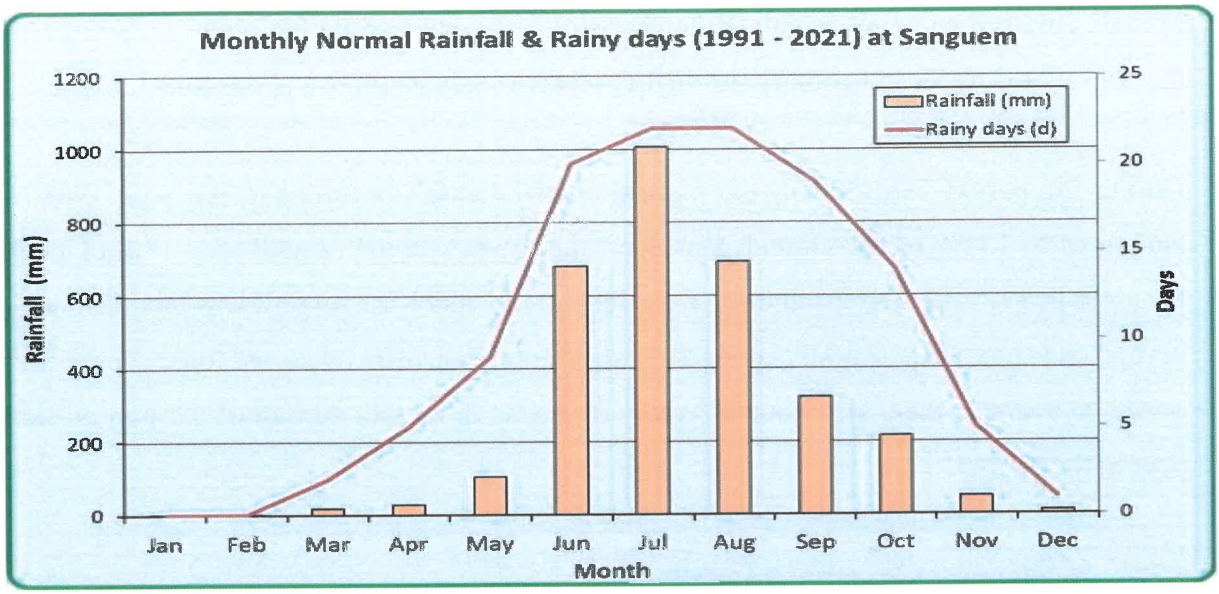


Fig. 9: Average Month-wise Rainfall for a 30-year period Santona Village, Sanguem Taluka

In general, the area experiences rainfall from May to October, and remaining months it is almost nil. A negligible amount of rainfall occurs during January, February, March, April, November, and December months. Bulk i.e., 96% of the annual rainfall occurs during monsoon months i.e. from June to September months.

The monthly normal rainfall recorded for the Block IV – Kalay Mineral Block for the period 2019-23 is presented in **Table 5** and graphically represented in **Fig. 10**.

Table 5: Monthly Rainfall Data Recorded at Santona Village (2019-2023)

Table-4: Monthly rainfall data for the last 10 years at Block IV – Kalay Mineral						
Month	**2019**	**2020**	**2021**	**2022**	**2023**	**Average**
January	0	0	27.6	0	0	5.52
February	0	0	16.2	0	0	3.24
March	0	0	0	0	0	0
April	1.2	9.2	46.4	84	5.6	29.28
May	0	83.4	335.1	110	57.8	117.26
June	790	819.6	1046.9	595.2	566.4	763.62
July	1808.8	1142.6	1412.82	1600	2062	1605.24
August	1702.4	1507.8	398	451	364.2	884.68
September	823	808.32	485.1	403.2	541.1	612.144
October	610.8	229	253.3	256	174.7	304.76
November	30.8	0	226.2	8.4	0	53.08
December	0	28.2	33.4	9.2	0	14.16
Total	**5767**	**4628.12**	**4281.02**	**3517**	**3771.8**	4392.99

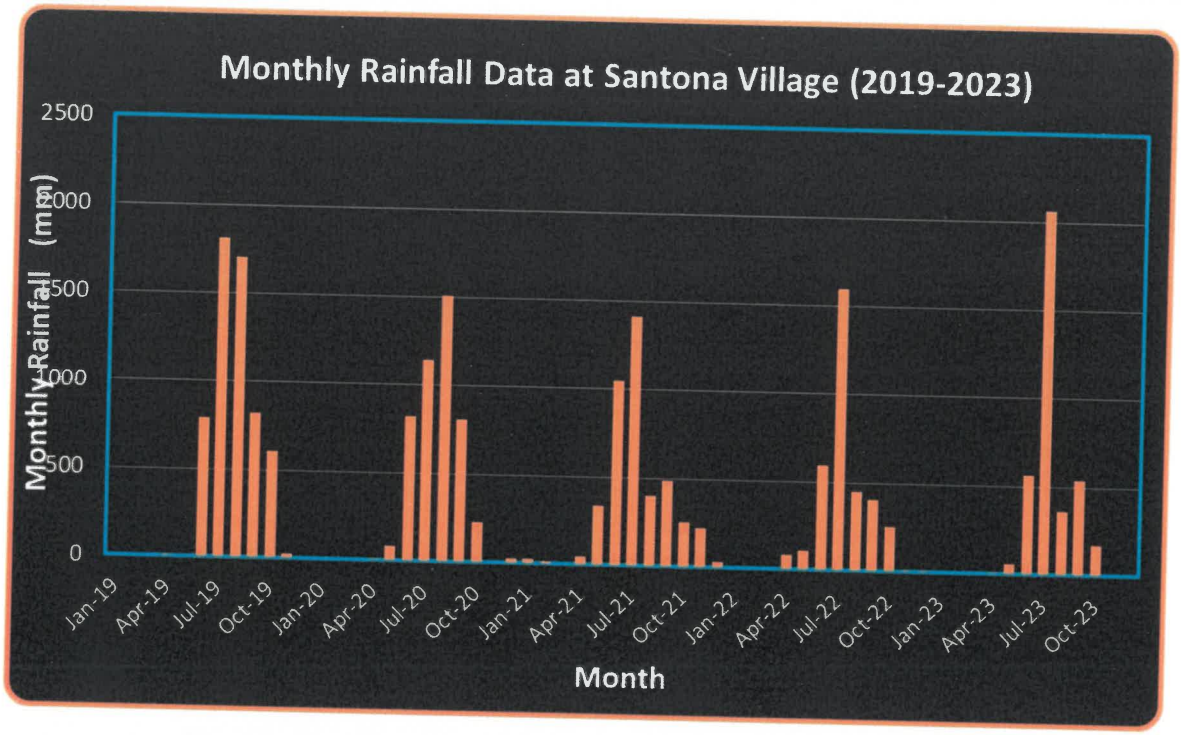


Fig. 10: Monthly distribution of rainfall at Santona Village

4.3.2 Behaviour of Annual Rainfall

The annual rainfall is studied for the period from 2019 to 2023 at Block IV – Kalay Mineral Block, Santona Village. It ranges from 3715 mm in 2022 to 5767 mm in 2019. The average annual rainfall for this period works out to be 4393 mm. The distribution of annual rainfall is presented in **Table 4** and Annual rainfall is presented in **Fig. 11**.

Dr. K.G. GUPTHA (Ph.D.IIT Bombay)
Professor & Head, Civil Engg.
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.
E-mail: kgg@gec.ac.in M: 9422063137

Dr. Purnanand P. Savoikar
Ph. D. (IITB)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

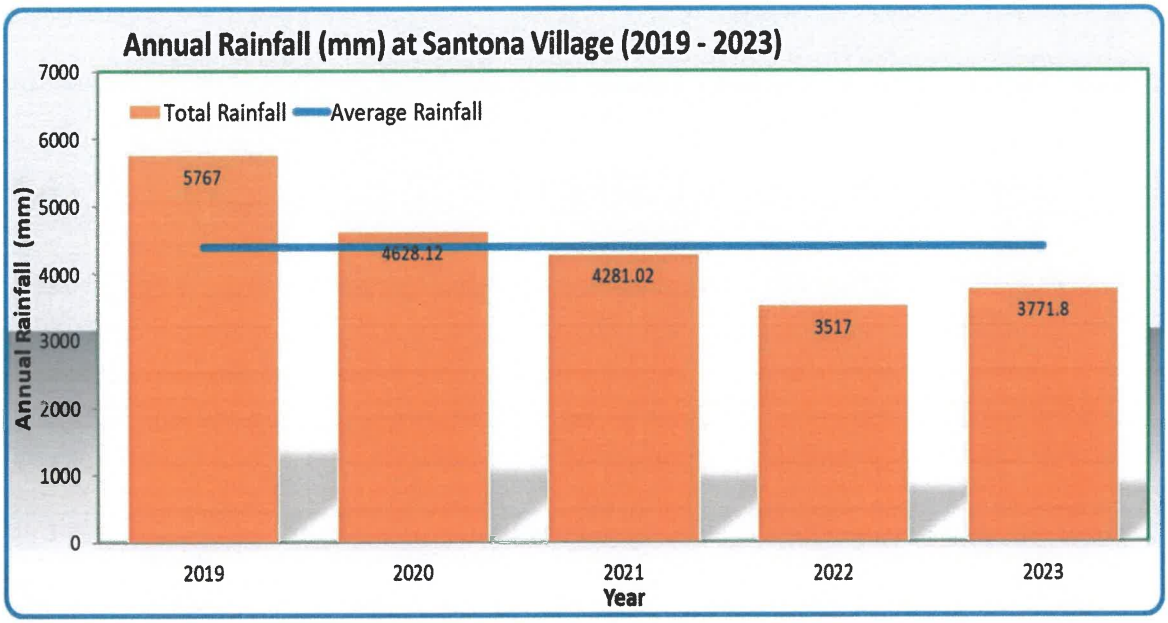


Fig. 11: Annual distribution of rainfall at Santona Village

4.4 Temperature

The study area experiences hot summer and mild winter. November to February is generally the pleasant climate and in December the mean temperature is lowest. The mean maximum temperature is around 33.2°C during May. The average monthly low temperature is around 28.2°C during May, which decreases to around 24.8°C during August. Graph showing monthly minimum and maximum temperature is given in **Fig.12**.

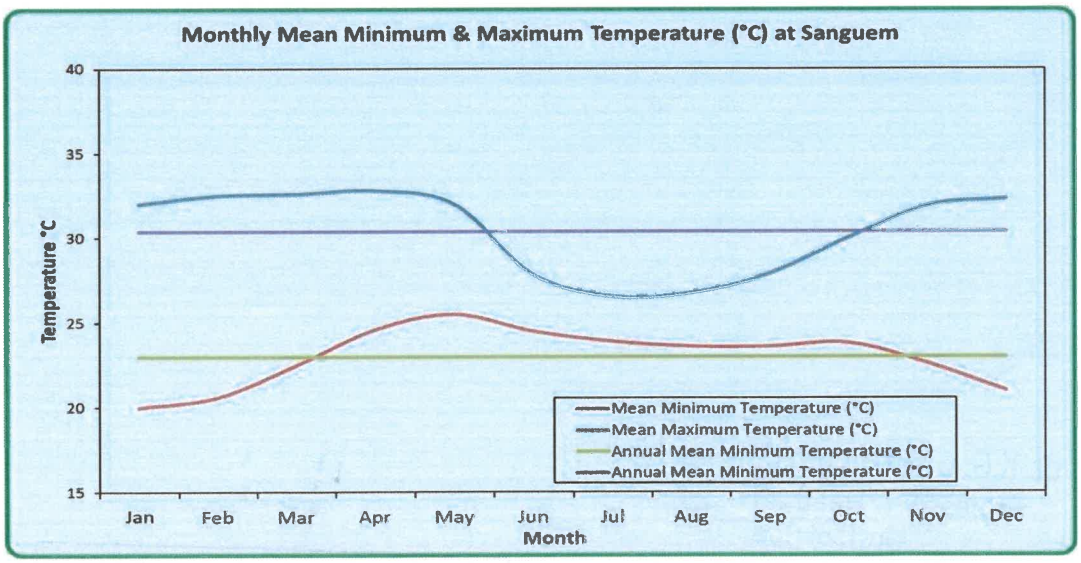


Fig. 12: Monthly Mean Minimum and Maximum temperatures at Sanguem Village

4.5 Humidity

Owing to the proximity of the sea, the district is on the whole very humid. Humidity is generally about 79 % in the morning and about 75% in the afternoon throughout the year. The relative humidity is the highest in the monsoon season when it is about 89% in the morning and about 85% in the afternoon. November to April period is slightly less humid with morning humidity at about 73% and afternoon humidity of about 67%.

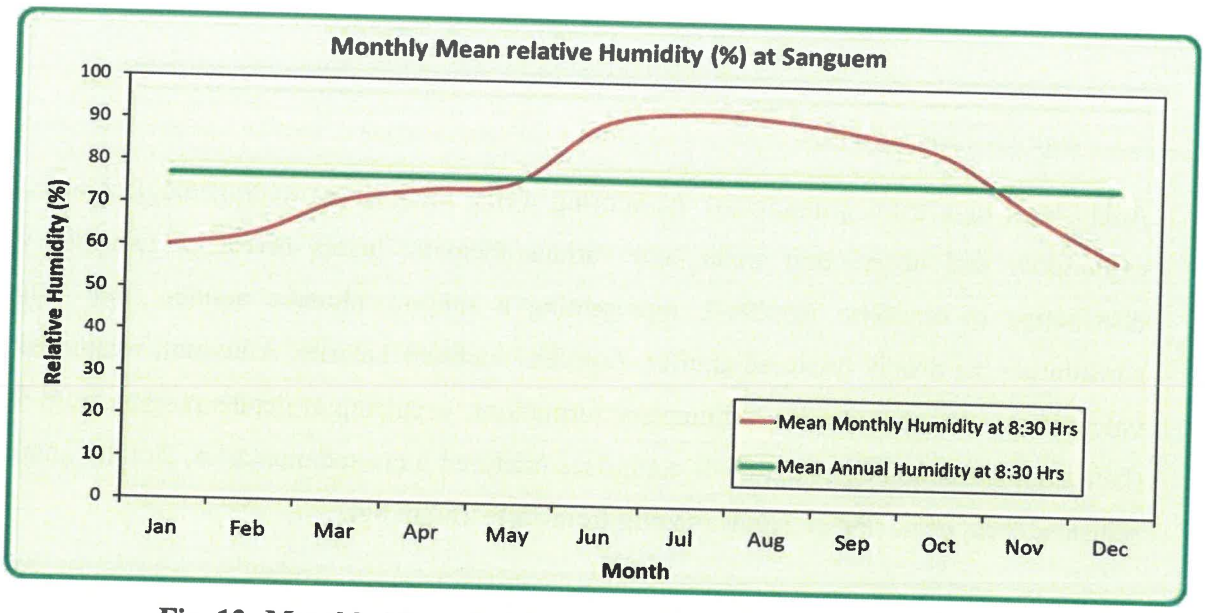


Fig. 13: Monthly Mean Relative Humidity (%) at Sanguem Taluka

In Sanguem Taluka, Relative Humidity is around 90% during rainy season. It ranges from 60% during January and December to attain maximum 93% during July. Its graphical representation is shown in **Fig.13**

4.6 Hydro-Geological Information

In the geological context of Goa, approximately 95% of the region is dominated by hard rock formations such as laterites, granite, granitic gneiss, meta-volcanic, meta-sedimentaries and basalts. The water storage and yielding capacities within these hard rock aquifers, measured through specific yield and storability, are relatively lower compared to soft aquifers. The occurrence and movement of groundwater are primarily influenced by weathering, fracturing, and the

Dr. K.G. GUPTHA (Ph.D,IIT Bombay)
Professor & Head, Civil Engg.
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.
E-mail: kgg@gec.ac.in M: 9422004...
Dr. Purnanand P. Savoikar
Ph. D. (IITB)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

geomorphological setup of the state. The lithological diversity results in nine major aquifers due to distinct geological formations.

Laterites, covering over 60% of the area, are identified as the most significant water-bearing formation. Metavolcanics formations, located in parts of Sanguem, Quepem, and Canacona talukas of South Goa district, exhibit water-bearing properties dependent on the degree of fracturing, jointing, and foliation present in the rocks.

4.7 Aquifer Description

Analysis of data from groundwater monitoring wells, micro-level hydrogeological inventories, exploratory and observation wells, and various thematic layers reveals a two-fold vertical distribution of aquifers: Aquifer-I, representing a shallow phreatic aquifer, and Aquifer-II, constituting the deeply fractured aquifer. Aquifer-I includes Laterite, Alluvium, weathered meta-volcanic, and weathered meta-sedimentary formations, occurring at depths ranging from 9-42 m (below ground level) bgl. Aquifer-II comprises fractured meta-sedimentaries, Granite gneiss, and schistose rock, occurring at depths ranging from 25 to 180 m bgl.

This nuanced scientific exploration integrates geological, topographical, climatic, and hydrological facets, providing a comprehensive understanding of the intricate dynamics within 'Block IV – Kalay Mineral Block.' The integration of scientific principles enhances the precision and depth of the study, laying a robust foundation for further assessments and informed decision-making in the context of resource utilization and environmental management.

4.8 Surface Water Quality Analysis

A surface water quality report was used while conducting a comprehensive and detailed examination of the engineering design aspects of protective measures such as garland drains, settling ponds, check dams, existing with the Mineral Block.

V. METHODOLOGY ADOPTED

5.1 General

In the pursuit of our objectives, diverse methodologies were employed in this investigation. A meticulous field study was executed in the designated area, focusing on comprehending the current state of the Mineral Block and assessing the functionality of various structures, including garland drains and settling ponds. The fieldwork encompassed an evaluation of the efficacy of the structures positioned at the western side of the River existing within the Mineral Block and, an examination of the soil composition in the study zone, and an assessment of measures to be implemented for sediment retention.

Verification of bed orientation, lithology within the project area, and scrutiny of mining plan cross-sections were conducted to gain insights into the geological characteristics. Preparation of drainage basin **Fig. 6** and land use land cover maps **Fig. 7** in the buffer zone facilitated an understanding of surface runoff, aiding in the strategic planning of garland and settling ponds.

Two site visits were conducted on December 26, 2023, and January 31, 2024, in the study area near the Kaley River, adjacent to the Mineral Block, significantly enhancing our fieldwork dataset. Essential information, including daily rainfall data within the Mineral Block, High Flood Level (HFL), and river depth of Kalay River was gathered from the Project Proponent. Information regarding suspended sediment load was collected from a comprehensive monthly surface water analysis report.

The site visit was conducted on December 26, 2023, and January 31, 2023, wherein the entire Mineral Block area as well as the area near Kalay River existing adjacent to the Mineral Block was studied, significantly enhancing our fieldwork dataset thorough assessment was made of the existing condition of the settling ponds, garland drains, check dams, etc., along with other essential information including High Flood Level (HFL) and river depth. Daily rainfall data were acquired from rain gauge stations strategically positioned within the Mineral Block. Additionally, water sample data analyzed was obtained from selected locations within the study area from the project proponent. Daily suspended sediment load was extracted from the comprehensive monthly surface water analysis report. This comprehensive analysis aims to provide insights into the overall condition of the study area and facilitate the formulation of future measures to effectively contain

Dr. K.G. GUPTHA (Ph.D,IIT Bombay)
Professor & Head, Civil Engg.
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.
E-mail: kgg@gec.ac.in M: 94

Dr. Purnanand P. Savoikar
Ph. D. (IITB)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

sediment runoff into natural water bodies. All pertinent observations and data were carefully documented for further analysis and consideration in this study. Accordingly, the ToRs (Page 1) A and B are addressed as follows:

5.2 Results and Discussions

The results are discussed based on the scope of the objectives framed on ToRs. The First ToR is:

A. Preparation of a detailed report on the engineering design for garland drain, settling tank, and check dams and their efficacy through recognized institutions. The study should also include the per day silt load, settling velocity of the silt, and retention time required based on the annual rainfall with a provision to monitor the turbidity of the overflow from the siltation tank as well as monitoring of the turbidity into the drains.

5.2.1 General

Block IV-Kalay Mineral Block, spanning 152.5073 hectares, is characterized by a hilly topography, featuring a gentle gradient ranging from 10 to 20 degrees towards the East. The highest elevation within the Block is recorded at 102 meters above Mean Sea Level (MSL) on Dump No. 1, located in the North East section of the Block. In contrast, the lowest elevation is -0.5 meters MSL towards the North of the Block in Pit No. 3.

The terrain is shaped by the presence of a seasonal drain/nalla traversing the Block, flowing from the west to the east during the monsoon season. This seasonal watercourse converges with the Kalay River, which flows towards the eastern side of the Block boundary. Notably, three open mining pits exists within the Block, covering an aggregate area of approximately 74.3004 hectares.

The Block experiences an average annual rainfall of about 4393mm, based on a 5-year rainfall dataset collected within the Mineral Block. During the monsoon period, rainwater originating from the catchment area, including mine faces and waste dumps within the expansive Mineral Block (152.5073 ha.), undergoes diversion through a network of garland drains and trenches into the designated mine pits. Simultaneously, the residual rainwater is channelled through additional trenches, garland drains, and a series of settling ponds. This intricate system

ultimately directs the water to the seasonal drain /nalla, culminating in its convergence with the Kalay River.

The management of stormwater is a crucial aspect of the Block's hydrological dynamics. The diversion of rainwater into mine pits is complemented by the channelization of the remaining water through a network of trenches, garland drains, and a sequence of settling ponds. Intermediate settling ponds play a pivotal role as silt arresters, effectively capturing sediment from stormwater runoff. For further insights into the existing mining pits and settling ponds, refer to the comprehensive details provided in **Table 6**. **Table 7** presents the service of the settling pond and the corresponding catchment area.

Table 6: Existing Mine Pits & Sedimentation Tanks/ Ponds with Their Holding Capacities

Particulars	Location	Size, m (L*W*H)	Capacity (M^3)	Co-ordinates	
				Northing	Easting
Mine Pit-1	South of Mineral Block	860*40*54.9	2984649	1690106.479 to 1690978.543	409018.113 to 409619.639
Mine Pit-2	South-East of Mineral Block	300*130*14.8	14280	1690176.312 to 1690553.361	409785.985 to 410021.160
Mine Pit-3	North of Mineral Block	860*540*78	5498031	1691073.016 to 1691965.164	408598.708 to 409356.577
Settling Pond 1	Near Office	35*20*2	1400	1691072.157	409177.825
				1691082.637	409193.951
				1691093.249	409175.989
				1691061.546	409196.311
Settling Pond 2	Near Office	50*25*2	2500	1691059.712	409142.032
				1691061.939	409182.151
				1691075.695	409137.443
				1691042.157	409179.005
Settling Pond 3	Near Office	30*25*2	1500	1691027.296	409194.177
				1691062.356	409213.835
				1691056.355	409191.843
				1691033.843	409217.429
Settling Pond 4	Near Office	92*20*1.8	3312	1691041.067	409140.092
				1690955.577	409150.617
				1691011.93	409124.494
				1690979.049	409159.262

Dr. K.G. GUPTHA (Ph.D,IIT Bombay)
Professor & Head, Civil Engg.
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.
E-mail: kgg@gec.ac.in M: 9422[illegible]

Dr. Purnanand P. Savoikar
Ph. D. (IITB)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

Particulars	Location	Size, m (L*W*H)	Capacity (M^3)	Co-ordinates	
				Northing	Easting
Settling Pond 5	Near Office (West side)	25*15*2	750	1691074.569	409089.3408
				1691058.125	409090.1525
				1691064.706	409073.1605
				1691065.951	409099.1186
Settling Pond 6	Near Office (West side)	72*17*2	2448	1691129.407	408895.1161
				1691067.128	408948.4674
				1691069.074	408916.9239
				1691074.524	408953.1405
Settling Pond 7	Near Office (West side)	60*18*2	2160	1691301.453	408780.9996
				1691237.872	408804.3604
				1691235.799	408798.3396
				1691270.479	408811.4098

Table 7: Settling Pond and the Corresponding Catchment Area

Sr. No.	Settling Pond	Catchment Area (Ha)	Proportional Runoff, m^3	Length of Garland Drain (m)
1	1,2 &3	4.1	4233	420
2	4	2.9	2995	180
3	5,6 &7	1.7	1755	520
Total		8.7	8983	1120

A surface plan showing the existing pits, settling ponds & Trenches is given below in **Fig. 14 &15**



Fig. 14: Surface Plan Showing the Existing Pits, Settling Ponds

Dr. K.G. GUPTHA (Ph.D,IIT Bombay)
Professor & Head, Civil Engg.
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.
E-mail: kgg@gec.ac.in Mob: 9422...

Dr. Purnanand P. Savoikar
Ph. D. (IITB)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

782

Dr. K.G. GUPTHA (Ph.D,IIT Bombay)
Professor & Head, Civil Engg.
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.
E-mail: kng@gec.ac.in M: 9422051202

Dr. Purnanand P. Savoikar
Ph. D. (IITB)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

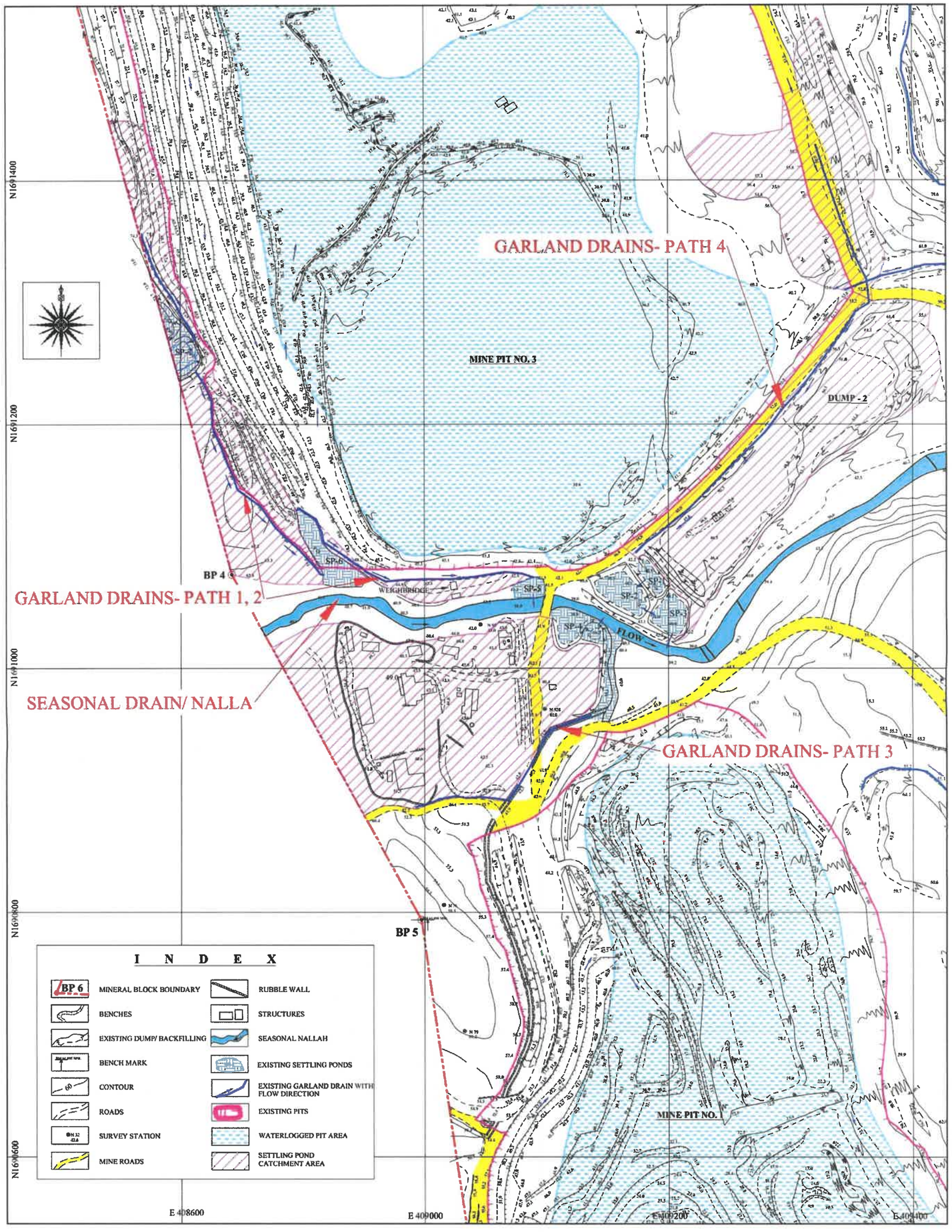


Fig. 15: Enlarged plan of the settling ponds & trenches

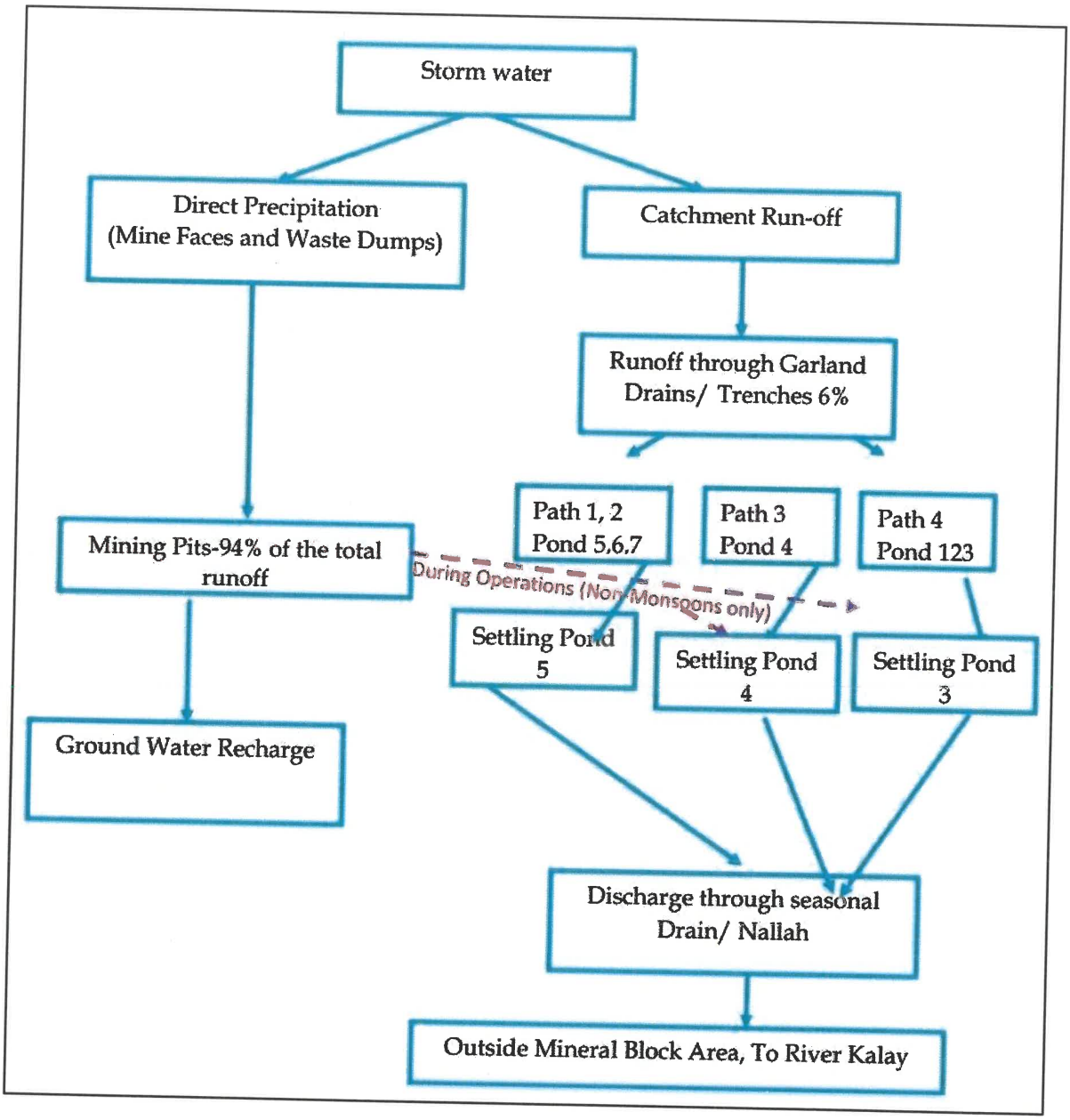


Fig.16: Flow Diagram and the corresponding channelization of stormwater into the settling ponds

5.2.2 Description of Mining pit, Garland drains, settling tanks/ Ponds/ Sedimentation tanks, Check dams.

There are 3 open mining pits viz. Mine Pit 1, Mine Pit 2, and Mine Pit 3 exist in the Mineral Block covering an area of about 74.3004 ha. Mine Pit 1, Mine Pit 2, and Mine Pit 3 areas depicted in pink act as rainwater harvesting structures, are shown in **Plate 1 attached as Annexure-B.**

Dr. K.G. GUPTHA (Ph.D IIT Bombay)
Professor & Head, Civil Engg.
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.
E-mail: kgg@gec.ac.in M: 9422061953

Dr. Purnanand P. Savoikar
Ph. D. (IITB)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

The designated area for the sedimentation of particles carried by stormwater, spanning various sizes, is strategically concentrated at a distinct location highlighted in blue within the adjoining Figure 18. This specific area maintains a low contour at RL 40.0.

The storm water, initially collected through garland drains is passed through a series of 3 settling ponds, where it undergoes a sequential retention process. Settling Pond 1 (SP-1) receives and retains the stormwater. The overflow from settling pond 1 (SP-1) is received in settling pond 2 (SP-2) with reduced velocities, allowing for the settling of particles post-coagulation. Pond 3 (SP-3) serves as the final stilling pond, where particle-free stormwater is discharged into the seasonal drain/ nalla.

Storm water from the Western side of Pit-3 of the Mineral Block gets collected into the settling pond (SP-7) which then flows through a series of settling ponds (SP-6) and (SP-5) located at a lower level. Sedimentation takes place within these settling ponds and the final discharge is from settling Pond SP-5 into the seasonal drain/ nalla.

Stormwater from the Western side of Pit-1 of the Mineral Block gets collected into the settling pond (SP-4) where sedimentation takes place and clean water is finally discharged into the seasonal drain/ nalla.

The location of the settling ponds is shown in Fig. 14 along with the contour levels. Table 7 presents the coordinates of each settling pond along with its capacities. Adjacent to settling ponds 3, 4, and 5 is a seasonal drain/nalla which exhibits flow exclusively during the monsoon from west-to-east. This watercourse merges with the South-to-North flowing Kalay River. To enhance water quality, multiple check dams are strategically positioned across the seasonal drain/nalla, functioning as effective filter barriers.

Gravity facilitates the flow between the settling ponds (1 to 2, 2 to 3, and 3 to drain/ nalla). The RL (Reduced Level) of the drain/ nalla is measured at about 39. These interconnected settling ponds play a crucial role in refining storm water for the Mineral Block.

Addressing storm water collected from the West of Mine Pit -1 of the Mineral Block, the garland drain is directed to settling pond 4. This particular pond maintains a low RL at 39.7. Following the sedimentation process, the storm water drains into the seasonal drain/nalla which has an RL of about

39 at its bottom. Consequently, the entire flow from the ponds to the drain/ nalla operates entirely under the **influence of gravity.**

Similarly, storm water collected from the West of the Mineral Block (Mine Pit 3) flows between the settling ponds (7 to 6, 6 to 5, and 5 to drain/ nalla). The RL of the drain/ nalla at discharge (SP-5) is 41.6. Following the sedimentation process, the storm water drains into the seasonal drain/ nalla which has an RL of 39 at its bottom. The entire flow from the settling ponds to the drain/ nalla operates entirely under the influence of gravity.

Water is treated at strategic settling ponds by adding lime and flocculants. A series of settling ponds further facilitate in arresting the flow of silt and clean water is discharged into the seasonal drain/ nalla. Fig.15 presents the flow diagram showing the above. Certain theoretical aspects corresponding to storm water flow are presented as follows.

5.2.3 Time of concentration (Tc)

The time of concentration (Tc) and time of flow (Tf) are critical parameters in hydrological studies, particularly in the context of storm water runoff. Various methods and equations exist to estimate these values, with one commonly used approach being the Rational Method. The Rational Method provides an estimate of peak discharge, and time of concentration is one of the key parameters in this method.

The equation to calculate the time of concentration (Tc) in the Rational Method is:

$Tc = (L/ C^* i^{0.385})$

Where:

Tc is the time of concentration (in minutes),

L is the length of the flow path (in feet or meters),

C is the runoff coefficient (dimensionless),

i is the rainfall intensity (in inches per hour or millimeters per hour).

It's important to note that the equation and coefficients may vary depending on the specific application and region. Additionally, the time of flow (Tf) is often considered as the sum of the time of concentration and the time it takes for the flow to travel through the drainage network.

Dr. K.G. GUPTHA (Ph.D. IIT Bombay)
Professor & Head, Civil Engg.
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.
E-mail: kgg@gec.ac.in M: 9422001958

Dr. Parmanand P. Savoikar
Ph. D. (IITB)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

$T_f = Tc + T_{travel}$

Where:

T_f is the total time of flow,

T_{travel} is the time it takes for the flow to travel through the drainage network (in minutes).

A comprehensive site investigation has been conducted, utilizing collected field data for an extensive topographic analysis. The dataset has undergone rigorous validation through ground truthing during field surveys. The mine site, having been previously operational, features a network of garland drains and settling ponds, and strategically positioned check dams throughout the area (refer to the surface plan above in Fig. 3).

The topographical examination, both in the field and through the elevation map, reveals a systematic drainage system where precipitation-induced runoff is efficiently directed through garland drains, ultimately converging into a series of settling ponds. The garland drains exhibit a well-maintained gradient, necessitating routine cleaning to mitigate potential blockages The drains are designed to ensure a controlled descent in elevation from upstream to downstream, facilitating the unimpeded flow of rainfall runoff. The dimensions of the drains, measuring 1.5 meters in width and 1.0 meter in depth, coupled with appropriately elevated bunds along the drain perimeters, prevent storm water spillage. Consequently, the capacity of the garland drains is calculated as 1680 m^3 based on the dimensions provided.

To maintain non-silting and non-scouring velocities in the garland drains, a proposal is made to incorporate small pits as shown in figure at every 100 meters along the length of the garland drain as velocity droppers. This provision in the design facilitates the smooth entry of storm water into settling pond 1 with the desired velocity of the storm water.

The length of the garland drain path 4 is 420 meters from dump-2, with a difference in elevation of RL 56 to RL 40, resulting in a 16-meter approach to Settling Pond 1. A garland drain path 3 extends about 180 meters from the area on the northern side of Mine Pit -1, with a difference in elevation of RL 52 to RL 40, leading to a 12-meter approach to Pond 4. Further, a garland drain path 1,2 extending 520m from the area on the west side of Mine Pit – 3 has an elevation difference from RL 74 to RL 41, leading to a 33-meter approach to Pond 5.

Other than the above-mentioned drainage system, well well-established scientifically designed drainage system exists that channelizes surface runoff water from mine benches into the Mine Pits. A portion of the generated runoff naturally percolates into the terrain, infiltrating the sub-surface due to the inherent properties of lateritic soils. Simultaneously, the remaining runoff is directed through the garland drains. Notably, the capacity of the garland drains for a length of 1120 meters is available in addition to the existing sedimentation tanks/ Settling Ponds.

5.2.4 Theory Behind the Process Adopted

In settling ponds, clarification of water is effected by providing conditions under which the suspended materials present in water, settle down. Hence, settling ponds may be defined as special basins constructed in order to purify the surface water of rivers, streams, or reservoirs by the process of sedimentation.

The three forces which control the settling tendencies of particles are:

i) Velocity of flow,

ii) The shape and size of particles, and

iii) Viscosity of water which depends on the temperature of the water

In settling ponds, the first two forces i.e. velocity of flow and the shape and size of the particles are controlled. The velocity of flow is reduced by increasing the length of travel and by detaining the particles for a longer time in the settling ponds. The size and shape of particles are altered by the addition of some chemicals in water known as coagulants and the process is known as "sedimentation with coagulation". Storage reservoirs also serve as sedimentation basins but proper sedimentation is not affected because of density currents and turbulence caused by winds. The principle involved in sedimentation tanks is the reduction of the velocity of flow such that particles settle during the detention period based on the size of the particles to be arrested.

Sedimentation tanks are classified as

i) Fill and draw type also known as batch process.

ii) Continuous flow type.

Dr. K.G. GUPTHA (Ph.D,IIT Bombay)
Professor & Head, Civil Engg.
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda- 403401 Goa.
E-mail: kgg@gec.ac.in M: 9422051953

Dr. Purhanand P. Savoikar
Ph. D. (IITB)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

In the instant case, it is the rectangular fill and draw-type as per the existing site conditions that are favourable to it.

Detention Time

This is the theoretical time that the water is detained in a settling pond. It is evaluated as the volume of the tank divided by the rate of flow and is denoted as Dt = V/Q. Thus, it is that time that would be required by the flow of water: to fill the tank if there were no outflows. Dt is the Detention time t for a rectangular tank, Volume of the tank –V, and rate of flow – Q, B, and L = Width and length of the rectangular tank respectively.

The detention time usually ranges between 4 to 8 hours for plain sedimentation and 2 to 4 hours when coagulants are used. Assuming the settling pond for the following conditions:

i) A rectangular tank is assumed to be ideal for a sedimentation tank.
ii) In the settling zone, sedimentation takes place as a quiescent fluid in a container.
iii) Flow is steady in the settling zone.
iv) The concentration of suspended particles of each size is uniform throughout the cross-sectional right angle to the flow.
v) Incoming flow is uniformly distributed over the cross-sectional area of the tank.
vi) Particles reaching the sludge zone are effectively removed.

The water containing uniformly distributed sediment enters the rectangular tank with a uniform velocity of V. Let Q be the discharge entering the basin. Thus, Flow velocity v, where, B = Width of the basin and H = Depth of water in the tank Each discrete particle is moving with a horizontal velocity VH and a downward velocity Vv. The resultant path is given by the vector sum of its flow velocity VH and settling velocity Vv Assuming that all particles whose paths of travel are will pass through the basin, from geometric considerations, it can be said that. Putting the value of VH thus, this shows that all particles having a settling velocity equal to a greater than Q/BL will settle down and be removed and hence, no particle having a settling velocity more than or equal to Q/BL will remain suspended in the tank. Some particles having settling velocities lower than Q/BL will also settle down if they enter at some other height H1 of the tank. Some particles have settling velocities lower than Q/B. L will also settle down.

Hence, it is inferred that quantity Q/BL i.e. the discharge per unit plan area is a very important term for the design of continuous flow type settling tanks and is known as overflow rate or surface loading or critical settling velocity or overflow velocity. Normal values of surface loading or overflow velocity range are assumed between 500 – 750 liters/hr/m2 of plan area for H plain sedimentation tanks and between 1000 – 1250 liters/hr/m2 of plan area for coagulants-aided tanks. The smaller particles will also settle down if the overflow rate is reduced. For a given value of Q overflow, the rate can be reduced by increasing the plan area of the basin. Thus "Theoretically the depth does not have any effect on the efficiency of sediment removal". The settling velocities of discrete particles for specific gravity corresponding to the soil sample collected from the site and assuming the temperature (average) during monsoon is 30 degrees centigrade the settling velocity minimum required to arrest particles of size 0.01mm is 8.15 x 10-5 m/s. Hence particles of size 0.01 mm are eliminated in Pond 1 itself. The pond 2 facilitates to eliminate the particles of size inferior to 0.01mm known as silt or fine silt or clay or fine clay. Due to quiescent conditions. As per the Schedule VI of the PCB, the scope to remove the particles is up to .085mm i.e., 850 microns. Hence coagulation aided sedimentation is not required.

5.2.5 Silt Load, Settling Velocity of Silt and Retention Time Based on Annual Rainfall

The details of the surface water analysis carried out were collected from the mine site. In the surface water analysis surface runoff samples have been collected at different locations in the mine site so that the sample gives the idea of the whole catchment from the contributing area.

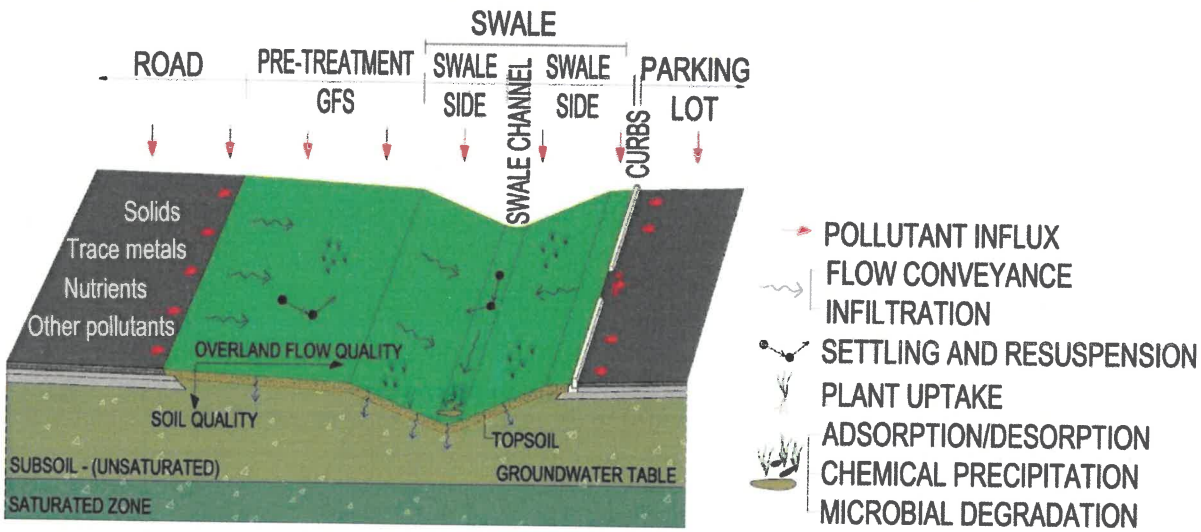


Fig.17: Typical Swale

Dr. K.G. GUPTHA (Ph.D,IIT Bombay)
Professor & Head, Civil Engg.
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.
E-mail: kgg@gec.ac.in M: 9422061...

Dr. Purnanand P. Savoikar
Ph. D. (IIT-B)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

Sedimentation analysis was made on the data made available, on mine pit water monitored, indicating that there is no contamination of the waters. The solids expected in stormwater runoff are:

1. Total Solids inclusive of: Total Suspended Solids, and Total Dissolved Solids.

   These Suspended solids could be differentiated into

   a. Suspended solids that float on the surface,
   b. Settelable solids and
   c. Solids that need coagulation to settle. The type of sediment and the treatment suggested are listed in Table 8.



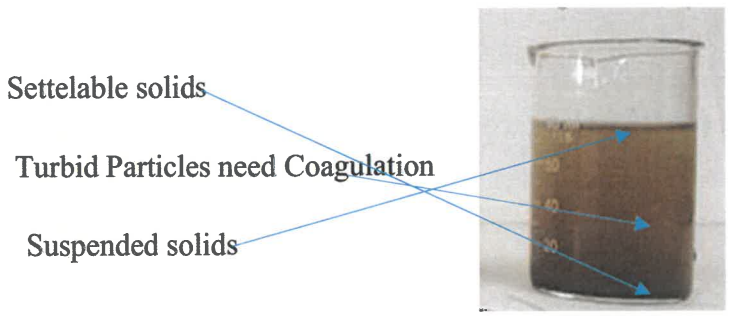


Table 8: Type of Solids Needs Treatment

Particles Nomenclature	Dia. In mm	Treatment suggested
Coarse Gravel	>2	Gravity settling In the scope as per Schedule VI of PCB Requirements
Fine Gravel	1-2	
Coarse Sand	0.5-1.0	
Medium sand	0.25-0.5	
Fine sand	0.1-0.25	
Very fine sand	0.05-0.1	
Silt	0.01-0.05	Higher Detention times by maintaining Quiescent conditions, but still achieved
Fine Silt	0.005-0.01	
Clay	0.001-0.01	
Fine Clay	0.0001-0.001	
Colloidal	<0.0001	Coagulation- Being taken care of although it is not in the scope as per schedule VI of PCB
Bacteria	.001	Ultrafiltration (Not in the scope of study)

5.2.6 Design Analysis and Calculations

a. Runoff Calculations

Total Rainwater collected in the Mine pit is discharged out of the Mineral Block in a controlled fashion passing through a series of settling ponds.

Total Average rainfall for the last 5 years	4.393 m
Area of the mineral block	1525073 m^2
Maximum rainfall recorded in a day in last 5 years (2019-2023)	0.165 m
Average daily rainfall = 4.393 m / 163 days	0.0269 m
Total surface runoff generated through the mineral block = area of block x total yearly rainfall x runoff coefficient	1525073x4.393x 0.85 = 5694698 m^3
Average surface runoff generated through the mineral block (in a day)	1525073x0.0269x 0.85 = 34870 m^3
Out of total mineral block area of 152.5073 Ha., interestingly, 94% of surface runoff is diverted to the mining pits	24409 x 0.94 = 32777.8 m^3 per day (5342781 m^3/year)

Dr. K.G. GUPTHA (Ph.D,IIT Bombay)
Professor & Head, Civil Engg.
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.
E-mail: kgg@gec.ac.in M: 9422061959

Dr. Purnanand P. Savoikar
Ph. D. (IITB)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

After evaporation & other loss	5342781 x 0.7 = 3739946 m^3
The total capacity of the mining pits (3 pits)	8.5 million cu.m. which is more than the yearly surface runoff into the pits.
Average surface runoff through settling pond in a day 6% of average surface runoff is generated through the mineral block (in a day)	34870 x 0.06 = 2092 m^3
Maximum surface runoff generated through the mineral block in a day	1525073x0.165x 0.85 = 213891 m^3
Maximum surface runoff through settling pond in a day is 6% of the average surface runoff generated through the mineral block (in a day)	213891 x 0.06 = 12833 m^3
After evaporation & other loss	12833 x0.7 = 8983 m^3
The total present capacity of the Settling ponds	14070m^3
Which is more than the maximum daily surface runoff into the settling ponds.	

Augmentation of silt in ponds and Bunds based on velocity and retention time in settling ponds is shown in Table 8.

Table 8: Retention time of particles

Pond No	Capacity in m3	Cumulative Capacity, m3	Cumulative Capacity Required, m3	Retention Time, days	Remarks
1	1400	5400	4233	1.28	All particles 0.01mm dia are retained
2	2500				
3	1500				
4	1200	3312	2995	1.1	Spilled-over particles are arrested by providing 3 bunds in series in the seasonal nalla
5	750	5358	1755	3.05	All particles 0.01mm dia are retained
6	2448				
7	2160				

b. Estimation of Silt Load

The average suspended sediment concentration was given by Project Proponent at 50-60 mg/l. The rain gauge stations are installed in the mine site area, daily average rainfall from 1st June to 30th Sept for the last two consecutive years (2021-22 and 2022-23) has been calculated based on rain gauge stations found to be 26.9 mm/day. Thus,

The efficacy of the existing garland drains and settling ponds is assessed in the present study, which is described herein below:

The capacity of the settling ponds	14070 m3
From the data provided, the suspended sediments per liter (considering the large value)	60 mg/l
Total suspended sediment load per day (in tonnes)	2092 x 0.06 125.52 kg/m3
Total suspended sediments per year in monsoon	125.52 x 163 days 20,459 kg 20.459 tonnes
Settelable solids at 40gm/ l contributes	2092 x 40 83680 kg 83.68 tonnes
Total suspended solids contributing to the settling pond during monsoon every year	20.459 + 83.68 104.17 tonnes

Thus, the existing settling ponds are enough to accommodate sludge/ suspended solids. And the storm water at any given time during monsoons. The ponds will be desilted annually after the monsoons.

To establish a monitoring framework for assessing turbidity in overflow from siltation tanks and storm water entering drains while ensuring compliance with environmental regulations in India, particularly those set by the Pollution Control Board, consider the following steps:

Dr. K.G. GUPTHA (Ph.D,IIT Bombay)
Professor & Head, Civil Engg.
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.
E-mail: kgg@gec.ac.in M: 9422061952

Dr. Purnanand P. Sawaikar
Ph. D. (IIT Bombay)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

1. Identification of Applicable Regulations

The relevant national and state-level environmental regulations and standards related to water quality, specifically those pertaining to turbidity as specified in Schedule –VI are complied with (Schedule –VI attached)

2. Review and Adopt Standards

Referring to the standards set by the Central Pollution Control Board (CPCB) and State Pollution Control Boards (SPCBs) in India for permissible turbidity limits in discharge water and complying with the requirements.

[1][SCHEDULE – VI]
(See rule 3A)

GENERAL STANDARDS FOR DISCHARGE OF ENVIRONMENTAL POLLUTANTS PART-A : EFFLUENTS

S. No.	Parameter	Standards			
		Inland surface water	Public Sewers	Land for irrigation	Marine coastal areas
1	2			3	
		(a)	(b)	(c)	(d)
1.	Colour and odour	See 6 of Annexure-I	--	See 6 of Annexure -I	See 6 of Annexure-I
2.	Suspended solids mg/l, Max.	100	600	200	(a)For process waste water- 100 (b)For cooling water effluent 10 percent above total suspended matter of influent.
3.	Particulate size of suspended solids	Shall pass 850 micron IS Sieve	--	--	(a)Floatable solids, max. 3 mm. (b)Settleable solids, max. 850 microns.
[2]4.	...	...	--	...	--
5.	pH Value	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0	5.5 to 9.0
6.	Temperature	shall not exceed 5°C above the receiving water temperature	--	--	shall not exceed 5°C above the receiving water temperature

1 Schedule VI inserted by Rule 2(d) of the Environment (Protection) Second Amendment Rules, 1993 notified vide G.S.R. 422(E) dated 19.05.1993, published in the Gazette No. 174 dated 19.05.1993.

2 Omitted by Rule 2(4)(i) of the Environment (Protection) Third Amendment Rules, 1993 vide Notification No.G.S.R.801(E), dated 31.12.1993.

3. **Define Compliance Criteria**

   Clearly defined the permissible turbidity limits of water discharge into the seasonal drain/ nallah.

4. **Monitoring Parameters**

   Refer to Schedule- VI for monitoring parameters, including sampling frequency, locations, and methods, in alignment with regulatory guidelines.

5. **Documentation and Reporting**

   Documentation of monitoring activities, calibration procedures, and reporting protocols as per regulatory requirements are met.

6. **Communication with Regulatory Authorities**

   Established communication channels with the relevant Pollution Control Board authorities to ensure transparency and compliance by way of periodic submission of reports and updates to regulatory bodies as required.

7. **Audit and Recordkeeping**

   An established system for periodic audits to ensure compliance with monitoring protocols and regulatory standards and detailed records of monitoring data, corrective actions taken, and communications with regulatory authorities is a part of the system at Fomento

8. **Continuous Improvement**

   Regular review of the monitoring framework in light of changes in regulations or best practices to ensure ongoing compliance and environmental protection as per the norms.

By aligning the monitoring framework with applicable environmental regulations and standards, the project can demonstrate a commitment to environmental stewardship and responsible management of storm water as a resource of the State. Regular engagement with regulatory authorities helped to maintain compliance and address any evolving requirements in the realm of storm water quality management is a part of the responsibility of Fomento.

Dr. K.G. GUPTHA (PH.D, IIT Bombay)
Professor & Head, Civil Engg.
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda, 403401, Goa.
E-mail: kgg@gec.ac.in M: 9422051952

Dr. Purnanand P. Savoikar
Ph. D. (IITB)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

B. The PP needs to explore the likelihood of river water entering the mine pit below the RL of the HFL and the measures that are required to be taken for the prevention of seepage and in the event of seepage to drain out the water through the settling tank. PP also needs to submit the measures to be taken for the protection of the river in the vicinity of the mine lease area due to mining activity.

A detailed field study was conducted to understand the likelihood of seepage of water from the Kalay River into the mining pits. The Kalay River flows towards the East of the Mineral Block boundary at a distance of 430m, 55m & 350m from Pit-1, Pit-2 & Pit-3 respectively. The high flood line for Kalay River measured near the Kalay River Bridge (also recorded at Kalay Railway Bridge) is found to be about 36.6m MSL. In the field, it is observed that the area between the river and the pit edge is high grounds having elevation differences ranging from approximately 10m to 25m, which will obstruct the flow of water between them even in the high flood conditions.

Towards the centre of the mineral block, where the river flows at a distance of 875m from the pit edge the elevation difference from river to pit edge is approximately 7m. While, at the southern part of the mineral block where the river flows at a distance of 55m from the pit edge, the elevation difference is approximately 25m MSL. Thus, even during the high floods, the river water will not interact with the mining pit water.

Further, over the years the rainwater and surface runoff from mine benches and dumps is diverted through garland drains into the mining pits and is stored in the pits. The historical data indicates that no overflow has been observed from the mining pits even during heavy rainy days. However, in the future, if the situation arises, the dewatering of mining pits in a systematic manner is already in the plan.

Field study, geological plan, borehole data, and NGRI Report suggest, that no regional flow pattern could be inferred from the groundwater table elevations. The steep hydraulic gradient found in the mining lease area may indicate the presence of low permeability Phyllitic clay and dyke clay formations encapsulating the iron ore formation in these mine pits. Since the ore body is encapsulated by a thick layer of impervious clays, thus, the impervious clay lithologies

between the river and the pits form a favourable condition for no seepage of water from the river to the pits.

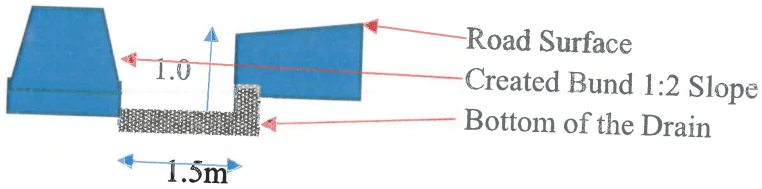
5.3 Recommendations

a. Garland Drains

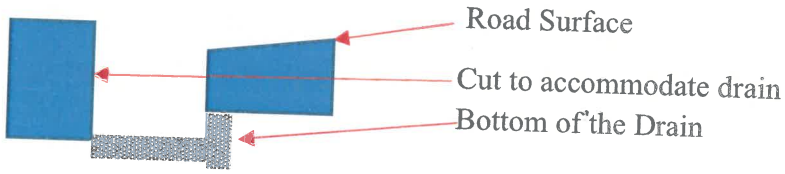
These represent the primary conduits within the efficient stormwater transport system leading to sedimentation ponds. Constructing and enhancing these channels in a well-planned manner will effectively capture particles and sediment.

1. Proposed garland drain cross-section

Runoff is augmented through the garland drains by creating a bund as shown in figure below



Cross Section Case-1: If Bund to be Created



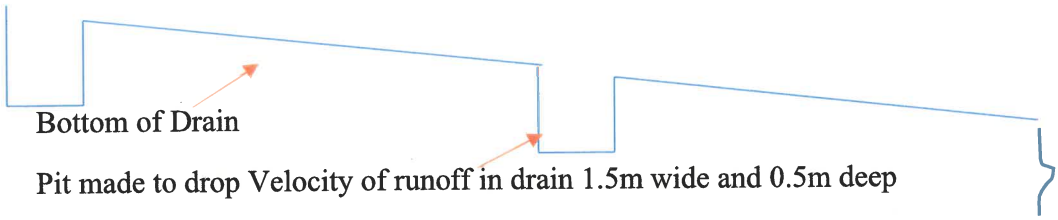
Cross Section-Case-2: If Cut to be Created

Note: Necessary arrangement to be made to train the stormwater into the drain from the surface of the road or otherwise

Dr. K.G. GUPTHA (Ph.D,IIT Bombay)
Professor & Head, Civil Engg.
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.
E-mail: kgg@gec.ac.in M: 9422061952

Dr. Purnanand P. Savoikar
Ph. D. (IITB)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

b. Velocity Dropping Arrangement



Cross Section along the length of drain (Typical)

c. Image of a Bund



VI. CONCLUSIONS

a. The project area primarily channels stormwater into the mine pits, with 94% of precipitation entering these pits and 6% flowing into garland drains. From there, it proceeds to settling ponds before ultimately reaching the seasonal nalla and River Kalay. The highest in a day volume of water reaching to the settling ponds is recorded at 8983m^3.

b. Annually, the settling ponds accumulate 104 tonnes of silt and sediments.

c. It is recommended to carryout desiltation activity post-monsoon each year from the settling ponds and garland drains, and dumped the same at the designated places with in the Block area

d. The proposed treatment for sediment control will align Schedule VI of EPA 1986 particularly in terms of particle size.

e. Mandatory annual cleaning of garland drains should be an integral part of the project, commencing before the post monsoons and no later than the end of May each year.

f. The maintenance of Velocity droppers is suggested, if deemed necessary, particularly during monsoons.

g. Routine maintenance includes the periodic creation of bunds to optimize the proper controlled flow of stormwater into garland drains.

h. Bunds in the nalla require pre-monsoon maintenance to ensure effectiveness.

i. The existing garland drains were presumed to be operational before the cessation of mining activities in 2018. Although they have been crucial for compliance, minor repairs are now necessary. The compliance report in this regard till 2022 is already filed with authorities

j. Reconstruction/repair of garland drains, especially concerning civil work, should be undertaken where necessary. Efforts should also be made to redirect the flow towards settling tanks/ponds.

Dr. K.G. GUPTHA (Ph.D. IIT Bombay)
Professor & Head, Civil Engg.
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.
E-mail: kgg@gec.ac.in M: 9422061952

Dr. Purnanand P. Savoikar
Ph.D. (IITB)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

k. Regulating the velocity of stormwater flow is crucial, and this can be achieved through the proposed implementation of drop structures.

l. The study is based on the analysis of the highest recorded daily rainfall, which served as the design basis, reaching 165mm in the year 2022.

m. The current protective measures are designed to effectively capture runoff sediment, guaranteeing the discharge of clean water from the settling pond.

n. There is no likelihood of water enter from the Kalay river into the mining pits of Block IV – Kalay Mineral Block below the RL of the HFL.

o. Since the ore body is encapsulated by a thick layer of impervious clay, thus, the impervious clay lithologies between the river and the pits form a favorable condition for no seepage of water from the river to the pits.

ANNEXURE-A: 10 Year Rainfall Data

Rainfall Data for the year 2013-14		
Month	Rainfall in MM	
	Monthly	Cumulative
Apr-13	0.00	0.00
May-13	70.40	70.40
Jun-13	1255.40	1325.80
Jul-13	2129.03	3454.83
Aug-13	723.00	4177.83
Sep-13	421.20	4599.03
Oct-13	240.20	4839.23
Nov-13	33.20	4872.43
Dec-13	0.00	4872.43
Jan-14	0.00	4872.43
Feb-14	0.00	4872.43
Mar-14	0.00	4872.43
Total	4872.43	

Rainfall Data for the year 2014-15		
Month	Rainfall in MM	
	Monthly	Cumulative
Apr-14	0.00	0.00
May-14	80.40	80.40
Jun-14	650.30	730.70
Jul-14	1584.00	2314.70
Aug-14	1302.10	3616.80
Sep-14	498.66	4115.46
Oct-14	206.70	4322.16
Nov-14	0.00	4322.16
Dec-14	49.40	4371.56
Jan-15	4.80	4376.36
Feb-15	0.00	4376.36
Mar-15	29.00	4405.36
Total	4405.36	

Rainfall Data for the year 2015-16		
Month	Rainfall in MM	
	Monthly	Cummulitive
Apr-15	1.40	1.40
May-15	55.10	56.50
Jun-15	796.20	852.70
Jul-15	967.20	1819.90
Aug-15	645.50	2465.40
Sep-15	304.90	2770.30
Oct-15	139.20	2909.50
Nov-15	40.40	2949.90
Dec-15	0.00	2949.90
Jan-16	0.00	2949.90
Feb-16	0.00	2949.90
Mar-16	0.00	2949.90
Total	2949.90	

Rainfall Data for the year 2016-17		
Month	Rainfall in MM	
	Monthly	Cummulitive
Apr-16	0.00	0.00
May-16	53.30	53.30
Jun-16	944.40	997.70
Jul-16	886.80	1884.50
Aug-16	644.80	2529.30
Sep-16	455.00	2984.30
Oct-16	70.20	3054.50
Nov-16	0.00	3054.50
Dec-16	0.00	3054.50
Jan-17	0.00	3054.50
Feb-17	0.00	3054.50
Mar-17	0.00	3054.50
Total	3054.50	

Dr. Purnanand P. Savoikar
Ph. D. (IITB)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

Dr. K.G. GUPTHA (Ph.D,IIT Bombay)
Professor & Head, Civil Engg.
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa

Rainfall Data for the year 2017-18		
Month	Rainfall in MM	
	Monthly	Cumulative
Apr-17	1.40	1.40
May-17	97.60	99.00
Jun-17	934.22	1033.22
Jul-17	1035.94	2069.16
Aug-17	596.00	2665.16
Sep-17	382.80	3047.96
Oct-17	153.90	3201.86
Nov-17	0.40	3202.26
Dec-17	13.00	3215.26
Jan-18	0.00	3215.26
Feb-18	0.00	3215.26
Mar-18	0.00	3215.26
Total	3215.26	

Rainfall Data for the year 2018-19		
Month	Rainfall in MM	
	Monthly	Cummulitive
Apr-18	2.80	2.80
May-18	214.60	217.40
Jun-18	900.10	1117.50
Jul-18	1169.00	2286.50
Aug-18	746.00	3032.50
Sep-18	122.00	3154.50
Oct-18	96.80	3251.30
Nov-18	0.00	3251.30
Dec-18	0.00	3251.30
Jan-19	0.00	3251.30
Feb-19	0.00	3251.30
Mar-19	0.00	3251.30
Total	3251.30	

Rainfall Data for the year 2019-20		
Month	Rainfall in MM	
	Monthly	Cummulitive
Apr-19	1.20	1.20
May-19	0.00	1.20
Jun-19	790.00	791.20
Jul-19	1808.80	2600.00
Aug-19	1702.40	4302.40
Sep-19	823.00	5125.40
Oct-19	610.80	5736.20
Nov-19	30.80	5767.00
Dec-19	0.00	5767.00
Jan-20	0.00	5767.00
Feb-20	0.00	5767.00
Mar-20	0.00	5767.00
Total	5767.00	

Rainfall Data for the year 2020-21		
Month	Rainfall in MM	
	Monthly	Cummulitive
Apr-20	9.20	9.20
May-20	83.40	92.60
Jun-20	819.60	912.20
Jul-20	1142.60	2054.80
Aug-20	1507.80	3562.60
Sep-20	808.32	4370.92
Oct-20	229.00	4599.92
Nov-20	0.00	4599.92
Dec-20	28.20	4628.12
Jan-21	27.60	4655.72
Feb-21	16.20	4671.92
Mar-21	0.00	4671.92
Total	4671.92	

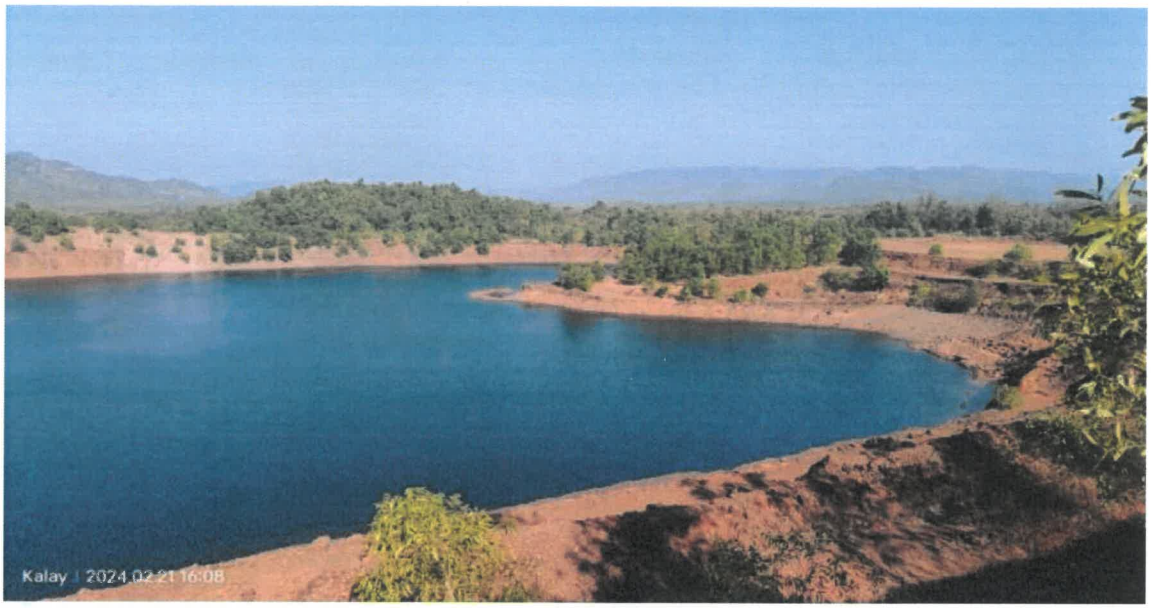
Rainfall Data for the year 2021-22		
Month	Rainfall in MM	
	Monthly	Cumulative
Apr-21	46.40	46.40
May-21	335.10	381.50
Jun-21	1046.90	1428.40
Jul-21	1412.82	2841.22
Aug-21	398.00	3239.22
Sep-21	485.10	3724.32
Oct-21	253.30	3977.62
Nov-21	226.20	4203.82
Dec-21	33.40	4237.22
Jan-22	0.00	4237.22
Feb-22	0.00	4237.22
Mar-22	0.00	4237.22
Total	4237.22	

Rainfall Data for the year 2022-23		
Month	Rainfall in MM	
	Monthly	Cummulitive
Apr-22	84.00	84.00
May-22	110.00	194.00
Jun-22	595.20	789.20
Jul-22	1600.00	2389.20
Aug-22	451.00	2840.20
Sep-22	403.20	3243.40
Oct-22	256.00	3499.40
Nov-22	8.40	3507.80
Dec-22	9.20	3517.00
Jan-23	0.00	3517.00
Feb-23	0.00	3517.00
Total	3517.00	

Dr. Purnanand P. Savoikar
Ph. D. (IITB)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

Dr. K.G. GUPTHA (Ph.D.IIT Bombay)
Professor & Head, Civil Engg.
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.
E-mail: kgg@gec.ac.in M: 9422061953

ANNEXURE- B- PLATE



Mining Pit-1



Mining Pit-3



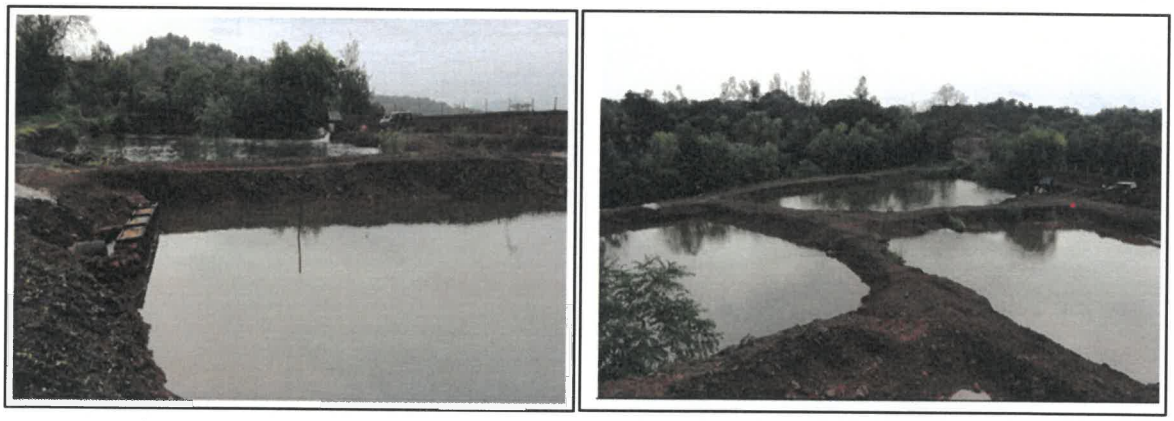
Settling Pond 1



Settling Pond 2



Settling Pond 3



Schematic Representation of Settling Pond During Monsoon

Dr. Purnanand P. Savoikar
Ph. D. (IITB)
Professor in Civil Engineering
Goa College of Engineering
Farmagudi - Ponda Goa 403401

Dr. K.G. GUPTHA (Ph.D,IIT Bombay)
Professor & Head, Civil Engg.
Govt. of Goa
Goa College of Engg.
Farmagudi, Ponda - 403401 Goa.
E-mail: kgg@gec.ac.in M: 9422061952