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# Environmental Impact Assessment of Gumgaon Mine MOIL Limited Saoner, Nagpur

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**ABSTRACT:** The expansion proposal of Gumgaon Manganese Mine belonging to the MOIL Limited is for Mining of Manganese mineral with enhancement of production capacity from 90,000 MTPA to 2,03,200 MTPA, M.L area 85.8969 ha, situated village: Gumgaon, Khapa, Tegai&Rajna, Tehsil: Saoner, Dist.: Nagpur, State Maharashtra. To extract above quantity of Manganese from this mine, the Environmental Clearance from SEIAA Maharashtra has to be obtained to mitigate the environmental hazardous which will be generated by the mining. The Environmental Impact Assessment has been prepared to assess the current environmental scenario of the area and then based on the activities of mining proposed, to carry out Environmental Management Plan. The plan will identify and address the impacts, where these are adverse in nature, and thereafter to design mitigation measures to manage such impacts in a manner as to conserve environment and ecology of the area. The EMP has been prepared with a view to ultimately ensure that the adverse impacts are minimized if these cannot be prevented altogether. To obtain the Environmental Clearance a detailed EIA & EMP study has been conducted with the consultation of Wolkem India Limited, Udaipur, Rajasthan who is A Category NABET accredited consultant for the Mining of Mineral.

**KEYWORDS-** Environment Management Plan, Environmental Impact Assessment, MOIL Limited

## I. INTRODUCTION

Executive summary is the brief of report prepared for Environmental Impact Assessment of Gumgaon, Khodegaon Manganese ore mine of M/s MOIL Ltd. (A Government of India Enterprise). It is fresh mining project in an area of 126.84 ha. and mining will be done by underground method with targeted production of 1,02,000 TPA (ROM).

**Profile of the project proponent and background:-**A Mini Ratna PSU was originally set up in the year 1896 as Central Province Prospecting Syndicate which was later renamed as Central Provinces Manganese Ore Company Limited (CPMO), a British Company incorporated in the UK. In 1962, as a result of an agreement between the Government of India and CPMO, the assets of the latter were taken over by the Government and MOIL was formed with 51% capital held between the Govt. of India and the State Governments of Maharashtra and Madhya Pradesh and the balance 49% by CPMO. It was in 1977, the balance 49% shareholding was acquired from CPMO and MOIL became a 100% Government Company under the administrative control of the Ministry of Steel.

At present, MOIL operates 11 mines, seven located in the Nagpur and Bhandara districts of Maharashtra and four in the Balaghat district of Madhya Pradesh. All these mines are about a century old. Except 3, rest of the mines is worked through underground method. The Balaghat Mine is the largest mine of the Company. The mine has now reached a mining depth of 309 meters from the surface. DongriBuzurg Mine located in the Bhandara district of Maharashtra is an opencast mine that produces manganese dioxide ore used by dry battery industry. This ore in the form of manganous oxide is used as micro-nutrient for cattle feed and fertilizers. MOIL fulfills about 50% of the total requirement of dioxide ore in India. At present, the annual production is around 90,000 tonnes/year which is expected to grow in the coming years. MOIL has set up Ferro Manganese Plant (10,000 TPY) and Electrolytic Manganese Dioxide (EMD) Plant (1500 TPY) as per its diversification plan for value addition to manganese ore. MOIL has also set up a Captive Power Plant and is further considering, expanding the capacity of ferro manganese plant and setting up a new Silico



Manganese Plant by means of joint ventures entered into with Rashtriya Ispat Nigam Limited and Steel Authority of India Limited.

**Importance of the Project to the region & use of Mineral:-** Manganese is one of the major mineral deposits occurring in the Indian sub-continent. It has played a great role in development of civilization and industrialization. The occurrence of Manganese ore in the proposed area is proved by the way of exploration and its production has important role in the steel industries.

The ore will be sold to Ferro/ Silico Industries. MOIL has its own specifications, which are derived as per buyer's demands & available quality. MOIL sales its ore to various Ferro/Silico producers as per demand. It is to be mentioned here that MOIL has set up its own lab, for chemical analysis the analytical results of the lab are expectable to all concerns MOIL Limited, the leading producer of high-grade Manganese ore and manufacturer of Electrolytic Manganese Dioxide and Manganese alloys in India, markets various grades and blends of ores to suits individual requirements of consumers, particularly for Steel, Ferro Manganese, Dry Battery, and Chemical Industries.

The ML area has been chosen due to the following:

- Availability of good quality Manganese deposits, the main raw material for manufacture of Steel in the proximity.
- Availability of adequate land, water, power and other infrastructure facilities for mineral based industry.
- Availability of social infrastructure, manpower and transportation facilities.

The present EIA/ EMP report has been prepared for Environmental Impact Assessment of proposed Gumgaon, Khodegaon and Tegai Manganese mining project of M/s MOIL Limited (A Government of India Enterprise) in an area of 126.84 ha. It is a green-field mining project and mining will be done by Underground method with targeted production of 1,02,000 TPA (ROM).

## II. PURPOSE OF THE REPORT

The Environmental Impact Assessment has been prepared to assess the current environmental scenario of the area and then based on the activities of mining proposed, to carry out Environmental Management Plan. The plan will identify and address the impacts, where these are adverse in nature, and thereafter to design mitigation measures to manage such impacts in a manner as to conserve environment and ecology of the area. The EMP has been prepared with a view to ultimately ensure that the adverse impacts are minimized, if these cannot be prevented altogether. As per EIA Notification dated 14th September 2006, Environmental Clearance is required for all existing and proposed mining projects/ Proposed enhancement of production.

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

#### Nature & Size of Project:

The applied lease covers an area of 126.84 Hectare (Govt. land 12.64 Ha + 114.20 Private land) comprising in village Gumgaon, Kodegaon, Tegai. It is proposed to produce 1,02,000 (TPA) ROM by underground method of mining "back overhand cut and fill method with hydraulic sand stowing" due to existence of 235m below the surface. For entry in underground, vertical shaft of 6.5m dia is proposed. Two ventilation shafts located on eastern and western side of lease will act as second outlet in case of emergency. All the shafts (winding and ventilation shafts) and winzes will have ladder ways to exit in case of emergency.

Site History: Maharashtra is one of the largest producers of manganese in the country. Manganese ore deposits of Maharashtra are one of the most remarkable in the world. They are associated with the Pre-Cambrian meta-sediments. Commercially exploitable manganese ore deposits occur in Nagpur, Bhandara and Sindhudurg districts of which those occurring in Nagpur district are the largest & the most important. Presently agriculture is being practised on the land.





Figure 1.1: Site Photographs

**LOCATION OF THE PROJECT:**

Table 1.2: Location based Details of Project

Particulars	Detail
Name of the applied mine area	Gumgaon manganese applied lease area
Near village	Gumgaon, Khodegaon and Tegai
Tehsil	Saoner
District	Nagpur
State	Maharashtra
Applied area	126.84 ha. (114.20 ha. of Govt Waste Land + 12.64 ha. of Private land)
Toposheet no.	55 K/15 and 55 O/3

**III. STUDY AREA**

To study the environmental baseline status of the prevailing conditions, geographic area within 10 km radius from the applied lease area is considered as study area, Core zone is the applied lease area of 126.84 Ha. Whereas area around the applied lease periphery within 10 Km is considered as Buffer zone.

Table 3.1: Study Area at A Glance

S. No.	Particulars	Details
<b>General Particulars</b>		
1.1	Near Villages	Gumgaon, Khodegaon and Tegai.
1.2	Tehsil & District H.Q.	Saoner & Nagpur
1.3	Latitude	27° 54' 29.89" to 27° 53' 35.89" N
1.4	Longitude	72° 49' 13.16" E to 72° 48' 17.95" E
1.5	Toposheet No.	55 K/15 and 55 O/3
<b>Demography</b>		
2.1	Total Population	67,101
2.2	Male	34,574
2.3	Female	32,527

2.4	Literates	49,529
2.5	No. of Household	15,450
2.5	No. of Villages	68
<b>Land use pattern (area in hectare)</b>		
3.1	Forest land	3,595.47
3.2	Habitation	1,087.17
3.3	Cropland	2,3307.32
3.4	Fellow land	9,903.45
3.5	River/water	9,80.42
3.6	Open scrub land	3,043.32
3.7	Wetland/wasteland	3,654.86
<b>Total</b>		<b>45,572.01</b>
<b>Climatology (as per site data)</b>		
4.1	Total rainfall in mm.	22.0
4.2	Maximum temp. °C	47.0
4.3	Minimum temp. °C	23.0
4.4	Relative humidity %	19-68

**3.1.1 STUDYPERIOD**

ThebaselineenvironmentalmonitoringwascarriedoutduringSummerseasonofyeari.e. 1<sup>st</sup>March'2018 to 31<sup>st</sup>May2018.

**3.1.2 ENVIRONMENTALCOMPONENTS**

The environmental components which are studied during the study period include:

- LandEnvironment
- WaterEnvironment
- AirEnvironment
- NoiseEnvironment
- BiologicalEnvironment
- Socio- Economic Environment

**3.1.3 METHODOLOGY**

The baseline information on meteorological data, ambient air quality, water quality, noise level, soil quality and floristic descriptions are largely drawn from the data generated by Wolkem India Limited, Udaipur (Raj). Apart from these, secondary data have been collected from Census Handbook, Revenue Records, Statistical Department, Soil Survey and Land use Organization, District Industrial Centre, Forest Department, Central Ground Water Authority and State Ground Water Department etc. The generation of primary data as well as collection of secondary data & information from site and surroundings was carried out.

**3.1.4 ESTABLISHMENTOFBASELINEFORVALUEDENVIRONMENTCOMPONENT****3.2 LANDENVIRONMENT****(A) Landuseofstudyarea(bufferzone)**

The existing land use pattern in the study area has been studied through satellite imagery and is divided into following categories: -

- a) Forestland
- b) Habitation
- c) Cropland
- d) Fellowland
- e) River/Waterbodies
- f) Open scrubland

g) Wetland/wasteland

**Data Input:** Sentinel-2, Multispectral digital TCC (True Colour Composite) data from

USGSEarthExplorerPortal has been used for preparation of LULC thematic map of study area. Project site mine plan map & Google maps and Toposheet (1:50,000, New Open Series) has been used as a reference map for preparation of base layer map like road, rail network, project site boundary, build-up land water bodies, forest etc.

#### Technical Details

- Satellite Image : Sentinel-2
- Band Combination : 4,3,2
- DIP Software : ERDAS Imagine 2014
- GIS Software : ArcGIS 10.1 & ERDAS Imagine 2014

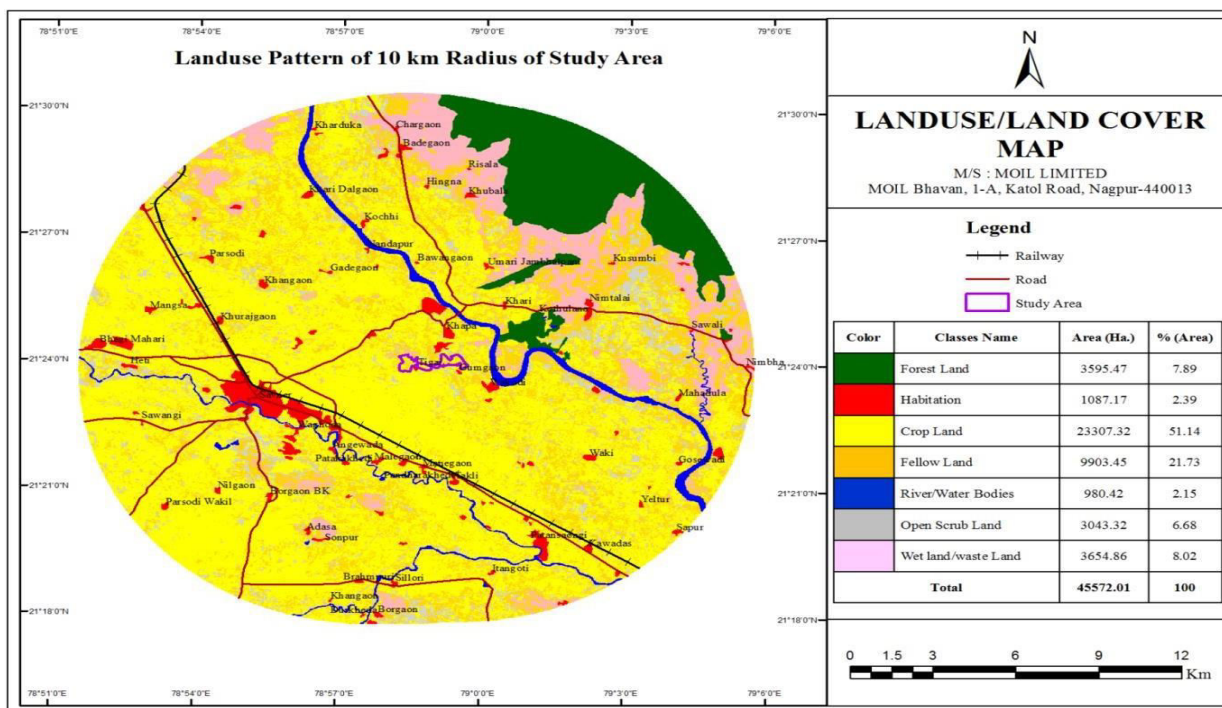
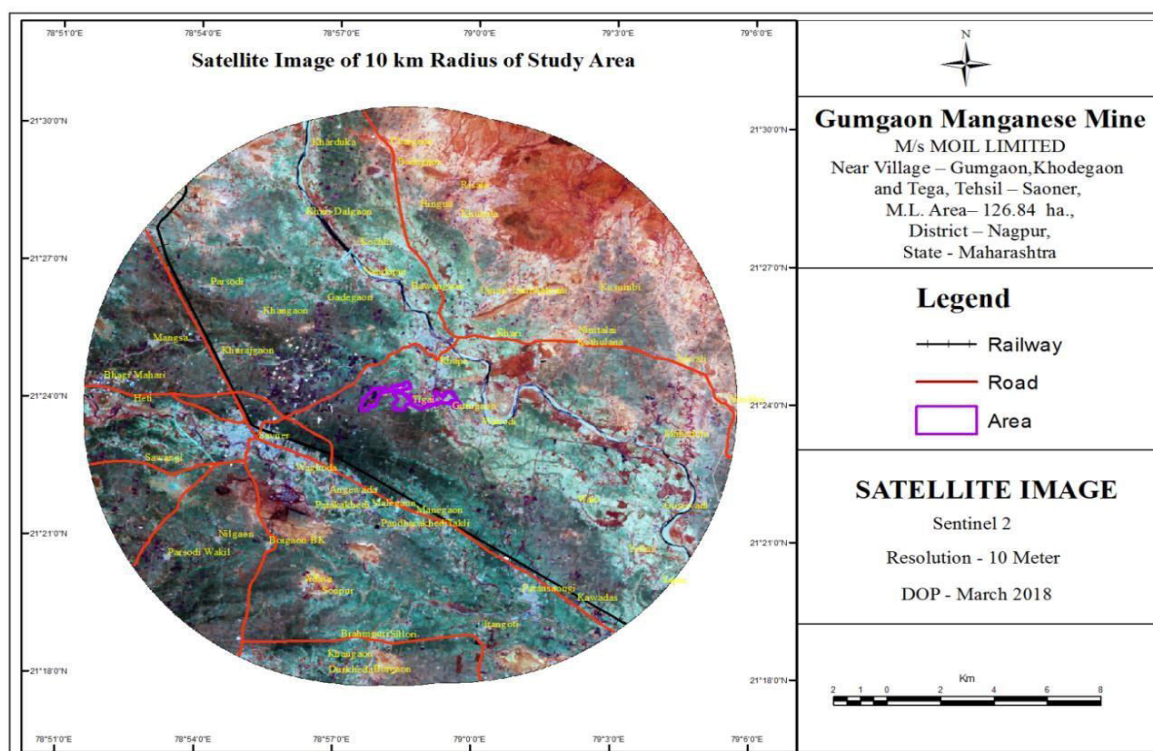
**Methodology:** Land use/ Land cover map preparation, Base map creation; and Geometric correction of satellite image has been processed using ERDAS Imagine 2014 Software. The methodology used for Land use pattern of study area is as follows:

**Geo-referencing of Topographical base (Toposheet):** SOI Toposheet (1:50,000, New Open Series) has been geo-referenced in geographic lat/long coordinate system using Arc GIS 10.1 Software.

**Base Map Layer Creation:** Project site mine map & Google maps and geo-referenced Toposheet used as a reference map for base layer creation. In base layer linear, polygon and point feature like road, rail, canal, village location and project site created in vector data format. Base map layer information used for analysis of surrounding feature like road, rail, and village location near project site activity through superimposed on thematic map for data integration.

**Table 3.2: Land Use Pattern Based on Satellite Image**

S. No.	Class Names	Area (Ha.)	% (Area)
i	Forest land	3,595.47	7.89
ii	Habitation	1,087.17	2.39
iii	Crop land	23,307.32	51.4
iv	Fallow land	9,903.45	21.73
v	River/water bodies	980.42	2.15
Vi	Open scrub land	3,043.32	6.68
vii	Wetland/wasteland	3,654.86	8.02
<b>Total</b>		<b>45,572.01</b>	<b>100</b>

**Figure 3.1: Land Use/ Land Cover Map Pattern of the Study Area**

**Figure 3.2: Satellite Image of 10 Km Radius of The Study Area**


**Interpretation of Satellite Image:** Hybrid technique has been used i.e. visual interpretation and digital image processing for identification of different land use and vegetation cover classes based on spectral signature of geographic feature. Spectral signature represents various land use classes. Image interpretation keys are developed, based on image characteristics like colour, tone, size, shape, texture, pattern, shadow, association etc., which enables interpretation of satellite images for ground feature.

For validation of land use plan, ground truth data on geographic features of the study area collected by site visit to the area for verification of information of the different doubtful features, which were found to be responsible for the occurrence of specific spectral reflectance behavioural patterns. Ground truth data has been carried out for verification of the ground features (esp. one in doubt) interpretation accuracy and reliability of remotely sensed data.

**Conclusion:** All vector layer superimposed on land use land cover map for final map composition and used for analysis and study of area.

**Agricultural Yield of Study Area:** Agricultural practice is the main source of income of study area. Major field crops grown are Soyabean, Maize, Wheat, Mustard, Urd, Gram etc. Horticulture crops – Orange, Sweet orange, Mango, Kazilime.

Horticulture crops vegetable – Cauliflower, Chilly, Brinjal, Tomato, Medicinal and Aromatic crops – Amla, Baheda, Hirda, Bel, Mahua, Karanj. Fodder crops – Neem, Sisso, Karanj, Ficus.

**(B) Land use of applied lease area (Core Zone)**

Land use of the applied lease area and proposed utilization for different purpose of mining during operational and post operational phase is given in the table below.

**Table 3.3: Land use Plan for Preoperational, Operational & Post Operational (In Ha.)**

S.No.	Head	Area put on use at start of plan	Additional requirement during plan period	Area considered as fully reclaimed & rehabilitated	Net area considered for calculation
1	Area to be excavated	NIL	1.00	Nil	1.00
2.	Storage for topsoil	Nil	0.25	Nil	0.25
3.	Overburden dumps	Nil	0.25	Nil	0.25
4.	Mineral storage	Nil	NIL	Nil	0.00
5.	Infrastructure	Nil	0.25	Nil	0.25
6	Roads	Nil	0.25	Nil	0.25
7	Railways	-	-	-	-
8.	Green Belt	Nil	5.00	2.00	7.00
9.	Tailing pond	-	-	-	-
10	Effluent treatment plant	-	-	-	-
11	Mineral separation plant	-	-	-	-



12	Township area	-	Nil	Nil	Nil
13	Other to specify	-	-	-	-
	<b>Total area</b>				<b>9.00 Ha</b>

Note - About 5.0 ha area will be planted in next five year & 2.0ha are will be planted in 6<sup>th</sup> to 10<sup>th</sup> year.

### (C) Topography & Drainage

The area is undulating with gently slope towards East. The general MSL is 310 and the highest MSL recorded is 331 MSL to the West. The hillock is standing in E-W direction, on North part of the area, made up of quartzite of Sitasong formation.

The main water course of the area is Kanhan River which flows about 1.5 kms on the Eastern side of the lease. The Korardharinallah flow through South of the lease and join at 2.5 km down South-East to Kanhan River. Also, there are number of non-perennial water courses and nallah originating from the above-mentioned ridges from higher slopes of the hill to main drainage system of Kanhan River.

Figure 3.3: Topography Map of the Study Area

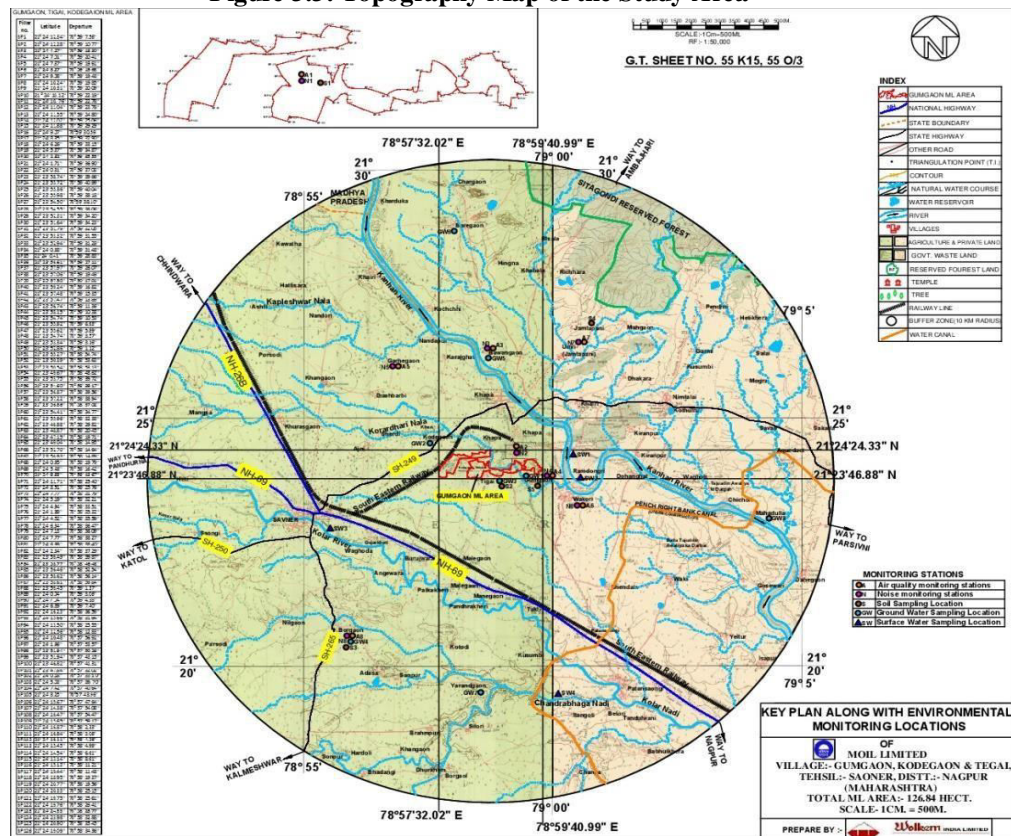
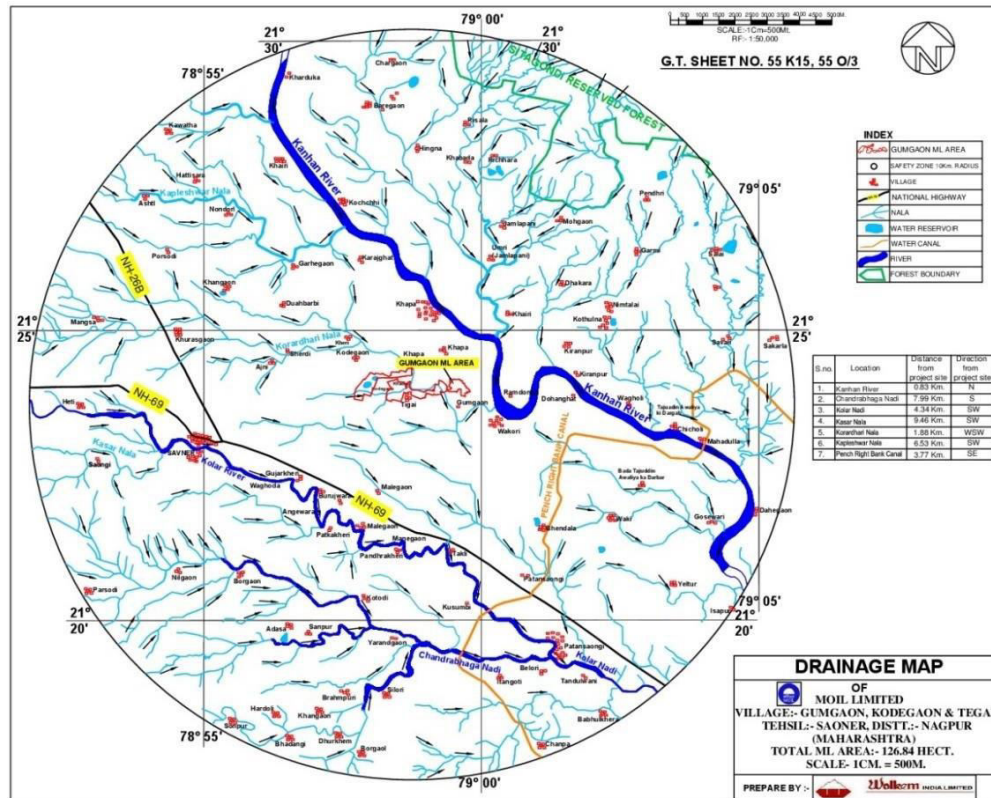


Figure 3.4: Drainage Map of the Study Area

**(D) Soil Quality**

The soil present in the study area is black cotton soil which are fine grained clayey in texture and varies in depth 1m to 6m or more and retain moisture. During the study period soil samples were collected from five locations.

**Methodology for Soil Monitoring**

Soil samples were collected from three different depths viz. 30 cm, 60 cm and 90 cm below the surface and are homogenized. This is in line with IS: 2720 & Methods of Soil Analysis, Part-1, 2<sup>nd</sup> Edition, 1986 of (American Society for Agronomy and Soil Science Society of America). Air-dried and sieved samples used for determination of physical properties of soil. Standard methods were followed for the analysis of soil samples. Soil sampling locations are given in the table below:

Table 3.4: Soil Sampling Locations in the Study Area

S. No.	Station Code	Station Name	Zone	Location with respect to site	
				Distance (Km)	Direction
1	S1	Topsoil from mine	Mining area	0	NA
2	S2	Village Tegai	Buffer zone	500m	S
3	S3	Village Borgaon	Buffer Zone	7.1	SW
4	S4	Village Jamlapani	Buffer Zone	5.4	NE
5	S5	Village Gumgaon	Buffer Zone	428m	N

Figure 3.5: Soil Sampling Location Map of the Study Area

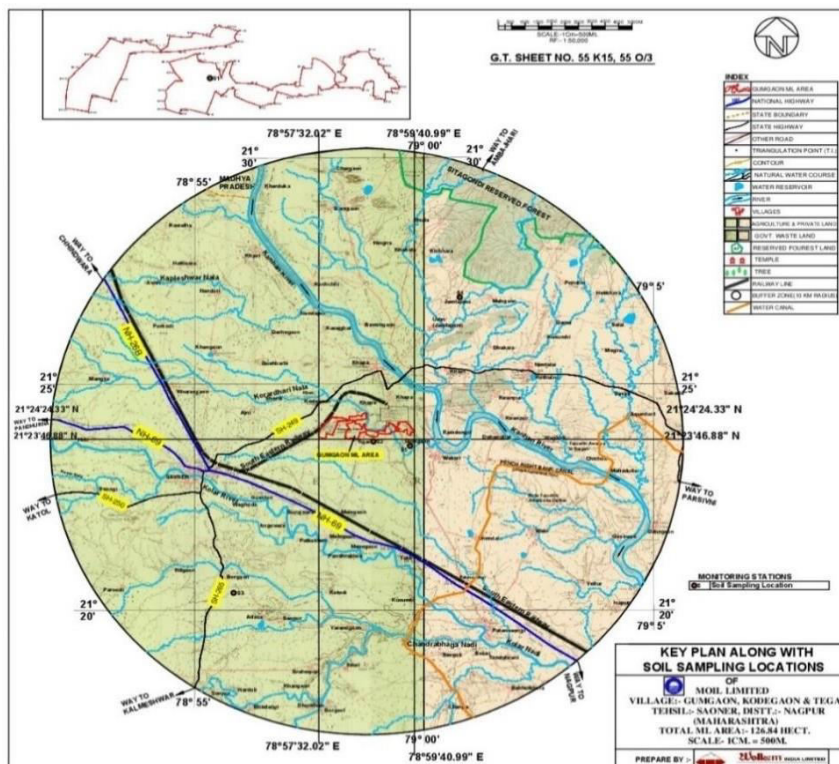


Figure 3.6: Photographs of Soil Sampling in the Study Area







### Soil Analysis

Analysis of soil samples done by Environmental and Chemical Laboratory, Wolkem India Ltd., Udaipur by following prescribed standard methods & the result of analysis is shown in below table.

**Table 3.5: Analysis Results of Soil Samples**

S. No	Parameters	unit	S1	S2	S3	S4	S5
1	pH	--	7.89	8.02	8.03	7.84	8.26
2	Electrical conductivity at 25 °C	--	0.295	0.341	0.382	0.506	0.411
3	*Water Holding Capacity	--	6.962	6.91	5.461	5.72	7.702
4	Moisture	%	10.06	8.744	8.71	9.94	8.37
5	*Silt	%	35.32	28.52	26.43	30.17	29.07
6	*Clay	%	29.88	49.05	51.56	46.40	46.46
7	*Sand	gm/cc	34.79	22.42	22.00	23.42	24.46
8	*Specific gravity	%	2.30	2.08	2.50	2.25	2.09
9	Bulk Density	μmhos /cm	1.45	1.56	1.47	1.56	1.49
10	Chloride as Cl		0.00072	0.00060	0.00070	0.00068	0.00065
11	*Porosity		37.01	25.02	41.15	30.67	28.45
12	Organic Matter		0.910	0.828	1.014	0.786	1.96
13	Available Phosphorous		0.0018	0.0022	0.0029	0.0019	0.0025
14	Copper		0.0029	0.0035	0.0019	0.0027	0.0030
15	Iron as Fe		0.6490	0.306	0.706	0.081	0.0511
16	Sodium as Na		0.012	0.011	0.013	271.9	0.013
17	Potassium as K		0.017	0.007	0.007	173.4	0.006
18	Zinc		0.0063	0.0051	0.0071	0.0046	0.0051
19	Aluminium as Al		0.0029	0.0030	0.0030	0.0009	0.0010



20	*Available Nitrogen		0.012	0.013	0.013	0.012	0.013
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Table 3.6: Standard Soil Classification

Chemical Parameters	Ranking				
	Very Low	Low	Moderate	High	Very High
pH	<4, very Strongly Acidic	4-5, Strongly Acidic	5-8, Ideal for Plant Growth	8-9 Strongly Basic	>9 Very Strongly Basic
Electrical conductivity ( $\mu\text{S}/\text{cm}$ )	<2000, Non saline	2000-4000 Saline	4000-8000 Moderately Saline	8000-16000 Highly Saline	>16000 Extremely Saline
Total Nitrogen (%)	<0.05 Very Low	0.05-0.15 Low	0.15-0.25 Moderate	0.25-0.5 High	>0.5 Very High
Total Phosphores(mg/kg)	<5 Very Low	5-10 Low	10-30 Moderate	30-60 High	>60 Very High
Sodium(mg/Kg)		<200 Non Sodic	200-500 Moderate	>500 Sodic	-
Potassium (mg/Kg)		<150 Low	150-250 Moderate	250-800 High	>800 Very High
Calcium (mg/Kg)		<1000 Low	100-2000 Moderate	>2000 High	-
Magnesium (mg/Kg)	<40 Very Low	40-100 Low	100-300 Moderate	>300 High	-
% Organic matter	0.5-1.0 Very Low	1.0-2.0 Low	2.0-3.0 Moderate	3.0-5.0 High	>5 Very High

**Interpretation & Result:** The pH values of the collected samples were in the range of 7.84 to 8.26, organic matter in the range of 0.786(%) to 1.96 (%), water holding capacity in the range of 5.56 to 7.70%, potassium in the range of 0.07 to 173, total nitrogen in the range of 0.012 to 0.013 %, bulk density in the range of 1.45 to 1.49gm/cc. These all parameter indicate that soil is not so fertile in this area.

## 1. WATER ENVIRONMENT

To conduct EIA Studies, baseline data pertaining to water environment of the existing project was carried out evaluating the basin characteristics & hydrogeology. Water availability and water quality are two major aspects considered for baseline status of water environment.

**Surface water:** The Korardhari nala flows through South of the lease and join at 2.5 km down South-East to Kanhan river which flows 0.8 km in N direction from lease. Four samples of surface water collected from study area including upstream & downstream of mine lease area.

**Ground water:** As it is underground mining, water table will be intersected during mining process. The water table in Pre-monsoon (in dry season) remain 8 to 10 mbgl & in post monsoon season it remains 2.0 to 6.0 mbgl.

**Hydrology & Hydrogeology:** The preliminary hydrological study of Korardhari sub-basin of Kanhan basin have been done and salient features have been given below.

**Table 3.7(A): Hydrological Study of Korardhari Sub-Basin**

S. No.	Parameters	Data
1	Drainage basin	Kanhan
2	Drainage sub basin	Korardhari
3	Area of sub basin	105 km <sup>2</sup>
4	Annual rainfall (normal)	0.988 m
5	24 hours heaviest rainfall, 11.07.1942 (extreme)	0.2157 m
6	24 hours peak water generation	22.6 MCM
7	24 hours peak runoff	5.66 MCM
8	24 hours peak infiltration	2.26 MCM
9	Annual groundwater recharge with normal rainfall	10.37 MCM
10	Annual draft likely by irrigation and other	5.04 MCM

(m = meter, MCM = Million Cubic Meter)

The study suggests that area have potential source of annual recharge to groundwater system. It is expected that unconfined aquifer in the area may pose series problem during shaft sinking. It is recommended that care should be taken to select the site with minimum alluvium unconfined aquifer and low infiltration zone as far as possible. Accordingly, the proposed site has been selected. The only concern is the flood plain of Korardhari Nallah. It is reported that, in upper catchment area a water reservoir exists and there is all possibility for release of excess water in event of flooding. It is expected that proper care will be undertaken to avoid Highest Flood Level.

**Table 7(b): Schematic of site elevation, working depth & ground water**

Details	Depth in Mean Sea Level (Meters)
Highest Contour in ML Area	325 MSL
Lowest Contour in ML Area	305 MSL (20m)
Water Table in Post-monsoon	299 MSL (6mbgl)
Water Table in Pre-monsoon	295 MSL (10mbgl)
Ultimate Working Depth	265 MSL (40 m below)
Groundwater Table Intersection	Yes
Permission from CGWA	Yes
<b>Note: Groundwater table will be intersected, and application prior permission has been applied vide no. 21-4/2019/MH/MIN/2019 dated 11.01.2019.</b>	

**Hydrogeology**

**Regional Hydrogeology:** The regional hydrogeology of the basin inferred that there is thick alluvium unconfined potential aquifer formed due to inter migration of two basin Kanhan and Pench. Similar situation is also encountered in Gondigaon/ Kmathi manganese mines area. The area may be a part of recent buried channel deposit of flood plain around hill rocks. The area possesses very good groundwater potential around mine.

**Water Level:** A systematic hydrogeological survey has been carried out in and around mine area. The water level measurement in the existing dug wells is monitored. Water level varies between 3.0 to 18.0 m bgl. The water table (unconfined) aquifer is potential aquifer in the area.

**Table 3.8: Water Level within Regional Study Area**

S. No.	Name of Village	Well	Dia (m)	Ht. Of	Depth (m)	SWL (m)
		Code		Parapet (m)		Winter
1	Ramdongari	W1	2.75	0.60	14.60	12.3
2	Ramdongari	W2	2.23	0.76	13.04	11.94
3	Khairy	W3	2.48	0.82	9.88	8.7
4	Khairy	W4	1.35	0.60	11.05	8.72
5	Khapa	W5	2.97	0.76	17.79	17.24
6	Khapa	W6	1.70	0.63	8.17	3.82
7	Khedi	W7	3.10	0.40	5.73	4.20
8	Khedi	W8	3.11	0.53	11.17	9.07
9	Kodegaon	W9	2.30	0.58	11.32	7.64
10	Kodegaon	W10	2.50	0.42	13.43	10.58
11	KodegaonKhadan	W11	3.13	0.63	12.27	7.58
12	KodegaonKhadan	W12	3.36	0.59	20.11	10.22
13	Tighai	W13	3.40	0.65	13.05	8.74
14	Gumgaon	W14	6.60	2.65	10.20	2.89
15	Gumgaon	W15	2.80	0.80	10.55	3.58
16	Gumgaon	W16	1.20	0.25	5.25	3.15

The area near hillock has restricted ground water flow due to negative boundary conditions. This may be comparatively favourable condition for shaft location. Detail hydrogeological study has been done at site specific for shaft location. The detailed hydrogeological study has been carried out and is enclosed as **Annexure-III**.

#### Surface and ground water monitoring methodology

Eight ground water samples and four surface water sample were collected during the summer season. The quality of ground water and surface water studied by collecting water samples from representative, dug wells, tube wells and by from different surface water sources. These samples were taken as grab sample and were analysed for various parameters and compared with standards IS: 10500.

**Table 3.9: Location of Ground Water Sampling in the Study Area**

Station Code	Location	Distance	Direction	Zone
GW1	Village Gumgaon	330m	S	Buffer Zone
GW2	Village Khodegaon	1.0Km	W	Buffer Zone
GW3	Village Tegai	500m	S	Buffer Zone
GW4	Village Boregaon	7.0Km	SW	Buffer Zone
GW5	Village Bawangaon	3.45Km	N	Buffer Zone
GW6	Village Baregaon	8.25Km	N	Buffer Zone
GW7	Village Yarandgaon	7.8Km	S	Buffer Zone
GW8	Village Mahadulla	8.35Km	ESE	Buffer Zone

Table 3.10: Location of Surface Water Sampling In the Study Area

Station Code	Location	Distance	Direction	Zone
SW1	Kanhan river upstream	1.26Km	E	Buffer Zone
SW2	Kanhan river down stream	1.7Km	ESE	Buffer Zone
SW3	Kolar nadi	4.13Km	SW	Buffer Zone
SW4	ChandrabhagaNadi	8.2Km	S	Buffer Zone

Figure3.7:Ground water Sampling Locations Map in the Study Area

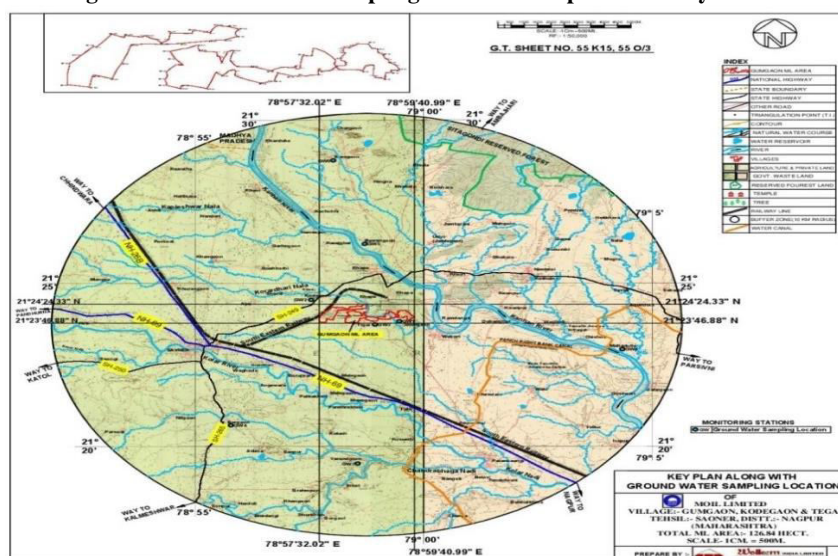


Figure3.8: Surface Water Sampling Locations Map in the Study Area

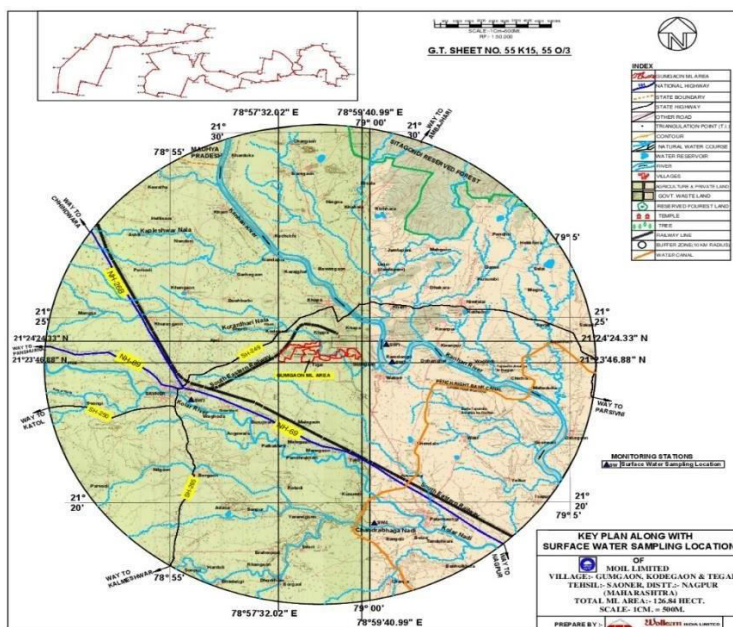




Figure 3.9: Photographs of Water Sampling In the Study Area



Table 3.11: Analysis Results of Ground Water Samples

S. No.	Parameter	Unit	Groundwater Locations				Limits	
			GW1	GW2	GW3	GW4	Acceptable	Permissible
1	pH (at 27°C)	-	7.29	7.17	7.53	7.62	6.5- 8.5	No relaxation
2	Conductivity (at 25°C)	µs	931.2	1.130	988.0	1.113	-	-
3	Color	Hazen	<5	<5	<5	<5	5	15
4	Odour	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
5	*Taste	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
6	Turbidity	NTU	0.68	0.40	0.42	0.36	1	5
7	Total Dissolve Solid	mg/l	622	784	590	632	500	2000
8	Total Hardness (as CaCO <sub>3</sub> )	mg/l	316	560	152	124	200	600
9	Calcium (as Ca <sup>2+</sup> )	mg/l	104	134.4	43.2	25.6	75	200
10	Magnesium as Mg <sup>2+</sup>	mg/l	13.44	53.76	10.56	14.4	30	100
11	Alkalinity (as CaCO <sub>3</sub> )	mg/l	264	312	228	256	200	600
12	Chlorides (as Cl <sup>-</sup> )	mg/l	220	164	48.0	74	250	1000
13	Flouride (as F)	mg/l	0.30	0.40	0.30	0.40	1.0	1.5
14	Phosphate	mg/L	0.23	0.26	0.24	0.24	-	-
15	Sulphate (as SO <sub>4</sub> )	mg/l	36.2	28.5	130.7	237.3	200	400
16	Nitrate (as NO <sub>3</sub> )	mg/l	3.23	2.37	13.06	21.3	45	No relaxation
17	Zinc (as Zn)	mg/l	0.04	0.05	0.06	0.06	5.0	15
18	Lead (as Pb)	mg/l	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	0.01	No relaxation
19	Potassium as K	mg/L	8.60	6.09	4.8	5.20	-	-
20	Sodium as Na	mg/L	48.9	22.10	13.4	33.4	-	-
21	Manganese (as Mn)	mg/l	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	0.1	0.3
22	Iron (as Fe)	mg/l	0.23	0.16	BDL (<0.1)	0.17	0.3	No relaxation
23	Cadmium (as Cd)	mg/l	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	0.003	No relaxation
24	Nickel	mg/l	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	0.02	No relaxation

25	Copper (as Cu)	mg/l	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	0.05	1.5
26	Chromium	mg/l	BDL (<0.02)	BDL (<0.02)	BDL (<0.02)	BDL (<0.02)	0.05	No relaxation
27	Mercury (as	mg/l	BDL	BDL	BDL	BDL	0.001	No

	Hg)		(<0.001)	(<0.001)	(<0.001)	(<0.001)		relaxation
28	Boron (as B)	mg/l	BDL (<0.1)	BDL (<0.1)	BDL (<0.1)	BDL (<0.1)	0.5	1.0
29	*Aluminum	mg/L	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	0.03	0.2

S. No.	Parameter	Unit	Groundwater locations				Limits	
			GW5	GW6	GW7	GW8	Acceptable	Permissible
1	pH (at 27°C)	-	7.32	7.34	7.34	7.59	6.5- 8.5	No relaxation
2	Conductivity (at 25°C)	µs	805.2	858.2	3.152	484	-	-
3	Color	Hazen	<5	<5	<5	<5	5	15
4	Odour	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
5	*Taste	-	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
6	Turbidity	NTU	0.30	0.42	0.58	0.28	1	5
7	Total Dissolve Solid	mg/l	436	500	2456	214	500	2000
8	Total Hardness (as CaCO <sub>3</sub> )	mg/l	248	356	1060	138	200	600
9	Calcium (as Ca <sup>2+</sup> )	mg/l	72	60.8	176	36.8	75	200
10	Magnesium as Mg <sup>2+</sup>	mg/l	16.32	48.9	148.8	18.24	30	100
11	Alkalinity (as CaCO <sub>3</sub> )	mg/l	212	172	392	156	200	600
12	Chlorides (as Cl <sup>-</sup> )	mg/l	40	72	864	24	250	1000
13	Flouride (as F <sup>-</sup> )	mg/l	0.20	0.30	0.80	0.20	1.0	1.5
14	Phosphate	mg/L	0.22	0.20	0.38	0.16	-	-
15	Sulphate (as SO <sub>4</sub> )	mg/l	61.5	23.07	265.9	14.9	200	400
16	Nitrate (as NO <sub>3</sub> )	mg/l	4.45	1.66	38.0	0.88	45	No relaxation
17	Zinc (as Zn)	mg/l	0.03	0.02	0.18	0.02	5.0	15
18	Lead (as Pb)	mg/l	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	0.01	No relaxation
19	Potassium as K	mg/L	3.69	1.96	7.50	0.90	-	-

20	Sodium as Na	mg/L	28.4	8.48	59.6	10.4	-	-
21	Manganese (as Mn)	mg/l	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	0.1	0.3
22	Iron (as Fe)	mg/l	BDL (<0.1)	BDL (<0.1)	0.28	BDL (<0.1)	0.3	No relaxation
23	Cadmium (as Cd)	mg/l	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	0.003	No relaxation
24	Nickel	mg/l	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	0.02	No relaxation
25	Copper	mg/l	BDL	BDL	BDL	BDL	0.05	1.5
	(as Cu)		(<0.01)	(<0.01)	(<0.01)	(<0.01)		
26	Chromium	mg/l	BDL (<0.02)	BDL (<0.02)	BDL (<0.02)	BDL (<0.02)	0.05	No relaxation
27	Mercury (as Hg)	mg/l	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)	0.001	No relaxation
28	Boron (as B)	mg/l	BDL (<0.1)	BDL (<0.1)	BDL (<0.1)	BDL (<0.1)	0.5	1.0
29	*Aluminum	mg/L	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	BDL(<0.01)	0.03	0.2

TABLE 3.12: ANALYSIS RESULTS OF SURFACE WATER SAMPLE

S. No.	Parameter	Unit	Surface water locations			
			SW1	SW2	SW3	SW4
1	pH (at 27°C)	-	7.39	7.28	7.22	7.29
2	Conductivity (at 25°C)	µs	498.6	527.2	797.2	670.0
3	Total Dissolve Solid	mg/l	234	266	498	476
4	Total Suspended Solid	mg/L	10	14	16	18
5	Total Hardness (as CaCO <sub>3</sub> )	mg/l	160	168	272	272
6	Calcium (as Ca <sup>2+</sup> )	mg/l	25.6	35.2	76.8	67.2
7	Magnesium as Mg <sup>2+</sup>	mg/l	23.04	19.2	19.2	24.9
8	Alkalinity (as CaCO <sub>3</sub> )	mg/l	168	156	152	140
9	Chlorides (as Cl <sup>-</sup> )	mg/l	42	44	88.0	126
10	Residual Chlorine	mg/L	BDL (<0.01)	0.02	0.02	0.03
11	B.O.D. 3 days @ 27°C	mg/L	1.4	1.6	2.2	3.0
12	Chemical Oxygen Demand	mg/L	8.03	8.03	16.06	24.09
13	Flouride (as F)	mg/l	0.10	0.10	0.30	0.2
14	Phosphate	mg/L	0.18	0.22	0.16	0.10
15	Sulphate (as SO <sub>4</sub> )	mg/l	12.9	13.8	43.9	59.3
16	Nitrate (as NO <sub>3</sub> )	mg/l	0.87	1.08	0.81	0.27
17	Zinc (as Zn)	mg/l	BDL (<0.01)	0.02	0.07	0.09



18	Lead (as Pb)	mg/l	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)
19	Potassium as K	mg/L	0.90	1.08	3.7	2.3
20	Sodium as Na	mg/L	6.10	7.22	8.9	8.10
21	Manganese (as Mn)	mg/l	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)
22	Iron (as Fe)	mg/l	BDL (<0.1)	BDL (<0.1)	BDL (<0.1)	0.11
23	Cadmium (as Cd)	mg/l	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)
24	Nickel	mg/l	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)
25	Copper (as Cu)	mg/l	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)
26	Chromium	mg/l	BDL (<0.02)	BDL (<0.02)	BDL (<0.02)	BDL (<0.02)
27	Mercury (as Hg)	mg/l	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)	BDL (<0.001)
28	Boron (as B)	mg/l	BDL (<0.1)	BDL (<0.1)	BDL (<0.1)	BDL (<0.1)
29	*Aluminum	mg/L	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)	BDL (<0.01)

## CONCLUSION

- It is observed that pH of the ground water samples are in range of 7.17 to 7.62, which is between the acceptable pH limit for drinking water.
- The concentration of Total dissolve solids (TDS) & Total hardness observed in different ground water samples are in range of permissible category stipulated by Bureau of Indian standards except village yarandagaon (8.3 km from mine site) where Total dissolved solid & Total hardness is observed 2456 & 1060 mg/l respectively which are above the range of permissible limit.
- Fluoride Concentration is in range of 0.1 to 0.4 mg/l. which is under permissible limit.
- Biochemical oxygen Demand - All surface water samples have BOD values ranging 1.4 to 3. which indicate very low organic pollution load. All samples have BOD values are within prescribed limit (<30.0 mg/l as in IS 10500 :2012)
- Chemical oxygen demand (COD) - All surface water samples have COD values ranging from <5 to 45.5 which indicates low level of organic pollution load in term of COD.

**Results & Discussion-** From the above data it is observed that all parameters are within permissible limit of drinking water standard except sample collected from village yarandagaon where TDS & Hardness in Ground water observed above the permissible limit which could be due to agricultural runoff, urban runoff, industrial wastewater etc.

## 3.4 AMBIENT AIR ENVIRONMENT

### 3.4.1 METEOROLOGY

Meteorological factors such as wind speed, direction variation in temperature, humidity etc. play a direct role in dispersion of pollutants atmospheric pressure, rainfall and cloud cover also govern this activity. In order to establish the prevailing climatic condition, a meteorological monitoring station was installed in the study area during the study period. Based on the site meteorological information gathered during the monitoring period, wind rose diagram was generated to understand the prevailing wind direction so as to anticipate the dispersion of pollutants in the wind direction.

### 3.4.2. METHODOLOGY FOR METEOROLOGICAL DATA COLLECTION

The methodology adopted for monitoring surface observations is as per the standard norms laid down by Bureau of Indian Standards and the India Meteorological

Department (IMD). On site monitoring was undertaken for various meteorological variables in order to generate site specific data. The generated data is then compared with the meteorological data generated by IMD.

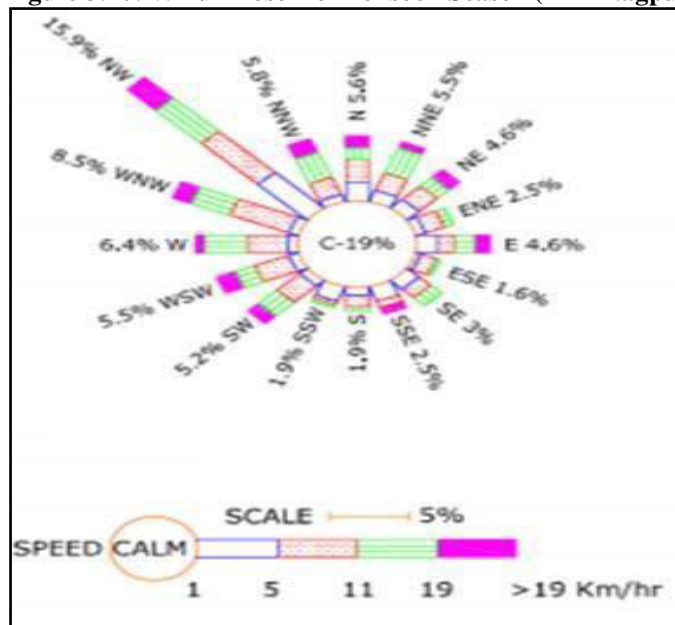
The Central Monitoring Station was set up near project site. The Central Monitoring Station (CMS) was equipped with monitoring equipment to record Wind speed and direction, temperature, relative humidity, cloud cover, rainfall and solar radiation. All the meteorological parameters were recorded continuously on hourly basis except rainfall. Rainfall was recorded on daily basis by using rain gauge.

#### Secondary Data collected from IMD- Nagpur

Secondary data from IMD-Nagpur has been collected for pressure, temperature, relative humidity, rainfall, evaporation, wind speed and direction. The data at IMD is usually measured twice a day viz., at 08:30 and 17:30 hr.

**Table 3.13: Climatological Data- Stations: IMD, Nagpur (Year 1981-2010)**

Month	Atmospheric pressure(mb)		Temp( $^{\circ}$ C)		Relative humidity		Rainfall (mm)	Average wind from
	0830	1730	Max	Min	0830	1730		
January	981	977.2	32.5	8.8	67	42	21.6	N & NW
February	979.3	975.1	35.7	11.1	54	31	15.6	
March	977.1	972.3	40.4	15.3	41	24	21.7	
April	974	968.9	43.9	19.4	33	19	9.2	
May	970.5	965.6	45.6	22.8	35	22	21.2	
June	967.5	963.6	44.3	22.5	61	49	168.8	
July	967.6	964.7	36.0	22.5	82	72	313.7	
August	968.7	966	34.1	21.8	85	76	267	
September	972.2	968.7	35.3	21.0	81	71	170.2	
October	976.9	973.3	35.6	15.4	71	58	64	
November	980.2	976.6	33.3	11.8	65	51	16	
December	981.9	978.2	31.9	9.1	66	47	11.3	

**Figure 3.10: Wind –RosePre-Monsoon Season (IMD Nagpur)****Meteorological Data**

The meteorological data generated at site during study period (March'2018 to May'2018) is summarized below:

**Table 3.14 Summary of Meteorological Data Recorded At Site**

Month	Wind Speed (kmph)			Temperature ( $^{\circ}$ C)			Relative Humidity (%)			Rain Fall (mm)			Cloud Cover
	Mean	Max.	% of calm	Mean (Dry Bulb)	Highest	Lowest	Mean	Highest	Lowest	Total	24-hours Highest	No. of rainy days	Mean
March 18	3.7	6.3	19% Average	24.5	44.5	20.5	37.2	68	24	.....	.....	.....	.....
April 18	3.9	7.2		25.6	45.0	22.0	38	52	20	.....	.....	.....	.....
May 18	3.9	8.3		29.0	47.0	23.0	40	48	19	.....	.....	.....	.....

**3.4.3 Ambient Air Quality Monitoring**

The ambient air quality with respect to the study zone of 10 km radius around the proposed mine site forms the baseline information. The various sources of air pollution in the region are traffic, urban and rural activities. This will also be useful for assessing the conformity to standards of the ambient air quality during the mine operation. The study area represents mostly rural environment.

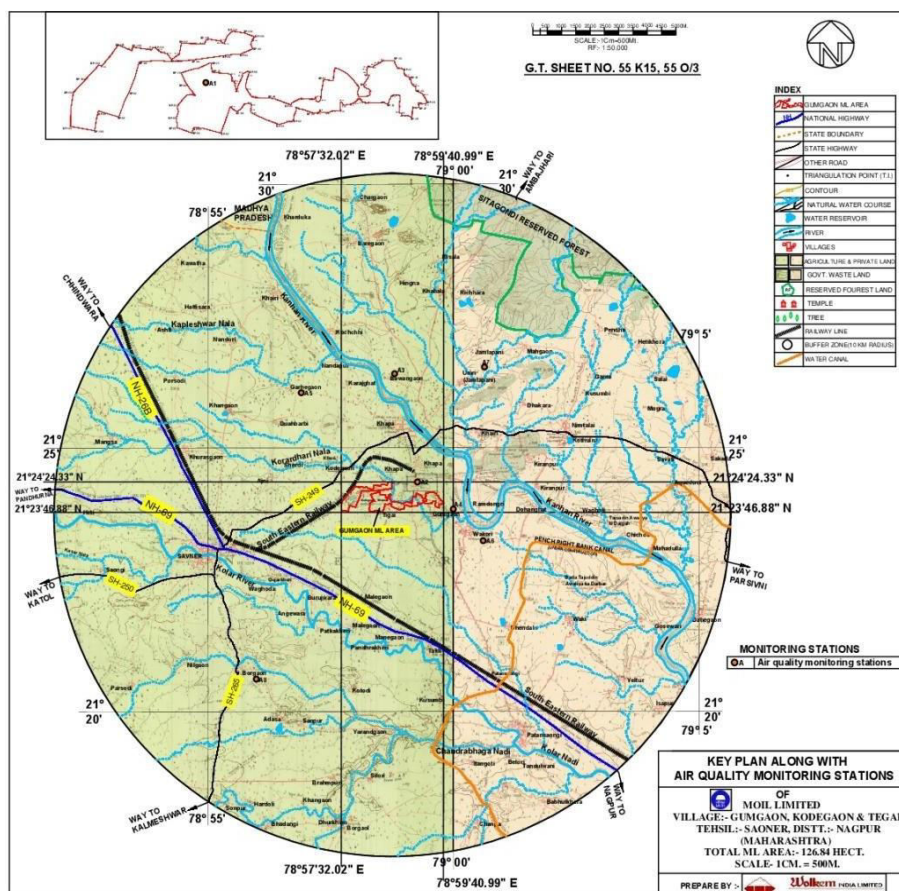
**3.4.4 Methodology & Location of Ambient Air Sampling Station**

The baseline status of the ambient air quality was assessed through a scientifically designed ambient air quality monitoring network based on the following considerations i.e. Meteorology, Topography of the study area & Representativeness of likely impact areas (as per CPCB guidelines). Sampling locations were established for ambient air monitoring in and around the core zone within a radius of 10.0 km, to study the present quality of the air. The monitoring locations are marked on map of Location of sampling points along with distance and direction with respect to applied lease are as under:

Table 3.15: Location of Ambient Air Monitoring Stations

Station Code	Station Name	Location with respect to Site		Latitude (N)	Longitude (E)
		Distance (Km)	Direction		
A1	Core zone	-----	-----	21°24' 12.00"	78°57' 57.40"
A2	Gumgaon mine (Mine quarters)	0.700 Km	N	21°24' 21.30"	78°58' 58.60"
A3	Bawangaon	3.8 Km	N	21°26' 22.30"	78°58' 36.30"
A4	Gumgaon (500d/w)	0.330 Km	SE	21°24' 21.30"	78°59' 28.90"
A5	Garegaon	3.9 Km	NW	21°26' 9.40"	78°56' 36.00"
A6	Wakori	2.0 Km	SE	21°23' 26.40"	79°00' 15.20"
A7	Jamlapani	4.1 Km	NE	21°26' 49.00"	79°00' 18.60"
A8	Boregaon	7.85 Km	SW	21°20' 41.60"	78°55' 32.50"

Figure 3.11: Ambient Air Sampling Location in the Study Area





**Figure 3.12: Photographs of Ambient Air Monitoring In the Study Area**



#### 3.4.5. Sampling Schedule (as per CPCB guidelines)

Sampling was done 24/7 hourly from each station round the clock, twice a week for continuous three months (Study period).

#### 3.4.6. AIR QUALITY PARAMETER

The following parameters were analysed for each sample.

- Particulate Matter (PM<sub>2.5</sub>)
- Particulate Matter (PM<sub>10</sub>)
- Sulphur dioxide (SO<sub>2</sub>)
- Nitrogen dioxide (NO<sub>2</sub>)

#### IV. CONCLUSION

This mining project is planned to produce mineral suitable for various industries like Steel, Ferro Manganese, Dry Battery, and Chemical Industries.etc. using environment friendly and appropriate mining and mineral beneficiation technology. Implementation of mining project approximately 524 people are required for direct and indirect operation of the project. In addition to this according to the established principle, indirect employment are about 2 to 3 times of the direct employment in other associated activities such as transport, loading/unloading, plantation, mine safety, measures of environmental protection, road repairs, etc.

Training and awareness activities supplemented by community development programmes will improve the overall environment and lifestyle of the inhabitants. Green belt development would be done and workers would be motivated for plantation not only in mining lease area but also in govt. waste land / Panchayat land. The local population will be encouraged to plant fodder / fuel wood so that their dependence on forest is reduced. The adequate technology, environmental strategy etc has been planned which will maintain the ecological balance and also ensure health & safety of the persons.

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