

ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL MANAGEMENT PLAN

For

**KHUB LIMESTONE MINES
OVER AN AREA OF 9.66 HECTARES
IN LUMSHONG VILLAGE, EAST JAINTIA HILLS DISTRICT
MEGHALAYA**

Prepared For

**CEMENT MANUFACTURING COMPANY LTD.
VILLAGE - LUMSHONG, EAST JAINTIA HILLS DISTRICT
MEGHALAYA**

Prepared By



GEOMIN CONSULTANTS (P) LTD.

(ISO 9001:2008 and OHSAS 18001:2007 Certified Company)

267, Kharvel Nagar, Bhubaneswar, Orissa

Phone: (0674-2392080, Fax : (0674) 2390687

E-mail ID: geomin@satyam.net.in

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CHAPTER – 1

INTRODUCTION

1.1 INTRODUCTION

Cement Manufacturing Company Ltd (CMCL) is an ISO9001:2000 certified Public Limited Company with Registered office and works at Lumshnong, East Jaintia Hills district, Meghalaya. CMCL was accorded approval for setting up a 900 TPD cement plant at Lumshnong village, East Jaintia Hills district Meghalaya by the Govt. of Meghalaya in the year 2002 and subsequently was accorded approval for expanding the capacity to 3000 TPD in the year 2003.

The cement plant with the present production capacity of 2400 TPD consists of dry process coal fired kiln with 5 stage suspension pre-heater system. The main components of plant consist of Crusher (Primary & Secondary) to reduce size of ROM limestone, Ball Mill for grinding raw mix, coal grinding mill, rotary kiln with grate cooler and cement mill of suitable capacities to manufacture 2400 tonnes of clinker / cement. The entire ROM as proposed in the mining plan will be used for manufacture of clinker/cement in this CMCL cement plant as it is a captive source. The plant is provided with the latest state-of-the-art pollution control equipment. A full fledged laboratory, workshop, stores etc. are provided. Township for the employees of CMCL along with social infrastructure like hospital, school, canteen, recreation centre etc. is provided at the plant site.

Cement Manufacturing Company Limited (CMCL) has proposed to amalgamate the two existing mining leases over an area of 4.96 & 4.70 hectares respectively, separated by a land of 0.24 hectares. They are situated at Lumshnong, District East Jaintia hills, Meghalaya. The latitude and longitude of the project site are 25° 9'48" to 25°10'4.3"N & 92°22'05.3" to 92°22'23.6"E respectively. Company applied to obtain Environment Clearance from SEIAA, Meghalaya. On 24.04.2013 SEIAA has granted the TOR.

The state Govt. granted the two mining leases mentioned vide letter no. 47/2008/23 dated 22/07/2004 for 4.96 hectares and vide letter no. MG/21/2003/394 dated 04/07/2005 for 4.70 hectares for meeting the requirement of the cement plant CMCL.

The two mining leases were applied for the amalgamation to the state Govt. on 08-12-2006 and was permitted vide letter no. MG.98/2008/23 dated 01/04/2009 (Annexure-2). Mining plan for the amalgamated mine along with the progressive mine closure plan over the combined area of 9.66 hectares was approved by the Indian Bureau of Mines vide letter No.- 314(3)/2010-MCCM (CZ)/MP-32/327 dated 08/04/2011.

In order to commence production of any mines, it is necessary to obtain Environmental Clearances from the Ministry of Environment and Forests, Govt. of India as per EIA Notification 2006. Mining Operation Plan including method of mining in details, Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) etc. are essential requisites for Environmental Clearance. Hence, the lessee has to prepare a Rapid Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) report for Environmental Clearance before commencement of mining activities. The reclamation plan for EIA/EMP provides the basis for Governments' decision to permit environmental acceptability of the proposal.

This mining project is for amalgamation of 2 MLs. Total production of Limestone is 8.5 lakh MT for running Cement plant which is 3.50 km from the pit head, the limestone at the pit head is the finished product of the mine which is acceptable by the plant. Transporting of limestone is being done from mines by TATA HYVA 2518 tippers, the requirement is based on the requirement of plant. The estimated limestone requirement of the plant is 8.5 Lakh MT though last year we dispatch from mines 8.0 lakh ton (approximately). Estimation is based on the capacity of plant quantity of limestone supplied (1.6 lakh MT) by local villagers as per the agreement made by company with the local body.

For optimizing the resources, CMCL applied amalgamation of two leases which is now approved by DMR, IB and DGMS. By doing amalgamation, the requirement of plant can be achieved with lesser running hours. The total produce from this mining projects are utilized for producing cement.

CMCL assigned to M/s Geomin Consultants Pvt. Ltd., Bhubaneswar, for the preparation of Impact Assessment study and Environmental Management Plan through Terms of Reference (TOR). The area of the ML area is 9.66 ha. So, it is coming under B category as per EIA notification 2006.

CMCL, has submitted the application for Terms of Reference (TOR) to SEIAA, Meghalaya and on 31.10.2012 SEIAA, Shillong issued the TOR vide the letter No.SEIAA/PR-20/2012/6 Dt.24.04.2014. As per the TOR baseline data for one Postmonsoon season i.e. from September 2013 to December 2013 has been generated from the study area. The study area constitutes the core zone (lease area) and the buffer zone (5 kms around the core zone from the periphery). The detailed scope of the study is outlined as follows.

1.2 SCOPE OF STUDY

- Collection, generation and compilation of required baseline environmental data/information covering both core and buffer zones.
- Analysis of all relevant parameters to evaluate the existing air, water and soil quality, and land use pattern and meteorological conditions.
- Study of prevalent ecological habitats, flora & fauna, socio-economic and demographic profile of the region.
- Study of the proposed project activities related to limestone mine.
- Study of the impact assessment of the proposed mining and allied activities likely to affect the various environmental attributes.
- Formulation of a suitable Environmental Management Plan indicating the mitigation measures to be implemented for improving and maintaining the ecological balance of the project area even during and after commencement of mining and allied activities.

1.3 CONTACT DETAILS OF PROJECT PROPONENT

Name & Designation of the Nominated owner

Name: Sri Devender Bansal

Designation: Resident Director / Designated owner of the Mine

Address:

Cement Manufacturing Co. Ltd.

Village - Lumshnong,
P.O - Lumshnong,
P.S - Khliehriat
Dist. —East Jaintia Hills
Meghalaya-793 210

1.4 DETAILS OF CONSULTANTS

M/s Geomin Consultants (P) Ltd.
267, Kharavela Nagar
Bhubaneswar - 751001
Phone: 0674-2392080, Fax – 0674-2390687
E-mail: geomin@satyam.net.in
Date of NABET Accreditation: 10.05.2010

Person Involved

Dr. S.K. Sarangi- Co-coordinator
Sri S. Mishra-FAE LU
Sri S.K. Patnaik- FAE AP & AQ
Sri S.Katei- FAE AP
Dr. P.C. Rath-FAE WP
Sri B.N. Mohanty- FAE EB
Sri KL Narayan- FAE NV
Sri P. Panigrahi- FAE SE
Sri N.K. Shukla- FAE HG
Sri R.N Mohapatra- FAE GEO
Sri B.P. Mishra-FAE GEO
Sri B.N. Mohanty-FAE SS
Sri A. Pothal- FAE RH
Sri S.K. Patnaik-FAE SHW

1.5 LITIGATION ON PROJECT

There is no litigation or court cases are pending against the project.

CHAPTER – 2

PROJECT PROFILE

2.1 INTRODUCTION

The cement plant with the present production capacity of 2400 TPD consists of dry process coal fired kiln. The main components of mines consist of Levelling of the surface by dozer → Drilling → Blasting → Loading to transport vehicles by Hydraulic Excavator → Transporting by TATA HYVA to plant → Weigh Bridge for weighment → Unloading to crusher/Limestone Stockyard in plant → Weigh Bridge for Empty weighment of HYVA → Return to Mines.

The plant is provided with the latest state-of-the-art pollution control equipment. A full fledged laboratory, workshop, stores etc. are provided. Township for the employees of CMCL along with social infrastructure like hospital, school, canteen, recreation centre etc. is provided at the plant site.

Cement Manufacturing Company Limited (CMCL) has proposed to amalgamate the two existing mining leases over an area of 4.96 & 4.70 hectares respectively, separated by a land of 0.24 hectares. They are situated at Lumshong, District East Jaintia hills, Meghalaya. The latitude and longitude of the project site are 25° 9'48" to 25°10'4.3"N & 92°22'05.3" to 92°22'23.6"E respectively. Company is applied to obtain Environment Clearance from SEIAA, Meghalaya. On 24.04.2013 SEIAA has granted the TOR.

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Land Use Pattern

The present land use pattern is as follows.

Land Use Pattern (Forest, Agricultural):- Non-forest & non-agriculture.

ML Area comprises Grazing, barren and fallow land, where mineral deposits exist. The area is surrounded by thick bushes. A perennial nala flows about 400 mtrs. south of the southern lease boundary. The area is devoid of any natural drainage course or nala.

Land Use Details

(Area in hectares)

Sl. No.	Pattern of Utilisation	Existing	Planned 5 years	Beyond 5 years	Total
1.	Area to be excavated ML area 4.96Ha &-ML area4.7Ha.	7.17	0.42	0.5	8.09
2.	Storage for top soil	Nil	Nil	Nil	Nil
3.	Overburden/dump	Nil	Nil	Nil	Nil
4.	Mineral Storage	Nil	Nil	Nil	Nil
5.	Infrastructure (Workshop, administrative building)	Nil	Nil	Nil	Nil
6.	Roads	Nil	Nil	Nil	Nil
7.	Railways	Nil	Nil	Nil	Nil
8.	Green Belt	Nil	Nil	Nil	Nil
9.	Tailing pond	Nil	Nil	Nil	Nil
10.	Effluent Treatment Plant	Nil	Nil	Nil	Nil
11.	Mineral Separation Plant	Nil	Nil	Nil	Nil
12.	Township area	Nil	Nil	Nil	Nil
13.	Others to specify	Nil	Nil	Nil	Nil
	Sub-Total	7.17	0.42	0.5	8.09
14.	Safety zone (7.5 ML boundary)	---	---	---	1.57
	Total	7.17	0.42	0.5	9.66

The above figures are inclusive of Deposit-I and Deposit-II both.

The EIA/EMP is prepared as per the mining plan submitted for approval by IBM and prescribed TOR by SEIAA, Meghalaya. The TOR letter and its clarification for reference appended to this report as Annexure-1.

2.2 LOCATION AND ACCESSIBILITY

The geographical location is given in Table - 2.1.

Table - 2.1
Geographical Location

State	Meghalaya
District	East Jaintia hills
Village	Lumshong
Lease Area	9.66 ha
Toposheet No.	83C/W
Latitude	25°9'48" to 25°10'4.3"N
Longitude	92°22'05.3" to 92°22'23.6"E
Altitude	520 m AMSL to 546m AMSL

The geographical location map is given in **Fig. 2.1**.

There is no public road or railway line within the M.L area. The lease area is situated at a distance 1 km east of NH-44 connecting Shillong to Silchar. The nearest railway station at a distance of 85km from Lumshnong is Badarpur on Guwahati-Lumding-Silchar meter gauge section of N.E.F. Railway. The lease area map is given in **Fig. 2.2** Topography of the ML area and its surroundings are rugged and mountainous. Maximum and minimum contours passing through the area are 546m and 520m respectively with graters relief of 20m. South-Western part of the area is at a higher elevation with respect to south-eastern part. The nearest airport at Silchar is 125 kms and Guwahati at about 211 kms from Lumshong village. There is no national Park, wild life sanctuary or any ecosensitive zone exists within 10kms of ML area.

2.3 PROJECT OBJECTIVES

This is a new mining project. Mining lease in principle granted in favour of CMCL. The proposed production target of limestone is 8,50,000 TPA from the lease. The limestone to be produced will be utilized in the existing cement plant of the company. Opencast mechanised means of mining will be adopted for mining of limestone.

2.4 SIGNIFICANCE OF PROJECT ON LOCAL/STATE/COUNTRY

Meghalaya is one of the north eastern states of India. The north eastern states are back ward in comparison to other part of the country. In order to develop the region infrastructural and industrial development is a must. Lime stone mines and Cement industry are the most required parameters for infrastructural development.

2.5 TOPOGRAPHY AND DRAINAGE

Topography of the ML area and its surroundings are rugged and mountainous. Maximum and minimum contours passing through the area are 535m and 481m respectively. South-Western part of the area is at a higher elevation with respect to south-eastern part. It is represented in lease plan and surface drainage plan (**Fig. 2.3**). A perennial nala flows about 400 mtrs. south of the southern lease boundary

No first order or second order stream is passing through the lease.

2.6 GEOLOGY

2.6.1 Regional Geology

The State of Meghalaya comprising eleven districts covers an area of approximately 22,429 sq km. Bordered to its North and East by the State of Assam and South and West by Bangladesh. The state presents a picturesque landscape of plateau, ravines, rivulets, lakes and water falls and magnificent gorges even exceeding 60 m. depth in Khasi Hills. Shillong the state capital is located at an elevation of 1800 m in the central part of Khasi Hills. The rock formations of the area fall under Jaintia series of Eocene age.

The Regional Stratigraphic Succession is as follows:

Age	Group/Series	Stage	Rock types
Oligocene	Barail Series	--	Sandstone & Shale.
Upper Eocene	Garo Group	Kopili Formation	Grey shale with alternate layers of Sandstone & Siltstone
Lower to Middle Eocene	Jaintia Group	Sylhet Limestone	Prang Limestone Narpuh Sandstone Umlatdoh Limestone Lakadong Sandstone Lakadong Limestone.
Palaeocene		Theria Sandstone	Sandstone

Limestones of Lakadong, Umlatdoh and Prang horizons are distinctly & sequentially separated by two bands of Sandstone known as Lakadong and Narpuh sandstones.

2.6.2 Local Geology

The present area under report falls under Survey of India Toposheet No. 83 C/SW and located near village Lumshnong ($25^{\circ}9'48''$ to $25^{\circ}10'4.3''$ N & $92^{\circ}22'05.3''$ to $92^{\circ}22'23.6''$ E). The minimum and maximum elevation of the area varies from **520m** to **546m** above M.S.L. The different lithounits of the area belong to Jaintia series of Eocene age. The limestone unit belongs to sylhet stage of Jaintia series of middle Eocene age.

Three bands of limestone occur in the area which are known as Prang, Umlatdoh and Lakadong limestone bands. These are separated by Narpuh sandstone and Lakadong sandstone. The topmost limestone band i.e Prang limestone occurs further south of the prospect.

Based on surface and sub-surface data generated during the exploration work, the following rock formations are encountered in the area. (Fig. 2.4).

Age	Group/Series	Stage	Rock types
Oligocene	Barail Series	--	Sandstone & Shale.
Upper Eocene	Garo Group	Kopili Formation	Grey shale with alternate layers of Sandstone & Siltstone
Lower to Middle Eocene	Jaintia Group	Sylhet Limestone	Prang Limestone Narpuh Sandstone Umlatdoh Limestone Lakadong Sandstone Lakadong Limestone.
Palaeocene		Theria Sandstone	sandstone

2.7 RESERVES AND GRADE

The estimated reserves are as follows (Table - 2.2).

Table - 2.2
Reserves

(in million tonnes)			
Category	Khub-I	Khub-II	Total
Measured Mineral Resources (331)	6.05	5.40	11.45
Proved Mineral Reserve (111)	3.33	2.82	6.15

2.8 MINING

2.8.1 Mining Method

Opencast fully mechanised method of mining will be adopted on one shift basis. Machineries/vehicles like crawler drill, air compressor, hydraulic excavators, dumpers, etc. will be used. The limestone shall be dislodged by drilling and blasting. Limestone will be handled by dumpers/ tipper trucks and Excavators. Height and width of the working mine benches would be 6 meters and 12 meters respectively. Slope of the benches will be 45° where as overall slope of the pit will be 45°. Production will be 8,50,000 TPA of limestone. Keeping the above production in view, the life of the mine will be 20 years. The capital cost of the project is Rs. 675 Lakhs. No waste will be generated from the mine.

Employment will be provided for 100 people in two shift basis. Ground water table is at 420m AMSL (in summer) and 425m AMSL (in rainy season). Hence mining will not touch ground water table. About 50 cum/day of water shall be utilized in the mining activities. Water will be supplied from MCL Plant site.

Proposed Production Programme of two years (Ref Fig No. 2.5)

Year	Production schedule (in lac tons)	Remarks
4 th Year (2013-14)	0.29	There is no wastes generation or rejects. 100% ROM is used for cement manufacturing.
5 th Year (2014-15)	0.58	
Total	0.87	

2.8.2 List of Equipments:

1. Hydraulic Excavator:-

Make : VOLVO.
Model : EC 290 BLC - 2 Nos.

Operation planned for 8 hours Limestone Production. 4 hours for Overburden Removal. Presently there is negligible O/B No removal of O/B during Rains.

2. Hydraulic Excavator:-

Make : L&T Komatsu,
Model : PC-200 - 01 No.

Mainly used with Secondary Rock Breaker HB 1200. Also to be used as standby during breakdown of Volvo.

3. Hydraulic Breaker HB 1200 :-

Make : Atlas Copco – 01 No.

120 mm dia Moil Point for breaking oversize boulders. Secondary Blasting is totally eliminated.

4. TIPPRS:-

Make : TATA
Model : 2516 HYVA - 15 Nos.

Approximate capacity of 20 MT. Will be used for Transportation of over Burden & Limestone.

5. Screw Compressor

Make : ATLAS COPCO,
Model : XAH 210 – 01 No.;

130-210 Ltr/Second Used with Crawler Drill ROC-203 – 01 No.;

Crawler Drill,

Make : Atlas Copco,
Model : ROC-203 – 01 No. 115mm dia hole drill, works as Primary Drill.

6. Bull Dozer:-

Make : BEML,
Model : D-50 – 01 No.

For Dozing after blasting & at dump

7. Water Tanker 10KL capacity Mounted on TATA Chassis – 01 No.

Used for dust suppression on road.

8. Maintenance Van – 01 No.

For maintenance at Site is available and in operation, we have one Diesel Bowser, one Explosive Van Mounted on Jeep Chassis (500kg) and light vehicle.

Angle hole drilling (5 to 10°) of 115m

2.8.3 Nature of Waste:

No waste to be generated from the mines

2.8.4 Blasting

Broad blasting parameters like Charge per hole – Charge per hole – $6 \times 4.66 \text{ Kg/m} = 27.96 \text{ Kg/hole}$

Blasting pattern-Depending on the availability of free face the hole pattern is designed, if single free face is there than 1st row of holes are drilled parallel to free face, second row of holes are drilled parallel to first row, but in triangular patten. Charging will be done by slurry/ANFO, keeping 25ms delay between hole to hole and there will be 42ms delay between row to row, the first hole which will be fired will have less burden and maximum free face.

Explosives used /to be used

Booster charge (83mm) = Slurry / Emulsion Explosives

Column charge (83mm) = ANFO (Ammonium Nitrate Fuel oil)/Non cap sensitive slurry Explosive)

NONEL/Shok Tubes

Electric Detonator

No secondary blasting will be required as hydraulic rock breaker is proposed to be used. The management has a magazine of 5000kg capacity

2.8.5 Type of explosive

To carryout blasting operation, Class-II (Slurry Cap & Non Cap Sensitive & ANFO with cast boosters/special gelatin 80% strength) and Class-VI explosive (detonating fuse & Electric detonator) to be utilized in the mine.

2.8.6 Explosive Consumption

Explosive of about 27.96 kg. per hole to be utilized.

2.8.7 Reclamation & Rehabilitation measures:

During Plan Period

During planned period limestone will not be exhausted within any part of the proposed quarry. So no reclamation proposal has been envisaged during these years. However, owing to certain land degradation a total of 2500 saplings are proposed to be planted. It is proposed to bring 7.5m zone under plantation @ 2500 saplings/ Ha.

2.9 EMPLOYMENT POTENTIAL

The mine requires 100 numbers of employees.

2.10 MINERAL BENEFICIATION

USE OF MINERALS

The entire limestone raised from the mine will be utilized in Lessee's own cement plant situated at a distance of 3.50 kms from the lease area.

Limestone of this mine finds its use in the Lessee's own cement plant with specification as follow:

CaO	-	44.50-48.50%
MgO	-	1.50-3.00%
SiO ₂	-	2.50-4.50%
Al ₂ O ₃	-	1.50-2.50%
Fe ₂ O ₃	-	1.00-2.00%
SIZE	-	The limestone is crushed and reduced to 25mm for the consumption in the raw-mill.

2.11 TRANSPORTATION AND INFRASTRUCTURE

The mining project is for amalgamation of 2 MLs. Total production of Limestone is 8.5 Lakh MT for running cement plant which is 3.5 Km from the pit head. The Limestone at the pit head is the finished product of the mine which is acceptable by the plant. Transporting of Limestone is being done from mines by TATA HYVA 2518 tippers. The requirement is based on the requirement of plant. The estimated Limestone requirement of the plant is 8.5 Lakh MT.

The working mines will be provided rest shed, first aid centre, ambulance facility etc. Besides this all infrastructural facility available in the plant of CMCL will be made available to the employees. The hazardous protecting equipment also will be provided to the employee such as helmet, ear muff and mask.

2.12 COST OF PROJECT

The expected cost of the project is Rs. 675 Lakhs.

2.13 CONSERVATION OF MINERAL

100% of ROM will be fed to the cement plant. No conservation of mineral is envisaged in the project.

2.14 LITIGATION AGAINST THE PROJECT

There is no litigation or court cases are pending against the project.

CHAPTER – 3

ANALYSIS OF ALTERNATIVES

3.1 INTRODUCTION

The applied lease area is over 9.66 ha. in the State of Meghalaya. For the Study as per the Terms of Reference lease area is considered as core zone and 5 kms radius area around lease area considered as buffer zone.

3.2 ANALYSIS OF ALTERNATIVES

Various alternate limestone deposits available around the CMCL's plant to meet the raw material requirement of the expanded plant capacity have been examined. The limestone deposit over 9.66 ha has been selected in view the following favourable considerations over other areas/deposits.

- i) The ML area is amalgamation of 2 existing operating leases.
- ii) The project is site specific in view of occurrence of limestone.
- iii) The deposit is closer to the operating cement plant.
- iv) The deposit is closer to the exiting road and no additional land is required for any road connectivity.
- v) The entire area belongs to one private individual, so complexities involved in negotiating with multiple owners is avoided.

3.3 STUDY CARRIED OUT

As per the standard TOR, the environmental parameters covering (a) land use (b) water environment (c) air quality (d) biological (flora and fauna) (e) noise and vibration (f) socio economic (g) health environment etc. parameters are considered for the EIA study and discussed in chapter 4 of the report.

CHAPTER – 4

PRESENT ENVIRONMENTAL SCENARIO

4.1 INTRODUCTION

Today the globe is engaged in seemingly endless discussions about the sustainable development while the mining industry stands on the cross roads involved in the problems of growth, sustainability and imperative need of an environmental agenda. Modern technology has enormously magnified the ability to extract the minerals. Mining activities represent one of the important and vital indexes of economic and industrial development of any country. The occurrence of mineral deposits, being site specific their exploitation cases do not allow for any choice except adoption of an eco-friendly operation. However, the methods are required to maintain environmental equilibrium ensuring sustainable development. Mining processes normally affect the existing environmental domains of the site. It has both adverse and beneficial effects. In a view to maintain the environmental commensuration with the mining operations, it is necessary to undertake studies on existing environmental scenario and impacts of mining activities on different environmental domains. This would help in formulating suitable management plans to effect sustainable development plan to effect sustainable development of the resources.

The entire mining lease area is considered as core zone. The surrounding area covering 5 Km radius from the periphery of the core zone is considered as buffer zone. The core zone and the buffer zone combinedly called as study area.

4.2 METHODOLOGY

An attempt has been made to assess the existing environmental scenario through generation of different data in the study area. Different environmental parameters required to evaluate the prevailing scenario have been generated/collected and compiled for the period from September-December 2013. The details of the sampling locations are represented in **Fig. 4.1**. The basic environmental attributes generated and compiled for study area are as follows.

- Meteorological Condition
- Ambient Air Quality
- Noise level
- Water Resource and Quality
- Soil Quality
- Land use Pattern
- Ecological Pattern
- Socio-Economic and Demographic Profile

To complete the assignment as per the scope of works the following methods have been adopted.

- ♦ Generation of Baseline data
- ♦ Analysis of data
- ♦ Preparation of report

The Public Consultation will be done before applying for the environmental clearance.

4.2.1 Generation of Baseline Data

i) Air quality, noise level and meteorological parameters

To evaluate the air quality, noise characteristics and meteorological parameters two permanent stations are fixed in the core zone and six permanent stations are fixed in the buffer zone by taking into account the prevailing wind conditions in the study season of Postmonsoon (**Fig. 4.1**). The sampling locations are selected in all the directions of the lease area.

The air monitoring station at the mining site in the core zone is fixed with conventional anemometer to measure the wind speed, wind vane to note wind directions, thermometer for temperature readings, and hygrometer for relative humidity data on hourly basis during monitoring periods. Eight locations are selected for studying the noise characteristics in the same place where the air samples are taken.

ii) Ecological Studies

Ecological study is based on the distribution pattern of the various species of plants and density of vegetation within the study area. Detailed species-wise floral surveys have been conducted. Random surveys inside core and buffer zone have been made for determining the faunal characteristics.

iii) Dust fall measurement

Dust fall kits are placed at eight different fixed stations in the core zone and the buffer zone to note the concentration of dust.

iv) Water Quality

Eight water samples were taken from different water sources i.e. six samples from surface water and four from ground water.

v) Soil Quality

Three soil samples were taken from five soil profiles (**Fig. 4.1**) to analysis the soil characteristics.

vi) Socio-economic and Demographic profile

Main villages within the core and buffer zones have been selected for sample survey on various aspects to decipher socio-economic and demographic profile. Data collected during survey have been compared with the data collected from the Census Survey of 2011. The details of Socio-economic and demographic profile is described in para 4.11 of this report .

4.2.2 Analysis of Samples Generated

i) Ambient air samples

PM_{2.5} & PM₁₀ samplers are used to collect 24 hourly samples for two consecutive days in a week in each permanent station collecting two samples per week, per station for a period of 3 months. This process continued for the study period and samples are collected from each station. The samples are analysed to know the concentration of PM₁₀, PM_{2.5}, SO₂, NO_x and CO as per the procedures laid down by the Indian Standards, IS Code No. 5182 (Part IV, 23, II, VI, X respectively). 24 hourly samples were collected for PM₁₀ and PM_{2.5} and 8 hourly collections were made for SO₂, NO_x and CO for two consecutive days in a week per station for a period of three months.

ii) Meteorological parameters

Meteorological data like wind speed; wind direction, temperature, relative humidity and rainfall are generated from all fixed stations on continuous basis for three months period. Data for previous years were collected mainly from the near by meteorological station for comparison.

iii) Noise characteristics

The noise measurements are made using a sound level meter on hourly basis for continuous period of one day (simultaneously during AAQ monitoring) during the study period and are compared with the prescribed Indian Standards.

iv) Dust fall

The dust fall data collected as per IS Code No. 5182 part-I and analysis was done.

v) Water quality

Samples collected from the representative sites (Figure 4.1) have been analysed to note different parameters as per IS Code NO. 10500 and IS 3025.

vi) Soil quality

The analysis has been conducted to note various (physical and chemical) parameters using Indian standard methods code (IS 2720).

vii) Land use and land cover pattern

Land use and land cover pattern maps are prepared for both core and buffer zone based on the satellite imageries maps. This is substantiated by actual field studies.

4.2.3 Preparation of report

Based on the data generated/complied, studies on Environmental Impact Assessment for the area is made which has helped to formulate a suitable Environmental Management Plan.

4.3 LAND USE PATTERN

The total M.L area is non-forest land. The existing land use pattern of the core zone is as follows (Table - 4.1).

Table - 4.1
Pre operational Core Zone Land use Pattern

Sl. No.	Pattern of Utilisation	Existing	Planned 5 years	Beyond 5 years	Total
1.	Area to be excavated ML area 4.96Ha &-ML area4.7Ha.	7.17	0.42	0.50	8.09
2.	Storage for top soil	Nil	Nil	Nil	Nil
3.	Overburden/dump	Nil	Nil	Nil	Nil
4.	Mineral Storage	Nil	Nil	Nil	Nil
5.	Infrastructure (Workshop, administrative building)	Nil	Nil	Nil	Nil
6.	Roads	Nil	Nil	Nil	Nil
7.	Railways	Nil	Nil	Nil	Nil
8.	Green Belt	Nil	Nil	Nil	Nil
9.	Tailing pond	Nil	Nil	Nil	Nil
10.	Effluent Treatment Plant	Nil	Nil	Nil	Nil
11.	Mineral Separation Plant	Nil	Nil	Nil	Nil
12.	Township area	Nil	Nil	Nil	Nil
13.	Others to specify	Nil	Nil	Nil	Nil
	Sub-Total	7.17	0.42	0.50	8.09
14.	Safety zone (7.5 ML boundary)	---	---	---	1.57
	Total	7.17	0.42	0.50	9.66

The land use pattern of buffer zone is presented in Table - 4.2 and **Fig. 4.2**.

The maximum elevation of the area is 546 meter AMSL and minimum elevation is 520 meter AMSL.

Table - 4.2
Land Use Pattern of Buffer Zone

Sl. No.	Land use	Area (sq.m.)	Percentage of total area
1.	Settlement	1.71	2.10
2.	Agriculture	17.25	21.95
3.	Forest	45.54	57.96
4.	Grass & shrubs	8.32	10.69
5.	Barren Land	5.75	7.30
	Total	78.57	100

The study area does not have harbour or archaeological site and any other places of historical importance.

4.4 SOIL CHARACTERISTICS

Soil samples were collected from four locations (**Fig. - 4.1**) in the study season and were analysed to know the soil type, moisture content, nutrients level and other chemical parameters of the soil. The analysis results of the samples are indicated in Table - 4.3.

Table 4.3
Result of Soil Sample Analysis

Sl. No.	Parameter	Unit	Soil Samples			
			S ₁	S ₂	S ₃	S ₄
1	pH	----	6.7	6.6	6.8	6.5
2	E.C	μS/cm	109	103	107	105
3	Sodium as Na	ppm	34	33	32	35
4	Bulk density	gm/c.c	2.3	2.5	2.4	2.6
5	Organic matter	%	1.82	1.98	2.05	1.89
6	Chloride	%	0.07	0.06	0.05	0.04
7	Sand	%	14	16	15	18
8	Salt	%	40	43	45	41
9	Clay	%	42	41	45	42
10	Texture	%	Silty-Clayee	Silty-Clayee	Silty-Clayee	Silty-Clayee
11	Porosity	%	42	47	45	43
12	Water holding	%	41	43	44	40
13	Organic carbon	%	1.07	1.18	1.05	1.11
14	N	ppm	14	13	16	15
15	P	ppm	12	13	15	17
16	K	ppm	16	14	15	13
17	S	ppm	13	15	12	14
S ₁ : Lease area			S ₂ : Near Tongseng village			
S ₃ : Near Lumshnong village			S ₄ : Near Umbadoh village			

In the proposed activity area the thickness of the topsoil zone is very thin. The soil is mostly red and brownish-red in colour and lateritic in nature. These lateritic soils are mostly poor in organic contents and moisture retaining capacity.

4.5 METEOROLOGY

The mining lease area experiences dry to moist subtropical climate. In a view to assess the meteorological parameters of the project area and its surroundings, studies have been made to generate/compile data on rainfall, wind speed, wind direction, temperature and relative humidity.

4.5.1 Rainfall Data

The annual mean rainfall observed at Shillong was 2415.3 mm while total number of rainfall days were 129.1. While the annual mean annual rainfall observed at Silchar was 3213.7 mm & total number of rainfall days were 132.6 mm.

The rainfall data of near by district i.e. Jaintia Hills District, East Garo Hills District and East Khasi Hills District has been collected from the Central Ground Water web site and given below:

Table - 4.4
Rainfall Data in mm.

Year	Name of the Districts		
	East Jaintia Hills	East Garo Hills	East Khasi Hills
2005	3145.6	2053.7	6239.9
2006	2778.3	1754.1	4600.5
2007	--	3270.8	8589.1
2008	--	3162.7	6885.2
2009	--	3059.8	5386.3
2010	--	2485.9	8291.4
2011	--	2616.6	7778.1
2012	3403.5	2695.5	6533.6

4.5.2 Temperature and Relative Humidity

The meteorological data for temperature and relative humidity were collected during the study period. The temperature ranged from 6.3⁰C to 25.7⁰C while the relative humidity varied from 62.0% to 95.0% during Postmonsoon season.

Month	Temperature in ° C		Relative Humidity %		Wind Speed km/Hr. Max	Predominant wind Direction
	Min	Max	Min	Max		
15 Sept – 14 Oct 13	16.7	25.3	62	93	10.6	SW-SSW
15 Oct – 14 Nov 13	12.9	25.2	65	95	8.3	SW-WSW
15 Nov – 14 Dec 13	6.3	22.5	64	89	7.9	W-SSW

4.5.3 Wind Speed and Direction

The meteorological data for wind speed and direction were collected in and around the core zone during the study period simultaneously AAQ monitoring. The predominant wind direction is from West to South West. The brief data are represented in Table - 4.5 and wind rose diagram in **Fig. 4.3**.

Table - 4.5
Frequency Distribution chart in %

Sl. No.	Direction	Wind speed in km/hr.			
	From	1.5-5.0	5.1-10.0	10.1-15.0	Total
1	N	1.1	0.5	0.1	1.7
2	NNE	--	--	--	--
3	NE	--	--	--	--
4	ENE	--	--	--	--
5	E	--	--	--	--
6	ESE	--	--	--	--
7	SE	--	--	--	--
8	SSE	1.3	0.5	--	1.8

Sl. No.	Direction	Wind speed in km/hr.			
	From	1.5-5.0	5.1-10.0	10.1-15.0	Total
9	S	4.9	0.7	0.2	5.9
10	SSW	5.6	0.6	0.5	6.8
11	SW	5.2	1.2	0.4	6.8
12	WSW	4.9	1.1	0.4	6.4
13	W	6.1	0.4	0.2	6.7
14	WNW	4.4	0.6	0.3	5.4
15	NW	3.6	0.5	0.3	4.4
16	NNW	1.9	0.5	0.2	2.6
Calm		51.5			

4.6 AMBIENT AIR QUALITY

Details of Sampling Location

Sl. No.	Station Codes	Stations	Direction	Distance (in Km) and Justification
01	A ₁	Mine Site	Inside the lease area	4.96 Ha.
02	A ₂	Mines Site	Inside the lease area	4.70 Ha.
03	A ₃	Umlaper	SE	1.0km(Nearby Village in the wind direction during study Period)
04	A ₄	Tongseng	SE	3.0km (Nearby Village in the wind direction during study Period)
05	A ₅	Umlong	WNW	2.5 KM (Nearby Village against wind direction during study Period)
06	A ₆	Umbadoh	N	3.5km (Project proponent Plant site where small township is exists)
07	A ₇	Lumshnong	NE	1.5 km (Nearby village in the wind direction during study Period)
08	A ₈	CMCL Plant Site	NEE	1.3km (Nearby Village in the wind direction during study Period)

Sampling was done in the above station and the same was carried out above 3 m of height from the ground level on a platform erected with outcrops the base. The station represents approximately the highest ground level of the area and practically having no obstruction. The Ambient Air Quality is presented in Table 4.6 and the standard in Table - 4.7.

AAQ monitoring work was carried out at the following stations during Postmonsoon season in the study area. The direction and the distance are represented with respect to the periphery of the core zone. . We had tested all the parameters as prescribed by CPCB but the all the parameters found below the detectable limit in the study area, so we had not given them in them in tabular form.

Table - 4.6
Ambient Air Monitoring Results

CORE ZONE

A1: Inside Lease area (4.96 Ha.)

Season: Post Monsoon

SL No.	Date of Monitoring	Duration of Monitoring in Hrs	Ground Level concentration In Microgram/cubic meter				
			PM ₁₀	PM _{2.5}	SO ₂	NO _x	CO
1	15.09.2013	24	50.2	30.1	12.5	17.0	<1000
2	16.09.2013	24	48.4	28.7	14.1	15.6	<1000
3	22.09.2013	24	42.3	23.8	14.3	22.6	<1000
4	23.09.2013	24	54.4	30.8	13.4	19.0	<1000
5	29.09.2013	24	55.7	31.7	13.8	17.0	<1000
6	30.09.2013	24	63.5	35.7	13.2	18.2	<1000
7	07.10.2013	24	54.5	31.2	16.5	18.0	<1000
8	08.10.2013	24	56.4	30.6	13.4	19.4	<1000
9	14.10.2013	24	55.8	31.7	14.9	16.2	<1000
10	15.10.2013	24	54.7	32.5	14.3	20.7	<1000
11	21.10.2013	24	55.4	30.8	14.2	16.9	<1000
12	22.10.2013	24	52.2	31.7	13.8	16.3	<1000
13	29.10.2013	24	57.4	34.2	14.9	17.1	<1000
14	30.10.2013	24	56.5	32.2	16.1	15.6	<1000
15	06.11.2013	24	45.8	31.4	17.2	15.5	<1000
16	07.11.2013	24	51.8	29.7	18.3	19.1	<1000
17	13.11.2013	24	49.9	30.8	16.2	20.6	<1000
18	14.11.2013	24	47.3	32.2	17.4	21.3	<1000
19	20.11.2013	24	52.4	31.4	16.8	16.2	<1000
20	21.11.2013	24	56.3	32.8	18.1	19.2	<1000
21	27.11.2013	24	53.5	33.8	17.2	18.4	<1000
22	28.11.2013	24	51.4	31.4	18.3	17.0	<1000
23	04.12.2013	24	60.4	33.4	19.3	16.6	<1000
24	05.12.2013	24	48.4	29.2	18.3	16.9	<1000
25	11.12.2013	24	49.5	28.2	13.3	17.1	<1000
26	12.12.2013	24	51.3	30.4	14.3	21.3	<1000
27	18.12.2013	24	54.2	32.4	15.1	19.2	<1000
28	19.12.2013	24	51.7	29.9	14.1	20.1	<1000
MAX			63.5	35.7	19.3	22.6	
MIN			42.3	23.8	12.5	15.5	
AVERAGE			52.90357	31.16786	15.475	18.14643	
95 PERCENTILE			59.35	34.06	18.3	21.3	

A2: Inside Lease Area (4.70 Ha.)**Season: Post Monsoon**

SL No.	Date of Monitoring	Duration of Monitoring in Hrs	Ground Level concentration In Microgram/cubic meter				
			PM ₁₀	PM _{2.5}	SO ₂	NO _x	CO
1	15.09.2013	24	44.8	31.3	13.6	21.3	<1000
2	16.09.2013	24	46.4	34.2	14.6	17.3	<1000
3	22.09.2013	24	48.7	33.7	15.1	16.5	<1000
4	23.09.2013	24	62.3	36.3	14.2	19.7	<1000
5	29.09.2013	24	61.4	33.5	15.6	18.1	<1000
6	30.09.2013	24	55.4	34.3	16.1	16.6	<1000
7	07.10.2013	24	60.2	36.2	14.3	24.3	<1000
8	08.10.2013	24	59.7	37.1	15.3	22.3	<1000
9	14.10.2013	24	53.2	31.5	14.2	16.7	<1000
10	15.10.2013	24	51.5	33.4	15.7	19.1	<1000
11	21.10.2013	24	57.2	32.4	14.5	16.7	<1000
12	22.10.2013	24	54.3	33.6	17.2	19.4	<1000
13	29.10.2013	24	53.8	34.6	15.1	20.6	<1000
14	30.10.2013	24	52.4	35.5	16.7	19.7	<1000
15	06.11.2013	24	50.6	35.0	18.5	16.4	<1000
16	07.11.2013	24	56.4	35.5	13.6	17.3	<1000
17	13.11.2013	24	49.4	31.2	16.8	19.8	<1000
18	14.11.2013	24	48.1	32.4	18.4	28.1	<1000
19	20.11.2013	24	56.4	29.9	17.7	24.6	<1000
20	21.11.2013	24	60.1	34.4	16.4	16.1	<1000
21	27.11.2013	24	56.3	35.8	13.1	17.2	<1000
22	28.11.2013	24	54.2	34.7	16.1	19.2	<1000
23	04.12.2013	24	60.1	33.2	14.4	17.3	<1000
24	05.12.2013	24	55.9	34.6	14.8	18.7	<1000
25	11.12.2013	24	57.3	33.4	18.1	18.6	<1000
26	12.12.2013	24	55.4	35.1	16.3	17.3	<1000
27	18.12.2013	24	60.1	34.2	17.6	21.3	<1000
28	19.12.2013	24	57.3	34.5	18.4	18.9	<1000
MAX			62.3	37.1	18.5	28.1	
MIN			44.8	29.9	13.1	16.1	
AVERAGE			54.96071	33.98214	15.8	19.25357	
95 PERCENTILE			60.98	36.265	18.4	24.495	

Buffer Zone**A3: Umlaper****Season: Post Monsoon**

SL No.	Date of Monitoring	Duration of Monitoring in Hrs	Ground Level concentration In Microgram/cubic meter				
			PM ₁₀	PM _{2.5}	SO ₂	NO _x	CO
1	15.09.2013	24	53.4	31.4	14.7	15.6	<1000
2	16.09.2013	24	54.1	32.1	15.4	13.9	<1000
3	22.09.2013	24	53.4	33.6	16.3	12.6	<1000
4	23.09.2013	24	56.4	32.4	18.3	17.4	<1000
5	29.09.2013	24	57.6	34.3	17.8	12.3	<1000
6	30.09.2013	24	49.3	30.2	18.1	15.1	<1000
7	07.10.2013	24	47.4	29.2	13.3	15.3	<1000
8	08.10.2013	24	45.4	25.9	13.7	13.8	<1000
9	14.10.2013	24	52.3	30.3	17.2	16.6	<1000
10	15.10.2013	24	56.4	34.2	15.9	17.9	<1000
11	21.10.2013	24	54.3	32.7	15.4	15.5	<1000
12	22.10.2013	24	53.5	29.8	19.1	18.2	<1000
13	29.10.2013	24	57.4	34.2	14.7	13.1	<1000
14	30.10.2013	24	58.2	35.3	17.9	11.6	<1000
15	06.11.2013	24	52.3	33.7	14.5	14.5	<1000
16	07.11.2013	24	50.4	32.4	16.0	16.3	<1000
17	13.11.2013	24	53.4	32.1	16.4	18.2	<1000
18	14.11.2013	24	51.0	31.9	17.4	15.1	<1000
19	20.11.2013	24	52.7	31.2	18.6	13.2	<1000
20	21.11.2013	24	57.0	30.4	17.3	16.1	<1000
21	27.11.2013	24	58.1	34.4	16.7	16.9	<1000
22	28.11.2013	24	52.5	30.4	17.1	13.4	<1000
23	04.12.2013	24	59.3	33.7	16.4	12.6	<1000
24	05.12.2013	24	51.3	34.3	17.2	14.1	<1000
25	11.12.2013	24	54.3	31.1	17.2	13.2	<1000
26	12.12.2013	24	56.3	34.2	14.9	15.0	<1000
27	18.12.2013	24	57.1	35.3	16.8	22.9	<1000
28	19.12.2013	24	56.1	33.2	17.9	19.3	<1000
MAX			59.9	36.8	19.8	24.5	
MIN			44.4	26.9	12.8	15.7	
AVERAGE			54.41071	33.02143	16.725	20.46429	
95 PERCENTILE			59.765	36.665	19.355	23.795	

A4: Tongseng
Season: Post Monsoon

Sl. No.	Date of Monitoring	Duration of Monitoring in Hrs	Ground Level concentration In Microgram/cubic meter				
			PM ₁₀	PM _{2.5}	SO ₂	NO _x	CO
1	15.09.2013	24	55.4	31.3	16.3	20.4	<1000
2	16.09.2013	24	55.2	32.6	15.6	23.1	<1000
3	22.09.2013	24	58.3	33.4	17.3	15.2	<1000
4	23.09.2013	24	61.7	35.2	15.4	18.1	<1000
5	29.09.2013	24	62.5	35.3	17.1	18.6	<1000
6	30.09.2013	24	64.8	35.7	15.5	17.9	<1000
7	07.10.2013	24	66.4	37.5	17.8	19.3	<1000
8	08.10.2013	24	61.8	34.7	16.2	18.8	<1000
9	14.10.2013	24	60.2	36.0	16.7	19.4	<1000
10	15.10.2013	24	59.4	34.8	15.3	22.3	<1000
11	21.10.2013	24	58.3	37.4	14.9	18.9	<1000
12	22.10.2013	24	56.5	29.3	18.2	18.6	<1000
13	29.10.2013	24	54.7	33.2	17.8	15.6	<1000
14	30.10.2013	24	57.6	34.8	16.5	18.9	<1000
15	06.11.2013	24	55.4	31.7	17.6	19.6	<1000
16	07.11.2013	24	62.5	32.4	16.8	17.6	<1000
17	13.11.2013	24	54.3	30.1	14.2	22.6	<1000
18	14.11.2013	24	56.4	32.3	16.7	18.4	<1000
19	20.11.2013	24	60.2	31.5	17.8	18.6	<1000
20	21.11.2013	24	56.4	31.2	18.5	17.6	<1000
21	27.11.2013	24	59.6	33.2	17.2	21.3	<1000
22	28.11.2013	24	62.1	30.2	15.8	16.5	<1000
23	04.12.2013	24	66.2	35.1	17.3	16.7	<1000
24	05.12.2013	24	65.3	39.5	16.6	17.9	<1000
25	11.12.2013	24	66.2	29.6	15.7	16.7	<1000
26	12.12.2013	24	66.4	33.5	17.5	17.1	<1000
27	18.12.2013	24	67.2	32.6	16.9	20.4	<1000
28	19.12.2013	24	64.9	32.6	18.1	19.2	<1000
MAX			68.8	43.8	19.3	20.8	
MIN			54.7	28.3	13.3	15.7	
AVERAGE			61.34286	34.20357	16.56071	18.81429	
95 PERCENTILE			67.76	39.485	18.695	20.565	

A5: Umlong
Season: Post Monsoon

SL No.	Date of Monitoring	Duration of Monitoring in Hrs	Ground Level concentration In Microgram/cubic meter				
			PM ₁₀	PM _{2.5}	SO ₂	NO _x	CO
1	15.09.2013	24	54.1	33.1	15.4	22.1	<1000
2	16.09.2013	24	55.7	34.4	14.3	19.6	<1000
3	22.09.2013	24	52.4	34.6	16.8	18.7	<1000
4	23.09.2013	24	58.8	35.7	16.3	17.2	<1000
5	29.09.2013	24	61.5	39.2	16.0	17.6	<1000
6	30.09.2013	24	58.6	37.2	13.3	16.3	<1000
7	07.10.2013	24	56.1	35.7	13.1	15.9	<1000
8	08.10.2013	24	57.5	36.4	13.0	16.3	<1000
9	14.10.2013	24	54.6	32.5	17.3	17.1	<1000
10	15.10.2013	24	60.3	35.6	14.4	16.1	<1000
11	21.10.2013	24	55.3	34.5	13.4	15.6	<1000
12	22.10.2013	24	60.7	38.5	16.6	17.2	<1000
13	29.10.2013	24	55.2	34.6	13.4	15.6	<1000
14	30.10.2013	24	60.8	40.4	19.5	16.9	<1000
15	06.11.2013	24	52.5	34.7	17.8	14.3	<1000
16	07.11.2013	24	53.5	30.4	14.2	15.9	<1000
17	13.11.2013	24	52.5	31.6	12.2	17.9	<1000
18	14.11.2013	24	58.5	36.6	18.1	18.9	<1000
19	20.11.2013	24	57.4	38.2	17.5	17.1	<1000
20	21.11.2013	24	50.4	30.8	11.4	18.6	<1000
21	27.11.2013	24	58.2	35.4	15.1	18.3	<1000
22	28.11.2013	24	53.2	31.2	12.1	19.1	<1000
23	04.12.2013	24	57.5	38.8	20.4	17.3	<1000
24	05.12.2013	24	52.7	48.6	14.2	17.3	<1000
25	11.12.2013	24	53.5	34.3	12.1	18.4	<1000
26	12.12.2013	24	61.2	37.6	21.7	16.6	<1000
27	18.12.2013	24	60.2	35.3	15.8	23.6	<1000
28	19.12.2013	24	58.5	34.2	14.1	21S.5	<1000
MAX			61.5	48.6	21.7	23.6	
MIN			50.4	30.4	11.4	14.3	
AVERAGE			56.47857	35.71786	15.33929	17.61111	
95 PERCENTILE			61.06	39.98	20.085	21.35	

A6: Umbadoh
Season: Post Monsoon

SL No.	Date of Monitoring	Duration of Monitoring in Hrs	Ground Level concentration In Microgram/cubic meter				
			PM ₁₀	PM _{2.5}	SO ₂	NO _x	CO
1	15.09.2013	24	58.8	36.5	18.4	12.2	<1000
2	16.09.2013	24	60.1	38.7	17.6	14.2	<1000
3	22.09.2013	24	56.5	37.6	15.8	10.2	<1000
4	23.09.2013	24	61.1	38.5	20.1	15.5	<1000
5	29.09.2013	24	62.6	36.4	13.2	11.5	<1000
6	30.09.2013	24	60.7	35.4	11.2	12.3	<1000
7	07.10.2013	24	58.4	37.2	15.6	14.1	<1000
8	08.10.2013	24	61.5	40.1	14.8	12.6	<1000
9	14.10.2013	24	60.4	40.5	13.1	14.0	<1000
10	15.10.2013	24	57.8	38.5	15.4	10.3	<1000
11	21.10.2013	24	60.6	40.2	15.5	16.1	<1000
12	22.10.2013	24	59.2	38.1	19.7	17.8	<1000
13	29.10.2013	24	60.6	39.1	20.8	18.2	<1000
14	30.10.2013	24	52.8	33.7	14.2	15.0	<1000
15	06.11.2013	24	62.4	37.7	13.8	16.5	<1000
16	07.11.2013	24	60.6	38.8	17.3	14.5	<1000
17	13.11.2013	24	58.5	39.7	18.4	15.8	<1000
18	14.11.2013	24	56.3	32.5	15.4	13.8	<1000
19	20.11.2013	24	61.7	35.3	14.2	15.0	<1000
20	21.11.2013	24	57.6	35.8	16.5	13.4	<1000
21	27.11.2013	24	58.3	34.1	17.8	16.2	<1000
22	28.11.2013	24	58.7	34.2	15.1	13.4	<1000
23	04.12.2013	24	53.6	30.5	16.4	12.1	<1000
24	05.12.2013	24	60.5	38.6	15.7	16.3	<1000
25	11.12.2013	24	59.2	37.8	20.1	18.2	<1000
26	12.12.2013	24	57.6	33.4	18.5	12.7	<1000
27	18.12.2013	24	56.6	33.4	12.5	18.4	<1000
28	19.12.2013	24	59.5	35.4	17.8	23.4	<1000
MAX			62.6	40.5	20.8	23.4	
MIN			52.8	30.5	11.2	10.2	
AVERAGE			59.00714	36.70357	16.24643	14.775	
95 PERCENTILE			62.155	40.165	20.1	18.33	

A7: Lumshong
Season: Post Monsoon

SL No.	Date of Monitoring	Duration of Monitoring in Hrs	Ground Level concentration In Microgram/cubic meter				
			PM ₁₀	PM _{2.5}	SO ₂	NO _x	CO
1	15.09.2013	24	49.5	29.8	14.7	19.6	<1000
2	16.09.2013	24	50.6	30.7	15.8	18.6	<1000
3	22.09.2013	24	58.7	30.6	16.3	19.2	<1000
4	23.09.2013	24	51.4	31.7	14.5	18.1	<1000
5	29.09.2013	24	52.3	30.6	14.4	17.5	<1000
6	30.09.2013	24	48.7	27.5	14.4	17.1	<1000
7	07.10.2013	24	45.8	27.5	14.4	20.0	<1000
8	08.10.2013	24	42.5	28.7	13.4	20.3	<1000
9	14.10.2013	24	44.4	30.2	16.5	16.1	<1000
10	15.10.2013	24	56.5	28.7	14.4	17.2	<1000
11	21.10.2013	24	52.7	30.3	17.4	18.0	<1000
12	22.10.2013	24	53.4	32.6	15.1	18.7	<1000
13	29.10.2013	24	60.4	38.8	18.2	20.0	<1000
14	30.10.2013	24	58.6	38.1	19.4	19.3	<1000
15	06.11.2013	24	58.8	37.3	19.6	17.4	<1000
16	07.11.2013	24	59.1	39.5	19.8	17.2	<1000
17	13.11.2013	24	61.3	40.8	18.6	20.2	<1000
18	14.11.2013	24	52.5	30.7	20.6	20.5	<1000
19	20.11.2013	24	49.6	38.7	20.8	19.5	<1000
20	21.11.2013	24	56.3	30.1	20.4	20.3	<1000
21	27.11.2013	24	60.8	38.4	20.3	20.2	<1000
22	28.11.2013	24	50.5	30.1	17.8	16.0	<1000
23	04.12.2013	24	48.4	22.7	13.3	18.1	<1000
24	05.12.2013	24	49.6	28.4	10.3	20.1	<1000
25	11.12.2013	24	52.8	30.4	13.5	18.3	<1000
26	12.12.2013	24	56.2	34.7	18.2	20.5	<1000
27	18.12.2013	24	55.1	34.5	16.4	17.3	<1000
28	19.12.2013	24	60.4	37.2	20.6	19.8	<1000
MAX			61.3	40.8	20.8	20.5	
MIN			42.5	22.7	10.3	16	
AVERAGE			53.46071	32.475	16.75357	18.75357	
95 PERCENTILE			60.66	39.255	20.6	20.43	

A8: CMCL Plant Site
Season: Post Monsoon

Sl. No.	Date of Monitoring	Duration of Monitoring in Hrs	Ground Level concentration In Microgram/cubic meter				
			PM ₁₀	PM _{2.5}	SO ₂	NO _x	CO
1	15.09.2013	24	54.2	32.9	18.2	20.4	<1000
2	16.09.2013	24	58.5	33.3	17.8	21.1	<1000
3	22.09.2013	24	52.8	35.7	19.4	22.3	<1000
4	23.09.2013	24	56.7	33.9	20.1	24.2	<1000
5	29.09.2013	24	55.4	33.4	18.3	24.7	<1000
6	30.09.2013	24	54.3	34.1	19.5	25.1	<1000
7	07.10.2013	24	50.2	30.4	17.2	23.1	<1000
8	08.10.2013	24	55.3	32.2	18.3	24.2	<1000
9	14.10.2013	24	54.3	31.1	19.5	25.7	<1000
10	15.10.2013	24	48.6	29.6	18.4	23.8	<1000
11	21.10.2013	24	47.9	28.2	17.6	21.1	<1000
12	22.10.2013	24	48.8	29.1	17.8	20.2	<1000
13	29.10.2013	24	47.5	27.4	15.1	19.4	<1000
14	30.10.2013	24	49.2	28.5	16.4	21.3	<1000
15	06.11.2013	24	54.5	33.1	17.8	22.3	<1000
16	07.11.2013	24	56.2	34.3	19.4	21.1	<1000
17	13.11.2013	24	52.3	32.7	20.3	23.7	<1000
18	14.11.2013	24	54.3	31.4	18.7	19.2	<1000
19	20.11.2013	24	55.4	32.8	19.4	16.7	<1000
20	21.11.2013	24	56.4	33.2	18.7	19.2	<1000
21	27.11.2013	24	54.7	33.1	19.4	20.5	<1000
22	28.11.2013	24	53.8	34.1	20.8	19.6	<1000
23	04.12.2013	24	52.4	31.7	17.3	21.4	<1000
24	05.12.2013	24	54.5	34.3	18.2	22.6	<1000
25	11.12.2013	24	53.2	33.1	19.2	23.3	<1000
26	12.12.2013	24	54.5	33.3	19.5	24.7	<1000
27	18.12.2013	24	58.4	35.4	16.1	21.2	<1000
28	19.12.2013	24	57.6	34.6	18.1	23.3	<1000
MAX			58.5	35.7	20.8	25.7	
MIN			47.5	27.4	15.1	16.7	
AVERAGE			53.63929	32.38929	18.44643	21.97857	
95 PERCENTILE			58.12	35.12	20.23	24.96	

The concentration of carbon monoxide found well below the prescribed limit of 1000 microgram/cum. PM values at all stations are much below the norms indicated below. We had tested all the parameters prescribed by the CPCB but all the parameters are below detective limit so we had not given in the tabular form. Some PM₁₀ samples were tested for free silica. The free silica in the PM₁₀ found to be <0.03%.

Table - 4.7

AMBIENT AIR QUALITY STANDARDS
(In microgram per cubic meter)

Sl. No.	Pollutant	Time Weighed average	Industrial, Residential, Rural and Other Residential areas	Ecologically sensitive area (notified by Central Government)	Methods of Measurement
1	PM ₁₀	Annual	60	60	Improved West and Gaeke
		24 hour	100	100	Ultraviolet fluorescence
2	PM _{2.5}	Annual	40	40	Improved West and Gaeke
		24 hour	60	60	Ultraviolet fluorescence
3	SO ₂	Annual	50	20	Modified Jacob &Hochheiser
		24 hour	80	80	Chemiluminescence
4	NO _x	Annual	40	30	Gravimetric
		24 hour	80	80	Beta attenuation

Source: Air Prevention and Control of Pollution Act, 1981 and National Ambient Air Quality Standards of CPCB 16 November 2009

4.7 DUSTFALL

Dust fall kits were placed at each permanent station of core and buffer zone for a continuous period of one month during study period to know the concentration of dust. Dust fall data are presented in the Table - 4.8.

As there is no prescribed limit of Indian Standard for dust fall, the data obtained have been compared with German norms. The norms as published in Ta LUFT, 1986 are as follows.

Maximum Concentrations :

Annual arithmetic mean	-	0.35g/sq.m/day	or	10.5 tonne/sq.km./month
98 percentile value	-	0.88g/sq.m/day	or	26.4 tonne/sq.km/month

Table - 4.8
Dust fall Rate (Post Monsoon Season)

Sl. No.	Station Code	Stations	Dust fall (Tonne/sq.km/month)
01	D ₁	Mine Site	0.9
02	D ₂	Mines Site	0.8
03	D ₃	Umlaper	0.6
04	D ₄	Tongseng	0.8
05	D ₅	Umlong	0.6
06	D ₆	Umbadoh	0.6
07	D ₇	Lumshnong	0.7
08	D ₈	CMCL Plant Site	0.6

4.8 WATER REGIME

4.8.1 Geohydrology

The area is predominantly made of highly dissected plateau (H.D.P.) followed by moderately dissected plateau (M.D.P.) Some denudation hills (D.H.H) and formation of mesa/butte clearly signifies that the area has been subjected to erosion over a considerable period of time. The Deep Gorge (D.G.) aligned in North-South direction in the eastern part of Lumshnong is a significant feature of the land morphology. Series of Structural Hills (SH) in the southern part of the fault form a peculiar topography near the international boundary.

Lumshnong is located at Highly Dissected Plateau (HDP) as shown in Figure 2.3. The area is composed of sedimentary rocks of Cretaceous – Tertiary origin. Some fractures are also present in the region. The area is characterized mainly by Karsts topography (Limestone) followed by sandstone, granite, and gneisses resulting in undulating uplands with gullies. The area possesses semi-confined to confined aquifers with moderate permeability suitable for bore wells. The area is marked with springs and seepages. Therefore, the area is suitable for dug wells and shallow tube wells etc. Many perennial streams are available in the area, which often make principal source of water for human use.

Parallel deep gorges aligned in North-South direction in the eastern and western part of Lumshnong are also present in the region. These areas are the formations of Archean Gneissic Complex. There are highly deformed massive rocks with fractures. The gorges are often very steep and interspersed with sharp crested hills. As a result, parallel deep valleys are noticed in the east and west part of Lumshnong.

Hydro geologically, the Jaintia Hills district can be divided into three units namely – consolidated, semi-consolidated and unconsolidated formations. Consolidated formations comprise of the oldest rock formation namely the peneplained gneissic complex and quartzite. Groundwater occurs under both water table and semi-confined condition in these consolidated formations. Unconsolidated formations mainly are represented by recent alluvium formation occurring near the southern fringe of the district adjacent to Bangladesh.

The major part of the district is covered by semi-consolidated formation covering Amlarem and Khliehriat blocks constituting the Shella formation and study area is also part of the same. This type of formation has:

- Fairly thick and discontinuous aquifer down to 200 m. Groundwater occurs under semi-confined to confined conditions. Water level rests at 4-9 below ground level and yield ranges from 25 – 150 m³/hr; and
- Groundwater occurs under unconfined to semi-confined conditions in cavernous limestone & sandstone and yield ranges from 25 – 150 m³/hr.

Drainage Pattern

Being hilly terrain water seepage is drained out along slope. The rain water collected in the pit will get accumulated in sump and from there it will be pumped out by pumps and finally it will be discharged to water settling tanks which are provided at the lowest point outside ML area.

- (a) Likely depth of water table based on observations from nearby wells and water bodies.
- (b) The area is hilly. There is no wells or water bodies in the M.L. area.
- (c) Workings are not likely to meet any underground water as observed in the last five years of operation.

Water Balance

The area receives heavy rainfall and rainy season extends from May to September, maximum precipitation is during the months of June to August. The annual rainfall recorded during the calendar year 2013 at site is 4880mm. Major part of rainfall (about 80%) is drained as surface runoff. The balance is charged into groundwater through soil capping, weathered sand stone, bedding planes, joints, fractures, solution cavities in the limestone and the dolomite formations occurring in the study area.

The data on water balance of the area is not available from secondary sources. At present, the Groundwater resource estimation is going on for the entire state of Meghalaya based on the latest Groundwater Estimation Committee (GEC 1997) norms. However, Groundwater Resource Potential of Jaintia Hills District was calculated to be 120.36 million cubic meter (MCM) based on GEC of 1984 norm. Out of the total resource, the utilizable resources were estimated to 102.31 MCM, which is 85% of the Gross recharge. As per norm, 15% of the gross recharge has to be kept for drinking and allied purpose.

The proposed water withdrawal locations at near by nalas proposed to sustain the water requirement of the plant are located on the downstream side of the villages Lumshnong. No irrigation facilities are available in the area for cultivation mainly due to rugged and rock terrain and absence of level and plain areas. The seasonal agriculture and orchards in the area sustained by monsoon rains. Further on the downstream side there are no villages and commercial establishments and the nalas join Lubha river further 4.0 km east.

However, the details of water requirement of other competing users in the study area is estimated and given in Table - 4.9.

Table – 4.9
Competing Users of Water Source in the Study Area

Sl. No	Usage	Present consumption (m ³ / day)		Addition proposed as per local plan (m ³ / day)		Total (m ³ / day)	
		Surface	Ground	Surface	Ground	Surface	Ground
1	Irrigation	0	0	0	0	0	0
2	Industry	500	100	-	-	500	100
3	Drinking	236	9	-	-	236	9
4	Others	-	-	-	-	-	-
	Total	736	109	0	0	736	109

Ground Water Recharge and Water Quality

The aquifers of this area are mainly recharged directly from precipitation and percolation through fractures. The recharge of the area varies on factors like amount of rainfall, topography, soil cover, degree and intensity of weathering, vegetation and drainage density. In the hilly terrain of this block, it does not have much scope of recharge through rainfall because of steep slope and rugged topography as all the amount of rainfall is lost through surface run off.

Ground Water Recharge of the Project Area

The area spreads over an area of 9.66 hect. and is characterized by almost flat topography. Considering the average rainfall of the area is 2400 mm. Since the area is occupied with the consolidated rocks, rate of infiltration due to rainfall is slow so the standard factor 10% is considered to find out groundwater recharge due to rainfall. The annual recharge in the area – Area x Annual rainfall x Infiltration factor = 9.66Ha. X 2.4m x 0.1 = 2.3184Ha. As such there is no human settlement and agricultural activities and also absence of any groundwater abstraction structure so annual groundwater recharge can safely met to the demand of water requirement.

4.8.2 Water Quality

All the surface water samples collected and analysed as per IS 3025 (Table -4.10). The ground water samples were analysed and compared with IS 10500 (Table - 4.11). It is observed that all the parameters were within the prescribed limit.

Table - 4.10
Result of Surface Water Samples Analysis

Parameter	Unit	Standard	Surface Water Samples			
			SW ₁	SW ₂	SW ₃	SW ₄
pH	---	6.5 - 8.5	6.7	6.6	6.8	6.8
Colour	---	Colourless	Colourless	Colourless	Colourless	Colourless
Odour	----	Odourless	Odourless	Odourless	Odourless	Odourless
Total solid	mg/l	----	228	236	241	236
Total suspended solid	mg/l	----	15	14	15	16
TDS	mg/l	1500	227	219	224	217
Oil and Grease	µg/l	----	0.04	0.06	0.03	0.04
Dissolve oxygen	Mg/l	----	5.8	6.3	5.7	6.5
Total kjeldahl nitrogen as N	mg/l	----	5.1	4.7	4.8	4.4
Ammoniacal nitrogen as N	mg/l	50	0.84	0.67	0.62	0.77
Free ammonia as NH ₃	mg/l	----	<0.1	<0.1	<0.1	<0.1
BOD	mg/l	3	0.3	0.5	0.7	0.9
Arsenic as As	mg/l	0.2	<0.01	<0.01	<0.01	<0.01
Mercury as Hg	mg/l	----	<0.005	<0.005	<0.005	<0.005
Lead as Pb	mg/l	0.1	<0.005	<0.005	<0.005	<0.005
Total chromium as Cr	mg/l	2.0	<0.1	<0.1	<0.1	<0.1
Hexavalent Chromium as Cr	mg/l	0.05	<0.01	<0.01	<0.01	<0.01
Copper as Cu	mg/l	3.0	<0.02	<0.02	<0.02	<0.02
Cadmium as Cd	mg/l	0.01	<0.002	<0.002	<0.002	<0.002
Zinc as Zn	mg/l	5	<0.002	<0.002	<0.002	<0.002
Selenium as Se	mg/l	0.05	<0.005	<0.005	<0.005	<0.005
Nickel as Ni	mg/l	3.0	<0.01	<0.01	<0.01	<0.01
Boron as B	mg/l	2.0	<0.05	<0.05	<0.05	<0.05
Cyanide as CN	mg/l	0.05	<0.01	<0.01	<0.01	<0.01
Chloride as Cl	mg/l	600	27	29	25	22
Nitrate as NO ₃	mg/l	50	0.7	0.5	0.9	0.8
Flouride as F	mg/l	1.5	<0.1	<0.1	<0.1	<0.1
Dissolved PO ₄	mg/l	5.0	0.4	0.2	0.3	0.4
Sulphate as SO ₄	mg/l	400	12	17	16	18
Sulphide as S	mg/l	2.0	0.8	0.5	0.4	0.3
Iron as Fe	mg/l	5.0	0.6	0.7	0.5	0.4
Silica as SiO ₂	mg/l	----	<0.01	<0.01	<0.01	<0.01
Phenolic compound	mg/l	0.005	<0.0001	<0.0001	<0.0001	<0.0001
Residual pesticide	mg/l	Absent	Absent	Absent	Absent	Absent
Sodium Percentage	mg/l	60	<0.05	<0.05	<0.05	<0.05
Calcium as Ca	mg/l	74	22	27	29	24
Magnesium as Mg	mg/l	32	8	7	5	9
Total hardness	mg/l	298	82	76	91.7	128
Coliform cells/100ml	MPN	BDL	Absent	Absent	Absent	Absent
Standard : IS 3025, Class – A, Inland Surface Water ND: Not detected Surface water sampling stations:- S1: Nalla near ML area S2- Wah Larian N. S3- Nalla near Lumshong S4- Nalla near Plant site						

Result of Surface Water Samples Analysis

Parameter	Unit	Standard	Surface Water Samples		
			W ₅	W ₆	W ₇
pH	---	6.5 - 8.5	6.7	6.6	6.9
Colour	---	Colourless	Colourless	Colourless	Colourless
Odour	----	Odourless	Odourless	Odourless	Odourless
Total solid	mg/l	----	263	214	217
Total suspended solid	mg/l	----	14	16	13
TDS	mg/l	1500	248	217	209
Oil and Grease	µg/l	----	0.04	0.07	0.08
Dissolve oxygen	Mg/l	----	4.7	4.9	5.2
Total kjeldahl nitrogen as N	mg/l	----	3.1	3.3	3.5
Ammoniacal nitrogen as N	mg/l	50	0.74	0.71	0.82
Free ammonia as NH ₃	mg/l	----	<0.1	<0.1	<0.1
BOD	mg/l	3	0.1	0.1	0.2
Arsenic as As	mg/l	0.2	<0.01	<0.01	<0.01
Mercury as Hg	mg/l	----	<0.005	<0.005	<0.005
Lead as Pb	mg/l	0.1	<0.005	<0.005	<0.005
Total chromium as Cr	mg/l	2.0	<0.1	<0.1	<0.1
Hexavalent Chromium as Cr	mg/l	0.05	<0.01	<0.01	<0.01
Copper as Cu	mg/l	3.0	<0.02	<0.02	<0.02
Cadmium as Cd	mg/l	0.01	<0.002	<0.002	<0.002
Zinc as Zn	mg/l	5	<0.002	<0.002	<0.002
Selenium as Se	mg/l	0.05	<0.005	<0.005	<0.005
Nickel as Ni	mg/l	3.0	<0.01	<0.01	<0.01
Boron as B	mg/l	2.0	<0.05	<0.05	<0.05
Cyanide as CN	mg/l	0.05	<0.01	<0.01	<0.01
Chloride as Cl	mg/l	600	27	25	28
Nitrate as NO ₃	mg/l	50	0.8	0.7	0.5
Flouride as F	mg/l	1.5	<0.1	<0.1	<0.1
Dissolved PO ₄	mg/l	5.0	0.3	0.4	0.6
Sulphate as SO ₄	mg/l	400	15	17	12
Sulphide as S	mg/l	2.0	0.5	0.3	0.4
Iron as Fe	mg/l	5.0	0.6	0.7	0.8
Silica as SiO ₂	mg/l	----	<0.01	<0.01	<0.01
Phenolic compound	mg/l	0.005	<0.0001	<0.0001	<0.0001
Residual pesticide	mg/l	Absent	Absent	Absent	Absent
Sodium Percentage	mg/l	60	<0.05	<0.05	<0.05
Calcium as Ca	mg/l	74	27	29	23
Magnesium as Mg	mg/l	32	10	8	5.4
Total hardness	mg/l	298	102	94	87
Coliform cells/100ml	MPN	BDL	Absent	Absent	Absent
Standard : IS 3025, Class – A, Inland Surface Water					
ND: Not detected					
Surface water sampling stations:-					
S5:Nalla near Tongseeng S6- Nalla near Umlong S7- Nalla near Umbadoh					

4.9 NOISE LEVEL

Monitoring was done on hourly basis for a continuous period of one day during the study season and presented as minimum and maximum values in Table - 4.11. The standard of various noise levels for different zones in respect of day and night is shown in Table - 4.12.

Table - 4.11
Noise Level monitoring (dBA)

Sl. No.	Station Code	Station	Date of Monitoring	Day (L _d)		Night (L _n)	
				MAX	MIN	MAX	MIN
1	N ₁	Mine Site	22.10.2013	63.8	47.5	43.4	41.3
2	N ₂	Mines Site	23.10.2013	66.5	45.3	44.2	42.5
3	N ₃	Umlaper	29.10.2013	58.3	46.4	46.1	40.7
4	N ₄	Tongseng	30.10.2013	54.1	46.2	43.1	40.2
5	N ₅	Umlong	06.11.2013	55.7	45.3	46.7	40.8
6	N ₆	Umbadoh	07.11.2013	56.8	43.6	45.6	41.9
7	N ₇	Lumshnong	13.11.2013	59.4	45.2	44.2	40.4
8	N ₈	CMCL Plant Site	14.11.2013	62.4	43.4	45.7	41.1

Table - 4.12
Standards With Respect To Ambient Noise Level

Land Use Category	Limit in dBA	
	Day time	Night time
Industrial area	75	70
Commercial area	65	55
Residential area	55	45
Silence area	50	40

(Source: Air Prevention and Control of Pollution Act, 1981)

Note:

- a) Day time : 6 A.M. to 9 P.M.
- b) Night time : 10. P.M. to 5 A.M.
- c) Silence zone: Hospital, Sanitarium, Educational Institution, Wild Life Sanctuary and Courts (within 100 meter around these locations).

4.10 BIODIVERSITY

Ecological study has been made to know the forest types, flora and faunal composition of the study area which were computed and compared with the satellite and information from other sources like BSI, ZSI, relevant forest department (Wildlife Department) and local NGO's. Subsequently through extensive field survey, forest types, flora and faunal composition of the study areas were computed and compared with the satellite and other information. The various ecosystems, vegetation, communities, faunal habitats prevalent in the study area were identified though Quadrant method with Random Sampling Technique was adopted to know distribution pattern of the plant species and faunal characteristics both in core and buffer zone. All the plant species in a quadrant of 10 x 10 sizes at an interval of 500 mtr from the

core of the mine in all four directions were recorded. A line transect was laid for entire area of 10 Sq Kms, species characteristics like frequency, abundance & density were computed.

Frequency:

The frequency of individual species is the number of times the species occurs in the sampling quadrant. It is actually represented as a percentage calculated as follows:

$$\text{Frequency} = \frac{\text{No. of quadrants in which the species occurred}}{\text{Total no. of quadrants studied}} \times 100$$

It reflects the probability of encountering the species within the sampled area.

Density:

Density is the measure of dense in the distribution of an individual species within a given area. Density of a species is defined as the average number of the species per quadrant and calculated as follows:

$$\text{Density} = \frac{\text{Total no. of individuals of the species}}{\text{Total no. of quadrants used in sampling}}$$

Abundance:

It reflects how evenly one species is distributed within the sampling area. Abundance of a species is defined as the number of individuals per quadrant and calculated as follows:

$$\text{Abundance} = \frac{\text{Total no. of individual of the species}}{\text{No. of quadrants in which the species occurred}}$$

In faunal studies, attempts were made for abundance computation by census techniques. Observation on feeding, breeding and nesting habitats on selected animals were attempted. Evidence of migratory routes was also investigated.

Recording of rare and endangered plant and animal species were also made. The detailed floristic composition of entire area under study is given in subsequent sections.

The floral pattern in the study area has been studied in detail. The project area is covered by forest having moderate density of tree growth predominated by scanty shrubs and bushes. Most of them are dry deciduous type. Mainly the regional flora and fauna is found in the study area. The local species are proposed to plant during afforestation. So biodiversity of the area due to the project shall be maintained. There are reserved forests within the study area. The study area does not contain any eco-sensitive zone like National park.

ECOLOGICAL PATTERN

The project site (core zone) as well the buffer zone area was surveyed to assess the ecological status.

FLORA

The vegetation of the project area can be broadly classified as tropical evergreen forest with elements from tropical moist deciduous and subtropical forest vegetation. The project area has less than 10% canopy cover. The forests within 5 km radius have three distinct strata, viz., (i) Upper canopy layer with dominance of emergent trees, (ii) Sub-canopy layer with dominance of small trees and pole size trees, and (iii) Under canopy layer with dominance of shrubs, herbs and juvenile trees. The details of species available are highlighted in Table - 4.13.

Table – 4.13
Details of Species available

LIST OF FLORA SPECIES

List of tree species around Project area

Species	Family	Vernacular Name
<i>Actinodaphne obovata</i>	Lauraceae	
<i>Ailanthus grandis</i>	Simarubaceae	Lalong-baiong
<i>Albizzia lucida</i>	Mimosaceae	
<i>Albizzia</i> sp.	Mimosaceae	
<i>Alstonia scholaris</i>	Apocynaceae	Diend-ryteng
<i>Anthocephalus chinense</i>	Rubiaceae	
<i>Aralia armata</i>	Araliaceae	Dieng-la-tymphu
<i>Ardisia nerifolia</i>	Myrsinaceae	
<i>Artocarpus heterophyllus</i>	Moraceae	Sohphan
<i>Bambusa tulda</i>	Gramineae	Shken, seij
<i>Bauhinia purpurea</i>	Caesalpinaceae	
<i>Bischofia javanica</i>	Bischofiaceae	
<i>Bombax ceiba</i>	Bombacaceae	
<i>Bridelia</i> sp.	Euphorbiaceae	
<i>Callicarpa arborea</i>	Verbenaceae	Dieng-lakhoit
<i>Caryota urens</i>	Palmae	
<i>Castanopsis indica</i>	Fagaceae	
<i>Castanopsis tribuloides</i>	Fagaceae	
<i>Cinnamomum bezolghota</i>	Lauraceae	
<i>Cinnamomum obtusifolium</i>	Lauraceae	
<i>Citrus</i> sp.	Rutaceae	
<i>Cyathea</i> sp.	Leguminosae	
<i>Cynometra polyandra</i>		
<i>Dalbergia</i> sp.		

Species	Family	Vernacular Name
<i>Dendrocalamus hamiltonii</i>	Gramineae	Siej
<i>Duabanga grandiflora</i>	Sonneratiaceae	
<i>Elaeocarpus aristatus</i>	Eleocarpaceae	Dieng-thang-khaphiah
<i>Elaeocarpus</i> sp.	Eleocarpaceae	
<i>Englegardtia spicata</i>	Juglanaceae	Dieng-lyba
<i>Exbucklandia populnea</i>	Hammamelidaceae	Dieng-sohmyndot
<i>Ficus elmeri</i>	Moraceae	Dieng-jri
<i>Ficus</i> sp.	Moraceae	Dieng-jri
<i>Garcinia acuminata</i>	Clusiaceae	
<i>Gmelina arborea</i>	Verbenaceae	Dieng-laphiang
<i>Grewia disperma</i>	Tiliaceae	Dieng-tiewser
<i>Grewia</i> sp.	Tiliaceae	
<i>Hevea brasiliensis</i>	Hernandiaceae	Dieng-jri
<i>Hibiscus macrophyllus</i>	Malvaceae	Tyllen-dkhar
<i>Hydnocarpus kurzii</i>	Flacourtiaceae	Dieng-sohlap
<i>Litsaea sebifera</i>	Lauraceae	Dieng-ja-lowan
<i>Litsea citrita</i>	Lauraceae	Dieng-si-ing
<i>Litsea laeta</i>	Lauraceae	
<i>Litsea salicifolia</i>	Lauraceae	Dieng-lali
<i>Litsea</i> sp.	Lauraceae	
<i>Macaranga denticulata</i>	Euphorbiaceae	
<i>Macropanax disperma</i>	Analiaceae	Dieng-ia-rasi
<i>Magnolia hodgsonii</i>	Magnoliaceae	
<i>Mallotus tetracoccus</i>	Euphorbiaceae	
<i>Meliosma</i> sp.	Meliaceae	
<i>Oroxylum indicum</i>	Bigoniaceae	Dieng-kawait-blai
<i>Pandanus</i> sp.	Pandanaceae	
<i>Persea</i> sp.	Lauraceae	
<i>Pithecellobium</i> sp.	Leguminosae	Dieng-iap-iar
<i>Premna milleflora</i>	Verbenaceae	Dieng-phonri
<i>Prunus acuminata</i>	Rosaceae	Dieng-soh-iong-blei
<i>Pterospermum acerifolium</i>	Sterculiaceae	Dieng-tharo-masi
<i>Pterospermum lancifolium</i>	Sterculiaceae	
<i>Quercus lancifolia</i>	Fagaceae	Dieng-sningrit, Dieng-patlua
<i>Quercus spicata</i>	Fagaceae	
<i>Sapium baccatum</i>	Euphorbiaceae	Dieng-jalong
<i>Sarcosperma griffithii</i>	Sapotaceae	Dieng-ja-lytpai, Dieng-kymbu-blang
<i>Saurauia roxburghii</i>	Ternstroemiaceae	Dieng-soh-la-pied
<i>Saurauia</i> sp.	Ternstroemiaceae	
<i>Schima wallichii</i>	Theaceae	Dieng-shyr-ngan
<i>Shima</i> sp.	Theaceae	
<i>Spondias pinnata</i>	Anacardiaceae	

Species	Family	Vernacular Name
<i>Streospermum chelenoides</i>	Bigoniaceae	Dieng-phsiar
<i>Syzygium</i> sp.	Myrtaceae	Soh-um
<i>Terminalia bellerica</i>	Combretaceae	
<i>Terminalia myriocarpa</i>	Combretaceae	
<i>Terminalia chebula</i>	Combretaceae	Diengsoh-khoru
<i>Tetrameles nudiflora</i>	Combretaceae	
<i>Toona ciliata</i>		
<i>Toona</i> sp.		
<i>Travesia palmata</i>		
<i>Trema orientalis</i>	Ulmaceae	Dieng-lattar
<i>Villebrunea frutescens</i>	Urticaceae	
<i>Vitex pedunculata</i>	Verbenaceae	
<i>Vitex</i> sp.	Verbenaceae	
<i>Wendlandia paniculata</i>	Rubiaceae	Deing-ja-lakba
<i>Xerospermum</i> sp.	Sapindaceae	Diengsoh-moni-ar-shree

List of shrub/herbs species in Project area

Species	Family	Vernacular Name
<i>Ageratum conyzoides</i>		
<i>Alpinia</i> sp.		
<i>Amaranthus</i> sp.	Amaranthaceae	
<i>Ardisia nerifolia</i>		
<i>Aroides</i> sp.		
<i>Arundina graminifolia</i>		
<i>Baliospermum montana</i>	Euphorbiaceae	Lasem-dumuin
<i>Begonia</i> sp.	Begoniaceae	Jajew
<i>Bidens biternata</i>		
<i>Bidens pilosa</i>		
<i>Blachnum</i> sp.		
<i>Boehmeria glomerulifera</i>		
<i>Boehmeria</i> sp.	Urticaceae	Diengsoh-khar, thynrait
<i>Calamus flagellum</i>		
<i>Calamus leptospadix</i>		
<i>Carax cruciata</i>		
<i>Chenopodium</i> sp.	Chenopodiaceae	
<i>Clerodendron colebrookianum</i>	Verbenaceae	Syntiew-dohmahi
<i>Clerodendron viscosum</i>		
<i>Clerodendrum</i> sp.		
<i>Coffea</i> sp.	Rubiaceae	Ja-laryngksang
<i>Coleus</i> sp.	Labiatae	
<i>Commelina</i> sp.		
<i>Crassocephalum crepidioides</i>		

Species	Family	Vernacular Name
<i>Cyathula prostrate</i>		
<i>Dracena</i> sp.		
<i>Elatostema</i> sp.	Urticaceae	Ja-ew
<i>Erigeron Canadensis</i>	Compositae	
<i>Eupatorium odoratum</i>	Compositae	Kynbat-nongrim
<i>Fagopteris auriculata</i>		
<i>Ferns</i> sp.		Tyrkhang
<i>Forrestia</i> sp.		
<i>Globba</i> sp.		
<i>Hedychium</i> sp.		
<i>Jasminum</i> sp.	Oleaceae	Mei-lar-um
<i>Laportea crenulata</i>	Urticaceae	Dieng-synrem
<i>Leea indica</i>	Ampelidaceae	
<i>Leea</i> sp.	Ampelidaceae	
<i>Licuala peltata</i>		
<i>Ludwigia octovalis</i>		
<i>Lycopodium</i> sp.	Lycopodiaceae	Tmain-khla
<i>Maesa indica</i>	Myrsinaceae	Diengsoh-jala-tyrkai
<i>Maesa</i> sp.	Myrsinaceae	
<i>Melastoma malabathricum</i>	Melastomaceae	Soh-khing
<i>Mannihot esculenta</i>	Euphorbiaceae	
<i>Mimosa himalayana</i>	Leguminosae	
<i>Morinda angustifolia</i>	Rubiaceae	Dieng-shongrei
<i>Musa</i> sp.	Musaceae	Lakait
<i>Osbeckia</i> sp.	Melastomaceae	Soh-kthem
<i>Osbeckia crenata</i>	Melastomaceae	Jalang-kthem
<i>Oxalis corniculata</i>	Oxalidaceae	Jajew
<i>Oxyspora</i> sp.	Melastomaceae	Tiew-sohkthem
<i>Phrynium capitata</i>		
<i>Phrynium pubenervae</i>		
<i>Pinanga gracilis</i>		
<i>Polygonum chinense</i>	Polygonaceae	
<i>Pteris</i> sp.		Tyrkhang
<i>Randia</i> sp.	Rubiaceae	Sohladung
<i>Rhynchotecom ellipticum</i>	Gesneraceae	Sieng-ia-mahek
<i>Rungia</i> sp.	Acanthaceae	
<i>Saccharum spontaneum</i>	Andropogonaceae	
<i>Salamona</i> sp.		
<i>Saurauia</i> sp.		
<i>Scoperia dulcis</i>		
<i>Selaginella</i> sp.	Selagenaceae	
<i>Solanum torvum</i>	Solanaceae	Soh-nang
<i>Spilanthes paniculata</i>		
<i>Tabernaemontana divericata</i>	Apocynaceae	
<i>Thysanolaena maxima</i>	Thysanotaceae	Synsar

Species	Family	Vernacular Name
<i>Trevesia palmata</i>	Araliaceae	Soh-kynthur
<i>Triumfetta pilosa</i>	Liliaceae	Soh-byrthid
<i>Urena lobata</i>	Malvaceae	Soh-byrthit
<i>Wallichia</i> sp.		

List of climbers/epiphytes species in Project area

Species	Family	Vernacular Name
<i>Acacia oxyphylla</i>	Leguminosae	Mei-suai
<i>Acacia pinnata</i>	Leguminosae	Jermai-sheih-lyngkshiah
<i>Acacia prunascens</i>	Leguminosae	Shitli
<i>Acampe</i> sp.		
<i>Aeschynanthus</i> sp.	Gesneraceae	
<i>Agapetes</i> sp.	Vacciniaceae	
<i>Asplenium nidus</i>		
<i>Byttneria aspera</i>		
<i>Calamus leptospadix</i>		
<i>Dendrobium</i> sp.	Orchidaceae	Tiew-dieng
<i>Derris</i> sp.	Leguminosae	Diengthing, Diengphulot, Meisohphlang
<i>Dioscorea</i> sp.		
<i>Ficus</i> sp.	Moraceae	
<i>Gnetum scandens</i>	Gnetaceae	Jermaisaprah
<i>Hedyotis scandens</i>	Rubiaceae	Jylli-iamu-sem
<i>Hoya</i> sp.	Asclepidiaceae	Tiew-reng-synreh
<i>Lusea</i> sp.		
<i>Lygodium flexuosum</i>		
<i>Lygodium fluxuosa</i>		
<i>Melocalamus compectiflorus</i>		
<i>Microsorium</i> sp.		
<i>Mikania macrantha</i>		
<i>Neohouzia helferii</i>		
<i>Nepenthes khasiana</i>	Nepenthaceae	Tiew-rakot
<i>Paederia scandens</i>	Rubiaceae	
<i>Porana paniculata</i>	Convolvulaceae	
<i>Pothos</i> sp.		
<i>Raphidophora decursiva</i>		
<i>Raphidophora lancifolia</i>		Lapadong
<i>Scefflera venulosa</i>		
<i>Smilax</i> sp.		
<i>Thunbergia grandiflora</i>	Acanthaceae	Jyrmi-khnong

List of plants found at the cement plant project site at Lumshnong

Trees
<i>Albizia lucida</i>
<i>Bauhinia purpurea</i>
<i>Bridellia</i> sp.
<i>Callicarpa arborea</i>
<i>Citrus</i> sp.
<i>Ficus elmeri</i>
<i>Litsea</i> sp.
Herbs/Shrubs
<i>Ageratum conyzoides</i>
<i>Bidens pilosa</i>
<i>Clerodendrum viscosum</i>
<i>Eupatorium odoratum</i>
<i>Fagopteris auriculata</i>
<i>Hedychium</i> sp.
<i>Maesa indica</i>
<i>Malastoma malabathricum</i>
<i>Oxalis corniculata</i>
<i>Polygonum chinense</i>
<i>Rhynchoetecum ellipticum</i>
<i>Solanum torvum</i>
<i>Thysanolaena maxima</i>
<i>Trevesia palmate</i>
<i>Triumfetta pilosa</i>
<i>Urena lobata</i>
Climber & epiphyte
<i>Ficus</i> sp.
<i>Hoya</i> sp.
<i>Mikania macrantha</i>
<i>Porana paniculata</i>
<i>Raphidophora decursiva</i>

List of plants found in Lumshnong – Umlong sector

Trees
<i>Actinodaphne obovata</i>
<i>Albizia lucida</i>
<i>Alstonia sholaris</i>
<i>Artocarpus heterophyllus</i>
<i>Bauhinia purpurea</i>
<i>Bischofia javanica</i>
<i>Bombax ceiba</i>

<i>Bridellia sp.</i>
<i>Callicarpa arborea</i>
<i>Caryota urens</i>
<i>Castanopsis indica</i>
<i>Citrus sp.</i>
<i>Duabanga grandiflora</i>
<i>Engelhardtia spicata</i>
<i>Ficus elmeri</i>
<i>Garcinia acuminata</i>
<i>Grewia disperma</i>
<i>Litsea laeta</i>
<i>Litsea sp.</i>
<i>Macaranga denticulate</i>
<i>Meliosma sp.</i>
<i>Pandanus sp.</i>
<i>Prunus acuminata</i>
<i>Pterospermum acerifoilium</i>
<i>Saurauia roxburghii</i>
<i>Schima wallichii</i>
<i>Syzygium sp.</i>
<i>Terminalis chebula</i>
<i>Trema orientalis</i>
<i>Villebrunea frutescens</i>
<i>Vitex pedunculata</i>
<i>Wendlandia paniculata</i>
Herbs/Shrubs
<i>Ageratum conyzoides</i>
<i>Baliospermum Montana</i>
<i>Bidens pilosa</i>
<i>Boehmeria sp.</i>
<i>Calamus flagellum</i>
<i>Calamus leptospadix</i>
<i>Clerodendrum viscosum</i>
<i>Crassocephalum crepidioides</i>
<i>Dracena sp.</i>
<i>Eupatorium odoratum</i>
<i>Fagopteris auriculata</i>
<i>Globba sp.</i>
<i>Jasminum sp.</i>
<i>Hedychium sp.</i>
<i>Laportia crenulata</i>
<i>Leea sp.</i>
<i>Lycopodium sp.</i>
<i>Maesa indica</i>
<i>Malastoma malabathricum</i>
<i>Mannihot esculanta</i>

<i>Morinda angustifolia</i>
<i>Musa</i> sp.
<i>Oxalis corniculata</i>
<i>Polygonum chinense</i>
<i>Randia</i> sp.
<i>Rhynchosyris ellipticum</i>
<i>Rungia</i> sp.
<i>Saccharum spontaneum</i>
<i>Solanum torvum</i>
<i>Spilanthus paniculata</i>
<i>Thysanolaena maxima</i>
<i>Trevesia palmate</i>
<i>Triumfetta pilosa</i>
<i>Urena lobata</i>
<i>Wallichia</i> sp.
Climber & Epiphyte
<i>Acacia oxyphylla</i>
<i>Acacia prunascens</i>
<i>Acacia pinnata</i>
<i>Acampe</i> sp.
<i>Asplenium nidus</i>
<i>Derris</i> sp.
<i>Ficus</i> sp.
<i>Hoya</i> sp.
<i>Lygodium fluviatilis</i>
<i>Mikania macrantha</i>
<i>Paederia scandens</i>
<i>Porana paniculata</i>
<i>Pothos</i> sp.
<i>Raphidophora decursiva</i>
<i>Raphidophora lancifolia</i>

List of plants found in Lumshnong - Umbadoh sector

Trees
<i>Actinodaphne obovata</i>
<i>Ailanthes grandis</i>
<i>Aralia armata</i>
<i>Ardisia nerifolia</i>
<i>Bambusa tulda</i>
<i>Bauhinia purpurea</i>
<i>Bischofia javanica</i>
<i>Caryota urens</i>
<i>Castanopsis tribuloides</i>
<i>Cinnamomum obtusifolium</i>

<i>Citrus</i> sp.
<i>Elaeocarpus</i> sp.
<i>Exbucklandia populnea</i>
<i>Ficus</i> sp.
<i>Litsea citrita</i>
<i>Lirsea sebifera</i>
<i>Litsea salacifolia</i>
<i>Litsea</i> sp.
<i>Macranga denticulate</i>
<i>Macropanax disperma</i>
<i>Persea</i> sp.
<i>Pithecellobium</i> sp.
<i>Quercus lancifolia</i>
<i>Quercus spicata</i>
<i>sapium baccatum</i>
<i>Sarcosperma griffithii</i>
<i>Shima</i> sp.
<i>Syzygium</i> sp.
<i>Trema orientalis</i>
<i>Vitex</i> sp.
<i>Travesia palmate</i>
Shrubs/Herbs
<i>Ageratum conyzoides</i>
<i>Ardisia nerifolia</i>
<i>Bidens biternata</i>
<i>Boehmeria glomerulifera</i>
<i>Calamus leptospadix</i>
<i>Carax cruciata</i>
<i>Clerodendrum</i> sp.
<i>Commelina</i> sp.
<i>Crassocephalum creepidioides</i>
<i>Cyathula prostrate</i>
<i>Eupatorium odoratum</i>
<i>Forrestia</i> sp.
<i>Hedychium</i> sp.
<i>Leea</i> sp.
<i>Maesa</i> sp.
<i>Morinda angustifolia</i>
<i>Musa</i> sp.
<i>Osbeckia</i> sp.
<i>Pinanga gracilis</i>
<i>Polygonum chinense</i>
<i>Rungia</i> sp.
<i>Tabernaemontana divericata</i>
<i>Thysanolaena maxima</i>

Climber/Epiphyte
<i>Aeschynanthus</i> sp.
<i>Agapetes</i> sp.
<i>Asplenium nidus</i>
<i>Byttneria aspera</i>
<i>Calamus leptospadix</i>
<i>Lygodium flexuosum</i>
<i>Miicrosorium</i> sp.
<i>Mikania macrantha</i>
<i>Scefflera venulosa</i>
<i>Smilax</i> sp.
<i>Thunbergia grandiflora</i>

List of plants found in Lumshnong - Tongseng sector

Trees
<i>Ailanthus grandis</i>
<i>Albizia</i> sp.
<i>Anthocephalus chinense</i>
<i>Bauhinia purpurea</i>
<i>Callicarpa arborea</i>
<i>Cinnamomum bezolghota</i>
<i>Cyathea</i> sp.
<i>Cynometra polyandra</i>
<i>Dalbergia</i> sp.
<i>Dendrocalamus hamiltonii</i>
<i>Duabanga grandiflora</i>
<i>Elaeocarpus aristatus</i>
<i>Elaeocarpus</i> sp.
<i>Englegardtia spicata</i>
<i>Ficus</i> sp.
<i>Gmelina arborea</i>
<i>Grewia</i> sp.
<i>Hevea brasiliensis</i>
<i>Hibiscus macrophyllus</i>
<i>Hydnocarpus kurzii</i>
<i>Magnolia hodgsonii</i>
<i>Mallotus tetracoccus</i>
<i>Oroxylum indicum</i>
<i>Pandanus</i> sp.
<i>Premna milleflora</i>
<i>Prunus acuminata</i>
<i>Pterospermum acerifolium</i>
<i>Pterospermum lancifolium</i>
<i>Sapium baccatum</i>
<i>Saurauia</i> sp.

<i>Spondius pinnata</i>
<i>Streospermum chelenoides</i>
<i>Terminalia bellerica</i>
<i>Terminalia myriocarpa</i>
<i>Tetrameles nudiflora</i>
<i>Toona</i> sp.
<i>Villebrunea frutescens</i>
<i>Xerospermum</i> sp.
Herbs/Shrubs
<i>Ageratum conyzoides</i>
<i>Alpinia</i> sp.
<i>Amaranthus</i> sp.
<i>Aroides</i> sp.
<i>Arundina graminifolia</i>
<i>Begonia</i> sp.
<i>Blachnum</i> sp.
<i>Boehmeria</i> sp.
<i>Carax cruciata</i>
<i>Chenopodium</i> sp.
<i>Clerodendron colebrookianum</i>
<i>Clerodendron viscosum</i>
<i>Coffea</i> sp.
<i>Coleus</i> sp.
<i>Dracena</i> sp.
<i>Elatostema</i> sp.
<i>Erigeron Canadensis</i>
<i>Eupatorium odoratum</i>
<i>Fagopteris auriculata</i>
<i>Ferns</i> sp.
<i>Leea indica</i>
<i>Leea</i> sp.
<i>Licuala peltata</i>
<i>Ludwigia octovalis</i>
<i>Mimosa himalayana</i>
<i>Musa</i> sp.
<i>Osbeckia crenata</i>
<i>Oxyspora</i> sp.
<i>Phrynium capitata</i>
<i>Phrynium pubenervae</i>
<i>Polygonum chinense</i>
<i>Pteris</i> sp.
<i>Saccharum spontaneum</i>
<i>Salamona</i> sp.
<i>Saurauia</i> sp.
<i>Scoperia dulcis</i>
<i>Sellaginella</i> sp.

<i>Solanum torvum</i>
<i>Thysanolaena maxima</i>
Climbers /Epiphyte
<i>Asplenium nidus</i>
<i>Dendrobium</i> sp.
<i>Dioscorea</i> sp.
<i>Gnetum scandens</i>
<i>Hedyotis scandens</i>
<i>Luisea</i> sp.
<i>Lygodium flexuosum</i>
<i>Melocalamus compectiflorus</i>
<i>Mikania macrantha</i>
<i>Neohouzia helferii</i>
<i>Paederia scandens</i>
<i>Raphidophora decursiva</i>
<i>Thunbergia grandiflora</i>

List of plants found in Tongseng – Sonapur sector

Trees
<i>Albizia</i> sp.
<i>Anthocephalus chinense</i>
<i>Bauhinia purpurea</i>
<i>Callicarpa arborea</i>
<i>Cyathea</i> sp.
<i>Dalbergia</i> sp.
<i>Dendrocalamus hamiltonii</i>
<i>Duabanga grandiflora</i>
<i>Elaeocarpus</i> sp.
<i>Engelhardtia spicata</i>
<i>Ficus</i> sp.
<i>Gmelina arborea</i>
<i>Grewia</i> sp.
<i>Hibiscus macrophyllus</i>
<i>Hydnocarpus kurzii</i>
<i>Mallotus tetracoccus</i>
<i>Oroxylum indicum</i>
<i>Pandanus</i> sp.
<i>Prunus acuminate</i>
<i>Pterospermum acerifolium</i>
<i>Sapium baccatum</i>
<i>Saurauia</i> sp.
<i>Streospermum chelenoides</i>
<i>Terminalia bellerica</i>
<i>Terminalia myriocarpa</i>

<i>Tetrameles nudiflora</i>
<i>Toona ciliate</i>
<i>Villebrunea frutescens</i>
<i>Xerospermum</i> sp.
Herbs/Shrubs
<i>Ageratum conyzoides</i>
<i>Alpinia</i> sp.
<i>Amaranthus</i> sp.
<i>Aroides</i> sp.
<i>Begonia</i> sp.
<i>Blachnum</i> sp.
<i>Boehmeria</i> sp.
<i>Chenopodium</i> sp.
<i>Clerodendron viscosum</i>
<i>Coffea</i> sp.
<i>Coleus</i> sp.
<i>Elatostema</i> sp.
<i>Erigeron Canadensis</i>
<i>Eupatorium odoratum</i>
<i>Fagopteris auriculata</i>
<i>Ferns</i> sp.
<i>Leea</i> sp.
<i>Licuala peltata</i>
<i>Ludwigia octovalis</i>
<i>Musa</i> sp.
<i>Osbeckia</i> sp.
<i>Oxyspora</i> sp.
<i>Phrynium pubenervae</i>
<i>Polygonum chinense</i>
<i>Pteris</i> sp.
<i>Saccharum spontaneum</i>
<i>Salamona</i> sp.
<i>Saurauia</i> sp.
<i>Sellaginella</i> sp.
<i>Solanum torvum</i>
<i>Thysanolaena maxima</i>
Climbers /Epiphyte
<i>Asplenium nidus</i>
<i>Dendrobium</i> sp.
<i>Dioscorea</i> sp.
<i>Lygodium flexuosum</i>
<i>Melocalamus compectiflorus</i>
<i>Mikania macrantha</i>
<i>Raphidophora decursiva</i>
<i>Thunbergia grandiflora</i>

List of plants found in Lumshnong – Umlunar sector

Trees
<i>Ailanthus grandis</i>
<i>Albizia</i> sp.
<i>Anthocephalus chinense</i>
<i>Bauhinia purpurea</i>
<i>Cinnamomum bezolghota</i>
<i>Cyathea</i> sp.
<i>Dalbergia</i> sp.
<i>Dendrocalamus hamiltonii</i>
<i>Duabanga grandiflora</i>
<i>Elaeocarpus aristatus</i>
<i>Engelhardtia spicata</i>
<i>Ficus</i> sp.
<i>Grewia</i> sp.
<i>Hydnocarpus kurzii</i>
<i>Mallotus tetracoccus</i>
<i>Pandanus</i> sp.
<i>Sapium baccatum</i>
<i>Saurauia</i> sp.
<i>Spondias pinnata</i>
<i>Tetrameles nudiflora</i>
<i>Toona ciliate</i>
<i>Villebrunea frutescens</i>
Herbs/Shrubs
<i>Ageratum conyzoides</i>
<i>Alpinia</i> sp.
<i>Aroides</i> sp.
<i>Begonia</i> sp.
<i>Boehmeria</i> sp.
<i>Carax cruciata</i>
<i>Chenopodium</i> sp.
<i>Clerodendron colebrookianum</i>
<i>Coffea</i> sp.
<i>Elatostema</i> sp.
<i>Erigeron Canadensis</i>
<i>Eupatorium odoratum</i>
<i>Fagopteris auriculata</i>
<i>Ferns</i> sp.
<i>Leea indica</i>
<i>Ludwigia octovalis</i>
<i>Mimosa himalayana</i>
<i>Musa</i> sp.
<i>Osbeckia</i> sp.

<i>Phrynium capitata</i>
<i>Phrynium pubenervae</i>
<i>Polygonum chinense</i>
<i>Pteris</i> sp.
<i>Saccharum spontaneum</i>
<i>Salamona</i> sp.
<i>Sellaginella</i> sp.
<i>Solanum torvum</i>
<i>Thysanolaena maxima</i>
Climbers /Epiphyte
<i>Asplenium nidus</i>
<i>Dendrobium</i> sp.
<i>Melocalamus compectiflorus</i>
<i>Mikania macrantha</i>
<i>Nepenthes khasiana</i>
<i>Raphidophora decursiva</i>
<i>Thunbergia grandiflora</i>

Agricultural Crops

The principal crop of the area is paddy. At some areas maize, rabi and other pulses are cultivated. Some of the agricultural crops are as follows: *Brassica nigra*, *Capsicum frutescens*, *Cucumis sativus*, *Oryza sativa*, *Phaseolus vulgaris*, *Raphanus sativus*, *Zea mays*

Commercial Crops

The commercial crops in the area are: *Citrus aurantium*, *Haevea brasiliensis*, *Thysanolaena maxima*.

Plantation

Some of the species normrmally planted here are: *Litsea citrate*, *Populus glambelei*, *Terminalia myriocarpa*

Grasslands

Mimosa himalayana, *Osbekia* sp., *Oxyspora* sp., *Saccharum spontaneum*, *Salamona* sp., *Sellaginella* sp., *Solanum torvum*

NTFP Species including Ornamentals

Aroides sp., *Begonia* sp., *Calamus*, *Phrynium capitata*, *Phrynium pubenervae*, *Raphidophora decursiva*

No rare and endangered species are recorded in the study area

FAUNA

Buffer Zone: The following species of fauna found in the buffer zone of the plant area

Table - 4.14
List of Fauna

List of Vertibrates

Mammals

Zoological Name	Common Name	Schedule Status
<i>Arctonyx collaris</i>	Hog Badger	Schedule I Part I
<i>Cannomys badius badius</i>	Bamboo Rat	Schedule V
<i>Collosciurus erythraeus erythraeus</i>	Squirrel	US
<i>Crocidura attenuata rubricosa</i>	Grey Shrew	Schedule V
<i>Felis bengalensis bengalensis</i>	Leopard Cat	Schedule I Part I
<i>Herpestes edwardsi</i>	Indian Grey Mongoose	Schedule IV
<i>Lutra lutra monticola</i>	Otter	Schedule II Part III
<i>Mus booduga</i>	Field Rat	Schedule V
<i>Mus musculus</i>	House Mouse	Schedule V
<i>Niviventer fulvescens fulvescens</i>	White bellied Rat	Schedule V
<i>Presbytis pileatus</i>	Monkey	Schedule V
<i>Rattus nitidus nitidus</i>	Himalayan Rat	Schedule V
<i>Rattus rattus</i>	House Rat	Schedule V
<i>Rattus rattus brunneusculus</i>	Black Rat	Schedule V
<i>Rhinolopus affinis himalayanus</i>	Intermediate Horse Shoe Bat	US
<i>Rhinolopus pearsoni</i>	Pearson's Horse Shoe Bat	US
<i>Scotomanes ornatus ornatus</i>	Harlequin Horse Shoe Bat	US
<i>Suncus murinus griffithi</i>	House Shrew	US

Birds

Zoological Name	Common Name	Schedule Status
<i>Acridotheres tristis tristis</i>	Indian Myna	US
<i>Bambusicola fytchii hokinsoni</i>	Assam Bamboo Partridge	Schedule I Part III
<i>Bubo flavipes</i>	Tawny Fish Owl	US
<i>Milvus migrans lineatus</i>	Large Indian Kite	US
<i>Motacilla indica</i>	Forest Wagtail	US
<i>Scolopax rusticola rusticola</i>	Wood Cock	US
<i>Alcedinidae</i>	Kingfisher	Schedule IV

Reptiles

Zoological Name	Common Name	Schedule Status
<i>Calotes versicolor</i>	Garden Lizard	US
<i>Collophis maclellandi</i>	Coral Snake	US
<i>Chrysopelea ornata</i>		US
<i>Natrix piscicolor</i>	Water Snake	US
<i>Varanus bengalensis</i>	Indian Monitor	Schedule II Part II
<i>Chameleon sp.</i>	Cameleon	Schedule II Part I

Amphibians

Zoological Name	Common Name	Schedule Status
<i>Amolops afghanus</i>		US
<i>Bufoides meghalayana</i>		US
<i>Microphyla ornata</i>		US
<i>Rana danieli</i>	Frog	US
<i>Rana livida</i>	Frog	US
<i>Rhacophorus maximus</i>		US

Fishes

Zoological Name	Khasi Name	Schedule Status
<i>Brachydanio rerio</i>	Shalynnai	US
<i>Danio aequipinnatus</i>	Shalynnai	US
<i>Danio dangila</i>	Shalynnai	US
<i>Labeo dera</i>	Kha bah	US
<i>Labeo rohita</i>	Kha bah	US
<i>Puntius shalynius</i>	Shalynnai	US

List of Invertebrate species found in the area

Group/Species of Invertebrates	Common Name	Schedule Status
Acari		
<i>Malaconothrus sp.</i>		US
<i>Scheloribates parvus</i>		US
<i>Paralamellobates bengalensis</i>		US
Annelida: Oligochaeta		
<i>Drawidia sp.</i>	Earthworm	US
Arthropoda: Crustacea		
<i>Macrobrachium assamensis</i>	Shrimp	US
Arthropoda: Lepidoptera		
<i>Arnetta atkinsoni</i>		US
<i>Eurema brigitta rubella</i>		US
<i>Halpe kumara</i>		US
<i>Matapa druna</i>		US

Arthropoda: Insecta		
Plecoptera- Immature		US
Trichoptera- Immature		US
Odonata- Immature		US
Chironomidae larvae		US
Mollusca: Gastropoda		
Bellamya bendalensis	Snail	US
Zooplankton: Rotifera		
Brachonus quadridentatus		US
Brachonus calciflorus		US
Filinia longiseita		US
Lecane sp.		US
Zooplankton: Cladocera		
Sida crystallina		US
Daphnia carinata		US
Zooplankton: Copepoda		
Arctodiaptomus keifari		US
Heliodiaptomus sp.		US
Mescocyclops leuckrti		US

Threatened Animal species in the Area

Zoological Name	Common Name	Schedule Status
<i>Lutra lutra monticola</i>	Otter	Schedule III
<i>Presbytis pileatus</i>	Monkey	Schedule II

Here no endemic, endangered migratory fauna found in the area. This area is not also a migratory path of any faunal species.

List of Aquatic Fauna

Fishes	Schedule status
<i>Brachydanio rerio</i>	US
<i>Danio aequipinnatus</i>	US
<i>Danio dangila</i>	US
<i>Labeo dera</i>	US
<i>Labeo rohita</i>	US
<i>Puntius shalynius</i>	US
Arthropoda: Insecta	
<i>Plecoptera- Immature</i>	US
<i>Trichoptera- Immature</i>	US
<i>Odonata- Immature</i>	US
<i>Chironomidae larvae</i>	US
Mollusca: Gastropoda	
<i>Bellamya bendalensis</i>	US

Zooplankton: Rotifera	
<i>Brachonus quadridentatus</i>	US
<i>Brachonus calciflorus</i>	US
<i>Filinia longiseita</i>	US
<i>Lecane sp.</i>	US
Zooplankton: Cladocera	
<i>Sida crystalline</i>	US
<i>Daphnia carinata</i>	US
Zooplankton: Copepoda	
<i>Arctodiaptomus keifari</i>	US
<i>Heliodiaptomus sp.</i>	US
<i>Mescocyclops leuckrti</i>	US

US- Un-scheduled animals

AESTHETIC BEAUTY

This area has got its own scenic beauty, with high hill ranges on either side which has greenery look with beautiful land scape. However, this beauty by and large is not going to be affected by the proposed project activity under this proposed plan. The project area is non-forest, barren and rocky land without any cultivation.

4.11 SOCIO-ECONOMIC ENVIRONMENT

The study of socio-economic component of environment is incorporating various facets related to socio-economic conditions in the impact zone which is an important part of Environmental Impact Assessment study. This includes demographic structure, population dynamics, infrastructure resources, economic attributes referring to employment, per capita income, agriculture, trade and industrial development. The aesthetic environment refers to the scenic value of the area, tourist attraction, forest and wild life, historic and cultural monuments. The study of these parameters helps in identifying, predicting and evaluating the likely impacts due to proposed project activities.

Baseline Status (Description of existing socio economic condition)

Since this project intends to develop a mining activity, the baseline study focuses on the community around the project site. The study area includes 9 inhabited villages from Khliehriat Tehsil of East Jaintia Hills District, Meghalaya State. (Ref. Fig. 4.4)

The latest available data has been complied to delineate the existing socio-economic scenario in study area.

Details of various facets of socioeconomic environment are gathered through secondary sources i.e. census records of East Jaintia Hills District, Meghalaya State are described below:

I Demographic Structure

Demographic structure of the study area was estimated for the selected parameters such as households, population, density, sex ratio, scheduled caste, scheduled tribes, and literacy from primary census abstract, CD 2011 & 2001. Study area highlights as per 2011 & 2001 census is depicted in **Table 4.15**.

Table - 4.15
Study area highlights as per 2011 & 2001 census

Study Area	
No. of State	1 (Meghalaya)
No. of District	1 (Jaintia Hills)
No. of Tehsil	1 (Khliehriat)
No. of Villages	9

Socio Economic Parameters		2011	2001
Population	Total	5248	3517
	Male	2673	1831
	Female	2575	1686
No. of Household		963	637
Child Population below the age of 6 years (%)		1272 (24.24)	741 (21.07)
Sex Ratio (No. of females per 1000 males)		963	921
Family Size (person per household)		5.4	5.5
Scheduled Castes	Total (%)	5 (0.10)	Nil
	Male (%)	4 (0.15)	Nil
	Female (%)	1 (0.04)	Nil
Scheduled Tribes	Total (%)	5110 (97.37)	3447 (98.01)
	Male (%)	2563 (95.88)	1775 (96.94)
	Female (%)	2547 (98.91)	1672 (99.17)
Literates	Total (%)	2579 (49.14)	1506 (42.82)
	Male (%)	1316 (49.23)	813 (44.40)
	Female (%)	1263 (49.05)	693 (41.10)
Total Area in sq. km.		78.57	
Population density in per sq. km.		66.79	44.76

The salient features arising out of demographic details are given below:

Total number of 9 villages are coming in the study area from Khliehriat Tehsil of East Jaintia Hills district. Total numbers of residential houses within the study area are 963. Total population of the study area as per 2011 census is 5248 out of which 2673 are males and 2575 are females. The child population below the age of six years account for about 24.24% of the total population. Scheduled caste population in the study area is 0.10%.

Sex ratio (number of females per thousand males) is 963 which indicates that females are less in number than their male counterparts in the study area and is also lower as compared to district & state average of 1013 & 972 respectively females per 1000 males. Sex Ratio of Study Area & its comparison with District & State level is presented in **Fig 4.5**.

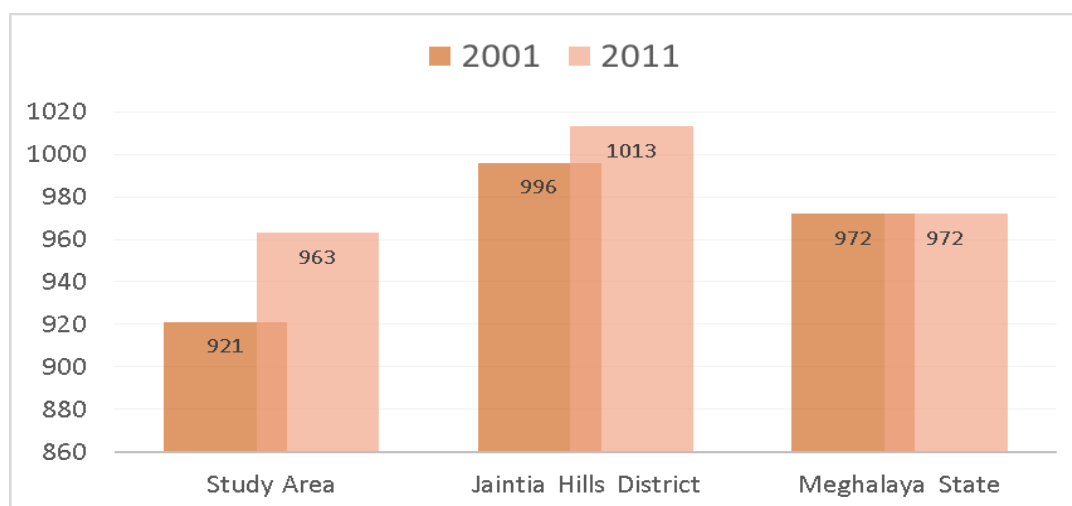


Fig 4.5: Sex Ratio of Study Area & its comparison with District & State level

Scheduled tribe population is a dominant caste group, predominantly belonging to Jaintia tribe constitutes about 97.37% of the total population. Scheduled castes & scheduled tribes population in the study area is shown in **Fig 4.6**.

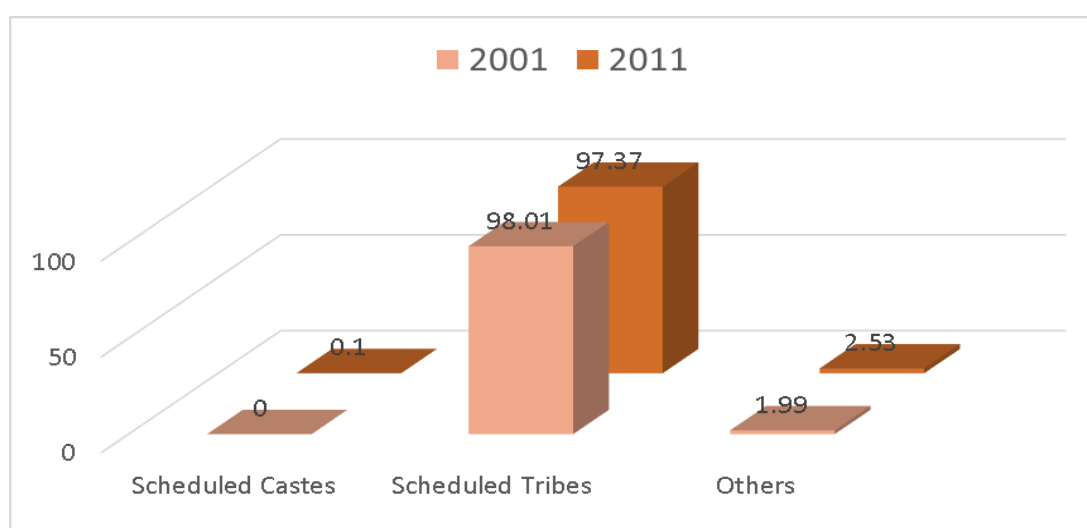


Fig 4.6: Scheduled Castes & Scheduled Tribes Population in the Study Area

There are 2579 literates and 2669 illiterates in study area. Improvement in literacy is seen in the study area during the decade 2001-11 are shown below:

Literate Population:	2001		2011		Change in %
	Persons	%	Persons	%	
Total	1506	42.82	2579	49.14	6.32
Male	813	44.40	1316	49.23	4.83
Female	693	41.10	1263	49.05	7.95

As per 2011 census overall literacy rate in the study area is 49.14%. Literacy level among the male & female population is quite similar. The reason for the low educational status may be due to lack of awareness about the importance of educational system.

Village wise demographic structure of the study area is shown in **Table 4.16**.

Table 4.16

Demographic Profile of the Study Area

Sr. No.	Villages	House holds	Population			Child Population (0 – 6 yrs)	Sche duled Castes	Scheduled Tribes			Literates		
			Total	Male	Female			Total	Male	Female	Total	Male	Female
Khliehriat Tehsil, Jaintia Hills District, Meghalaya State													
1	Chieh Ruphi	124	670	329	341	160	0	668	327	341	343	161	182
2	Thang Skai	111	635	334	301	156	3	625	327	298	386	204	182
3	Wahiajer	114	602	297	305	159	0	600	297	303	214	98	116
4	Lum Shnong	367	1945	1017	928	462	1	1829	920	909	1170	627	543
5	Umlong	69	418	223	195	99	0	416	221	195	140	77	63
6	Um Latdoh	60	349	171	178	77	0	349	171	178	103	55	48
7	Umlaper	7	41	19	22	10	0	41	19	22	11	6	5
8	Tongseng	87	486	230	256	128	1	480	228	252	188	79	109
9	Lum Tongseng	24	102	53	49	21	0	102	53	49	24	9	15
Total		963	5248	2673	2575	1272	5	5110	2563	2547	2579	1316	1263

Source: Primary Census Abstract CD 2011 Jaintia Hills District, Meghalaya State.

II Infrastructure Resource Base

The infrastructure resource base of the villages in the study area with reference to education, medical facilities, water supply, post and telegraph, transportation and communication, approach road and power supply etc. is based on Village Directory, Census of India 2001(CD) of Jaintia Hill district is described below:

Educational Facilities: Educational facility is available in 7 villages in the study area and mainly in the form of Primary and middle school. In some villages adult literacy centers are running to provide education to the illiterate adults.

Medical Facilities: Two villages within the study area are having medical facilities. Good medical facilities are available in the township area of M/s CMCL and is close to the project site.

Drinking water supply: All the villages in the region are having drinking water facility in the form of spring, tap water, tank water& others.

Communication, Transportation, Approach Road: Post office facility available in the plant premises of CMCL and Shiehruphi and Lumshnong villages in the study area. The region is well connected with both Paved (Pucca) and Mud (Kuccha) roads. Bus facility is available in most of the villages it means local people generally not facing too much difficulty in accessing the local areas.

Banking Facilities: Commercial bank facility is available in Lumshnong village.

Power Supply: 6 villages are electrified in study area of the total 9 villages and it is mostly used for domestic purpose.

Types of Infrastructural facilities available in No. of villages is depicted in **Fig 4.7**.

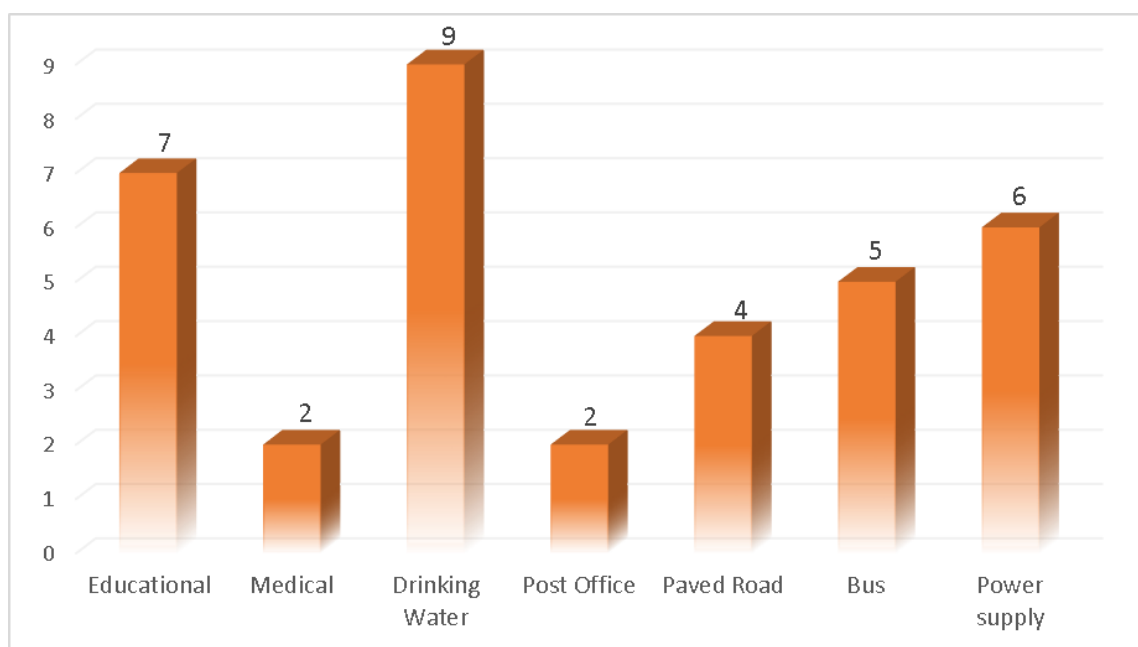


Fig 4.7: Types of Civic Amenities Available in No. of Villages

III Occupational Pattern/ Economic Resource Base

Economic resource base of any region mainly depends upon its economically active group i.e. the working population involved in productive work. According to census department, work defined as a “participation in any economically productive activity”. Such participation may be physical or mental in nature. **Work** involves not only actual work but also effective supervision and direction of work. It also includes unpaid work in farm or in family enterprise. **Worker** is defined as a person who has participated in any economically productive activity with or without compensation or profit during one year preceding the date of enumeration. **Work Participation Rate** is defined as the number of workers per 100 populations. Total worker population & work participation rate in both 2011 & 2001 decades are illustrated below:

Total / Male / Female	Total Population/ Total Male/Total Female		Total Workers Population		Work participation rate		Change in %
	2001	2011	2001	2011	2001	2011	
Total	3517	5248	1592	1807	45.27	34.43	-10.84
Male	1831	2673	904	1141	49.37	42.69	-6.68
Female	1686	2575	688	666	40.81	25.86	-14.95

Type of Workers- Main Worker: Persons who ‘worked’ for 6 months or more during one year preceding the date of enumeration. **Marginal Worker:** Persons who ‘worked’ for less than 6 months during one year preceding the date of enumeration. **Non-Worker:** Persons who did not ‘work’ at all during one year preceding the date of enumeration includes students, persons engaged in household duties, dependents, pensioners, beggars, etc. As per 2011 census percentage of types of workers i.e. main, marginal and non-workers in the study area is presented in **Fig. 4.8**.

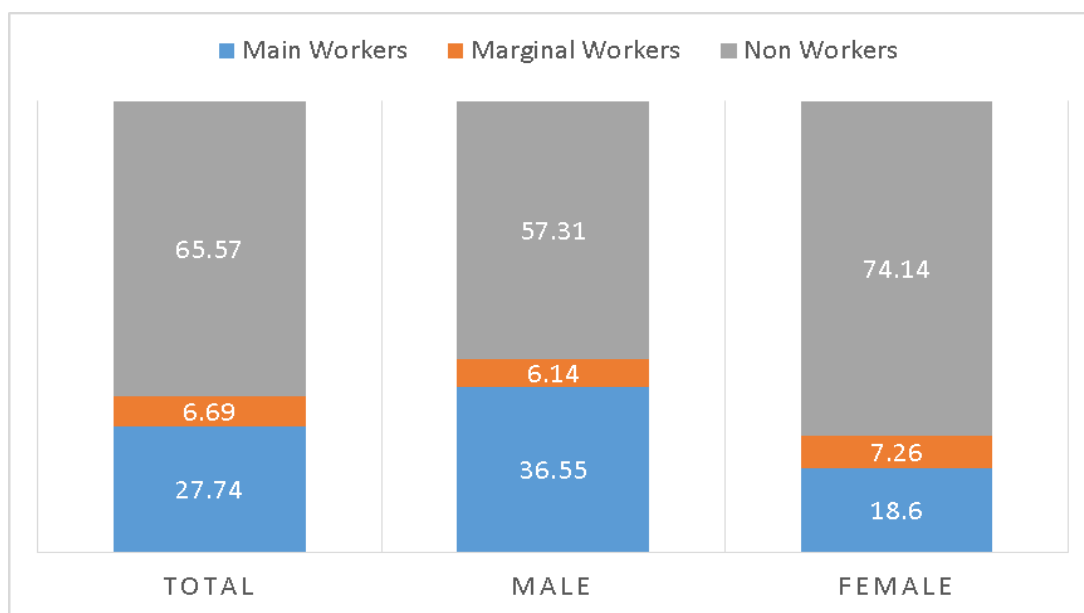


Fig 4.8: Types of Workers in the Study Area as per 2011 Census

Main workers and marginal workers population in the study area is 1456 (27.74%) & 351 (6.69 %) respectively it means that the unemployment level is high in the region as non-worker population share more than 60% of the total population in the region i.e. 3441 (65.57%).

Decadal Changes in types of workers in the study area is described below:

Types of Workers	Total/ Male/ Female	2001		2011		Change in %
		Number	%	Number	%	
Main Workers	Total	1446	41.11	1456	27.74	-13.37
	Male	838	45.77	977	36.55	-9.22
	Female	608	36.06	479	18.60	-17.46
Marginal Workers	Total	146	4.15	351	6.69	2.54
	Male	66	3.60	164	6.14	2.54
	Female	80	4.74	187	7.26	2.52
Non Workers	Total	1925	54.73	3441	65.57	10.84
	Male	927	50.63	1532	57.31	6.68
	Female	998	59.19	1909	74.14	14.95

As compared to 2001 Census, the percentage of main workers to total population has decreased from 41.11% in 2001 to 27.74% in 2011 (by 13.37 percentage point), while marginal workers and non workers are increased by 2.54% and 10.84% respectively.

Category of (Main & Marginal) Workers – The main workers and marginal workers are further classified into four different economic categories– viz. cultivators, agricultural labourers, workers in household industries and other workers. **Cultivator** means person is engaged in cultivation of own land and person who works on other person's land for wages in money or kind of share will be regarded as an **Agricultural labourer**. **Household industry** is defined

as an industry conducted by one or more members of the household at home, large proportion of workers in the household industry should consist of members of the household. 'All workers engaged in some economic activity since last one year but are not cultivators, agricultural labourers or in household industry are categorized as **'Other Workers'** (OW), include all government servants, municipal employees, teacher, factory workers, plantation workers, those engaged in trade, commerce, business, transport, banking, mining, construction, political or social work, priest, entertainment artists etc.

Economic pattern of the study region gauged by the pattern of distribution of the main worker and marginal worker as per the 2011 & 2001 census data is shown in **Fig 4.9**. People in the region are mostly engaged in agriculture sector which is supported by the fact that as per 2011 census cultivators (43.20 %) and agriculture laborers (10.85%) both together constitute 54.05% but decline by 20.15 percent points as compared with earlier census of 2001.



Fig 4.9: Economic category wise break up of Main Worker

Village wise occupational structure of the study area is depicted in **Table 4.17**.

Table 4.17
Occupational Structure of the Study Area

Sr. No.	Villages	Main Workers					Marginal Workers					Total Workers (Main + Marginal)	Non Workers
		CL	AL	HIW	OW	Total	CL	AL	HIW	OW	Total		
Khliehriat Tehsil, Jaintia Hills District, Meghalaya State													
1	Chieh Ruphi	9	8	0	94	111	55	57	0	6	118	229	441
2	Thang Skai	17	16	1	159	193	1	13	1	5	20	213	422
3	Wahiajer	7	100	5	35	147	1	12	0	87	100	247	355
4	Lum Shnong	185	5	5	349	544	22	51	2	28	103	647	1298
5	Umlong	90	28	0	3	121	0	1	0	1	2	123	295
6	Um Latdoh	156	0	0	5	161	0	0	0	0	0	161	188
7	Umlaper	14	1	1	0	16	0	0	0	2	2	18	23
8	Tongseng	113	0	0	10	123	4	0	0	2	6	129	357
9	Lum Tongseng	38	0	0	2	40	0	0	0	0	0	40	62
Total		629	158	12	657	1456	83	134	3	131	351	1807	3441

Source: Primary Census Abstract CD 2011 Jaintia Hills District, Meghalaya State.

C: Cultivators AL: Agricultural Labourers HW: Household Industry Workers OW: Other Workers

IV Cultural and Aesthetic Attributes

There is no place of historical/archeological sites present within 5km radius around the project site.

CHAPTER – 5

ANTICIPATED ENVIRONMENTAL IMPACTS & MITIGATION MEASURES

5.1 INTRODUCTION

While providing essential minerals for the use in our economies, uncontrolled mining can also have many adverse impacts on the environment and human health. Potential impacts include air and water pollution, mine waste disposal and land degradation. Hence, environmental impact assessment is essential for the present environmental scenario.

The project activities have certain effects on various environmental domains that exist in the area. A scientific assessment of these impacts those are likely to influence the existing environmental scenario is needed. This could also facilitate in formulating a suitable environmental management plan depicting all mitigation measures. It can help in implementing the project in an eco-friendly manner. The project activities influencing the following environmental attributes have been studied and their impacts on the following attributes have been assessed.

- Land use pattern
- Air Quality
- Noise Quality
- Water Quality
- Ecological Condition
- Socio-Economic Condition

The mining and allied activities in the proposed project area have influence on environmental attributes. These attributes include:

- Excavation
- Construction of approach and haulage road
- Drilling and Blasting
- Loading and Transportation
- Site preparation

The magnitude of the proposed mining activity being small is not likely to create any serious impacts on the existing environmental set up of the area. However, the likely impacts of the proposed mining and allied activities on the various environmental parameters are discussed.

5.2 IMPACT ON LAND USE PATTERN

The project area, which is classified as non- forestland, has got sparse vegetation. The area is devoid of irrigation facility so agricultural yield is very less in percentage. A good number of people are depending on other jobs. The proposed land use pattern is as follows. (Table - 5.1)

Table 5.1
Proposed Land Pattern (Area in Ha.)

Sl. No.	Pattern of Utilisation	Existing	Planned 5 years	Beyond 5 years	Total
1.	Area to be excavated ML area 4.96Ha &-ML area4.7Ha.	7.17	0.42	0.5	8.09
2.	Storage for top soil	Nil	Nil	Nil	Nil
3.	Overburden/dump	Nil	Nil	Nil	Nil
4.	Mineral Storage	Nil	Nil	Nil	Nil
5.	Infrastructure (Workshop, administrative building)	Nil	Nil	Nil	Nil
6.	Roads	Nil	Nil	Nil	Nil
7.	Railways	Nil	Nil	Nil	Nil
8.	Green Belt	Nil	Nil	Nil	Nil
9.	Tailing pond	Nil	Nil	Nil	Nil
10.	Effluent Treatment Plant	Nil	Nil	Nil	Nil
11.	Mineral Separation Plant	Nil	Nil	Nil	Nil
12.	Township area	Nil	Nil	Nil	Nil
13.	Others to specify	Nil	Nil	Nil	Nil
	Sub-Total	7.17	0.42	0.5	8.09
14.	Safety zone (7.5 ML boundary)	---	---	---	1.57
	Total	7.17	0.42	0.5	9.66

Provision of drinking water, canteen, and rest shed and recreation facilities will be provided for workers.

To mitigate the adverse impact plantation to be carried out in and around the area and scientific progressive reclamation plan to be followed. At the end of the mining activity total area will be covered under plantation.

As such the area is of non-agriculture category. There will not be any effect on agricultural point of view. The area is in hilly terrain. Soil erosion is a main concern of the area. Care will be taken by plantation and other measures to minimize the effect the soil erosion.

Garland drain, check dam and retaining wall shall be provided to control the surface runoff.

5.3 IMPACT ON AIR QUALITY

The dust generated from mining activities is the primary source of air pollution. The emission sources include excavation and mining of limestone, drilling, blasting, and transportation within the project area. During air quality monitoring it is observed that dust generation is of short term and settle quickly within close ranges. There is very less scope of spreading of dust particles to the near by residential areas as these operations are carried out at far off distances from the habitation areas. Hence, human population is not directly affected by the air pollution as the impact of dust generation. It is found that the dust nuisance is not a problem due to deployment

of water tankers with sprinklers and keeps the haulage road surface wet resulting suppressed dust particles. It is also observed that the dust nuisance is localized i.e. within the project area only.

Negligible amount of auto exhaust emissions also expected to be found in the core zone because of vehicular activities arising due to transportation of limestone by dumpers and excavators. However, there will be very little impact on air quality due to automobiles.

Air quality modelling is carried out for prediction of impact of the project on the air quality of the area. The impact of movement of vehicles for transportation of mineral is considered. “Breeze Aeromod” software is used for prediction of air. As per the meteorological condition & production activity the maximum increment value of Particulate matter will be less than $10\text{microgram}/\text{m}^3$, hence the resultant value will be less than $78.8\text{ microgram}/\text{m}^3$, which will be within the prescribed limit.

To mitigate the adverse impact the following measures to be carried out. Sprinkling of water to be carried out during winter and summer season on haul road, face of working pit, loading site. Drilling to be carried out by wet drill method. Plantation all around the lease boundary, Maintenance of vehicles.

5.4 IMPACT ON WATER QUALITY

Water is one of the most precious resources on the earth. The applied area does not have any perennial nala. The source of water in the project area is from near by nala only. More over due to small scale mining operation as well as by fully mechanised method of mining using minimum machineries, dust suppression is by water spraying through water sprinkler limited to haulage road. Rainwater flowing through the exposed mine cuts would carry some sediment of soil and rock. These are found to be non-toxic in nature. Surface runoff water from mines has only high turbidity during monsoon. As discussed, the mining activity will require very less quantity of water in comparison to the recharging. Hence, it will not affect the water regime of the area. Quarry water shall be treated before releasing to natural drainage system.

As discussed in chapter-4, the annual ground water recharge will be 2.3184 Ham. For facilitating mining and allied activities water requirement will be 50 m^3 per day, it will be met from plant supply. Thus, the annual requirement of water by taking 330 working days shall be 16500Cum or 1.65 Ham. This water requirement is less than that of the utilizable water resources. Water requirement for the area is given in **Fig. 5.1**.

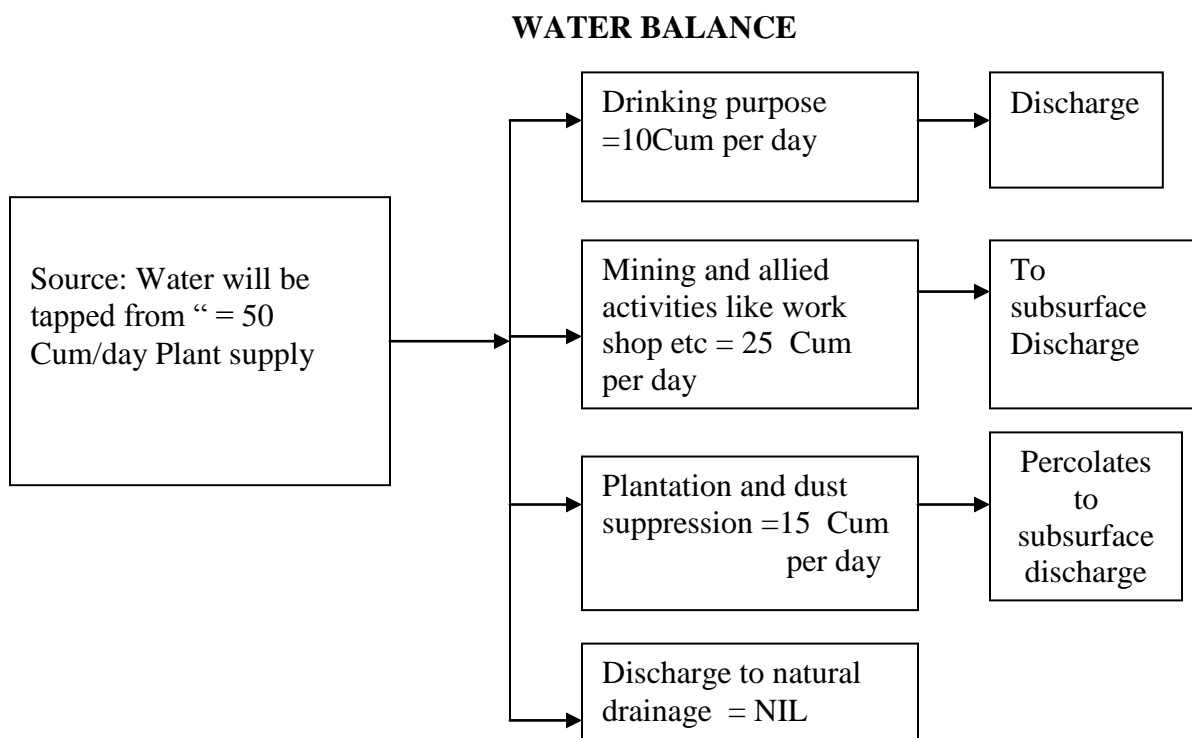
The exploitation of ground water for irrigation and other purposes is minimum in the buffer zone surrounding the mine lease area as the area falls in the nonforest category and sparsely populated. Ultimate working depth of the mine will be 430 m AMSL where as ground water table is at 420m AMSL (in summer) and 425m AMSL (in rainy season). Hence mining will not touch ground water table (**Fig. 5.2**).

It is further noted that, due to excavation of hard rock the filtration rate will increase. So, due to mining the ground water recharge will increase as requirement of water is very small in

comparison to the availability and ground water recharge. Hence, on ground water impact will be marginal.

To mitigate any adverse impact due to the mining activity, surface runoff shall not be allowed to flow out side lease before settling.

Figure: 5.1



5.5 IMPACT ON NOISE QUALITY

As mentioned in chapter-2 the proposed mining will be open cast mostly mechanised working. In this open cast Mechanized mining the various sources of noise in the area are attributable mainly due to drilling, blasting, operation of compressor, loading and haulage, operation of diesel pump and vehicular traffic.

The level of limestone production, being very small, and the operation will be limited to one shift of eight hours duration in a day. The various sources of noise mentioned above shall only be periodical and is limited to a fixed period of operation only. In addition to this, the transportation of limestone might cause a little effect on the noise level. The noise level result due to such operations in the active working zones in the area do not indicate any serious concern as it is well below in prescribed standard limit.

The various noise levels and their effects along with hazards on the human being are noted (Table - 5.2). The ambient noise level data (Table - 4.6) of the area on comparison with the

possible health hazards due to noise level (Table - 5.2), it can be concluded that there is no serious alarming effect due to mining.

Table - 5.2
Health Hazards by Different Noise Levels

Sl.No.	dB(A)	Effects
01	20	No sound perceived
02	25	Hearing threshold
03	35	Slight sleep interference
04	50	Moderate sleep interference
05	55	Annoyance (mild)
06	60	Normal speech level
07	70	Smooth muscles/glands react
08	75	Changed motor coordination
09	80	Moderate hearing damage
10	85	Very annoying
11	90	Affect mental and motor behaviour
12	95	Severe Hearing Damage
13	100	Awaken Everyone
14	115	Maximum Vocal Effort
15	125	Pain Threshold
16	130	Limit Amplified Speech
17	135	Very painful
18	140	Potential of hearing loss high

To mitigate any adverse impact regular maintenance of vehicle & machineries shall be carried out.

5.6 TRANSPORTATION

Almost 3000 TPD of limestone will be produced. However this vehicle will ply in the road between plant and mines. This transportation will partly utilize the existing public road. Steps will be taken care by providing peripheral development money to district authority and help the govt. agencies for road repairing. Awareness campaign among dumper /truck drivers will be generated for clearance of road and lower down the pollution load due to transportation.

The transportation shall be carried out from lease area to plant site which is situated within 2 kms through interconnected road. Only existing NH shall be used for administrative vehicle movement purpose. So, existing road is not required to expand due to this project.

5.7 ECOLOGICAL CONDITIONS

The proposed mining operation shall have little impact on the existing ecological conditions. The area required for mining is having very less vegetation cover. Plantation shall be carried out to minimize the adverse impact.

5.8 IMPACT ON SOCIO-ECONOMIC CONDITIONS

Any development activities would cause certain impact on the socio-economic environment of the study area. The socio-economic impact would be of varied nature such as beneficial and adverse, direct and indirect, temporary or permanent as well as local or regional level on different indicators of human interests. In responses to the need based assessment study, proposes the adequate & suitable mitigation measures for minimizing the adverse impacts & enhancing the beneficial impacts for the welfare of the society. The details of impacts predicted, mitigation measures and EMP are given below.

5.8.1 Enhancement in Employment & Income

The proposed project will contribute direct employment scope for about 155 persons including skilled, semi-skilled and un-skilled mine workers, supervisory staffs, mining engineers, geologists and surveyors. It can create indirect employment scope for about 90 persons. For ensuring this beneficial socio economic impact, project proponent is committed to recruit local manpower as far as possible.

Increase in the income, wages, and salaries earned by the local people go into the local economy. The regular & profitable mining will ensure improvement of economic status of the people around the lease area and local and regional economy.

Proposed limestone activity would ultimately result in enhancement of production level of cement which will enhance the trading and supply of cement at local, regional and national level thus leading to economic development of the region.

Human Settlement

There will be no human settlement in the core zone of mining lease area. Therefore social demographical profile of the area will not be affected in terms of displacement of human settlements, loss of human assets & structures, community facilities during the whole life of mine. The mining operations will not disturb/relocate any village. Thus no adverse impact is anticipated.

Agriculture based livelihood

The crop yield may be affected due to dust pollution, change in soil characteristics or reduction in agricultural area.

The mining activities will be restricted to the lease area (core zone) and appropriate measures will be taken for various pollutions that can arise out of mining. Mined out area is converted back to agricultural land by backfilling & soil capping over it.

Thus there may be no or negligible impact on the crop productivity or cropping pattern therefore there will be no adverse impact predicted on agriculture based livelihoods

Influx of Outsiders

Influx of outsiders in the area would create number of problems such as stress on existing infrastructural facilities i.e. drinking water, sanitation, housing etc., new health problems may cause in the region as immigrants may carry different contagious diseases that may spread in the locality, social & culture values of local population may be disturb.

Local work force will be given first preference in the proposed mining activity due to which influx of the outsiders is not foreseen or it will be very minimal. If sufficient number of local workers will not be available, then workers from outside will be engaged. Thus no adverse impact is anticipated.

Health Status

The mining activities like blasting, handling & sizing of limestone and haulage transportation of limestone etc. may result in fugitive dust emissions and significant noise levels within mining operation area as well as closed proximity of mine area and thereby pose health hazards which likely to harm the health status of natives .

But during air quality monitoring it is observed that dust generation is of short term and settle quickly within close ranges. There is very less scope of spreading of dust particles to the near by residential areas as these operations are carried out at far off distances from the habitational areas. Hence, human population is not directly affected by the air pollution as the impact of dust generation.

Adequate measures have been envisaged in the project design to control dust & noise. Adequate & effective control measures will be provided which include dust suppression, water sprinkling in area around sizing to reduce the fugitive dust emissions. Well maintained tarpaulin covered trucks etc. will be used. Therefore no likely adverse impacts on people health, social & economical factors will be occurring or it will be very minor.

Further the proponent is plan to undertaken a number of health related welfare activities under CSR which is considerably helpful to ameliorate the health status of people in the study area.

Infrastructural Developments

Strengthen existing infrastructural facilities such as educational, communication, transportation, drinking water etc. in the surrounding villages.

5.8.2 Education:

As per 2011 census overall literacy rate in the study area is 49.14%. The reason for the low educational status may be due to lack of awareness about the importance of education.

The project activities shall create awareness with the local people regarding the importance of education. With the increased amount of income people can send their children to nearby schools.

These schools are taking care of the local students in their study. However, the Project proponent will take necessary steps to improve the literacy level of the local people with the elders also. The implementation of this project shall naturally augment the education status of the local people.

5.8.3 Communication

The mining area is well connected with important places in the vicinity. Nearest Railway station is at Badarpur, The mine area is connected with the National Highway-44 by a fair weathered road.

Therefore no traffic congestion is envisaged and if required road construction and maintenance will be done otherwise provide financial assistance to respective civic authorities of region for construction and maintenances of roads as a part of infrastructural development.

Collaboration between Project Authority and Local Bodies - Whenever necessary, collaboration between project authority and local bodies will be done on regular basis with an objective to build and maintain a good relationship which is necessary for smooth functioning of the project as well as progress and welfare of the people in the study area.

Proposed CSR Activities - Apart from the various environmental protection measures, the project proponent is conscious of its social responsibility and as any good corporate citizen, it is proposed to undertake the following welfare activities in the surrounding areas of the proposed mine on the following domains.

Livelihood Development Activities includes Employment, Vocational Training Programs and Financial Assistance to local manpower, Distribution of seeds & saplings and assistance to farming community.

Healthcare: Assistance to hospitals and foundations, promotion and assistance to the Government of India initiatives like Pulse Polio, arranging free health camps, free medicine distribution, mobile ambulance and doctor facility etc. Providing medical kits to villages along with basic first-aid training, micro-financing support to the leprosy affected people.

Education Facilities improvement: Financial help to schools, sponsored funds for school building, teachers' salaries, books, school uniforms and other study materials, Donation of Computers in Government school, formation & modernization of school rooms etc.

5.9 SCOOPING PROCESS

As it is evident, due to mining activities the environment of the area in respect of Air and land use will be affected due to activities like drilling, blasting and transportation. The PM₁₀ level shall not go up.

Adverse effect in respect of air shall be mitigated by

- a) Construction of well compacted roads.
- b) Regular water sprinkling on roads and waste dumps by tankers.
- c) Provision of dust collectors for the drill machines during drilling operation.
- d) Controlled blasting.
- e) Supply of dust masks for the drill operators.
- f) Plantation of wide leaf trees, creepers, tall grasses around quarry sites, roads, colony and other surrounding barren zones.

Land degradation affect shall be mitigated by proper plantation programme and reclamation programme.

5.10 MITIGATION MEASURES

The various mitigation measures covering both physical as well as socio-economic factors, to minimise the adverse environmental impacts are proposed to be taken up for the following environmental components.

<ul style="list-style-type: none">• Degradation of land/soil	<ul style="list-style-type: none">• Disturbance of habitat
<ul style="list-style-type: none">• Degradation of natural vegetation cover/forest	<ul style="list-style-type: none">• Disposal and management of waste
<ul style="list-style-type: none">• Pollution of air	<ul style="list-style-type: none">• Socio-economic measures
<ul style="list-style-type: none">• Noise pollution	<ul style="list-style-type: none">• Occupational safety and health

Various mitigative measures for all these environmental components are discussed in Chapter-10.

CHAPTER – 6

ENVIRONMENTAL MONITORING PROGRAM

6.1 INTRODUCTION

The mitigation measures suggested in page 64 should be implemented so as to reduce the impact on environment due to the operations of the proposed mining activities. In order to facilitate easy implementation, the mitigation measures are phased as per the priority of implementation. The implementation schedule is given as below. (Table - 6.1).

Table - 6.1
Implementation Schedule

Sl. No.	Recommendations	Time Requirement (Months)	Immediate	Progressive	Discretion of the Management
1	Air pollution control measures	Before commissioning of respective units	*	--	--
2	Water pollution control measures	Before percolation/seepage and dewatering status	*	--	--
3	Noise control measures	Along with the commissioning of the mine project	*	--	--
4	Ecological preservation and upgradation	Stagewise implementation	*	*	--
5	Land reclamation/Soil waste management	Stagewise implementation	*	*	--
6	Socio-economic measures	As per the policies of the State Govt. and the need of the local residents			*

Note (*) indicates implementation of recommendations

6.2 MONITORING AND REPORTING PROCEDURE

The monitoring of various environmental parameters is necessary which is a part and parcel of the environmental protection measures. Monitoring is as important as that of control of pollution since the efficacy of control measures can only be determined by monitoring. A comprehensive

monitoring program is suggested underneath. Environmental attributes should be monitored as given below:

- Air Pollution and Meteorological Aspects;
- Water and Wastewater Quality;
- Noise Levels;
- Soil Characteristics; and
- Ecological Preservation and Up gradation

6.3 INFRASTRUCTURE FOR ENVIRONMENTAL PROTECTION

A full fledged environmental cell with qualified and experienced personnel established at the company's cement plant, which is located close by, will supervise and implement the environmental issues. This environmental cell is supported by a fully equipped laboratory to carry out the analysis. The proposed organization of the environmental cell should have the following manpower on regular basis.

6.4 BUDGETARY COST ESTIMATE

The cost estimates give only the indication of the likely cost. The estimated environmental i.e. mainly monitoring and green belt development, cost of the project is as follows. (Table - 6.2).

Table - 6.2
Cost of Environmental Protection Measures (In Lakh)

Sl. No.	Measures	Annual Recurring Cost
1	Pollution Control equipments & consumables	--
2	Laboratory chemicals	10
4	Green Belt (Nursery)	14
5	Reclamation	-
6	Staff Salary	9
Total		33

CHAPTER – 7

ADDITIONAL STUDIES

7.1 PUBLIC CONSULTATION

This Mining project is a small scale activity with limited effects on the community within which they are to take place. However, the need for the project to take place in response to the requirements of the local community establishes the necessity for effective public consultation. Without such consultation the project may take on a direction that (although seemingly directed towards public benefit) is counterproductive to the community needs.

The Public consultation will be done with appropriate person(s) to get some additional information. It is necessary for the following general objectives.

- Information, education, liaison
- Identification of real problems, needs and importance
- Idea generation and problem solving
- Reaction and feedback on proposals
- Evaluation of alternatives

Public consultation will provide some useful information for the project, especially when some factors cannot be easily identified and quantified. This process helps to enhance the confidence and decision making among public because local people and citizens can see the environmental impacts which can be carefully handled. The public consultation in decision making provides both judicial and public examination of the factors and consideration in the decision making process.

7.2 RISK ASSESSMENT

Human health and Environmental risk from developmental activities is mainly due to occurrence of some accident consisting of an event or sequence of events explosion, fire and toxic hazards. Risk analysis provides a numerical measure of the risk that a particular facility poses to the public. It begins with the identification of probable hazardous events at an operational area and categorization as per the predetermined criteria. The consequences of major events or accidents are calculated for different combinations of weather conditions to stimulate worst possible scenario. These predictions of consequences are combined to provide numerical measures of the risk for the entire facility. Risk assessment should be done on the basis of past accident analysis at similar projects, previous judgments and expertise in the field of risk analysis especially in accident analysis.

7.3 DISASTER MANAGEMENT PLAN

Disaster management plan is prepared with respect to the following accidents.

7.3.1 Open Cast Bench Slope Failure

For determining factor of safety, the bench slopes are to be monitored regularly by sensitive instruments at precise level at regular intervals to check for any possible ground movement. A well developed drainage system over the lease hold area is to be ensured to check the storm water flows out of the lease area.

- Failure to make and keep the quarry sides secure by proper benching, sloping and keeping benches of adequate height and width.
- Undercutting so as to cause dangerous covering.
- Inadequate nos. of competent persons for carrying out statutory inspections.
- Lack of supervision.

7.3.2 Accidents due to Machinery

- During reversal operation
- Unauthorised driving of vehicles (mostly by helpers)
- Riding of vehicles unauthorisedly
- Attempt to ride moving vehicles
- Overloading
- Driving vehicles in a intoxicated stage
- Vehicles moving in steep gradient or on benches of inadequate width

7.3.3 Other than Transportation Machinery

- Use of sub standard equipments
- Attempt to clean moving parts of machinery
- Non provision or removal of guards for moving parts of machinery

7.3.4 Accidents due to use of Explosives

- Fly rock throw due to blasting
- Inadvertent handling of explosives

TABLE – 7.1
RISK ASSESSMENT

METHOD STAGES	SURVEILLANCE AND MONITORING	TOXICITY ASSESSMENT	HEALTH SERVICE PROVISION	SAFETY PROVISION AND PREVENTION	OBTAINING ADVICE FROM HEALTH SECTOR
LOCATION	Site specific health hazards, general health status of local communities, common causes of mortality, location and functioning of health service.		Access to Health services	Settlement citing	Disease foci, vector biology
PLANNING AND DESIGN	Improve routine health service surveillance though retraining, health information systems.	Toxicological and epidemiological risk valuation, hazard identification for pollutants, dose response assessment, exposure assessment, risk characterization.	Health centre, trained staff, drug supply equipment maintenance, casualty/ emergency unit	OHS planning environmental management	Communicable disease control, vector control environmental health
CONSTRUCTION	OHS monitoring, environmental health: water supply, sanitation, drug supply, vector monitoring.		STD clinic, distribution of contraceptives, health training casualty/ emergency unit, communicable disease control	Safety measures, OHS training, traffic routing	Communicable disease control, environmental health
OPERATION	Routine medical examinations, OHS monitoring, IMR and vector monitoring, casualty rates.		Health education, immunization, supplementary nutrition, training of workers, casualty/ emergency visit, disease control	OHS implementation, environmental management	Communicable disease control, environmental health, human behavior modification
PROJECT ENHANCEMENT	Health information system, laboratory services		Healthy workforce is more productive and vice-versa	Safer working methods, training, injury compensation	Intersectoral collaboration

7.4 RISK MANAGEMENT

The following precautionary measures shall be taken to prevent any accident

- Elimination of the source of hazard
- Substitution of hazardous process and materials by those which are less hazardous
- Geographical/ physical isolation of hazards from vulnerable communities
- Use of engineering controls to reduce the health risk
- Adoption of safe working practices such as regular equipment maintenance
- Use of Personal Protective Equipment should be mandatory.
- Top edge of opencast workings shall be kept properly fenced.
- Quarrying shall be done from top downwards. No overhang will be allowed.
- Special attention and requisite provisions shall be taken while working in areas of geological weakness like existence of slip, fault etc.
- Regular dressing of bench sides to ensure safety of workers employed within 5m or working face.
- Provision of safety belt or rope while persons are at work at the quarry sides or benches from where there are chances of falling down for more than 1.8m.
- Spoil banks not to be retained by artificial means at an angle of repose in excess of its natural angle.
- Drafting and implementation of preventive maintenance schedule for various kinds of machinery deployed in opencast workings.
- Provision of maintenance of properly laid haul roads with parapet wall fencing or guards and road signs at strategic points.
- Precautions against danger while traversing dumpers, excavators etc. by installing audio-visual alarms and appointment of spotters.
- Transportation of Limestone within mine workings by vehicles under the direction, supervision and control of Mine Management only.
- Proper maintenance of vehicles and weekly examination by an engineer and daily examination by a competent person.
- Training and retraining (at specified interval) of the machinery operators.
- Use of controlled blasting techniques. 500 m radius danger zone to be followed strictly.
- Provision of blasting shelters – properly constructed and maintained.
- Adequate maintenance of electrical equipments.
- Adequate illumination after daylight.

7.4.1 Social Impact

Socio-economic impact assessment has taken on a new and important direction. Decision makers at all levels, as well as community members have developed an increasing awareness of the need for estimating the effects for projects on communities. Estimation and analysis of these impacts have direct and immediate action in planning for change and growth that might occur. The categories of effects that may be covered in socio-economic impact analysis includes:-

- Housing status effects
- Educational effects
- Government fiscal effects
- Labor force effects
- Economic status effects
- Family status effects
- Public health status effects
- Public safety effects
- Physical environmental quality effects
- Recreational opportunity effects
- Cultural alternative effects

7.4.2 Occupational Health

Since it is opencast mining, health problems due to dust may be expected. By using various PPEs, the chances of occupational health disease will be lowered. Due to dust various diseases like Asthma, TB, Pneumoconiosis, Silicosis etc. may occur. Periodical medical check up & treatment and job rotation of employees the impact would be minimized.

7.4.3 R&R Action Plan

No displacement is required for the proposed project. Hence R&R action plan is not applicable for the project.

7.5 CSR ACTIVITY

CORPORATE SOCIAL RESPONSIBILITY (CSR)

For social sustainability of any project, attentions need to be paid to the development of the society that existed before or builds up around the project area. The Corporate Social Responsibility is the internalization of the social and environmental effect of its operations through proactive pollution prevention and social impact assessment so that it is anticipated and avoided and benefits are optimized.

The concept is about companies seizing opportunities and targeting capabilities that they have built up for competitive advantages to contribute to sustainable development goals in ways that go beyond traditional responsibilities to shareholders, employees and the law. It is the active partnership of the company which defines the voluntary works with local communities as well as with regional and national Government and reciprocity based on trust and openness to reach agreed objectives and shared involvement. The development activities for the locality have been taken by the lessee for the locality is as follows.

Livelihood Development Activities

- **Employment:** The best method to improve the living standard of any the area is to provide employment for the locality. The lessee has always followed this principle and will do the same in future as well. 80% of workers (un-skilled, semi skilled and skilled) engaged in the mine belong to local villages. The lessee also proposes for maximum appointment of local people to fulfill the manpower requirement for this proposal.

- **Vocational Training Programs:** Project Authority should provide educational and vocational training to unemployed youth in coordination with local vocational institute
- **Financial Assistance:** Project authority must provide low interest loan or zero interest loan for the youth in the study area so that they can be self employed

Education:

A strong promoter of basic and primary education has been adopted for educational institutions to enhance their education standards and equip them with better infrastructure facilities.

- Financial help to schools in tribal villages and slum areas, sponsored funds for school building, teachers' salaries, books, school uniforms and other study materials has been done.
- Construction & repairs of schools building, rooms & toilets etc.
- Computers will also be donated to Government schools and schools in rural remote areas promoting computer literacy.
- Development of school play grounds and children parks
- Scholarship to merit Tribal Students or childrens belongs to BPL families

Community Development:

Being committed and socially responsible, the objective of the Lessee is community development.

- Providing villages with basic amenities, and extending friendship to senior citizens, orphans and physically challenged people are few initiatives taken in the direction of community development.
- The lessee has regularly been providing funds for cultural activities such as football tournament, local festivals etc.
- Drinking water supply to near by villagers.

Healthcare:

The objective is to provide basic healthcare facilities and a better quality of life to people in the lower rung of the ladder. As a part of the healthcare program, hospitals and foundations of the area are supported by the lessee, and also promotion and assistance to the Government of India initiatives like Pulse Polio drive has been provided. Some instances include:

- Arranging health camps, free medicine distribution, eye check up camp, mobile ambulance and doctor facility etc.
- Providing medical kits to villages along with basic first-aid training
- Organising blood donation drives for well-known blood banks
- Organising a Cancer Screening in coordination with a renowned medical foundation
- Extending support to the leprosy affected people through micro-financing and providing sewing machines and utensils to Leprosy homes

Environmental Awareness:

The lessee will play a conscious and active role to improve the quality of life around the mine. A variety of campaigns to be initiated towards environmental causes including awareness sessions for employees on issues like global warming, environment day celebration through pamphlet distribution and planting of saplings and other environmental awareness campaigns across various locations.

Other Peripheral Development Activities:

Development of infrastructure facility is one of the main activities in CSR domain. Water supply, road construction and maintenance bridges etc. are main infrastructure for any area. The project proponent is also involved in the development of all these activities.

The CSR activity capital cost will be 37 lakh and recurring cost will be 21 lakh per year.

CSR Activity Cost

A	Capital expenses (Rs : lakh)	
	Health facilities (ambulance)	18.00
	Education Facilities (Development of School)	10.00
	Welfare of youth (development of play ground)	5.00
	Community development	4.00
	Sub-Total	37.00
B	Annual Recurring Expenses (Rs : lakh)	
	Education	9.00
	Welfare of youth	4.00
	Water spraying	4.00
	Plantation in nearby villages	4.00
	Sub-Total	21.00

The proposed mine, a captive source of limestone to the plant of CMCL. Due to the installation of the plant the positive influence of the activity already reflected in the area it will continue further due to the proposed mining project.

CHAPTER – 8

PROJECT BENEFITS

8.1 IMPROVEMENTS IN THE PHYSICAL INFRASTRUCTURE

8.1.1 Communication

The mining area is well connected with important places in the vicinity. The M.L area can be approached from National highway at a distance of 40 m. nearest railway station is Badarpur, 80 km from the lease area.

8.1.2 Food and Public Health

Greenery development can lead to improved public health and increased yield of crops and fodder which in turn results in better socio-economic environment. It protects land degradation and erosion, protects and improves soil nutrients.

8.2 IMPROVEMENTS IN THE SOCIAL INFRASTRUCTURE

The project activities shall create awareness with the local people for preferring permanent services than periodical agricultural activities. The activities will help them to analyse the importance of education. With the increased amount of income people can send their children to nearby schools and colleges. These schools are taking care of the local students for their studies. The Project proponent has decided to improve the literacy level of the local elders also. The implementation of this project shall naturally augment the education status of the local people.

8.3 EMPLOYMENT POTENTIAL

The project will contribute direct employment scope for about 155 persons including skilled, semi-skilled and un-skilled mine workers, supervisory staffs, mining engineers, geologists and surveyors. It can create indirect employment scope for about 90 persons.

8.4 OTHER TANGIBLE BENEFITS

This project, on implementation shall help in increasing the overall income pattern of the neighbouring people which shall indirectly help them to improve their living standards. Facilities like electricity and telephone are available in these interior/remote areas. There will be no displacement of families for the mining of limestone.

CHAPTER – 9

ENVIRONMENTAL COST BENEFIT ANALYSIS

No recommendations at the Scoping stage.

CHAPTER – 10

ENVIRONMENTAL MANAGEMENT PLAN

(DESCRIPTION OF THE ADMINISTRATIVE ASPECTS OF ENSURING THE MITIGATIVE MEASURES)

10.1 INTRODUCTION

The environment management plan is prepared considering the impacts and areas of concern which have been indicated in Chapter – 5. This covers management of air quality, noise pollution, land use pattern, water pollution, socio-economic conditions etc.

10.2 MANAGEMENT OF LAND

Plantation will be made accordingly. The selection of plant species will be based on the local soil conditions. No waste to be generated from the mines. OB management for the project is not required. Post plantation care like watering and protection from grazing will be done. The scheme of reclamation and plantation has been proposed (**Fig. 10.1**).

Table - 10.1
Post-operational Land use

Sl. No.	Pattern of Utilisation	Existing	Planned 5 years	Beyond 5 years	Total
1.	Area to be excavated ML area 4.96Ha &-ML area4.7Ha.	7.17	0.42	0.5	8.09
2.	Storage for top soil	Nil	Nil	Nil	Nil
3.	Overburden/dump	Nil	Nil	Nil	Nil
4.	Mineral Storage	Nil	Nil	Nil	Nil
5.	Infrastructure (Workshop, administrative building)	Nil	Nil	Nil	Nil
6.	Roads	Nil	Nil	Nil	Nil
7.	Railways	Nil	Nil	Nil	Nil
8.	Green Belt	Nil	Nil	Nil	Nil
9.	Tailing pond	Nil	Nil	Nil	Nil
10.	Effluent Treatment Plant	Nil	Nil	Nil	Nil
11.	Mineral Separation Plant	Nil	Nil	Nil	Nil
12.	Township area	Nil	Nil	Nil	Nil
13.	Others to specify	Nil	Nil	Nil	Nil
	Sub-Total	7.17	0.42	0.5	8.09
14.	Safety zone (7.5 ML boundary)	---	---	---	1.57
	Total	7.17	0.42	0.5	9.66

The stage wise cumulative plantation is as follows.

Table - 10.2
Stage Wise Cumulative Plantation

REQUIREMENT OF PLANTS FOR AFFORESTATION / RECLAMATION										
Year	Un-worked Area (Greenbelt)		Out Side Dump		Dump Area		Top Soil Dump		Total	
	Area (Ha)	Trees	Area (Ha)	Trees	Area (Ha)	Trees	Area (Ha)	Trees	Area (Ha)	Tree
1st	0.5	1250	--	--	--	--	--	--	0.5	1250
2nd	1.0	2500	--	--	--	--	--	--	1.0	2500
3rd	1.5	3750	--	--	--	--	--	--	1.5	3750
4th	1.57	3925	--	--	--	--	--	--	1.57	3925
5th	1.57	3925	--	--	--	--	--	--	1.57	3925
Ultimate	1.57	3925	8.09	20225	--	--	--	--	9.66	24150

The lease and buffer area lacks irrigation facilities. There will be less chance of improvement in agriculture. By using these land in mining there will be generation of employment and revenue.

Green Belt Development

As per the guidelines of CPCB for developing of green belts, different species of saplings will be planted. For development of green belt an amount of Rs. 30,000/- per hectare will be allocated. The area considered for green belt and its phase wise plantation programme is shown in Table 10.2. The plant species to be planted is reflected in Table - 10.3.

Table - 10.3
List of different Species selected for Plantation

Scientific Name	Common Name
<i>Aegle Marmelos</i>	Bael (wood Apple)
<i>Azadirachta indica</i>	Nim (Neem)
<i>Cassia Fistula</i>	Sunari (Golden Shower)
<i>Citrus limon</i>	Nimbu (Lemon)
<i>Dalbergia Latifolia</i>	Sitsal (Black wood)
<i>Dalbergia Sisoo</i>	Sisoo (Sisoo)
<i>Derris indica</i>	Karanja (India beech)
<i>Diospyros melanoxylon Roxb.</i>	Kend (Ebony)
<i>Emblica officinalis</i>	Amla (Emblic myrobalan)
<i>Ficus Benghalensis</i>	Bar (Banyan Tree)
<i>Ficus religiosa</i>	Ashthwa (Peepal tree)
<i>Grevillea robusta</i>	Silky oak
<i>Madhuca Latifolia</i>	Mahuwa (Butter tree)
<i>Magifera indica</i>	Am (Mango)
<i>Moringa oleifera</i>	Drumstick
<i>Pinus khasiana</i>	Khasipine

Scientific Name	Common Name
<i>Pinus roxburghii</i>	Chiri
<i>Pinus wallichiana</i>	Chir pine
<i>Populus deltoids</i>	Caroline popular
<i>Populus euphratica</i>	Indian Popular
<i>Quercus palustris</i>	Oak
<i>Quercus petraea</i>	Oak
<i>Tamarindus indica</i>	Tamarind tree

10.3 MEASURES FOR CONTROLLING WATER POLLUTION AND CONSERVATION OF WATER

The cause and source of pollution of water in the area could be attributed mostly to the surface run-off during rainy season. The following measures are to be taken for preventing possible water pollution.

- No overburden or loose sediments will be kept in the working benches particularly during monsoon months.
- Peripheral drain proposed to arrest the inflow of run-off water to the quarry area.
- The possibility of the project activity contributing to the pollution of watercourses of the region or to the ground water regime is so less that this does not significantly constitute an area of concern.
- A rain water harvesting pond will be built up in lower part of the proposed site, by which natural surface rain water will automatically come to the pond. The rain water harvesting pond will be in the size to carry minimum 5 days of heavy rain fall in the tank. These water passes through the settling tanks for treatment and then it will be used. The rain waters will be used for fire fighting, gardening and plantation etc.

10.4 MEASURES FOR CONTROLLING AIR POLLUTION

The mining area, due to its very nature and scale of operation is likely to marginally contribute towards air pollution in the area. The effect is analyzed and this effect is mostly due to fugitive emission. For the mine, the only pollution occurs from dust (SPM) during vehicular traffic, blasting, loading / unloading of limestone etc. As the particles are heavy in nature, they settle easily in the immediate vicinity. There is no other source for SO₂, NO_x and CO except a little contributed by the vehicular traffic, which is well below the prescribed limits. Still, the following different control measures are proposed.

- Construction of well-compacted roads.
- Regular water spraying on roads by tankers.
- Provision of dust collectors for the drilling machines
- Controlled blasting
- Supply of dust masks for the drill operators
- Plantation of wide leaf trees, creepers, tall grasses around quarry sites, roads, and other surrounding barren zones.

10.5 NOISE ABATEMENT

The sources and causes of noise have been discussed in Chapter-3 and its negligible impact has been highlighted in Chapter – 4. However, the following measures will be taken for analyzing the adverse impact of noise, though negligible within the project area and its surrounding region.

- Proper and regular maintenance of heavy earth moving equipment, vehicles, compressors-
- Provision of supplying earplugs for compressor operators.
- Carrying of blasting only during daytime (not during cloudy weather and when strong wind is blowing towards residential areas). Blasting will be carried out with limited explosives at a time so that the noise generation can be well maintained with the prescribed limits.
- Provision of Green Belt (thick foliage) along the lease boundary and road.

10.6 SOCIO-ECONOMIC MEASURES

The impact of the project on the socio-economics of the region has been discussed in Chapter – 4. Apart from overall beneficial impact of the project on the local people of the region, it is felt necessary to augment facilities in the fields of education, health and social awareness including concern for ecology. These are presented in an analyzing form in the following statement:-

Sl. No.	Environmental Attributes	Nature of Impact
a	Employment	Beneficial
b	Service, trade/commerce	- do -
c	Public utility/education, social awareness	Augmentation
d	Health care facilities	- do -

It is necessary to create awareness among the people. The beneficial aspects of the following measures that would be taken up by the mine as a peripheral development project.

- Family planning
- Abandonment of shift cultivation
- Planting of trees and social forestry
- Reduction in the consumption of fuel wood and encourage use of alternative fuels
- Use of clean and boiled water
- Reducing the consumption of alcohol
- Saving from earnings
- Personal hygiene
- Regular health check up.

In implementation of these measures, the mine management can contribute a lot on the overall socio-economic scenario of the region.

10.7 SAFETY AND OCCUPATIONAL HEALTH

The proposed mining will be operated by fully mechanised methods by deploying man and machines. Hence, it is envisaged to take up the following precautionary measures.

- Strict observance of the provisions of Acts, Rules and Regulations in respect of safety both by management and the workers.
- Proper planning and designing of work in order to reduce the risk of hazards.
- Specific instructions and supervisions of working where danger due to fall of side (overhanging, undercutting of bench, fall of objects from higher benches/places, working at height is apprehended).
- Training of work persons and the officials.
- Since the haul road will be of nearly 2.5 kms long and in the hilly terrain, due importance will be given in the construction of road. Parapet walls have been constructed on the sides of the haul road to prevent fall of vehicles. The width of road will be maintained more than thrice the maximum width of any deployed vehicle. A code of traffic rules will be implemented.
- A code of practices for tipping in stock piles and loading point will be implemented.
- A code of practice for fighting fire will be implemented.
- Competent persons like fitters, mechanics will be imparted with special attention to the safe handling of materials while attending to repair, maintenance of HEMM.
- Provision of pit safety committee meeting every month to discuss the safety of the mines and the persons employed.
- Celebration of annual mines safety week and environmental week in order to develop safety and environmental awareness amongst employees.
- Pre joining medical check up shall be done and regular health check up in 6 monthly intervals is planned for the employees.

10.8 IMPLEMENTATION AND MONITORING

As the major attributes of environment are not confined to the project area alone, implementation of the proposed control measures and monitoring there of have to be undertaken on a regional basis. The mine management will however, implement the control measures and monitor the efficacy within the lease area relating to the following specific areas as per the action plan.

- Collection of air and water samples at strategic locations with appropriate frequency and testing there of. If the parameters exceed the permissible tolerance limits, corrective measures should be taken to arrest the pollution.
- Collection of soil samples at strategic location at least once in every year and testing there of with regards to deleterious constituents, if any.
- Desiltation of drainage system and check dams.
- Measurement of water level fluctuation in the near by dug wells and bore wells periodically.
- Plantation/afforestation as per programme, regular watering of plants and fencing to protect them from animals.
- Measurement of noise levels at the mine site, stationery and mobile sources, mine office, canteen would be taken during day time only as mining operation will be carried out in one long day shift.

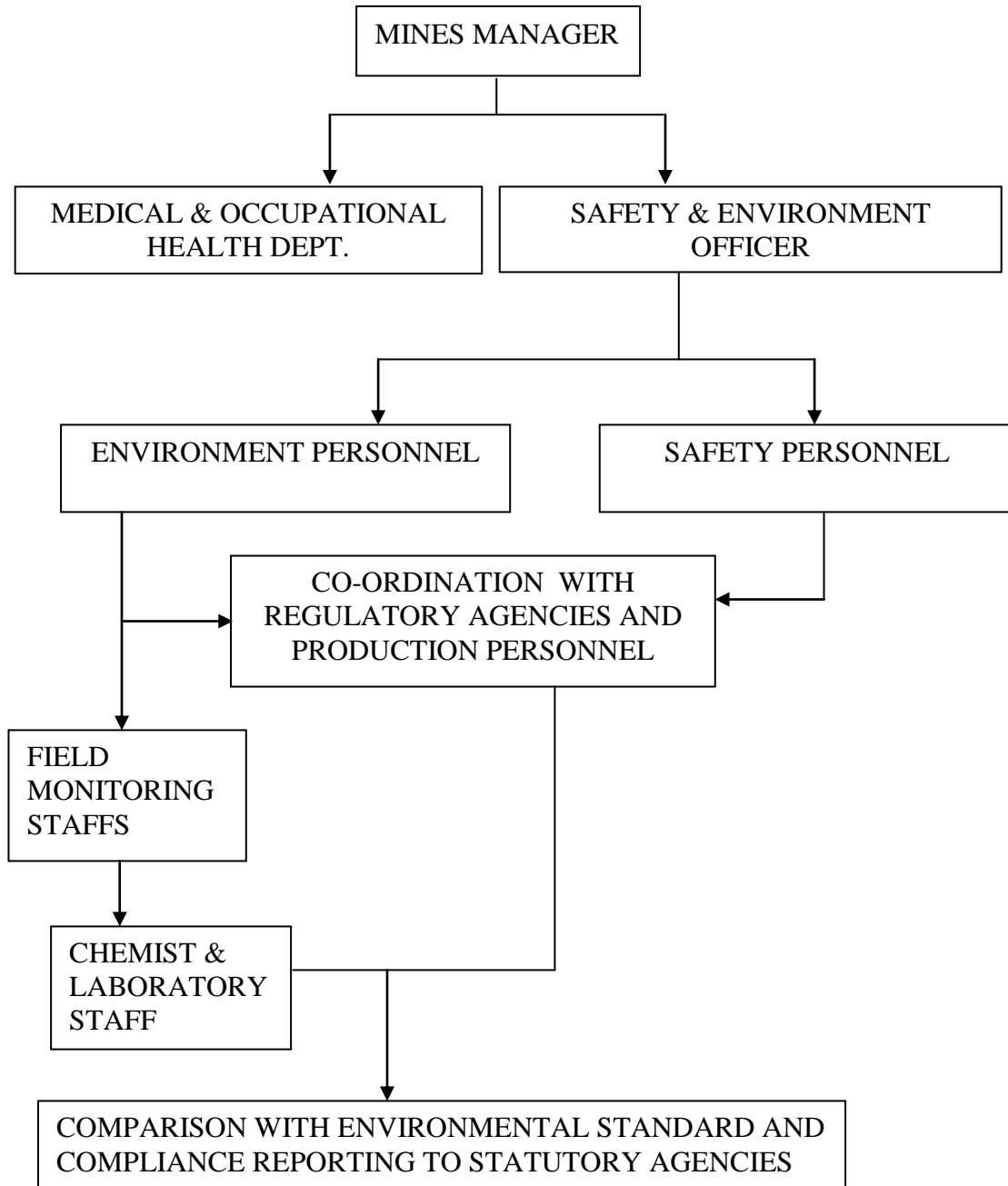
10.9 PLANS TO MAINTAIN BETTER ENVIRONMENT IN THE AREA

For maintaining better environment in the area the components relevant to the project that need to be taken into account include.

- Afforestation/plantation details of plantation/afforestation programme
- Reclamation of degraded land and quarries. Constructions of check dam, boulder pitching of bench edges and haul roads etc.
- Monitoring of environmental parameters.

Organisational chart for environmental monitoring in the mining lease area, fiscal estimates for year-wise expenditure (both capital and recurring) and action plan to maintain better environment and to augment the environmental development, the following measures are suggested.

Fig. No. 10.2
ORGANISATIONAL CHART
(ENVIRONMENTAL MANAGEMENT)



10.10 BUDGETARY COST ESTIMATES

The cost estimates presented in this section are for the recommendations made above. These cost estimates give only the indication of the likely cost. The estimated environmental cost of the project is as follows:

The total; cost of the project will be Rs. 9.00 crore INR. (Table - 10.4). A full fledged environmental cell in operation at the CMCL plant will comply with all the environmental monitoring jobs.

Table - 10.4
Cost of Environmental Protection Measures (In Rs. Lakh)

Sl. No.	Measures	Annual Recurring Cost
1	Pollution Control equipments & consumables	--
2	Laboratory chemicals	10
4	Green Belt (Nursery)	14
5	Reclamation	-
6	Staff Salary	9
Total		33

10.11 CSR ACTIVITY

CORPORATE SOCIAL RESPONSIBILITY (CSR)

For social sustainability of any project, attentions need to be paid to the development of the society that exists before or builds up around the project area. The Corporate Social Responsibility is the internalization of the social and environmental effect of its operations through proactive pollution prevention and social impact assessment so that it is anticipated and avoided and benefits are optimized.

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- **Vocational Training Programs:** Project Authority should provide educational and vocational training to unemployed youth in coordination with local vocational institute
- **Financial Assistance:** Project authority must provide low interest loan or zero interest loan for the youth in the study area so that they can be self employed

Education:

A strong promoter of basic and primary education has been adopted for educational institutions to enhance their education standards and equip them with better infrastructure facilities.

- Financial help to schools in tribal villages and slum areas, sponsored funds for school building, teachers' salaries, books, school uniforms and other study materials has been done.
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- Scholarship to merit Tribal Students or childrens belongs to Below Poverty Line (BPL) families

Community Development:

Being committed and socially responsible, the objective of the Lessee is community development.

- Providing villages with basic amenities, and extending friendship to senior citizens, orphans and physically challenged people are few initiatives taken in the direction of community development.
- The lessee has regularly been providing funds for cultural activities such as football tournament, local festivals etc.
- Drinking water supply to near by villagers.

Healthcare:

The objective is to provide basic healthcare facilities and a better quality of life to people in the lower rung of the ladder. As a part of the healthcare program, hospitals and foundations of the area are supported by the lessee, and also promotion and assistance to the Government of India initiatives like Pulse Polio drive has been provided. Some instances include:

- Arranging health camps, free medicine distribution, eye check up camp, mobile ambulance and deployment of doctor with medical facility etc.
- Providing medical kits to villages along with basic first-aid training.
- Organising blood donation drives for well-known blood banks.
- Organising a Cancer Screening in coordination with a renowned medical foundation.
- Extending support to the leprosy affected people through micro-financing and providing sewing machines and utensils to Leprosy homes.

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The lessee will play a conscious and active role to improve the quality of life around the mine. A variety of campaigns to be initiated towards environmental causes including awareness sessions for employees on issues like global warming, environment day celebration through pamphlet distribution and planting of saplings and other environmental awareness campaigns across various locations.

Other Peripheral Development Activities:

Development of infrastructure facility is one of the main activities in CSR domain. Water supply, road construction and maintenance bridges etc. are main infrastructure for any area. The project proponent is also involved in the development of all these activities.

The CSR activity capital cost will be Rs. 37.0 lakh and recurring cost will be Rs. 21.0 lakh per year.

CSR Activity Cost

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	Health facilities (ambulance)	18.00
	Education (Development of School)	10.00
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	Community development	4.00
	Sub-Total	37.00
B	Annual Recurring Expenses (Rs : lakh)	
	Education	09.00
	Welfare of youth	4.00
	Water spraying	4.00
	Plantation in nearby villages	4.00
	Sub-Total	21.00

CHAPTER – 11

SUMMARY & CONCLUSION

11.1 INTRODUCTION

Cement Manufacturing Company Ltd (CMCL) is an ISO9001:2000 certified Public Limited Company with Registered office and works at Lumshnong, East Jaintia Hills district, Meghalaya. CMCL was accorded approval for setting up a 900 TPD cement plant at Lumshnong village, East Jaintia Hills district Meghalaya by the Govt. of Meghalaya in the year 2002 and subsequently was accorded approval for expanding the capacity to 3000 TPD in the year 2003.

The proposal for the cement project was conceived on the basis of reports of abundant occurrence of high grade limestone around Lumshnong village by Geological Survey of India and Directorate of Mineral Resources, Govt of Meghalaya.

Cement Manufacturing Company Limited (CMCL) has proposed to amalgamate the two existing mining leases over an area of 4.96 & 4.70 hectares respectively, separated by a land of 0.24 hectares. They are situated at Lumshong, District Jaintia hills, Meghalaya. The latitude and longitude of the project site are 25° 09' 48" - 25°10'4.3" N & 92° 22'5.3" - 92°22'23.6" respectively. Company is applied to obtain Environment Clearance from SEIAA, Meghalaya. On 24.04.2013 SEIAA has granted the TOR.

This EIA report is prepared as per the mining plan and standard TOR.

11.2 PROJECT DESCRIPTION AND PROJECT BENEFITS

The state Govt. granted the two mining leases mentioned vide letter no. 47/2008/23 dated 22/07/2004 for 4.96 hectares and vide letter no. MG/21/2003/394 dated 04/07/2005 for 4.70 hectares for meeting the requirement of the cement plant CMCL.

The two mining leases are applied for the amalgamation to the state Govt. on 08-12-2006 and was permitted vide letter no. MG.98/2008/23 dated 01/04/2009. Mining plan for the amalgamated mine along with the progressive mine closure plan over the combined area of 9.66 hectares was approved by the Indian Bureau of Mines vide letter No.- 314(3)/2010-MCCM (CZ)/MP-32/327 dated 08/04/2011.

The location of the ML area is as follow:

Geographical Location

State	Meghalaya
District	Jaintia hills
Village	Lumshong
Lease Area	9.66 ha
Toposheet No.	83C/SW
Latitude	25°9'48" to 25°10'4.3"N
Longitude	92°22'05.3" to 92°22'23.6"E
Altitude	520 m AMSL to 546m AMSL

There is no public road or railway line within the M.L area. The lease area is situated at a distance 1 km east of NH-44 connecting Shillong to Silchar. The nearest railway station at a distance of 85km from Lumshnong is Badarpur on Guwahati-Lumding-Silchar meter gauge section of N.E.F. Railway. (**Fig. 2.2**). The lease area map is given in **Fig. 2.3** Topography of the ML area and its surroundings are rugged and mountainous. Maximum and minimum contours passing through the area are 546m and 520m respectively. South-Western part of the area is at a higher elevation with respect to south-eastern part. The nearest airport at Silchar is 125 kms and Guwahati at about 211 kms from Lumshong village. There is no national Park, wild life sanctuary or any ecosensitive zone exists within 10kms of ML area.

Topography of the ML area and its surroundings are rugged and mountainous. Maximum and minimum contours passing through the area are 520m and 546m respectively. South-Western part of the area is at a higher elevation with respect to south-eastern parts.

Topography of the ML area and its surroundings are rugged and mountainous. Maximum and minimum contours passing through the area are 535m and 481m respectively. South-Western part of the area is at a higher elevation with respect to south-eastern part. It is represented in lease plan and surface drainage plan). A perennial nala flows about 400 mtrs. south of the southern lease boundary.

No first order or second order stream is passing through the lease.

The geological and mineable reserve of the area as follows:

Category	Khub-I	Khub-II	Total
Measured Mineral Resources (331)	6.05	5.40	11.45
Proved Mineral Reserve (111)	3.33	2.82	6.15

There is no waste to be generated in the mines.

Opencast fully mechanised method of mining will be adopted on one shift basis. Machineries/vehicles like crawler drill, air compressor, hydraulic excavators, dumpers, etc. will be used. The limestone shall be dislodged by drilling and blasting. Limestone will be handled by dumpers/ tipper trucks and Excavators. Height and width of the working mine benches would be 6 meters and 6 meters respectively. Slope of the benches will be 45⁰ where as overall slope of the pit will be 45°. Production will be 8,50,000 TPA of limestone. Keeping the above production in view, the life of the mine will be 20 years. The capital cost of the project is Rs. 675 Lakhs. No waste will be generated from the mine.

The capital cost of the project is 675 Lakhs. No waste to be generated from the mines. Employment will be provided for 200 people in two shift basis. Ultimate working depth of the mine will be 430m AMSL where as ground water table is at 420 AMSL (in summer) and 425m AMSL (in rainy season). Hence mining will not touch ground water table. About 50 Cum of water will be required daily which will be supplied from CMCL Plant site.

The limestone to be produced from the mine shall be utilised in the plant of the Lessee. In the mining project along with the cement plant shall uplift the socio-economic, educational and cultural status of the local inhabitants.

11.3 ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

Mining activities and related operations can cause several beneficial and adverse impacts on the environment. The adverse impacts are proposed to be mitigated. Using 'Matrix method' the impact on the environment has been assessed.

The expected beneficial impacts on the society are Health, Population/Migration, Employment, Literacy, Services and Aesthetic sense. The proposed mining operation will generate direct employment for 155 nos. of employees and indirectly for 50 people. Communication, education, medical, power and employment facilities will be improved.

Various mining operations will generate dust and gaseous pollutants. With a view to the scale of mining and existing environmental back ground condition it is anticipated that increment impact due to the mining operation will be within the prescribed limit. Further mitigation measures like water sprinkling and plantation will reduce the pollution level in the area.

Contamination/siltation of surface water might occur due to mixing of runoff during rainy season with high-suspended particles. As it is proposed to construct settling tank and garland drain around the mining area the level of concentration of suspended particles in the surface water shall be well within the prescribed limit.

The contamination of surface water may cause diseases in the area. Treatment of water will be done. Medical treatment will be provided as per the requirement. The impact on ground water will be marginal since proposed mining activities will be much above the ground water table.

Due to the opencast mining project, the noise level of the area on account of drilling, blasting, transportation and running of heavy machineries will increase. Controlled blasting, proper maintenance of machineries and soundproof cabins, noise level can be minimized.

Plantation will neutralize this impact on flora. The present and so also proposed land use pattern of the mine will be as follows.

Existing Core Zone Land use Pattern

Classification of land	Village/District	Total area in Hects.
Total Private Land (non-forest)	Lumshnong/East Jaintia hills	9.66 Waste land

Proposed Land Pattern (Area in Ha.)

Sl. No.	Pattern of Utilisation	Existing	Planned 5 years	Beyond 5 years	Total
1.	Area to be excavated ML area 4.96Ha &-ML area4.7Ha.	7.17	0.42	0.5	8.09
2.	Storage for top soil	Nil	Nil	Nil	Nil
3.	Overburden/dump	Nil	Nil	Nil	Nil
4.	Mineral Storage	Nil	Nil	Nil	Nil
5.	Infrastructure (Workshop, administrative building)	Nil	Nil	Nil	Nil
6.	Roads	Nil	Nil	Nil	Nil
7.	Railways	Nil	Nil	Nil	Nil
8.	Green Belt	Nil	Nil	Nil	Nil
9.	Tailing pond	Nil	Nil	Nil	Nil
10.	Effluent Treatment Plant	Nil	Nil	Nil	Nil
11.	Mineral Separation Plant	Nil	Nil	Nil	Nil
12.	Township area	Nil	Nil	Nil	Nil
13.	Others to specify	Nil	Nil	Nil	Nil
	Sub-Total	7.17	0.42	0.5	8.09
14.	Safety zone (7.5 ML boundary)	---	---	---	1.57
	Total	7.17	0.42	0.5	9.66

Post-Operational Land Pattern (Area in Ha.)

Sl. No.	Pattern of Utilisation	Existing	Planned 5 years	Beyond 5 years	Total
1.	Area to be excavated ML area 4.96 Ha. & ML area4.7Ha.	7.17	0.42	0.5	8.09
2.	Storage for top soil	Nil	Nil	Nil	Nil
3.	Overburden/dump	Nil	Nil	Nil	Nil
4.	Mineral Storage	Nil	Nil	Nil	Nil
5.	Infrastructure (Workshop, administrative building)	Nil	Nil	Nil	Nil
6.	Roads	Nil	Nil	Nil	Nil
7.	Railways	Nil	Nil	Nil	Nil
8.	Green Belt	Nil	Nil	Nil	Nil
9.	Tailing pond	Nil	Nil	Nil	Nil
10.	Effluent Treatment Plant	Nil	Nil	Nil	Nil
11.	Mineral Separation Plant	Nil	Nil	Nil	Nil
12.	Township area	Nil	Nil	Nil	Nil
13.	Others to specify	Nil	Nil	Nil	Nil
	Sub-Total	7.17	0.42	0.5	8.09
14.	Safety zone (7.5 ML boundary)	---	---	---	1.57
	Total	7.17	0.42	0.5	9.66

The stage wise cumulative plantation is as follows.

Stage Wise Cumulative Plantation

REQUIREMENT OF PLANTS FOR AFFORESTATION / RECLAMATION										
Year	Un-worked Area (Greenbelt)		Out Side Dump		Dump Area		Top Soil Dump		Total	
	Area (Ha)	Trees	Area (Ha)	Trees	Area (Ha)	Trees	Area (Ha)	Trees	Area (Ha)	Tree
1st	0.5	1250	--	--	--	--	--	--	0.5	1250
2nd	1.0	2500	--	--	--	--	--	--	1.0	2500
3rd	1.5	3750	--	--	--	--	--	--	1.5	3750
4th	1.57	3925	--	--	--	--	--	--	1.57	3925
5th	1.57	3925	--	--	--	--	--	--	1.57	3925
Ultimate	1.57	3925	8.09	20225	--	--	--	--	9.66	24150

11.4 ENVIRONMENTAL MONITORING PROGRAM

The existing environmental Cell at CMCL plant will monitor regularly the environmental assessment on air, water, noise and soil qualities at nearby habitational area. Four permanent Air quality stations will be fixed as per the SPCB guidance to monitor the AAQ in quarterly basis. Quarterly water samples of ground water and surface water shall be collected and analysed. Noise level monitoring at Noise generating points and AAQ locations shall be done in quarterly basis

11.5 ENVIRONMENTAL MANAGEMENT PLAN

The mining activities will have certain adverse effects on the existing environment like air, water, land and noise. The following protection measures will be adopted to minimize pollution.

- Provision of planting emission and noise absorbing species (with dense/thick type canopy), and soil erosion control and nutrient enhancing species
- To suppress fugitive dust, provision of water sprinkler, dust extractor etc at the dust generation source
- Adoption of controlled blasting techniques (using advanced non-electric detonator)
- Construction of garland drains around the quarry area with proper gradients
- The settling tank will have adequate dimension
- Surface runoff through drain and channel shall be channelized into sedimentation pond before discharging into natural drainage
- Proper maintenance of plant and machinery
- Providing sound proof cabins with proper ventilation
- Provision of personal protective equipment according to the pollution.
- Stone pitched walls in garland drains will be prepared to arrest flow of loose sediments.
- Provision of speed breaker (stone pitching) at regular intervals in garland drains
- Reclamation through plantation

11.6 RISK ASSESSMENT (RA) AND DISASTER MANAGEMENT PLAN (DMP)

The following precautionary measures shall be taken to prevent any accident

- Elimination of the source of hazard
- Substitution of hazardous process and materials by those which are less hazardous
- Geographical/ physical isolation of hazards from vulnerable communities
- Use of engineering controls to reduce the health risk
- Adoption of safe working practices such as regular equipment maintenance
- Use of Personal Protective Equipment shall be mandatory.
- Top edge of opencast workings shall be kept properly fenced.
- Quarrying shall be done from top downwards. No overhang will be allowed.
- Special attention and requisite provisions shall be taken while working in areas of geological weakness like existence of slip, fault etc.
- Regular dressing of bench sides to ensure safety of workers employed within 5m or working face.
- Provision of safety belt or rope while persons are at work at the quarry sides or benches from where there are chances of falling down for more than 1.8m.
- Drafting and implementation of preventive maintenance schedule for various kinds of machinery deployed in opencast workings.
- Provision of maintenance of properly laid haul roads with parapet wall fencing or guards and road signs at strategic points.
- Precautions against danger while traversing dumpers, excavators etc. by installing audio-visual alarms and appointment of spotters.
- Transportation of Limestone within mine workings by vehicles under the direction, supervision and control of Mine Management only.
- Proper maintenance of vehicles and weekly examination by an engineer and daily examination by a competent person.
- Training and retraining (at specified interval) of the machinery operators.
- Use of controlled blasting techniques. 500 m radius danger zone to be followed strictly.
- Provision of blasting shelters – properly constructed and maintained.
- Adequate maintenance of electrical equipment.
- Adequate illumination after daylight.

CHAPTER – 12

BRIEF RESUME AND NATURE OF CONSULTANCY

12.1 ORGANISATION

Geomin Consultants (P) Ltd. is registered in 1990 under Companies Act and is having registered office at Bhubaneswar, Orissa. The company, a pioneer consultancy house in Eastern India is engaged for various activities related to mining, geology, geoengineering, geohydrology environmental engineering and other engineering project. The company has also undertaken studies on socio-economic survey, flora & fauna survey, river dynamics & siltation process and forestry. Geomin has also extended its activities related to various irrigation and power projects. Though the company is located in Orissa, it's activities have spread in the states like Uttarakhand, Assam, Bihar, Chhatisgarh, Gujrat, Jharkhand, Madhya Pradesh, Maharastra, Meghalaya, Nagaland and Sikkim. The company also worked as the supporting organisation for undertaking exploration for gold, diamond, precious and semi-precious stones on behalf of Empire Gold mine NL., Australia, Australian Kimberley Diamonds NL., Australia and Mackay and Schnellmann Pty. Limited, western Australia. Geomin has got the recognition from Indian Bureau of Mines (IBM) Govt. of India and also enlisted as approved consultant for Orissa. Within this span of time, the organisation has completed more than 250 mining plans and schemes, 64 environmental projects for mining and allied industries and more than 56 forestry projects. The growth rate of the company can be judged by the technical support for different clientele of prominence like IBM, TISCO, Larsen & Toubro, Indian Rayon & Industries Ltd., MESCO, FACOR, NALCO, INDAL, Aditya Aluminium Project, Jindal Strips Ltd., Usha Rectifier Corporation (India) Ltd., Orissa Minerals Development Company Ltd., Orissa Mining Corporation Ltd., Orissa Sponge Iron Ltd., Bhalotia Granite, Orissa Cement Ltd., Kalinga Power Corporation Ltd., Nagpur Alloys & Castings Ltd., Raipur Alloys & Steels Ltd., Bihar State Mineral Development Corporation, Pollution Control Board of Orissa, Irrigation Department, Govt. of Maharastra, The Maharashtra State Mining Corporation Ltd., Nagpur, Dept. of Power, Govt. of Nagaland, State Electricity Board, Meghalaya, Prakash Industries Ltd., New Delhi, Sterlite Industries (India) Ltd., Empire Gold Mine NL., Australia, Australian Kimberley Diamonds NL, Australia and Mackay and Schnellmann Pty. Limited, Western Australia. Geomin interacts with Ministry of Environment and Forests, Govt. of India, Dept. of Forest and Environment, Govt. of Orissa, Federation of Indian Mineral Industries, Confederation of Indian Industry, Australasian Institute of Mining & Metallurgy, Australia.

Geomin has always put its vision on to be a premier environmental friendly project developer for mineral resources, industry, Infrastructure, Information Technology, Research and Development with Financial Services.

The mission of the group is to achieve excellence in providing services for customers' satisfaction with objectives of

- Creating a data base center
- Creating a research and development center
- Providing support for project development

- Creating a project engineering division for industrial and infrastructure projects
- Sustainable business development.
- Development of center for business process out sourcing and imparting training for skill development.

12.2 FIELD MONITORING AND LABORATORY FACILITIES

Monitoring of air, water, noise and soil quality is now a routine requirement for all kinds of projects. There has been a growing realization among the citizens that the deterioration of environment has harmful effects. Hence, to assess the existing environmental quality, the 'GEOMIN' is also engaged in field monitoring. The firm has the following instruments of different make.

12.2.1 Instruments (Used in Field Monitoring)

1. RDS (Respirable Dust Sampler)
2. HVS (High Volume Sampler)
3. Anemometer
4. Barometer
5. Wind vane
6. Hygrometer
7. Thermometer
8. Dust Sampling Kit
9. Noise Level Meter
10. Water Sampling Kit (Portable)
11. Soil augers

12.2.2 Make (Used in Field and Laboratory)

1. Envirotech Instruments Pvt. Ltd.
2. Vayubodhan Upkaran Pvt. Ltd.
3. Elico Pvt. Ltd.
4. Systronics
5. Lucid Laboratories Pvt. Ltd.
6. Bhanu Scientific Instruments Company

12.3 IMPACT ASSESSMENT FACILITIES

For the impact assessment, the persons are involved from several fields like, Geology, Chemistry, Mining Engineering and environmental Science.

12.4 EMPANELMENT

The company is empanelled in State Pollution Control Board, Orissa to carry out REIA/EMP studies for various developmental activities.

12.5 INVOLVED PERSONNELS

Person actively involved in the preparation of this report are as follows.

NAME	ASSOCIATION IN THE PROJECT	EXPERTISE
Dr. S.K. Sarangi	Managing Director of the company, Co-ordinator	M.Sc Ph.D (Geology) Approved co-ordinator for Mining O/C and U/G, Pelletisation
Dr. R.C. Mohanty	Project Co-ordinator, Project evaluation, Field Study and EIA and EMP preparation (Approved Co-Ordinator for Mining and Thermal Power)	Ph. D, (Geology) (Approved Coordinator for Mining and Thermal Power)
Dr. S.K. Misra	Project Co-Coordinator, Project evaluation, Field Study and EIA and EMP preparation	Ph. D (Geology), (Approved Coordinator for Mining, beneficiation and Thermal Power Plant)
Mr. R.N. Mahapatra	Assisting in EIA/EMP preparation in Geology and Mining	M.Sc., Geology, Approved expert for Geology and soil
Mr.B .P. Mishra	Assisting in EIA/EMP preparation in Geology and Mining	M.Sc., Geology, Approved expert for Geology and Soil
Mr. P.C.Panigrahi	Assisting in EIA/EMP preparation in Socio Economic study	MA (Economics) and MA (Social Work)
Mr. K.L. Narayana	Assisting in EIA/EMP preparation for Noise Level	M.Sc. (Physics), Approved expert for NV
Mr. N.K. Shukla	Assisting in EIA/EMP preparation for Hydrology, Geo-hydrology aspect	M.Sc., Geology, Approved expert for Hydrogeology
Dr. P.C. Rath	Assisting in EIA/EMP preparation for Water Pollution, Air, Occupational Health aspect	M.Sc (Chemistry, Ph.D (Approved expert for water Pollution)
Mr. A. Pothal	Assisting in EIA/EMP preparation in risk hazard and solid waste management etc.	MA (Pub Admn) & PG Diploma in Industrial Safety Management
Mr. S.Mishra	Assisting in EIA/EMP preparation for interpretation of satellite imagery and preparation of land use plan	M.Sc., Geology (Approved expert for Land Use).
Mr. S.K. Patnaik	Assisting in EIA/EMP preparation for Air Pollution Control, Air Quality Modeling and Solid & hazardous waste management System etc.	B.Tech. (Chemical Engineering)
Mr. B.N. Mohanty	Assisting in preparation of EIA/EMP in relation with Ecology & Bio Diversity and Soil Conservation	M.Sc (Botany)
Mr. S.C. Khattai	Assisting in EIA/EMP preparation for Air Pollution Control	B.Sc. Engg.(Mechanical)

ANNEXURE-I

TOR letter and point wise compliance.

TERMS OF REFERENCE FOR ENVIRONMENTAL IMPACT ASSESSMENT OF MINING OF MINERALS SECTOR

Objectives

Terms of Reference (TOR) for preparation of Environmental Impact Assessment (EIA) and Environmental Management Plan for "Mining of Minerals" as per the EIA Notification, 2006 has been devised to improve the quality of the reports, to facilitate decision-making, to have transparency and to make it easy. TOR will help the project proponents and consultants to prepare report with relevant project specific data and easily interpretable information. TOR for mining of minerals is expected to cover all environmental related features.

General Information

Mining of stone and metals has been done since pre-historic times. Mining is the extraction of valuable minerals or other geological materials from the earth, which are processed and/ or used for production of materials of economic value. Mining of minerals plays a positive role in the process of country's economic development. In addition to the contribution towards economic growth, mining can also be a major source of degradation of physical as well as social environment, unless it is properly managed.

Environmental impacts can arise during all activities of the mining process. Minimizing the damage due to mining operations depends on sound environmental practices in a framework of balanced environmental legislation. The potential adverse effects of mining activities include air pollution, surface and groundwater pollution, noise and vibration, damage to local ecology, natural topography and drainage, depletion of water resources etc. All these environmental components are required to be considered while selecting a proper methodology of mining, mitigation measures to reduce pollution load, conservation of natural resources etc.

1.0 Introduction

This chapter should cover purpose of the project, project proponent, brief description of the project name, nature, size, location of the project and its importance to the region/country.

As per the EIA Notification, 2006 under Environment (Protection) Act, 1986, the mining of minerals with more than 50 hectare of mining lease area (Asbestos mining irrespective of mining area) are categorized as Category-A projects.

In case of coal mining projects, mining lease area more than 150 hectares are categorized as category-A projects.

Mining lease areas of 5-50 hectare are classified as Category-B projects. In case of coal projects mining lease area of 5-150 hectares are classified as Category- B projects. Both the above categories are subject to the applicability of General Conditions.

All these mining projects are statutorily required to conduct Environmental Impact Assessment study for obtaining environmental clearance.

Mining Lease area less than 5 hectare is not covered under the EIA Notification, 2006. Profile of the Project Proponent, name and contact address, Implementing Organization, Organizational Chart, Project Consultants etc., should be mentioned clearly.

Land description- plot/ survey/khasra numbers, village, tehsil, district, state and extent of the land must be mentioned clearly. The project site should conform to the CRZ guideline or modifications or stipulations made by the Central / State Govt., as applicable.

The proponent should confirm that the project meets all Centre/State/Local regulations and standards applicable for mining of minerals and allied activities.

Any litigations pending against the proposed project and/or any directions or orders passed by any court of law/any statutory authority against the project are to be detailed out.

In case of expansion/modernization of the project, the environmental compliance status for the existing project should be explained.

The EIA-EMP report should be based on maximum mineral extraction capacity and it should be based on generic structure given in Appendix III of EIA Notification, 2006 for the project or its expansion based on the proposed maximum mineral extraction capacity.

The mining projects linked to be associated projects such as coal to power plant, limestone to cement plant etc., located within the area of impact zone required to take up integrated EIA.

The report, the page numbers of various chapters, sections and sub-sections, tables, appendices, drawings and figures, source of data incorporated should be clearly mentioned etc., with titles should be clearly indicated under the heading contents.

Ref. Chapter-1 of EIA EMP report

2.1 Project Description

The chapter contains the broader details of the basic activities, location, lay out and implementation schedule of the project.

Background of the project:

- Location of the project (Longitude, Latitude, revenue village, Tehsil, District, State, nearest Railway station, airport, and MSL)
- Objective of the project (captive mine, standalone etc) whether it is new or expansion (Increase in ML area or increase in annual production) or modernization. Proposed use of minerals (sale, use as intermediates or raw materials). Any change in technology proposed should be specified.

- Significance and relevance of the project highlighting the benefit to surrounding area and economic development of the Local/State/ Country.
- Location of National Park, Wildlife sanctuary, migratory routes of wild animals etc. within 10 km of mine lease area should be authenticated by the Chief Wildlife Warden.

Ref. chapter 2 para 2.1, 2.2 & 2.3 of EIA/EMP report

Project details should include:

- Overall note on mineral reserves, rated capacity, life of the mine
- If the lease area/buffer zone is ecologically fragile, a detailed justification is to be given.
- Period of mining lease and calendar programme of ore and waste production.
- Status and stages of other regulatory clearances like approval of mining plan, forest clearance, consent to establish from State Pollution Control Board etc.
- In case of expansion/modernization, compliance of the statutory conditions given by SPCB, MoEF, DGMS, FC etc.
- Solid waste dumping strategy and management
- Energy demand/specific energy consumption
- Water requirement and reliability of its supply
- Manpower recruitment
- Capital cost estimate
- Market conditions vis a vis validity of the project Essential Toposheets/Maps to be provided with TOR application

Re. Chapter 2 para 2.4 to 2.14 of EIA/EMP report

Topographical map

A topographical map 1:25,000 scale (if not available in 1:50000) of the study area (core zone and 10 km area of the buffer zone from boundary of the core zone) delineating the major topographical features such as land use, drainage, locations of habitats, major constructions including roads, railways, pipelines, major industries if any in the area are to be mentioned.

A topographical map, covering aerial distance of 15 km from the proposed project location and delineating environmental sensitive areas as specified in Form I of EIA Notification dated 14th Sep'06. In the same map the details of environmental sensitive areas present within a radial distance of 1 km from the project boundary should be specifically shown

Remote sensing imagery

Land use and land cover map of the study area in 1: 25,000 scales based on recent satellite imagery of 5.6 m or higher resolution of multispectral sensor delineating double crop, single crop, agricultural plantation, scrub land , land with or without shrub, forest land - dense, open, degraded, forest blank, waste land, water bodies, builtup area is to be shown.

Digital Elevation Model (DEM) /Slope/Contour maps

- Contour/slope map, as required for the study of core zone and site plan of the area showing the various proposed break-up of the land.
- Description of the project site, geology, topography, hydrology, climate, transport and connectivity, demographic aspects, socio-cultural and economic aspects, villages, settlements, meteorological data.
- Notified restrictions and limitations from environmental considerations etc., if any.
- Environmental data relating to history of natural calamity such as cyclones, storms surges (Coastal areas), tornado, flood, etc. should be discussed.

The project description should include

- Geology (Regional and Local)
- Reserves and quality of the ore with chemical composition (Grade or Percentage). Associated minerals, if any, should be mentioned.
- Deposit condition such as ore strength, host rock strength, shape, grade, dip, size, uniformity and depth.
- General description of the project with ancillary operations such as crushing, beneficiation etc.
- Surface geological plan in the leasehold area, transverse section of mineral deposits, contour maps at intervals of not more than 03 meters
- Breakup of land use of leasehold area
- Project falling on Coastal Zone for mining in coastal area. Details of Coastal Zone Classification, Low Tide Line (LTL), High Tide Line (HTL), characteristics of beach
- Drawing (Digitized) showing project layout, components of project, leasehold area
- Type (Open cast, Underground or Both) and method of mining (Manual, Semi-mechanized or mechanized)
- Nearness to a large water body.
- Mode of transportation of ore and waste
- Hydrology of the area and calculation for mine seepage water and Groundwater drawdown

Open Cast Mining

- Deposit conditions
- Maximum allowable stripping ratio (ratio of overburden in m³ to mineral in ton), thickness of top soil and overburden (minimum, maximum and average),
- Working depth (below ground level and Mean Sea Level)
- Mining Plan (Height and Width of the benches in overburden, ore body, proposed inclination/slope of the sides)
- Surface plan showing mine working 5th year, 10th year, 15th year, 20th year, 25th year, 30th year as per the approved mine plan.
- Type of blasting, drilling and explosives
- Detail of machineries (mining ,transportation, and material handling) with production capacity

- Plan for backfilling of mine pit.
- Overburden dumps stability study and reclamation.

Underground Mining

- Deposit conditions
- Mode of entry to the mine (Shaft, Adit, Incline)
- Details of machineries in underground and on surface
- Method of mine development and stoping
- Subsidence (Maximum predicted subsidence, max. slope change, impact on surface features like natural drainage pattern, houses water bodies, water table etc.)
- Mine drainage water management details
- Ventilation system for adequate control of quality and quantity of air underground

General Features

- Surface drainage pattern at mine site (modification/diversion in the existing drainage pattern)
- Mineral transportation outside mining lease area (road, rail, conveyor, Rope way, waterway, pipeline, others etc.)
- Beneficiation, Crushing, Processing etc. (process flow)
- Township description, (area, dwelling units, distance from mine, distance of water bodies)
- Power and water supply

Reference Chapter 2 Fig. 2.1 to 2.6 of EIA /EMP report.

3.0 Analysis of alternatives

This should be project specific and decided during the scoping process.

3.1 Description of the Environment/ Baseline Environmental Status

Environmental data to be collected in relation to proposed mining would be: (a) land (b) water (c) air (d) biological (e) noise and vibration (f) socio economic (g) health environment etc.

Study area:

Study area for the mining projects should be defined as follows:

- Mine lease area should be the "core zone"
- 10 km radius from the boundary limits of the mine lease area of more than 50 hectares should be the "buffer zone".
- 5km radius from the boundary limits of mine lease area of 5-50 hectares should be "buffer zone".
- Maps (appropriate scale) of the study area (core and buffer zone), clearly delineating the

locations of various monitoring stations (air/water/noise/soil), superimposed on locations of habitats are to be shown.

- Indicate 2km, 5km distance from the boundary limits of mine lease by appropriate line.
- Monitoring and testing should be done as per guidelines of CPCB/MOEF.

Baseline information is required to be collected by field survey, monitoring etc. Secondary data with source should be clearly mentioned. Normally, one season monitoring data (excluding monsoon) are to be collected. However, Expert Appraisal Committee (EPC) may specify collection of baseline data for a longer period base on the nature, size and location of the project.

Ref. Chapter 3 of EIA/EMP report

4.1 Land Environment

Pre-mining land use pattern of (agricultural land/ forest land/ grazing land/ wasteland / water bodies/settlement) of the area is to be detailed out. Details of mineral resources, geological status of the study area and the deposit to be worked, ultimate working depth and progressive stage wise working plan / scheme until the end of the mine life should be mentioned on the basis of the approved rates capacity and calendar plan (s) of production. From the approved mining plan, geological maps should be drawn.

4.1.a Land

Baseline data on land, of mine leased-area is to be described. Total land available and proposed utilization for different purposes including built-up area be given. Justification of the use of area is to be given.

4.1.b Topography

Topography the study area through topographical maps (1: 50000), showing all relevant details required for assessment of the proposed activities. Description in relation to following be given.

- Slope and elevation
- Natural drainage pattern and water bodies
- Land use pattern (habitation, cropping, forest cover, ecologically sensitive features etc. by employing remote sensing techniques (If available).

Ref. Chapter 4 para 4.3 of EIA/EMP report

4.1.c Geology

Geology of the area is to ascertain seismic sensitivity. It also defines the layers of geological formations, from which the permeability and possible faults and fissures can be known.

4.1.d Soil

The study should include

- Soil quality at representative monitoring stations (type, classification, soil characteristics etc.)
- Fertility status of soil samples
- Pre-mining land use pattern, cropping pattern, vegetation cover etc. (remote sensing data)

Ref. Chapter 4 para 4.4 of EIA/EMP report

4.2 Air Environment

The study should include the following;

- Climate and meteorology (temperature (max. and min.), relative humidity, and rainfall) indicate the nearest IMD meteorological station from which climatological data have been obtained.
- Wind rose (Wind directions and speeds, 24 hourly data)
- Air quality monitoring data in respect of SPM, RSPM, SO₂, NO_x, CO, Heavy Metals in SPM (Mineralogical Fe, Mn, Pb etc.), any other project specific pollutants. Monitoring should cover one full season except monsoon. Frequency and methodology adopted should be as per CPCB/MOEF guidelines.
- Monitoring stations are to be located based on dominating wind directions, habitations and terrain features in the study area. The monitoring stations should cover upwind, downwind, crosswind, core zone, habitations and sensitive areas.

Ref. Chapter 4 para 4.5 of EIA/EMP report

4.3 Water environment

Sources of water (river, groundwater, mine water, other surface water), their requirement, and utilization for various operational need of the project, at different stages are to be discussed.

A detailed water balance should be provided. The breakup of water requirement as per different activities in the mining operations should be given separately. Approval of competent authority for utilization of ground and surface water should be provided.

4.3. a. Surface Water

The study should cover the following;

- Locations of representative monitoring stations showing direction and distance from the mine lease site
- Details of rivers, springs, lakes, reservoirs and drains up to first order in study area.
- Physio-chemical analysis including heavy metals, biological, bacteriological

characterization for assessment of water quality. Water quality of water body with respect to upstream and downstream should be covered.

- Delineation of water sheds and water drainage pattern in the study area using remote sensing satellite imageries
- Surface water balance (Withdrawal of surface water and release of mine drainage water)
- Lean season flow of the nallah from where water is drawn

4.3.b Groundwater

Since the mining is excavation of the earth, the groundwater is affected to a great extent. The study should include;

- Groundwater potential, recharge and budgeting
- Hydrogeology and aquifer characteristics of the area
- Groundwater quality, groundwater potential of the area and its availability, groundwater, table (pre monsoon and post monsoon)
- The details of locations of groundwater observation wells with respect to core zone should be described.
- The monitoring stations should cover the whole study area

Ref. Chapter 4 para 4.8 of EIA/EMP report

4.3.c Additional Information

- Water bodies existing and water bodies likely to be created due to mining activities
- Water requirement and waste water generation from various activities of mine, including township, beneficiation etc.
- Waste water treatment, recycling and reuse

4.4 Noise Environment

The study should include

- Locations of monitoring stations for noise measurements in accordance with the direction and distance from the sources and habitations.
- Day-time and night-time noise level monitoring (leq)
- Vibration and air over pressure, caused due to blasting, transport and process equipments, wherever applicable

Ref. Chapter 4 para 4.9 of EIA/EMP report

4.5 Biological Environment

Information on flora and fauna within the study area should be given separately

4.5 (a) Flora

- Detail description of vegetation type in core and buffer zone (including photograph)
- Assessment of plant species with respect to their dominance, density, frequency,

- abundance, diversity index, similarity index, importance value Index.
- Quantitative estimation of forest and non-forest flora
- Type of forest in study area and its conservation status.
- Information on the dependence of local people on minor forest products
- Location of National Parks, Sanctuary, Biosphere Reserve, Tiger Reserve, Elephant Reserve, wild life migratory routes in core and buffer zones

4.5(b) Fauna

- Assessment of fauna and avi-fauna.
- List out endangered and endemic species as per the schedule of the Wildlife Protection Act, 1972
- Information on breeding and hibernating sites in core and buffer zone.

Ref. Chapter 4 para 4.10 of EIA/EMP report

4.6 Socio- Economic Environment

The baseline study should cover the following:

- Data on demography, traditional skills, sources of livelihood within the study area
- Socio-economic profile of the people with in 2, 5 and 10 km from the mine.
- Human settlement, health status, sources of livelihood
- Data relating to historically, culturally and ecologically important places in core as well as buffer areas
- Information on notified tribal settlements, if any
- Details of private lands with ownership in the core area indicating financial loss annually
- Health status of the population in the study area

Ref. Chapter 4 para 4.10 of EIA/EMP report

4.7 Waste Generation

The report should cover the following

- Solid waste from mining and processing operations, their quality and quantity (overburden, low-grade ore etc.) Quantity and quality of associated minerals and possible recovery
- Top soil quantity , quality and its management
- If waste contain any hazardous/toxic/radioactive substances or heavy metals, then details
- Recovery and recycling possibilities
- Site features of locations of waste storage and disposal
- Leaching properties of overburden and other solid waste
- Solid waste generation from Effluent Treatment Plant township, hospitals etc.

Not Applicable

- 4.8 Any specific inputs which are likely to be added the site and its surroundings. Salient feature of the area, which require specific study.

Specific Condition	Study Required
Nearness to Water Body/reservoir	Detail Hydrogeology and Hydrology
Nearness to Forest/	Detail Conservation Plan
Nearness to Township	Blasting Vibration Study
Groundwater Scarcity Area	Details of Groundwater Recharge

Ref. Chapter 4 para 4.8 & 4.10 of EIA/EMP report

Anticipated Impacts and Mitigation Measures

This chapter should describe the likely impact on each of the identified environmental component by adopting methods such as mathematical model, empirical method, reference of previous studies etc., Details of mitigation measures proposed in the project (site specific) to minimize the adverse effect, should be discussed. The information should cover mine development, operation and closure phases of the project, as applicable.

5.1 Land Environment

Anticipated Impacts:

- 5.1.1 Impact on topography, drainage pattern, land use with respect to agriculture, forestry, built-up area etc.
- 5.1.2 Impact on soil quality and agriculture
- 5.1.3 Soil erosion
- 5.1.4 Subsidence
- 5.1.5 Visual Impact on surrounding environment

Ref. Chapter 5 para 5.2 of EIA/EMP report

Mitigation Measures:

- 5.1.6 Plan for restoration/rehabilitation of mined-out area
- 5.1.7 Technological measures to prevent soil erosion from core and buffer zones
- 5.1.8 Plantation/afforestation of local varieties of plants
- 5.1.9 Measures to control and conserve runoff from various locations.
- 5.1.10 Landscaping, plantation, aforestation to minimize adverse visual and noise impact

Ref. Chapter 5 para 5.2 of EIA/EMP report

5.2 Air Environment

Impact of mineral transportation within and outside the lease. The entire sequence of mineral production, transportation, handling, transfer and storage of minerals and wastes and the impacts on air quality is to be shown in a flowchart with specific points where fugitive emissions can arise and specific pollution control / mitigative measures are proposed to be put

in place. The adequacy of roads existing in the area and if new roads are to be laid the impact of the construction of roads particularly if it is crossing forest lands.

Ref. Chapter 5 para 5.3 of EIA/EMP report

Anticipated Impacts:

- 5.2.1 Emission Inventory of SPM, RSPM, SO₂, NO_x, and site specific pollutants
- 5.2.2 Prediction of fugitive dust emissions due to mining activities, crushing and cleaning plants, loading and unloading, transportation by rail, road or conveyor.
- 5.2.3 Impact of fugitive dust emission on flora and fauna
Prediction of impact on ambient air quality using appropriate mathematical model (area, point and line sources). Description of model, input requirements and reference of derivation. Isopleths distribution of major pollutants and their analysis and presentation in tabular form/base map.

Mitigation Measures:

- 5.2.4 Measures to reduce the emissions of pollutants during mining, loading, unloading, transportation, drilling, blasting, crushing etc to maintain the air quality
- 5.2.5 Adoption scientific mining methods to reduce dust emission from point and line source
- 5.2.6 Planned green belt development

Ref. Chapter 5 para 5.3 of EIA/EMP report

5.3 Water Environment (surface and groundwater)

Impact of mining on hydrology, changes of natural drainage, diversion and channeling of the existing rivers/water courses flowing through the mine lease and adjoining area and its impacts on existing users and mine operations.

Impact of water drawal and mine water discharge on the hydrogeology and use of groundwater regime in the core zone and buffer zone are to be detailed out. Long- term modeling studies on the impact of mining on the underground water regime should be carried out.

Ref. Chapter 5 para 5.4 of EIA/EMP report

Anticipated Impacts:

- 5.3.1 Impact on groundwater regime/streams/lake/springs due to mining, to be assessed from hydro-geological study
- 5.3.2 Impact of water drawal on surface and groundwater resources
- 5.3.3 Impact on surface and groundwater quality due to discharges from mining, tailings pond, workshop, township, leachate from solid waste dumps etc.
- 5.3.4 Ingress of sea water, particularly for mining projects in coastal areas.

Mitigation Measures:

- 5.3.5 Measures to minimize contamination of surface and groundwater
- 5.3.6 Construction of gully checks, check dams, sedimentation ponds, settling tanks, water weirs, retaining walls etc. with design and site features for control of run-off
- 5.3.7 Mine water treatment for meeting the prescribed standard
- 5.3.8 Slope stabilization by constructing retaining walls, vegetation etc.
- 5.3.9 Steps to minimize impact on water table if mining intercepts groundwater regime.
- 5.3.10 Wastewater treatment for township sewage, workshop(s), tailing pond overflow etc.

Ref. Chapter 5 para 5.4 of EIA/EMP report

5.4 Noise Environment

Anticipated Impacts:

- 5.4.1 Prediction of noise level by using mathematical modeling at different representative monitoring stations
- 5.4.2 Impact of vibrations including damage to materials/structures due to blasting
- 5.4.3 Impact on ambient noise level due to rock excavation, transportation, processing equipments and ancillaries.

Ref. Chapter 5 para 5.5 of EIA/EMP report

Mitigation Measures:

- 5.4.4 Measures for noise abatement including point source and line source
- 5.4.5 Measures to minimize effect by blasting
- 5.4.6 Lay out planning to minimize the impact on receiving environment
- 5.4.7 Planned preventive maintenance
- 5.4.8 Selection of low noise equipment failing which use of retrofit for existing equipment

Ref. Chapter 5 para 5.5 of EIA/EMP report

5.5 Biological

Anticipated Impacts (Flora and Fauna):

- 5.5.1 Impact on forest resources, economically important plants, medicinal plants and threat to rare, endemic and endangered species
- 5.5.2 Impact on terrestrial and aquatic biodiversity
- 5.5.3 Impact on wildlife including avi-fauna
- 5.5.4 Impact on wildlife habitat and migratory corridors
- 5.5.5 Impact on flora and fauna due to air emissions, noise, vibration, illumination, vehicular movement, waste water discharges, changes in land use, township etc.

Ref. Chapter 5 para 5.7 of EIA/EMP report

Mitigation Measures:

- 5.5.6 Measures to compensate the loss of forest coverage
- 5.5.7 Regeneration of rare and endangered plants of economic importance including medicinal plants.
- 5.5.8 Measures for protection and conservation of wildlife species
- 5.5.9 Green belt and its raising schedule
- 5.5.10 Progressive afforestation in overburden, reclaimed mined out areas

Ref. Chapter 5 para 5.7 of EIA/EMP report

5.6 Socio- Economic Environment

Anticipated Impacts:

- 5.6.1 Displacement of human settlements during the life of the mine
- 5.6.2 Positive and negative impacts on present status of livelihood in the area
- 5.6.3 Impact on the cropping pattern and crop productivity in the buffer zone
- 5.6.4 Impact on community resources such as grazing land

Ref. Chapter 5 para 5.8 of EIA/EMP report

Mitigation Measures:

- 5.6.5 Rehabilitation and resettlement of land oustees and displaced people
- 5.6.6 Compensation for loss of land and crops
- 5.6.7 Training to locals for employment in the project
- 5.6.8 Employment opportunities and access to other amenities such as education, health care facilities to be extended to locals

Ref. Chapter 5 para 5.8 of EIA/EMP report

5.7 Mine Wastes

Anticipated Impacts:

- 5.7.1 Impact of runoff from overburden, top soil, low-grade ore and other stock piles on water bodies (siltation, contamination etc)
- 5.7.2 Loss of vegetation and wildlife habitat
- 5.7.3 Impact on surrounding agricultural land
- 5.7.4 Impact on groundwater quality due to leachate
- 5.7.5 Sliding of waste dump
- 5.7.6 Impact of hazardous wastes and liquids

Not applicable for the project

Mitigation Measures:

- 5.7.7 Land reclamation and mine closure plan
- 5.7.8 Overburden dumps stabilization to minimize impact due to runoff
- 5.7.9 Overburden utilization for back-filling and other purposes. Simulation model with 5 years projection with digitized maps
- 5.7.10 Municipal solid waste management in township
- 5.7.11 Measures to control runoff from waste dumps and mining surface.
- 5.7.12 Hazardous waste management as per regulatory guidelines

Not Applicable for the Project

6.1 Environmental Monitoring Program

In order to focus on environmental management during project implementation and execution stage, the project proponent is required to spell out detailed plan and should include the following;

- Monitoring of quality of water, air, noise, vibration and occupational health status of project personnel and surrounding habitations.
- Planned monitoring program to evaluate the effectiveness of various/specific aspects of technological/mitigation measures.
- Environmental audit of various activities including budgeting and financial management with reference to environmental management.
- Hydrogeological monitoring for the entire mine life and restrictive monitoring during reclamation.
- Plantation monitoring programme to ensure survival and growth rate of plantations.
- Analysis of data, its interpretation and evaluation (any additional studies to be carried out if required)
- Mine closure plan along with the fund requirement for implementation of the activities proposed there under.

7.1 Additional Studies

Ref. Chapter 7 para 7.1 of EIA/EMP report

7.2 Public consultation

Public hearing with the issues raised by the public and the response of the project proponent in tabular form should be discussed

To be incorporated after Public hearing

7.3 Risk Assessment (RA) and Disaster Management Plan (DMP)

Mining activities are always associated with risk relating to hazards and accidents. Therefore risk analysis and risk mitigation should be clearly indicated in the report. This should include the following:

- Identification and type of risk associated with mining (slope failure, subsidence, fly rock fragments, fires, toxic / hazardous / flammable gas release / explosion, inundation etc.)
- Details of safety measures to prevent accident and disaster
- Disaster management plan and emergency response system with proper organizational setup to deal with such situation.
- Disaster management plan for safe mining particularly for underground mines where toxic fumes and other risks are involved.
- Occupational health risks

Ref. Chapter 7 para 7.3 of EIA/EMP report

7.4 Natural resource conservation

Plan of action for conservation of natural resources and recycle waste materials due to the project activity in the construction and operational phase of the project is to be discussed. Energy efficiency measures in the activity are to be drawn up.

Not Applicable for the project

7.5 R & R Action Plan

Detailed R & R plan with data on the existing socio-economic status of the population in the study area and broad plan for resettlement of the displaced population, site for the resettlement colony, alternative livelihood concerns/employment for the displaced people, civil and housing amenities being offered, etc and the schedule of the implementation of the project specific R & R Plan if any is to be given. Details of provisions (capital and recurring) for the project specific R & R Plan and monitoring mechanism for the implementation of the plan.

Details of Corporate Social Responsibility activities and cost provisions (capital and recurrent per annum over the life of the project)

Ref. Chapter 7 para 7.5 of EIA/EMP report

8.0 Project benefits

This section describes the improvements in physical and social infrastructure. It details out the employment potential and other benefits that are accrued.

Ref. Chapter 8 of EIA/EMP report

9.0 Environmental cost-benefit analysis

The environmental cost-benefit analysis is to be taken up if recommended in the scoping stage.

Ref. Chapter 8 of EIA/EMP report

10.1 Environmental Management Plan (EMP)

- Administrative and technical set up for management of environment
- Mechanism of self monitoring for compliance with environmental regulations
- Institutional arrangements proposed with other organizations/ Govt. authorities for effective implementation of proposed environmental management plan
- Conservation plan for the endangered / endemic flora and fauna found in the study area and for safety of animals visiting / residing in the study area and also those in the migratory corridor.
- Integrating in the environmental management plan measures for minimising use of natural resources - water, land, energy etc.

Ref. Chapter 10 para 10.1-10.11 of EIA/EMP report

11.1 Summary and Conclusion (Summary EIA)

The summary should be a clear presentation of the finding of critical environmental issues and their resolutions. Whenever possible, the summary should make use of base maps, tables and figures. Information should be succinct with meaningful presentations. It must be able to stand alone as a document. It should necessarily cover the following:

- Introduction
- Project description and Project benefits
- Anticipated environmental impacts and mitigation measures
- Additional studies
- Environmental Monitoring Program
- Environmental Management Plan
- Risk Assessment (RA) and Disaster Management Plan (DMP)

Ref. Chapter 11 para 11.1 to 11.7 of EIA/EMP report

12.0 Disclosure of consultants engaged

The team of consultants engaged in this project is to be given.

Ref. Chapter 12 of EIA/EMP report

ANNEXURE-2
LETTER OF AMALGAMATION