

**RAPID ENVIRONMENTAL IMPACT ASSESSMENT  
&  
ENVIRONMENTAL MANAGEMENT PLAN**

**PROJECT : CANELI DONGOR MINE**  
(T.C. No. 60/59)

SPONSOR

**SHRI. FRANCIS MIGUEL MASCARENHAS**  
**Goa**

CONSULTANTS

**MINERAL ENGINEERING SERVICES**

**Mining & Environmental Engineers**  
**25/XXV, Club Road, Bellary - 583 103**

**TEL/FAX : 08392 – 267421 /268365**

**0832 – 2313057**

**email – [mes\\_msraju@yahoo.co.uk](mailto:mes_msraju@yahoo.co.uk)**

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**RAPID ENVIRONMENTAL IMPACT ASSESSMENT (REIA) &  
ENVIRONMENTAL MANAGEMENT PLAN (EMP) FOR  
CANELI DONGOR MINE**

**CHAPTER - 1**

**1.0 INTRODUCTION :**

Shri. Miguel Mascarenhas has been operating a mining lease in the name and style of Caneli Dongor Mine (T.C. No. 60/1951) since year 1951. The mining lease is located in Vichundrem village, Sanguem taluka in South Goa district of Goa State. The extent of mining lease is 82.60 Ha. The lease is valid upto 21.11.2007.

The mine was operating using only manual mining methods. The mine was under discontinuance during the period between 1992 to till date due to unfavorable market conditions for the low grade siliceous iron ore. Lessee intends to restart mining activity using mechanised mining operations and it is now proposed to produce iron ore @ 4 lakh tonnes per annum due to the favorable market conditions.

As per EIA notification an application to Goa State Pollution Control Board is being submitted to conduct a Public Hearing and issue CFE(Consent for Establishment).

The lessee seeks an environmental clearance for lease renewal and for in production using mechanised methods to produce iron ore @ 4 lakh tonnes per annum as per the provisions of EIA notification, 1994 and guidelines issued there under.

A Rapid EIA & EMP covering baseline data for winter season i.e., Dec 04, Jan 05 and Feb 05 is presented here.

## CHAPTER – 2

### **2.0 GEOLOGY, EXPLORATION & MINING :**

#### **2.1 Location :**

Caneli Dongor Mine (T.C. No. 60/1951) is located in Vichundrem village, Sanguem taluk, South Goa district, Goa State. The extent of ML area 82.60 Ha. The details of **location** and **lease sketch** are given vide **Figure Nos. 2.1 and 2.2** respectively.

#### **2.2 Topography :**

The study area is hilly terrain, the highest and lowest elevation are 80 mts and 240 mts respectively.

#### **2.3 Drainage :**

In the study area the main drainage controlled by Pareveda and Guloli nallhas flowing SW to NW and West to north direction respectively and joins to Kushavati rivulet which is a tributary of Zuari river.

#### **2.4 Geology :**

The iron ore formation of Goa belongs to Dharwar Super Group of Archaen Protozonic age, which consists of Vagurim formation, Bicholim formation, Sanvordem formation and Barcem formation. These formations have quartz-chlorite-amphibolite schist, ferruginous pink phyllites, limestone and manganiferous quartzites with pink ferruginous phyllites and banded ferruginous quartzites.

#### **2.5 Local Geology :**

Virgin land is covered with thick cap of laterite. Litho units observed from various exposures and inferred from the bore hole logs are as given below.

Laterite  
Limonitic Clay  
Low grade iron ore  
High grade iron ore  
Mn. Clay with Manganese ore

Thickness of low grade iron ore and high grade iron ore are 5m and 10m respectively. The proved ore body has a strike exposure of 350m and average width is 150 mtr. Fe content of high grade ore is 58% to 64% and low grade ore is 55% to 58%. Cut off grade is 55% Fe.

A **geological plan and section** is enclosed vide **Figure Nos. 2.3 and 2.4.**

## **2.6 Exploration :**

The iron ore deposit is explored by drilling 25 Nos. of holes. In future ten boreholes have been proposed with a cumulative meterage of 1000m. These bore holes are proposed in the unexplored portion of the ML area. With this, further reserves could be proved.

## **2.7 Mining :**

Open cast mine proposed deploy heavy earth moving machineries. There are old working pits which shall be expanded laterally and deepened to carry out development and production.

The mining operations include removal of overburden by using ripper dozer. No blasting shall be proposed in this mine. The loosened material shall be loaded into 10 tonne tipper trucks by hydraulic excavators. The waste shall be hauled to the predetermined dump yard beyond ultimate pit limit within ML area.

Separate benches in waste and ore shall be maintained with 6m height and width exceeding 6m to facilitate movement of HEMM and tippers. It is estimated that 1 hydraulic excavators with 25 tippers shall be sufficient to meet the requirement of waste handling.

To produce 4 lakh tonnes of ROM ore per annum about 5.5 lakh tonnes of waste shall be handled, thus for each tonne of ore 0.56 cu. m. waste shall be generated.

The estimated mineable reserves is 4.5 million tonnes. The life of the mine at proposed production shall be more than 12 years and the proposed exploration will enhance the life of this mine after proving additional reserves . A conceptual plan is enclosed vide **Fig. No 2.5.**

## **CHAPTER - 3**

### **3.0 ENVIRONMENTAL IMPACT ASSESSMENT METHODOLOGY**

#### **3.1 METHODOLOGY FOR EIA :**

For assessing Environmental Impact causing due to Caneli Dongor Mine an area of 10 kms radius was selected. The 10 kms radius was split into two zones viz., Core and buffer zones. The core zone represents the mining lease area, which is a potential source of pollution. The buffer zone consists of the balance of 10 kms radius area. The methodology adopted for each parameter of study is discussed briefly here.

##### **3.1.1 Air Environment :**

Ambient air quality data from the buffer zone villages of 10 kms radius is obtained. The location of air monitoring stations were fixed after considering the previous years meteorological data of predominant wind direction. Totally four stations were fixed during winter season, out of these four stations, one stations represent the core zone activities and three stations represent the air quality status in the buffer zone. The air samples were collected continuously for 24 hours per sample basis for core zone & buffer zone stations and 8 hourly samples for mining operations i.e., for fugitive samples. The parameters such as SPM, RPM, SO<sub>2</sub>, NO<sub>x</sub> & CO were monitored.

Respirable Dust Sampler with facility to separate respirable dust were fixed at 1.5 meters above the ground level free from obstructions taking into consideration the wind direction and wind speed.

The frequency of sampling is as given below.

**For Buffer zone and Core zone Stations :**

1 station x 1 (24 hrly.) sample/day x 2 days/week x 13 weeks/season = 26 samples/season for buffer zone villages and core zone

1 station x 1 (8 hourly) sample/day x 2 days/month x 3 months/season = 6 samples/season for fugitive samples.

The standard procedures and methods as outlined by the Central Pollution Control Board (CPCB), Bureau of Indian Standards (BIS) and National Environmental Engineering Research Institute (NEERI), Nagpur were adopted for chemical analysis.

**3.1.2 Meteorology :**

Meteorological data has been collected using weather monitoring station located at the mines office during the study period.

The parameters like daily maximum and minimum temperatures, Relative Humidity, wind speed and wind direction were collected for all the three months of the winter season 2004-05.

**3.1.3 Water Environment :**

Both surface and ground water samples were analysed to know the baseline status of the water quality. Total five monitoring stations were setup, out of which four stations represent the ground water and one station represent the surface water quality. The water samples were collected and analysed as per procedures outlined in IS : 2488, IS : 3025/AWWA/APHA during winter season 2004-05. The results were compared with the standard of IS : 2296 and IS : 10500 standards.

Parameters such as pH, DO, Temperature, conductivity and total dissolved solids were analysed at the field using field kits. All the samples were collected in 2 litre plastic cans and transported in aluminum box filled with ice to Environmental Laboratory for analysis.

#### **3.1.4 Noise Environment :**

Noise locations were fixed after identifying the different noise sources. The sources identified in the core zone were operation of various mining equipment such as excavators, loaders and tippers. The noise monitoring for buffer zone villages were conducted both during day and night time i.e., 6.00 to 22.00 hrs and 22.00 to 06.00 hrs respectively. The noise levels were measured in dB(A).

#### **3.1.5 Land Environment :**

**Soil samples** were collected at four locations. The soil samples represent various land uses in and around the project site. The soil samples were collected using core-cutter and augur combination. The soil samples were collected upto 15cms depth, which represents the topsoil. They were analysed to determine the fertility of the soil.

#### **3.1.6 Biological Environment :**

Data have been collected from various government departments such as Forest, agriculture, fisheries and animal husbandry to establish the biological environmental conditions.

The status of Flora & Fauna within the core zone and buffer zone were collected from the local forest department and also limited field studies were conducted to identify the different species that are prevalent.

#### **3.1.7 Socio-economic Environment:**

A limited field survey was conducted among some of the selected villages falling within the buffer zone area of 10 kms radius. The information regarding population, family members, occupation, literacy level and amenities etc., were obtained from census data of 2001.

## CHAPTER - 4

### **4.0 BASELINE INFORMATION :**

#### **4.1 GENERAL :**

Baseline information regarding the existing environmental quality in respect of parameters like meteorology, ambient air quality, water quality, noise levels, soil quality has to be collected before commencement of any project. In the present case the project is already an on going one and hence the existing quality forms the baseline. The environmental quality of future mining activity shall be compared against this baseline data.

Baseline data has been generated by M/s. Mineral Engineering Services, Bellary during the year 2004-05 covering the three months of winter season (i.e., December-04, January-05 & February-05).

#### **4.2 METEOROLOGY :**

Meteorological data was collected using a manual weather monitoring station located at mines office during the study period. The month-wise rainfall data is shown in **Annexure No. I** and **Figure Nos. 4.1 a & 4.1 b**. From the figures it is seen that the area experiences heavy rainfall. The annual average rainfall for the past 10 years was found to be 3421 mm/year.

The parameters like daily maximum & minimum temperatures, relative humidity, wind speed and wind directions were collected. The data is given vide **Annexure Nos. II to IV**. The windrose diagram is given vide **Figure No. 4.2**. The maximum and minimum temperature during December-04, January and February 2005 were found to be 32.5<sup>0</sup>C and 17.5<sup>0</sup>C. The relative humidity ranged from 43.5% to 95%. The day maximum wind speed recorded was 8.6 km/hr during the study period. The predominant wind direction was from SEE to NWW.

### **4.3 AIR ENVIRONMENT**

#### **4.3.1 Ambient Air Quality Monitoring (AAQM) :**

The principal objective of Ambient Air Quality Monitoring (AAQM) was to assess the existing levels of air pollution surrounding the ML areas and the corezone. The air pollution of any area is a direct indication of the magnitude of human activities in the areas and also has a direct bearing from the wind direction. Polluted air could be hazardous for human beings and other biotic life. Hence air quality is the most important single parameter to be monitored on a continuous basis.

#### **4.3.2 Location of the Monitoring Stations :**

For assessing the quality of air in core zone and buffer zone villages (10 kms radius) in respect of Suspended Particulate Matter (SPM), Respirable Particulate Matter (RPM), Sulphur dioxide (SO<sub>2</sub>), Oxides of Nitrogen (NO<sub>x</sub>) and Carbon monoxide (CO) were monitored during winter season. Totally four stations were monitored during study period. The **location** of these **monitoring stations** is given vide **Fig. No. 4.3.**

#### **4.3.3 Data Analysis :**

##### **AI – Core zone :**

This station represents the combined mining operations within the core zone area. The SO<sub>2</sub> and NO<sub>x</sub> values ranged from 5 to 11 µg/cu.m and 7 to 14 µg/cu.m respectively. The SPM & RPM values ranged from 40 to 115 µg/cu.m and 15 to 36 µg/cu.m respectively. The air quality levels are given vide **Annexure No. V.**

**Buffer zone :**

**A II - Cazur Village :**

This station is located at a distance of 0.4 kms towards SW of mining lease area. The SO<sub>2</sub>, NO<sub>x</sub>, SPM & RPM values ranged from 5 to 9 µg/cu.m, 6 to 14 µg/cu.m, 48 to 112 µg/cu.m and 18 to 42 µg/cu.m. respectively. The air quality levels are shown vide **Annexure No. VI.**

**A II - Vichundrem village :**

This station is located at a distance of 1.4 kms towards North of ML area. The SO<sub>2</sub>, NO<sub>x</sub>, SPM and RPM values ranged from 5 to 8 µg/cu.m, 6 to 13µg/cu.m, 42 to 110 µg/cu.m and 16 to 43µg/cu.m respectively. The air quality levels are shown vide **Annexure No. VII.**

**A III - Neturlim village :**

This station is located at a aerial distance of 3.5 kms towards East of ML area. The SO<sub>2</sub>, NO<sub>x</sub>, SPM and RPM values ranged from 5 to 9 µg/cu.m, 7 to 13 µg/cu.m, 38 to 93 µg/cu.m and 12 to 32 µg/cu.m respectively. The air quality levels are shown vide **Annexure No. VIII.**

The statistical representation of air quality data is given vide **Annexure Nos. IX to X.** The air quality levels are shown graphically in **Fig. No. 4.4.**

***The carbon monoxide (CO) for the above buffer zone stations were found to be below detection limit of 100 µg/cu.m.***

#### 4.4 WATER QUALITY DATA :

Any mining activity has a direct bearing to the water pollution. The region has good rainfall. During precipitation the runoff water carries along with it the silt particles leading to water pollution. The major pollutant in water is suspended solids. Essential precautionary measures are taken to see that the silt does not pass into the river and pollute the water.

##### 4.4.1 Location, Rationale & Data Analysis :

Four ground water and one surface water samples were collected during winter season 2004-05. The locations were selected based on the potential pollution indicators, topography and by field situation. **The location of ground water & surface water sampling stations** are given vide **Fig No. 4.5**.

##### Ground water :

##### **GW1 - Open well at Cazur:**

This station is located at a distance of 0.4 km towards SW from the mining lease area. The analysis results show that the all the parameters are within the permissible limits of IS:10500. The analysis results are given vide **Annexure No. XI A**.

##### **GW2 - Open well at Vichuendrem village :**

This station is located at a distance of 1.4kms towards North from the mines. The analysis results show that all the parameters are within the permissible limits of IS: 10500. The analysis results are given vide **Annexure No. XI A**.

##### **GW3 - Open well at Neturlim village:**

This station is located at a distance of 3.5 kms towards East from the ML area. The analysis results show that all the parameters are within

the permissible limits of IS:10500. The analysis results are given vide **Annexure No. XI A.**

**GW4 - Open well at Devrem village:**

This station is located at a distance of 6.5 kms towards SEE from the ML area. The analysis results show that the all the parameters are within the permissible limits of IS : 10500. The analysis results are given vide **Annexure No. XI A.**

**Surface water :**

**SW1 Spring Water :**

This station is located at a adjacent to mine lease towards West of mining lease area. This station represents a natural surface spring water . The analysis results show that all the parameters are within the permissible limit of IS:2296. The analysis results are given vide **Annexure No. XI B.**

**4.5 NOISE ENVIRONMENT :**

Noise is defined as unwanted sound. Noise interferes with speech communication, causes annoyance, distracts from work and disturbs sleep. Thus noise pollution deteriorates quality of human environment.

**4.5.1 Noise Monitoring Data :**

Noise levels were monitored using an electronic sound level meter for 24 hours both during day and night time starting from 6.00 Hrs to 22.00 Hrs and 22.00 Hrs to 6.00 Hrs respectively. Noise was monitored at core zone station (within ML area) and four buffer zone villages. The analysis results show that all the buffer zone villages are below the permissible limits of CPCB.

In core zone station all the values are below the permissible limits of ILO code of practice. The analysis results are given vide **Annexure No. XII.** Location of noise monitoring stations are given vide **Fig. No. 4.6.**

## **4.6 SOIL ENVIRONMENT :**

### **4.6.1 General**

Flora and fauna of any area depend largely upon the quality of soil. Therefore, it is essential to know the quality of soil in the core zone and buffer zone areas. The soil quality data obtained will help one to plan properly plantation and green belt development etc., The various mining activities have an adverse impact on soil quality thus the study of soil quality is vital.

### **4.6.2 Location and Rationale :**

Four soil samples were collected within the buffer zone of 10 kms radius. Four stations located at agricultural field soils at Cazur, Vichundrem, Neturim, and Deverem villages and one station at paddy field near dumps and one station at top soil at pit edge. These locations are shown in **Fig. No. 4.7**.

### **4.6.3 Methodology :**

At the above mentioned sites, 2 kgs of soil samples were collected by means of augur and core cutter in polythene bags and sent to the laboratory for analysis. The soil samples were collected over a depth of 15 cms that represents the top soil layer.

### **4.6.4 Data Analysis :**

The analysis results are given vide **Annexure No. XIII**. The results show that most of the soil samples are silty clayey in nature and rich in organic carbon content. For better crop yield addition of urea and phosphorous-based fertilizers is required.

## 4.7 FLORA & FAUNA :

### 4.7.1 Flora :

a) **Core zone** : Vegetation is seen around already broken up area within the corezone. Some small shrubs and thorny bushes also can be seen along with dominant *Terminilia species*. The other species found in the core zone are *Semicarpus anacardium*, *Embllica officinalis*, *Xylia xylocarpa*, *Spondias mangfera*, *Arlocarpus heterophyllus*, *Magnefera indica*, *Delonix regia*, *Cocus Nucifera*, *Zizphus jujuba* and *Ixora parviflora* etc.

b) **Buffer zone** : In the buffer zone covering 10 kms radius area the floral species are covered to assess the baseline environmental quality.

In the study area we come across moist deciduous, semi-evergreen and evergreen forest types. Terminalias are the dominant species in the canopy. Most of the species exist in the core zone area also spread in the buffer zone area . Other than the core zone species the buffer zone also contains species as *Erythrina indica*, *Lannea grandis*, *Garcinia indica*, *Adina cordifolia*, *Fragara budrunga*, *Mimosops elengi*, *Artocapus lakoocha*, *Albizzia lebbeck*, *Ficus bengalensis*, *Vitex negundo* and *Dendrocalmus strictus* etc.

### 4.7.2 Fauna :

#### a. **General** :

Industrialization normally effect the environment including fauna of the area. The impact of mining activities on the surrounding fauna will be significant. This is mainly due to the impact of mining activities on the quality of air, water, noise and soil. This will be reflected in the faunal content, distribution, proliferation etc. So the study of fauna within the core zone and buffer zone to assess the baseline environmental status was established.

**b. Species:**

In the core zone commonly found animals are Rat, Indian rat, Common mouse, Monkey and Fruit bat.

The avifauna found are Weaver bird, Common kite, House crow and Koel. The reptiles found are Garden lizard, fresh water snake, kraits, pit viper and house lizard.

In the bufferzone, most of the corezone fauna are also seen. The other faunal animals are, Fox, Jackal, common mongoose, Porcupine, Fruit bat, Rat, Indian Hare, Rock pigeon, Indian oriole, Weaver bird, Little egret and Pond heron. The reptiles are House lizard, rat snake, Cobra, Fresh water snake, Kraits, Pit viper, Fresh water tortoise.

**4.8 LAND ENVIRONMENT :**

**Bufferzone Landuse :**

The landuse pattern within the study area is given in Table No.4.1. Most of the area within the study area of 10 km buffer zone is covered by forest area/natural cover of 84.07%. The different land use pattern with percentages are given in the table below.

**Table No. 4.1 : Buffer zone Landuse**

<b>Sl. No.</b>	<b>LAND USE</b>	<b>AREA (Sq.Km)</b>	<b>PERCENTAGE (%)</b>
1	Roads	0.86	0.27
2	Water bodies	12.84	4.09
3	Orchard	9.68	3.08
4	Cultivable land	24.20	7.71
5	Settlement area	2.43	0.78
6	Forest/natural cover	263.99	84.07
	<b>TOTAL</b>	<b>314.00</b>	<b>100.00</b>

### **Core Zone :**

The ultimate land use pattern within the core zone is given in Table No.4.2

**Table No. 4.2: Landuse (Core zone)**

<b>Sl. No.</b>	<b>LAND USE</b>	<b>AREA (Ha.)</b>
1	Area for Mining	11.65
2	Overburden / waste	10.00
3	Roads	1.60
6	Future Exploration/Mining	59.35
	<b>TOTAL</b>	<b>82.60</b>

### **4.9 DEMOGRAPHY AND SOCIO-ECONOMICS :**

Mining activities invariably bring about change in the environment including socio-economic environment. Mostly remote areas tucked away from urbanization and influence of modern civilization fall within the limits of mine development. Due to the development of mining activity in the region life style of the local inhabitants who have been dwelling in this region for generations, get exposed to this activity. So it is essential to assess the baseline socio-economics and the expected impact due to the mining activity in the study area.

The baseline data on socio-economic aspect are meant to cover the following.

- (i) Demographic features
- (ii) Amenities like educational facilities, medical facilities etc.,
- (iii) Cultural aspects
- (iv) Economic aspects

#### **4.9.1 Demographic Profile :**

Totally there are 15 villages falling within the buffer zone of 10 kms radius. The population breakup of all villages falling within the buffer zone as per 2001 census data are given in **Annexure No. XIV**. From the data it is seen that the total population within the buffer zone works out to be 11308 vide census of 2001. Population breakup of the study area is shown in **Fig No. 4.8 a**. The schedule caste and schedule tribe population in the buffer zone works out to be 1.02% and Nil respectively. Whereas the others male & female population comprises of 49.70% & 49.28% respectively.

#### **4.9.2 Literacy :**

The literacy levels within the buffer zone are given in **Annexure No. XX**. The literacy level is depicted pictorially in **Fig. No. 4.8 b**. The literacy levels within the buffer zone is 59.35% of the total population.

#### **4.9.3 Occupation structure:**

The details about the occupation of the population within the buffer zone are tabulated in **Annexure No. XV**. Occupational pattern within the buffer zone is shown in **Fig. No. 4.8 c**. The main workers comprises of 35.83%, marginal workers 14.97% & 49.19% non workers.

#### **4.9.4 Amenities available in the buffer zone :**

The study area is provided with good basic amenities like education, medical, drinking water and approach roads.

- a) Transportation & Communication** - All the villages in the buffer zone are well connected by tar roads and public transport facility.
- b) Educational facilities-** In all the village panchayats educational facilities are available upto primary standards. For higher education the students of this area have to go to Curchorem, Margao, Ponda and Panjim.
- c) Medical Facilities** -

The area has good medical facilities. There are a number of private practitioners to meet the requirement in all the villages.

Apart from medical and health care rendered to the mine workers, there is also a govt. hospital at Quepem to meet the medical requirement of mine workers, staff and bufferzone villagers. The company shall maintain ambulance for speedy transportation of the patients.

**d) Drinking water supply :**

In the villages a number of wells are situated from where potable water is drawn. As the area receives copious rainfall, the water level in the wells is very shallow and water can be seen at a shallow depth of 2.5 meters. But during summer the ground water table is lowered. Some of the villages have piped water supply.

**e) Post, telegraph and telephone facilities:**

Postal, telegraphic and telephone facilities are available in major villages where as other small villages have only postal facilities.

**f) Electricity :**

All the villages in the buffer zone are serviced by state electricity department.

**g) Marketing facility :**

All the villagers and village panchayats have regular marketing facilities. But the villagers for their bulk purchases go to the nearest major towns such as Quepem, Margao etc.

## **CHAPTER - 5**

### **5.0 ENVIRONMENTAL IMPACT ASSESSMENT (EIA)**

#### **5.1 GENERAL :**

The mining activities proposed will have both positive and negative effect on the surroundings. This change is called an impact. The impact could be either useful or detrimental to the environment. The net impact could be determined by evaluating the impact on various parameters.

The parameters with adverse impact due to unavoidable reasons have to be nullified, kept to the minimum or brought to have positive effects by taking suitable corrective measures, it is possible to create better environment.

The project being considered will have a bearing on the socioeconomic aspects as well as on the environment due to mining and other incidental activities. The impact depends upon the extent of mechanisation, method of mining, infrastructure facilities, environmental profile and characteristics of environment.

The impact prediction due to the project has been made in respect of the parameters considered in the present scenario. i.e., the quality parameters of ambient air, water, socio-economic aspects, inventory of flora and fauna.

#### **5.2 EVALUATION OF IMPACTS :**

For the purpose of evaluation of quality of the environment at the Caneli Dongor Mine, Battelle Environmental Evaluation System (BEES) methodology has been adopted. This methodology is the most commonly adopted method for evaluation, through a weighing – scaling checklist. The checklist for the present opencast iron ore project would consist of 45 selected parameters identified for this purpose. All these

parameters have been assigned importance weight by experts in different fields.

The resultant importance weight points i.e., Parameter Importance Unit (PIU) are presented in **Fig. 5.1** by indicating the numbers in the parenthesis. The typical functional relationships also called value function graphs have been developed for various parameters chosen are used to assess the impact. The value function graphs are illustrated in **Fig. No. 5.2 to 5.13**. The Environmental Quality (EQ) is represented on a scale of 0 to 1. '0' represents poor environmental quality and '1' representing good environmental quality.

An index is obtained in Environmental Impact Unit (EIU) for each alternative and baseline environmental conditions (i.e., EIU with EMP & EIU without EMP).

$$EIU_j = \sum_{i=1}^n (EQ)_{ij} (PIU)_i$$

Where,

- EIU<sub>j</sub> = Environmental Impact Units for j<sup>th</sup> alternative
- EQ<sub>ij</sub> = Environmental Quality Scale for i<sup>th</sup> factor
- PIU<sub>i</sub> = Parameter Importance Unit for i<sup>th</sup> factor

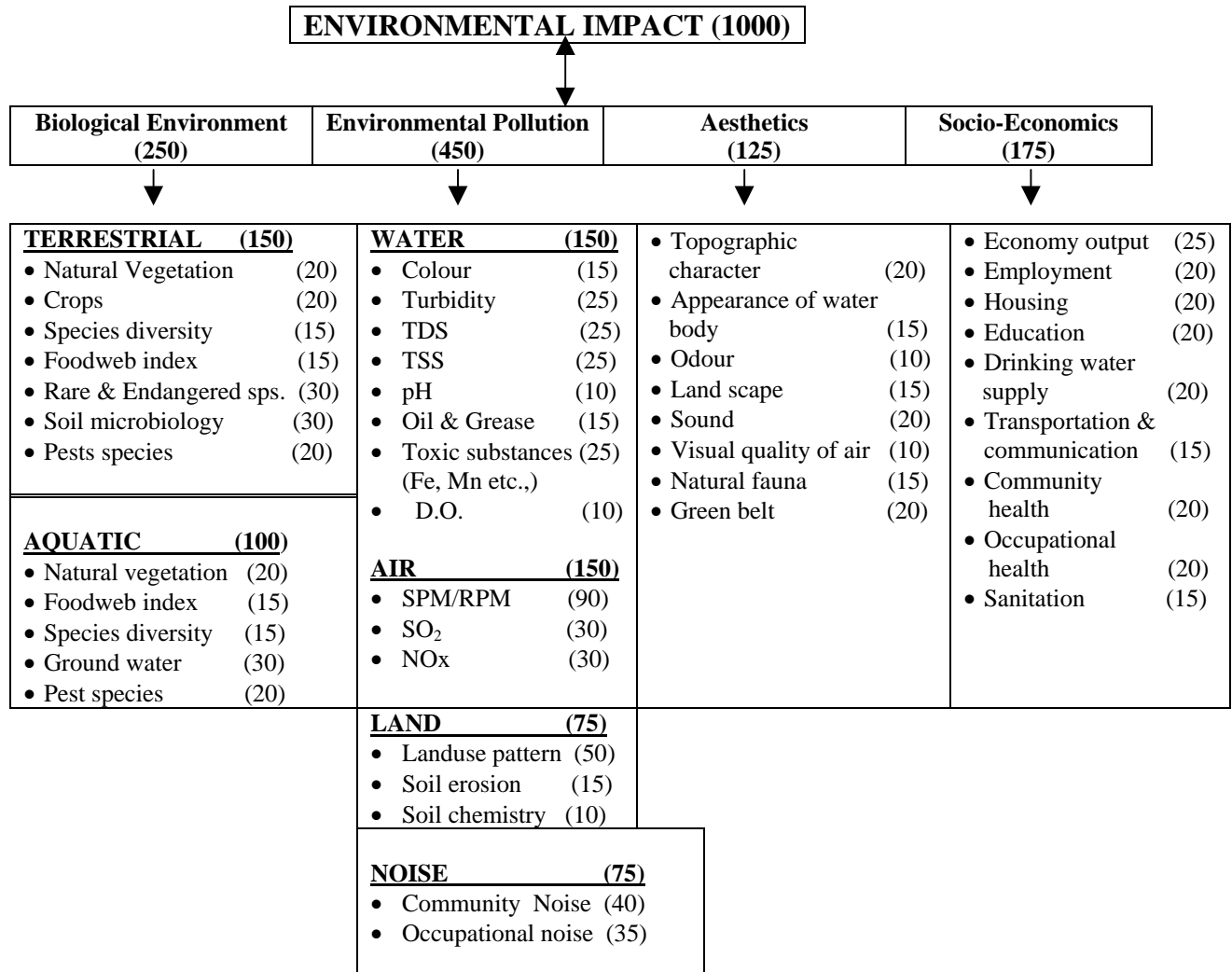
All the parameters identified for this project have been distributed in four major categories viz.,

- 1) Biological Environment
- 2) Environmental Pollution
- 3) Aesthetics
- 4) Socio-economics

Impact of mining activities has been assessed taking into consideration Biological Environment, Environmental Pollution, Aesthetics and Socio-economics. Total numbers of parameters considered are 45. For Biological Environment a score of 250 has been allotted out of a total of 1000. A bulk score 450 has been allotted aptly to Environmental Pollution. Scores of 125 and 175 have been allotted for

Aesthetics and Socio-economic parameters respectively. The scores have been allotted depending upon the importance of each parameter.

**Figure No.5.1 : Assigned Weights for Environmental Parameters for Caneli Dongor Mine.**



## 5.2.1 Biological Environment :

### (A) Terrestrial Environment :

The impacts of iron ore mining activities on terrestrial environment at Caneli Dongor mine is presented in **Table No. 5.1**.

The tree species found within the core zone represent the common type of flora species along with small shrubs and bushes. Due to mining activities community structure of the vegetation will not change. Where as diversity of plant species and food web index of the area reduced to certain extent.

However, if the proposed reclamation of the mining area and dumped out area using proper re-vegetation techniques and development of green belt around the ultimate pit limit and roadside there shall be an improvement in the species diversity and Food web Index compared to the existing level.

### (B) Aquatic Environment :

The existing quality of natural vegetation in the aquatic environment is good. However, due to the handling of overburden from the mines may lead to slight soil erosion ultimately affecting the turbidity and chemical characteristics of surface water. This in turn will alter the aquatic natural vegetation by way of change in species diversity. With the provision of retention walls, garland drains and vegetation of dumped areas there shall be reduction in soil erosion. This intern will improve the natural vegetation by improving the species diversity, foodweb index and surface water characteristics.

There are no rare and endangered aquatic species reported in the study area. There are no aquatic weeds reported in the surface waters. Hence no change in this parameters are anticipated.

In general, due to various mining activities, adverse impacts are anticipated in terrestrial and aquatic components of the Biological Environment. However, with the implementation of the environmental management measures, there will be improvement in the parameters of biological environment

**Table No.5.1 : Environmental Evaluation of Caneli Dongor Mine :**

**Biological Environment :**

Environmental Parameters	PIU	BASELINE EIU (A)	WITHOUT EMP EIU (B)	WITH EMP EIU (C)	CHANGE IN EIU (C-B)	CHANGE IN EIU (B-A)	NET CHANGE EIU (C-A)
<b>TERESTRIAL</b>							
Natural vegetation	20	12	11	13	3	-1	1
Crops	20	13	10	14	4	-3	1
Species diversity	15	10	7	9	2	-3	-1
Foodweb Index	15	11	10	13	3	-1	2
Rare & Endangered plant sps.	30	18	15	16	1	-3	-2
Pests species	20	15	14	16	2	-1	1
Soil microbiology	30	21	16	18	1	-5	-3
<b>Sub-Total</b>	<b>150</b>	<b>100</b>	<b>83</b>	<b>99</b>	<b>16</b>	<b>-17</b>	<b>-1</b>
<b>AQUATIC</b>							
Natural vegetation	20	14	13	15	2	-1	1
Foodweb Index	15	10	8	11	3	-2	1
Species diversity	15	10	7	8	1	-3	-2
Ground water characteristics	30	20	18	19	1	-2	-1
Pests species	20	16	15	16	1	-1	0
<b>Sub-Total</b>	<b>100</b>	<b>70</b>	<b>61</b>	<b>69</b>	<b>8</b>	<b>-9</b>	<b>-1</b>
<b>TOTAL</b>	<b>250</b>	<b>170</b>	<b>144</b>	<b>168</b>	<b>24</b>	<b>-26</b>	<b>-2</b>

## **5.2.2 Environmental Pollution :**

Due to the continuity of the mining activities of the project the following four components are affected viz.,

- (A) Air
- (B) Water
- (C) Land
- (D) Noise

### **(A) Air Environment :**

In the subject opencast mining, operations like loading, transportation, unloading operations of overburden and iron ore may deteriorate the air quality.

The levels of Suspended Particulate Matter (SPM) for the ambient air quality in the buffer zone villages are well within the permissible limits. However, the SPM content in the fugitive sources like various mining operations are likely to be high. The concentration of NO<sub>x</sub> and SO<sub>2</sub> are very much below the permissible limits in the buffer zone villages.

Green belt development and water spraying on haul roads results in the reduction in dust concentration.

### **(B) Water Environment :**

Parameters, which represent the water environment, are DO, Total Solids (TS), Turbidity, Oil & grease, toxic metals, pH, colour and nutrients. The water flowing through the overburden dumps will carry suspended solids, dissolved metals and nutrients, which will affect the quality of the ground water as well as surface waters.

Provision of check bunds and plantation of trees, grasses, legumes etc., on the overburden dumps as envisaged in EMP will arrest soil erosion to a great extent. This will improve the surface and ground water quality.

**(C) Land Environment :**

Except the mining lease area and the degraded forest land for dumping mineral rejects, there will not be any adverse effect on the land in the buffer zone area.

With the measures proposed under EMP there would be marginal effect of land degradation other than the mining lease area. In the Conceptual stage the mining lease area will be developed for a good land use and land cover with green belt development and other engineering structure (checkdams, retention wall/gully plugs etc.) proposed in the EMP.

**(D) Noise Environment :**

The sources of noise in mining area are due to running of dozers, excavators, wheel loaders and Dumpers for overburden and ROM handling with the use of ripper dozers for removing of hard Laterite capping and occasional drilling and blasting.

In general, noise generated by these sources is well within the limits of ILO Code of Practice. The work persons will not be exposed to more than 115 dB(A). But the higher noise levels are encountered for a shorter period and hence the Leq (8 hours) limit for this mine is found to be below this level.

In the EMP, it is proposed to employ noise protection measures for machinery and workers and development of green belt will keep the noise levels well within the limits.

Table No. 5.2 shows the Environmental Impact Units in respect of environmental pollution parameters.

Table No. 5.2

**ENVIRONMENTAL EVALUATION OF CANELI DONGOR  
MINE : Environmental Pollution**

Environmental Parameters	PIU	BASELINE EIU (A)	WITHOUT EMP EIU (B)	WITH EMP EIU (C)	CHANGE IN EIU (C-B)	CHANG E IN EIU (B-A)	NET CHANGE EIU (C-A)
<b>WATER</b>							
Colour	15	13	13	14	1	0	1
TSS	25	15	12	14	2	-3	-1
pH	10	8	6	7	1	-2	-1
D.O.	10	8	5	6	1	-3	-2
T.D.S	25	14	10	13	3	-4	-1
Turbidity	25	15	8	12	4	-7	-3
Oil & grease	15	13	10	12	2	-3	-1
Toxic substances	25	16	13	15	2	-3	-1
<b>Sub-Total</b>	<b>150</b>	<b>102</b>	<b>77</b>	<b>93</b>	<b>16</b>	<b>-25</b>	<b>-9</b>
<b>AIR</b>							
SPM	90	74	55	70	15	-19	-4
SO <sub>2</sub>	30	22	17	20	3	-5	-2
NO <sub>x</sub>	30	24	18	22	4	-6	-2
<b>Sub-Total</b>	<b>150</b>	<b>120</b>	<b>90</b>	<b>112</b>	<b>22</b>	<b>-30</b>	<b>-8</b>
<b>LAND</b>							
Land use pattern	50	40	28	36	8	-12	-4
Soil erosion	15	10	6	8	2	-4	-2
Soil Chemistry	10	7	5	6	1	-2	-1
<b>Sub-Total</b>	<b>75</b>	<b>57</b>	<b>39</b>	<b>50</b>	<b>11</b>	<b>-18</b>	<b>-7</b>
<b>NOISE</b>							
Community noise	40	35	30	34	4	-5	-1
Occupational noise	35	24	22	27	5	-2	3
<b>Sub – Total</b>	<b>75</b>	<b>59</b>	<b>52</b>	<b>61</b>	<b>9</b>	<b>-7</b>	<b>2</b>
<b>TOTAL</b>	<b>450</b>	<b>338</b>	<b>258</b>	<b>316</b>	<b>58</b>	<b>-80</b>	<b>-22</b>

### 5.2.3 Aesthetic Environment :

The topography of the mining area shall alter to certain extent due to excavation of iron ore. The development of proposed green belt around the ultimate pit limit and reclamation of mined out area will enhance diversity of vegetation. The visual quality of water may change slightly. The aesthetic parameters with EMP and without EMP have been presented in Table No. 5.3.

**Table No.5.3. ENVIRONMENTAL EVALUATION OF CANELI DONGOR MINE AESTHETIC ENVIRONMENT :**

Environmental Parameters	PIU	BASELINE EIU (A)	WITHOUT EMP EIU (B)	WITH EMP EIU (C)	CHANGE IN EIU (C-B)	CHANGE IN EIU (B-A)	NET CHANGE EIU (C-A)
<b>AESTHETICS</b>							
Topographic Character	20	14	8	11	3	-6	-3
Appearance of water body	15	10	7	8	1	-3	-2
Odour	10	9	8	9	1	-1	0
Land scape	15	10	6	9	3	-4	-1
Sound	20	12	9	13	4	-3	1
Visual quality of air	10	6	6	7	1	0	1
Natural fauna	15	13	9	11	2	-4	-2
Green belt	20	12	7	15	8	-5	3
<b>Total</b>	<b>125</b>	<b>86</b>	<b>60</b>	<b>83</b>	<b>23</b>	<b>-26</b>	<b>-3</b>

### 5.2.4 Socio economic :

Operations of mining and associated activities will result in some socio- economic impacts of direct consequence and some of indirect nature. The social status of the people will improve due to increased income for workers as a result of increase in employment opportunities. There will be occupational problems due to the mining activity, but adopting all the measures suggested in EMP and following DGMS circulars for premedical and post medical checkups and the ill patients shall be properly treated can contain these problems. Education and sanitation status will improve in this area due to this project.

The respective score for all the human-interest parameters are present in **Table No. 5.4**.

**TABLE NO. 5.4 : ENVIRONMENTAL EVALUATION OF CANELI DONGOR MINE - SOCIO-ECONOMIC :**

Environmental Parameters	PIU	BASELINE EIU (A)	WITHOUT EMP EIU (B)	WITH EMP EIU (C)	CHANGE IN EIU (C-B)	CHANGE IN EIU (B-A)	NET CHANGE EIU (C-A)
Employment	20	16	16	18	2	-0	2
Economy output	25	20	20	23	3	0	3
Housing	20	15	16	18	2	1	3
Education	20	16	15	19	4	-1	3
Drinking water supply	20	15	15	18	3	0	3
Sanitation	15	11	10	13	3	-1	2
Transport & Communication	15	11	10	14	4	-1	3
Community Health	20	12	14	17	3	2	5
Occupational Health	20	10	8	15	7	-2	5
<b>Total</b>	<b>175</b>	<b>126</b>	<b>124</b>	<b>155</b>	<b>31</b>	<b>-2</b>	<b>29</b>

### 5.2.5 Summary of Environmental Evaluation :

The Net Environmental Impact for the Caneli Dongor Mine of M/s. F.M.Mascarenhas, Goa for biological category is - 2. The Net Impact under environmental pollution category is -ve with -22 points. This -ve impact for Biological and Environmental pollution are due to mining operations and transportation activities. The SPM levels are bound to increase. The noise levels also will increase due to the operation of various mining equipments.

The Aesthetic category marks minor -ve impacts (-3) due to proposed mining activity and changes in the landuse pattern of the mining lease area. The socio-economic parameters show +ve impact (24) due to increased job opportunities, transportation, medical facilities etc.

It is observed that the estimated change in EIU from baseline to the project without EMP is –135. The overall change in EIU due to the project with EMP over the baseline is a +ve of +2. The total Net Impact is therefore +ve for this iron ore mine. The summary of environmental evaluation is presented vide **Table No. 5.5**.

**TABLE NO. 5.5 SUMMARY OF ENVIRONMENTAL EVALUATION**

Environmental Parameters	PIU	BASELINE EIU (A)	WITHOUT EMP EIU (B)	WITH EMP EIU (C)	CHANGE IN EIU (C-B)	CHANGE IN EIU (B-A)	NET CHANGE EIU (C-A)
BIOLOGICAL ENVIRONMENT	250	170	144	168	24	-26	-2
ENVIRONMENT POLLUTION	450	338	258	316	58	-80	-22
AESTHETIC	125	86	60	83	23	-26	-3
HUMAN INTEREST	175	126	124	155	31	-2	29
<b>TOTAL</b>	<b>1000</b>	<b>720</b>	<b>586</b>	<b>719</b>	<b>136</b>	<b>134</b>	<b>+2</b>

## CHAPTER – 6

### **6.0 ENVIRONMENTAL MANAGEMENT PLAN :**

#### **6.1 GENERAL**

Environmental Management Measures are suggested to mitigate the possible impacts that may be caused on various environment parameters due to the proposed mining operations at Caneli Dongor Mine.

#### **6.2 CONTROL ON MICRO-METEOROLOGICAL ASPECTS :**

Keeping in view the size of the mining activity in the area, there shall not be any impact on the micrometeorology.

#### **6.3 Management Measures for Air Quality :**

Generation of dust in the working area shall be controlled by suitable methods such as –

- i) Water sprinkling on haulage and mine roads.
- ii) Development of green belt along the roads, waste dumps and around the ultimate pit limit in the mine
- iii) The transportation vehicles carrying ROM ore from mine shall be covered with tarpaulin so as to avoid spillage of fines on the haulage road and to avoid excessive dust generation.
- iv) Ambient air quality monitoring shall be done regularly all the three seasons except monsoon season to monitor the air quality level in the area.
- v) Drivers are trained and prohibited from over speeding

#### **6.4 MANAGEMENT MEASURES FOR WATER QUALITY:**

As mentioned earlier the only water that is encountered in the project is rain water. The main drainage is towards west. This mining area receives copious amount of rain fall of 350 cms per annum. Monsoon season is spread over 4 month i.e., June to September. To reduce and check the silt wash off management has implemented the following measures as given below.

- a) Construction of protective walls at a suitable distance from the toe of the dump slopes to arrest the suspended solids from the wash –offs.
- b) Providing catch water drains around dumps and at higher contours to channelize the water down the slope before every monsoon season.
- c) Providing filter beds/arrestors in the drain before the water is discharged to the main water course.
- d) Periodic desiltation and clearing of trenches/drains.
- e) Dead dumps and slopes of dumps and boundary of the lease are covered by plantation.
- f) Collection of water samples from different points of discharge before their leaving mining area during monsoon.
- g) Creation of water garland drain to regulate the rain water from the dumps and direct its course.
- h) Creation of settling tanks to settle the silt contents flowing from the mine runoff using suitable flocculants.
- i) Creating of trenches to arrest the silt content.
- j) Inactive dumps and foot of the active dumps are stabilised with plantation.
- k) Lime shall be added to settle the silt before discharging water from the pit.

Apart from above, regular pre-monsoon de-silting of trenches shall be annually carried out.

## **6.5 CONTROL OF NOISE :**

The following abatement measures shall be taken

- i) Planting of trees with thick foliage along roads act as acoustic barriers and creation of green belt along the periphery of the mining lease
- ii) No drilling shall be done drilling is replaced by ripper dozer.
- iii) Proper maintenance of equipment
- iv) Provision of earmuffs/ear plugs to dozer operators, loader operators and dumper operators.
- v) Working confined to day shift
- vi) Regular noise level monitoring

## **6.6 VIBRATION :**

No blasting is proposed in this mine and hence Vibrations due to blasting shall be avoided.

## **6.7 TOP SOIL STORAGE :**

The entire ML area is covered with laterite zone no significant top soil exist where mining activities were proposed area. Hence very little quantity of top soil is available. During the course of mine development, where ever possible and separable, such soil shall be collected, stacked and preserved for appropriate use i.e. for plantation.

## **6.8 LAND RESTORATION :**

The degraded land due to various mining operations within the lease area need restoration or reclamation by taking up suitable management methods as spelt out below.

The measures to reclaim the lease area are categorised as under and are explained.

- i) Areas to be dumped and planted
- ii) Engineering structures and their construction

The following measures are suggested for bringing back the lease area to near original or better land use.

#### **6.9 AREAS TO BE DUMPED AND PLANTED:**

It is envisaged that the total waste handling of 0.6 million tonnes from this mine during plan period shall be accommodated in the surface dumps inside ML area (Ha.). These dumps will have protective retention walls all around to arrest any silt. The slopes shall be afforested with suitable local species such as cashew, acacia and casuarinas plantation.

#### **6.9 AREAS BACKFILLED WITH WASTE :**

No backfilling is proposed for present mining scheme period i.e., upto November, 2007. The waste generated during the course of future mining after exploration of virgin areas is anticipated to be backfilled in the exhausted pit area. A **Conceptual plan** is enclosed showing the land restoration works vide **figure No. 2.5**.

#### **6.10 PLANTATION PROGRAMME:**

During the next 5 year plan period plantation will be carried out on the dumps and slopes. During ensuing plan period, plantation is proposed mainly on waste dump slopes. Nearly 5000 saplings over an area of 2 Ha. @ 2500 saplings minimum/Ha will be planted. Further, it is proposed to plant 25000 saplings covering an area of 12 Ha. (dump, road side and green belt area) conceptually.

**6.11 ENGINEERING CONSTRUCTION MEASURES** :The aim of these constructions is to see that no silt is allowed to flow down the dump slopes carrying the solid particles along with the rain waters and deposit in the water tanks.

Following are the various types of engineering measures :

- (a) **Settling Ponds and filter beds**
- (b) **Retention walls**

**(a) Settling Ponds and filter beds:**

The runoff from the dumps will be passed to the settling ponds where the silt content is settled using suitable flocculants like hydrated lime. The overflow from settling pond is allowed to pass through the contour trenches and arrestor walls and only clear water is allowed to pass to the streams. The settling ponds are regularly desilted

**(b) Retention walls :**

The purpose of the retention wall is to arrest flow of any silt from the dump slopes. These are required to be constructed below the dumps. About 500 m long retention wall is proposed to be constructed at the dump bottom. Also 3 Nos. check dams shall be constructed conceptually.

## **6.12 HAZARD CONTROL :**

### **6.12.1 Mining :**

In the mining operations the hazards are due to operation of various mining equipments such as dozers, excavators, running of dumpers etc., These are hazards of mechanical nature. Also use of explosives also is one of the important safety hazard un mining.

Periodic Preventive maintenance of all the above equipment shall be undertaken to avoid accidents due to failure of these equipment while in operation.

### **6.12.2 Slope Failure :**

Failure of benches where phyllitic material is involved is another possibility.

### **6.12.3 Fire :**

There could be fire accidents due to electrical short circuiting, diesel fuels getting into contact of naked flames, machinery developing excessive heat due to imperfect lubrication of bearings etc.

### **6.12.4 Inundation :**

Inundation of mine pit due to excessive rains in the worked out area due to cloud burst etc., is a remote possibility. Normally there will be sufficient warning time before any such inundation takes place harming human life.

### **6.12.5 Health Hazards :**

Normally there shall not be any hazards due to gaseous pollutants like SO<sub>2</sub>, NO<sub>x</sub> & CO and there are no carcinogenic or unhealthy chemicals due to the liquid discharges from the mine.

### **6.12.6 Steps taken by the project authority to avoid hazards/accidents are as under**

#### **a) Mining**

- (i) Machinery maintained properly giving emphasis on preventive maintenance (Replacing all worn out parts)
- (ii) Imparting proper training to all the operators
- (iii) Following strict traffic discipline
- (iv) Not allowing unauthorized persons to enter the mine or traveling in the dumpers or other units
- (v) Storage, transport and use of explosives as per the provisions of Explosives Act , Rules and DGMS issued in this regard.

**(b) Slope failure of benches :**

- i) Regular bench geometry so as to keep the near all pit slope less than  $45^{\circ}$  .
- ii) Regular inspection for cracks and crevices in benches and bench movement including dumps.

**(c) Inundation :**

Inundation of lower benches of the mine is a remote possibility. But this hamper the mining operations on those benches but it is not likely to cause any casualties.

**(d) Fire :**

To avoid occurrence of fire accidents within the mine the following management measures shall be undertaken :

- 1. Proper maintenance of equipment including the electrical fittings
- 2. To have firelines cut to avoid spreading of forest fires during summer seasons.
- 3. Provision of fire fighting equipment at various installations
- 4. Training of personnel in fire fighting.

**(e) Gaseous Pollutants :**

The precautions such as proper maintenance of equipment shall reduce gaseous emissions such as  $SO_2$ ,  $NO_x$  and  $CO$  so that their emissions are below the permissible limit in the mine environment.

## **CHAPTER - 7**

### **7.0 IMPLEMENTATION AND MONITORING SYSTEM :**

#### **7.1 GENERAL :**

In chapter 6, elaborate measures have been proposed to mitigate the adverse effects due to the mining operations on the eco-systems in the area.

The mine management will undertake the control measures in coordination with respective statutory agencies. The management of environment shall be made an integral part of the major activities of mining.

#### **7.2 IMPLEMENTATION :**

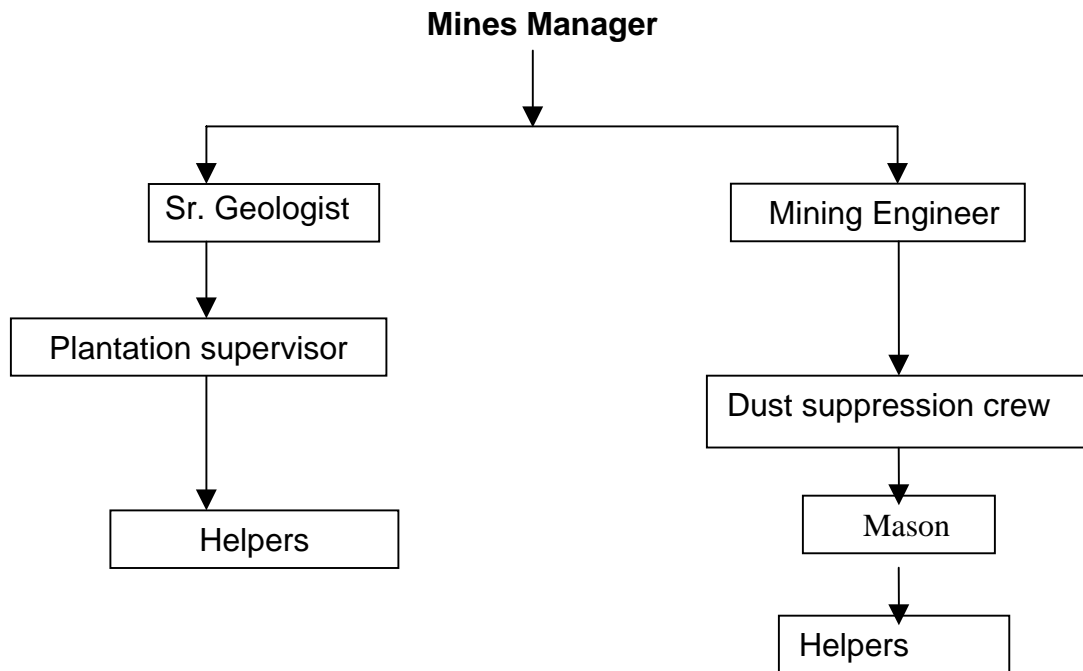
The following system shall be followed to see that the scheme is implemented as per schedule.

- 1) A separate environmental cell shall be formed to oversee the engineering measures such as construction of check dams and retention walls are taken up.
- 2) A crew shall attend afforestation measures on a regular basis for culturing, manuring and watering.
- 3) On an annual basis the quality of air, water, sound and soil will be tested to know the status vis-a-vis the base line data. This will enable us to take any corrective measures, if required. The frequency of sampling shall be as prescribed by the MOEF guidelines issued in this regard.
- 4) Continuous monitoring of any impending slope failures shall be maintained to avoid any loss of life and property.

### 7.3 MONITORING :

The monitoring is being done by the supervisory officers of the mine in coordination with the respective statutory agencies. Any abnormalities shall be brought to the notice of management to take immediate corrective action.

Following is the proposed environmental organisation chart for this mine.



The environmental data shall be monitored by using an out side agency having valid laboratory recognition from MOEF / CPCB.

#### 7.4 ENVIRONMENTAL COST :

It is necessary to include the Environmental cost as a part of the budgetary cost component.

It is proposed to take up protective measures like filter beds and retaining walls near the toes of the dumps. The road ways both within the lease and outside the mining lease have to be watered regularly. The project authorities propose to undertake the following environmental works to achieve the environmental quality as desired.

Cost is incurred for land restoration, engineering structures like filter beds, retention walls, embankments and trenches, water spraying on haul roads and mine workings and for monitoring of environmental parameters.

A time specific budgetary cost is allocated for conducting the environmental works on a continuous basis is as given vide **Table No. 7.1.**

**Table – 7.1 : Cost of Environmental works at Caneli Dongor Mine**

**(In Rs. lakhs)**

Sl. No.	Activity	Capital cost	Annual recurring cost
		Proposed	Proposed
1	Pollution Control * <b><u>(Separately provide break-up)</u></b> a) Pollution control for air b) Pollution control for water c) Pollution control for noise	16.00 1.00	a) 8.00 b) 3.00 c) 1.00
2	Pollution Monitoring	Nil Nil	3.00
3	Occupational Health	Nil Nil	0.50
4	Green Belt • Mine • Township	Nil Nil	0.50
5	Reclamation/ Rehabilitation of mined out area	Nil	Nil
6	Others (specify)	Nil	Nil
	<b>TOTAL</b>	<b>17.00</b>	<b>16.00</b>

The amount earmarked for socio-economic welfare measures for the nearby villagers shall be Rs.10 lakhs/annum of recurring cost. This money shall be spent for education, sanitation , health in the neighboring villages. Majority of the employers shall be drawn from the nearby villages.

The project authorities shall make available necessary funds as suggested in the scheme.

The project authorities hope to reclaim majority of mining lease area with better environmental quality indices due to raising of good forest with creation of water storage which can improve the floral content and attract fauna to the mined out area. Thus the project shall ultimately contribute to the improvement of the environmental quality of the region.