CHAPTER 4

ANTICIPATED ENVIRONMENTAL IMPACTS AND MITIGATION MEASURES

4.1 DETAILS OF ENVIRONMENTAL IMPACTS

Environmental impacts both direct and indirect on various environmental attributes due to the proposed mining activity in the surrounding environment, during pre-operational, operational and post-operational are discussed. The impacts due to mining operations commence from the exploration activities, extend through extraction and processing of minerals, may continue to post- closure of the operation, with the nature and extent of impacts varying thorough out the stages of project development.

4.1.1 Project location

The various impacts of mining limestone at Trumboo and its location can be grouped as

4.1.1.1 Impact on Landuse

Due to mining activities in this project, there are significant impacts on landuse pattern. Mining operations like quarrying, approach roads, service facilities and construction of embankment etc. affect land. The impact on land form or Physiography will be limited to modification of slope. The land surface on this hilly area, the landscape and land use will undergo a radical change due to the open cast mining. The impact during first five years is limited in extent as only fourteen benches will be formed. Besides these benches the haul road will also modify the existing slope. A road measuring about 5124 m. in length having width 8m & gradient 1:14 also will cause slight modification of existing Physiography.

Physiography of the area will also change. From sloping ground the area will have mining pits and haul roads. The completed benches will give new look to the Physiography, especially after systematic afforestation. The proposed land use, will improve the aesthetics of the area. The mine working at the end of fifth year will go upto the level of 2440mRL and the depth of pit at the end of fifth year will reach upto 60m.

The impact on land use will also be limited. The various modifications due to mining activities after five year working will be as shown in the table (4.1) below:

Table : 4.1 Mining activities after five years

Activity	Area Occupied (Ha.)	
	End of Fifth year	**End of lease period**
Mining	5.52	20.12
Road	4.10	0.050
Retaining walls	0.038	0.248
(Rest Shelter Office & others)	0.012	0.036
Balance undisturbed Land	38.33	27.546
Total	**48.0**	**48.0**

No channel sampling is proposed in future programme. However the Wagon drilling in the limestone beds for future exploration as well as for development of benches shall not cause any considerable impact on land form as long as it is not blasted. It is proposed that promoter shall carry out the study of blast vibration test to ensure safe charge per hole to avoid any kind of damage.

The land use pattern at the end of fifth year is shown in **Figure 4.1**

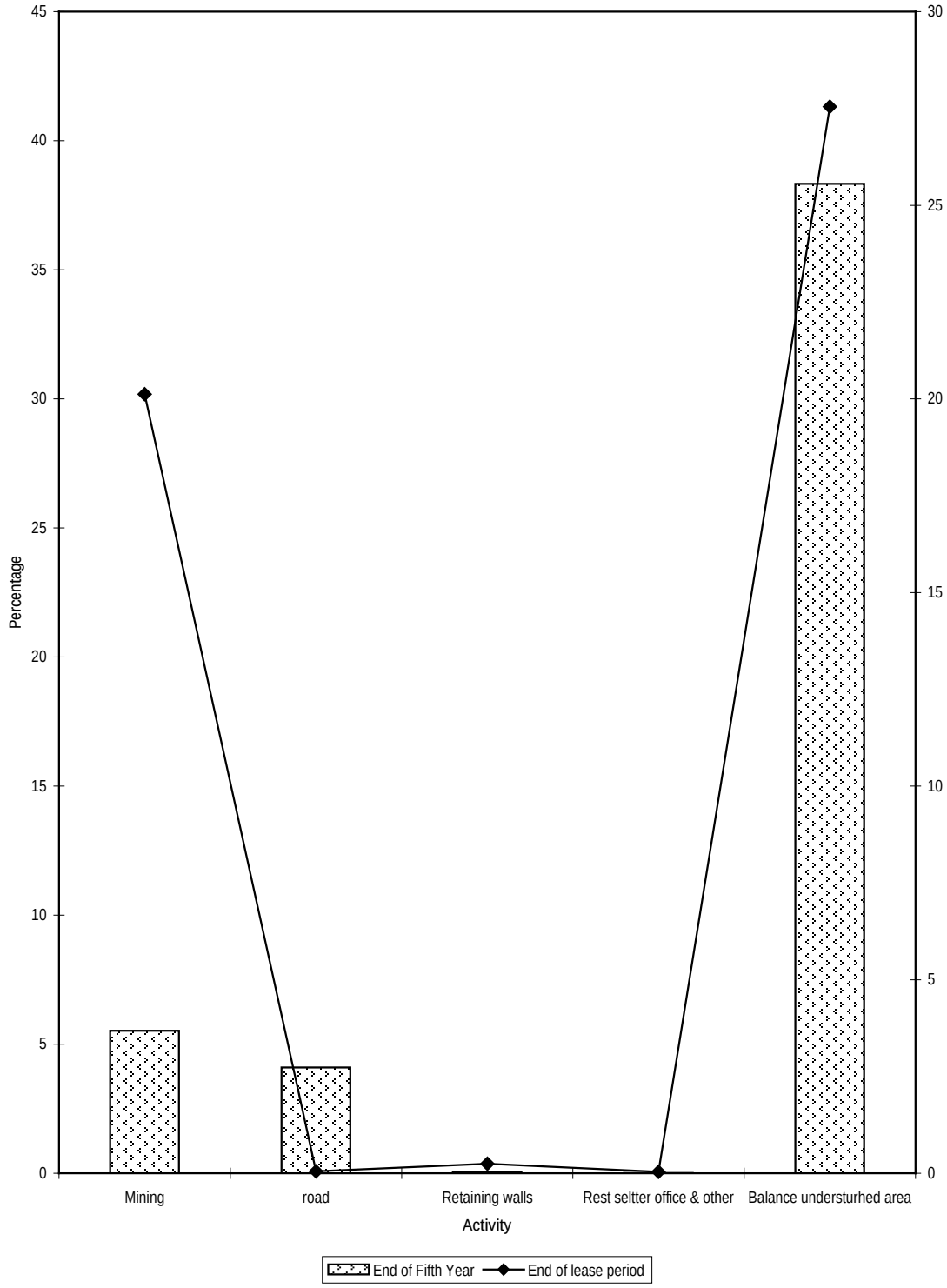

Figure 4.1 Land use pattern at the end of fifth year

4.1.1.2 Surface drainage

The topography of the area is rugged mountainous terrain. It is characterized by deep ravines having steep to moderate slopes. The general slope of the area is towards east and south east. The north east flank of the area has steeper slope as compared to south west. No springs are situated with in the area. The highest point of the area is 2502.3mRL along boundary pillar H-I while the lowest level is 2132.34 mRL is at boundary pillar A-J. Two prominent ridges are seen in the area one ridge is trending by and large south east to north west & another ridge trending by & large east to west. The main drainage in the surrounding area is Bajnar nallah with a number of tributaries. The catchment water from the area is drained through the gullies and slopes which ultimately meets the Bajnar Nallah which is the main catchment of the area.

One dug well is situated about 1.5 Km. aerial distance towards south west of applied area in village Bathyan . The top level of the well is 2095 mRL & water table encountered in the well is about 15 m. deep and the expected depth of water table in the region is about 2080 m. RL. During summers the water table goes down about 3.0m & depth of water table will be about 2077mRL. In winters, the water table goes down about 2.0m & expected depth of water level is about 2078mRL. During rainy season the water table further rises about 3.0m & depth of water table is about 2083mRL.

b) Working is expected to be 360m above the water table during first five years. During first five years, the mine working will be confined up to 2440mRL Water table will not be affected by mining operations.

c) Quantity and quality of water likely to be encountered, the pumping arrangement and places where the mine water is finally proposed to be discharged**.**

The mining operations will be limited in the upper levels & the lowest bench will be formed at 2440mRL, hence water table will be not be encountered by mining activities during first five years.

4.1.1.3 Impact on socio economic environment

No rehabilitation or human settlement is involved due to mining operations. Hence the major consequence or impact of mining industry does not arise.

Mining is expected to have positive impact on the socio economic life of the people living in nearby villages. Some of them have been directly employed, some others indirectly.

Almost all the parameter point out that area is highly backward. Any industrial intervention in this area should and must be welcomed. The proposed mining will provide direct employment to about 70 people whereas indirect employment in way of business opportunities like, contracts, transport etc. will be many times. The management should also take help of NGO's to create awareness about education and formation of self help groups and opportunity of self employments so that socioeconomic equilibrium is maintained with definite forward progress.

The impact of an industry on educational front is always positive which is evident from the surrounding areas which shows higher literates than normally seen in rural areas.

Finer aspects of socioeconomic imbalance and cultural interactions were also assessed. When industries come in a virgin area, the economic balance gets distributed due to employment opportunities to most of the people. Though over all per capita income grows but pattern of distribution changes.

4.1.2 Possible Accidents

Opencast mine is safest method of working a limestone deposit. It is totally free from strata movement, roof control and ventilation problems. Normally in opencast mines no major disaster affecting nearby residents is foreseen. However, accidents inside the mines affecting work force cannot be ruled out. Some of the likely hazards affecting the opencast mining operations would be slope failure.

It would be advisable to have a close look on slope stability in hilly terrain. Something always is possible before it really fails. It would be advisable to monitor all the slopes along road side once a month.

4.1.3 Project Design

Mining will be open cast semi-mechanized.

Mining benches will be opened from top to downward so that completed benches shall be rehabilitated. The primary drilling with 83 mm size wagon drill shall be supported by secondary jackhammer drilling. Blasting will be undertaken with suitable slurry explosives. The area consists of high-grade limestone & no beneficiation shall be carried out. The maximum height and minimum width of the benches shall remain 6 meter and 6 meter respectively.

As the benches reach their ultimate pit limit, the plantation will be undertaken over the benches. 5124m long road having width 8.0m & gradient 1:14 shall be made at 2128mRL to 2494mRL to open the benches from top to downward. Parapet walls of 1.5 meter length, 0.75 meter height and 0.5 meter width along southern side of the road for a length of 1200 meters with a gap of 1 meter between each wall shall be erected.

The slope of the mining faces will be kept 75deg. to 80 deg.

Big boulders of limestone will be broken manually with the help of hammer or blasted through secondary blasting.

Limestone shall be loaded into tippers initially manually & transported to cement plant with passage of time; loading shall be done by poclain/loader shovel.

5% provision has been considered mining loses including various geological factors. The recovery of limestone has been considered 95% of the total excavation. The area consists of high grade limestone having no soil cover. Therefore the generation of top soil, subgrade mineral & mineral rejects shall be nil.

Mining faces will open from the top level from the proposed haul roads. From first year onward the production will be achieved through the opening of mining faces. Waiting points will be provided at each turning of roads to ensure safe passing of tippers.

The area consists of high grade limestone having no soil cover. Therefore no benches shall be formed in the overburden. All the benches shall be formed in high grade limestone band.

Mining is proposed in high grade limestone therefore no subgrade mineral or mineral reject shall be generated during first five years. About 5.52m^2 area shall be covered by mining faces & it will be in between the local coordinates N 2210 to N 2530 & E 1290 to E 1570. During first five years benches 2494.mRL to 2470 mRL will reach their ultimate pit limits and plantation will be undertaken over these benches. Local species will be planted over the benches.

Length of benches will vary from 10m. to 460m, width of benches vary from 4.0m to 8.0m, height of the benches will be 3.0m & 6.0m and slope of the faces will be 75 deg. to 80 deg. . The ultimate width and height of the completed benches will be kept 6.0m maintaining ultimate pit slope 45 deg. About 358 nos. parapet walls having length 3m x with & height 0.75m shall be erected at an internal of 3m along the approach roads.

About 0.396 ha. area shall be covered by plantation over the completed benches & 0.419ha. area shall be covered by plantation within 7.5m wide strip along proposed boundary pillars ABJ.

The year wise quantities of overburden & limestone to be excavated is given below (Table 4.2):

Table 4.2 The year -wise quantities of overburden & limestone

Year	ROM Limestone (Tonnes)	Usable quantities (Tonnes)	Subgrade ore (Tonnes)	Mineral Reject (Tonnes)	Ore to Interburden ratio
Ist	407895	387500	Nil	Nil	Nil
IInd	423000	401850	Nil	Nil	Nil
IIIrd	424875	403631	Nil	Nil	Nil
IVth	427350	405982	Nil	Nil	Nil
Vth	444000	421800	Nil	Nil	Nil
Total	**2127120**	**2020763**			

4.1.4 Project Construction

The project construction can be broadly classified into two different phases Viz; pre-operational and site preparation/facilities. The various activities involved in the pre-operational and site preparation/facilities. The various activities involved in the pre-operational phase, which are likely to have impact on the environment and the potential environmental impact of the same are given in the following table 4.3

Table 4.3 Impact during Project Construction

Constructional Phase	Activity	Potential Environmental Impact
a) Pre- Operational	Exploration Environmental Monitoring	Negligible Negligible
b) Site Preparation/facilities	Clearing and Grading Temporary facilities such as sheds approach roads, sanitary facilities. Earthwork comprising of excavation, guarding and trenches, Foundation work, piling and drainage system of construction of check dams. Construction of permanent structures like roads,colony etc. Mechanical erection and utility systems	Mild dust emissions Dust emission and change in traffic intensity Soil erosion,run-off, increase in traffic,dust emission Dust, visual and noise pollution Dust and noise pollution Dust and noise pollution

The pre-operational phase activity mainly involves creating facilities for future mining operations and includes clearing of bushes and land etc., Structural deployment of machinery and erection work will also result in dust, noise pollution and vehicular traffic. Material handling and transportation would result in dust, noise pollution and vehicular traffic. However there may not be major environment impacts during the pre- operational phase than change in land use pattern.

The labour for this activity shall be engaged from the surrounding villages. Some essential services are also required to be provided. This will have an impact on drinking water supply and sanitary facilities. Economy of the nearby area will be improved due to increased job opportunities with corresponding increase in income. Other associated business activities like transport, hotels, consumer goods etc will be benefited.

4.1.5 Regular Operations

The opencast mining operations basically consist of drilling, blasting, loading and transport. But certain ancillary facilities are necessary for the efficient utilization of the machinery used in these operations. Thus facilities for supplying explosives for blasting at site, creating properly-shaped heaped of debris for efficient operation of loading units, water sprinkling on the transport roads for dust suppression, supplying fuel to diesel operated machinery working on the benches, routine maintenance of loading units at the face itself and provision of accessories for blasting such as exploders, ohm-meters, sirens, etc. are essentially required.

The requirement of excavator will be basically for cleaning the drilling area for loading and dozing of the scattered debris after blasting for creating properly –shaped heaps of debris for efficient loading operation. The excavator will also be helpful in the construction and repair of roads. Besides these regular jobs, excavator will also take care of miscellaneous jobs such as towing of other machines.

A diesel-driven truck-mounted water tanker of about 500 liter capacity shall be envisaged for water sprinkling.

It is proposed to install a diesel pump within the proposed cement plant, it shall cater to the diesel requirement of machinery in cement plant and mine.

One 7 tonner explosive van shall be engaged for the transportation of explosive. Other items like exploders, ohm-meters, sirens, portable blasting shelter etc. shall be procured.

Table 4.4 Impact Identification during Operational Phase

Operational Phase	Activity	Potential Environmental Impact
Limestone extraction	Drilling and blasting	Dust, noise and vibration
	Loading	Dust, noise and vibration
	Transportation	Dust, noise and vibration

The alignment of benches by and large will have north, north east-south, south west directions.

5124m long haul roads having width 8m & gradient 1:14 shall be made at 2128mRL to 2494mRL to open the mining faces from top to downward. The length of faces shall vary from 10 to 460m About 5.52ha. area shall be covered by mining faces & it shall be in between the local coordinates N 2210 to N 2530 E 1290 to E 1570.

The slope of the faces will be kept 75 deg to 80 deg. The bench will be opened through a box cut and advance towards west direction. This will facilitate environmentally safe mining as rolling of boulders and debris will be avoided. The ultimate bench height will 6.0m which will be advanced through sub benches of 3.0m each.

Mining is proposed in high grade limestone thus no sub grade mineral or mineral rejects shall be generated.

4.1.6 Final Decommissioning

The final decommissioning phase consists of only one major activity, ie., land reclamation in which productive use of the land will be taken up. In this process the activities involved are plantation of trees on the reclaimed area so as to attain its original form to the extent possible. The main activities that may cause environmental impact on the surrounding environment during project close out are

- Transport/ procurement of materials
- Removing of temporary facilities, Cleaning etc.,

The above activities indicate that during the post project period of reclamation the likely potential environmental impacts are mainly due to dust and noise.

4.2 IDENTIFICATION OF IMPACTS

The impact of the proposed mining activity on environment (air, water, noise, land and socio-economic) are predicted in this section. The proposed open cast mining activity may cause some adverse impacts on the surrounding environment unless otherwise proper environmental management plan is adopted. An attempt has been made to quantify the possible impacts on various environmental parameters. The impacts of opencast mining ion various environmental parameters are discussed in detail and an effort has been made to assess the degree of impact on the basis of past experience. The following

are the identified impacts on the environmental parameters and discussed in detail in the subsequent sections of this chapter

- Air quality
- Noise
- Ground vibrations
- Water quality
- Flora and Fauna
- Soil quality

The impacts of the mining operations are felt from the exploration activities, extend through extraction and transportation which will continue up to post closure of the operation, with the nature and extent of impacts varying throughout different stages of project development.

It is necessary to analyse the nature of the impacts on different environmental parameters in detail, in order to formulate an effective Environmental Management Plan (EMP) for the proposed Trumboo mining project.

4.2.1 Impact of Air Environment

Considering the past experience of the surrounding areas, the impact on air quality is not expected of significance. However the only cause of concern in future will be SPM content. The present ambient quality is comparable to any other remote place in Himalayan region. The daily average will be less than 80 microgramme per meter cube. Due to the mining and movement of vehicles SPM content will seldom exceed 150 microgrmme per meter cube. It is proposed that air quality will be monitored in every season. The duration of sampling period will be four weeks and eight hourly samples will be collected. The frequency of sampling will be thrice a day/Morning 6.0 a.m. to 2.0 p.m., afternoon 2 to 10 p.m., night 10 p.m. to 6 a.m. In future, air quality will be monitored in every season, except the rainy season. Due to small scale of mining operations, two stations will be selected to monitor the air quality in accordance with CCOM's circular of 3/1992 and 2/1993.

Air quality impact prediction (AQIP) model is a set of mathematical equations that stimulated the release and dispersion of the sir pollutants into the atmosphere. These models are typically computer based and are used by scientists and engineers to assess ambient air concentrations. They incorporate the effects of physical and chemical processes through mathematical expressions derived from fundamental scientific principle. AQIP dispersion modeling tool is used to relate the release of air pollutants o the corresponding pollutant concentrations in the ambient atmosphere. Models are useful to study the consequences of new sources of air pollution or changing the amount of

pollutants released into the air from existing emission sources. AQIP is an essential part of Environment Impact Assessment (EIA).

The main air pollutant in the mining area is particulate mater (mostly dust released by various mining activities. Although some gaseous pollutants like CO, NO_x, SO_x etc., are also released from blasting and other mining operations, the magnitude of such emissions is small and the concentration of such pollutants is generally much lower than the prescribed threshold limit values. Here, the air quality dispersion modeling exercise is generally restricted to the determination of particulate mater concentration at various receptor locations (US EPA AP 42 1998)

All dispersion models require emission source data and micro-meteorological data to be given as input for running the models. The rate of emission of pollutants from various activities in the mine can be calculated on the basis of emission factors of the activities. An emission factor is a representative value that attempts to relate the quantity of a pollutant released to the atmosphere with an activity associated with the release of that pollutant. These factors are usually expressed as the weight of the pollutant divided bu a unit weight ,volume ,distance or duration of the activity emitting the pollutant. (eg. Kilograms of particulate emitted per tonne of limestone loaded or per hour of dozer operation or per vehicle –kilometer traveled ,or per hour of erosion from unit area of a stock pile etc.). It is obvious that emission factors in general, will depend to a great extent due to a mining activity depends on a number of variable factors, such as the brittleness and hardness of the material being handled the moisture content of the rock or soil material, the wind speed in the region, the size of the machinery or transport equipment etc., Refinement of simple emission factors by incorporating such site variables leads to what is known as predictor equations.

Considerable amount of air pollution will be caused at various stages of mining operations such as drilling, blasting, loading and transportation of material. Suspended Particulate Mater (SPM) and Respirable dust are the main pollutant during mining; most of the dust arises from drilling, blasting, excavation, crushing and transportation operations. Large quantities of dust become air- borne and are carried away from limestone dumps. The fugitive dust released from mining operations may cause immediate effect on the mine workers who are directly exposed to the fugitive dust. Simultaneously, the air borne dust would travel to longer distances and may settle in the villages located nearby the proposed mining site. The impact on air is mainly localized in nature i.e., within 2 to 3 km

4.2.1.1 Drilling

Drilling of vertical holes is proposed for mining of limestone. To control the problem of toes, a provision of 10% sub-grade drilling has been made. In case toes still tend to appear, these may be tackled by drilling and blasting of some toe periodically, depending upon the situation.

The diameter of blast holes is generally governed by the bench height. The larger the diameter of the hole, the more will be the burden and spacing, which in turn will yield bigger size boulders in the blasted mass. If the shovel size is already fixed, as is the case in this area, and the boulders are too big for the shovel to load, secondary drilling and blasting for reducing the size of such boulder will have to be increased. On the contrary, the smaller the hole diameter, lesser would be the burden and spacing of holes which means more meterage of drilling for the same excavation. Accordingly for the 6m high benches adopted for this mine, the diameter of blast holes is proposed 83 mm.

The requirement of drills has been calculated as follows:

A)	High grade limestone Production :	:	4,21,800 tonnes
i)	Yield per hole with a burden and spacing of4.0m x 4.0m bench height 6 m. and sp. gr of limestone 2.5 in tonnes	:	4mx4mx6mx2.5=240 tonnes per hole
ii)	Excavation required per day considering maximum fifth year 421800 tonne & considering 300 working days in a calendar year.	:	1406 tonnes
iii)	Number of holes to be drilled per shift .	:	1406/240 = 5.85 Say 6 nos.
iv)	Length of each hole with a sub-grade drilling of 10%	:	6.6m
v)	Therefore meterage required to be drilled per shift	:	6.6 m
vi)	Assuming 10% extra drilling for tacking the toes total meterage to be drilled per shift	:	6.6 x 1.1= 7.26m Say 7m

vii)	On the basis of past mining experience, powder factor in these type of rock has been taken 8 tonnes/kg.	:	25 m.
viii)	Charge per hole (Therefore 30 kg slurry explosive shall be required for charge per hole)	:	240 (tonne) / 8 tonne/Kg. = 30Kg.
ix)	Expected performance of drills in proposed mine site per wagon drill in effective 5 hours per shift		25m
x)	Therefore number of drills required for limestone production	:	7/25= 0.28

Thus DTH drill shall be provided including one stand-by unit. These units will be tyre-mounted drills of 83 mm dia to drill on 6 m.high benches. Down-the –hole drilling units are proposed at this mine having one Atlas Copco DTH wagon drill, 15 to 20 meter capacity, XA-210,83mm dia hole tyre mounted.

4.2.1.2 Blasting

Blasting of vertical holes will be done for limestone production. A suitable drilling pattern has to be evolved drilling pattern has to be evolved to ensure good fragmentation, minimum secondary blasting & efficient direct loading by loading equipment after primary blasting. Accordingly for 6m high benches adopted for this area the diameter of blast hole is proposed 83mm.

1	Yield per hole with a burden and spacing of4.0m x 4.0m bench height 6 m. and sp. gr of limestone 2.5 in tonnes	:	4mx4mx6mx2.5=240 tonnes per hole
2	Excavation required per day considering maximum fifth year 421800 tonne & considering 300 working days in a calendar year.	:	1406 tonnes
3	Number of holes to be drilled per shift .	:	1406/240 = 5.85 Say 6 nos.
4	Length of each hole with a sub-grade drilling of 10%	:	6.6m

5	Therefore meterage required to be drilled per shift	:	6.6 m
6	Assuming 10% extra drilling for tacking the toes total meterage to be drilled per shift	:	6.6 x 1.1= 7.26m Say 7m
7	On the basis of past mining experience, powder factor in these type of rock has been taken 8 tonnes/kg.	:	25 m.
8	Charge per hole (Therefore 30 kg slurry explosive shall be required for charge per hole)	:	240 (tonne) / 8 tonne/Kg. = 30Kg.
9	Expected performance of drills in proposed mine site per wagon drill in effective 5 hours per shift		25m
10	Therefore number of drills required for magnesite production	:	7/25= 0.28

Blasting Pattern:

The pattern of initiation adopted affects the standard of fragmentation, muck profile after the blast, ground vibrations are caused, noise generated besides fly rock and air blast. Some of the blasting patterns are indicated below in brief:

Single Row

Case 1 Simultaneous firing

0----------0----------0----------0----------0----------0

It gives spread out muck pile

Case 2 Using short delays, single hole per delay

0----------0----------0----------0----------0----------0---------

Zero 1 2 3 4 5

It gives minimum vibrations

Case 3 Using short delays, in pair (s)

0----------0----------0----------0----------0----------0---------0---------

3 2 1 Zero 1 2 3

4.2.1.4 Transportation and Equipments

It is proposed to blast only 6 to 10 holes per day and transport 1400 tons of mineral and there is no overburden. Hence, the quantum of dust generated would be minimal.

(a) Estimating emissions from unpaved roads

Emissions from unpaved roads for transportation of limestone to the crushing unit has been calculated using the formula given in USEPA – AP 42 series. The following formula is considered for computation.

$E=2.82\ (S/12)^{0.8}(W/3)^{0.5}\ (M/0.2)^{-0.4}$ kg/VKT

Where,

E = Emission factor, kg/vehicle- kilometre travelled, (kg/VKT)

S= Silt content of road surface material (%)

W = Mean vehicle weight (tons) taken as 22 T for dumpers and 10 T for tippers

M = Moisture content in percentage

(number of days per year with at least 0.01 inches of precipitation, taken as 10 days)

(b) Requirement of Jack hammers

The production of limestone requires manual sorting. The manual sorting of big boulders involves their breaking. Therefore, for limestone and waste, the blasted mass should have good fragmentation, which necessitates secondary blasting. It has been anticipated that 10% of minerals will be subjected to secondary blasting. In general, the bigger boulders may require one hole each. The drilling performance in respect of secondary holes by jackhammers has been taken as 50 holes per shift. On this basis, the requirement of jackhammer drills to deal with secondary blasting will be as follows;

i)	For Limestone 10% of 1140 tonnes to be blasted	:	1406x0.1=141 tonnes
ii)	Assuming average size of boulders as one tonnes each, number of holes to be drilled per day	:	141 tonnes
iii)	Therefore number of jackhammer drills required@ 50 holes / drill		141/50=2.82 say 3
iv)	Stand by unite proposed		1
v)	Therefore total number of jackhammer drills required		3+1 = 4

Lessee have got 3 nos. jack hammers.

(c) Compressors

Taking into consideration the topography of the area, distribution of working places and exiting practice tyre mounted disel-operated portable compressors have beeb recommended. The capacity of each unit is proposed to be 10 cum/min. The requirement of compressors will be as follow:

i)	For primary drills in operation	1
ii)	Compressor required for two jackhammer drills	1
iii)	Stand by @ 25%	2 x 0.25 = 0.5 say 1
iv)	Total number of compressors required	3

Local problems have often forced the management to do away with deep hole blasting particularly in mineralized zones. Thus, present practices to win minerals mostly by jackhammer drilling. To meet such eventuality, if apprehended, proportionate reduction of 1 tyre mounted wagon drill may be done by management with proportionate increase in jackhammer, if necessary, over and above the present number.

The requirement of dumpers for the transport of limestone from the mine to the cement plant out as follow.

i) Loading time of dumpers :

The average load per pass of wheel loader bucket : 68/60+1.13 t
(@ 68 tonnes/hr and 60 passes/hr)
Average load carried per dumper trip : 7t

Therefore, average number of passes per dumper : 7/ 1.3 = 5.38
Therefore, average loading time per dumper:5.38x60)/60 =5.38 Say 6 mim.

ii) To and fro journey time :

To and fro journey of 1.5 km mine road @ 15km/hr :4 min
From mine site to stack yard.

iii) Cycle time of dumpers

Spotting and waiting : 2 min

Loading (manual loading as practiced now to : 20 min
Ensure quality control is recommended)
To and fro journey : 4 min
Turning and unloading : 2min
Therefore total cycle time : 28 min

iii) Requirement of dumpers :

Usable limestone siliceous & argillaceous rock : 1406 t
to be transported form different blocks in first shift.

Cycle time of dumpers	: 28minute
Therefore round trips per dumper per hour	: 60/28=2.14
Taking 5 effective hours of utilisation per shift	:5x2.14=10.7
Round trip per dumper–shift.	Say 10
Average load carried per round trip	: 7t
Therefore average carrying capacity per	: 10x7 = 70
dumper shift	:4.05x7=28.35
Therefore number of dumpers	:1406/70=20.08 say 20nos.
Stand by dumper @ 25%	: 20x 0.25 = 5
Therefore total requirement of tippers	: 20+5= 25

After execution of lease deed the lessee shall deploy few dumpers on behalf on company side & as well as engaging dumpers on contract for the purpose of transporting limestone to the factory. The transport on contract basis works out to be slightly cheaper than the departmental transport possible because of the lower overhead expenses of the contractors. Therefore, it is recommended that this mixed system of transport shall be continued so that while complete dependence on outside agencies is avoided, some economy is also achieved in the operation.

No overburden shall be generated during course of mining, therefore requirement of dumpers for overburden disposal is not applicable in this mine.

d) General Services:

The opencast mining operations basically consist of drilling, blasting, loading and transport. But certain ancillary facilities are necessary for the efficient utilisation of the machinery used in these operations. Thus facilities for supplying explosives for blasting at site, creating properly-shaped heaped of debris for efficient operation of loading units, water sprinkling on the transport roads for dust suppression, supplying fuel to diesel operated machinery working on the benches, routine maintenance of loading units at the face itself and provision of accessories for blasting such as exploders, ohm-meters, sirens, etc are essentially required.

The requirement of excavator will be basically for cleaning the drilling area for loading and dozing of the scattered debris after blasting for creating properly – shaped heaps of debris for efficient loading operation. The excavator will also be helpful in the construction and repair of roads. Besides these regular jobs, excavator will also take care of miscellaneous jobs such as towing of other machines.

A diesel-driven truck-mounted water tanker of about 500 liter capacity shall be envisaged for water sprinkling.

It is proposed to install a diesel pump within the proposed cement plant, it shall cater to the diesel requirement of machinery in cement plant and mine.

One 7 tonner explosive van shall be engaged for the transportation of explosive. Other items like exploders, ohm-meters, sirens, portable blasting shelter etc. shall be procured.

f) Drilling Equipments

The details of the machineries likely to be deployed at the mines is given below (Table 4.5):

Table 4.5 Details of the machineries

S. No	Type	Nos	Dia of hole	Size/capacity	Make	Motive power	H.P.
1.	DTH wagon drill	2	83mm	24m	Atlas COPCO	compress	NA
2	Air compressor	3	NA	600 cfm	Atlas COPCO	Diesel	180
3	Jack hammer	4	25mm	90cfm	XA-280 Atlas COPCO	compressed air	-

ii) Loading equipment:

S. No	Type	Nos	Bucket capacity	Make	Motive Power	H.P.
1.	Hydraulic excavator	1	$0.9m^3$	L& T Ltd.	Diesel	107-125

(ii) Haulage & transportation equipment:

S. No	Type	Nos	Size/ Capacity	Make	Motive Power	H.P.
1	Tippers	25	10MT	Tata	Diesel	31.5

g) Miscellaneous Equipment:

In addition to above, equipment should be provided for dozing, construction & maintenance of haul roads, cleaning of faces & haul roads, dust suppression along haul roads, transportation of men (jeeps) & material etc.

The dozing equipment to be provided is below:

S.No	Type	Make	Motive Power	H.P.
1	Dozer D-155 A-I	BEML	Diesel	320

4.2.1.5 Details of emissions from different sources

Based on USEPA emission factors, the possible emissions from different mining activities such as drilling and transportation has been computed. The mean wind speed is considered in computing emissions wherever applicable. The summary of emissions from different mining activites calculated is given in the following table 4.6

Table 4.6 Emissions of Total Suspended Particulate from different mining activities

Activity	Type of source	Emission factor	Emission rate
Blasting	Area	$0.00022\ (A)^{1.5}$	0.2069 kg/day
Drilling	Point	0.59 kg/hole	3.54 kg/day
Dozing	Area	1.79 kg/hr	8.95 kg/day
Excavation/truck loading	Area	0.0485 kg/tonne limestone	68.191 kg/day
Transportation	Line	1.80 kg/Vehicle – km travelled	67.5 kg/day
		Total	148.389 kg/day 4.128 g/sec

4.2.1.6 Impact due to gaseous emissions

It is observed through monitoring of the Trumboo Mining site and as discussed in the section 4.2.1 that there is no impact on ambient air quality around Trumboo mines in respect to gaseous pollutants like SO_2 and NO_X and the concentration of these pollutants will be well within the prescribed limits. Hence, it is anticipated that there will not be any affect because of the proposed mine.

4.2.1.7 Air Quality modelling

In order to predict the particulate emissions as mentioned earlier, ISCST3 model (revised) was used to predict air quality ie., Maximum Ground Level Concentration (GLCs) of particulate mater due to the various mining activities of the proposed mine for one season was used. The model uses the steady state Gaussian plume equation for continuous source. The inputs required for the model is

- Hourly meterological data
- Source data
- Receptor data
- Programme control parameters

The GLC's are predicted for the Trumboo mining scenario as indicated in the Table 4.7and shown in the figure 4.2. The GLCs for one season are made for rural setting and simple terrain.

Table 4.7 Predicted GLCs for SPM

GROUP ID AVERAGE CONC RECEPTOR (XR, YR, ZELEV, ZFLAG) OF TYPE GRID-ID

ALL 1ST HIGHEST VALUE IS 86.76994 AT (-400.00, -400.00, 0.00, 0.00) GC CART1
2ND HIGHEST VALUE IS 51.30904 AT (-200.00, -200.00, 0.00, 0.00) GC CART1
3RD HIGHEST VALUE IS 11.87264 AT (0.00, 0.00, 0.00, 0.00) GC CART1
4TH HIGHEST VALUE IS 6.52019 AT (-400.00, -1000.00, 0.00, 0.00) GC CART1
5TH HIGHEST VALUE IS 6.36397 AT (-400.00, -1200.00, 0.00, 0.00) GC CART1
6TH HIGHEST VALUE IS 5.68836 AT (-400.00, -1400.00, 0.00, 0.00) GC CART1
7TH HIGHEST VALUE IS 5.56324 AT (-400.00, -800.00, 0.00, 0.00) GC CART1
8TH HIGHEST VALUE IS 5.52859 AT (200.00, 200.00, 0.00, 0.00) GC CART1
9TH HIGHEST VALUE IS 5.43674 AT (-600.00, -600.00, 0.00, 0.00) GC CART1
10TH HIGHEST VALUE IS 4.96573 AT (-400.00, -1600.00, 0.00, 0.00) GC CART1

*** RECEPTOR TYPES: GC = GRIDCART
GP = GRIDPOLR
DC = DISCCART
DP = DISCPOLR
BD = BOUNDARY

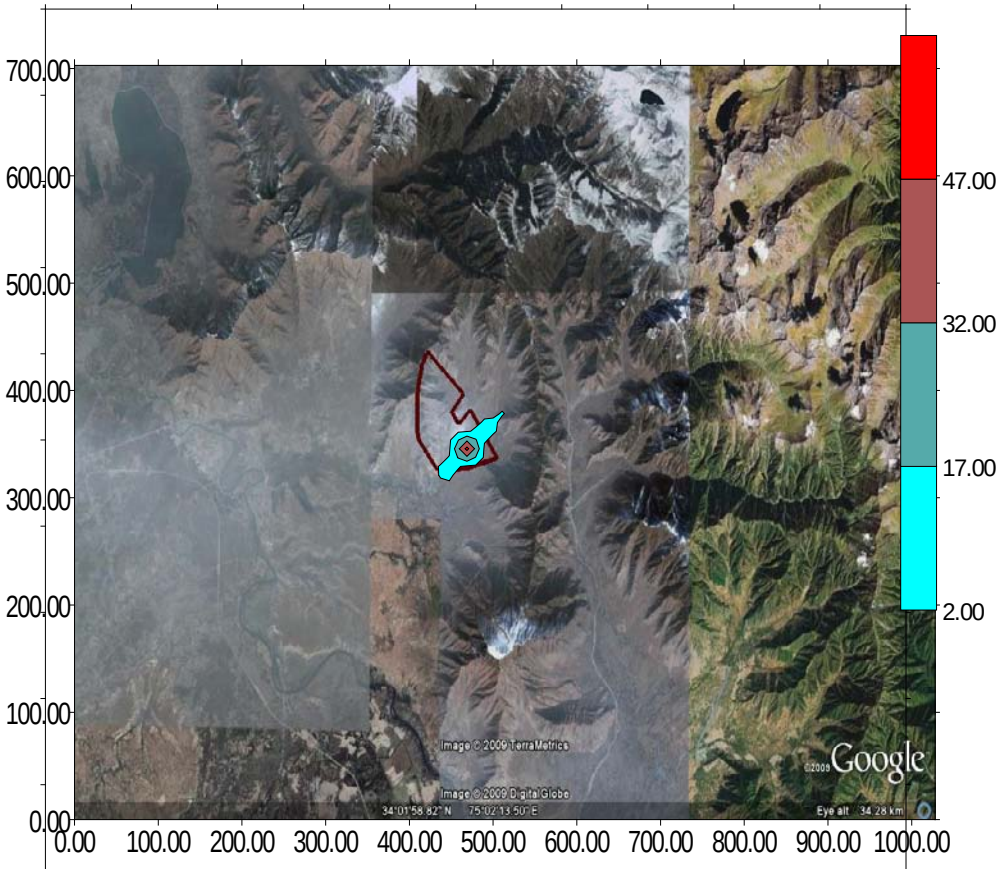

Figure 4.2 Isopleths showing ground level concentrations

Conclusion

Predictions have been carried out using ISC ST3 model (revised) for the study period. The predicted concentrations of the suspended particulate mater are presented . The highest predicted value of increase in SPM due to proposed mining operations would be about 86.7994 g/sec, the study clearly depicts that the increase in the incremental value is highly negligible.

4.2.2 Noise Levels:

Noise level may be monitored once a year specially close to heavy machinery equipments since it causes concern only for those who work in proximity to these equipments. It would be a good idea to monitor periodically the hearing threshold of the people exposed to noise. Noise levels for damage for damage risk criteria for hearing loss as given by CPCB is presented in table 4.8.

Table 4.8 Permissible limit of noise level as per CPCB standards

Area code	Category of the area	Limits in db (A)L-eq (A	
		Day time	Night time
A	Industrial area	75	70
B	Commercial area	65	60`
C	Residential area	55	45
D	Silence zone	50	40

Note: *Day time is recokoned in between 6.00 am and 9.00 am*

Night time is recokoned in between 9.00 am to 6.00 am

(Source : Central Pollution Control Board)

4.2.2.1 Noise level at Neighbouring Villages

Generally the noise level recorded in the neighbouring village were around 45 to 51.2 dB (A) day time L-eq and 40.8 to 45.4 dB (A) during the night time. The noise levels in these villages have relevance to the mining activities. They are well within the limits prescribed by CPCB for residential and business areas. However, no villages is in the radius of 2 kms of mining operation. From the above estimates, its is evident that the noise levels likely to be generated buy the mining activity in the future will not have effects in the nearby habituate villages.

4.2.2.2 Noise and Air Blast due to Blasting

Blasting operations are carried out in open cast mining for loosening the insitu strata making it amenable for extraction through various equipment. Air blast and blast ground vibrations are the undesirable features associated with blasting. It is subjective to the environmental problems

Air blast is a pressure wave transmitted through the atmosphere from the blast site. The resulting shock wave has a steep stock front followed by a rapidly decreasing pressure. Air blast wave consists of a wide of frequencies, some of which are audible

(noise, whose frequency ranges from 20 – 20,000 Hz) while rest in inaudible (concussion, having frequency content either below 20 Hz or above 20,000 Hz). The lower frequency below 20 Hz portion excites structure, which in turn causes a secondary and audible rupture within the structure, giving rise to secondary noise, due to ratting of window panes etc. Human response to a blast is often more intense inside than outside a structure. This difference may be caused by the sound produced inside the structure by the structure itself. There has been little attempt to quantify blast over pressure for damage. This is due to the fact that the standard for limiting the air blast due to mining are not important, as the charge contributing damage due to air blast is much higher than for limiting the ground vibration. Hence, in a normal blast when ground vibration are limited to safe value the over pressure created due to air blast is automatically restricted within the safe limits.

The major concern for air- over pressure or air blast is that it causes annoyance for a very short duration to the nearby residents but it would not result in structural damage.

4.2.2.3 Ground Vibrations

Blast vibrations are transmitted along the ground following a blast, the vibration radiates from the blast hole, as it passes surface structures, it indicates vibration in these structures. These vibrations can induce a resonance in the structures and the amplitude of the resonance may exceed the amplitude of the initial ground vibrations, the relative amplitudes of ground vibration and induced structural vibration depend largely on the match between frequencies of the structure.

After reviewing all available research data, it can be concluded that the Peak Particle Velocity (PPV) and frequency of the wave is the best criterion for evaluation blast vibrations in term of its potential to cause damage. PPV is a term for the greatest speed in which the earth moves while it travelled back and forth during the passage of the blast wave.

A number of blasting factors affect particle velocity of the ground vibrations which include distance from the blasts to the position of interest, the exposure charge weight per delay, frequency of vibrations, blast geometry, physical properties of the rocks etc. As mentioned earlier, PPV along with the frequency of the blast waves is the best criterion for evaluating the damage to structures due to blast vibrations.

In order to estimate the safe explosive charge to contain he vibrations within the statutory limits (DGMS Circular 1997 dated 29/8/97. Field trails have to be conducted to arrive the site specific constants.

Table 4.9 Permissible Peak Particle Velocity (PPV) at foundation level of structures in mining area (in mm/sec)

	Type of Structure	**Dominant excitation (frequency ,Hz)**		
		<8Hz	**8-25 Hz**	**>25 Hz**
A	Building/Structures not belonging to owner,dome houses/structures (kuchha,brick &cement)	5	10	15
	Industrial buildings (RCC & framed structures).	10	20	25
	Objects of historical importance and sensit structures	2	5	10
B	Building belonging to owner with limited span of l Domestic	10	15	25
	Houses/structures (kuccha,brick &Cement). Indust buildings (RCC & framed structures)	15	25	50

4.2.2.4 Fly Rock

Opencast operations involve blasting in limestone mining. The blast parameter during ,mining operation have to be established after actual field trial blasting considering the local geo-mining conditions . Whenever the mine boundary approaches the danger zone of 300 m from villages/dwellings/structures etc., controlled blasting and vibration study have to be conducted by scientific agency for relaxation of danger zone, i.e., to work within 300 m but beyond 100 m. Blasting with pre-splitting will be done at quarry surface boundary to control the vibrations. By a proper choice of blasting technique it is possible to minimise ground vibrations. It is therefore suggested that charge /hole be restricted as per distance from villages. Safety zone as required by statue will also be ensured.

For the reduction of ground vibrations, in addition to the above the following will be considered in general.

a) Blasting design and initiation pattern such that the maximum charge per delay is within the stipulated range.

b) Wherever possible, the progress of detonating holes, through delay intervals, should progress away from the structures to be protected

c) Burden and spacing should be the requirement

d) Avoid blasting during cloudy days and when the wind is blowing towards structures

The blast parameters during mining operation have to be established after actual field trial blasting considering the local geo- mining condition.

For the controlled blasting operations, the following will be considered in general:

1) Distance between blasting point and the structures to be protected will be earmarked
2) A free face always be maintained\
3) In multi row blasting, greater relief will be provided between rows using suitable delay intervals.
4) Proper use of different type of relay/delay detonator for proper sequencing of the blast will be used.
5) All loose debris will be cleared off the blasting site.
6) All the holes be suitably muffled before blasting to control fly rock.

4.2.3 Impact of Water quality:

There is no source of water within the area. There is no chance of any damage to perennial source of water or water course in the surrounding area. It has already mentioned that impact on water quality is not expected of any significance mainly as no perennial surface body exist within proposed mining area or in close vicinity. Further ground water goes deep in mountainous region and no spring was noted having catchment relationship with proposed mining activities. However water quality of spring & drainage water should be monitored at least once in a year.

4.2.4 Soil Quality:

Soil quality monitoring will be done from the soil spread over the benches & maize fields towards North Eastern slopes. The samples shall be collected in dry & wet seasons. Collection & analysis of these soil samples are required to monitor the improvement in soil characteristics & will be useful in selection of proper species for establishing vegetation, type and quantities of fertilisation required. The quantities of

soil samples should be around 300 gms & its analysis should include the following constituents :

pH value, Nitrogen, Potassium, Phosphorus, Colour, Bulk density, Porosity, Moisture Content, Grain size.

4.3 ASSESSMENT OF SIGNIFICANCE OF IMPACTS

The environmental impact of a [project depends both on the project activities and on the background environmental setting. The environmental impact assessment process involves the four basic steps

- Identification
- Evaluation
- Interpretation
- Communication

For the present project matrix method is used foe assessment of the impacts. This method is selected because it identifies the impact of each project activity on each of the environmental attributes. Evaluation and interpretation of impacts is mostly subjective and convey a holistic view of the environmental impact of the project.

4.3.1 Environmental Impact Matrix

The environmental impact parameters with their intensities are clubbed into a matrix. In the matrix given in table, the impact parameters are taken in the vertical column and the different mining operations that are involved are taken in the horizontal row.

The environmental and eco- system, under each of these sets, sub-sets are made showing the specific topics involved under each set. For example, land degradation is divided into subsets of alteration in relief, soil erosion, deforestation, change in land pattern, landslides and vibration and so on. After listing these topics, ratings are assigned to each of these topics in numerical values showing the relative weightage of these sets.

After listing out the environmental parameters under the vertical column if matrix and assigning their weightage (points) on the basis of importance as above, the different operations involved in the mining activity are tabulated under the horizontal axis. The number of total number of total actions listed in the matrix is 13 and the vertical list of environmental parameter topics contains 27 items, which gives a total of 351 possible interactions. After tabulating these items the next step is to make interaction

between mining activity and environmental parameters. The places of interactions are marked on the matrix by judgment and numerical score values for impact assessment ranging from 1 to 5 are marked on these places. Assignments of these values are made on the basis of the best judgement. Positive or negative signs are assigned to these score values to denote beneficial or adverse effects. It must be emphasized here that the significance of higher or low values for any item only indicates the degree of impact of one type of action on the particular environmental parameter.

Once the weighing points of each of the environmental parameters is fixed and corresponding values for magnitude of impact are assigned under different types of operations, the product of the weightage points with the arithmetical sum of the values of magnitude of impact will give individual score for each of the environment topics. The cumulative score indicates the overall impact. The cumulative score obtained in this case is -200

As per the significance of score values this score falls just above in the group of appreciable but reversible impact on environment mitigation measures should be taken.

4.3.2 Evaluation for alternative scenarios

a) EIA without EMP

The scenario was based upon the assumption that the proposed development would go ahead without any environmental management portions being implemented. The total project impact for the scenario, as can be seen in the table- 4.10. The impact due to the present development is negligible. The EMP described in the Chapter 9 will have to be implemented to minimise the potential negative impact due to the proposed activity.

b) EIA with EMP

If the environmental management strategies discussed in the chapter 6 is fully implemented the adverse impact of the project would be further reduced and there will be an overall improvement in physical, chemical, biological and socio-economic environment of the region. This is reflected in the total project impact score, indicating that these is no appreciable impact. Therefore, the proposed activity will be beneficial for the environment of the area, provided the EMP is in place.

Table 4.10 : Impact assessment for the proposal project (EIA without EMP)

ITEM	PTS	EXV	D& B	L& T	SOW	LE F	GEF	SRF	BLD	CPL	DAM	EGY	ACC	WRY	TOTAL
1. LAND															
1.ALR	25	-2													-50
2.SOE	25	-1													-25
3.DEF	100	-2													-200
4. LUS	25	-3													-75
5.LSL	25	-													
6.AST	25	-													
7.SEA	25	-													
8.FLY	25	-													
2. WATER															
1.SUR		-													
a.TOX	75	-													
b.SOL	50	-													
2.GRD															
QLT	75	-													
3.RES															
a.SUR	25	-													
b.GRD	25	-													
c.AQL	25	-													
3.AIR															
1.DUS	50	-1													-50
2.NOX	75	-													
4. NOISE															
1.HAB	25	-1													-25
2.WLF	25	-													
5. HUMAN ENV															
1. ECO	25	+2													50
2.INF	25	+2													50
3.CUL	25	-													
4.HEL	75	-1													-75

5.POD	25	-1													-75
6. ECOSYSTEM															
1.WLF	25	-													
2.RSP	25	-													
3.FCH	25	-													
4.MCR	25	-													
TOTAL SCORE															**-475**

Table 4.11 : Impact assessment for the proposed project (EIA with EMP)

ITEM	PTS	EXV	D & B	L& T	SOW	LE F	GEF	SRF	BLD	CPL	DAM	EGY	ACC	WRY	TOTAL
1. LAND															
1.ALR	25	-1													-25
2.SOE	25	-1													-25
3.DEF	100	-1													-100
4. LUS	25	-2													-50
5.LSL	25														
6.AST	25														
7.SEA	25														
8.FLY	25														
2. WATER															
1.SUR		-													
a.TOX	75	-													
b.SOL	50	-													
2.GRD															
QLT	75	-													
3.RES															
a.SUR	25	-													
b.GRD	25	-													
c.AQL	25	-													
3.AIR															
1.DUS	50														
2.NOX	75														
4. NOISE															
1.HAB	25														
2.WLF	25														
5. HUMAN ENV															
1. ECO	25														
2.INF	25														

3.CUL	25														
4.HEL	75														
5.POD	25														
6. ECOSYSTEM															
1.WLF	25														
2.RSP	25														
3.FCH	25														
4.MCR	25														

TOTAL SCORE															- 200

Score values of impact assessment:

Minimum : 1
Small : 2 + ve sign shows beneficial
Moderate : 3
Significant : 4 - ve sign shows adverse
Severe : 5

Significance of score values:

Upto -1000: No appreciable impact of environment – only minor remedial measures may be necessary

-1001 to -2000: Appreciable but reversible impact on environment mitigation measures should be taken

-2001 to -3001: Significant impact on environment, mostly reversible-environment control measures are very important

-3001 to -4001: Major injurious impact, slightly irreversible major environmental control measures are crucial

-4001 to -5001: Severe injuries impact, mostly irreversible large scale environmental protection measures with slight modification in mining scheme is required

-5001 & above: Permanent irreversible impact, mining environmentally not feasible-entire mining scheme to be revised

Abbreviations used in the Environmental Impact Matrix:

Along vertical column

LAND

1. ALR : Alteration in Relief
2. SOE : Soil Erosion
3. DEF : Deforestation
4. LUS : Existing Land Use
5. LSL : Land Slides & Vibrations
6. AST : Aesthetic Beauty
7. SEA : Sensitive Areas like Mountains, Sanctuaries, Monuments, etc.
8. FLY : Generation of Fly Rocks and fall of scree

WATER

1. SUR : Surface Water
2. TOX : Toxic Substances
3. SOL : Suspended Solids
4. GRD : QLT Groundwater Quality
5. RES : Water Resources
6. SUR : Surface Water
7. GRD : Ground Water
8. AQL : Effect on Aquatic Life

AIR

1. DUS : Emission of Dust
2. NOX : Generation of Noxious Gases

NOISE

1. HAB : Nuisance of inhabitants
2. WLF : Scaring of Wild Life

HUMAN ENV (HUMAN ENVIRONMENT)

1. ECO : Effect of Economy
2. INF : Infrastructural & Service Facilities
3. CUL : Cultural & Recreational Facilities
4. HEL : Health Conditions
5. POD : Population Density

ECO-SYST (ECO SYSTEM)

1. WLF : Wild Life Protection
2. RSP : Rare and Endangered Flora and Fauna
3. FCH : Effect on Food Chain
4. MCR : Effect on Micro Organisms

Along horizontal axis

1. ITEM & PTS : Item and its Importance Points
2. EXV : Mineral Excavation
3. D&B : Drilling & Blasting
4. L&T : Loading & Transport
5. SOW : Solid Waste Disposal
6. LEF : Liquid Effluents
7. GEF : Gaseous Effluents
8. SRF : Service Facilities
9. BLD : Building Constructions
10. CPL : Crushing/Processing plant
11. DAM : Construction of Tailing Dams and Impoundments'
12. EGY : Energy Generation
13. ACC : Accidents
14. WRY : Waste Recycling
15. TOL : Total Score of Points

Conclusion

It is clear from the above that the proposed mining project would have negative effect without implementing certain environmental strategies. It EMP, as discussed in the subsequent paragraphs is strictly adopted and implement, the adverse impacts will be reduced (-200) and the overall environmental quality of the area would improve.

4.4 MEASURES FOR MINIMISING/OFFSETTING IDENTIFIED ADVERSE IMPACTS

4.4.1 Measures against air pollution

The proposed production target is 421800 tonnes per annum by the end of fifth year, which is not too large. Considering experience of other places the impact on air quality is not expected of significance. However the only cause of concern in future will be SPM content. The present ambient air quality is pure as the applied area lies in the Himalayan region. The quality of air will be deteriorated during blasting operations & movement of vehicles.

The following is proposed to efficiently control of SPM level.

i) It is proposed that one sprinkler may be added to reduce the time gap of resprinkling of water on the same spot (within two hours) with long gap a particular spot may get dry before the sprinkler returns for second trip. Sprinkling should be extended to all the haul road and unmetalled roads.

ii) Drilling will be done with dust collectors, it would be advisable that all the persons close to drilling machines and other operations be provided with dust masks.

4.4.2 Measures against water pollution

There is no source of water within the applied area. There is no chance of any damage to perennial source of water or water course in the surrounding area. It has already been mentioned that impact on water quality is not expected of any significance mainly, as no perennial surface body exist within the applied area or in close proximity. Further ground water goes deep in mountainous region and no spring was noted within proposed mining area having catchment relationship with mining area.

4.4.3 Measures against noise pollution

The operations of the mining equipments and plying of vehicles are the major sources of undesirable noise in the proposed area. The problem of noise pollution will be of work zone. The mining equipments proposed are limited to compressor, Wagon drill, shovels, jack hammers and tippers etc. and considering the fact that nearest habitation is about 2.5 km aerial distance from the area, it may be concluded that noise will not cause any impact on surrounding community, however operators and workers close to machineries will get exposed to this hazard. The noise produced by various equipment to be used are as below (Table 4.12):

Table 4.12 Noise produced by equipments

Equipment	Noise Level db(A)	Equipment location
Portable compressor	80	at about 7m.
Jack hammer	95	at about 10m.
Tippers	74	at driver seat

The use of ear plugs and proper maintenance schedule will help them to avoid harmful impact of noise. The instantaneous peak value of blasting may arise, so control measures suggested are as below:

i) Blasting should be carried out during the period when back ground noise is at its maximum. Time of blasting should be well publicized so that people are aware of blasting hours. Variable which effect are wind velocity and temperature. Therefore no blasting operations should be carried out when strong winds are blowing towards inhabited areas.

ii) Adequate stemming of holes at collor zone with drill cuttings will be done so as to keep the minimum stemming length at 30% of the drill hole depth. It was observed that maintenance schedules shall adhered to strictly which minimize the generation of noise due to machine operations. However blast vibration shall be checked with use of delay detonators and studies shall be carried out by the applicant to decide the minimum charge per hole so that ground vibration & noise level could be maintained.

ii) Secondary blasting will be almost eliminated by way of large modern type crusher installed at the plant site. The crusher will handle large size input material and thereby secondary blasting will be avoided. This will also reduce the amount of noise during mining exercise.

4.4.4 Measures to control Vibration Levels (Due to Blasting):

Drilling will be done through Wagon drill, jack hammers during next five years. The Wagon drill, jack hammer blasting does not cause problem of vibration to any significant level. More over nearest habitation is about 2.5 km aerial distance from the area thus eliminating all the possibility of this nuisance. In blasting use of delay detonators besides effective stemming shall reduce vibrations.

The blasting operation in the quarry will be carried out with 83 mm. dia holes with burden & spacing 4m and 4m with hole depth 6 m. & sub grade drilling 10%. The maximum explosive charge per delay will not exceed 30 Kg. and there will no danger to any nearby structure due to blasting. However the near by habitation is about 2.5 Km. away from the proposed mine site.

To ensure minimum vibrations due to blasting, delay detonators in continuous sequence is suggested. Over charging of explosives should be avoided and blast should be confined to the explosive charge as suggested earlier.

4.4.5 Measures to maintain soil quality

Soil quality monitoring will be done from the soil spread over the benches & maize fields towards North Eastern slopes. The samples shall be collected in dry & wet seasons. Collection & analysis of these soil samples are required to monitor the improvement in soil characteristics & will be useful in selection of proper species for establishing vegetation, type and quantities of fertilisation required. The quantities of soil samples should be around 300 gms & its analysis should include the following constituents:

pH value, Nitrogen, Potassium, Phosphorus, Colour, Bulk density, Porosity, Moisture Content, Grain size.

ii) Slope Stability:

It would be advisable to have a close look on slope stability in hilly terrain. Something always is possible before it really fails. It would be advisable to monitor all the slopes along road side once a month.

iii) Retaining walls:

The rain fall is evenly distributed in this region throughout the year. Therefore it would be in fitness of things to monitor all these control measures at least once a month and strengthening will be provided wherever required.

iv) Plantation:

Monitoring will be required for plantation undertaken specially for latest one for survival and replacement of mortalities. There may not be a specific frequency but once a week visit is generally common in post plantation care.

4.4.6 Measures for minimizing adverse effect on water regime

.

No perennial nala passes through the area or in close proximity of the area. The chances of surface water pollution are remote, however erection of retaining walls in vulnerable points will completely eliminate the eventualities.

No spring exists with in the area or in the vicinity of area thus having no probable catchment relationship with mining area, thus eliminating impact on ground water to a large extent. However there will be change in relationship of base flow and surface run-off in the beginning but assessing cautiously it may revealed that the present slopes are mostly barren and rocky therefore after initial breaking when benches are formed the situation may project a positive impact by increasing the base flow specially after reclamation of these benches.

Two kinds of impacts are possible on sub surface water as below:

i) Deterioration of ground water quality due to interaction of in filtrating water and freshly exposed material. In this case freshly exposed material will be limestone which will not have any adverse impact except little increase in hardness.

ii) Impact on quantity of sub surface water:

In this case quantitative impact is inevitable, information as gathered from local enquiries reveal that, depth of pieziometric surface is quite below. Mining level will not go below the pieziometric surface.

The proposed afforestation is expected to improve the infiltration-surface run off relationship. Due care has been taken so that surface water does not receive any

suspension from the mining areas. As mentioned earlier the impact on water regime will be limited as no perennial stream passes through the area and there is no spring having catchments relationship with mining. However periodically water sampling will be conducted after rainy season to take care of eventualities of screen and increased suspension, in the water.

4.4.7 Socio-Economics:

No rehabilitation or human settlement is involved due to mining operations. Hence the major consequence or impact of mining industry does not arise.

Mining is expected to have positive impact on the socio economic life of the people living in nearby villages. Some of them have been directly employed, some others indirectly.

The base line data in regard to socio-economic scenario presence an economically backward picture. Almost all the parameter point out that area is highly backward. Any industrial intervention in this area should and must be welcomed. The proposed mining will provide direct employment to about 70 people whereas indirect employment in way of business opportunities like, contracts, transport etc. will be many times. The management should also take help of NGO's to create awareness about education and formation of self help groups and opportunity of self employments so that socioeconomic equilibrium is maintained with definite forward progress.

The impact of an industry on educational front is always positive which is evident from the surrounding areas which shows higher literates than normally seen in rural areas.

Finer aspects of socioeconomic imbalance and cultural interactions were also assessed. When industry come in a virgin area, the economic balance gets distributed due to employment opportunities to most of the people. Though over all per capita income grows but pattern of distribution changes.

4.4.7 Socioeconomic benefits arising out of mining:

First and foremost benefit is that the mine will provide direct and indirect employment to about 100 people. The systematic extraction of mineral reserves of limestone from the area will definitely reduce the unemployment problems to some extent. The industry will contribute to the socio economic growth of the area. The indirect employment will be

many times of direct employment in way of business opportunities, construction and transport contracts, dhabas, tea stalls, grossory shops etc. Besides direct and indirect employment there will be improvement in communication and medical facilities. Literacy is also bound to go high. In a nut shell industrial activity in this backward area will be a boon to the people who are otherwise force to migrate from this place for survival and growth.

4.4.8 Measures to control erosion/sedimentation of water courses:

No water courses exists with in the area or in the vicinity of the area. The area is marked by limestone out crops having no soil cover, therefore the question of erosion & sedimentation of water courses shall not arise plantation over completed benches and retaining wall at the edge of the benches will also control the sedimentation / erosion.

4.4.9 Treatment and disposal of waste from mine:

Mining activities will not penetrate the water table during first five years. The rainy water will drain out through the slopes. However the water accumulate in the working pit will be pumped out and channelize through the slopes. No toxic elements will present in the water and no need of treatment of water will be required.

4.4.10 Measures for protecting historical monuments and for rehabilitation of human settlement likely to be disturbed due to mining activity:

It has already been stated that nearest habitation is at least 2.5 Km aerial distance away from mining area hence question of rehabilitation and disturbance does not arise. Further there is no building like historical monument or public place within the applied area which need to be protected.

4.4.11 Temporary Storage and Utilisation of Top Soil:

The area proposed for first five year is mainly marked by limestone outcrops having no soil cover. Top soil shall not be generated during first time years of mining operations therefore temporary storage of top soil has not been proposed. However, the top soil shall be brought from out side the area for the propose of plantation over the completed benches.

4.4.12 Asthetics

Mining operations open ugly sights of dug out slopes and fuming debris which in the hills are visible from long distances. It is desirable to screen away such sights so that invitable unpleasantness of operations is not exposed to the public eye.

Well planned plantation of ornamental trees improves the asthetic value of land.Trees and shrubs produce timber, fooder, fuel, fruits, fibres etc. for direct use of village community.

4.4.13 Yearwise proposal for reclamation of land affected by abandoned quarries and allied mining activities during five year period :

Human approach to managing the environment judiciously has changed greatly in the recent years. While there has been an upward need for use of non-renewable mineral resources, there is also growing recognition that and disturbance & dereliction can and should be minimal. Extraction of mineral is a temporary land use that sometimes may extend over decades, but the land continues to be useful in perpetuity. Rehabilitation of the extracted land has to be designed skilfully in order to restore it to its former use, or to an alternate use that is compatiable with the surroundings. Plantation with grasses, herbs, shrubs and trees is an important means for restoring such areas; particularly those which are situated in an around existing forest & so are not suitable or wanted for other use.

Conservation:

Stabilising and revegetating the devegetated areas and viz mined areas, debris, dumps slopes which get degraded due to rolling stones etc, are important for the conservation of soil, regulation of surface and under ground water and for re-establishing wild life habitat, these generally are extracting operations and need planting in various phases by selected species. Protective engineering measures, in conjuction become necessary.

4.4.14 Programme of Afforestation:

Based on the above consideration, the following afforestation programme has been worked out:

a) Mining area:

The mine faces will be rehabilitated in the following manner:

i) After completion of mining bench, it will be left exposed for about one month for weathering and for soil working.

ii) The soil working will consist of waste & soil. Smaller pieces of waste rock should first be laid for about 200mm. and about 300mm. soil layer will be spread over it. If more soil is easily available it will be advantageous to have this layer even thickner.

iii) 500mm. high dry stone wall should be constructed along the bench edge. The bench filling should be kept slightly sloping say 1 in 200, inward to facilitate drainage.

iv) One the outer one third width of the bench, grasses and shrubs will be planted at 1m. x 1m. spacing.

v) Tree species should be planted in the inner two thrid width at 1.5m. x 1.5m. spacing in pits prepared in advance.

vi) The species recommended for planting are:

Grasses & Hedges:

Local grass, Pudina, ivory hedges

Shrubs & Herbs: Zeera, Ven, rose

Trees: Kikar, Walnut, white willow, Handoon .

Various methods adopted for reclamation and afforestation of mining benches are as below:

I) Method of Pitting and Planting:

Reclamation in the worked out mining benches shall be undertaken by making pits of 75cm. x 75.0cm. x 1.0m. size, 1.5m. apart. The pits shall be filled with sweet earth sand & cowdung.

i) Neem powders should also be applied in the pit to protect the plants from white ants.

ii) After such ground preparation before monsoon, appropriate varities of saplings shall be planted in March.

iii) During May the weeds shall be allowed to be cleared from planted area & chemical manures shall be applied to ensure healthy growth of the plants and to enhance the rate of survival.

iv) The planted area shall be adequately fenced with wooden poles and barbed wire to protect the plants from cattle grazing and destruction.

By adopting the above methods the applicant shall be able to achieve 60% rate of survival of plants.

II) Method of Silting, Plantation and grassing on the mined out benches:

After mining, the land scape will be left in the form of benches. Gradually, due to weathering and mostly during rains, the loose earthen material accumulate at the feet of the rock walls in silt formation.

Generally very hardy species and some species of legiminous plants may be used. This will help mitrogenating the soil. This will help mitrogenating the soil. On the silt, appropriate saplings are planted in the usual manner.

Besides on the upper slopes of the benches, re-greening activities are undertaken by planting grasses of local species.

c) Other area:

Plantation shall be undertaken towards the east slope of the area. Out side the applied area. The pits having dimension of 75 cm. x 75 cm. x 100 cm. will be dug. about 40 - 45 day before the plantation and soil and manure will be filled in the pits. Planting should be done in large sized 75cm. x 75cm. x 100cm. due in advance and filled about 50 days before planting. The plantation raised earlier should be carefully maintained mortalities should be replaced by fresh planting.

Table 4.13 Year wise afforestation programme

Year	Bench RL (m)	Mined out Benches		within 7.5m strip		
		Area in (Ha.)	No. of Trees	Area in (Ha.)	No. of Trees	Total no. of trees
I	NIL	-	-	0.135	130	130
II	NIL		-	0.101	100	100
III	NIL	-	-	0.043	40	40
IV	2494 mRL to 2482mRL	0.132	130	0.058	60	190
V	2476 mRL to 2470mRL	0.264	260	0.082	80	340
Total		**0.396**	**390**	**0.419**	**410**	**800**

It has been revealed from the adjacent areas and from the data of forest department, the survival rate of saplings will be about 60%.

Post plantation care:

This will include the following measures:

- Protection from grazing and fire.
- Watering at least once a week during dry spells.

- Manuring.
- Weeding three times in the first year and twice a year during the sub sequent two years soil working.
- Mulching.
- Replacement of causalities.
- Protection from pests.

This past-plantation care will undertaken at least for three years after the plantation.

Choice of Species:

The area is well known for fruit trees like apples and wall nuts. It would be in fitness of things that local fruit species are planted in abundance however a few pine, Kikar, trees and Handon may be introduced in between to create variety. The outer and inner part of plantation may be overlapped with a screen of Rose to ameliorate the asesthetic sense.

Technique for plantation:

a) Spacing:

As quick closing of canopy is necessary, the spacing adopted should be 75cm. x 75cm. In view of rocky formation at places it may note possible to follow this spacing strictly but effort should be to adhere as nearly as possible, to this spacing.

b) Soil Working:

75 cm. x 75cm. pits should be dug in February. The soil and well rotten farmyard manure (5 Kg. per pit) should be mixed well with the dug out soil and refilled by the third week of March. The level of the refilled soil should be about 30cm. above the general ground level. Stone pieces should be carefully separated from the soil.

In many places, the pits will be larger the underlying rock will need to be broken. Care should be taken to ensure that the rock at the bottom of the pit should be thoroughly cracked to ensure easy penetration of roots of the seedlings.

c) Planting:

Only strong healthy nursery raised plants should be used to ensure success. The plants of coniferous should be at lease 40cm. in height and broad leaves species should have a minimum height of 60cm.

The seedling should be dug out from the nursery with sufficient earth around the roots. The earth should be tied with grass or hessian. Plants raised in polythene container are best. Transport to the site should be done in baskets to avoid damage to the roots. Damaged plants should be sorted out.

Planting should be done after the first monsoon showers. A hole should be made at the top of the filled pit and the seedling put in it such that the collar is at level with the top of the soil. The soil around the root should then be pressed with feet to ensure that no air space is left between the roots and the soil. Half a bucket full of water should be given, if planting is done on a rainless day. If a dry spell follows, watering should continue till the rains start again.

d) Cleaning and Weeding:

Grasses and weeds start appearing on the worked soil and will smother the seedling, if not controlled. At least two weedings should be done during the rains. One weeding is necessary during the second year.

e) Beating up of mortalities:

Before the following planting season, the planted area should be inspected and mortality assessed. The dead and dying seedlings should be replaced by fresh planting.

f) Fertilizer and insecticides:

Chemical fertilizer at the rate of 15 gm. per plant should be added at the time of planting. NPK mixture is effective to promote growth. The powder should be added in a 10 cm. deep ring dug out 15 cm. away from the collar of the plant.

About 10 gm. of insecticide, B.H.C. 10 per cent, should be sprinkled on the sides and base of the pit to prevent damage by insect larvae. Another 10 gms. should be mixed with the soil before refilling.

ii) Fruit Trees:

Species suggested are Apple, Walnut and Apricot. The method adopted should be same as for forest trees but the pits should be larger and deeper (75cm x 75cm). Manure, chemical fertilizer and insecticide should be used more liberally (twice as much as for the forest trees). The frequency of weeding and cleaning should also be increased to three in the first year and two in the second year.

iii) For Shrubs:

The shrubs suggested are mostly those which occur naturally in the adjoining areas. These are Pudina, rose, ivory shrubs etc. Small pits of 30 cm x 30 cm should be dug before the rains. Soon after the rains set in, surplus plants from the adjoining forests should be dug out along with roots and earth around them, with a spade and transported to the site carefully. As leaves cause water loss due to transpiration, the shoots of shurbs should first be trimmed with a garden scissor at a height of about 30 cm from the ground level, leaving only few leaves in the lower portion.

The root stock of the shrubs should be place in the dug out and refilled soil so that the collar is at the general ground level. 1kg farmyard manure should be added to the soil before refilling. The planting spacing should be 1m x 1m.

The same technique should be followed for grasses and sedges also.

iv) Stabilisation and Vegetation of Dumps:

It has been already stated that area consists of high grade limestone having no soil cover & generation of soil & waste shall be nil. Therefore no waste dumps shall be created & proposal stabilisation & vegetation of waste dumps shall not arise.

4.4.15 Recommendations / Suggestions by the Office of Wildlife Warden Central Division.

The recommended objectives and the environmental budgetary allocation by the department is attached as in **Annexure VI** and the same will be strictly followed.