Chapter- 4

ANTICIPATED ENVIRONMENTAL IMPACTS & MITIGATION MEASURES

4.1 INTRODUCTION

The impacts (both beneficial and adverse) of mining and its allied activities of the project have been assessed and presented in respect of air, water, noise, blasting vibration, socio-economic profile, flora & fauna, land resource, traffic movement and visual/aesthetic aspect in this chapter.

The control measures to mitigate various environmental impacts are also highlighted in this chapter for carrying out mining operation in an environmentally compatible manner. Further, all provisions of Coal Mines Regulations and Directives shall be followed in this project.

4.2 IMPACT ASSESSMENT & POLLUTION CONTROL MEASURES FOR AIR

The impact assessment has been carried out. Appropriate air pollution control measures will be taken to contain the air pollution for maintaining the ambient air quality within the stipulated standards besides making the mining operation eco-friendly in this project. All provisions of Coal Mines Regulations and Directives shall be followed.

4.2.1 AIR POLLUTION IMPACT ASSESSMENT

The pollution sources are obvious and to assess the impact, the project life is divided into following time frames:

- Operation phase
- Post-operational stage

The activities associated with these time frames and having impact on the ambient air quality along with the pollutants are enumerated in the following sections:

- **Operation phase:** During this phase, activities necessary for mining of coal, its handling and transport are taken up. Such activities having impact on ambient air quality are detailed below:

(i)	Drilling	:	Dust
(ii)	Blasting of OB	:	Dust and noxious gases
(iii)	Handling of coal	:	Dust and noxious gases
(iv)	Overburden handling	:	Dust and noxious gases
(v)	Dump formation (internal /external)	:	Dust and exhaust fumes from dumpers and dust till the development of green cover
(vi)	Movement of vehicles	:	Dust and noxious fumes

Blasting of coal has not been considered for AQIP because of the highly inclined seams in the proposed mining area attain a depth of nearly 200 m within a length of 520 m and coal of these seams is soft and powdery in nature. There is no underground working in the mining area. 0.25 Mt. of coal will be produced per annum from the three coal seams and quantity of OBR is 3.10 Mcum per annum in 3rd production year , which is considered for the Air Quality Impact Prediction.

- **Post-operational stage:** During this stage of the project, the activities related to the closure of mine are to be carried out. Preparation of mine closure plan shall be carried out during the period four to five years before the closure of the mine. Some of the activities for the closure are:
  - Modifications in physical and biological reclamation of backfilled area
  - Salvaging and shifting operation of HEMMs and other equipment
  - Clearing of coal and other materials, restoration of infrastructure area & colony area to the extent possible and necessary if not useful for other projects

- Management of hydrology and hydrogeology.
- Redeployment of workforce, etc.
- Arrangement & implementation of post-operation monitoring mainly keeping watch, vigil, etc.

The activities having impact on the ambient air quality are enumerated below:

(i)	Movement of HEMMs for physical reclamation of backfilled area	:	Dust and obnoxious fumes
(ii)	Movement of vehicles for shifting and salvaging operation of HEMMs and other equipment	:	Dust and obnoxious fumes
(iii)	Movement of vehicles for clearing of coal and other materials	:	Dust and obnoxious gases

The impacts are both direct and indirect. The nature of adverse impacts is short-term.

The mining and its related activities create ambient air pollution. The impact of mining on ambient air quality are highlighted in the following paragraphs:

(a) The ambient air quality is influenced due to the presence of RPM, SPM, SO_2, NOx, etc., which are generated due to various activities like drilling, blasting and handling related to the project. Further, the ambient air quality may be affected marginally to a varying degree due to the mining activities of other nearby opencast and underground coal mines of North Eastern Coalfields. The concentration of pollutants may vary depending upon the various micro-meteorological parameters and the seasons of a year.

(b) The ambient air quality of the proposed w.r.t. SPM, RPM, SO_2 and NO_X for the period Jan'09 to March '09 is within the limits of the prescribed standard.

So the ambient air quality will have no effect on human being, flora and fauna, soil quality, surface structures and aesthetic value of the surrounding environment as suitable mitigation measures will be taken to make the operation eco-friendly.

(c) As the project area (core zone) is small in comparison to the region, the mining activities of this project will not affect the climate, rainfall, and temperature.

4.2.1.1 AIR QUALITY MODELING

AIR QUALITY MODEL

The effects of air pollutants upon receptors are influenced by concentration of pollutants and their dispersion in the atmosphere. Air quality modeling is an important tool for prediction, planning and evaluation of air pollution control activities besides identifying the requirements for emission control to meet the regulatory standards. The efficient management of air quality requires the use of modeling techniques to analyze the patterns of pollutant concentrations from many individual sources of air pollutants operating simultaneously .

Models for regional concentration patterns are based on "emission inventory" data for the region, and on standard meteorological observations assumed to be representative of the entire region.

Various attempts have been made to establish empirical relations to predict the dust emission characteristics for mining operations. These relations may give only a rough estimate of the total dust emission and provide no information about the contour of the dust plume. The generation rate of the contaminant for most mining operations cannot be precisely determined by empirical relations because there is a high degree of variance in the way such operations are conducted in different mines. Nevertheless, the empirical relations provide the first hand information to the health workers, administrators, planners, and engineers for the development of dust control strategies.

A model namely, Industrial Source Complex Short Term version 3 (ISCST 3), of USEPA has been used to predict the air quality of the core and buffer zone of the study area due to mining operations in the proposed Lekhapani OCP. The dust emission levels from mining operations are based on USEPA publications and the findings of a MOEF funded Research Project undertaken by ISM, Dhanbad for estimation of emission factors.

AIR QUALITY PREDICTION

The Air Quality Impact Prediction has been done by using "Industrial Source Complex Short Term version 3 (ISCST 3), of USEPA". Estimation for increase in SPM at the existing Ambient Air Quality Stations, chosen for the purpose of baseline AAQ data generation, has been done with the help of the above model. The impact due to existing mining activities in the vicinity has already been considered in the baseline AAQ study. The predicted air quality has been arrived at by adding the incremental prediction to the baseline concentration.

Identification of sources of TSP

The main sources of air pollution with regard to Lekhapani OCP for the purpose of estimation of increase in SPM was identified as-

1) Mining activities inside the OCP viz. Drilling, Blasting, OB removal, transport and dumping, both externally and finally extraction and loading of coal.
2) Transport of coal from mine to Coal depot
3) Storage of coal at the Coal depot.

Receptors

The existing Ambient Air Quality Stations (2 in Core Zone and 4 in the Buffer Zone), chosen for the purpose of baseline data generation by M/S ENVIROCON,

Assam, have been treated as receptors for estimation of increase in TSP and gaseous pollutants.

Meteorological Input

Micrometeorological and microclimatic parameters were recorded M/S ENVIROCON, Assam, by installing one meteorology station in Core Zone. During the study period from January to March 2009, hourly reading of wind velocity, wind direction, temperature, relative humidity and rainfall data were recorded.

Emission Standards

The USEPA Emission Factor Equation, 1988, has been used to calculate the emission factors for the various sources as explained above.

1) SPM - SPM Emission Factors for Various Mining Operations have been given below:

Source	Material	TPM Emission Factor	Unit
Top soil removal	Soil	0.029	Kg/te
Overburden removal			
Drilling	O.B.	0.59	Kg/hole
*Blasting	O.B.	$0.00022(A)^{1.5}$, A = area being blasted in sq. m.	Kg/day
Dumper loading by shovel	O.B.	0.018	Kg / te
Transportation in haul road	O.B.	2.25	Kg/vkt
Unloading	O.B.	0.001	Kg / te
Coal Extraction			
Drilling	Coal	0.10	

*Blasting	Coal	$0.00022(A)^{1.5}$, A = area being blasted in sq. m.	Kg/day
Loading in dumper	Coal	0.014	Kg/te
Transportation in haul road	Coal	2.25	Kg / te
Coal unloading	Coal	0.033	Kg / te
Wind erosion			
Coal stockyard	Coal	2.33	Kg/ha/d
OB dumps(Not reclaimed)	O.B.	2.33	Kg/ha/d

Description of mining activities in 3rd year of the production

This model has been used for impact assessment of air quality in and around the Lekhapani OCP leasehold area. For this the 3rd year is critical year because the production of coal & OB from the mine will be highest as detailed below:

1. During this period the coal production is 0.25 MT.
2. Volume of OB estimated to be handled would be 3.10 Mm^3 (Peak).

   Schematic Layout of Mine at the End of Year 3(Year of Peak Production) has been enclosed as Plate VIII.

The program run Input and Output file is as below:

```
CO STARTING
CO TITLEONE AIR QUALITY IMPACT DUE TO LEKHAPANI OCP OF NEC
CO MODELOPT DFAULT CONC   RURAL
CO AVERTIME 24 PERIOD
CO POLLUTID SPM
CO RUNORNOT RUN
CO ERRORFIL ERRORS.LST
CO FINISHED

SO STARTING
**         SRCID  SRCTYP    XS      YS       ZS
**         -----  ------   -----    -----    -----
SO LOCATION  LINE1   AREA     1459     855      .0000
SO LOCATION  LINE2   AREA     1462     934      .0000
SO LOCATION  LINE3   AREA     1463     1000     .0000
SO LOCATION  LINE4   AREA     1445     1060     .0000
SO LOCATION  LINE5   AREA     1403     1106     .0000
SO LOCATION  LINE6   AREA     1329     1136     .0000
SO LOCATION  LINE7   AREA     1263     1143     .0000
SO LOCATION  LINE8   AREA     1189     1126     .0000
```

```
SO LOCATION  LINE9   AREA     1005     1049     .0000
SO LOCATION  LINE10  AREA     957      415      .0000
SO LOCATION  LINE11  AREA     977      390      .0000
SO LOCATION  LINE12  AREA     995      367      .0000
SO LOCATION  SIDE    AREA     1086     383      .0000
SO LOCATION  PIT     AREA     1194     759      .0000
SO LOCATION  EXTOB   AREA     894      1557     .0000
**         SRCID     QS      HS      XINIT   YINIT    ANGLE
**         -----     ----    ---     -----   -----    ------
SO SRCPARAM   LINE1   2.920E-4  1.0      88      30       85
SO SRCPARAM   LINE2   2.920E-4  1.0      30      80       171
SO SRCPARAM   LINE3   2.920E-4  1.0      30      65       180
SO SRCPARAM   LINE4   2.920E-4  1.0      30      63       163
SO SRCPARAM   LINE5   2.920E-4  1.0      30      62       136
SO SRCPARAM   LINE6   2.920E-4  1.0      30      80       111
SO SRCPARAM   LINE7   2.920E-4  1.0      30      66       170
SO SRCPARAM   LINE8   2.920E-4  1.0      30      70       75
SO SRCPARAM   LINE9   2.920E-4  1.0      30      200      68
SO SRCPARAM   LINE10  4.080E-5  1.0      20      30       106
SO SRCPARAM   LINE11  4.080E-5  1.0      20      30       142
SO SRCPARAM   LINE12  4.080E-5  1.0      20      26       170
SO SRCPARAM   SIDE    2.699E-6  2.0      95      85       158
```

```
SO SRCPARAM   PIT     7.520E-5  1.0      520     237      151
SO SRCPARAM   EXTOB   5.806E-5  60.0     785     439      149
SO EMISUNIT   1.0E+06 (GRAMS/(SEC-M**2))  MICROGRAM/M**3
SO SRCGROUP ALL
SO FINISHED

RE STARTING
RE DISCCART    1381   1519
RE DISCCART    427    699
RE DISCCART   -517   -396
RE DISCCART    240    2246
RE DISCCART    2666   3012
RE DISCCART    909    3280
RE FINISHED

ME STARTING
ME INPUTFIL  LEKHA.MET
ME ANEMHGHT  10.0 METERS
ME SURFDATA  99999  2009   LEKHA
ME UAIRDATA  99999  2009   LEKHA
ME WDROTATE  180
ME FINISHED
```

```
OU STARTING
OU RECTABLE ALLAVE FIRST  SECOND
OU MAXTABLE ALLAVE  6
OU PLOTFILE 24 ALL FIRST LEKHA.DAT
OU FINISHED
```

Out put file of ISCST3 for Lekhapani OCP of NEC is as below :

```
CO STARTING
CO TITLEONE AIR QUALITY IMPACT DUE TO LEKHAPANI OCP OF NEC
CO MODELOPT DFAULT CONC   RURAL
CO AVERTIME 24 PERIOD
CO POLLUTID SPM
CO RUNORNOT RUN
CO ERRORFIL ERRORS.LST
CO FINISHED

SO STARTING
**         SRCID  SRCTYP    XS       YS       ZS
**         -----  ------   -----    -----     -----
SO LOCATION  LINE1   AREA     1459     855      .0000
```

```
SO LOCATION  LINE2   AREA     1462     934      .0000
SO LOCATION  LINE3   AREA     1463     1000     .0000
SO LOCATION  LINE4   AREA     1445     1060     .0000
SO LOCATION  LINE5   AREA     1403     1106     .0000
SO LOCATION  LINE6   AREA     1329     1136     .0000
SO LOCATION  LINE7   AREA     1263     1143     .0000
SO LOCATION  LINE8   AREA     1189     1126     .0000
SO LOCATION  LINE9   AREA     1005     1049     .0000
SO LOCATION  LINE10  AREA     957      415      .0000
SO LOCATION  LINE11  AREA     977      390      .0000
SO LOCATION  LINE12  AREA     995      367      .0000
SO LOCATION  SIDE    AREA     1086     383      .0000
SO LOCATION  PIT     AREA     1194     759      .0000
SO LOCATION  EXTOB   AREA     894      1557     .0000
**         SRCID     QS      HS      XINIT   YINIT    ANGLE
**         -----     ----    ---     -----   -----    ------
SO SRCPARAM   LINE1   2.920E-4  1.0      88      30       85
SO SRCPARAM   LINE2   2.920E-4  1.0      30      80       171
SO SRCPARAM   LINE3   2.920E-4  1.0      30      65       180
SO SRCPARAM   LINE4   2.920E-4  1.0      30      63       163
SO SRCPARAM   LINE5   2.920E-4  1.0      30      62       136
SO SRCPARAM   LINE6   2.920E-4  1.0      30      80       111
```

```
SO SRCPARAM   LINE7   2.920E-4  1.0      30      66       170
SO SRCPARAM   LINE8   2.920E-4  1.0      30      70       75
SO SRCPARAM   LINE9   2.920E-4  1.0      30      200      68
SO SRCPARAM   LINE10  4.080E-5  1.0      20      30       106
SO SRCPARAM   LINE11  4.080E-5  1.0      20      30       142
SO SRCPARAM   LINE12  4.080E-5  1.0      20      26       170
SO SRCPARAM   SIDE    2.699E-6  2.0      95      85       158
SO SRCPARAM   PIT     7.520E-5  1.0      520     237      151
SO SRCPARAM   EXTOB   5.806E-5  60.0     785     439      149
SO EMISUNIT   1.0E+06 (GRAMS/(SEC-M**2))  MICROGRAM/M**3
SO SRCGROUP ALL
SO FINISHED

RE STARTING
RE DISCCART    1381   1519
RE DISCCART    427    699
RE DISCCART   -517   -396
RE DISCCART    240    2246
RE DISCCART    2666   3012
RE DISCCART    909    3280
RE FINISHED
```

ME STARTING
ME INPUTFIL LEKHA.MET
ME ANEMHGHT 10.0 METERS
ME SURFDATA 99999 2009   LEKHA
ME UAIRDATA 99999 2009   LEKHA
ME WDROTATE 180
ME FINISHED

OU STARTING
OU RECTABLE ALLAVE FIRST SECOND
OU MAXTABLE ALLAVE 6
OU PLOTFILE 24 ALL FIRST LEKHA.DAT
OU FINISHED

****
*** SETUP Finishes Successfully ***
****

*** ISCST3 - VERSION 02035 *** *** AIR QUALITY IMPACT DUE TO LEKHAPANI OCP OF NEC ***
07/25/09
*** *** 12:35:48

**MODELOPTs:

CONC RURAL FLAT DFAULT

*** MODEL SETUP OPTIONS SUMMARY ***

- -

**Intermediate Terrain Processing is Selected

**Model Is Setup For Calculation of Average CONCentration Values.

-- SCAVENGING/DEPOSITION LOGIC --

**Model Uses NO DRY DEPLETION. DDPLETE = F

**Model Uses NO WET DEPLETION. WDPLETE = F

**NO WET SCAVENGING Data Provided.

**NO GAS DRY DEPOSITION Data Provided.

**Model Does NOT Use GRIDDED TERRAIN Data for Depletion Calculations

**Model Uses RURAL Dispersion.

**Model Uses Regulatory DEFAULT Options:

1. Final Plume Rise.
2. Stack-tip Downwash.

3. Buoyancy-induced Dispersion.
4. Use Calms Processing Routine.
5. Not Use Missing Data Processing Routine.
6. Default Wind Profile Exponents.
7. Default Vertical Potential Temperature Gradients.
8. "Upper Bound" Values for Supersquat Buildings.
9. No Exponential Decay for RURAL Mode

**Model Assumes Receptors on FLAT Terrain.

**Model Assumes No FLAGPOLE Receptor Heights.

**Model Calculates 1 Short Term Average(s) of: 24-HR
and Calculates PERIOD Averages

**This Run Includes: 15 Source(s); 1 Source Group(s); and 6 Receptor(s)

**The Model Assumes A Pollutant Type of: SPM

**Model Set To Continue RUNning After the Setup Testing.

**Output Options Selected:

Model Outputs Tables of PERIOD Averages by Receptor

Model Outputs Tables of Highest Short Term Values by Receptor (RECTABLE Keyword)

Model Outputs Tables of Overall Maximum Short Term Values (MAXTABLE Keyword)

Model Outputs External File(s) of High Values for Plotting (PLOTFILE Keyword)

**NOTE: The Following Flags May Appear Following CONC Values: c for Calm Hours
m for Missing Hours
b for Both Calm and Missing Hours

**Misc. Inputs: Anem. Hgt. (m) = 10.00 ; Decay Coef. = 0.000 ; Rot. Angle = 180.0
Emission Units = (GRAMS/(SEC-M**2)) ; Emission Rate Unit Factor = 0.10000E+07
Output Units = MICROGRAM/M**3

**Approximate Storage Requirements of Model = 1.2 MB of RAM.

**Input Runstream File: LEKHAW.INP
**Output Print File: LEKHAW.OUT
**Detailed Error/Message File: ERRORS.LST

*** ISCST3 - VERSION 02035 *** *** AIR QUALITY IMPACT DUE TO LEKHAPANI OCP OF NEC ***
07/25/09
*** *** 12:35:48

**MODELOPTs:
CONC RURAL FLAT DFAULT

*** AREA SOURCE DATA ***

SOURCE ID	NUMBER PART. CATS.	EMISSION RATE (USER UNITS /METER**2)	COORD (SW CORNER) X (METERS)	Y (METERS)	BASE ELEV. (METERS)	RELEASE HEIGHT (METERS)	X-DIM OF AREA (METERS)	Y-DIM OF AREA (METERS)	ORIENT. OF AREA (DEG.)	INIT. SZ (METERS)	EMISSION RATE SCALAR VARY BY
LINE1	0	0.29200E-03	1459.0	855.0	0.0	1.00	88.00	30.00	85.00	0.00	
LINE2	0	0.29200E-03	1462.0	934.0	0.0	1.00	30.00	80.00	171.00	0.00	
LINE3	0	0.29200E-03	1463.0	1000.0	0.0	1.00	30.00	65.00	180.00	0.00	
LINE4	0	0.29200E-03	1445.0	1060.0	0.0	1.00	30.00	63.00	163.00	0.00	

LINE5	0	0.29200E-03	1403.0	1106.0	0.0	1.00	30.00	62.00	136.00	0.00
LINE6	0	0.29200E-03	1329.0	1136.0	0.0	1.00	30.00	80.00	111.00	0.00
LINE7	0	0.29200E-03	1263.0	1143.0	0.0	1.00	30.00	66.00	170.00	0.00
LINE8	0	0.29200E-03	1189.0	1126.0	0.0	1.00	30.00	70.00	75.00	0.00
LINE9	0	0.29200E-03	1005.0	1049.0	0.0	1.00	30.00	200.00	68.00	0.00
LINE10	0	0.40800E-04	957.0	415.0	0.0	1.00	20.00	30.00	106.00	0.00
LINE11	0	0.40800E-04	977.0	390.0	0.0	1.00	20.00	30.00	142.00	0.00
LINE12	0	0.40800E-04	995.0	367.0	0.0	1.00	20.00	26.00	170.00	0.00
SIDE	0	0.26990E-05	1086.0	383.0	0.0	2.00	95.00	85.00	158.00	0.00
PIT	0	0.75200E-04	1194.0	759.0	0.0	1.00	520.00	237.00	151.00	0.00
EXTOB	0	0.58060E-04	894.0	1557.0	0.0	60.00	785.00	439.00	149.00	0.00

*** ISCST3 - VERSION 02035 *** *** AIR QUALITY IMPACT DUE TO LEKHAPANI OCP OF NEC ***
07/25/09
*** *** 12:35:48

**MODELOPTs:
CONC RURAL FLAT DFAULT

*** SOURCE IDs DEFINING SOURCE GROUPS ***

GROUP ID SOURCE IDs

ALL LINE1 , LINE2 , LINE3 , LINE4 , LINE5 , LINE6 , LINE7 , LINE8 , LINE9 , LINE10 , LINE11 , LINE12 , SIDE , PIT , EXTOB ,

*** ISCST3 - VERSION 02035 *** *** AIR QUALITY IMPACT DUE TO LEKHAPANI OCP OF NEC *** 07/25/09

*** *** 12:35:48

**MODELOPTs:

CONC RURAL FLAT DFAULT

*** DISCRETE CARTESIAN RECEPTORS ***
(X-COORD, Y-COORD, ZELEV, ZFLAG)
(METERS)

(1381.0, 1519.0, 0.0, 0.0); (427.0, 699.0, 0.0, 0.0);
(-517.0, -396.0, 0.0, 0.0); (240.0, 2246.0, 0.0, 0.0);
(2666.0, 3012.0, 0.0, 0.0); (909.0, 3280.0, 0.0, 0.0);

```
 *** ISCST3 - VERSION 02035 ***    *** AIR QUALITY IMPACT DUE TO LEKHAPANI OCP OF NEC                    ***
07/25/09
                         ***                                                  ***        12:35:48
**MODELOPTs:
CONC                RURAL FLAT       DFAULT
```

*** METEOROLOGICAL DAYS SELECTED FOR PROCESSING ***
(1=YES; 0=NO)

```
1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1 1 1 1 1
1 1 1 1 1 1 1 1 1 1  1 1 1 1 1 1
```

NOTE: METEOROLOGICAL DATA ACTUALLY PROCESSED WILL ALSO DEPEND ON WHAT IS INCLUDED IN THE DATA FILE.

*** UPPER BOUND OF FIRST THROUGH FIFTH WIND SPEED CATEGORIES ***
(METERS/SEC)

1.54, 3.09, 5.14, 8.23, 10.80,

*** WIND PROFILE EXPONENTS ***

STABILITY	WIND SPEED CATEGORY					
CATEGORY	1	2	3	4	5	6
A	.70000E-01	.70000E-01	.70000E-01	.70000E-01	.70000E-01	.70000E-01
B	.70000E-01	.70000E-01	.70000E-01	.70000E-01	.70000E-01	.70000E-01
C	.10000E+00	.10000E+00	.10000E+00	.10000E+00	.10000E+00	.10000E+00
D	.15000E+00	.15000E+00	.15000E+00	.15000E+00	.15000E+00	.15000E+00
E	.35000E+00	.35000E+00	.35000E+00	.35000E+00	.35000E+00	.35000E+00
F	.55000E+00	.55000E+00	.55000E+00	.55000E+00	.55000E+00	.55000E+00

*** VERTICAL POTENTIAL TEMPERATURE GRADIENTS ***

(DEGREES KELVIN PER METER)

STABILITY	WIND SPEED CATEGORY					
CATEGORY	1	2	3	4	5	6
A	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00
B	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00
C	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00
D	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00	.00000E+00
E	.20000E-01	.20000E-01	.20000E-01	.20000E-01	.20000E-01	.20000E-01
F	.35000E-01	.35000E-01	.35000E-01	.35000E-01	.35000E-01	.35000E-01

*** ISCST3 - VERSION 02035 *** *** AIR QUALITY IMPACT DUE TO LEKHAPANI OCP OF NEC *** 07/25/09

*** *** 12:35:48

**MODELOPTs:

CONC RURAL FLAT DFAULT

*** THE FIRST 24 HOURS OF METEOROLOGICAL DATA ***

FILE: LEKHA.MET

FORMAT: (4I2,2F9.4,F6.1,I2,2F7.1,f9.4,f10.1,f8.4,i4,f7.2)

SURFACE STATION NO.: 99999 UPPER AIR STATION NO.: 99999

NAME: LEKHA NAME: LEKHA

YEAR: 2009 YEAR: 2009

YR	MN	DY	HR	FLOW VECTOR	SPEED (M/S)	TEMP (K)	STAB CLASS	MIXING HEIGHT (M) RURAL	MIXING HEIGHT (M) URBAN	USTAR (M/S)	M-O LENGTH (M)	Z-0 (M)	IPCODE	PRATE (mm/HR)
09	03	13	01	45.0	1.68	293.2	3	700.0	700.0	0.0000	0.0	0.0000	0	0.00
09	03	13	02	22.5	1.12	293.8	3	700.0	700.0	0.0000	0.0	0.0000	0	0.00
09	03	13	03	45.0	1.40	294.4	2	800.0	800.0	0.0000	0.0	0.0000	0	0.00
09	03	13	04	22.5	1.96	294.7	3	1000.0	1000.0	0.0000	0.0	0.0000	0	0.00
09	03	13	05	45.0	1.12	295.6	2	1000.0	1000.0	0.0000	0.0	0.0000	0	0.00
09	03	13	06	45.0	1.68	295.5	5	1000.0	1000.0	0.0000	0.0	0.0000	0	0.00
09	03	13	07	45.0	1.12	297.3	1	1000.0	1000.0	0.0000	0.0	0.0000	0	0.00
09	03	13	08	45.0	1.40	297.9	1	1000.0	1000.0	0.0000	0.0	0.0000	0	0.00
09	03	13	09	45.0	1.12	298.7	1	1000.0	1000.0	0.0000	0.0	0.0000	0	0.00
09	03	13	10	45.0	1.40	299.2	1	1000.0	1000.0	0.0000	0.0	0.0000	0	0.00
09	03	13	11	22.5	1.96	298.8	1	1000.0	1000.0	0.0000	0.0	0.0000	0	0.00
09	03	13	12	90.0	2.52	298.5	5	900.0	1260.0	0.0000	0.0	0.0000	0	0.00
09	03	13	13	45.0	2.24	297.6	4	1000.0	1000.0	0.0000	0.0	0.0000	0	0.00
09	03	13	14	45.0	2.52	297.1	3	1000.0	1000.0	0.0000	0.0	0.0000	0	0.00
09	03	13	15	45.0	1.96	296.5	5	750.0	750.0	0.0000	0.0	0.0000	0	0.00

09 03 13 16 45.0 1.68 296.1 5 1000.0 1000.0 0.0000 0.0 0.0000 0 0.00
09 03 13 17 45.0 1.40 295.6 5 1000.0 1000.0 0.0000 0.0 0.0000 0 0.00
09 03 13 18 22.5 1.40 294.8 4 1000.0 1000.0 0.0000 0.0 0.0000 0 0.00
09 03 13 19 45.0 1.68 294.0 4 1000.0 1000.0 0.0000 0.0 0.0000 0 0.00
09 03 13 20 45.0 1.40 293.7 4 1000.0 1000.0 0.0000 0.0 0.0000 0 0.00
09 03 13 21 45.0 1.50 293.3 4 1000.0 1000.0 0.0000 0.0 0.0000 0 0.00
09 03 13 22 45.0 1.36 291.6 4 700.0 700.0 0.0000 0.0 0.0000 0 0.00
09 03 13 23 22.5 1.12 293.2 3 800.0 800.0 0.0000 0.0 0.0000 0 0.00
09 03 13 24 45.0 1.12 293.5 4 1000.0 1000.0 0.0000 0.0 0.0000 0 0.00

*** NOTES: STABILITY CLASS 1=A, 2=B, 3=C, 4=D, 5=E AND 6=F.
FLOW VECTOR IS DIRECTION TOWARD WHICH WIND IS BLOWING.

*** ISCST3 - VERSION 02035 *** *** AIR QUALITY IMPACT DUE TO LEKHAPANI OCP OF NEC *** 07/25/09

*** *** 12:35:48

**MODELOPTs:
CONC RURAL FLAT DFAULT

*** THE PERIOD (24 HRS) AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***

INCLUDING SOURCE(S): LINE1 , LINE2 , LINE3 , LINE4 , LINE5 , LINE6 , LINE7 , LINE8 , LINE9 , LINE10 , LINE11 , LINE12 , SIDE , PIT , EXTOB ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF SPM IN MICROGRAM/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	X-COORD (M)	Y-COORD (M)	CONC
1381.00	1519.00	0.00000	427.00	699.00	66.50941
-517.00	-396.00	64.52030	240.00	2246.00	0.00000
2666.00	3012.00	0.00000	909.00	3280.00	0.00000

*** ISCST3 - VERSION 02035 *** *** AIR QUALITY IMPACT DUE TO LEKHAPANI OCP OF NEC ***
07/25/09
*** *** 12:35:48

**MODELOPTs:
CONC RURAL FLAT DFAULT

*** THE 1ST HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***
INCLUDING SOURCE(S): LINE1 , LINE2 , LINE3 , LINE4 , LINE5 , LINE6 , LINE7 , LINE8 , LINE9 , LINE10 , LINE11 , LINE12 , SIDE , PIT , EXTOB ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF SPM IN MICROGRAM/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
1381.00	1519.00	0.00000	(00000000)	427.00	699.00	66.50941	(09031324)
-517.00	-396.00	64.52030	(09031324)	240.00	2246.00	0.00000	(00000000)
2666.00	3012.00	0.00000	(00000000)	909.00	3280.00	0.00000	(00000000)

*** ISCST3 - VERSION 02035 *** *** AIR QUALITY IMPACT DUE TO LEKHAPANI OCP OF NEC *** 07/25/09

*** *** 12:35:48

**MODELOPTs:

CONC RURAL FLAT DFAULT

*** THE 2ND HIGHEST 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***

INCLUDING SOURCE(S): LINE1 , LINE2 , LINE3 , LINE4 , LINE5 , LINE6 , LINE7 , LINE8 , LINE9 , LINE10 , LINE11 , LINE12 , SIDE , PIT , EXTOB ,

*** DISCRETE CARTESIAN RECEPTOR POINTS ***

** CONC OF SPM IN MICROGRAM/M**3 **

X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)	X-COORD (M)	Y-COORD (M)	CONC	(YYMMDDHH)
1381.00	1519.00	0.00000	(00000000)	427.00	699.00	0.00000	(00000000)
-517.00	-396.00	0.00000	(00000000)	240.00	2246.00	0.00000	(00000000)
2666.00	3012.00	0.00000	(00000000)	909.00	3280.00	0.00000	(00000000)

*** ISCST3 - VERSION 02035 *** *** AIR QUALITY IMPACT DUE TO LEKHAPANI OCP OF NEC *** 07/25/09

*** *** 12:35:48

**MODELOPTs:

CONC RURAL FLAT DFAULT

*** THE MAXIMUM 6 24-HR AVERAGE CONCENTRATION VALUES FOR SOURCE GROUP: ALL ***

INCLUDING SOURCE(S): LINE1 , LINE2 , LINE3 , LINE4 , LINE5 , LINE6 , LINE7 , LINE8 , LINE9 , LINE10 , LINE11 , LINE12 , SIDE , PIT , EXTOB ,

** CONC OF SPM IN MICROGRAM/M**3 **

RANK CONC (YYMMDDHH) AT RECEPTOR (XR,YR) OF TYPE RANK CONC (YYMMDDHH) AT RECEPTOR (XR,YR) OF TYPE

- -

1.	66.50941 (09031324) AT (427.00, 699.00) DC	4.	0.00000 (00000000) AT (0.00, 0.00)
2.	64.52030 (09031324) AT (-517.00, -396.00) DC	5.	0.00000 (00000000) AT (0.00, 0.00)
3.	0.00000 (00000000) AT (0.00, 0.00)	6.	0.00000 (00000000) AT (0.00, 0.00)

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

*** ISCST3 - VERSION 02035 *** *** AIR QUALITY IMPACT DUE TO LEKHAPANI OCP OF NEC *** 07/25/09

*** *** 12:35:48

**MODELOPTs:

CONC RURAL FLAT DFAULT

*** THE SUMMARY OF MAXIMUM PERIOD (24 HRS) RESULTS ***

** CONC OF SPM IN MICROGRAM/M**3 **

GROUP ID		AVERAGE CONC	RECEPTOR (XR, YR, ZELEV, ZFLAG)				NETWORK OF TYPE	GRID-ID
ALL	1ST HIGHEST VALUE IS	66.50941 AT (	427.00,	699.00,	0.00,	0.00)	DC	NA
	2ND HIGHEST VALUE IS	64.52030 AT (	-517.00,	-396.00,	0.00,	0.00)	DC	NA
	3RD HIGHEST VALUE IS	0.00000 AT (	0.00,	0.00,	0.00,	0.00)		
	4TH HIGHEST VALUE IS	0.00000 AT (	0.00,	0.00,	0.00,	0.00)		
	5TH HIGHEST VALUE IS	0.00000 AT (	0.00,	0.00,	0.00,	0.00)		
	6TH HIGHEST VALUE IS	0.00000 AT (	0.00,	0.00,	0.00,	0.00)		
	7TH HIGHEST VALUE IS	0.00000 AT (	0.00,	0.00,	0.00,	0.00)		
	8TH HIGHEST VALUE IS	0.00000 AT (	0.00,	0.00,	0.00,	0.00)		
	9TH HIGHEST VALUE IS	0.00000 AT (	0.00,	0.00,	0.00,	0.00)		
	10TH HIGHEST VALUE IS	0.00000 AT (	0.00,	0.00,	0.00,	0.00)		

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

*** ISCST3 - VERSION 02035 *** *** AIR QUALITY IMPACT DUE TO LEKHAPANI OCP OF NEC ***
07/25/09
*** *** 12:35:48
**MODELOPTs: PAGE 12
CONC RURAL FLAT DFAULT

*** THE SUMMARY OF HIGHEST 24-HR RESULTS ***

** CONC OF SPM IN MICROGRAM/M**3 **

GROUP ID	AVERAGE CONC	DATE (YYMMDDHH)	NETWORK RECEPTOR (XR, YR, ZELEV, ZFLAG)	OF TYPE	GRID-ID
ALL	HIGH 1ST HIGH VALUE IS	66.50941	ON 09031324: AT (427.00, 699.00, 0.00, 0.00)	DC	NA
	HIGH 2ND HIGH VALUE IS	0.00000	ON 00000000: AT (0.00, 0.00, 0.00, 0.00)		

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

*** ISCST3 - VERSION 02035 *** *** AIR QUALITY IMPACT DUE TO LEKHAPANI OCP OF NEC ***
07/25/09
*** *** 12:35:48

**MODELOPTs:
CONC RURAL FLAT DFAULT

*** Message Summary : ISCST3 Model Execution ***
--------- Summary of Total Messages --------
A Total of 0 Fatal Error Message(s)
A Total of 0 Warning Message(s)
A Total of 0 Informational Message(s)

******** FATAL ERROR MESSAGES ********
*** NONE ***

******** WARNING MESSAGES ********
*** NONE ***

****
*** ISCST3 Finishes Successfully ***
****

By examining the result of the model we can say that the project will not have any significant impact as the increase in the dust concentration is estimated to be marginal.

It can be seen from below that the maximum values of SPM are much less than the permissible values specified in NAAQS.

From the Air Quality Modeling results and also by analyzing the data generated for the Environment Baseline Study it can be concluded that the Lekhapani OCP shall not have any significant impact in the increase in pollution level.

Predicted concentration of SPM at different station in ug/m^3.

Stn Code	Stations	Background conc. (SPM)	Incremental conc. (SPM)	Total predicted concentration	NAAQS Standards
A1	Core zone (proposed mine area)	55	00	55	500
A2	Core zone – near Bhanga pool (proposed mine area)	58	66.5	124.5	500
A3	Dense forest (Buffer zone)	89	64.5	153.5	200
A4	Near Burma Camp (Buffer zone)	77	00	77	200
A5	Lalpahar Village (Buffer zone)	81	00	81	200
A6	Sindhi gaon (Buffer zone)	89	00	89	200

4.2.2 AIR POLLUTION CONTROL MEASURES

As per AQIP resultant SPM value seems to be low and well within the permissible limits. Even in the buffer zone at only one location (in the down wind direction) have some incremental value of SPM and rest other three location of buffer zone the incremental is zero, where the habitat area lies.

The measures taken (both preventive and suppressive) shall be as enumerated below:

- **Drilling operation**

The following steps will be taken to reduce dust generation:

- All the drills will be equipped with well-designed dust extractor arrangement. Again, the thrust shall be put on their proper maintenance and handling.

- **Blasting operation**

The following practices will be maintained:

- Appropriate design of the geometry of blast holes.
- Use of proper amount of explosive taking into consideration the geo-mechanical conditions of the site.
- Controlled blasting will usually be done in daytime during the shift change over period.
- The operation shall be in conformity to the extant laws with more closer control of blasting parameters including results of blasting like desired fragmentation, permitted vibration, etc.

- **Loading and transport**

The following measures will be taken:

- Surfacing of all service roads/permanent roads by asphalt.
- The length of haul road will be reduced to the minimum possible. The permanent haul roads will be boulder pitched and maintained properly.
- The unmetalled roads shall be kept free of ruts, potholes, etc.
- Regular maintenance of HEMM engines to limit emission of harmful exhaust fumes.
- Provision of gas filter for exhaust fumes from HEMM.
- Frequent and at regular intervals, water will be sprayed on haul roads, service roads. Mobile water sprinklers will be provided in the project for dust suppression.
- Physical removal of dust from the roads.
- Greenbelts around quarry, industrial sites, service building area besides avenue plantation along roads.
- Suppression of coal dust during coal handling by fine nozzle mounted fixed sprinklers.

Sufficient water sprinkler shall be provided for dust suppression for main haul roads, approach roads.

❁ **Fires at coalfaces, coal stockyards**

(a) **At coal faces**

To prevent and control such fires, the following measures will be taken:

- Exposures of coal benches for long time will be avoided.
- Provision of adequate fire fighting arrangements including storage of sufficient quantity of water at all critical points.
- Careful removal of all loose coal from the abandoned coal faces.
- Regular supervision.

(b) **At coal stockyards**

- Limiting the amount of stock by giving close attention to marketing besides following the "first-in and first-out" sequence.
- Attention to the following while stacking of coal:
  - Proper dimensions of stack (height to be limited to not more than 8m).
  - Dozing/compaction to make the stock semi-consolidated.
  - Regular and strict supervision of stacks.
  - Provision of fire fighting arrangement with supply of adequate quantity of water at sufficient pressure.
  - Infusion of nitrogen along with new fire fighting chemicals like 'Soil-Cement', through perforated pipes laid in the grooves made on the ground to delay spontaneous heating by reducing/preventing ingress of oxygen or air into the stack.

4.3 IMPACT ASSESSMENT & POLLUTION CONTROL MEASURES FOR WATER

4.3.1 IMPACT ASSESSMENT ON WATER QUALITY

Likely sources of water pollution from this project along with the type of pollutants are as follows:

(i)	Sanitary (domestic) wastewater	:	Suspended solids and BOD.
(ii)	Industrial wastewater from workshop	:	Suspended solids, oil & grease;
(iii)	Wastewater from mine	:	Suspended solids of coal, clay and oil;
(iv)	Surface run-off passing through coal stockpiles	:	Suspended solids;
(v)	Storm water from leasehold area and built-up area	:	Suspended solids.

MINE WATER DISCHARGE

The pumping system of Lekhapani Opencast mine has been designed to dewater the inflow of water due to precipitation falling within the active pit limit during the monsoon season.

The area is characterised by rugged hilly terrain with elevations ranging from lower heights in the southern part of the western half of the block (with reference to colliery Bench-mark) to 675.24m in south eastern part. However, the elevation above mean sea level ranges from 280.00m to 520.00m in the eastern part of the block. In general the ground slope is towards north but it is towards north & south both in central and western parts of the block. The surface contours, floor contours, and RL values of boreholes are with respect to local drainage level (named zero level by NEC). It is 155.24m above mean-sea-level. Therefore, to arrive at values of contours and borehole RL with respect to M.S.L, 155.24m should be deducted from their respective values. The Lekhapani river in the north and the Tipong river in south control the drainage of the block. The water flowing from northerly slopes feeds the Lekhapani river. The Lekhapani river flows from SW to NE and joins the Tirap river, which flows from east to west. The water flowing from southerly slopes feed the Tipong river flowing from south to north.

The atmospheric precipitation is non-uniform during the year. The maximum precipitation will be during the period of about five months (June to October) in a year. During dry season, say November to May, seepage from strata is expected to be moderate and the same can be dealt by running a few number of pumps provided for monsoon pumping. During this period, repair & overhauling of the pumps will be done by rotation.

The make of water during a day of peak rainfall in monsoon will be handled by the main pumps.

Pumping system has been designed for the volume of water accumulated in the mine at the final stage of production considering maximum daily rainfall 190mm.

The quality of effluent generated from the mining activities can only be assessed once the project starts. It can be assumed that the likely effluent generated from the proposed Lekhapani OCP will also be well within permissible limits. However, special care shall be taken to ensure implementation of proper safeguards in respect of effluent quality discharge from mine.

WORKSHOP DISCHARGE

The HEMM will be deployed through outsourcing/contractor. However, special care shall be taken to ensure implementation of proper safeguards in respect of effluent quality discharge from the workshop.

In Lekhapani OCP water in the workshop shall be used for washing of heavy mining machinery, which would be discharged. The effluent generated from the workshop is expected to contain mainly suspended solids and oil and grease. For removal of oil and grease and suspended solids, provision of effluent treatment have been proposed. The clear water obtained shall be re-circulated for use. The workshop effluent discharged to nearby water surface will affect the water quality if not treated before discharge.

COLONY SEWERAGE AND INDUSTRIAL SEWERAGE

Colony Sewerage and Industrial Sewerage have been proposed to be dealt through septic tank and soak pits.

4.3.1.1 IMPACT OF MINING ON GROUND WATER SYSTEM

The impact of opencast mining on local water regime largely depends on mine geometry, groundwater recharge potential and aquifer parameters of the formations and Materials present in formation such as pyrite etc. In opencast mine, the aquifer units lying above the bottom most working seam contributes the major inflow and prone to get effected.

As the permeability decreases with depth, the inflow from lower most formations is also reduces proportionally and marginal to negligible impact may be anticipated. As the unconfined aquifer (i.e. the OB benches), with comparatively high K, contributes the maximum inflow and the exposed hydrogeological unit receives the maximum impact. With the presence of multiple-aquifer system and low permeability of the lower aquifer units, the drawdown cones in the lower hydrogeological units will be small and stacked.

In Lekhapani OCP area where the aquifer is intermixed with shale, siltstone ,clay and mudstones and exhibits poor aquifer qualities, the impact on water levels is going to be minimum and there by restricting the radius of influence. Presence of perennial nallas flowing close to the mine may recharge and reduce this effect.

RADIUS OF INFLUENCE*:*

As mentioned earlier, because of the poor permeability of lower aquifer units, the impact of mining on local water regime will be marginal and the radius of influence will be limited to a small distance. So also, due to stratification of clay, siltstone, claystone, shale and in high dipping strata the individual permeable beds develop individual drawdown cones and the impact is usually limited to few hundred meters.

However, to estimate a probable zone of influence, dewatering of the entire unconfined aquifer was considered. As the permeability is likely to vary and reduce largely in the mine area due to presence of clay & mudstone, the radius of influence was estimated considering a permeability of 0.5 m/day.

The radius of influence (R) for Lekhapani O.C mine is calculated by using Sichardt's formula ($R = c*(h-h_w)*\sqrt{k}$):

Project	Mine depth (m)	Maximum probable drawdown (m)	Radius of influence (m) K=1.0 m/d
Lekhapani OCP	335	39	282

Say 300m.

With the variation in aquifer/mine geometry, multi-aquifer system, return flow from mine discharge, abundant recharge due to rain and nearby nalla the zone of disturbance will be reduced further. Thus, the radius of influence will be limited to a small distance.

As it is practiced, after passing through the E.T.P. after treated with lime, the treated mine water is discharged into the local drainage/tanks.

IMPACTS AND MITIGATORY MEASURES:

Impact on Topography & Drainage:

Pre-mining elevation of topography varies from 430 m to 675 m above M.S.L. Post mining elevation after back filling and leveling varies form 360 m to 550m above M.S.L. The impact of the total mining area (0.96 Sq. Km.) on catchments area of Lekhapani (38 Sq. Kms) is very small and this worked out to be 2.5% of the total catchments area. Moreover rain water which falls on the mining area will also be pumped out in the drainage system after treatment. Hence there is no impact on drainage quantitatively. A void of 47 Ha will be left at the closure of mine. This void will have a depth of 35m and will be filled with water to recharge aquifers and to prevent acid mine drainage formation.

Impact on Surface Water Quality and Sediment Load:

Mining activity increases sediment load and total dissolved solids in streams due to erosion activity of over burden dumps and loosened top soil by blasting activity.

Following steps will be taken up by NEC to reduce this load:

1) Dense Plantation.

2) Construction of Siltation Pond.

3) Construction of Garland drainage

4) Construction Gabbion Wall

Analyses of surface water (from Lekhapani nalla) during pre-mining condition indicate that the total dissolved solids (TDS) varies from 203 to 316mg/l and pH 6.6-6.9 which is well within the IS 2296 standards. (Table 6B). This will be maintained during mining period.

Changes in Aquifer Properties:

Internal dumping of lose overburden material may increase the permeability of the aquifer within the mined out area.

Groundwater flow direction gets disturbed due to continuous dewatering activity and the water level in the surrounding also get affected. It is predicted for this mine that water level upto a distance of 300 m may get affected and the direction of ground water flow reversed. However the presence of clay, shale, silt stone and mudstone may restrict the expansion of the cone of depression thereby limiting the radius of influence. Presence of Ledopani nalla close to the mining area may also restrict the radius of influence acting as a positive recharge boundary.

Changes in Ground Water Quality:

ACID MINE DRAINAGE

Dissolved constituents in water from unsaturated mine spoils and dumps are more concentrated than those formed in the undisturbed aquifer. Minerals that had originally resided in saturated zone where the potential for oxidation was slight now may lie in the unsaturated zone where weathering and oxidation can release soluble salts. Presence of pyrite and sulphur content in coal may make the water acidic due to formation of sulphuric acid due to weathering and oxidation activity. The present pH of groundwater is 7.3 (Table 6A). Mine effluent water of Tirap O.C has pH of 5.1 (acidic) Table 6C. Due to presence of pyrite and high sulphur content in coal acid drainage is expected in this mine.

ACID MINE DRAINAGE PREVENTION

The following steps are recommended to prevent and slowdown acid mine drainage activity:

BY not leaving mined-out area exposing overburden material for weathering and oxidation of pyrites.

Identification of pyrite layer and isolating the pyrite layer and filling them at deeper level during internal dumping activity so that water level will rise above them and prevent oxidation activity.

Filling mined out voids immediately with water to prevent oxidation of pyrite which gives rise to formation of sulphuric acid.

Capping landfills (External dump) with impervious material such as clay.

Ten exploratory boreholes drilled in Lekhapani block indicate no presence of pyrite in the overburden material as a continuous or lensoidal bed. However coal has high sulphur content in from of pyrite and organic sulphur. (1.8-3.8%) The formation such as clay, siltstone, mudstone and shale which has poor conductivity from the base of the 60′ seam. They are seen outcropping on the outside of the steep dipping coal seam on the dip-side. This may prevent outward movement of groundwater which will accumulate in the mine after closure of mine and thereby preventing intermixing with groundwater on lower plains.

ACID MINE DRAINAGE TREATMENT

Acid mine drainage (pH<4) may occur if the OB formation/Coal with high sulphur content is left exposed to an moist condition to undergo oxidation to form acid giving rise to acid mine Drainage. Mine water at the time of working may have acidity (upto pH 5).

(1) Mine water is to be treated with lime to raise the pH > 6.5 before the water is discharged in to nallah :

(2) At the closure of the mine, it should be flooded with water to present further Oxidation activity and avoid Acid Mine Drainage.

Conservation Measures :

The treated mine discharge will be effectively utilized to meet the mine's needs, dust suppression and other industrial water needs.

After the cessation of mining, the mine will be filled up with nallah water to prevent oxidation of coal and O.B material of mine faces to give rise to acid drainages. Thus, the impact of mining on groundwater quality may be reduced.

With no processing activity in coal mining, the mine water is free from any pollutants. However, with movement of HEMM and overburden/coal handling, the discharge will have high TSS. To reduce the TSS and increase the pH the mine water is discharged after passing through siltation pond and the E.T.P. after treatment with lime. Hence, the quality of groundwater in and around the mine will be protected/ maintained as per the standards stipulated by the regulatory authorities.

After cessation of mining, part of quarry area will be reclaimed with highly permeable overburden material. Thereby, in post-mining condition, the recharge and source potential in core zone will be much higher than the existing condition. The open void (47 Ha) which will be left inside the mine after backfilling will be filled with water and act as surface water storage. This water can be gainfully used for irrigation and also it will induce recharge to ground water. Proper safety measures will be taken by project authorities to provide proper slope, fence, and hedge plants to prevent animals falling into the water body. This water body can be converted into picnic spot and pisci-cultured.

So also, the discharged mine water has been gainfully utilized by the local people for irrigation and domestic use. Thereby the mine water is a resource for many of the local villagers.

FUTURE STRATEGY:

To assess the impact in time and space, a close monitoring network around the mine area has been identified and quarterly water levels to be monitored.

For observing the impact on aquifer system, shallow and deeper piezometers will be constructed for monitoring the unconfined and confined aquifers respectively.

They will be constructed in a protected place and monitored quarterly. (Feb, May, Aug and Nov).

The water quality is monitored under routine monitoring.

On analysing the data if any area is found to be receiving the maximum impact control measures will be suggested and implemented by the project authorities.

Effective utilisation of mine water both in the industry and by local public.

Acid mine drainage study has been under taken in this area, monitoring is in progress.

4.4 IMPACT ASSESSMENT & CONTROL MEASURES FOR NOISE & BLASTING

The sources of noise will be:

- Drilling operation in OB.
- Blasting for overburden
- Operation of HEMMs like shovels, dumpers, dozers, graders, front-end loaders, etc
- Operation of equipment in workshop, etc.

The noise associated with mining activities may be classified into three types

- Continuous
- Intermittent
- Impulse

The workmen associated with the operation of HEMMs, etc. will experience a noise level above stipulated 90 dB (A) [DGMS Circular, No.18 (Tech.) of 1975] for more than 4-4.5 hours per shift. Unless suitable mitigatory measures are taken, high noise pollution will have impact on the workmen. It is worthwhile to mention that intermittent and impulse noises are considered to be less dangerous than continuous noise due to the short exposure duration except under the situation when the level exceeds 115 dB (A).

4.4.1 IMPACT OF NOISE NUISANCE & BLASTING

The ambient noise level of the project will be monitored regularly. Noise levels are likely to remain within the limits of the prescribed standard. So the noise produced from this project will not have auditory, non-auditory, masking effects, etc. as suitable mitigation measures shall be taken in the project.

Controlled blasting technique will be adopted in the project. So, there will be no adverse effects on life, property and ambient noise.

Acceptable noise levels

Assessment of impact of noise nuisance of a workplace can be achieved by comparing the level with TLV prescribed by the DGMS. The acceptable noise levels for residential, commercial and other institutional areas prescribed by the Central Pollution Control Board are given in Chapter III.

4.4.2 NOISE POLLUTION CONTROL MEASURES

The following measures shall be taken :

- Proper designing of plant & machinery by providing in-built mechanisms like silencers, mufflers and enclosures for noise generating parts and shock absorbing pads at the foundation of vibrating equipment.
- Routine maintenance of equipment.
- Rational deployment of noise generating plant and machinery.
- Greenbelts around the safety zone besides avenue plantation on both sides of the roads to maintain noise level at night time within the limit for the inhabited localities situated at a very close proximity.
- HEMMs with sound proof cabins.
- Personal protective devices to all the persons working in high noise areas.
- Regular monitoring of noise levels at various points.

4.4.3 BLASTING VIBRATION CONTROL MEASURES

- **Measures for safe blasting**

Due attention will be given to the following factors:

(a) All provisions of Coal Mines Regulations will be followed.

(b) Quantity of explosive

The quantity of explosive will be decided as per condition imposed by DGMS.

(c) Stemming material

Stemming material to be used is sand. However, the drill cuttings and chips of triangular shape can be used as an effective stemming material with proper packing.

(d) Delay system

Use of millisecond delay detonators that are initiated by shock tube initiation system, between rows and between holes in the same row.

(e) Blasting time

Blasting will be done in day time during the shift change over period as per requirement. However, the frequency of blasting will depend upon the availability of land (tenancy in particular), DGMS permission for use of explosive, meteorological condition, geo-mining condition and method of mining.

(f) Warning

Before blasting is done, warning sound shall be given and placards/flags will be displayed so that people can move to safe places.

- **Vibration control**

- Proper conformation to measures for safe blasting as mentioned above, to avoid damage to any structure or annoyance to the people in the adjoining areas.
- Proper design factor will be taken while constructing various structures for stability against vibration.

- A safe blasting zone will be kept around the periphery of the quarry. This zone is kept free from village habitation and community infrastructure and thus impact of vibration after blasting on the surface structures is avoided.
- Controlled blasting will be done near built-up areas and surface features, as and when required.
- Special care will be taken to minimize any impact on rail line, National Highway 38 and residential areas.

4.5 IMPACT ON LAND RESOURCE AND ITS MANAGEMENT

IMPACT ON LAND RESOURCE

The break-up showing the types of land to be acquired for the project is given in table below. The safety zone is taken 100 m from quarry surface edge on the assumption that Controlled blasting techniques will be adopted during mining operation with prior permission from statutory/regulatory body.

Land requirement for the project

The total land requirement is 235.0 Ha. Headwise requirement of land as follows :

Sl.no.	Particulars	Hiring option (Land requirement in Ha)
1	Mining	80.0
2	Mine Periphery including haul roads, power supply arrangements etc.	15.0
3	External dumps	120.0
4	Office, Workshop, Store & repair facilities, Coal Stock Yard etc.	10.0
5	Approach road etc.	10.0
	Total	**235.0**

IMPACT ON LAND USE PATTERN

OB REMOVAL/ DUMPING STRATEGY

In view of the steep floor gradient, simultaneous backfilling of OB will not be possible with conventional strike faces and the entire waste will have to placed in the external dumps. Requirement of external dumping space depends on annual rate of production and the dumping strategy adopted.

The proposed sequence of mining is ideally suited for achieving the objective of placing maximum possible OB in the internal dumps. The proposed location of IMC gives earliest back-filling opportunity, owing to the relatively shallow depth. Thus external dump quantities will be minimized. The following design criteria have been considered for waste dumps.

i. OB to be dumped in 30 meter high decks.
ii. 40 m berm width for allowing safe transport, where necessary.
iii. Dump slope for each deck to be at natural angle of repose (37 degree)
iv. Track dozers to be deployed for shaping the dumps
v. Final reclamation will be achieved using the equipment provided for the purpose.

The adopted dumping strategy has enabled external dumps to be kept at bare minimum. A total of 120 hectares of land will be needed for this purpose. It is envisaged to accommodate about 50.32 Mm^3 of OB in the external dump. Balance 19.00 Mm^3 of OB will be accommodated in the internal dump constituting about 28% of the total OB.

LAND RECLAMATION

In OB dumps, berm & batter drain will be incorporated to control the effect of erosion on the dumps. In respect of both the external as well as internal dumps, the top surface will be graded with wide blade dozers. After the material has reached the final level to the extent possible, the filled spoil will be graded conforming to the surrounding ground profile. The making of green belt over the internal dump will be done simultaneously along with its build up. Since the area experiences heavy

rainfall for a prolonged period, nearly six months, there are better chances of growth of vegetation over the spoil.

During grading of the spoil dump, it will be difficult to totally avoid compaction due to deployment of heavy machinery. So, ripping will be resorted to for loosening of the graded spoil before soil cover is spread over it. For this purpose, dozer with ripper attachment is to be used. The ripping breaks up compaction and permits root penetration and also assists water infiltration and lessen run off. Biological reclamation will then be followed up giving better results.

Schematic final stage dump plan showing external dump on dip side is shown as **Plate No. X,** Post Mining Land Use Plan with Plantation & Water Body as **Plate No. XIII** and Cross Section across opencast mine at the end of mine as **Plate No. XII**.

LAND USE

There are several options available for land use pattern of the reclaimed land. The following factors have been considered for selection of appropriate land use pattern

- Pre-mining land use pattern
- Topsoil/sub-soil quality
- Socio-economic parameters of the area
- Availability of technology for land reclamation
- Climatic conditions of the area
- Local flora.

The alternatives available for utilising the reclaimed land are :

- Agricultural use
- Afforestation

The option for using the reclaimed backfilled area for agricultural purpose immediately is ruled out due to the following reasons :

- The reclaimed land is very different from its pre-mining conditions. It cannot sustain crops as the soil has poor fertility status. So the agriculture may prove uneconomic venture compared to afforestation.
- The development of soil regime for agriculture will take a considerable time.
- Reclamation is proposed to be done progressively and concurrently with mining operation. Carrying out agriculture within mining activity area by releasing reclaimed area in a phase-wise manner, may not be advisable from safety point of view.

In view of the above, it is suggested to utilise the reclaimed land for afforestation purpose which will help improve the soil status i.e texture and nutrient levels, etc.

❋ **Quarry and internal/external dumps**

A part of the decoaled area will be backfilled with overburden. Internal/external dumps will be reclaimed and then revegetated.

The remaining void in the quarry will be developed as water harvesting structure as well as public utility lagoon which will serve following purposes :

- Source of supply of water for industrial and fire fighting purposes.
- Source of supply of potable water after necessary treatment.
- A place of bathing and washing for the local population.
- Pisciculture.
- For recharging the aquifer in the area.

For such purposes, the pathway to the reservoir is gently graded and the depth of water is limited.

❋ **Industrial structures**

The industrial structures will be dismantled and salvaged. The equipment will be removed and used somewhere else. Every effort will be made to restore the area to economic utilisation value as per the mine closure plan.

❋ **Service buildings**

In association with the appropriate agencies (Central/State/Social Organisation), these buildings will be utilised for some beneficial purposes. No building will be abandoned to prevent unauthorised occupation. The vacant land within the leasehold area will be afforested and made fit for purposeful usage.

Stages of Land Reclamation

This is carried out in two distinct phases:

- Physical/technical reclamation.
- Biological reclamation.

❋ **Physical/technical reclamation**

uring the process, the geometrical shape of the internal dumps is altered to make it amenable to effective biological reclamation and also to provide safety and stability.

Backfilling & reshaping of internal dumps:

A part of the quarry will be backfilled with overburden. The backfilling will be carried out in a phased manner. Once the backfilling has reached a certain predetermined reduced level, the plots will be levelled, graded and cleared of large stone pieces lying on the surface. The slope of the ground will be made very gentle as far as possible (preferably less than 2%). The graded and levelled area will be divided into small sectors and small check bunds will be constructed to retain moisture and humus in the soil. The outer slope of each bench will be kept at the natural angle of repose of the spoil material and at overall slope angle of 24^{o} considering all benches.

The drainage arrangements for precipitation run-off are as follows :

- During working stage, the run-off will be collected from internal dump by foot drain for diverting to sump on mine floor for pumping.
- In the post-mining period, the drainage pattern of the reclaimed area will be such that the run-off will be diverted to final void of the quarry.

❋ **Topsoil management**

Topsoil from unbroken excavation areas will be scraped for progressive and concurrent utilization during physical/technical reclamation of backfilled area, thus obviating the necessity of large storage area of topsoil separately.

❋ **Biological reclamation**

For successful biological reclamation of the reclaimed area, preference will be given to endemic species and mixed culture. The species will be selected carefully from the following groups for quick reclamation :

- Nitrogen fixing tree species for fuel wood, timber and fodder
- Fruit bearing tree species
- Tree species with dense foliage for shade
- Flowering and ornamental tree species.

The list of the species recommended for afforestation on the overburden of mined out areas is as given below:

List of Species Suggested For Afforestation

Trees

Mangifera Indica
Anthocephallus Cadamba Mig
Azadirachta Indica A Juss
Delbergia Sisso Roxb
Accacia auriculiformis Benth
Leucaena leucocephala Dwit
Acacia arabica
Alastonia scholaris Roxb.
Delonix Regia Raf.
Melia azedarah L.

Shrubs,Grasses & Herbs

Adhatoda vesika

Calotropes gigantean

Ziziphus oenoplia Mill.

Bambusa arundinaceae Willd.

Cyperus rotendus L

Andropogon esiculatus Retz.

Clirodendron viscosum Vent.

Boerhaavia repensis

The above list is indicative and will only be finalized in consultation with Forest Department. During the life of mine efforts will be made for plantation of trees in all possible places e.g. OB dumps, road side, reclaimed area etc. These are expected to become habitat suitable for wild life.

(i) Details of Reclamation Technique

(a) Topsoil will be re-spread over the backfilled area.

(ii) Afforestation Programme

(a) The excavated area will be reclaimed concurrently with different phases of backfilling starting from 4th year of mine operation and will continue upto the end of mine life.

(b) To mitigate air pollution, it is desirable to provide a thick barrier of trees around the quarry edge. Three rows of plantation in the safety zone for blasting will be afforested. Avenue plantation will be done by the side of haul road on the surface, approach road.

(c) The details of progressive green belt development are given below:

The details of progressive green belt development

Period of Mine-life	Green belt development (Ha)	Plantation on Internal dump (Ha)	Plantation in External dump	Plantation in & around Infrastructure, colony , road etc. and after decommissioning of the above	Total area covered under plantation & Green Belt
At the end of 4th Year	-	-	-	-	-
At the end of 5th Year	-	-	3	-	3
At the end of 6th Year	-	-	3	-	3
At the end of 7th Year	-	-	4	-	4
At the end of 8th Year	-	-	4	-	4
At the end of 9th Year	-	-	4	-	4
At the end of 10th Year	-	-	4	-	4
At the end of 11th Year	-	-	4	-	4
At the end of 12th Year	-	-	4	-	4
At the end of 13th Year	-	-	6	-	6
At the end of 14th Year	-	-	6	-	6
At the end of 15th Year	-	-	6	-	6
At the end of 16th Year	-	-	6	-	6
At the end of 17th Year	-	-	6	-	6
At the end of 18th Year	-	-	6	-	6
At the end of 19th Year	-	-	6	-	6
At the end of 20th Year	-	-	6	-	6
At the end of 21th Year	-	-	6	-	6
At the end of 22th Year	-	-	6	-	6
At the end of 23th Year	-	-	6	-	6
At the end of 24th Year	-	-	6	-	6
At the end of 25th Year	-	-	6	-	6
At the end of 26th Year	-	6	6	-	12
At the end of 27th Year	-	6	6	-	12
At the end of 28th Year	-	22	-	6	28
Total		**34**	**120**	**06**	**160**

Gainful post-mining land utilization of mine lease area as highlighted in the table below:

Pre-mining vs post-mining land use

Land Use During Mining		Post –mining Land Use (Conceptual)	
Particulars	**Area (ha)**	**Particulars**	**Area (ha)**
1. Area to be excavated	80.0	Reclaimed (Internal dump) and afforested area Water Body Void	34.0 8.0 38.0
2. Mine Pheriphery & safety zone	15.0	Green belt (already exists)	15.0
3. Approach road	10.0	Community use	10.0
4. Coal storage & handling/office/Workshop/Store/power supply arrangements/ETP (including haul/service roads)	10.0	Decommisioning and Afforestation Existing plantation	6.0 4.0
5.External dumps	120.0	Reclaimed and afforested area	120.0
TOTAL	235.0	TOTAL	235.0

Post mining Land-use Plan of Core Zone has been enclosed as Plate No. XIII.

(iii) Financial outlay

The Capital expenditure for plantation/Biological reclamation is given below:

Sl#	Particulars	Amount
1	Biological reclamation of the OB dumps	Rs 50.0 lakh
2	Green belt development	Rs 20.0 lakh

Rs 50.00 Lakh par annum has also been envisaged for environment control measures including biological reclamation and green belt development as revenue expenditure.

Conclusion-

The environmental control measures suggested in the report are likely to significantly reduce the adverse impacts so that the mining operation can be undertaken in a environment friendly manner. Massive plantation has been planned for better environmental control.