Chapter-IV

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.

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 coal and overburden	:	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

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'07 to March '07 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.

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, Fugitive Dust Model (FDM) version 90121, 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 expansion of Tikak Extension 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 Dust Model (FDM) version 90121, Air Quality Model of USEPA. Estimation for increase in SPM, NO_X and SO_2 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 Tikak Extension OCP for the purpose of estimation of increase in SPM, SO_2 and NO_X were identified as-

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

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 2007, 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

Control Factors

The various control factors for dust suppression have been summarized below for the sources.

Table

Operation / Activity	**Control method and emission reduction**
Transporting	50 % for metalled road (Water spraying @ 2 litres/m^2/h)
Dust generation at the conveyor point	> 90 % for enclosures and dust extraction system
Dust generation at unloading point	> 90 % for enclosures and dust extraction system
Dust generation due to truck loading/ unloading	50 % with water spraying

Description of mining activities in 4th year of the production

This model has been used for impact assessment of air quality in and around the Tikak Extension OCP leasehold area. For this the 4th 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 0.20 MT.
2. Volume of OB estimated to be handled would be 2.44 Mm^3.

The program run Input and Output file is as below:

PREDICTION OF SPM (WITHOUT CON) DUE TO TIKAK EXTENSION OCP OF NEC (0.2 MTY)

1 1 2 1 1 1 2 1 1 2 1

45 6 7 24

60.0 0.15 1000.0 2.0

1.00 3.5 7.5 15.0 30.0 50.0 80.0

0.06 0.06 0.12 0.26 0.36 0.11 0.03

2.53 0.83

0.94 0.35

1.12 2.38

0.39 1.63

2.18 0.51

3.10 2.46

20.32500E-2	0.93	0.56	0.98	0.63	0.005	0.02
20.32500E-2	0.98	0.63	1.22	0.71	0.005	0.02
20.32500E-2	1.22	0.71	1.38	0.85	0.005	0.02
20.32500E-2	1.38	0.85	1.70	1.05	0.005	0.02
20.32500E-2	1.70	1.05	1.90	1.12	0.005	0.02
20.32500E-2	1.90	1.12	2.20	1.29	0.005	0.02
20.32500E-2	2.20	1.29	2.42	1.55	0.005	0.02
20.32500E-2	2.42	1.55	2.58	1.56	0.005	0.02
20.32500E-2	2.58	1.56	2.58	1.66	0.005	0.02
20.32500E-2	2.58	1.66	2.46	1.66	0.005	0.02
20.32500E-2	2.46	1.66	2.78	1.77	0.005	0.02
20.32500E-2	2.78	1.77	2.23	1.66	0.005	0.02
20.32500E-2	2.23	1.66	2.08	1.66	0.005	0.02
20.32500E-2	2.08	1.66	1.81	1.83	0.005	0.02
20.32500E-2	1.81	1.83	1.24	1.92	0.005	0.02

20.32500E-2	1.24	1.92	0.34	1.91	0.005	0.02
20.307000E-2	0.93	0.56	0.98	0.63	0.005	0.02
20.307000E-2	0.98	0.63	1.22	0.71	0.005	0.02
20.307000E-2	1.22	0.71	1.38	0.85	0.005	0.02
20.307000E-2	1.38	0.85	1.56	0.94	0.005	0.02
20.307000E-2	1.56	0.94	1.70	1.05	0.005	0.02
20.307000E-2	1.70	1.05	1.89	1.09	0.005	0.02
20.307000E-2	1.89	1.09	1.88	1.06	0.005	0.02
20.218000E-1	0.93	0.56	0.98	0.63	0.005	0.02
20.218000E-1	0.98	0.63	1.22	0.71	0.005	0.02
20.218000E-1	1.22	0.71	1.38	0.85	0.005	0.02
20.218000E-1	1.38	0.85	1.56	0.94	0.005	0.02
20.218000E-1	1.56	0.94	1.70	1.05	0.005	0.02
20.218000E-1	1.70	1.05	1.89	1.09	0.005	0.02
20.218000E-1	1.89	1.09	2.18	1.27	0.005	0.02
20.218000E-1	2.18	1.27	2.23	1.38	0.005	0.02
20.218000E-1	2.23	1.38	2.29	1.44	0.005	0.02
20.218000E-1	2.29	1.44	2.25	1.46	0.005	0.02
20.218000E-1	2.25	1.46	2.12	1.38	0.005	0.02
20.218000E-1	2.12	1.38	1.96	1.51	0.005	0.02
30.596000E-05	1.00	1.46	0.20	0.44	0.020	00
30.596000E-05	1.02	1.46	0.20	0.44	0.020	00
30.596000E-05	1.40	1.44	0.20	0.44	0.020	00
30.596000E-05	1.60	1.45	0.20	0.44	0.020	00
30.596000E-05	1.81	1.45	0.24	0.44	0.020	00
30.596000E-05	2.04	1.45	0.24	0.37	0.020	00
30.172000E-04	1.98	1.06	0.59	0.14	0.020	00
30.519000E-04	2.39	0.98	0.49	0.16	0.020	20
30.519000E-04	1.34	0.65	1.02	0.10	0.020	30
30.242000E-04	0.44	1.96	0.40	0.06	0.020	00

0.00	000.0	3	0700.0	293.20
0.29	067.5	4	0700.0	293.80
0.31	022.5	5	0800.0	294.40
0.41	045.0	4	1000.0	294.70
1.04	022.5	5	1000.0	295.60
0.62	022.5	5	1000.0	296.50
0.32	045.0	6	1000.0	297.30
0.65	045.0	6	1000.0	297.90
0.64	045.0	6	1000.0	298.70
0.39	022.5	6	1000.0	299.20
0.86	045.0	6	1000.0	298.80
0.40	022.5	2	0900.0	298.50
0.00	000.0	3	1000.0	297.60
0.56	045.0	4	1000.0	297.10
0.35	045.0	2	0750.0	296.50
0.40	022.5	2	1000.0	296.10
0.53	045.0	2	1000.0	295.60
0.00	000.0	3	1000.0	294.80
0.60	045.0	3	1000.0	294.00
0.39	045.0	3	1000.0	293.70
0.52	045.0	3	1000.0	293.30
0.69	022.5	3	0700.0	291.60
0.00	000.0	3	0800.0	293.20
0.00	000.0	4	1000.0	293.50

FUGITIVE DUST MODEL (FDM)

VERSION 90121

MAY, 1990

RUN TITLE:

PREDICTION OF SPM (WITHOUT CON) DUE TO TIKAK EXTENSION OCP OF NEC (0.2 MTY)

INPUT FILE NAME: tikak.IN

OUTPUT FILE NAME: tikak.OUT

PLOT OUTPUT WRITTEN TO FILE NAME: tikak.DAT

CONVERGENCE OPTION 1=OFF, 2=ON 1

MET OPTION SWITCH, 1=CARDS, 2=PREPROCESSED 1

PLOT FILE OUTPUT, 1=NO, 2=YES 2

MET DATA PRINT SWITCH, 1=NO, 2=YES 1

POST-PROCESSOR OUTPUT, 1=NO, 2=YES 1

DEP. VEL./GRAV. SETL. VEL., 1=DEFAULT, 2=USER 1

PRINT 1-HOUR AVERAGE CONCEN, 1=NO, 2=YES 2

PRINT 3-HOUR AVERAGE CONCEN, 1=NO, 2=YES 1
PRINT 8-HOUR AVERAGE CONCEN, 1=NO, 2=YES 1
PRINT 24-HOUR AVERAGE CONCEN, 1=NO, 2=YES 2
PRINT LONG-TERM AVERAGE CONCEN, 1=NO, 2=YES 1
NUMBER OF SOURCES PROCESSED 45
NUMBER OF RECEPTORS PROCESSED 6
NUMBER OF PARTICLE SIZE CLASSES 7
NUMBER OF HOURS OF MET DATA PROCESSED 24
LENGTH IN MINUTES OF 1-HOUR OF MET DATA 60.
ROUGHNESS LENGTH IN CM 0.15
SCALING FACTOR FOR SOURCE AND RECPTORS 1000.0000
PARTICLE DENSITY IN G/CM**3 2.00

GENERAL PARTICLE SIZE CLASS INFORMATION

PARTICLE SIZE CLASS	GRAV. CHAR. DIA. (UM)	SETTLING VELOCITY (M/SEC)	DEPOSITION VELOCITY (M/SEC)	FRACTION IN EACH SIZE CLASS
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1	1.0000000	**	**	0.0600
2	3.5000000	**	**	0.0600
3	7.5000000	**	**	0.1200
4	15.0000000	**	**	0.2600
5	30.0000000	**	**	0.3600
6	50.0000000	**	**	0.1100
7	80.0000000	**	**	0.0300

** COMPUTED BY FDM

RECEPTOR COORDINATES (X,Y,Z)

(2530., 830., 0.) (940., 350., 0.) (1120., 2380., 0.)
(390., 1630., 0.) (2180., 510., 0.) (3100., 2460., 0.)

SOURCE INFORMATION

ENTERED EMIS. TOTAL
RATE (G/SEC, EMISSION WIND

TYPE	G/SEC/M OR G/SEC/M**2)	RATE (G/SEC)	SPEED FAC.	X1 (M)	Y1 (M)	X2 (M)	Y2 (M)	HEIGHT (M)	WIDTH (M)
2	0.003250000	0.27958	0.000	930.	560.	980.	630.	5.00	20.00
2	0.003250000	0.82219	0.000	980.	630.	1220.	710.	5.00	20.00
2	0.003250000	0.69096	0.000	1220.	710.	1380.	850.	5.00	20.00
2	0.003250000	1.22642	0.000	1380.	850.	1700.	1050.	5.00	20.00
2	0.003250000	0.68866	0.000	1700.	1050.	1900.	1120.	5.00	20.00
2	0.003250000	1.12066	0.000	1900.	1120.	2200.	1290.	5.00	20.00
2	0.003250000	1.10691	0.000	2200.	1290.	2420.	1550.	5.00	20.00
2	0.003250000	0.52101	0.000	2420.	1550.	2580.	1560.	5.00	20.00
2	0.003250000	0.32500	0.000	2580.	1560.	2580.	1660.	5.00	20.00
2	0.003250000	0.39000	0.000	2580.	1660.	2460.	1660.	5.00	20.00
2	0.003250000	1.09973	0.000	2460.	1660.	2780.	1770.	5.00	20.00
2	0.003250000	1.82290	0.000	2780.	1770.	2230.	1660.	5.00	20.00
2	0.003250000	0.48750	0.000	2230.	1660.	2080.	1660.	5.00	20.00
2	0.003250000	1.03695	0.000	2080.	1660.	1810.	1830.	5.00	20.00
2	0.003250000	1.87545	0.000	1810.	1830.	1240.	1920.	5.00	20.00
2	0.003250000	2.92518	0.000	1240.	1920.	340.	1910.	5.00	20.00
2	0.003070000	0.26409	0.000	930.	560.	980.	630.	5.00	20.00
2	0.003070000	0.77666	0.000	980.	630.	1220.	710.	5.00	20.00

2	0.003070000	0.65269	0.000	1220.	710.	1380.	850.	5.00	20.00
2	0.003070000	0.61783	0.000	1380.	850.	1560.	940.	5.00	20.00
2	0.003070000	0.54660	0.000	1560.	940.	1700.	1050.	5.00	20.00
2	0.003070000	0.59609	0.000	1700.	1050.	1890.	1090.	5.00	20.00
2	0.003070000	0.09708	0.000	1890.	1090.	1880.	1060.	5.00	20.00
2	0.021800000	1.87531	0.000	930.	560.	980.	630.	5.00	20.00
2	0.021800000	5.51501	0.000	980.	630.	1220.	710.	5.00	20.00
2	0.021800000	4.63474	0.000	1220.	710.	1380.	850.	5.00	20.00
2	0.021800000	4.38717	0.000	1380.	850.	1560.	940.	5.00	20.00
2	0.021800000	3.88138	0.000	1560.	940.	1700.	1050.	5.00	20.00
2	0.021800000	4.23279	0.000	1700.	1050.	1890.	1090.	5.00	20.00
2	0.021800000	7.44080	0.000	1890.	1090.	2180.	1270.	5.00	20.00
2	0.021800000	2.63410	0.000	2180.	1270.	2230.	1380.	5.00	20.00
2	0.021800000	1.84979	0.000	2230.	1380.	2290.	1440.	5.00	20.00
2	0.021800000	0.97493	0.000	2290.	1440.	2250.	1460.	5.00	20.00
2	0.021800000	3.32763	0.000	2250.	1460.	2120.	1380.	5.00	20.00
2	0.021800000	4.49418	0.000	2120.	1380.	1960.	1510.	5.00	20.00
3	0.000005960	0.52448	0.000	1000.	1460.	200.	440.	20.00	0.00
3	0.000005960	0.52448	0.000	1020.	1460.	200.	440.	20.00	0.00
3	0.000005960	0.52448	0.000	1400.	1440.	200.	440.	20.00	0.00
3	0.000005960	0.52448	0.000	1600.	1450.	200.	440.	20.00	0.00

3	0.000005960	0.62938	0.000	1810.	1450.	240.	440.	20.00	0.00
3	0.000005960	0.52925	0.000	2040.	1450.	240.	370.	20.00	0.00
3	0.000017200	1.42072	0.000	1980.	1060.	590.	140.	20.00	0.00
3	0.000051900	4.06896	0.000	2390.	980.	490.	160.	20.00	*******
3	0.000051900	5.29380	0.000	1340.	650.	1020.	100.	20.00	*******
3	0.000024200	0.58080	0.000	440.	1960.	400.	60.	20.00	0.00

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TOTAL EMISSIONS 79.83881

24 HOUR AVERAGE FOR HOUR ENDING 24

CONCENTRATIONS IN MICROGRAMS/M**3

(2530., 830., 1.087) (940., 350., 104.971) (1120., 2380., 0.000)
(390., 1630., 12.015) (2180., 510., 18.599) (3100., 2460., 0.000)

24 HOUR AVERAGE FOR HOUR ENDING 24

DEPOSITION RATE IN MICROGRAMS/M**2/SEC

(2530., 830., 0.131) (940., 350., 1.019) (1120., 2380., 0.000)
(390., 1630., 0.201) (2180., 510., 0.478) (3100., 2460., 0.000)

By examining the result of the model we can say that the 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 Tikak Extension 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 concentration (SPM)	Incremental concentration (SPM)	Total predicted concentration	NAAQS Standards
TA1	Pit - I	96.0	1.1	97.10	500
TA2	Pit - 3	110.0	105	215.0	500
TA3	Kalparagaon	94.0	00	94.0	200
TA4	Tikak Siv Mandir	86.0	12.0	98.0	200
TA5	Malugaon 3	92.0	18.60	110.60	200
TA6	Ledo Bazar Basti	91.0	00	91.0	200

Air Pollution Control Measures

Appropriate mitigative measures shall have to be taken to contain the predicted level within prescribed level. These measures (both preventive and suppressive) are 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 of 28 kl capacity each will be provided in the project
- Provision of auto-start, time cycle controlled, fine nozzle mounted fixed sprinklers at siding and haul roads.
- Physical removal of dust from the roads.
- Greenbelts around quarry, industrial sites, service building area besides avenue plantation along roads.

Coal handling

The following control measures will be adopted during coal handling:

- Suppression of coal dust during coal handling by fine nozzle mounted fixed sprinklers.
- Minimization of the height of coal-fall at transfer points to reduce the dust generation.
- Improved maintenance of plant and machinery.

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

Impact Assessment on Water

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 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 Tikak Extension OCP will also be well within permissible limits.

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.

Impact of Mining on Ground Water System

Impact of mining on ground water system can be studied by calculation the radius of influence of cone of depression created by mine discharge. It has been calculated from flownet analysis that the hydraulic conductivity (K) for the top aquifer (which is likely to be affected by mine advancement) is estimated at 2 m/day and the specific yield as 0.01. Hence considering the dewatering of top aquifer in the immediate mine area, the radius of influence for proposed 0.20 MTY production of coal for 23 years has been estimated as below:

Radius of Influence (Sichardt's formula)

$R = c * (h-hw) * \sqrt{k}$

Where

R = radius of influence

c = constant (2 in this case)

h – hw = draw down in m

k = hydraulic conductivity in 10^{-4} cm/sec

thus R = about 250m

Project	Area	Ultimate Mine depth (m)	Probable draw down (m)	Radius of influence (m) K= m^2/d
Tikak Extn. Project	WBCF	175	50	242 (About 250)

The radius of influence as obtained by the aquifer parameters of nearby areas, obtained from CGWB, comes to 242 m. Hence on an average it can be considered as 250 m from the quarry boundaries.

It is also observed that due to mine discharges at various points and water lagoons to be formed for arresting discharge, the artificial discharge system will work. This will further reduce the radius of influence.

- **Impact of opencast mine operation on groundwater resource with in the buffer zone**

  It is concluded from this study that there is no impact due to mining on village wells. The extraction of ground water from all the mines within area of 10km radius and the proposed mine is less than the annual rainfall recharge.

  - Except for coal mining no major industrial development activity is going in the area. Therefore, the ground water development in the area is negligible,
  - Mining operation will create voids or depressions, this will induce or accelerate rainfall recharge and run-off in the mining area.
  - Mine discharge water is allowed to go as recharge/run-off in the same basin of the area.

- No significant impact on water level of open dugwell is observed due to cumulative withdrawal of mine water in the area.
- In opencast mining, only the aquifers lying above the working seam are affected. Due to stratification, the permeable beds act as individual hydrogeological units and develop multi-aquifer system. With this, the propagation of drawdown cone is limited to small distance from the mine edge. So also, with the presence of boundaries/ faults the propagation drawdown cone is further restricted. The mine water discharged into the local drainage/tanks act as a constant source of recharge and improves the water levels near the mine area.

  After the cessation of mining, with considerable reclamation, the ground water levels will recoup and attain normalcy. The back-filled area with high permeability increases the groundwater recharge in many folds. So also, a water reservoir will be developed in the left out mine area to provide a reliable water source to the local people and also improves the groundwater system. Thus the impact on ground water system is a temporary phenomenon. The abundant mine workings behave as water reservoirs and improve source availability in the area.

However, the project shall have on a whole a positive impact on socio-economic profile of the area. Both positive and negative impacts are listed below:

Positive Impact

a) Coal produced from Tikak Extension Project is high quality coking coal used for steel plants, which other wise would have to be imported from outside.

b) Investment will have effect on the economic status of the community. Thus adding to the gross national income of the country.

c) The mining activities accelerate the economic activities and urbanisation in the region with the creation of new direct/ primary employment opportunities.

d) In addition to direct employment, indirect/secondary/tertiary employment opportunities in long term will be created.

e) Electricity is being produced from the rejects from the washery.

Negative Impacts

a**)** Some agricultural land shall be acquired. This land is a source for livelihood for those families.

Water Quality

During detailed hydrogeological investigation, the ground water quality was monitored and found to be within the permissible standards. As a part of environmental monitoring surface water, groundwater and mine water quality in the nearby operating mines have been monitored and found to be well within the permissible stipulated standards. Water quality reports are given in Chapter- III.

Impact on Topography and Soil

A local change in ground topography will be created at Tikak Extension OCP due to mining operation such as open pit, embankment, dumps of overburden and coal, etc. As a result, there would be marginal change in the drainage and surface run-off. During the mining process, soil is more susceptible for changes due to erosion, leaching phenomena/process, etc. Further the fine

dust particles of coal and overburden may adversely affect the porosity of soils.

Within the core zone area, cracks and loosening of soils would be resulted due to mining and associated activities such as drilling, blasting, etc thereby physical/textural changes would occur in soil/formation. This mine induced process increases the rate of infiltration and recharge. The back-filled may be a good media for high groundwater recharge due to high permeability. Further, the void would store substantial quantity of rainwater, which can be utilised for domestic and agriculture use and also for recharging the groundwater source. It may be appropriate to highlight the fact that temporary groundwater loss/deficit created during active mining stage would be compensated by these different means in the post mining stage so that the initial groundwater levels are regained to normalcy at the earliest for utility of the area.

Water Pollution Control Measures

Effective water pollution control measures shall be taken as necessary keeping the following point.

- Sufficient safeguards during the planning stage to make the project eco-friendly from water pollution control point of view.

- Recycling of wastewater at some sources after appropriate treatment to the extent possible.

- Conforming to the limits of the Environment (Protection) Amendment Rules, 2000 ("Schedule-VI", General Standards for discharge of environmental pollutants, Part-A : Effluents) for the quality of the treated effluents.

The mitigation measures to be adopted in this project are given below in the following paragraphs :

Industrial wastewater from workshop

Industrial wastewater will be suitably treated in a plant consisting of primary sedimentation basins, oils & grease traps and secondary sedimentation basins. The treated effluent from this plant will be collected in a tank for recycling the same for industrial use resulting in 'zero discharge'. The sludge collected from the sedimentation basins will be disposed off as landfill in the decoaled area. Oil and grease manually reclaimed from the trap will be stored in drums safely for disposal through auction. Oily sludge will be disposed off in the impervious layer lined pit.

Wastewater from mine

Mine discharge water will be collected in a sump pit located in the mine floor from where it is pumped out and diverted to oil and grease traps and sedimentation pond(s) to arrest suspended solids and oil and grease. Then, clear water will be used for dust suppression in haul road besides washing of dumpers and/or dozers in workshop. The sludge collected from the pond(s) will be utilized as landfill in the decoaled area. The oily sludge from oil and grease trap(s) will be disposed off in the impervious layer lined pit. Oil and grease recovered manually from the trap(s) will be stored in drums safely for disposal through auction.

Surface run-off

From coal dumps

Drains will be provided around the coal dumps to collect run-off for diverting into sedimentation ponds before discharge into natural water courses.

Storm water

To prevent inrush of precipitation run-off from the outside area to the quarry, storm water drains of suitable dimensions will be provided at appropriate locations with outlets to natural water courses. Settling tanks/ponds will be provided in the storm water drains at convenient locations to take care of suspended solids. Both storm water drains and settling tanks/ponds will be cleaned periodically to avoid choking of drains & malfunctioning of tanks/ponds.

Open masonry drains of appropriate dimensions with outlets to nearby natural water courses will be provided for handling the run-off from the built-up area. The above drains will be cleaned periodically to avoid choking.

Point of final discharge

After arresting the suspended particles in settling tanks of wastewater will be discharged on land surface for agriculture use if required otherwise into local drain.

Users of discharge water

(i)	Human	No
(ii)	Livestock	Yes
(iii)	Irrigation	Yes
(iv)	Industry	Yes
(v)	Others (specify)	

Conservative Measures for Ground Water

The mine discharge has also been effectively utilized to meet the mine's domestic, dust suppression and other industrial water needs.

After the cessation of mining, with copious rainfall and abundant groundwater recharge, the water levels will recoup and attain normalcy. Thus, the impact of mining on groundwater system may be considered as a temporary phenomenon. The abandoned mine workings also behave as water pools and improve the resource availability in the area.

With no processing activity in coal mining, the mine water is free from any pollutants. However, with movement of HEMM and OB/Coal handling, the discharge will have high TSS. To reduce the TSS, the mine water is discharged after passing through the sedimentation tanks. Hence, the quality of groundwater in and around the mine will be protected/maintained as per the standards stipulated by the regulatory authorities.

The surface tanks and deepening of ponds provided in the local villages as well as the mine water would be utilised for irrigation, which will enhance the ground water recharge.

After cessation of mining, part of quarry area will be reclaimed with highly permeable OB material. The final void will be converted into a water reservoir. Thereby, in post-mining condition, the recharge and source potential in core zone will be much higher than the existing. So also, the discharged mine water has been gainfully utilised 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, it is proposed to develop a close monitoring network in the zone of influence and monitor the quarterly water levels.
- The ground water quality will be monitored once every year..
- Creation of awareness, among workers and local people, about rainwater harvesting.

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

4.4 Impact Assessment & Control Measures for Noise & Blasting

The sources of noise will be:

- Drilling operation in coal and OB.
- Blasting for coal & 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).

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 and peak particle velocity

Assessment of impact of noise nuisance of a workplace can be achieved by comparing the level with TLV prescribed by the DGMS. There are also standards relating exposure time with noise levels from the International Standard Organization (ISO) and American Conference of Governmental Industrial Hygienists (ACGIH). These standards may also be used to assess the impact of noise in workplaces.

The acceptable noise levels for residential, commercial and other institutional areas prescribed by the Central Pollution Control Board are given in Chapter III.

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 quarry, infrastructure sites and service building area 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.

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.

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

Sl. No	Particulars	Total land (Ha)
1	Mining	72.00
2	Mine Periphery including haul roads, power supply arrangements etc.	35.00

3	External dumps	85.00
4	Office, workshop, Stores & Repair facilities, coal stock yard etc.	0.00
5	Rehabilitation Colony	0.00
Grand Total		**192.00**

Impact on land use pattern

The impact of opencast coal mine on land is the change in land use pattern. The changes in this project are due to the following:

- Quarrying and external dumping
- Construction of infrastructure.

The alteration in land use pattern due to infrastructure is not to be considered as true degradation as these facilities can be utilized for some other purposes after the mining operation is over. The change in land use pattern due to activities of quarrying may be considered as true change in land use pattern. Hence, land rehabilitation scheme is planned for reclaiming the excavation area of this project.

Land Reclamation

Proposed land use plan

Operational stage land use plan

Plate-VI shows the existing land use plan of the project area including all surface features along with the mine surface plan for the initial stage. **Plate-X XI** highlights the mine surface plan at end of mine operation.

Post-operational stage land use plan

Dumping strategy

Nature of the deposit in the project area makes it difficult to accommodate overburden internally. Whereas, the nature of surrounding land and present infrastructure make it necessary to minimize external dump area.

Quantity of overburden to be handled from sub-pit – 1 is 10.57 Mcum and out of this 2.41 Mcum will be accommodated internally. Rest 8.16 Mcum will be dumped at external dump. At the end of mining of sub-pit – 2, out of 25.52 Mcum of overburden 21.68 Mcum will be dumped externally. At the final stage, a total of 85 hectares of land will be needed for external dumps. External dumps will accommodate about 25.23 Mm^3 of overburden. Balance 13.02 Mm^3 of overburden will be accommodated in the internal dumps constituting nearly 34% of the total overburden.

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, if any 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.

Stages of Land Reclamation

This is carried out in two district phases:

- Physical/technical reclamation.
- Biological reclamation.

Physical/technical reclamation

During 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 20^{o} considering all benches. The land reclamation details at final year stages of the project are given in **Plate XXI**. HEMM for land reclamation will be provided by the contractor.

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 respread over the backfilled area.

(ii) Afforestation Programme

(a) The excavated area will be reclaimed cocurrently with different phases of backfilling and will continue upto 4 years beyond the project life i.e. upto 23 rd year.

(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-li fe	Green belt development (Ha)	Plantation on Internal dump (Ha)	Plantation in External dump	Plantation in & around Infrastructure, colony , road etc.	Total area covered under plantation & Green Belt
At the end of 4th Year	1	-	2	1	4
At the end of 5th Year	1	-	3	2	6
At the end of 6th Year	1	-	2	1	4
At the end of 7th Year	1	2			3
At the end of 8th Year	1	2			3
At the end of 9th Year		2			2
At the end of 10th Year		3			3
At the end of 11th Year		3			3
At the end of 12th Year		3			3
At the end of 13th Year		3			3
At the end of 14th Year		3			3
At the end of 15th Year		3			3
At the end of 16th Year		3			3
At the end of 17th Year		4			4
At the end of 18th Year		4	5		9
At the end of 19th Year		4	10		14
At the end of 20th Year		5	10		15
At the end of 21th Year		5	20		25
At the end of 22th Year		5	20		25
At the end of 23th Year		4.5	20		24.5
Total	**5.00**	**58.50**	**85.00**	**4.0**	**152.50**

(iii) Financial outlay

The expenditure for plantation/compensation is given below :

Sl#	Particulars	Amount
1	Biological reclamation of the external OB dumps	Rs 15.00 lakh/annum
2	Green belt development	
3	Arboriculture and plantation in industrial area	
Total		