Chapter- 2

Project description

2.0 Type of project

This is open cast coal mining project for the nominal rated capacity of 0.15 Mty and would excavate 1.68 Mt of coal in 14 years of mining life span with deployment of diesel hydraulic Shovel/backhoe- dumper combination at the initial cost of Rs. 4178.10 Lakhs.

2.1 Need of the Project

The Tirap and Tikak opencast mines are at present the only coal producing opencast mines in NEC. The projectised balance mineable reserves at Tirap OC mine would last for another 3-4 years at the current rate of production. Thus the Tirap OC mine is nearing its closure.

Tikak OC mine would be the only OC mine producing coal at the rate of 1.20-1.25 lakh tonne per annum for another 12-15 years.

By closing one OC mine producing coal at the rate of 3.40-3.50 lakh tonne per annum would bring down NEC further into red. The demand of coal as well as overall economics of the northeastern coalfields has therefore necessitated for looking at alternatives. Thus, the alternative lies in increasing opencast production in current economic situation.

The proposed project will be able to compensate partly for the loss of production due to closure of Tirap opencast mine.

2.2 Location

The Ledo OCP (covering an area of 0.85 km^2), situated in the northern part of Makum coalfield, is defined by North Latitudes $27^o17'25"$ & $27^o17'50"$ and East longitudes $95^o45'$ & $95^o45'45"$ falling in the survey of India toposheet no. 83M/1.

Proposed Ledo OCP lies about 10 km northeast of Margherita town, the headquarters of the North Eastern Coalfield (a division of Coal India Limited) and 60 km southeast of Tinsukia district HQs town. The area is connected with the rest of the country by the National Highway No. 38 and NE Frontier Railway's broad gauge up-to Tirap siding located at 1.5 km west of the property and thereafter meter gauge section up-to Lekhapani which incidentally passes through the central part of the block dividing it into two parts. The nearest railway station is Ledo, which is located at a distance of nearly 1 km west of the property on the Tinsukia-Lekhapani section of NF Railway. The National Highway -38 running east west also passes through middle of the property alongwith the railway line. Nearest airport Dibrugharh (Mohanbari) is at a distance of nearly 100 km northwest from the project.

The project is surrounded by Ledo town on the west & Ledopani nala on the east side and Tirap OCP on the southeast side.

Habitants & Land Use

The area under reference forms a part of the Ledo town, the second most important town after Margherita in the Makum coalfield. A mixed urban and rural population of over 50000 inhabits the town. Urban population predominantly consists of Coal India Ltd's colliery employees, NEF railway employees and other small industrial workers apart from the local inhabitants.

Sixty percent of the area under reference is built up area and is occupied by surface structures viz. railway line, national highway, colliery workers residential quarters, brick factory etc. Twenty five percent area is occupied by the Ledopani nallah and its flood plain. A small part of balance fifteen percent of the area has been quarried out mainly in the incrops and remaining is lying as barren land.

2.3 Mining

A net geological reserve of 6.22 Mt. from 60' seam only was assessed in the Ledo OCP block. '60 ft' seam is the most important coal seam. The other coal seams are impersistent and have very limited area of disposition. The '60 ft' seam is almost

virgin in the entire block except a small linear stretch in the southern limb where the seam has been extracted manually through opencast method. The '60-ft' seam occurs splitted at the most places.

The coal seams are steeply inclined and the area has flat terrain. The proposed mining area is heavily built-up. This consists of a railway line and NH in the middle of the property, Ledopani river, brick kiln and NEC quarters alongwith other non-CIL residential areas. LVRC (Ledo Valley Recreation Centre) in the southwestern corner of the property may also restrict some mining prospects of Ledo OCP Block.

Hence, taking into account the techno-economics, socio-economics as well as environmental aspects related to opencast mining in this block, the option of mining the Ledo block in three separate pits has been envisaged for starting the mining activities in the block. This mining option is mainly governed by existence of surface features. However, the maximum exploitation of reserves depends on removal/diversion of all surface structures, river, railway line and road.

Mine Limit:

In this option the surface constraints viz. river, railway track are not required to be diverted except a small patch of one Km of road. This option can be implemented without much administrative hindrances from other authorities. This pit mining option would involve the least rehabilitation and resettlement of colonies and quarters. Here it has been proposed to extract coal from the following three pits. The proposed mine boundaries of the different pits of this option of the Ledo OCP are as under.

PIT-I

North: Incrop of the 60-'ft' seam

South: Railway track and NH 38 at a distance of minimum 45 m for the pit surface

East: Safe distance of 45 m from Ledopani river

West: Incrop of the '60-ft' seam

A total of 0.29 Mt. of coal is available for exploitation in this pit at an average stripping ratio of 5.14 cum/t. The maximum depth of the pit would be 80 m.

PIT-II

North: Railway track and NH 38 at a distance of minimum 45 m for the pit surface

South: Incrop of the ’60-ft’ seam

East: Safe distance of 45 m from Ledopani river

West: Incrop of the ’60-ft’ seam

This pit is the largest in area among all the three pits. Total mineable reserve available for exploitation in this pit would be 1.03 Mt. at an average stripping ratio of 5.84 cum/t. The maximum depth of this pit will be 90 m.

PIT-III

North: Incrop of the 60-‘ft’ seam

South: Railway track at a distance of minimum 45 m for the pit surface

East: Incrop of the 60-‘ft’ seam

West: Safe distance of 45 m from NH 38

This is a smaller pit compared to pit-II and has a mineable reserve of only 0.36 Mt. at an average stripping ratio of 3.61 cum/t. The maximum depth of the pit would be 85 m.

Hence, total mineable coal available in this option is 1.68 Mt. whereas total OB required to be removed would be 8.81 Mcum at an average stripping ratio of 5.24 cum/t. Maximum depth of the quarry in this option would be 90 m.

The break-up of mineable reserves, overburden quantities and stripping ratio for all the three pits of this boundary option are summed up below:

Sl. No.	Particulars	Unit	Pit-I	Pit-II	Pit-III	Total
1	Mineable Reserves	Mt	0.29	1.03	0.36	1.68
2	Overburden Quantities	Mm3	1.49	6.02	1.30	8.81
3	Stripping Ratio	M3/t	5.13	5.84	3.61	5.24

2.3.2 RATE OF COAL PRODUCTION & MINE LIFE

Rate of coal production from Ledo OCP is 0.15 Mt per annum and the mine life will be 14 years including the construction period of one year.

Relative parameters of the selected mine boundary option is summed up in table below

RELATIVE PARAMETERS OF THE LEDO OCP

Table 2.3.2

Sl. No.	Particulars	Unit	Selected mine boundary option
1	Geological Gross Reserves	Mt	6.22
2	Mineable Reserves	Mt	1.68
3	Overburden Volume	Mm^3	8.81
4	Average Stripping Ratio	m^3/t	5.24
5	Nominal Production Capacity	Mtpa	0.15
6	Mine Life at rated capacity	Years	14
7	Depth -Min. -Max.	m	 15 90

Sl. No.	Particulars	Unit	Selected mine boundary option
8	Floor Gradient Northern limb -Min. -Max. Southern limb -Min. -Max. -Usual	Deg.	 20 25 25 50 30
9	Mine Area	Ha	40

2.4 Mining Method

Analysing geo-mining characteristics of the deposit, the mine is proposed to be worked by horizontal slicing method. Slope of the final quarry batter varies from 45^o to 37^o. Height of the coal/overburden benches is proposed to be maximum 10 m, whereas, bench width of working and non-working benches is 25 m & 15 m respectively with a proposed cut width of 10 m. Slope of the bench will vary from 45^o to 70^o based on the nature of material. Overburden is to be stacked tier by tier and height of each such tier is proposed to be 30 m. Angle of repose of the overburden dump is assumed to be 37^o. Lag between two tiers of overburden dump is proposed to be 40 m.

Mining system parameters are tabulated in table no. 2.4.1

Table no. 2.4.1

Sl. No.	Particulars	Unit	OB	Coal	Dump
1	Bench height	m	10	10	30
2	Working bench width	m	25	25	40
3	Nonworking bench width	m	15	15	-
4	Bench slope	Deg.	45-70	70	37

2.5 Mining Strategy and Mine Scheduling

In this option, the Ledo opencast project is proposed to be divided into three pits namely pit-1, pit-2 and pit-3. Pit-1 will be mined out first then pit-2 and finally pit-3.

The pit-1 is proposed to open up from the northwest side at the incrop of 60' seam where the depth is minimum. An Initial Mining Cut will be developed along the incrop by horizontal slicing and the bottom most bench will be maintained at 120 m level with a maximum bench height of 10m.

The proposed sequence of mining will permit start-up of mining operations at minimum depth as well as low ratio zone and requires least amount of external dumping of waste. The proposed sequence will facilitate coal production from lower stripping ratio zone to gradually higher stripping ratio zone. Any alternative sequence of mining will necessitate considerably greater land requirement for external overburden dump due to limited back-filling opportunity.

2.5.1 Mining Schedule

The mine has been planned to produce at the nominal rated capacity of 0.15 MTY of coal. The design of the mine is mainly based on lay & deposition of coal seams and intervening partings of the block as estimated in the Geological report and the HEMM productivity norms adopted in CIL mines.
Life of mine with schedule of mining indicating year-wise & cumulative coal production, waste removal along with running & running average stripping ratios for this option is given in table no. 2.5.1 below.

The proposed mining schedule permits optimum backfilling of overburden into the voids created by the different pits.

In the process of coal winning, 8.81M cum of Over burden will be excavated. The entire OB of Pit-1 will be dumped externally. Thereafter, the mined out area of pit-1 will be filled completely by the OB material of pit-2. The balance quantities of OB material of pit-2 will be accommodated internally. The OB quantities of pit-3 will be taken and dumped into the void of Tirap OCP. 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.

In the boundary option-I, it is proposed to deploy 1 no. 3.7 – 4.0 cum diesel hydraulic shovel along with 3 nos. of 35 T rear dumper for this purpose. In 2nd year of mine operation 5 nos. additional 35 T RD will be required for OB removal and coal winning. In the third year, it is proposed to add 1 no. 2.7 – 2.8 cum diesel hydraulic backhoe alongwith 1 no. 3.7 – 4.0 cum diesel hydraulic shovel and 4 nos. 35 T rear dumper to mine out scheduled 0.10 Mt. coal and 0.65 Mcum overburden. Rear dumpers are provided to transport coal at Tikak siding and overburden at external dump. Yearly 0.80 Mcum of overburden is required to be handled from fourth year to eleventh year. 2 nos. 160 mm drill and 1 no. 100 mm drill are proposed for drilling operation. 4 nos. 320 hp crawler dozer and 1 no. 300 hp wheel dozer are provided for dozing, leveling and reclamation works.

Mining Schedule

Table No. 2.5.1

Year	Coal Production (Mt)		OB Removal (Mcum)		Stripping Ratio (cum/t)	
	Annual	Cumulative	Annual	Cumulative	Running	Running Average
1	-	-	0.25	0.25		
2	0.05	0.05	0.35	0.60	7.00	12.00

Year	Coal Production (Mt)		OB Removal (Mcum)		Stripping Ratio (cum/t)	
	Annual	Cumulative	Annual	Cumulative	Running	Running Average
3	0.10	0.15	0.65	1.25	6.50	8.33
4	0.15	0.30	0.80	2.05	5.33	8.33
5	0.15	0.45	0.80	2.85	5.33	6.33
6	0.15	0.60	0.80	3.65	5.33	6.08
7	0.15	0.75	0.80	4.45	5.33	5.93
8	0.15	0.90	0.80	5.25	5.33	5.83
8	0.15	1.05	0.80	6.05	5.33	5.76
10	0.15	1.20	0.80	6.85	5.33	5.71
11	0.15	1.35	0.80	7.65	5.33	5.67
12	0.15	1.50	0.60	8.25	4.00	5.50
13	0.11	1.61	0.40	8.65	3.64	5.37
14	0.07	1.68	0.16	8.81	2.29	5.24
Total	**1.68**		**8.81**		**5.24**	

2.6 Dumping Strategy

Nature of the deposit in the project area as well as mining sequence of the different pits makes it easy to accommodate overburden internally in early years of mining operation. Whereas, the nature of surrounding land and present infrastructure makes it necessary to minimize external dump area.

Quantity of overburden to be handled from pit-1 is 1.49 Mcum and whole of this 1.49 Mcum will be dumped externally beyond the incrop i.e. on the north-west of the quarry. At the end of mining of pit- 2, out of 6.02 Mcum of total overburden quantities, 1.50 Mcum of overburden will be dumped into the void of pit-1 and the rest (4.52 Mcum) will be backfilled into the pit-2 itself. The entire overburden of pit-3 will be taken to the nearby Tirap OCP and will be dumped internally into the void of Tirap OCP. This way land required for external dump in this option of mining operation would be minimized. At the final stage, a total of only 10 hectares of land

will be needed for external dump purpose. External dumps will accommodate about 1.49 Mm^3 of overburden. Balance 7.32 Mm^3 of overburden will be accommodated in the internal dumps constituting nearly 83% of the total overburden.

Year-wise overburden removal, dumping schedule and annual lead of overburden dumps for Ledo opencast mine is presented in table no. 2.6.1. The final stage dump plan is shown vide figure no. 2.4**.**

Table No. 2.6

Annual OB Removal, Dumping Schedule and Lead

Year	Annual OBR (Mcum)	Location wise Dump Qty. & Annual Lead				Average Lead (Km)
		External Dump		Internal Dump		
		Quantity (Mcum)	Lead (Km)	Quantity (Mcum)	Lead (Km)	
1	0.25	0.25	1.00	0.00	-	1.00
2	0.35	0.35	1.25	0.00	-	1.25
3	0.65	0.65	1.50	0.00	-	1.50
4	0.80	0.24	1.50	0.56	1.50	1.50
5	0.80	0.00	-	0.80	1.50	1.50
6	0.80	0.00	-	0.80	1.75	1.75
7	0.80	0.00	-	0.80	1.75	1.75
8	0.80	0.00	-	0.80	2.00	2.00
9	0.80	0.00	-	0.80	2.00	2.00
10	0.80	0.00	-	0.80	2.25	2.25
11	0.80	0.00	-	0.80	2.25	2.25
12	0.60	0.00	-	0.60	2.50	2.50
13	0.40	0.00	-	0.40	2.50	2.50
14	0.16	0.00	-	0.16	2.50	2.50
Total	8.81	1.49	-	7.32	-	-

2.7 OUTSOURCED OPERATIONS

In the hiring/outsourcing option, it is proposed to outsource the following major operations:

Excavation & transportation of overburden

Excavation & transportation of coal

Loading & dispatch of coal at siding

Drilling of blast hole

Preparation of road, ramp etc

Dozing & leveling works

Reclamation works

Security

All statutory rules, regulations and applicable laws are to be followed including those related to the Govt. licenses, workmen compensation, insurance etc. Rest activities of mine operations, like blasting operation, power supply arrangements, surface illumination and dewatering etc will be carried out by the project.

It is essential that sequence of mining and dumping of overburden be executed as prescribed in calendar programme of excavation and schedule of dumping. Haul road will have to be maintained with requisite gradient as per regulations and in according to the conditions imposed by DGMS in its permission under regulation 98(1) & (3) and other relevant provisions of the Coal Mines Regulation 1957.

It is proposed to deploy diesel hydraulic shovel/backhoe in combination with dumper/tipping truck for mining in this hiring option. No provision has been made towards HEMM as well as maintenance and repair of HEMM. There will be no departmental workshop for the outsourced HEMM. Construction of a small capacity workshop, however, has been envisaged for the maintenance of the vehicles in case of the hiring option. Envisaged requirement of manpower is 52 to supervise and manage the project.

2.8 Project Component

(A) Requirement of Land

Head-wise requirement of land for the hiring/outsourcing option is presented in Table 2.8.1.

Table No. 2.8.1

Sl. No.	Particulars	Land Requirement (Ha)
1.	Mining	40.00
2.	Mine Periphery including haul roads, power supply arrangements etc.	10.00
3.	External dumps	7.00
4.	Rehabilitated colony	4.00
	Total	**61.00**

(B) INFRASTRUCTURE

The mine site infrastructure includes the power distribution system, water supply, sewerage, communications, roads, workshops, stores, offices and other buildings.

(C) POWER SUPPLY

Source of power for the OCP will be 33/11 kV Ledo sub-station of ASEB that would supply power to Ledo mine sub-station through 11 kV overhead line. This sub-station will be installed between pit-1 and pit-2 mine entry beside NH - 38. Mine pumping, quarry lighting and workshop will be supplied from this sub-station.

The maximum demand and energy consumption with all the equipment working is estimated as under:

Working Option	Max. demand (kVA)	MkWh consumption
Option - 1		
Outsourcing	153	0.230

The contract demand with ASEB shall be decided after selection of type of working, option and tariff pattern of ASEB.

(D) WATER SUPPLY AND SEWERAGE

The water demands for the different options of the Project as envisaged are indicated in the following Table.

Technological Option	Potable Water Demand in MGD	Industrial Water Demand in MGD	Total Water Demand in MGD
Departmental & Hiring	0.24	0.04	0.28

Separate sewerage system for domestic & industrial sewage has been envisaged for the Project.

Colony water supply

Deep well boring has been envisaged for water supply system for Ledo OCP. A provision of an overhead tank has been made to cater the needs of potable water for the proposed residential units for rehabilitated persons of Ledo OCP. This overhead tank will be fed with treated water from the proposed bore wells. From this tank, water will be distributed to the residential units through gravity flow. The details for all the boundary options have been furnished.

Industrial water supply

Existing IWSS has been identified as the source of water for the water demand at project site. Water shall be drawn and conveyed through the pipe network of IWSS to the ground reservoir located in the proposed industrial

area. This water shall be treated first and pumped to an overhead tank. From this tank, water for industrial purposes has been considered to be delivered to the various industrial buildings, administrative complex & quarry sites and is proposed to be distributed by gravity to the point of consumption through a distribution network.

For fire fighting purposes in the industrial areas like workshops, stores and quarry area, separate distribution networks have been proposed from the ground reservoir. Provision towards requirement of water for public utilities like garden, afforestation etc. has been made in this report. It has been envisaged that the distribution network for fire fighting purposes shall also be utilised for these purposes.

Colony sewerage

Colony sewage has been proposed to be dealt through septic tanks and soak pits.

Industrial sewerage

It has been considered that the industrial waste from workshop and other industrial establishments would be led through oil & grease traps. The effluent coming out of the industrial premises is proposed to be treated and led to the settling tank and to be recycled for various industrial uses for this project. The domestic sewage generated in industrial premise has been considered to be dealt in septic tanks and soak pits.

(E) ROAD NETWORK AND CULVERTS

Colony Roads

The length of colony roads for both the options has been estimated.

Haul Road

For all the boundary options, the length of double lane haul road has been estimated as 0.5 Kms for plying of 35T dumpers. This provision of capital is not required in case of hiring option since the hiring charges of OB removal & coal extraction are inclusive of preparation of cost of haul road.

Heavy duty Road

The dumpers deployed in the benches will also go to the workshop for maintenance. Hence a provision of heavy-duty road of 0.5 Kms for Option-I (both departmental & hiring) has been envisaged in the present report.

Approach road to Project & Township

Approach road of 2.5 Km length has been envisaged in this report. An RCC over bridge of 200 meter length over Tikak Railway siding has also been envisaged.

Approach road to Magazine

The capital investment under this head, as advised by NEC, has been taken as nil.

(F) Townships :

Ledo OCP block is about 10 Km east of Margherita township (Head Quarter of NEC). The National Highway No. 38 passes through the proposed Ledo OCP Block. The proposed Ledo OCP is adjacent to the forthcoming Tikak Extension OCP. Taking into account the scarcity of non-coal bearing areas, the proposed colonies for Ledo OCP and Tikak Extension OCP are envisaged to be located at a common site. This site has been envisaged adjacent to the existing Tikak colony and nearby the existing office of the Manager, Tikak OCP. The proposed site is approachable through the road connecting NH-38 and the Tikak colony. This proposed location has sufficient area to accommodate the common township. Some welfare and community facilities like College, Cinema Halls, Officers' Club, Officers' Rest House, Bank etc. are

available in the surrounding areas and hence these have not been considered in this report.

In view of the common township for both the proposed OCPs, the Capital Investment towards Welfare and Community Buildings and facilities have been apportioned for these two projects and shown in the concerned Appendices.

(G) Service Buildings :

Service buildings like office, workshop, store, Sub station, Magagine, statutory building (canteen, first aid centre, rest shelter, training centre ,pit head bath etc on the basis of BPE guideline),community building, community centre, school, hospital etc. will be constructed.

2.9 Geology

2.9.1 General Geology

The coal bearing Tikak Parbat formation, occurring outside the confines of the main synclines, is disposed as an elongated E-W trending closed synformal basin surrounded by older Baragolai formation. The stratigraphic sequence encountered in this area is shown in table no. 2.9.1

Table no. 2.9.1

Stratigraphic Sequence at Ledo Area

Age	Group	Thickness(m)	Lithology
Recent		1-28	Terrace deposits and alluvium comprising sand, clay, gravel & boulder bed.
Oligocene	Barail	10-110	Tikak Parbat Formation. Black and grey silty mudstone, dark grey to grey shales, grey to greyish white clays, siltstone, light coloured yellowish white fine grained sandstone with several coal seams including one thick seam which marks the base of the

Age	Group	Thickness(m)	Lithology
			formation.
		1-120	Baragolai Fomation. Well-bedded micaceous sandstone alternating with mottled sandy clays and grey shales. Bluish white to chocolate coloured clay and thin carbonaceous band.

The exploration carried out by the CMPDI and earlier by other agencies in Ledo OCP area has proved the existence of four coal seams; '60-ft' seam, '7-ft/New' seam, '20-ft' seam and '5-ft' seam in the ascending order. Of the four coal seams, the '60-ft' seam is the thickest and most important coal seam and found to occur over an area of 0.57 km^2 whereas other three younger seams have very limited occurrence along the axial region of the Ledo synformal structure in the west and the east. As a result, the exploration activity was primarily oriented towards proving of the '60-ft' seam. Out of the total 31 boreholes drilled by the CMPDI, '60-ft' seam has been encountered in 27 boreholes, 3 boreholes were beyond the incrop of '60-ft' seam and one borehole has not been drilled down to the '60-ft' seam. '7-ft'/new seam' has been encountered in 8 boreholes, '20-ft' seam in 4 boreholes and '5-ft' seam in only one borehole.

The '60-ft' seam splits into 4 identified sections viz. the '60-ft' Top Upper & Lower and the '60-ft' Bottom Upper & Lower. The '20-ft' seam splits into 2 identified sections viz. the '20-ft' Top and the '20-ft' Bottom whereas the other two seams occur individually as composite seam. The sequence of the coal seams, as delineated from the borehole data based on the megascopic examination of the samples from coal and associated non-coal strata and the results of chemical analysis, in the area under reference is given in table no.2.9.2

Table no. 2.9.2

Sequence of coal seams and their thickness at Ledo OCP

(Thickness values are in m)

Coal seam/Parting		Split sections/parting		Secondary splits	
Name	**Combined thickness**	**Name**	**Thickness**	**Name**	**Thickness**
'5-ft'	Part thickness encountered in only one borehole located in incrop region.				
Parting	9.68				

(Thickness values are in m)

Coal seam/Parting		**Split sections/parting**		**Secondary splits**	
Name	**Combined thickness**	**Name**	**Thickness**	**Name**	**Thickness**
'20-ft'	4.75	Top Sec.	4.47		
		Parting	1.70		
		Bottom sec.	3.40		
Parting	24.19				
'7-ft'/New seam	0.43-1.83				
Parting	30.17(4.60-33.31)				
'60-ft'	11.20-18.29	Top sec.	4.00-9.15	Top upper	0.90-6.35
				Parting	0.30-8.63
				Top lower	0.60-6.70
		Parting	3.05-10.06		0.50-7.80
		Bottom sec.	3.80-10.15	Bottom upper	0.60-4.15
				Parting	0.25-3.20
				Bottom lower	2.75-8.50

The coal bearing strata of Tikak Parbat formation, surrounded by the older Baragolai formation, occurs as closed elliptical E-W trending synformal structure. The E-W trending longer axis stretches about 1.5 km while the N-S trending shorter axis stretches just about 300 metres. The western closure of the synformal basin is wider than that of eastern closure. The strata in general strike in an E-W direction in both the limbs with local swings leading to development of minor warps. The southern limb is relatively steeply inclined-25o to 50o. The area is free from any major fault. The three small quarries that have exposed the ‘60-ft seam’ on the southern limb of the syncline also do not show the existence of any fault. The axial region of the synformal

structure is represented by two isolated micro basins around borehole CMLM-002 and CMLM-028/MLO-1 which are separated by a local high around BH no. CMLM-012 and CMLM-023. The deepest part of the basin is around BH no. CMLM-002 where the maximum depth of Tikak Parbat formation has been recorded as 114m and the '60-ft seam has been encountered in a composite form.

The ‘Margherita Thrust', which was earlier thought to have truncated the north limb of the above syncline, is now proved to lie further north of the present area of investigation.

2.9.2 Status of Exploration

The Makum coalfield in the Tinsukia district of Assam state is the most important coalfield in the northeastern region of India. The coal deposits occur in difficult terrain generally forest clad and in high rainfall areas. The quantity of reserve in Makum coalfield is 280.62 million tonnes (as on 1.1.2002, as per G.S.I). Though the reserves of Makum coalfield are small, yet the coal deposits are important by virtue of their location away from major coal deposits and its quality. High vitrinite, low ash, strongly caking alongwith high volatile matter and high sulphur characterize the Makum coal.

CMPDI prepared a Report on coal exploration in Ledo Mechanised OCP block in July 1986 with the data of 25 nos. of boreholes drilled earlier by GSI, DGM Assam and NECF and 31 nos. of boreholes drilled by CMPDI. The proposed Ledo opencast project is being prepared based on this geological report.

2.10 COAL QUALITY

It is seen that the ’60ft‘ seam is characterised by low ash content (5 to 8%) but high volatiles (41 to 43%) and high sulphur (1.9 to 3.5%). Of the total sulphur nearly 80 to 85% occurs in organic form as coherent mass of the coal.

Caking index ranges from 22 to 25 and the calorific value is 7100 to 7865 Kcal/kg.

Overall, grade of product Coal comes to 'F'.

2.11 COAL RESERVES

60' seam is the most important coal seam in Ledo OCP block. Apart from this coal seam, three other younger seams viz. 5' seam, 20' seam and new seam (7' seam) are also present within the block but because of their impersistent nature and very limited area of disposition, only the 60' seam has been considered for the purpose of estimating the quarriable coal reserves.

60' seam is almost virgin in the entire block except a small linear stretch in the southern limb where the seam has been extracted manually through opencast methods. In view of the generally plain topography contributing to a more or less favourable stripping ratio and the possibility of intersecting the floor of 60' seam at a maximum depth of about 100 m in the area, the reserves have been estimated for the entire block without categorizing the same under different depth cut-offs.

The reserves have been estimated by excluding all the dirt bands, irresepective of their thickness, from the seam section in view of the non-combustible nature of almost all the bands.

A geological model of Ledo OCP was prepared by using a computerized software. For reserves estimation all the splits viz. 60' top-upper, 60' top-lower, 60' bottom-upper, 60' bottom-upper including its combined thickness and part of 20' seam have been considered. For computing the tonnage of coal, an average specific gravity of 1.34 has been considered.

A gross geological reserves of 7.82 Mt. was considered for the entire block. For estimating the net geological reserves 15% deduction has been

considered in gross geological reserves on account of geological nature of the deposit.

2.12 OVERBURDEN AND STRIPPING RATIO

It is proposed to excavate 0.25 Mcum of overburden in the first year & 0.35 Mcum in the second year to produce 0.05 Mt coal in the second year of mine life in option-I. Thereafter, 0.80 Mcum of overburden is required to be removed from fourth year per annum till 11th year of mine life to maintain targeted coal production of 0.15 MTY. After that, rate of overburden removal will decrease to 0.60 Mcum per annum in the 12th year, 0.40 Mcum in 13th year and 0.16 Mcum in the 14th year i.e. in the last year of mine to produce the coal production of 0.15 Mt., 0.11 Mt. and 0.07 Mt. respectively.

The proposed mining schedule permits optimum backfilling of overburden into the voids created by the different pits.

Mining Schedule

Year	Coal Production (Mt)		OB Removal (Mcum)		Stripping Ratio (cum/t)	
	Annual	Cumulative	Annual	Cumulative	Running	Running Average
1	-	-	0.25	0.25		
2	0.05	0.05	0.35	0.60	7.00	12.00
3	0.10	0.15	0.65	1.25	6.50	8.33
4	0.15	0.30	0.80	2.05	5.33	8.33
5	0.15	0.45	0.80	2.85	5.33	6.33
6	0.15	0.60	0.80	3.65	5.33	6.08
7	0.15	0.75	0.80	4.45	5.33	5.93
8	0.15	0.90	0.80	5.25	5.33	5.83
8	0.15	1.05	0.80	6.05	5.33	5.76
10	0.15	1.20	0.80	6.85	5.33	5.71
11	0.15	1.35	0.80	7.65	5.33	5.67

12	0.15	1.50	0.60	8.25	4.00	5.50
13	0.11	1.61	0.40	8.65	3.64	5.37
14	0.07	1.68	0.16	8.81	2.29	5.24
Total	**1.68**		**8.81**		**5.24**	

2.13.1 Major Affected Parameter of Environment

Worst affecting parameter due to coal mining activities are Air and water and land.

Air- One of the worst affected environmental attributes in mining project is air which get polluted due to blasting, excavating, transporting, loading & unloading of coal and OB. This activities of mining create the pollution by increasing the SPM level in the environment. This is low fugitive in nature and settled quickly and more over this is not harmful gas.

Water- Water get polluted from the effluent of mine water, workshop and etc. In rainy days, effluent is allowed to discharge only after proper treatments. More over these pollutants are only physical in nature the form of TSS which are easily filterable and not much harmful to human or aquatic life.

There will be increase in the depth of water table due to deep excavation for mining but this effect would be occurred up-to maximum extent of one Km. from the cutting edge of mine.

Land- Land is the worst affected parameter in the mining projects. Mining activities completely changed the topographic and characteristics of the land. It create large void of more than 100 m depth at one side and form huge OB, like mountain on other side. This gives the bad appearance as well as air pollution due to wind erosion.

Over Burden dumps (external or Internal) needs the continuous parallel process (progressive) of reclamation with mining works till the closer of mines. After close of mines it needs reclamation of whole area to improve the

over all aesthetics view in such away that area become the source of income for the local inhabitant.

2.14 Environmental Pollution Mitigation Measures

Development activities are of prime importance for the economic growth and fulfillment of basic needs of the society and take a nation forward but at the same time, give rise to many environmental problems. The exploitation of mineral resources through surface or underground mining is invariably associated with a number of wide ranging environmental problems, which results in an impact on the surrounding environmental components. Therefore, while implementing the developmental project environmental aspects of the project must be taken into account and due attention must be paid to protect the environment. Baseline status of the environment is the basic step in this direction. This helps in assessing the existing environmental conditions of the study area and identifying the critical environmental attributes, which would be monitored after implementation of the project.

Mitigation measures are broadly divided into two categories namely preventive measures and suppressing measures. Stress has been given on adoption of preventive measure, which is more effective and economical. In this EMP various type of preventive as well as suppressing measures has been advised for different type of source of pollution for all environmental attributes such that Air, Water, Noise & Vibration, Land. These mitigation measures have been discussed broadly in the respective chapters.

2.14 Assessment of new & untested technology: