

PRE- FEASIBILITY STUDY REPORT

For

EXPANSION OF

BODAI DALDALI BAUXITE MINE

Villages – Mundadadar, Keshmarda, Rabda & Semsata,

From 1.25 MTPA to 1.75 MTPA

Tahsil – Bodla, District – Kabirdham,

State – Chhattisgarh

Area– 626.117 Ha



Lessee

M/S BHARAT ALUMINIUM COMPANY LIMITED

(BALCO)

[Aluminium Sadan, Core-6, 2nd Floor, 7 Lodhi Road, New Delhi –

110003]

1.0 INTRODUCTION:

M/s Bharat Aluminum Company Limited (BALCO) has an integrated aluminium plant at Korba district of Chhattisgarh. BALCO was established on 27th Nov 1965 and its production started from 1973. Initial capacity of BALCO was 1.0 Lakh Tonnes of Aluminium per Annum. Over the years, to meet the domestic requirement of aluminium, Balco has been gradually ramping up its production capacity and currently it stands at 5.70 lakh tons per annum.

Balco was the first public sector enterprise in the country which started producing aluminium in 1973. Government of India still holds 49% of Balco's share after the disinvestment in year 2001.

BALCO is having IMS (Integrated Management System) certificate (ISO 9001: 2008 QMS, ISO 14001: 2004 EMS, and OHSAS 18001: 2007) for all of its Bauxite mines. Aluminium produced from Balco is used in Energy Sector, Space Organization, Railways, Defence, Automobiles and other downstream sectors.

Balco was chosen by DRDO to supply special quality aluminium for Agni and Prithavi Missiles system.

1.1 Need for the proposed expansion and its importance to the Country or Region

Bharat Aluminum Co. Ltd. (BALCO) has been closely associated with the Indian aluminium industry for over fifty years. Today Balco imports approximately 50% of its alumina requirement from outside country. To align ourselves with Prime Minister Vision of **"MAKE IN INDIA"** we have embarked on a journey to meet our requirement of alumina from our captive mines. This would help in reducing outflow of precious Foreign Exchange and also to generate additional employment potential in remote areas in line with Prime Minister Vision of **"SKILL INDIA DEVELOPMENT"** Furthermore addition of additional mining capacity would add revenue to the State Government.

Consequent to the expansion of Aluminium production capacity, there is increased requirement of Alumina and therefore that of Bauxite.

The proposal is to increase the production of bauxite of the existing Bodai-Daldali bauxite mine from the level of 1.25 to 1.75 million tons per annum. The proposed increase is sought to be achieved by simply operating the mine on three shifts basis as against the current operations which are being carried out only in a single shift.

This proposal has multi-dimensional advantages not just for the company but for the people of this region and country. The salient advantages are as follows

- (a) Given the current stripping ratio of this mine, mere the increase of 40% in production of bauxite, it is estimated additional 100 persons have to be employed both direct and contingent indirect activities. Greater employment opportunities therefore going to be beneficial for the people of Bodai-Daldali bauxite Mines, Bodla Tahsil, where this mine is located.
- (b) It is also beneficial for the country and the company, as the productive assets like HEMM existing infrastructure etc. shall be utilized round the clock as opposed to current utilization during one shift only.
- (c) Environmentally also this proposal, offers following major advantages
 - (i) Since the production activities will be undertaken round the clock (as against the current single shift operation), the emission of pollutants such as particulates, Sox, NOx etc. on hourly basis is likely to go down by at least 50%. As such due to dispersion, neither there will be any pollutants build up in the environment nor there will be any significant fugitive emissions, since round- the – clock operations will enable the mine to suppress the dust by wetting all the 24 hours in a day.
 - (ii) Simultaneous back filing of mined out areas shall virtually eliminate the need of dumping of over burden and rejects. This use for direct backfilling shall reduce the emission due to multiple handling of over burden / rejects from dumps.
 - (iii) Proposed increased production & simultaneous back filling would result in faster rehabilitation of mined out areas either through enhanced rate of afforestation or creation of a secured water body.

- (iv) Considering that proposals involve mining of bauxite containing even 30% Al_2O_3 and the same would be made feed grade to alumina plant, offers the “Environmental Advantage” of not looking at opening of another mine if 30% Al_2O_3 containing bauxite is considered as rejects. In nutshell it eliminates early offsite pollution elsewhere.

2.0 Location and Accessibility:

The Bodai-Daldali Bauxite Mine, District Kawardha (Kabirdham) of BALCO is located in Bodai-Daldali plateau, which is about 65 kms from the district headquarter Kawardha (Kabirdham) and about 135 km from Amarkantak. It forms the central part of Maikal range.

The lease-hold area can be approached from Daldali by all-weather road. There are mainly 4 villages on the plateau are Mundadadar, Keshmarda, Rabda and Semsata.

2.1 Location: Co-ordinates: Topo sheet No F44 J3,

Latitude 22⁰ 24' 49.01709" to 22⁰ 29' 11.90077" N

Longitude 81⁰ 10' 15.60718" to 81⁰ 11' 47.28739" E

2.2 Road Link:

The mine can be approached from Kawardha which is 65 Km from the mine via Bodla. The Bodla is about 23 kms from Kawardha, and from Bodla the mine is connected with black topped 42 kms road.

2.3 Rail Link:

The mine is almost at same distance of about 180 kms from Bilaspur, Raipur & Durg Railway stations.

2.4 Air Link:

The mine is about 200 kms from Raipur Airport.

Figure-1
Location Map of Bodai Daldali Bauxite Mine

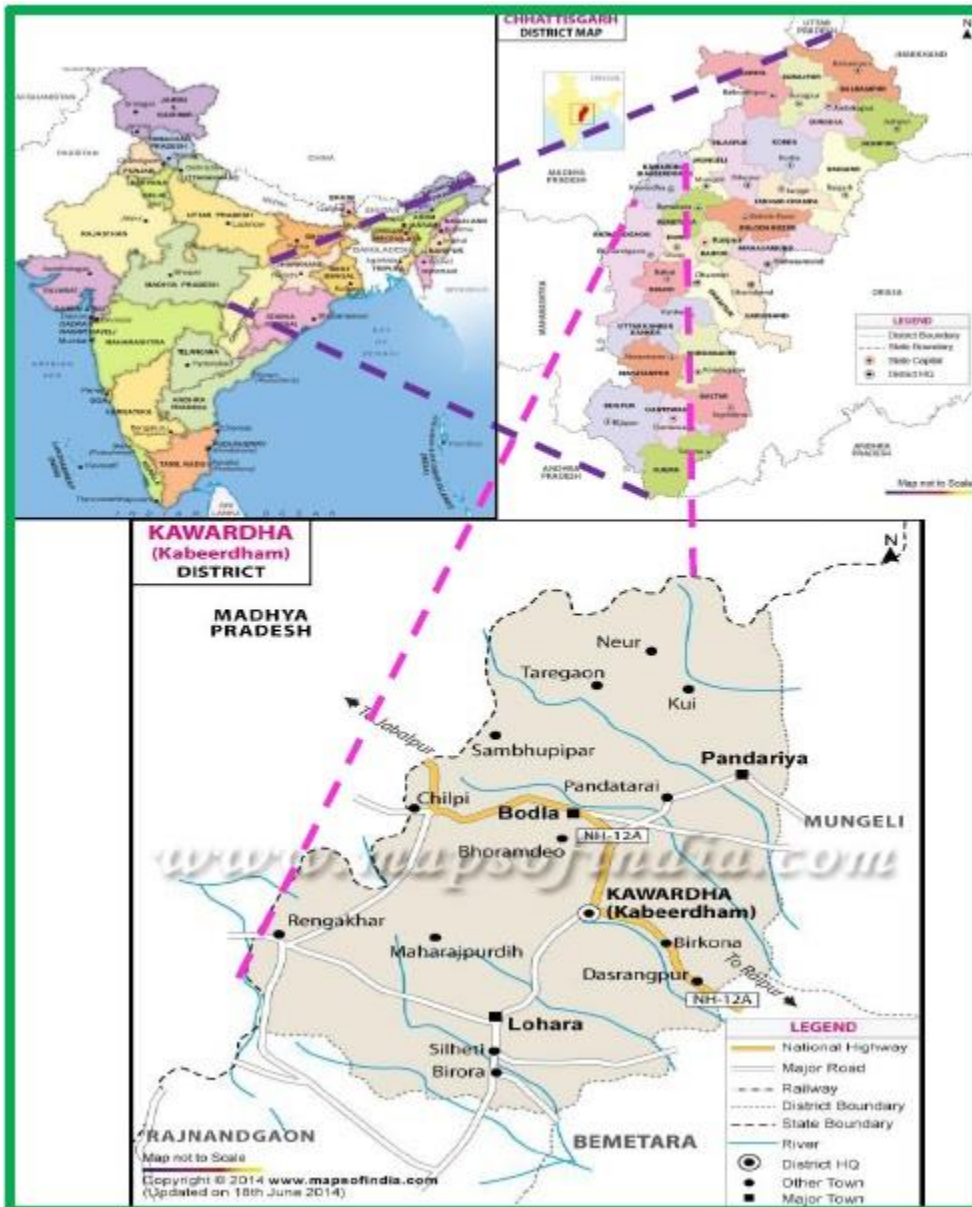
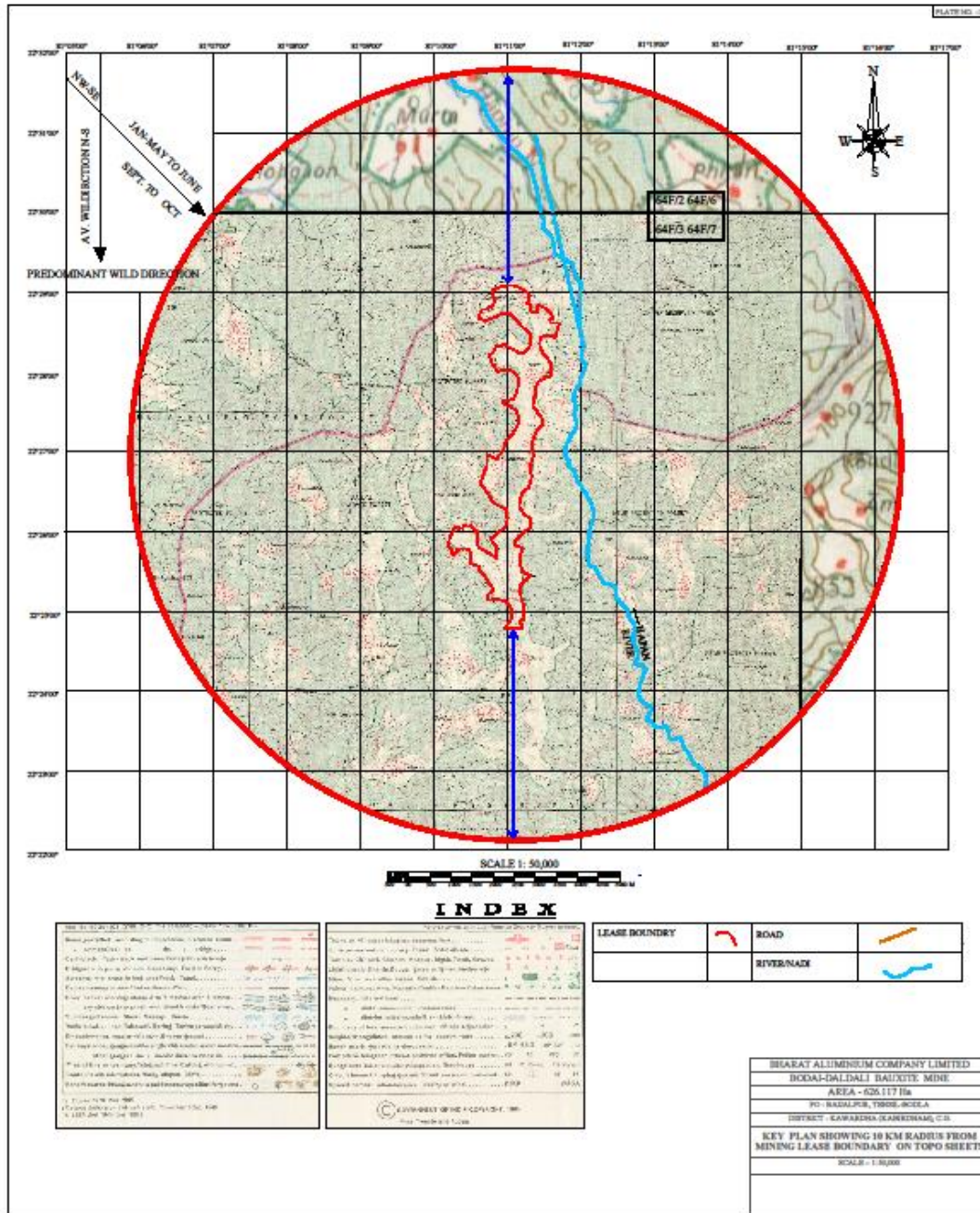


Figure-2
Lease area of Bodai Daldali Bauxite Mine on Toposheet



3.0 Climate:

During peak summer the temperature rises to 42°C, while winter temperature falls down to 03°C (average 15°C). The rain fall is confined to the rainy season from July to September and annual rain fall is average 1200 mm.

4.0 Topography

The plateau of Bodai-Daldali forms the central part of Maikal range. The average elevation of the area is 940 MSL. The plateau trending N-S has irregular margin and bounded by steep escarpments. It is about 12 km long N-S linear plateau with width varying from 0.5 to 2.0 km.

A well defined scarp marks eastern boundary of the main plateau i.e. Mundadadar, Bodai, Keshmarda, Rabda, Semsata and Darai. However, the mining lease area extends over mainly four villages; almost half of mining lease area was originally occupied by unirrigated/agriculture land. Density of trees on the plateau is very thin while on the slopes, there is thick vegetation.

5.0 Drainage:

The lease-hold area is drained by Hanp-Hapan River in the east and Katai River on the west. The Hapan River flows south to north and Hanp River from north to south, while Katai River flows south to north. The drainage pattern of the plateau is radial. All these rivers are tributaries of Shivrath River which ultimately meets Mahanadi River.

6.0 Lease Area and Land Details

The lease area of Bodai-Daldali mines is 626.117 Hectares. The mining lease for bauxite ore was granted to Balco for 20 years from – 27/03/1997 to 26/03/2017 and now Mining Lease is deemed to be extended for further 30 year period as per the section 8(A) of MMDR Amendment Act 2015.

The details of lease-hold area as per revenue records (All figure in Ha):

Village	Revenue Forest Land (Van Nistar area)	Govt.	Private	Total	Grand Total
Mundadadar	8.040	67.141	26.977	94.118	102.158
Kesmarda	22.463	121.514	185.862	307.376	329.839
Rabda	3.063	63.406	65.596	129.002	132.065
Samseta	0.000	24.723	37.332	62.055	62.055
Total	33.566	276.784	315.767	592.551	626.117

The land use pattern of the lease-hold area in initial stage was as under (All figures in Ha):

Village	ML Area	Private Land (Un-irrigated/ Agricultural Land)	Government Land						Revenue Forest Land (Van Nistar Land)	Total
			Populated area	Area under water/ stream	Road	Marghat / grazing land	Gothan	Waste / rocky terrain / Barren land		
Mundadadar	102.158	26.977	-	0.005	0.455	1.445	0.323	64.913	8.04	102.158
Keshmarda	329.839	185.862	6.216	1.788	5.881	0.553	-	107.076	22.463	329.839
Rabda	132.065	65.596	0.21	-	3.198	4.6	-	55.398	3.063	132.065
Samseta	62.055	37.332	0.625	-	0.365	-	-	23.733	-	62.055
Total	626.117	315.767	7.051	1.793	9.899	6.598	0.323	251.12	33.566	626.117

Present Land Status

All leasehold is under possession for mining except 33.566 Ha revenue forest land (Van Nistar land) being “nistary” (public utility land) land will not be mined out therefore no working permission will be sought. The area under Marghat, Gothan and water stream (8.714 Ha) will not be mined. The private land has already been acquired under land Acquisition Act 1894, and is under possession.

7.0 Regional geology:

The area constitutes central part of the extensive laterite-capped plateau of the Maikal Range hills. In plains to the north-western part of the area around Mawai and Kathaitola, gneissose and schistose rocks form the core of the range, whereas around Kukrapani and Taregaon in the south-east, phyllite, slates and quartzites belonging to Chilphi Group are exposed. In the lower part of the plateau, narrow patches of Lametas, represented by calcareous gritty sandstones and pink & white clays are seen in the Kanai river section at Kukri. These are overlain by horizontally disposed basaltic lava flows of Deccan Trap. Good exposures of Deccan Trap are noticed along the Kukrapani Daldali ghat section. The traps are capped by about 25 m thick laterite. Bauxite is normally found within upper part of the laterite capping.

The geological sequence of the area is as under:

Upper Tertiary	High level laterite & bauxite	Clay, laterite & bauxite
Lower Eocene to upper Cretaceous	Deccan Trap	Basaltic rocks and intertrappeans
Cretaceous (Turonian)	Lameta	Calcareous & gritty sandstone and clay
-----unconformity-----		
Precambrian	Chilphi Group Archaean basement complex	Phyllite, slates & quartzites Gneisses and schists

A typical profile of the leased out area is summarized as under:

Lithology	Thickness	Description
Top soil	0.00 -2.00 m	Dark gray grading downwards into laterite soil
Upper laterite	0.00 - 1.00 m	Pisolitic, loose or undulated, scoraceous contains pebbles and boulders of the bauxite and shows undulating but sharp contact with the underlying bauxite
Bauxite	0.00 - 3.30 m	Massive, sometimes pisolitic, hard and compact, denser than the laterite vesicular and pitted; displays shades of light gray and pink colour
Lower laterite	0.00 - 3.30 m	Massive locally oolitic and pisolitic, moderately hard to soft vermicular and scoraceous, porous and shows darker shades of red, yellow and brown colour
Lithomerge	0.00 -15.3 m	Light gray, yellow & red clay, laminated; laminae impersistent; highly porous
Trap	+ 30 m	Weathered, at the contact with the Lithomerge, followed downwards by fresh unaltered trap

8.0 Physical Property of the Bauxite:

The bauxite & laterite are composed essentially of varying mixture of hydroxide of Al and Fe and small percentage of TiO_2 and show a great deal of variation. The bauxite is mostly light pink and gray in colour, hard, compact and massive in texture, pisolitic, oolitic and brecciated with sub-conchoidal fracture. Mineralogically, bauxite is mainly in the form of gibbsite with minor hematite and good amount of anatase (TiO_2) with traces of kaolinite.

The quality of bauxite can be judged from its colour, texture and specific gravity. Higher alumina content is indicated by light shades of colour lack of cavities and greater density. The ferruginous bauxite has different shades of pink colour and the dark coloured patches contain more iron due to which its specific gravity is also normally high. The clayey bauxite is characterized by high porosity and in turn low specific gravity. Colour– pinkish, Form– pisolitic / botryoidal and massive, Lusture– earthy, Streak– white to yellowish brown, Hardness– variable maximum 3, Sp. gr. – 2.3.

Plant Feed Grade of the Bauxite:

Bauxite having Alumina up to +42% and having reactive silica less than 5% is suitable for producing alumina at our Alumina Plant. This can be achieved with Al_2O_3 cut off of 30%.

9.0 Exploration work carried out in the area:

The exploration was carried out by the company through Central Drill Associate, Nagpur and GEIM, Kolkata during the period 1999 to 2007 in entire lease area on grid pattern of 50 m x 50 m, thus the entire lease area has been covered by detailed exploration to establish the ore reserves in proved category. The details of exploration drilled in the lease hold area is as under:

Exploration period	No. of BH Drilled	Meterage
1999-2000	280	2008.76
2002-2004	732	4427.13
2005-2007	1092	7491.18
Total	2104	13927.07

10.0 Reserve:

The entire lease area has been covered by detailed exploration to establish the ore reserves in proved category.

The Geological and Recoverable Reserve of the Mine as on 1st April 2016 is given below-

Category of Reserve	Quantity (Tonnes)
Geological Reserve	73,76,652
Recoverable Reserve	55,32,489

Recovery Factor: There is 75% of recovery of bauxite from the ROM to achieve the plant feed grade. The rest 25% of the ROM has very high silica content and is treated as reject. ROM reject is simultaneously backfilled in already mined out area.

Thus, 75% of the Proved Reserves has been considered as recoverable reserves which is $73,76,652 \times 75\% = 55,32,489$ tonnes.

11.0 Mining:

The bauxite deposit of Bodai-Daldali Bauxite mines is situated over the plateau and the ground terrain is flat.

As the Bauxite deposit is found in shallow depth, therefore opencast mining method has been adopted. All workings are being carried out by mechanised way, by using excavator of 2.5 to 4.6 Cum size, dumper of 15- to 25 tons capacity, blast hole drill machine, 110 mm dia, dozer and now crusher with screening plant is being proposed instead of manual sorting and sizing.

The over burden is top soil & soft laterite of 0 to 3.00 meters thickness after which there is a hard overburden of thickness varying from 0 to 6.00 meters. The thickness of ore zone is 0 m to 4.00 m and is flat.

In general working is of shallow depth of avg. 4 to 6 m (maximum up to 10 m), therefore concurrent backfilling method has been adopted.

The general practice is to scrap the top soil separately by dozer, or excavator dumper combination and use it for directly spreading over already backfilled compacted area.

Drilling and blasting is practiced in hard OB benches and ore benches. Excavation is done by excavator dumper combination.

Since the deposits are boulder in nature, bauxite needs to be separated from laterite and murrum. It is proposed to mechanically crush and screen the ore so as to obtain desired grade bauxite with acceptable silica content.

The backfilling is done in same sequence as it is found in the nature, i.e. hard OB in bottom, then soft OB above the hard OB, then top soil.

The height of OB benches is kept maximum of 6 meters and the ore benches are kept generally of 1 to 4 meters of height as per thickness of ore body.

The blast boreholes of 2 to 4 m depth are being drilled by DTH drills, which are required for blasting. Controlled blast technique is used for keeping the ground vibration, blast through and noise within permissible limit. The blast design and charge per delay are kept strictly as per the requirement of DGMS.

For getting the bauxite of desired grade and size, from blasted ore muck, it is subjected to mineral dressing, and this will be carried out by two ways.

- Where the deposits is homogeneous in quality, then the ROM will be processed, through mechanized way of mineral dressing by crusher and screening plant sets
- And, where deposit is of heterogeneous w.r.t. Quality, then the ROM will be subjected to manual method of sorting and sizing.

The sized and sorted bauxite found after crushing /screening or manual sorting is stored and analyzed for its quality before dispatch to plant by truck.

The mining are planned in such a way that, a consistent plant feed grade can be obtained. For this, the quality analysis of the bore hole data is done and various patches are selected in such a way that the blended quality is in line with plant feed grade.

11.1 Summary of the proposed year wise production is as under:

Year	OB Quantity (Tonnes)			Recovery		Stripping Ratio (Tonnes)
	Soft OB	Hard OB	ORE	Plant Feed Grade Bxt form ORE 75%	Rejection (from ORE) 25%	
2016- 17				3331637	573221	2333163
2017-18	3002650	460354	2333226	1749919	583307	1.48
2018-19	1948883	397244	2333241	1749931	583310	1.01
2019-20	357245	31510	377022	282767	94256	1.03
Total	8640415	1462329	7376652	5532489	1844164	1.37

12.0 Working Hours

Working will be carried out in three shifts.

13.0 Concurrent backfilling of mined out area:

After removal of entire bauxite from the mined out area, the same is being back-filled in the order of occurrence of different types of material in nature, like hard laterite at bottom, then soft laterite and subsequently, top soil. Two mined out pits have been developed as water reservoir for storing of rain water for increasing the surface water availability and at the same time for ground water recharging. In this way, after removal of bauxite the mined out areas are concurrently backfilled with generated OB (hard /soft laterite) and reject material. Leveling and compaction of backfilled area is being done from time to time by dozer so as to restore the topography in its original shape. Thereafter, the back-filled leveled areas are being covered with top soil for plantation. The species for plantation are selected in consultation with State Forest department and also with involvement of locals.

14.0 Land Use Details:

Current Land Use Details- As on as on 1st April 2016 in Ha

SN	Total Lease Area	Mined Out Area	Backfilled & Reclaimed Area	Afforested Area	Remaining Area for Mining	Undisturbed Area
1	626.117	299.07	285.54	184.10	167.060	159.987

15.0 Equipment and Machineries for mining operation and allied activities :

There is no regular industrial power available in the area, and capacity of the machines being small, only diesel power equipment are being used.

SN	Name	Nos	Capacity	Purpose
1	DTH Drills	4	110 mm dia	For drilling above 1.5 m hole
2	Jack Hammer	3	32 mm dia	For drilling upto 1.5 m hole
3	Compressor	4	--	For operation of drill machines, & jack hammers
4	Hydraulic Excavators, 2.5 to 4.6 cum size nos of above 300 HP	4	2.5 to 4.6	To excavate OB and ore
5	Hydraulic Excavators, 1 cum size	1	1 Cum	To excavate OB and ore
6	Hydraulic rock breaker	3	Attachment with excavator	For breaking big boulders
7	Portable small Dozer	2	-	For leveling of blasting surface and back-filled area
8	Loader	3	1.50 cum bucket	For crusher feeding & reject loading from crusher yard
9	Dumpers	15	20 tonner	For transportation of OB and ore
10	Diesel Tanker	1	2000 liters	For filling diesel to different equipment
11	Water Tanker	2	10000 liters	For sprinkling of on quarry road
12	Service-Van (well-equipped)	1	-	For repairs / maintenance of machines.
13	Explosive Van	1	3 Tonner	For bringing explosive from magazine to quarry at blasting site
14	DG set	2	50KVA Capacity	For water pump & Lighting stand by
15	Diesel Gen set	3	100 KVA	For electricity generation in case of normal electric supply failure.
16	Diesel Gen set	1	15 KVA	For electricity generation at LAB
17	Water pump	1	5 HP	For pumping of water
18	Crusher & Screening plant	2	150 TPH-	For Sizing & Sorting of bauxite from ore
19	Portable light tower mask	6		For lighting purpose.

16.0 Employment

SN	Management and Supervisory Personnel	Qualification	Nos. required
1	Agent Mines	B.E. Mining with FMC	1
2	Mine Manager	B.E. Mining with FMC	1
3	Asstt. Manager (Mines)	B.E. Mining with SMC	3
4	Geologist	M.Sc. or M. Tech Geology	1
5	Mechanical Engineer	B. E. Mechanical/	1
6	Electrical Engineer	B.E. Electrical	1
7	Mining Foreman	SMC/ foreman competency	12
9	Mining Mate	Matriculation with Mining Mate's certificate	12
10	Safety, Training and Environment	B. E. Mining with SMC	1
11	Blaster	Blaster Certificate holder / Mining Mate's certificate	6
12	Medical Officer	MBBS	1
13	Surveyor	Surveyor certificate of competency	1
	Total		41

With the capacity addition approximately more than 100 indirect employment would be generated.

17.0 Infrastructure and Services:

The essential facilities like office, first-aid station, drinking water arrangement, canteen, rest shelter, maintenance shed etc. already existing at mine site and are adequate for proposed increase in production.
