ANNEXURE –B

GOVERNMENT OF INDIA
MINISTRYT OF MINES
INDIAN BUREAU OF MINES
MCCM CENTRAL ZONE

No. 314(3)/2006-MCCM(CZ)/MP-20 Nagpur, Dated : 02/03/2007

To

R. S. Singh
Executive Director (Mines)
Electro Steel Castings Limited
19, Camac Street,
Kolkata – 700 017

Subject :- Approval of Mining Plan alongiwh Progressive Mine Closure Plan in respect of Dirsumburu iron ore deposit of M/s Electro Steel Castings Limited over an area of 192.50 hectares in West Singhbhum district, Jharkhand submitted under Rule 22 of MCR, 1960, for grant of mining lease.

Ref :-
1) Your Letter No. Nil dated 09.11.2006.
2. This office letter of even no. dated 23.01.2007
3) Your Letter No. Nil dated 20.02.2007.
4. This office letter of even no. dated 23.02.2007.
5) Your Letter No. Nil dated 26.02.2007.

Sir,

In exercise of the powers conferred by Clause (b) of Sub-Section (2) of Section 5 of Mines & Minerals (Development & Regulation) Act, 1957 read with Government of India Order No S.O.445(E) dated 26.4.1987, I hereby approve the above said mining plan. This approval is subject to the following conditions :-

i) This mining plan is approved without prejudice to any other laws applicable to the mine/area from time to time whether made by the Central Government, State Government or any other authority.

ii) It is clarified that this approval of mining plan does not, in any way, imply the approval of the Government in terms of any other provisions of the Mines & Minerals (Development & Regulation) Act, 1957 or the Mineral Concession Rules, 1960 and any other laws including the Forest Conservation Act, 1980.

iii) It is further clarified that this approval of mining plan under Rule 22 of MCR 1960 is subject to the provisions of Forest (Conservation) Act, 1980, Forest Conservation Rules, 1981, and other relevant statues orders and guidelines as may be applicable to the lease area from time to time.

iv) The provisions of Mines Act, 1952 and Rules and Regulations made there under including submission of notice of opening, appointment of Manager and other statutory officials as required by the Mines Act, 1952 shall be complied with.

v) The mining plan is approved without prejudice to any other order or direction from the court of competent jurisdiction.

6th Floor, 'D' Block, Indira Bhavan, Civil Lines, Nagpur – 440001
Email : com_cz@ibm.mah.nic.in ; Fax : (0712) 2585603 Telephone : (0712) 2565603

vii) Your attention is invited to the Supreme Court interim order in W.P.(C) No.202 dated 12-12 96 for compliance. The approval of mining plan is, therefore, issued without prejudice to and is subject to the said directions of the Supreme Court as applicable.

viii) The details of grant of the lease by the State Government, whenever such an order is passed may be intimated to the Regional Controller of Mines, Indian Bureau of Mines Kolkata.

viii) A copy of Environment Impact Assessment – Environment Management Plan (EIA-EMP)as approved by MOEF (Ministry of Environment & Forest) shall be submitted to IBM within a month of approval alongwith a copy of their approval letter.

ix) If anything is found to be concealed as required by the Mines Act in the content of the mining plan and the proposals for rectification has not been made, the approval shall be deemed to have been withdrawn with immediate effect.

x) The department does not undertake any responsibility regarding correctness of the boundaries of the lease area shown on the ground with reference to lease map & other plans furnished by the applicant/lessee.

xi) Yearly report as require under rule23E(2) of MCDR'88 setting forth the extent of protection and rehabilitation works carried out as envisaged in the approved progressive mine closure plan and if there is any deviations, reasons thereof shall be submitted before 1st July of every year.

xii) The lessee should submit the financial assurance to the Regional Controller of Mines , Indian Bureau of Mines, Kolkata before executing the mining lease deed as per rule 23(F)(3) of Mineral Conservation & Development Rules, 1988.

xiii) The Environmental Monitoring Cell shall be established by the company. This Environmental Monitoring Cell of the company, shall continue monitoring ambient air quality, dust-fall rate, water quality, soil sample analysis and noise level measurements at various stations established for the purpose both in the core zone and buffer zone as per requirement of Environment Guidelines and keeping in view IBM's circular No. 3/92 & 2/93 season-wise every year or by engaging the services of an Environmental Laboratory approved by MOEF/CPCB. The data so generated shall be maintained in a bound paged register kept for the purpose and the same shall be made available to the inspecting officer, on demand.

Yours faithfully,

Encl Two copies of approved mining plan

(Ranjan Sahai)
Controller of Mines (CZ)

Contd.

Copy for information to :-

1. The Director, Directorate of Mines Safety, Chaibasa Region, P.O. : Chaibasa 833 201, Dist.Singhbhum West, Jharkhand, alongwith one copy of approved mining plan.

2. The Director Of Mines, Department of Mines & Geology, Government of Jharkhand, Engineering Hostel 2nd Floor, Goal Chakkar, Dhurwa, Ranchi-834 004. It is requested to advise the applicant/lessee to submit the financial assurance to the Regional Controller of Mines, Indian Bureau of Mines, Kolkata to comply with the provisions of rule 23(F) of the Mineral Conservation & Development Rules, 1988 before executing the mining lease deed. The lease deed shall be executed only after receiving a confirmation letter from The Regional Controller of Mines, Indian Bureau of Mines, Kolkata.

3. SRG Services & Consultancy (P) Ltd. 135, Jodhpur Park, Kolkata - 700 068

(Ranjan Sahai)
Controller of Mines (CZ)

"This mining plan is approved subject
to the conditions ... at the end
in the Mining Plan approval letter No.
314(3)/2006-MCCM(CZ)/MP-39 dated 02/03/07"

ELECTROSTEEL CASTINGS LIMITED

19, Camac Street, Kolkata - 700017

MINING PLAN

(Including Progressive Mine Closure Plan)

DIRSUMBURU IRON ORE DEPOSIT

Mining lease applied for over 192.50 Ha

(Falls within Kodolibad Reserve Forest, Manoharpur BD, Singhbhum (West), Jharkhand)

Submitted under Rule 22(4) of MCR, 1960 for Grant of Mining Lease

अनुमोदित
APPROVED

2/3/07

खान नियंत्रक (मध्यांचल)
Controller of Mines (Central Zone)
भारतीय खान ब्यूरो
Indian Bureau of Mines

FEBRUARY 2007

RQP/CAL/287/99/B

SRG Services & Consultancy (P) Ltd

155, Jodhpur Park, Kolkata - 700 068

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7 Environment plan
8 Mine Closure Plan

ELECTROSTEEL CASTINGS LIMITED

19, CAMAC STREET, KOLKATA-700 017 (INDIA)
TEL : Board Number 91-33-2283 9990
Fax : (Directors) 91 33 22894336, (Sales) 91 33 22894337, (Export) 91 33 22894338, (Finance) 91 33 22894339

February 13, 2007

TO WHOMSOEVER IT MAY CONCERN

I, Umang Kejriwal, Managing Director, Electrosteel Castings Limited, 19 Camac Street, Kolkata 700017, hereby appoint Mr. Rama Shankar Singh, Executive Director in the company as an 'Applicant' and subsequently 'Owner' for all Intents and Purposes of the mining lease applied for 192.50 hectares over the DIRSUMBURU IRON ORE DEPOSIT in Kodolibad Reserve Forest, Manoharpur BD, Singhbhum (West), Jharkhand.

Mr. Rama Shankar Singh will be responsible for all communication, execution of deeds and agreement etc. and will act as Signatory on behalf of Electrosteel Castings Limited.

For Electrosteel Castings Limited,

Umang Kejriwal
(Managing Director)

अनुमोदित
APPROVED

ELECTROSTEEL CASTINGS LIMITED

19, CAMAC STREET, KOLKATA-700 017 (INDIA)
TEL Board Number 91-33-2283 9990
Fax : (Directors) 91-33 22894336, (Sales) 91 33 22894337, (Export) 91 33 22894338, (Finance) 91 33 22894339

CONSENT LETTER

This is to certify that SRG Services & Consultancy (P) Limited, 135, Jodhpur Park, Kolkata 700068 who are Recognized Qualified Person bearing RQP / CAL / 287/ 99/ B have been authorized by us to prepare the Mining Plan and Progressive Mine Closure Plan in respect of the mining lease area applied for over 192.50 ha in Dirsumburu Hill, Kodolibad Forest Area, Manoharpur BD, West Singhbhum District, Jharkhand.

It is further certified that this mining plan and progressive mine closure plan has been prepared in full consultation with us and we have understood its contents. We agree to implement the same in accordance with law and in a time bound manner.

For Electrosteel Castings Limited

R. S. Singh
Applicant of the Mining Lease &
Executive Director (Mines)

Dated 20/02/2007

अनुमोदित
APPROVED

Certificate for provisions of Mines Act, Rules & Regulations

Certified that the provisions of Mines Act, Rules & Regulations made there under have been observed in the Mining Plan & Progressive Mine Closure Plan for Mining Lease applied for in the Dirsumburu Iron Ore Deposit over an area of 192.50 hectares in Kodolibad Reserve Forest, Manoharpur BD, Singhbhum (West), Jharkhand. Where specific permissions are required, the applicant will approach the Director General of Mines Safety.

It is also certified that information furnished in the above Mining Plan and Progressive Mine Closure Plan is true and correct to the best of our knowledge.

Place: Kolkata
Date: 20/02/07

RQP/CAL/287/99/B
SRG Services & Consultancy (P) Limited
Key Person: TN Gunaseelan

APPROVED

Certificate for provisions of MCDR

This is to certify that the provisions of Mineral Conservation & Development Rules, 1988 and amendments made thereon have been observed in the Mining Plan and Progressive Mine Closure Plan for Mining Lease applied for in the Dirsumburu Iron Ore Deposit over an area of 192.50 hectares in Kodolibad Reserve Forest, Manoharpur BD, Singhbhum (West), Jharkhand. Where specific permissions are required, the applicant will approach the concerned authorities of Indian Bureau of Mines.

It is also certified that information furnished in the above Mining Plan and Progressive Mine Closure Plan is true and correct to the best of our knowledge.

Place: Kolkata
Date: 20/02/07

RQP/CAL/287/99/B
SRG Services & Consultancy (P) Limited
Key Person: TN Gunasedan

अनुमोदित
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INTRODUCTION

ELECTROSTEEL CASTINGS LIMITED (ECL) is an engineering company engaged in the infrastructure business of water supply and sewerage conveyance system projects. Superior corrosion resistant 'ductile iron spun pipes' manufactured by the company are used for conveying water and sewerage. These not only provide long service, safety and reliability in the system, but very much help in protecting and preserving the environment.

The company specializes in the vital sector of water infrastructure development and undertakes complete turnkey projects to supply, lay and commission pipelines to transport water safely and efficiently for everyday use.

In the company's plant at Khardah, 24 Parganas, West Bengal, India ECL manufactures ductile iron pipes to international standards with in-house mini blast furnace facility for preparation of pig iron from iron ore i.e., complete manufacture from ore to pipe totally in-house. The company also specializes in the manufacture of 'ductile iron pipe fitting' required for the pipeline systems. ECL also manufactures 'DI pipes with cement mortar lining' on the inner surface of the pipe and 'Zn and bitumen coating' on the outer surface in standard lengths of 5.50 and / or 6.00 metre each pipe in the sizes ranging from 80 to 1,000 mm diameter. ECL also supplies DI Pipes with special internal & external coatings. The plant at Khardah is registered by BSI (UK) for ISO-9002 and ductile iron pipes have product certification to use BSI-Kitemark. These pipes are manufactured confirming to International Standards ISO-2531: 1998/BS EN-545: 1995/BS EN-598. Recently, the company has obtained approval from the Korean Standards Association for the Korean Industrial Standard (KS) Marking Licence.

ECL exports ductile iron spun pipes, fittings and flange pipes to countries like Singapore, Brunei, Hong Kong, Bahrain, Sultanate of Oman, Qatar, Spain, UK, South Africa, Bangladesh, Sri Lanka, Nepal, Syria and Jordan, among other countries.

The company also has set up a coke oven plant at Haldia for production of blast furnace quality coke, as a backward integration to meet its MBF coke requirement. At Haldia, ECL is also setting up a sponge iron plant with rotary kiln of capacity 200 tpd to substitute the scrap requirement for ductile iron manufacture in the first phase. Rotary kiln of capacity 300 tpd to augment liquid metal production to manufacture steel and rolled products is planned in the second phase.

To meet the increasing power demand, the company has plans to set up a thermal power plant of capacity 40 MW.

अनुमोदित
APPROVED

Key person, EOP CAL 287 dt 11

213107

खान नियंत्रक (मध्यांचल)
Controller of Mines (Central Zone)
भारतीय खान ब्यूरो
Indian Bureau of Mines

While all the above plans are already under implementation stage, ECL has conceived setting up an Integrated Steel Plant of 3 million tonnes per annum in the State of Jharkhand in the initial phase and subsequently expand it. With this in mind, ECL intends to develop captive iron ore mines.

ELECTROSTEEL CASTINGS LIMITED OVER THE YEARS

Ductile Iron Pipe Plant 60,000 TPA capacity commissioned	1993-1994
Mini Blast Furnace commissioned	1996-1997
Achieved Ductile Iron Pipe capacity increase from 60,000 TPA to 90,000 TPA	1997-1998
Co-Generation Power Plant commissioned	1997-1998
Achieved Ductile Iron Pipe capacity increase from 90,000 to 1,20,000 TPA	1999-2000
Achieved Ductile Iron Pipe capacity increase from 1,20,000 to 1,50,000 TPA	2001-2002
Commissioned a Ductile Iron Fittings Plant with a capacity of 5,000 TPA	2001-2002
Achieved Ductile Iron Pipe capacity increase from 150,000 to 200,000 TPA	2002-2003

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Key person RQP CAL 287-99-B

CHAPTER I: GENERAL

I.A NAME AND ADDRESS OF THE APPLICANT

Name of the authorized Applicant	:	Mr RS Singh
Name of the Company	:	Electrosteel Castings Limited
Office	:	19, Camac Street, Kolkata - 700017
Tel No	:	+91-33-22839990
Fax No	:	+91-33-22894340

For all correspondence regarding the Mining Plan, the following authorized person may please be contacted. The authorization letter is placed at the beginning of this volume:

Name	:	Mr. R.S. Singh
Designation	:	Executive Director
Address	:	Electro Steel Castings Limited 19, Camac Street, Kolkata - 700 017
Tel No	:	+91-33-22839990
Fax No	:	+91-33-22894340
Email	:	rssingh@electrosteel.com

I.B STATUS OF THE APPLICANT

Electrosteel Castings Limited is a Public Listed Company, in the business of making iron pipes. To become an integrated company, ECL is setting up a steel plant and in order to have a secured source of raw materials, ECL has applied for mining leases for iron ore and coal. The Board of Directors and their contact details are enclosed as Annexure 1

I.C MINERAL WHICH THE APPLICANT INTENDS TO MINE

Iron and Manganese Ore

I.D PERIOD FOR WHICH THE MINING LEASE APPLIED FOR

30 years

I.E NAME OF THE RQP PREPARING THE MINING PLAN

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Key person, RQP CAL 287 99 B

1.E.1	Name of the RQP	SRG Services & Consultancy (P) Ltd.
	Address	135, Jodhpur Park, Kolkata- 700 068
	Phone No.	+91-33-24139826/29
	Fax	+91-33-24148761
	Email	srg@vsnl.com
	Registration No.	RQP/CAL/287/99/B. A copy of the certificate is enclosed as Annexure 2.
	Valid upto	21.02.2011

1.E.2 Declaration of the Applicant to abide by the commitment made in the Mining Plan is placed at the beginning of this volume.

1.E.3 The key person who has prepared the mining plan with the support of other geologists and mining engineers are given below:

TN Gunaseelan – Mining Engineer (Key Person)
SM Kolay Dr – Mining Engineer
AK Mukhopadhyay –Geologist
Suman Talukdar – Mining Engineer
Arunabha Duari - Geologist

1.F NAME AND ADDRESS OF THE PROSPECTING AGENCY

Discovery of the iron ore deposition and regional level work was carried out by GSI. Recent geological prospecting work has been carried out by M/s SRG Services & Consultancy (P) Limited, 135, Jodhpur Park, Kolkata 700068.

1.G CONSENT LETTER FROM THE STATE GOVERNMENT

The consent letter from the State Government is enclosed as Annexure 3.

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Key person: EQP CAL 287 99 B

CHAPTER II: LOCATION AND ACCESSIBILITY

2.A DETAILS OF THE AREA

The lease area applied for (hereinafter referred as lease area) over 192.50 ha by Electrosteel Castings Limited is polygonal in shape and falls within Survey of India Topo Sheet No. 73 F/8. The lease area is bounded within Latitude 21°54'30"N, Longitude 85°18'E and lies in Manoharpur BD in Paschimi Singhbhum District of Jharkhand. The entire lease area falls within Kodolibad Reserve Forest. The key plan is presented in the Plate 1.

2.B ACCESSIBILITY TO THE AREA .

2.B.1 **Road:** The lease area is situated within Kodolibad R.F. The nearest village is Usanya which lies 12km from Chota Nagra. The two places are connected by a road passing through Sonapi & Hatnaburu. Chota Nagra lies between Barajamda and Chiriya and is 40 km from Barbil and 32 km from Barajamda.

2.B.1 **Rail:** Manoharpur on SE Railway, at a distance of 36 km from the lease area is the nearest rail head. Barbil also in SE Railway is another near railhead 40 km away from the lease area.

2.B.3 **Air:** Jamshedpur is the nearest public airport situated at a distance of 140 km from the lease area.

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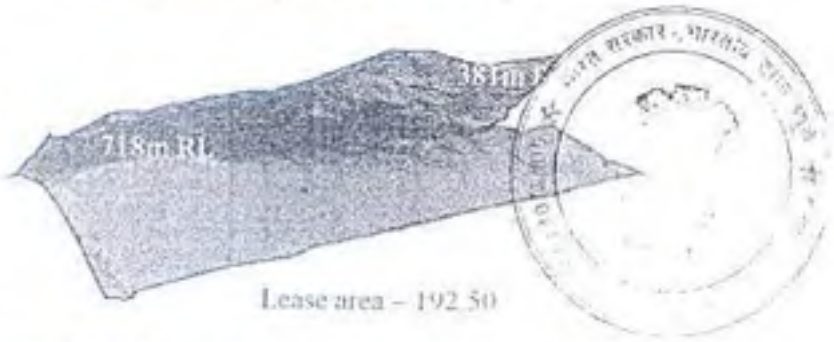
Key person RQP CAL 287 99 B

CHAPTER III: GEOLOGY AND EXPLORATION

3.A BRIEF DESCRIPTION OF GENERAL AND LOCAL GEOLOGY

3.A.1 Physiography: The lease area lies about 3.5 km to the southeast of the village Marang Ponga (22 14', 85 14') and to southwest of village Chota Nagra at a distance of about 12 km. The area occupies the top of a fairly high sub-conical hill (see picture alongside) known as Dirsumburu Hill against which the Iron Ore lease is named. The hill has marked steep scarps to the south and south-east.



The hill also slopes off gradually in the north and northeasterly direction with a re-entrant slope. The nearest village Usanya lies to the northwest at the plain at a distance of about 2.5 km from the hill peak (~718m RL). The western and northwestern slopes are comparatively gentle to moderately steep. The entire area is the catchment area of Koina River which is perennial in nature. It has two perennial tributaries, Koina Gara and Saraiko (Ponga Nadi). These tributaries are in turn fed by sub tributaries or *nallahs* which are seasonal in nature. However, the sub tributary of Koina Gara namely Ambabai Gara is perennial and lies 2 km beyond the SW corner of the lease area. The lease area and its surroundings show the dendritic drainage pattern flowing radially from the higher elevation of Dirsumburu hill. Three such seasonal *nallahs* run towards NNE, SE and SW areas of the hill. The lease area is studded with flat topped low ridges resembling a relict erosional hill range type of topography, originating from differential weathering and erosion of different rocks. The maximum RL within the area is 718m to the southern part of the lease area and the minimum RL of 381m at the NE side. The area has a fairly thick forest cover.

3.A.2 Regional geology: The Precambrian rocks of this region comprising of mafic lava, tuffs, BIF, shales, conglomerate and sand stones etc. were mapped for the first time by Jones (1934). The most acceptable litho-stratigraphic succession for the belt was proposed by Murthy and Acharya (1975). They identified different depositional facies and proposed a more detailed stratigraphic succession. They also proposed a new name the 'Koira Group' to the rocks of Bonai-Keonjhar belt. The iron and manganese deposits in the area form a part of South eastern portion of the

Key person, RQP CAL 287/99 B

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Singhbhum-Keonjhar-Bonai belt known as Jamda-Koira valley and is represented by a narrow NNE plunging folded synclinorium of 60Km long and 25Km in width. The Pre-cambrian horse-shoe shaped belt has general strike NE to N and dips are moderate to the west. The western limb of the synclinorium is slightly overturned. The present area relates to the depositional basin of Western Singhbhum and Keonjhar extending from Malangtoli in the south to Chakradharpur in north (West Singhbhum-Keonjhar basin). According to Sarkar and Saha (1983) the Modified Chrono-stratigraphic succession of Iron Ore Craton of Singhbhum Orissa is given in Table 3.1.

Table 3.1: Generalized chrono-stratigraphic succession of the iron ore craton of Singhbhum

	Newer Dolerite Dykes and Sills	
	Mayurbhanj Granite	
	Gabbro- Anorthosite	
	Ultramafic intrusions	
	Kolhan Group: Shale, Limestone, Sandstone and Conglomerate	
	----------Unconformity----------	
Dhanjori Group	Jagannathpur Lavas	Dhanjori-Simlipal Lavas
	Malangtoli Lavas	Quartzite, Conglomerate
Singhbhum Group	Pelitic and Arenaceous Metasediments	
	----------Unconformity----------	
	Singhbhum Granite	
	----------Iron ore Orogeny----------	
	Epidiorite (Intrusive)	
Iron Ore Group	Upper Shales with Sandstones and Volcanics	
	Banded Hematite Jasper with Iron Ore	
	Tuffs, Acid Volcanics and Tuffacious Shales	
	Mafic Lavas with Tuffs	
	Sandstones and Conglomerate (local)	
	----------Unconformity----------	
	Folding and Metamorphism	
	Older Metamorphic Tonalite-Trondhjemite	
	----------Older Metamorphic Orogeny----------	
Older Metamorphic Group (?)	Mafic Intrusives	
	Ortho-Amphibolites, Metagabbro	
	Calc-Mangesian Metasediments, Calc-Gneiss	
	Calc-Schist, Hornblende Schist, muscovite-biotite schist	
	Quartz schist	

3.A.3 **Local geology, description of litho-units & mode of occurrence of iron ore:** The Iron ore deposit within the lease area (over the Dirsumburu Hill) form a part of the Bonai-Keonjhar-Bonai-Keonjhar group of rocks with associated mineral deposits. The lease area represents a part of the western flanks of the main synclinorium (Jones'34). The rocks belonging to the Iron Ore Group mainly comprise Banded Hematite Quartzite, BHJ, Shale, Volcanics, Sandstones, Quartzite and Conglomerate. The host rock of the mineral deposits of Iron ore is BHQ that form a part of the western limb of the famous 'Horse Shoe' shaped Bonai-Keonjhar synclinorium.

It is generally contended that these iron ores have been formed by the process of leaching, replacement and concentration of iron oxides and hydroxides by the action of circulating meteoric water on the iron bearing rocks of the Iron Ore Series under certain structural control.

The entire sequence of various formations from the phyllite base at 540m RL followed by iron ore up to 716m level upward could be clearly observed along the very steep slope on the southeastern side of the hill which exposes almost the entire thickness of the Iron Ore body above phyllite. Intercalations of BHQ etc. of varying thickness are likely at various depths.

Based on surface indications, the litho-units observed can be broadly described as a lower phyllite horizon and banded iron formation with iron ore. Gradually towards the top, massive as well as laminated hematite can be observed forming the hill cliff all along the hill ridge following the regional strike (NNE-SSW) at the top replacing the BHQ. Along the slope, mass of hematite scree is formed more or less insitu and also as a result of transportation by gravity. This gives indication of lateral spread of the ore along the slope. Screes of BHQ and phyllite are also observed at lower horizons.

Towards the northeastern boundary of the lease, exposures of massive quartzite with noticeable development of schistosity have been observed, though, with limited continuity. The Sandstone encountered towards northeastern part is grey coloured, medium grained, hard and compact.

The antichinal and synclinal folds in the quartzite are not often seen on a large scale, but folding on a small scale is common even in laminated hard iron ore and is often very sharp. Although there is change of dip and strike where folds occur, these make practically no difference to the general strike and dip of the rocks as a whole. The planer structures indicate strike varying from north to northwesterly and northeasterly with westerly dips varying from 25° to 50° and also 80° at places.

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Faulting could not be evidenced due to lack of more detailed work and also due to thick top soil cover but its presence can not be ruled out.

The iron ore deposit of this area is mostly massive but thinly laminated hard varieties are also common. Jointing in the ore bodies and types of rocks indicates that tectonic forces were active after formation of the ore.

3.B DETAILS OF GEOLOGICAL INVESTIGATION CARRIED OUT

3.B.1 **Topographical survey carried out:** Three Base Stations were established by Differential Global Positioning System (DGPS). The topographical survey was carried out within the 192.50 ha lease area using Total Survey Station during June 2006. Surface Plan was generated in a scale of 1:2,000 with 3m contour intervals. Since Base Stations were established by DGPS, the coordinates system was laid in UTM using WGS 84. Thus, the area is linked with the National Grid system.

3.B.2 **Geological mapping:** Systematic geological mapping was carried out during June-July 2006. The entire lease area of 192.50 ha was mapped to include geological features including structural elements, delineation of outcrops, outcrop mapping including trend, dips and strikes with interpretation of outcrop and [illegible] geology. A geological Map was prepared in 1:2000 scale.

3.B.3 **Sampling & drilling:** The entire sequence of various formations from the phyllite base at 540m RL followed by iron ore up to 716m level upward could be clearly observed along the very steep slope (cliff structure) on the southeastern side of the hill which exposes almost the entire thickness of the iron ore body above phyllite. Thus, it was felt that initially sampling along the almost vertical column of exposure be carried out at intervals of 150m. Such sampling as well as the complete exposure of the iron ore body in two dimensions (surface as well as the vertical column) increases the confidence level of reserves estimates. All along the hard ore zone on the eastern steep slope samples were collected along three vertical lines, to partly effect the requirement of quality from borehole, separated at horizontal distances of 150m. The details are given below:

Vertical sample line no. 1 (ABH1) - 75m vertical thickness. No of samples - 16
Vertical sample line no. 2 (ABH2) - 50m vertical thickness. No. of samples - 10
Vertical sample line no. 3 (ABH3) - 50m vertical thickness. No. of samples - 10

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3.C PLANS AND SECTIONS

3.C.1 Surface plan: Presented in Plate 2

3.C.2 Geological plan: Presented in Plate 3.

3.C.3 Geological section: One longitudinal and three transverse sections has been drawn along section line AA', BB', CC' and DD' respectively. One more cross-section has been drawn along OO' to visualize the three vertical sample lines (ABH1-3). The sections are presented in Plate 4.

3.D FUTURE EXPLORATION PROGRAMME

Once the mining lease is granted and executed, it is proposed to completely explore the area within the first five years by diamond core drilling in a grid of 100mx100m. The locations of the proposed boreholes with the borehole numbers are shown in Plate 3. Tentatively the average depth of the proposed holes is fixed at 100m. However, the actual depth of each hole will depend on the extent of mineralized zone. The proposed exploration programme is given in the Table 3.2 below:

Table 3.2 - Proposed exploration programme

Year	No of holes	Average depth of hole (m)	Total meterage (m)
1st	31	100	3,100
2nd	31	100	3,100
3rd	31	100	3,100
4th	31	100	3,100
5th	31	100	3,100
Total	155	100	15,500

3.E QUALITY

From the sample along the notional boreholes (vertical lines) (ABH1, ABH2 & ABH3) indicate presence of good grade. The chemical analysis is given in Plate 4. The average Fe% in iron ore within the proved category of reserves is 61.93%.

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3.F RESERVES

3.F.1 Classification of reserves: UNFC system has been adopted to categorize the reserves.

Proved Reserve: Considering the geological axis, detailed geological survey has been carried out and notional borehole data are available. Thus, certain part of the iron ore resource can be brought under G1 category. On the feasibility axis, mining plan has been prepared, investment and manpower requirement firmed up. Thus, the resources can be brought under F1 category. On the economic axis, since the end use, land use pattern, working plan is already known or designed, the resources can be brought under E1 category. Thus, reserves can be classified under 111 group. Based on exposure of iron ore along the vertical cliff and sampling done systematically along 3 channels that are treated as notional boreholes. Horizon considered for this category of reserve is 645m. This ore reserve category limit is marked in Plate 3.

Probable Reserve: Taking into consideration the mineralization within the area under the category of reserve classified as 122 group and also extension of ore deposits in both lateral and vertical directions, probable reserves have been defined. On the geological axis, manifestation of mineralization can be observed. However, the extent of this deposition has not been proved by drilling. Detailed geological survey shows that it has a high probability of ore deposition. The reserve can be classified under 122 group. The nature of mineralization in the proved zone denotes that there is a possibility of ore occurrence in the adjoining area. According to the detailed geological survey and the float ore visible on the surface, the horizon considered for this category of reserve is 630m. This ore reserve category limit is marked in Plate 3. The depth has been decided as per the average ore occurrence in the lease area.

Inferred Resources: This portion of the lease area has not been investigated through out, though the trend shows a possibility of iron ore deposition in this area. So the geological reserves has to be termed in the geological axis of 3. Thus, resources under this area are classified under 333 group. Another 6m below the horizon of probable reserves as well as the balance part of the area within the lease where iron ore exposure is observed are considered under this category. This reserve category limit is marked in Plate 3.

3.F.2 Method of estimation of reserves: Surpac software was utilized for estimation of reserves.

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Proved Reserve (111): Firstly, a Digital Terrain Model (DTM) for the surface topography was constructed using the survey data. From this data contour 645m was generated. The 645m contour was considered as the lower datum and the volume between this datum and natural surface was estimated. The conversion factor is taken as 4 ton/m^3 of hard ore. While estimating the reserves, a cut off value of 58% Fe was considered.

Probable Reserve (122): In this case, the method of calculation was similar to the manner used for estimating the reserves under proved category. The lower datum used was 630m. The reserve between this lower datum and 645m has been grouped under this category. The conversion factor is taken to be 3.5 tonnes per m^3 considering presence of soft and flaky ores.

Inferred Resource (333): In this case, the topography after removing the proved and probable reserves zone is considered as the upper DTM. This DTM was uniformly lowered by 6m within the area defined as inferred resource zone. The volume between the two DTMs is estimated using Surpac software. The conversion factor is taken to be 3.5 tonnes per m^3. The quantity so arrived was brought under this category of reserves.

3.F.3 Geological reserves

The reserves estimated is given in Table 3.3.

Table 3.3: Geological Reserves

Category	Top RL	Bottom RL	Surface Area	Volume	Conversion Factor	Geological Resources
	(m)	(m)	(sqm)	(cum)	(t/cum)	(t)
Proved (111)	Surface	645	325,332	9,552,823	4	38,211,292
Probable (122)	645	630	413,754	5,533,149	3.5	19,366,022
Total			413,754	15,085,972		57,577,314
Inferred (333)	Below Proved & Probable zone	6 below	1,600,835	9,605,010	3.5	33,617,535

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CHAPTER IV: MINING

4.A PROPOSED METHOD OF WORKING

4.A.1 Factors influencing the choice of method of mining:

Availability of reserves: The in-situ iron ore reserve under the proved category (UNFC 111) is estimated at 38.21 million tonnes. The probable reserve (UNFC 122) is estimated at 19.37 million tonnes. The inferred resource (UNFC 333) is estimated at 33.62 million tonnes.

Quality: The cut off grade for iron ore has been considered to be 58% Fe.

Scale of operation: The rate of production when the mine is fully stabilized is planned to be 10 million tonnes of iron ore per annum. The gradual build-up of iron ore production is depicted as scheduled Table 4.1.

Table 4.1: **Production build-up**

Year	Million Tonnes
1st	1.00
2nd	1.00
3rd	3.00
4th	5.00
5th	5.00
6th onwards	10.00

Overburden: Iron ore is outcropping everywhere within the proved and probable reserve zones. There is hardly any overburden. Thus, during mining, it is not anticipated to maintain separate overburden benches. However, some lateritic and clayey intercalations are expected in the iron ore scree zone.

Nature of rock & topography: Mainly massive & bedded haematite deposit. The lease area is conical in shape, gradually rising from a height of about RL of 381m in the north eastern part of the lease to RL of 718m on the south western part. There is a vertical fall of about 30 metres just below the 718m point in the south western part. There is no perennial nallah flowing through the lease area though the existence of seasonal nallahs is found in the North eastern side of the lease area. The area is

thickly vegetated. The only source of water is the perennial river or nallah known as Ponga nadi about 1.5 km from the lease area.

Other factors: The other mining and economic factors include the following: Safety, Recovery, Productivity, Crushing requirement, Costs & Flexibility in level of production.

4.A.2 Method of mining:

Based on the above factors, the following method of mining is proposed:

- Type of working: Mechanized Opencast Mining
- Haul Road Parameters:

✓	Width	: 14m
✓	Gradient	: Minimum 1 in 16
✓	Slope	: 2% towards valley side for drainage

- Bench Parameters:

✓	Height	: Up to maximum 12m
✓	Width (Ultimate)	: Maximum 12m
✓	Width (Working)	: Minimum 20 m
✓	Individual Bench Face Slope	: 70° – 85°
✓	Ultimate pit slope	: 45° maximum

4.B DEVELOPMENT & PRODUCTION PROGRAMME FOR THE FIRST FIVE YEARS

The final production of the mine has been planned to be 10 million tonnes per annum. However, the mine will attain a production of 5 million tonnes per year within the five years from the fourth year onwards. The initial development like the establishment of offices, infrastructure, construction of haul roads etc will be carried out in the first year and the first half of the second year. From then onwards the production will be stepped up to the target production. The quantum of production for the first five years will be from the top of the hill on the south-western side of the lease area. In this area, bedded hard ore is exposed. As no overburden is anticipated, no separate overburden benches will be maintained. The year-wise build-up of production is already mentioned in Table 4.1. The bench-wise excavation programme is described in section 4.E.

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4.C PROPOSED RATE OF PRODUCTION & LIFE OF THE MINE

The mine is proposed to attain a rate of production of 5 million tonnes per annum within the first five years and subsequently the rate of production will be 10 million tonnes per year. The life of the mine is estimated considering the tentative estimation of all category of reserves as given in Table 3.3. After detailed exploration by drilling and bringing further quantum of reserves under inferred resources category (333) to higher confidence level reserves category, the life of the mine needs to be revised. For mine design and scheduling, it is imperative to consider only the proved and probable reserves and accordingly tentative mineable limits need to be drawn. Considering the production pattern as mentioned in Table 4.1, the tentative life of the mine works out to 12.5 years.

4.D CONCEPTUAL PLAN

4.D.1 Reserves: The reserve has been calculated from the hard ore outcrops and the vertical line notional borehole samples. Drilling will be carried out further to bring the inferred resources under proved category. The entire area is expected to be explored fully within the first five years of operation. Thus, pending further exploration, a conceptual plan has been developed which is limited to the current proved (111) and probable (122) reserve category only.

4.D.2 Ultimate Pit Limit: The tentative ultimate pit limit is shown in Conceptual Mining Plate 5A. The tentative conceptual pit sections are shown in Plate 5B. The mining parameters considered for design of tentative ultimate pit are given below:

- Bench height : Maximum of 12m
- Overall pit slope : Minimum of 45°
- Gradient of haul road : 1 in 16 outside the quarry face
- Gradient of ramp : 1 in 10 maximum
- Statutory barriers : 7.5m from lease boundary

4.D.3 Overburden (Rejects): With the hard rock exposure and the grade of iron ore, no overburden or rejects is anticipated. Whatever is mined will be consumed and no reject or sub-grade ore is envisaged. Whatever insignificant quantity of lower grade patches that may be encountered will be used in construction of roads, pavements, safety berms, infrastructure area filling, etc.

4.D.4 Post mining reclamation and afforestation: As explained in para 4.D.1 and 4.D.2, the tentative mining limits are designed upto proved and probable reserve category zone. The top of the hill, that is from 718m to 630m will be shaved off. Rest of the

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area will remain virgin barring the road layout and infrastructure area. Post mining reclamation is visualized as afforestation in the mined out area. When further areas are brought under proved reserves category, even then the same concept of afforestation in mined out area will be planned. The details of post mining reclamation concept is given below:

- Afforestation in the mined out area
- A gradient of 2% will be maintained in the mined out bench (630m) and proper drainage design will be made in the mined out plateau and guided to the slopes of the hill. The gradient and drainage design will be made to ensure that the afforested hill top has no water logging.
- Since the mined out floor and benches would be hard and devoid of top soil, prior to afforestation, pitting and trenching will be carried out at a spacing so as to ensure about 4,000 trees per ha of surface area. Top soil will be brought from the plains.
- 3 years of care and attention would be provided post-mining for the saplings to grow.

4.D.5 Ultimate land use: Based on the post mining reclamation envisaged in para 4.D.4, the ultimate land use will be forest in the area.

4.E. OPENCAST MINES

4.E.1 **Method of mining**: The following method of working is proposed:

- Type of working: Mechanized Opencast Mining
- Bench Height: 12m approx
- Overall pit slope: 45° maximum
- Process: Taking into account of the target level, mining operation has to be completely mechanized, employing hydraulic shovels, dumpers, drills, dozers, graders, front-end-loaders and auxiliary equipments.
- Working hours: 3 shifts.

4.E.2 **Description of year-wise mining scheme and layout**:

4.E.2.0 **Method of excavation volumes**: As regards to excavation volume calculations, Surpac software has been used. In this software, volumes are calculated between 2 Digital Terrain Model (DTM) created. Conversion factor of 4 tonnes/cum is fed into the software for tonnage estimation. The upper DTM is the topographic surface. The lower DTM is created by the bench outlines at the end of the

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year. The volume between the 2 DTMs is multiplied by the conversion factor (fed in the software) which gives the excavation tonnage. A number of iterations with different bench outlines are done, till the volume between the 2 DTMs equals the desired tonnage. As regards to incidental generation of iron ore during the developmental phase of haul road in the initial years, the various haul road's (which is over 5km) excavation has been considered. Part of this material can be used in steel making and part will be used for site development and haul road stability.

4.E.2.1 **Excavation programme for the first year (Plate 6A1)**: The first year programme will be from the date of notice of opening, which will be after the mining lease is granted and executed. During the fist year, the following developmental work will be initated:

- Haul Road from 480m to 718m
- Site development for crushing system
- Site development for mine office, workshop & other infrastructure

Haul road will be developed at a gradient of 1 in 16. However, beyond 660m RL, the haul roads would be developed at 1 in 10 as this stretch of road would be eaten away during mining as mining advances from top to lower horizons. The roads are designed with primarily all-cut and at some places cut-and-fill depending on the terrain. Since the road development is primarily on iron bearing zone spanning inferred resource, probable and proved reserve category zone, whatever material generated during haul road development will be incidental iron ore generation and therefore, can be utilized in steel making. Thus, the incidental generation of iron ore during this year can be scheduled as production. The incidental generation of iron ore during this year development is expected to 1 million tonnes. The composite section for first five years is presented in Plate 6B.

Table 4.2: **First Year Excavation Programme**

Bench	ROM	Overburden	Waste	Production
(m RL)	(mt)	(cum)	(cum)	(mt)
Haul Road & crusher site	1.00 *	Nil	Nil	1.00 *

* Incidental generation of iron ore during development and is expected to be utilized in steel making instead of stacking it separately.

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4.E.2.2 **Excavation programme for the second year (Plate 6A2):** The developmental work will continue for another half year or so. After the haul road reaches the top, the area upto 666m RL will be cleared of trees. Bench formations would be initiated. It is anticipated that about 0.6 million tonnes is likely to get generated in bench development. Another 0.40 million tonnes is envisaged to get generated from the haul road development as well as site clearing and development for primary crusher housing, secondary crusher housing and stock pile area. The benches would be developed upto 696m RL.

Table 4.3: Second Year Excavation Programme

Bench	ROM	Overburden	Waste	Production
(m RL)	(mt)	(cum)	(cum)	(mt)
Haul Road & Crusher Site	0.40 *	Nil	Nil	0.40
+708	0.39	Nil	Nil	0.39
-708+696	0.21	Nil	Nil	0.21
Total	1.00	Nil	Nil	1.00

* Incidental generation of iron ore during development and is expected to be utilized in steel making instead of stacking it separately.

4.E.2.3 **Excavation programme for the third year (Plate 6A3):** During the third year, the –702+696 bench will be developed further and completely exhausted. Another bench, –696+684 bench will be developed.

Table 4.4: Third Year Excavation Programme

Bench	ROM	Overburden	Waste	Production
(m RL)	(mt)	(cum)	(cum)	(mt)
-708+696	1.499	Nil	Nil	1.499
-696+684	1.501	Nil	Nil	1.501
Total	3.00	Nil	Nil	3.00

4.E.2.4 **Excavation programme for the fourth year (Plate 6A4):** During the fourth year of mining operations, the mine will reach a production level of 5 million tonnes. The balance reserves of about 2.2 million tonnes will be completely extracted from the bench –696+684 and a new bench at –684+672 will be developed to produce the balance requirement.

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Table 4.5: Fourth Year Excavation Programme

Bench	ROM	Overburden	Waste	Production
(m RL)	(mt)	(cum)	(cum)	(mt)
-696+684	2.205	Nil	Nil	2.205
-684+672	2.795	Nil	Nil	2.795
Total	5.00	Nil	Nil	5.00

4.E.2.5 **Excavation programme for the fifth year (Plate 6A5):** In the fifth year the bench -684+672m RL will be completely excavated and another bench of -672+654m RL will be started.

Table 4.6: Fifth Year Excavation Programme

Bench	ROM	Overburden	Waste	Production
(m RL)	(mt)	(cum)	(cum)	(mt)
-684+672	4.009	Nil	Nil	4.009
-672+660	0.991	Nil	Nil	0.991
Total	5.00	Nil	Nil	5.00

4.F EXTENT OF MECHANISATION

Based on the method of mining as proposed in Section 4.A, it is proposed to deploy 250mm dia drills, blasting, 5.5cum bucket capacity shovel, 60t dumpers, 410 hp dozers, etc. The following mine-working schedule is proposed:

Major Assumptions

No of working days	300days
No of working shifts per day	3shifts/day
Drill (Hydraulic):	
Bench Ht	12m
Burden	5m
Spacing	6m
Drilling Rate	8m/hr
Availability of Drill	80%
Utilization of Drill	80%
Effective Working Hours/day	21hrs
Shovel:	
Bucket Capacity	5.5cum

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Fill Factor	80%
Time per pass	45sec
Spotting time	1min
Hours of work	18hrs/day
Availability	80%
Utilization	80%
Effective Working Hours/day	
Truck	
Capacity of truck - Mine	60t
Distance (to&fro) - Mine	3km
Av Speed - Mine	15kmph
Unloading time	1min
Availability	80%
Utilization	80%
Effective Working Hours/day	21hrs/day

Calculation of Major Equipment

Drilling	
ROM Yield/hole	360cum/hole
ROM Yield/hole	1080t/hole
ROM Yield/metre	90t/m
Effective Working Hours/Day	21hrs/day
Drilling per day	184.8M
Achievable ROM / day	16632t/drill
Quantity to be drilled/day	16667T
No of drills required	1.00drills
No. of drills taking availability and utilization	1.57drills
No of drills in the fleet	2drills

Shovel	
Effective Bucket Capacity	4.4cum/bucket
Effective Bucket Capacity	13.2t/bucket
No. of passes	5passes
Loading time	3.75Min
Total Loading+spotting time	4.75Min
No. of trucks loadable per hour	12.6trucks/hr
Total trucks loadable per day	227trucks
Total quantity / day shovel can handle	13620t/day

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Excavation Quantity	16667t/day
Shovels required	1.22shovels
Shovels required taking avl & util	1.91shovels
Shovels required in the fleet	2shovels

Mine Transportation	
Loading+spotting time	4.75Min
Travel time	12Min
Total cycle time per truck(incl unloading time)	17.75Min
Trips/hr	3.4Trips/hr/truck
Trips/Day possible per truck	45Trips/day/truck
Total quantity to be handled	16667t/day
No. of trips required/day	278Trips/day
Trucks Required incl avl & util	9.6trucks
Trucks Required in fleet	10trucks

In addition to the major production equipment, 2 dozers would be required at the mine faces and ROM / crushed ore stockpile. 1 Grader is proposed for haul road maintenance. 1 water sprinkler of 28 kl is proposed for haul road sprinkling. 2 Loaders are proposed to load the crushed ore for despatch. Other equipment as required for supervision, maintenance are proposed. The list of equipment required is provided in the next para.

4.G REQUIREMENT OF EQUIPMENT

The Run-of-Mine iron ore will be moved by the dumpers to the crusher house to be located midway at a location marked in the plan which will not be disturbed during the first 10 years operation of the mine. Feed of the primary gyratory crusher – 1 number 2000 tonnes/hr will be 54cm×74cm. After secondary crushing by twin cone crusher, the product will be loaded onto a downhill 1400 mm cable belt conveyor with a speed of 1.80 m/s. The gradient of the belt conveyor will not exceed 15°. For this, necessary cutting and filling will be done along alignment. Based on the assumptions and calculations made in para 4.F, the requirement of equipment is provided in the table below:

Table 4.7: **Requirement of Equipment**

Hydraulic shovels 5.5 m^3	: 2
Drills (Hydraulic) 250 mm	: 2
Dumpers 60T	: 7
Dozers 410 HP	: 2
Grader 410 HP	: 1
Water sprinkler 28 kl	: 1
Loaders (5.47 cum)	: 2
Maintenance Van	: 1
Service trucks	: 2
SMS Van	: 1
LCV	: 4
Ambulance	: 1

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CHAPTER V: BLASTING

5.1 BLASTING PARAMETERS

- It is suggested to use site mix slurry based explosives.
- Blasting pattern: Spacing = 6m, Burden = 5m, Hole Depth (including 10% sub-grade drilling) = 13m
- "Directional blasting" is suggested for better throw. Manner and sequence of firing= series
- Bottom initiation to be employed.
- Delay between rows of holes should be at least 10 ms per metre of burden.
- Charge per hole=177 kg
- Powder factor of 5.5 kg of explosives / tonne of ore.
- No of blasts per week proposed is 3, that is, on alternate days. Maximum number of holes per round will be 31, with 2-3 rows per blast.

5.2 STORAGE

The total explosives required per month is about 84 tonnes. Silos for storage of slurries will be constructed. An SMS van would be provided for this purpose. However, a Magazine of 2t capacity is proposed additionally for secondary blasting, if any, and for exigency purposes. The exigency purpose is estimated as equivalent to 1 blast requirement. 1 blast requires explosives of about 6.7 tonnes out of which ANFO will be 70-80%. Thus, capacity of the magazine is proposed as 2t. The magazine will be constructed with proper safety zone, security watch towers and flood-lights.

5.3 SAFETY ASPECTS

- Visible warning boards to be erected before blasting.
- Sirens
- Blasting shelter
- Blasting to be conducted on twice weekly basis at fixed times.
- A designated Mining Engineer should have responsibility to follow the blast-hole geometry and other statutory precautions for safe blasting and ensuring proper fragmentation, avoidance of toe, and availability of sufficient blasted materials for the excavators.

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CHAPTER-VI: MINE DRAINAGE

6.1. The entire area is the catchment area of Koina River which is perennial in nature. It has two perennial tributaries, Koina Gara and Sarako (Ponga Nadi). These tributaries are in turn fed by sub tributaries or *nallahs* that are seasonal in nature. However, the sub tributary of Koina Gara namely Ambabai Gara is perennial and lies within 2 km of SW corner of the lease area. The lease and the surrounding area shows the dendritic drainage pattern flowing radially from the higher elevation of Dirsumburu hill. Three such seasonal *nallahs* run towards NNE, SE and SW areas of the hill.

6.2 During the first five years, workings will be confined to only the top of the hill. Workings will be restricted to 660m RL. The floor of lowermost bench will be above the water table. Thus, ingress of water through seepage from the floor is unlikely.

6.3 During rains (particularly during monsoon), water will fall within the mine. The following proposal is made to ensure that water is drained properly after collecting any mine scree:

- There will be a garland drain made around the lowest bench at any point of working along the west and southern mining periphery so as to prevent rainwater falling within the mining area to flow out on the southern part of the lease.
- The mining benches will be maintained at 2% gradient and all the water falling within the mining area is channeled towards the valley side in the north and east.
- The channeled rainwater will then allowed to joined the natural rainwater channels existing in virgin areas of the hill.
- At appropriate intervals in the natural drain channel on the hill, scree-arrest pits of size 20m x 20m x 6m will be created to settle the water and permit the decanted water to join the downhill natural drainage system. These scree-arrest pits will be located on the slopes and will permit easily 8 hours of settling during peak rainfall. Please refer to Plate 5A.

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CHAPTER-VII: STACKING OF MINERAL REJECTS AND DISPOSAL OF WASTE

7.A NATURE OF MINERAL REJECTS AND WASTE GENERATED

7.A.1 Topsoil:

Within the mining area proposed in the first five years, there is no separate cover that can be demarcated as top soil and can be extracted separately. The area is either completely exposed with hard iron ore or with iron ore scree. Thus, no major quantity of top soil is expected to be recovered separately.

7.A.3 Rejects and Waste:

Whatever will be mined will be taken to the crushing plant and consumed. No overburden or rejects is anticipated.

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CHAPTER-VIII: USE OF MINERALS

8.1 END USE OF MINERAL:

Electrosteel Castings Limited intends to use the iron ore for steel making. As mentioned in the Introduction-chapter, ECL has developed plans to set up an Integrated Steel Plant of 3 ½ million tonnes per annum in the State of Jharkhand in the initial phase and subsequently expand it. With this in mind, ECL intends to develop captive iron ore mines. The iron ore mined from this lease area will primarily be used in steel making.

8.2 SPECIFICATIONS

The specification of iron ore for the steel plant is indicated as follows:

Fe	63 – 65%
SiO2	6.5% max
Al2O3	1.5% max
P	0.05% max
S	0.02% max

The above specification can be met from the ores mined from the deposit within the lease area.

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CHAPTER-IX: SITE SERVICES & EMPLOYMENT POTENTIAL

9.A SITE SERVICES

Electric Sub-station: An electric sub-station of sufficient capacity will be erected for the incoming supply and stepping it down for use in the mine complex.

Workshop: A workshop will be erected where all the mobile equipment will be maintained, repaired and overhauled in designated bays and sheds and also the engineers' office and stores for running requirement of spares. It will be adequately lighted and should work in two shifts. There will be washing facilities.

Stores: Modular stores will be built for keeping adequate stock of the HEMM spares and sub-assemblies and other electrical and mechanical spares. Proper computerized system for material management will be installed along with reliable telecommunication and internet facilities. Diesel dispensing unit will be housed in the stores premises. Stocking philosophy will be worked out and put in place.

Office Complex: This will house the office of the Manager of the mine, Personnel Managers' office, despatch office, Engineer's office, Management Information System, office of the Accounts officer and pay office.

Magazine: A licensed magazine built as per statue for storing of explosives and detonator with adequate security, fencing, watch tower and flood lights and safety zone will be constructed at a suitable point near the mine.

Blasting Shelters: Adequate blasting shelters will be provided. Blasting will generally be done during change over of first and second shifts.

Rest Shelters: Rest shelter as per statute will be provided. First-aid room will be constructed adjoining the rest shelter.

Ambulance: An ambulance with wireless communication will be provided in the mine.

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Lighting System: Sodium vapour lamps will be put up on suitable towers and poles along the haul road, around the office complex, workshops, stores, crusher house, iron ore transfer point, ore dump and reject dump.

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Communication System: A reliable communication system will be established for communication between different executives, supervisors and key personnel.

Fire-fighting System: A suitable fire-fighting system will be installed.

Warning System: Visible sign-boards written in Hindi will be erected at prominent display points to prevent unauthorized entries and precautions during blasting and from moving vehicles.

Drinking water: Drinking water will be provided in the mine at suitable points and at other places where persons are engaged.

9.B EMPLOYMENT POTENTIAL

Mechanized mining has been proposed within this lease area. During the first five years, the following mine design parameters are proposed:

Number of days of working : 300 days
Number of working shifts : 3 shifts
Working hours : 5am – 1pm; 1pm – 9pm; 9pm – 5am
Production planned : 5,600 tonnes / shift
Standard Force build up over Work Force : 15% extra to account for leave, absenteeism.

The manpower for the mine is proposed in Table 9.1. OMS being a key performance indicator (KPI), in a mechanized mine, this KPI needs to be continuously monitored and improved with implementation of latest technologies like truck despatch system for dynamic allocation, modular maintenance for improving productivity, hot seat arrangement for increasing effective human working hours, use of mine planning software for better planning and grade control, etc. With the work force mentioned below, the KPI – OMS works out to 108 tonnes.

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Table 9.1: Proposed Manpower (For the First Five Years)

No	Manpower	Strength
1	Manager (FCC)	1
2	Asst Manager (FCC) / Shift-in-Charge	6
3	Mining Engineer (MCDR), Planning (FCC)	1
4	Mining Engineer (FCC) – Safety, Voc Training, HR	1
5	Engineer, Crushing Plant Operation	1
6	Asst Engineer	3
7	Mechanics, Electrician, FCO	33
8	Blaster	1
9	Helpers	28
10	Operators	55
11	Other staff including quality control, accounts, administration, stores, human resources development, vocational training support, etc.	24
	Total	154

Certain works like security, canteen services, will be off-loaded on contract. Professional organizations will be engaged for certain professional services like quality control, environment monitoring, occupational health monitoring, etc.

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CHAPTER-X: MINERAL PROCESSING

10.1 The Run-of-Mine iron ore will be moved by the dumpers to the primary crusher house to be located midway at a location marked in Plate 6A. This crusher will be shifted after a period of 10 years. Feed of the primary gyratory crusher – 1 number 2000 tonnes/hr will be 54cm ×74cm. The secondary crushers would be located at the south-western part of the lease area as shown in the same plate. After secondary crushing by cone crusher, the product will be loaded onto a downhill 1400 mm cable belt conveyor with a speed of 1.80 m/s. The gradient of the belt conveyor will not exceed 15°. For this, necessary cutting and filling will be done along alignment.

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CHAPTER-XI: ENVIRONMENT MANAGEMENT PLAN

11.A PRESENT ENVIRONMENTAL SCENARIO

11.A.1 General: The first step towards assessment of environmental impacts and formulation of management plans of any mining project is the determination of baseline status of environmental factors in the surrounding area of likely influence. The mining lease area along with infrastructure development area forms the 'core zone', whereas the area within a distance of 10 km around the core zone forms the 'buffer zone'. The core zone is 192.5 Ha located in Kodolibad Reserve Forest in west Singhbhum district of Jharkhand. Data generation with respect to air quality, water quality, soil characteristics, noise levels, traffic density and micro-meteorology was carried out by Min Mec R&D Laboratory. Baseline status of flora and fauna as well as hydrology in the study area has been established through study conducted by in-house experts of Min Mec Consultancy Pvt. Ltd, New Delhi. Secondary data on long-term meteorology, recorded at the nearest meteorological station, has been collected from India Meteorological Department. Apart from these, secondary data has also been collected from Village Directory (Census of India), Revenue Records, Statistical Department, Soil Survey and Land Use Organisation, District Industries Centre, University library, local reports, information from Central Ground Water Board, as well as through field surveys and interviews.

11.A.2 Physiography and Drainage:

Core zone: There is a north-south trending hill in Kodolibad Reserve Forest along eastern side of Kadai-Holo road. The elevation of its highest peak is 718 m RL. The lowest elevation is 381m RL. The entire area is the catchment area of Koina River which is perennial in nature. It has two perennial tributaries, Koina Gara and Sarako (Ponga Nadi). These tributaries are in turn fed by sub tributaries or *nallahs* that are seasonal in nature. However, the sub tributary of Koina Gara namely Ambabai Gara is perennial and lies within 2 km of SW corner of the lease area. The lease and the surrounding area show the dendritic drainage pattern flowing radially from the higher elevation of Dirsumburu hill. Three such seasonal *nallahs* run towards NNE, SE and SW areas of the hill.

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Buffer Zone: The eastern and southern directions around the ML area are hilly whereas, the area on the west, north and south west is relatively plain. Sarako nadi joins Koina river at an aerial distance of about 7 km. While the western part of study area is drained by Sarako nadi, the eastern part is drained by Koina river flowing from south to north.

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11.A.3 Long Term Climate and Meteorology:

The nearest monitoring station of India Meteorological Department is located at Keonjhar, the district head quarters. The parameters studied through the data are in respect of temperature, rainfall, humidity and wind condition.

Temperature: The average daily maximum and minimum temperatures for each of the twelve months for the period 1993 - 2002 have been furnished in Table 11.1.

Table 11.1: Average daily max & min temperature for various months at IMD, station Keonjhar for the period of 1993 to 2002

Months	Temperature °C	
	Maximum	Minimum
January	26.44	10.99
February	28.94	13.86
March	33.02	17.83
April	36.04	21.02
May	36.64	23.84
June	32.49	23.36
July	30.16	23.15
August	29.68	22.75
September	29.22	22.07
October	29.87	19.94
November	27.88	15.42
December	25.81	10.82
Mean	30.52	18.75

The mean of minimum temperatures recorded ranges from 10.82°C in December to 23.84°C in May. The mean of maximum temperature ranges from 25.81°C in December to 36.64°C in May.

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Rainfall: Bulk of the rainfall in the study area is received during the monsoon between June to September. Almost 85-90% of the rainfall is recorded in the months of May to September on an average. The least rainfall was observed in the month of December. The month wise average rainfall is given in Table 11.2.

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Table 11.2: Average month wise rainfall at IMD station, Keonjhar (1993 to 2002)

Month	Rainfall (mm)
January	21.3
February	13.0
March	26.4
April	61.6
May	123.5
June	207.2
July	277.6
August	298.7
September	195.3
October	97.0
November	41.1
December	6.9
Total average	1369.6

Relative Humidity: The average daily relative humidity data has been studied for a decade, which is given in Table 11.3.

Table 11.3: Average monthly relative humidity IMD station, Keonjhar (1993 to 2002)

Months	Relative humidity in %	
	at 8.30 hrs	at 17.30 hrs
January	62.0	40.1
February	59.8	33.2
March	49.3	26.5
April	49.7	30.5
May	55.4	39.3
June	73.8	63.9
July	80.8	75.5
August	84.2	72.8
September	76.3	72.9
October	76.8	62.0
November	68.7	47.6
December	62.6	37.3
Average	66.6	50.1

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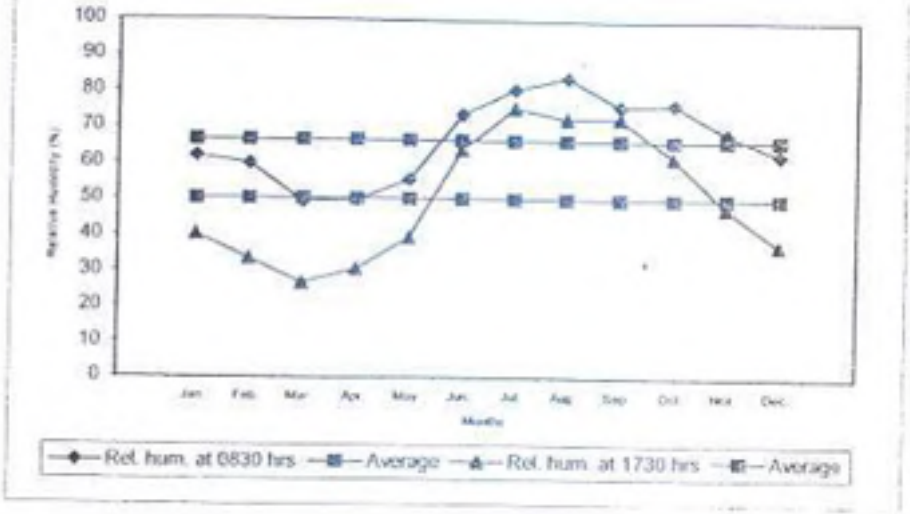
FIGURE 11.3 : MONTHLY RELATIVE HUMIDITY (%)
IMD STATION, KEONJHAR (1993-2002)



It is seen from the above table that relative humidity is higher during the period of monsoon and lower during non-monsoon months.

Wind Speed and Windrose: To demonstrate the wind flow pattern of the study area, wind rose diagram of IMD station at Keonjhargarh are given in figure attached on the next pages for 0830 hrs and 1730 hrs respectively. To supplement the data, the frequency of wind directions as derived from climatological tables of IMD station, Keonjhargarh for the period of 1957-1980 are given in Table 11.4.

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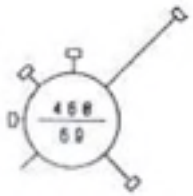
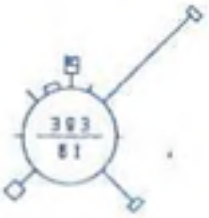
WIND ROSES

STATION : KEONJHARGARH

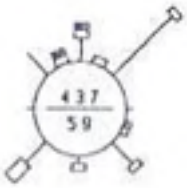
0830 HRS IS



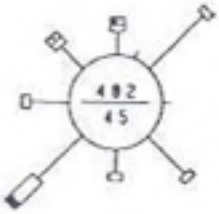
JANUARY



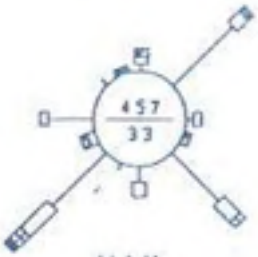
FEBRUARY



MARCH



APRIL



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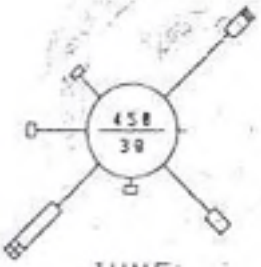
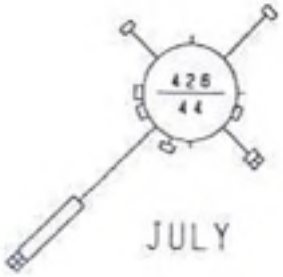


JUNE



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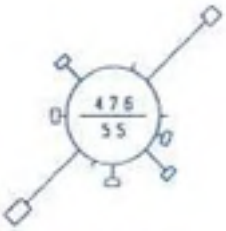
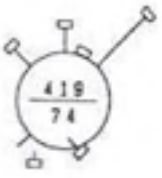
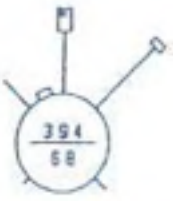


AUGUST

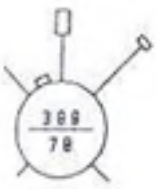
SEPTEMBER



OCTOBER



NOVEMBER

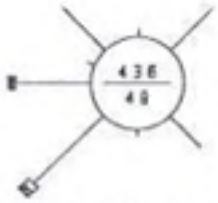


DECEMBER

SCALE OF FREQUENCIES (%)

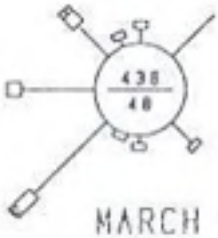
WIND ROSES

STATION : KEONJHARGARH 1730 HRS I



JANUARY

FEBRUARY



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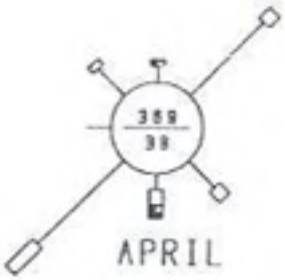
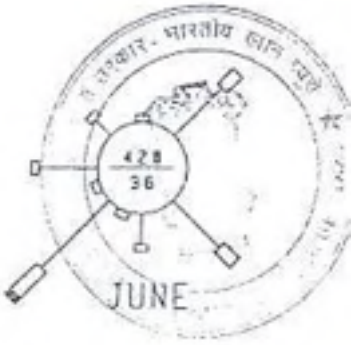
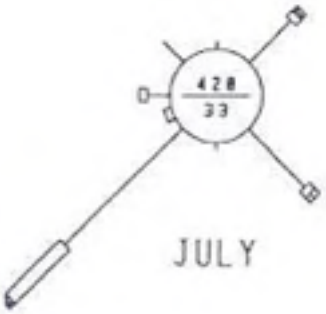


APRIL

MAY



JUNE



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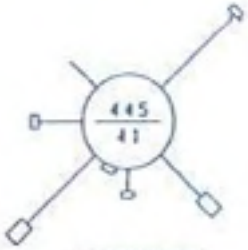
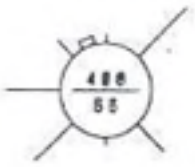
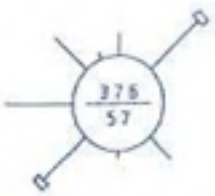


AUGUST

SEPTEMBER



OCTOBER



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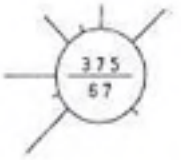

DECEMBER

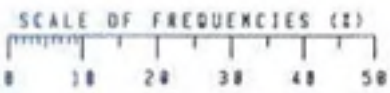

Table 11.4: Annual average wind frequency recorded at IMD station, Keonjhar

Month	Time (hrs)	Percentage No. of days wind from								
		N	NE	E	SE	S	SW	W	NW	LM
JAN	0830	12	8	5	5	2	5	11	12	40
	1730	8	12	4	6	3	8	19	9	31
FEB	0830	12	8	3	7	3	9	16	12	30
	1730	7	8	4	7	2	10	29	13	20
MAR	0830	8	7	5	4	4	11	17	11	33
	1730	7	9	3	5	2	11	28	15	20
APR	0830	7	11	7	10	4	11	17	7	26
	1730	4	7	6	11	8	15	19	12	18
MAY	0830	5	12	8	18	6	13	16	6	16
	1730	3	11	5	16	10	16	20	9	10
JUN	0830	4	6	5	14	6	13	27	7	18
	1730	2	7	6	14	7	16	26	7	15
JUL	0830	6	5	4	9	5	14	33	7	17
	1730	2	6	4	10	8	21	30	4	15
AUG	0830	5	6	5	11	4	14	28	8	19
	1730	2	5	4	13	8	19	27	6	16
SEP	0830	6	8	6	9	4	13	18	12	24
	1730	3	8	8	14	7	17	16	8	19
OCT	0830	11	8	4	8	4	9	11	10	35
	1730	6	12	7	13	4	9	11	6	32
NOV	0830	13	6	2	2	1	8	12	16	40
	1730	10	15	2	2	2	6	14	10	39
DEC	0830	13	6	2	4	2	7	14	16	36
	1730	8	13	3	2	3	9	17	10	35
ANNUAL TOTAL OR MEAN	0830	9	8	5	8	4	11	18	10	27
	1730	5	9	5	9	5	13	21	9	24

11.A.4 Micro meteorology survey

Micro-meteorological survey was undertaken for monitoring wind speed, wind direction, ambient air temperature, relative humidity and cloudiness during the sampling period. Readings were recorded at an interval of one hour each using an automatic weather station. The observed values of various parameters are summarised in Table 11.5.

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Table 11.5: Summary of micrometeorological data (March 2005 to May 2005)

Parameter	Maximum	Minimum	Mean
Temperature (°C)	38.60	13.10	23.27
Relative Humidity (%)	96.00	22.80	47.25
Wind speed (km/hr)	19.90	0.00	4.13
Wind direction*	Predominant wind direction is from SW (15.40%)		

** mean of all directions including calm*

The above table shows that temperature recorded was minimum of 13.10°C and maximum of 38.60°C, relative humidity as a minimum of 22.80% and maximum of 96.0% during the monitoring period. Wind speed and direction play a dominant role in dispersion of air pollutants. The wind speed varies from calm to 19.90 km/hr and the predominant wind direction was observed from SW with 15.40% of occurrences. The wind frequency table is given in Table 11.6.

Perusal of the wind frequency table shows that the wind direction excluding calm is mostly from SW (14.18%) followed by SE (10.47% of total readings) during summer season.

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Table 11.6: Wind frequency table for monitored data during summer

Direction from	Wind speed in Km/hr							
	Calm	1-5	5-10	10-15	15-20	>20	Total	Total except calm
	% of time during day hours							
E	0.72	0.45	0.27	0.00	0.00	0.00	1.44	0.72
ENE	1.09	0.27	0.27	0.00	0.00	0.00	1.63	0.54
NE	1.09	6.25	3.62	0.63	0.00	0.00	11.59	10.50
NNE	1.18	2.45	1.00	0.18	0.00	0.00	4.81	3.63
N	1.72	5.43	2.99	0.36	0.00	0.00	10.50	8.78
NNW	1.27	1.54	0.63	0.09	0.00	0.00	3.53	2.26
NW	1.34	3.89	1.45	0.27	0.00	0.00	7.15	5.61
WNW	1.18	1.72	0.91	0.00	0.00	0.00	3.81	2.63
W	1.36	2.90	1.18	0.36	0.00	0.00	5.80	4.44
WSW	1.18	1.90	0.63	0.00	0.00	0.00	3.71	2.53
SW	1.54	7.34	3.08	0.82	0.00	0.00	12.78	11.24
SSW	1.27	2.45	1.27	2.45	0.36	0.00	7.80	6.53
S	0.54	4.35	1.63	0.82	0.18	0.00	7.52	6.98
SSE	0.91	1.36	1.45	0.27	0.00	0.00	3.99	3.08
SE	1.00	7.16	2.26	0.63	0.00	0.00	11.05	10.05
ESE	0.91	0.63	1.27	0.09	0.00	0.00	2.90	1.99
TOTAL	**18.50**	**50.09**	**23.91**	**6.97**	**0.54**	**0.00**	**100.01**	**81.51**
	% of time during night hours							
E	1.27	0.91	0.45	0.09	0.00	0.00	2.72	1.45
ENE	1.27	0.36	0.09	0.00	0.00	0.00	1.72	0.45
NE	1.63	6.61	1.99	0.09	0.00	0.00	10.32	8.69
NNE	1.18	0.54	0.36	0.09	0.00	0.00	2.17	0.99
N	1.72	3.26	0.63	0.18	0.09	0.00	5.88	4.16
NNW	1.36	1.54	0.72	0.00	0.09	0.00	3.71	2.35
NW	1.09	4.08	1.54	0.00	0.00	0.00	6.71	5.62
WNW	1.36	0.00	0.27	0.09	0.00	0.00	1.72	0.36
W	1.90	5.80	2.36	0.00	0.09	0.00	10.15	8.25
WSW	1.72	2.54	0.63	0.00	0.00	0.00	4.89	3.17
SW	0.91	13.04	3.99	0.00	0.09	0.00	18.03	17.12
SSW	1.09	0.91	2.08	0.72	0.09	0.00	4.89	3.80
S	1.18	2.36	1.36	0.54	0.09	0.00	5.53	4.35
SSE	1.18	1.45	1.99	0.82	0.36	0.00	5.80	4.62

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Direction from	Wind speed in Km/hr							
	Calm	1-5	5-10	10-15	15-20	>20	Total	Total except calm
SE	0.91	5.98	4.17	0.54	0.18	0.00	11.78	10.87
ESE	1.45	1.00	1.27	0.27	0.00	0.00	3.99	2.54
TOTAL	21.22	50.38	23.90	3.43	1.08	0.00	100.01	78.79
	% of time composite (day and night)							
E	1.00	0.68	0.36	0.05	0.00	0.00	2.09	1.09
ENE	1.18	0.32	0.18	0.00	0.00	0.00	1.68	0.50
NE	1.36	6.43	2.81	0.36	0.00	0.00	10.96	9.60
NNE	1.18	1.49	0.68	0.14	0.00	0.00	3.49	2.31
N	1.72	4.35	1.81	0.27	0.05	0.00	8.20	6.48
NNW	1.31	1.54	0.68	0.05	0.05	0.00	3.63	2.32
NW	1.31	3.99	1.49	0.14	0.00	0.00	6.93	5.62
WNW	1.27	0.86	0.59	0.05	0.00	0.00	2.77	1.50
W	1.63	4.35	1.77	0.18	0.05	0.00	7.98	6.35
WSW	1.45	2.22	0.63	0.00	0.00	0.00	4.30	2.85
SW	1.32	10.19	3.53	0.41	0.05	0.00	15.49	14.18
SSW	1.18	1.68	1.68	1.59	0.23	0.00	6.36	5.18
S	0.86	3.35	1.49	0.68	0.14	0.00	6.52	5.66
SSE	1.04	1.40	1.72	0.54	0.18	0.00	4.88	3.84
SE	0.95	6.57	3.22	0.59	0.09	0.00	11.42	10.47
ESE	1.18	0.82	1.27	0.18	0.00	0.00	3.45	2.27
TOTAL	19.84	50.24	23.91	5.23	0.84	0.00	100.06	80.22

Note : CALM is cut off at wind speed <1.8 km/hr as per CPCB

11.A.5 Ambient air quality:

To establish the ambient air quality, ambient air quality study has been carried out during summer, 2005 (March to May) by establishing five ambient air quality monitoring stations. Ambient air quality sampling was carried out with the help of Respirable Dust Sampler designed by Envirotech Instrument Pvt. Ltd. Monitoring and testing was carried out by Min Mec R&D Laboratory, New Delhi.

Location of ambient air sampling stations: The ambient air sampling stations were established in and around the core and buffer zone to study the present ambient air quality. The locations of sampling stations are given in Table 11.7 and shown in Plate 1.

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Table 11.7: Location of ambient air sampling stations

No	Location	Station	Distance from Core Zone
1	Coze Zone	CA1	With in core zone
2	Hatnaburu	BA1	1.7 km north east of core zone
3	Balbba	BA2	2.6 km south west of core zone
4	Holo	BA3	1.2 km north west of core zone
5	Bahada	BA4	3.5 km south east of core zone

Sampling schedule: Twenty four hourly samples were collected from each station, round the clock during summer, March to May 2006 with a frequency of twice a week.

Air quality parameters: The following parameters were determined for each sample:

- Suspended particulate matter (SPM)
- Oxides of nitrogen (NOx)
- Sulphur di-oxide (SO_2)
- Respirable particulate matter (RPM) was also monitored in the core zone

The sampling and testing of ambient air quality parameters were carried out by adopting the methods specified in National Ambient Air Quality Standards. The brief details of testing procedure adopted are given in Table 11.8.

Methodology

Respirable Particulate Matter: The sampling of ambient air was performed with Respirable Dust Sampler (Make: Envirotech Instruments, New Delhi), which is primarily a High Volume Sampler fitted with a cyclone separator for pre-separation of particles larger than 10 microns diameter. Air exiting from the separator is drawn at a measured rate through the separator followed by a pre-weighed glass fibre sheet of 20 cm x 25 cm sizes (Whatman, EPM-2000). The RPM concentrations are determined gravimetrically from the average airflow rate, sampling period and the mass of particulate matter collected over the GF filter surface.

Suspended Particulate Matter: Sampling for SPM was also performed with the sampler used for RPM sampling. The coarser particles (NRPM) collected in the cyclone separator are transferred quantitatively on a petri dish and evaluated gravimetrically. The sum of masses of coarser (NRPM) and respirable particles (RPM) gives the mass of SPM collected during sampling. The SPM concentrations are computed from the total mass of SPM and total volume of air sampled.

Sulphur dioxide: The sampling of ambient air for evaluating SO_2 concentrations was performed with a Multigas Sampler, using the vacuum created by the Respirable Dust Sampler for drawing the air samples through the impingers. Air is drawn at a measured and controlled rate of 400 to 500 ml/min through a solution of sodium tetrachloromercurate. After completion of the sampling, the used absorbing reagent is treated with dilute solutions of sulfamic acid, formaldehyde and para rosaniline hydrochloride. The absorbance of the intensely coloured para rosaniline methyl sulphonic acid is measured and the amount of SO_2 in the sample is computed from graphs prepared with standard solutions. The ambient SO_2 concentrations were computed from the amount of SO_2 collected and the volume of air sampled.

Oxides of Nitrogen: The sampling of ambient air for evaluating NOx concentrations was performed with a Multigas Sampler, using the vacuum created by the Respirable Dust Sampler for drawing the air samples through the impingers. Air is drawn at a measured and controlled rate of about 200 ml/minute through an orifice-tipped impinger containing solutions of sodium hydroxide and sodium arsenite. After completion of the sampling, an aliquot of the used absorbing solution was treated with solutions of H_2O_2, sulphanilamide and NEDA. The nitrite ion present in the impinger was calculated from the absorbance of the resulting solution and from the graphs prepared with standard solutions. The ambient NOx concentrations were computed from the total nitrite ion present in the impingers, overall efficiency of the impinger and the procedure, and the volume of air sampled.

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Table 11.8: Procedure for determining various air quality parameters

Parameters	Testing Procedure
SPM	Gravimetric method using Respirable Dust Samplers IS : 5182 (Part IV) 1973
NOx	Absorption in nil. NaOH and then estimated colorimetrically with sulphanilamide and N (1-Nepthyle) Ethylene diamine Dihydrochloride and Hydrogen Peroxide (IS : 182 1975, Part VI)
SO_2	Absorption in Sodium Tetra Chloro-mercurate followed by Colorimetric estimation using P-Rosaniline hydro-chloride and Formaldehyde (IS : 5182 Part II 1969)
RPM	Respirable particulate matter sampler

Observation: The summarised results of the air quality studies are given in Table 11.9.

Table 11.9: Summary of ambient air quality monitoring results

No.	Location	24 hourly average concentration in $\mu g/m^3$															
		SPM				RPM				SO_2				NOx			
		Max	Min	Avg	98% tile	Max	Min	Avg	98% tile	Max	Min	Avg	98% tile	Max	Min	Avg	98% tile
CA1	Core Zone	110	40	71	109	34	12	22	34	7.0	5.1	6.0	6.9	8.0	5.0	6.5	8.0
BA1	Hatnaburu	126	52	95	125	38	16	29	38	8.0	5.1	6.4	8.0	8.8	6.1	7.5	8.7
BA2	Baliba	116	51	83	115	35	15	25	35	7.9	5.1	6.4	7.9	9.9	6.1	7.6	9.5
BA3	Holo	113	46	83	111	34	14	25	34	8.0	5.0	6.4	7.9	9.0	5.0	7.1	9.0
BA4	Bahada	86	42	63	85	26	13	19	26	7.0	5.1	5.9	7.0	7.9	5.0	6.8	7.8

Twenty four hour average SPM levels were found to be well below 200$\mu g/m^3$ at all the locations. The concentrations of SO_2 and NOx are considerably low compared to the 80 $\mu g/m^3$ NAAQS limit for residential, rural and other areas. The concentrations of respirable particulate matter (RPM) are well within limits of 100 $\mu g/m^3$, the National Ambient Air Quality Standard for residential areas. This is a virgin area with large tracts of forests; therefore, it is unpolluted at present.

11.A.6 Water Resources

Surface water: The study area falls in the upper reaches of Koina river catchment which is a perennial river. Its tributary Sarako nadi remains dry during summer season and carries huge volume of water during monsoon season. As the study area occupies the upper reaches of the catchment, no major surface water source exists.

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nearby. The drainage pattern within core zone constitutes first order drains flowing away from the M1, area towards north.

Ground water: The core zone is relatively on a higher elevation than the valley area on its west and south west hence the ground water will be at least 60 m below its surface level. The area on the east and south west is hilly hence the ground water is more than 60 m below surface. At the valley levels on the north near the villages the depth of ground water is 4 to 10 m in pre-monsoon and 2 to 5 m in post-monsoon season.

11.A.7 Water Quality

Sampling stations: To evaluate the quality of water resources of the study area, seven water samples were taken - five for ground water and two for surface water. Water samples were collected from the sources during the course of investigation. Water samples were collected with the frequency of once in a season from all the identified sources. Some of the water quality parameters were determined at the sampling site, immediately after collection of the samples. For the remaining parameters, water samples were brought to New Delhi after addition of preservatives, and characterized in Min Mec R&D Laboratory. The location of sampling stations, as given in Table 11.10 has been shown in Plate 1.

Table 11.10: Location of water sampling station

Location	Location	Source	Distance, Direction
GW1	Near core zone	Hand pump	Adjoining (W)
GW2	Sonapi	Hand pump	3.0 km, (NE)
GW3	Chota Nagra	Hand pump	4.5 km, (NE)
GW4	Baliba Village	Hand pump	3.5 km, (SSW)
GW5	Kadai Village	Hand pump	5 km, (SSW)
SW1	Sarako nadi (down stream)	Nadi	1.7 km, (NE)
SW2	Koina River	River	3.8 km, (SE)
SW3	Sarako nadi (up stream)	Nadi	2.5 km, (NE)

Methodology of Sampling: Samples from surface and ground water sources were collected by adopting grab-sampling method. The sample was filled into a sampling bottle. In case of surface water, sample was collected from a point 12" below the

surface. The physico-chemical quality of water samples was characterised by adopting the relevant parts of IS:3025, "Standard Methods for Water Analysis" and the methods prescribed under IS:10500. Evaluation of parameters like odour, taste, temperature, pH, and turbidity were carried out at the sampling stations immediately after collection of samples with the help of Field Analysis Kits (ELICO). For analysis of other parameters, the samples were brought to Min Mec R&D Laboratory, New Delhi, after addition of proper preservatives.

Water characteristics: A review of chemical analysis results indicate that the pH is normal ranging between 6.8 to 8.2. The total mineralization of water is quite low with dissolved solid varying between 74-180 mg/l. The Chlorides are as low as < 40 mg/l. The water is soft with low iron and low sulphate content. The ground as well as surface water is potable and the various parameters are well within the desirable limits for human consumption. The chemical analysis results have been summarised in Table 11.11.

Table 11.11: Summary of water quality result

Sl. No.	Parameter	Drinking Norms		Observed Range in ten samples
		Desirable	Permissible	
1.	pH	6.5 - 8.5	6.5 - 8.5	6.8 - 8.2
2.	Total dissolved solids,	500	2000	74 - 180
3.	Chloride, mg/l	250	1000	12 - 40
4.	Sulphate, mg/l	200	400	1.3 - 11
5.	Total hardness, mg/l	300	600	44 - 112
6.	Iron, mg/l	0.3	1.0	0.11 - 0.25
7.	Calcium, mg/l	75	200	9.6 - 28.8
8.	Nitrate, mg/l	45	100	7.3 - 9.5
9.	Fluoride, mg/l	1.0	1.5	0.10 - 0.33

11.A.8 Ecology:

Study of flora and fauna has been done by visiting the area of core as well as buffer zone and were aimed at assessing the diversity pattern of the floral species. Faunistic pattern of the area was studied based on inquiries from the local population and forest officials.

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Flora: A plant community may be viewed as a vegetational unit characterised by an essentially constant floristic composition with a uniform appearance. The salient floral features of core zone and buffer zone have been discussed subsequently.

Core Zone: The species found in the core zone area: Haldu [H] (*Adina cordifolia*), Bael/Bel[E/H] (*Aegle marmelos*), Ekdania [H] (*Bridelia retusa*), Chironji [H] (*Buchanania lanzan*), Sisam (*Dalbergia sisoo*), Banyan/Bargad [E/H] (*Ficus benghalensis*), Dhaura [H] (*Largerstroemia parviflora*), Mahua tree/Mahua [E/H] (*Madhuca indica*), Sandan [H] (*Ougenia oojeinensis*), Indian Kino [E] (*Pterocarpus marsupium*), Bhilawa [H] (*Semecarpus anacardium*), Sahuya [H] (*Shorea robusta*), Jambolana/Jamun [E/H] (*Syzygium cumini*), Gastard myrobalan/Bahera [E/H] (*Terminalia bellirica*), Chebulic myrobalan/Harara [E/H] (*Terminalia chebula*), Sajada [H] (*Terminalia tomentosa*).

Buffer Zone:

Trees: Australian wattle [E] (*Acacia auriculiformis*), Sweet acacia/Gandh babul [E/H] (*Acacia farnesiana*), Soap pod/Shikakai [E/H] (*Acacia rugata*), Jadambo (*Actinodaphne hookeri*), Malabar nut/Basak [E/H] (*Adhatoda zeylanica*), Haldu [H] (*Adina cordifolia*), Bael/Bel [E/H] (*Aegle marmelos*), Kokko/Siris [E/H] (*Albezia lebbeck*), Sugar apple/Sarifa [E/H] (*Annona squamosa*), Yon/Dhaura [E/H] (*Anogeissus accuminata*), Black current/Umtao [E/H] (*Antidesma ghaesembilla*), Jack tree/Kathal [E/H] (*Artocarpus heterophyllus*), Margosa/Neem [E/H] (*Azadirachta indica*), Red silk cotton/Semur [E/H] (*Bombax ceiba*), Ekdania [H] (*Bridelia retusa*), Chironji [H] (*Buchanania lanzan*), Flame of the forest/Palas [E/H] (*Butea monosperma*), Sappan wood/Bakam [E/H] (*Caesalpinia sappan*), Bottle bursh/Lal botal brush [E/H] (*Callistemon citrinus*), Papaya/Papita [E/H] (*Carica papaya*), She oak/Jangli jhau [E/H] (*Casuarina equisetifolia*), Sisam (*Dalbergia sisoo*), Peacock flower/Gulmohar [E/H] (*Delonix regia*), Tendu [E/H] (*Diospyros melanoxylon*), Eucalyptus/Safeda [E/H] (*Eucalyptus spp.*), Banyan/Bargad [E/H] (*Ficus benghalensis*), Cluster fig/Gular [E/H] (*Ficus glomerata*), Peepal/Pipal [E/H] (*Ficus religiosa*), Jasmin/Chameli [E/H] (*Jasminum grandiflorum*), Dhaura [H] (*Largerstroemia parviflora*), Wood apple/Kavitta [E/H] (*Limonia acidissima*), Mahua tree/Mahua [E/H] (*Madhuca indica*), Mango/Aam [E/H] (*Mangifera indica*), Champac/Champa [E/H] (*Michelia champaca*), Drumstick tree/Sahinjna [E/H] (*Moringa oleifera*), Sandan [H] (*Ougeinia oojeinensis*), Mounteak/Halis [E/H] (*Podocarpus nerifolius*), Pongam/Karanj [E/H] (*Pongamia pennata*), Indian Kino [E] (*Pterocarpus marsupium*), Rain tree/Vilayati sirs [E/H] (*Samanea saman*), Lac tree/Kusum [E/H] (*Schleichera oleosa*), Bhilawa [H] (*Semecarpus anacardium*), Sahuya [H] (*Shorea robusta*), Hog plum/Amra [E/H] (*Spondias pinnata*), Rose apple/Gulab jaman [E/H] (*Syzygium jambos*),

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Jambolana/Jamun [E/H] (*Syzygium cumini*), Teak/Sagwan [E/H] (*Tectona grandis*), Castarad myrobalan/Bahera [E/H] (*Terminalia bellirica*), Chebulic myrobalan/Harara [E/H] (*Terminalia chebula*), Sajada [H] (*Terminalia tomentosa*). Please note that [E] denotes English and [H] denote Hindi.

Shrubs: Indian liquorice/Ghumchi [E/H] (Abrus precatorius), Chirchitta [H] (Achyranthus aspera), Akund/Madar [E/H] (Calotropis procera), Tall morning glory [E] (Ipomea purpurea), Besharm [H] (Lantana camara), Mimosa/Chhuimui [E/H] (Mimosa pudica), Sweet basil/Ban tulsi [E/H] (Ocimum basilicum), Foreign henna/Harmal [E/H] (Peganum harmata), Chinese data/Ber [E/H] (Ziziphus mauritiana). Please note that [E] denotes English and [H] denote Hindi.

The floral composition of the proposed ML area shows a close similarity to the vegetation structure of the buffer area. The entire core zone is forest land covered under the category of dense mixed jungle. The detailed study of the core zone has been carried out by a specialized expert separately for De-reservation Proposal of the forest land within ML. The study area is mainly covered with dense mixed jungle. The vegetation of buffer zone can be broadly categorized under two heads.

Natural / Forest: The general character of the vegetation of the area is tropophylous. Sal is the main species in almost all the forest blocks. The area is forested on the upper reaches of the Kodolibad Reserve Forest, which encompasses the Kodolibad ML. There are diverse plant species available in the area. The main species found in association with sal are *Terminalia tomentosa, Terminalia chebula, Terminalia belerica, Terminalia arjuna* (along streams), *Anogeissus latifolia, Diospyros melanoxylon, Madhuca indica, Syzygium cumini, Pterocarpus marsupium, Schleichera oleosa, Careya arborea, Bridelia retusa, Emblica officinalis, Dillenia pentagyna, Bombax ceiba, Adina cordifolia, Mitragyna parvifolia, Lagerstroemia parviflora, Cleistanthus collinus, Garuga pinnata, Ougeinia oojeinensis, Lannea coromandelica, Semecarpus anacardium, Albizzia procera* (in damp localities), *Albizzia odoratissima, Buchanania lanzan* and *Randia* species. As per the revised classification of the forest types of India by Champion and Seth, the study area is classified as sub group 3C/C_2 as moist sal bearing forest under the major sub group 3C as North Tropical Moist Deciduous Forest. The buffer zone of this proposed mine comprises an area falling within a radius of 10 km from the property. The roadsides and cultivable lands of the village area are thickly grown with '*Shorea robusta*' and '*Madhuca indica*'. Common grasses available in the area are spear grass (*Andropogon contortus*), sabai (*Eulaliopsis binata*) and broom-grass (*Thysanolaena agrostis*).

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Man made:

Vegetation in the hamlets: The species compositions near the hamlets are different from those found in the natural environmental conditions. The vegetation structure surrounding the hamlets reflects a typical character of tribal habitation. The trees in the settlement area are catering to the needs of local population such as fodder, fuel-wood, fruit, and timber and for religious purposes. Some of the common species found in the hamlets comprise *Mangifera indica, Ficus religiosa, Azadirachta indica, Eucalyptus spp., Carica papaya, Tamarindus indica, Syzygium cumini, Syzygium jambos, Madhuca indica, Terminalia chebula, Terminalia tomentosa* etc.

Agriculture: As indicated above, bulk of water availability in the area is through heavy monsoon but the drainage channels carry base flows as can be made use of for irrigation of the agricultural lands even during dry months. Where such irrigation facilities are available both kharif and Rabi crops are raised. The predominant crops raised during the rain fed kharif season are paddy; maize, jowar, bajara and those raised during the Rabi cropping season are paddy, wheat, gram etc.

Fauna: The fauna of the area was studied and it is practically not possible to define separate lists of fauna species in core zone and buffer zone. However, an attempt has been made to do so with the information from villagers living near the ML area.

Core Zone:

Avifauna: Open bill stork (*Anastomus oscitans*), House crow (*Corvus splendens*), Cheel, Chilla (*Milvus migrans*), Pea fowl (*Pavo cristatus*), Bulbul (*Corydon benghalensis*), Baya (*Ploceus philippinus*).

Reptiles: Banded karit (*Bungarus fasciatus*), Indian cobra, Naga (*Naja naja*), Rat snake, Dhaman (*Ptyas mucosus*), Blind snake (*Typhlina braminus*), Common Indian monitor (*Varanus bengalensis*)

Mammals: Spotted deer (*Axis axis*), Wolf (*Canis lupus*), Elephant (*Elephas Maximus*), Mongoose (*Herpestes edwardsi*), Jhunk (Hystrix indica), Otter (*Lutra lutra*), Bear (*Melursus ursinus*), Barking deer (*Muntiacus muntjak*), Flying squirrel (*Petaurista petaurista*), Monkey (*Presbytis entellus*), Rhesus macaque (*Macaca Mulatta*), Wild boar (*Sus scrofa*)

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Buffer zone: The study area is mainly covered with dense mixed jungle. The area is thickly forested towards east, north and south west side.

Avifauna: Myna (*Acridotheres tristis*), Brown crake (*Amaurornis akool* अकुल), Openbill stork (*Anastomus oscitans*), Wood pecker (*Micropternus brachyurus*), Horned owl (*Bubo bubo*), Pigeon (*Columba livia*), Roller (*Coracias benghalensis*), House crow (*Corvus splendens*), Quail (*Coturnix coturnix*), Vulture (*Gyps benghalensis*), Cheel, Chilla (*Milvus migrans*), House sparrow (*Passer domesticus*), Baya (*Ploceus philippinus*), Pea fowl (*Pavo cristatus*).

Reptiles: Green whip snake (Ahaetulla nasutus), Banded krait (Bungarus fasciatus), Garden lizard (Calotes versicolor), Saw scaled viper (Echis carinatus), Russell's earth boa (Eryx johni), House gecko (Hemidactylus flaviviridis), Indian cobra, Naga (Naja naja), Common kukri snake (Oligodon arnensis), Rat snake, Dhaman (Ptyas mucosus), Blind snake (Typhlina brmina), Common Indian monitor (Varanus bengalensis), Russells viper (Vipera russelli).

Mammals: Spotted deer (Axis axis), Wolf (*Canis lupus*), Elephant (*Elephas Maximus*), Mongoose (*Herpestes edwardsi*), Jhunk (*Hystrix indeca*), Otter (*Lutra lutra*), Bear (*Melursus ursinus*), Barking deer (*Muntiacus muntjak*), Flying squirrel (*Petaurista petaurista*), Monkey (*Presbytis entellus*), Rat (Rattus rattus), Rhesus macaque (*Macaca Mulatta*), Five striped palm squirrel (*Funambus palmarum*), Wild boar (*Sus scrofa*), Fox (*Vulpes bengalensis*).

There is no National Park and Sanctuary in this forest division while the Protected and Reserved forests of the study area host a variety of faunal species. The study area has low density of wild fauna. Amongst the Schedule - I animals peafowl, rhesus macaque and bear are found.

11.A.9 **Noise level:** Noise levels were observed in and around the ML area using second level meters at 8 locations (Plate 1). The monitored locations are given in Table 11.12.

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Table 11.12: Location of noise monitoring stations

No	Location	Number	Distance from ML (Direction)
1	Core zone	N1	Within
2	Holo	N2	1.0 km, (NW)
3	NW of Holo	N3	3.0 km, (NW)
4	Baliba	N4	3.5 km, (SSW)
5	Kadai	N5	5.0 km, (SSW)
6	Bahada	N6	3.5 km, (SE)
7	Hatnaburu	N7	1.5 km, (NNE)
8	Chhota Nagra	N8	4.5 km, (NE)

The monitored noise level has been summarised in Table 11.13.

Table11.13: Summary of noise levels monitored

No	Location	Day time Leq	Night time Leq	Average Leq
1	Core zone	51.00	35.60	45.20
2	Holo	55.90	35.70	48.30
3	NW of Holo	44.90	35.10	41.20
4	Baliba	53.60	35.20	41.20
5	Kadai	49.80	34.70	44.20
6	Bahada	51.20	35.70	45.40
7	Hatnaburu	51.30	36.70	45.80
8	Chhota Nagra	57.70	37.30	50.10

The noise level during night and day both are well within specified permissible limit of residential area.

11.A.10 **Traffic Density:** Traffic density was observed over 24 hour period on 22 & 23 May, 2006. The summarized data is mentioned in Table 11.14. As can be seen from above table, there is virtually no traffic in this area.

Table 11.14: Traffic density

Location	No. of motorized vehicles
Holo-Chhota nagra road	38
Holo-Tholkabad road	17

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11.A.11 Ground vibration due to mining activities: Ground vibration studies have not been conducted in the area so far since no mining activities have been carried out till date in and around the area by the project proponent or by any other agency. Hence, the study will be conducted during the development of the mine.

11.A.12 Seismicity: Low seismicity zone ie. Zone - I.

11.A.13 Land use:

Core zone: The core zone comprises of 192.50 Ha area, which is totally forest area.

Buffer zone: There are 21 villages falling in Manoharpur CD Block of Pashchimi Singhbhum district of Jharkhand State as per Census 2001. The land use break up is given in Table 11.15.

Table 11.15: Land use pattern of buffer zone

Land use	Area (ha)	Percentage
Irrigated Land	12.25	0.03
Un-irrigated Land	1744.92	4.52
Culturable waste	572.87	1.48
Area not available for cultivation	916.33	2.37
Forest land	35367.95	91.59
Total	38614.32	100

A perusal of above table indicates that more than 90% of study area is forested, while 4.5% is un-irrigated and balance is culturable waste or not available for cultivation.

11.A.14 Soil: Soil samples (see Plate 1 for location) were taken from agricultural field of Usirayan village and Holo village. The soil is sandy loam. The organic matter content lies between 0.65 and 0.70. It has moderate CaO content, low potash and nitrogen.

11.A.15 Demography and Socio-Economic profile: A socio-economic study was conducted in the area to establish the baseline status with respect to demographic profile, economic conditions and employment pattern, amenities etc. The study was based on 2001 Census data as well as sample surveys conducted in 2006. Within the study area (core and buffer zones), there are 21 inhabited revenue villages.

Demography: The demogcaphic details tehsil wise is shown in Table 11.16. The population density in the study area is 19.3 persons per Sq.km. The male population

constitutes 51.2%. There are 937 females per 1000 males. SC percentage is 1.73 while ST constitutes bulk of population (90.27%). The average literacy is 22.95%, which is quite low. The literacy among women is still poorer at 4.0% of total population.

Table 11.16: Tehsil wise population detail

District	CD Block	No of village	No of household	Total Population	Male	Female
Singhbhum(W)	Manoharpur	21	1426	7455	3847	3608

Economic profile: The employment pattern in study area is given in Table 11.17. From the table, it is obvious that nearly half the population is non worker. Agriculture and its related activities are the main occupation of the people.

Table 11.17: Employment pattern in study area

Occupation	Population	%
Main Workers	1816	24.36
Marginal workers	1846	24.76
Non workers	3793	50.88
Total workers	**3662**	**100**
Break-up of main workers		
Cultivators	1012	55.73
Agriculture labour	400	22.03
Household industry	33	1.82
Others	371	20.43
Total	**1816**	**100**
Break-up of marginal workers		
Cultivators	411	22.26
Agriculture labour	1190	64.46
Household industry	160	8.67
Others	85	4.60
Total	**1846**	**100**

11.A.16 Amenities:

Educational Facilities: There are 19 primary schools and 3 middle schools available in the study area.

Health and Medical facilities: No medical facility available.

Drinking water: There are 16 villages with well water, 8 with tank water, 19 with hand pumps and 12 with river water.

Post and Telegraph: 1 post office available in the study area.

Banks/Credit societies: 1 Commercial bank is available.

Approach to village: 2 villages have pucca road approach, 20 have mud road and 20 have footpath approaches.

11.A.17 Industries and Places of Tourist / Religious / archaeological Importance: No industry or place of tourist, religious or archaeological importance was observed within the study area i.e., within 10 km radius of the ML boundary.

11.B ENVIRONMENT MANAGEMENT SYSYTEM (EMP)

Electrosteel will put in place a proper Environment Management System (EMP) to meet present and future environment needs. This System will provide a structural control for the environment performance of the mine that will be integrated with mine planning during the life of the mine and planned for post-mining reclamation. The EMS will contain the following components:

1. Environmental policy
2. Organizational commitment
3. Objectives and targets.
4. Identification of significant impacts
5. Environmental management plan
6. Socio-economic measures
7. Concurrent reclamation and post-mining reclamation
8. Occupational health and safety
9. Accident prevention and disaster management
10. Budgetary provisions
11. Responsibility and reporting structures
12. Implementation and monitoring, audits and training

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11.B.1 Environment Policy: Electrosteel will operate their mine in an environmentally manner. Important issues may be mine water discharge and post-mining land use, which will be addressed properly. The project shall work towards sustainable development and shall contribute towards community and peripheral development.

11.B.2 Organizational Commitment: The mine management and the corporate management are committed for implementation of EMS. The General Manager shall be accountable and bear the responsibility for the purpose while interacting with Government agencies and public. He will be the management spoke-person in all such matters.

11.B.3 Objectives And Targets: Objective of Electrosteel is to make mining and allied activities environmentally sustainable. The targets are sound air quality control, containing the silt-load in mine discharge water, reclamation in mined out area, green belt development. These targets will be integrated with development of the mine.

11.B.4 Identification Of Significant Impacts

- Loss of forest cover
- Dust control
- Discharge of mine water
- Noise pollution
- Ground vibration
- Post-mining land use

11.B.5 Management Of The Above Impacts

- Compensatory afforestation
- Afforestation programme (during the first five years): The area as such falls under reserve forest. No barren areas are found within the lease area where specific afforestation programme can be taken up. Mining is proposed in the hilltop by shaving off level by level. Thus, while mining is in progress, no afforestation can be carried out in mining areas. Till the time ultimate pit limit is reached, afforestation in mining area cannot be carried out. Only avenue plantations along the haul roads, along the periphery of the office and crushing plant areas have been proposed. Avenue plantation afforestation programme proposed during the first five years is indicated in the table below. The location of plantation is shown in environment plan.

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Year	Area (ha)	Plantation (no of trees)
1st		-
2nd	0.123 (Mine office area)	492
3rd	0.18 (Crusher areas)	720
4th	1.00 (along haul road)	4,000
5th	0.59 (along haul road)	2,360

- Afforestation Programme from 5th year to conceptual plan and post mining: As mentioned earlier, mining will be carried out on hilltop by shaving. Prior to exhausting the proved reserves, detailed exploration by core drilling will be carried out and reserves and resources under probable and inferred category will be brought under proved reserves. The exact year-wise programme subsequent to the first five years will be laid which then will indicate zone wise ultimate pit limits. Accordingly, afforestation in mined out area will be taken up. As regards to post mining, the land use is envisaged as forest and therefore, the entire mined out area, areas earmarked for mineral separation, infrastructure area, plant area (all these will be dismantled) will be afforested. The post mining afforestation programme is given in the table below and shown in mine closure plan.

Area (ha)	Plantation (no of trees)
47.22	188,880

- Dust control: Regular spraying of water on roads and blasted materials. A water sprinkler 28 kl is also proposed to be provided. All drill machines will have dust collectors. Provision of dust masks to the operators. Green belt development with plantation of wide-leaf trees, creepers, tall grass all along the lower horizons of the haul roads, crusher area and mine infrastructure area.
- Water management: Garland drains (Plate 5A and 7) are to be made around the pit to prevent ingress of rainwater into the working pit. Scree-arrest pits will be constructed as explained in section 6.3.
- Noise control: Proper preventive maintenance of noise generating machinery including transport vehicles. The green belt proposed along the lower horizons of the haul road, plant and mine infrastructure will reduce the ambient noise by providing a natural barrier. Blasting operation will be carried out during day time and avoiding the same when strong wind blows across. Provision of protective devices like acoustic wool, ear plugs to shovel and drill operators. Drilling machines will be hydraulic. All HEMM equipment shall have air conditioned cabins.

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- Ground vibration control: Controlled blasting, use of the latest technology chords, proper initiation pattern are some of the methods proposed to control ground vibration. Efforts will be made to have blasting only twice a week.
- Post-mining land use: The mined out are will be afforested.

11.B.6 Socio-Economic Measures: The beneficial aspects of the projects on the socio-economic environment of the area are in areas of employment, service, trade, commerce, public utility, literacy, social awareness, health care facilities, recreation etc. Electrosteel is committed to supplement the existing governmental programs, among the local population by encouraging the following measures:

- Family planning
- Abandonment of shifting cultivation , if any
- Planting of trees and social afforestation
- Use of alternate sources to replace fuel wood
- Use of clean and boiled water
- Prohibition of liquor
- Habit of savings
- Personal hygiene and regular health check

11.B.7 Concurrent Reclamation And Post-Mining Reclamation: Concurrent reclamation is not being envisaged as mining is on the hill and lower horizons can be extracted only after removing entirely the upper horizons. Besides, further exploration by drilling will be carried out to bring the inferred resources to proved reserves category as well explore further in depth. As the entire area is outcropping with iron ore within the reserve zone, no overburden or waste generation is likely that can be used for back-filling.

11.B.8 Occupational Health & Safety: The main factors affecting occupational health in iron ore mines are fugitive dust and noise. To avoid any adverse affect on the health of the workers due to dust, heat, noise and vibration, sufficient measures are suggested. They include:

- Provision of wet drilling and dust collectors on the drills.
- Provision of personal protection devices to the workforce.
- Rotation of workers exposed to noisy premises.
- All safety measures like-use of safety appliances, safety trainings etc.
- Extensive publicity and propaganda related to safety.

- Identification and assessment of the risk from health hazards at work places and taking adequate steps to reduce the risks.
- Education of workers on sanitation, cleanliness, hygiene and health care.
- Periodical medical examination of all workers by medical specialist so that any adverse affect may be detected in its early state.
- Monitoring the values of the different environment health related parameters, which may lead to occupational health hazards to the workmen and specifying various control measures.

11.B.9 Accident Prevention And Disaster Management: The entire mining operation will be done under the supervision of the Mines Manager having first class mines managers' certificate of competency and supported by a team of mining engineers. Nevertheless, the following natural/industrial problems may be encountered during the mining operation:

- Filling of the mine pit due to excessive rains.
- Slope failures at the mine faces
- Accident due to blasting
- Accident due to plying of heavy mining equipment
- Sabotage in case of magazine.

In order to take care of above hazards/disasters, the followings will be strictly followed:

- Working of mines as per approved plans.
- All safety precautions and preventions of MMR 1961 shall be strictly followed during all mining operations.
- Regular maintenance and testing of all mining equipment as per manufacturer's guidelines.
- Provision of adequate capacity pumps for pumping out water from the mining pit with standby arrangements.
- Checking and regular maintenance of garland drainage and earthen bunds.
- Entry of unauthorized persons will be prohibited.
- Periodic checking of worthiness of fire fighting and first aid provision in the mining area.
- Training and refresher courses for all the employees.
- Cleaning of mining faces regularly.

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- As a part of disaster management plan, a rescue team will be formed by imparting specialized training to selected mining staff.

11.B.10 Budgetary Provisions: Adequate budgetary provisions will be made for capital as well as recurring expenditure and this will be reviewed every year for accommodating additional provisions, if required on account of additional environmental measures. Budgetary provisions will cover plantation for green belt development, dust control and suppression, construction and maintenance of bunds, garland drains, scree-arrest pits, post-mining land reclamation & mine closure, regular monitoring of environment domains, compensatory afforestation against use of forest land, etc.

11.B.11 Responsibility And Reporting Structures

1. General Manager: The General Manager will be responsible for overall management of the crushing plant and the mines including those pertaining to mining, administration, implementation of environmental management plan, etc.
2. Mines Manager: The Mines Manager will be responsible for mining operations, administration, implementation of environmental management plan, etc. He will be guided by the General Manager.
3. Environmental Engineer: The functions include actual implementation of the environmental plan consisting of – periodic monitoring of the levels of different parameters pertaining to the ambient air quality, water quality, noise level, soil characteristics, meteorological data collection of samples, etc., and to take suitable remedial measures, if and when the pollutants exceed the prescribed safe limits. The environmental engineer and the supporting staff will be part of the Company's overall environment team covering crusher unit, mines, unit, etc.

11.B.12 Implementation And Monitoring, Audits And Training: The significant impacts of the mine being mine water discharge and air quality control, the Mine Manager will closely monitor these aspects. He will have a monthly appraisal on performance of these areas and take actions to improve the same. An important aspect of EMS will be of regulatory compliance. The ambient air quality will be measured near the area of activity regularly, for presence of SPM, RPM, SO_2, NO_x. The mine water discharge will be monitored every month, particularly from the point of view of silt load. An external monitoring agency whose competency will be certified by the State Pollution Control Board will be engaged for the data collection and analysis. Proper records of these monitoring reports will always be made available with the Mine Manager for the scrutiny by the officials of the Government agencies as well as the interested people of the region. Total transparency will be maintained as far as

monitoring results are concerned. As a part of the regular and ongoing process of environmental performance, environmental audits will be conducted at least once in a year. Mines Manager will identify some executives and employees who will act as internal auditors for conducting in house audits. One or two executives will be trained outside to understand the procedures of environmental audits and they in turn will conduct training classes for others who will be involved. Apart from environmental audits, periodic training and awareness programmes will be conducted for executives and workers. Important events like world Environment Day, Earth Day, World Health Day, etc will be celebrated. All the employees will be encouraged to participate in plantation programmes that will be undertaken each year.

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Key person, RQP/CAL/287/99/B

ELECTROSTEEL CASTINGS LIMITED
19, Camac Street, Kolkata - 700017

PROGRESSIVE MINE CLOSURE PLAN

For

DIRSUMBURU IRON ORE DEPOSIT

Mining lease applied for over 192.50 Ha
(Falls within Kodolibad Reserve Forest, Manoharpur BD, Singhbhum (West), Jharkhand)

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FEBRUARY 2007

RQP/CAL/287/99/B

SRG Services & Consultancy (P) Ltd
135, Jodhpur Park, Kolkata - 700 068

CHAPTER-XII: PROGRESSIVE MINE CLOSURE PLAN

12.1 INTRODUCTION

12.1.1 Brief Introduction:

Name and address of the applicant:

Applicant : Mr RS Singh
Company : ELECTRO STEEL CASTINGS LIMITED
Office : 19, CAMAC STREET
KOLKATA – 700 017 (INDIA)
PHONE NO. 91 33 22839990
FAX NO. 91 33 22894340

Extent of lease area: 192.50 Ha

Type of lease area: Wholly situated within Kodolibad Reserve Forest

Present land use pattern: The present land use pattern is entirely forest.

Method of Mining: Mechanized, Drilling and Blasting, Crushing.

12.1.2 **Reason for closure:** This plan is a progressive mine closure plan.

12.1.3 **Statutory obligations:** All specific permissions from the DGMS under MMR-1961 will be obtained before commencing actual mining operations.

12.1.4 **Progressive Closure plan preparation:**

Name : ELECTRO STEEL CASTINGS LIMITED
Office : 19, CAMAC STREET
KOLKATA – 700 017 (INDIA)
PHONE NO. 91 33 22839990
FAX NO. 91 33 22894340

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For all correspondence regarding mines, the following authorized person may please be contacted:

Name : Mr. R.S. Singh

Key person, RQP/CAL/287/99/B

Designation	: Executive Director
Address	: Electro Steel Castings Limited 19, Camac Street, Kolkata – 700 001
Tel No	: +91-33-22839990
Fax No	: +91-33-22894340
Email	: rssingh@electrosteel.com

RQP	:SRG Services & Consultancy (P) Ltd.
Address	: 135, Jodhpur Park, Kolkata- 700 068
Phone No.	: +91 33 24149826/29
Fax	: +91 33 24148761
Email	: srg@vsnl.com
Regn No.	: RQP/CAL/287/99/B. A copy of the Certificate is enclosed as Annexure 2.
Valid upto	: 21.02.2011

12.2 MINE DESCRIPTION

12.2.1 **Geology:** The details of geology are described in chapter-3 of this document. A brief description of the same is given below.

Topography & Drainage: The lease area occupies the top of a fairly high subconical hill known as Dirsumburu Hill against which the Iron Ore lease is named. The hill peak has a Survey of India Triangulation point (Δ716m) that occurs inside the lease towards its central southwestern part. The hill has marked steep scarps to the south and south east. The hill also slopes off gradually in the north and northeasterly direction with a reentrant slope. The entire area is the catchment area of Koina River which is perennial in nature. It has two perennial tributaries, Koina Gara and Sarako (Ponga Nadi). These tributaries are in turn fed by sub tributaries or *nallahs* which are seasonal in nature. However, the sub tributary of Koina Gara namely Ambabai Gara is perennial and lies within 2 km of SW corner of the lease area. The lease and the surrounding area shows the dendritic drainage pattern flowing radially from the higher elevation of Dirsumburu hill. Three such seasonal *nallahs* run towards NNE, SE and SW areas of the hill. The maximum RL within the area is 718m to the southern part of the lease area and the minimum RL of 381m at the NE side. The area has a thick forest cover.

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Local Geology: The Iron ore deposit around Dirsumburu Hill forms a part of the Singbhum-Bonai-Keojhar group of rocks with associated mineral deposits. The rocks belonging to the Iron Ore Group mainly comprise Banded Hematite Quartzite, BHJ, Shale, Volcanics, Sandstones, Quartzite and Conglomerate. The host rock of the

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mineral deposits of Iron ore is BHQ which form a part of the western limb of the famous 'Horse Shoe' shaped Bonai-Keonjhar synclinorium. Based on surface indications, the litho-units observed can be broadly described as a lower phyllite horizon and banded iron formation with iron ore. Gradually towards the top, massive as well as laminated hematite can be observed forming the hill cliff all along the hill ridge following the regional strike (NNE-SSW) at the top replacing the BHQ. Along the slope, mass of hematite scree is formed more or less in-situ and also as a result of transportation by gravity. This gives indication of lateral spread of the ore along the slope. Screes of BHQ and phyllite are also observed at lower horizons. The planer structures indicate strike varying from north to northwesterly and northeasterly with westerly dips varying from 25° to 50° and also 80° at places. The iron ore deposit of this area is mostly massive but thinly laminated hard varieties are also common. Jointing in the ore bodies and types of rocks indicates that tectonic forces were active after formation of the ore.

Reserves: Based on the limited exploration carried out, proved reserves (UNFC 111) is estimated at 38.21 mt; Probable reserves (UNFC 122) at 19.37 mt; and reserves estimated under inferred resource category (UNFC 333) is 33.62 mt.

12.2.2 **Mining Method:** Mechanized method using Heavy Earth Moving Machineries will be adopted. 12m high benches will be maintained. The insitu ore will be drilled and blasted and then loaded by hydraulic shovels in dumpers which will unload on to the hopper over the primary crusher.

12.2.3 **Mineral Beneficiation:** No specific beneficiation is envisaged. However, the ore will be dry crushed and screened before conveying to the railhead proposed outside the lease area.

12.3 REVIEW OF IMPLEMENTATION OF MINING PLAN/SCHEME OF MINING INCLUDING FIVE YEARS PROGRESSIVE CLOSURE PLAN UPTO THE FINAL CLOSURE OF THE MINE

Not applicable. Mining has not commenced as yet and the progressive mine closure plan is being prepared for the first time in respect of this mine.

12.4 CLOSURE PLAN

12.4.1 Mined Out Land:

This is a virgin project and there is no mined out land.

12.4.2 Water Quality Management

As the mine will use dry crushing process, the only industrial use of water is for workshop and cleaning activities and water sprinkling to control dust pollution. For this purpose, at the workshop, an oil & grease separation treatment unit is proposed to be set up.

During monsoon period the mine water is likely to contain iron ore scree. To prevent this, a series of scree-arrest pits are proposed at appropriate places. The dimension of these check pits will be 20m x 20m x 6m. These pits can hold mine discharge water for 8 hours allowing effecting sedimentation of the scree in the run-off before decantation into the natural drainage. This is explain in detail in section 6.3. The location of such pits along with the mine garland drains are shown in Plate 8.

12.4.3 Air Quality Management

- Regular spraying of water on roads and blasted materials. A water sprinkler of 28 kl will be provided for this purpose.
- Provision of dust collectors for drilling machines.
- Provision of dust masks to the operators.
- Green belt development with plantation of wide-leaf trees, creepers, tall grass around the lower horizons of the haul road, crushing plant and mine infrastructure areas.

While the first three activities pertain to the ongoing mining activity, the last item puts in place a system which will improve air quality by mitigating pollution, after closure of the mine.

12.4.4 Waste Management

No waste is likely to be generated. As the quality of iron ore is such that the entire quantum can be consumed with certain likely generation of inferior grades getting blended with richer grades of ore. Thus, no waste dump creation is envisaged.

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12.4.5 Topsoil Management

The area where mining is proposed is either outcropping with limestone or covered with iron ore scree. There is hardly any topsoil cover. The laterised and small quantities of clayey material associated with is not mechanically separable and therefore will be consumed as ROM. If there are any substantial parches of topsoil observed, these will be removed by manual means and utilized for green belt development. Thus, no separate storage of topsoil is envisaged.

12.4.6 Tailing Dam Management

No wet processing is proposed and therefore, no tailings disposal is envisaged.

12.4.7 Infrastructure

The infrastructure consisting of electrical sub-station, workshop, stores, diesel dispensing unit, magazine, watch towers, crusher house, water supply system, pumping system, etc will be put in disuse at the end of life of mine. These will then be dismantled and removed from the site. As regards to the concrete constructions such as mine office and rest shelters, these may be handed over to the Forest Department or Local bodies. Before final closure, adequate plantations will be done to restore ecology.

12.4.8 Disposal of Mining Machinery

At the time of closure of the mine, all mining machinery will be moved to the other mines of the company or auctioned.

12.4.9 Safety & Security

After closure of the mine, some security persons will be retained for a period of three years for protecting freshly planted trees in the reclamation area in consultation with the forest department. The abandoned pits will be suitably fenced to prevent ingress of stray persons or animals.

12.4.10 Disaster Management & Risk Assessment

Provisions under MMR for disaster and risk management will be followed by the Mine Manager, who will take adequate steps for suitable training to be imparted to the workers for safety against fall of stones, movement of equipment and for regular drills for fire fighting.

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12.4.11 Care & maintenance during temporary discontinuance

In such an event, till such time, mining is once again commenced, security guard will be provided to prevent stray or travelers entering the mining area.

12.5 ECONOMIC REPURCUSSIONS OF CLOSURE OF MINE AND MANPOWER RETRENCHMENTS

When the mine is closed, there are some economic repercussions. The company will pursue the following:

1. Transfer the skilled employees to other mines under the same management.
2. Vocational training to semi-skilled/unskilled workers in the right age group for upgrading their skills, dovetailed to the requirement of the company.
3. Training in collaboration with State Government to desirous employees for self-employment schemes.
4. Compensation as per law or VRS in consultation with District Labour Commissioner.

12.6 TIME SCHEDULE OF ABANDONMENT

Not applicable as this is PMCP. Nevertheless, if such an event occurs, the following tentative time schedule will be followed:

Table 12.1: Time Schedule of Abandonment

Heads	Quarters											
	1	2	3	4	5	6	7	8	9	10	11	12
Disposal of Mobile Machinery												
Disposal of Plant Machinery												
Rehabilitation of Mine workers												
Reclamation of Quarry land												
Rehabilitation of dump area	Nil											
Tailing dam management												
Top soil management	Nil											
Disposal of Township, Office												

12.7 ABANDONMENT COST

As this is a PMCP only a tentative cost estimation has been done at the time of mine closure. The cost estimation has been provided in the chart below.

Table 12.2: Tentative Abandonment Cost

HEADS	Rs in lakhs
Disposal of Mobile Machinery	Nil – all shifted to other units
Disposal of Plant Machinery	35.00
Rehabilitation of Mine workers	Nil - all shifted to other units
Reclamation of Quarry land	293.00
Rehabilitation of dump area	Nil – No waste dump
Tailing dam management	Nil – No tailings dam
Top soil management	Nil – No topsoil dump
Disposal of Township, Office	Nil - handed over to government officials
TOTAL	328.00

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12.8 FINANCIAL ASSURANCE

Table 12.3: Degradation of Land

Sl No.	Type of land use	Area put on use at start of plan	Additional requirement during plan period	Total	Area considered as fully reclaimed and rehabilitated	Net area considered for calculation
a	b	c	d	e e=(c+d)	f	g g=(e-f)
1	Area to be excavated	Nil	14.746	14.746	Nil	14.746
2	Storage for topsoil	Nil	Nil	Nil	Nil	Nil
3	Overburden/dump	Nil	Nil	Nil	Nil	Nil
4	Mineral storage	Nil	1.00	1.00	Nil	1.00
5	Infrastructure	Nil	1.90	1.90	Nil	1.90
6	Roads	Nil	7.525	7.525	Nil	7.525
7	Railways	Nil	Nil	Nil	Nil	Nil
8	Green belt	Nil	1.893	1.893	Nil	1.893
9	Tailing pond	Nil	Nil	Nil	Nil	Nil
10	Effluent treatment plant (Garland drain & check dam)	Nil	1.22	1.22	Nil	1.22
11	Mineral separation plant	Nil	1.40	1.40	Nil	1.40
12	Township area	Nil	Nil	Nil	Nil	Nil
13	Others	Nil	Nil	Nil	Nil	Nil
	Total	Nil	29.684	29.684	Nil	29.684

The start date of the proposed mining plan will depend on the forest diversion clearance, environment clearance and grant and execution of mining lease. Tentatively, the start and end of the five year period dates are given below:

Start date of five year period : 1st April 2008
End date of five year period : 31st March 2013

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@ Rs 25,000 per ha, the financial assurance required: Rs 7,42,100.00 (Rupees Seven Lakh Forty Two Thousand One Hundred Only).

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12.9 CERTIFICATES

The said closure plan complies with all statutory rules, regulations, orders made by Central and State Government, statutory organizations, etc. all measures proposed in this plan will be implemented in a time bound manner as proposed.

Certificate from the Applicant to abide by the progressive mine closure plan as well as the mining plan together is placed as part of applicant's authorization letter in after the contents pages in this volume.

12.10 RELEVANT PLANS AND SECTIONS

Geological plan (Plate 3)
Geological sections (Plate 4)
Conceptual plan (Plate 5A)
Mine Closure Plan (Plate 8)

(TN Gunaseelan)
Key Person – RQP/CAL/287/99/B
SRG Services & Consultancy (P) Limited.
Kolkata

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21/3/07

खान नियंत्रक (मध्यांचल)
Controller of Mines (Central Zone)
भारतीय खान ब्यूरो
Indian Bureau of Mines

ANNEXURE-1

DIRECTORS	
Sl.	Details
1	SRI UMANG KEJRIWAL
	S/O SRI GHANSHYAM KEJRIWAL
	NAV - NIKUNJ
	13, GURUSADAY ROAD
	KOLKATA
	PIN - 700 019
	PHONE: 2247 0454
	E-MAIL:ukejriwal@kdh.ecl.co.in
2	SRI MAYANK KEJRIWAL
	S/O SRI GHANSHYAM KEJRIWAL
	NAV - NIKUNJ
	13, GURUSADAY ROAD
	KOLKATA
	PIN - 700 019
	PHONE: 2247 4462
	E-MAIL: mkejriwal@kdh.ecl.co.in
3	SRI UDDHAV KEJRIWAL
	S/O SRI MAYANK KEJRIWAL
	NAV - NIKUNJ
	13, GURUSADAY ROAD
	KOLKATA
	PIN - 700 019
	PHONE: 2247 4462
	E-MAIL: uddhavkejriwal@kdh.ecl.co.in
4	SRI PRADIP KUMAR KHAITAN
	S/O LATE BHAGWATI PRASAD KHAITAN
	B-103, RAI ENCLAVE
	7/1A, SUNNY PARK
	KOLKATA
	PIN - 700 019
	PHONE: 2461 4213
	E-MAIL: pinto@khaitanco.com
5	SRI BINOD KHAITAN
	S/O M.D.Khaitan
	5, QUEENS PARK
	KOLKATA
	PIN - 700 019
	Phone No.2461 4474
	E-MAIL: kaitan@cal2.vsnl.net.in

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6	SRI S. Y. RAJAGOPALAN
	S/O LATE YEGNASWAMI IYER
	UD-08-1003, 1050/1, SURVEY PARK
	KOLKATA-700 075
	PIN - 700 017
	PHONE: 2418 8122
	E-MAIL: sy.rajagopalan@kdh.ecl.co.in
7	SRI NIGAM CHANDER BAHL
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9	DR. J.J. IRANI
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10	MR. NARESH CHANDRA
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	SECTOR,C-4, 4053
	VASANT KUNJ
	NEW DELHI-110 070
	PHONE (011) 2689 7295
	E-Mail: -

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ANNEXURE - 2

CERTIFICATE OF RECOGNITION AS QUALIFIED PERSON TO PREPARE MINING PLANS

(Under Rule 22 (c) of Mineral Concession Rules 1960)

M/s SRG Services & Consultancy Pvt. Ltd. having registered office at 1/158/1, I. Floor, Naktala, Calcutta-47..., and having given satisfactory evidence of the qualifications and experience of their key persons is hereby granted recognition under Rule 22 (c) of the Mineral Concession Rules 1960 as a Qualified Person to prepare Mining Plans.

The registration number is RQP/CAL/287/99/B

This recognition is valid for a period of two years ending 21.2.2001.....

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स्वीकृत दिनांक.....
Received up to 21.02.2011

Place : Calcutta
Date : 22.2.1999

क्षेत्रीय खान नियंत्रक
Regional Controller of Mines
भारतीय खान ब्यूरो
Indian Bureau of Mines
कलकत्ता
Calcutta

Regional Controller of Mines
Indian Bureau of Mines
.....

ANNEXURE - 3

[illegible]

[illegible]

[illegible]

सेवा में

सर्वश्री इलेक्ट्रो स्टील कास्टिंग लि०
19, कैमक स्ट्रीट कोलकाता–700017

विषय :– प० सिंहभूम जिलान्तर्गत मौजा कोदलीबाद रक्षित वन के 192.50 हेक्टर (संशोधित) क्षेत्र पर लौह एवं मैंगनीज अयस्क के खनन पट्टा की स्वीकृति हेतु सर्वश्री इलेक्ट्रो स्टील कास्टिंग लि० का आवेदन पत्र।

प्रसंग :– प्रभारी खान निदेशालय का पत्रांक ख०नि० (चाईबासा)–192/05–1467/एम० दिनांक 18.10.2006

उपर्युक्त विषय एवं प्रसंग में प्रभारी खान निदेशालय झारखण्ड राँची से प्राप्त अनुशंसित मानचित्र 192.50 हेक्टर की सत्यापित प्रति संलग्न करते हुए अनुरोध है कि निम्नांकित कागजात एवं सूचनाएं दाखिल करें :–

1. वन संरक्षण अधिनियम की धारा 2 के अन्तर्गत भारत सरकार के पर्यावरण एवं वन मंत्रालय का पूर्वानुमति पत्र।

1.1 इण्डियन ब्यूरो ऑफ माईन्स द्वारा अनुमोदित माईनिंग प्लान (भारत सरकार पर्यावरण एवं वन मंत्रालय का गाईड लाईन पत्र सं० 5-5/86-FC(Pt) दिनांक 26.02.1999)

2. भारत सरकार द्वारा जारी पर्यावरणीय स्वच्छता प्रमाण पत्र।

3. अनुशंसित सत्यापित मानचित्र के आलोक में भूमि सूची/ट्रेसिंग सहित मानचित्र/अंचलाधिकारी/वन प्रमण्डल पदाधिकारी का प्रतिवेदन/अनापत्ति पत्र।

4. विभागीय पत्रांक – 180/एम०, दिनांक 25.01.06 के आलोक में राज्य के अन्दर खनिज आधारित उद्योग की स्थापना एवं पूंजीनिवेश की अद्यतन स्थिति।

जिला खनन पदाधिकारी
चाईबासा।

APPROVED

ANNEXURE 4

DAILY AVERAGE OF MICRO-METEOROLOGICAL MONITORED DATA
1 MARCH, 2006 TO 31 MAY, 2006

DATE	CALM <1.8kmph	E	ENE	NE	NNE	N	NNW	NW	WNW	W	WSW	SW	SSW	S	SSE	SE	ESE	TEMP (°C)	REL_HUM (%)
		DIRECTION WISE AVERAGE WIND SPEED (km/hr) EXCLUDING CALM																	
01/03/2006	1.10	0.00	0.00	2.60	0.00	4.10	0.00	2.70	0.00	5.35	0.00	3.90	0.00	0.30	0.00	2.10	0.00	18.84	50.00
02/03/2006	0.50	0.00	0.00	4.85	2.80	2.60	5.10	2.30	0.00	5.30	0.00	3.08	0.00	6.40	0.00	3.05	0.00	17.95	51.00
03/03/2006	0.85	0.00	0.00	5.35	2.90	4.15	3.45	3.35	0.00	4.10	0.00	3.15	0.00	3.00	0.00	3.45	0.00	18.07	49.00
04/03/2006	1.33	0.00	0.00	4.90	0.00	3.50	0.00	3.18	0.00	5.17	0.00	3.11	0.00	0.02	0.00	3.40	0.00	18.06	50.00
05/03/2006	1.50	0.00	0.00	3.20	5.60	3.40	4.30	0.00	0.00	2.40	0.00	3.83	0.00	2.90	0.00	2.75	0.00	18.52	50.00
06/03/2006	1.20	0.00	0.00	2.80	11.00	3.07	2.40	6.70	0.00	0.00	0.00	4.36	0.00	4.10	0.00	2.83	0.00	18.02	50.00
07/03/2006	1.10	0.00	0.00	3.70	0.00	0.00	0.00	3.82	0.00	3.65	0.00	5.60	0.00	0.00	0.00	4.18	0.00	18.10	49.00
08/03/2006	1.14	0.00	0.00	6.35	3.30	4.67	3.05	0.00	0.00	3.00	0.00	5.07	0.00	1.80	0.00	8.23	0.00	18.36	49.00
09/03/2006	0.63	0.00	0.00	2.60	0.00	7.78	3.65	3.73	0.00	5.00	0.00	3.65	0.00	3.00	0.00	3.97	0.00	18.38	48.00
10/03/2006	0.55	0.00	0.00	4.53	2.70	0.00	5.00	6.45	0.00	4.65	0.00	3.75	0.00	0.00	0.00	4.90	0.00	18.96	47.00
11/03/2006	1.01	0.00	0.00	2.80	5.50	3.00	12.00	0.00	0.00	5.85	0.00	2.58	0.00	8.40	0.00	2.88	0.00	19.96	46.00
12/03/2006	1.20	0.00	0.00	2.60	7.40	2.87	6.70	2.85	0.00	8.20	0.00	5.65	0.00	11.80	0.00	6.30	0.00	20.73	46.00
13/03/2006	1.24	0.00	0.00	4.38	0.00	3.30	2.85	2.78	0.00	3.50	0.00	5.47	0.00	0.00	0.00	3.05	0.00	19.68	45.00
14/03/2006	1.50	0.00	0.00	5.73	3.40	4.25	2.50	5.65	0.00	3.10	0.00	2.35	[illegible]	3.05	0.00	8.00	0.00	20.26	46.00
15/03/2006	1.19	0.00	0.00	5.15	0.00	8.85	3.00	4.35	0.00	3.15	0.00	4.00	3.00	3.10	0.00	2.10	0.00	19.71	47.00
16/03/2006	0.85	0.00	0.00	2.15	0.00	7.30	6.00	3.13	0.00	5.55	0.00	2.53	3.00	3.00	0.00	4.30	0.00	20.04	47.00
17/03/2006	1.44	0.00	0.00	3.83	3.90	0.00	3.30	2.20	0.00	5.07	0.00	4.18	[illegible]	1.60	0.00	3.35	0.00	20.24	46.00
18/03/2006	0.85	0.00	0.00	4.17	3.30	5.57	2.60	4.80	0.00	5.40	0.00	3.10	[illegible]	1.15	0.00	3.45	[illegible]	20.72	45.00
19/03/2006	1.45	0.00	0.00	4.10	0.00	2.53	3.00	3.10	0.00	2.40	0.00	2.70	[illegible]	0.00	0.00	4.58	[illegible]	19.72	45.00
20/03/2006	1.16	0.00	0.00	5.38	5.70	0.00	0.00	3.05	0.00	3.13	0.00	5.30	[illegible]	5.50	0.00	5.13	1.00	20.46	45.00
21/03/2006	0.90	0.00	0.00	2.47	12.35	3.73	5.35	3.00	0.00	1.10	0.00	4.40	0.20	3.90	0.00	2.83	5.08	20.25	44.00
22/03/2006	0.85	0.00	0.00	6.43	0.00	7.00	2.80	4.40	0.00	0.00	0.00	5.73	0.00	0.00	0.00	2.85	2.00	20.73	44.00
23/03/2006	1.37	0.00	0.00	5.58	1.80	3.10	2.60	6.25	0.00	2.55	0.00	3.07	0.20	0.00	2.30	2.35	0.00	20.84	45.00
24/03/2006	0.83	0.00	0.00	6.45	2.90	2.75	4.55	6.98	0.00	4.37	0.00	4.50	0.00	6.00	0.00	6.80	2.58	20.28	44.00
25/03/2006	1.42	0.00	0.00	2.77	0.00	4.93	5.70	2.90	0.00	0.00	0.00	3.48	0.00	0.00	0.00	6.57	3.00	20.41	43.00
26/03/2006	0.88	0.00	0.00	2.92	7.70	4.40	7.30	2.30	0.00	7.15	0.00	8.47	0.00	11.30	0.00	7.32	0.00	20.70	44.00
27/03/2006	0.55	0.00	0.00	2.73	1.90	6.15	9.30	2.70	0.00	4.37	0.00	2.68	5.00	2.70	3.00	2.55	0.00	20.45	44.00
28/03/2006	0.95	0.00	0.00	6.65	0.00	3.60	4.00	7.65	0.00	4.95	0.00	4.60	0.30	0.00	0.00	4.78	0.00	21.01	43.00
29/03/2006	1.00	0.00	0.00	3.93	2.50	3.30	3.35	2.70	0.00	2.80	0.00	2.94	0.00	1.80	0.00	4.55	0.00	20.26	43.00
30/03/2006	1.27	0.00	0.00	5.20	7.50	3.10	2.90	5.90	0.00	2.50	0.00	5.75	3.00	5.30	0.00	5.85	2.90	20.32	43.00
31/03/2006	1.05	0.00	0.00	2.40	0.00	3.15	3.00	3.13	0.00	2.57	0.00	5.31	0.00	0.00	0.00	2.25	0.00	20.11	43.00
01/04/2006	1.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.72	0.25	2.30	0.00	3.60	0.00	21.35	43.00
02/04/2006	0.81	0.00	0.00	3.48	0.00	0.00	0.00	7.60	0.00	7.10	2.15	3.89	0.00	2.80	3.10	4.65	0.00	20.85	44.00
03/04/2006	1.02	0.00	0.00	0.00	0.00	6.10	0.00	3.70	3.10	2.70	2.40	3.90	3.10	2.10	0.00	5.82	0.00	19.92	45.00
04/04/2006	0.46	0.00	0.00	3.78	0.00	0.00	0.00	2.40	0.00	2.50	4.60	2.55	0.00	3.00	6.20	3.85	0.00	21.10	44.00
05/04/2006	0.99	0.00	0.00	3.70	0.00	2.30	0.00	3.00	3.30	7.60	0.00	3.88	5.23	2.20	0.00	3.20	0.00	20.38	42.00
06/04/2006	0.88	0.00	0.00	3.60	0.00	0.00	0.00	8.20	0.00	2.55	2.75	0.00	0.00	4.50	3.80	3.83	0.00	21.65	39.00
07/04/2006	1.04	0.00	0.00	0.00	3.10	0.00	0.00	2.10	2.80	2.70	0.00	3.44	4.15	3.90	0.00	2.50	0.00	21.33	38.00
08/04/2006	0.95	0.00	0.00	3.17	0.00	7.30	0.00	2.55	0.00	4.50	5.35	0.00	5.10	4.47	1.80	3.10	0.00	21.84	38.00
09/04/2006	0.85	0.00	0.00	7.00	0.00	0.00	0.00	0.00	3.80	6.40	0.00	3.63	3.80	0.00	0.00	3.78	0.00	21.55	38.00
10/04/2006	0.88	0.00	0.00	2.40	0.00	0.00	0.00	6.50	0.00	2.35	4.70	0.00	3.20	3.03	2.90	3.75	0.00	21.27	37.00
11/04/2006	0.95	0.00	0.00	3.90	0.00	0.00	0.00	0.00	2.90	1.00	4.90	3.70	0.00	3.00	0.00	5.25	0.00	21.04	38.00
12/04/2006	0.53	0.00	0.00	6.10	0.00	3.70	0.00	2.05	3.60	4.95	[illegible]	0.00	8.00	2.37	6.80	3.20	0.00	21.58	38.00
13/04/2006	1.08	0.00	0.00	4.17	[illegible]	3.00	0.00	[illegible]	0.00	3.25	[illegible]	4.43	[illegible]	5.97	0.00	2.55	0.00	21.12	39.00

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ANNEXURE-4

DATE	CALM <1.8kmph	E	ENE	NE	NNE	N	NNW	NW	WNW	W	WSW	SW	SSW	S	SSE	SE	ESE	TEMP (°C)	REL_HUM (%)
		DIRECTION WISE AVERAGE WIND SPEED (km/hr) EXCLUDING CALM																	
14/04/2006	0.86	0.00	0.00	3.10	0.00	2.20	0.00	3.70	6.90	2.80	1.95	4.50	3.15	3.50	2.90	5.00	0.00	21.71	37.00
15/04/2006	1.06	0.00	0.00	4.67	0.00	0.00	0.00	0.00	0.00	7.95	4.90	3.13	4.00	0.00	0.00	2.80	0.00	21.60	38.00
16/04/2006	1.01	0.00	0.00	2.60	0.00	8.10	0.00	5.55	0.00	6.70	3.35	3.13	6.15	2.97	3.20	3.50	0.00	21.58	38.00
17/04/2006	0.68	0.00	0.00	4.50	0.00	0.00	0.00	7.80	0.00	2.90	3.20	4.10	0.00	2.93	0.00	3.40	0.00	22.09	38.00
18/04/2006	0.83	0.00	0.00	3.10	0.00	2.90	0.00	1.90	0.00	2.40	3.80	4.88	2.40	2.70	7.10	0.00	0.00	23.47	39.00
19/04/2006	0.81	0.00	0.00	5.13	0.00	0.00	0.00	4.10	0.00	2.70	4.57	4.80	0.00	4.40	0.00	3.17	0.00	21.72	38.00
20/04/2006	1.05	0.00	0.00	4.80	0.00	2.70	0.00	2.90	3.50	4.80	3.40	4.20	7.35	3.00	2.30	0.00	0.00	21.01	37.00
21/04/2006	0.99	0.00	0.00	2.80	0.00	0.00	0.00	6.40	0.00	4.50	3.55	2.80	0.00	5.25	0.00	3.47	0.00	21.23	37.00
22/04/2006	0.95	0.00	0.00	2.10	0.00	4.70	0.00	2.70	5.30	3.50	3.70	3.64	3.00	3.00	3.10	0.00	0.00	21.80	37.00
23/04/2006	0.73	0.00	0.00	4.13	0.00	0.00	0.00	3.00	0.00	4.03	3.47	2.00	8.70	3.50	2.20	3.43	0.00	21.04	37.00
24/04/2006	0.76	0.00	0.00	4.20	0.00	2.90	0.00	7.50	3.90	0.00	0.00	3.64	2.60	0.00	0.00	4.20	0.00	21.56	38.00
25/04/2006	1.07	0.00	0.00	3.10	0.00	0.00	0.00	7.20	0.00	3.96	3.65	0.00	0.00	2.79	4.00	3.60	0.00	26.05	40.00
26/04/2006	0.47	0.00	0.00	2.30	0.00	0.00	2.00	0.00	3.13	0.00	0.00	0.00	0.00	2.90	2.90	4.32	0.00	28.28	51.00
27/04/2006	0.69	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.70	2.70	0.00	2.10	3.90	3.83	6.08	4.17	0.00	27.47	59.00
28/04/2006	0.94	3.97	1.80	0.00	0.00	0.00	0.00	0.00	8.60	0.00	6.60	5.30	0.00	0.00	1.80	3.10	0.00	27.24	57.00
29/04/2006	0.50	2.50	0.00	2.80	0.00	4.74	6.20	0.00	0.00	3.20	9.50	5.10	4.80	2.00	0.00	4.37	3.60	29.63	53.00
30/04/2006	1.07	0.00	0.00	0.00	0.00	4.40	3.30	0.00	3.20	2.30	0.00	3.15	0.00	8.80	10.33	5.70	2.35	29.23	62.00
01/05/2006	0.00	4.55	5.10	4.45	4.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.50	12.40	9.03	4.54	6.20	29.24	42.00
02/05/2006	0.80	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	5.94	8.75	8.07	10.01	2.40	28.76	67.00
03/05/2006	1.80	3.80	[illegible]	0.00	2.30	5.17	0.00	0.00	3.00	0.00	5.00	0.30	5.15	4.57	8.43	3.20	6.75	29.95	54.00
04/05/2006	0.00	2.30	[illegible]	2.50	4.40	0.00	0.00	2.20	0.50	2.10	6.70	7.40	2.30	7.60	4.60	10.95	7.75	29.50	58.00
05/05/2006	1.20	4.40	[illegible]	4.07	7.30	0.00	0.00	0.00	5.70	0.00	0.00	0.00	11.20	5.70	8.47	4.33	4.05	28.19	71.00
06/05/2006	0.00	[illegible]	[illegible]	3.00	0.00	0.00	0.00	0.00	0.00	3.40	0.00	8.24	12.91	8.74	8.75	8.00	5.53	30.11	58.00
07/05/2006	1.38	8.32	[illegible]	4.00	4.20	14.50	0.00	0.00	0.00	0.00	0.00	0.00	8.01	11.22	6.22	8.30	8.57	30.54	54.00
08/05/2006	0.60	4.35	[illegible]	0.00	0.00	5.97	0.00	0.00	0.00	1.20	0.00	7.10	11.81	3.90	12.18	8.32	0.00	29.10	52.00
09/05/2006	1.35	3.30	[illegible]	7.10	0.00	2.10	3.70	0.00	0.00	0.00	4.60	5.76	4.01	0.00	0.00	8.00	9.40	29.15	63.00
10/05/2006	1.05	7.70	[illegible]	7.60	0.00	0.00	10.35	0.00	0.00	0.00	0.00	0.00	0.00	7.82	8.30	13.20	0.00	28.87	67.00
11/05/2006	0.00	4.82	[illegible]	6.15	5.28	5.05	0.00	0.00	0.00	0.00	0.00	0.00	3.70	9.50	8.17	8.57	3.43	29.51	67.00
12/05/2006	0.00	4.97	5.87	4.03	3.60	0.00	2.80	0.00	9.60	0.00	5.10	8.35	0.00	17.70	10.03	11.38	3.10	29.72	68.00
13/05/2006	1.60	6.15	5.46	5.60	4.40	7.12	0.00	0.00	6.50	0.00	0.00	0.00	3.38	12.10	18.20	12.70	8.50	26.52	81.00
14/05/2006	0.00	5.10	0.09	0.00	6.70	0.00	3.40	2.90	0.00	0.00	5.37	9.27	0.00	11.50	18.40	0.00	11.00	28.50	74.00
15/05/2006	1.17	3.20	3.40	7.45	8.80	5.77	0.00	0.00	0.00	0.00	2.10	0.00	0.00	0.00	0.00	5.90	7.07	25.53	88.00
16/05/2006	1.30	4.20	2.70	0.00	3.35	4.79	2.00	0.00	0.00	3.00	0.00	0.00	3.50	0.00	9.85	5.82	0.00	24.48	80.00
17/05/2006	0.50	0.00	4.15	4.30	4.17	3.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.20	6.00	0.00	26.93	75.00
18/05/2006	0.20	0.00	0.00	0.00	3.73	4.52	0.00	2.20	3.60	3.70	4.10	0.00	0.00	2.20	4.55	5.85	4.70	28.02	71.00
19/05/2006	0.30	0.00	0.00	0.00	4.90	3.20	3.50	0.00	6.95	11.20	4.20	11.50	2.90	3.00	3.70	8.52	5.07	28.70	70.00
20/05/2006	0.85	0.00	0.00	4.80	2.20	4.00	0.00	5.80	0.00	4.53	0.00	8.10	8.55	0.00	7.80	4.30	4.88	27.97	67.00
21/05/2006	0.43	0.00	0.00	0.00	0.80	2.60	0.00	2.10	3.90	2.80	2.50	3.93	13.10	2.25	3.40	2.90	3.00	26.07	28.00
22/05/2006	1.08	0.05	0.00	4.48	0.00	3.00	0.00	2.40	0.00	8.43	0.00	2.30	0.00	2.80	3.20	3.25	6.80	25.63	25.00
23/05/2006	1.42	0.00	0.00	8.00	5.00	0.00	0.00	0.00	7.20	4.50	2.20	3.57	11.10	3.50	7.40	3.07	0.00	25.63	25.00
24/05/2006	1.04	0.00	0.00	4.70	0.00	4.25	0.00	3.15	5.40	7.40	4.45	3.10	10.90	2.70	4.25	0.00	0.00	25.60	25.00
25/05/2006	0.88	0.00	0.00	5.23	0.00	0.00	0.00	0.00	0.00	8.00	0.00	3.10	0.55	0.00	0.00	4.62	0.00	25.50	24.00
26/05/2006	0.90	0.00	0.00	0.00	0.00	2.45	0.00	3.35	7.20	3.50	4.10	3.90	9.60	4.05	4.65	9.83	0.00	25.53	24.00
27/05/2006	0.99	0.00	0.00	6.27	0.00	2.10	0.00	5.30	0.00	3.57	0.00	3.25	0.00	3.90	3.60	2.33	0.00	25.73	24.00
28/05/2006	0.86	0.00	0.00	8.10	0.00	3.30	0.00	0.00	6.50	0.00	2.55	3.70	10.30	3.30	5.28	3.93	0.00	25.73	26.00
29/05/2006	1.48	0.00	0.00	5.17	0.00	2.60	0.00	2.75	6.70	4.35	2.50	8.10	12.00	4.00	7.00	0.00	0.00	25.83	25.00
30/05/2006	0.79	0.00	0.00	5.10	7.90	0.00	0.00	0.00	0.00	6.43	0.00	2.86	0.00	0.00	0.00	3.37	0.00	25.87	26.00
31/05/2006	0.70	0.00	0.00	2.10	0.00	3.40	0.00	2.90	7.90	3.10	3.45	2.10	7.14	3.00	4.95	2.85	0.00	25.89	26.00

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ANNEXURE-5

AMBIENT AIR QUALITY TEST RESULTS

KODOLIBAD IRON ORE MINE

Sl. No.	Date of sampling	24 hrly concentrations (in µg/m³)																			
		RPM	SPM	SO_2	NOx	RPM	SPM	SO_2	NOx	RPM	SPM	SO_2	NOx	RPM	SPM	SO_2	NOx	RPM	SPM	SO_2	NOx
	LOCATION :	Core zone (CA1)				Hatnaburu (BA1)				Bailba (BA2)				Holo (BA3)				Bahada (BA4)			
1	02-03/03/2006	15	47	7.0	6.8	20	68	5.5	6.9	33	110	5.9	6.8	33	109	7.5	6.6	19	64	6.6	7.9
2	06-07/03/2006	22	73	6.3	6.6	34	113	7.6	7.2	20	68	6.0	6.6	26	84	5.0	7.9	18	56	5.9	6.0
3	09-10/03/2006	17	55	5.5	7.7	25	80	6.3	7.0	24	79	7.8	9.9	15	47	5.3	5.3	16	50	5.3	7.6
4	12-13/03/2006	13	43	5.2	5.8	21	70	7.9	6.1	34	111	5.9	8.0	23	76	8.0	8.9	18	58	5.5	7.3
5	16-17/03/2006	17	55	5.9	7.5	32	106	6.2	7.0	34	111	7.0	8.9	19	61	6.4	8.4	23	75	5.5	6.8
6	21-22/03/2006	18	57	6.6	6.7	36	118	7.1	6.9	35	116	5.5	7.8	33	108	6.9	8.3	20	66	7.0	7.0
7	25-26/03/2006	20	65	6.1	5.6	38	126	5.4	8.5	26	85	6.0	6.4	17	56	5.8	5.8	26	86	6.9	7.2
8	29-30/03/2006	33	109	5.2	7.0	19	61	5.7	7.3	21	66	5.8	7.2	31	99	6.4	7.2	13	43	5.4	6.1
9	02-03/04/2006	18	60	5.5	6.8	36	119	5.3	8.4	32	104	5.2	8.2	31	101	7.8	7.3	14	43	6.0	7.0
10	06-07/04/2006	33	108	5.9	7.0	36	121	5.4	8.4	16	52	5.3	8.4	24	77	5.7	6.8	16	50	5.6	5.3
11	10-11/04/2006	28	90	6.8	5.6	34	110	5.4	8.8	17	53	7.0	9.1	16	51	6.4	7.6	19	62	5.2	6.1
12	13-14/04/2006	14	45	6.8	7.1	24	76	7.2	7.3	15	51	5.3	6.1	28	89	5.3	8.8	23	74	6.8	7.2
13	17-18/04/2006	29	95	5.5	5.0	33	107	5.9	7.6	22	73	5.2	8.4	31	102	5.9	6.1	19	61	5.1	7.3
14	21-22/04/2006	13	42	6.0	5.8	24	78	7.3	7.2	35	113	7.0	8.0	28	92	6.6	7.1	16	53	6.7	7.4
15	25-26/04/2006	21	67	6.0	7.6	28	91	8.0	8.0	24	76	5.1	8.3	22	74	7.8	8.4	17	55	5.2	6.9
16	29-30/04/2006	21	67	5.5	7.8	32	107	5.8	8.4	29	95	7.8	8.0	34	113	7.1	5.3	16	50	6.4	7.7
17	03-04/05/2006	28	94	6.0	7.0	28	90	5.1	6.9	22	73	7.5	7.2	17	56	6.1	5.0	15	46	5.2	7.7
18	07-08/05/2006	12	40	5.8	5.8	36	120	6.3	8.0	21	67	7.5	7.7	32	107	5.5	9.0	22	71	5.5	5.0
19	11-12/05/2006	34	110	5.7	7.9	30	99	6.2	6.6	21	70	6.5	6.3	32	103	6.5	7.2	13	42	5.2	7.7
20	14-15/05/2006	18	59	6.5	6.0	37	123	5.8	8.4	29	97	7.7	7.9	23	77	5.7	7.2	26	83	5.5	6.9
21	17-18/05/2006	32	102	6.4	5.0	16	52	7.2	8.4	16	53	7.9	7.8	22	73	5.6	5.2	25	79	5.6	6.0
22	20-21/05/2006	13	43	6.5	5.1	27	87	7.4	7.3	25	82	6.4	7.9	14	46	6.8	7.1	25	82	6.4	6.6
23	23-24/05/2006	25	81	5.1	5.5	22	74	5.5	7.1	35	113	5.7	6.6	32	104	6.9	5.5	26	84	5.6	5.6
24	27-28/05/2006	29	94	6.4	8.0	27	88	7.7	6.9	24	81	7.7	8.1	27	87	7.4	8.6	22	69	6.4	6.1
	Minimum	12	40	5.1	5.0	16	52	5.1	6.1	15	51	5.1	6.1	14	46	5.0	5.0	13	42	5.1	5.0
	Maximum	34	110	7.0	8.0	38	126	8.0	8.8	35	116	7.9	9.9	34	113	8.0	9.0	26	86	7.0	7.9
	Average	22	71	6.0	6.5	29	95	6.4	7.5	25	83	6.4	7.6	25	83	6.4	7.1	19	63	5.9	6.8
	98 percentile	34	109	6.9	8.0	37	125	8.0	8.7	35	115	7.9	9.5	34	111	7.9	9.0	26	85	7.0	7.8

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ANNEXURE

WATER TEST RESULTS

Sl No	Parameters	Near Core zone (GW1) (H.P.)	Sonapi (GW2) (H.P.)	Chota Nagra (GW3) (H.P.)	Sarako Nadi, down stream (SW1)	Koina River (SW2)	Baliba village (GW4) (H.P.)	Kadai village (GW5) (H.P.)	Sarako Nadi, up stream (SW3)
	Date of sampling	01-05-06	01-05-06	01-05-06	01-05-06	01-05-06	01-05-06	01-05-06	01-05-06
1.	Colour, (Hazen units)	<5	<5	<5	<5	<5	<5	<5	<5
2.	Odour	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
3.	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4.	Turbidity, (NTU)	<5	<5	<5	<5	<5	<5	<5	<5
5.	pH value	7.9	7.7	8.2	7.7	6.8	7.8	7.6	7.7
6.	Total hardness as $CaCO_3$, (mg/l)	112	44	84	60	108	77	69	59
7.	Iron as Fe, (mg/l)	0.12	0.25	0.17	0.47	0.11	0.15	0.18	0.44
8.	Chloride as Cl, (mg/l)	24	12	16	16	40	17	23	16
9.	Residual, free chlorine, (mg/l)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
10.	Dissolved solids, (mg/l)	150	74	114	77	180	75	75	73
11.	Calcium as Ca, (mg/l)	28.8	9.6	19.2	11.2	24.0	14.7	16.7	11.2
12.	Copper as Cu, (mg/l)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
13.	Manganese as Mn, (mg/l)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
14.	Sulphate as SO_4, (mg/l)	2.2	1.4	11.6	1.7	1.3	2.1	2.0	1.7
15.	Nitrate as NO_3, (mg/l)	7.3	6.9	3.5	8.7	8.2	7.4	7.9	8.7
16.	Fluoride as F, (mg/l)	0.33	0.16	0.22	0.12	0.10	0.23	0.17	0.12
17.	Mercury as Hg, (mg/l)	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
18.	Cadmium as Cd, (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
19.	Selenium as Se, (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
20.	Arsenic as As, (mg/l)	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
21.	Lead as Pb, (mg/l)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
22.	Zinc as Zn, (mg/l)	0.09	0.04	0.04	0.04	0.05	0.05	0.04	0.04
23.	Chromium as Cr^{6+}, (mg/l)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
24.	Magnesium as Mg, (mg/l)	9.7	4.8	8.7	7.7	11.6	6.5	5.9	7.7
25.	Alkalinity, (mg/l)	104	40	68	40	100	35	4	40
26.	Aluminium as A, (mg/l)	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
27.	Boron as B (mg/l)	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
28.	Nickel as Ni, (mg/l)	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
29.	Sodium as Na, (mg/l)	10.6	2.4	3.4	2.7	24.2	2.7	3.1	2.7
30.	Potassium as K, (mg/l)	2.6	1.8	2.6	1.9	2.9	2.2	2.5	2.5

Kodolibad Iron Ore Mine

ANNEXURE-7

NOISE LEVELS WITHIN THE STUDY AREA (Leq in dB(A))
KODOLIBAD IRON ORE MINE

Hours	Core zone (N1)	Hola (N2)	NW of Hola (N3)	Boliba (N4)	Kada (N5)	Bahada (N6)	Hatnaburu (N7)	Chhota Nagra (N8)
Date of monitoring	01-02/05/06	03-04/05/06	05-06/05/06	07-08/05/06	09-10/05/06	12-13/05/06	14-15/05/06	15-16/05/06
1.00	36.50	35.30	33.10	34.70	35.80	34.70	37.60	37.50
2.00	33.50	36.80	34.90	33.70	37.10	34.90	35.90	36.30
3.00	34.90	37.20	34.80	35.60	33.30	36.80	34.60	37.00
4.00	35.10	34.30	33.90	37.50	34.30	38.00	35.40	35.20
5.00	37.10	35.20	35.10	37.90	34.40	34.40	37.90	38.60
6.00	37.50	34.20	33.90	37.80	33.40	34.60	44.00	38.10
7.00	51.90	58.80	46.20	55.70	50.40	50.80	54.00	62.70
8.00	50.30	55.20	46.70	54.10	53.60	54.20	50.70	63.30
9.00	49.30	55.20	43.90	51.40	51.90	47.50	50.20	60.70
10.00	52.40	52.10	44.90	56.30	47.50	51.60	50.00	54.80
11.00	52.80	57.50	43.30	55.50	50.10	54.50	51.80	57.60
12.00	52.40	54.90	46.40	56.50	47.10	53.90	53.40	53.20
13.00	49.60	58.90	44.80	51.70	52.00	49.70	48.90	55.80
14.00	53.10	55.00	45.40	50.30	45.60	47.30	49.30	56.60
15.00	50.70	58.10	44.70	52.40	53.70	48.10	50.60	58.40
16.00	50.50	54.90	44.70	53.00	53.20	53.10	51.20	63.20
17.00	49.20	58.40	45.80	54.00	47.30	49.60	52.60	57.70
18.00	51.30	53.10	46.50	52.40	51.80	54.30	52.50	55.50
19.00	50.00	57.90	42.10	54.70	46.70	51.20	50.90	58.30
20.00	53.90	54.80	45.10	52.00	48.60	49.20	53.40	51.20
21.00	48.10	53.20	42.50	54.20	47.50	52.50	49.60	57.10
22.00	34.70	37.60	37.50	33.10	36.40	37.00	35.60	35.60
23.00	35.00	35.50	37.40	33.30	33.80	33.20	34.00	36.90
24.00	36.10	35.40	35.70	33.20	34.20	37.40	35.10	39.80
Day time Leq.	51.00	55.90	44.90	53.60	49.80	51.20	51.30	57.70
Night time Leq.	35.60	35.70	35.10	35.20	34.70	35.70	36.70	37.30
Average Leq	45.20	48.30	41.20	46.70	44.20	45.40	45.80	50.10
Permissible (Day)	55	55	55	55	55	55	55	55
Permissible (Night)	45	45	45	45	45	45	45	45

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Noise_Leq

ANNEXURE-A

SOIL ANALYSIS RESULT

Sl. No.	Parameters	Unit	Usirayan village (Core zone)	Kolo village
1.	Colour		Red	Redish
2.	pH value		7.1	7.2
3.	Temperature	°C	34	34
4.	Type of soil		Sandy loam	Sandy loam
5.	Moisture	% by mass	2.18	2.11
6.	Bulk density	gm/cm^3	1.24	1.19
7.	Conductivity	micro-mhos/cm	105	98
8.	Organic matter	% by mass	0.70	0.65
9.	Chloride as Cl	% by mass	0.010	0.010
10.	Sulphate as SO_4	% by mass	0.007	0.007
11.	Calcium carbonate as $CaCO_2$	% by mass	9.5	8.7
12.	Available Iron	% by mass	0.130	0.10
13.	Available Phosphorous	% by mass	0.003	0.003
14.	Nitrate Nitrogen	% by mass	0.028	0.027
15.	Sodium as Na	% by mass	0.028	0.029
16.	Potassium as K	% by mass	0.009	0.008

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