

# MINING PLAN

(Submitted under Rule 13 of MCR 2016)

ALONGWITH

## PROGRESSIVE MINE CLOSURE PLAN

(Submitted under Rule. 23B (1) of MCDR. 1988)

*In respect of*

**GHORABURHANI - SAGASAH I IRON ORE BLOCK  
FOR IRON ORE OVER AN AREA OF 139.165 HA IN GHORABURHANI,  
SAGASAH I & KALMANGA VILLAGES IN KOIRA TAHASIL  
OF SUNDARGARH DISTRICT, ODISHA**

MINERAL	LAND DETAILS		CATEGORY OF PROPOSED MINE	CAPACITY OF PROPOSED MINE
	FOREST	NON-FOREST		
<b>IRON ORE</b>	<b>126.137HA</b>	<b>13.028HA</b>	<b>'A' FULLY MECHANISED</b>	<b>7.16 MTPA (ROM)</b>

(THE IRON ORE BLOCK HAS BEEN ALLOTTED THROUGH BIDDING AS PER MMDR AMENDMENT ACT, 2015)

*Prepared on behalf of*



**M/S. ESSAR STEEL INDIA LIMITED  
(APPLICANT)**

*Prepared by*

**SRI PRADEEPT MOHAPATRA  
QUALIFIED PERSON  
UNCHABALI, BAMEBARI, JODA,  
KEONJHAR, ODISHA**

**SHRI SABYASACHI MOHANTY  
QUALIFIED PERSON  
M/S ESSAR STEEL INDIA LTD  
BARBIL, KEONJHAR, ODISHA**

Approved work letter NO:-  
MP/ FM/ 02. ORF/ BHO/ 2016.17  
Dated 11.07.2016.



भारत सरकार  
खान मंत्रालय  
राष्ट्रीय खान बोर्ड  
केन्द्रीय खान नियंत्रक का कार्यालय

REGD. PARCEL  
E-mail: [ru.bhubaneswar@fim.gov.in](mailto:ru.bhubaneswar@fim.gov.in)

No. MP/FM/02-ORI/BHU/2016-17 / 964

Plot No. 149, Pokhariput  
Bhubaneswar - 751 020  
Date: 11.07.2016

To

✓ M/s Essar Steel India Ltd Ore Club,  
Near Bank of India ATM,  
Bhadrasahi Chowk,  
Joda -Barbil High way,  
Barbil, Keonjhar- 758035

**Sub:** Approval of Mining Plan of Ghorabuhrani-Sagasahi Iron Ore Mine along with Progressive Mine Closure Plan (PMCP), over an area of 139.165 Ha. in Sundargarh district of Odisha State, submitted by M/s Essar Steel India Ltd under Rule 13 of MCR, 2016..

**Ref:** - i) Your letter No. Nil dated 29.04.2016 received on 12.05.2016.  
ii) This office letter of even no. dated 16.05.2016.  
iii) This office letter of even no. dated 30.05.2016.  
iv) Your Qualified Person letter No. Nil dated 13.06.2016..  
v) This office letter of even no dated 21.06.2016.  
vi) Your letter No. Nil dated 04.07.2016.

Sir,

In exercise of the power delegated to me under Rule 13 (1)(a) of Mineral Concession Rules, 2016 vide Gazette Notification No. S.O. 1857(E) dated 18.05.2016, I hereby **Approve** the Mining Plan of Ghorabuhrani-Sagasahi Iron Ore Mine along with Progressive Mine Closure Plan (PMCP), over an area of 139.165 Ha. in Sundargarh district of Odisha State, submitted by M/s Essar Steel India Ltd under Rule 13 of MCR, 2016. This approval is subject to the following conditions:

- I. The Mining Plan is approved without prejudice to any other law applicable to the mine area from time to time whether made by the Central Government, State Government or any other authority and without prejudice to any order or direction from any court of competent jurisdiction.
- II. The proposals shown on the plates and/or given in the document is based on the lease map /sketch submitted by the applicant/ lessee and is applicable from the date of approval.
- III. It is clarified that the approval of aforesaid Mining Plan does not in any way imply the approval of the Government in terms of any other provision of Mines & Minerals (Development & Regulation) Act, 1957, or the Mineral Concession Rules, 2016 and any other laws including Forest (Conservation) Act, 1980, Environment

- (Protection) Act, 1986 or the rules made there under, Mines Act, 1952 and Rule & Regulations made there under.
- IV. Indian Bureau of Mines has not undertaken verification of the mining lease boundary on the ground and does not undertake any responsibility regarding correctness of the boundaries of the leasehold shown on the ground with reference to lease map & other plans furnished by the applicant / lessee.
  - V. Mineral Block map duly authenticated by ORSAC is considered for this approval as per Director of Mines, Government of Odisha letter No . MXIII-(b)-60/2015 – 5227/DM dated 04.06.2016.
  - VI. At any stage, if it is observed that the information furnished, data incorporated in the document are incorrect or misrepresent facts, the approval of the document shall be revoked with immediate effect.
  - VII. If this approval conflicts with any other law or court order/ Direction under any statute, it shall be revoked immediately.
  - VIII. Next Financial Assurance shall be due for submission on or before 31.03.2021.

Further, the Ghoraburhani Sagasahi Iron ore block has been allotted to M/s Essar Steel India Ltd through competitive bidding by auction for captive use in their Integrated Steel Plant. Iron ore occurring in this area is mostly of high grade, e.g., average grade of iron ore at 55% Fe cut off is above 63%. This material constitutes about 80% of the ROM. Average grade of iron ore deposit in the area at 45% Fe threshold value is estimated at 62.25%.

The preferred bidder, as a captive user, has a steel plant at Hazira, Gujrat claimed to be an integrated steel plant. On verification of the document, it is observed that the preferred bidder's steel plant is reported to be integrated mostly through DRI route. This DRI plant reported to have been commissioned sometime in the 1990. As per the technical report of the DRI plant the acceptable feed grade to the plant is reported to be 64% Fe; in contrast to the acceptable feed grade to blast furnace of about 62% Fe, or even below it.

In view of above, the lessee has submitted mining plan with excavation proposal spreading into two different ore zones for wining high grade iron ore of 64% Fe content. This aspect of consuming only high grade ore has been looked into from the angle of conservation of mineral and therefore scrutiny comment was issued to modify the mining proposal. However, the applicant did not modify the proposal arguing that their plant needs iron ore of 64% Fe.

In view of above, it is established that;

- a. The average grade of the deposit and that of the ROM would be 62.25% Fe.
- b. Applicant plans to use only +64% Fe content iron ore.

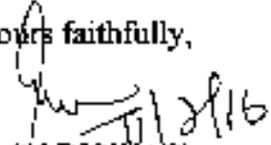
Hence, in the interest of mineral conservation & environment friendly mining; as well as in the interest of maximising mineral revenue, this approval is further subject to the following special conditions;

- i. The total ROM including mineral reject as indicated in Page 37 shall be taken out from the lease for dispatch and consumption.
- ii. The royalty and other taxes would be as per Rule 39(2) of Mineral Concession Rules, 2016 and other rules made under the MMDR ACT'2015 and calculated on the basis of sale price published by IBM.

- iii. In the interest of scientific mining, complete deposit shall be explored under UNFC-G-I and the ore body details shall be delineated in complete with its grade, boundary, incidence of different grades of ore in lateral and vertical direction etc. and the mining plan shall be modified accordingly.

Encl: - One copy of approved  
Mining Plan

भवदीय / yours faithfully,

  
(M BISWAS)

क्षेत्रीय खान नियंत्रक / Regional Controller of Mines

Copy for kind information to:-

1. Shri Pradeept Mohapatra and shri Sabyasachi Mohanty, Post Box No. 1, P.o- Joda, At - Unchabali, Bamebari, Dist - Keonjhar, Odisha - 758034.
2. The Director of Mines, Directorate of Mines, Government of Odisha, Heads of the Department Building, New Capital, Bhubaneswar- 751001, Odisha along with one copy of Mining Plan by **REGISTERED PARCEL**.

  
(M BISWAS)

क्षेत्रीय खान नियंत्रक / Regional Controller of Mines

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PRADEEP MOHAPATRA  
QUALIFIED PERSON  
SARAYKACHI MOHANTY  
QUALIFIED PERSON

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**PRADDEPT MOHAPATRA**  
QUALIFIED PERSON

**SABAYASACHI MOHANTY**  
QUALIFIED PERSON

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PRADEEPT MOHAPATRA  
QUALIFIED PERSONSABAYASACHI MOHANTY  
QUALIFIED PERSON

**INTRODUCTORY NOTE**

**BACKGROUND**

Pursuant to the Mines and Minerals (Development and Regulation) ACT, 1957 and The Minerals (Auction) Rules, 2015, Govt of Odisha issued the notice inviting tender dated December 23, 2015 for commencement of the auction process to grant the mining Lease under captive category in respect of **Ghoraburhani - Sagasahi Iron ore Block** located in Koira Tahasil of Sundargarh district of Odisha. The e-auction process was conducted in accordance with the tender document and the mineral auction rule, 2015 for said mineral block and M/s Essar Steel India Limited was declared as the **preferred Bidder under Rule 9(4) (b) (iii)** of the Rules.

Further, M/s Essar Steel India Ltd has made payment of **Rs 9, 26,24,600.00** (Rupees Nine crore twenty six lakhs twenty four thousand six hundred only) through treasury challan on dated 17.03.2016 against the first installment being ten percent of the upfront money. Accordingly, the Government of Odisha has issued letter of Intent (copy enclosed as Annexure-I) under Rule 10(2) of Mineral Auction Rules 2015 to M/s Essar Steel India Ltd for grant of Mining Lease for **Ghoraburhani - Sagasahi Block** for iron ore over an area of 139.165Ha (90.629Ha of Mineralized area and 48.536ha for ancillary activities) in Ghoraburhani, Sagasahi and Kalamang village, Koira Tahasil of Sundargarh district of Odisha for a period of 50 years.

This letter of intent is valid subject to the provision of the Act and the Rules made there under as amended from time to time and M/s Essar Steel India Limited shall be designated as the **Successful Bidder** and the subsequently granted the mining lease only upon satisfactory completion of all the requirements under the Act and Rules made there under.

**(A) M/s Essar Steel India Limited shall be considered to be successful bidder upon**

- (i) Continuing to be in compliance with all the terms and conditions of eligibility.
- (ii) Payment of second instalment being ten percent of the upfront payment.
- (iii) Furnishing performance security. **APPROVED**
- (iv) Satisfying the conditions specified in clause (b) of sub section (2) of section 5 of the Act with respect to Mining Plan.

**PRADEPT MOHAPATRA**  
QUALIFIED PERSON

REGIONAL CONTROLLER OF MINES  
INDIAN BUREAU OF MINES  
HUBANE SWAP

**BABYBACHI MOHANTY**  
QUALIFIED PERSON

**(B) Signing of Mine Development and Production Agreement (MDPA)**

M/s Essar Steel India Limited shall sign the **Mine Development and Production Agreement (MDPA)** with the Government of Odisha upon obtaining all consents, approvals, permits, NOC and the like as may be required under applicable laws for commencement of Mining operation.

**(C) Grant of Mining Lease**

Subsequent to signing of the **MDPA**, **M/s ESSAR Steel India Limited** shall make payment of the third instalment being the eighty percent of the upfront value and thereafter Government of Odisha shall grant the said Mining Lease.

Hence, it is worth mentioning here that the successful bidder i.e. **M/s ESSAR Steel India Limited** is required to obtain following statutory clearances for signing of **MDPA** and grant of **Mining Lease**.

<b>Name of the statutory clearances</b>	<b>Authority from which clearances to be obtained</b>	<b>Status of statutory clearances</b>
Approval of Mining Plan	Indian Bureau of Mines, GOI	It is under process for approval
Forest Clearance	Ministry of Environment and Forest, GOI	After the approval of mining Plan Forest proposal will be submitted.
Environment Clearance	Ministry of Environment, Forest & Climate Change GOI	EC Application and TOR will be submitted shortly.
Surface Right	Collector, Sundargarh	After execution of the lease surface right will be granted.
Consent to Establish	State Pollution Control Board, Odisha	After getting approved mining plan, EC and FC, order from SPCB for Consent to Established will be obtained
Consent to Operate	State Pollution Control Board, Odisha	After getting approved mining plan, EC, FC and CTE order from SPCB for Consent to Operate will be obtained.

As part of the statutory clearance, this **Mining Plan** and **Progressive Mine Closure Plan** is prepared under **Rule 13 of MCR, 2016** and **Rule 23B (1) of MCDR, 1988** respectively for a period of 5 years from the date of opening of the mine for grant of Mining Lease in favor of **M/s ESSAR Steel India Limited**

### **UTILIZATION OF IRON ORE**

M/s Essar Steel India Ltd is one of India's leading integrated steel producers with an annual production capability of 10 million tones supported by a 20 million tone pellet facility. The manufacturing operations comprise iron ore beneficiation, pellet making, iron making, steel making, and downstream facilities, including a cold rolling mill, a galvanizing and pre-coated facility, a steel-processing facility, an extra-wide plate mill and pipe mills with coating facilities.

#### **Iron ore beneficiation facility**

M/s Essar Steel India Ltd has an Integrated Pellet making facility of 12 MTPA capacity at Odisha state. This facility consists of a Beneficiation plant at Dabuna, Joda (Odisha), which is strategically located in the region to leverage the rich iron ore deposits of the State, a 253 Kms long Slurry pipeline to transport the beneficiated ore in slurry form to the Pellet Plant located at Paradip in Jagatsinghpur district of Odisha.

#### **Pelletization**

Essar Steel India Limited has a Pellet Plant of 12.0 MTPA capacity (consisting of two units of 6.0 MTPA capacity each) at Paradip. Out of these two units, one 6.0 MTPA capacity first unit is already in production and the second unit of 6.0 MTPA is under commissioning.

#### **Iron and steel**

M/s Essar Steel India Ltd has a fully integrated world-class facility at Hazira, Gujarat housing the world's fourth largest single-location steel plant. The Iron ore produced out of the proposed ML area will be utilized in the Integrated Steel Plant. It has a steel-making capacity of 10.0 MTPA, holds ISO: 9001:2000, IS 9002 and TUV and ISO 14001 certification.

The facility also houses a 6.8 MTPA DRI plant (the world's largest gas-based sponge iron plant in a single location), a 1.5 MTPA plate mill (the largest in India), a 0.6 MTPA Pipe mill with internal and external coating facilities of up to 2 Million square meters annually, and a 1.4 MTPA cold rolling complex comprising two galvanizing lines, a batch annealing furnace and a skin pass mill.

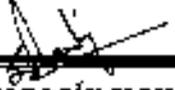


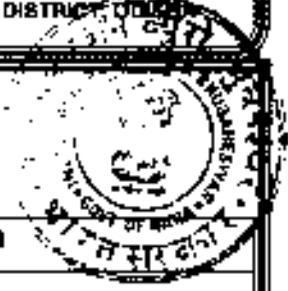
View of steel plant, Hazira, Gujarat

**Proposed capacity of the mine**

As earlier mentioned, the present capacity of the Integrated Steel plant at Hazira is 10.0 MTPA. This plant requires minimum 16 million tons of raw materials (iron ore) for steel making. The said Ghoraburhani – Sagasahi block has been auctioned under captive category and it will partially cater the requirement of the steel plant. The deposit will be operated exclusively for captive use. Production target has been fixed at 7.16 MT of ROM /annum, which has been planned to achieved in 5<sup>th</sup> year of the plan period. The area has been explored in detail by Geological Survey of India under G2 category. As per the estimation the total resource of +45%Fe is estimated to be 98.61 Million tons and the mineable reserve is estimated to be 78.24 million tons. This estimated reserve is enough to achieve the proposed rated production capacity for the 1<sup>st</sup> five years. Further, it is envisaged to explore the area within a period of 5 years from date of commencement of mining operation under G1 level. As a result of which the resource/ reserve is likely to change.

  
**PRADHEPT MOHAPATRA**  
QUALIFIED PERSON

  
**SARYASACHI MOHANTY**  
QUALIFIED PERSON



**1.0 GENERAL**

**a) Name and Address of the Applicant**

**M/s ESSAR STEEL INDIA LIMITED**

<b>Corporate office - Mumbai, India</b>	<b>Registered office - Hazira, India</b>
<b>Essar Steel India Limited</b> Essar House 11, Keshavrao Khadye Marg, Mahalaxmi Mumbai - 400 034 Phone: +91 (22) 2495 0606 / 6660 1100 Fax: +91 (22) 2492 6896 Email: pdpmining@essar.com	<b>M/s Essar Steel Limited</b> 27th KM Surat - Hazira Road District - Surat, Hazira 394 270 Gujarat, India Telephone: +91-261-2872400 Fax: +91-261-2872796

**Rule 45 registration No. :** To be obtained after commencement of mining operation.

**b) Status of the Lessee/Applicant**

M/s Essar Steel India, part of the Essar Group is a limited company and one of the leaders in India and abroad in the steel sector. The company is a fully integrated flat carbon steel manufacturer – from iron ore to ready-to-market products – with a current capacity of 10 million tonnes per annum (MTPA) in India. M/s Essar Steel India Ltd does not have any iron ore mines in the state of Odisha. The company has been awarded with the Ghoraburhani - Sagasahi iron ore block in Odisha under Mines & Minerals (Development & Regulation) Amendment Act- 2015 and Mineral (Auction Rules), 2015 under captive category.

**Name, Address and the Position of the Directors are as follows:**

<b>Sl. No</b>	<b>Name</b>	<b>Position</b>	<b>Address</b>
1.	Mr Prashant Rana,	Director	Lereve Tower, 4300 Dubai Marina, Post box No 293776, Dubai
2.	Mr Jatinder Mehra	Director	C-1/36, Safdarjung Dev area, New Delhi-110065
3.	Mr Arvind Pande	Independent Director	E-148(FF), East of Kailash, New Delhi-1100165
4	Mr VG Raghavan,	Independent Director	No-33, 1 <sup>st</sup> Cross Street, Classic Orchard, Behind Meenakshi, Amman Temple, Bannerhatta Road, Bangalore-560076
5	Mr S Santhanakrishnan	Nominee Director — SBI	Flat-G5, Block -2, Prime Terrace, 150LB Road Trivanmiyur, Chennai-600041

**PRADDEPT MOHAPATRA**  
**QUALIFIED PERSON**

**SARYASACHI MOHANTY**  
**QUALIFIED PERSON**

6	Mr Hiranmoy Biswas	Nominee Director- IDBI Bank Ltd.	E-42, Maker Kundan, Gaforta, Juhu Road, Santacruz (West), Mumbai 400049
7	Ms. S Gayathri Sukumar	Director	1/1205, Viman Darehan, Sahar road, Andheri (East), Mumbai-400069
8	Mr Dilip C Oommen	Managing Director and CEO	D-3/4, Nand Niletan, Essar Township, Hazira-Surat Road, Surat- 394270
9	Mr Mahadev Iyer	Director (Finance) and CFO	109/110, Indira Apartment, Govandi Station Road, Deonar, Mumbai-400088

Managing Director, Sri Dilip Oommen, is nominated as owner vide Resolution of Board of Directors (Ref: Annexure- II). The copy of the ID and address proof of nominated owner is enclosed as Annexure-III

c) Mineral(s) which is / are included in the prospecting license (For Fresh grant)  
Iron ore

d) Mineral(s) which is / are included in the letter of Intent / lease deed

Iron ore is included in the letter of intent

e) Mineral(s) which is the applicant lessee intends to mine

The applicant intends to mine iron ore.

f) Name and Address, Registration No. of the Recognized Person Together With Validity of Date/Person Employed Under Rule 42(1)(b) Who Has Prepared Mining Plan

As per Rule 15 of MCR 2016, the Qualified Persons who have prepared the Mining Plan is furnished below:

Name	<b>Shri Sabyasachi Mohanty</b>	<b>Pradeept Mohapatra</b>
Address	M/s Essar Steel India Ltd Ore Club, Bhadrasahi chowk Near Bank of India (ATM) NH-215, Barbil, Keonjhar, Odisha-758035 Email: <a href="mailto:sabyasachi.mohanty@essar.com">sabyasachi.mohanty@essar.com</a> Mob: 7381007215	At : Unchabali, Po - Bamebari, Joda Keonjhar, Odisha Pin-758034 Email: <a href="mailto:pmohapatra_07@yahoo.com">pmohapatra_07@yahoo.com</a> Mob: 9438149715
Registration Number	Not Applicable	Not Applicable
Date of Registration	Not Applicable	Not Applicable
Valid up to	Not Applicable	Not Applicable

Self certified copies of working experience along with certificates in support of educational qualifications required as per the Rule 15 of MCR 2016 is attached as Annexure IV.

**PRADEEPT MOHAPATRA**  
QUALIFIED PERSON

**SABYASACHI MOHANTY**  
QUALIFIED PERSON

**2.0 LOCATION AND ACCESSIBILITY**

<b>(a) Lease Details</b>	
Name of the Mine	Ghoraburhani - Sagasahi Iron ore block
Latitude	21° 56' 08.83896" to 21° 57' 09.61956"N
Longitude	85° 17' 02.52096" to 85° 17' 48.99336"E
The above co-ordinate is as per the geo-referenced map prepared by ORSAC through DGPS survey (ref: Plate-IB) and forms a part of Survey of India toposheet No.73G/1 and 73G/5 (Ref:Plate-I).	

Sl No	Latitude	Longitude
1	21° 57' 06.29532"	85° 17' 03.00372"
2	21° 57' 09.61956"	85° 17' 09.01968"
3	21° 56' 50.03844"	85° 17' 21.45300"
4	21° 56' 53.35224"	85° 17' 27.44988"
5	21° 56' 47.75784"	85° 17' 31.00200"
6	21° 56' 57.69888"	85° 17' 48.99336"
7	21° 56' 52.10412"	85° 17' 52.54548"
8	21° 56' 54.85884"	85° 17' 57.53148"
9	21° 56' 47.13972"	85° 17' 57.23808"
10	21° 56' 36.56832"	85° 17' 38.10588"
11	21° 56' 42.16308"	85° 17' 34.55412"
12	21° 56' 40.50600"	85° 17' 31.55568"
13	21° 56' 18.12696"	85° 17' 45.76308"
14	21° 56' 28.90752"	85° 17' 10.56660"
15	21° 56' 27.04776"	85° 17' 07.20132"
16	21° 56' 27.50640"	85° 17' 06.59328"
17	21° 56' 27.86316"	85° 17' 04.44444"
18	21° 56' 31.10316"	85° 17' 03.43608"
19	21° 56' 32.93592"	85° 17' 02.52096"
20	21° 56' 33.15480"	85° 17' 02.54580"
21	21° 56' 33.20304"	85° 17' 03.33816"
22	21° 56' 14.82396"	85° 17' 19.50864"
23	21° 56' 13.68312"	85° 17' 21.47820"
24	21° 56' 13.08624"	85° 17' 22.49808"
25	21° 56' 11.98644"	85° 17' 25.11672"
26	21° 56' 11.44068"	85° 17' 26.00088"
27	21° 56' 11.08752"	85° 17' 26.48688"
28	21° 56' 10.72824"	85° 17' 26.92968"
29	21° 56' 10.20984"	85° 17' 27.48912"
30	21° 56' 09.49980"	85° 17' 28.30776"
31	21° 56' 08.83896"	85° 17' 28.95432"
32	21° 56' 19.40100"	85° 17' 44.95416"
33	21° 56' 20.71500"	85° 17' 36.05892"
34	21° 56' 26.27520"	85° 17' 36.62988"
35	21° 56' 26.62404"	85° 17' 35.54520"
36	21° 56' 29.53428"	85° 17' 34.64880"
37	21° 56' 32.10288"	85° 17' 36.89052"

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Date of Grant of Lease	The Government of Odisha has issued letter of intent vide MXIII-(b)-60/2015-3115/DM dated 28.03.2016. The lease to be granted.	
Date of execution of Lease	After obtaining all necessary statutory clearances, the ML will be executed in favor of M/s ESSAR STEEL INDIA LTD.	
Period/Expiry date	As per Mines & Minerals Development & Regulation (Amendment) Act, 2015, and as per terms of LOI, the date of expiry of the lease is 50 years from the date of execution of the same..	
Name of the Lease holder	M/s Essar Steel India Ltd	
Postal Address	M/s Essar Steel India Limited 27 <sup>th</sup> KM Surat - Hazira Road District -- Surat, Hazira 394270 Gujarat	M/s Essar Steel India Ltd Ore Club Near Bank of India ATM, Bhadrasahi Chowk,Barbil- 758035 Odisha
Telephone	+91-261-2872400	06767242150
Fax	Fax: +91-261-2872796	Nil
Email id	pdpmining@essar.com	pdpmining@essar.com
Mobile No	09879100030	7381007215
(b) Details of Applied Lease area with location map(fresh area /mine)	The allotted M.L area over 139.165hectares falls in villages Ghorburhani - Sagasahi and Kalamang, Tahasil Koira, Sub-division Bonai, District Sundargarh, Odisha. Khesra/Khata No/ Plot No. has been given in the land schedule vide Annexure-V.	

As per the land schedule, the pre-operational land use pattern is given as follows:

Type of Land	Category	Revenue Name	Area In Hectares
Forest Land	Village Forest	---	20.885
	DLC Forest	---	105.252
	Reserved Forest	---	--
	<b>Sub-total</b>	---	<b>126.137</b>
Non-Forest land	Govt. Land		6.327
	Private tenanted land		3.257
	Grazing land	Gochar	3.444
	<b>Sub - total</b>	---	<b>13.028</b>
<b>Total</b>	---	---	<b>139.165</b>

Pre-operational land use pattern with respect to forest land and non-forest land is authenticated by the concerned authorities of the State Govt.

Total lease area / applied area :	139.165 hectares
District & State :	Sundargarh & Odisha
Taluka :	Bonai
Village	Ghorburhani, Sagasahi and Kalamang.
Whether the area falls under Coastal Regulation Zone (CRZ) :	No
If yes, details thereof :	Not Applicable
Existence of public road/railway line, if any nearby and approximate distance	The area can be approached from Barbil or Koira through NH-215. The said National Highway is connecting Panikoli on National Highway No.5 with Rourkela via Keonjhar, Joda, Barbil and Koira passes through the area. The other important mining centers in the vicinity are Kalta, Tensa and Barsuan. The nearest rail head is Barbil which is located at a distance of 30km from the block and on the Tatanagar-Barbil section of the South-Eastern Railway.
Toposheet No. with latitude & longitude of all corner boundary point/pillar	Ref: Para-(a) of this chapter.
c) Attach a general location map showing area and access routes.	The area has been earmarked on a survey of India topographical map as well as cadastral map. Ref Plate No-I and II

**3.0 DETAILS OF APPROVED MINING PLAN/SCHEME OF MINING.****3.1 Date and reference of earlier approved Mining Plan/Scheme of Mining**

Not applicable, as this lease is yet to be executed.

**3.2 Details of Last Modifications If any**

Not applicable as it is the 1<sup>st</sup> Mining Plan being submitted for grant of the Mining Lease.

**3.3 Review of earlier approved proposal in respect of exploration, excavation, reclamation etc.**

This is the 1<sup>st</sup> Mining Plan being submitted for approval. Hence, review in respect of exploration, excavation, reclamation etc. is not applicable.

**3.4 Give Status of Compliance of violations pointed out by IBM**

Not Applicable

**3.5 Details of any suspension/closure/prohibitory order issued by any Government agency under any Rule or court of Law.**

Not Applicable

**3.3 In case the MP/SOM is submitted under Rule 9 and 10 of the MCDR 1988 or under Rule 22(5) of the MCR' 1980 for approval of Modification, specify reason and justification for modification under these Rule.**

Not Applicable

  
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**PART-A  
CHAPTER-1**

**1.0 GEOLOGY AND EXPLORATION**

**a) Briefly describe the Topography, Drainage pattern, Vegetation, Climate, Rainfall data of the Mining Lease area.**

**• Topography**

The allotted block under study is a highly rugged terrain, with elongated hills trending ENE-WSW direction, low mounds and narrow valleys. The highest elevation of ridges in the area is 745m. The low lying valleys occur at an elevation of around 600m. Lateritic soil recorded in the ridges and valleys are mainly covered by alluvial soil.

**• Drainage**

Drainage system in this area is radial type. The drainage pattern in this area is mostly controlled by Sona River and then ultimately by River Baitarani. A seasonal nala namely Kalamanga nala is passing in the central part of the lease area and joins with Sona Nadi in the east at a distance of 5km from the applied lease area. Sona Nadi is flowing due NNE outside of the lease area at a distance of 5km constitutes the principal drainage system locality and collects surface run-off water through the seasonal nalas/streams and ultimately joins with the River Baitarani in the North East at a distance of about 55km near Kandra village.

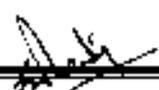
**• Vegetation**

Total 139.165Ha consists of 126.137Ha of Forest land and 13.028Ha of Non-forest Land. Based on the secondary information, the vegetation comprises mainly bushy forest and having species like Asan, Amla, Bahada, Chara, Dhaura, Harida, Dhaman, Jamun, Kendu, Kusum, Mango, Patul, Sal, Semul, Chhana, Atundi, Muturi & Siall etc.

**• Climate**

Climate and meteorology of a place play an important role in the implementation of any developmental project. Meteorology (weather climate) is also the key to understanding local air quality as there is essential relationship between meteorology and atmospheric dispersion involving the wind in the broadest sense of them.

  
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**(a) Temperature:**

The climate of the study area is characterized by an oppressively hot summer with high humidity. Summer generally commences in the month of March. Temperature begins to rise rapidly attaining the maximum in the month of May. During the summer maximum temperature can go up to 47.4°C. The weather becomes pleasant with onset of monsoon in June and remains as such up to the end of October. The temperature in the month of December is lowest i.e. 7°C.

**(b) Relative Humidity**

The air is dry except during the South – West monsoon season. The maximum humidity ranges from 55% to 76% with annual average of 64.83% while the minimum humidity ranges from 26% to 43% with an annual average of 34%.

**(c) Rainfall Data**

The rain fall data has been obtained from IMD for the financial year 2009-2013. Based on the data the rain minimum Annual rainfall is 971mm during 2010 and the maximum rain fall is 1820mm during 2013. The average rainfall is 1325.16 mm.

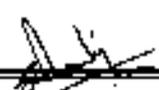
- **Predominant wind direction is South-West.**

Predominant wind direction is South-West. Area remains calm for nearly 50% of the year.

**b) Brief description of regional Geology with reference to location of the lease area.**

The allotted Ghoraburhani - Sagasahi area is a part of the Bonai - Kendujhar belt falling in Sundargarh districts. The feebly metamorphosed Precambrian volcano-sedimentary rocks exposed in this belt between the Singhbhum granite on the east and Bonai granite on the west and are classified as 'Iron ore Group' (Sarkar & Saha, 1962) or 'Koira Group' (Murty and Acharya, 1975). These rocks are disposed in form of a low northerly plunging 'Horse-shoe' shaped synclinorium (Jones, 1934). The litho - stratigraphic succession of this area, as worked out by earlier workers, based on regional field studies is shown below:

  
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Jones (1934)	Saha(1994) Modified after Sarkar & Saha (1977)	Murthy & Acharya (1975)
Upper shales, epidiorite and ash bed B.H.Q. with iron ore bodies Shales with occasional sandstones Purple sandstone with basal conglomerate -----Unconformity----- Older Dharwars	I R O N O R E G R O U P Singhbhum granite Upper Shale with volcanics. BHU with iron ore, ferruginous quartzite Lower shale and acid, intermediate tuffs, local dolerite	K O I R A G R O U P Mixed facies formation Upper Shale Formation Banded Iron Formation Volcanic Formation Basal sandstone- Quartzite

The stratigraphy of the area modified after Murty and Acharya (op. cit) is given below:

Kolhan Group	
KOIRA GROUP	Upper Shale Formation
	Banded Iron Formation
	Lower Shale Formation
	Volcanic Formation
	Basal sandstone - Quartzite
	Singhbhum & Bonai Granites and metamorphosed sediments

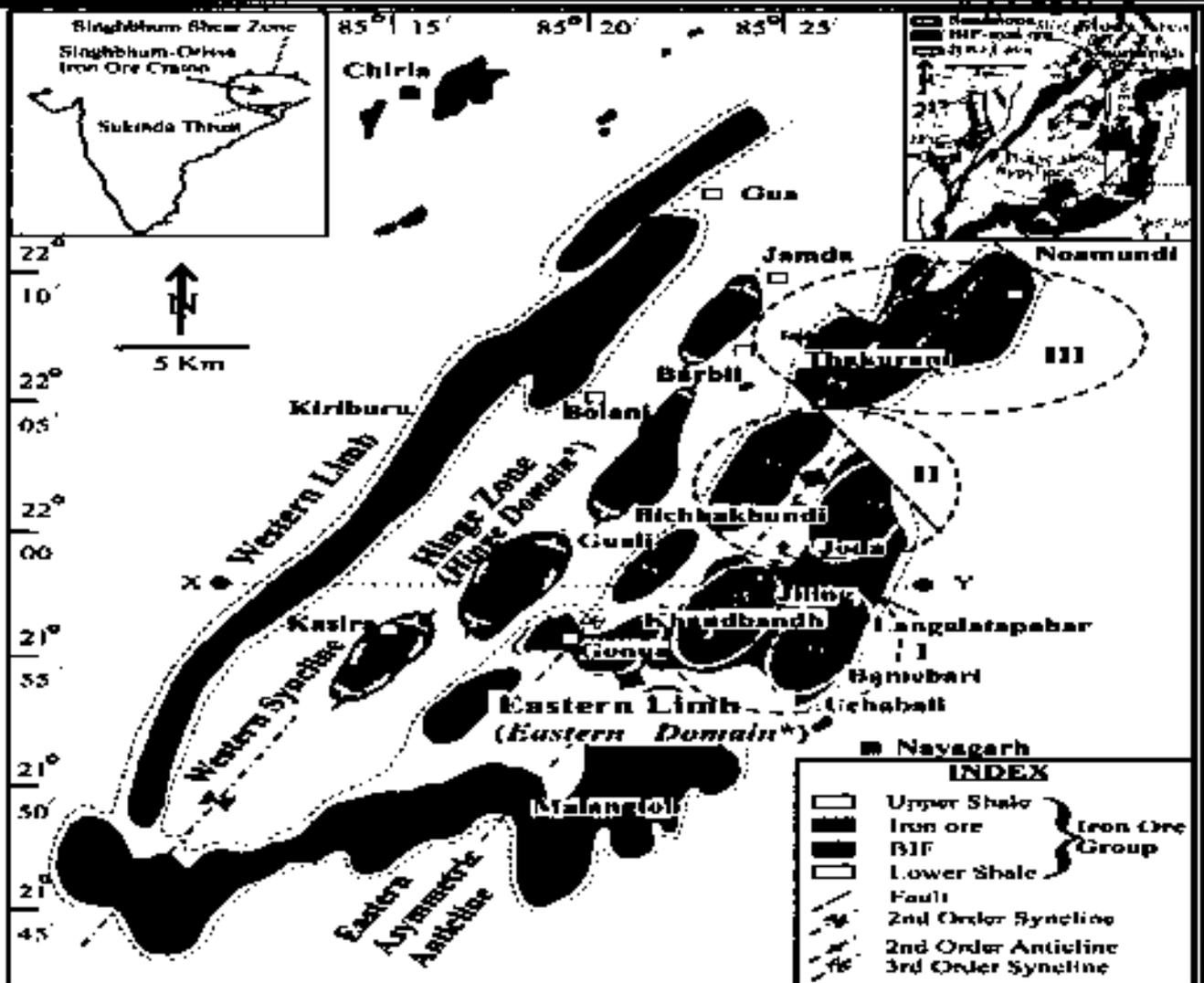
The base of the Koira Group is marked by a pronounced unconformity over the Singhbhum granite in the eastern side and has a sheared inter-fingering contact relationship with Bonai granite on the western side. The basal formation comprises of gritty sandstone, which ranges from ortho quartzite on one hand to pebbly sandstone and conglomerate on the other. This arenaceous unit is followed by mafic volcanics which is found all along the outer periphery of the horse-shoe synclorium. The volcanic formation comprises predominantly of Lower volcanic flows dominantly of mafic composition and an upper tuffaceous zone. The lava is pillowed at the bottom part and amygdaloidal at the top indicating its sub-aqueous and subsequent sub-aerial character. The lava grades into purple color tuffaceous shale conformably towards the upper part and described as 'Lower shale formation' (Murty and Acharya, op. cit.). By the appearance of jasper and banded jasper inter banded with the greenish and black shale towards the top, the lower shale pass into the 'Banded Iron Formation' proper.

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The 'Banded iron Formation' is represented by Banded hematite jasper (BHJ)/ Banded hematite quartzite(BHQ)/ Banded magnetite quartzite(BMQ), inter-bedded black or green shale and banded ferruginous chert. Due to high resistance to erosion these litho-units form high ridges conspicuously marking the outline of the 'horse-shoe' synclinorium and depict the major structural pattern of the belt.

The 'Banded Iron Formation' is overlain by the 'Upper Shale Formation' comprising of thick sequence of tuffaceous purple, white and buff coloured shale, black shale, banded ferruginous shale with inter-bedded chert and Banded hematite jasper (BHJ)/ Banded hematite quartzite(BHQ)/ Banded magnetite quartzite(BMQ) bands and spreading over the entire core of the synclinorium. The 'Upper Shale Formation' can be divided into two horizons/ zones (Patel, et.al. 2005) namely, lower manganiferous shale horizon/ zone and upper ferruginous shale horizon/ zone. These two horizons/zones exhibit conformable relationship and are each characterized by their typical litho-assemblages. The manganiferous horizon/ zone comprising predominantly of manganiferous grayish green shale, carbonaceous black shale with inter-beds of chert locally grading to dolomite hosts almost all the major manganese ore deposits of the area. Whereas, ferruginous shale horizon/ zone comprising of banded ferruginous shale with inter-beds of Banded hematite jasper (BHJ)/ Banded hematite quartzite(BHQ) and Banded ferruginous chert (BFC) gives rise to isolated iron ore deposits within the core of the synclinorium. A younger sequence of conglomerate and sandstone exposed on the northern and north eastern part of the belt are unconformably overlying the Koira Group of rocks. This arenaceous rock sequence have been described as Kolhan Series (Dunn, 1940) or Kolhan Group (Murty and Acharya, 1975) and it is differentiated from the basal sandstones and conglomerate by the presence of jasper pebbles, iron ore pebbles and fragments of BHJ. The view of Bonai Iron ore synclinorium is given below:



c) Detail Description of the geology of the lease area such as shape, and size of the mineral/ore deposit, disposition of various litho units indicating structural features if any etc.

**Geology of the Area**

Ghoraburhani – Sagasahi iron Ore block lies within the Upper Shale Formation of the Koira Group as described by Murthy & Acharya (1975). Litho units like Iron ores of HLO, SLO, lateralized HLO types, Fa-Shala, laterites of both aluminous and ferruginous nature, float ores concealed under soil and alluvial cover at places are mapped in the Ghoraburhani - Sagasahi block. The local stratigraphic succession as worked out is as follows:

Koira Group	Upper Shale Formation	Ferruginous Shale Unit: Shales of different colour like pink, yellow, variegated with inter beds of Iron ore.
	Banded Iron Formation	Coarsely banded jaspellite followed up by finely banded jaspellite.

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**Disposition of various litho units****Banded Iron Formation (BHJ & BHC):**

The BHJ/BHC is not exposed in the area. However, it is intersected in few boreholes like SSB-3, SSB-5 and SSB-6. Megascopically, the BHJ comprises alternate bands (laminations less than 5mm thick) of hematite and dark brown to red jasper. BHC comprises of alternate bands of haematite and light grey colored chert. Both these units were intersected nearer to the bottom portion of these three boreholes. Cherts, banded cherts also occur associated with BHJ and BHC and have been intersected in few boreholes.

**Ferruginous Shale:**

It occupies the valley portion represented by a finely laminated rock having varied shades of colour ranging from white, maroon, dark gray, brownish and purple to green etc. The colouration of the shale is largely dependent on the mineral composition (Murthy & Acharya, 1975). It is mostly composed of clayey micaceous minerals, with lenses of chert. Most of the area containing this unit is lateralised extensively. It occurs in the north eastern part of the mapped area.

**Iron ore:**

Based on surface exposures and sub-surface geology 5 (five) types of iron ore are recorded in the exploration block. These are Hard Laminated Ore (HLO), lateritised HLO, Soft laminated Ore (SLO) and powdery ore (blue dust, reddish brown powdery ore) and float/Kanga ores.

The HLO is exposed and preserved on the surface, described as the southern and northern bands in the block. The southernmost iron ore band is most prominent and is exposed discontinuously over a total strike length of 1.960km. The length of individual HLO varies from 250m to 600m parallel to strike and surface width varies from 50 – 156m trending in ENE – WSW direction, with 20° - 40° dip towards northwest in the southern part and southeast in the northern part of the area. The northern band exposed near the base of the hill extends discontinuously for about 100 to 150m along strike in an ENE-WSW direction, with surface width varying from 40 to 70m. It is continuing under laterite cover towards east as observed on W-9 section line near Mankadachua, where nearly 20m thick laminated iron ore is exposed below 1.0m thick laterite.

The minor folds observed in the northern band near the road section along the base line,

shows  $10^{\circ}$  plunge towards  $S30^{\circ}W$  and  $15^{\circ}$  plunge towards  $S60E$  forming overturned, bowl structure. The southern band on the hilltop shows mesoscopic folds where  $S0 / S_{15}$  planes are asymmetrically folded showing  $65^{\circ}$  plunge towards  $N30^{\circ}E$ . The superposition of a broad, open F2 fold is also found which shows  $38^{\circ}$  plunge towards  $N50^{\circ}W$ . The lateritised HLO exposed on the northern slopes extends parallel to the southern band over a length of about 600m which is the lateral extension of the main iron ore band.

Float ores and the cemented float ores (Canga) are demarcated in the map occurring over the lateritic HLO and HLO. 'Canga' zones contain mostly iron ore floats which are deposited in the saddle region. The thinly laminated, hematitic ore bodies exposed in the valley area are very often lateritised near the surface.

The SLO due to its soft nature are not exposed on the surface. However, thick zones of SLO were intersected in most of the boreholes at different depths given in the lithologs.

**Laterites :**

Most part of the area is covered by laterite of various types. The laterites have been developed mostly over the shale unit of the area and depending upon the composition of the shale, different types of laterites have been developed. The shale rich in alumina has given rise to aluminous laterite and those rich in iron developed into ferruginous laterites. Ferruginous laterite occupies most of the high lands in the vicinity and is wide-spread. Aluminous laterite/bauxite occurs in form of small patches and narrow bands, spread over the area.

**Soil/alluvium:** The low lying areas, river banks etc. are filled up with alluvial soil

**Shape and size of the mineral/ore deposit,**

Iron ore in the Ghoraburani-Sagasahi block occur as isolated bodies associated with buff coloured variegated shale and ferruginous shale. The ore bodies are capped by ferruginous and aluminous laterite on surface. Though the ore types show outcrops of hard ore, lateritic ore and float ore on the surface but soft laminated and powdery ore constitutes the bulk thickness of the ore zone as evidenced from pit sections and drill cores.

The ore is mostly powdery to soft laminated varieties with partings of ferruginous shale. Thin layer of Hard Laminated ore are present on the surface, followed by powdery and soft laminated

at depth, which are inseparable during dry drilling. At depths thin bands of hard laminated ore also occur along with powdery and soft laminated ore having thickness of less than 10 cm. The Ore is mainly hematite but limonite and goethite also occur.

**Structural features**

In general the Iron Ore Super Group represented by the Bonai-Kendujhar belt in Koirā-basin is disposed in the form of an "Omega" and referred to as "Horse shoe synclinorium" (Jones, 1934). This belt is 60 km long and 25 km wide extending from south of Malangtoli in Kendujhar district up to Chakradharpur in West Singhbhum district (Jharkhand). The structural fabrics in the above, feebly metamorphosed volcano-sedimentary litho-sequences indicate at least two phases of deformation and folding. The earlier phase is the most prominent and resulted in formation of two synclines intervened by an anticline trending NNE-SSW with a low north-north easterly plunge. The western limb is slightly overturned to the east and dip westerly (65°-75°) whereas, the eastern limb is a normal one with moderate to low (30°-45°) westerly dip. This phase of folding is affected by a later NW-SE to WNW-ESE trending fold axis resulting in broad warps and formation of structural domes and basins in the area. The western syncline known as Koirā syncline, due to steep dip and overturned nature of its limb forms a deeper basin with thick sequence of younger shales in the core region.

**d) Name of the prospecting/exploration agency:**

Geological Survey of India (GSI) has undertaken a detailed exploration under G2 level as per UNFC norms. A total of 28 core drill hole has been drilled by GSI within the allotted block to estimate the resource under G2 category.

**e) Details of prospecting / exploration already carried out.**

Exploration Agency	Geological Survey of India(GSI)
Geological mapping	139.165Ha
Surveying & contouring (5m interval )	139.165Ha
Core Drilling	2201.70m(28 nos)

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The details of survey and geological mapping already carried out by GSI are as follows:

#### Survey work

The topographical features as well as ore geometry was taken into consideration while fixing the base line. The survey work was carried out by Geological Survey of India (GSI) with the help of Theodolite, Dumpy level and Prismatic compass. The base line (0-0) was fixed parallel to the regional trend of the ore body i.e.  $N60^{\circ}E-S60^{\circ}W$  and the grid lines parallel to Base line, at an interval of 100m towards north and named as N-1, N-2, N-3 etc. and similarly towards south named as S-1, S-2, S-3 etc. The section lines were laid at 100m interval perpendicular to the base line. These are named as E-1, E-2, E-3 etc. towards east of the 0/0 location on the map, and similarly W-1, W-2, W-3 etc. towards west. The R.L. of base and section lines was connected from the nearest bench mark at Sagasahi hill located 4km from west of the mapped area by dumpy level and calibrated with the GPS data.

#### Geological mapping

Detailed mapping on 1:2000 scale was carried out and the litho units exposed in the mapped area comprises of iron ore bodies/ bands mostly lateritised on the surface, ferruginous shale, laterites of both ferruginous and aluminous category and soil cover. Iron ore in this area occur as isolated bodies associated with buff colored variegated shale and ferruginous shale. The iron ore is capped by ferruginous and aluminous laterite.

(i) Number of pits and trenches indicating dimensions, spacing etc along and across the strike/ foliations with reference to geological plan.

#### Pitting & Trenching

Information on the sub-surface behavior of the iron ore bodies of the area was obtained through trial excavations i.e., pitting and trenching on locations between two discontinuous ore bodies covered with float ore zone. Small excavations were made based on favorable surface indications. The pits show lateritised hard laminated ore (HLO) at the bottom of pit and float ore/ ferruginous laterite on the surface. The trenches in the central & western part of the block show lateralized soft laminated ore (SLO) at the bottom and float ore/ ferruginous laterite on the surface. In the eastern part of the block the trenches put along W-2 line for planning the future

exploration work and encountered mainly ferruginous shale with little iron at places due to thick overburden. Therefore resource estimation was carried out only with the borehole data instead of pitting/trenching data.

(ii) **Number of boreholes indicating type (core type/DTH), diameter, spacing, inclination, collar level, depth etc. with standard borehole logs duly marking on geological plan/sections.**

A total of 28 no. of boreholes were drilled by Geological Survey of India within the block. All the boreholes are vertical in nature except two boreholes SGB -11 and SSB-4 which was inclined. The borehole locations are shown in the Geological map of Ghoraburhani - Sagasahi block. These boreholes are drilled at strike intervals of 100m to 200m and at 200m spacing along the dip direction. The boreholes have depths varying from 39.65m to 126m and cumulative thickness of ore bodies intersected at 55% Fe cut off varies from 2.00m to 113.0m having average iron content from 59.99% to 65.51% Fe. The thickness of low grade ore zone (45% - 55% Fe) intersected in the boreholes varies from 1.75m to 28.00m having average iron content from 45.45% to 54.74%. Buff coloured shale and grey banded hematite chert is found in the foot wall side, whereas lateralized ferruginous shale occur as overburden. The ore is mainly hard laminated type towards top and grades over to soft laminated and powdery ore towards bottom. Ferruginous shale occurring as partings within the ore zone shows gradual decrease of iron content towards bottom. The summarized lithology of the boreholes drilled is given in Annexure-VI.

#### **Results of Drilling:**

The details of the ore zones intersected in different boreholes drilled on various section lines along with grade, overburden thickness. The maximum overburden thickness of 52.0m is found in borehole SEB-7 though it contains 1.0m high grade ore between 21.0 to 22.0m and 3m low grade ore from 35.0 to 38.0m. SEB-7 is located in the extreme end of north-eastern part of the block. Similarly three boreholes SGB-3, SGB-17 and SGB-18 have overburden thickness of 11.0m, 35.0m and 28.80m respectively. SGB-17 and SGB-18 are located in the valley part and the ore body is underlain by shale.

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As per the summarized litho logs provided by GSI, the details of bore hole depth & ore zone thickness etc. within three different blocks are furnished below:

**(A) Ghoraburhani sub-block**

Section Line	Bore hole no.	Depth of borehole (m)	Ore zone thickness (m)	Avg. grade (at 55% Fe cut off)	Low grade ore zone thickness (m)	Avg. grade (45% - 55% Fe)	Overburden thickness (m)
O-0	SGB-1	60.40	21	59.99	----	----	Nil
	SGB-2	69.30	61.35	63.42	-----	-----	5.60
	SGB-8	68.40	69.30 *	63.38	7.85	47.27	Nil *
E-2	SGB-3	79.00	51.45	62.23	----	----	11.05
	SGB-7	43.95	29.25	63.72	6.00	47.86	2.00
	SGB-15	55.50	40.00	63.09	6.00	46.98	7.00
E-4	SGB-4	115.10	100.85	62.53	5.00	48.61	Nil
	SGB-6	94.00	76.10	63.17	1.75	48.69	Nil
	SGB-18	60.20	11.95	60.92	9.85	49.82	28.80
W-2	SGB-9	85.90	32.40	65.32	11.30	51.07	Nil
	SGB-14	126.00	113.00	64.46	4.00	47.51	Nil
W-4	SGB-10	80.60	29.05	65.50	27.30	45.45	Nil
	SGB-11	100.80	70.20	64.32	11.00	51.12	Nil
	*SGB-17	-	-----	-----	-----	-----	-----
W-6	SGB-12	65.00	56.10	65.35	Nil	-----	Nil
	SGB-13	65.60	58.60	65.33	8.00	48.67	Nil
	SGB-16	70.30	34.00	63.06	20.00	49.75	4.0

\* Bore hole no. SGB-17 drilled during FS: 2010-12 and considered in Sagasahi East sub block

**(B) Sagasahi sub-block**

Section Line	Bore hole no.	Depth of borehole (m)	Ore zone thickness (m)	Avg. grade (at 55% Fe cut off)	Low grade ore zone thickness (m)	Avg. grade (45% - 55% Fe)	Overburden thickness (m)
W-10	SSB-3	39.65	11.00	60.64	20.00	11.00	Nil
	SSB-4	88.35	57.05	62.27	3.90	52.55	Nil
W-9	SSB-7	93.85	75.85	65.49	9.00	48.20	4.0
W-8	SSB-5	85.95	71.30	63.73	13.00	52.35	Nil
	SSB-6	45.25	28.00	65.51	10.00	52.29	Nil
	SSB-9	72.15	57.80	63.15	8.00	54.74	Nil

**C. Sagasahi east sub-block**

Section Line	Bore hole no.	Depth of borehole (m)	Ore zone thickness (m)	Avg. grade (at 55% Fe cut off)	Low grade ore zone thickness (m)	Avg. grade (45%-55% Fe)	Nature of Overburden thickness(m)
W-6	SEB-2	82.30	57.00	63.73	7.00	51.53	1.0
	SEB-5	84.0	64.00	64.28	7.00	49.43	Nil
W-4	SGB-17	70.40	2.00	60.92	-	--	35.0
	SEB-1	80.30	80.00	64.02	-	--	Nil
	SEB-6	94.45	69.00	61.60	5.00	51.80	4.0
	SEB-7	97.00	17.00	60.18	26.00	51.15	52.00, laterite & shale

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(iii) Details of sample analysis indicating type of sample (surface, sub-surface, free-pit, trenches/bore holes etc) complete chemical analysis for entire strata for all radicals may be undertaken for selected samples from a NABL accredited Lab or Government Laboratory or equivalent. (Annexure-VII.)

The samples of Core were analyzed by Geological Survey of India. From the drill cores, 182 nos. of samples were processed. The samples were mostly of 1.0 m length but at times 0.50 m core length was also sampled depending upon the width of the particular type of iron ore. Since different types of ores i.e. hard and soft laminated and powdery ores occur together in varying proportions, individual ore types were not processed separately. The drill core was made into two equal halves and one part is preserved in the core box and the other half was powdered to -200 mesh size and after coning and quartering, one part is being submitted for chemical analysis and the rest were preserved as duplicate samples.

#### CHEMICAL ANALYSIS DETAILS

The analysis of drill core samples is given in the Annexure-VII. The samples are analysed by Wet-cum- Instrument method in GSI, State Unit Odisha Laboratory. When some radicals like  $\text{Na}_2\text{O}$  or  $\text{K}_2\text{O}$  occurs in very less amount or in traces, it was analysed by AAS. Repeat analysis of some of the samples was carried out maintaining the same condition in the same laboratory for cross checking. The chemical analysis result for the Ghoraburhani block shows Iron content (at 55% Fe cut off) to vary from 55.02% to 69.6% and 21 nos. of samples are between 45.85% to 54.93 and one sample shows values of 41.44% Fe.  $\text{SiO}_2$  varies from 0.01 to 6.68 % (average within 2-3%) and  $\text{Al}_2\text{O}_3$  varies from 0.33 to 5.61%. Higher  $\text{Al}_2\text{O}_3$  % (10-20%) is seen in few samples of low grade shaly ore having Fe content varying from 45% to 55%. However, the weighted average of all the core samples of borehole no SGB-1 to SGB-18 of Ghoraburhani sub-block analyzed at 55% Fe cut off shows values of Fe: 63.64%,  $\text{SiO}_2$ : 2.08% and  $\text{Al}_2\text{O}_3$ : 3.17%. The low grade ores show average iron content to vary from 45.45% to 54.74%,  $\text{SiO}_2$  varies from 1.17% to 10.21% and  $\text{Al}_2\text{O}_3$  varies from 7.5 to 20.55%. The weighted average of all low grade samples of the boreholes of Ghoraburhani sub-block show Fe: 48.39%,  $\text{SiO}_2$ : 7.17% and  $\text{Al}_2\text{O}_3$ : 11.24%. The line graphs plotted for analytical values of Fe,  $\text{SiO}_2$  and  $\text{Al}_2\text{O}_3$  of samples of both high grade and low grade iron ores show that the low grade iron ore (45 to 55% Fe) contain more

alumina than silica which indicates that the iron ore in this valley area is shale hosted. The weighted average of all the core samples of boreholes drilled in Sagasahi sub-block show a cut off of Fe: 63.86%, SiO<sub>2</sub>: 2.09%, and Al<sub>2</sub>O<sub>3</sub>: 2.46%. The weighted average of all low grade samples of the same boreholes of Sagasahi sub-block show Fe: 52.00%, SiO<sub>2</sub>: 6.52% and Al<sub>2</sub>O<sub>3</sub>: 8.68%. Further, the weighted average of all the core samples of boreholes drilled in Sagasahi East sub-block considered 55% as Fe cut off which shows Fe: 62.94%, SiO<sub>2</sub>: 3.52%, and Al<sub>2</sub>O<sub>3</sub>: 2.17%. The weighted average of all low grade samples of the same boreholes of Sagasahi East sub-block show Fe: 51.02%, SiO<sub>2</sub>: 15.19% and Al<sub>2</sub>O<sub>3</sub>: 6.22%. The weighted average of all the three sub-blocks considered 55% Fe as cut off which shows Fe: 63.23%, SiO<sub>2</sub>: 2.39% and Al<sub>2</sub>O<sub>3</sub>: 2.81% and at 45-55% Fe range shows Fe: 49.97%, SiO<sub>2</sub>: 8.59% and Al<sub>2</sub>O<sub>3</sub>: 9.54%. The line graphs plotted for analytical values of Fe, SiO<sub>2</sub> and Al<sub>2</sub>O<sub>3</sub> of core samples in boreholes of Sagasahi sub-block also shows that the low grade rocks contain more alumina than silica.

The analyses of pit & trench samples from the blocks indicate rich iron concentration due to lateralization near the surface which varies from 35.2% to 43% Fe. Even at places, occurrence of fragments of hard laminated ores within the laterite profile or conga zones gives iron content more than 55%.

**(iv) Expenditure Incurred in various prospecting operation.**

As the prospecting operations including sampling and analysis have been done by Geological Survey of India, there is no data available with regard to expenditure incurred for the purpose.

**f) The surface plan of the lease area may be prepared on a scale of 1:1000 or 1:2000 with contour interval of maximum 10m depending upon the topography and size of the area duly marked by grid lines showing all features indicated under Rule 28(1)(a) of MCDR 1988**

Surface plan on a scale of 1:2000 scale was prepared by Geological Survey of India by using Theodolite, Dumpy level and Prismatic compass. As old method of survey was adopted by GSI, a fresh survey has been conducted by using Total Station showing all existing features at a contour interval of 5m. Accordingly, a surface plan of the lease area has been modified on a scale of 1:2000 with a contour interval of 5m. As per the Rule 28(1) of MCDR 1988, all the existing features have been marked along with grid lines shown at an interval of 100m. Based on the survey it is found that there is an altitude difference of 5-30m from earlier survey carried out by GSI. (Ref Plate No- III)



**(g) Geological Plan**

The Geological Plan matching with geological plan of GSI vide **Plate-IV** prepared on scale of 1:2000 with contour interval of 5m showing all features under Rule 28(1)(b) of MCDR, 1985 including locations of existing as well as proposed exploration, various litho-units along with structural features and iron ore zone with grade. Geo-structural information like strike, dip and dip direction are reflected in Geological Plan.

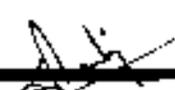
**h) Geological sections.**

Based on the geological plan, totally 8 numbers of cross sections have been prepared in 1:2000 scale covering the total area and from lease boundary to boundary. Position of holes are well shown on the cross sections and the lithology as encountered in each of the bore holes were plotted indicating the run wise grade of ore encountered in the hole. The ore zones are plotted in each of the bore holes of respective cross sections and are connected to arriving sectional area of different grade of the ore zone for that section. (Ref Plate No-IVA).

**(i) Broadly indicate the future programme of exploration with due justification (duly marking on Geological plan year wise location in different colors) taking into consideration the future tentative excavation programme planned in next five years:**

As earlier explained, the area has been explored under G2 category at a grid interval of 200m x 200m. As per the rule 27(3) and CCOM circular no. 3/2010 vide letter no. M-11012/1/2009-CCOM Nagpur, dated, 14/07/2010, a detail exploration has to be carried out within entire area (139.165ha) at a grid interval of 100m x 100m to assess the resource under G1 category. Hence, it is proposed to drill about 75nos of core type bore holes within the lease area to cover entire area at a grid interval of 100m x 100m. However within the mining lease, in the area designated by Govt of Odisha in the tender document as "ancillary area" which is supposed to be non-mineralised, the bore hole grid will be narrowed from 400 x 400 m to 100 x 100 m depending on ore occurrence. It is proposed to drill up to a depth of average 100m or up to the bottom of mineralization. The details of proposed exploration programme during this plan period is given in **Table below** and location of these boreholes is shown in Geological Plan (**Plate No- IV& IVA**)

  
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Year	Bore Hole ID	Easting	Northing	No. of Bore Holes	Type of Bore Hole	Details of Analysis
1 <sup>st</sup>	PBH-01	322881	2428374	54 Nos	Core type (HQ3/NO Size)	 <p>The analysis will be done at every one meter interval. Further, if there is any change in lithology within the sampled interval of 1m then based on lithology additional sampling will be carried out.</p>
	PBH-02	322965	2428423			
	PBH-03	322931	2428288			
	PBH-04	322896	2428152			
	PBH-05	322981	2428201			
	PBH-06	323065	2428250			
	PBH-07	322865	2428016			
	PBH-08	323032	2428113			
	PBH-09	322915	2427930			
	PBH-10	322997	2427977			
	PBH-11	323082	2428026			
	PBH-12	323166	2428075			
	PBH-13	322882	2427796			
	PBH-14	322932	2427709			
	PBH-15	323015	2427757			
	PBH-16	323097	2427804			
	PBH-17	323182	2427853			
	PBH-18	323266	2427902			
	PBH-19	323352	2427952			
	PBH-20	322905	2427566			
	PBH-21	323070	2427661			
	PBH-22	322873	2427433			
	PBH-23	322955	2427480			
	PBH-24	323037	2427527			
	PBH-25	323120	2427575			
	PBH-26	323202	2427622			
	PBH-27	323287	2427671			
	PBH-28	323005	2427393			
	PBH-29	323170	2427488			
	PBH-30	323337	2427585			
	PBH-31	323137	2427354			
	PBH-32	323220	2427402			
	PBH-33	323302	2427449			
	PBH-34	323387	2427498			
	PBH-35	323471	2427547			
	PBH-36	323557	2427597			
	PBH-37	323270	2427315			
	PBH-38	323437	2427411			
	PBH-39	323607	2427510			
	PBH-40	323237	2427181			
	PBH-41	323402	2427276			
	PBH-42	323571	2427373			
	PBH-43	323370	2427142			
	PBH-44	323537	2427238			
	PBH-45	323337	2427008			
	PBH-46	323502	2427103			
	PBH-47	323671	2427200			

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	PBH-48	323470	2426969			
	PBH-49	323637	2427065			
	PBH-50	323437	2426834			
	PBH-51	323602	2426929			
	PBH-52	323771	2427027			
	PBH-53	323652	2426843			
	PBH-54	323821	2426840			
2 <sup>nd</sup>	PBH-55	323237	2427758	11 Nos	Core type (HQ3/NQ Size)	The analysis will be done at every one meter interval. Further, if there is any change in lithology within the sampled interval of 1m then based on lithology additional sampling will be carried out.
	PBH-56	323407	2427856			
	PBH-57	323371	2427720			
	PBH-58	323457	2427770			
	PBH-59	323544	2427820			
	PBH-60	323507	2427683			
	PBH-61	323628	2427868			
	PBH-62	323678	2427782			
	PBH-63	323713	2427917			
	PBH-64	323797	2427968			
3 <sup>rd</sup>	PBH-65	323847	2427879	10 Nos	Core type (HQ3/NQ Size)	The analysis will be done at every one meter interval. Further, if there is any change in lithology within the sampled interval of 1m then based on lithology additional sampling will be carried out.
	PBH-66	323897	2427793			
	PBH-67	323947	2427706			
	PBH-68	324027	2427752			
	PBH-69	323961	2428061			
	PBH-70	324011	2427974			
	PBH-71	324061	2427888			
	PBH-72	324111	2427801			
	PBH-73	324096	2428023			
	PBH-74	324233	2427987			
	PBH-75	324283	2427900			

(j) Reserve and Resources as per UNFC with respect to threshold value notified by IBM.

Parameters considered for estimation of the reserve/resource

The tentative parameters considered and methods adopted by Geological Survey of India have been followed to estimate the geological resource and reserve of iron ore.

Parameters considered for resource calculation

Sl. No.	Parameters	Quantitative Aspects	
1	Length of Influence	100 to 200m	
2	ROM ore	100 % w.r.t total excavation	
3	Tonnage factor	2.7 T/m <sup>3</sup> *	
4	Cut-off grade	58% Fe	
5	Usable ore	Recovery factor	80% w.r.t total excavation
		Grade	+45% Fe
7	Waste materials	20%	

Note\*

The Bulk density is assumed as 2.7 T/cum as the total resources are powdery in nature. From bore hole results, it can be observed that, the different types of ore intersected in the boreholes



are Hard Laminated Ore (HLO), Soft Laminated Ore (SLO) and Powdery Ore. The Soft Laminated Ore being friable in nature, is recovered in the form of powdery ore in the mine though small pieces of flaky ore is present in it. Hard Laminated Ore (HLO) is present in minor amounts in some of the boreholes and its resource has not been calculated separately. Hence, for all practical purposes the total resource may be considered as Powdery Ore.

The bulk density has been tentatively considered based on the GR provided by GSI. As per GSI, the tonnage has been calculated by assuming tonnage factor of the ore to be 2.7 T/cum, since the ore is mostly powdery ore. The tonnage factor has been estimated taking data of nearby mines like Mankarnacha of TISCO as well as similar type of ore estimated by GSI from other blocks.

The recovery factor of 80% has been assumed based on Geological report provided by GSI. However, after the commencement of Mining operation, study for bulk density and recovery factor will be undertaken by an institute of repute. An undertaking in this regard is enclosed for reference.

**(k) DETAIL CALCULATION OF RESERVES/RESOURCES SECTION WISE**

**Parameters considered during estimation of the reserve/resource**

The reserve of the mines has been re-estimated by taking various parameters in to account. The total mining lease was resurveyed & geological mapping was carried out for the same. Based on the topographical survey, it can be observed that there is a variation 5-30m of altitude difference between the GSI contour plan and the contour plan surveyed by M/s Essar Steel India Ltd. As far as geological mapping is concerned; there is no variation in the geology/ litho contact in comparison with GSI. However, following parameters have been considered for the estimation of resource.

Threshold value	+45%Fe
Cut-off grade	+58%Fe
Sub-grade	45% - 58%Fe
Waste	-45%Fe
No of bore holes considered	28 nos
No of cross sections	8 nos

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**Assumption of Recovery Factor and bulk density Based on the GSI Report**

Parameter	Ore zone of usable iron ore			Ore zone of sub-grade iron ore (55-58%Fe)		Ore zone of sub-grade iron ore (45-55%Fe)	
	(+58%Fe)	(45-58)	-45%Fe	55-58% Fe	-45% Fe	(45-55%)	-45%Fe
Recovery factor (%)	80%	NII	20%	80%	20%	80%	20%
Bulk density	2.7	NII	2.0	2.7	2.0	2.7	2.0

**Geological and Recoverable Reserve and Grade**

**Method of Reserve Estimation**

On the basis of the above exploration and parameters considered, the resource/reserve of iron has been estimated by cross sectional area method. Cross sectional area measured from the sections was multiplied with the length of influence, bulk density and recovery factor to arrive at the quantity of the ore in tones. The formula implemented to calculate the ore resource was as follows:

<b>M</b>	$C \times L \times D \times R$
Where, M	Mineral resource / reserve of ore in tones.
C	Cross sectional area in $m^2$
L	Length of influence between two conjugative sections (sum of half distances on either side of each section),
D	Bulk density ( $t/m^3$ ).
R	Recovery factor of ROM iron ore has been considered as 80% based on GR of GSI

**CATEGORY WISE OF RESOURCE/RESERVE ESTIMATED AS PER UNFC**

**Indicated Resource (332):**

An 'indicated Mineral Resource' is that part a Mineral Resource for which tonnage, densities, shape, physical characteristics, grade and mineral content has been estimated with a lower level of confidence is based on general exploration. The UNFC code for Ghoraburhani - Sagasahi deposit has been considered 332 (Indicated Mineral resource) categories because of the following reason:

**Economic axis (E3)**

Detailed geological study and general exploration has been made. Rough estimates of tonnage and grades known. General idea about forest /non -forest and land use status is known. Economic Viability categories, however, cannot in general be defined from the Geological Study because of the lack of detail necessary for an Economic Viability evaluation. The resource quantities estimated may indicate that the deposit is of intrinsic economic interest, i.e. in the range of economic to potentially economic (E- 3).

### Feasibility Axis (F3)

The area under investigation is well within the existing mining belt. The geographical conditions are favorable. Infrastructures like public utilities, roads & railways and manpower exists in the area. Geological study under G-2 stage has been carried out and can be sufficient for deciding whether a Pre-feasibility Study and Detailed Exploration are warranted. Hence the Feasibility axis can be F3.

### Geological axis (G2)

The present work is under General Exploration which involves initial delineation of the ore deposit. Large scale surface mapping (1:2000 scale), contour surveying carried out. Sampling, pit-trenching: Widely spaced. Location of boreholes: Widely spaced (200x100 & 200x200m, Tonnage, shape, grade and mineral content estimated with reasonable level of confidence. Limited interpolation made. Hence the present exploration in the geological axis may be under G-2 category.

### GEOLOGICAL RESOURCE

The geological resources (indicated) have been re-estimated considering the level of exploration undertaken by GSI. The Geological resource in different categories for entire area will be as follows:

#### Geological Resources (In Million Tons)

Category	Resource +45-55% Fe	Resource (55 to 58%Fe)	Resource (+58%Fe)	Resource of ROM (+45%Fe)
Indicated	10.76	9.06	78.79	98.61
<b>Total</b>	<b>10.76</b>	<b>9.06</b>	<b>78.79</b>	<b>98.61</b>

The detail section wise calculations are furnished below:

#### Indicated Resource (332)

Section Considered	Cross Sectional area (Sq.m)			Length of Influence	>58% Fe		55% to 58% Fe		45% to 55% Fe	
	>58% Fe	55% to 58% Fe	45% to 55% Fe		Volume of Ore Zone @ 80%(Cu.m)	Quantity of Ore in Tones	Volume of Ore Zone @ 80%(Cu.m)	Quantity of Ore in Tones	Volume of Ore Zone @ 80%(Cu.m)	Quantity of Ore in Tones
	a	b	c		d	e=acd/80%	f=ef/2.7	g=bcd/80%	h=gh/2.7	i=cid/80%
A-A'	4598	3185	2760	135	492254	1340776	343990	926748	288080	604816
B-B'	34218	2511	8228	190	5200832	14042246	381672	1030614	1250656	3376771
C-C'	44599	1090	3545	190	8773048	18303428	101120	436024	538840	1454868
D-D'	40317	5210	8270	195	6269452	18661820	812760	2194452	1290120	3482624
E-E'	23787	2060	950	195	3710772	10018084	321360	887672	148200	400140
F-F'	17222	1008	0	190	2617744	7067908	153216	413688	0.00	0.00
G-G'	13284	2394	1830	190	2026688	5455857	363888	882497	279160	751032
H-H'	12905	5119	1130	200	2064800	5874960	819040	2211408	190800	488160
<b>Total</b>					<b>29179928</b>	<b>76785764</b>	<b>3357036</b>	<b>9063997</b>	<b>304488</b>	<b>1076811</b>
<b>Total (Million Tonnes)</b>						<b>76.76</b>		<b>9.06</b>		<b>10.76</b>

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**MINEABLE RESERVE:**

**Mineral/ ore blocked dues to benches:**

During mining operation certain resources have been blocked under UPL, lease boundary safety zone, road safety zone within bench slope. The iron ore in these blocked areas are non-mineable. The detail mineable reserves are given below:

**Mineable Reserve (In Million Tons)**

Category	Reserve (+45-55% Fe)	Reserve (55 to 58%Fe)	Reserve(+58Fe)	Reserve of ROM (+45%Fe)
Probable (122)	9.20	7.25	61.79	78.24
<b>Total</b>	<b>9.20</b>	<b>7.25</b>	<b>61.79</b>	<b>78.24</b>

The detail section wise calculations are furnished below:

**Probable Reserves (122)**

Section Considered	Cross Sectional area (Sq. m)			Length of Influence	>58% Fe		55% to 58% Fe		45% to 55% Fe	
	+58% Fe	55% to 58% Fe	45% to 55% Fe		Volume of Ore Zone @ 80%(Cu. m)	Quantity of Ore in Tones	Volume of Ore Zone @ 80%(Cu.m)	Quantity of Ore in Tones	Volume of Ore Zone @ 80%(Cu.m)	Quantity of Ore in Tones
	a	b	c		e=axdx80%	f=bx2.7	g=bxdx80%	h=bx2.7	i=cxdx80%	j=lx2.7
A-A'	2195	2858	2460	135	237080	640062	296848	774480	265880	717338
B-B'	21729	1750	7705	190	3302608	8917582	286000	718200	1171160	3162132
C-C'	38166	620	3520	190	5801232	15863328	94240	254448	535040	1444608
D-D'	38540	4060	5430	195	6012240	16233048	633960	1710072	847080	2287116
E-E'	18497	1840	940	195	2885532	7790936	287040	775008	146640	395928
F-F'	13340	1008	0	190	2027680	5474736	153216	413883	0	0
G-G'	10195	2122	1780	190	1549640	4184028	322544	870888	287520	722304
H-H'	6580	4020	1090	200	1068800	2885760	643200	1736640	174400	470680
<b>Total</b>					<b>22884992</b>	<b>61789478</b>	<b>2886448</b>	<b>7283410</b>	<b>3407820</b>	<b>9200304</b>
<b>Total (Million Tons)</b>						<b>61.79</b>		<b>7.25</b>		<b>9.20</b>
<b>Mineable Reserve in Million Tons</b>										<b>78.24</b>

Although Pre-feasibility study has been carried out and the quantity has been established, because of the above mentioned blockages the quantity falls under F-2 category. By considering these blockages, due to above mention various factors, the mineable resource has been estimated. The blocked iron ore within indicated resources has been categorized under 222. Considering the blockage of iron ore the mineable and non-mineable reserve has been estimated. The details of resource under pre-feasibility category (222) are furnished below:

**Summary of Pre-Feasibility Resources (222)**

Category	Resource +45-55% Fe	Resource (55 to 58% Fe)	Resource (+58Fe)	Resource of ROM (+45%Fe)
Pre-Feasibility Resources (222)	1.56	1.81	17	20.37
<b>Total</b>	<b>1.56</b>	<b>1.81</b>	<b>17</b>	<b>20.37</b>

The detail section wise estimation is shown below:

Section Considered	Cross Sectional area (Sq. m)			Length of Influence (m)	>50% Fe		50% to 50% Fe		45% to 50% Fe	
	+50% Fe	50% to 50% Fe	45% to 50% Fe		Volume of Ore Zone @ 80%(Cu.m)	Quantity of Ore in Tonnes	Volume of Ore Zone @ 80%(Cu.m)	Quantity of Ore in Tonnes	Volume of Ore Zone @ 80%(Cu.m)	Quantity of Ore in Tonnes
	a	b	c		d	e=a×d×80%	f=e×2.7	g=b×d×80%	h=g×2.7	i=c×d×80%
A-A'	2403	529	300	135	259524	700715	57132	154258	32400	87480
B-B'	12487	761	523	190	1898024	5124665	115672	312314	79496	214638
C-C'	6433	440	25	190	977815	2640103	66880	180575	3800	10280
D-D'	1777	1150	2840	195	277212	748472	179400	484380	443040	1198208
E-E'	5290	220	10	195	825240	2228148	34320	82554	1560	4212
F-F'	3882	0	0	190	590064	1593173	0	0	0	0
G-G'	3089	272	70	190	471048	1271830	41344	111829	10640	28728
H-H'	8225	1089	40	200	996000	2688200	175840	474768	8400	17280
<b>Total</b>					<b>8294928</b>	<b>18086306</b>	<b>870588</b>	<b>1810588</b>	<b>577336</b>	<b>1556007</b>
<b>Total (Million Tonnes)</b>						<b>17.00</b>		<b>1.81</b>		<b>1.56</b>

Pre- Feasibility Resources In Million Tonnes **20.37 million tons**

**(I) Mineral Reserves/ Resources:**

Mineral Resources: (Mineral resources has been estimated purely based on level of exploration, with reference to the threshold value of minerals declared by IBM)

Level of Exploration	Resources In Million tone	Grade
G1-Detail Exploration	--	<b>+45%Fe</b>
G2-General Exploration	<b>98.61</b>	
G3-Prospecting	--	
G4- Reconnaissance	--	
<b>Total</b>	<b>98.61</b>	

The status of time bound Exploration as per UNFC norms in pursuance of Ministry of Mines Letter No. F-10/75/2008-MV dated 23.12.2010.

Item of information	Lease area explored as per UNFC norms (in Ha)					Remarks/Comments including reasons for not carrying out the exploration as per UNFC norms.
	<b>Total Lease area = A+B+C+D+E</b>					
	G1 Level	G2 Level	G3 Level	Explored and found non-mineralized with level of exploration (Remarks)	Unexplored lease area	
	A	B	C	D	E	
Area as per level of exploration	--	90.62	--	--	48.545	
No. of BH Drilled	--	28	--	--	--	
No. of BH considered for Resource Estimation.	--	28	--	--	--	
Meterage Drilled In 67BHs	--	2201.70m	--	--	--	
Grid Interval	--	--	--	--	--	
Scale of Mapping	--	1:2000	--	--	--	
Reserve estimated after above exploration						78.24 million tons
Remaining Resource after above exploration						20.37 million tons
Total Reserve/Resource after above exploration						98.61 million tons

Resources and Reserves within the lease have been arrived after applying results of feasibility/pre-feasibility study and economic evaluation of deposit based on various factors such as:

**Mining Method**

The mine will be operated by Fully Mechanized Method. The quarry bench height & width will be maintained at 10m & 20m respectively. But at the ultimate stage the bench height and width will be kept at 10m each. Mining equipment like DTH drill of 150mm dia, compressor of 450cfm, dumper (85t), hydraulic excavators of 5.5 cum capacity etc will be used during ensuing plan period to achieve the targeted production. Processes of excavation and loading of overburden/waste will be done by deploying hydraulic excavators and dumpers.

**Geo-mining Character/Recovery factor/ Tonnage Factor:**

Geo-Mining Parameters	Quantitative Description
Usable ore incidence	80% of excavation in +58%Fe zone
Sub-grade ore generation	80% of excavation in +45-58% Fezone
Intercalated waste	20% of total excavation in the + 58%Fe and +45% -58%Fe zone
Bulk density	Total average bulk density considered for ore (usable ore & sub-grade ore) 2.7 T/m <sup>3</sup>
Bench height	10m
Bench width	20m at working stage and 10m at ultimate stage
Cut-off Grade	58% Fe
Threshold Value	45% Fe
Sub-grade ore	+45% Fe to -58% Fe

The tonnage factor of 2.7MT/cum and recovery factor of 80% (out of total volume of ore zone) has been assumed based on the geological report provided by GSI (Geological Survey of India). However, after the commencement of Mining operation, study for the Bulk density will be undertaken by an institute of repute. An undertaking in this regard is enclosed for reference.

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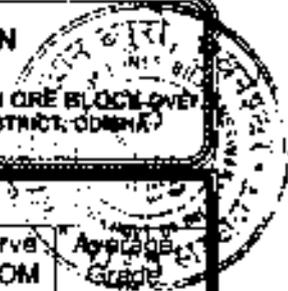


M/s ESSAR STEEL INDIA LTD)  
(APPLICANT)

**MINING PLAN**

In respect of

GHORABUHRANI-SAGASAHIRON ORE BLOCK OVER  
132.165 HA IN SUNDARGARH DISTRICT, ODISHA



**Summary of Reserve with Average Grade:**

Category	Reserve (+45-55% Fe)	Average Grade	Reserve (55 to 58% Fe)	Average Grade	Reserve (+58Fe)	Average Grade	Reserve of ROM (+45Fe)	Average Grade
	Million tone	% of Fe	Million tone	% of Fe	Million tone	% of Fe	Million tone	% of Fe
Probable Reserve (122)	9.20	51.43	7.25	57.44	61.79	64.328	78.24	62.173
Pre-Feasibility Resources (222)	1.56	51.45	1.81	57.37	17.0	64.13	20.37	62.56
<b>TOTAL</b>	<b>10.76</b>		<b>9.06</b>		<b>78.79</b>		<b>98.61</b>	<b>62.25</b>

**Reserve & Grade as per United Nations Framework Classification:**

Total Resources	Category	Code	Quantity (Million tons)	Grade (+45 %Fe)
	Total Mineral Resource(A+B)	-	98.61	62.25 % Fe
A. Reserve	Proved	(111)	-	62.173% Fe
	Probable	(121)	-	
		(122)	78.24	
	Total Remaining Reserve(A)		78.24	
B. Remaining Resources	Feasibility Mineral Resources	(211)	-	62.56% Fe
	Pre-feasibility Mineral Resources	(221)	-	
		(222)	20.37	
	Measured Mineral Resources	(331)	-	
	Indicated Mineral Resources	(332)	-	
	Inferred Mineral Resources	(333)	-	
	Reconnaissance Mineral Resources	(334)	-	
	Total Remaining Resource (B)		20.37	

Note: It may not be possible to quantify grade wise reserves, as normally there is considerable variation in size and grade distribution within the ore zone, which results variable recovery factor and bulk density. Thus tonnages arrived currently are tentative. A detailed exercise will be done after G1 level exploration is taken up.

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**CHAPTER-II**

**2.0 MINING**

**Open cast mining**

a) Briefly describe the existing as well as proposed method for excavation with all design parameters indicating on plans /sections.

M/s Essar Steel India Ltd has been awarded the block through competitive bidding. Mining operation will start after the execution of the Mining Lease. During field visit, a numbers of small pits were found having 1m to 1.5m depth. The materials excavated are very insignificant from mining point of view. The proposed methods of mining have been furnished below:

**Selection of area for development**

As stated in the chapter -3, the iron ore block consists of three numbers of separate hills where iron ore deposit occurs at various levels. Geographically, the iron ore block over 139.165ha has been designated as north block, (north of the village road passing within the block); south block (immediate below the north block) and east block (eastern part of south block). Keeping in view the production requirement, the mining operations will be carried out in two different blocks i.e. in north block (pit-1) and south block (pit-2) during plan period. In the proposed pit-1, the results of bore holes SEB-06, 01, 02, 16 and 05 indicating that iron ore body occurs in shallow depth and in pit-2 the bore holes SSB-5, SSB-06, SGB-12 and SGB-13 indicating that high grade iron ore occurs below 20m depth. Pit-1 and pit-2 has been selected for development to get early production as well as required grade i.e. +64%Fe for feeding to the plant. Besides good grade, required amount of mineable reserve is also available within these two mining pits where mining operation can be done for 5 years.

**Proposed method of mining:**

The Ghoraburhani - Sagasahi iron ore block is proposed to be developed for the captive purpose in which the products will be used in company's Integrated Steel Plant for the purpose of steel making and hence the mine will be developed scientifically and systematically for making the products suitable for the Integrated Steel Plant (ISP).

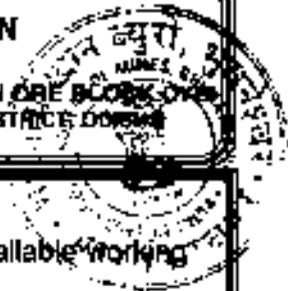
Taking into consideration the topography of the deposit, estimated reserve and grade, disposition of ore body, nature of intercalated waste, incidence of iron ore, and production requirement, the deposits will be mined by fully mechanized method with the deployment of earth moving machines like blast hole drill, hydraulic shovel, dumpers, dozers etc on three shift basis.

**Capacity of the Mine:**

The annual requirement of iron ore for the Integrated Steel plant at Hazirawill be met partially from Ghoraburhani- Sagasahi iron ore block. The mine has been planned to achieve the production at the rate of 7.16million tons of ROM per annum at the end of 5<sup>th</sup> year.

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**Working Schedule**

After allowing for 52 Sundays and 3 National holidays and 4 major holidays, the available working days in a year workout to be 306. However, the effective working days have been kept as 300 days. Taking into consideration the scale of production three shifts working of the mine, each of 8 hours duration has been assumed.

**Pre-production development work:**

During 1<sup>st</sup> year of mine plan period all the pre-production activities will be achieved. It has been envisaged that the pre-production development will be carried out in the following order.

- (i) Clearing the areas to be opened up of forest growth for main and access road as well as for bench preparation.
- (ii) Preparation of access road to the benches as well as roads leading to waste dump.
- (iii) Removal of top soil if any from the benches to be developed and simultaneously construction of the main mine road.
- (iv) Advancing the upper bench to permit development of adequate working width at the lower bench.

For carrying out the pre-production development work certain equipment like hydraulic excavator, dumper, bull dozer, blast hole drill etc will be procured well in advance to be supplemented later by main production equipment. In order to complete the pre-production development work in time, action for procurement of all equipment necessary for this work, will be initiated immediately, with the start of the project.

**Bench Parameter**

The iron ore block is proposed to be operated by mechanized open cast method of operation in a series of 10m high benches with the help of shovel-dumper combination. The minimum bench width in the working benches shall be maintained at 20m while in the ultimate stage, the bench width shall be reduced to 10m, thus having a final pit slope of 45°.

**Road alignment**

The layout of roads for haulage of ore/waste and access to different installation in the mine will be developed complying with the statutory regulations stipulated in the Metalliferous Mines Regulations, 1961. The main haul roads shall generally be of 20m width, the width of 50-80 ton rear-dump trucks envisaged for haulage of material being about 6m. The haul roads will be maintained with a gradient of less than 1 in 16 except for short ramps, which will have a maximum gradient of 1 in 10. The floor level of each bench will be maintained with the help of graders and dozers. This will help in easy, safe and efficient mobility of HEMM.

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### **Drilling and blasting**

Drilling is proposed to be done using 150mm/115mm diameter drills with 10% sub grade drilling. Blasting will be done by adopting the State of Art technology by using mostly SME (Site Mixed Emulsion Explosives) along with conventional explosives such as PGC, toe blast and ANFO. Controlled blasting along with shock tube initiation system / NONEL system will be practiced for getting optimum blast results and minimization of hazards. Boulders generated during the course of blasting will be broken in to smaller pieces by using rock breaker.

### **Excavation, Loading and transportation**

The blasted material will be excavated by shovels of 4.5 cum - 5.7cum capacity and loaded onto 50 - 80T dumpers for transportation of the ROM, sub-grade and waste. Loading will be done mechanically. The ROM ore from different mining faces will be transported by dumpers of 50-80T in a pre-determined proportion (for blending different qualities of ore), and delivered to the processing plant.

### **Mineral processing**

ROM to be excavated from the mine will categorized in to two types as mentioned below:

1. ROM having Fe content + 45 - 58 %
2. ROM having Fe content > 58 %

The requirement of the plant is +64%Fe. Low grade iron ore (+58%Fe to 63%Fe) and high grade (+64%Fe) will be blended proportionately to meet the requirement of plant. ROM having +45-55%Fe will be dumped separately. The above ROM (+55 - 58 % Fe) shall be upgraded to get the desired products in future after commissioning of beneficiation plant which will be in the 4<sup>th</sup> year of the plan period.

Initially, ROM having Fe of +58% with an average of 64%Fe(after blending/direct ore) will be directly fed to mobile/static screening & crushing plant as mentioned in the subsequent paragraph. The lumps& fines produced will be transported from the mine head by Road

It has also been planned to install a beneficiation plant within the allotted block itself. After the commissioning of the beneficiation plant the Iron ore fines will be beneficiated and converted in to cake for onward transportation by Road. The lumps will also continue to be transported by Road as mentioned earlier.

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**Mining of the Deposit**

Mining of the deposit will be carried out by conventional cyclic operations namely removal of topsoil, drilling and blasting of ore zone, excavation, loading and haulage of run of mine ore. Top soil if any will be removed first, which will be stock piled for future use for plantation purposes. After the removal of top soil, drilling and blasting operation will be carried out at hard / laminated iron ore zone for loosening. These loosened iron ore then excavated and loaded to the **APPROVED** for processing. The processed ore shall be sent to the different destinations by and means as explained above.

b) Indicate year-wise tentative Excavation In Cubic Meters Indicating development, ROM, pit wise as in table below.

**I. In situ Tentative Excavation (cum)**

Year	Pit no.	Total tentative Excavation (Cum)	Top Soil (cum)	OB/SB/IB (Cum)		ROM (Cu m)		Ratio
						Ore (cum)	MINE PLAN OBTAINED FROM THE MINING BUREAU OF INDIAN BUREAU OF MINES HUBBARDIAN SWAR	
1 <sup>st</sup>	Pit-1	1494550	12500	SB	116250	790960	301680	1 : 0.387
			--	IB	273160			
	Sub Total		12500		389410	790960	301680	
	Pit-2	461300	--	SB	18000	174640	180000	1 : 0.300
Sub Total		--	--	106660	174640	180000	1 : 0.300	
<b>Total</b>		<b>1955850</b>	<b>12500</b>		<b>496070</b>	<b>865600</b>	<b>481680</b>	<b>1 : 0.351</b>
2 <sup>nd</sup>	Pit-1	1649470	--	SB	39700	1219688	67928	1 : 0.280
			--	IB	321954			
	Sub Total		--	--	361654	1219688	67928	1 : 0.280
	Pit-2	802130	--	SB	--	235048	246656	1 : 0.25
Sub Total		--	--	120428	235048	246656	1 : 0.25	
<b>Total</b>		<b>2251600</b>			<b>482080</b>	<b>1454836</b>	<b>314584</b>	<b>1 : 0.272</b>
3 <sup>rd</sup>	Pit-1	2126360	--	SB	230960	1454848	63072	1 : 0.402
			--	IB	379480			
	SUB Total		--	--	610440	1454848	63072	1 : 0.402
	Pit-2	1215990	--	SB	76500	605128	306464	1 : 0.333
Sub Total		--	--	227898	605128	306464	1 : 0.333	
<b>Total</b>		<b>3342350</b>			<b>814838</b>	<b>2059976</b>	<b>369536</b>	<b>1 : 0.378</b>
4 <sup>th</sup>	Pit-1	3024840	--	SB	440340	1795432	272188	1 : 0.482
			--	IB	518900			
	SUB Total		--	--	957240	1795432	272188	1 : 0.482
	Pit-2	724670	--	SB	--	447730	132000	1 : 0.250
Sub Total		--	--	144940	447730	132000	1 : 0.250	
<b>Total</b>		<b>3749510</b>			<b>1102180</b>	<b>2243162</b>	<b>404188</b>	<b>1 : 0.416</b>
5 <sup>th</sup>	Pit-1	2429570	--	SB	331684	1117608	209128	1 : 0.831
			--	IB	771150			
	Sub Total		--	--	1102834	1117608	209128	1 : 0.831
	Pit-2	1667570	--	SB	--	1120752	205304	1 : 0.250
Sub Total		--	--	331514	1120752	205304	1 : 0.250	
<b>Total</b>		<b>4067140</b>			<b>1434348</b>	<b>2238360</b>	<b>414432</b>	<b>1 : 0.540</b>
<b>Grand total</b>		<b>15388450</b>	<b>12500</b>		<b>4429516</b>	<b>8962034</b>	<b>1964400</b>	<b>1 : 0.404</b>

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**Note:** Tentative tonnage of the ore may be arrived by computing approximate bulk density and recovery factor as these data are variable and may be established on time series.

**Mineral rejects** include all the excavated materials that do not constitute useful material. Such material may be either grade or size reject. The mineral reject may be (i) chemically sub grade which is below the acceptable limits of specifications that is below the cutoff grade and above the threshold value within or outside ore zone, (ii) materials of physical characteristics not acceptable to the market, (iii) material having deleterious constituents.

**ROM** constitutes the material excavated from mineralized zone and includes mineral reject and useable mineral component.

**OB:** means overburden capping waste

**SB:** means side burden waste on both hang wall and foot wall sides of the ore body

**IB:** means intermediate burden waste between two or more ore body

At present in this document, the tonnage factor and recovery factor has been considered as per exploration input from the drilled bore-hole data and time series data as below:

Based on the Geological report provided by GSI, tonnage factor and recovery factor has been assumed as 2.7MT/ cum and 80% respectively. Thus, tentative tonnage proposed to be produced per year is arrived as below:

**I. In situ Tentative Excavation (MT)**

Year	Pit no.	Total tentative Excavation (MT)	Top Soil MT	OB/SB/IB (MT)		ROM (MT)		ROM Waste / Ratio
						Ore (MT)	Mineral reject (MT)	
1 <sup>st</sup>	Pit-1	3747898	18750	SB	232500	2135592	814536	01:0.263
			--	IB	546320			
	<b>SUB Total</b>	<b>3747898</b>	<b>18750</b>		<b>778820</b>	<b>2135592</b>	<b>814536</b>	
	Pit-2	1170848	--	SB	36000	471528	486000	
		--	IB	177320				
	<b>Sub Total</b>		--		<b>213320</b>	<b>471528</b>	<b>486000</b>	<b>01:0.222</b>
<b>Total</b>		<b>4918548</b>	<b>18750</b>		<b>992140</b>	<b>2807120</b>	<b>1300536</b>	<b>01:0.263</b>
2 <sup>nd</sup>	Pit-1	4200411	--	SB	79400	3293698	183405.6	01:0.208
			--	IB	643908			
	<b>Sub Total</b>	<b>4200411</b>	--		<b>723308</b>	<b>3293698</b>	<b>183405.6</b>	
	Pit-2	1541453	--	SB	--	634630	665971.2	
		--	IB	240852				
	<b>Sub Total</b>	<b>1541453</b>	--		<b>240852</b>	<b>634630</b>	<b>665971.2</b>	<b>01:0.185</b>
<b>Total</b>		<b>5741864</b>	--		<b>964160</b>	<b>3928327</b>	<b>848376.8</b>	<b>01:0.201</b>
3 <sup>rd</sup>	Pit-1	15919657	--	SB	461920	3928089	170294.4	01:0.062
			--	IB	758960			
	<b>Sub Total</b>	<b>15919657</b>	--		<b>1220880</b>	<b>3928089</b>	<b>170294.4</b>	
	Pit-2	1215990	--	SB	153000	1633846	827452.8	
		--	IB	455796				
	<b>Sub Total</b>	<b>3070095</b>	--		<b>608796</b>	<b>1633846</b>	<b>827452.8</b>	<b>01:0.247</b>
<b>Total</b>		<b>6389358</b>	--		<b>1829676</b>	<b>5561935</b>	<b>997747.2</b>	<b>01:0.278</b>

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4 <sup>th</sup>	Pit-1	7497000	--	SB	860880	4847666	734853.6	
			--	IB	1033800			
	<b>SUB Total</b>	<b>7497000</b>	<b>--</b>		<b>1814480</b>	<b>4847666</b>	<b>734853.6</b>	<b>01:0:342</b>
	Pit-2	724870	--	SB	--	1208871	356400	
			--	IB	289880			
	<b>Sub Total</b>	<b>1855151</b>	<b>--</b>		<b>289880</b>	<b>1208871</b>	<b>356400</b>	<b>01:0:185</b>
	<b>Total</b>	<b>9352151</b>	<b>--</b>		<b>2204360</b>	<b>6056537</b>	<b>1091253.6</b>	<b>01:0:308</b>
5 <sup>th</sup>	Pit-1	5787855	--	SB	663368	3017542	5694645.6	
			--	IB	1542300			
	<b>Sub Total</b>	<b>5787855</b>	<b>--</b>		<b>2205668</b>	<b>3017542</b>	<b>564645.6</b>	<b>01:0:615</b>
	Pit-2	4243379	--	SB	--	3026030	554320.8	
			--	IB	663028			
	<b>SUB Total</b>	<b>4243379</b>	<b>--</b>		<b>663028</b>	<b>3026030</b>	<b>554320.8</b>	<b>01:0:185</b>
	<b>Total</b>	<b>10031234</b>	<b>--</b>		<b>2868696</b>	<b>6043572</b>	<b>1118966.4</b>	<b>01:0:400</b>
	<b>Grand total</b>	<b>38433153</b>	<b>18750</b>		<b>8868032</b>	<b>24187492</b>	<b>5357880</b>	<b>01:0:298</b>

**EXCAVATION PROPOSAL DURING 1<sup>ST</sup> YEAR**

As explained earlier, pre-production developmental work shall be started and achieved during 1<sup>st</sup> year of Mining Plan period. During developmental work, prime work will be to set up infrastructure facilities like office, work shop, canteen, etc. It has been planned to open two pits namely pit-1 and pit-2 simultaneously at north and south block respectively. The production capacity of the proposed mine will be 3907656 tons of ROM in this year. The height and width of the benches will be kept at 10m and 20m respectively. The individual bench slope will be maintained at 80<sup>o</sup>-85<sup>o</sup> whereas the gradient of the proposed road will be maintained at 1:16 and at ramp the gradient will be at 1:10.

Iron ore strata will be loosened through drilling and blasting. Blasted rocks in each bench will be carried by mechanized means to the processing unit. Drilling is proposed to be done using 150mm/115mm diameter drills with 10% sub grade drilling. Blasting will be done by adopting the State of Art technology by using mostly SME (Site Mixed Emulsion Explosives) along with conventional explosives such as PGC, Toe blast and ANFO. Controlled blasting along with shock tube initiation system / NONEL system will be practiced for getting optimum blast results and minimization of hazards. Boulders generated during the course of blasting will be broken in to smaller pieces by using rock breaker.

The blasted material will be excavated by shovels of 4.5 cum - 5.7cum capacity and loaded onto 50- 80 ton dumpers for transportation of the ROM, sub grade and waste.

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**Development of pit-1**

During this year total ROM production is estimated to be 2950128MT. The Pit -1 will be developed by depth ward and laterally. The depth ward development will be done from RL 620m to 600m. Laterally, the bench movement shall be done within the co-ordinates 2428100-2428400N and 322800 to 323100E. Development will be done from safety zone so that early reclamation can be achieved. The planning has been made from one end of the Pit - 1 and the progressive closure will be undertaken with in Pit - 1 during the plan period itself.

**Development of pit-2**

It has been planned to produce 957528 MT of ROM from Pit-2. To achieve the desired production, Pit-2 will be developed from RL 670m to 620m. Lateral movement of benches in Pit-2 will be within co-ordinates 2427500 to 2427700N and 322900 to 323350E. At the end of the year the dimension of two pits, will be as follows:

Name of the pit	Dimension
Pit -1	340m x 275m x 60m
Pit-2	450m x 160m x 50m

**Mineral Processing**

During this year, two mobile 500TPH capacity crushing and screening unit for one in each pit shall be established for processing of ROM. The mineral rejects of 45-55%Fe and 55-58%Fe will be stored at earmarked site for future beneficiation after commissioning of beneficiation plant. The product will be in the ratio of approximately 90% fines (-10mm) and balance 10% as lumps (5-18mm).

**Transportation of ore**

The mode of transportation of lumps as well fines from mine head will be by road.

**Disposal of waste and sub-grade ore**

Total generation of waste from pit-1 during this year will be 389410cum and from pit-2 will be 106860cum. There will be two separate dumps for each pit. Out of the total waste from pit-1 50% will be utilized for road maintenance and balance 50% will be dispose of at dump-1. Similarly, the waste to be generated from pit-2 will be utilized for road maintenance and dumping. It has been planned to utilize 10% of total waste generation for road maintenance and remaining 90% for dumping at dump-2.

During 1<sup>st</sup> year, 725544 MT (45-55%Fe) and 574992 MT (55-58%Fe) of mineral reject/sub-grade will be generated. There will be two separate sub-grade ore/ mineral reject stack for each grade.

The sub-grade/mineral reject stack - 1 will be for (45-55%Fe) and sub-grade/mineral reject stack - 2 will be for (55-58%Fe).



The details of proposed mining and lay out of benches, road design etc during 1<sup>st</sup> year will be as follows:

Particulars		Pit-1	Pit-2
Bench Geometry	Height	10m	10m
	Width	20m or more than the height	20m or more than the height
		At ultimate stage the bench width will be 10m	At ultimate stage the bench width will be 10m
Individual bench slope angle		85°	85°
Road design	Average width of the road after leaving the berms	17m	17m
	Gradient of Haul road	1:16	1:16
	Ramp Gradient	1:10	1:10
	Berm height	1.5m	1.5m
Quarry development	Sections considered for development	CC' and DD'	BB', and CC'
	Benches considered for development with RL	CC' - 620m to 600m DD' - 620m to 600m	BB' - 660 to 620 CC' - 680 to 620
	Length of proposed benches	900m(avg.)	595m(avg)
	Length of advancement of benches	110m	100m
	Direction of advancement	Down ward and laterally	Lateral and down ward
	Dimension of Quarry at the end of the year including existing benches	340m x 230m x 30m	450m x 130m x 60m
	Overall quarry slope angle	37.5	37.5
	Production of usable ore(MT)	2135592	471528
	Generation of mineral rejects (MT)	814536	486000
	Production of ROM (Ore + sub-grade) (MT)	2950128	957528
	Inter-burden (MT)	546320	177320
	Side burden(MT)	232500	36000
	Generation of Waste(MT)	778820	213320
Total Excavation		3747698	1170848

The details of layout of proposed benches have been shown in Plate no - VII A & B. The details of production of ROM in this year will be as follows:

year	Name of the pit	Mineral rejects/sub-grade ore(46-55% Fe) (MT)	Mineral rejects/sub-grade ore (55-56%Fe) (MT)	Usable ore (+58%Fe) (MT)	Total ROM (MT)
1 <sup>st</sup>	Pit-1	285768	528768	2135592	2950128
	Pit-2	439776	46224	471528	957528
<b>Total</b>		<b>725544</b>	<b>574992</b>	<b>2607120</b>	<b>3907656</b>

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**Proposed blending scheme during 1<sup>st</sup> year.**

The requirement of iron ore in the Steel plant of M/s Essar Steel India Ltd is average +64%Fe. To achieve/maintain the quality of average +64%Fe it has been planned to open two pits namely pit-1 and pit-2 and work them simultaneously to obtain a blended ore. The proposed blending from said pits will be as follows:

Quarry	RL (m)	Quantity (Tones)	Grade (Fe%)	Blendeable Material	
				Quantity (Tones)	Grade (Fe%)
Pit-1	630	200448.00	58.5		
		217728.00	50.44		
	620	444744.00	65.25	444744.00	65.25
		320780.00	57.09		
	610	502632.00	64.89	502632.00	64.89
		437400.00	62.52	437400.00	62.52
		126360.00	57.50		
		68040.00	53.32		
	600	550368.00	62.75	550368.00	62.75
		81648.00	57.83		
<b>Sub Total</b>				<b>1935144.00</b>	<b>63.93</b>
Pit-2	660	38880.00	61.50		
	650	47520.00	61.77		
		73310.40	54.50		
	640	69768.00	65.35	69768.00	65.35
		138974.40	49.92		
	630	146880.00	65.15	146880.00	65.15
		9720.00	57.31		
		187400.00	53.13		
	620	168480.00	62.49		
		36504.00	57.31		
60091.20		53.13			
<b>Sub Total</b>				<b>216648.00</b>	<b>65.21</b>
<b>Grand Total</b>				<b>2151792.00</b>	<b>64.07</b>

As per the planning, about 2607120MT of usable ore will be produced during 1<sup>st</sup> year. From above table, it can be observed that, tentatively, 2151792MT of iron ore with average of 64.07%Fe will be achieved after blending from two pits. The remaining 455328MT will have the average grade of 61.02%Fe. This quantity will also be dispatched for further blending to maintain the average grade of +64%Fe.

  
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Section Considered	R/L	Cross Sectional area (Sq.m)				Length of Influence	>58% Fe		55% to 58% Fe		45% to 55% Fe		Total Quantity of ore in Tones (+58% Fe)	Total Quantity of Mineral Reject in Tones (45% to 58% Fe)	Waste
		+58% Fe	55% to 58% Fe	45% to 55% Fe	Volume of Ore Zone (Cu.m)		Quantity of Ore in Tones	Volume of Ore Zone (Cu.m)	Quantity of Ore in Tones	Volume of Ore Zone (Cu.m)	Quantity of Ore in Tones	k=l			
Section C-C'	630.00	580.00	0.00	630.00	160.00	92800.00	200448.00	0.00	100800.00	217728.00	200448.00	217728.00	77440.00		
	620.00	1420.00	0.00	0.00	145.00	205900.00	444744.00	0.00	0.00	0.00	444744.00	0.00	82360.00		
	610.00	1790.00	0.00	0.00	190.00	232700.00	502632.00	0.00	0.00	0.00	502632.00	0.00	93080.00		
Section D-D'	620.00	0.00	990.00	0.00	150.00	0.00	0.00	320760.00	0.00	0.00	0.00	320760.00	59400.00		
	610.00	1350.00	390.00	210.00	150.00	202500.00	437400.00	126360.00	31500.00	68040.00	437400.00	194400.00	117000.00		
	600.00	1820.00	270.00	0.00	140.00	254800.00	550368.00	81648.00	0.00	0.00	550368.00	81648.00	117040.00		
<b>Total</b>						<b>988700.00</b>	<b>2135592.00</b>	<b>2135592.00</b>	<b>244800.00</b>	<b>528768.00</b>	<b>132300.00</b>	<b>285768.00</b>	<b>814536.00</b>	<b>548320.08</b>	
<b>Total (Million Tones)</b>							<b>2.136</b>			<b>0.529</b>		<b>0.288</b>	<b>0.815</b>	<b>0.548</b>	

Section Considered	R/L	Cross Sectional area (Sq.m)				Length of Influence	>58% Fe		55% to 58% Fe		45% to 55% Fe		Total Quantity of ore in Tones (+58% Fe)	Total Quantity of Mineral Reject in Tones (45% to 58% Fe)	Waste
		+58% Fe	55% to 58% Fe	45% to 55% Fe	Volume of Ore Zone (Cu.m)		Quantity of Ore in Tones	Volume of Ore Zone (Cu.m)	Quantity of Ore in Tones	Volume of Ore Zone (Cu.m)	Quantity of Ore in Tones	k=l			
Section B-B'	650.00	0.00	0.00	126.00	190.00	0.00	0.00	0.00	0.00	23940.00	51710.40	0.00	51710.40	9576.00	
	640.00	0.00	0.00	184.00	170.00	0.00	0.00	0.00	0.00	31280.00	67564.80	0.00	67564.80	12512.00	
	630.00	0.00	30.00	222.00	150.00	0.00	0.00	9720.00	33300.00	71928.00	0.00	81648.00	15120.00		
Section C-C'	620.00	0.00	130.00	214.00	190.00	0.00	0.00	36504.00	27820.00	60091.20	0.00	96595.20	17888.00		
	660.00	90.00	0.00	0.00	200.00	18000.00	38880.00	0.00	0.00	0.00	0.00	38880.00	7200.00		
	650.00	110.00	0.00	50.00	200.00	22000.00	47520.00	0.00	10000.00	21600.00	47520.00	21600.00	12900.00		
Section C-C'	640.00	170.00	0.00	174.00	190.00	32300.00	69788.00	0.00	33060.00	71409.60	69788.00	71409.60	26144.00		
	630.00	400.00	0.00	280.00	170.00	68000.00	146880.00	0.00	44200.00	95472.00	146880.00	95472.00	44880.00		
	620.00	520.00	0.00	0.00	150.00	78000.00	168480.00	0.00	0.00	0.00	168480.00	0.00	31200.00		
<b>Total</b>						<b>210300.00</b>	<b>471528.08</b>	<b>21400.00</b>	<b>46224.00</b>	<b>203800.08</b>	<b>439776.00</b>	<b>471528.00</b>	<b>486800.00</b>	<b>177320.00</b>	
<b>Total (Million Tones)</b>							<b>0.472</b>		<b>0.048</b>		<b>0.440</b>	<b>0.472</b>	<b>0.496</b>	<b>0.177</b>	

Quarry	Section Considered	R/L	Cross Sectional area (m <sup>2</sup> )	Length of Influence (m)	Volume (Cu.m)	Quantity (MT)
Pit-1	Section C-C'	620	730	145	105850	211700
		610	80	130	10400	20800
Pit-2	Section C-C'	630	120	150	18000	36000
		<b>Total</b>				<b>134250</b>

  
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**EXCAVATION PROPOSAL DURING 2<sup>ND</sup> YEAR**

Proposed targeted production of usable iron ore (+58%Fe) during this year is 3.92 Mil.T. To achieve the target product, total ROM production is about 4.77 Mil.T. To obtain the said quantity it has been planned to develop the Pit-1 and Pit-2 both laterally and depth ward.

The height and width of the benches will be kept at 10m and 20m respectively. The individual bench slope will be maintained at 80°-85° whereas the gradient of the proposed road will be maintained at 1:16 and at ramp the gradient will be at 1:10.

Iron ore strata will be loosened through drilling and blasting. Blasted rocks in each bench will be excavated & carried by mechanized means to the processing unit. Drilling is proposed to be done using 150mm/115mm diameter drills with 10% sub grade drilling. Blasting will be done by adopting the State of Art technology by using mostly SME (Site Mixed Emulsion Explosives) along with conventional explosives such as PGC, Toe blast and ANFO. Controlled blasting along with shock tube initiation system / NONEL system will be practiced for getting optimum blast results and minimization of hazards. Boulders generated during the course of blasting will be broken in to smaller pieces by using rock breaker.

The blasted material will be excavated by shovels of 4.5 cum - 5.7cum capacity and loaded onto 50-80 T dumpers for transportation of the ROM, sub grade and waste.

**Development of pit-1**

It has been planned to produce 3477103MT of ROM from Pit-1 during this year in which the usable iron ore will be 3283698MT. To obtain the production, it is envisaged to extend the 1<sup>st</sup> year benches of pit-1 further south and depth ward. Laterally, the bench movement shall be done within the co-ordinates 2428050-2428400N and 322800 to 323100E and in depth the 1<sup>st</sup> year benches will further go down up to the RL 570m.

**Development of pit-2**

It has been planned to produce 1300601T of ROM from pit-2 during this year in which the usable iron ore will be 634630T. To obtain the production, it is envisaged to extend the 1<sup>st</sup> year benches of pit-2 further south laterally. There will not be depth ward movement of benches. Development of pit-2 shall be done within the co-ordinates 2427490-2427730N and 322830 to 323400E. At the end of the year the approximate dimension of two pits, will be as follows:

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Name of the pit	Dimension
Pit -1	340m x 275m x 60m
Pit-2	520m x 210m x 60m

**Disposal of waste and Sub-grade/mineral rejects**

Total generation of waste from pit-1 during this year will be 361654cum and from pit-2 will be 120426cum. Out of the total waste generation from Pit-1, about 30% will be utilized for road maintenance and remaining 70% will be utilized for dumping at dump-1. Similarly, out of total waste generation from pi-2, about 10% shall be utilized for road maintenance and remaining 90% will be disposed of for dumping at dump-2.

During 2<sup>nd</sup> year, 621994MT (45-55%Fe) and 227383 MT (55-58%Fe) of mineral reject/sub-grade will be generated. There will be two separate sub-grade ore/ mineral reject stack for each grade. The sub-grade/mineral reject stack – 1 will be for (45-55%Fe) and sub-grade/mineral reject stack – 2 will be for (55-58%Fe).

**Mineral Processing**

During this year, two mobile 500TPH capacity crushing and screening unit for one in each pit shall be established for processing of ROM. The mineral rejects of 45-55%Fe and 55-58%Fe will be stored at earmarked site for future beneficiation after commissioning of beneficiation plant. The product will be in the ratio of approximately 90% fines (-10mm) and balance 10% as lumps (5-18mm).

**Transportation of ore**

The mode of transportation for lumps as well as fines will be by Road from the Mine head. The details of proposed mining and lay out of benches, road design etc during 2<sup>nd</sup> year will be as follows:

Particulars		Pit-1	Pit-2
Bench Geometry	Height	10m	10m
	Width	20m or more than the height At ultimate stage the bench width will be 10m	20m or more than the height At ultimate stage the bench width will be 10m
	Individual bench slope angle	85°	85°
Road design	Average width of the road after leaving the berms	17m	17m
	Gradient of Haul road	1:16	1:16
	Ramp Gradient	1:10	1:10
	Berm height	1.5m	1.5m

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Quarry development	Sections considered for development	CC' and DD'	BB' and CC'
	Benches considered for development with RL	CC' - 630m to 570m DD' - 620m to 580m	BB' - 890 to 820 CC' - 700 to 620
	Length of proposed benches	680m(avg.)	535m(avg.)
	Length of advancement of benches	40m	60m
	Direction of advancement	Down ward and laterally (due south)	Lateral movement due south
	Dimension of Quarry at the end of the year including existing benches	340m x 275m x 60m	520m x 210m x 60m
	Overall quarry slope angle	37.5	37.5
	Production of usable ore(MT)	3293698	634630
	Generation of mineral rejects (MT)	183405.6	665971
	Production of ROM (Ore + sub-grade) (MT)	3477104	1300601
	Inter-burden (MT)	643908	240852
	Side burden(MT)	79400	--
	Generation of Waste(MT)	723308	240852
Total excavation (MT)	4200411	1541453	

The details of layout of proposed benches have been shown in Plate no - VII C & D. The details of production of ROM in this year will be as follows:

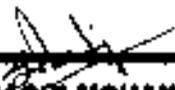
year	Name of the pit	Mineral rejects (45-55% Fe) (MT)	Mineral rejects (55-58%Fe) (MT)	Usable ore (+58%Fe) (MT)	Total ROM(MT)
2 <sup>nd</sup>	pit-1	45144	138262	3293698	3477103
	pit-2	576850	89121.6	634630	1300601
<b>Total</b>		<b>621994</b>	<b>227383</b>	<b>3928327</b>	<b>4777704</b>

**Proposed blending scheme during 2<sup>nd</sup> year**

As per the above table, during this year, tentatively, 3928327MT of usable ore will be produced to achieve 4777704MT of ROM. This usable ore quantity will have the average grade of 64.23%Fe after blending from the two pits. The proposed blending will be as follows:

Quarry	RL (m)	Quantity (Tones)	Grade (Fe%)	Blendable Material	
				Quantity (Tones)	Grade (Fe%)
Pit-1	620	41493.60	58.33		
	610	142992.00	63.11	142992.00	63.11
		96768.00	55.46		
	600	694656.00	64.76	694656.00	64.76
		140400.00	63.18	140400.00	63.18
	590	1113177.60	64.67	1113177.60	64.67
	580	787968.00	64.55	787968.00	64.55
	570	414504.00	62.62	414504.00	62.62
		45144.00	53.15		
	<b>Sub Total</b>				<b>3293697.60</b>
Pit-2	680	60480	62.9	60480.00	62.90
		75600	54.76		
	670	110808	60.76	110808.00	60.76
		118735.2	54.76		
	660	99144	66.33	99144.00	66.33
		142884	54.76		
	650	95472	66.66	95472.00	66.66
		103831.2	54.76		
	640	89856	65.34	89856.00	65.34
		21297.6	57.31		
		73440	53.13		
	630	84240	63.82	84240.00	63.82
		45360	57.31		
		35964	53.13		
	620	94629.6	62.49	94629.60	62.49
		22464	57.31		
		26395.2	53.13		
	<b>Sub Total</b>				<b>634629.60</b>
<b>Grand Total</b>				<b>3928327.20</b>	<b>64.23</b>

  
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Section Considered	RL	Cross Sectional area (sq.m)			Length of Influence	Volume of Ore Zone (Cum)	>58% Fe		55% to 58% Fe		45% to 55% Fe		Total Quantity of ore in Tones (+58% Fe)	Total Quantity of Mineral Reject in Tones (45% to 58% Fe)	Waste						
		+58% Fe	55% to 58% Fe	45% to 55% Fe			Quantity of Ore in Tones	Volume of Ore Zone (Cum)	Quantity of Ore in Tones	Volume of Ore Zone (Cum)	Quantity of Ore in Tones	Volume of Ore Zone (Cum)				Quantity of Ore in Tones	Quantity of Mineral Reject in Tones				
Section C-C'	620	0	113	0	170	0	0.00	19210.00	41493.60	0.00	0.00	0.00	41493.60	7884							
	610	300	0	0	160	48000	103680.00	0.00	0.00	0.00	0.00	103680.00	19200								
	600	2144	0	0	150	321800	694656.00	0.00	0.00	0.00	0.00	694656.00	128640								
	590	1904	0	0	140	252560	545529.60	0.00	0.00	0.00	0.00	545529.60	101024								
	580	1460	0	0	130	189800	408968.00	0.00	0.00	0.00	0.00	408968.00	75920								
	570	1010	0	0	120	130	191800	414504.00	0.00	0.00	0.00	414504.00	85120								
Section D-D'	610	130	320	0	140	18200	39312.00	44800.00	96768.00	0.00	0.00	39312.00	25200								
	600	500	0	0	130	65000	140400.00	0.00	0.00	0.00	0.00	140400.00	28000								
	590	2190	0	0	120	262800	567648.00	0.00	0.00	0.00	0.00	567648.00	105120								
	580	1750	0	0	100	175000	378000.00	0.00	0.00	0.00	0.00	378000.00	70000								
<b>Total</b>		<b>Total (Million Tones)</b>		<b>3.29</b>		<b>3293997.6</b>		<b>64010</b>		<b>138261.6</b>		<b>45144</b>		<b>20900</b>		<b>3293997.6</b>		<b>183405.6</b>		<b>649908</b>	

Section Considered	RL	Cross Sectional area (sq.m)			Length of Influence	Volume of Ore Zone (Cum)	>58% Fe		55% to 58% Fe		45% to 55% Fe		Total Quantity of ore in Tones (+58% Fe)	Total Quantity of Mineral Reject in Tones (45% to 58% Fe)	Waste			
		+58% Fe	55% to 58% Fe	45% to 55% Fe			Quantity of Ore in Tones	Volume of Ore Zone (Cum)	Quantity of Ore in Tones	Volume of Ore Zone (Cum)	Quantity of Ore in Tones	Volume of Ore Zone (Cum)				Quantity of Ore in Tones	Quantity of Mineral Reject in Tones	
Section B-B'	680	0	0	140	250	0	0.00	0.00	0.00	0.00	0.00	0.00	75800.00	14000				
	670	0	0	239	230	0	0.00	0.00	0.00	0.00	0.00	54970.00	118735.20	21988				
	660	0	0	315	210	0	0.00	0.00	0.00	0.00	0.00	65150.00	142884.00	26460				
	650	0	0	283	190	0	0.00	0.00	0.00	0.00	0.00	48070.00	103831.20	18828				
	640	0	0	200	170	0	0.00	0.00	0.00	0.00	0.00	34000.00	73440.00	17544				
	630	0	0	111	150	0	0.00	0.00	0.00	0.00	0.00	18690.00	36984.00	15060				
Section C-C'	620	77	80	94	130	10010	21621.60	16400.00	22464.00	12220.00	26395.20	21821.80	48859.20	15052				
	680	140	0	0	200	29000	60480.00	0.00	0.00	0.00	0.00	60480.00	0.00	11200				
	670	270	0	0	190	51300	110808.00	0.00	0.00	0.00	0.00	110808.00	0.00	20520				
	660	255	0	0	180	45900	99144.00	0.00	0.00	0.00	0.00	99144.00	0.00	18360				
	650	260	0	0	170	44200	96472.00	0.00	0.00	0.00	0.00	96472.00	0.00	17680				
	640	260	0	0	160	41600	89856.00	0.00	0.00	0.00	0.00	89856.00	0.00	16840				
Total	<b>Total (Million Tones)</b>		<b>0.53</b>		<b>293810</b>		<b>834629.6</b>		<b>41260</b>		<b>89121.8</b>		<b>267060</b>		<b>606971.2</b>		<b>240652.00</b>	

Quarry	Section Considered		R.L	Cross Sectional area (m <sup>2</sup> )	Length of Influence (m)	Volume (Cum)	Quantity (MT)
	a	b					
Pit-1	Section C-C'	610	220	155	34100	68200	
	Section D-D'	610	40	140	5600	11200	
<b>Total</b>		<b>39700</b>		<b>79400</b>			

  
 PRADEEP MOHAPATRA  
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 SABYASACHI MOHANTY  
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**EXCAVATION PROPOSAL DURING 3<sup>RD</sup> YEAR**

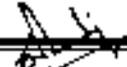
Proposed targeted production of usable iron ore (+58%Fe) during this year is 5561935MT. To get this quantity of product, total ROM production is about 6559682 MT. To obtain the said quantity it has been planned to develop the pit-1 and pit-2 both laterally and depth ward from the 2<sup>nd</sup> year position. The individual bench faces will be kept nearly vertical ( $80^{\circ}$ - $85^{\circ}$ ) whereas the overall quarry slope angle is proposed to be kept at less than  $45^{\circ}$  with the horizontal. Iron ore strata will be loosened through drilling and blasting. Blasted rocks in each bench will be carried by mechanized means to the processing unit. The height and width of the benches will be kept at 10m and 20m respectively. The individual bench slope will be maintained at  $85^{\circ}$  whereas the gradient of the proposed road will be maintained at 1:16 and at ramp the gradient will be at 1:10.

**Development of Pit-1**

It has been planned to produce 4098384MT of ROM from pit-1 in this year. Out of which usable ore will be 3928090MT and balance quantity will be 170294tons of mineral rejects of 45-58%Fe. To achieve the quantity lateral development of 5 nos benches (570m.RL, 580m.RL, 590m.RL, 600m.RL and 610m.RL) will be done due south. Length of advancement will be about 145m due south. Further a new bench will be developed at 560m.RL. The development of pit-1 will be within the co-ordinates 2427900-2428400N and 322800 to 323100E and in depth the 2<sup>nd</sup> year benches will further go down up to the RL 560m. In this year the benches in the west will reach their ultimate stage. Hence, 10m benches have been proposed in the western part of the pit. In all other sides, bench width will be kept at 20m as their will be further development of benches.

**Development of Pit-2**

It is envisaged to produce 2461298MT of ROM from pit-2 in this year in which the usable ore of +58%Fe will be 1633846MT. The remaining quantity will be 827452MT with 45 - 58%Fe. To achieve the targeted production from pit-2, it has been planned to develop the pit along three sections e.g. BB', and CC'. Along BB' RL at 620m to 680m will push for 20m and two new benches at RL 690m and at RL 700m in south and at RL 610m and 600m in the North shall be formed.

  
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Further, along the section CC', RL 570m to 610m shall be advanced in the South for a length of 150m. The development of pit-2 will be within the co-ordinates 2420754-2421230N and 330515 to 330775E and in depth the 2<sup>nd</sup> year benches will further go down up to the RL 560m. At the end of the year the dimension of two pits, will be as follows:

Name of the pit	Dimension
Pit -1	440m x 350m x 70m
Pit-2	550m x 310m x 110m

**Disposal of waste and Sub-grade/mineral rejects**

During this year 610440 cum of waste will be generated from pit-1 and 304398cum of waste will be generated from pit-2. As the dump near pit -1 cannot accommodate the total waste to be generated from pit-1, it has been planned to use the said quantity for construction of bund of proposed tailing pond. The waste to be generated form pit-2 will also be used for construction of bund.

During 3<sup>rd</sup> year, 803023MT (45-55%Fe) and 194724MT (55-58%Fe) of mineral reject/sub-grade will be generated. There will be two separate sub-grade ore/ mineral reject stack for each grade.

The sub-grade/mineral reject stack - 1 will be for (45-55%Fe) and sub-grade/mineral reject stack - 2 will be for (55-58%Fe).

**Mineral Processing**

After the production of ROM, it will be processed through the integrated crushing and screening unit. The mineral rejects of 45-55%Fe and 55-58%Fe will be stored at earmarked site for future beneficiation after commissioning of beneficiation plant. The product will be in the ratio of approximately 90% fines (-10mm) and balance 10% as lumps (5-18mm).

**Transportation of ore**

The mode of transportation for lumps as well as fines will be by Road from the Mine head

The details of proposed mining and lay out of benches, road design etc during 3<sup>rd</sup> year will be as follows:

Particulars		Pit-1	Pit-2
Bench Geometry	Height	10m	10m
	Width	20m or more than the height At ultimate stage the bench width will be 10m	20m or more than the height At ultimate stage the bench width will be 10m
	Individual bench slope angle	85°	85°

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Road design	Average width of the road after leaving the berms	17m	17m
	Gradient of Haul road	1:16	1:16
	Ramp Gradient	1:10	1:10
	Berm height	1.5m	1.5m
Quarry development	Sections considered for development	CC' and DD'	BB', and CC'
	Benches considered for development with RL	CC' - 630m to 570m DD' - 620m to 580m	BB' - 600 to 700 CC' - 700 to 620
	Length of proposed benches	600m(avg.)	550m(avg.)
	Length of advancement of benches	145m	150m
	Direction of advancement	Down ward and laterally (due south)	Lateral movement due south
	Dimension of Quarry at the end of the year including existing benches	440m x 350m x 70m	550m x 310m x 110m
	Overall quarry slope angle	37.5	37.5
	Production of usable ore(MT)	3928090	1633846
	Generation of mineral rejects (MT)	170294	827453
	Production of ROM(Ore + sub-grade) (MT)	4098384	2461299
	Inter-burden (MT)	758960	455796
	Side burden (MT)	461920	153000
	Generation of Waste(MT)	1220880	608796
Total excavation (MT)	5319264	3070095	

The details of layout of proposed benches have been shown in Plate no - VIII & F. The details of production of ROM in this year will be as follows:

year	Name of the pit	Mineral rejects (45-55% Fe) (MT)	Mineral rejects (55-58% Fe) (MT)	Usable ore (+58% Fe) (MT)	Total ROM (MT)
3 <sup>rd</sup>	pit-1	170294	0	3928090	4098384
	pit-2	632729	194724	1633846	2461299
<b>Total</b>		<b>803023</b>	<b>194724</b>	<b>5561935</b>	<b>6556682</b>

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**Proposed blending scheme during 3rd year**

As per the above table, during this year, tentatively, 5561935MT of usable ore will be produced to achieve 6559682MT of ROM. This usable ore quantity will have the average grade of 64.48%Fe after blending from the two pits. The proposed blending will be as follows:

Quarry	RL (m)	Quantity (Tones)	Grade (Fe%)	Blendeable Material		
				Quantity (Tones)	Grade (Fe%)	
Pit-1	610	735220.80	62.36	735220.80	62.36	
		129686.18	47.87			
	600	225028.80	64.02	225028.80	64.02	
	590	631584.00	63.62	631584.00	63.62	
	580	724356.00	63.39	724356.00	63.39	
	570	944460.00	64.89	944460.00	64.89	
	560	667440.00	64.32	667440.00	64.32	
		40608.00	53.13			
	<b>Sub Total</b>				<b>3628089.60</b>	<b>63.79</b>
	Pit-2	700	21600.00	62.42	21600.00	62.42
48427.20			54.44			
690		75038.40	62.42	75038.40	62.42	
		97632.00	54.44			
680		73440.00	62.42	73440.00	62.42	
		85968.00	54.44			
670		77760.00	60.15	77760.00	60.15	
		80784.00	54.44			
660		77760.00	64.81	77760.00	64.81	
		13392.00	57.31			
		64800.00	54.44			
650		77760.00	64.86	77760.00	64.86	
		35424.00	57.31			
		39744.00	54.44			
640		81842.40	67.03	81842.40	67.03	
		48016.80	57.31			
		20930.40	54.44			
630		101433.60	66.57	101433.50	66.57	
		23133.60	57.31			
		17258.40	53.13			
620		120852.00	66.40	120852.00	66.40	
		44064.00	53.13			
610		516391.20	67.40	516391.20	67.40	
		41839.20	57.31			
		106423.20	53.13			
600		409968.00	67.40	409968.00	67.40	
		32918.40	57.05			
		26897.60	50.77			
<b>Sub Total</b>				<b>1633845.60</b>	<b>66.15</b>	
<b>Grand Total</b>				<b>5561935.20</b>	<b>64.48</b>	

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3rd Year Production Plan for Pit-1

Section Considered	RL	Cross Sectional area (Sq.m)			Length of Influence	Volume of Ore Zone (Cum)	>58% Fe		55% to 58% Fe		45% to 55% Fe		Total Quantity of ore in Tones (+58% Fe)	Total Quantity of Mineral Report in Tones (45% to 58% Fe)	Waste
		+58% Fe	55% to 58% Fe	45% to 55% Fe			a=abcd	b=(a+b*c)/2.7	c=abcd	d=(a+b*c)/2.7	e=abcd	f=(a+b*c)/2.7			
Section C-C	510	1581	0	333.665	180	340380	735220.80	0.00	0.00	80039.90	128888.18	735220.80	128888.18	160167.96	
	500	430	0	0	170	73100	157898.00	0.00	0.00	0.00	0.00	157898.00	0.00	29240	
	580	1415	0	0	160	228400	489024.00	0.00	0.00	0.00	0.00	489024.00	0.00	90550	
	560	1749	0	0	150	282350	598878.00	0.00	0.00	0.00	0.00	598878.00	0.00	104940	
	570	1749	0	0	250	432250	944460.00	0.00	0.00	0.00	0.00	944460.00	0.00	174900	
580	1545	0	0	94	306000	667440.00	0.00	0.00	19820.00	40508.00	667440.00	40508.00	131130		
500	222	0	0	140	31080	67132.80	0.00	0.00	0.00	0.00	67132.80	0.00	12432		
580	550	0	0	120	68000	142560.00	0.00	0.00	0.00	0.00	142560.00	0.00	26400		
580	730	0	0	100	79000	157680.00	0.00	0.00	0.00	0.00	157680.00	0.00	29200		
Total						1818580	3929089.6	0	0	78839.4	170294.184	3929089.6	170294.184	754628.96	
Total (Million Tones)							3.93	0.00	0.00	0.00	0.17	0.17	0.17	0.76	

3rd Year Production Plan for Pit-2

Section Considered	RL	Cross Sectional area (Sq.m)			Length of Influence	Volume of Ore Zone (Cum)	>58% Fe		55% to 58% Fe		45% to 55% Fe		Total Quantity of ore in Tones (+58% Fe)	Total Quantity of Mineral Report in Tones (45% to 58% Fe)	Waste
		+58% Fe	55% to 58% Fe	45% to 55% Fe			a=abcd	b=(a+b*c)/2.7	c=abcd	d=(a+b*c)/2.7	e=abcd	f=(a+b*c)/2.7			
Section B-B	700	0	0	118	190	0	0.00	0.00	0.00	22420.00	49427.20	0.00	48427.20	8988	
	690	0	0	226	200	0	0.00	0.00	0.00	46200.00	97632.00	0.00	97632.00	18780	
	680	0	0	188	200	0	0.00	0.00	0.00	38800.00	85868.00	0.00	85868.00	15920	
	670	20	0	187	200	4000	8840.00	0.00	0.00	37400.00	80784.00	8840.00	90794.00	16580	
	660	20	0	150	200	4000	8840.00	0.00	0.00	30000.00	64800.00	8840.00	73192.00	14080	
	650	20	0	92	200	4000	8840.00	0.00	0.00	18400.00	39744.00	8840.00	48168.00	9120	
	640	31	0	51	190	5890	12722.40	22290.00	49016.80	9990.00	20830.40	29847.20	68947.20	15124	
	630	88	63	47	170	14980	32313.60	10710.00	23133.80	7930.00	17258.40	32313.60	40382.00	13454	
	620	173	0	25	150	25950	56052.00	0.00	0.00	3750.00	8100.00	56052.00	8100.00	11880	
	610	628	149	271	130	81640	176242.40	19370.00	41839.20	35230.00	76096.80	176242.40	117936.00	64498	
Section C-C	800	709	127	103	120	85080	183772.80	18240.00	32918.40	12360.00	26697.60	183772.80	59818.00	46072	
	700	50	0	0	200	10000	21600.00	0.00	0.00	0.00	0.00	21600.00	0.00	4000	
	690	193	0	0	180	34780	75036.40	0.00	0.00	0.00	0.00	75036.40	0.00	13888	
	680	200	0	0	170	34000	73440.00	0.00	0.00	0.00	0.00	73440.00	0.00	13600	
	670	200	0	0	160	32000	68120.00	0.00	0.00	0.00	0.00	68120.00	0.00	12800	
	660	200	0	0	180	32000	69120.00	0.00	0.00	0.00	0.00	69120.00	0.00	12600	
	650	200	0	0	180	32000	69120.00	0.00	0.00	0.00	0.00	69120.00	0.00	12600	
	640	200	0	0	180	32000	69120.00	0.00	0.00	0.00	0.00	69120.00	0.00	12600	
	630	200	0	0	180	32000	69120.00	0.00	0.00	0.00	0.00	69120.00	0.00	12600	
	620	200	0	0	150	30000	64800.00	0.00	0.00	0.00	0.00	64800.00	0.00	12600	
Section D-D	610	1211	0	108	130	157430	340048.80	0.00	0.00	14040.00	30326.40	340048.80	30326.40	68588	
	600	962	0	0	110	104720	226195.20	0.00	0.00	0.00	0.00	226195.20	0.00	41888	
	Total						758410	183945.6	90150	194724	292990	69728.8	183945.6	82742.8	45796.00
	Total (Million Tones)							1.63	0.19	0.19	0.63	0.63	1.63	0.83	0.45

Side Burden

Quarry	Section Considered	RL	Cross Sectional area (m <sup>2</sup> )	Length of Influence (m)	Volume (Cum)	Quantity (Mt)	
Pit-1	Section C-C	510	186	160	31380	52720	
		500	774	150	118100	228200	
		580	210	130	27300	54800	
		560	310	120	37200	74400	
Pit-2	Section C-C	590	190	100	19000	38000	
		630	60	150	9000	18000	
		620	450	150	67500	135000	
Total						307480	614920

  
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**EXCAVATION PROPOSAL DURING 4<sup>TH</sup> YEAR**

During 4<sup>th</sup> year of plan period, it is proposed to produce usable iron ore of 6056618.4 MT. To achieve the targeted usable quantity it is envisaged to produce 7147872 MT of ROM in this year. To obtain the said quantity it has been planned to develop the pit-1 and pit-2 both laterally and depth ward from the 3<sup>rd</sup> year bench position. The individual bench faces will be kept nearly vertical ( $80^{\circ}$ - $85^{\circ}$ ) whereas the overall quarry slope angle is proposed to be kept at less than  $45^{\circ}$  with the horizontal. Iron ore strata will be loosened through drilling and blasting. Blasted rocks in each bench will be carried by mechanized means to the processing unit. The height and width of the benches will be kept at 10m and 20m respectively. The individual bench slope will be maintained at  $85^{\circ}$  whereas the gradient of the proposed road will be maintained at 1:16 and at ramp the gradient will be at 1:10.

**Development of Pit-1**

It has been planned to produce 5582519MT of ROM from Pit-1 in this year. Out of which usable ore will be 4847656.40MT and balance quantity will be 734853.6MT of mineral rejects of 45-58%Fe. To achieve the quantity lateral development of Pit-1 will be done along CC' and DD'. Along CC' advancement of benches will be done due south from 560m.RL to 610m.RL and another two benches below 560m.RL will be formed at RL 550m and 540m. Similarly along section DD' advancement of benches at 580m to 620m will be done due north. Further, another 4 benches will be formed having RL 580-540m and another bench of 630m.RL will be created above the RL 620m. As a result of this development part of the area within pit-1 will be exhausted. Hence, concurrent back-filling has been proposed to done over the exhausted part of the area.

**Development of Pit-2**

It is envisaged to produce 1565352MT of ROM from pit-2 in this year in which the usable ore will be 1208952MT. The remaining quantity will be 356400MT with 45 – 58%Fe. To achieve the targeted production from pit-2 it has been planned to develop the pit along three sections e.g. BB', and CC'. Advancement along the section BB' and CC' will be made from 600m.RL to 700m.RL due south and another bench having RL 710m will be formed above 700m.RL. The advancement of 20m

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along BB' section will be done. The development of pit-2 will be within the co-ordinates 2427850-2428400N and 322800 to 323210E and in depth the 3<sup>rd</sup> year benches will further go down up to the RL 560m.

At the end of the year the dimension of two pits, will be as follows:

Name of the pit	Dimension
Pit -1	520m x 350m x 100m
Pit-2	500m x 370m x 120m



#### Disposal of waste and Sub-grade/mineral rejects

During this year 957240 cum of waste will be generated from pit-1 and 1102180cum of waste will be generated from pit-2. Out of the total waste generated from pit-1 about 10% will be utilized for road maintenance and balance 90% will be utilized for back-filling in the exhausted part of Pit-1. Similarly, the waste to be generated from pit-2 will be utilized for road maintenance and construction of retaining wall. About 10% will be utilized for road maintenance and construction of retaining wall and balance 90% will be utilized for dumping at dump-2.

The tailings generated from the beneficiation plant will be disposed of within proposed tailing dam earmarked in the map. It is estimated that approximately 682281.6 MT will be disposed of during the year at the said location.

During 4<sup>th</sup> year, 828274MT (45-55%Fe) and 262980MT (55-58%Fe) of mineral reject/sub-grade will be generated. There will be two separate sub-grade ore/ mineral reject stack for each grade.

The sub-grade/mineral reject stack - 1 will be for (45-55%Fe) and sub-grade/mineral reject (55-58%Fe) to be generated will be subjected for beneficiation.

#### Mineral processing

In this year the mineral processing unit of 6.0MTPA (product) capacity will be established. It is proposed to upgrade the low grade ore to +64%Fe so that the product can be usable in the steel plant. After the production of ROM, it will be processed through the integrated crushing and screening unit. The fines produced from the said crushing and screening unit will be subjected to

beneficiation unit to be installed inside the block. The beneficiated ore will be converted to cake and the same will be transported by Road from the mine head.

**Transportation of ore**

As mentioned above, the lumps will be transported by Road from the mine head and the iron ore fines in the form of Cake will also be transported by Road from the mine head.

The details of proposed mining and lay out of benches, road design etc during 4<sup>th</sup> year will be as follows:

Particulars		Pit-1	Pit-2
Bench Geometry	Height	10m	10m
	Width	20m or more than the height	20m or more than the height
		At ultimate stage the bench width will be 10m	At ultimate stage the bench width will be 10m
	Individual bench slope angle	85°	85°
Road design	Average width of the road after leaving the berms	17m	17m
	Gradient of Haul road	1:14	1:14
	Ramp Gradient	1:10	1:10
	Berm height	1.5m	1.5m
Quarry development	Sections considered for development	CC' and DD'	BB', and CC'
	Benches considered for development with RL	CC' - 630m to 570m DD' - 620m to 580m	BB'- 600 to 700 CC'- 700 to 620
	Length of proposed benches	1100m (avg.)	550m (avg.)
	Length of advancement of benches	120m	20m
	Direction of advancement	Down ward and laterally (due north)	Lateral movement due south
	Dimension of Quarry at the end of the year including existing benches	520m x 350m x 100m	550m x 370m x 120m
	Overall quarry slope angle	37.5	37.5
	Production of usable ore(MT)	4847666	1208871
	Generation of mineral rejects (MT)	734854	356400
	Production of ROM (Ore + sub-grade) (MT)	5582520	1565271
	Inter-burden (MT)	1033800	289880
	Side burden(MT)	880680	--
	Generation of Waste(MT)	1914480	289880
Total excavation (MT)	7497000	1855151	

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The details of layout of proposed benches have been shown in Plate no – VII of A.H. The details of production of ROM in this year will be as follows:

year	Name of the pit	Mineral rejects (45-55%Fe) (MT)	Mineral rejects (55-58%Fe)(MT)	Usable ore (+58%Fe)(MT)	Total ROM(MT)
4 <sup>th</sup>	pit-1	487966	246888	4847666	5382520
	pit-2	340308	16092	1208871	1565271
<b>Total</b>		<b>828274</b>	<b>262980</b>	<b>6056537</b>	<b>7147791</b>

**Proposed Blending Scheme during 4<sup>th</sup> year:**

As per the above table, tentatively 6056537MT of usable grade of iron ore will be produced from two pits after blending from two pits. This usable ore quantity will have the average grade of 64.79%Fe after blending from the two pits. The proposed blending will be as follows:

Quarry	RL (m)	Quantity (Tones)	Grade (Fe %)	Blendable Material	
				Quantity (Tones)	Grade (Fe%)
Pit-1	620	15552.00	62.39	15552.00	62.39
		103615.20	53.77		
	610	73224.00	62.39	73224.00	62.39
		15648.00	57.52		
		85752.00	54.73		
	600	69660.00	60.83	69660.00	60.83
		59616.00	53.34		
	590	129600.00	63.95	129600.00	63.95
	580	347328.00	63.02	347328.00	63.02
		155520.00	56.38		
		21772.80	52.45		
	570	1183204.80	66.89	1183204.80	66.89
		132192.00	52.45		
	560	1190721.60	65.36	1190721.60	65.36
		24192.00	52.45		
	550	1192190.40	64.61	1192190.40	64.61
		60825.60	54.25		
	540	646185.60	82.51	646185.60	82.51
		74520.00	54.25		
	<b>Sub Total</b>				<b>4847665.40</b>



M/s ESSAR STEEL INDIA LTD)  
(APPLICANT)

**MINING PLAN**

In respect of

GHORABUHRAM- SAGASAHIRON ORE BLOCK  
138 185 HA IN SUNDARGARH DISTRICT, ODISHA



Pit-2	710	35640.00	54.44		
	700	40176.00	62.90	40176.00	62.90
		77976.00	54.44		
	690	73872.00	62.90	73872.00	62.90
		82080.00	54.44		
	680	82728.00	62.90	82728.00	62.90
		73440.00	54.44		
	670	116640.00	60.22	116640.00	60.22
		38880.00	54.44		
	660	138240.00	64.80	138240.00	64.60
		9936.00	57.31		
		6480.00	54.44		
	650	138240.00	64.89	138240.00	64.89
		12096.00	54.44		
	640	138888.00	67.93	138888.00	67.93
		6156.00	57.31		
		8208.00	45.52		
	630	138888.00	66.57	138888.00	66.57
		5508.00	54.44		
	620	129600.00	62.63	129600.00	62.63
610	112320.00	64.98	112320.00	64.98	
600	99360.00	67.25	99360.00	67.25	
<b>Sub Total</b>			<b>1208952.00</b>	<b>64.58</b>	
<b>Grand Total</b>			<b>8056818.40</b>	<b>64.79</b>	

However, as there has been proposal of establishment of beneficiation plant during this year, iron ore containing +55 - 64%Fe will be upgraded to make +64%Fe, so that it can be used in company's steel plant.

**Production from Beneficiation Plant during 4<sup>th</sup> year**

During the year the total feed to the beneficiation plant will be 3411410 MT which will produce upgraded iron ore fines of 2729128 MT and 682282 MT of tailings.

**PRADDEPT MOHAPATRA**  
QUALIFIED PERSON

**SABYASACHI MOHANTY**  
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4th Year Production Plan for Pit-1

Section Considered	RL	Cross Sectional area (Sq.m)			Length of Influence	>58% Fe		58% to 58% Fe		48% to 58% Fe		Total Quantity of ore in Tonne (+58% Fe)	Total Quantity of Mineral Reject in Tonne (48% to 58% Fe)	Waste
		>58% Fe	58% to 58% Fe	45% to 55% Fe		Volume of Ore Zone (Cum)	Quantity of Ore in Tonne	Volume of Ore Zone (Cum)	Quantity of Ore in Tonne	Volume of Ore Zone (Cum)	Quantity of Ore in Tonne			
Section B-B'	820	80	0	633	90	7200	15552	0	0	47970	109615.2	15552	102616.2	22088
	610	339	78	52	100	33900	73224	7900	16648	52000	11292	73224	28080	18760
	580	590	400	56	180	100800	217728.00	72000.00	155520.00	100800.00	217728.00	217728.00	177282.00	73192
	570	1004	0	360	170	240880	368688.00	0.00	0.00	612000.00	132182.00	368688.00	132182.00	92752
Section C-C'	580	1501	0	70	160	240160	518745.00	0.00	0.00	120080.00	24182.00	518745.00	24182.00	100544
	550	1826	0	176	180	291840	630374.40	0.00	0.00	281600.00	60825.60	630374.40	60825.60	128000
	540	600	230	0	150	90000	194400.00	34500.00	74520.00	0.00	0.00	194400.00	74520.00	49600
	510	0	0	230	160	0	0.00	0.00	349600.00	74520.00	0.00	0.00	74520.00	13900
Section D-D'	590	216	0	184	150	32250	68880.00	0.00	0.00	276000.00	59616.00	68880.00	59616.00	23640
	580	400	0	0	150	60000	129600.00	0.00	0.00	0.00	0.00	129600.00	0.00	24000
	570	2514	0	0	150	377100	814536.00	0.00	0.00	0.00	0.00	814536.00	0.00	150840
	560	2074	0	0	150	311100	671976.00	0.00	0.00	0.00	0.00	671976.00	0.00	124440
Total	550	1734	0	0	150	250100	551816.00	0.00	0.00	0.00	0.00	551816.00	0.00	104040
	540	1494	0	0	140	209160	451785.60	0.00	0.00	0.00	0.00	451785.60	0.00	83604
Total (Million Tonne)						2244290	4847666.4	114300	248885	229910	487905.6	4847666.4	734853.6	103900
							4.85	0.23	0.49		0.49	4.85	0.73	1.03

4th Year Production Plan for Pit-2

Section Considered	RL	Cross Sectional area (Sq.m)			Length of Influence	>58% Fe		58% to 58% Fe		45% to 55% Fe		Total Quantity of ore in Tonne (+58% Fe)	Total Quantity of Mineral Reject in Tonne (45% to 58% Fe)	Waste
		>58% Fe	58% to 58% Fe	45% to 55% Fe		Volume of Ore Zone (Cum)	Quantity of Ore in Tonne	Volume of Ore Zone (Cum)	Quantity of Ore in Tonne	Volume of Ore Zone (Cum)	Quantity of Ore in Tonne			
Section B-B'	710	0	0	110	150	0	0	0	0	16800	35640	0	35640	6600
	700	0	0	190	180	0	0.00	0.00	0.00	36100.00	77976.00	0.00	77976.00	14440
	690	0	0	190	200	0	0.00	0.00	0.00	38900.00	82080.00	0.00	82080.00	15200
	680	30	0	170	200	6000	128640.00	0.00	0.00	34000.00	73440.00	129600.00	73440.00	16000
	670	130	0	360	200	22000	473200.00	0.00	0.00	19000.00	38880.00	473200.00	38880.00	16000
	660	160	23	15	200	32000	691200.00	4890.00	9838.00	30000.00	64800.00	691200.00	64800.00	15840
	650	180	15	28	200	32000	691200.00	0.00	0.00	30000.00	12096.00	691200.00	12096.00	15840
	640	170	15	20	190	32300	69780.00	2850.00	6156.00	39000.00	8208.00	69780.00	8208.00	15560
	630	180	15	15	170	32300	69780.00	0.00	0.00	29500.00	5508.00	69780.00	5508.00	13940
	620	200	0	0	150	30000	64800.00	0.00	0.00	0.00	0.00	64800.00	0.00	12000
Section C-C'	810	200	0	0	130	26000	56180.00	0.00	0.00	0.00	0.00	56180.00	0.00	10400
	800	200	0	0	120	24000	51840.00	0.00	0.00	0.00	0.00	51840.00	0.00	9600
	790	124	0	0	160	18600	40176.00	0.00	0.00	0.00	0.00	40176.00	0.00	7440
	690	190	0	0	180	34200	73672.00	0.00	0.00	0.00	0.00	73672.00	0.00	13680
	680	190	0	0	170	32300	69780.00	0.00	0.00	0.00	0.00	69780.00	0.00	12920
	670	200	0	0	160	32300	69780.00	0.00	0.00	0.00	0.00	69780.00	0.00	12920
	660	200	0	0	160	32300	69780.00	0.00	0.00	0.00	0.00	69780.00	0.00	12920
	650	200	0	0	160	32300	69780.00	0.00	0.00	0.00	0.00	69780.00	0.00	12920
	640	200	0	0	160	32300	69780.00	0.00	0.00	0.00	0.00	69780.00	0.00	12920
	630	200	0	0	160	32300	69780.00	0.00	0.00	0.00	0.00	69780.00	0.00	12920
Total	620	200	0	0	150	30000	64800.00	0.00	0.00	0.00	0.00	64800.00	0.00	12800
	610	200	0	0	130	26000	56180.00	0.00	0.00	0.00	0.00	56180.00	0.00	10400
Total						220000	475200.00	0.00	0.00	0.00	475200.00	0.00	8900	
Total (Million Tonne)						559700	1208862	7480	16092	187980	340308	1208862	366400	289880
							1.21	0.02	0.34		1.21	0.36	0.29	

Side Burden

Quarry	Section Considered	RL	Cross Sectional area (m2)	Length of Influence (m)	Volume (Cum)	Quantity (MT)
Pit-1	Section C-C'	610	104	180	16720	37440
		600	820	180	148400	298800
		590	903	180	162540	325080
		580	200	180	72000	144000
		570	110	150	16500	33000
		560	337	150	50550	101100
Section D-D'	610	189	150	25360	50700	
	Total				440940	890600


  
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### EXCAVATION PROPOSAL DURING 5<sup>TH</sup> YEAR

During 5<sup>th</sup> year of plan period, it is proposed to produce usable iron ore of 6043572 MT. To achieve the targeted usable quantity it is envisaged to produce 7162538 MT of ROM in this year. To obtain the said quantity it has been planned to develop the pit-1 and pit-2 both laterally and depth ward from the 4<sup>th</sup> year bench position. The individual bench faces will be kept nearly vertical ( $80^{\circ}$ - $85^{\circ}$ ) whereas the overall quarry slope angle is proposed to be kept at less than  $45^{\circ}$  with the horizontal. Iron ore strata will be loosened through drilling and blasting. Blasted rocks in each bench will be excavated & transported by mechanized means to the processing unit. The height and width of the benches will be kept at 10m and 20m respectively. The individual bench slope will be maintained at  $85^{\circ}$  whereas the gradient of the proposed road will be maintained at 1:16 and at ramp the gradient will be at 1:10.

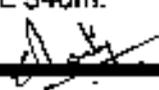
#### Development of Pit-1

It has been planned to produce 3582187MT of ROM from pit-1 in this year. Out of which usable ore will be 3017542MT and balance quantity will be 5694645 MT of mineral rejects of 45-58%Fe. To achieve the quantity lateral development of pit-1 will be done along DD'. Along section DD' advancement of benches at 540m to 830m will be done due north. As a result of this development pit-1 will be fully exhausted. Hence, concurrent back-filling has been proposed to done over the exhausted part of the area from southern end of the quarry.

#### Development of Pit-2

It is envisaged to produce 3580351tons of ROM from pit-2 in this year in which the usable ore will be 3026030tons. The remaining quantity will be 554321 tons with 45 - 58%Fe. To achieve the targeted production from pit-2 it has been planned to develop the pit along three sections e.g. BB', and CC'. Advancement of benches for 70m along the section BB' will be done from 600m.RL to 710m.RL due south and another bench having RL 720m will be formed above 710m.RL. Similarly along CC', the benches of 4<sup>th</sup> year having RL 600m to 700m will be advanced due south for 15m. The development of pit-2 will be within the co-ordinates 2427850 - 2428570N and 322800 to 323210E and in depth the 4<sup>th</sup> year benches will further go down up to the RL 540m.

  
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At the end of the year the dimension of two pits, will be as follows:

Name of the pit	Dimension
Pit -1	590m x 350m x 90m
Pit-2	500m x 400m x 130m

**Disposal of waste and Sub-grade/mineral rejects**

During this year 1102834 cum of waste will be generated from pit-1 and 331514cum of waste will be generated from pit-2. Out of the total waste generation from pit-1 about 10% will be utilized for road maintenance and balance 90% will be utilized for back-filling in the exhausted part of Pit-1. Similarly, the waste to be generated from pit-2 will be utilized for road maintenance and construction of retaining wall. About 10% of the waste will be utilized for construction of retaining wall & road maintenance and balance 90% will be utilized for dumping at dump-2. During this year there will be re-handling of waste dump-1. The same quantity shall be utilized for back filling of pit-1.

The tailings generated from the beneficiation plant will be disposed of within proposed tailing dam earmarked in the map. It is estimated that approximately 660812 MT will be disposed of at the said location.

During 5<sup>th</sup> year, 719431MT (45-55%Fe) and 399535MT (55-58%Fe) of mineral reject/sub-grade will be generated. There will be two separate sub-grade ore/ mineral reject stack for each grade.

The sub-grade/mineral reject stack -1 will be for (45-55%Fe) and sub-grade/mineral reject stack - 2 will be for (55-58%Fe).

**Mineral Processing**

After the production of ROM, it will be processed through the integrated crushing and screening unit. The fines produced from the said crushing and screening unit will be subjected to Beneficiation unit installed inside the lease hold area. The beneficiated ore will be converted to cake and the same will be transported by Road from the mine head.

**Transportation of ore**

As mentioned above, the lumps will be transported by Road from the mine head and the Iron ore fines in the form of Cake will also be transported by Road from the mine head.

  
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The details of proposed mining and lay out of benches, road design etc during 6<sup>th</sup> year will be as follows:

Particulars		Pit-1	Pit-2
Bench Geometry	Height	10m	10m
	Width	20m or more than the height	20m or more than the height
		At ultimate stage the bench width will be 10m	At ultimate stage the bench width will be 10m
Individual bench slope angle	85°	85°	
Road design	Average width of the road after leaving the berms	17m	17m
	Gradient of Haul road	1:16	1:16
	Ramp Gradient	1:10	1:10
	Berm height	1.5m	1.5m
Quarry development	Sections considered for development	DD'	BB', and CC'
	Banches considered for development with FL	DD' - 630m to 540m	BB' - 720 to 590 CC' - 720 to 600
	Length of proposed benches	550m (avg.)	480m (avg.)
	Length of advancement of benches	178m	75m
	Direction of advancement	Laterally (due north)	Laterally due south
	Dimension of Quarry at the end of the year including existing benches	590m x 350m x 90m	500m x 400m x 130m
	Overall quarry slope angle	37.5	37.5
	Production of usable ore(MT)	3017542	3026030
	Generation of mineral rejects (MT)	564645	554321
	Production of ROM (Ore + sub-grade) (MT)	3582187	3580351
	Inter-burden (MT)	1542300	663026
	Side burden(MT)	663368	--
Generation of Waste(MT)	2205668	663028	
Total excavation (MT)	5787855	4243379	

The details of layout of proposed benches have been shown in Plate no - VII (I & J). The details of production of ROM in this year will be as follows:

year	Name of the pit	Mineral rejects (45-55% Fe) (MT)	Mineral rejects (55-58% Fe) (MT)	Usable ore (+58% Fe) (MT)	Total ROM(MT)
5 <sup>th</sup>	pit-1	165110	399535	3017542	3582187
	pit-2	554321	0	3026030	3580351
Total		719431	399535	6043572	7162538

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**Proposed blending scheme during 5<sup>th</sup> Year**

As per the above table, tentatively, 6043572MT of usable iron ore of average 63.30%Fe will be produced from two pits after blending. The details of blendable ore will be as follows:

Quarry	RL (m)	Quantity (Tones)	Grade (Fe%)	Blendable ore	
				Quantity (Tones)	Grade (Fe%)
Pit-1	600	165110.40	53.52		
	590	250344.00	62.39	250344.00	62.39
		142408.80	53.52		
	580	475113.60	63.02	475113.60	63.02
		151632.00	53.52		
	570	656294.40	64.75	656294.40	64.75
		53913.60	53.52		
	580	678456.00	62.29	678456.00	62.29
	550	439452.00	63.95	439452.00	63.95
	540	517881.60	63.3	517881.60	63.30
51580.80		53.52			
<b>Sub Total</b>				<b>3017541.60</b>	<b>63.36</b>
Pit-2	720	48384.00	54.44		
	710	10368.00	58.94	10368.00	58.94
		179712.00	54.44		
	700	163512.00	59.85	163512.00	59.85
		161568.00	54.44		
	690	314452.80	59.85	314452.80	59.85
		81648.00	54.44		
	680	374025.60	59.85	374025.60	59.85
		89984.00	54.78		
	670	373809.60	59.97	373809.60	59.97
	680	376034.40	64.55	376034.40	64.55
	650	351648.00	64.83	351648.00	64.83
	640	313200.00	66.90	313200.00	66.90
	630	210816.00	66.57	210816.00	66.57
	620	164592.00	65.02	164592.00	65.02
	610	113097.60	61.64	113097.60	61.64
	600	46440.00	66.35	46440.00	66.35
214034.40		67.77	214034.40	67.77	
590	13024.80	51.54			
<b>Sub Total</b>				<b>3026030.40</b>	<b>63.23</b>
<b>Grand Total</b>				<b>6043572.00</b>	<b>63.30</b>

However, as the beneficiation plant will be in operation from 4<sup>th</sup> year onwards, the iron ore containing +55 - 64%Fe will be upgraded to +64%Fe so that it can be usable in the company's steel plant.

**Production from Beneficiation Plant during 5<sup>th</sup> year**

During the year the total feed to the beneficiation plant will be 3387918 MT which will produce upgraded iron ore fines of 2707106 MT and 680812 MT of tailings.

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Section Considered	RL	Cross Sectional area (Sq.m)			Length of Influence	Volume of Ore Zone (Cum)	55% to 58% Fe		45% to 55% Fe		Total Quantity of Ore in Tonne (+58% Fe)	Total Quantity of Mineral Present in Tonne (45% to 58% Fe)	Waste
		+58% Fe	55% to 58% Fe	45% to 55% Fe			Length of Influence	Volume of Ore Zone (Cum)	Quantity of Ore in Tonne	Quantity of Ore in Tonne			
Section C-C	800	0	0	364	210	0	0	0	76440	185140.4	0	165110.4	30575
	590	610	347	0	180	115900	260344	65930	0	0	250344	142408.8	72732
	580	1222	380	0	180	219990	475113.60	70200.00	0.00	0.00	475113.60	151632.00	116084
	570	1899	169	0	180	303840	655294.40	28860.00	0.00	0.00	655294.40	53913.60	131520
	560	2094	0	0	150	314100	678456.00	0.00	0.00	0.00	678456.00	0.00	128640
	550	1585	0	0	130	203450	438452.00	0.00	0.00	0.00	438452.00	0.00	81980
540	1998	199	0	120	239760	517881.60	28800.00	0.00	0.00	517881.60	51580.80	106456	
<b>Total</b>						1387010	3017541.6	184970	76440	165110.4	3017541.6	64845.8	663368
<b>Total (Million Tonnes)</b>							3.02		0.40	0.17	3.02	0.56	0.56

Section Considered	RL	Cross Sectional area (Sq.m)			Length of Influence	Volume of Ore Zone (Cum)	58% Fe		45% to 55% Fe		Total Quantity of ore in Tonne (+58% Fe)	Total Quantity of Mineral Present in Tonne (45% to 58% Fe)	Waste
		+58% Fe	55% to 58% Fe	45% to 58% Fe			Length of Influence	Volume of Ore Zone (Cum)	Quantity of Ore in Tonne	Quantity of Ore in Tonne			
Section B-B	720	0	0	140	180	0	0	0	22400	46394	0	46394	8960
	710	30	0	520	160	4800	10988	0	63200	179712	10968	179712	35200
	700	210	0	440	170	35700	77112.00	0.00	74800.00	181688.00	77112.00	161568.00	44200
	690	566	0	210	180	101880	220080.80	0.00	37800.00	81848.00	220080.80	81648.00	55372
	680	722	0	180	180	128860	290713.80	0.00	32400.00	69924.00	290713.80	69924.00	54944
	670	798	0	0	170	135860	293025.80	0.00	0.00	0.00	293025.80	0.00	54264
	660	817	0	0	170	138880	300002.40	0.00	0.00	0.00	300002.40	0.00	55566
	650	830	0	0	160	132800	286848.00	0.00	0.00	0.00	286848.00	0.00	63120
	640	780	0	0	150	117000	252720.00	0.00	0.00	0.00	252720.00	0.00	49800
	630	530	0	0	140	74200	160272.00	0.00	0.00	0.00	160272.00	0.00	29680
	620	470	0	0	120	58400	121824.00	0.00	0.00	0.00	121824.00	0.00	22560
	610	310	0	0	140	34100	73656.00	0.00	0.00	0.00	73656.00	0.00	13640
600	50	0	0	100	5000	10600.00	0.00	0.00	0.00	10600.00	0.00	2000	
590	441	0	0	67	90	39680	85730.40	0.00	6030.00	13024.80	13024.80	16288	
700	200	0	0	200	40000	85400.00	0.00	0.00	0.00	85400.00	0.00	16000	
690	230	0	0	180	43700	84392.00	0.00	0.00	0.00	84392.00	0.00	17480	
680	240	0	0	180	43200	83312.00	0.00	0.00	0.00	83312.00	0.00	17280	
670	220	0	0	170	37400	80784.00	0.00	0.00	0.00	80784.00	0.00	14960	
660	220	0	0	180	35200	78032.00	0.00	0.00	0.00	78032.00	0.00	14080	
650	200	0	0	150	30000	64800.00	0.00	0.00	0.00	64800.00	0.00	12000	
640	200	0	0	140	28000	60480.00	0.00	0.00	0.00	60480.00	0.00	11200	
630	180	0	0	130	29400	60544.00	0.00	0.00	0.00	60544.00	0.00	9360	
620	185	0	0	120	19800	42768.00	0.00	0.00	0.00	42768.00	0.00	7920	
610	185	0	0	110	18260	39441.80	0.00	0.00	0.00	39441.80	0.00	7364	
600	165	0	0	100	18500	35840.00	0.00	0.00	0.00	35840.00	0.00	6800	
590	660	0	0	90	69400	128304.00	0.00	0.00	0.00	128304.00	0.00	23780	
<b>Total</b>						1406440	3026020.4	0	258630	654320.8	3026020.4	654320.8	663028
<b>Total (Million Tonnes)</b>							3.08		0.15	0.17	3.03	0.55	0.66

Side Burden						
Quarry	Section Considered	RL	Cross Sectional area (m <sup>2</sup> )	Length of Influence (m)	Volume (Cum)	Quantity (MT)
Pit-1	Section D-D	820	845	190	160550	321100
		810	1455	180	281900	523800
		800	1190	170	202300	404800
		690	890	180	110400	220800
		580	240	150	36000	72000
<b>Total</b>					771150	1542300



  
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(c) Enclose individual year wise development plans and sections showing pit layouts, dumps, stacks of mineral reject, if any, etc. in case of 'A' category mines.

On account of exposures of iron ore and its limited depth of occurrence, open cast method of mining will be continued on three shift basis with the deployment of DTH drills, associated compressors, dumpers, excavators and other auxiliary equipment for development, production, processing, protection of environment and safety. Separate year wise development plan along showing pit layouts, dumps, stacks of mineral rejects along with sections are attached. (Ref plate No- VII-A to VII-J)

(d) Describe briefly giving salient features of the proposed method of working indicating Category of mine.

The mine comes under Category "A" fully mechanized mines. Proposed bench height in the quarry area is 10 m with 20 m working width. Bench slope angle of  $85^{\circ}$  has been considered for the quarry. Inter bench ramp of 20 m at a gradient of 1 in 16 has been planned to facilitated transportation ore ROM from different faces to the crushing plants respectively.

Drilling is proposed to be done using 150mm/115mm diameter drills with 10% sub grade drilling.

Blasting will be done by adopting the State of Art technology by using mostly SME (Site Mixed Emulsion Explosives) along with conventional explosives such as PGC, Toe blast and ANFO. Controlled blasting along with shock tube initiation system / NONEL system will be practiced for getting optimum blast results and minimization of hazards. Boulders generated during the course of blasting will be broken in to smaller pieces by using rock breaker.

The blasted material will be excavated by shovels of 4.5 cum - 5.7cum capacity and loaded onto 50- 80 T dumpers for transportation of the ROM, sub grade and waste. The ROM ore from different mining faces will be transported by dumpers of 50-80T in a pre-determined proportion (for blending different qualities of ore), and delivered to the processing plant.



e) Describe briefly the Layout of Mine Workings, Pit road layout, the layout of faces and sites for disposal of overburden/waste along with ground preparation prior to disposal of waste, reject etc. A reference to the plans and sections may be given. UPL or ultimate size of the pit is to be shown for identification of the suitable dumping site.

**LAY OUT OF MINE WORKING**

Development of existing benches will be done laterally as well as depth ward. At the end of the plan period the approximate dimension of the quarry will be as follows:

Sl. No.	Parameters	Pit-1	Pit-2
1.	Quarry Size (L x W x D)	590m x 350m x 90m	500m x 400m x 130m
2.	Total No. of Benches	9 nos	13 nos
3.	Top Bench RL	630 m. RL	720m
4.	Bottom Bench RL	540 m. RL	590
5.	Maximum Bench Height	10 m	10 m
6.	Bench Width	20 m(max) 10m(min)	20 m(max) 10m(min)
7.	Average Bank Slope	85°	85°

**PIT ROAD LAYOUT**

As far as economically feasible, all geometric elements of haulage roads will be designed to provide safe, efficient travel at normal operating speeds. Considering the capacity of the dumper, the haul road will be designed by safe and scientific way up to the final dispatch point.

**Haul Road Geometry**

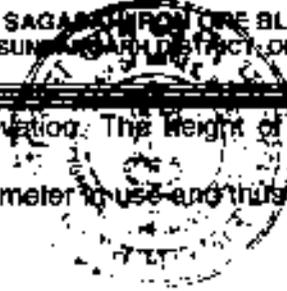
There will be both temporary and permanent nature of haul road within the block. The temporary haul road in each pit will change from time to time. The length of the permanent haul road with in the Pit -1 & Pit-2 will be approx. 1 Km.

The proposed benches of the pit-1 and 2 will be utilized for haul road. The bench width has been kept at 20m. However, the after keeping safety berms of 1.0m width and 1.5m height on either side of the haul road along with drainage channel the effective width of haul road will be kept at 17m with gradient of 1:16.

The haul roads are designed to be 2 to 3 times the width of the largest dumper using the road. This thumb rule is intended to provide adequate passing clearance between dumpers. Haul road geometry is comprised of many factors including maximum grade, cross slopes of road, running width etc. The maximum haul road gradient will be limited to 6% and maximum 10% in short ramps between benches. Maximum curve super-elevation will be limited to 3% and speed limits

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will be imposed at tighter curves to reduce the required super-elevation. The height of safety berms will be generally calculated as 1/2 to 3/4 of the largest tire diameter (muse) and thus varied from 1.0m to 1.5m.

**Haulage Road Cross Section**

A stable road base is one of the most important fundamentals of road design. Moreover, lack of a sufficiently rigid bearing material beneath the road surface will permit excessive rutting, sinking, and overall deterioration of the travelled way. As far as lithology is concerned the proposed haulage road will be over the laterite, and hard hematite. Hence, there will be mainly sub base of 1.0m, over which the base course will be another 0.5m. Above the base course it has been envisaged to put surface course of 0.5m. All together the sub-base, base course, surface course will be 2.0m. Over the surface course it has been proposed to make 2% of crowning. The schematic diagram of proposed haul road is furnished below:



**Symptoms and Causes of Haul Road Deterioration**

Potholes, rutting, and settlement are major symptoms of haul road deterioration. The running surface of the road suffered mostly due to precipitation/runoff, heavy traffic volume, spring breakup, and vehicle spillage. Main causes of deterioration to the base layer are spring breakup, precipitation/runoff, heavy traffic volume and poor compaction. Poor compaction, high ground water level and precipitation are major causes of deterioration to other layers.

**Haul Road Maintenance**

Lack of road maintenance can increase the operating cost for haulage. Proper maintenance of the road surface minimizes the effect of bumps, holes, spillage, and rolling resistance on the haulage fleet. Haul roads will not propose to be allowed to remain rutted or grooved. Graders will be used to keep the road surface smooth to maintain cross slope, and to remove loose rocks

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from the surface. All roads deteriorate gradually with time due to the effect of weather and repetitive loading from passing vehicles. Road maintenance can slow the rate of deterioration, but eventually a point is reached where repairs or rehabilitation is necessary. For permanent roads the repair may involve removal of the surface layer and replacement and compaction of portions of the damaged base and sub-base. Often the existing surface layer can be scarified and compacted followed by placement of an additional thickness of compacted material on top. Rehabilitation of the road may be a strategy used to extend the life of a road.

**Layout of faces**

Layouts of faces have been tentatively furnished as follows:

Name of the quarry	Description	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>	5 <sup>th</sup>
Pit-1	Face RL(m)	600-620	570-630	560-630	540-640	540-630
	Length of face(m)	900(avg.)	680(avg.)	600 (avg.)	1000m	550m (avg.)
	Direction of advancement	Down ward and laterally	Down ward and laterally (due south)	Down ward and laterally (due south)	Down ward and laterally (due north)	Laterally (due north)
	Length of Advancement	110m	40m	145m	120m	178m
Pit-2	Face RL	620-680	620-700	600-710	600-720	590-720
	Length of face	595m(avg)	535(avg.)	550(avg.)	550m(avg.)	480m (avg.)
	Direction of advancement	Lateral and down ward	Lateral movement due south	Lateral movement due south	Lateral movement due south	Laterally due south
	Length of Advancement	100m	60m	150m	20m	75m

**Sites for disposal of waste along with ground preparation**

There will be 2 waste dumps one for pit-1 at northern part of the lease area and the other one will be at southern part of the lease area for pit-2. Approach road to the proposed dumping site already exists. Prior to commencement of dumping all statutory clearances will be made. After tree felling, retaining wall & garland drains along with settling pits will be constructed to protect the surrounding environment from wash-offs etc.

**Site for disposal of mineral rejects along with ground preparation**

There will be two mineral reject/ sub grade dumps, one is for 45-55%Fe and other is for 55-58%Fe. The proposed sub-grade/mineral reject dump area has been shown in the earmarked site. The area selected will be made ready by clearing the vegetation. Further retaining wall and garland drains will be made on the toe of the mineral reject dump as a part of mineral reject stack management.

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f) Conceptual Mine planning up to the end of lease period taking into consideration the present available reserves and resources describing the excavation, recovery of ROM, Disposal of waste, backfilling of voids, reclamation and rehabilitation showing on a plan with few relevant sections.

• **LIFE OF THE MINE**

Total mineable reserve of iron ore under all the categories (Probable) within the area has been worked and it is estimated that 78.24Mil.T up to of +45 % Fe grade available as on date as per present exploration data. The total production (+58% Fe & +45 to -58%Fe) from mines during the present plan period will be 29.55Mil.T. Hence reserve available for conceptual period will be 48.685Mil.T. The calculation detail for the life of the mine is given below:

✓ Total reserves under proved category	-	78.24Mil.T
✓ Production during balance 5 years	-	29.555 Mil.T
✓ Balance reserves for conceptual period	-	48.685 Mil.T
✓ Rated production per annum	-	7.16Mil.T
✓ No. of years production will be carried out during Conceptual period	-	48.685/7.16=6.799Years (say 7 years)
Life of mine	-	12 years

(5 years of plan period + 7.0 years of conceptual period)

However, the life of the mines may vary depending upon the raw material requirement for the steel plant and marketing scenario as well as remaining reserve to be established during conceptual period.

**Time frame for completion of Exploration within the lease holds area**

Total 28 bore holes have been drilled. During plan period an additional 75 bore holes have been proposed to prove the mineral resource under G1 category. After completion of these boreholes the exploration of the whole lease area will be complete.

**Ultimate extent & Size of the pit**

The conceptual iron ore quarry has been projected considering the ultimate pit slope, boundary safety zone and road safety zone. As a village road is passing within the lease area, a 10m safety distance has been kept from both side of village road. Due to this road, there will be two ultimate pits within the lease area. The ultimate pit limit has been earmarked within the conceptual plan. Height and width of the benches will be kept at 10m each for optimum recovery of ore and to maintain final slope angle of the pit at around 45° with the horizontal. Maximum 9nos of benches will be formed within UPL-1 and 21nos of benches within UPL-2 during life of the mine. (Ref conceptual plan and section).

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A total of 88.759 Ha will be utilized for mining during conceptual period. In the northern part the UPL covers about 22.114 ha and in the southern and eastern part the UPL covers an area of about 66.645 Ha. The details are given below:

Name	Ultimate Boundaries		Level (m RL)	Area	
	Northing	Easting		(m <sup>2</sup> )	(ha)
UPL-1	2427850-2428570	322800-323210	620-540	221140	22.114
UPL-2	2427270-2428180	322800-324340	730-520	666450	66.645
<b>Total</b>				<b>887590</b>	<b>88.759</b>

**Final slope angle at the close of mine:**

The individual bench slope would be kept nearly vertical, height and width of the benches would be kept at 10m each. The individual bench slope will be kept at 85° with the horizontal whereas the overall quarry slope angle would be maintained at less than 37° to the horizontal during plan period and 45° at the end of the life of the mine.

**Ultimate Pit Limit Boundaries**

The ultimate pit limit boundaries have been earmarked in the conceptual plan and conceptual sections.

**Ultimate capacity of Dump**

**Dumping during plan period:**

The material generated during mining, having less than 45% Fe, is considered as waste. The waste includes the laterite, shale etc. Based on the exploration data, different ore zones has been marked over the geological plan and sections. Based on these earmarked zones, the recovery percentage of ore has been considered as per the GSI report. The percentage of iron content (-45%Fe) within each zone has been considered as waste i.e. 20% of total volume of ore zone. Besides, side burden development will also take place which has been calculated yearly basis.

During plan period of 5 years waste will be generated from both pit-1 and pit-2 as intercalated waste and side burden. The year wise pit wise waste generation during plan period will be as follows:

Year	Waste from Pit-1(cum)			Waste from Pit-2 (cum)			Total waste (cum)
	Inter burden	Side burden	Total	Inter burden	Side burden	Total	
1 <sup>st</sup>	273180	116250	389410	88660	18000	106660	496070
2 <sup>nd</sup>	321954	39700	361654	120426	--	120426	482080
3 <sup>rd</sup>	379480	230960	610440	227898	76500	304398	914838
4 <sup>th</sup>	518900	440340	957240	144940	--	144940	1102180
5 <sup>th</sup>	771150	331684	1102834	331514	--	331514	1434348
<b>Total</b>	<b>2262644</b>	<b>1168934</b>	<b>3421578</b>	<b>913438</b>	<b>94500</b>	<b>1007938</b>	<b>4429516</b>

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From the above table it can be observed that 3421578cum of waste will be generated from pit-1 and 1007938 cum from pit-2. There will be two separate dumps for each pit. Dump-1 will be done temporarily within ultimate pit limit and dump-2 will be permanently kept and stabilized within non-mineralized area.

**Re-handling of waste**

The waste of pit-1 has been proposed to be dumped at dump-1 which is located within ultimate pit limit. Hence during 5<sup>th</sup> year of plan period it is envisaged to re-handle the dump-1 and that quantity of waste i.e. 447862cum will be utilized for back-filling of exhausted part of pit-1. The details of year wise dumping will be as follows:

**Management of waste from pit-1**

Year	Waste from Pit-1(cum)			Management of waste						RL
	Inter burden	Side burden	Total	Road maintenance/ Construction of bund at mineral reject dump area		Dumping at Dump-1	Area of dumping (m <sup>2</sup> )	Back-filling at pit-1	Area of back-filling (m <sup>2</sup> )	
				%age	Quantity					
1 <sup>st</sup>	273160	116250	389410	50	194705	194705	30053	--	--	620-630
2 <sup>nd</sup>	321954	39700	361654	30	108496.2	253157.8	18108	--	--	630-645
3 <sup>rd</sup>	379460	230960	610440	100	610440*	0	--	--	--	Total waste will be utilized for making bund
4 <sup>th</sup>	516900	440340	957240	10	95724	--	--	861516	34446	
5 <sup>th</sup>	771150	331684	1102834	10	110283.4	--	--	1440413 (992550 + 447862 re-handling of dump-1)	28132  26711	540-580  580-590
<b>Total</b>	<b>2262644</b>	<b>1158934</b>	<b>3421578</b>		<b>1116649</b>	<b>447862</b>	<b>48181</b>	<b>2301926</b>		

\*The total waste of 610440cum will be utilized for embankment making in the proposed tailing pond area.

**Management of waste from pit-2**

The waste to be generated from pit-2 will be utilized partly for road maintenance and dumping at dump-2. The year wise utilization of waste will be as follows:

Year	Waste from Pit-2 (cum)			Road maintenance @10%	Dumping at Dump-2	Area (m <sup>2</sup> )	RL (m)
	Inter burden	Side burden	Total				
1 <sup>st</sup>	88660	18000	106660	10666	95994	11317	615-630
2 <sup>nd</sup>	120426	--	120426	12042.6	108383.4	11316	615-630
3 <sup>rd</sup>	227898	76500	304398	30439.8	273958.2	--	Total waste will be utilized for making bund
4 <sup>th</sup>	144940	--	144940	14494	130446	10133	630-645
5 <sup>th</sup>	331514	--	331514	33151.4	298362.6	10134	630-645
<b>Total</b>	<b>913436</b>	<b>84500</b>	<b>1007936</b>	<b>100793.8</b>	<b>807144.2</b>		

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**Waste generation by digging of tailing pond area.**

It is envisaged to divide the tailing pond area into 3 compartments. Accordingly excavations will be carried out. As per the lithology, the tailing pond area is soil and alluvium. From the field observation it could be found that the thickness of soil cover is 3m from the surface. The scrapped top soil will be utilized for afforestation purpose and the overburden below the top soil which is likely to be removed will be utilized for making of embankment for the tailing pond.

**Waste generation from Beneficiation plant**

As earlier explained, beneficiation plant of 6.0MTPA (product) capacity will be established from 4<sup>th</sup> year on wards. As per the material balance, about 20% of total feed capacity will be generated as mineral rejects having -45%Fa which will be in the form of tailings. The details of year wise generation of mineral rejects from beneficiation plant will be as follows:

Year	Generation of waste from Beneficiation plant	
	MT	cum
1 <sup>st</sup>	--	--
2 <sup>nd</sup>	--	--
3 <sup>rd</sup>	--	--
4 <sup>th</sup>	682281	341141
5 <sup>th</sup>	680812	340406
<b>Total</b>	<b>1363093</b>	<b>681546.5</b>

The waste to be generated from beneficiation plant will be disposed of at proposed tailings pond. A total of 4.92 Ha has been earmarked for tailing pond. During the conceptual period an area of 6.93 Ha of Pit -1 (mineral exhausted pit) will be used as tailing pond.

**Dumping During conceptual period:**

Total waste generation during conceptual period will be as follows:

Intercalated waste to be generated during conceptual period	=	4068558cum
Side burden removal during conceptual period	=	2379655cum
<b>Total waste generation during conceptual period</b>	=	<b>6448513cum</b>

**Utilization of conceptual waste**

Total waste generation from quarry as intercalated waste and side burden during conceptual period (6<sup>th</sup> year to 12<sup>th</sup> year) will be 6448513cum. Likely generation of waste from quarry during 6<sup>th</sup> to 8<sup>th</sup> year will be 2763648cum. Out of which, it is envisaged that 30% i.e. 829094.5 Cu m will be utilized for road maintenance and balance 70% i.e. 1934554cum will be utilized for dumping at dump-2 and back-filling within pit-1. It is proposed to dispose of 216855cum of waste over dump-

2and remaining 1717699cum will be utilized for back-filling within exhausted part of pit-1. It is expected that the pit -2 will be exhausted during 8<sup>th</sup> year of plan period. Hence, from 9<sup>th</sup> year onwards the pit-2 will be reclaimed by means back-filling with 2522432cum of waste. The remaining waste i.e. 1162433cum will be utilized for back filling of in the eastern part of UPL-2.

Period	Volume of waste (cum)	Road maintenance	Management	Location of dumping	Area of dumping/ back filling (m <sup>2</sup> )	RL
6 <sup>th</sup> to 8 <sup>th</sup> year	2763648	829094.5 @ 30% as road maintenance	216855cum at waste dump-2 and 1717699cum for back-filling at pit-1	Dump-2 and pit-1	Dump-2 14457m <sup>2</sup> Back-filing 43783m <sup>2</sup>	645-660 540-610
9 <sup>th</sup> year to 10 <sup>th</sup> year	2522432	-	To be utilized for back-filling in pit-2	Pit-2(UPL-2)	99504	560-610
11 <sup>th</sup> to 12 <sup>th</sup> year	1162433	-	Back filling of in the eastern part of UPL-2	Eastern side UPL-2	112281	550-600
<b>Total</b>	<b>6448513</b>	<b>829094.5</b>				

Further, it is expected that 2380000cum of waste will be generated from the beneficiation plant as tailings. From 6<sup>th</sup> year onwards it has been planned to dispose of the tailings within exhausted part of pit-1. The retaining wall to be constructed after the back filling of pit-1 will separate the waste from tailings of beneficiation plant.

**\* GENERATION OF SUBGRADE ORE AND ITS DISPOSAL**

**During plan period**

Year	sub-grade(cum) from Pit-1			sub-grade(cum) from Pit-2			Total sub-grade(cum)			Total sub-grade (MT)		
	+45-58	+55-58	Total	+45-58	+55-58	Total	+45-58	+55-58	Total	+45-58	+55-58	Total
1 <sup>st</sup>	105840	195840	301680	162880	17120	180000	268720	212960	481680	725544	574992	1300536
2 <sup>nd</sup>	18720	51208	69928	213648	33008	246656	230368	84216	314584	821992	227382	849374
3 <sup>rd</sup>	83072	0	83072	234344	72120	306464	287418	72120	368538	803022	194724	897747
4 <sup>th</sup>	193728	91440	272168	128040	8860	132000	308788	87400	404188	828272	282880	1091254
5 <sup>th</sup>	51152	147976	209128	205304	0	205304	288488	147976	436464	719431.2	349535.2	1118966
<b>Total</b>	<b>427872</b>	<b>408864</b>	<b>836736</b>	<b>842216</b>	<b>128208</b>	<b>970424</b>	<b>1389728</b>	<b>614472</b>	<b>1984400</b>	<b>3682266</b>	<b>1899814</b>	<b>5367880</b>

**Proposed sub-grade stack**

**Utilization of mineral rejects**

A total of 1984400cum of mineral rejects/sub-grade iron ore will be generated during proposed plan period. From above table, it is observed that about 913976cum of mineral rejects will be generated from pit-1 and 1070424cum will be generated from pit-2. It is envisaged to stack the sub-grade iron ore containing +45-55%Fe at sub-grade stack-2 over an area of 3.52 ha and that of +55-58%Fe at sub-grade stack -1 over an area of 1.13ha.

As earlier explained the beneficiation plant will come into force on 4<sup>th</sup> year. Hence, it is envisaged to use sub-grade containing iron ore of +55-58%Fe from 4<sup>th</sup> year onwards in the beneficiation plant to up-grade the ore for making it usable. The cumulative sub-grade stock from 1<sup>st</sup> year to 3<sup>rd</sup>

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year containing +55-58%Fe is 997099MT. During 4<sup>th</sup> year earlier accumulated sub-grade along with the sub grade (+55- 58% Fe) generated during the year will be used for beneficiation. The said quantity along with 4<sup>th</sup> year sub-grade (+55-58%Fe) generation will be utilized for beneficiation. However, it is proposed to utilize the sub-grade (+55-58%Fe) to be generated in each year for the purpose of beneficiation. During the 5<sup>th</sup> year sub grade ore generated during the year will be fed to the beneficiation plant.

To up-grade the sub-grade iron ore/mineral rejects and to make it usable, It has been planned to establish a 6.0 MTPA capacity beneficiation plant during ensuing plan period. The said plant is expected to be commissioned in 4<sup>th</sup> year after obtaining the environment clearance from MoEF & CC and Consent to Establish from State Pollution control Board, Odisha.

**Conceptual generation of sub-grade ore and its utilization:**

Beyond plan period about 5593796MT of sub-grade ore containing+45-55% Fe and 5503038 MT of +55-58%Fe will be generated. At the end of plan period sub-grade containing +55-58%Fe will be 880629MT. Hence, total availability of sub-grade iron ore of +55-58%Fe will be 6383667MT. The said quantity will be utilized for beneficiation during conceptual period for up gradation. Regarding +45-55%Fe, all efforts will be made find out the appropriate and economic technology to up-grade the sub-grade material to acceptable quality for captive consumption for the steel plant. Till such time the sub-grade variety of ore will be systematically stacked at designated place inside the ML area.

**Precaution for confinement of dump to prevent pollution of surface water bodies/ courses:**

The waste generated from the mines shall be dumped in the non-mineralized area earmarked in the plan. The precautionary and protective measures to be adopted during waste disposal are as follows:

- The ultimate dump slope shall be maintained at 28° with individual terrace slopes not exceeding 37°.
- Each terrace will have inward slope with catch drain at the inward slope of terrace.
- Catch drain of the individual terrace shall be connected to the garland drain outside the periphery of dump. Catch drain preferably to be made up of the half concrete open pipes followed by settling tanks to avoid wash offs and have provision of berms at the outer side to reduce gully formation due to rain water wash offs.
- Toe wall, garland drain and settling tank will be constructed around the dump.

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**ENVIRONMENTAL ASPECTS**

**LAND DEGRADATION / UTILIZATION**

As given earlier, the total area covers is 139.165Ha. At the end of ensuing plan period, an area of 85.9451 Ha will be utilized. However, the detail land use pattern will be as follows:

Particulars	AREA IN HECTARE				
	At present	Additional area during plan period	Land use at the end of plan period	Additional area beyond plan period	Land-use during conceptual period
Area under mining	0.50	40.273	40.773	47.986	88.759
Storage of topsoil	0	0.320	0.32	0	0
Waste dump	0	4.967	4.967	1.036	6.003
Sub grade stack / Mineral storage	0	7.551	7.551	0	0
Infrastructure Facilities (Site services & utilities, admin. building, Conveyor belt, etc)	0	2.4303	2.4303		2.4303
Roads	0.598	2.2714	2.8694	0	0.950
Railway	0	0	0	0	0
Tailing Pond	0	4.923	4.923		4.923
Effluent treatment plant	0	0	0		0
Mineral separation plant (Crushing & screening unit, beneficiation plant)	0	15.8557	15.8557	0	12.85
Township area	0	0	0	0	0
Others (Retaining wall, Garland drain, check dams, settling tank, Sump, embankment etc magazine with safety zone)	0	6.4557	6.4557		6.4557
<b>Sub Total</b>	<b>1.098</b>	<b>84.8471</b>	<b>85.9451</b>	<b>49.022</b>	<b>122.371</b>
Safety zone (ML Boundary, road)	6.755		6.755		6.755
Untouched area	131.312		46.4649		10.039*
<b>Grand total</b>	<b>139.165</b>		<b>139.165</b>		<b>139.165</b>

\* It is proposed to do exploration over 10.039 Ha during plan period. After exploration the area will be utilized as per the outcome of the result.

\*\* During conceptual period the sub grade iron ore will be kept over the back-filled area.

\*\*\* The total area required for mineral separation plant (i.e. crushing and screening, beneficiation facility) is 15.8557Ha out of which crushing and screening facility is 4.9057 Ha. This will be utilized in virgin area during plan period and part of conceptual period. During the 11<sup>th</sup> year part of crushing and screening facility area is required for mining. Hence part of the facility over an area of 2.8067 ha will be dismantled and placed on the backfilled area. Thus the area of crusher and screening facility remains the same i.e. 4.9057 ha.

**RECLAMATION / REHABILITATION**

**Plan period.**

**Back-filling**

After the execution of the lease, initially two pits namely pit-1 and pit-2 will be opened. Planning of pit- 1 has been envisaged in such way that it can be exhausted during plan period. It has been envisaged that, the part of pit-1 will be exhausted during 4<sup>th</sup> and 5<sup>th</sup> of plan period. The 4<sup>th</sup> & 5<sup>th</sup>

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year waste from pit-1 will be utilized for the back-filling of the exhausted part of pit-1. Total generation of waste from pit-1 during 4<sup>th</sup> and 5<sup>th</sup> year will be 2060074cum. Out of which 10% i.e. 206007.4cum will be utilized for road maintenance and balance 1854067cum will be utilized for back filling. Further, during 5<sup>th</sup> year it is proposed to re-handle the waste dump-1 as it is being proposed within ultimate pit limit. A total of 447882cum will be re-handled during 5<sup>th</sup> year. Cumulatively, 2301929 cum of waste will be back-filled within pit-1 during plan period. The details of back-filling during plan period will be as follows:

Year	Waste generation from pit-1 (cum)	Road maintenance @ 10%	Balance waste from pit-1 to be used for back filling	Re-handling of waste (cum)	Total waste to be used for back filling (cum)	Area of back-filling (m <sup>2</sup> )	RL
4 <sup>th</sup>	957240	95724	861516	--	861516	34446	540-570
5 <sup>th</sup>	1102834	110283.4	992550.6	447882	1173303	29132	540-580
					267110	26711	580-590
<b>Total</b>	<b>2060074</b>	<b>206007.4</b>	<b>1854066.6</b>		<b>2301929</b>	<b>90289</b>	

**Plantation over back filled area**

No plantation will be undertaken during plan period over the back-filled area since concurrent back-filling will be continued up to 8<sup>th</sup> year. From 9<sup>th</sup> year plantation over the back-filled area can be started.

**Bench plantation**

There will be no bench plantation during plan period of five years. However, during plan period it proposed to make plantation over 2.20 Ha (within safety zone and over the proposed dump). The year wise plantation within safety zone and dump area during planned period will be as follows:

Year	Area of plantation (m <sup>2</sup> )	No of saplings	Location	Name of the species
1 <sup>st</sup>	0.55	1375	Safety zone	Neem, Mango, Chakunda, Sissoom, Shrubs etc.
2 <sup>nd</sup>	0.37	925	Safety zone	
3 <sup>rd</sup>	0.61	1525	Safety zone	
4 <sup>th</sup>	0.30	750	Safety zone	
5 <sup>th</sup>	0.37	925	Safety zone and proposed dump	
<b>TOTAL</b>	<b>2.20</b>	<b>5600</b>		

**Conceptual period**

As the life of the mines is 12 years considering the mineable reserve, and targeted production, the conceptual period has been assumed as 6<sup>th</sup> year to 12<sup>th</sup> year.

**Method of reclamation**

During conceptual period, the mined out land will be reclaimed both by means of back-filling and bench plantation.

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**Back-filling and plantation**

**Back-filling of UPL-1**

The life of the mine is 12 years including plan period of 5 years. As per the present exploration results after plan period there will be 7 years to fully exhaust of iron ore within the lease area. As earlier mentioned, from the 4<sup>th</sup> year onwards, back-filling will be started within the pit-1. During 4<sup>th</sup> and 5<sup>th</sup> year of plan period, roughly 90289 m<sup>2</sup> or 9.028ha of exhausted part of pit-1 will be back-filled by the available waste from Pit-1 and re-handling of waste dump-1.

During conceptual period it has been envisaged to back-fill 97060m<sup>2</sup> or 9.706Ha within the pit-1 in which tailings disposal of 2380000cum of tailings will be made over 69300m<sup>2</sup> or 6.930Ha and remaining 2.776ha area by disposal of waste from pits. Balance 3.380ha will be reclaimed by means of bench plantation.

**Plantation over back-filled area:**

Out of the total 22.114ha area, plantation can be done over 14.934Ha over back-filled area and 3.38ha over dead benches. Remaining, 3.80Ha will be utilized for stacking of mineral rejects (45-55%Fe). Hence 45000 numbers of saplings will be planted over UPL-1 over 18.314Ha.

**Back-filling of UPL-2**

The UPL-2 covers an area of 666450m<sup>2</sup>. Out of which, 99504m<sup>2</sup> in the western part and 112281m<sup>2</sup> in the eastern part will be reclaimed by means of back-filling. Ultimately, 21.17ha will be back-filled from available waste from UPL-2. Hence, out of 66.645 Ha areas, back-filling will be carried out over 21.17Ha, bench plantation will be carried out over 43.443Ha and remaining 2.032Ha will be kept as water reservoir. Out of 21.17Ha, it has been planned to make plantation over 19.37Ha and remaining 1.80Ha will be utilized for storing of mineral rejects containing 45-55% Fe.

**Bench plantation**

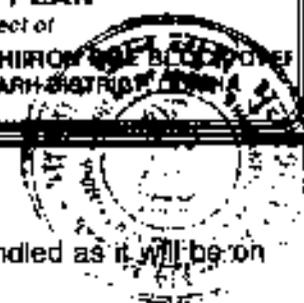
It is envisaged that 33800m<sup>2</sup> or 3.38Ha in UPL-1 and 434430m<sup>2</sup> or 43.443ha in UPL-2 will be reclaimed by means of bench plantation.

Total mining area at end of conceptual period will be 88.758 Ha. Out of which an area of 45.823Ha will be covered under plantation during conceptual period. Bench plantation will be started at the end of 5<sup>th</sup> year.

Hence, cumulatively, at the end of the life of the mine total plantation area over the quarry area will be 2.20 (plan period) + 74.197 (conceptual period) = 76.397 hectares.

  
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**Dump plantation:  
Plan period**

There will be two dumps during plan period. However, dump-1 will be re-handled as it will be on the ultimate pit limit and the waste will be utilized for back-filling. The lower terrace of dump-2 will be stabilized during plan period. Hence, the lower terrace will be covered under coir matting and plantation.

**Conceptual period:**

During conceptual period 6.003 Ha will be covered by waste dump. Both coir matting and plantation will be undertaken over the waste dump to stabilize the dump during conceptual period.

**Other areas**

Other areas like mineral storage removed area, infrastructure dismantled area, road etc over 20.1513Ha will be reclaimed by means of plantation.

**POST MINING LAND USE PATTERN**

Life of the mine is calculated as 12 years from the date of commencement of mining operation based on the existing reserve and production capacity. As earlier explained from 4<sup>th</sup> year to end of the conceptual period the back-filling and plantation will be continued. However, part of the quarry area over 14.0Ha cannot be reclaimed during conceptual period. Hence, it is envisaged to reclaim the said area after end of the conceptual period i.e. on 13<sup>th</sup> year. Out of the total mined out area of 14.0 ha, about 2.032 ha will be reclaimed by means of water reservoir and remaining 11.968 Ha by plantation. Beyond 12<sup>th</sup> year, it is envisaged to dismantle all the infrastructures and the said area will be reclaimed by means of plantation. Similarly, other areas like mineral storage, top soil stack, road, magazine etc will be covered under plantation. However, the post mining land use will be as follows:

Sl. No.	Name of Mining features	Name of Post Mining Land Use	Area (ha)
1	Quarry	Reclamation (back filling & Plantation)	27.374
		Mineral reject to be stored over back-filled area and covered under plantation.	5.600

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2	Quarry	Rehabilitation (Plantation)	4.923
3	Quarry	Tailing pond (mineral exhausted pit-1) to be covered under plantation	5.830
4	Quarry	Water Reservoir	7.040
5	Exploration area converted to mining and allied activities	Rehabilitation (Plantation)	10.039
6	Top soil stack yard	Plantation	00
7	Waste Dump	Dump Plantation	6.003
8	Infrastructure Facilities (Site services & utilities, admn. building, Conveyor belt, etc)	Plantation	2.4303
9	Road	used for public purpose	0.950
10	Tailing Pond	Plantation	4.923
11	Mineral separation plant	Plantation	12.85
12	Others (Retaining wall, Garland drain, check dams, settling tank, Sump, embankment etc magazine with safety zone)	Plantation	6.4557
	Safety zone(MLB and road)	Plantation	6.755
—	<b>Total</b>	—	<b>139.165</b>

At the end of the life of the mine, 136.163Ha will be covered under plantation and then handed over to govt.

**B. UNDERGROUND MINING**

Not Applicable

**Extent of Mechanization**

Proposed method of Mining will be open cast and fully mechanized. Drilling and blasting will be adopted for loosening of hard rock mass which is about 50% of the total excavation. Drilling of the blast holes will be done by DTH drill having 150mm/115mm dia drill. However, the drilling details are as follows:

❖ **Output per hole**

Blast hole Parameters	Ore Zone
Burden	3.0m
Spacing	3.5m
Blasting length / Bench height	10m
Sub-grade drilling (10%)	1m
Depth of the hole	10 + 1.0 = 11 m
Volume of Blasted / Loosen materials	3.0 x 3.5 x 10 = 105 m <sup>3</sup>

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Drill diameter	150mm
Drilling speed	30m /hr.
Working hours in a shift	8
Number of shifts per day	3
Annual working days	300
Expected utilization	80%
Operating efficiency	70%
Effective hour per shift	8 x 70% = 6.5
Meters to be drilled/ drill / annum	30 x 6.5 x 3 x 300 x 80% = 140400 m

❖ **Drilling machines required**

Item	Ore Zone
Volume of excavation (Max in 5 <sup>th</sup> year)	= 4087140m <sup>3</sup>
Volume to be loosened through drilling and blasting	= 4087140x 40% = 1634856m <sup>3</sup>
Annual requirement of holes	=1634856/105=15570nos.
Meterage of drilling required	= 15570 x 11 = 171270
No. of drills required to be in operation	= 171270/140400 = 1.21 say 2 nos 2+1 (Stand by)= 3 nos

**Blasting**

As the nature of the ore is soft, about 40% of the total production will be obtained through blasting within iron ore zone. The proposed mining will have 10.0m height benches in iron ore zone. Drilling will be done for blast hole by 150mm/115mm dia DTH in iron ore zone fed by compressed air. These holes will be drilled in staggered pattern with burden and spacing of 3.0m and 3.5m respectively. During conceptual period, the mine will reach lower level where the ore is very soft and may not require drilling and blasting. Excavators will be directly used to win the material. Rock breakers will be used for breaking of bigger boulders generated during blasting and in case of encountering any hard patches. At present following parameters have been considered for the purpose of blasting. However, after the commencement of mining operation, blast induced vibration study will be carried by an institute of repute and accordingly the optimum charge per delay and most suitable drilling and blasting design along with initiation/firing pattern will be considered. An undertaking has been enclosed to carry out the blasting induced vibration study.

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Drilling Parameters	Iron Ore Zone
Burden	3.0m
Spacing	3.5m
Bench height	10m
Output / hole	$3.0 \times 3.5 \times 10 = 105m^3$
Mineral reject drilling (10%)	1.0m
Depth of the hole	$10 + 1 = 11 m$
Drill diameter	150mm
Drilling speed	30m /hr.
Working hours in a shift	8
Number of shifts per day	3
Annual working days	300
Expected utilization	80%
Operating efficiency	70%
Meters to be drilled/ drill / annum	$30 \times 8 \times 3 \times 300 \times 80\% \times 70\%$ $=120960 m$



**Powder factor**

A powder factor of 7tonne of Usable ore per Kg of explosive is considered for estimating explosive requirement. However, this may suitably be changed depending upon the type of ore and other site conditions.

**TYPE OF EXPLOSIVE TO BE USED:**

High explosives will be loaded by bottom charging or deck charging. The stemming length is proposed to be one third of the hole depth. The explosive column will be blasted under 'V' type blasting pattern initiated by detonator & NONEL and safety fuse. The calculation is however made as follows:

Max Annual Excavation in 5 <sup>th</sup> year	=	7162538 T
Production to be obtained from blasting	=	$7162538 \times 0.4$
	=	2865015
Powder factor	=	7.0t / kg
Explosive requirement per annum	=	$2865015/7$
	=	409288Kg or 409.28 TPA

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**The major hazards associated with blasting are as follows:**

- i) Ground vibration and resulting damage to structure and surrounding rock strata.
- ii) Fly rock
- iii) Noise and air overpressure and
- iv) Dust and fumes

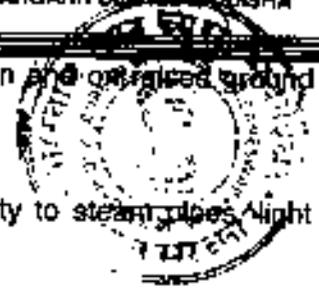
Some of measures proposed to be adapted to restrict these hazards with acceptable limit are.

- i) Provision of a safe zone of about 500m radius around the blasting location, wherever feasible.
- ii) Adopting the safe charge per day to restrict the peak particle velocity (ppv) of ground vibration as per blasting test results.
- iii) Avoiding holes of uneven depth of blocked holes from tie-up sequence.
- iv) Avoiding water accumulation in the holes, and if there is any water accumulation in the hole, the same has to be dewatered wherever practicable.
- v) Muffling the blasting, as far as practicable, particularly where safe zone is not possible to be adhered to and covering the detonating cords by soil layers.
- vi) Controlled blasting with shock tube initiation system/Nonel thro' electronic detonator will be used for getting optimum blast result and minimization of hazards.

**Precautions Proposed to be taken for Storage and Handling of Ammonium Nitrate.**

Stock of ammonium nitrate will be maintained in the store. The precautions proposed to be taken for storage and handling of ammonium nitrate are given below:

- i) Ammonium nitrate would not be stored with other explosives in the magazine. It would be stored separately in waterproof bags.
- ii) Ammonium nitrate should be handled like gasoline. Under all normal circumstances, the material is quite safe to handle.
- iii) Under conditions of extreme heat, confinement or open flame, ammonium nitrate can be dangerous and therefore these situations will not be allowed to arise.
- iv) Fertilizer grade ammonium nitrate should be stored on dry, clean floor. The floor should be constructed with non-combustible materials unless it is protected against impregnation with ammonium nitrate. Floor drains into which molten nitrate could flow and be confined in case of a fire, should be eliminated. These precautions would be taken.
- v) It would be stored in a building with good ventilation.



- vi) The storage premises would be of waterproof construction and on raised ground not liable to flooding.
- vii) Ammonium nitrate should not be stored in close proximity to steam pipes, light bulbs and similar sources of heat.
- viii) The bags of ammonium nitrate shall be stacked in piles, each pile being not more than 1m high and shall be readily accessible in case of fire.
- ix) Metallic substances in powder form, combustible materials (including diesel oil and other fuels) of acids should not be left in the same storage premises.
- x) The ammonium nitrate should be used in sequence of delivery to prevent accumulation of old materials.
- xi) Smoking, naked light or open flame should not be allowed in the vicinity of ammonium nitrate.
- xii) Flooding with water is the only effective way to fight a nitrate fire as the nitrate has its own built-in oxygen supply

**Excavation and loading**

Run-off-mine ore and overburden will be excavated & loaded in the 50t to 80t dumpers by 4.5 to 5.7m<sup>3</sup> capacity excavators. However, for calculation purpose 80t dumper and 5.7m<sup>3</sup> excavators has been considered. The detailed calculation is as follows:

❖ **Excavation parameters**

Bucket Capacity	= 5.7 m <sup>3</sup>
Bucket fill factor	= 0.9
Swelling volume	= 20%
Swell factor	= 100/(100+20) = 0.83
Utilization	= 80%
Operating efficiency	= 85%
Shovel cycle time	= 35 sec.
Swing factor	= 1
Seconds in an hour	3600
No. of working hours in a shift	8
No. of shifts to be worked in a day	3
No of working days in a year	300

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❖ Number of shovels required

Item	Quantity
Volume required to be handled per annum	= 4087140m <sup>3</sup>
Volume to be handled / shovel	= 5.7 x 0.9 x 0.83 x 80% x 85% x 3600 x 8 x 3 x 300 / (80x1) = 938100 m <sup>3</sup>
Number of shovels required	= 4087140/ 938100 = 4.35 say 5 no.

**Excavation Machine details**

Type	Nos	Size/Capacity	Make
Excavator	5	5.7Cu.m bucket	Tata Hitachi

**Hauling**

The dumping area is located on the barren area/ non-mineralized zone. However, for calculation of number of dumpers requirement, 2.0 km have been taken into consideration as lead on an average. The same distance is assumed for transportation of all materials including R.O.M ore, sub-grade ore etc. Run of mine ore and overburden will be transporting in the 50t to 80t dumpers.

❖ Dumper / Tipper Parameters

Parameters	Ore Zone
Dumper Capacity	80 t
Bucket capacity	5.7 m <sup>3</sup>
Bucket fill factor	0.85
Swelling volume	20 %
Swell factor	100/(100+20) = 0.833
Tonnage factor	2.7 t/m <sup>3</sup>
Tonnes per pass	5.7 x 0.80 x 0.83 x 3.0 = 10.218 t
No. of passes	Average tonnage rating of dumper/tonnes per pass = 80/10.218=7.829 say 8 passes

❖ Dumper / Tippers requirement

Loading time	8 x 35= 280 sec.
Lead	2 km
Load travel time	(3600 x 2)/20 =360 sec.
Dumping time	60 sec.
Empty travel time	(3600 x 2 )/25 = 288 sec.

Spotting time	60sec.
Dumper cycle time	280+360+60+286+60 = 1048 sec
Number of rear dump trucks required /shovel	=Cycle time /(loading + spotting time) = 1048/(280+ 60) = 1048/340 = 3.08, say 3
Number of excavators	3
Number Dumpers required in all total	3 x 4 = 12

**Hauling Equipment details**

\* Two numbers of 80T dumpers will be kept as a standby for breakdown purpose.

Type	Nos	Size/Capacity	Make
Dumpers	12+2=14nos	80 Tons	TATA/ BEML

**Requirement of loader**

Loading will be done by mechanized method. The usable ore, mineral rejects and waste material will be loaded by the loader to the dumper. The bucket capacity of the loader will be 9.0Cu.m. The detail calculation of loader will be as follows:

C =	Nominal Bucket Capacity	=	9.0m <sup>3</sup>
F =	Bucket fill factor	=	0.8
S =	Swell factor (at 25% swell)	=	0.85
t =	Time cycle per pass	=	120sec
e =	Overall efficiency for three working shift	=	0.80
T =	Seconds per hour	=	3600
n =	Number of working shifts/day	=	3
h =	Hours per shift	=	8
W =	Working days in a year	=	300
A =	Availability of machine	=	0.85
U =	Utilization Factor	=	0.80
B.D =	Bulk Density	=	2.7

**Rate of Production**

$$\text{Output/loader/hour} = (C \times F \times S \times T)/(t)$$

$$= 9.0 \times 0.8 \times 0.85 \times 3600/120 = 183.6m^3 \text{ or } 495.7\text{Tons say } 495 \text{ T}$$

$$\text{Output/loader/year} = 495 \times h \times n \times w \times e \times A \times U$$

$$= 495 \times 8 \times 3 \times 300 \times 0.85 \times 0.80$$

$$= 2423520 \text{ TPA}$$

**Number of Loaders**

Item	Quantity
Volume required to be handled per annum( @ total excavation)	= 4087140m <sup>3</sup> x 0.3 = 1226142cum
Rate of production per Annum (9.0cum)	= 897600 m <sup>3</sup>
Number of loader required (9.0cum)	= 1226142/897600=1.36 say 2Nos
Keeping one stand by Number of loader required (9.0 cum)	= 2+1(Stand by)=3nos

**Loading Machine Details**

Type	No	Size/Capacity	Make
Loader (L2 20G)	3	9.0 Cu.m bucket	Volvo

**LIST OF MACHINERIES.**

As before, mining operation will be continued as Category-A (fully mechanized) mine. Due to the development of 7.16MTPA capacity iron ore, heavy earth moving machine (HEMM) population is required to be arranged in the following manner:

**PROPOSED**

Unit operation	Name	Dis / Capacity	Numbers
Drilling	DTH	150 mm	2
Excavation & loading	Excavator	5.7 m <sup>3</sup>	5+1
	Loader	9.0m <sup>3</sup>	2+1
Transporting	Dumper	80 T	12+2
Leveling & road making	Dozer	300 HP	2
Mineral processing	Crushing and screening unit (Stationary)	1350TPH	1
	Crushing and screening unit (mobile)	500TPH	2
Motor Grader		120K	01
Water Tanker		35KL	04
Light vehicle		07seater	04
Explosive Van			01
Ambulance			01
D.G.Set		1000KVA	01
Rock Breaker	SPN220B		01
Bus	Tata LP709	36 seater	01

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**CHAPTER-III**

**3. MINE DRAINAGE**

**a) Minimum and Maximum depth of water table based on observations from the nearby well.**

The nearest villages from the mine are Kalmanga, Sagasahi, Ghoreburhani etc. The wells at village Ghoreburhani and Sagasahi is indicating that the water level is encountering at RL 480m tentatively. Also the nearby water body i.e. Sona Nadi is flowing at RL 475m. However, ground water study will be carried out by CGWB, GOI. After the detail study the exact level of water table will be furnished.

**b) Indicate Maximum and Minimum depth of working**

It has been proposed to open two pits during plan period of 5 years. At the end of the Plan period the bottom RL of pit-1 will be 540m and that of pit-2 will be 590m. However, the expected working depth of these quarries by the end of this plan period and Conceptual period is given in the table below. Therefore, such depth of mining would not affect the ground water table as the level of ground water is at 480 MRL.

NAME OF QUARRY	At the end of Plan period (M RL)		At the end of Conceptual period (M RL)	
	Top	Bottom	Top	Bottom
Pit-1	620	540	--	--
Pit-2	730	590	--	--
UPL-1	--	--	620	540
UPL-2	--	--	730	520

**(c) Quantity and quality of water likely to be encountered, the pumping arrangements and places where the mine water is finally proposed to be discharged.**

As almost all the pits are located at slopes of the hill, there is no chance of inundation of pits. As stated above, the proposed working depth of quarries during the plan period excavation will not touch the water table. As such, question of encountered of water due to seepage does not arise.

**(d) Describe regional and local drainage pattern. Also indicate annual rainfall, catchment area and likely quantity of Rainwater to flow through the lease area, arrangement for arresting solid wash:**

**Regional Drainage Pattern**

The area falls within the Baitarani river basin and watershed of the Kundra or Suna river which flows towards north in the NE to SW direction ultimately joins the Baitarani River. The river Suna originate from Hills of Khajurdih Reserve forest present around 12km south of mine lease area. A number of streams originating from the hills in the surrounding regions flow into Suna River, thereby adding to its flow.

The drainage pattern is dendritic generally but since the region is fracture controlled, trellis pattern is also observed. Network of small nalas joins Suna River. The Suna nala flows in a meandering pattern but are also lineament controlled. The drainage density is moderately high indicating more run-off than infiltration.

**Annual Rainfall**

The rain fall data has been obtained from IMD for the financial year 2006-2012. Based on the data the average rain minimum Annual rainfall is 1325mm.

**Catchment area and likely quantity of Rainwater to flow through the lease area:**

The total area is 139.165Ha. However, the catchment area is coming around 850000sqm. An average rainfall of 1325mm has been taken into consideration for the calculation of run-off. The details of runoff per annum and the quantity of Rainwater to flow through the lease area are as follows:

- Run off co-efficient considered = 0.15
- Average annual rainfall = 1.325 m/yr.
- Runoff = catchment area x Runoff coefficient x Annual rainfall  
= 850000 Sq. m x 0.15 x 1.325 m/ year = 168938cu.m / yr.

Keeping in view the avapo-transpiration and seepage into sub-surface at 40%, water flow within lease area will be  $168938 \times 60\% = 101363 \text{ m}^3$  which will be allow to flow within proposed drainage system to be constructed during plan period.

The area experiences high rainfall, the site will generate above volume of run offs during such rainy periods. The surface run off from the uncovered site would contain high concentration of suspended matter and eroded matter. This may result potential impact to surface water body.

**Arrangement for arresting solid wash:**

Surface run off from pits and OB dump site if directly discharged into the river may cause siltation problem. However, it is proposed construct protective measures like retaining wall, garland drain settling pond etc in and around the proposed dump and at strategic point of quarries.

Further, it has been proposed to cover the coir mate over part of the proposed dump and subsequently plantation will be carried out over the coir matting area. It has been proposed to made surface drainage system around the mine to discharge the mine water outside the lease. Further, a

scientific study regarding rainwater management will be under taken, by an institute of repute after the commencement of mining operation. The details of year wise construction of protective measures to be constructed are explained in **chapter-IV**

**Surface Run off Management:**

The mining operation within pit-2 and eastern part of the UPL-2 will be undertaken over hilly terrain. During rainy season the water from hill may come to the lower level. As a result of which there is a chance of accumulation of water at pit -1. It is required to make a proper drainage system for pit-1 and eastern part of UPL-2.

It is envisaged to provide garland drain of 1157m over the pit-2 which will be connected to the proposed sump located at pillar no 3. The rain water will be allowed to flow within this garland drain and ultimately stored in the proposed sump. De-silting work will regularly be carried out for facilitating maximum storage of water within the sump. The dimension of the proposed settling will be 30.m x 20 m x 10m. It is estimated that 6000 cum of water will be stored within the sump. The water from the sump will be utilised for plantation and dust suppression measures.

Similarly, another, garland drain of 1693cum is proposed to be provided over the eastern part of UPL-2. The garland drain is proposed to be connected with the proposed sump to be located at pillar no-8. The dimension of the proposed settling will be 80m x30 x 10m. About 24000cum of water will be accumulated within the sump. Regular de-silting of the sump will be carried out for facilitation of maximum storage of water. The water from the sump will also be utilised for dust suppression and plantation purpose.

Further, the proposed tailing dump is located at hilly terrain. It has been planned to make a garland drain of 2850m over the top of the pond and the garland drain will be connected with the garland drain of proposed dump-2. The water will be allowed to flow through the proposed garland drain and it will be passes through the settling pond and the clean water will be discharged outside the lease area.

**Engineering details of Garland drains and settling ponds****Garland drains**

Garland drains of 1.5 m deep and 1.0 m wide shall be constructed in which rain water will allow to flow to protect the rain water entering into the quarry. The side wall and the base of the garland drain will be constructed by RCC. The side wall will be of 0.25m and the base of the drain will of 1.0m wide.

**Sump**

The garland drain shall be channelized to the proposed sump. Side wall of the proposed sump will be of cement concrete structure whereas the base shall be packed with locally available boulders mixed with cement and sand.

In addition to the above proposals, it is envisaged to carry out a study for Rain Water Management Plan i.e. drainage plan along with arrangement for arresting solid wash offs by incorporating engineering details and materials to be used for the erection of protective measures like Retaining wall, garland drain, settling pond etc. by an institute of repute. The said study will be undertaken after the commencement of mining operation. An **undertaking** is enclosed in this regard.

  
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**CHAPTER- IV**

**4.0 STACKING OF MINERAL REJECT /SUB GRADE MATERIAL AND DISPOSAL OF WASTE**

a) Indicate briefly the nature and quantity of top soil, overburden / waste and Mineral Reject to be disposed of.

**Nature of Waste:**

- (i) **Overburden waste:** Containing laterites, & shale, etc.
- (ii) **Intercalated waste:** Found in between the ore zone having no or negligible mineral content less than the threshold value of iron ore (i.e. below 45% Fe).

**Quantity of yearly generation of waste and proposals for disposal of waste:**

Intercalated waste which will be predominantly laterite, Limonite and shale will be excavated along with iron ore and also separately as side burden. The intercalated waste will be 20% of the total volume of ore zone. Further, there will be handling of side burden/intermediate burden (mainly shale) during ensuing plan period. The pit wise and year wise waste generation will be as follows:

**GENERATION OF WASTE**

Year	Waste from Pit-1(cum)			Waste from Pit-2 (cum)			Total waste
	Inter burden	Side burden	Total	Inter burden	Side burden	Total	
1 <sup>st</sup>	273180	116250	389410	88660	18000	106660	496070
2 <sup>nd</sup>	321954	39700	361654	120426	--	120426	482080
3 <sup>rd</sup>	379480	230960	610440	227898	76500	304398	914838
4 <sup>th</sup>	516900	440340	957240	144940	--	144940	1102180
5 <sup>th</sup>	771150	331684	1102834	331514	--	331514	1434348
<b>Total</b>	<b>2262644</b>	<b>1158934</b>	<b>3421578</b>	<b>913438</b>	<b>94500</b>	<b>1007938</b>	<b>4429516</b>

From the above table it can be observed that 3421578cum of waste will be generated from pit-1 and 1007938 cum from pit-2. There will be two separate dumps for each pit. Dump-1 will be done temporarily within ultimate pit limit and dump-2 will be permanently kept and stabilized as it is within non-mineralized area.

**Waste generation from Beneficiation plant**

A beneficiation plant of 6.0MTPA (product) capacity will be established from 4<sup>th</sup> year onwards during the plan period, as per the material balance, approximately 3.4million tons of iron ore with average Fe of 61% will be fed to the beneficiation plant for up-gradation. It has been envisaged

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that based on the material balance, about 20% of total feed quantity will emerge as mineral rejects having Fe content less than 45%. The details of year wise generation of mineral rejects from beneficiation plant will be as shown below:

Year	Generation of waste from Beneficiation plant	
	MT	cum
4 <sup>th</sup>	682281	341141
5 <sup>th</sup>	680812	340406
<b>Total</b>	<b>1363093</b>	<b>681546.5</b>

The waste to be generated from beneficiation plant during the plan period as shown above will be disposed of at proposed tailings pond and an area of 4.92Ha has been earmarked for the same. During the conceptual period from 6<sup>th</sup> year onwards an area of 6.93 Ha of Pit -1 (mineral exhausted pit) will be used for disposal of tailings.

**Waste generation by digging of tailing pond area.**

As per the lithology, the tailing pond area is covered with soil and alluvium. From the field observation it could be found that the thickness of soil cover is about 3m. The scrapped top soil will be utilized for afforestation purpose and the overburden below the top soil that is likely to be removed will be utilized for making of embankment for the tailing pond.

**Tailing Dam Design**

As stated above, tailings generated from the wet processing beneficiation plant shall be stored in a dam, adjacent to the proposed plant site in a natural valley within the block. The design of tailing pond will be undertaken after considering the characteristics of tailings. However, the selection of site for construction of tailing dam has been made considering the following factors:

- Topography
- Barren land as far as mineralization is concerned.
- Required land availability
- Accessibility
- Geology and geo technology
- Habitation

The existing topography is supporting for the construction of tailing pond at the proposed site. The height of the proposed tailing pond in the western part will be 645m whereas in the eastern part it is 630m. The slope of the tailing pond area will be due east.

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The proposed tailing pond area is barren as far as mineralization of iron ore is concerned. However, it has been proposed to put bore holes to prove the barrenness of the area.

It has been envisaged that, about 4.92 Ha area will be utilized for 4<sup>th</sup> and 5<sup>th</sup> year of planned period. After two years, the mined out pit - 1 will be used for disposal of tailings.

The designated tailing dam area can easily be approached from the beneficiation plant and also proposed mine pits. Suitable road will be laid for the purpose.

Geological condition plays a critical role for locating a tailing dam. In particular site geological condition affects the stability of foundation of the embankment, seepage rate etc. Sloping foundations and the presence of weak layers in the foundations will need to be investigated since they may contribute slope failure.

As far geology of the site area is concerned the proposed tailing dam will be on lateritic zone. Laterite is a hard rock which will be suitable for the construction of tailing pond. Regarding geo technical parameters of the rock occurring within the proposed tailing pond area, a detail rock mechanic study will be undertaken during 3<sup>rd</sup> year of plan period by a reputed institute.

The habitation is far away from the proposed tailing pond. Hence, location of tailing dam will not have any hazardous effect on the habitation. Further, proper safety measures will be taken to prevent any hazardous effect the on surrounding habitation.

#### **Tailing dam volume study**

##### **Design Criteria:**

Plant Feed - 3.4 Mtpa

Feed Fe Quality - +81%Fe

Fe Quality - 66 %

Plant Yield - 80%

Tailing - 0.680 Mtpa

Plant Operating Days per year - 305 Days

Plant Operating Hours per day - 24 Hours

The composition of tailing is 75% solids and 25% water by weight. It is proposed to recycle about 80% water. Tailing pond will be provided with decant well inside the pond and connecting it to a water pumping system outside the bund/ wall by a buried pipeline. Water pumping system will be provided for pumping the clear water back to the beneficiation plant. The parameters considered for tailing dam are given below:

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**After Tailing disposal (Assuming 75% solids retained after drying)**

Total Solids feed rate	205	tph
% solids in Tailing pond	75 %	(w/w)
Total Water feed rate	68.3	tph.
Solid Density	3.33	t/m <sup>3</sup>
Slurry Density @ 75% solids w/w	2.1	t/m <sup>3</sup>
Total Slurry volume retained	130	m <sup>3</sup> /hr.

**Construction of Embankment/bund/dam**

It has been envisaged to construct an embankment/bund at the proposed tailing pond area. This embankment will connect the 645m contour so that a dam like engineering structure will be created. During 3<sup>rd</sup> year It is proposed to construct an embankment for the tailings disposal utilizing mine waste material. The dimension of the proposed embankment will be as follows:

Length	300m
Base	45m
Height	Variable up to 30m
Width	6m

A spill way channel will be created to take care off any over flow of water in case of any eventualities. At the end of the channel an additional embankment will be created to restrict the flow of water outside the block.

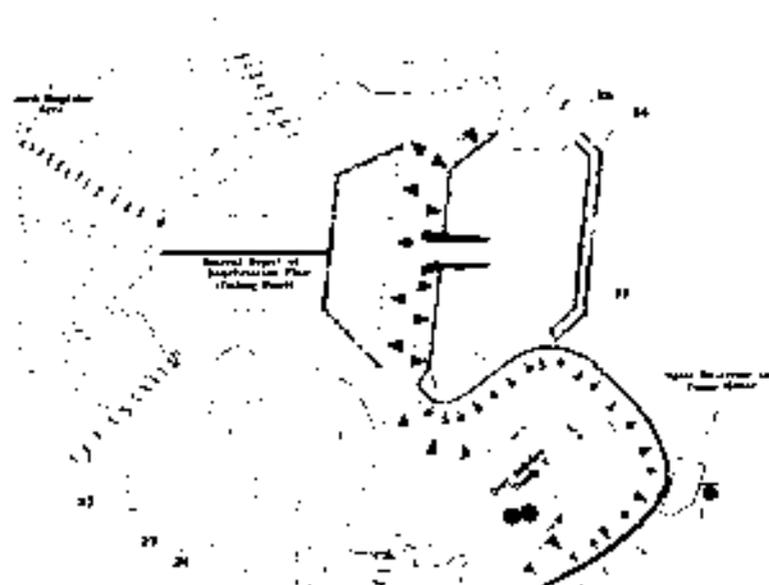
**Design detail and disposal of tailings**

It is envisaged to dispose the tailings over the proposed tailing pond area to accommodate 681546.5cum tailings. It has been planned to dig the proposed tailing pond area 20m from the surface. As a result of which the floor RL will be 625m in the west and 610m in the east. There will be three compartments. Two retaining walls have been envisaged along east- west direction and another along north - south direction. The east- west retaining wall will be provided to make the sludge area into two compartments whereas the north - south retaining wall (perforated wall) will be provided to separate the sludge and water and has been designated as compartment-3. The natural slope of the area will help the water to flow into the lower level. The compartment-1 will accommodate 341141cum of waste, whereas compartment-2 will accommodate 340406 cum of waste. Dewatering will be made by deploying a 5HP pump. This water will be utilized for water sprinkling, afforestation etc.

**Protective Measures for tailing pond**

Year	Retaining wall			Garland drain		
	Length(m)	Width(m)	Height(m)	Length(m)	Width(m)	Depth(m)
3 <sup>rd</sup> year	400	3	25	2850	1.5	2.0
4 <sup>th</sup> year	Maintenance			Maintenance		
5 <sup>th</sup> year	Maintenance			Maintenance		

It has been envisaged to construct a garland drain of 2850m long around the tailing pond area at 645m.RL. This garland drain will be connected to the settling pond provided in the lower level. The rain water will be allowed to flow through the proposed garland drain and it will be channelized through the settling pond and clean water will be discharged outside the b.



**Engineering details of proposed structures for tailing ponds:**

**Embankment**

As mentioned above, a 300m long, 45m wide and 15m high embankment will be constructed to protect the tailings. There will be two numbers of terraces and each terrace will be stabilised by stone pitching. An additional embankment of 200 m long 10m wide and 5m height will be created to restrict the flow of water to beyond the allotted block. Mine wastes to be produced from the proposed quarries will be utilised for construction of embankments. There will be provision of catch drains at regular interval.

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**Retaining wall**

Cement concrete structure retaining wall of said dimensions will be constructed to make three different compartments. However, the 3<sup>rd</sup> compartment will be created with the help of boulders available within the mine. There will be perforations within the wall for passage of water into the 3<sup>rd</sup> compartment.

**Garland drain**

Cement concrete garland drain will be constructed above the top of the tailing pond to carry the rain water within it.

(b) The proposed dumping ground within the lease area be proved for presence or absence of mineral and be outside the UPL unless simultaneous backfilling is proposed or purely temporary dumping for a short period is proposed in mineralized area with technical constraints & justification.

Selection of dumping site mostly depends upon the factors like topography, drainage, land use, mineral inventory, Pit configuration; mine waste characteristics, its volume of generation and economy in transportation etc. Keeping in view the above physical as well as techno-economic factors, and extent of non-mineralized zone, it has been planned to dispose of the waste at two different locations. The proposed dump-1 will be within UPL-1 while the proposed dump-2 will be within non-mineralized zone. However, before dumping at dump-2, the area will be proved as barren first and then waste disposal will be started. Further, waste generated from beneficiation plant scheduled to be operated from 4<sup>th</sup> year of planned period will be disposed of at the proposed tailing pond in the southern part of the lease area.

c) Attach a note indicating the manner of disposal of waste, configuration and sequence of year wise buildup of dumps along with the proposals for protective measures.

**Method and manner of disposal of waste:**

From the table indicated above, it can be observed that 3421578 cum of waste will be generated from pit-1 and 1007938 cum from pit-2. There will be two separate dumps for each pit. Dump-1 will be created temporarily within ultimate pit limit and dump-2 will be permanently kept and stabilized as it is within non-mineralized area.

Retreating method will be adopted for the disposal of waste at proposed dumping site. During dumping, care will be taken to ensure that the waste is leveled, compacted and terraced. There will be 2 terraces in the proposed dump-1 and two terraces in the proposed dump-2. The average height of the proposed dump-1 and 2 will be of 30m respectively. After achieving the height of 15m, further terracing will be made.

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**Re-handling of waste**

The waste of pit-1 has been proposed to be dumped at dump-1 which is located within ultimate pit limit. Hence, during 4<sup>th</sup> and 5<sup>th</sup> year of plan period it is envisaged to re-handle the dump-1 and that quantity of waste i.e. 447862cum will be utilize for back-filling of exhausted part of pit-1. The details of year wise dumping will be as follows:

**Management of waste from Pit-1**

Year	Waste from Pit-1(cum)			Management of waste						RL
	Inter burden	Side burden	Total	Road maintenance/ Construction of bund at mineral reject dump area		Dumping at Dump-1	Area of dumping (m <sup>2</sup> )	Back-filling at pit-1	Area of back-filling (m <sup>2</sup> )	
				%age	Quantity					
1 <sup>st</sup>	273180	116250	389410	50	194705	194705	30059	--	--	620-630
2 <sup>nd</sup>	321954	39700	361654	30	108496.2	253157.8	18108	--	--	630-645
3 <sup>rd</sup>	379480	230960	610440	100	610440*	0	--	--	--	Total waste will be utilized for making bund
4 <sup>th</sup>	518900	440340	957240	10	95724	--	--	861518	34446	
5 <sup>th</sup>	771150	331884	1102834	10	110283.4	--	--	1440413 92560.6+ 447862 re-handling of dump-1)	29132  26711	540-580  580-590
<b>Total</b>	<b>2262444</b>	<b>1158934</b>	<b>3421378</b>		<b>1119849</b>	<b>447862</b>	<b>48161</b>	<b>2301928</b>		

\* As the waste of this year cannot be accommodated over dump-1, total waste of 610440cum will be utilized for bund making.

**Management of waste from pit-2**

The waste to be generated from pit-2 will be utilized partly for road maintenance and dumping at dump-2. The year wise utilization of waste will be as follows:

Year	Waste from Pit-2 (cum)			Road maintenance @ 10%	Dumping at Dump-2	Area (m <sup>2</sup> )	RL (m)
	Inter burden	Side burden	Total				
1 <sup>st</sup>	88660	18000	106660	10666	95994	11317	615-630
2 <sup>nd</sup>	120426	--	120426	12042.6	108383.4	11316	615-630
3 <sup>rd</sup>	227898	76500	304398	30439.8	273958.2	--	Total waste will be utilized for making bund
4 <sup>th</sup>	144940	--	144940	14494	130446	10133	630-645
5 <sup>th</sup>	331514	--	331514	33151.4	298362.6	10134	630-645
<b>Total</b>	<b>913438</b>	<b>94500</b>	<b>1007938</b>	<b>100793.8</b>	<b>907144.2</b>		

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**Precaution for confinement of dump to prevent pollution of surface water bodies/courses:**

The waste generated from the mines shall be dumped in the non-mineralized area earmarked in the plan. The precautionary and protective measures to be adopted during waste disposal are as follows:

- The ultimate dump slope shall be maintained at 20-27° with individual terrace slopes not exceeding 37°.
- Each terrace will have inward slope with catch drain at the inward slope of terrace.
- Catch drain of the individual terrace shall be connected to the garland drain outside the periphery of dump. Catch drain preferably to be made up of the half concrete open pipes followed by settling tanks to avoid wash offs and have provision of berms at the outer side to reduce gully formation due to rain water wash offs.
- Toe wall, garland drain and settling tank will be constructed around the dump. The details of proposed protective measures will be as follows:

**Proposed protective measures**

**Retaining wall**

It has been proposed to construct retaining wall of 2230m around the bottom periphery of proposed dump, sub-grade dump, back-filled area etc. The retaining wall will be of concrete structure which will be constructed from 1<sup>st</sup> year onwards subsequently, maintenance will be done for betterment.

Location	Retaining wall		
	Length(m)	width(m)	height(m)
Dump-1	580	1.0	1.5
Dump - 2	530	1.0	1.5
Sub grade stack 1	350	1.0	1.5
Sub grade stack-2	590	1.0	1.5
Back filled area pit-1	180	1.0	1.5
<b>Sub total</b>	<b>2230</b>	<b>1.0</b>	<b>1.5</b>

Further, there will be embankment and retaining wall for tailing pond. The dimension of embankment and retaining wall are furnished below:

Tailings area (retaining wall)	400	3	25
Tailings area(embankment)	300	45	15
	200	10	5

**Garland drain**

Proposal of garland drain of 5430m has been made around dump, around quarry and tailings pond. The location of garland drain to be constructed will be as follows:

Location	Garland drain		
	Length(m)	width(m)	height(m)
Dump-1	600	2.0	1.0
Dump - 2	530	2.0	1.0
Sub grade stack 1	--	--	--
Sub grade stack-2	--	--	--
Back filled area pit-1	--	--	--
Tailings area	1190	2.0	1.0
Around pit-2	1157	2.0	1.0
Eastern part UPL-2	1699	2.0	1.0

**Settling pond**

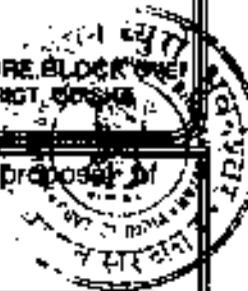
Two settling ponds around the dump and two sumps around the quarries (for surface run off management) are proposed to be constructed during 1<sup>st</sup> year of plan period. The location and dimension of settling pond and sumps will be as follows:

Location	Settling pond/sumps (2nos and sump-2 nos)		
	Length(m)	Width(m)	Depth(m)
Dump-1	10	8	2
Dump - 2	20	10	3
Sub grade stack 1	-/-	-/-	-/-
Sub grade stack-2	-/-	-/-	-/-
Back filled area pit-1	-/-	-/-	-/-
Tailings area	-/-	-/-	-/-
Around pit-2	30	20	10
Eastern part UPL-2	80	30	10

Water in the rainy season that will be percolated through the waste in the waste dump shall be drained to the existing garland drain and the retaining wall shall help in arresting movement of waste materials along with water. The garland drains shall be canalized in such a way that the water flows to an area which will be on non-ore bearing and a wasteland. Regular cleaning of the drain shall be done for easy flow of water. Besides the garland drains and the retaining walls, two settling ponds and two sumps has been envisaged at strategic point at the end of garland drain, in which water will be accumulated. The dimensions of the settling pond and sumps have been furnished in the above tables. The sump will be utilized for storing of water and the stored water

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will be utilized for dust suppression and plantation purpose. The year wise proposal of construction of protective measures will be as follows:

Year	Location	Dimension								
		Retaining wall			Garland drain			Settling tank(2Nos)		
		Length (m)	width (m)	height (m)	Length (m)	width (m)	height (m)	Length (m)	Width (m)	Depth (m)
1 <sup>st</sup>	Proposed quarry, dump and sub-grade stack	1110	1.0	1.5	3980	2.0	1.0	10	8	2
								20	10	3
2 <sup>nd</sup>		630	1.0	1.5	260	2.0	1.0	Maintenance		
3 <sup>rd</sup>		100	1.0	1.5	1190	2.0	1.0	Maintenance		
4 <sup>th</sup>		110	1.0	1.5	Maintenance			Maintenance		
5 <sup>th</sup>	280	1.0	1.5	Maintenance			Maintenance			
Total		2230	1.0	1.5	5430	2.0	1.0	10.0	8.0	2.0

NB. Two sumps will be constructed during 1<sup>st</sup> year of plan period at the earmarked site. The dimension of sumps has been already furnished.

Coir matting over proposed dump:

Year	Coir Matting with seedling
5 <sup>th</sup>	2800Sq.m

**Plantation details**

Year	Area of plantation (m <sup>2</sup> )	No of saplings	Location	Name of the species
1 <sup>st</sup>	0.55	1375	Safety zone	Neem, Mango, Chakunda, Sissom Shrubs
2 <sup>nd</sup>	0.37	925	Safety zone	
3 <sup>rd</sup>	0.61	1525	Safety zone	
4 <sup>th</sup>	0.30	750	Safety zone	
5 <sup>th</sup>	0.37	925	Safety zone and proposed dump	
Total	2.20	5500		

**Engineering details of retaining walls & Garland drains**

The average rain fall has been considered as 1325mm/year. Since the proposed waste dump and tailings dump are located in areas which is a sloppy terrain, maximum flow of water in rainy season will endanger the retaining walls. Following precautionary measures shall be taken while designing the retaining walls and garland drains.

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**Retaining Walls**

Retaining boulder wall (1.5 m high and 1.0 m width) of substantial strength shall be constructed all around the bottom periphery of waste dumps with locally available boulders mixed with sand and cement, to arrest any rolling down of the dump materials. Perforation shall be left at around 10 m intervals to allow for passage of water.

**Garland drains**

Garland drains of 1.5 m deep and 1.0 m wide shall be constructed all along the bottom periphery of waste dumps followed by the retaining wall to prevent any wash off or leaching of dump materials during heavy rains. Side walls and the base shall be pitched with locally available boulders. Joints shall be filled up with cement and sand mixture so that water cannot percolate.

**Settling Tank**

The garland drain shall be channelized to settling tank of 10m long, 8m width and 2.0m deep. Side walls and base shall be packed with locally available boulders mixed with cement and sand.

**Mineral Rejects/ Sub-grade ore:**

As per the threshold value, iron ore containing above 45%Fe and below 58%Fe which cannot be used at present, is considered as sub-grade iron ore. Separate zone has been marked for the sub-grade based on the existing borehole data.

**Rate of yearly generation of sub-grade mineral with reference to threshold values and proposals for stacking during the remaining 5 years of plan period:**

Year	sub-grade(cum) from Pit-1			sub-grade(cum) from Pit-2			Total sub-grade(cum)			Total sub-grade (MT)		
	45-55	55-58	Total	45-55	55-58	Total	45-55	55-58	Total			
1 <sup>st</sup>	105840	195840	301680	162880	17120	180000	288720	212960	481680	726544	574892	1300636
2 <sup>nd</sup>	16720	51208	67928	213648	33008	246656	230968	84218	314584	621993	227383	848376
3 <sup>rd</sup>	63072	0	63072	234344	72120	306464	297416	72120	369536	809023	104724	997747
4 <sup>th</sup>	180728	91440	272168	128040	5960	132000	306768	97400	404168	828273	282980	1081254
5 <sup>th</sup>	81152	147978	209128	206304	0	206304	288456	147978	414432	719431.2	399535.2	1118966
Total	427512	486464	913976	942218	128208	1070424	1389728	614672	1984400	3688288	1889814	8357888

**Utilization of mineral rejects**

A total of 1984400 cum of mineral rejects/sub-grade iron ore will be generated during proposed plan period. From above table, it is observed that about 913976 cum of mineral rejects will be generated from pit - 1 and 1070424 cum will be generated from pit - 2. It is envisaged to stack the

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sub-grade iron ore containing +45-55% Fe at sub-grade stack-2 over an area of 3.52 ha and that of +55-58%Fe at sub-grade stack -1 over an area of 1.13ha.

As earlier explained the beneficiation plant will come into force on 4<sup>th</sup> year. Hence, it is envisaged to use sub-grade containing iron ore of +55-58%Fe from 4<sup>th</sup> year onwards in the beneficiation plant to up-grade the ore for making it usable. The cumulative sub-grade stock from 1<sup>st</sup> year to 3<sup>rd</sup> year containing +55-58%Fe is 997099 MT. During 4<sup>th</sup> year earlier accumulated sub-grade along with the sub grade (+55- 58% Fe) generated during the year will be used for beneficiation. The said quantity along with 4<sup>th</sup> year sub-grade (+55-58%Fe) generation will be utilized for beneficiation. However, it is proposed to utilize the sub-grade (+55-58%Fe) to be generated in each year for the purpose of beneficiation. During the 5<sup>th</sup> year sub grade ore generated during the year will be fed to the beneficiation plant.

To up-grade the sub-grade iron ore/mineral rejects and to make it usable, it has been planned to establish a 6.0 MTPA capacity beneficiation plant during ensuing plan period. The said plant is expected to be commissioned in 4<sup>th</sup> year after obtaining the environment clearance from MoEF & CC and consent to Establish from State Pollution control Board, Odisha.

**Production from Beneficiation Plant during 4<sup>th</sup> year**

During the year the total feed to the beneficiation plant will be 3411410 MT which will produce upgraded iron ore fines of 2729128 MT and 682282 MT of tailings.

**Production from Beneficiation Plant during 5<sup>th</sup> year**

During the year the total feed to the beneficiation plant will be 3387918 MT which will produce upgraded iron ore fines of 2707106 MT and 680812 MT of tailings

**CHAPTER-V**

**5.0 USE OF MINERAL AND MINERAL REJECT**

- a) Describe briefly the requirement of end-use industry specifically in terms of physical and chemical composition

M/s Essar Steel India Ltd is one of India's leading integrated steel producers with an annual production capability of 10 million tonnes supported by a 20 million tonne pellet facility. The manufacturing operations comprise iron ore beneficiation, pellet making, iron making, steel making, and downstream facilities, including a cold rolling mill, a galvanizing and pre-coated facility, a steel-processing facility, an extra-wide plate mill and pipe mills with coating facilities. For end use iron ore will be processed through different intermediate industries like beneficiation, pelletisation etc.

**Iron ore beneficiation facility**

M/s Essar Steel India Ltd has a 12 MTPA plant at Dabuna, Joda (Odisha), which is strategically established to leverage the rich iron ore deposits of the state. The beneficiated ore is transported in slurry form to company's pellet plant at Paradip through 253km slurry pipe from Dabuna to Paradip.

**Pelletisation**

Essar Steel India Limited is having a pellet plant of 6.0 Million ton per annum capacity at Paradip and the second module of 6.0 MTPA is under commissioning stage a 6.0 MTPA pellet plant at Paradip to provide vital raw material to the steel plant at Hazira (Gujarat). The requirement of pellet plant as per physical and chemical specification is as follows:

Sl. No	Constituents	Grade
1	Fe	+84%
2	SiO <sub>2</sub>	2.5% (max)
3	Al <sub>2</sub> O <sub>3</sub>	2% (max)
4	Al <sub>2</sub> O <sub>3</sub> + SiO <sub>2</sub>	3-4.5%
5	Al <sub>2</sub> O <sub>3</sub> / SiO <sub>2</sub>	1.5-3%
6	CaO + MgO	2% (max)
7	P	0.05 (max)
8	S	0.02-0.03%
9	Cu	0.01-0.04%
10	Size	-150mm

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**(b) Give brief requirement of Intermediate Industries Involved In up-gradation of mineral before its end-use.**

The intermediate industries involved in the up-gradation of mineral before its end use is crushing and screening unit, wet beneficiation plant, etc. ROM iron ore will be crushed and screened in the M.L. area to cater to the need of the plant in respect of quality and size. Further as a part of the up-gradation of low grade ore it has been planned to install a beneficiation plant of 6.0MTPA capacity per annum and it will be in operation from 4<sup>th</sup> year onwards. The details of beneficiation plant have been explained in CH-VI

**c) Give detail requirements for other industries, captive consumption, export, associated industrial use etc.**

The iron ore produced from the lease area will be used for the captive purpose only. The other associated industries involved are beneficiation plant and palletisation plant.

**d) Indicate precise physical and chemical specification stipulated by buyers**

Not Applicable

**e) Give details of processes adopted to upgrade the ROM to suit the user requirements.**

It has been ascertained that ROM produced from the mines will pass through two streams namely unit 1 & Unit 2. Unit one will have only screening facility. The -10mm obtained from unit 1 which does not need any up gradation is directly sent for grinding. The +10m from unit 1 and rom having grade of +58 to - 64 Fe will pass through Unit which has crushing facility. The +5 to -18mm produced from the crusher i.e. lumpy ore will be directly sent to the plant and the -10mm fraction will be subjected to beneficiation as per the requirement.

The details of mineral processing/beneficiation have explained in chapter-VI

  
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**CHAPTER-VI****6.0 PROCESSING OF ROM AND MINERAL REJECT**

For Ghoraburhani – Sagasahi mining project, up-gradation of ore is essentially required along with systematic development of the mine to ensure conservation of mineral. Therefore, this chapter "Mineral Processing" has been detailed to include the associated impurities, their removal process and the processing technique proposed in the M.L area.

a) If processing / beneficiation of the ROM or Mineral Reject is planned to be conducted, briefly describe nature of processing / beneficiation. This may indicate size and grade of feed material and concentrate (finished marketable product), recovery etc.

In general, the essential impurities in Iron ore are silica, alumina, sulphur and phosphorus which are in the form of  $\text{SiO}_2$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{FeS}_2$  or  $\text{CaSO}_4$  and  $\text{Ca}_3(\text{PO}_4)_2$  respectively. The  $\text{Al}_2\text{O}_3 / \text{SiO}_2$  ratio has an important role in the economics of Fe-ore smelting.

**Product Quality and Grade Control:** Grade control will be managed throughout the mining sequence to meet the product specifications acceptable to the steel plant in terms of size distribution and content of key elements such as Fe,  $\text{SiO}_2$  and  $\text{Al}_2\text{O}_3$ . Following practices are envisaged to manage product quality & grade control.

**Blast hole sampling:** Regular blast hole sampling will be undertaken to design blast round either in isolation or a combination of two or more rounds to match the quality and quantity requirement for a definitive period. The composite blast hole samples of a blast round will be analyzed in the site laboratory to provide a reliable estimate of the ROM grade; based on which the appropriate blending technique can be designed. High and low grade ROM delineated by the blast hole sampling process will be blended to have an average grade of about +64% Fe and will be stockpiled at screening and crushing locations which will be fed to the crushing and screening plants

**Grade control at screening and crushing feed locations:** As stated above, based on the outcome of the blast hole results, the grade of the ROM will be ascertained. The grade of ROM will also be controlled by blending at screening and crushing feed locations. Regular assaying of the feed and final output product will be done to enable the site technical team to vary the blend to maintain the appropriate grade.

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During the plan period both dry processing (through crushing and screening) and beneficiation will be adopted for sizing and upgradation of ore respectively.

### **SYSTEM DESCRIPTION:**

#### **I. Crushing, Screening and Beneficiation process :**

Overall Flow Diagram of Primary Screening, Crushing & Screening with the Grinding and Beneficiation Plant is enclosed vide Plate No XV-XVIII

#### **Crushing & Screening:**

A dumping platform shall be made for feeding the ROM (- 600 m) into a hopper. A triple deck screen under the hopper will screen the feed into four (4) different sizes i.e.: -600 to +80mm, - 80 to +40 mm, -40 to +10mm and -10mm. The coarse product of screen (-600mm to + 80 mm) will pass through a Jaw Crusher where it will be crushed..

The -80+40 mm size fraction will be fed to a secondary crusher through a surge hopper, which will crush the material to a size around 80% passing -40mm.

Product of the secondary crusher will be screened in the triple deck screen to separate the lumps (-18 to +5 mm) which will be stacked separately. The over size material (+40 mm) will be recycled back to the cone crusher.

The -40 to +10mm product size from triple deck screen will be subjected to further crushing in a High Pressure Grinding Roll (HPGR) to -10mm size. The crushed product from the HPGR will be screened in a single deck screen of 10mm screen. The oversize of the screen will be recycled back to HPGR circuit.

#### **Dry processing & Beneficiation**

The total overview of the Mineral processing has been envisaged in two different modes of operation mentioned as below:

1. **Direct Ore:** The ore which can be used without beneficiation for steel making has been defined as direct ore. For this type of ore, processing includes primarily screening of natural fines followed by crushing & screening of the oversize fraction of the above plant feed.

  
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2. **Beneficiable Ore:** The ore which is required to be upgraded before it is used in the steel making has been classified as beneficiable ore. The process of up gradation for this type of ore comprises of crushing, screening, grinding, gravity separation and subsequent magnetic separation in multiple stages to up-grade the ore so that the desired quality can be achieved.

- It is proposed that during the initial period till 3<sup>rd</sup> year of plan period, there will be two nos of mobile crushing and screening plant of 500 TPH one in each pit (Pit 1 & Pit 2). During these years, the crushed Iron ore fines from mobile crusher will be transported from the mine head by Road.
- Further, it has been envisaged that the stationery crushing and screening facilities will be commissioned by the end of third year of the plan period.
- The Stationary Crushing and Screening unit will be having two units, one unit with 3 MTPA capacity will be having screening facility only wherein predominantly powdery ore, blue dust and ore flaky in nature will be processed to produce Iron ore fines ( -10 mm) of about 2.70 MTPA (i.e. 90% of the total feed to this unit). Since the ore types mentioned above predominantly have higher Fe content (Fe > 64.5 %), it will not be subjected to the up-gradation process. The rest 0.30 MTPA i.e. 10% (avg. Fe of 67.7 %) having a size of +10mm will go in for crushing in the second unit.
- Second unit will have the facility of Crushing and Screening in which the over size of the screening plant ( +10 mm size of Unit – 1) of 0.30 MTPA (Fe % of 67.7) along with the ROM of about 3.02 MTPA having Fe % of 62.1 % and sub grade material of 0.40 MTPA of 56.5 % Fe will be feed. Besides, a quantity of 0.266 MTPA sub grade stacked material of 55 – 58 % Fe will be fed for beneficiation. The average Fe content of the feed to the second unit (i.e. 3.98 MTPA) is envisaged as 61.5 % which will be crushed, & screened to produce -10 mm and +5 -18 mm fractions.
- From the feed quantity of 3.98 MTPA in the Second unit, about 15% of the material i.e. 0.60 MTPA will be generated as lumps of +5 to – 18mm size and the remaining 85% i.e. 3.38 MTPA will be subjected to grinding and beneficiation.

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- The lumps (0.60 MTPA of size +5 to -18mm) will be transported by road from the mining head.
  - It is estimated that the recovery of the product from the said beneficiation plant will be 80 % (i.e. 2.70 MTPA) and the rest 0.68 MTPA (20% of feed of 3.38 MTPA) will form the reject.
  - The beneficiable grade material will be subjected to the Mineral processing plant, having capacity of 1250 TPH for further up-gradation.
  - Capacity of the screening, Crushing, grinding and beneficiation plant is 7.16 MTPA (throughput) which will generate the product capacity of 6 MTPA with 100 % capacity utilization.
  - The grinding of direct ore and grinding and beneficiation of Beneficiable ore has been proposed to be done in batches.
3. The beneficiation plant comprises of grinding mills of primary mill, secondary mill and regrind mill. There are gravity separators using separate gravity principles according to the size of application, magnetic separators of Wet high intensity magnetic separator, high gradient magnetic separators according to the magnetic magnetic properties of the ore in this plant. There is a screw scrubber in the line to scrub the amorphous alumina and clay form the course and segregate for the up-gradation.
- Concentrate thickener will be located in the plant to concentrate the product for final pumping. Similarly intermediate thickener will be there to thicken the material for proper density feeding to the required equipment. A conventional tailing pond is proposed for water recovery and tailing management.

**Beneficiation plant:**

It is proposed to install a beneficiation facility in the mine site. It can be seen that the main process consists of:

1. Scrubbing
2. Magnetic separation in two stages
3. Screening
4. Primary grinding and classification

  
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5. Re-grinding in secondary mill and classification
6. Gravity Separation by Spiral and Jig
7. Pumping to Dabuna facility

The feed (-10 mm) will be transported to hopper by a conveyor and fed by a weigh feeder. The screw scrubber scrubs and classifies the -150 micron material in the overflow and collected in the intermediate thickener. The underflow material from the screw scrubber will be screened in a single deck screen of 1mm apertures. The coarser product -10 +1 mm will be subjected to Jig for gravity separation and the finer product is subjected to vertical spiral for classification.

The Jig reject particles will again subjected to ground in the primary grinding mill (closed circuit) and classification by a hydro cyclone cluster. The overflow of the cyclone shall flow to the spiral and the underflow is re-circulated back to the primary mill.

The spiral product (heavies) and the product from Jig are both carried to the re-grinding ball mill for further grinding to 150 micron. The regrind mill product will again be classified by its closed circuit cyclone to separate the -150 micron product flows to the concentrate thickener.

The light particles from spiral classifier will be ground in the secondary grinding mill for reducing the size to liberate the locked particles. The closed circuit cyclone shall separate out the fines collected in the intermediate thickener. The thickened slurry from the intermediate thickener will pass to the two stages of magnetic separation as roughening ( WHIMS) and scavenging ( HGMS), thereby upgrading the final product to + 64%Fe. Finally the magnetic product will be thickened in the concentrate thickener along with re-grinding mill material and pumped to the buffer slurry product tank.

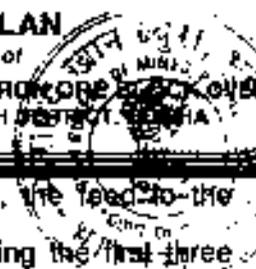
In the above flow sheet description, there is an up gradation of Fe to + 64 % from an input of 61.15 % Fe feed.

The overall mass yield is envisaged to be around 80% with and Fe recovery of 85% in this process.

The HGMS reject materials will be the final tailing (<45 % Fe) and sent to the tailing thickener. The thickened underflow of the tailing thickener will be sent to tailing pond in the form slurry from where the water will be recovered and re-circulated to the plant.

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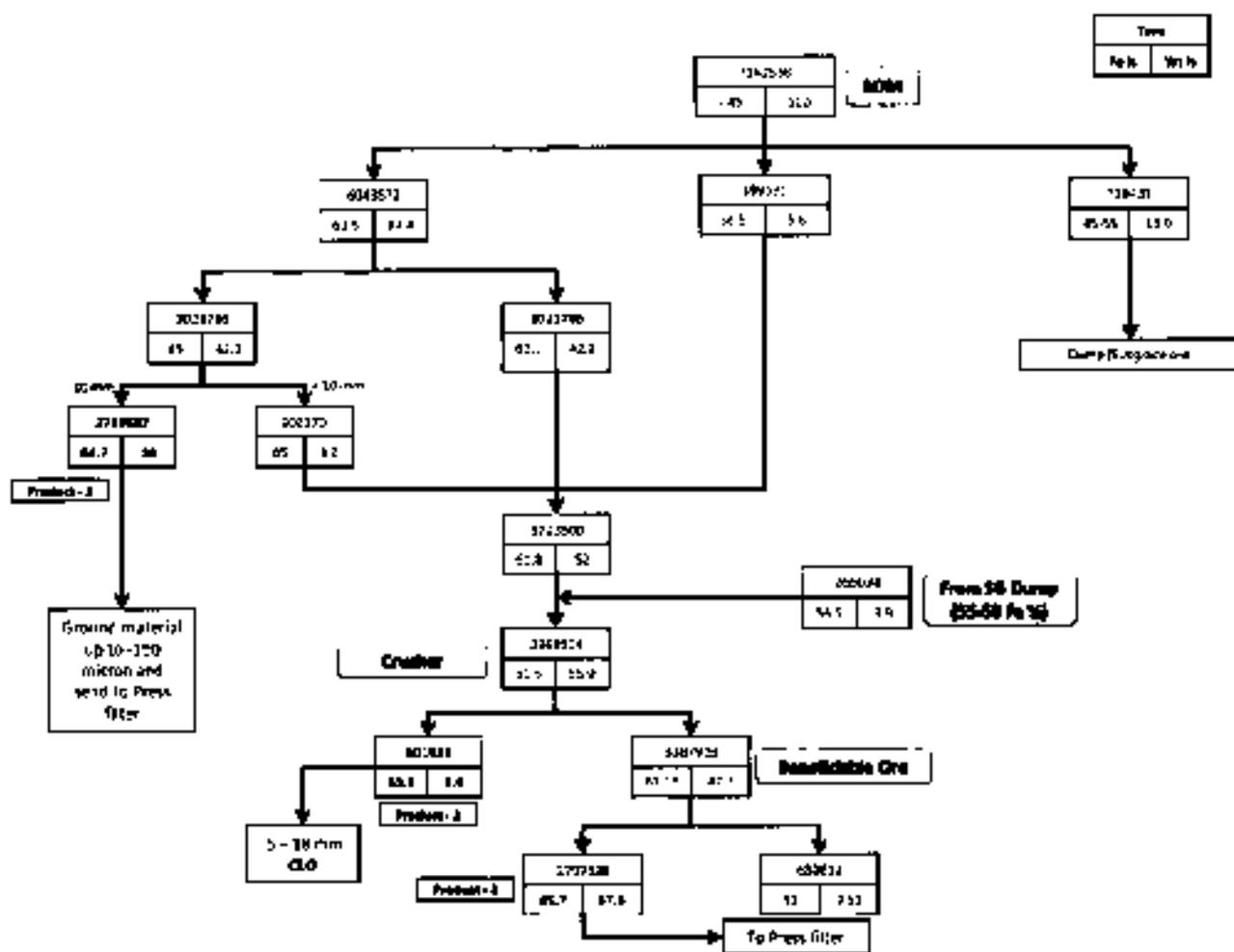
During the initial years, for the operation of crushing-beneficiation system, the feed to the system will be supplemented by the sub-grade ore (55-58%Fe) stacked during the first three years of the plan period. However, feed from the stack will gradually be reduced since the fresh generation of 55-58%Fe material will be directly fed to the plant.

The flow of the material (5<sup>th</sup> year) to the crushing-screening and beneficiation plant is depicted below:

Source	Feed to the plant (MTPA)			Sub-grade Iron ore (45-55%Fe)
	>58%Fe	55-58%Fe	Total	
Pit	6.04	0.40	6.44	0.72
Accumulated sub-grade material	--	0.26	0.26	-
<b>Total</b>	<b>6.04</b>	<b>0.66</b>	<b>6.68</b>	<b>0.72</b>

Note: The flow of material during the 4<sup>th</sup> year is in line as above

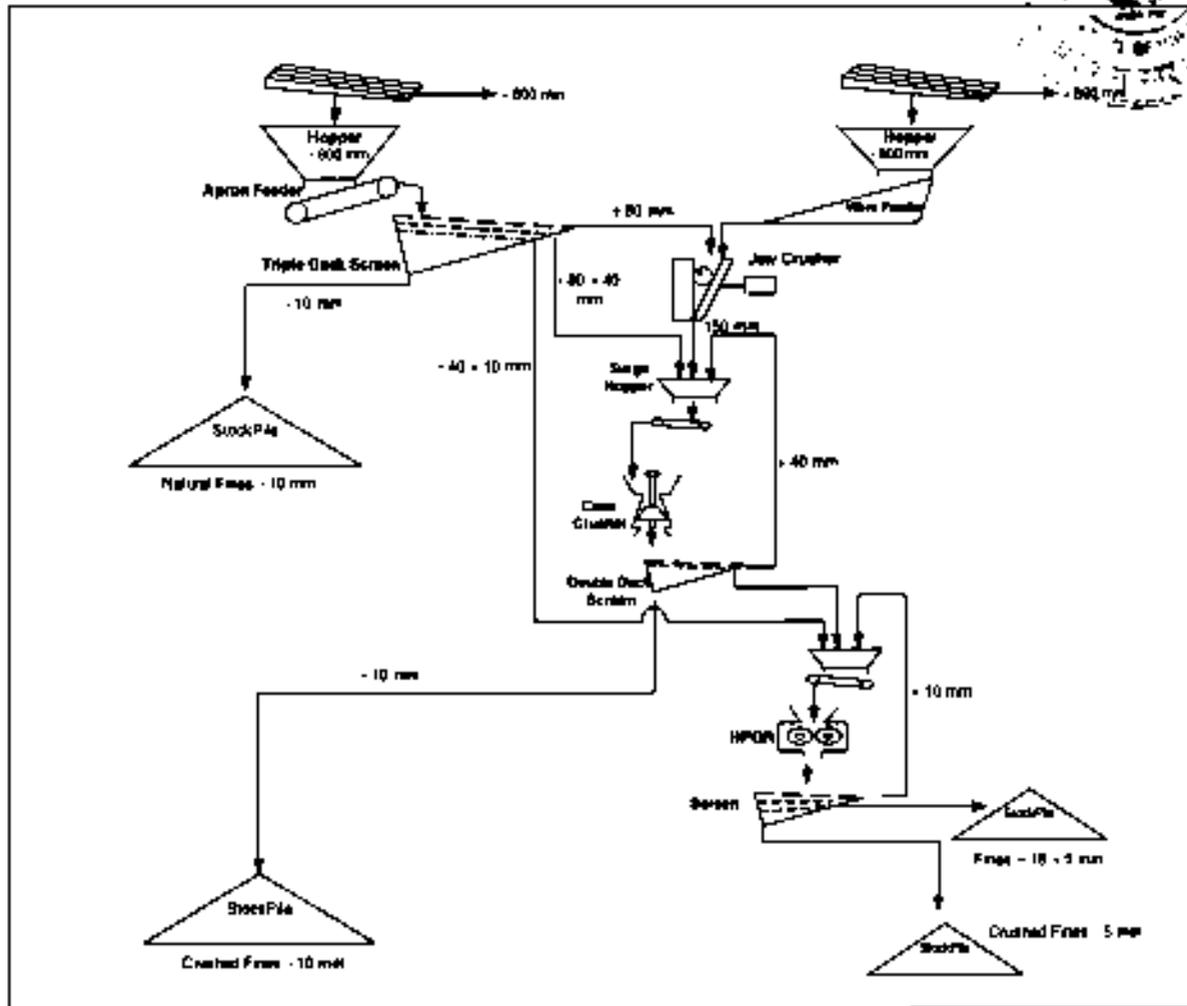
The flow sheet with material balance of screening and crushing and Beneficiation Plant are furnished below:



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**Conceptual Flow sheet of 1350 TPH Crushing and Screening plant**

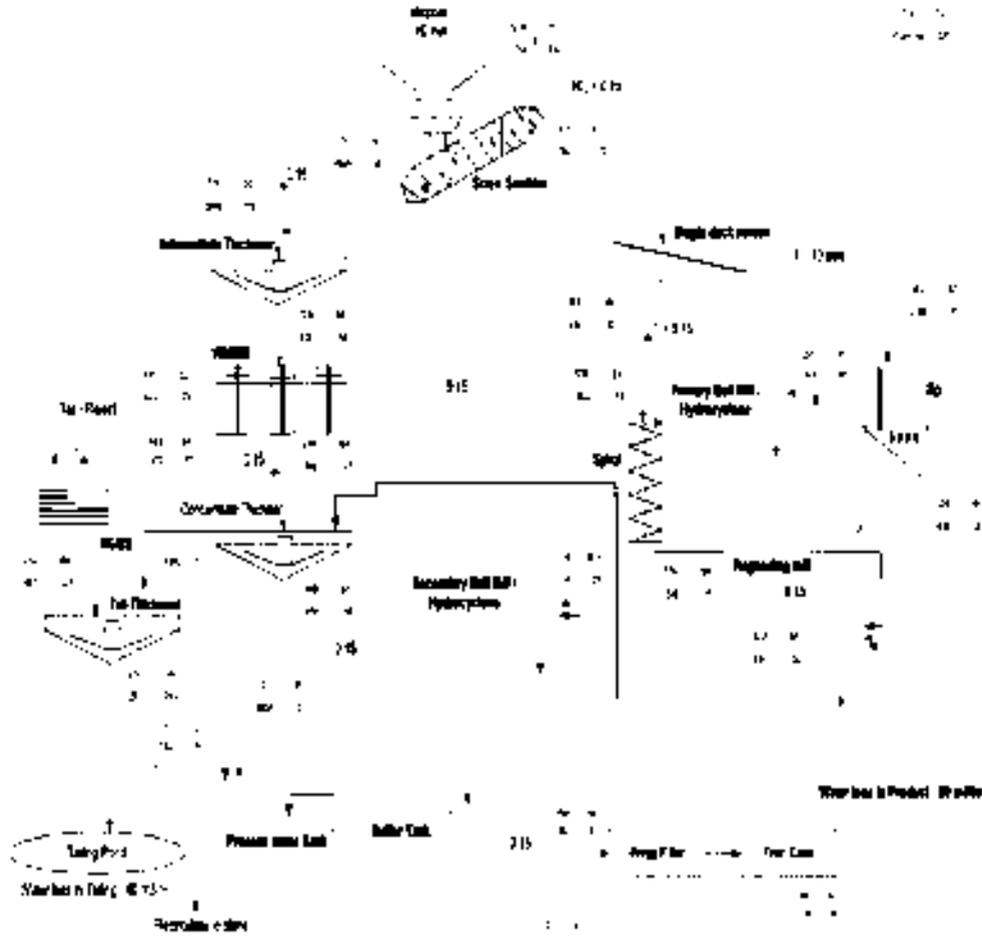


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**Conceptual Flow sheet of 1250 TPH Beneficiation Plant**



**Electrical Load list**  
**1350 TPH Static Screen and Crushing Plant**

Sl. No	Equipment Details	TPH	POWER, Kw
1	Triple Deck Screen	1350	150
2	Primary Jaw Crusher	750	350
3	Secondary Cone Crusher	1000	350
4	Secondary cone Crusher discharge Double Deck Screen	1000	500
5	HPGR (Tertiary Crusher)	1000	300
6	HPGR Discharge Single Deck Screen	1000	500
7	Conveyors	-	500
8	Others Like Compressor, Filter and spray system, Illumination, etc.	-	500
<b>Total Power Consumption</b>			<b>3150</b>

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Note: Initially during the first two years, mobile crushing & screening unit will be under operation which will be replaced by stationary crushing and screening unit during the third year. However, as a standby, mobile crushing & screening unit will also be placed in the mine.

The working hours of crushing and screening unit will depend on the requirement of proposed iron ore production.

**1250 TPH Beneficiation Plant**

Sl. NO	Equipment	Capacity(TPH)	No's	POWER, kW
1	Screw Scrubber	250	5	200
2	Single deck screen	250	4	200
3	Coarse & Fines Jig	125	5	500
4	Primary Ball mill with hydro cyclone	250	1	3000
5	Spiral set/Flotex	150	4	200
6	Secondary Ball mill with hydro cyclone	200	2	3000
7	Intermediate Thickener	300	3	150
8	WHIMS	200	4	1000
9	HGMS	150	3	500
10	Concentrate Thickener	250	2	100
11	Regrinding Ball Mill with hydro cyclone	200	3	4500
12	Tailing Thickener	300	1	100
13	Buffer tank	-	1	50
14	Press Filter	80	13	2000
15	Pumps, utilities & Other electrical accessories	-	-	1500
<b>Total Power</b>				<b>17000</b>

Total Installed Power requirement: 20150 KW (i.e. 20.15 MW) and the source of power will be grid. However, considering the safety factor of 1.1Kw the power requirement will be 22165KW (22.16MW).

**c) Explain the disposal method for tailings or reject from the processing plant.**

It has been estimated that the generation of mineral rejects will be approx. 20 % of beneficiable ore. The tailings from the HGMS will be fed into the tailing thickener. From the tailing thickener water will be recovered in the tailing pond, over an area of 4.92 ha. The tailing pond will be divided into three compartments. Out of the three compartments, each compartment will be of 2.00 ha size for holding the tailings. The third compartment of .92 ha will be for clarified water, which will be re-circulated back in to the process. This tailing pond will be made of lining to prevent any seepage. Besides, the floor of the sump will be sloping for effective settlement. Since this tailing sump is a totally lined no seepage is expected. A embankment is proposed in the downside to prevent overflow of water from tailing pond.

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The tailing will flow initially in one compartment and clarified water from the tailing will be recirculated back to process as such there will be "Zero Discharge" outside the mine lease area from the beneficiation plant. The tailing reject collected in the tailing pond, will be periodically desilted and backfilled into the mine voids. The tailing will not have any harmful elements. Once the first compartment is filled the second compartment will be used for tailing collection.

**d) Quantity and quality of tailings /reject proposed to be disposed, size and capacity of tailing pond, toxic effect of such tailings, if any, with process adopted to neutralize any such effect before their disposal and dealing of excess water from the tailings dam.**

A total of 0.68 Mil. Cu.m of tailings or mineral rejects will be generated from the beneficiation plant during 4<sup>th</sup> and 5<sup>th</sup> year of plan period. The iron content of the tailings/mineral rejects will be less than 45%Fe. An area over 4.92ha has been earmarked for the disposal of the mineral rejects during 4<sup>th</sup> and 5<sup>th</sup> year. The tailing pond will be in three compartments each of 2.0 Ha, 2.0 Ha & 0.92 Ha respectively. During the conceptual period an area of 6.93 Ha of Pit -1 (mineral exhausted pit) will be used as tailing pond.

**Toxic effect of the tailings:** Nil

**Dealing of excess water from the tailings dam:** The tailing will flow into the tailing pond and clarified water from the tailing will be recirculated back to process as such there will be "Zero Discharge" outside the mine lease area from the beneficiation plant.

**e) Specify quantity and type of chemicals if any to be used in the processing plant.**

Not Applicable

**f) Specify quantity and type of chemicals to be stored on site / plant.**

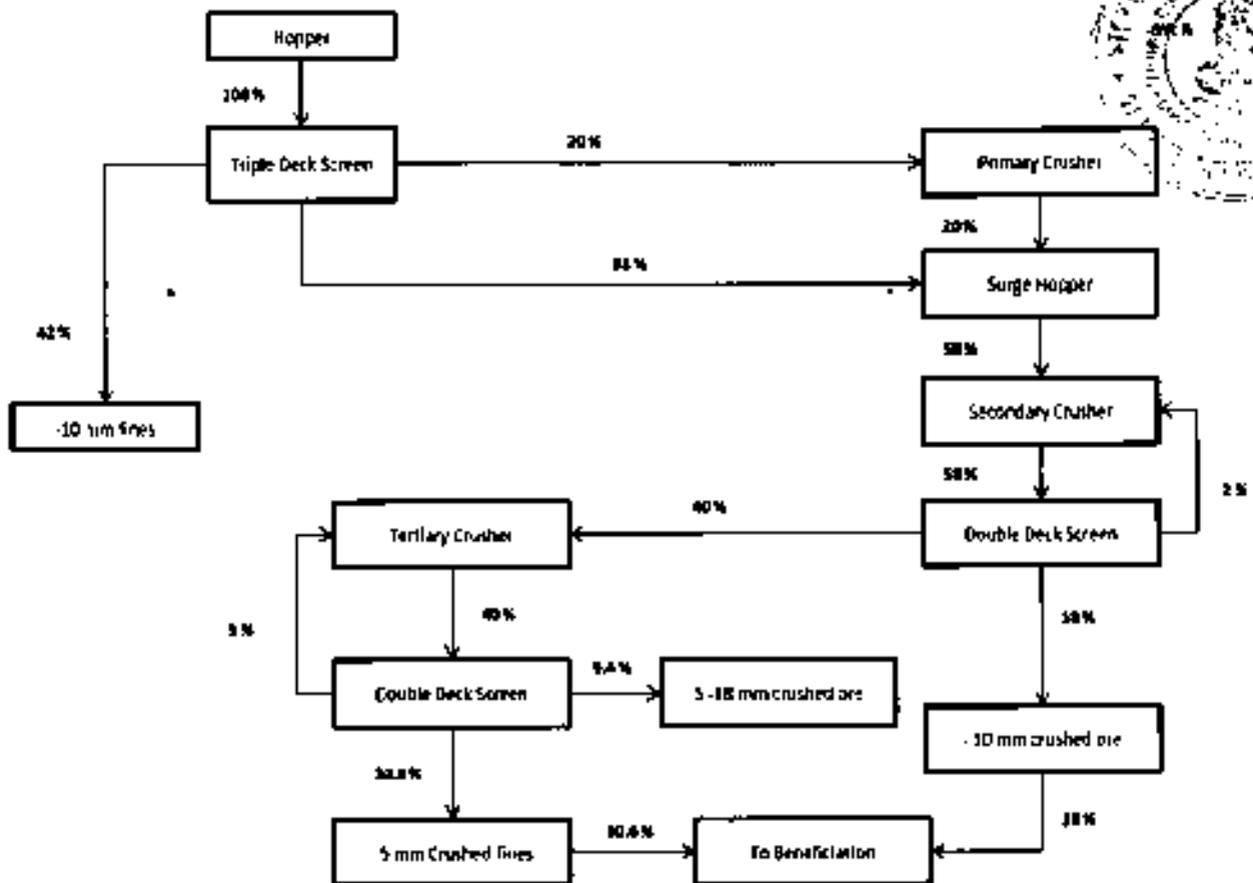
Not Applicable

**g) Indicate quantity (cum per day) of water required for mining and processing and sources of supply of water, disposal of water and extent of recycling. Water balance chart may be given.**

The total make up water for beneficiation plant will be about 2800 m<sup>3</sup>/day. The water requirement will be fulfilled from bore well. The water will be re-used in a cyclic manner so that there will be zero discharge. The water balance chart is given below:



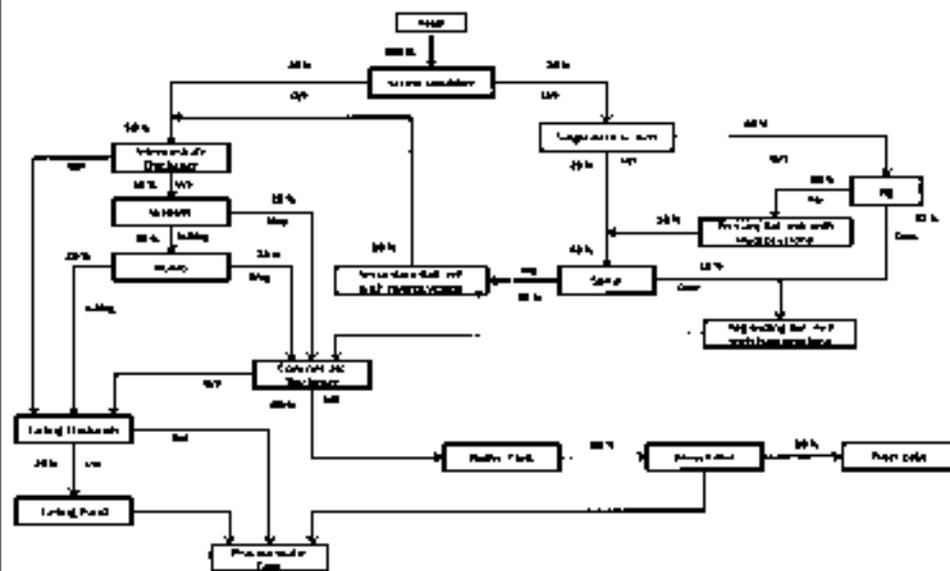
**Equipment wise Mass balance for Crushing & Screening Plant**



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**Equipment wise Mass balance for Beneficiation Plant:**



- For domestic, dust suppression and environment requirement.

**Breakup of water requirement**

Consumer Unit	Consumption (m <sup>3</sup> /day)
Water sprinkling in mining areas (haul road) and dust suppression measure provided at ore fines stockpile etc	370
Drinking, domestic and Sanitation (Mine and Plant)	30
Environmental Requirements	30
<b>Total</b>	<b>430</b>

The requirement of water for domestic use, dust suppression and environment will also be sourced from bore well.

**Land requirement:**

The total land requirement for this plant is estimated to be 23.8757 ha out of which 16.9457 ha is virgin area and remaining 6.93 Ha is mined out area of Pit-1, with the following breakup.

S. No.	Description	Area in Ha
1.	Process plant area (screening, crusher, beneficiation plant)	15.6557
2.	Tailing pond	4.92 (virgin area)
		6.93 Ha (Mined out pit – pit1)
	<b>Total</b>	<b>27.5057 Ha</b>

The land is within the mining lease area and as such no additional land is required.

**Manpower requirement for plant:**

Since the process is fully automated with process control systems, the man power requirement is minimum. The total manpower requirement for the plant for various categories (skilled, semi- skilled etc) is estimated to be 45.

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**CHAPTER-VII****7.0 OTHER INFORMATION:**

The utilities and auxiliary facilities provided for mining and ore processing plant are described in detail in this chapter.

**7.1 Facilities for Mining:****7.1.1 Mine Office**

A single storied temporary building is proposed to be made available to house the following rooms:

- Offices for Mines Manager, Assistant Mines Manager, Geologist, Surveyor & Labour Welfare Officer (LWO).
- Vocational Training Centre
- Canteen
- General office (Records, time keeping & cash counter, typing facilities etc).
- Toilet

**7.1.2 Servicing and Repairing Shop**

The structural steel construction with CGI sheet roofing will house the following facilities:

- Servicing and repairing space
- Emergency spares room (store) with tools
- Service station (with water treatment facilities)
- Mechanical (Garage) Engineer-Cum-Record room
- Foreman's Office
- Toilet

**7.1.3 Fuel pump station**

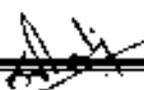
There will be an underground storage in steel tank of 20 kl or 20,000 liters of diesel storage capacity. Fuel pumps with meter shall be provided.

**7.1.4 Rest Shed**

The rest shed-cum-lunch room shall be provided near quarry site as per mines rules-56. First-aid facilities and toilet will be attached to the rest shed.

**7.1.5 Explosive Magazine**

A 1t capacity temporary magazine is to be constructed as per the Indian Explosive Rules. The area around the magazine will be fenced. An explosive guard house will be constructed at a distance of 25 meters from the magazine to prevent pilferage and theft.

  
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**7.1.6 Blasting Shed**

Portable blasting sheds of one end open type will be provided at the mine site for giving protection to the blasters during blasting. These blasting sheds are made up of steel and will be shifted in accordance with the shifting of blast hole locations.

**7.2 Facilities for ore processing plant**

For handling R.O.M to produce Fines, an arrangement for establishment of 1350TPH processing plant will be made in which ore handling plant (OHP) has been envisaged incorporating ore handling stock piling, reclaiming and loading arrangement.

**7.3 Power Supply System**

It is envisaged that requisite power will be supplied at 33KV by NESCO. Main receiving substation (MRS) proposed to be located within nearby the lease area where the applicant has already purchased a private land.

Power will be received at 33KV and primary distribution within the mine complex will be at same voltage. The power distribution system for the mines and office has been planned on the basis of the ground layout, and expected overall power demand as well as those in individual units.

For high / medium bay lighting, high pressure sodium vapor fittings will be adopted, whereas for low bay lighting as well as lighting of various offices, fluorescent and incandescent fittings will generally be adopted. The number and arrangement of the lighting fittings will be selected to match the required illumination levels in the various areas. All non-current carrying parts of various electrical equipment will be properly earthed.

**Emergency power supply**

Emergency power will be required only for emergency supply and switch gear controls during a total power failure. This requirement will be met from the generator of 1000 KVA capacity.

**7.4 Water supply system**

Water will be required for sprinkling on the haul road to suppress dust, servicing of earth moving equipment, drinking, sanitation and for watering the proposed plantations in their initial stages.

Besides water will also be required for grinding and beneficiation.

  
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**Source of water**

**Water supply**

The total make up water for beneficiation plant will be about 2800 m<sup>3</sup>/day. The water requirement will be fulfilled from bore well. The water will be re-used in a cyclic manner so that there will be zero discharge.

- For domestic, dust suppression and environment requirement.

**Breakup of water requirement**

Consumer Unit	Consumption (m <sup>3</sup> /day)
Water sprinkling in mining areas (haul road) and dust suppression measure provided at ore fines stockpile etc	370
Drinking, domestic and Sanitation (Mina and Plant)	30
Environmental Requirements	30
<b>Total</b>	<b>430</b>

Thus the total requirement of water is 3230 m<sup>3</sup>/day which includes 2800m<sup>3</sup>/day for beneficiation plant and remaining 430 m<sup>3</sup>/day for mining, green belt, domestic and dust suppression requirement. Besides, water may also be required for Pumping Slurry through the pipe line. The exact quantity required for pumping slurry is being worked in the detailed project report under preparation.

**Source:** Ground water i.e. Bore well water will be utilized for meeting the requirements of Mining, dust suppression as well as crushing/screening/grinding/Beneficiation plant.

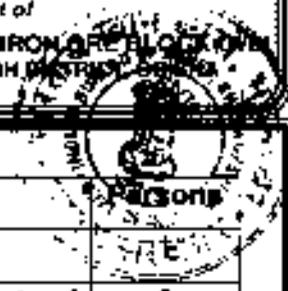
**7.5 Employment Potential:**

**7.5.1 Administrative Personnel:**

Sl. No.	Designation	Qualification	Persons
1.	Mines Manager	Degree in Mining Engineering with 1 <sup>st</sup> class Mines Manager's certificate of competency having 10 years of mining experience.	1
2.	Asst. Mines Manager	Degree in Mining with 2 <sup>nd</sup> class Mines Manager certificate of competency.	2
3.	Mechanical Engineer	Degree in Mechanical Engineering with experience in repair and maintenance of machines.	1
4.	Electrical Engineer	Degree in Electrical Engineering	1
5.	Exploration Geologist	Master Degree in Geology / Applied Geology having 10 years of experience.	1
6.	Geologist (Quality control and planning)	Master Degree in Geology / Applied Geology having 10 years of experience.	1
6.	Personnel Officer	Degree in Personal Management and Labour Laws.	1
<b>Total</b>			<b>8</b>

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**7.5.2 Supervisory Personnel**

Sl. No.	Designation	Qualification	
1.	Mines Surveyor	Survey certificate of competency	
2.	Foreman (Mines)	Diploma in mining with foreman's certificate of competency	6
3.	Foreman (Drilling & Blasting)	Foreman's certificate of competency with experience in drilling & blasting.	3
4.	Foreman (Mechanical)	Diploma mechanical engineering with experience in repair and maintenance of diesel machines.	4
5.	Foreman (Electrical)	Diploma in electrical engineering with license and with experience in maintenance and repair of electrical equipment.	4
6.	Mining Mate	Mate's certificate of competency	6
7.	Charge Man	I.T.I in diesel mechanics	4
<b>Total</b>			<b>28</b>

**7.5.3 Technical Operators (Mining)**

1.	Blast hole Drill-cum-compressor Operator	8
2.	Jack-hammer Drill-cum-compressor Operator	3
3.	Blaster	2
4.	Shovel Operator	14
5.	Bull-Dozer Operator	2
6.	Dumper Driver	29
7.	Water Tanker Operator	3
<b>Sub-Total :</b>		<b>61</b>

**7.5.4 Assistants (Mining)**

1.	Drilling Assistant	8
2.	Blasting Helper	5
3.	Survey Assistant	2
4.	Spotter	10
5.	Labour (Road repair)	5
6.	Sampler	5
<b>Sub-Total :</b>		<b>35</b>

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**7.5.5 Technical staff (Repair and Maintenance)**

1.	Diesel Mechanic	4
2.	Fitter	4
3.	Welder / Gas Cutter	9
4.	Auto-Electrician	3
5.	Greaser / Tyre man	3
<b>Sub-Total :</b>		<b>17</b>

**7.5.6 Assistants (Repair and Maintenance)**

1.	Khalasi	6
2.	Helper	6
3.	Worker	6
<b>Sub-Total :</b>		<b>18</b>

**7.5.7 Office Staff**

1.	Steno-cum-typist	1
2.	Clark-cum-record keeper	1
3.	Cost Accountant	1
4.	Cashier / Accountant	1
5.	Time keeper	2
6.	Asst. store keeper	2
7.	Store keeper	1
8.	Office peon	2
<b>Sub-Total :</b>		<b>11</b>

**7.5.8 Others**

1.	Tool room attendant	3
2.	Record keeper	2
3.	Canteen staff	6
4.	Compounder	2
5.	Light vehicle operator	5
6.	Security guard	14
7.	Sweeper	2
<b>Sub-Total :</b>		<b>34</b>

**7.5.6 Category wise Manpower List**

1.	Administrative	8
2.	Supervisory personnel	28
3.	Technical operator (mining)	61
4.	Assistants (mining)	35
5.	Technical staff (Repair and maintenance)	17
6.	Asst. (Repair and maintenance)	18
7.	Office staff	11
8.	Others	34
<b>Sub-Total :</b>		<b>212</b>

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**CHAPTER-VIII**

**8.0 PROGRESSIVE MINE CLOSURE PLAN UNDER RULE 23 OF MCDR'1988**

The mining activities adversely affect the environment. Due to lack of proper planning, an appreciable amount of environmental degradation and ecological damage to water, air and soil occurs. The problems associated with mining activities are land degradation, disposal of over burden (OB), deforestation, water pollution due to wash off, damage to forest flora and fauna, occupational health hazards etc. Hence, detail base line information collected, impact of mining on the environment and environment Management plan has to be conceptualized for the implementation practically on the field.

**8.1 Environment Base line Information: Attach a note on the status of baseline Information with regard to the following.**

The Environmental Base line information will be conducted after obtaining Terms of Reference, (TOR) from MoEF & CC, Govt of India, and according Environment Management will be undertaken. However, as per the field observation and data from nearby mines following base line information has been furnished.

**8.1.1 Existing land use pattern indicating the area already degraded due to mining, roads, processing plant, workshop, township in a tabular form.**

The existing land use pattern as per land schedule provided by the state govt. is as follows:

Type of Land	Category	Revenue Name	Area in Hectares
Forest Land	Village Forest	---	20.885
	DLC Forest	---	105.252
	Reserved Forest	---	--
	<b>Sub-total</b>	---	<b>126.137</b>
Non-Forest land	Govt. Land		6.327
	Private tenanted land		3.257
	Grazing land	Gochar	3.444
	<b>Sub - total</b>	---	<b>13.028</b>
<b>Total</b>	---	---	<b>139.165</b>

**8.1.2 Water regime, quality of air, ambient noise level, flora, climatic conditions:**

**i) Water Regime:**

The area falls within the Baitarani river basin and watershed of the Kundra or Suna River which flows towards north in the NE to SW direction ultimately joins the Baitarani River. The river Suna

originate from Hills of Khajurdi Reserve forest present around 12km south of mine lease area. A number of streams originating from the hills in the surrounding regions flow into Suna River thereby adding to its flow. The drainage pattern is dendritic generally but since the region is fracture controlled, trellis pattern is also observed. Network of small nalas joins Suna River. The Sunanala flows in a meandering pattern but are also lineament controlled. The drainage density is moderately high indicating more run-off than infiltration.

**ii) Quality of air:**

Presently, base line information in regards to air quality has not been furnished in detail. The objective of the ambient air quality monitoring will be determining the concentration of particulate matters in the ambient air and its conformity to the prescribed standards by CPCB (NAAQ standard). The existing ambient air quality, in terms of Suspended Particulate Matter (PM<sub>10</sub> & PM<sub>2.5</sub>), Sulphur dioxide (SO<sub>2</sub>), Nitrogen (NO<sub>x</sub>) and carbon monoxide (CO) will be monitored within core and buffer zone after obtaining the TOR from MoEF & CC. Accordingly, the results of the core zone and buffer zone will be submitted to SPCB, MoEF & IBM. The yearly maximum & minimum values of PM<sub>10</sub>, PM<sub>2.5</sub>, SO<sub>2</sub> and NO<sub>x</sub> in the core zone and buffer zone.

**iii) Ambient noise level:**

Noise produced at mine will be due to drilling, blasting, compressors, pumps, movement of vehicles, crushing plant, screening plant and other machinery. The noise to be generated by the mining activity may be dissipated within surrounding area. Effect may be felt only near the active working area and on the personnel working in the vicinity.

**iv) Flora and fauna:**

A site specific wild life Management plan will be prepared and approved by Chief Wild life warden. A detail biological study to know the type of flora and fauna available will be undertaken as a part of the Site specific Wild life conservation plan.

**v) Climatic conditions:**

Climate and meteorology of a place play an important role in the implementation of any developmental project. Meteorology (weather climate) is also the key to understanding local air

quality as there is essential relationship between meteorology and atmospheric dispersion involving the wind in the broadest sense of them. The detail study on climatic conditions will be undertaken as a part of Environment clearance. From secondary data the following information has been furnished in regards to climate.

**(a) Temperature:**

The climate of the study area is characterized by an oppressively hot summer with high humidity. Summer generally commences in the month of March. Temperature begins to rise rapidly attaining the maximum in the month of May. During the summer maximum temperature can go up to 47.4°C. The weather becomes pleasant with onset of monsoon in June and remains as such up to the end of October. The temperature in the month of December is lowest i.e. 7°C.

**(b) Relative Humidity**

The air is dry except during the South – West monsoon season. The maximum humidity ranges from 55% to 76% with annual average of 64.63% while the minimum humidity ranges from 26% to 43% with an annual average of 34%.

**(c) Rainfall Data**

The rain fall data has been obtained from IMD for the financial year 2009-2013. Based on the data the rain minimum Annual rainfall is 971mm during 2010 and the maximum rain fall is 1820mm during 2013. The average rainfall is 1325.16 mm.

- **Predominant wind direction is South-West.**

Predominant wind direction is South-West. Area remains calm for nearly 50% of the year.

• **Human settlements:**

There is no human settlement /residential areas within the lease area.

• **Public buildings:**

There are no public buildings within the lease hold area.

• **Places of worship and monuments:**

There is no place of worship and monuments within the lease area.

• **Indicate any sanctuary is located in the vicinity of leasehold:**

There is no sanctuary located in the vicinity of the leasehold area.

**B.2. Impact Assessment: Attach an Environmental Impact Assessment Statement describing the impact of mining and beneficiation on environment on the following:**

- i) Land area indicating the area likely to be degraded due to Pitting, dumping, roads, workshop, processing plant, tailing pond/dam, township etc.

Land degradation is one of the major adverse impacts of opencast mining activities and effort to control adverse impacts would be incomplete without appropriate land reclamation strategy. The degraded lands are mining pit; waste dumping, crusher & screening plant area, roads for mineral transportation etc. In course of mining operation & other allied activities the detail land use pattern will be changed as given in the table below up to the conceptual period.

Particulars	AREA IN HECTARE				
	At present	Additional area during plan period	Land use at the end of plan period	Additional area beyond plan period	Land use during conceptual period
Area under mining	0.50	40.273	40.773	47.966	88.759
Storage of topsoil	0	0.320	0.32	0	0
Waste dump	0	4.967	4.967	1.038	6.003
Sub grade stack / Mineral storage	0	7.551	7.551	0	0
Infrastructure Facilities (Site services & utilities, admin. building, Conveyor belt, etc)	0	2.4303	2.4303		2.4303
Roads	0.598	2.2714	2.8694	0	0.950
Railway	0	0	0	0	0
Tailing Pond	0	4.923	4.923		4.923
Effluent treatment plant	0	0	0		0
Mineral separation plant (Crushing & screening unit, beneficiation plant)	0	15.6557	15.6557	0	12.85
Township area	0	0	0	0	0
Others (Retaining wall, Garland drain, check dams, settling tank, Sump, embankment etc magazine)	0	6.4557	6.4557		6.4557
<b>Sub Total</b>	<b>1.098</b>	<b>84.8471</b>	<b>85.9451</b>	<b>49.022</b>	<b>122.371</b>
Safety zone (ML Boundary, road)	6.755		6.755		6.755
Untouched area	131.312		46.4649		10.039*
<b>Grand total</b>	<b>139.165</b>		<b>139.165</b>		<b>139.165</b>

\* It is proposed to do exploration over 30.039 Ha during plan period. After exploration the area will be utilized as per the outcome of the result.

\*\* During conceptual period the sub grade iron ore will be kept over the back-filled area.

\*\*\* The total area required for mineral separation plant (i.e. crushing and screening, beneficiation facility) is 15.6557Ha out of which crushing and screening facility is 4.9067 Ha. This will be utilized in virgin area during plan period and part of conceptual period. During the 11<sup>th</sup> year part of crushing and screening facility area is required for mining. Hence part of the facility over an area of 2.8057 ha will be dismantled and placed on the backfilled area. Thus the area of crusher and screening facility remains the same i.e. 4.9057 ha.

**II) Air Quality:**

The air borne particulate matter is the main air pollutant contributed by open cast mining. Various emission sources are identified from the mining operations and for the increased material handling due to increase of production. The deposit of iron ore is medium hard to soft in nature and ore body is quite thick and is intercepted by different types of unwanted rock types available at different layers.

**III) Water Quality:**

The main drainage system nearby the block is Suna Nadi which is perennial in nature. Tube wells and dug wells in the Ghoraburhani, Kalamanga village meet the drinking water requirements of the villagers. As the mining operation shall be done within the mining lease without any discharge of water & without any interference with the nearest water bodies, it will not alter the local drainage pattern. So, there will no adverse effect due to the said project on the surface water.

It has been proposed to open two pits during plan period of 5 years. At the end of the Plan period the bottom RL of pit-1 will be 540m and that of pit-2 will be 590m. However, the expected working depth of these quarries by the end of this plan period and Conceptual period is given in the table below.

NAME OF QUARRY	At the end of Plan period (M RL)		At the end of Conceptual period (M RL)	
	Top	Bottom	Top	Bottom
Pit-1	620	540	--	--
Pit-2	730	590	--	--
UPL-1	--	--	620	540
UPL-2	--	--	730	520

Therefore, such depth of mining would not affect the ground water table as the level of ground water is at 480 MRL.

**IV) Noise Levels**

The proposed mining operation will be carried out open cast Fully Mechanized method. In this open cast mechanized mining the various sources of noise in the area are attributable mainly due to drilling, blasting, operation of compressor, loading and haulage, crushing, screening, grinding operation of diesel pump and vehicular traffic.

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The various sources of noise mentioned above shall only be periodical and will be limited to a fixed period of operation only. In addition to this, the transportation of ores might cause a little effect on the noise level. Effect may felt only near the active working area and on the personnel working in the vicinity.

**V) Vibration Levels (Due To Blasting)**

There is a possibility of occurrence of ground vibration due to blasting. As a result of which there will be negative impact of blasting on surrounding villagers.

**vi) Water Regime**

As the Sona Nadi is around 4km from the block, the run-off of water from the core zone during the monsoon period may have little effect on it. Runoff if not properly managed is likely to carry the silt from the proposed mine area to the nearby water bodies & agricultural land.

**vii) Acid Mine Drainage**

Not applicable

**viii) Surface Subsidence**

Not applicable

**vii) Socio-Economics**

Socio-economic status of the population is the indicator of the development of the region. Any developmental project of any magnitude will have a bearing on the living conditions and the economic base of the population in particular and the region as a whole. About 15 villages are coming under Sundargarh and Keonjhar district within 5km radius of the proposed mine area. Population distribution pattern, population break-up, literacy level and occupational structure of these villages as per the census data of 2011 are furnished below:

Name of Village	Population			SC	ST	Literacy				Working Population			
	Male	Female	Total			Male	Female	Total	(%)	Main Workers	Marginal Workers	Total	Non-Workers
Kalmanga	691	710	1401	265	796	421	297	658	47	345	134	479	822
Ghoraburhan	82	85	167	0	167	37	11	48	29	27	25	52	115
Atala	297	267	564	113	369	143	95	238	42	174	0	174	390
Nadikazira	290	251	541	86	352	184	122	306	57	210	0	210	391
Kendudih	1468	1581	3060	188	2210	898	867	1583	51	842	667	1509	1941
Sargigarh	788	788	1554	122	1046	449	321	770	50	181	395	556	998
Sanindupur	414	372	786	15	512	214	113	327	42	287	7	274	512
Beraindupur	284	264	548	20	337	115	63	178	32	121	19	140	408
Patmunda	501	512	1013	86	352	307	70	377	37	315	28	343	670

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Ganus	820	787	1617	266	931	446	241	687	42	297	145	442	1175
Karesahi	261	263	524	25	390	95	45	140	27	127	18	145	379
Kolha-													
Rudukala	229	244	473	11	446	67	12	69	15	153	0	153	324
Rugudih	587	585	1182	36	772	314	160	474	40	352	168	518	664
Kundrapani	248	237	486	56	370	134	72	206	42	21	178	198	267
Chomalda	297	268	565	40	457	178	102	280	50	171	12	183	362
<b>Total</b>	<b>7249</b>	<b>7222</b>	<b>14471</b>	<b>1287</b>	<b>9601</b>	<b>3960</b>	<b>2331</b>	<b>6321</b>	<b>602.4</b>	<b>3583</b>	<b>1794</b>	<b>5377</b>	<b>9094</b>

The summarized details of workers and non-workers within surrounding 15 villages are furnished below:

Working population	No of population	% of total population
Main Workers	3583	25
Marginal Workers	1794	12
<b>Total Workers</b>	<b>5377</b>	<b>37</b>
Non-Workers	9094	63

**vii) Historical monuments etc.**

There are no historical monuments available in the core and buffer zone of the Mines.

**MITIGATION MEASURES OF IMPACT ASSOCIATION OF THE MINING**

**Mitigation measures for Impact of Mining on land.**

From the land use table we can be observed that, an area of 88.759 Ha will be used for quarrying upto conceptual period. In the post mining scenario after winning the ore, the mined out quarries over 33.9076ha will be backfilled with waste material under reclamation/rehabilitation/restoration proposal. An area of 6.93 ha will in mineral exhausted pit -1 will be utilized as tailing pond during the conceptual period. Topsoil mixed with manures will be used for plantation. Preferably local species will be selected so that the growth of the plant will be fast and healthy. A portion of mined-out area of 2.0320 hectare will be converted into a water reservoir with suitable precautionary safety measures and further plantation to improve the aesthetic beauty. Rest of the excavated area of 45.8692 hectares will be covered with plantation.

**Mitigation measures of Impact associated with mining i.e. mainly related to Air**

The following prevention and control measures will be undertaken by the management in order to reduce the dust emission from various mining and allied activities like ore extraction, processing, and transportation etc.

- ◆ Drill machines equipped with air conditioner operator cabin will be used for better productivity. Environmental friendly dust collector system will be provided in the drill machine. The wet drilling arrangement with drill bit grinding will also be provided.

- ❖ Blasting will be carried out by emulsion explosives which optimize transfer of energy from explosive to rock. To get the better fragmentation and to avoid fly-rock, ground vibration noise, air over-pressure, staggered pattern multi row blasting and row-by-row initiation with an optimum inter row delay will be adopted.
- ❖ Non-electric shock tubes will be used to minimize the noise and ground vibration.
- ❖ Installation of mist gun sprayer arrangement at screening & crushing unit as well as loading & unloading point for dust suppression.
- ❖ To suppress the dust on the feeder roads and haul roads 4 nos. of 35 KL capacity pressurized water sprinkler will be deployed for sprinkling on the haul road.
- ❖ Water sprinkling will be done on the working faces, screening & crushing plants areas and the stacking areas by mist gun water sprayers and mobile water tankers.
- ❖ Frequency of water sprinkling by high pressure pumping facility water tankers may increase to keep the haul roads wet including both sides of the haul roads, working surfaces and the stacking dumps to control the dust pollution.
- ❖ Chemical based Dust Bloc agents will be used along with sprinkling for effective binding and suppression of dust besides reducing water consumption.
- ❖ Appropriate Personnel Protective Equipment (PPE) and enclosed AC cabins will be provided.

**Mitigation measures of impact associated with mining i.e. mainly related to water**

As earlier explained there may be adverse impact of surface and ground water due to implementation of this project. However, this can be controlled by adopting the following mitigation measures:

- ❖ The following initiatives will be taken to prevent solid wash off to enter the surface water body:
- ❖ RCC retaining wall will be constructed at toe of dump periphery.
- ❖ Series of garland drains will be constructed along the periphery of retaining wall following the contours.

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- ❖ The berms & check dams will be constructed across the gully/rain cuts etc. which will check the wash off & divert the run off to the settling pit through garland drain.
- ❖ After spreading of sweet earth & fertilizer, grass seeding, agave and other fast growing shrubs will be planted on the slope of the dumps and on the berms to stabilize the dumps.
- ❖ Settling ponds, sumps, embankments, are proposed at strategic locations to prevent water getting contaminated.
- ❖ Regular monitoring of the flow rate as well as the water quality of Suna Nadi will be undertaken after the resumption of mining operation and records will be maintained and the data thus monitored will be regularly submitted to MoEF, SPCB, and CPCB & IBM. The water sample will be carried out during the lean to find out any seasonal impacts. Collection of water sample will be in practice on monthly basis. Similarly, ground water level and quality monitoring will be done four times in a year covering core zone & buffer zone.

**❖ Waste Water Management at Mines Site****Rainwater Harvesting**

Mine management will take various steps towards rain water harvesting and artificial recharge for ground water level augmentation. A rainwater harvesting Management plan will be prepared by an institute of repute after the commencement of mining operation. As per the report, the RWH structure will be constructed within the proposed mine site. Part of harvested water will also be used for both dust suppression and beneficiation plant.

**Surface Run off Management:**

As the pits will be opened in the lower part of the hill, it is expected that, rain water may enter into the proposed pits i.e. pit-1 and pit-2. Considering this it has been planned to make proper surface drainage system to manage the rain water for preventing the entry into the pits.

It is envisaged to provide garland drain of 1157m over the pit-2 which will be connected to the proposed sump located at pillar no 3. The rain water will be allowed to flow within this garland drain and ultimately stored in the proposed sump. De-silting work will regularly be carried out for facilitating maximum storage of water within the sump. The dimension of the proposed settling will be 30.m x 20 m x 10m. It is estimated that 6000 cum of water will be stored within the sump. The

water from the sump will be utilised for plantation and dust suppression measures.

Similarly, another, garland drain of 1693cum is proposed to be provided over the eastern part of UPL-2. The garland drain is proposed to be connected with the proposed sump to be located at pillar no-8. The dimension of the proposed settling will be 80m x30 x 10m. About 24000cum of water will be accumulated within the sump. Regular de-silting of the sump will be carried out for facilitation of maximum storage of water. The water from the sump will also be utilised for dust suppression and plantation purpose.

Further, the proposed tailing dump is located at hilly terrain. It has been planned to make a garland drain of 2850m over the top of the pond and the garland drain will be connected with the garland drain of proposed dump-2. The water will be allowed to flow through the proposed garland drain and it will be passes through the settling pond and the clean water will be discharged outside the lease area.

In addition to the above proposals, it is envisaged to carry out a study for Rain Water Management Plan i.e. drainage plan along with arrangement for arresting solid wash off by incorporating engineering details and materials to be used for the erection of protective measures like Retaining wall, garland drain, settling pond etc. by an institute of repute. The said study will be undertaken after the commencement of mining operation. An undertaking is enclosed in this regard.

#### **Mitigation measures of Impact associated with mining i.e. related to Noise**

M/s Essar Steel India Ltd is adopting the following mitigation measures in the mine area to control noise pollution

- ❖ Regular maintenance of equipment will be carried out in company's workshop.
- ❖ Silencers and mufflers will be provided in the exhaust pipes.
- ❖ Oversize boulders will reduced in size through Flock Breaker to avoid secondary blasting.
- ❖ The workers employed will be provided with earmuffs/ear-plugs.
- ❖ Noise levels and air over pressure in blasting will also be controlled by following optimum blast design as per the technical studies conducted.
- ❖ Planting of trees will be taken up along the mining lease boundary.

Location of Noise level Monitoring will be fixed as per the advice of MoEF.

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**Mitigation measures of impact associated with mining i.e. related to ground vibration due to blasting**

Blasting will be carried out by emulsion explosives which optimize transfer of energy from explosive to rock. To get the better fragmentation and to avoid fly-rock, ground vibration, noise, air over-pressure, staggered pattern multi row blasting and row-by-row initiation with an optimum inter row delay will be adopted. Non-electric shock tubes will be used to minimize the noise and ground vibration.

A vibration study will be carried out by an institute of repute to assess the effects of ground vibration on surrounding structures and to optimize blast parameters with the objective of controlling fly-rock within the blast zone.

**Acid Mine Drainage**

Not applicable

**Surface Subsidence**

Not applicable

**Socio-Economics**

M/s ESSAR Steel India Limited will work on developmental activities for growth of the Tribal Community in and around the surrounding area. The strategy will be to empower the marginal community by building up their capacities and realize their potential; its main objectives encompass community participation, human capital development, personality development, resource mobilization and networking with government agencies and other counterpart organizations. It will be involved in learning programmes such as the Education and Capacity Building, and growing up healthy (Through Health Programme) livelihood and environmental sustainability programme and espouses Social Cause.

**8.3 Progressive Reclamation Plan:**

To mitigate the impacts and ameliorate the condition, describe year wise steps proposed for phased restoration, reclamation of lands to be degraded in respect of following items separately for plan period.

**Plan period.**

**Back-filling**

After the execution of the lease, initially two pits namely pit-1 and pit-2 will be opened. pit-1 has been envisaged in such way that it can be exhausted during plan period. The waste to be generated during 4<sup>th</sup> and 5<sup>th</sup> year will be utilized for back-filling. During 4<sup>th</sup> year of plan period part of the pit-1 will be exhausted and concurrent back filling will be carried out within pit-1. Total generation of waste from pit-1 during 4<sup>th</sup> and 5<sup>th</sup> year will be 2060074cum. Out of which 10% i.e. 206007.4cum will be utilized for road maintenance and balance 1854067cum will be utilized for back filling. Further, during 5<sup>th</sup> year it is proposed to re-handle the waste dump-1 as it is being proposed within ultimate pit limit. A total of 447862cum will be re-handled during 5<sup>th</sup> year. Cumulatively, 2301929 cum of waste will be back-filled within pit-1 during plan period. The details of back-filling during plan period will be as follows:

Year	Area of back-filling (m <sup>2</sup> )	RL
1 <sup>st</sup>	Nil	Nil
2 <sup>nd</sup>	Nil	Nil
3 <sup>rd</sup>	Nil	Nil
4 <sup>th</sup>	34446	
5 <sup>th</sup>	29132	540-580
	26711	580-590
<b>Total</b>	<b>90296</b>	

**Plantation over back filled area**

No plantation will be undertaken during plan period over the back-filled area since concurrent back-filling will be continued up to 8<sup>th</sup> year. From 9<sup>th</sup> year plantation over the back-filled area can be started.

**Bench plantation**

There will be no bench plantation during plan period of five years. During ensuing plan period it has been planned to make plantation over 2.20 Ha within safety zone and over the proposed dump. The year wise plantation within safety zone and dump area during planned period will be as follows:

Year	Area of plantation (m <sup>2</sup> )	No of saplings	Location	Name of the species
1 <sup>st</sup>	0.55	1375	Safety zone	Neem, Mango, Chakunda, Sissom Shrubs etc.
2 <sup>nd</sup>	0.37	925	Safety zone	
3 <sup>rd</sup>	0.61	1525	Safety zone	
4 <sup>th</sup>	0.30	750	Safety zone	
5 <sup>th</sup>	0.37	925	Safety zone and proposed dump	
<b>TOTAL</b>	<b>2.20</b>	<b>5500</b>		

**PRADHEPT MOHAPATRA**  
QUALIFIED PERSON

**SABYASACHI MOHANTY**  
QUALIFIED PERSON

**1.3.1. Mined-Out Land:**

Describe the proposals to be implemented for reclamation and rehabilitation of mined-out land including the manner in which the actual site of the pit will be restored for future use. The proposals may be supported with yearly plans and sections depicting yearly progress in the activities for land restoration/ reclamation/rehabilitation, afforestation etc., called "Reclamation Plan".

Mine reclamation is an integral part of the mineral development process. It has been designed to restore to an acceptable state the physical, chemical, and biological quality of land and water regimes disturbed by proposed mining. Planning has been made in such a way that reclamation will be started from 4<sup>th</sup> year onwards. It will include best management practices for surface mine reclamation. It will also provide communities with greater certainty regarding sustainable environmental practices with respect to reclamation of degraded land. During this plan period it is proposed to undertake pit-1 reclamation.

**8.3.2 Topsoil Management: The topsoil available at the site and its utilization may be described.**

About 12500 cum of top soil will be scrapped during plan period. The said quantity has been proposed to be stored separately and will be utilized for plantation.

**8.3.3 Tailings Dam Management: The steps to be taken for protection and stability of tailing dam, stabilization of tailing material and its utilization, periodic de-silting measures to prevent water pollution from tailings etc, arrangement for surplus water overflow along with detail design, structural stability studies, the embankment seepage loss into the receiving environment and ground water contaminant if any may be described.**

It has been planned to establish a beneficiation plant during 4<sup>th</sup> year of plan period. The mineral rejects will be produced in the form of tailings. To dispose the tailings it has been planned to construct a pond in the southern part of the lease area over an area of 4.93 Ha. This tailing pond will be utilized during the plan period. Further during the conceptual period an area of 6.93 Ha of Mine out pit (pit-1) will be utilized for tailing disposal.

During 3<sup>rd</sup> year, it is proposed to construct a bund/embankment for the tailings disposal. The dimension of the bund will be as follows:

Length	300m
Base	45m
Height	15m
Width	6m

The details of tailing dam design and its management are explained in CH-IV.

**8.3.4 Acid mine drainage, if any and its mitigative measures.**

No acid mine drainage is there within the leasehold area.

**8.3.5 Surface subsidence mitigation measures through backfilling of mine voids or by any other means and its monitoring mechanism.**

Mining operation is going on by open cast method. So, there is no chance of surface subsidence within the mining lease area.

**SUMMARY OF YEARWISE PROPOSAL FOR ITEM NO. 8.3**

**Information on protective measures for reclamation and rehabilitation works for 1<sup>st</sup> year:**

Items	Details	Proposed
Dump management	Area to be afforested (ha)	Nil
	No of saplings to be planted (Coir matting with seeding)	2700 m <sup>2</sup>
	Cumulative no of plants	Nil
	Cost including watch and care during the year	Rs. 297000
Management of worked out benches	Area available for rehabilitation (ha)	Nil
	Afforestation to be done (ha)	Nil
	No of saplings to be planted in the year	Nil
	Cumulative no of plants	Nil
	Any other method of rehabilitation (specify)	Nil
	Cost including watch and care during the year	Nil
Reclamation and Rehabilitation by backfilling	Void available for Backfilling (L x B x D) pit wise /slope wise	Nil
	Void filled by waste /fallings	Nil
	Afforestation on the backfilled area	Nil
	Rehabilitation by making water reservoir	Nil
	Any other means (specify)	Nil
Rehabilitation of waste land within lease	Area available (ha)	6.7941 Ha
	Area to be rehabilitated	0.55 Ha
	Method of rehabilitation	Gap Filling & Causality Replacement
Others (specify)	Construction of Retaining wall (Waste Dump No-1&2 and sub grade dump-1&2)	1550 m
	Construction of garland drain & settling pit etc.	1130 m
	De-bilting of garland drain & settling pit	0.1 Ha.
	(i) Ambient Air Quality	Pit-1&2, Dump area, Ghoraburhani Village, Sagashai Village, Malda Village and Kalamang Village
	(ii) Water Quality	GWL- Ghoraburhani Village, Sagashai Village, Malda Village and Gondhalpada Village. SWQ-Suna Nadi Upstream and downstream, Ghoraburhani Village, Sagashai Village, Malda Village
	(iii) Noise Level Study	Pit-1 & 2, Dump area and Mineral processing areas
	(iv) Ground Vibration	Pit-1&2
	(v) Fugitive Dust	Pit-1&2, Haul Road, Screen and crushing area
	(vi) Soil Quality	Mineral Processing area, Ghoraburhani Village and Malda Village
	(vii) Water Level Monitoring	Ghoraburhani Village, Sagashai, Malda, Kalamang and Gondhalpada Village.

**Information on protective measures for reclamation and rehabilitation works for 2 years**

Items	Details	Proposed
Dump management	Area to be afforested (ha)	Nil
	No of saplings to be planted (Coir matting with seeding)	2600 m
	Cumulative no of plants	Nil
	Cost including watch and care during the year	Rs. 275000
Management of worked out benches	Area available for rehabilitation (ha)	Nil
	Afforestation to be done(ha)	Nil
	No of saplings to be planted in the year	Nil
	Cumulative no of plants	Nil
	Any other method of rehabilitation (specify)	Nil
	Cost including watch and care during the year	Nil
Reclamation and Rehabilitation by backfilling	Void available for Backfilling (L x B x D) pit wise /slope wise	Nil
	Void filled by waste /tailings	Nil
	Afforestation on the backfilled area	Nil
	Rehabilitation by making water reservoir	Nil
	Any other means (specify)	Nil
Rehabilitation of waste land within lease	Area available (ha)	6.2441 Ha
	Area to be rehabilitated	0.37 Ha
	Method of rehabilitation	Gap Filling & Causality Replacement
Others (specify)	Construction of Retaining wall (Waste Dump-2 and Sub Grade dump-1&2)	630 m
	Construction of garland drain & settling pit etc.	260 m
	De-silting of garland drain & settling pit	Nil
	(i) Ambient Air Quality	Pit-1&2, Dump area, Ghoraburhani, Sagashai, Malda and Kalamang Village
	(ii) Water Quality	GWL- Ghoraburhani, Sagashai, Malda and Gondhalpada Village. SWQ- Suna Nadi Upstream and downstream, Ghoraburhani, Sagashai, Malda Villages
	(iii) Noise Level Study	Pit-1 & 2, Dump area and Mineral processing areas
	(iv) Ground Vibration	Pit-1&2
	(v) Fugitive Dust	Pit-1&2, Haul Road, Screen and crushing area
	(vi) Soil Quality	Mineral Processing area, Ghoraburhani Village and Malda Village
	(vii) Water Level Monitoring	Ghoraburhani, Sagashai, Malda Kalamang and Gondhalpada Village.

**Information on protective measures for reclamation and rehabilitation works for 3<sup>rd</sup> year:**

Items	Details	Proposed
Dump management	Area to be afforested (ha)	Nil
	No of saplings to be planted (Coir matting with seeding)	1500 m
	Cumulative no of plants	Nil
	Cost including watch and care during the year	Rs. 165000
Management of worked out benches	Area available for rehabilitation (ha)	Nil
	Afforestation to be done (ha)	Nil
	No of saplings to be planted in the year	Nil
	Cumulative no of plants	Nil
	Any other method of rehabilitation (specify)	Nil
	Cost including watch and care during the year	Nil
Reclamation and Rehabilitation by backfilling	Void available for Backfilling (L x B x D) pit wise /slope wise	Nil
	Void filled by waste /tailings	Nil
	Afforestation on the backfilled area	Nil
	Rehabilitation by making water reservoir	Nil
	Any other means (specify)	Nil
Rehabilitation of waste land within lease	Area available (ha)	5.8741 Ha
	Area to be rehabilitated	0.61 Ha
	Method of rehabilitation	Gap Filling & Causality Replacement
Others (specify)	Construction of Retaining wall (Sub Grade Dump-1)	100 m
	Construction of garland drain & settling pit etc.	Nil
	De-silting of garland drain & settling pit	Nil
	(i) Ambient Air Quality	Pit-1&2, Dump area, Ghoraburhani, Sagashai, Malda and Kalamang Village
	(ii) Water Quality	GWL- Ghoraburhani, Sagashai, Malda and Gondhalpada Village. SWQ-Suna Nadi Upstream and downstream, Ghoraburhani, Sagashai, Malda Village
	(iii) Noise Level Study	Pit-1 & 2, Dump area and Mineral processing areas
	(iv) Ground Vibration	Pit-1&2
	(v) Fugitive Dust	Pit-1&2, Haul Road, Screen and crushing area
	(vi) Soil Quality	Mineral Processing area, Ghoraburhani Village and Malda Village
	(vii) Water Level Monitoring	Ghoraburhani, Sagashai Malda, Kalamanga and Gondhalpada Villages.

**Information on protective measures for reclamation and rehabilitation works for 4<sup>th</sup> year**

Items	Details	Proposed
Dump management	Area to be afforested (ha)	Nil
	No of saplings to be planted (Coir matting with seeding)	2200 m <sup>2</sup>
	Cumulative no of plants	Nil
	Cost including watch and care during the year	Rs. 242000
Management of worked out benches	Area available for rehabilitation (ha)	Nil
	Afforestation to be done (ha)	Nil
	No of saplings to be planted in the year	Nil
	Cumulative no of plants	Nil
	Any other method of rehabilitation (specify)	Nil
	Cost including watch and care during the year	Nil
Reclamation and Rehabilitation by backfilling	Void available for Backfilling (L x B x D) pit wise / slope wise	3.4446 Ha (Pit-1, 540-570RL)
	Void filled by waste /tailings	3.4446 Ha (Pit-1, 540-570RL)
	Afforestation on the backfilled area	Nil
	Rehabilitation by making water reservoir	Nil
	Any other means (specify)	Nil
Rehabilitation of waste land within lease	Area available (ha)	5.2641 Ha
	Area to be rehabilitated	0.30 Ha
	Method of rehabilitation	Gap Filling & Causality Replacement
Others (specify)	Construction of Retaining wall (Pit-1)	110 Mtr
	Construction of garland drain & settling pit etc.	Nil
	De-silting of garland drain & settling pit	Nil
	(i) Ambient Air Quality	Pit-1&2, Dump area, Ghoraburhani, Sagashai, Malda and Kalmang Village
	(ii) Water Quality	GWL- Ghoraburhani, Sagashai, Malda Village and Gondhalpada Village. SWQ- Suna Nadi Upstream and downstream, Ghoraburhani, Sagashai, Malda Village
	(iii) Noise Level Study	Pit-1 & 2, Dump area and Mineral processing areas
	(iv) Ground Vibration	Pit-1&2
	(v) Fugitive Dust	Pit-1&2, Haul Road, Screen and crushing area
	(vi) Soil Quality	Mineral Processing area, Ghoraburhani Village and Malda Village
	(vii) Water Level Monitoring	Ghoraburhani, Sagashai, Malda, Kalmanga and Gondhalpada Village.



**Information on protective measures for reclamation and rehabilitation works for 1 year;**

Items	Details	Proposed
Dump management	Area to be afforested (ha)	Nil
	No of saplings to be planted (Coir matting with seeding)	2800 m <sup>2</sup>
	Cumulative no of plants	Nil
	Cost including watch and care during the year	Rs. 308000
Management of worked out benches	Area available for rehabilitation (ha)	Nil
	Afforestation to be done (ha)	Nil
	No of saplings to be planted in the year	Nil
	Cumulative no of plants	Nil
	Any other method of rehabilitation (specify)	Nil
	Cost including watch and care during the year	Nil
Reclamation and Rehabilitation by backfilling	Void available for Backfilling (L x B x D) pit wise /slope wise	2.9132 Ha. (Pit-1 540-570RL)
		2.6711 Ha. (Pit-1 570-590RL)
	Void filled by waste /tailings	2.9132 Ha. (Pit-1 540-570RL)
		2.6711 Ha. (Pit-1 570-590RL)
	Afforestation on the backfilled area	Nil
	Rehabilitation by making water reservoir	Nil
Any other means (specify)	Nil	
Rehabilitation of waste land within lease	Area available (ha)	4.9641 Ha
	Area to be rehabilitated	0.37 Ha
	Method of rehabilitation	Gap Filling & Causality Replacement
Others (specify)	Construction of Retaining wall (Pit-1)	70 m
	Construction of garland drain & settling pit etc.	Nil
	De-silting of garland drain & settling pit	Nil
	(i) Ambient Air Quality	Pit-1&2, Dump area, Ghoraburhani, Sagashai, Malda and Kalmanga Village
	(ii) Water Quality	GWL- Ghoraburhani, Sagashai, Malda and Gondhalpada Village.
		SWQ-Suna Nadi Upstream and downstream, Ghoraburhani, Sagashai, Malda Village
	(iii) Noise Level Study	Pit-1 & 2, Dump area and Mineral processing areas
	(iv) Ground Vibration	Pit-1&2
	(v) Fugitive Dust	Pit-1&2, Haul Road, Screen and crushing area
	(vi) Soil Quality	Mineral Processing area, Ghoraburhani and Malda Village
(vii) Water Level Monitoring	Ghoraburhani, Sagashai, Malda, Kalamanga and Gondhalpada Village.	

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**8.4 Disaster Management and Risk Assessment:** This may deal with action plan for natural disasters like landslides, subsidence flood, inundation in underground mines, fire, seismic activities, tailing dam failure etc. and emergency plan proposed for quick evacuation, alternative measures to be taken etc. The capability of lessee to meet such eventualities and the assistance to be required from the local authority may also be described.

A disaster is a catastrophic situation whereby suddenly, people are plunged into helplessness and suffering and, as a result, need protection, clothing, shelter, medical and social care and other necessities of life.

Disasters can be divided into two main groups. In the first, disasters resulting from natural phenomena like earthquakes, volcanic eruptions, storm surges, cyclones, tropical storms, floods, avalanches, landslides, forest fires. The second group includes disastrous events occasioned by man, or by man's impact upon the environment. Examples are armed conflict, industrial accidents, radiation accidents, factory fires, explosions and escape of toxic gases or chemical substances, river pollution, mining or other structural collapses, air, sea, rail and road transport accidents and can reach catastrophic dimensions in terms of human loss.

There can be no set criteria for assessing the gravity of a disaster in the abstract since this depends to a large extent on the physical, economic and social environment in which it occurs. What would be consider a major disaster in a developing country, ill-equipped to cope with the problems involved, may not mean more than a temporary emergency elsewhere. However, all disasters bring in their wake similar consequences that call for immediate action, whether at the local, national or international level, for the rescue and relief of the victims. This includes the search for the dead and injured, medical and social care, removal of the debris, the provision of temporary shelter for the homeless, food, clothing and medical supplies, and the rapid re-establishment of essential services.

#### **Objectives of Disaster management Plan (DMP)**

The Disaster Management Plan is aimed to ensure safety of life, protection of environment, protection of installation, restoration of production and salvage operations in this same order of priorities. For effective implementation of the Disaster Management Plan, it should be widely circulated and personnel training through rehearsals / drills.

  
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The Disaster Management Plan will reflect the probable consequential severalties of the undesired event due to deteriorating conditions or through 'Knock on' effects. Further, the management should be able to demonstrate that their assessment of the consequences is based on good supporting evidence and is based on currently available and reliable information, incident data from internal and external sources and if necessary the reports of the outside agencies.

To tackle the consequences of a major emergency inside the mines or immediate vicinity of the mines, a Disaster Management Plan has to be formulated and this planned emergency document is called "Disaster Management Plan".

The objective of the Industrial Disaster Management Plan is to make use of the combined resources of the plant and the outside services to achieve the following:

- Effect the rescue and medical treatment of casualties;
- To Safeguard other people;
- Minimize damage to property and the environment;
- Initially contain and ultimately bring the incident under control;
- Provide authoritative information to the news media;
- Secure the safe rehabilitation of affected area;
- Preserve relevant records and equipment for the subsequent inquiry into the cause and circumstances of the Emergency.

In effect, it is to optimize operational efficiency to rescue rehabilitation and render medical help and to restore normalcy.

**Failure of slope in the pit:**

In order to avoid risk due to open cast slope failure, slope stability estimation will be made for the existing quarries after determining various physical parameters of the ground mass like; uniaxial compressive strength, triaxial compressive strength, cohesion, angle of friction, specific gravity of the rock, water pressure etc. Besides, all the discontinuities have been plotted in stereo-plots (Net), which indicates that there is no chance of any planer failure or wedge failure, even than factor of safety has been determined against overall slope failure as well as against individual

  
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bench slope by circular failure, planer failure and wedge failure. Besides determining factor of safety, the slopes are monitored at regular intervals to check for any possible failure. The well developed drainage system over the lease area ensures that storm water does not accumulate in the lease area and therefore hydrostatic pressure remains at a low level. For future working, also similar measurement and inspection shall be carried out. The mine has been designed based on the above consideration with sufficient safety margin to eliminate any chance of slope failure in the pit.

**Failure of slope of external dump:**

The slopes of external dump have been initially planned at the angle of repose of the dump material. However, as the edges attend final position, the slopes will be terraced and proper vegetation will be laid which will cause lowering of slopes as well as binding of the soil, preventing any slope failure.

**Fly rock fragment & vibration due to blasting operation:**

Trial blasting will be carried out at the field empirical equation based on which the charge for delay shall be regulated to protect the nearby structures. All the precaution related to control of fly rocks (are / will be) taken during the blasting operations. Safety zone of 500 meters as per statutes will be maintained from habitation area.

**Surface fire:**

Spillage of HSD and resultant fire constitutes a potential risk. The quantity of oil, which can spill will not much more and can be easily controlled. Sufficient numbers of potable fire extinguishers will be provided at strategic location to take care of any eventually.

There are risks of fire at the electrical sub-station and transformers. Dry and foam type potable fire extinguisher will be provided at the electrical sub-station and control room. In case of any electrical fire, the personnel on duty shall shutdown the electrical fire and inform the shift-in-charge. Personnel trained in dealing with electrical fire will be summoned. The fire area will be cordoned off till the fire is fully extinguished and remain so until all wreckage and debris is cleared away. After effecting necessary repairs the power may be restored. The clearance for restoration of power shall be given only by the shift- in-charge.

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As soon as any fire reported the shift-in-charge shall assume the function of disaster controller. In case of serious fire and depending on the gravity of the situation, the Mines Manager may be summoned to assume charge. Personnel trained in dealing with fires will be summoned. Meanwhile the hospital will be informed to handle the casualties. The fire area will be cordoned off till the fire is fully extinguished and remain so until all wreckage and debris is cleared away.

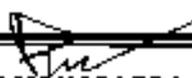
**Possible danger due to storage of explosive:**

An explosive magazine will be provided in the proposed mine. Adequate safety zone will be provided as per statutory requirement while locating the magazine. The magazine will be constructed as per plan approved by the department of explosive. The following precautionary safety measures will be considered in the design of the magazine:

- a) All dry vegetation within a 15 meters radius to be cleared
- b) Lightning arrester installed in the magazine roof
- c) Safety zone around the magazine to be created
- d) In summer, the temperature inside the magazine will be monitored to guard against spontaneous fire.
- e) The manufacturing date of all explosives stored in the magazine will carefully be recorded, so that no explosive whose self-life will be expired is kept in stock.

In case of any fire, who so ever notices that the fire will sound the alarm and inform the shift-in-charge. The shift-in-charge will inform the security personnel and arrange to evacuate all personnel except those who are required for firefight, from the area. The fire brigade shall be summoned to deal with the emergency. Concern district official will be informed. The hospital will be informed to standby to handle the casualties.

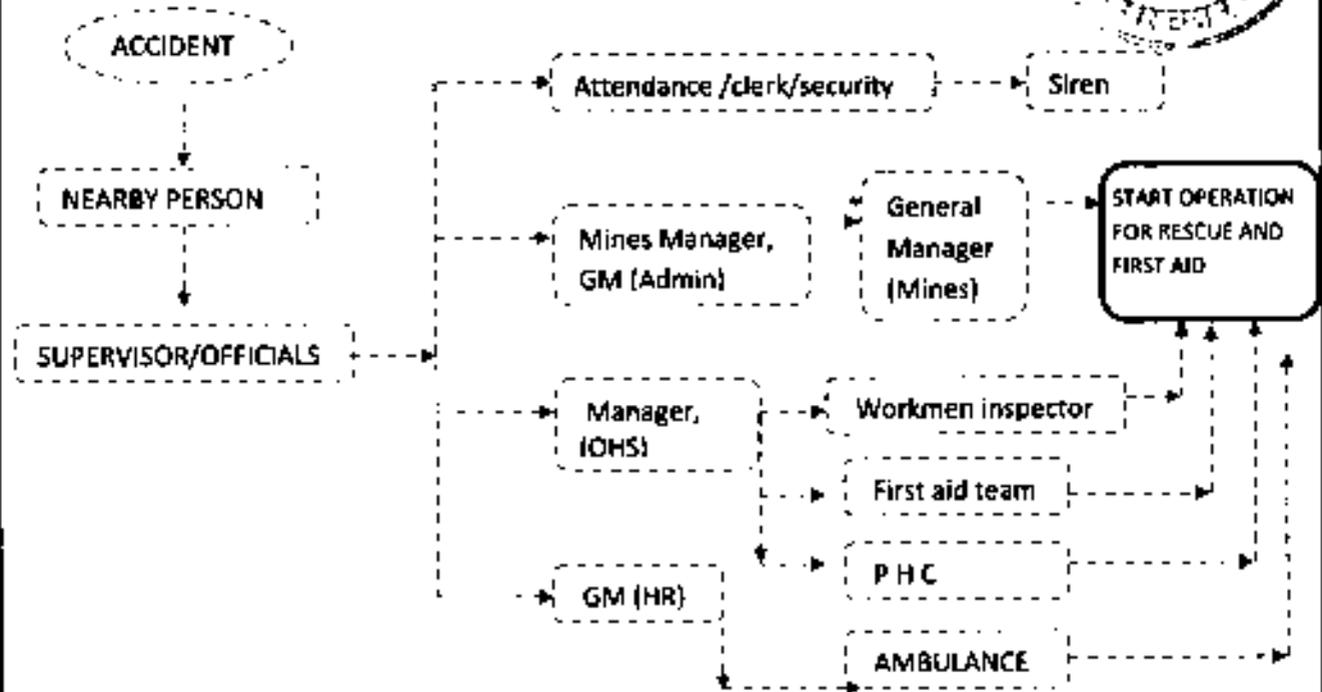
A comprehensive elaborate HIRA structure will be created by M/s Essar Steel India Pvt Ltd. A detail Hazard Identification and Risk Assessment study will be carried out internally based upon the guideline of OHSAS: 14001.

  
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**EMERGENCY PLAN:**

In case of any emergency the help of authorities like Fire Department, Tehsil and other concerned officials will be taken. Emergency plan for serious accidents is given below.



**Training:**

Training program will be arranged for all the workers as per MVTR-1966 by internal and external faculty as well regarding safety of the men & machine from time to time as per the schedule. The training & safety officer will be permanently appointed to carry out the training program. A Group Vocational Training Centre will facilitate the training program as per the guide lines of DGMS (Directorate General of Mines Safety).

**8.5 Care and maintenance during temporary discontinuance:** An emergency plan for the situation of temporary discontinuance due to court order or due to statutory requirements or any other unforeseen circumstances may indicate measures of care, maintenance and monitoring of status of discontinued mining operations expected to re-open in near future.

Even if something happens that will be taken care by the management & other manpower will be deputed for the mine closure activities as well as post mine closure activities. Proper care and maintenance during temporary discontinuance shall be followed as per guidance, rules and regulations as applicable by any legal statutory like MMR 1961, MCDR 1988 & Environment Protection Act 1986.

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**B.6 Financial Assurance:**

The financial assurance can be submitted in any encashable form preferably a Bank Guaranteed from a Scheduled Bank as stated in Rule 23(F)(2) of Mineral Conservation and Development Rules, 1988 for five years period expiring at the end of validity of the document. The amount calculated for the purpose of Financial Assurance is based on the CCOM's Circular no. 4 dated 2006 as below.

**Table indicating the break-up of areas in the Mining Lease for calculation of Financial Assurance**

Sl. No.	Head	Area Put On Use At Start of plan of Mining (Ha)	Additional Requirement During Plan Period (Ha)	Total Area (Ha)	Area Considered As Fully Reclaimed & Rehabilitated (Ha)	Net Area Considered For Calculation (Ha)
1	Area under mining	0.500	40.273	40.773	Nil	40.773
2	Storage for top soil	Nil	0.320	0.320	Nil	0.320
3	Waste dump site	Nil	4.967	4.967	Nil	4.967
4	Mineral storage/sub-grade stacking	Nil	7.551	7.551	Nil	7.551
5	Infrastructure Facilities (Site services & utilities, admn. building, Conveyor belt, etc)	Nil	2.4303	2.4303	Nil	2.4303
6	Roads	0.598	2.2714	2.8694	Nil	2.8694
7	Railways	Nil	Nil	Nil	Nil	
8	Tailing Pond	Nil	4.923	4.923	Nil	4.923
9	Effluent Treatment Plant	Nil	Nil	Nil	Nil	
10	Mineral separation plant (Crushing & screening unit, beneficiation plant)	Nil	15.6557	15.6557	Nil	15.6557
11	Township area	Nil	Nil	Nil	Nil	
12	Others (Retaining wall, Garland, drain, check dams, settling tank, Sump, embankment magazine etc)	Nil	6.4557	6.4557	Nil	6.4557
<b>Grand Total</b>		<b>1.098</b>	<b>84.8471</b>	<b>85.9451</b>		<b>85.9451</b>

Accordingly, the amount of financial assurance has been calculated @ Rs 25,000/- per hectare for Category - A Mines. Total area of 85.9451 ha coming under utilization for different purpose for end of the planning period. Therefore financial assurance has been computed i.e. 85.9451 ha x Rs. 25,000/- = Rs 21, 48,628.00

**APPROVED**

**PRADEEPT MOHAPATRA**  
QUALIFIED PERSON

REGIONAL CONTROLLER OF MINES  
भारतीय खान ब्यूरो  
INDIAN BUREAU OF MINES  
पुर्नपुर/भुवनेश्वर

**SABYASACHI MOHANTY**  
QUALIFIED PERSON

As estimated based on the present exploration, the mineable reserve is 78.61 million tones. Considering the targeted annual production the life of the mines will be 12 years from the date of commencement of mining operation. As an obligation on the part of the lessee for mine closure, the progressive mine closure as envisaged above shall be adhered to.

However, the infrastructure available in the lease shall be dismantled or handed over to the subsequent incumbent with book value as will be decided by the government.

The contractual manpower shall be engaged by the respective contractors in their other establishment and the departmental manpower shall be engaged with company's other units. The machineries and equipment shall be shifted to other locations of the company.

#### **9.0 Certificate and Undertaking**

The above mentioned actions have been taken to be stated clearly in the mine closure plan. A certificate duly signed by the applicant to the effect that said closure plan complies all statutory rules, regulations, orders made by the Central or State Government, statutory organizations, court etc. have been taken into consideration and wherever any specific permission is required, the applicant will approach the concerned authorities. The applicant may also give an undertaking to the effect that all the measures proposed in this closure plan will be implemented in a time bound manner as proposed.

**10.0 Plans & Sections** - This Progressive Mine Closure Plan is submitted as per the Rule 23 B (2) under MCDR 1986. Plans and sections for this plan have been referred to that of Mining plan, which is being submitted simultaneously for approval.

  
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 U27100GJ1978PLC013767

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 www.essarsteel.com

**CONSENT LETTER / UNDERTAKING / CERTIFICATE FROM THE APPLICANT**

- The Mining Plan in respect of **Ghoraburhani - Sagasahi Iron Ore block of M/s Essar Steel India Ltd over an area of 139.165 hectares** in villages Ghoraburhani, Sagasahi and Kalamanga, PO- Kalamanga under Bonai Sub-division, District Sundargarh, Odisha has been prepared under **Rule 13 of Minerals (Other than Atomic and Hydro Carbon Energy Minerals) Concession Rule 2016** by Qualified persons: **Shri Sabyasachi Mohanty, B.Tech (Mining Engineering) and Shri Pradeep Mohapatra, MSc (Geology)** having relevant professional experiences of more than five years of working in a supervisory capacity in the field of mining after obtaining the Degree as per Rule 15 of MCR, 2016.

This is to request the Regional Controller of Mines, Indian Bureau of Mines, and Bhubaneswar to make any further correspondence regarding any correction of the Mining Plan with the said recognized person at his address below:

<p><b>Shri Sabyasachi Mohanty</b>          Essar Steel India Ltd          Ore Club, Bhadrasahi Chowk          Near Bank of India ATM,          Dist -Keonjhar, Odisha-758035          Email:          Sabyasachi.mohanty@essar.com          Mobile:+917381007215</p>	<p><b>Shri Pradeep Mohapatra</b>          At- Unchabali, PO- Bamebari,          Via- Joda, Dist-Keonjhar, Odisha          E mail: <a href="mailto:pmohapatra_07@yahoo.com">pmohapatra_07@yahoo.com</a>          Mobile No. - +919438149715</p>
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I, do hereby undertake that all modifications / updating as made in the said Mining Plan by the said qualified persons be deemed to have been made with my knowledge and consent and shall be acceptable on me and binding in all respects.

2. It is certified that the CCOM's Circular No.-2/2010 will be implemented and complied with when an authorized agency is approved by the State Government.
3. It is certified that the Progressive Mine Closure Plan of Ghoraburhani –Sagasahi Iron ore block of M/s Essar Steel India Ltd over an area of 139.166 hectares complies with all statutory Rules, Regulations, Orders made by the Central or State Government, Statutory Organization, Court etc. which have been taken into consideration and wherever any specific permission is required, the applicant will approach the concerned authorities.

The information furnished in the Progressive Mine Closure Plan is true and correct to the best of my knowledge and records.

4. The provisions of Mines Act, Rules and Regulations made there under have been observed in the Mining Plan over an area of 139.165 hectares in Sundargarh districts in Odisha State belonging to Ghoraburhani-Sagasahi Iron ore block and where specific permissions are required, the Lessee will approach the DGMS. Further, standards prescribed by DGMS in respect of miners' health will be strictly implemented.

Place : *Mumbai*  
Date : *01/07/2014*

  
(Dilip Gommen)  
Nominated Owner &  
Managing Director & CEO  
Essar Steel India Limited



**ESSAR**  
STEEL

Essar Steel India Limited  
Essar House  
11 K. K. Marg  
Mumbai  
Mumbai - 400 034  
India

Corporate Identity Number :  
U27100GJ1978FLC013767

+91 22 8880 1100  
+91 22 2353 2695  
www.essarsteel.com

### UNDERTAKING

We do hereby undertake that, after the commencement of Mining operation, we will complete exploration in time bound manner, as proposed in the Mining Plan to convert the resources from G2 to G1 category.

Place : Mumbai  
Date : 01/07/2016

  
(Dilip Gommen)  
Nominated Owner &  
Managing Director & CEO  
Essar Steel India Limited



**ESSAR**  
STEEL

Essar Steel India Limited  
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F +91 22 2353 2995  
www.essar.com

### UNDERTAKING

We hereby undertake that, after the commencement of Mining operation we will carry out bulk density and recovery factor study by an institute of repute.

Place : Mumbai  
Date : 01/07/2016

  
(Dilip Gommen)  
Nominated Owner &  
Managing Director & CEO  
Essar Steel India Limited



**ESSAR**  
STEEL

Essar Steel India Limited  
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India

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Fax: +91 22 2353 2695  
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### UNDERTAKING

We hereby undertake that, after the commencement of Mining operation, **Blasting induced vibration study** will be carried out by an institute of repute and accordingly optimum charge per delay and most suitable drilling and blasting design along with initiation/firing pattern will be considered.

Place : Mumbai  
Date : 01/07/2016

(Dilip Gommen)  
Nominated Owner &  
Managing Director & CEO  
Essar Steel India Limited



Essar Steel India Limited  
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F +91 22 2353 2895  
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## UNDERTAKING

We hereby undertake that, after the commencement of Mining operation we will prepare Rain water Management Plan i.e. drainage plan along with arrangement of arresting solid wash off by incorporating Engineering details and material to be used for erection of protective measures like retaining wall, garland drain, settling pond, etc. by an institute of repute.

Place : *Mumbai*

Date : *01/07/2016*

(Dilip Gommen)  
Nominated Owner &  
Managing Director & CEO  
Essar Steel India Limited



## CERTIFICATE

The provisions of the Mineral Conservation and Development Rules 1988 have been observed in the preparation of the Mining Plan for Ghoraburhani - Sagasahi Iron ore block over an area of 139.165Ha, of M/s Essar Steel India Ltd in Ghoraburhani, Sagasahi and Kalamanga villages, Post office Kalamanga, District Sundargarh of Odisha State and Whenever specific permissions are required, the applicant will approach the concerned authorities of Indian Bureau of Mines.

The information furnished in the Mining Plan is true and correct to the best of our knowledge.

Place: Barbil

Date: 01/07/2016

  
Pradeep Mohapatra  
Qualified person

  
(Sabyasachi Mohanty)  
Qualified person