VOLUME-I

TIRINGPAHAR MANGANESE MINE
DISTRICT : KEONJHAR
STATE : ODISHA
OWNER : TATA STEEL LIMITED

3RD REVIEW OF MINING PLAN
&
SCHEME OF MINING
(FROM 2015-16 TO 29.02.2020)
[Submitted under Rule No. 12, MCDR 1988]
&
PROGRESSIVE MINE CLOSURE PLAN
(FROM 2015-16 TO 29.02.2020)
[Submitted under Rule No. 23B, MCDR 1988]

Lease Area	643.710 Hect.
Date of Lease Execution	16.03.1985
Executed Lease Period	20 Years (2nd Renewal from 01.03.1980 to 29.02.2000)
Date of Lease Expiry	01.03.2000
Date of Renewal Application	31.12.1998 (For 3rd Renewal over 169 Hect)
Date of ML Application	09.12.2004
Forest Area within RML	68.914 Hect.
Non-Forest Area within RML	100.086 Hect.
Category of Mine	A-OTFM

PREPARED BY:-
HARIDRUMAT BEHERA
REGD. NO. RQP/BBS/093/2010-A

TATA STEEL LIMITED
FERRO ALLOYS & MINERALS DIVISION
TIRINGPAHAR MANGANESE MINE,
AT/P.O.: BAMEBARI, VIA: JODA,
DIST: KEONIHAR (ODISHA)

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Haridrumat Behera
Regd.No.-RQP/BBS/093/2010-A

1.0 GENERAL

a) Name of the Applicant / Lessee / Rule 45 registration no. :

Mr. Thachat Viswanath Narendran / Tata Steel Limited / **IBM/4376/2011**

Address : AT/P.O. Jamshedpur, District : East Singhbhum, State : Jharkhand, PIN – 831001, Phone : 06572424602, FAX : 06572431818, Mobile No. : NA, Email ID : mdoffice@tatasteel.com

- Copy of the Resolution by Board of Directors nominating the Owner enclosed as Annexure – I-A.
- Copy of Photo ID & Address proof of Applicant is enclosed as Annexure – I-B.

b) Status of Applicant / Lessee : Nominated Owner / Private Company

- Copy of Certificate on change of company's name is enclosed as Annexure – I-C.
- List of Board of Director of the Company is enclosed as Annexure – ID.

c) Mineral(s) which is / are included in the prospecting license (For Fresh Grant) : Not Applicable

d) Mineral(s) which is / are included in the letter of intent / lease deed : Manganese & Iron Ore

e) Mineral(s) which is the applicant / lessee intend to mine : Manganese Ore

f) Name of Recognized Person under Rule 22C of MCR, 1960 or a person employed under clause (C) of Sub Rule (1) of Rule 42 of MCDR,1988 (Applicable for Scheme of Mining) preparing :

Name : Mr. Haridrumat Behera,
Head (Underground Mining Project), Tata Steel Ltd., Sukinda
Address - At/P.O. : Kalarangiatta, District : Jajpur, State : Odisha,
Pin Code : 755028
Phone : NA, Mobile : +91 9238087091, Fax : 06726268734
Email ID : haridrumat@tatasteel.com
Registration No.: RQP/BBS/093/2010-A (Copy enclosed as Annexure – II A)
Date of Grant / Renewal : 20.04.2010
Valid up to : 19.04.2020

2.0 LOCATION AND ACCESSIBILITY

a) Lease Details (Existing Mine) :

- **Name of Mine :** Tiringpahar Manganese Mine
- **Latitude / Longitude of any Boundary Point :**

  Guruda Block : Boundary Pillar No. A –
  Latitude : $21^0$55'7.81128"
  Longitude : $85^0$23'35.35928"

- **Date of Grant of Lease :**
  - 1st Grant - The Mining lease was granted for 30 years from 01.03.1930 to 29.02.1960.
  - 1st Renewal - The first renewal was done for the period of 20 years from 01.03.1960.
  - 2nd Renewal - The second renewal was for a period of 20 years with effect from 01.03.1980 till 29.02.2000. (Copy of the executed Lease Deed is enclosed as Annexure – III)
  - 3rd Renewal - The application for third renewal over a reduced area of 169 ha. was made on 31.12.1998. From the covering letter of renewal application (Copy of Letter no. MD/LO/336/869, Dt.31.12.2009 is enclosed as Annexure – III A), it is evident that the Steel Company had at that point of time considered applying for areas having minimum forest land. The mining operations are thus continuing and confined within the RML applied area of 169 ha. as per the provisions of Rule 24 (A) of MCR, 1960. Form – D of the same is enclosed as Annexure – III B. In the meantime, the company in view of its further expansion programme for higher production of Steel, Ferro Alloys, Ferro Chrome and Sponge Iron etc, and additional requirement of ore later in 2004, re-applied for the ML over balance area of 474.710 ha. The covering letter for the mining lease application is enclosed as Annexure – III C. The Mining Lease application for the balance area of 474.710 ha has been received vides Form D no: 7628/ Mines, dated 09.12.2004 that is enclosed as Annexure-III D. This balance area of 474.710 ha is entirely forest land. As per the Forest (Conservation) Act, 1980, the status thus continues to remain as forest land. The entire Tiringpahar block which forms a part of lease and the above balance area falls under Baitarani Reserve Forest. In view of the above, there has been no mining activity taken up by the company within this balance area after 1980. The State Govt. has not yet passed any order in favor of applied mining lease over an area of 474.710 ha**.** a) 2nd Renewal Grant Order (Govt. of Odisha) Ref.No. 2976 /MG, BBSR Dt.16.02.1982 for the period 01.03.1980 to 29.02.2000 over an area of 643.710 ha.. Lease No. 1133 & Deed was executed on 21.03.1985.

- The original lease area consists of three discontinuous blocks, viz. Tiringpahar, Joruri and Guruda. The areas applied against each of these blocks are as given in Table no. 2.0 below.

Table No. 2.0

Block Name	Original Lease (Area in Hectares)	Renewal of Mining Lease (RML) Applied on 05.01.1999 (Area in Hectares)	Mining Lease (ML) Applied over balance area on 09.12.2004 (Area in Hectares)
Tiringpahar	195.540	0.000	195.540
Joruri	74.120	0.000	74.120
Guruda	374.050	169.000	205.050
Total	643.710	169.000	474.710

- **Period / Expiry Date :** 29.02.2000

- **Name of Leaseholder :** Tata Steel Limited

- **Postal Address :** AT/P.O. Jamshedpur, District : East Singhbhum, State : Jharkhand, PIN – 831001

- Phone : 06572424602, FAX : 06572431818, Mobile No. : NA

- Email ID : mdoffice@tatasteel.com

b) Details of applied / lease area with location plan :

The legal status of land within Guruda Block is furnished below in Table 2.1(A).

Table No. 2.1(A)

Block	Forest Area (ha)		Non Forest Area (ha)	
Guruda	Reserve Forest	0.000	Waste Land	52.066
	Khesra Forest	10.392	Grazing Land	0.000
	DLC Forest	58.522	Agricultural Land	4.852
	Total Forest	68.914	Other Land	43.168
			a) Gharabari	0.000
			b) Road	0.000
			c) Khani	43.168
			Sub Total (Other Land)	43.168
			Total Non-Forest	100.086

The total forest land diverted is 52.348 ha. The Stage II Clearance letter (Ref. No. 8-80/2004-FC, Dt.28.03.07) from the MoEF, GoI in this regard, is enclosed as Annexure – VII A. The company has further applied for diversion of 13.798 ha of forest land on 24.06.2010 (Copy of Receipt letter of the same is enclosed as Annexure – VII B). The forest diversion proposal has been forwarded to the DFO, Keonjhar under State serial no. 431, dated 27.10.2010 for scrutiny. The Collector, Keonjhar is yet to allot equivalent non-forest land for compensatory afforestation. The diversion of this 13.798 ha is therefore still under process. The balance forest land is earmarked for safety zone. The site inspection report of DFO, Keonjhar showing the forest area in RML is enclosed as Annexure – VII C.
The details diverted forest land is furnished below in Table No. 2.1 (B)

Table No. 2.1 (B)

Guruda Block	Reserve Forest (ha.)	Khesra Forest (ha.)	DLC Forest (ha.)	Total Forest (ha.)	Non Forest (ha.)	Total (ha)
RML Area	0	10.392	58.522	68.914	100.086	169
Diverted Forest Area	0	2.782	49.566	52.348*	-	-
Surface Right Area	0	2.782	42.470	45.252	54.920	100.172
Applied Forest Area for diversion	0	7.068	6.730	13.798 *	-	-
Area applied for Surface Right	0	0	10.347	10.347	42.747	53.094

* The area mentioned is excluding Safety Zone.

Company has also made the Payment of NPV for the balance Forest area, Rs 12093180/- paid vide Demand Draft No. 771230 dated 01.07.2010 drawn in favour of Compensatory Afforestation fund Orissa on the basis of Class-I of Eco value class and 0.2 canopy density as assessed by Divisional Forest Office, Keonjhar, Govt. of Odisha. The copy of the demand notice mentioning the class of forest land within the lease area is enclosed as Annexure – VII D.

- District & State : Keonjhar & Odisha
- Taluka – Champua
- Village - Guruda, Palasa (Kha), Jadibahal, Khondbondh, Joruri, Jalahari, Jajanga and Baitarani Reserve Forest

- Whether the area fall under Coastal Regulation Zone (CRZ) : No

- Existence of public road / railway line :

  Guruda Block – The express way is 1.4 Km from the Lease Pillar H2. The Railway line (Banspani – Daitary) is passing 660m North-East from the lease pillar H2.

- Topo Sheet No. with latitude & longitude of all corner boundary point / pillar :

  The lease blocks fall in villages Guruda, Palasa (Kha), Jadibahal, Khondbondh, Joruri, Jalahari, Jajanga and Baitarani Reserve Forest in the Keonjhar district of Orissa. The lease area falls in Survey of India Topo sheet No. 73 G/5 (Guruda Block) (New Topo sheet No. F45 N/5). The Key Plan of the applied RML area of 169 ha. along with the applied ML area of 474.710 ha. is shown in Drawing No. MP/TMM/R3/01/14.

  With compliance to the Circular No. 02/2010, Odisha Remote Sensing Application Centre (ORSAC) had carried out the DGPS survey of the lease boundary pillars. The lease boundary superimposed over Satellite Image for Guruda Block is being enclosed as Drawing No. MP/TMM/R3/02/14. The co-ordinates of the lease pillars of Guruda Blocks is furnished below in Table No. 2.2.

Table : 2.2
(GURUDA BLOCK)

PILLAR NO.	LONGITUDE			LATITUDE		
	DEGREE	MINUTE	SECOND	DEGREE	MINUTE	SECOND
A	85	23	35.35928	21	55	7.81128
B	85	23	50.30405	21	55	8.57046
C	85	23	51.2371	21	55	17.139
D	85	23	55.64371	21	55	33.11609
E	85	24	7.37952	21	55	39.70014
F	85	24	7.1355	21	55	42.91164
G	85	24	7.53693	21	55	45.62005
H	85	24	10.76353	21	55	45.59234
I	85	24	10.71781	21	56	10.65715
I-2	85	24	6.96937	21	56	10.65641
J	85	23	57.81036	21	56	10.66672
K	85	23	55.27139	21	56	7.73101
L	85	23	51.82265	21	56	4.7962
M	85	23	50.22636	21	56	4.84389
N	85	23	47.65905	21	56	6.2027
O	85	23	44.50262	21	56	6.38713
P	85	23	43.20918	21	55	40.37034
Q	85	23	30.97505	21	55	35.17312
R	85	23	20.88053	21	55	34.78817
S	85	23	21.19464	21	55	14.97712
T	85	23	23.04181	21	55	14.84395
U	85	23	23.49522	21	55	8.60999
V	85	23	22.82521	21	54	57.04724
W	85	23	28.55276	21	54	54.41605
X	85	23	35.84584	21	54	53.05435
Y	85	23	38.79073	21	54	52.93991

3.0 DETAILS OF APPROVED MINING PLAN / SCHEME OF MINING :

3.1 The Mining Plan and subsequent scheme of mining was approved as per the details given below in Table No. 3.1.

Table No. 3.1

Mining Plan / Scheme of Mining	Submitted Under (Rule Reference)	Approval Letter No. & Date	Period
Mining Plan	Rule 12 of MCDR, 1988	CAL/KJ/Mn/MP-247, Dt.14.06.1993	1991-92 to 1996-97
1st Review & Scheme of Mining	Rule 12 of MCDR, 1988 & Rule 24(A) of MCR'1960	314(3)/97-MCCM(O)/MP/Scheme 7, Dt.15.06.1998	1997-98 to 2003-04
Mod. Of Scheme of Mining	Rule 10 of MCDR, 1988	BBS/KJ/Mn/MS Tiringpahar, Dt.24.03.2005	2003-04 to 2004-05
Scheme of Mining	Rule 12 & 23B of MCDR, 1988	BBS/KJ/Mn/MS-147, Dt.28.04.2006	2005-06 to 2009-10
Scheme of Mining	Rule 12 & 23B of MCDR, 1988	MS/OTF.MECH/21-ORI/BHU/2010-11, Dt. 09.07.2010.	2010-11 to 2014-15
Mod. Of Scheme of Mining	Rule 10 & 23B of MCDR, 1988	MS/OTFM/66-ORI/BHU/2011-12, Dt. 13.04.2012.	2011-12 to 2014-15

While the Rule 23A of the MCDR,1988 inserted by G.S.R. 330 (E), dated 10.4.2003, Indian Bureau of Mines vide their letter no. 313(3)/96-MCCM(CZ)/MP-G, dated 02.03.2005 allowed to submit the Progressive Mine Closure Plan along with Scheme of Mining due for 01.04.2005. Copy of the letter is being enclosed as Annexure – X-B.

3.2 Details of last modification if any (for the previous approved period) of the approved MP / SoM indicating the date of approval, reasons for modification.

The Scheme of Mining was submitted under Rule 12 of MCDR, 1988 and approved vide letter no. MS/OT-MECH/21-ORI/BHU/2010-11, Dt.09.07.2010 for the period from 2010-11 to 2014-15. Further, a modification of above said scheme was submitted and approved vide letter no. MSM/OTFM/66-ORI/BHU/2011-12, Dt. 13.04.2012 for the period from 2011-12 to 2014-15.
This modification to the above Scheme of Mining was being proposed for the following reasons:

a) It was observed that, although the total reserves as on 01.04.2010 given in the approved Scheme of Mining for the period 2010-11 to 2014-15 (under Table 3.4.1. of Para 3.4) was correct, there were some typographical errors in the block-wise and grade-wise proved reserve figures. The corrected geological reserve and resource as on 01.04.2010 has now been furnished in Table 3.1.1 as per this modification.

The geological resources of each individual block was therefore reviewed afresh considering all the boreholes that have been drilled so far till 2010-11 and except those boreholes drilled during 2011-12 (April to September). This has also been done to recheck all estimations as per the norms under UNFC Guidelines. The manner, in which the different mineralized zones have been categorized to proved, probable, indicated, inferred and barren have now been shown in the Surface Geological Plan as per Drawing No. MP/TMM/R3/10.Mod.01.

b) With the change in the block-wise reserves and resources as given under Table No. 3.4.1, higher total reserves and resources in Guruda Block-A and the grade-wise demand of ore in our plants, a need for modifying the production level from the individual blocks / quarries was felt.

The proposed production plan vis-à-vis the earlier approved quantity as per Scheme of Mining for both the blocks for the period from 2011-12 to 2014-15 in order to take care of the above need, is given in the table below. It may be observed that while the total proposed production from the lease remains the same at 85000 TPA, the proposed production level from each of the two quarries has undergone a change.

3.3 Review of earlier approved proposal (if any) in respect of exploration, excavation, reclamation etc.

Review of the compliance position of conditions imposed, while approving the last scheme of mining vide Letter No.: MS/OTF.MECH/21-ORI/BHU/2010-11, Dt. 09.07.2010.

Table No. 1.0

Conditions		Compliance
I.	This Scheme of Mining is approved without prejudice to any other law applicable to the mine area from time to time whether made by Central Govt, State Govt or any other authority.	Noted & Agreed
II.	It is also clarified that the approval of aforesaid Scheme of Mining does not in any way imply the approval of Govt. in terms of any other provision of MMDR Act, 1957 or the MCR, 1960 and any	Noted & Agreed

	other laws including FC Act, 1980, EP Act, 1986 or the rules made there under.	
III.	It is clarified that the approval is subject to the provisions of FC Act, 1980. FC Rules, 2003 and other relevant statutes, orders and guidelines as may be applicable to the lease area from time to time.	Noted & Agreed
IV.	It is further clarified that, this approval of the modification to approved Scheme of Mining under Rule 12 of MCDR 1988 is subject to the provision of Mines Act, 1952 and Rule & Regulations made thereunder including submission of notice of opening, appointment of manager and other statutory officials as required under the Mines Act,1952.	Noted & Agreed
V.	The execution of the Scheme of Mining shall be subjected to vacation of prohibitory orders / notices, if any.	Noted & Agreed
VI.	This approval for mining operation and associated activities is restricted to the mining lease area only and also within the diverted area by the competent authorities of forest department till the requisite permission is granted by such authorities in additional areas as proposed in the document. The mining lease area is shown on the statutory plan under Rule 28 of MCDR, 1988 by the Lessee / RQP / Applicant and IBM has not undertaken verification of the mining lease boundary on the ground.	Noted & Agreed
VII.	If anything is found to be concealed as required by the Mines Act in the contents of the Scheme of Mining and proposal for rectification has not been made, the approval shall be deemed to have been withdrawn with immediate effect.	Noted & Agreed
VIII.	At any stage, if it is observed that the information furnished in the document are incorrect or misrepresent facts, the approval of the document shall be revoked with immediate effect.	Noted & Agreed
IX.	Your attention is invited to the Supreme Court interim order in W.P.(C) No. 202, dated 12.12.96 for	Noted & Agreed

	compliance. The approval of the Scheme of Mining is, therefore, issued without preudice to and is subject to the said directions of the supreme court as applicable in your case.	
X.	The department does not undertake any responsibility regarding correctness of the boundaries of the lease shown on the ground with reference to lease map and other plans furnished by the applicant /lessee.	Noted & Agreed
XI.	This approval is given for the received proposals as applicable from this date onwards.	Noted & Agreed
XII.	The modification to approved Scheme of Mining is approved wothout preudice to any order or direction from any court of competent jurisdiction.	Noted & Agreed
XIII.	Any yearly report before 1st July of every year setting forth the extent of protective and rehabilitative works carried out as envisaged in the approved mine closure plan and if there is any deviation, reasons thereof should be submitted to RCOM, IBM, Bhubaneswar under Rule 23 E (2) of MCDR, 1988.	The yearly report is being sent to RCOM, BBSR with details of work carried out as envisaged in approved PMCP with reasons for deviation is any before 1st July every year.
XIV.	The financial Assurance submitted for an amount of Rs. 18,53,475/- is valid up to 31.03.2015. A new bank guarantee is to be submitted on or before its expiry i.e. 31.03.2015 or before the expiry of Scheme period whichever is earlier.	Noted & Agreed
XV.	The next Scheme of Mining is due for submission on 01.12.2014.	The Mining scheme for the period of 2015-16 to 29.02.2020 has been submitted on 28.11.2014.
XVI.	A copy of EC letter issued by MoEF should be submitted to IBM, BBSR immediately after approval of EIA - EMP for record and information.	The EC granted has been enclosed with Approved Scheme of Mining as Annexure - VI.
XVII.	The Environmental Monitoring Cell established by the company shall continue monitoring of ambient air quality, dust fall rate, water quality, soil sample analysis and noise level measurements at various stations established for the purpose both in	The department is in place and the Head of the department is reporting to General Manager of the division. The following parameters are being monitored by M/s SS Environics India Pvt.Ltd at Bhubaneswar. (Recognized as "A" category

	core zone and buffer zone as per requirement of Environment Guidelines and keeping in view IBM's Circular no. 3/92 & 2/93 season-wise every year or by engaging the services of an Env. Laboratory approved by MoEF/CPCB. The data so generated shall be maintained in a bound paged register kept for the purpose and the same shall be made available to the inspecting officer, on demand.	consultant as by State Pollution Control Board, Orissa). > Ambient Air Quality - twice in a week at two loocations in Core Zone. > Ambeint Air Quality - once in a month at four locations in Buffer Zone > Water Quality - twice in a month at two location (upstream entering to lease) and downstream leaving the lease) > Drinking Water Quality - once in a quarter > Monitoring of ground water level in nearby wells - pre-monsoon, monsoon, post-monsoon & winter. > Monitoring of Ground Water quality - pre-monsoon, monsoon, post-monsoon & winter. > Analysis of trace metals in ground water at lower elevations (Fe, Cr+6, Cu, Se, As, Cd, Hg, Pb, Zn & Mn) - pre-monsoon, monsoon, post-monsoon & winter. > Analysis of trace metals in dust fall and soil samples (Ni, Co, As & Hg) - summer, monsoon and winter season. > Quarterly personal dust sampling & Noise Survey
XVIII.	The provision of circular no. 2/2010 of CCOM, IBM, Nagpur issued vide letter no. N-11013/3/MP/90-CCOM, Vol.VII, dated 06.04.2010 shall be compled within a period of six (6) months of approval of this document.	M/s ORSAC, Bhubaneswar has been declared as the authorized agency by the State Govt. for carrying out the DGPS survey to comply with the CCOM Circular No. 02/2010. Such DGPS survey by ORSAC has been done for this lease during Mar'2011. The copy of the drawing showing the lease boundary over the satellite image received from ORSAC is being enclosed as Drawing No. MP/TMM/R3/02/14. However, the complete superimposed geo-referenced maps have still not been provided by ORSAC although we have been following up on the matter regularly since long. The information in this regard shall be furnished to the IBM as soon as the same is finalized and

		received from ORSAC. The Minutes of the Meeting as circulated in the website of the Dept. of Steel & Mines, Govt. of Odisha vide letter no. 6202/SM, Bhubaneswar, dated 06.08.2011 in this regard, may please be referred to.

CHAPTER 3.4: RESERVES

Exploration Proposed:

Table 1.1 below gives the exploration figures as proposed in the approved modified scheme of mining and the actual exploration done. Details of Bore hole logs is enclosed as Annexure-XI

Table 1.1

Year	Planned		Actual	
	No.of Bore Holes	Meterages	No.of Bore Holes	Meterages
2010-11	20	1000	21	910.60
2011-12	20	1000	20	900.05
2012-13	15	750	5	246
2013-14	15	750	16	1177.40
2014-15	15	750	0	0
Total	85	4250	62	3234.05

The major reasons for deviation: - In 2010-11, exploration meterage was marginally less than proposal due to discontinuation of particular boreholes beyond its mineralization. Boreholes proposed to be drilled during 2012-13 were falling in the approved diverted forest area but necessary clearances for carrying out exploratory drilling could not be obtained.

Also, the mining operation was suspended as per order of Deputy Director Mines, Joda Circle, Keonjhar Dist. (letter no.2160/Mines, dt. 17-05-14), due to which the proposed exploration could not be completed for 2014-15.

CHAPTER 5.0: MINING

SECTION 5.2 & 5.3 : Yearly Pit-wise Development & Production Plan

Table 1.4.2 below gives the details of development carried out at each quarry with production of ROM and saleable ore during the plan period from 2011-12 to 2014-15 (till Oct'2014).

Table 1.4.2

Year	Blocks	Planned			Actual		
		Overburden (CuM)	ROM (MT)	Production (MT)	Overburden (CuM)	ROM (MT)	Production (MT)
2010-11	Guruda - A	216788	45529	38700	285594	55014	46305
	Guruda - B	253212	54471	46300	39676	1178	992
	Sub Total	470000	100000	85000	325270	56192	47297
2011-12	Guruda - A	388118	64706	55000	230984	55160	46415
	Guruda - B	185882	35294	30000	108920	20981	17655
	Sub Total	574000	100000	85000	339904	76141	64070
2012-13	Guruda - A	388118	64706	55000	314134	57887	49204
	Guruda - B	185882	35294	30000	175332	26953	24101
	Sub Total	574000	100000	85000	489466	84840	73305
2013-14	Guruda - A	388118	64706	55000	225702	64700	54995
	Guruda - B	185882	35294	30000	116430	35288	29995
	Sub Total	574000	100000	85000	342132	99988	84990
2014-15 (Till Oct'14)	Guruda - A	388118	64706	55000	28512	14689	12486
	Guruda - B	185882	35294	30000	15840	7220	6137
	Sub Total	574000	100000	85000	44352	21909	18623
Total	Guruda - A	1769260	304353	258700	1084926	247450	209405
	Guruda - B	996740	195647	166300	456198	91620	78880
	Sub Total	2766000	500000	425000	1541124	339070	288285

Reasons for deviation:

Production: The ROM and saleable ore production during the year 2010-11 has been less than the planned quantity due to poor market demand for low grade ore and substantial increase in low grade inventory at mines. The ROM and saleable ore production for the years 2011-12 to 2013-14 has been almost up to the planned quantity (91%) for Guruda Block-A, but was slightly low (79%) in case of Guruda Block-B. Our own Silico Manganese plant, was proposed to be erected and commissioned in the plan period, this could not be executed, which reduced the low grade demand from our mines, automatically increasing the low grade inventory at mines resulting in less production. In the year 2014-15 (till Oct'2014) the ROM and saleable ore production couldn't be done as per the proposed plan because of the closure of the Mine from

17.05.2014 as directed by Hon'ble Supreme Court of India vide order dt. 17.05.2014 in the writ petition Civil No. 114/2014 filed by common cause-vs-Union of India & others.

Development: As the production was less, the removal of overburden was correspondingly reduced.

SECTION 9 : Environment Management Plan

Table 1.4.3 below gives the afforestation and construction of toe wall with garland drain as proposed in the approved modified scheme of mining and the actual carried out so far.

Table – 1.4.3

Year	Planned				Actual			
	Nos. of Saplings to be planted	Area of Plantation (in ha.)	Construction of Retaining Wall (m)	Construction of Garland Drain (m)	Nos. of Saplings planted	Area of Plantation (in ha.)	Construction of Retaining Wall (m)	Construction of Garland Drain (m)
2010-11	625	0.25	675	2380	5000	0.8	350	1700
2011-12	625	0.25	475	1985	22260	2.0	0	0
2012-13	2500	1	1070	1070	42000	1.0	212	212
2013-14	1000	0.4	0	0	8500	2.0	570.15	570.15
2014-15 (till Oct'14)	500	0.2	0	0	20890	3.9*	0	0
Total	5250	2.1	2220	5435	98650	9.7	1132.15	2482.15

* Includes 1.2 ha Safety Zone.

Reasons for deviation: The actual work done as mentioned above for the year 2010-11 to Oct'2014 has exceeded in plantation. As far as the Retaining wall and Garland Drain is concerned, it has been lower than the plan for the year 2011-12 due to very low excavation at Guruda Block-A and B (as mentioned above under Table 1.4.2), which led to a reduced extension of the waste dump and the immediate need for extending the retaining wall. But, when the waste dump was extended in the year 2013-14, an additional 570.15m was constructed exceeding the overall planned quantity for the proposed years.

II) Air and Water Quality :

Air and water quality monitored at regular interval and the data generated indicate that the pollution levels are well within the prescribed limits. The data generated are presented as Annexure IV A & IV B. The major source of dust in the mines is the haul road. This is being effectively managed by regular water sprinkling during mine working hours. All precautions were taken to reduce

ground vibration caused due to blasting by adoption of controlled blasting technique.

3.4 Status of Compliance of Violations pointed out by IBM.

The violation pointed out by IBM during inspection and the compliance submitted thereof are being enclosed as Annexure – XIII.

Sl.No.	Violation / Show Cause (Letter No. & Date)	Compliance Submitted (Letter No. & Date)	Reference
1.	ORI/MN/KJR/MCDR-21/BBS, Dt.29.11.2011	MGM/P&E/49, Dt. 11.01.2012	Annexure - XIII
2.	ORI/MN/KJR/MCDR-21/BBS, Dt.24.01.2013	MGM/P&E/198/2013, Dt. 08.03.2013	
3.	ORI/MN/KJR/MCDR-21/BBS, Dt.23.04.2013	MGM/P&E/405/2013, Dt. 18.05.2013	
4.	ORI/MN/KJR/MCDR-21/BBS, Dt. 13.02.2014	MGM/P&E/247/2014, Dt. 23.03.2014	

3.5 Indicate and give details of any suspension / closure / prohibitory order issued by any Government Agency under the rule or Court of law :

Stoppage of mining operation from 17.05.2014 with respect to deemed renewal (2nd & subsequent renewal) in accordance to the verdict by Hon'ble Supreme Court of India.

3.6 In case the MP/SoM is submitted under Rule 9 & 10 of the MCDR, 1988 or under Rule 22(6) of the MCR,1960 for approval of modification, specify reason and justification for modification under these rules.

Same as mentioned in Section 1.2 above.

PART – A

1.0 GEOLOGY AND EXPLORATION

a) Topography, Drainage Pattern, Vegetation, Climate & Rainfall :

The Tiringpahar Manganese Mines consisting of three detached blocks (Tiringpahar, Joruri and Guruda), covering a total area of 643.710 ha. in Champua Sub-division of Keonjhar district in the state of Orissa. A topographical plan (Drawing no MP/TMM/R3/01/14), showing position of all the blocks is enclosed.

The details of physiography for the Guruda block are as follows:

Guruda Block : Lease area – 169 ha.

The area is approachable by kucha road from Joda. It is about 12 km away from the nearest town of Joda.

The area is characterized by undulating topography. Mainly two hills are persent in the area. One hill is on the southern side of the lease area with its highest peak RL of 732m. The other hill is on the north-western part of the lease with its highest peak RL of 704m and forms an elongated ridge sloping gradually towards east. The central part of the lease area is low lying having a gentle slope towards east.

The area is intersected by several small nalas mostly flowing towards east. These nalas remain dry for most part of the year. The nearest source of water is "Dalko Nala" which flows along north of Joruri Block and is a tributary of Baitarani river.

The block is covered by moderate Sal forest on the higher slopes and shrubs/bushes on the lower level. Prominent botanical species like Shorea Robusta (Sal), Terminalia Tomentosa (Asan), Bassia Latifolia (Mahua), Butea Monosperma (Kosi), Magnifier Indicia (Mango) etc are in abundance. The animals consisting of elephants, bears, squirrels, jackals, mongoose, while among the avians are white chlorospsis, woodpecker, crows, bulbul.

The climate is tropical with maximum temperature going up to 44-46°C in summer months and a minimum temperature going down to 5-6°C in winter months. The annual rainfall during 2003-14 is about 1573mm. (Ref. Table No. 3.18)

b) REGIONAL GEOLOGY –

The rock formations of the area belong to the Iron ore group (earlier called as series) of Upper Dharwar age. In south Singhbhum, Bonai & Keonjhar district Manganese ore deposits are associated with Shales, Laterite, Chert & Quartzite of the Iron Ore Group & are distributed within the Horse shoe shaped synclinorium, plunging towards NNE over-folded towards SW. The shale formation occurs as a core of the synclinorium along Jamda-Koira valley overlying the Banded Iron Formation. The position of the Iron ore group and the rocks associated with it in the stratigraphic column is as follows:

The Generalized stratigraphic succession of Precambrian formations of Singhbhum-Orissa craton

(After Sarkar & Saha, 1977, 1983; Basu, Ray, Sarkar & Saha, 1981; Saha, Ray & Sarkar; 1986)

SOUTH OF SINGHBHUM SHEAR ZONE	NORTH OF SINGHBHUM SHEAR ZONE
End of the Singhbhum Orogenic cycle (c. 850 Ma)	
Newer Dolerite (c. 1600-950 Ma)	Soda Granite, Granophyre, Chakradharpur Granite gneiss,
Kuilapal granite	
Mayurbhanj Granite (c.2000-2100 Ma)	Gabbro-Anorthosite,Ultramafic intrusions
Kolhan Group (c.2100 Ma)	
~~Unconformity~~~~~~~~~~~~~~~~~~~~	
Jagannathpur-Dhanjori- Similipal Dhanjori group (c.2200Ma)	
Quartzite conglomerate	
~~Unconformity~~~~~~~~~~~~~~~~~~~~	
Chaibasa formation (c.23000 Ma)	Dalbhum formation
Singhbhum Chaibasa formation	Group
~~Unconformity~~~~~~~~~~~~~~~~~~	
Singhbhum granite (Phase-III.c.3000 Ma)	
Iron Ore Orogeny	
Iron Ore Group (c. 3300 Ma)	
~~Unconformity~~~~~~~~~~~~~~~~~~	
Singhbhum Granite (Phase I&II.c.3300 Ma)	

Older Metamorphic Gneiss (Metamorphic age.c.3300 Ma)
Older Metamorphic Tonalite Gneiss (OMTG) (c.3800 Ma)
Older Metamorphic Gneiss (Metamorphic age c. 3800 Ma)

The manganese ore deposits of the area occur within the weathered shale horizon (lower shale??) of Iron ore group as tabular lenses & as irregular veins. Manganese ore also occurs in the form of Rugri & nodular masses and are formed by the process of leaching, replacement & concentration through the agencies of meteoric waters. The ore mineral are mainly oxides and generally occurs as Pyrolusite, Psilomelane & Wad. The deposits greatly vary in size & shape & range in length from about a meter to more than 200 mts. The width of the ore bodies is very small compared to the length.

c) Local Geology:-

The local geology of the Tiringpahar Manganese Blocks as observed from different boreholes more or less confirms the fact that manganese mineralization is mainly confined to the weathered shale horizon (lower shale ??) of Iron Ore group.

The different lithologies encountered in the area are: -

a) Soil / Alluvium with floats of iron and manganese ores
b) Laterite, manganiferous in places
c) Cherty and Jaspery quartzite
d) Manganese Ore
e) Shale

Manganese Ore: Manganese Ore occurs as lenses and pockets in association with laterite, cherty and jaspery quartzites, shales and iron ores. Dip and strike of the ore patches are not much in evidence. The solid ore patches at times have capping of soil of varying thickness with stray pieces of manganese ores. The top layer of the ore is generally hard and massive and it passes on to spongy and porous varieties in depth.

The nodules of manganese or rugri ore usually occur in laterite and lateritic morrum and in places they are seen in the intervening portions of the ore lenses. The nodules are hard and do not appear to be contaminated except for a coating of clayey matter on individual nodules. The ore consists of a mixture of pyrolusite and psilomelane proportions of which vary from zone to zone.

Manganese Ore deposits are of secondary in nature and are derived from manganiferous shales of the iron ore series by the processes of leaching, concentration and replacement giving rise to manganese deposits through the agency of circulating waters of meteoric origin, perhaps aided in some cases by hydrothermal action due to the igneous intrusions. Replacement of brecciated, cherty and jaspery quartzite by manganese is clearly noticed. Here the

solutions appear to have followed certain definite planes of crushing and fracture of the country rocks in the zone of oxidation.

Laterite: Extensive patches of laterite and latertic soil are found in the area. Very often, lumps and nodules of manganese and iron ore are found to be irregularly distributed in the latertic morrum. Also, compositon of laterite varies at different places. At some places it is iron rich while at other places it is manganese rich.

Quartzite: Large irregular patches of cherty and jaspery quartzite are encountered in the area while some of the biggest patches occur towards the northern portion of the property. The rock is usually bouldery, sometime massive and weathered in places. It is unbanded and no definite dip is observed. Stringers and veins of quartz, iron and manganese are at times seen to traverse the rock.

Shale: Shales found in the area are mostly lateritized; banded and unbanded varieties, which occur elsewhere in the district, are rare. Latertized shale grades from a few centimetres to several metres are encountered at places. Highly lateritized shales have also been marked on the geological map as lateritic.

b) (i) Name of prospecting /exploration agency : FAM Division
(ii) Address: TATA STEEL LIMITED
P.O. – Bichakundi
JODA WEST
Dist. – Keonjhar
State – Odisha

(iii) E mail address : jwoffice@tatasteel.com
Phone no. : +919238120148

e) Details of prospecting/exploration already carried out:

i) Number of pits and trenches: Nil

ii) Number of boreholes drilled:

Details of exploration carried out till date at Guruda A and Guruda B blocks are given in Table No. 1.1 a & b respectively.

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Table 1.1a: Summary of Exploration at Guruda A Block

Location	Year	No. of Bore Holes	Meterage	Borehole Type	Expenditure Incurred (Rs. Lakhs)
Guruda A	1972-73	35	905.19	Core	NA
	1977-78	19	707.09	Core	NA
	1978-79	13	636.57	Core	NA
	1979-80	23	937.91	Core	NA
	1981-83	15	907.55	Core	NA
	1983-84	19	923.85	Core	NA
	1984-86	20	1139.66	Core	NA
	1998-99	72	4072.75	Core	NA
	2010-11	11	520.60	Core	24.54
	2011-12	10	515.65	Core	25.65
	2012-13	5	246.00	Core	12.47
	2013-14	6	430.20	Core	24.66
	Grand Total	**248**	**11943.02**	**Core**	**87.32**

Table 1.1b: Summary of Exploration at Guruda B Block

Location	Year	No. of Bore Holes	Meterage	Borehole Type	Expenditure Incurred (Rs. Lakhs)
Guruda B	1983-86	81	3976.37	Core	NA
	2003-04	87	4484.85	Core	98.94
	2007-08	5	128.60	Core	2.84
	2010-11	10	390.00	Core	18.39
	2011-12	10	384.40	Core	19.12
	2012-13	0	0.00	Core	0.00
	2013-14	10	747.20	Core	42.83
	Grand Total	**203**	**10111.42**	**Core**	**182.11**

Cumulative exploration carried out in the Guruda block of Tiringpahar lease is summarized in Table No. 1.1c.

Table 1.1c: Summary of Exploration in Tiringpahar Lease

Location	No. of Bore Holes	Meterage	Expenditure Incurred (Rs. Lakhs)
Guruda A	248	11943.02	87.32
Guruda B	203	10111.42	182.11
Total	**451**	**22054.44**	**269.43**

Exploration carried out as per UNFC norms

Exploration carried out at Guruda Block as per UNFC norms is given below in Table No. 1.2 (Ref. Drawing No. MP/TMM/R3 /04A-1/14).

Table 1.2

Name of Mineral : Manganese & Iron							
Sl. No.	Name of the Block	Total Lease Area (in Ha)	Lease Area Explored as per UNFC Norms (in Ha) C=D+E+F+G				Remarks/Comments including reasons for not carrying out the exploration as per UNFC norms.
			G1 Level	G2 Level	G3 Level	Other Lease Area*	
A	B	C	D	E	F	G	H
1	Guruda	169	52	40	36	41	Additional exploration is required for upgrading resources from G2, G3 & G4 categories to G1 category as per UNFC norms. For, this forest clearance is required.
Total		169	52	40	36	41	

* Other Lease Area includes G4 area in which preliminary geological investigation in terms of geological mapping (1:1000 scale), random sampling & chemical analysis of different rock types, delineation of forest areas, geomorphology, landforms etc., petrographic and mineragraphic studies have been carried out.

iii) Details of sample analysis indicating type of sample (surface / sub-surface form pits / trenches / boreholes etc)

The detailed analysis of boreholes during the last Scheme period is being enclosed as Annexure-XI A. The sample were analyzed at our own laboratory having recognition from Directorate of Geology, Govt. of Odisha and also duly accredited by NABL. The copies of laboratory recognition and NABL certificate are being enclosed as Annexure – IX A & B respectively.

iv) Expenditure incurred various prospecting operation:

The details of expenditure incurred for prospecting operation has been duly furnished in Table No. 1.1 (a) to (c). Further, the expenditure incurred during last Scheme period (i.e 2010-11 to 2014-15) has been duly certified by Agent of the Mine and copy is being enclosed as Annexure – XI B.

f) Future Exploration Proposal:

Exploration in the Tiringpahar leasehold area will be carried out in different phases. The main objective of the exploration program is to increase the resource base of manganese and iron ore and also to cover the total lease area by exploration sequentially up to G1 stage of UNFC.

For this, the exploration program has been categorized based on the status of land available for carrying out exploration. The broken forest and non-forest areas and the diverted (stage II approved) areas has been considered first for carrying out exploration. Subsequently, the forest areas will be taken up after getting necessary clearances.

Exploration in the lease area will be carried out in different phases. During Phase I, the potential areas with necessary clearances will be covered. Infill drilling will also be done in order to increase the confidence level of resources. Phase II drilling will be done at 100m interval to demarcate potential ore zones. RC drilling, which is quite faster method than core drilling may be done during this phase to cover more area. Subsequently core drilling will be done in the potential zones demarcated by RC drilling for more precise estimation of resources. Phase III drilling will be done as infilling drilling in the potential ore zones demarcated during phase II exploration.

Most of the manganese ore bodies show typically erratic behavior in the working quarries and therefore no generalized rules can be framed for carrying out exploration.

Manganese occurrence of Jamda- Koira valley is associated with a mixed facies having Shale, Chert, Laterite, Iron & mostly with lower shale of Iron Ore Group. Since genesis of Manganese is of secondary nature (replacement / residual type), where ore occurs as discontinuous lenses, it is very difficult to go for a concrete exploration plan.

However, based on past exploration experience, surfacial exposure & future requirement, exploration plan for the period of 2016-2020 has been made for estimation of resource both in quantity & quality. The year wise exploration plan is summarized below in Table No. 1.3 and location of proposed boreholes is shown in drawing nos. MP/TMM/R3/04A/14, MP/TMM/R3/04B/14 and MP/TMM/R3/04C/14.

Table – 1.3

Year	No. of boreholes (Core/RC/DTH)		Grid Interval (m)	No. of Pits, Dimensions and volume	No. of Trenches, Dimensions and volume
	Nos.	Meterage (m)			
2015-16	10	500	50 X 50 & 200 X 200	Nil	Nil
2016-17	10	500			
2017-18	10	500	50 X 50		
2018-19	10	500			
2019-20	10	500			
Total	**50**	**2500**			

In order to cover the total lease area, exploration has been proposed in forest land and also in areas where necessary clearances are not available at present. The said exploration will be done only after getting necessary clearances. However, if we obtain the forest clearances, we shall conduct the proposed exploration early. If required, we may also drill more boreholes in order to delineate the ore body.

There is also proposal for drilling of RC drill holes in the current pits to increase the confidence level during excavation. A total of 50 RC boreholes with a cumulative meterage of 2500 m are proposed to be carried out during the scheme period.

g) Reserves and Resources as per UNFC with respect to the threshold value notified by IBM:

Deposit evaluation was done by using mine planning software Surpac Version 6.6.

Steps followed:

- Data collection from graphical borehole logs, recording and codification.
- Data punching in to computer files and its validation.
- Creation of database in application software.
- Creation of digital database of topography, geological features (litho-contact) and surface features by digitization.
- Preparation of Digital Terrain Model (DTM) of topography using survey data and extraction of surface profiles along cross section lines.
- Preparation of geological cross sections from geology and assay database of boreholes.
- Correlation of ore bodies in cross sections.
- Solid body modeling: In this method the ore bodies are digitized across the transverse cross sections. All the ore bodies prepared from different transverse cross sections is taken in one file and longitudinal correlation is done. Than solid body modeling is done to get a 3 dimensional model of the ore body.

- Block Modeling and estimation of grade by Inverse Square Distance (ISD) method:
  - In this method, down-hole compositing of assays was carried out for manganese ore zones. Compositing of samples are taken as 1m (based on average sample length within ore zone) with condition of inclusion of any sample with length upto 75% of the designated composite length.
  - For block grade estimation, block size chosen is 5m X 5m X 2m in Y, X & Z directions. Standard subblocking is applied with minimum size of 1.25m X 1.25m X 0.5m in Y, X & Z directions, considering the pockety nature of manganese ore bodies.
  - Minimum and maximum number of samples considered for estimation is 2 and 10 respectively. An ellipsoidal search (omnidirectional) with a maximum search distance of 50m in the horizontal plane and 8m in the vertical plane has been considered for estimation. Anistropic ratio between major & semi-major and also between major & minor axis is considered to be 1.
- Insitu bulk density for manganese is considered to be 2.5 t/Cu m and for iron, it is considered to be 3.0 t/Cu m.
- The cut-off grade for manganese ore is considered to be 25% Mn and the threshold limit is considered as 10% Mn. The cut-off grade for iron ore is considered to be 58% Fe and the threshold limit is considered as 45% Fe.
- Resource classification has been done as per UNFC norms. Measured mineral resources (UNFC 331) has been established for the areas where there is proving information with higher confidence level provided by less than 50 m x 50 m grid space drilling. Indicated mineral resource (UNFC 332 category), is categorized for the resource estimated for the areas where there is proving information with lower confidence level provided by more than 50 m x 50 m and less than 100 m x 100 m grid space drilling. Inferred mineral resource (UNFC 333 category), is categorized for resource estimated for the areas where there is proving information with lowest confidence level provided by more than 100 m x 100 m grid space drilling and also for exposed outcrops mapped in 1:5000 scale.
- Following the UNFC norms for codifying reserve under Proved (111) and Probable (122) category, mine feasibility as well as economic aspects are implied on the geologically Measured (331) and Indicated (332) mineral resources. Resources blocked due to lease boundary constraint are classified into Pre-feasibility resources (221 & 222).
- The subgrade manganese and iron resources has been categorized into Measured (331), Indicated (332) and Inferred (333) resources as per UNFC norms since feasibility study has not been carried out and it is not economically mineable at the present moment.
- All the outcrops of manganese/iron ore mapped (on 1:5000 scale) in the lease area (including the forest areas) which indicate occurrence of potential ore zones, however, feasibility of mining, economics and the

exact geological details in terms of actual depth and grade distribution cannot be qualified for such outcrops at this stage are brought under inferred (333) category. Possible depth for such outcrops is assumed to be 3 meters for resource estimation.

Classification of Manganese Ore:

On the basis of Mn content, manganese ore is divided into 4 grades as given below:-

Mn (%)	Grade of Manganese Ore
> 45	Chemical & High Grade
35 – 45	Medium Grade
25 – 35	Low Grade
10 – 25	Subgrade

The typical analysis for the different grades of manganese ore described above is given in Table No. 1.4a.

Table 1.4a

Grade	Mn%	Fe%	SiO_2%	Al_2O_3%	P%
Chemical	53.6	4.40	0.8	1.09	0.046
High	47.70	9.20	1.10	3.02	0.078
Medium	38.10	19.40	3.10	4.28	0.068
Low	29.40	26.50	3.52	2.68	0.072
Subgrade	18.56	20.84	22.48	8.21	0.071

Classification of Iron Ore:

On the basis of Fe content, iron ore is divided into 2 grades as given below:-

Fe (%)	Grade of Iron Ore
> 58	Ore
45 – 58	Subgrade

The typical analysis for the different grades of iron ore is given in Table No. 1.4b.

Table 1.4b

Grade	Mn%	Fe%	SiO_2%	Al_2O_3%	P%
Ore	0.35	59.23	5.23	3.34	0.050
Subgrade	1.20	47.60	11.72	14.58	0.060

Validation of Block Model:

Validation of the block model for Mn ore zones has been done by comparing the estimated value of Mn% / Fe% for a block with the average composite values of the borehole within that block. The difference between the composite value and estimated value should be less than 5%. The comparison between estimated and actual value of Manganese ore zones is given in Table No. 1.5a.

Table 1.5a

Validation of Block model value with composite value for +25% Mn ore zone

Borehole No.	Avg. Composite value of Mn% within Block	Block Value of Mn%	Difference in Mn% between composite and block value	Percentage Difference in Mn% between composite and block value
GDP/59	52.90	51.64	1.26	2.3%
	54.86	52.83	2.03	3.7%
	48.74	49.60	-0.86	1.7%
BH-142/86	44.22	44.41	-0.19	0.4%
	37.63	38.23	-0.60	1.6%
	32.96	32.01	0.95	2.8%
180/98	42.74	42.40	0.34	0.8%
	35.09	35.97	-0.88	2.5%
	31.92	31.55	0.37	1.2%
PNP/21	37.79	37.29	0.50	1.3%
	39.27	38.52	0.75	1.9%
	38.23	37.69	0.54	1.4%
BH-73/86	29.01	28.73	0.28	0.9%
	32.07	31.91	0.15	0.5%
	37.77	37.90	-0.13	0.3%

Validation of block model has also been done by comparing the basic statistics of Mn% of the composite file and the Mn% of the block centroids extracted from the block model (Table No. 1.5b). The percentage variation of mean and median between the average input grade (of composite file) and the average estimated grade (of block centroids) should be less than 5%.

Table 1.5b

Comparison of Basic Statistics of Composite file & Block Centroid for +25% Mn Ore Zone

Parameter	Mn% of Composite	Mn% of Block Centroid	Variation	Variation%
Mean	36.48	35.82	0.66	1.81
Median	35.66	35.34	0.32	0.90
Geometric Mean	35.66	35.30	0.36	1.01
Variance	62.31	38.30	24.01	
Standard Deviation	7.89	6.19	1.7	
Coefficient of Variation	0.22	0.17	0.05	
Skewness	0.54	0.37	0.17	
Kurtosis	2.43	2.39	0.04	

Category-Wise Reserves Indicated In The Approved Scheme Of Mining :

Mineral Resource & Reserve of Manganese ore as mentioned in approved, Modified, Scheme of Mining is given in the Table No. 1.6a below:

Table 1.6a

Mineral Reserve and Resource as on 1.4.2011 (figs in tonnes) : Manganese Ore

Block	Mineral Reserve						Mineral Resource		Grand Total
	Proved (111)				Probable (121&122)	Total	Indicated (332)	Inferred (333)	
Quarry	Ch+H Gr	Med Gr	Low Gr	Sub – Total					
Block - A	142085	44632	156162	342879	0	342879	50000	172151	**565030**
Block - B	39577	1608	255891	297076	3350	300426	46587	0	**347013**
Total	**181662**	**46240**	**412053**	**639955**	**3350**	**643305**	**96587**	**172151**	**912043**

Depletion of Reserves :

The year wise ROM production of manganese ore for the period 01.04.2011 to 31.10.2014 is given in Table No. 1.6b below.

Table 1.6b

Block-wise production of ROM of Manganese Ore in tonnes

Year	Quarry	Ch+H Gr	Med Gr	Low Gr	Total
2011-12	Block – A	8434	22629	24059	55123
	Block – B	900	3998	16121	21018
	Sub Total	**9334**	**26627**	**40180**	**76141**
2012-13	Block – A	8478	23409	24649	56536
	Block – B	2900	1929	23475	28304
	Sub Total	**11378**	**25338**	**48124**	**84840**
2013-14	Block – A	15252	21920	27528	64700
	Block – B	976	2167	32145	35288
	Sub Total	**16228**	**24087**	**59673**	**99988**
2014-15*	Block – A	3868	3272	7549	14689
	Block – B	88	373	6758	7220
	Sub Total	**3956**	**3645**	**14307**	**21909**
Total	**Block – A**	36032	71230	83785	191048
	Block – B	4864	8467	78499	91830
	Total	**40896**	**79697**	**162284**	**282878**

* Till Oct'14

The reserve and resource after deduction of ROM has been shown in Table No. 1.6c.

Table 1.6c

Mineral Reserve and Resource as on 1.11.2014 (figs in tonnes) : Manganese Ore

Block	Mineral Reserve						Mineral Resource		Grand Total
	Proved (111)				Probable (121&122)	Total	Indicated (332)	Inferred (333)	
Quarry	Ch+H Gr	Med Gr	Low Gr	Sub – Total					
Block - A	98074	0	53758	151831	0	151831	50000	172151	**373982**
Block - B	32655	0	172591	205246	3350	208596	46587	0	**255183**
Total	**130729**	**0**	**226349**	**357077**	**3350**	**360427**	**96587**	**172151**	**629165**

It is observed that in the course of mining, the production of medium grade ore was more in certain areas where chemical and low grade ore was estimated. Therefore, the figures of different grades of ore were revised accordingly.

Additional Reserves Established :

Resource evaluation has been done based on the new boreholes drilled during the approved scheme of mining period from FY'11 to FY'15 and re-estimation of resources has been done for all old boreholes drilled till FY'11 as per UNFC norms. Resource estimation has been carried out using ore body modeling and block modeling technique. The updated reserves/resources for the 2 blocks of Tiringpahar Manganese Mine were estimated as per the details given under the Para "Category wise updated Reserves". Working back from the updated reserves, the net addition/depletion of resources (calculated by substracting the earlier resources from updated resources as on 01.11.2014) is given in Table No. 1.6d.

Table 1.6d

Additional Manganese Ore (+25% Mn) Resources Established

(figs in tonnes)

Block	Mineral Reserve				Mineral Resource			Grand Total
	Proved (111)				Pre-feasibility (221 & 222)	Indicated (332)	Inferred (333)	
Quarry	Ch+H Gr	Med Gr	Low Gr	Sub – Total				
Block - A	37373	238865	246496	522735	362588	-50000	-172151	**663172**
Block - B	-21226	16544	-112515	-117197	167971	-46587	0	**4187**
Total	**16147**	**255409**	**133981**	**405538**	**530559**	**-96587**	**-172151**	**667359**

In Block – B, part of the proved reserves estimated earlier has been re-classified into Pre-feasibility resource (221), as it is blocked due to lease boundary constraint.

Subgrade manganese (+10-25% Mn) and iron ore (+58% Fe) & subgrade (+45-58% Fe) resources have been estimated in view of new threshold value notified and given in Table No. 1.6e and 1.6f respectively.

Table 1.6e
Additional Subgrade Manganese (+10-25% Mn) Resources Established
(figs in tonnes)

Block	Measured (331)	Indicated (332)	Inferred (333)	Total
Block - A	1725549	59408	0	1784957
Block - B	536055	2793	0	538848
Total	**2261604**	**62201**	**0**	**2323805**

Table 1.6f
Additional Iron Ore (+58% Fe) & Subgrade (+45-58% Fe) Resources Established
(figs in tonnes)

Block	Grade	Measured (331)	Indicated (332)	Inferred (333)	Total
Block - A	+45-58% Fe	3188109	451062	43563	3682734
	+58% Fe	487280	115793	32269	635342
Block - B	+45-58% Fe	281667	0	0	281667
	+58% Fe	173698	0	0	173698
Total	**+45-58% Fe**	**3469776**	**451062**	**43563**	**3964401**
	+58% Fe	**660978**	**115793**	**32269**	**809040**

Category wise updated Resources/Reserves:

The category-wise updated resources & reserves of Tiringpahar lease for manganese and iron ore as on 01.11.2014 follows from above paragraphs. The details of block-wise geological reserve and resource of manganese (+25% Mn) ore within the lease area of 169.00 ha is given in Table No. 1.7a.

The details of block-wise geological resource of subgrade manganese (+10-25% Mn) and iron ore (+58% Fe) & subgrade (+45-58% Fe) within the lease area of 169.00 ha is given in Table No. 1.7b and Table No. 1.7c respectively.

Table 1.7a
Mineral Reserve and Resource as on 1.11.2014 (figs in tonnes) : **Manganese Ore**

Block	Mineral Reserve						Mineral Resource			Grand Total
	Proved (111)				Probable (121& 122)	Total	Pre-feasibility (221 & 222)	Indicated (332)	Inferred (333)	
Quarry	Ch+H Gr	Med Gr	Low Gr	Sub – Total						
Block - A	135447	238865	300254	674566	0	674566	362588	0	0	**1037154**
Block - B	11429	16544	60076	88049	3350	91399	167971	0	0	**259370**
Total	**146876**	**255409**	**360330**	**762615**	**3350**	**765965**	**530559**	**0**	**0**	**1296524**

Table 1.7b
Mineral Reserve and Resource as on 1.11.2014: **Subgrade Manganese Ore**
(figs in tonnes)

Block	Measured (331)	Indicated (332)	Inferred (333)	Total
Block - A	1725549	59408	0	1784957
Block - B	536055	2793	0	538848
Total	**2261604**	**62201**	**0**	**2323805**

Table 1.7c
Mineral Reserve and Resource as on 1.11.2014: **Iron Ore & Subgrade**
(figs in tonnes)

Block	Grade	Measured (331)	Indicated (332)	Inferred (333)	Total
Block - A	+45-58% Fe	3188109	451062	43563	3682734
	+58% Fe	487280	115793	32269	635342
Block - B	+45-58% Fe	281667	0	0	281667
	+58% Fe	173698	0	0	173698
Total	+45-58% Fe	3469776	451062	43563	3964401
	+58% Fe	660978	115793	32269	809040

Category wise Summary of updated Resources/Reserves:

The category-wise summary of resources & reserves of Tiringpahar lease within the RML area of 169.00 ha are given in Table No. 1.8.

Table 1.8a

Mineral Reserve and Resource as on 1.11.2014: Manganese Ore

Classification	UNFC Code	Quantity (in Million Tonnes)			Grade
		Guruda A	Guruda B	Total	
A. Mineral Reserve					Mn > 25%
(1) Proved Mineral Reserve	111	0.675	0.088	**0.763**	
(2) Probable Mineral Reserve	121 and 122	0	0.003	**0.003**	
B. Remaining Resources					
(1) Feasibility Mineral Resource	211	0	0	**0**	
(2) Pre-feasibility Mineral Resource	221 and 222	0.363	0.168	**0.531**	
(3) Measured Mineral Resource	331	0	0	**0**	
(4) Indicated Mineral Resource	332	0	0	**0**	
(5) Inferred Mineral Resource	333	0	0	**0**	
(6) Reconnaissance Mineral Resource	334	0	0	**0**	
Total Reserves + Resources		**1.037**	**0.259**	**1.297**	

Table 1.8b

Mineral Reserve and Resource as on 1.11.2014: Subgrade Manganese Ore

Classification	UNFC Code	Quantity (in Million Tonnes)			Grade
		Guruda A	Guruda B	Total	
A. Mineral Reserve					Mn 10 - 25%
(1) Proved Mineral Reserve	111	0	0	**0**	
(2) Probable Mineral Reserve	121 and 122	0	0	**0**	
B. Remaining Resources					
(1) Feasibility Mineral Resource	211	0	0	**0**	
(2) Pre-feasibility Mineral Resource	221 and 222	0	0	**0**	
(3) Measured Mineral Resource	331	1.726	0.536	**2.262**	
(4) Indicated Mineral Resource	332	0.059	0.003	**0.062**	
(5) Inferred Mineral Resource	333	0	0	**0**	
(6) Reconnaissance Mineral Resource	334	0	0	**0**	
Total Reserves + Resources		**1.785**	**0.539**	**2.324**	

Table 1.8c

Mineral Reserve and Resource as on 1.11.2014: Iron Ore

Classification	UNFC Code	Quantity (in Million Tonnes)			Grade
		Guruda A	Guruda B	Total	
A. Mineral Reserve					Fe > 58%
(1) Proved Mineral Reserve	111	0	0	**0**	
(2) Probable Mineral Reserve	121 and 122	0	0	**0**	
B. Remaining Resources					
(1) Feasibility Mineral Resource	211	0	0	**0**	
(2) Pre-feasibility Mineral Resource	221 and 222	0	0	**0**	
(3) Measured Mineral Resource	331	0.49	0.17	**0.66**	
(4) Indicated Mineral Resource	332	0.12	0	**0.12**	
(5) Inferred Mineral Resource	333	0.03	0	**0.03**	
(6) Reconnaissance Mineral Resource	334	0	0	**0**	
Total Reserves + Resources		**0.64**	**0.17**	**0.81**	

Table 1.8d

Mineral Reserve and Resource as on 1.11.2014: Subgrade Iron Ore

Classification	UNFC Code	Quantity (in Million Tonnes)			Grade
		Guruda A	Guruda B	Total	
A. Mineral Reserve					Fe 45 - 58%
(1) Proved Mineral Reserve	111	0	0	**0**	
(2) Probable Mineral Reserve	121 and 122	0	0	**0**	
B. Remaining Resources					
(1) Feasibility Mineral Resource	211	0	0	**0**	
(2) Pre-feasibility Mineral Resource	221 and 222	0	0	**0**	
(3) Measured Mineral Resource	331	3.19	0.28	**3.47**	
(4) Indicated Mineral Resource	332	0.45	0	**0.45**	
(5) Inferred Mineral Resource	333	0.04	0	**0.04**	
(6) Reconnaissance Mineral Resource	334	0	0	**0**	
Total Reserves + Resources		**3.68**	**0.28**	**3.96**	

The total resources of manganese ore (+10% Mn) is given in Table No. 1.8e.

Table 1.8e

Mineral Reserve and Resource as on 1.11.2014: Manganese Ore (+10% Mn)

Classification	UNFC Code	Quantity (in Million Tonnes)			Grade
		Guruda A	Guruda B	Total	
A. Mineral Reserve					Mn > 10%
(1) Proved Mineral Reserve	111	0.675	0.088	**0.763**	
(2) Probable Mineral Reserve	121 and 122	0	0.003	**0.003**	
B. Remaining Resources					
(1) Feasibility Mineral Resource	211	0	0	**0**	
(2) Pre-feasibility Mineral Resource	221 and 222	0.363	0.168	**0.531**	
(3) Measured Mineral Resource	331	1.726	0.536	**2.262**	
(4) Indicated Mineral Resource	332	0.059	0.003	**0.062**	
(5) Inferred Mineral Resource	333	0	0	**0**	
(6) Reconnaissance Mineral Resource	334	0	0	**0**	
Total Reserves + Resources		**2.823**	**0.798**	**3.621**	

The total resources of iron ore (+45% Fe) is given in Table No. 1.8f.

Table 1.8c

Mineral Reserve and Resource as on 1.11.2014: Iron Ore (+45% Fe)

Classification	UNFC Code	Quantity (in Million Tonnes)			Grade
		Guruda A	Guruda B	Total	
A. Mineral Reserve					Fe > 45%
(1) Proved Mineral Reserve	111	0	0	**0**	
(2) Probable Mineral Reserve	121 and 122	0	0	**0**	
B. Remaining Resources					
(1) Feasibility Mineral Resource	211	0	0	**0**	
(2) Pre-feasibility Mineral Resource	221 and 222	0	0	**0**	
(3) Measured Mineral Resource	331	3.68	0.45	**4.13**	
(4) Indicated Mineral Resource	332	0.57	0	**0.57**	
(5) Inferred Mineral Resource	333	0.07	0	**0.07**	
(6) Reconnaissance Mineral Resource	334	0	0	**0**	
Total Reserves + Resources		**4.32**	**0.45**	**4.77**	

Justification of Classification as per UNFC Codes

Manganese Ore (+25% Mn):-

Proved Mineral Reserve (111):-

Geological Axis (G1): The following steps are involved for assessment:

(i) Geological mapping on 1:5000 and 1:1000 scale has been done.

(ii) Detail topographic contouring has been done.

(iii) Detail geological map prepared showing topography, all geological features, location of boreholes, trenches/pits etc.

(iv) Drilling has been done with the spacing
- ≤ 50m.over the potential ore zones for manganese ore.

(v) Detail sampling and analysis has been done for cores recovered during drilling of bore holes.

(vi) Mineralogical study has been done (Given in Annexure IX D).

(vii) Geostatistical analysis of borehole data by considering the thickness of ore and waste encountered in boreholes, assay value etc has been done.

Feasibility Axis (F1):

(i) Geology: Evaluation of deposit being done by Mine Planning Software (Surpac). Quarries already exist and mining is being done since long.

(ii) Mining: Excavation Plans are being prepared by referring to the solid body of ore prepared with Mine Planning Software (Surpac). A recovery and efficiency factor of 85% is considered for taking care of losses due to mining operation and natural voids / spaces etc.

(iii) Environment: EIA & EMP has been prepared for present and proposed production level and has been duly approved by MoEF.

(iv) Processing: The manganese ore is being dressed, sorted, sized and graded manually at sorting yard. The process of mineral beneficiation of the low grade manganese ore is known since long. However, the economic viability of the process has been doubtful in view of the high energy cost. Our company's R&D proposed to take up pilot plant studies for assessing the feasibility of beneficiation of the low grade manganese ores and fines.

(v) Infrastructure and services are adequate to exploit the ore at present level of production plan.

(vi) Costing: The operating and capital costs are being planned for each year to execute the mining operation.

(vii) Marketing: The entire manganese ore will be consumed at our captive plant.

(viii) Other Factor: Statutory provisions pertaining to mines are being strictly adhered.

Economic Axis (E1):-

(i) The excavation plans are being made for scientific exploitation of manganese ore.
(ii) The stripping ratio (main cost driver) has been calculated on pit designs made through mine planning software by considering all statutory operating conditions as imposed thereof.
(iii) Specific knowledge of forest and other land use data:
The forest area has been demarcated and Forest Diversion Proposal has been submitted. Present in diverted forest area.

Probable Mineral Reserve (122):-

Geological Axis (G2): The following steps are involved for assessment:

(i) Geological mapping on 1:5000 and 1:1000 scale has been done.
(ii) Detail topographic contouring has been done.
(iii) Detail geological map prepared showing topography, all geological features, location of boreholes, trenches/pits etc.
(iv) Drilling has been done with the spacing
- 100m to 50m over the potential ore zones for manganese ore.
(v) Detail sampling and analysis has been done for cores recovered during drilling of bore holes.
(vi) Mineralogical study has been done (Given in Annexure IX D).
(vii) Geo-statistical analysis of borehole data by considering the thickness of ore and waste encountered in boreholes, assay value etc has been done.

Feasibility Axis (F2):

(i) Geology: Detailed geological study, exploration, ore body modeling, mineralogical studies has been done.
(ii) Mining: Mining methods, pre-production plan, etc. has been enclosed in the scheme.
(iii) Environment: EIA studies and EMP has been done.
(iv) Processing: The manganese ore is being dressed, sorted, sized and graded manually at sorting yard.
(v) Infrastructure and services and construction activities: Enclosed in the scheme.
(vi) Costing: Costs details have provided in annual returns.
(vii) Marketing: Marketing of Manganese Ore is being done by Company's central team.
(viii) Economic viability: This is being constantly monitored by Company's accounts department.
(ix) Statutory provisions: Statutory provisions pertaining to mines are being strictly adhered.

Economic Axis (E1):-

(i) The excavation plans are being made for scientific exploitation of manganese ore.

(ii) The stripping ratio (main cost driver) has been calculated on pit designs made through mine planning software by considering all statutory operating conditions as imposed thereof.
(iii) Specific knowledge of forest and other land use data:
The forest area has been demarcated and Forest Diversion Proposal has been submitted. Present in non forest area.

Pre-feasibility Mineral Resource (221 & 222):-

Geological Axis (G1 & G2): The following steps are involved for assessment:

(i) Geological mapping on 1:5000 and 1:1000 scale has been done.
(ii) Detail topographic contouring has been done.
(iii) Detail geological map prepared showing topography, all geological features, location of boreholes, trenches/pits etc.
(iv) Drilling has been done with the spacing
- ≤ 50m.over the potential ore zones for manganese ore.
(v) Detail sampling and analysis has been done for cores recovered during drilling of bore holes.
(vi) Mineralogical study has been done (Given in Annexure IX D).
(viii) Geostatistical analysis of borehole data by considering the thickness of ore and waste encountered in boreholes, assay value etc has been done.

Feasibility Axis (F2):

(i) Geology: Detailed geological study, exploration, ore body modeling, mineralogical studies has been done.
(ii) Mining: Ore is below ultimate pit and blocked due to lease boundary constraint.
(iii) Environment: EIA studies and EMP has been done.
(iv) Processing: Not studied.
(v) Infrastructure and services and construction activities: Enclosed in the scheme.
(vi) Costing: Not estimated.
(vii) Marketing: Not estimated.
(viii) Economic viability: Ore present below ultimate pit and is locked up due to lease boundary constraint.
(ix) Statutory provisions: Statutory provisions pertaining to mines are being strictly adhered.

Economic Axis (E2):-

(i) General and detail exploration have been carried out.
(ii) Grades of ore established. It is above cutoff grade (25% Mn). It is below ultimate pit.
(iii) Specific knowledge of forest and other land use data:
The forest area has been demarcated and Forest Diversion Proposal has been submitted. Present in diverted forest and non-forest area.

Subgrade Manganese Ore (+10-25% Mn):-

Measured Mineral Resource (331):-

Geological Axis (G1): The following steps are involved for assessment:

(i) Geological mapping on 1:5000 and 1:1000 scale has been done.
(ii) Detail topographic contouring has been done.
(iii) Detail geological map prepared showing topography, all geological features, location of boreholes, trenches/pits etc.
(iv) Drilling has been done with the spacing
- ≤ 50m.over the potential ore zones for manganese ore.
(v) Detail sampling and analysis has been done for cores recovered during drilling of bore holes.
(vi) Mineralogical study has been done.
(vii) Geo-statistical analysis of borehole data by considering the thickness of ore and waste encountered in boreholes, assay value etc has been done.

Feasibility Axis (F3):

(i) Geology: Detailed geological study, exploration, ore body modeling, mineralogical studies has been done.
(ii) Mining: Not done.
(iii) Environment: EIA studies and EMP has been done.
(iv) Processing: Not studied.
(v) Infrastructure and services and construction activities: Enclosed in the scheme.
(vi) Costing: Not estimated.
(vii) Marketing: Not estimated.
(viii) Economic viability: Mining of these resources is not economical at present.
(ix) Statutory provisions: Statutory provisions pertaining to mines are being strictly adhered.

Economic Axis (E3):-

(i) Detail exploration has been carried out.
(ii) Grades of ore established. It is below cutoff grade (i.e. 25% Mn).
(iii) Specific knowledge of forest and other land use data:
The forest area has been demarcated and Forest Diversion Proposal has been submitted. Present in diverted forest and non-forest area.

Indicated Mineral Resource (332):-

Geological Axis (G2): The following steps are involved for assessment:

(i) Geological mapping on 1:5000 scale has been done.
(ii) Detail topographic contouring has been done.
(iii) Detail geological map prepared showing topography, all geological features, location of boreholes, trenches/pits etc.
(iv) Drilling has been done with the spacing

- 100m to 50m.over the potential ore zones for manganese ore.

(v) Detail sampling and analysis has been done for cores recovered during drilling of bore holes.
(vi) Mineralogical study has been done.
(vii) Geo-statistical analysis of borehole data by considering the thickness of ore and waste encountered in boreholes, assay value etc has been done.

Feasibility Axis (F3):
(i) Geology: Detailed geological study, exploration, ore body modeling, mineralogical studies has been done.
(ii) Mining: Not done.
(iii) Environment: EIA studies and EMP has been done.
(iv) Processing: Not studied.
(v) Infrastructure and services and construction activities: Enclosed in the scheme.
(vi) Costing: Not estimated.
(vii) Marketing: Not estimated.
(viii) Economic viability: Mining of these resources is not economical at present.
(ix) Statutory provisions: Statutory provisions pertaining to mines are being strictly adhered.

Economic Axis (E3):-
(i) General exploration has been carried out.
(ii) Grades of ore established. It is below cutoff grade (i.e. 25% Mn).
(iii) Specific knowledge of forest and other land use data:
The forest area has been demarcated and Forest Diversion Proposal has been submitted. Present in diverted forest and non-forest area.

Inferred Mineral Resource (333):-

Geological Axis (G3): The following steps are involved for assessment:
(i) Geological mapping on 1:5000 scale has been done.
(ii) Detail topographic contouring has been done.
(iii) Detail geological map prepared showing topography, all geological features, location of boreholes, trenches/pits etc.
(iv) Drilling has been done with the spacing
- 200m to 100m.over the potential ore zones for manganese ore.

(v) Detail sampling and analysis has been done for cores recovered during drilling of bore holes.
(vi) Mineralogical study has been done.
(vii) Geo-statistical analysis of borehole data by considering the thickness of ore and waste encountered in boreholes, assay value etc has been done.

Feasibility Axis (F3):

(i) Geology: Detailed geological study, exploration, ore body modeling, mineralogical studies has been done.
(ii) Mining: Not done.
(iii) Environment: EIA studies and EMP has been done.
(iv) Processing: Not studied.
(v) Infrastructure and services and construction activities: Enclosed in the scheme.
(vi) Costing: Not estimated.
(vii) Marketing: Not estimated.
(viii) Economic viability: Mining of these resources is not economical at present.
(ix) Statutory provisions: Statutory provisions pertaining to mines are being strictly adhered.
(x)

Economic Axis (E3):-

(i) Prospecting has been carried out.
(ii) Grades of ore established. It is below cutoff grade (i.e. 25% Mn).
(iii) Specific knowledge of forest and other land use data:
The forest area has been demarcated and Forest Diversion Proposal has been submitted. Present in diverted forest and non-forest area.

Iron Ore (+58% Fe) and Subgrade (+45-58% Fe):-

Measured Mineral Resource (331):-

Geological Axis (G1): The following steps are involved for assessment:

(i) Geological mapping on 1:5000 and 1:1000 scale has been done.
(ii) Detail topographic contouring has been done.
(iii) Detail geological map prepared showing topography, all geological features, location of boreholes, trenches/pits etc.
(iv) Drilling has been done with the spacing
- 100m to 50m interval for ore zones with iron ore.
(v) Detail sampling and analysis has been done for cores recovered during drilling of bore holes.
(vi) Mineralogical study has been done.
(vii) Geo-statistical analysis of borehole data by considering the thickness of ore and waste encountered in boreholes, assay value etc has been done.

Feasibility Axis (F3):

(i) Geology: Detailed geological study, exploration, ore body modeling, mineralogical studies has been done.
(ii) Mining: The iron ore is associated with manganese ore which occurs in lenses and pockets. The confidence level with respect to stripping ratio and recovery is extremely low to arrive at an accurate prediction

of the cost of mining.
(iii) Environment: EIA studies and EMP has been done.
(iv) Processing: Not studied.
(v) Infrastructure and services and construction activities: Enclosed in the scheme.
(vi) Costing: Not estimated.
(vii) Marketing: Not estimated.
(viii) Economic viability: Not done.
(ix) Statutory provisions: Statutory provisions pertaining to mines are being strictly adhered.

Economic Axis (E3):-
(i) Detail exploration has been carried out.
(ii) Grades of ore established.
(iii) Specific knowledge of forest and other land use data:
The forest area has been demarcated and Forest Diversion Proposal has been submitted. Present in diverted forest and non-forest area.

Indicated Mineral Resource (332):-
Geological Axis (G2): The following steps are involved for assessment:
(i) Geological mapping on 1:5000 scale has been done.
(ii) Detail topographic contouring has been done.
(iii) Detail geological map prepared showing topography, all geological features, location of boreholes, trenches/pits etc.
(iv) Drilling has been done with the spacing
- 200m to 100m interval for ore zones with iron ore.
(v) Detail sampling and analysis has been done for cores recovered during drilling of bore holes.
(vi) Mineralogical study has been done.
(vii) Geo-statistical analysis of borehole data by considering the thickness of ore and waste encountered in boreholes, assay value etc has been done.

Feasibility Axis (F3):
(i) Geology: Detailed geological study, exploration, ore body modeling, mineralogical studies has been done.
(ii) Mining: The iron ore is associated with manganese ore which occurs in lenses and pockets. The confidence level with respect to stripping ratio and recovery is extremely low to arrive at an accurate prediction of the cost of mining.
(iii) Environment: EIA studies and EMP has been done.
(iv) Processing: Not studied.
(v) Infrastructure and services and construction activities: Enclosed in the scheme.
(vi) Costing: Not estimated.
(vii) Marketing: Not estimated.

(viii) Economic viability: Not done.
(ix) Statutory provisions: Statutory provisions pertaining to mines are being strictly adhered.

Economic Axis (E3):-
(i) General exploration has been carried out.
(ii) Grades of ore established.
(iii) Specific knowledge of forest and other land use data:
The forest area has been demarcated and Forest Diversion Proposal has been submitted. Present in diverted forest and non-forest area.

Inferred Mineral Resource (333):-
Geological Axis (G3): The following steps are involved for assessment:
(i) Geological mapping on 1:5000 scale has been done.
(ii) Detail topographic contouring has been done.
(iii) Detail geological map prepared showing topography, all geological features, location of boreholes, trenches/pits etc.
(iv) Drilling has been done with the spacing
- 400m to 200m interval for ore zones with iron ore.
(v) Detail sampling and analysis has been done for cores recovered during drilling of bore holes.
(vi) Mineralogical study has been done.
(vii) Geo-statistical analysis of borehole data by considering the thickness of ore and waste encountered in boreholes, assay value etc has been done.

Feasibility Axis (F3):
(i) Geology: Detailed geological study, exploration, ore body modeling, mineralogical studies has been done.
(ii) Mining: Not done.
(iii) Environment: EIA studies and EMP has been done.
(iv) Processing: Not studied.
(v) Infrastructure and services and construction activities: Enclosed in the scheme.
(vi) Costing: Not estimated.
(vii) Marketing: Not estimated.
(viii) Economic viability: Not done.
(ix) Statutory provisions: Statutory provisions pertaining to mines are being strictly adhered.

Economic Axis (E3):-
(i) Prospecting has been carried out.
(ii) Grades of ore established.
(iii) Specific knowledge of forest and other land use data:
The forest area has been demarcated and Forest Diversion Proposal has been submitted. Present in diverted forest and non-forest area.

h) Detailed Calculation of Reserves/Resources Section Wise

The detailed calculation of reserves and resources for both Manganese and Iron Ore as per UNFC norms in different categories at Guruda Block A and B is furnished below in the Table No. 1.9:

Table No. 1.9

Manganese Ore (+25% Mn) Resources & Reserves as on 01-11-2014

Proved Mineral Reserve (111)

Guruda Block A

Section No.	Volume (m^3)	Density (tonnes/m^3)	Tonnage (tonnes)	Tonnage (mt)	Mn %	Fe %
11140	1292	2.5	3230	0.0032	31.11	18.15
11165	26	2.5	64	0.0001	31.37	18.00
11215	91	2.5	227	0.0002	32.97	20.31
11240	4134	2.5	10334	0.0103	30.48	21.76
11265	1723	2.5	4309	0.0043	28.14	23.77
11290	7255	2.5	18137	0.0181	38.84	13.98
11315	445	2.5	1113	0.0011	42.74	12.56
11365	306	2.5	766	0.0008	32.49	25.59
11390	9982	2.5	24955	0.0250	33.45	24.37
11415	18916	2.5	47289	0.0473	37.66	19.70
11440	60174	2.5	150436	0.1504	39.85	18.03
11465	51868	2.5	129670	0.1297	38.08	18.99
11490	32871	2.5	82178	0.0822	40.70	13.74
11515	8859	2.5	22146	0.0221	38.52	12.67
11540	23213	2.5	58033	0.0580	35.81	16.62
11565	22957	2.5	57393	0.0574	35.91	15.10
11590	6774	2.5	16936	0.0169	36.69	15.81
11615	2850	2.5	7125	0.0071	36.53	19.69
11640	5029	2.5	12572	0.0126	31.69	20.75
11665	4942	2.5	12355	0.0124	31.65	22.03
11690	5591	2.5	13977	0.0140	30.38	20.74
11725	273	2.5	682	0.0007	31.18	19.09
11750	69	2.5	172	0.0002	39.72	11.76
11775	188	2.5	469	0.0005	27.44	25.78
Total	269827	2.5	674566	0.675	37.57	17.63

Prefeasibility Mineral Resource (221 & 222)
Guruda Block A

Section No.	Volume (m^3)	Density (tonnes/m^3)	Tonnage (tonnes)	Tonnage (mt)	Mn %	Fe %
11365	9021	2.5	22553	0.0226	32.58	24.05
11390	48999	2.5	122498	0.1225	35.12	22.52
11415	55416	2.5	138539	0.1385	36.21	21.28
11440	26021	2.5	65053	0.0651	41.37	14.06
11465	1713	2.5	4281	0.0043	42.84	11.49
11490	3666	2.5	9166	0.0092	43.27	11.03
11515	199	2.5	498	0.0005	42.74	11.31
Total	145035	2.5	362588	0.363	36.81	20.19

Proved Mineral Reserve (111)
Guruda Block B

Section No.	Volume (m^3)	Density (tonnes/m^3)	Tonnage (tonnes)	Tonnage (mt)	Mn %	Fe %
10225	227	2.5	566	0.0006	29.87	24.72
10250	652	2.5	1631	0.0016	29.33	23.85
10275	935	2.5	2338	0.0023	35.79	20.38
10300	1318	2.5	3295	0.0033	29.52	17.38
10325	3470	2.5	8674	0.0087	33.95	17.44
10350	192	2.5	480	0.0005	30.22	22.76
10375	249	2.5	623	0.0006	30.92	19.23
10400	121	2.5	303	0.0003	34.59	17.22
10425	983	2.5	2457	0.0025	35.56	16.55
10450	642	2.5	1605	0.0016	35.25	20.41
10475	602	2.5	1506	0.0015	35.63	20.90
10500	327	2.5	816	0.0008	29.80	27.23
10525	88	2.5	219	0.0002	29.72	27.78
10550	293	2.5	732	0.0007	36.16	19.63
10575	40	2.5	100	0.0001	38.29	10.47
10600	863	2.5	2158	0.0022	29.58	27.81
10625	91	2.5	227	0.0002	33.31	23.84
10650	355	2.5	887	0.0009	33.77	19.81
10675	30	2.5	74	0.0001	32.58	21.28
10700	752	2.5	1881	0.0019	35.99	15.28
10725	1652	2.5	4131	0.0041	33.36	17.05
10750	87	2.5	217	0.0002	27.89	30.28
10825	295	2.5	736	0.0007	30.39	19.66
10850	1115	2.5	2787	0.0028	29.98	12.19
10875	6906	2.5	17266	0.0173	32.21	13.91
10900	7128	2.5	17820	0.0178	35.32	12.08

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10925	641	2.5	1602	0.0016	32.48	19.30
10950	4548	2.5	11369	0.0114	26.59	27.58
10975	620	2.5	1549	0.0015	26.58	27.80
Total	35220	2.5	88049	0.088	32.32	17.80

Probable Mineral Reserve (122)
Guruda Block B

Mn Outcrop	Area (m^2)	Width (m)	Volume (m^3)	Tonnage (tonnes)	Tonnage (mt)
I	106	5	530	1325	0.0013
II	162	5	810	2025	0.0020
Total	268	5	1340	3350	0.003

Prefeasibility Mineral Resource (221 & 222)
Guruda Block B

Section No.	Volume (m^3)	Density (tonnes/m^3)	Tonnage (tonnes)	Tonnage (mt)	Mn %	Fe %
10275	1226	2.5	3064	0.0031	30.23	20.60
10300	13523	2.5	33809	0.0338	36.28	14.02
10325	25082	2.5	62705	0.0627	34.11	18.17
10350	16073	2.5	40182	0.0402	32.76	23.11
10375	2903	2.5	7258	0.0073	42.50	13.45
10400	4902	2.5	12256	0.0123	35.72	16.59
10425	2360	2.5	5900	0.0059	34.20	18.48
10450	862	2.5	2154	0.0022	31.47	20.36
10475	256	2.5	641	0.0006	33.86	21.18
10500	1	2.5	2	0.0000	30.43	22.87
Total	67188	2.5	167971	0.168	34.60	18.29

Subgrade Manganese Ore (+10-25% Mn) Resources as on 01-11-2014
Measured Mineral Resource
(331)
Guruda Block A

Section No.	Volume (m^3)	Density (tonnes/m^3)	Tonnage (tonnes)	Tonnage (mt)	Mn %	Fe %
11115	1920	2.5	4799	0.0048	14.84	30.85
11140	19100	2.5	47750	0.0478	15.50	32.05
11165	27516	2.5	68789	0.0688	16.09	28.38
11190	42356	2.5	105891	0.1059	14.52	27.61
11215	25002	2.5	62504	0.0625	15.19	27.64
11240	43387	2.5	108467	0.1085	16.94	30.05

11265	63411	2.5	158527	0.1585	16.92	29.97
11290	90280	2.5	225699	0.2257	16.53	32.07
11315	33466	2.5	83664	0.0837	16.58	32.70
11340	9911	2.5	24777	0.0248	15.76	33.16
11365	16166	2.5	40414	0.0404	16.02	29.81
11390	10541	2.5	26354	0.0264	19.22	33.10
11415	7919	2.5	19797	0.0198	18.75	37.75
11440	22541	2.5	56354	0.0564	16.55	28.79
11465	29776	2.5	74439	0.0744	15.64	31.80
11490	63409	2.5	158521	0.1585	17.07	27.56
11515	46736	2.5	116840	0.1168	16.44	26.01
11540	40305	2.5	100762	0.1008	17.63	24.06
11565	40385	2.5	100963	0.1010	17.88	15.66
11590	13688	2.5	34219	0.0342	17.51	14.40
11615	3466	2.5	8666	0.0087	18.42	31.59
11640	5792	2.5	14480	0.0145	17.82	22.48
11665	15320	2.5	38299	0.0383	17.05	32.35
11690	10231	2.5	25578	0.0256	16.95	34.94
11725	1414	2.5	3535	0.0035	15.63	29.41
11750	2020	2.5	5051	0.0051	17.14	32.67
11775	4054	2.5	10135	0.0101	18.37	30.40
11800	110	2.5	275	0.0003	18.81	29.49
Total	690220	2.5	1725549	1.726	16.63	28.47

Indicated Mineral Resource (332)

Guruda Block A

Section No.	Volume (m^3)	Density (tonnes/m^3)	Tonnage (tonnes)	Tonnage (mt)	Mn %	Fe %
11115	348	2.5	869	0.0009	14.89	29.56
11240	797	2.5	1992	0.0020	19.73	22.21
11265	5230	2.5	13076	0.0131	18.37	29.34
11290	10700	2.5	26750	0.0268	17.38	33.99
11315	1525	2.5	3813	0.0038	17.87	30.40
11340	320	2.5	799	0.0008	17.51	27.58
11365	20	2.5	49	0.0000	23.62	33.02
11465	38	2.5	96	0.0001	11.40	46.05
11515	9	2.5	23	0.0000	11.78	44.74
11725	104	2.5	260	0.0003	17.58	37.47
11750	3868	2.5	9670	0.0097	16.74	34.35
11775	201	2.5	502	0.0005	17.58	37.47
11800	604	2.5	1510	0.0015	15.75	24.78
Total	23763	2.5	59408	0.059	17.52	32.08

Measured Mineral Resource
(331)
Guruda Block B

Section No.	Volume (m^3)	Density (tonnes/m^3)	Tonnage (tonnes)	Tonnage (mt)	Mn %	Fe %
10025	5	2.5	14	0.0000	12.21	36.59
10050	73	2.5	182	0.0002	12.17	36.69
10175	2537	2.5	6342	0.0063	15.95	21.04
10200	3763	2.5	9406	0.0094	17.25	21.52
10250	930	2.5	2324	0.0023	18.12	24.05
10275	10955	2.5	27387	0.0274	17.10	25.22
10300	12822	2.5	32055	0.0321	17.32	29.70
10325	15871	2.5	39678	0.0397	17.28	27.45
10350	13380	2.5	33451	0.0335	19.67	22.01
10375	8995	2.5	22488	0.0225	18.07	30.38
10400	17284	2.5	43209	0.0432	18.95	28.64
10425	25784	2.5	64461	0.0645	17.60	28.76
10450	9819	2.5	24547	0.0245	17.11	28.32
10475	51	2.5	127	0.0001	18.08	29.39
10500	2119	2.5	5297	0.0053	20.97	29.22
10525	1226	2.5	3064	0.0031	21.34	29.55
10550	668	2.5	1670	0.0017	19.11	26.70
10575	363	2.5	908	0.0009	16.77	17.30
10600	2002	2.5	5004	0.0050	23.04	31.04
10625	483	2.5	1207	0.0012	22.77	30.05
10650	6459	2.5	16148	0.0161	17.39	22.91
10675	2601	2.5	6502	0.0065	17.13	23.23
10700	1208	2.5	3020	0.0030	15.01	15.63
10725	3024	2.5	7561	0.0076	15.49	22.63
10750	2626	2.5	6564	0.0066	16.21	33.87
10775	214	2.5	535	0.0005	16.21	34.16
10825	3957	2.5	9893	0.0099	15.99	14.11
10850	22738	2.5	56846	0.0568	15.87	22.42
10875	22560	2.5	56400	0.0564	13.96	21.36
10900	3950	2.5	9875	0.0099	14.16	20.63
10925	4148	2.5	10369	0.0104	17.12	22.07
10950	10534	2.5	26336	0.0263	13.56	24.47
10975	1274	2.5	3186	0.0032	12.63	26.26
Total	214422	2.5	536055	0.536	16.89	25.37

Indicated Mineral Resource (332)
Guruda Block B

Section No.	Volume (m^3)	Density (tonnes/m^3)	Tonnage (tonnes)	Tonnage (mt)	Mn %	Fe %
10875	983	2.5	2457	0.0025	11.35	24.15
10900	134	2.5	336	0.0003	11.46	23.82
Total	1117	2.5	2793	0.003	11.36	24.11

Iron Ore (+58% Fe) Resources as on 01-11-2014
Measured Mineral Resource (331)
Guruda Block A

Section No.	Volume (m^3)	Density (tonnes/m^3)	Tonnage (tonnes)	Tonnage (mt)	Mn %	Fe %
11140	86	3.0	258	0.0003	4.89	59.70
11165	11105	3.0	33314	0.0333	4.89	59.49
11190	20284	3.0	60853	0.0609	4.76	59.74
11215	12385	3.0	37155	0.0372	4.02	59.43
11240	5411	3.0	16233	0.0162	2.63	59.43
11265	4852	3.0	14555	0.0146	3.40	58.83
11290	3870	3.0	11611	0.0116	3.02	58.71
11315	320	3.0	961	0.0010	0.74	58.77
11365	12042	3.0	36127	0.0361	1.32	60.68
11390	36198	3.0	108593	0.1086	1.16	61.05
11415	29298	3.0	87895	0.0879	1.19	60.71
11440	15495	3.0	46484	0.0465	0.71	58.84
11465	4105	3.0	12314	0.0123	1.97	58.70
11490	1208	3.0	3623	0.0036	2.09	58.79
11515	2146	3.0	6438	0.0064	1.04	61.78
11540	987	3.0	2960	0.0030	1.14	60.73
11615	1382	3.0	4146	0.0041	1.80	58.40
11640	470	3.0	1409	0.0014	1.80	58.40
11665	588	3.0	1765	0.0018	3.10	59.00
11690	195	3.0	586	0.0006	3.10	59.00
Total	162427	3.0	487280	0.487	2.26	60.07

Indicated Mineral Resource (332)
Guruda Block A

Section No.	Volume (m^3)	Density (tonnes/m^3)	Tonnage (tonnes)	Tonnage (mt)	Mn %	Fe %
11140	1648	3.0	4945	0.0049	5.40	59.43
11165	7714	3.0	23142	0.0231	5.45	59.38
11190	5075	3.0	15225	0.0152	5.42	59.39
11215	4026	3.0	12077	0.0121	5.02	59.28
11240	2220	3.0	6659	0.0067	3.44	58.72
11265	896	3.0	2688	0.0027	3.28	58.91
11290	8	3.0	23	0.0000	3.28	58.88
11340	6595	3.0	19786	0.0198	1.03	60.70
11365	10416	3.0	31247	0.0312	0.88	60.56
Total	38598	3.0	115793	0.116	3.25	59.87

Inferred Mineral Resource (333)
Guruda Block A

Section No.	Volume (m^3)	Density (tonnes/m^3)	Tonnage (tonnes)	Tonnage (mt)	Mn %	Fe %
11140	10	3.0	30	0.0000	5.71	59.33
11165	151	3.0	452	0.0005	5.69	59.23
11190	2925	3.0	8775	0.0088	5.48	59.36
11215	1688	3.0	5065	0.0051	5.38	59.44
11240	99	3.0	298	0.0003	3.28	58.88
11315	1445	3.0	4336	0.0043	0.51	60.65
11340	4438	3.0	13313	0.0133	0.70	60.70
Total	10756	3.0	32269	0.032	2.80	60.09

Measured Mineral Resource (331)
Guruda Block B

Section No.	Volume (m^3)	Density (tonnes/m^3)	Tonnage (tonnes)	Tonnage (mt)	Mn %	Fe %
10050	9603	3.0	28809	0.0288	0.15	59.59
10075	27648	3.0	82943	0.0829	0.15	59.79
10100	20444	3.0	61331	0.0613	0.14	59.42
10125	173	3.0	520	0.0005	0.07	58.76
10350	31	3.0	94	0.0001	3.26	58.43
Total	57899	3.0	173698	0.174	0.14	59.62

Subgrade Iron Ore (+45-58% Fe) Resources as on 01-11-2014

Measured Mineral Resource (331)

Guruda Block A

Section No.	Volume (m^3)	Density (tonnes/m^3)	Tonnage (tonnes)	Tonnage (mt)	Mn %	Fe %
11115	20	3.0	61	0.0001	4.55	56.05
11140	8935	3.0	26805	0.0268	5.40	54.70
11165	34784	3.0	104351	0.1044	5.60	53.34
11190	73431	3.0	220294	0.2203	5.65	51.44
11215	90180	3.0	270541	0.2705	4.71	51.82
11240	94990	3.0	284970	0.2850	4.07	51.20
11265	75344	3.0	226031	0.2260	3.99	51.04
11290	51627	3.0	154882	0.1549	3.94	50.71
11315	21817	3.0	65452	0.0655	3.51	50.25
11340	78	3.0	234	0.0002	1.52	49.58
11365	62582	3.0	187746	0.1877	1.77	53.81
11390	154760	3.0	464280	0.4643	1.87	53.81
11415	143519	3.0	430556	0.4306	1.47	53.11
11440	113587	3.0	340760	0.3408	1.42	51.66
11465	54555	3.0	163666	0.1637	2.71	52.18
11490	33098	3.0	99293	0.0993	3.70	52.45
11515	18017	3.0	54052	0.0541	4.01	52.22
11540	20179	3.0	60537	0.0605	3.92	52.44
11565	7234	3.0	21701	0.0217	4.05	52.13
11590	1338	3.0	4015	0.0040	2.30	46.00
11615	617	3.0	1852	0.0019	8.09	47.04
11640	1025	3.0	3075	0.0031	3.82	53.81
11665	891	3.0	2674	0.0027	5.17	53.54
11690	94	3.0	281	0.0003	7.56	53.76
Total	1062703	3.0	3188109	3.188	3.10	52.29

Indicated Mineral Resource (332)

Guruda Block A

Section No.	Volume (m^3)	Density (tonnes/m^3)	Tonnage (tonnes)	Tonnage (mt)	Mn %	Fe %
11140	1588	3.0	4765	0.0048	5.14	56.27
11165	12190	3.0	36570	0.0366	5.13	55.22
11190	14753	3.0	44259	0.0443	5.09	54.08
11215	17153	3.0	51459	0.0515	3.64	54.35
11240	24590	3.0	73770	0.0738	2.23	55.38

11265	10871	3.0	32613	0.0326	2.67	54.37
11290	1833	3.0	5498	0.0055	7.50	48.87
11315	3448	3.0	10343	0.0103	4.93	50.27
11340	9707	3.0	29121	0.0291	2.50	54.30
11365	40008	3.0	120023	0.1200	1.65	54.13
11465	262	3.0	785	0.0008	6.55	50.17
11490	1202	3.0	3607	0.0036	6.71	49.69
11515	6321	3.0	18963	0.0190	6.79	49.38
11540	3244	3.0	9731	0.0097	5.28	50.52
11565	112	3.0	335	0.0003	2.38	52.49
11800	1105	3.0	3316	0.0033	1.21	50.12
11825	30	3.0	89	0.0001	1.21	50.13
11850	1938	3.0	5813	0.0058	0.40	49.28
Total	150354	3.0	451062	0.451	3.23	53.93

Inferred Mineral Resource (333)
Guruda Block A

Section No.	Volume (m^3)	Density (tonnes/m^3)	Tonnage (tonnes)	Tonnage (mt)	Mn %	Fe %
11165	109	3.0	328	0.0003	5.42	56.50
11190	4088	3.0	12263	0.0123	5.01	55.99
11215	2321	3.0	6963	0.0070	4.25	55.15
11240	1898	3.0	5693	0.0057	2.61	55.22
11265	3	3.0	9	0.0000	3.18	55.57
11315	1910	3.0	5730	0.0057	0.33	56.12
11340	4192	3.0	12577	0.0126	0.50	56.22
Total	14521	3.0	43563	0.044	2.66	55.84

Measured Mineral Resource (331)
Guruda Block B

Section No.	Volume (m^3)	Density (tonnes/m^3)	Tonnage (tonnes)	Tonnage (mt)	Mn %	Fe %
10025	187	3.0	560	0.0006	1.39	49.40
10050	677	3.0	2030	0.0020	1.04	51.34
10075	4173	3.0	12520	0.0125	0.07	55.80
10100	12229	3.0	36687	0.0367	0.07	54.95
10125	14316	3.0	42947	0.0429	0.18	53.23
10150	4573	3.0	13718	0.0137	0.36	51.18
10300	6216	3.0	18649	0.0186	1.73	50.53
10325	15213	3.0	45640	0.0456	1.64	50.94

10350	9697	3.0	29091	0.0291	3.72	51.81
10375	17887	3.0	53660	0.0537	4.07	49.96
10400	2338	3.0	7015	0.0070	4.30	49.88
10425	63	3.0	188	0.0002	1.92	45.91
10450	785	3.0	2355	0.0024	1.92	45.91
10475	1006	3.0	3019	0.0030	5.85	52.90
10500	1339	3.0	4017	0.0040	5.85	53.97
10525	720	3.0	2161	0.0022	5.81	54.13
10675	963	3.0	2890	0.0029	3.20	54.33
10700	349	3.0	1048	0.0010	3.21	54.32
10750	1119	3.0	3356	0.0034	7.38	48.09
10775	39	3.0	117	0.0001	7.40	48.15
Total	93889	3.0	281667	0.282	2.06	51.94

i) Mineral Reserves/Resources:

Mineral Resources: (Mineral resources may be estimated purely based due to exploration, re-estimation and re-categorization as per UNFC norms of resources, with reference to the threshold value of minerals declared by IBM).

Table 1.10a
Mineral Resource as on 1.11.2014: Manganese Ore

Level of Exploration	Resources in million tons			Grade
	Guruda A	Guruda B	Total	
G1 - Detailed exploration	1.034	0.256	**1.290**	Mn > 25%
G2 - General Exploration	0.004	0.003	**0.007**	
G3 – Prospecting	0	0	**0**	
G4- Reconnaissance	0	0	**0**	
Total	**1.038**	**0.259**	**1.297**	

Table 1.10b
Mineral Resource as on 1.11.2014: Subgrade Manganese Ore

Level of Exploration	Resources in million tons			Grade
	Guruda A	Guruda B	Total	
G1 - Detailed exploration	1.726	0.536	**2.262**	Mn 10 - 25%
G2 - General Exploration	0.059	0.003	**0.062**	
G3 – Prospecting	0	0	**0**	
G4- Reconnassance	0	0	**0**	
Total	**1.785**	**0.539**	**2.324**	

Table 1.10c
Mineral Resource as on 1.11.2014: Iron Ore

Level of Exploration	Resources in million tons			Grade
	Guruda A	Guruda B	Total	
G1 - Detailed exploration	0.49	0.17	**0.66**	Fe > 58%
G2 - General Exploration	0.12	0	**0.12**	
G3 – Prospecting	0.03	0	**0.03**	
G4- Reconnassance	0	0	**0**	
Total	**0.64**	**0.17**	**0.81**	

Table 1.10d
Mineral Resource as on 1.11.2014: Subgrade Iron Ore

Level of Exploration	Resources in million tons			Grade
	Guruda A	Guruda B	Total	
G1 - Detailed exploration	3.19	0.28	**3.47**	Fe 45 - 58%
G2 - General Exploration	0.45	0	**0.45**	
G3 – Prospecting	0.04	0	**0.04**	
G4- Reconnassance	0	0	**0**	
Total	**3.68**	**0.28**	**3.96**	

2.0 MINING

A. OPENCAST MINING :

Manganese mine operations are spread at Block A & B of Guruda Block of Tiringpahar Manganese Mine lease.

Overburden and ROM are being removed by using shovel-dumper combination. The benches are being planned with 6 - 8 m high with width of 8 – 10m. The haul road having width of 10 – 12m wit gradient of 1:16 has been assumed for designing of pits Blast holes for both overburden and ore are drilled by 100mm diameter crawler drills with 365cfm compressors.

The manganese ore deposits occur as small tabular lenses and irregular veins. In spite of lot of geological exploration already done the occurrence of manganese ore and its continuity is still very unpredictable. This plan has been prepared with a view to mine in areas having the highest potential of proved mineral reserve and having relatively large ore zones. This is done with a view to have concentrated workings in order to economize on the other resource requirements. However, there are many other small pockets of ore, where such detailed exploratory drilling may not have been viable and are therefore often ignored at the planning stage.

Considering the high demand of high-grade manganese ore, it will be necessary to open up many more production faces simultaneously. It is often very difficult to meet the production demand as per plan due to the sudden disappearance of the ore body in contradiction with the geological predictions. The availability of sufficient high-grade ore also varies with the geological predictions. Under the circumstances, it is sometimes necessary to resort to exploratory mining in new areas based on surface exposures or even where sufficient geological information is yet to be collected. Often such areas are worked for a very short span of time because of very low reserves.

BLASTING METHOD:

The purpose of the blasting is to induce a heaving effect so that, excavator can load the blasted material easily into dumpers. The requirement of blasting is mainly to break the hard in-situ patches which otherwise cannot be removed. The blasting is carried out with large diameter (83mm) slurry explosive cartridges. Cap-sensitive slurry explosive cartridges are being used as base charge and non-cap sensitive are used as column charge.

The blasting will therefore be scattered in the quarry. The details of burden, spacing and explosive consumption pattern are mentioned below,

Depth of the hole	= 8m (bench height) + 10% as sub grade drilling)
	= 8.8 m (max)
Spacing	= 3m
Burden	=2.5m
Volume/ hole (in-situ)	= 60 CuM
Specific Gravity	= 2.5
Tonnage/ Hole	= 150 Tonnes
Powder factor	= 6.0 Kg/Tonne

So, Quantity of explosive/hole = 25 Kg.

After charging with 250ms delay DTH & stemming of holes, connection is done with detonating fuse. Cord relay of 25 ms / 50 ms are used for delay in case of normal blasting (i.e. if there is no permanent structure within danger zone not belonging to owner or danger zone is free from intersection of public road etc.). Cord Relay of 25 ms / 50 ms is fixed between holes along the spacing as well as between rows. There after shot is fired electrically after taking clearance from guards posted to prevent un-authorized entry to mine.

In case of controlled blasting (i.e in close proximity to roads, hutments etc) bottom initiation pattern by using 250 ms delay Down To Hole (DTH) followed by connection of hole to hole with 17ms Trunk Line Delay (TLD). In case of multi row holes, 42 ms, 65 ms, 100 ms TLD are used for subsequent rows respectively.

The charge per delay in all cases is maintained within 66 Kg to minimize the ground vibration and noise caused due to blasting operation.

The explosives are brought from Joda West magazine. The explosives are brought in the working hours and blasting carried out. Blasting operation is / and to be carried out in different blocks at scattered day and time, so that same blasting crew can carry out operations in all the blocks.
Rock breaker may alternatively be used as and when required.

The details of explosives presently used are furnished below in the Table No. 3.6.

Table No. 3.6

Class 2	Aquadyne 83mm	M/s. IDL Chemicals Ltd., Hyderabad
	Emulboost 25mm	M/s. IDL Chemicals Ltd., Hyderabad
	Energel 83mm	M/s. IDL Chemicals Ltd., Hyderabad
	Kelvex 83mm	M/s. Keltech Energies Ltd., Bangalore
	Kelvan 83mm	M/s. Keltech Energies Ltd., Bangalore
	Novadyne 25mm	M/s Navbharat Fuse Co.(P) Ltd., Rajpur (M.P.)
	Nova Prime 83mm	M/s Navbharat Fuse Co.(P) Ltd., Rajpur (M.P.)
	Nova Column 83mm	M/s Navbharat Fuse Co.(P) Ltd., Rajpur (M.P.)
	Superdyne 25mm	M/s. IDL Chemicals Ltd., Hyderabad
	Supergel 83mm	M/s. IDL Chemicals Ltd., Hyderabad
	Toeblast 83mm	M/s. IDL Chemicals Ltd., Hyderabad
Class 6	Safety Fuse	M/s. IDL Chemicals Ltd., Hyderabad
	Cord Relay	M/s. IDL Chemicals Ltd., Hyderabad
	D. Cord II	M/s. IDL Chemicals Ltd., Hyderabad
	Detonating Fuse	M/s. IDL Chemicals Ltd., Hyderabad
	Detonator	M/s. IDL Chemicals Ltd., Hyderabad
	Electric Detonator	M/s. IDL Chemicals Ltd., Hyderabad
	Raydet (Nonel)	M/s. IDL Chemicals Ltd., Hyderabad

Future Proposal: The site mixed emulsion (SME) will be used by replacing the usage of explosive with cartridge form after grant of permission and license as applicable. The blasting parameters for proposed SME usage commensuration the present parameters are given below in Table No. 3.7.

Table No. 3.7

Blasting Parameters	Existing (Cartridge form)	Proposed (SME)
Drill hole diameter[mm]	100	100
Bench height [m]	8	8
Burden[m]	2.75-3.0	2.75-3.0
Spacing[m]	2.75-3.0	2.75-3.0
Stemming[m]	3.0	3.0
Sub grade drilling[m]	0.4-0.6	0.4-0.6
Charge per hole[kg]	30-33	30-35
Booster[gm]	0	100

Further to the mentioned parameters, there may be scope to change the parameters considering the strata and field conditions.

Similarly, the blasted run-off mine ore is being hauled to sorting places located at the top of the quarry. The ROM is then dressed, sorted, sized and graded manually at sorting place. The piece-rated (Mazdoor/Reja) are deployed at different sorting places considering the average output per man

shift of 1.2 ton (Avg.) viewing the finished ore production required from the particular quarry / pit. For annual production of 85000 MT max. of manganese ore in 300 working days, about 236 piece-rated workers will be deployed for production of 283 MT/day. The different quality of finished ore are then loaded manually to the dumpers and transported to stacking ground for stacking the ore in regular geometrical shapes and samples are collected and analyzed at our laboratory. Then removal permission is obtained from Mining & Geology Department of State Government after stack verification.

Thereafter, the stacks are dispatched to designated place as mentioned in the ore removal permission obtained.

Miscellaneous operations in the mine includes leveling of dumping yard, preparation and maintenance of haul roads, dozing of boulders from the mine face, loading of trucks at stack yard etc.

The manganese ore deposits occur as small tabular lenses and irregular veins. In spite of lot of geological exploration already done the occurrence of manganese ore and its continuity is still very unpredictable. This plan has been prepared with a view to mine in areas having the highest potential of proved mineral reserve and having relatively large ore zones. This is done with a view to have concentrated workings in order to economize on the other resource requirements. However, there are many other small pockets of ore, where such detailed exploratory drilling may not have been viable and are therefore often ignored at the planning stage.

Considering the high demand of high-grade manganese ore, it will be necessary to open up many more production faces simultaneously. It is often very difficult to meet the production demand as per plan due to the sudden disappearance of the ore body in contradiction with the geological predictions. The availability of sufficient high-grade ore also varies with the geological predictions. Under the circumstances, it is sometimes necessary to resort to exploratory mining in new areas based on surface exposures or even where sufficient geological information is yet to be collected. Often such areas are worked for a very short span of time because of very low reserves.
Thus, while the development plans for major pits have been covered, the smaller ore zones that may be mined mostly as a contingency measure or as an exploratory mining activity has been indicated in the end of life / conceptual plan enclosed (MP/TMM/R3/13/14).

The present dimensions of the two major quarries is as follows:

Guruda Block-A Quarry:

pit slope	:	35 degrees
depth of pit	:	86.1 m
Length	:	523 m
Breadth	:	420 m

Guruda Block-B quarry:

pit slope	:	35 degrees
depth of pit	:	52 m
Length	:	500 m
Breadth	:	240 m

The present dimensions of the Subgrade Dump is as follows:

Guruda Block-A:

Dump slope	:	37 degrees
Height of the dump	:	12 m
Length	:	348 m
Breadth	:	80 m

Guruda Block-B:

Dump slope	:	37 degrees
Height of the dump	:	20 m
Length	:	125 m
Breadth	:	60 m

The present dimensions of the Mineral Reject Dump is as follows:

Guruda Block-A:

Dump slope	:	37 degrees
Height of the dump	:	6 m
Length	:	135 m
Breadth	:	130 m

Guruda Block-B:

Dump slope	:	37 degrees
Height of the dump	:	6.1 m
Length	:	170 m
Breadth	:	80 m

I. INSITU TENTATIVE EXCAVATION :

The development of the respective quarries has been proposed starting from the ultimate pit limit at the top that has been established from the geological sections. The overburden quantities that have to be removed in the respective quarries have been arrived at based on the stripping ratios. The quantities of overburden proposed to be removed year wise have been mentioned below. The manners in which the overburden will be generated during the next 5 years from the individual lease blocks is proposed to be dumped have also been mentioned below.

The yearly proposed excavation plans for the next 5 years for Guruda Block A and B are shown in drawing no's MP/TMM/R3/06A/14 & MP/TMM/R3/06B/14 respectively. The relevant sections are shown in drawing no.'s MP/TMM/R3/05/06.

The year-wise excavation plan for Guruda Block A and B is given in the Table no. 3.9.

The ROM shown in cum will be converted to tonnage by multiplying with average conversion factor of 2.5. The saleable ore will be considered as 85% (recovery) of the ROM ore. The grade-wise conversion factor for saleable ore is being determined pit wise with the consonance of Directorate of Mining & Geology, Govt. of Odisha. The generation of sub-grade mineral and mineral fines (-10 mm) / Rejects are around 10% and 5% of ROM production respectively.

Sub Grade Mineral: The Mn. content >10% & <25% in ROM of all size is considered as Sub Grade Mineral.

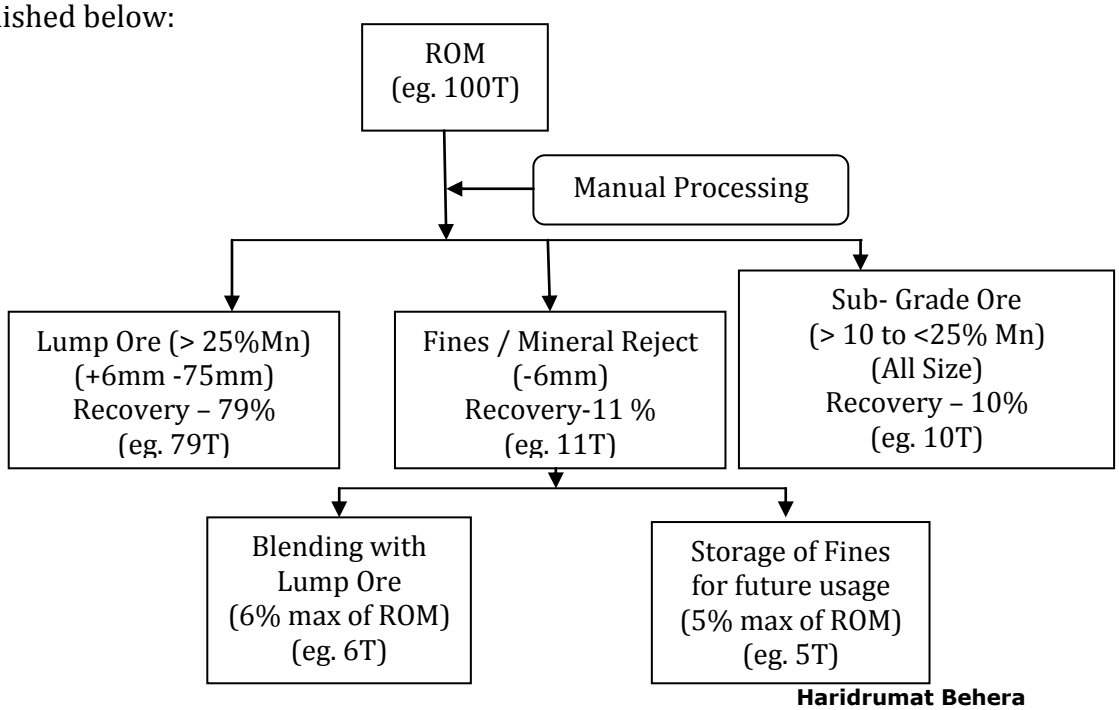
Mineral Fines: The fines generated during manual processing (dressing and sizing) of ROM (Size : < 6 mm) is considered as Mineral Fines. The mineral fines do not have a regular market throughout the year. It has got limited use and occasionally consumed by Ferro alloys making plants.

Table No. 3.9

Year	Pit	Total Tentative Excavation (cum)	Top Soil (cum)	OB/~~SB/IB~~ (cum)	ROM (cum)		Mineral Reject (cum) (Fines)	ROM / Waste Ratio
					Ore (cum)	Mineral Reject (cum) (Sub Grade Ore + Fines)		
1	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***
2015-16	Guruda Block A	485000	590	454292	25600	4518	1506	1:15.1
2016-17		490000	1050	458832	25600	4518	1506	1:15.2
2017-18		507000	260	476622	25600	4518	1506	1:15.8
2018-19		218000	1140	186742	25600	4518	1506	1:6.2
2019-20		233000	1570	201312	25600	4518	1506	1:6.7
Total		1933000	4610	1777800	128000	22590	7530	1:11.8
2015-16	Guruda Block B	250000	740	239378	8400	1482	494	1:24.2
2016-17		220000	840	209278	8400	1482	494	1:21.2
2017-18		230000	2270	217848	8400	1482	494	1:22.0
2018-19		160000	1030	149088	8400	1482	494	1:15.1
2019-20		167000	1311	155807	8400	1482	494	1:15.8
Total		1027000	6191	971399	42000	7410	2470	1:19.7
2015-16	TOTAL	735000	1330	693670	34000	6000	2000	1:17.3
2016-17		710000	1890	668110	34000	6000	2000	1:16.7
2017-18		737000	2530	694470	34000	6000	2000	1:17.4
2018-19		378000	2170	335830	34000	6000	2000	1:8.4
2019-20		400000	2881	357119	34000	6000	2000	1:8.9
Total		2960000	10801	2749199	170000	30000	10000	1:13.7

*2019-20 indicates the period from 01.04.2019 to 29.02.2020

The typical material balance of ROM by manual processing of Manganese Ore is furnished below:



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This may be noted that, blending of 6% fines in lump ore stacks not only reduces the ROM consumption but also enhances mineral conservation.

Considering the conversion factor of 2.5 T/cum for ROM with 85% recovery (79% max of ROM as lump and 6% max of ROM as Fines), the saleable ore from different pits are furnished in Table No. 3.10 as given below.

Table No. 3.10

Year	Pit	ROM (cum)	ROM (Ton)	Saleable Ore (Ton)	Subgrade Ore (cum)	Mineral Reject (cum) (Fines)
1	***2***	***3=(Col 6+7 of Table 3.09)***	***4=2.5*Col 3***	***5= (0.79+0.06)* Col 4***	***6***	***7=Col 8 of Table 3.09***
2015-16	Guruda Block A	30118	75294	64000	3012	1506
2016-17		30118	75294	64000	3012	1506
2017-18		30118	75294	64000	3012	1506
2018-19		30118	75294	64000	3012	1506
2019-20		30118	75294	64000	3012	1506
Sub Total		150590	376470	320000	15060	7530
2015-16	Guruda Block B	9882	24706	21000	988	494
2016-17		9882	24706	21000	988	494
2017-18		9882	24706	21000	988	494
2018-19		9882	24706	21000	988	494
2019-20		9882	24706	21000	988	494
Sub Total		49410	123530	105000	4940	2470
2015-16	**TOTAL**	**40000**	**100000**	**85000**	**4000**	**2000**
2016-17		**40000**	**100000**	**85000**	**4000**	**2000**
2017-18		**40000**	**100000**	**85000**	**4000**	**2000**
2018-19		**40000**	**100000**	**85000**	**4000**	**2000**
2019-20		**40000**	**100000**	**85000**	**4000**	**2000**
Total		**200000**	**500000**	**425000**	**20000**	**10000**

*2019-20 indicates the period from 01.04.2019 to 29.02.2020

As mentioned in Table No. 1.6c and 1.6d under Para 1.0 (Geology and Exploration chapter) , the occurrence of Iron Ore is in Measured, Indicated and Inferred (331, 332 & 333) category. However, it is expected that while pits are developed for winning the manganese ore, excavation of Iron ore (+58% Fe) is also envisaged at Guruda – A in course of lateral development of mine benches. The year-wise tentative excavation of Iron ore (+58% Fe) is given below in Table No. 3.10(A). The Iron ore (+58% Fe) so excavated shall be stored separately at Mineral Storage Area for its future usage.

Table No. 3.10(A)

Year	Block	Iron Ore (CuM)	Density (T/m3)	Iron Ore (Tonnes)
2015-16	Guruda - A	1666	3	4998
2016-17		1666	3	4998
2017-18		3333	3	9999
2018-19		3333	3	9999
2019-20		3333	3	9999
Total		13331	3	39993

The year-wise and bench-wise excavation at Guruda Block A and B are given in Table No. 3.11 to 3.12 respectively.

Table No. 3.11
(Guruda Block A)

Year	Extent of Working	Level (mRL)		OB	Top Soil	ROM	Total Excavation
		From	To	(CuM)	(CuM)	(CuM)	(CuM)
2015-16	11329 N-11575 N & 11900 E-12091 E	621	629	47909	0	12118	60027
		629	637	71795	0	4000	75795
		637	645	80458	0	400	80858
		645	653	70863	0	0	70863
		653	661	48627	0	2000	50627
		661	669	48809	0	800	49609
		669	677	45398	581	0	45979
	11420N-11531N & 12175E-12283E	609	617	7507	0	8000	15507
		617	625	17792	0	2800	20592
		625	633	14414	0	0	14414
		633	641	720	9	0	729
	Total			454292	590	30118	485000
2016-17	11289 N-11606 N & 11889 E-12098 E	612	620	66441	0	8118	74559
		620	628	65385	0	0	65385
		628	636	58463	0	0	58463
		636	644	48365	0	0	48365
		644	652	40767	0	0	40767
		652	660	31876	0	0	31876
		660	668	24527	0	0	24527
		668	676	21846	575	0	22421
	11409 N-11560 N & 12175 E-12299 E	600	608	16839	0	20000	36839
		608	616	34406	0	2000	36406
		616	624	31892	0	0	31892

		624	632	18025	475	0	18500
		Total		458832	1050	30118	490000
2017-18	11346 N-11635 N & 12067 E-12224 E	573	581	12584	0	3200	15784
		581	589	38740	0	12118	50858
		589	597	70001	0	14800	84801
		597	605	107310	0	0	107310
		605	613	94787	0	0	94787
		613	621	67565	0	0	67565
		621	629	40738	0	0	40738
		629	637	17399	0	0	17399
		637	645	20938	0	0	20938
		645	653	4820	0	0	4820
		653	661	1740	253	0	1993
		661	669	0	7	0	7
		Total		476622	260	30118	507000
2018-19	11498 N-11626 N & 11645 E-11766 E	684	692	93914	0	16118	110032
		692	700	92828	1140	14000	107968
		Total		186742	1140	30118	218000
2019-20	11594 N-11734 N & 11716 E-11870 E	666	674	61449	0	8000	69449
		674	682	58715	0	22118	80833
		682	690	66846	0	0	66846
		690	698	14302	1570	0	15872
		Total		201312	1570	30118	233000

*2019-20 indicates the period from 01.04.2019 to 29.02.2020

Table No. 3.12
(Guruda Block B)

Year	Extent of Working	Level (mRL)		OB (CuM)	Top Soil (CuM)	ROM (CuM)	Total Excavation (CuM)
		From	To				
2015-16	10255N - 10518N & 10930E - 11080E	630	638	56154	0	691	56845
		638	646	55918	0	312	56230
		646	654	47310	0	3530	50840
		654	662	49641	0	5349	54990
		662	670	30355	740	0	31095
		Total		239378	740	9882	250000
2016-17	10449N - 10650N & 10896E - 11092E	620	628	14397	0	815	15212
		628	636	28400	0	1185	29585
		636	644	39470	0	4424	43894
		644	652	48530	0	3458	51988
		652	660	43875	0	0	43875
		660	668	34606	840	0	35446
		Total		209278	840	9882	220000
2017-18	10609N -	620	628	12266	0	654	12920

	10819N & 10910E - 11100E	628	636	21346	0	2084	23430
		636	644	32838	0	4120	36958
		644	652	45099	0	2544	47643
		652	660	57628	0	0	57628
		660	668	37541	0	0	37541
		668	673	2213	1787	0	4000
		Sub Total		208931	1787	9402	220120
	10316N - 10500N & 11588E - 11673E	620	626	4850	0	350	5200
		626	632	3470	0	130	3600
		632	637	597	483	0	1080
		Sub Total		8917	483	480	9880
		Total		217848	2270	9882	230000
2018-19	10798N - 10906N & 10915E - 11032E	636	644	13656	0	6926	20582
		644	652	47844	0	2476	50320
		652	660	78209	1009	0	79218
		Sub Total		139709	1009	9402	150120
	10328N - 10486N & 11600E - 11693E	616	622	4480	0	320	4800
		622	628	3240	0	160	3400
		628	630	1659	21	0	1680
		Sub Total		9379	21	480	9880
		Total		149088	1030	9882	160000
2019-20	10857N - 11012N & 10893E - 11010E	639	647	31089	0	8186	39275
		647	655	55089	0	1336	56425
		655	663	51805	0	0	51805
		663	671	11452	993	0	12445
		Sub Total		149435	993	9522	159950
	10341N - 10475N & 11613E - 11693E	612	618	2832	0	232	3064
		618	621	3540	318	128	3986
		Sub Total		6372	318	360	7050
		Total		155807	1311	9882	167000

*2019-20 indicates the period from 01.04.2019 to 29.02.2020

DEPLOYMENT OF MACHINERIES:-

Considering the average yearly excavation during next 5 years plan period as mentioned above in Table No. 3.9, the required fleet size has been calculated for Shovel, Dumper and Wagon Drill and given in the Table no. 3.13 to 3.15 respectively. The proposed fleet of ancillary equipment to be deployed is given in Table no. 3.16. The fleet shall be common to all the quarries of Tiringpahar Manganese leases.

Table No. 3.13 - (Shovel)

Deployment of Shovel						
Sl.No.	Description	UOM	Type of shovel		Calculation Details	Remarks
			PC 300	PC 200		
a	Bucket capacity of Shovel	CuM	2.1	0.9		
b	Formation		OB/Ore	OB/Ore		
c	Fill factor		0.96	0.96		
d	Swell factor		1.1	1.1		
e	Actual Quantity in one bucket	CuM	1.83	0.79	(a*c/d)	
f	Cycle time for one pass	Sec	30	30		
g	Dumper cap.(in situ)	CuM	9	7		
h	No .of Shovel pass required to fill one Dumper	nos.	5	9	g/e	
i	Spotting time for Dumper	Sec	60	60		
j	Loading time for one dumper	Min	3	5	(h*f+j)/60	
k	No .of Dumpers loaded per hour	nos.	17	11	60/j	
l	Shovel Loading capacity per hour	CuM/hr	156	77	k*g	
m	No. of working day per annum	nos.	300	300		
n	No of shifts per day	nos.	1	1		
0	Actual Working hours per shift	hrs	6	6		
p	Capacity/shovel/annum	CuM	281302	138563	l*m*n*o	
q	Yearly Excavation	CuM	487000	250000		Requirement for 2015-16 to 2017-18
r	Working fleet required	Nos.	2	2	q/p	
s	Availability	%	75	75		
t	Fleet required	nos.	2.31	2.41	t/s	
u	Recommended fleet	nos.	**3**	**3**		
q1	Yearly Excavation, CuM	CuM	233000	167000		Requirement for 2018-19 to 2019-20
r1	Working fleet required	nos.	1	2	q1/p	
s1	Availability	%	75%	75%		
t1	Fleet required	nos.	1.10	1.61	t1/s1	
u1	Recommended fleet	nos.	**2**	**2**		

Table No. 3.14 - (Dumper)

Sl.No.	Description	UOM	Type		Calculation Details	Remarks
a	Formation		OB/Ore	OB/Ore		
b	Dumper cap.(in situ), cum.	Cum	9	7		
c	Type of Shovel to be used	nos.	PC 300	PC 200		
d	Loading time for one dumper	min	3	5		
e	Lead distance one side	km	2	2		
f	Speed of dumper	km/hr	20	20		
g	Travel time	min	12	12	(2*e*60)/f	
h	Unloading time	min	1.5	1.5		
i	Total cycle time for one dumper	min	17	19	d+g+h	
j	Hourly hauling capacity of one dumper	cum/hr	33	23	(60/i)*b	
k	No. of day/annum	Nos.	300	300		
l	No of shifts/day	Nos.	1	1		
m	hrs/shift	hours	6	6		
n	No .of dumper required per shovel	Nos.	6	4	((i-d)/d)+1	
p	Working fleet	Nos.	17	11	No. Of shovel required *(n)	Requirement for 2015-16 to 2017-18
q	Availability	%	75%	75%		
r	Fleet required	nos.	22.0	14.8	(p/q)	
s	Recommended fleet	nos.	**22**	**15**		
p1	Working fleet	nos.	11	7	No. Of shovel required *(n)	Requirement for 2018-19 to 2019-20
q1	Availability	%	75%	75%		
r1	Fleet required	nos.	14.7	9.9	(p1/q1)	
s1	Recommended fleet	nos.	**15**	**10**		

Table No. 3.15 – (Wagon Drill)

Sl. No.	Description	UOM	Year		Calculation Details	Remarks
			2015-16, 2016-17 & 2017-18	2018-19 & 2019-20		
a	Yearly Excavation	Cum	737000	400000		
b	Formation		OB+Ore	OB+Ore		
c	Blasted material required	Cum	442200	240000	a*.60	Avg 60% Blasting considered
d	Drill hole diameter	mm	100	100		
e	Bench Height	m	8	8		
f	Spacing	m	3	3		
g	Burden	m	2.5	2.5		
h	Avg. Hole depth	m	8.8	8.8		10% subgrade drilling
i	Yield	Cum/m	6.8	6.8		
j	Drilling meterage required	m	64856	35200	c/i	
k	Hourly Drilling rate	m/hr	10	10		
l	Drill Hours required,hrs		6485.6	3520.0	j/k	
m	No. of days/annum	Nos.	300	300		
n	No of shifts/day	Nos.	1	1		
p	Hours/shift	Hours	6	6		
q	Meterage/Drill/Annum	m	18000	18000	k*m*n*p	
r	Working fleet	Nos.	4	2	f/l	
s	Availability (%)	%	75%	75%		
t	Required fleet size	Nos.	4.8	2.6	(r/s)	
u	Recommended fleet size	Nos.	**5**	**3**		

Table No. 3.16
(Ancillary Equipment)

EQUIPMENT	CAPACITY	FLEET
Dozer (BEML)	175 & 325 HP	2
Rock Breaker		1
Water Sprinkler	8000 litres	2
Explosive Van	10 tonnes	2
Jeeps		3
Flat Body Truck		1
Ambulance		1
Crane	3 tonnes	1

CONCEPTUAL MINING

The conceptual mining plan as far as the area of excavation of the pits are concerned remains the same as was envisaged in the approved mining plan and first review of mining plan and scheme of mining for Guruda Block – A and Block – B pits. However, considering the higher rate of high grade production desired from the mine in order to meet the needs of our Ferro Alloy Plant, Joda it is now necessary to develop the mines further in order to exploit the reserves from the deeper levels.

As mentioned in Section 2.0 of this scheme the production demand of high grade and medium grade ore will continue to be higher and will demand opening up of more number of production faces in order to meet the production, particularly for high-grade manganese ore. With the depleting reserve base and increased production demand it may no longer be possible to meet the entire production from the present two major working pits in Guruda Block-A & Block-B during the plan period. Hence it is apprehended that it may be necessary to exploit the other small occurrences. The deposits of manganese ore in this lease follows no regular pattern and the mine operation staff relies heavily on the experienced mining personnel who are able to often provide worthwhile additional clues to the patchy and tricky occurrences. Thus exploration activities are planned and carried out based on these field observations, yet it is extremely difficult to predict the evolving shape of the pits and to estimate the ore reserves for an accurate prediction of the life of the pits. An effort has been made to conceptualize the mining operation under such conditions for exploitation of the ore bodies. Mining of such small patchy occurrences have therefore been indicated to be taken up through exploratory mining.

In view of the mineral conservation and proper utilization of low grade manganese ore produced from the mine which amounts to around 35% of total production, Research and development initiatives have been taken up by R & D wing of Tata Steel to come up with a breakthrough beneficiation technique for enriching the low grade manganese ore. The progress in this direction is quite satisfactory and the results are very much promising. We hope to commission a beneficiation plant during FY'18 which will be a first of its kind in India for beneficiation of low grade unusable ore being produced from our mines

The deposits of manganese ore in the entire lease follows no regular pattern and the mine operation staff relies heavily on the experienced mining personnel who are able to often provide worthwhile additional clues to the patchy and tricky occurrences. Thus exploration activities are planned and carried out based on these field observations, yet it is extremely difficult to predict the evolving shape of the pits and to estimate the ore reserves for an accurate prediction of the life of the pits.

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An effort has been made to conceptualize the mining operation under such conditions for exploitation of the ore bodies. Mining of such small patchy occurrences have therefore been indicated to be taken up through exploratory mining.

Further, the Company with its on-going expansion of its Steel making capacities envisages to enhance the Ferro manganese production capacity at its exiting Ferro Alloys Plant at Joda from 0.0540 MTPA tom0.060 MTPA, installing new Silico manganese plant of 0.060 MTPA and one sinter plant of 0.050 MTPA within the existing plant at Joda. Further, company proposes to acquire one Silico manganese plant of 0.050 MTPA. The high grade and low grade manganese ore required for production of Ferro manganese and Silico manganese would be produced from all the manganese mines of the company including the Tiringpahar Manganese mines. In order to meet the higher quantity of raw material requirement, the low grade ores is likely to be beneficiated to meet the quality requirement (subject to economic viability of such beneficiation process) for which the present manual means of processing of manganese ore may be required to be mechanized. Further, company would also use the sintering route to make use of the low grade ore.

Exploration carried out along the common lease boundary of Tiringpahar & Joribar has revealed that manganese ore is continuing beyond the lease boundary (Figure-1). Substantial thickness (>20m) of ore has been encountered in some of these boreholes which cannot be excavated at present due to lease boundary constraints. Excavation of the same has been envisaged in the future after getting necessary statutory clearances.

Life of Mine: The reserves of manganese ore is about 0.766 million tons (+25% Manganese Ore) and the reserves and resources combined is 1.297 million tons (+25% Manganese Ore) total (please refer Table-1.6a in Part-A). At the proposed average rate of ROM excavation during the period 2015-16 to 2019-20 (i.e. around 0.1 MTPA), the anticipated life of mine is about a). 8 years (if only reserve figure is taken for calculation) and b). 13 years (if reserves and resources combined figure is taken for calculation). However, the life of mine may increase depending upon findings from future exploration program.

Land Use Pattern:

The detailed land use pattern of the Tiringpahar lease over an area of 169 ha. (applied area for renewal) at present, at the end of the planned period and at the conceptual end of life is furnished below in Table No. 3.17.

Table No. 3.17

Type of Use	As at Present (01.10.2014) (in ha.)					As at End of Scheme Period (in ha.)					End of Life (in ha.)				
	Forest			Non-Forest	Grand Total	Forest			Non-Forest	Grand Total	Forest			Non-Forest	Grand Total
	DLC	KF	Total			DLC	KF	Total			DLC	KF	Total		
Area Excavated	2.064	0	2.064	18.438	20.502	3.020	0	3.020	28.283	31.303	24.209	6.384	30.593	43.753	74.346
Storage of Top Soil	0	0	0	0	0	0	0	0.000	0	0	0	0	0	0	0
Waste Dump	8.846	1.538	10.384	9.396	19.78	18.669	1.700	20.369	21.075	41.444	25.366	2.04	27.406	41.189	68.595
Mineral Storage	3.09	0	3.09	6.231	9.321	3.59	0	3.590	6.731	10.321	2.844	0	2.844	7.594	10.438
Infrastructure (Workshop, Magazine etc)	0.278	0	0.278	0.022	0.300	0.378	0	0.378	0.022	0.400	1.202	0.047	1.249	1.747	2.996
Roads	0.055	0	0.055	2.481	2.536	0.572	0	0.572	2.481	3.053	1.2	0	1.2	2.758	3.958
Railways	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Greenbelt	0.377	0	0.377	2	2.377	0.377	0	0.377	2	2.377	0.52	0	0.52	0.48	1
Tailing Pond	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Effluent Treatment Plant	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mineral Separation Plant	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Township Area	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Others (to be specified)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Area that remains untouched(including Safety Zone, private land, ST land etc.)	43.812	8.854	52.666	61.518	114.184	31.916	8.692	40.608	39.494	80.102	3.181	1.921	5.102	2.565	7.667
Total	58.522	10.392	68.914	100.086	169	58.522	10.392	68.914	100.086	169	58.522	10.392	68.914	100.086	169

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It shall be noted that the provisions of the Odisha Scheduled Areas Transfer of Immovable property (by Scheduled Tribes) Regulation, 1956 (Odisha Regulation 2 of 1956) and the Forest (Conservation) Act, 1980 will be followed and for the time being the area concerned has been identified under the category of area to remain untouched. However, specific permission shall be obtained from appropriate authority for doing mining in future.

The ultimate pit limit has been conceptualized after considering all the borehole sections assuming a pit slope of 45 degrees as shown on schematic excavation / ultimate pit plan in Figure 4 & 5. The stripping ratio has accordingly been estimated based on total overburden and spoils that has to be removed to mine out the entire proved and probable mineral reserve, as mentioned below in section 6.1. The conceptual plan is given in drawing no MP/TMM/R3/13/14.

Considering the continued high production demand during the next 5 years it is proposed to mechanize the ore mining as well to the extent possible with 8 meter high benches .Development of the pit is proposed with 8 meter high benches in overburden and ore by shovel-dumper combination.
Due to the irregular nature and patchy occurrence of manganese, it is not feasible to calculate the pit limit for the individual deposits. However, an attempt has been made to design the ultimate pit limits for the ore bodies that have been already explored extensively in Block-A and Block-B.
In order to exploit the entire proved and probable reserves of Guruda working pits, the ultimate pit limit has been conceptualized as shown in drawing no. MP/TMM/R3/13/14.

The extents of the two major quarries at the end of life shall be as follows

Guruda Block-A Quarry:

Ultimate pit slope	:	45 degrees
Ultimate depth of pit	:	136 m
Top mRL	:	708
Bottom mRL	:	572
Length	:	740 m
Breadth	:	712 m
No. of benches	:	26

Guruda Block-B quarry:

Ultimate pit slope	:	45 degrees
Ultimate depth of pit	:	64 m
Top mRL	:	676
Bottom mRL	:	612
Length	:	820 m
Breadth	:	220 m
No. of benches	:	11

The above pit limits are subject to change with future exploration and proving of additional reserves.
The extents of the two dumps at the end of life shall be as follows

Guruda Block-A Dump:

Ultimate dump slope	:	28 to 37 degrees
Ultimate height of dump	:	100 m
Top mRL	:	708
Bottom mRL	:	608
Length	:	750 m
Breadth	:	515 m
No. of lifts	:	10

Guruda Block-B Dump:

Ultimate dump slope	:	28 to 30 degrees
Ultimate height of dump	:	60 m
Top mRL	:	690
Bottom mRL	:	630
Length	:	1180 m
Breadth	:	650 m
No. of lifts	:	6

As a part towards mechanization, crushing, screening and mechanical sorting (based on Radiometric X-Ray technology) unit is proposed to be commissioned during the scheme period for mechanizing the subsequent processing of the ROM. The plant shall have a capacity up to 100 TPH to crush the ROM to -75mm size. The screening shall be done at 10 mm size. The products of -75 +10mm shall be shifted to stack yard for preparation of stacks in geometrical shape. The fines (-10mm) shall be shifted to the mineral reject stacking area by using loader and dumpers. The waste generated if any shall be shifted to waste dumps.

The above unit shall be of dry process and the following environment protection measures shall be taken to control the air pollution:

- Enclosures shall be provided to trap the dust while crushing, screening and conveying.
- Water spray shall be provided at all transfer points.

To make use of low grade manganese ore for the production of Mn. alloys, it is envisaged to evaluate various available technologies and its techno-economic viability for beneficiation. It is proposed to take up pilot plant studies for assessing the feasibility of beneficiation of the low grade manganese ores.

Conceptual exploration

Exploration in the Tiringpahar leasehold area will be carried out in different phases. The main objective of the exploration program is to increase the resource base of manganese and iron ore and also to cover the total lease area by exploration at least up to inferred category stage of UNFC in the next five years.

For this, the exploration program has been categorized based on the status of land available for carrying out exploration. The broken forest and non-forest areas and the diverted (stage II approved) areas has been considered first for carrying out exploration. Subsequently, the forest areas will be taken up after getting necessary clearances.

The number of ore bodies to be explored in the mining lease is divided into Phase I, II, III etc. and Phase I will be the priority ore bodies for which exploration work will be planned.

The ore bodies of Phase II will not be taken up without completing ore bodies of Phase I. The Phase II is again divided in to Stages I, II, III etc, where Stage I will include random bore holes to locate ore bodies. In Stage II, a drilling pattern may be followed with wide spacing and the detailed exploration of the deposit / lenses / pockets as per existing practice may be taken up in a subsequent stage. Stage II or III can be done away with if stage I proves negative. Similarly, stage III can be dispensed with if Stage I is promising but Stage II is discouraging. In spite of such detailed geological investigation.

Most of the ore bodies show typically erratic behavior in the working quarries and no generalized rules can be framed.

Conceptual exploitation

The occurrence of the Manganese ore bodies along with the host rock formation as shown in Schematic geological plan (Figure-1) and Schematic geological section (Figure-2) indicates the degree of irregularity in shapes of various litho units both in horizontal and vertical directions. As such, based on the past experience, geological investigation and surface exposure of Manganese ore, conceptualized mining is generalized in Figure-3, 4 & 5.

The Lease Line E-F of Joribar Block coincides with the Lease Line H-I of Tiringpahar Mn. Mine (Guruda Block) which is under same management control. The common area of 158m also been conceptualized for exploitation after due clearance from Forest Department & DGMS for working in safety zone of both the mine. The common boundary has been generalized in Figure 6 & 7.

The method of Mining adopted at present shall be continued till end of life as conceptualized, if operated at the present capacity. Simultaneously, recovery of saleable ore from ROM, disposal of waste and subgrade ore shall be continued in same manner.

The fines (Mineral rejects) generated in the course of mining are approximately 5% of the ROM production and is stored separately for future use and has been conceptualized to be used completely. With the current reserve of about 0.766 Million Tons of Manganese Ore (+25% Mn), refer Table No. 1.6 (a), almost 0.0383 Million Tons of Mineral Reject has been conceptualized to be generated till the end of life of mine. Further to increase the recovery of residual lumps from the existing fines, screening will be done during dry season only. With the expansion at FAP, Joda with upcoming sinter plant of 0.050 MTPA, the fines shall be utilized through sintering route.

Conceptual reclamation

The Steel Company proposes to reclaim the mining pits and dumps by backfilling and afforestation when they are permanently abandoned. The afforestation of the dumps and mining benches will be done by following methods.

a) Method of pitting and planting.

i. The worked out mining benches will be reclaimed by making pits 0.3 m X0.3 m X0.3 m size 2m apart. The pits will then be filled with sweet earth, sand and cow-dung.
ii. Neem cake powder will be applied in the pit to protect the plants from white ants.

iii. Such ground preparation will be done before monsoon after which appropriate varieties of saplings will be planted during monsoon.

The method of pitting and planting has been explained in Figure - 8

b) Method of planting by contour trenching

This method is proposed for slopes wherein contour trenches are dug at 3m interval along the contour. The excavated earth is stacked on the edge of the trench on the lower slope side to arrest the water flow that comes due to rains and accumulates on the trenches and gradually seeps through the strata enabling the planted saplings to get water and nutrients regularly for healthy growth. The method has been shown in Figure - 9.

Manganese Ore Beneficiation:

At present, the manganese ore is being dressed, sorted, sized and graded manually at sorting yard. The process of mineral beneficiation of the low grade manganese ore is known since long. A beneficiation process flow sheet is in process to explore to upgrade these ores using high intensity magnetic separators and reduction roasting followed by low intensity magnetic separation. Beneficiation and agglomeration test is being carried out to demonstrate the beneficiation process flow sheet at R & D, Tata Steel, IIMT- Bhubaneswar and Mintek Laboratory of South Africa. High Intensity magnetic separation can upgrade the Mn ore up to usable for Silico manganese Production and detail test work on reduction roasting process is in progress to upgrade this resource, which can be used for Ferro manganese making. The progress in this direction is quite satisfactory and the results are very much promising. We hope to commission a beneficiation plant during FY'18 which will be a first of its kind in India for beneficiation of low grade unusable ore being produced from our mines

However, the economic viability of the process is under study in view of the high energy cost. Our company's R&D proposed to take up pilot plant studies for assessing the feasibility of beneficiation of the low grade manganese ores and fines.

FIGURE – 1

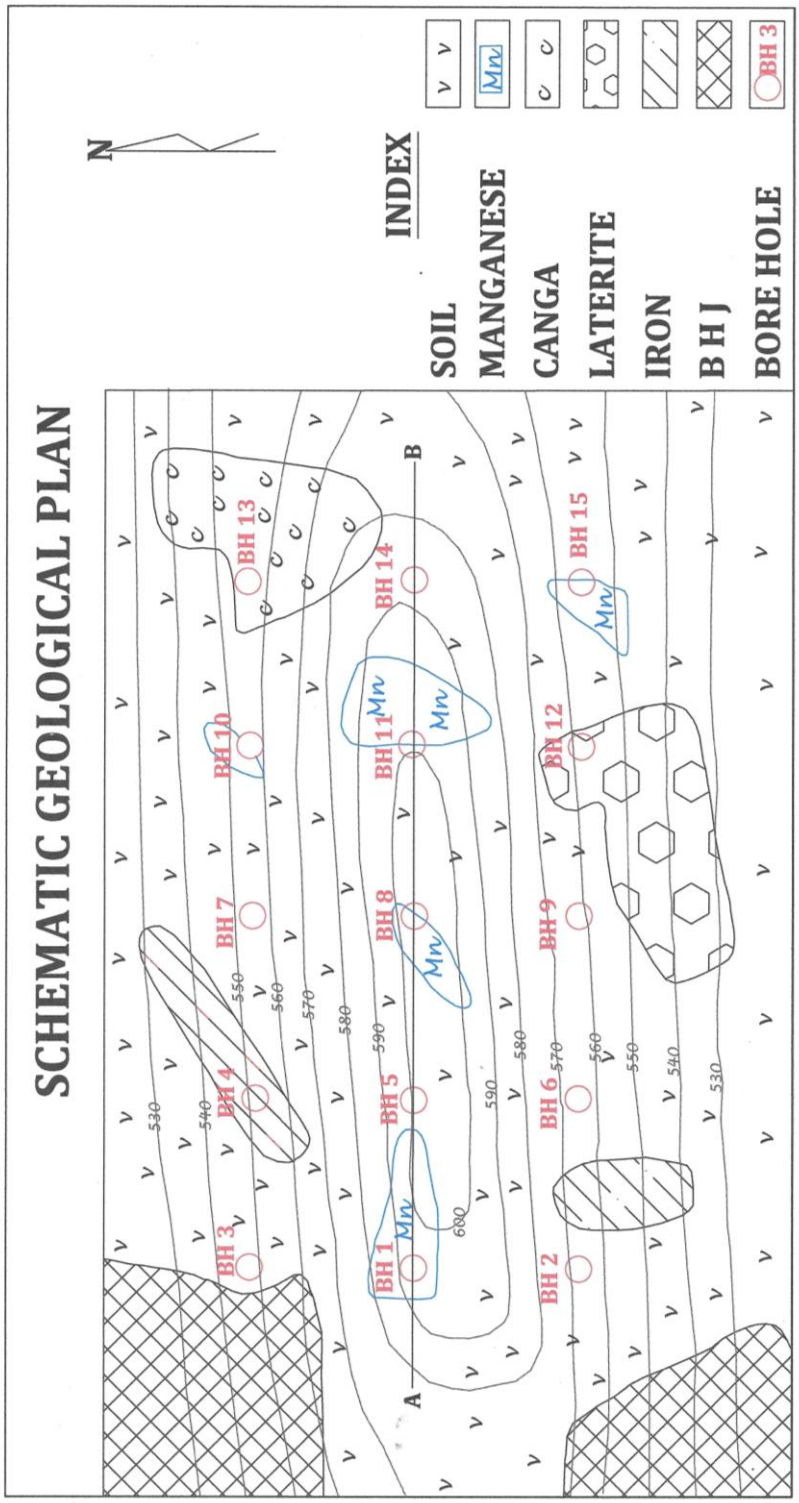

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FIGURE – 2

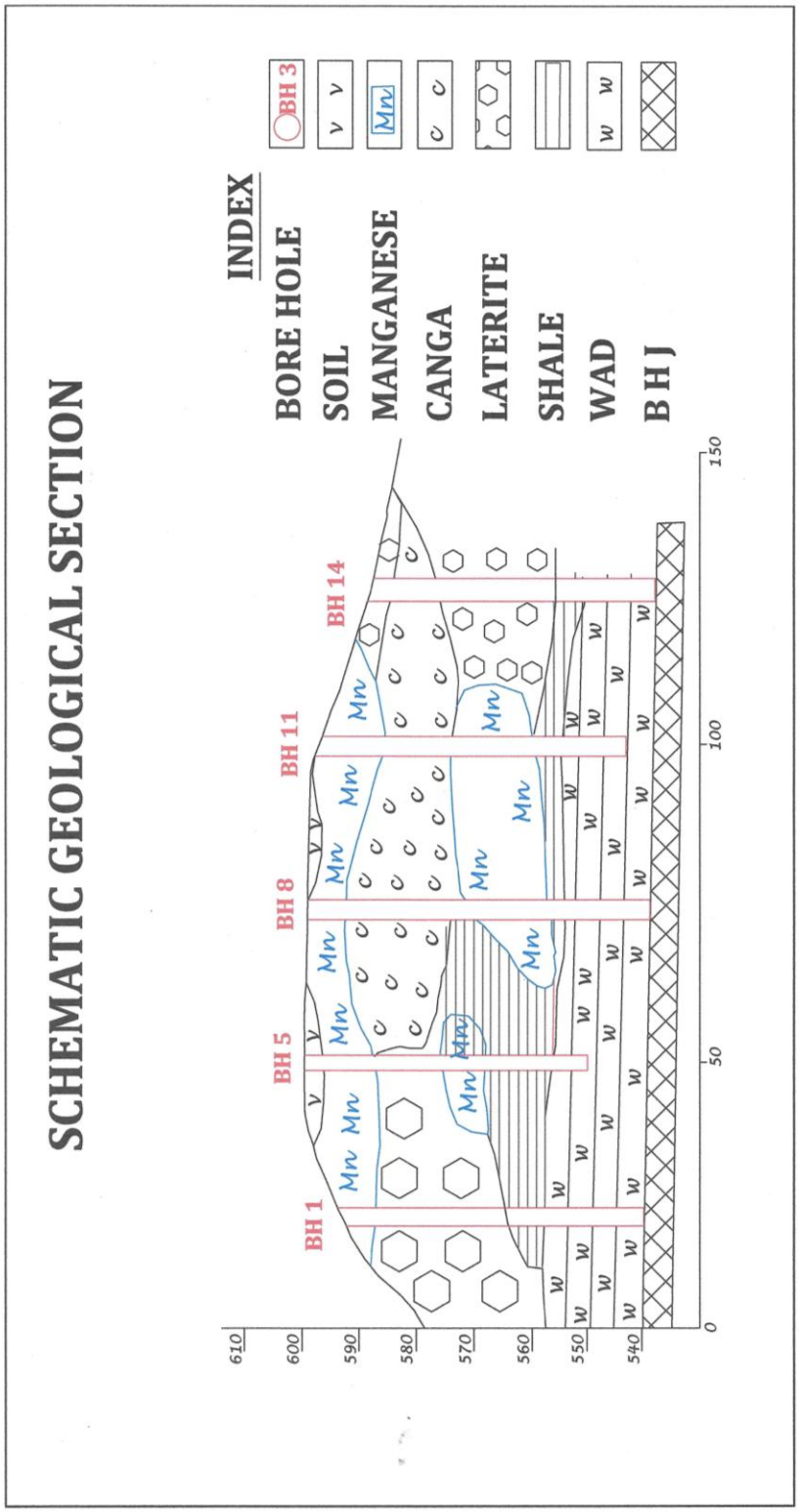

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FIGURE – 3

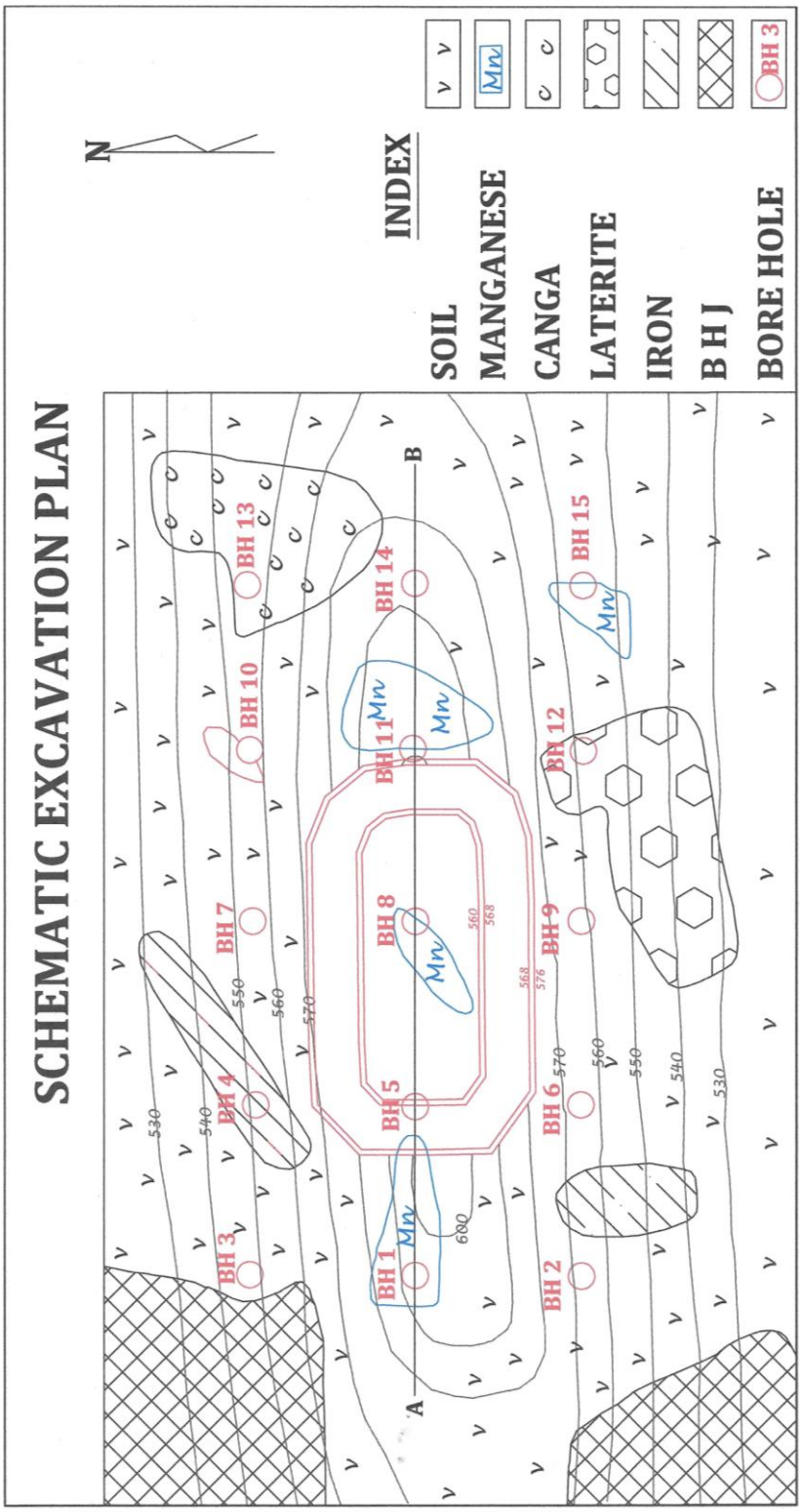

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FIGURE – 4

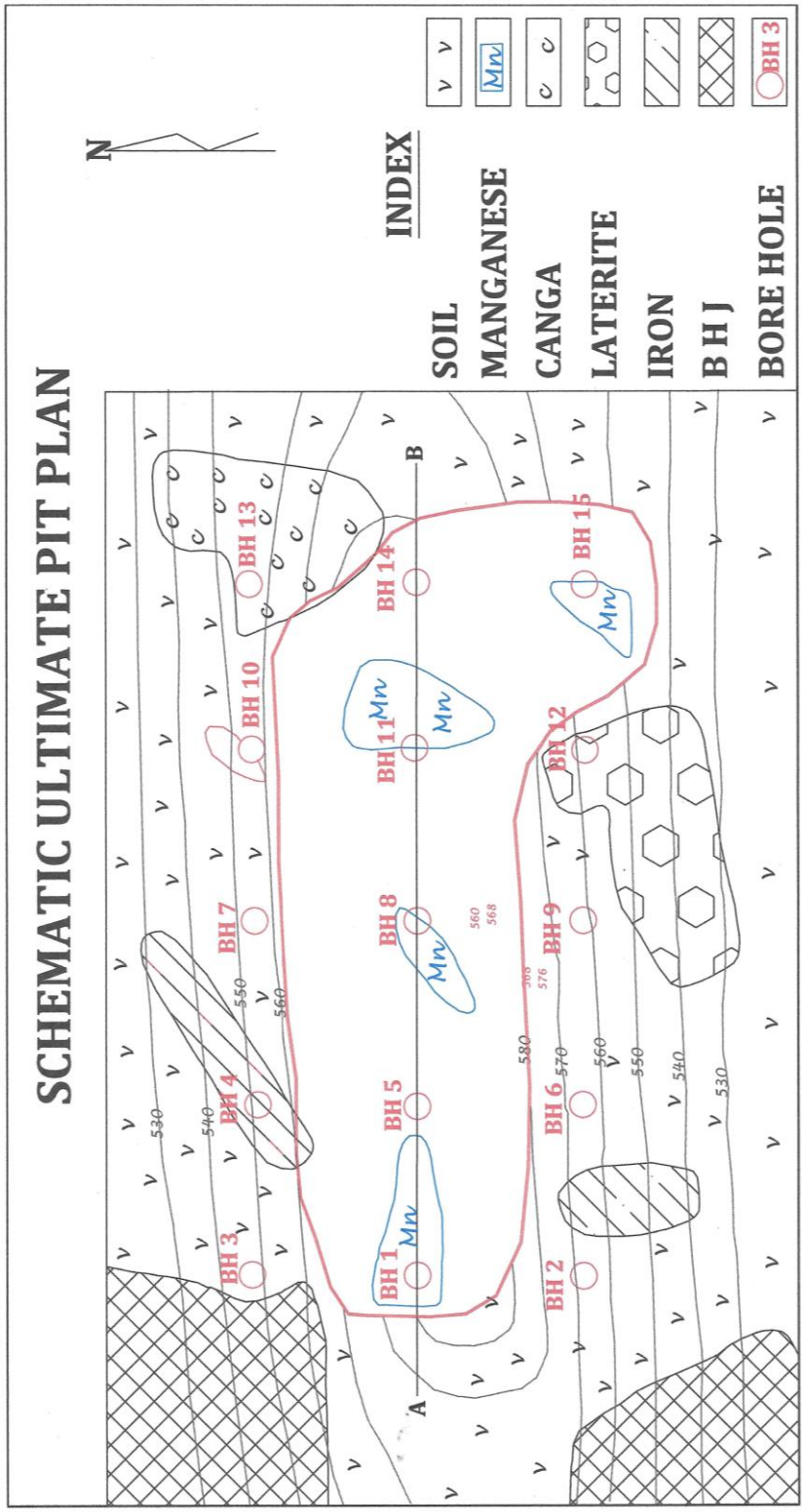

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FIGURE – 5

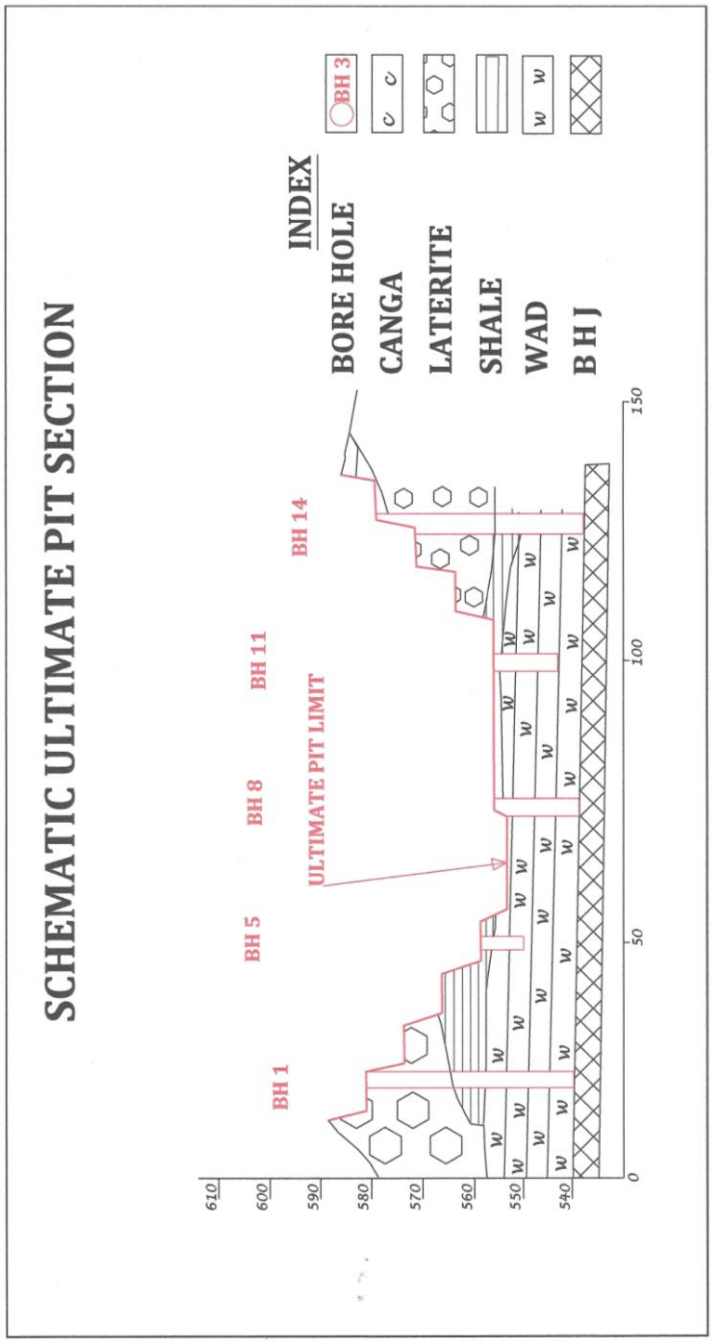
SCHEMATIC ULTIMATE PIT SECTION
INDEX
BORE HOLE
CANGA
LATERITE
SHALE
WAD
B H J
BH 3
BH 1
BH 5
BH 8
BH 11
BH 14
ULTIMATE PIT LIMIT
610
600
590
580
570
560
550
540
0
50
100
150

FIGURE – 6

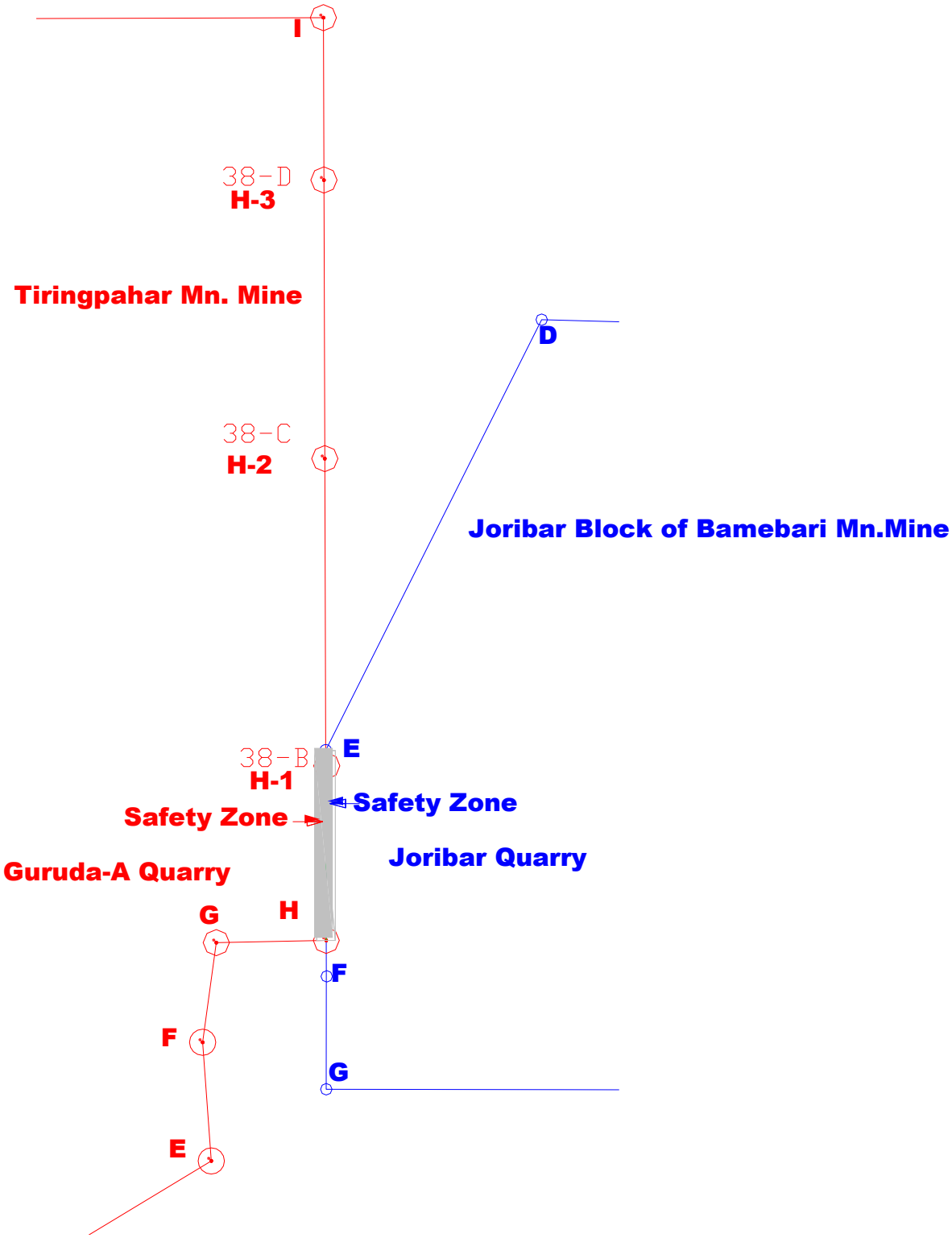

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FIGURE – 7

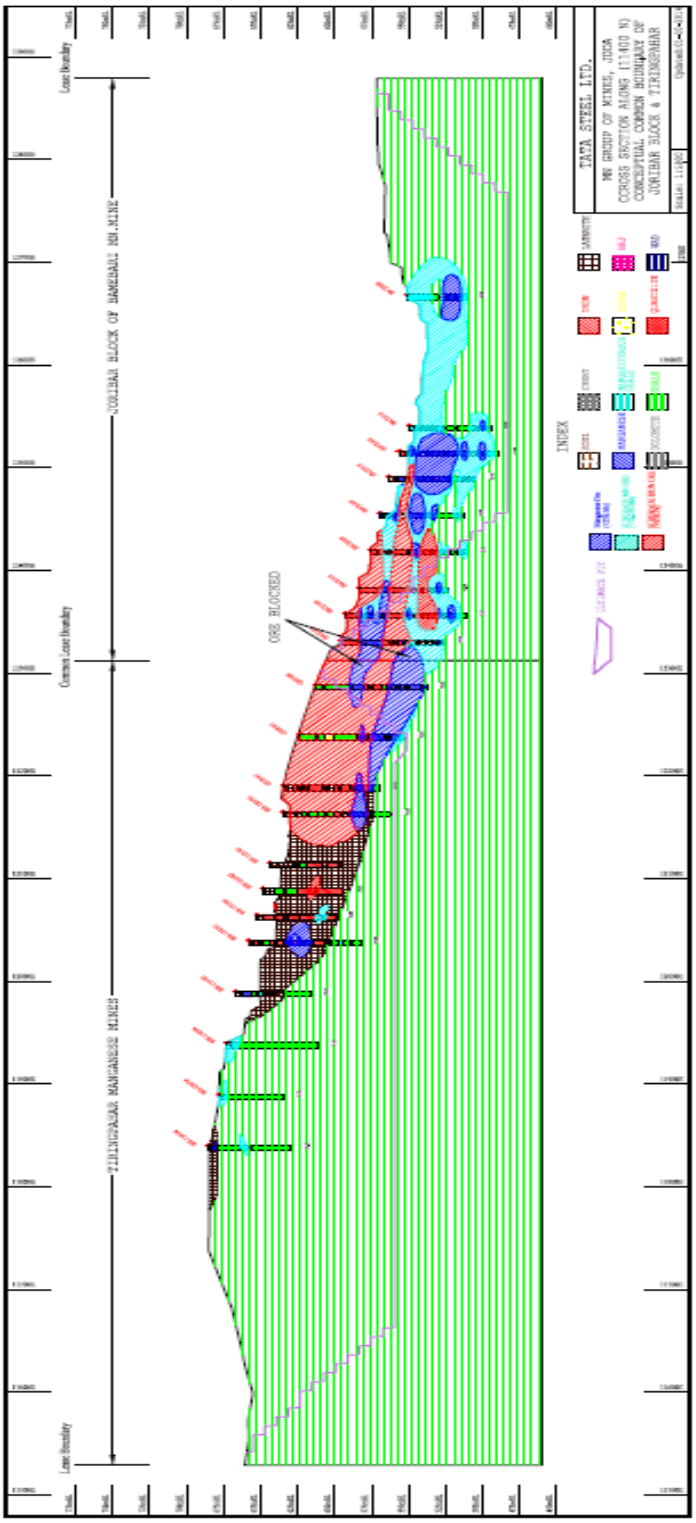

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FIGURE – 8

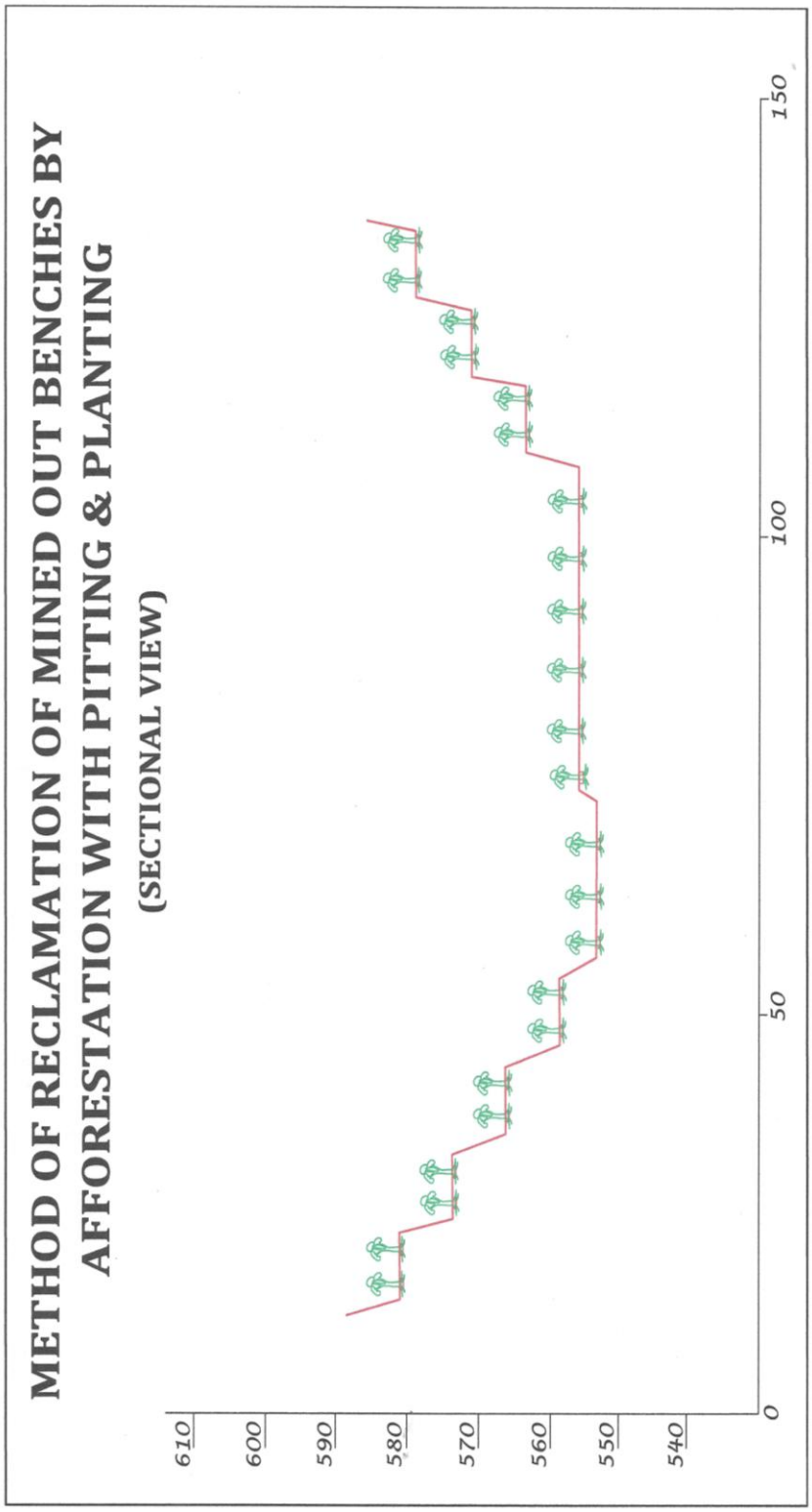

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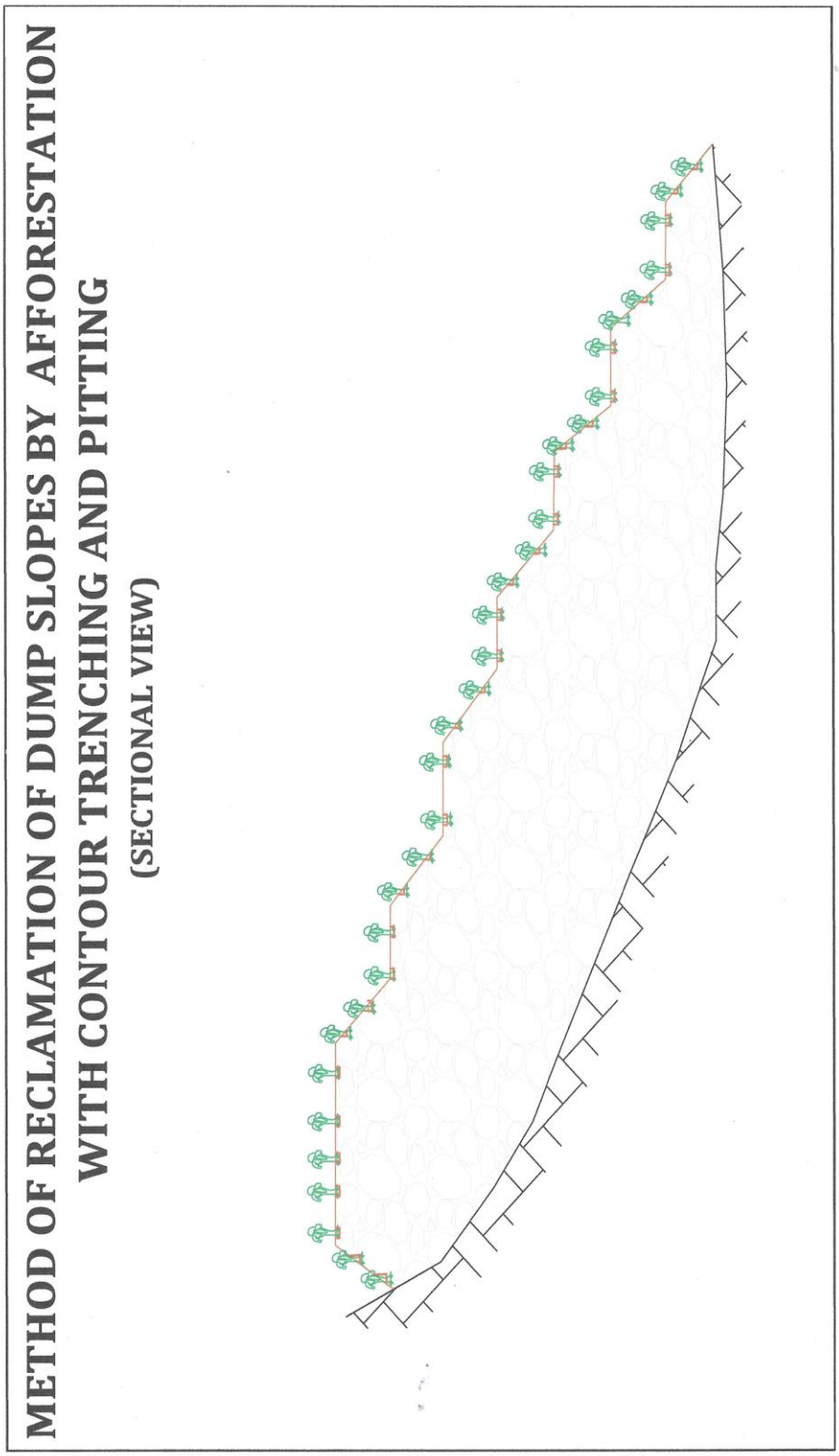
FIGURE – 9


METHOD OF RECLAMATION OF DUMP SLOPES BY AFFORESTATION
WITH CONTOUR TRENCHING AND PITTING
(SECTIONAL VIEW)

II. DUMP REHANDLING (FOR THE PRUPOSE OF RECOVERY OF MINERAL) :

No dump working for recovery of ore is envisaged during this plan period.

III. UNDERGROUND MINING : None

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3.0 MINE DRAINAGE

Regional Drainage: The natural drainage system is distinct due to hilly topography in most part of the study circle. Baitarani river flowing at a distance of about 4.5 km on eastern side of the Tiringpahar lease forms the major drainage system of the area. Kundra nala or Sona nadi originating little distance beyond the study circle on southern hilly region flows across the study circle from N to NE at a distance of about 6.6 km from the lease. Major part of the area has dendritic drainage pattern. The hill ranges are drained by seasonal nallahs in all directions. A few seasonal streams flow through the lease. High flood level of Baitarani river and Sona nadi is much below the mining lease.

Local Drainage: Core zone is mainly hilly terrain. The area is under hard rock formations. The rocks do not have primary porosity; only structural weaknesses like joints, fractures, folds, faults and weathering process provide secondary porosity for storing and transmitting water. The buffer zone is by and large occupied by iron ore series. The extent of weathering varies from a few centimeters in upland areas to several meters in villages. The structural weakness persists for couple of 100 meters locally along deep-seated lineaments. The ground water occurs under unconfined to semi-confined conditions. The area receives recharges mainly from precipitation and surface sources. Study area's subsurface and surface drainage is controlled by Baitarani river on east (approx. 4.5 km from lease) and Kundra nala on west (at 6.6 km from the lease). Depth of water table in the valley region as observed from wells varies from 5.76 m bgl during monsoon to 6.36 m bgl during summer.

Effect of Mining on Water Environment: Where surface mines are excavated into aquifer materials, they clearly remove part of the aquifer, which in itself may represent a loss of resource (e.g. increased evaporation from the post – mining pit-lake) or at least an increase in vulnerability for the surrounding aquifer resources (i.e. removal of the barrier to pollutants represented by the unsaturated zone). Besides these obvious impacts, most other effects of surface mines on natural hydrogeology are rather subtle. A "halo" of increased permeability (100 times greater than background values) can develop around open-pit walls, due to extensional fracturing induced by blasting and the reduction of lateral stresses. Indeed, permeability close to the void may be so high as to favour turbulent flow near the void, resulting in a near-pit water table which is much more steep than would be expected if groundwater flow remained strictly Darcian. This phenomenon has been extensively analyzed by Dudgeon (1985), and is also discussed by Younger et al. (2002). A further impact of pit lakes left behind after cessation of surface mining is that the water table tends to be steeper on the up-gradient side of the pit, and more gentle on the down-gradient side of the pit, than would be the case under natural conditions (Morgan-Jones et al., 1984). On the

other hand, although many pit lakes are in hydraulic continuity with the surrounding ground water, in some cases the blinding of the pit floor with fine-grained sediments can effctively "perch" water in the open-pit, with little or no interaction with the surrounding ground water system.

Changes in topography may result in storage of water in surface depressions, impoundments, or mine sumps. Unplanned detention in such areas can reduce mine productivity and encourage infiltration of polluted water into the ground water It is important to note that not all hydrologic effects of mining are negative. For example, excavated surface depressions and impoundments can serve as a beneficial water resource to an area and aid in ground water recharge. In some situations, the backfill material of a mining area can also act as an aquifer recharge zone (Wood 1981). Considering regional climatic conditions, average rainfall statistics (1000 to 1450 mm) and potential evapo-transpiration, the area has good ground water availability and high yield potential in general.

Observation : As there are hilly terrains in each block, to drain out the surface run-off water, a small sump is maintained at the lowest level of the quarry. Because the quantity is very small, the water gets automatically soaked into the ground. The spoil banks are in stages which helps to restrict the solids flowing thru' the water during rainy season. This prevents wash offs of solid along the slope. The run-offs water passing through the drain does not get contaminated by any dirt or soil except turbidity in rainy season. The water ultimately get discharged into small seasonal nallahs passing through the lease area.

The annual rain fall recorded at the mine site is furnished below in Table No. 3.18.

Table No. 3.18

Months	Year : 2010-11		Year : 2011-12		Year : 2012-13		Year : 2013-14	
	Rain Fall (mm)	Rainy Days	Rain Fall (mm)	Rainy Days	Rain Fall (mm)	Rainy Days	Rain Fall (mm)	Rainy Days
Apr	1.00	1	58.80	6	42.80	3	8.5	3
May	16.20	4	80.70	6	28.00	3	35.6	6
Jun	70.80	8	233.60	11	152.70	9	108.3	11
Jul	83.60	10	215.00	12	162.70	18	368.70	19
Aug	87.10	15	161.80	21	261.60	20	333.40	15
Sep	106.00	13	429.90	21	136.60	14	251.60	13
Oct	28.80	4	11.40	2	99.20	6	371.00	11
Nov	0.00	0	0.00	0	27.10	2	0.00	0
Dec	29.70	3	0.00	0	14.60	1	0.00	0
Jan	0.00	0	37.60	7	2.10	1	0.00	0
Feb	15.90	2	4.20	1	12.80	1	38.70	2
Mar	6.40	2	0.00	0	6.20	1	57.80	2
Total	445.50	62	1233.00	87	946.40	79	1573.60	82
Avg. Rain Fall (mm)/Year			1050					
Avg. Rainy Days / Year			78					

While carrying out the hydro-geological studies, test hole were drilled near the mine working up to at least 10% more than the ultimate pit depth, no ground water was intersected. The mining operation at Guruda Block consist of two parts, the southern part of the Block is Block B and the northern part of the Block is Block A, both are active and under operation. The maximum depth of the Block B Quarry is 57 m with top and bottom levels are 687 mRL and 630 mRL respectively. Similarly, the maximum depth at Block A Quarry is 86.1 m with top and bottom levels are 687 mRL and 630 mRL respectively. At end of the Scheme of Mining period (i.e 29.02.2020) the bottom level of both Block A and B would be 573 mRL and 620 mRL respectively, i.e. no further extension beyond existing ultimate pit depth. It was observed that, the level of ground water during winter was at 507.90 mRL and 510.60 mRL during post-monsoon. Hence, the Mine workings will not intersect groundwater table in the lease area and no requirement of pumping to evacuate water except accumulated surface run off caused due to heavy rain fall.

Considering the average rain fall and rainy days as mentioned in Table No. 3.18, the surface run off has been calculated for the entire lease over an area of 169 ha. and furnished in Table No. 3.19.

Table No. 3.19

(A) Mining Catchment Area (Sqm)=A	184950	Sqm	(Includes the area influenced due to active mining) (Excludes the Quarry, Colony, Workshop area & dumps)					
Avg Rain Fall (mm) [P]	Rain Fall (m3) [B]	Runoff Curve Number [CN]	Retention Parameter [S= (1000/CN)-10]	Initial Abstraction [Ia (mm)]	Total Surface Run off (mm) $Q = (P-Ia)^2/[(P-Ia)+S]$	Total Surface Run off (m3) [Q' = Q*A]	Infiltration (m3) [(X)= B*15%]	Initial Loss (m3) [Y = P*Ia]	Final Runoff (m3) [Z = Q'-X-Y]
1050	194198	76	3.16	4.5	1042	192783	29130	4725	158928
								Total Days of Rainfall	78
								(A) Average Surface Runoff from Other Area (KLD)	2038
(B) Dump Catchment Area (Sqm)=A	246600	Sqm	(Includes all OB Dump, Waste, Reject and Subgrade dumps)						
Rain Fall (mm) [P]	Rain Fall (m3) [B]	Runoff Curve Number [CN]	Retention Parameter [S= (1000/CN)-10]	Initial Abstraction [Ia (mm)]	Total Surface Run off (mm) $Q = (P-Ia)^2/[(P-Ia)+S]$	Total Surface Run off (m3) [Q' = Q*A]	Infiltration (m3) [(X)= B*15%]	Initial Loss (m3) [Y = P*Ia]	Final Runoff (m3) [Z = Q'-X-Y]
1050	258930	51	9.61	4.5	1036	255473	38840	4725	211908
								Total Days of Rainfall	78
								(B) Average Surface Runoff from Dump Area(KLD)	2717
								(A+B) Total Average Surface Runoff (KLD)	4754

Management of Surface Run off :

Trees and forests improve stream quality and watershed health primarily by decreasing the amount of storm water runoff and pollutants that reaches our local water bodies as well inlands. Trees and forests reduce storm water runoff by capturing and storing rainfall in the canopy and releasing water into the atmosphere through evapotranspiration. In addition, tree roots and leaf litter create soil conditions that promote the infiltration of rainwater into the soil.

The presence of trees also helps to slow down and temporarily store runoff, which further promotes infiltration, and decreases flooding and erosion downstream. Trees and forests reduce pollutants by taking up nutrients and other pollutants from soils and water through their roots, and by transforming pollutants into less harmful substances. In general, trees are most effective at reducing runoff from smaller, more frequent storms.

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In addition to these storm water benefits, trees provide a host of other benefits such as improved air quality, reduced air temperatures in summer, reduced heating and cooling costs, increased property values, habitat for wildlife, and recreation and aesthetic value.

In order to manage the surface run off effectively, the following steps are being undertaken;

a) Plantation in the vacant areas, colony area and inactive dump slopes to provide aesthetic value as well as ground stability.
b) Limitation of tree felling within the diverted forest land as per the requirement in line with approved proposals.

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

STACKING OF MINERAL REJECT / SUB GRADE MATERIAL :

As mentioned earlier, a small quantity of top soil will be generated while developing the virgin land and care shall be taken to excavate the top soil during end of summer season for its immediate usage for plantation during monsoon. Efforts shall be reserved for not to store the top soil more than three months so as to loss of its nutrients caused due to seasonal effects.

During manual sorting of ROM, generation of mineral reject and sub-grade material is visualized. Maximum 6% of mineral reject (fines) is blended with lump ore stacks to make it saleable and treated as undersize of the stack. Hence, this is included in saleable ore and balance is stored over the sorting yard for its future usage. Similarly the sub-grade ore generated from the sorting yard as well as from the mine as in-situ excavation are also stacked at identified place for its future usage.

Sub-grade ore had been defined as manganese ore having Manganese content of 10% to 25%. The threshold value of sub-grade mineral is kept at 10% Mn as recommended by IBM. The generation of sub-grade mineral as per estimates is around 10% of the total ROM. 5% of the ROM production is considered as fines (-10 mm.) meant for stacking for future usage is considered as mineral rejects (fines).

Sub-grade manganese ore having Mn. content of 10% to 25% generated in course of mining are stacked at different location and duly shown in the Surface Plan (Drawing No. MP/TMM/R3/03/14). The detail dimension of sub-grade dump is given below;

The quantum of top soil and mineral reject generation from the Guruda Block A and B is furnished below in Table No. 4.1.

Table No. 4.1

Year	Pit	Generation of Top Soil (cum)		Generation of Mineral Reject (cum)			
		Re-use/ Spreading	Storage	Backfilling	Storage	Blending	Beneficiation
2015-16	Guruda Block A	590	Nil	Nil	1506	1807	Nil
2016-17		1050	Nil	Nil	1506	1807	Nil
2017-18		260	Nil	Nil	1506	1807	Nil
2018-19		1140	Nil	Nil	1506	1807	Nil
2019-20		1570	Nil	Nil	1506	1807	Nil
Sub Total		4610	Nil	Nil	7530	9035	Nil
2015-16	Guruda Block B	740	Nil	Nil	494	593	Nil
2016-17		840	Nil	Nil	494	593	Nil
2017-18		2270	Nil	Nil	494	593	Nil
2018-19		1030	Nil	Nil	494	593	Nil
2019-20		1311	Nil	Nil	494	593	Nil
Sub Total		6191	Nil	Nil	2470	2965	Nil
2015-16	**Total**	**1330**	**Nil**	**Nil**	**2000**	**2400**	**Nil**
2016-17		**1890**	**Nil**	**Nil**	**2000**	**2400**	**Nil**
2017-18		**2530**	**Nil**	**Nil**	**2000**	**2400**	**Nil**
2018-19		**2170**	**Nil**	**Nil**	**2000**	**2400**	**Nil**
2019-20		**2881**	**Nil**	**Nil**	**2000**	**2400**	**Nil**
Total		**10801**	**Nil**	**Nil**	**10000**	**12000**	**Nil**

*2019-20 indicates the period from 01.04.2019 to 29.02.2020

The yearly generation of sub-grade ore from Guruda Block A and B of Tiringpahar Manganese Mines is furnished below in Table No. 4.2

Table No. 4.2

Year	Generation of Sub-Grade Ore (CuM)		
	Guruda Block - A	Guruda Block - B	Total
2015-16	3012	988	4000
2016-17	3012	988	4000
2017-18	3012	988	4000
2018-19	3012	988	4000
2019-20	3012	988	4000
Total	15060	4940	20000

*2019-20 indicates the period from 01.04.2019 to 29.02.2020

The sub-grade mineral and mineral rejects produced shall be stacked separately from the overburden and waste dumps.

The quantum of sub-grade mineral and mineral fines available in the existing stacks and its grade as on Oct'2014 are as given in Table 4.3 below.

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Table 4.3

Type of Ore	Sub-grade mineral	Mineral Rejects
Quantity, CuM	45919	19964
Mn, %	10-25%	<10%

As had been proposed in the earlier approved mining plan and schemes, the following precautions will be undertaken as;

a) Retaining Wall (stonewalls) of 1-1.2 m width, 1m height and garland drains of 1m width, 1m depth shall be provided around downhill of the stacks to arrest and guide any wash offs of the material dumped.
b) The edges of each terrace shall be inward slope to guide the rain water while preventing the formation of gullies.
c) The slope angle of the stacks shall be maintained by dozing and leveling at suitable intervals.

The present Sub-Grade Dump and Mineral Reject Dump dimension has been furnished in the Table No. 4.3 (a), and the yearly build-up of the Sub-Grade Dump and Mineral Reject Dump dimension has been furnished in the Table No. 4.3 (b) below:

Table No. 4.3 (a)

As on 01.10.2014							
Sl.No	Dump No.	Location	Length (m)	Width (m)	No.of Terrace	Top mRL	Bottom mRL
1	SG Dump	Guruda - A	348	80	1	675	663
2	Mineral Reject		135	130	1	664	658
3	SG Dump	Guruda - B	125	60	1	671	651
4	Mineral Reject		170	80	1	650	644

Table No. 4.3 (b)

Yearly Build up Proposal							
Sl.No	Dump No.	Location	Length (m)	Width (m)	No. of Terrace	Top mRL	Bottom mRL
2015-16	SG Dump	Guruda - A	348	80	2	625	609
	Mineral Reject		135	130	1	666	658
	SG Dump	Guruda - B	125	60	2	672	651
	Mineral Reject		170	80	1	652	644
2016-17	SG Dump	Guruda - A	350	80	2	634	625
	Mineral Reject		135	130	1	668	658
	SG Dump	Guruda - B	125	60	2	674	651
	Mineral Reject		170	80	1	654	644
2017-18	SG Dump	Guruda - A	350	80	2	645	634
	Mineral Reject		135	130	1	670	658
	SG Dump	Guruda - B	125	60	2	676	651
	Mineral Reject		170	80	1	656	644
2018-19	SG Dump	Guruda - A	350	80	3	665	645
	Mineral Reject		135	130	1	672	658
	SG Dump	Guruda - B	125	60	2	678	651
	Mineral Reject		170	80	1	658	644
2019-20	SG Dump	Guruda - A	350	80	4	676	665
	Mineral Reject		135	130	1	674	658
	SG Dump	Guruda - B	125	60	2	680	651
	Mineral Reject		170	80	1	660	644

*2019-20 indicates the period from 01.04.2019 to 29.02.2020

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DISPOSAL OF WASTE:

The yearly generation of overburden with the stripping ratio from the respective quarries has been based on the pit design corresponding to the yearly planned production given under Table No. 3.9 & 3.10, is given in Table No. 4.4 below.

The stripping ratio has been estimated based on total overburden and spoils that has to be removed to mine out the proved and probable mineral reserve during the scheme period. The stripping ratios for the Guruda Block A and B of Tiringpahar Manganese Mines are also given in Table 4.4 below.

Table 4.4

Year	Pit	Overburden (cum)	ROM (T)	Stripping Ratio (Cum of OB / T of ROM)
2015-16	Guruda Block A	454292	75294	6.03
2016-17		458832	75294	6.09
2017-18		476622	75294	6.33
2018-19		186742	75294	2.48
2019-20		201312	75294	2.67
Sub Total		1777800	376470	4.72
2015-16	Guruda Block B	239378	24706	9.69
2016-17		209278	24706	8.47
2017-18		217848	24706	8.82
2018-19		149088	24706	6.03
2019-20		155807	24706	6.31
Sub Total		971399	123530	7.86
2015-16	**Total**	**693670**	**100000**	**6.94**
2016-17		**668110**	**100000**	**6.68**
2017-18		**694470**	**100000**	**6.94**
2018-19		**335830**	**100000**	**3.36**
2019-20		**357119**	**100000**	**3.57**
Total		**2749199**	**500000**	**5.50**

*2019-20 indicates the period from 01.04.2019 to 29.02.2020

Present Dump Dimensions:

Guruda Block A:

Length : 452m (max)
Breadth : 315m (max)
Height : 52m (5 lift)
Area : 10.696 ha.

Guruda Block B:
Length : 746m (max)
Breadth : 151m (max)
Height : 48m (5 lift)
Area : 8.4 ha.

Buildup of Dumps

At Guruda Block A, seven numbers of Boreholes were drilled in the North-West part during the previous scheme period and found to be devoid of mineral (Borehole logs are enclosed as Annexure XI A). In the extreme northern side, no Borehole was proposed on account of dire valley, wherein placement of Borehole rigs is not possible. Hence the existing dump will be extended in the North-West direction while finishing the slopes at extreme northern side as shown in drawing No. MP/TMM/R3/07A/14. This dump will be having lifts of 10 m height during this plan period. The further holding capacity of this dump has been estimated to be increased by 17.8 lakh CuM which will be generated during the next five years after obtaining the necessary clearances. Out of this total quantity, 4.6 lakh CuM of Overburden will be used for backfilling of Northern side of Guruda A Quarry over 3 ha. area in the extent of 11615N – 11760N and 11865E – 12108E. As proposed for waste dump disposal, only the existing slope will be finally terraced towards valley side during the first year. The buildup of dumps during subsequent years shall be in isolation over the existing dump, while excluding adequate terrace width for effective distribution of load. Further the disposal shall be continued in a retreating manner to facilitate the compaction of floor while increasing the holding capacity of the dump. It may be noted that the dump height from the bottom of the valley to the proposed top mRL is 100m whereas, valley portion is 65 m and proposed waste dump over the super adjacent ground is 35m. The plan and section of the Guruda Block-A dump is enclosed as drawing no. MP/TMM/R3/07A/14.

At Guruda Block B, 18 numbers of Boreholes were drilled in the southern side during the previous scheme period and found to be devoid of mineral (Borehole logs are enclosed as Annexure XI A). In the Guruda Block-B quarry the existing waste dump lying east of the pit shall be further extended as shown in drawing no. MP/TMM/R3/7B/14. This dump will have lifts of 10 m height. The further holding capacity of this dump has been estimated to be increased by 9.8 lakh cum which will be generated during the next five years after obtaining the necessary clearances. The plan and section of the respective dump for Guruda Block-B quarry in the direction of advance have been enclosed as drawing no. MP/TMM/R3/7B/14. The position of existing dumps and position at end of planned period is given in the Table No. 4.5.1 to 4.5.3 below:

Table No. 4.5.1
Waste Dump Dimension & capacity

Status		Guruda Block A (D#1) Along Section A-A' and B-B'	Guruda Block B (D#2)	Back filling of portion of Guruda Block A Quarry by overburden.
Ref.Drg.		MP/TMM/R3/07A/14	MP/TMM/R3/07B/14	
Existing	Length	452 mtr.	746 mtr.	
	Breadth	315 mtr.	151 mtr.	
	Top Level	682 mRL.	683 mRL.	
	Bottom Level	630 mRL	635 mRL	
	Height	52 mtr.	48 mtr.	
	Terraces	5 lift of 10 mtr. max for each lift	5 lift of 10 mtr. max for each lift	
	Area	10.696 ha	9.084 ha	
	Capacity	19.5 lakh CuM	8.4 lakh CuM	
Yearly built-up	At end of 2015-16	Up to 688 mRL with (Lateral extension over existing terrace)	Up to 650 mRL with additional area with two lift of max. 10m high	
	At end of 2016-17	Up to 672 mRL with additional 4 Lifts (Lateral extension over existing terrace)	Up to 660 mRL with additional area with one lift of max. 10m height over existing terrace	Up to 710 mRL filling in existing opencast void
	At end of 2017-18		Up to 670 mRL with additional area with one lift of max. 10m high	

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	At end of 2018-19	Up to 710 mRL with additional 4 Lifts	Up to 680 mRL with additional area with one lift of max. 10m high	
	At end of 2019-20	Up to 706 mRL with additional 3 lift.	Up to 690 mRL with additional area with two lift of max. 10m high	

Status		Guruda block A	Guruda block B	Back filling of portion of Guruda Block A Quarry by overburden.
Ref.Drg.		MP/TMM/R3/07A/14	MO/TMM/R3/07B/14	
At the end of 5 years planned period	Length	742 mtr.	708 mtr.	270 mtr.
	Breadth	375 mtr.	311 mtr.	180 mtr.
	Proposed Top Level	708 mRL	690 mRL	710 mRL
	Proposed Bottom Level	608 mRL.	630 mRL.	636 mRL.
	Height	100 mtr.	60 mtr.	10m. Height with7 lift above the ground.
	Terrace	10 lift of 10 mtr. max for each lift	6 lift of 10 mtr. max for each lift	
	Max. Lift Height	10 mtr.	10 mtr.	10 mtr.
	Method of Dumping	Retreating method		Back filling
	Area	19.174 ha	19.27 ha	3 ha.
	Addl. Capacity	14.0 lakh CuM	9.8 lakh CuM	3.8 lakh CuM
	Total Capacity	33.5 lakh CuM	18.2 lakh CuM	3 lakh CuM
	Terrace Slope	37 Deg.	37 Deg.	37 Deg.
	Overall Slope	28 Deg.	28 Deg.	28 Deg.
	Remarks	This dump will cover the old dump	This dump will cover the old dump	

As had been proposed in the earlier approved mining plan and scheme garland drains and or bundhs (stonewalls) shall be provided around the dumps to arrest any wash offs of the material dumped. The slope angle of the dumps shall be maintained by dozing and leveling at suitable intervals. Concurrent reclamation of dumps will be done as per the practice mentioned.

The yearly buildup of dumps along the respective section lines of Drawing No. MP/TMM/R3/07A/14 and MP/TMM/R3/07B/14 is furnished below in Table No. 4.5.2:

Table No. 4.5.2

Status		Guruda Block A (D#1)	Guruda Block B (D#2)	Back filling of portion of Guruda Block A Quarry by overburden.
Ref.Drg.		MP/TMM/R3/07A/14 (Along Section A-A' and B-B')	MP/TMM/R3/07B/14 (Along Section A-A' and B-B')	
Yearly built-up	At end of 2015-16	In Section B-B' from 627 mRL to 675 mRL with (Lateral extension over existing terrace)	In Section A-A' from 635 mRL to 649 mRL with two lift of max. 10m high	
	At end of 2016-17	-	In Section A-A' from 649 mRL to 661.5 mRL with additional one lift of max. 10m height over existing terrace	In Section A-A' up to 670 mRL filling in existing opencast void
	At end of 2017-18	In Section A-A' from 670 mRL to 687 mRL with additional 2 Lifts (Lateral extension over existing terrace)	In Section A-A' from 661.5 mRL to 672.1 mRL with one lift of max. 10m high	
	At end of 2018-19	In Section A-A' from mRL 687 to 710 mRL with additional 3 Lifts	In Section A-A' from 672.1 mRL to 680 mRL with one lift of max. 10m high	
	At end of 2019-20	In Section B-B' from 675 to 695.7 mRL with additional 3 lift.	In Section A-A' from 680 mRL to 689 mRL with one lift of max. 10m high	

As had been proposed in the earlier approved mining plan and schemes, the following precautions will be undertaken as;

a) Retaining Wall (stonewalls) of 1-1.2 m width, 1m height and garland drains of 1m width, 1m depth shall be provided around downhill of the dumps to arrest and guide any wash offs of the material dumped.
b) The edges of each terrace shall be inward slope to guide the rain water while preventing the formation of gullies.
c) The slope angle of the dumps shall be maintained by dozing and leveling at suitable intervals.
d) Concurrent reclamation of dumps will be done by plantation over the inactive slopes. The amount of area likely to be degraded by way of dumping and proposed retreating method is given in Table No.4.6.

Table No. 4.6

Year	Nature of Dump	Area at beginning of the year (ha)	Additional area degraded during the year (ha)	Area to be rehabilitated during the year (ha)	Balance area at the end of year (ha)
2015-16	Overburden Dump	19.780	3.040	0	22.820
2016-17		22.820	6.560	5.457	23.923
2017-18		23.923	4.511	7.022	21.412
2018-19		21.412	5.676	5.438	21.650
2019-20		21.650	1.867	5.770	17.747
Total		19.780	3.040	0	22.820

*2019-20 indicates the period from 01.04.2019 to 29.02.2020

The Proposed yearly plantation programme (Table No. 4.7) and Toe wall-garland drain construction programme(Table No. 4.8) for next five years period is given below-

Table 4.7
Yearly Plantation programme

Year	Afforestation over inactive dump slope			Total	
	Location	Plan area (ha.)	No.of saplings	Area (ha)	No.of saplings
2015-16	Guruda - A	0	0	0	0
	Guruda - B	0	0		
2016-17	Guruda - A	2.752	6880	5.5	13643
	Guruda -B	2.705	6763		
2017-18	Guruda - A	4.16	10400	7.0	17555
	Guruda -B	2.862	7155		
2018-19	Guruda - A	3.14	7850	5.4	13595
	Guruda -B	2.298	5745		
2019-20	Guruda - A	3.7	9250	5.8	14425
	Guruda -B	2.07	5175		
Total		23.7	59218	23.7	59218

Table No.4.8
Construction of Toe Wall and Garland Drain

Year	Construction of Retaining Wall for Dump (m)	Construction of Garland Drain for Dump (m)	Breadth (m)	Height / Depth (m)
2015-16	550	550	1.2	1
2016-17	575	575		
2017-18	0	0		
2018-19	0	0		
2019-20	0	0		
Total	1125	1125		

While providing the garland drain, one no. setting pit having dimension of 3m Length x 3m Breadth x 1m Depth with check dam of 6m Length x 2m Width x 1m height will be provided to settle and arrest the suspended solids from the waste dump caused due to rain.

The year-wise area proposed to be taken up for afforestation and construction of protective measures has been duly shown in the environment management plan enclosed as drawing no. MP/TMM/R3/10/14.

5.0 USE OF MINERAL AND MINERAL REJECT

As mentioned in the approved scheme of mining, manganese ore is mostly being mined to cater to the requirements of its Steel Plant at Jamshedpur and Ferro Alloys Plant at Joda. The company was in the past purchasing certain amount of ore to meet its requirements at the Ferro Alloys Plant, Joda at a very high cost. This was mainly because of its inability to produce the required quantities of high grade ore with Mn:Fe ratio greater than 5.3:1.

With the enhanced production of high grade manganese ore as envisaged in this mining scheme it is hoped that the purchase of manganese ore shall be substantially reduced. In the course of producing higher grade manganese ore a surplus quantity of medium and low grade manganese ore shall be produced.

Now, Company intends to enhance High Carbon Ferro Manganese (HC Fe-Mn) production capacity from 0.0504 MTPA to 0.06 MTPA by design modifications in the existing 1x9 MVA furnace and with addition of 0.06 MTPA Si-Mn plant and 0.05 MTPA sinter plant at Joda, Keonjhar district, Odisha.

In this proposed scheme period, the pre requisite of EIA-EMP, Public Hearing, has been completed successfully on 12.11.2014 and the EIA-EMP approval is in process. Apart from this, company also proposes to acquire a Silico-Manganese plant of 0.050 MTPA capacity. This would help to utilise the medium grade, low grade and manganese ore fines generate during the mining operation.

The fines generated during the manual sorting process of different grade type having physical and chemical specification shall be utilized in the upcoming sinter plant followed by consuming it in the above mentioned plants.

Further, as mentioned in section 3 of this scheme of mining, some small quantities of iron ore is likely to be produced incidental to manganese ore production. This ore may be utilized in the company's Sponge Iron Plant at Joda.

CHANGES IN SPECIFICATIONS:

There is no change in the specifications of the manganese ore to be produced from the mine. However, the Ferro Alloys Plant, Joda presently requires an Mn:Fe ratio of 5.3:1 in the manganese ore as against its earlier requirement of Mn:Fe ratio of 4.8:1 as mentioned in the approved mining scheme. The specifications of ore required for Ferro manganese alloy production is as follows:

Mn.	Fe.	SiO2	Al2O3	P	Mn/Fe
46 -48%	8-9%	4.5-5%(Min.)	4%(Max.)	0.15%(Max.)	5-6

The specifications of ore required for Silico manganese alloy production is as follows:

Mn.	Fe.	SiO2	Al2O3	P	Mn/Fe
32 -40%	5-12%	10-15%(Min.)	2%(Max.)	0.15%(Max.)	2-8

Specification of ore produced:

Grade Type	Chemical Specification	Physical Spec.
Chemical Grade / Dioxide	Mn > 48 % & Fe < 4 %	+10 -75 mm, + 6 – 25 mm - 10 mm
High Grade	Mn > 46 %	+10 -75 mm, + 6 – 25 mm - 10 mm
Medium Grade	Mn > 35 % & Fe < 26 %	+10 -75 mm, + 6 – 25 mm - 10 mm
Low Grade	Mn > 25 % & Fe < 35 %	+10 -75 mm, + 6 – 25 mm -10 mm
Sub Grade Mineral	Mn >10% & < 25% &	All Size

The different grades of ore from all the quarries/mines of the Company are ultimately blended in the plant to meet the desired specification as mentioned above for production of Ferro manganese / other alloys. The typical chemical analysis of the above ore types analyzed at Company's Geological Laboratory is given in Table No. 5.1. This laboratory at Joda is recognized by the Directorate of Geology, Govt. of Odisha as well as NABL and letter in support of the same is enclosed as Annexure-XIA & XIB respectively.

Table No. 5.1
(Typical Chemical analysis)

	Grade	Chemical Analysis					Ratio	O/s%	U/s%
		Mn%	Fe%	SiO2%	Al2O3%	Phos%	Mn:Fe		
Tiringpahar	High	47.52	9.63	0.88	4.57	0.07	4.93	1.75	4.88
	Medium	36.54	18.87	1.64	6.17	0.07	1.94	1.92	4.76
	Low	28.84	26.63	2.29	6.21	0.08	1.08	2.01	4.55

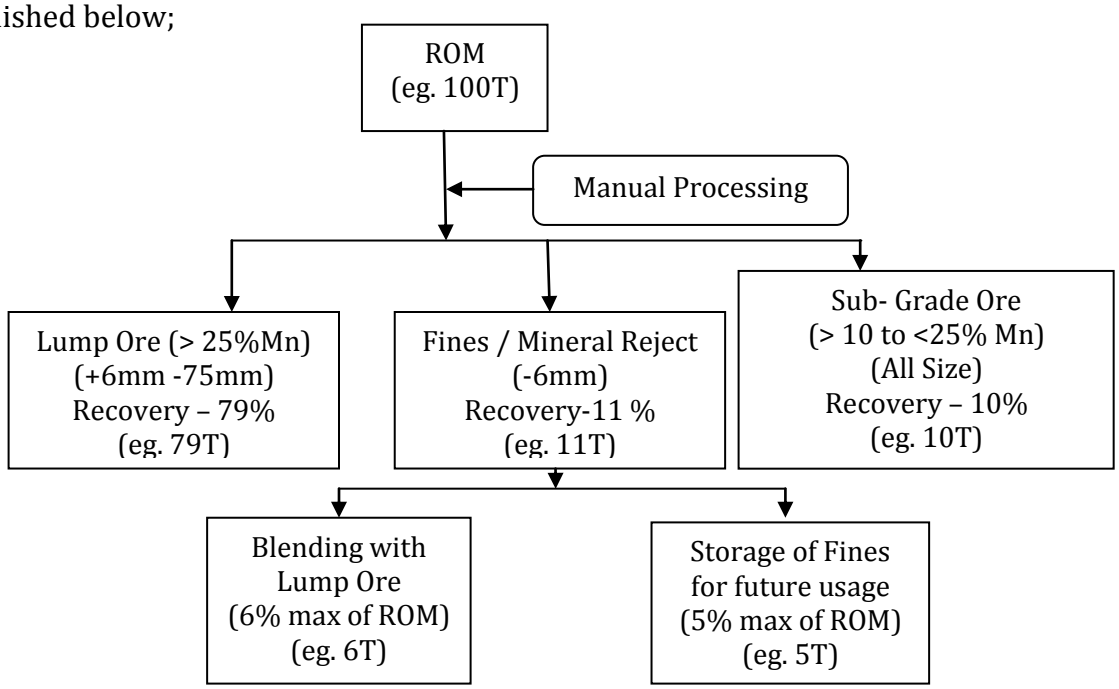
EFFORTS MADE FOR UTILIZATION OF SUB-GRADE MINERAL INCLUDING FINES:

The fines generated in the course of mining are approximately 5% of the ROM production and is stored separately for future use. Further to increase the recovery of residual lumps from the existing fines, screening will be done during dry season only. With the expansion at FAP, Joda with upcoming sinter plant of 0.050 MTPA, the fines shall be utilized through sintering route.

6.0 PROCESSING OF ROM AND MINERAL REJECT

The manganese ore is being dressed, sorted, sized and graded manually at sorting yard. These activities are highly labour intensive. Despite the availability of time-proven material handling and sizing equipment such as vibro-feeders, belt conveyors and conventional crushing equipment, the ROM ore is sized and sorted manually with respect to grade (% Mn) by visual inspection based on their expertise/experience.

The typical material balance of ROM by manual processing of Manganese Ore is furnished below;



This may be noted that, blending of 6% fines in lump ore stacks not only reduces the ROM consumption but also enhances mineral conservation.

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To improve upon the quality, productivity and safety, we are proposing to install a dry crushing and screening plant along with a mechanical sorter which is found to be successful at pilot scale for our ore.

Tata Steel's Manganese group of Mines, Joda produces ~ 3.5 lakh tons/annum high and low grade manganese ores by semi mechanized mining. Around 17.5% of ore material is get converted into low grade fines, Chips and lumps (Mn: 15-35, Mn/Fe: <1) as sub grade mineral or mineral rejects. The preferred feed size of Manganese ore for ferro Alloys making is -75, +10mm size lumps. These low grade resources cannot be used in the Sub-merged arc furnace and these are dumped at different subgrade/mineral reject dumps. Tata Steel Mn mines are producing ~50,000 ton/annum of such low/ sub grade ore and existing dumps contain ~100000 tons of such material at Joda West, Bamebari and Malda Mines. R &D studies have been carried out to utilize these resources in a cost effective and environmental friendly manner. R &D studies find that these fines can be beneficiated and agglomerated to use in Ferro alloys making process.

Future proposal for mechanized processing of Manganese Ore :-

As a part towards mechanization, crushing, screening and mechanical sorting (based on Radiometric X-Ray technology) unit is proposed to be commissioned during the scheme period for mechanizing the subsequent processing of the ROM. The plant shall have a capacity up to 75 TPH to crush the ROM to -75mm size. The screening shall be done at 10 mm size.

The products of -75 +10mm shall be shifted to stack yard for preparation of stacks in geometrical shape. The fines (-10mm) shall be shifted to the mineral reject stacking area by using loader and dumpers. The waste generated if any shall be shifted to waste dumps.

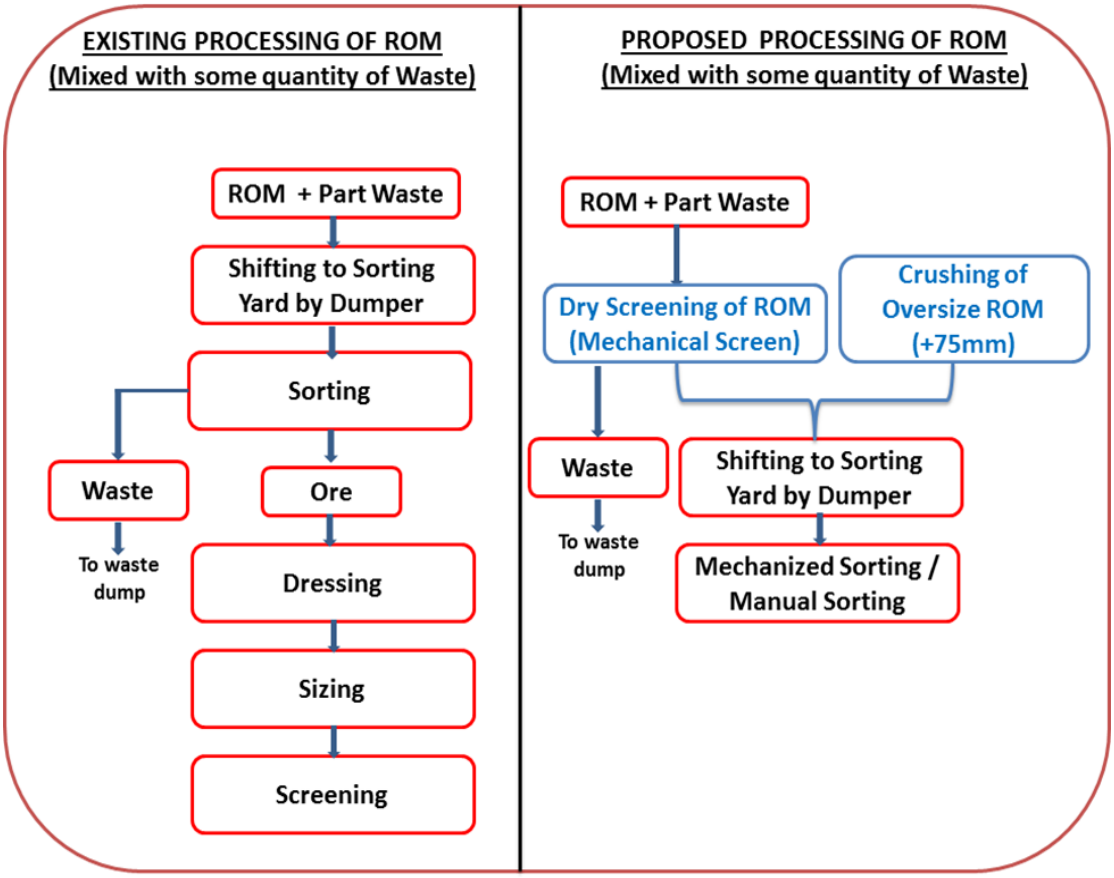
The above unit shall be of dry process and the following environment protection measures shall be taken to control the air pollution:

- Enclosures shall be provided to trap the dust while crushing, screening and conveying.

- Water spray shall be provided at all transfer points.

As the detailed feasibility report is yet to established by several trials for different types of grades to extricate the recovery of saleable ore with material balance. However. the schematic comparison of existing and proposed process is furnished below in Figure 10.

Figure - 10



Further, a beneficiation process flow sheet is in process to explore to upgrade these ores using high intensity magnetic separators and reduction roasting followed by low intensity magnetic separation. Beneficiation and agglomeration test is being carried out to demonstrate the beneficiation process flow sheet at R & D, Tata Steel, IIMT- Bhubaneswar and Mintek Laboratory of South Africa.

High Intensity magnetic separation can upgrade the Mn ore upto usable for Silico manganese Production and detail test work on reduction roasting process is in progress to upgrade this resource, which can be used for Ferro manganese making.

In view of mineral conservation and proper utilization of low grade manganese ore produced from Tiringpahar Mn. Mines and other surrounding manganese mines of Tata Steel Ltd. We propose to commission a beneficiation plant during FY'18 which will be a first of its kind in India for beneficiation of low grade unusable ore being produced from our mines.

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The details of study for beneficiation of Low/ Sub Grade Manganese Ore and Fines carried out so far:-

Reduction roasting has been explored to convert the feebly magnetic hematite to magnetite using coal but techno economics can be a debatable issue. The high intensity magnetic separator can recover the feebly magnetic particles but particle size as well as liberation characteristics play a crucial role in this process. Reduction roasting studies were carried out for temperature range 500^0C to 1000^0C using various types of reductant. These studies were carried out and major findings are:

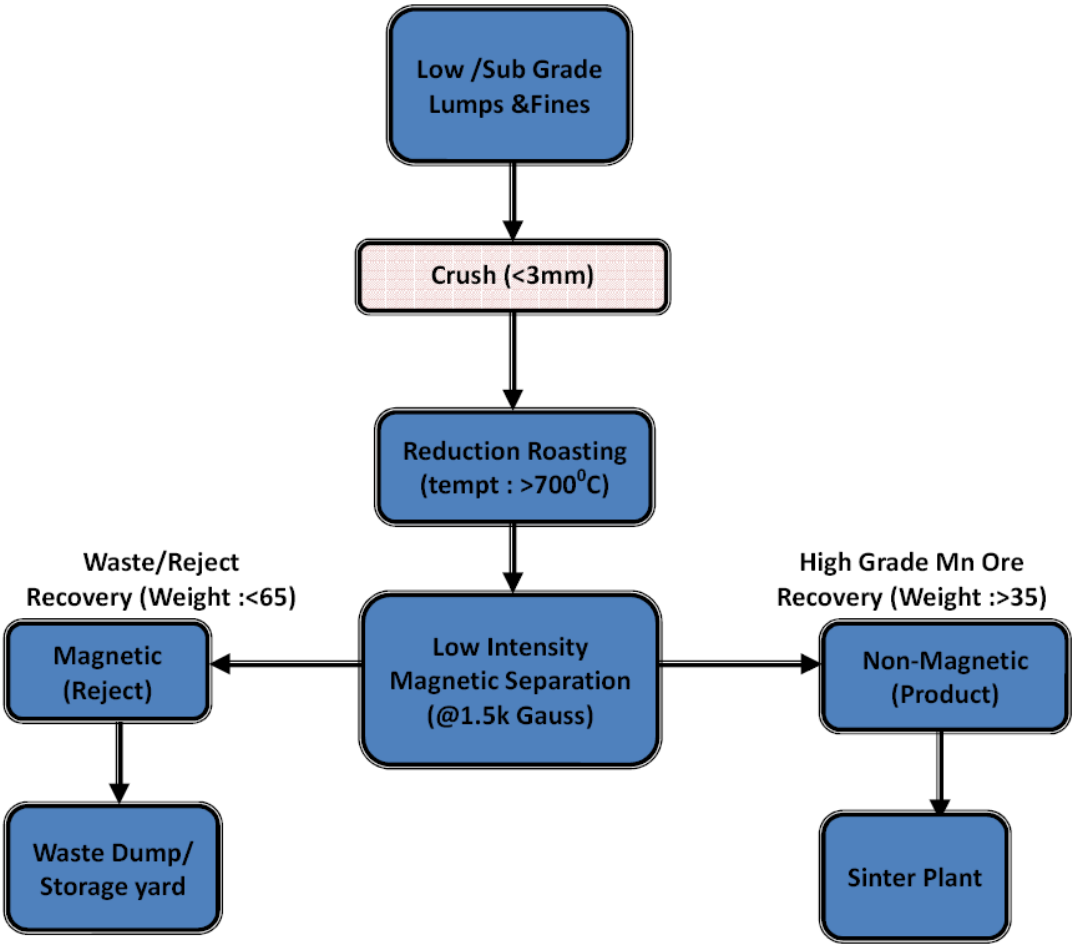
1. Roasting in coarser sizes (>6mm) is not successful and <3mm is most suitable size.
2. FeMn grade product (Mn >46%, Mn/Fe >7%) can be achieved at yield depends on roasting temperature (700-1000^0C) and time. Weight Recovery was 37-45%, and test work in progress to optimize that.
3. R&D Tata Steel and MINTEK, South Africa is doing detailed test work (tempt: 800, 900,1000^oC, Time: 2,4 and 6 hours, Ore types : 5 to produce high grade Mn ore concentrate using Low grade ore fines.
4. Yield and product grade is sensitive to sources of low grade at different mines sites and composition (Fe & SiO_2).

Sintering Process also carried out for agglomerate the Mn ore fines and found to be commercially viable to utilize the ore fines. So, the area of work to commercialize this project are as follow:

1. Techno-economic studies of different process flow sheets (Fig. 11)
2. Material balance for beneficiation plant inputs and output disposal plans
3. Detailed Project Report for Sinter plant and beneficiation plant
4. Statutory requirements for beneficiation and sinter plant.

Figure – 11

TENTATIVE PROCESS FLOW SHEET FOR LOW/ SUB GRADE MANGANESE ORE BENEFICIATION



7.0 OTHERS

a) SITE SERVICES

- The lease hold area does not fall within or near to any National Parks and Sanctuaries.

- Rights and Ownership – M/s. Tata Steel Ltd. has hold the ownership of lease area and obtained the surface right over an area of 100.172 ha.

- Socio economic Study – The Public hearing has been conducted by State Pollution Control Board during processing of Environmental Clearance for approval in favour of the mine.

  With the increase of mining the following socio economic changes are expected to take place especially within 4 – 5 km from the project area.

  a) The project will improve the overall quality of life of the community and society at large.

  b) The project is not going to cause any damage to existing agricultural situation which is scanty, characteristically low yield and seasonal in this area. Rather the project will help the farmers by improving agriculture. Supplementary income shall in turn increase investment in agriculture and consequently agricultural production.

  c) The project is going to have positive employment and income effects, on account of indirect employment associated with allied activities.

  d) The project is going to have positive impact on consumption behavior by way of raising average consumption and income through multiplier effect.

  e) The project is likely to accelerate the need and importance of education among the local people and increase the literacy rate.

  f) The project is going to push up the demand for water for drinking and other purposes in the region

- Roads: Well developed roads within and to the lease hold already exist. Other mining roads shall be developed in due course, for which adequate and suitable mining equipment (viz. dozer, grader etc.) are already there.

- Power Source: The manganese ore occurs as small lenses and pockets in the area in a scattered manner. Small diesel operated hydraulic excavators with medium size dumpers are therefore being presently used to provide mobility. It is also not advisable to carry out the excavation of ore beyond day light hours as it shall increase the dilution. Further the low grade ore are also being consumed for Silico manganese alloy production. Thus the existing infrastructure for power for taking care of the lighting load in the colony etc. is sufficient to cater to the needs for the near future.

- Labour supply and skill: No increase in production and change in technology is proposed during the current planned period. Hence, the existing human resource is sufficient. However, the skill of the work force shall be further enhanced by providing further training. The infrastructure for training is already in place and adequate to take care of the same.

b) EMPLOYMENT POTENTIAL

The proposed requirement of manpower considering the proposed production as well as mine development as mentioned in Section 3.9 is given in Table No. 7.1 below.

Sl.No.	Category		No.	Remarks
1	Manager	:	1	
2	Mining Engineer	:	1	Qualification & Experience : Whole time Mining Engineer shall have Degree in Mining Engg. from any recognized College / University with minimum ten years of professional experience of working in a supervisory capacity in the field of mining.
3	Geologist	:	1	Qualification & Experience : Whole time Geologist shall have post graduate Degree in Geology from any recognized College / University with minimum ten years of professional experience of working in a supervisory capacity in the field of mining.
4	Asst. Manager (Mines)	:	2	For Mining, Drilling & Blasting
5	Asst. Manager (Mechanical Maint.)	:	1	
6	Asst.Manager (Electrical Maint.)	:	1	

7	Surveyor	:	1	
8	Environment Officer	:	1	
9	Sr.Mines Foreman	:	3	For Mining Operation
10	Mines Foreman / Mining Mate	:	6	For Mining Operation & Stack Yard
11	Blaster	:	3	
12	Blaster Helper	:	6	
13	Survey Helpers	:	4	
14	Shovel Operator & Helpers	:	12	
15	Dumper Operator	:	19	
16	Drill Operator & Helper	:	8	
17	Dozer Operator	:	3	
18	Water Sprinkler Driver	:	3	
19	Explosive van Driver	:	3	
20	Light Vehicle Driver	:	4	
21	Ambulance Driver	:	1	
22	Crane Operator	:	2	
23	Mechanic / Fitter	:	7	
24	Electrician	:	7	
25	Maintenance Helper	:	8	
26	Clerk	:	2	
27	Sampler	:	2	
28	Sampling Helper	:	2	
29	Piece Rated (Mazdoor/Reja)	:	236	Assumption : OMS=1.2MT/Manday
	Total		**352**	

While summing of the above table, the category of employment is mentioned in Table No. 7.2 as given below.

Table No. 7.2

Highly Skilled	20
Skilled	64
Semi-Skilled	32
Un-Skilled	236
Total	352

8.0 PROGRESSIVE MINE CLOSURE PLAN UNDER RULE 23 OF MCDR, 1988

8.1 ENVIRONMENT BASE LINE INFORMATION :

Physiography:

The area under study consists of a part of Orissa's plateau region (Keonjhar plateau) and a strip of Orissa's mountain region. The area under study is situated in Singhbhum - Bonai synclinorium which is characterized by gentle to moderately steep or steep slopes. Part of the study circle is covered by reserved forests on hills viz Baitarani reserved forest on the north, and Chamakpur reserved forest on E – NE sector. The area of two reserved forests are separated by the Baitarani river flowing towards NE at a distance of 4.5 km from Tiringpahar lease. Average ground level in Tiringpahar lease is 700 mRL. Highest elevation at hilly regions at Baitarani and Chamakpur reserved forests are 805 mRL and 572 mRL respectively. Mixed forests are sparsed mostly beneath the hilly reserved forests on moderate slopes and also on smaller hillocks occupied on the southern part of the study area. Villages are located mostly in the central part of the study circle on plain (or gently sloping) land. Tiringpahar leasehold area is located in the central gentle slope. The leasehold area has two hillocks on Northern and Southern part with a valley like region in between. Highest elevation at the hillocks is around 700 mRL whereas the central valley is at 640 mRL. The land under mining lease consists of 68.914 ha of Reserved forests, 47.518 ha of wasteland, 1.311 ha reported as agricultural land, 5.653 ha of grazing land, 3.778 ha of roads and 41.826 ha of fallow land. . The lease area has only 1.311 ha of private land as agricultural land as indicated above.

There is no national park, biosphere reserve, sanctuary, habitat for migratory birds, archeological site, defense installation, and airports within 10 km of the periphery of core/ buffer zone. As explained earlier, the 10 km radius study area has mostly hilly forests and villages on the central part. The lease is connected by an all weathered motorable road to Barbil-Keonjhar State Highway no 10. Within study area the only existing railway line is from Banspani (at a distance of 8 km from the lease), which is connected by Tata Barbil branch line of Southeastern Railway at Padapahar.

Land Use Pattern :

The land use pattern within the RML applied area of 169.000 ha. within Guruda block is given in drawing no. MP/TMM/R3/08A/14. The land use pattern within the balance applied area of 474.710 ha. in the Tiringpahar, Joruri & Gurda blocks is shown in drawing nos. MP/TMM/R3/08B/14. respectively. The activity wise breakup of the land is given below in Table – 8.0.

Table No. 8.0

Type of Use	Land Use Pattern within applied RML area of 169 ha (Date of application : 05.01.1999)				Land Use Pattern within applied ML area of 474.710 ha (Date of application : 09.12.2004)				Total Area (ha)			
	Guruda	Tiringpahar	Joruri	Total	Guruda	Tiringpahar	Joruri	Total	Guruda	Tiringpahar	Joruri	Total
Area Excavated	20.502	0	0	20.502	0	2.180	0	2.180	20.502	2.180	0	22.682
Storage of Top Soil	0.000	0	0	0.000	0	0	0	0.000	0.000	0	0	0
Waste Dump	19.780	0	0	19.780	0	4.160	0	4.160	19.780	4.160	0	23.940
Mineral Storage	9.321	0	0	9.321	0	0	0	0.000	9.321	0	0	9.321
Infrastructure (Workshop, Magazine etc)	0.300	0	0	0.300	0	0	0	0.000	0.300	0	0	0.300
Roads	2.536	0	0	2.536	0	0	0	0.000	2.536	0	0	2.536
Railways	0.000	0	0	0.000	0	0	0	0.000	0.000	0	0	0.000
Greenbelt / Plantation Area	2.377	0	0	2.377	0	2.000	0	2.000	2.377	2.000	0	4.377
Tailing Pond	0.000	0	0	0.000	0	0	0	0.000	0.000	0	0	0.000
Effluent Treatment Plant	0.000	0	0	0.000	0	0	0	0.000	0.000	0	0	0.000
Mineral Separation Plant	0.000	0	0	0.000	0	0	0	0.000	0.000	0	0	0.000
Township Area	0.000	0	0	0.000	0	0	0	0.000	0.000	0	0	0.000
Others (to be specified)	0.000	0	0	0.000	0	0	0	0.000	0.000	0	0	0.000
Area that remains untouched	114.184	0	0	114.184	205.050	187.200	74.120	466.370	319.234	187.200	74.120	580.554
Total	169.000	0.000	0.000	169.000	205.050	195.540	74.120	474.710	374.050	195.540	74.120	643.710

Water Regime:

The natural drainage system is distinct due to hilly topography in most part of the study circle. Baitarani River flowing at a distance of about 4.5 km on eastern side of the Tiringpahar lease forms the major drainage system of the area. Kundra nala or Sona nadi originating little distance beyond the study circle on southern hilly region flows across the study circle from N to NE at a distance of about 6.6 km from the lease. Major part of the area has dendritic drainage pattern. The hill ranges are drained by seasonal nallahs in all directions. A few seasonal streams flow through the lease. High flood level of Baitarani River and Sona nadi is much below the mining lease.

Core zone is mainly hilly terrain. The area is under hard rock formations. The rocks do not have primary porosity; only structural weaknesses like joints, fractures, folds, faults and weathering process provide secondary porosity for storing and transmitting water. The buffer zone is by and large occupied by iron ore series. The extent of weathering varies from a few centimeters in upland areas to several meters in villages. The structural weakness persists for couple of 100 meters locally along deep-seated lineaments. The ground water occurs under unconfined to semi-confined conditions. The area receives recharges mainly from precipitation and surface sources. Study area's subsurface and surface drainage is controlled by Baitarani River on east (approx. 4.5 km from lease) and Kundra nala on west (at 6.6 km from the lease).

The surface water quality is being analyzed fortnightly and analysis report is being enclosed as Annexure – V.

The present and proposed water quality monitoring location is furnished in the Table No. 8.1 (a) below:

Table No. 8.1 (a)

Location	Present		Proposed	
	Easting	Northing	Easting	Northing
Guruda	10494.277	10551.885	10494.277	10551.885
Guruda	12386.551	10392.935	12386.551	10392.935
Monitoring Schedule : Once in fortnight at two locations.				

Quality of Air & Ambient Noise level :

Quality of Air :

The baseline status of the ambient air quality has been established through a scientifically designed ambient air quality monitoring network and was based on following considerations:

- Meteorological condition on synoptic scale.
- Topography of the study area
- Representatives of regional background air quality for obtaining baseline status
- Location of residential areas representing different activities in absence of any stack, the ambient air quality is expected to be affected in and around the mining areas up to a limited distance (within 5 km). Keeping this in view, air quality of core and nearby buffer zone mainly has been monitored.

To assess the ambient air quality level, monitoring stations were set up in the core zone and neighboring buffer zone up to 5 km distance.

The present and proposed ambient air quality monitoring station location is furnished in the Table No. 8.1 (b) below:

Table No. 8.1 (b)

Location	Present		Proposed	
	Easting	Northing	Easting	Northing
Guruda	11147.617	10597.364	11147.617	10597.364
Guruda	12129.429	11692.554	12129.429	11692.554
Monitoring Schedule : Twice in a week at two locations.				

Existing Air Quality Status: During the operational stage the air quality monitoring is being done at different work zone locations like in the open pit faces, waste and reject dumps, dressing and sorting yard for three dry seasons, as per IBM/ MoEF norms; to draw on climatic data coupled with emission data. The pollutants to be monitored are respirable particulate matter & suspended particulate matter containing significant silica/ silicates, trace & heavy metals, toxic elements and other gases like CO, SO_x & NO_x.

To monitor the effectiveness of dust prevention and control actions, it is necessary to compare background levels of airborne dust with conditions down wind, and back this up with adequate meteorological equipments. Dust samplers complete with particle size partitioning and independent power generators provide sufficient data. The equipment selected is capable of collection of Sulphur dioxide

and Nitrogen oxides samples.

The method of deployment of respirable dust samples is down wind condition at the mine site where there is chance of dust nuisance. Air quality analysis is carried out by engaging competent and approved agency by Odisha Pollution Control Board twice in a week all around the year. Air Quality Data reveals no adverse impact on the air quality due to the mining activity.

The results of Ambient Air Quality are enclosed as Annexure – IV A.

Ambient Noise Level :

In order to have an idea about the existing noise levels of the study area, noise monitoring has been carried out. At each noise monitoring station, Leq. noise level has been recorded at hourly intervals for 8 hours continuously by operating the noise recording instrument for fifteen (15) minutes during each hour.

The results of Ambient Noise level are enclosed as Annexure – IV B

The present and proposed ambient noise level monitoring location is furnished in the Table No. 8.1 (c) below:

Table No. 8.1 (c)

Location	Present		Proposed	
	Easting	Northing	Easting	Northing
Guruda	12101.177	11657.514	12101.177	11657.514
Guruda	10974.103	10653.350	10930.706	10755.724
Monitoring Schedule : Once in quarter at two locations.				

Flora & Fauna :

The lease area doesn't form part of any National Park, Wild Life Sanctuary, Elephant Reserve, Biosphere Reserve or any critical wildlife habitat. There are no endangered or endemic wildlife species in the area. Some of the common species of flora and fauna available in the area are as follows.

Sl. No.	**Local Name**	**Scientific Name**
1.	Babul	*Acacia arabica*
2.	Akasmoni	*Acacia moniliformis*
3.	Kurum	*Adina cordifolia*
4.	Bel	*Aegle marmelos*

Sl. No.	Local Name	Scientific Name
5.	Kala siris	*Albizzia lebbek*
6.	Safed siris	*Albizzia procera*
7.	Dhanra	*Anogeissus latifolia*
8.	Sharifa (ata)	*Anona squamosa*
9.	Rathal	*Artocarpus heterophyllus*
10.	Nim	*Azadiractha indica*
11.	Chatim	*Alstonia scholaris*
12.	Kaju	*Anacaedium occidentale*
13.	Kadam	*Anthocephalus cadamba*
14.	Mahua	*Madhuka latifalia*
15.	Deva kanchan	*Bauhinia purpurea*
16.	Rokta kanchan	*Bauhinia veriegata*
17.	Shimool	*Bombax malabaricum*
18.	Tal	*Borassus flabellifer*
19.	Palas	*Butea monosperma*
20.	Krishnachura	*Caesalpinia pulcherryma*
21.	Karamcha	*Carissa carandus*
22.	Amaltus	*Cassia fistula*
23.	Barun	*Crataeva religiosa*
24.	Gulmoor	*Delonix reqia*
25.	Eucalyptus	*Eucalyptus globosus*
26.	Monsa	*Enphorbia neriifolia*
27.	Kathbel	*Feronia elephantum*
28.	Bot	*Ficus benghalensis*
29.	Dimari	*Ficus eunea*
30.	Kak Dimari	*Ficus hispida*
31.	Gamari	*Gmelina arborea*
32.	Kurchi	*Holarrhena antidycentrica*
33.	Am	*Mangifera indica*
34.	Ghoramin	*Melia azedarch*
35.	Champa	*Michelia champaca*
36.	Akashnim	*Millingtonia hortensis*
37.	Ansphal	*Aphelium longana*
38.	Sona	*Oroxylon indicum*

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Sl. No.	Local Name	Scientific Name
39.	Khejur	*Phoenix sytvestris*
40.	Amloki	*Phyllanthus emblica*
41.	Dekani Tentul	*Pitheeolobim dulce*
42.	Karanja	*Pongamia glabra*
43.	Peyara	*Psidium guyava*
44.	Pistal	*Pterocarpus marsupium*
45.	Dalim	*Punica granatum*
46.	Ritha	*Sapindus mukorossic*
47.	Bhelua	*Semecarpus anacardium*
48.	Sal	*Shorea robusta*
49.	Amrah	*Spondias pinnata*
50.	Tentul	*Tamarindus indica*
51.	Shegun	*Tectona grandis*
52.	Arjun	*Terminalia arjuna*
53.	Ber	*Zizyphus mauratiana*
54.	Basak	*Adhatoda vasica*
55.	Potari	*Abntilon indicum*
56.	Muktaijuri	*Acalypha indica*
57.	Apomargo	*Achyranthus aspera*
58.	Janti	*Berleria eristata*
59.	Kanta-janti	*B. prionitis*
60.	Shet-Akand	*Calotropis procera*
61.	Chakunda	*Cassia tora*
62.	Chakunda	*Cassia sophera*
63.	Sada Morgaphul	*Celosia argentea*
64.	Hasna-hana	*Cestrum noctrunum*
65.	Khudi-okra	*Chrozophora plicata*
66.	Ghetu	*Cleodendon infortunatum*
67.	Ban-Tulasi	*Croton bonplandianum*
68.	Dhutra	*Datura metel*
69.	Kalo-Dhutra	*D. stramonium*
70.	Duranta	*Duranta plumieri*
71.	Gurhal	*Hibiscus rosa sinensis*
72.	Kalmi	*Ipomea pestigridis*
73.	Achhe	*Morinda tictora*
74.	Asan	*Terminalia tomentosa*

Sl. No.	Local Name	Scientific Name
75.	Bahera	*Terminalis belerica*
76.	Bandhan	*Dugeinia dalbergiodes*
77.	Basna	*Sesbania grandiflora*
78.	Guli	*Hymenodictyon excelsion*
79.	Dhatiki	*Woodfordia fracticosa*
80.	Haldo	*Diospyros mantana*
81.	Harar	*Terminalia Chebula*
82.	Jamun	*Syzygium cuminii*
83.	Karanj	*Pangamia glabra*
84.	Kasi	*Bridelia Retusa*
85.	Kendu	*Diospyros melanoxylon*
86.	Bija	*Pterocarpus marsupium*
87.	Ashok	*Saraca asoca*
88.	Sisoo	*Dalbergia latifolia*
89.	Simili	*Bombax ceiba*
90.	Rani	*Flamingia Chhapar*
91	Putali	*Lagerstroemia flosreginae*
92	Khokra	*Xylia dolabrifanis*
93	Kusum	*Schleichera oleosa*
94	Chahar	*Buchaninia lanzan*
95		*Gardenia Gummifera*
96		*Diospyros malabarica*
97	Kantokali	*Zizyphus oenoplia*
98	Kirkichi	*Mimosa rubicaulis*
99	Moi	*Garuga pinnata*
100	Anwala	*Emblica officinalis*

Fauna

English name	Scientific name
Common Indian garden lizard	*Calotes versicolor*
House lizard	*Hemidactylus*
Toad	*Bufo malanostictios*

Frog	*Rana tigrina*
Greater Indian fruit bat	*Pteopus giganter*
Indian palm squirrel	*Funambulus rufa*
Langur	*Lemur*
Elephant	*Elephas maeinaus indians*
Sloth bear	*Melursus usinus*
Spotted dear	*Axix axis*
Jackle	*Caris aurensindicus*
Jangli cat	*Felis chaus affioris*
Baya	*Paro cristatus*
Peacock	*Corvus splendens*
Crow	*Corvus macrorhyneos*
Parrot	*Pisittacua krameri*
Whisling till	*Dendrocygna javauica*
Python	*Pythan molurus*
King cobra	*Naga hannab*
Cobra	*Naja naja*
Rat snake	*Ptyas mucosus*
Russel's viper	*Russel's viper*

Climate & Meteorology:

The area lies in tropical region where climate is characterised by very hot summers and moderate winters. Strictly speaking, however, the winter temperatures of the study area indicate that it is in the sub-tropical region. Summer is typically from March to mid-June when temperature ranges from a maximum of 44°C during daytime to a minimum of 23°C at night. Winter is from December to February when the maximum temperature during day goes up to 29°C and minimum temperature at night becomes as low as 4°C.

The annual rain fall recorded at the mine site is furnished in Table No. 3.18.

Human Settlements :

Population in the study area is little less than 1 lakh. . Excluding the urban polpulation the average settlement size is 501. 69% of the settlements have a population less than 501 while almost 92% of the settlements have less than 1000 inhabitants. The terrain and ecology do not permit larger settlements.

Name of the Block	Number of village	Total Population		
		Male	Female	Total
Champua	148	39,776	40,329	80,105

Literacy :

Literacy rate of the area is 45.4%. Male literacy is 56% and Female literacy is 33.7%. This compares favorably with the district average. There are 3 colleges, 23 high schools, 39 middle schools, 165 primary schools and 34 adult literacy centers within 25 km from the lease.

Occupational profile:

Though agriculture is the primary activity, a very large percentage of the people are employed as laborers in the mining companies. A number of economic activities are evident like agriculture, trade vending, employment in Government or private sector, mine labour etc. A wider variety of occupations are practiced nearer to mining camps. One of the major reasons for a large dependence on wages as mine labour is the poor agricultural returns. Mono cropping on lateritic soil does not provide yields beyond 5 quintals/ha. Another reason is that hardly 2% of the land is irrigated and the total agricultural dependence is on rainfall. Therefore, most of the agriculturists supplement their income by taking up employment as contract labour.

8.2 ENVIRONMENT IMAPCT ASSESSMENT :

The environmental impacts due to mining and its allied activities largely depend upon the size of operation; stripping ratio and extent of mechanization. The matrix for impact identification is shown in Table No. 8.1.

Table No. 8.1

Environmental Imapct Identification Matrix

Aspects / Impacted Attribues	Site Preparation	Mining & Allied activities										Post Operational Phase		
		Opencast Excavation	Dumping of Overburden	Sizing of Ore & Transportaion	Storage of Ore / Stacking	Water Consumption	Water Discharge	Maintenance of Equipment	Power Generation by DG Set	Development of Green belt	Employment	Urbanisation (Buffer Zone)	Transportaion	Industrialisation
Ambient Air		■	■	■	■			■	■	■		■	■	■
Water Resources		■				■						■		■
Water Quality		■	■		■		■	■				■		■
Ambient Noise		■	■	■				■	■			■	■	■
Flora & Fauna	■	■	■							■		■		■
Soil & Land Use	■	■	■		■		■			■		■	■	■
Infrastructure		■		■								■	■	■
Health & Safety		■	■	■	■		■	■		■				
Socio-econimics										■	■	■	■	
Aesthetics	■		■							■				

■ Adverse Impact
■ Beneficial Impact

The environmental attributes that are subjected to test for having impact on them by varying degree include ambient air quality, water resources & quality, noise levels, flora and fauna (ecology), soil and land-use, socio-economic environment and infrastructural development, health etc. Various activities causing impacts have been considered under various stages viz. siting, operation of opencast mines and secondary activities and also at post operational phase.

The activities have been arranged in columns and environmental attributes in rows in the matrix. A preliminary scrutiny has been made and the cells which fall at the junction of "activity" and “attribute", that have possible interaction with each other, have been crossed.

The matrix thus, identifies the environmental attributes likely to be affected and the activities responsible for this. The impacts may be beneficial or adverse.

i) **Future Land Use Pattern :** Considering the existing Manganese Ore production the land use has been planned for next five years till 29.02.2020 and conceptualized at end of life of the mine. The end of life land use patter may change considering up-coming expansion w.r.t. production of Iron Ore and existence of Manganese Ore at a greater depth. The detail break up of land use patter for the Guruda block is furnished below in Table No. 8.2.

It shall be noted that the provisions of the Odisha Scheduled Areas Transfer of Immovable property (by Scheduled Tribes) Regulation, 1956 (Odisha Regulation 2 of 1956) and the Forest (Conservation) Act, 1980 will be followed and for the time being the area concerned has been identified under the category of area to remain untouched. However, specific permission shall be obtained from appropriate authority for doing mining in future.

The mineral storage area includes the finished ore stacking area, sorting yard and mineral fines stacks.

Table No. 8.2

Type of Use	As at the end of plan period 29.02.2020 (in ha.)	As at End of Life (in ha.)
Area Excavated	31.303	84.367
Storage of Top Soil	0.000	0.000
Waste Dump	41.444	61.861
Mineral Storage	10.321	10.150
Infrastructure (Workshop, Magazine etc)	0.4	1.761
Roads	3.053	3.958
Railways	0.000	0.000
Greenbelt	2.377	1.000
Tailing Pond	0.000	0.000
Effluent Treatment Plant	0.000	0.000
Mineral Separation Plant	0.000	0.000
Township Area	0.000	0.000
Others (to be specified)	0.000	0.000
Area that remains untouched(including Safety Zone, Private land, ST land etc.)	80.102	5.903
Total	169.000	169.000

ii) Air Quality:

In semi mechanized opencast mine mining operations such as mining extraction, loading and unloading, movement of dumpers on haul roads and external dumping and sizing of ore etc are expected to generate airborne fugitive dusts. Comparatively higher level of SPM and RPM are expected due to fine particles which becomes easily airborne after blasting and in haul roads. Due to high specific gravity of the ore raising of dusts shall be not much. But excavated wastes shall raise the airborne dust level to some extent. The detail analysis of ambient air quality is enclosed as Annexure – IV A.

The fugitive pollution is localized and there is no stack pollution from mining area caused to the villages. Maximum concentration predicted at express way is close to active work zone. Dust generated in excavation area shall be screened by artificially generated forests which have not been taken into account when predicting the ground level concentration.

While transporting manganese ore from mine to Joda Ferro Alloys plant as manganese ore is hard lumpy in nature, substantial raising of dust during transportation is not expected. As a precautionary measure the loaded trucks will be covered with tarpaulin sheets.

There is no potential source of NOx generation at the core zone other than blasting. Thus SO2 and NOx levels shall remain very less throughout the life of the mine and hence have not been considered for predictive modeling.

The region is full of mining and allied industry. The existing background level of ambient air quality also includes the effect of neighboring mines. The estimated dust level rise, may not cause any appreciable impact in core zone and neighboring environment.

iii) Water Quality:

The main minerals in the country rock are goethite, limonite, clay, pyrolusite, psilomilane and bauxite. These minerals are non-toxic in nature in nature even when exposed to superficial weathering under tropical humid conditions. However, higher amount of suspended particles are released into surface water during rainy seasons. The stream water during the summers is remarkable clear. The surface water quality analysis report is enclosed as Annexure – IX.

Water balance chart for Guruda block is given in Table No. 8.2 (a) & 8.2(b)

Table No. 8.2 (a)
WATER BALANCE CHART DURING LEAN SEASON
GURUDA BLOCK
(Avg. m^3/day)

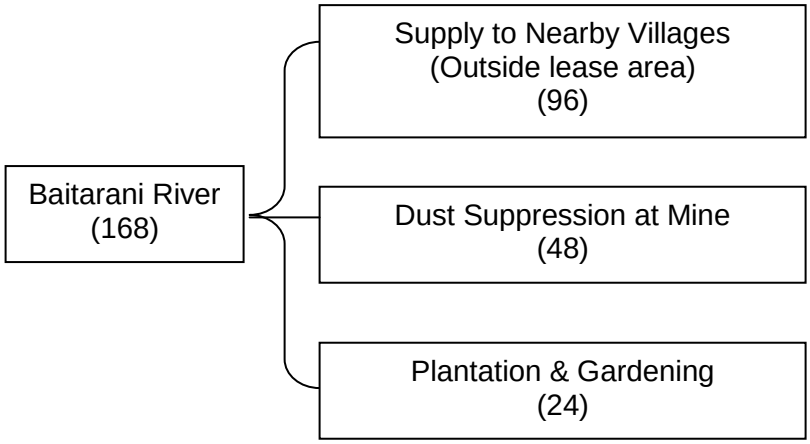
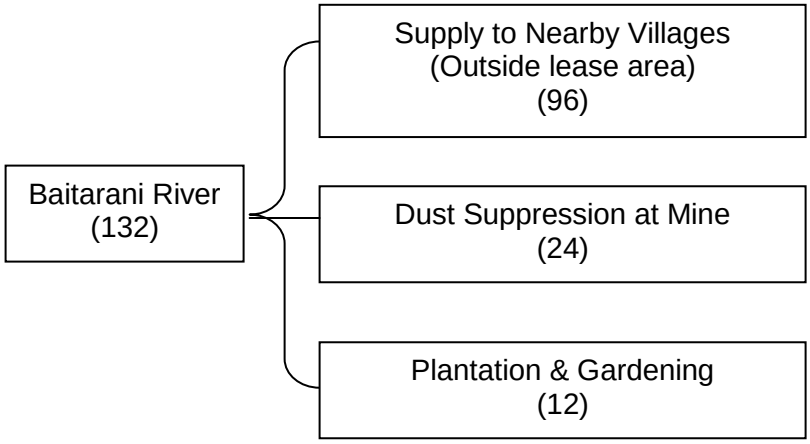


Table No. 8.2 (b)
WATER BALANCE CHART DURING MONSOON
GURUDA BLOCK
(Avg. m^3/day)



iv) Noise Level :

In order to have an idea about the existing noise levels of the study area, noise monitoring has been carried out at all vulnerable locations. Measurements have been carried out at all the monitoring stations. At each noise monitoring station, Leq. noise level has been recorded at hourly intervals for 8 hours continuously by operating the noise recording instrument for fifteen (15) minutes during each hour.

The results of Ambient Noise level are enclosed as Annexure – IV B

v) Vibration Level :

The purpose of the blasting is to induce a heaving effect so that, excavator can load the blasted material easily into dumpers. The requirement of blasting is mainly to break the hard in-situ patches which otherwise cannot be removed. The blasting is carried out with large diameter (83mm) slurry explosive cartridges. Cap-sensitive slurry explosive cartridges are being used as base charge and non-cap sensitive are used as column charge.

The blasting will therefore be scattered in the quarry. The details of burden, spacing and explosive consumption pattern are mentioned below,

Depth of the hole	= 8m (bench height) + 10% as sub grade drilling)
	= 8.8 m (max)
Spacing	= 3m
Burden	=2.5m
Volume/ hole (in-situ)	= 60 CuM
Specific Gravity	= 2.5
Tonnage/ Hole	= 150 Tonnes
Powder factor	= 6.0 Kg/Tonne
So, Quantity of explosive/hole	= 25 Kg.

After charging with 250ms delay DTH & stemming of holes, connection is done with detonating fuse. Cord relay of 25 ms / 50 ms are used for delay in case of normal blasting (i.e. if there is no permanent structure within danger zone not belonging to owner or danger zone is free from intersection of public road etc.). Cord Relay of 25 ms / 50 ms is fixed between holes along the spacing as well as between rows. There after shot is fired electrically after taking clearance from guards posted to prevent un-authorized entry to mine.

In case of controlled blasting (i.e in close proximity to roads, hutments etc) bottom initiation pattern by using 250 ms delay Down To Hole (DTH) followed by connection of hole to hole with 17ms Trunk Line Delay (TLD). In case of multi row holes, 42 ms, 65 ms, 100 ms TLD are used for subsequent rows respectively.

vi) Water Regime :

The natural drainage system is distinct due to hilly topography in most part of the study circle. Baitarani River flowing at a distance of about 4.5 km on eastern side of the Tiringpahar lease forms the major drainage system of the area. Kundra nala or Sona nadi originating little distance beyond the study circle on southern hilly region flows across the study circle from N to NE at a distance of about 6.6 km from the lease. Major part of the area has dendritic drainage pattern. The hill ranges are drained by seasonal nallahs in all directions. A few seasonal streams flow through the lease. High flood level of Baitarani River and Sona nadi is much below the mining lease.

Core zone is mainly hilly terrain. The area is under hard rock formations. The rocks do not have primary porosity; only structural weaknesses like joints, fractures, folds, faults and weathering process provide secondary porosity for storing and transmitting water. The buffer zone is by and large occupied by iron ore series. The extent of weathering varies from a few centimeters in upland areas to several meters in villages. The structural weakness persists for couple of 100 meters locally along deep-seated lineaments. The ground water occurs under unconfined to semi-confined conditions. The area receives recharges mainly from precipitation and surface sources. Study area's subsurface and surface drainage is controlled by Baitarani River on east (approx. 4.5 km from lease) and Kundra nala on west (at 6.6 km from the lease).

The surface water quality analysis report is enclosed as Annexure – V.

vii) Acid Mine Drainage :

The main minerals in the country rock are goethite, limonite, clay, pyrolusite, psilomilane and bauxite. These minerals are non-toxic in nature in nature even when exposed to superficial weathering under tropical humid conditions. However, only higher amount of suspended particles are released into surface water during rainy seasons. The stream water during the summers are remarkable clear. Since there is no washing / beneficiation of ore except for manual breaking and dry screening, treatment / disposal of water from processing operations are not required. As mining operations are on hill slopes, there is no possibility of ground water getting intercepted in future also.

Also viewing the regional as well as local geology, there is no surficial exposure of iron sulphide which can form chemical reaction with the surface run offs to make it acidic. Hence, acid mine drainage is not envisaged.

viii) Surface Subsidence :

Although there is change in elevations caused due to opencast mining, neither the ground water intersected nor the workings are over the ground water table which may cause the land weaker than the original mass. Hence, surface subsidence is not envisaged.

ix) Socio-Economics :

With the increase of mining the following socio economic changes are expected to take place especially within 4 – 5 km from the project area.

a) The project will improve the overall quality of life of the community and society at large.

b) The project is not going to cause any damage to existing agricultural situation which is scanty, characteristically low yield and seasonal in this area. Rather the project will help the farmers by improving agriculture. Supplementary income shall in turn increase investment in agriculture and consequently agricultural production.

c) The project is going to have positive employment and income effects, on account of indirect employment associated with allied activities.

d) The project is going to have positive impact on consumption behavior by way of raising average consumption and income through multiplier effect.

e) The project is likely to accelerate the need and importance of education among the local people and increase the literacy rate.

f) The project is going to push up the demand for water for drinking and other purposes in the region

x) Historical Monuments:

There is no historical monuments, national parks, biosphere reserve, sanctuary, habitat for migratory birds, archaeological site, defence installation, airports within 10 km of the periphery of core/ buffer zone.

Environment Clearance :

The mine has already obtained the Environmental Clearance from the MoEF vide letter no.J-11015/87/2004-IA.II(M), Dt.17.11.2005 for production @ 85000 TPA of Manganese Ore. The Copy of the Environmental clearance is enclosed as Annexure-VI.

The mine has also obtained the Consent to operate for production level at 85000 TPA of Manganese Ore under Air (Prevention and Control of Pollution) Act, 1981 & Water (Prevention and Control of Pollution) Act, 1974 from State Pollution Control Board, Orissa. (Consent Order No.115, valid up to 31.03.2016. The Copy of the same is enclosed as Annexure-VIII.

<table>
<tr><th>SALIENT ITEMS</th><th>PROPOSAL AS PER APPROVED SCHEME OF MINING</th><th>POSITION AT THE END OF 4 YEARS OF SCHEME OF MINING PERIOD</th><th>PROPOSAL FOR THE NEXT FIVE YEAR PLAN PERIOD</th></tr>
<tr><td>Top Soil Storage, Preservation & Utilization</td><td>No proposal for Top soil collection & storage</td><td>No top soil generated at the end of 4 yrs of scheme period</td><td>500 m3 of top soil will be generated during 4th yr. and 5th yr. of plan period and will be consumed immediately for plantation.</td></tr>
<tr><td>Land Reclamation & Rehabilitation</td><td>No proposal for pits reclamation as they are in active stage.</td><td>No reclamation of pits was undertaken as abandoned pits were not available.</td><td>Pits will remain active during next 5 years & hence no proposal for pit reclamation.</td></tr>
<tr><td rowspan="3">Waste Dump Management</td><td>Proposed garland drains around dumps to check run-off and</td><td>Garland drain is excavated at toe of the dump to check surface run-off.</td><td>Garland drain and retaining wall will be made around the active OB dumps during next 5 years. Year-wise details & dimensions is given below;</td></tr>
<tr><td colspan="3"><table>
<tr><th>Year</th><th>Construction of Retaining Wall for Dump (m)</th><th>Construction of Garland Drain for Dump (m)</th><th>Breadth (m)</th><th>Height / Depth (m)</th></tr>
<tr><td>2015-16</td><td>550</td><td>550</td><td rowspan="6">1.2</td><td rowspan="6">1</td></tr>
<tr><td>2016-17</td><td>575</td><td>575</td></tr>
<tr><td>2017-18</td><td>0</td><td>0</td></tr>
<tr><td>2018-19</td><td>0</td><td>0</td></tr>
<tr><td>2019-20</td><td>0</td><td>0</td></tr>
<tr><td>Total</td><td>1125</td><td>1125</td></tr>
</table></td></tr>
<tr><td>Provision to reclaim dumps by slope plantation over the inactive slope.</td><td>Dumps were active & hence reclamation was done only on slopes of inactive portion.</td><td>Dumps will remain active during the next 5 yrs.
However rehabilitation will be undertaken by slope plantation as shown in the Figure 7. The details of the proposal in year wise the area to be rehabilitated by slope plantation is given below;</td></tr>
<tr><td colspan="3"><table>
<tr><th>Year</th><th>Nos. of Saplings to be planted</th><th>Area of Plantation (in ha.)</th></tr>
<tr><td>2015-16</td><td>0</td><td>0.0</td></tr>
<tr><td>2016-17</td><td>13643</td><td>5.5</td></tr>
<tr><td>2017-18</td><td>17555</td><td>7.0</td></tr>
<tr><td>2018-19</td><td>13595</td><td>5.4</td></tr>
<tr><td>2019-20</td><td>14425</td><td>5.8</td></tr>
<tr><td>Total</td><td>59218</td><td>23.7</td></tr>
</table></td></tr>
</table>

Haridrumat Behera
Regd.No.-RQP/BBS/093/2010-A

<table>
<tr><th>SALIENT ITEMS</th><th>PROPOSAL AS PER APPROVED SCHEME OF MINING</th><th>POSITION AT THE END OF 4 YEARS OF SCHEME OF MINING PERIOD</th><th>PROPOSAL FOR THE NEXT FIVE YEAR PLAN PERIOD</th></tr>
<tr><td>Afforestation Programme With Precaution Proposed</td><td>Proposal for afforestation:
Total – 4625 nos. of saplings over 1.85 ha.

Care Proposed:

-Safeguarding the plants.

-Application of insecticides & pesticides.</td><td>Total saplings of 93650 nos. were planted over 8.9 ha. during 2011-12 to 2014-15(till Oct’ 14)

Post plantation care undertaken :-
-Watch & ward arrangement for safety.
-Watering the plants during dry period.
-Application of fertilizers, insecticide & pesticide.</td><td>Post plantation care proposed is :
-Watch & ward arrangement
-Watering the plants during dry period.
-Application of fertilizers, insecticide & pesticide.</td></tr>
<tr><td colspan="4"><table>
<tr><th>Year</th><th>Nos. of Saplings to be planted</th><th>Area of Plantation (in ha.)</th></tr>
<tr><td>2015-16</td><td>0</td><td>0.0</td></tr>
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<tr><td>Total</td><td>59218</td><td>23.7</td></tr>
</table></td></tr>
<tr><td>Quality Of Air</td><td>No adverse impact on ambient air quality is expected.</td><td>Monitoring data of AAQ enclosed indicate that all parameters are well within the limits.(see Annexure - IV)

Water tanker has been provided for sprinkling on haul roads on a regular basis and in the mine pit as and when required.

Wet Drilling method is adopted to reduce dust generation while drilling blast holes.</td><td>Quality of ambient air will be assessed as per the statutory requirements for PM_{10} & PM $_{2.5}$,Sox,Nox , Mn etc.

Dust suppression measures such as water sprinkling in mine pit as and when required.

Wet drilling will be continued during the plan period.</td></tr>
</table>

SALIENT ITEMS	PROPOSAL AS PER APPROVED SCHEME OF MINING	POSITION AT THE END OF 4 YEARS OF SCHEME OF MINING PERIOD	PROPOSAL FOR THE NEXT FIVE YEAR PLAN PERIOD
Quality Of Make -Up Water Including Surface & Ground Water	No beneficiation is done for Mn Ore and thus no make-up water is required.	Water quality data generated indicates no impact on nearby surface water quality. Avg. Monthly monitoring report is enclosed as Annexure – V.	Water will be required for dust suppression and drinking purpose only.
		No make-up water requirement.	Water quality will be monitored in concurrence with the statutory provisions.
		Water used for dust suppression & drinking purpose only.	No adverse impacts are envisaged due to mining operations on surface & ground water quality.
Noise Level And Vibration	Precautions proposed during blasting: • guarding of blasting area. • no big blasts at a time • covering the holes with stone & sand bags to reduce noise	All precautions were taken to reduce vibration & noise during blasting. To reduce the noise levels in the mine, the Equipment were maintained properly. Since the mining activities are largely manual, the Noise generations are negligible and the levels are monitored as per the statute and record kept.	Similar precautions as during last 5 yrs. will be undertaken. Periodic maintenance of the equipment shall be undertaken Noise levels will also be monitored seasonally except monsoon.
Treatment Of Mine Water And Recirculation	No discharge from mine as groundwater table is much below the bottom of mining pit. No ore beneficiation was proposed hence no discharge from mine.	Most of the rain water gets soaked in the ground and no pumping is necessary to discharge out the water from the quarry.	Discharge from the mine is not expected. The surface run off from the dumps gets soaked in the garland drains made around the dumps. No further treatment of the surface run off water from other areas is deemed necessary as the TSS values are well below the permissible limits as per the monitoring data for nearby surface water body which is not within the buffer zone of existing RML area.

8.3 PROGRESSIVE RECLAMATION PLAN :

8.3.1 MINED OUT LAND

The land use patterns within the Tiringpahar mining lease area of 169 ha. with respect to present as on 01.10.2014, at the end of this plan period (i.e 29.02.2020) and at end of life is furnished in Table no. 8.3 as follows:-

Table No. 8.3

Type of Use	As at Present 01.10.14 (in ha.)	As at the end of plan period 29.02.2020 (in ha.)	As at End of Life (in ha.)
Area Excavated	20.502	31.303	84.367
Storage of Top Soil	0.000	0.000	0.000
Waste Dump	19.780	41.444	61.861
Mineral Storage	9.321	10.321	10.150
Infrastructure (Workshop, Magazine etc)	0.300	0.4	1.761
Roads	2.536	3.053	3.958
Railways	0.000	0.000	0.000
Greenbelt	2.377	2.377	1.000
Tailing Pond	0.000	0.000	0.000
Effluent Treatment Plant	0.000	0.000	0.000
Mineral Separation Plant	0.000	0.000	0.000
Township Area	0.000	0.000	0.000
Others (to be specified)	0.000	0.000	0.000
Area that remains untouched(including Safety Zone, Private land, ST land etc.)	114.184	80.102	5.903
Total	169.000	169.000	169.000

The year-wise land degradation by virtue of development and their concurrent rehabilitation during this planned period of 2015-16 to 2019-20 is given in Table No.8.4 below;

Table No. 8.4

Year	Pit No	Mined Out area at the beginning	Additional area proposed during the year	Total Area (ha)	Area to be reclaimed & rehabilitated during the year	Mined out area at the end of the year (ha)
2015-16	Guruda - A	12.424	0.59	13.014	0	13.014
	Guruda - B	8.078	0.74	8.818	0	8.818
	Total	20.502	1.33	21.832	0	21.832
2016-17	Guruda - A	13.014	1.05	14.064	0	14.064
	Guruda - B	8.818	0.84	9.658	0	9.658
	Total	21.832	1.89	23.722	0	23.722
2017-18	Guruda - A	14.064	0.26	14.324	0	14.324
	Guruda - B	9.658	2.27	11.928	0	11.928
	Total	23.722	2.53	26.252	0	26.252
2018-19	Guruda - A	14.324	1.14	15.464	0	15.464
	Guruda - B	11.928	1.03	12.958	0	12.958
	Total	26.252	2.17	28.422	0	28.422
2019-20	Guruda - A	15.464	1.57	17.034	0	17.034
	Guruda - B	12.958	1.311	14.269	0	14.269
	Total	28.422	2.881	31.303	0	31.303

Overburden will be used for backfilling of Northern side of Guruda A Quarry over 3 ha. area in the extent of 11615N – 11760N and 11865E – 12108E. As this is a partial back filling of existing quarry and will remain active during the entire scheme period, hence this has not been considered as reclaimed and rehabilitated

It is further proposed that the slopes of all the overburden dumps shall be afforested by planting different local / forestry species for rehabilitation, varieties of grass and bushy plants along these slopes to further arrest the solids from wind erosion. The Concurrent reclamation of dumps will be done as per the practice. The amount of area likely to be degraded by way of dumping and proposed retreating method is given in Table No. 8.5.

Table No. 8.5

Year	Nature of Dump	Area at beginning of the year (ha)	Additional area degraded during the year (ha)	Area rehabilitated during the year (ha)	Balance area at the end of year (ha)
2015-16	Overburden	19.780	3.040	0	22.820
2016-17		22.820	6.560	5.457	23.923
2017-18		23.923	4.511	7.022	21.412
2018-19		21.412	5.676	5.438	21.650
2019-20		21.650	1.867	5.770	17.747

The proposal of mining operation,, dumping of overburden and stacking of finished product is as shown in the plan MP/TMM/R3/06A/14, MP/TMM/R3/06B/14, MP/TMM/R3/07A/14, MP/TMM/R3/07B/14.

The year-wise reclamation and rehabilitation measures to be undertaken during plan period is shown in plan no. MP/TMM/R3/10/14.

8.3.2 TOP SOIL MANAGEMENT:

As mentioned earlier, a small quantity of top soil will be generated while developing the virgin land and care shall be taken to excavate the top soil during end of summer season for its immediate usage for plantation during monsoon. Efforts shall be taken for not storing the top soil for more than three months to prevent the loss of its nutrients caused due to seasonal effects.

8.3.3 TAILING DAM MANAGEMENT:

Presently no mineral beneficiation is being done for low-grade manganese ore. Hence the generation of tailing from the mineral beneficiation process is not envisaged within the scope of present Progressive Mine Closure Plan.

8.3.4 ACID MINE DRAINAGE:

The main minerals in the country rock are goethite, limonite, clay, pyrolusite, psilomilane and bauxite. These minerals are non-toxic in nature in nature even when exposed to superficial weathering under tropical humid conditions. However, only higher amount of suspended particles are released into surface water during rainy seasons. The stream water during the summers are

remarkable clear. Since there is no washing / beneficiation of ore except for manual breaking and dry screening, treatment / disposal of water from processing operations are not required. As mining operations are on hill slopes, there is no possibility of ground water getting intercepted in future also.

Also viewing the regional as well as local geology, there is no surficial exposure of iron sulphide which can form chemical reaction with the surface run offs to make it acidic. Hence, acid mine drainage is not envisaged.

8.3.5 SURFACE SUBSIDENCE :

Although there is change in elevations caused due to opencast mining, the ground water did not intersect nor the workings are over the ground water table which may cause the land weaker than the original mass. Hence, surface subsidence is not envisaged.

INFORMATION ON PROTECTIVE MEASURES FOR RECLAMATION AND REHABILITATION:

The existing protective measures have been quantified in Table No. 8.5 (a) below:

Table No. 8.5 (a)

As on 01.10.2014					
Sl.No.	Dump No.	Location	Length (m)	Width (m)	Height / Depth (m)
1	Retaining Wall	Guruda - A	1027	1.2	1.2
2	Garland Drain		268	1.2	1
3	Settling Pit		14	8	1.2
4	Check Dam		13	2.9	1.2
			17	2.8	1.2
			18	3	1.2
5	Retaining Wall	Guruda - B	1220	1.2	1.2
6	Garland Drain		750	1.2	1
7	Settling Pit		12	9	1.2
8	Check Dam		17	8	1.3

The information on protective measures for reclamation and rehabilitation works carried out during last scheme period (i.e 2010-11 to 2014-15) is furnished below in Table No. 8.6.

Similarly, information on protective measures for reclamation and rehabilitation works to be carried out during ensuing scheme period (i.e 2015-16 to 2019-20) is furnished below in Table No. 8.7.
Further, the year-wise expenditure to be incurred for protective measures for reclamation and rehabilitation works to be carried out during ensuing scheme period (i.e 2015-16 to 2019-20) is furnished below in Table No. 8.8.

Table No. 8.6

Items	Details	Proposed (during last Scheme Period)	Actual (during last Scheme Period)	Remarks
Dump Management	Area Afforested (hect.)	2.1	8.5	
	No. of Saplings Planted	5250	56200	
	Cumulative no. of plants	Nil	79410	
	Cost including watch and care during the year	108000	1270560	During Scheme Period
Management of worked out benches	Area available for rehabilitation (ha.)	Nil	Nil	
	Afforestation done (ha)	Nil	Nil	
	No. of saplings planted in the year	Nil	Nil	
	Cumulative no. of plants	Nil	Nil	
	Any other method of rehabilitation (specify)	Nil	Nil	
	Cost including watch and care during the year	Nil	Nil	
Reclamation and Rehabilitation by Back Filling	Void available for Back Filling (L x B x D) pit wise	Nil	Nil	
	Void filled by waste / tailings (cum)	Nil	Nil	
	Afforestation on the back filled area	Nil	Nil	
	Rehabilitation by making water reservoir	Nil	Nil	
	Any other means (specify)	Nil	Nil	
Rehabilitation of waste land within lease	Area Available (ha)	Nil	Nil	
	Area Rehabilitated (ha.)	Nil	NIl	
	Method of Rehabilitation	Nil	Nil	
Others (specify)	-	Nil	Nil	

Table No. 8.7

Items	Details	Proposed (during this Scheme Period)	Actual (during this Scheme Period)	Remarks
Dump Management	Area Afforested (ha.)	23.700	Compliance shall be reported on yearly basis under Rule 23E (2) of the MCDR'1988	Ref. Table No.
	No. of Saplings Planted	59218		
	Cumulative no. of plants	138628		
	Cost including watch and care during the year	1475325		During Scheme Period
Management of worked out benches	Area available for rehabilitation (ha.)	Nil		
	Afforestation done (ha)	Nil		
	No. of saplings 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 Back Filling	Void available for Back Filling (L x B x D) pit wise	3 ha.		Back filling to be carried out during 2016-17
	Void filled by waste / tailings (cum)	460000		
	Afforestation on the back filled area	Nil		
	Rehabilitation by making water reservoir	Nil		
	Any other means (specify)	Nil		
Rehabilitation of waste land within lease	Area Available (ha)	Nil		
	Area Rehabilitated	Nil		
	Method of Rehabilitation	Nil		
Others (specify)	Construction of Retaining Wall	1125m		2015-16 - 550m + 2016-17- 575m
	Construction of Garland Drain with Settling Pit	1125m		2015-16 - 550m + 2016-17- 575m

Table No. 8.8

Sl.No.	Activity during plan period	Expenditure Planned (Rs)					
		2015-16	2016-17	2017-18	2018-19	2019-20	Total
1	Partial Back Filling of Guruda Block A Quarry	-	Expenditure included in Cost of Mining	-	-	-	Expenditure included in Cost of Mining
2	Construction of parapet wall/ retaining wall at toe of dumps	473000	494500	-	-	-	967500
3	Construction of check dams along the slope of valleys etc.	-	-	-	-	-	-
4	Construction of settling ponds (Garland drains etc.).	49500	51750	-	-	-	101250
5	Afforestation	0	342375	435750	336150	361050	1475325
6	Environmental Monitoring in Core & Buffer Zone	1500000	1500000	1500000	1500000	1500000	7500000
Total		2022500	2388625	1935750	1836150	1861050	10044075

8.4 DISASTER MANAGEMENT AND RISK ASSESSMENT:

Potential risks which may cause severe environmental degradation with or without the damage to properties, loss of life or serious bodily injuries are assessed based on the identified environmental impacts of all operations carried out in the mine. The potential emergency situations at Tiringpahar Manganese Mine may arise from the following causes:

(i) Damage to lubricant and HSD storage chambers / tankers
(ii) Failure of check dams
(iii) Explosions (in magazine, HSD tankers / storage chambers, LPG storage)
(iv) Fire

Action plan to deal with the above emergency situations are as follows:

No.	Emergency Situation	Steps to deal with the emergency
(i)	Damage to lubricant and HSD storage chambers / tankers	(a) Shift injured personnel, if any, to hospital (b) Cordon of the area (c) Plug the leakages, as far as possible (d) Stop the spillages spreading to larger areas (e) Arrange to collect the spilled material, as far as possible (f) Arrange to scrap the contaminated ground, if possible and dispose of the same as oily waste (g) Assess the impact and restore the normal situation
(ii)	Failure of check dams	(a) Arrange medical assistance, in case of injury (b) Block and plug the leakages with cement / sand bags (c) Intimate the people downstream or those likely to be affected by Public Address System (d) Assess the water quality leaving the lease area and environmental impacts
(iii)	Explosions / Fire	(a) Cordon of the area (b) Shift injured personnel, if any, to hospital (c) Arrange water tanker / fire brigade to deal with the fire (d) Roll call to search for missing person (e) Assess the impact and restore the normal situation (f) Investigate reasons for failure and take necessary corrective action for future

The following personnel with their responsibility shall be contacted in case of any disasters occurred within the Tiringpahar Lease in Table No. 8.9

Table No. 8.9

Designation	Contact No.	Responsibility
Mr. R.L.Joshi Designation: Manager At/PO: Bamebari, Via : Joda Dist. Keonjhar PIN - 758034 (ODISHA)	09438887806	➢ Identify and allocate the resources as required to alleviate the circumstances. ➢ Communicate the fact associated with disaster to all concerned for provision of resources, legal authorities as applicable and stake holders. ➢ Understand and implement at all levels including roles, responsibilities, authorities, initial & periodic training and continuous monitoring of activities and results to demonstrate the effectiveness of systems implemented to meet the company's policy and legal requirements.
Mr. Maruti Nandan Suman Designation: Safety Officer At/PO: Bichhakundi, Via : Joda Dist. Keonjhar PIN - 758034 (ODISHA)	09438887797	➢ Identify the safety aspects and impacts of the conditions and suggest immediate measures. ➢ Organize the resources as required to alleviate the circumstances. ➢ When determining controls, or considering changes to existing controls, consideration shall be given to reducing the risks according to the following hierarchy; a) Elimination; b) Substitution; c) Engineering controls; d) Signage/warnings and/or administrative controls; e) Personal protective equipment.
Mr. Apoorv Shukla Designation: Environment Officer At/PO: Bichhakundi, Via : Joda Dist. Keonjhar PIN - 758034	09438887804	➢ Identify the environmental aspects and impacts of the conditions and suggest immediate measure. ➢ When determining controls, or considering changes to existing controls, consideration shall be given to reducing the risks according to the following hierarchy; a) Elimination;

(ODISHA)		b) Substitution; c) Engineering controls; d) Signage/warnings and/or administrative controls;
Mr. VJ Ousepachan Designation: Sr.Manager (Security), At/PO: Bichhakundi, Via : Joda Dist. Keonjhar PIN - 758034 (ODISHA)	09438887779	➢ Assist Safety Officer & Environment Officer Organize the resources as required to alleviate the circumstances. ➢ Assist Manager Communicate the fact associated with disaster to all concerned for provision of resources, legal authorities as applicable and stake holders.

8.5 CARE AND MAINTENANCE DURING TEMPORARY DISCONTINUATION:

During temporary discontinuance, the following shall be complied.

(i) All access roads to the mine site are proposed to be stopped by a temporary drop gate.
(ii) Display boards are proposed in the access roads indicating "Mine Closed Temporarily – No Trespassers Allowed".
(iii) The top of every mine working is proposed to be adequately fenced so as to prevent any inadvertent fall within the pit.
(iv) Toe-wall with adequate height is proposed around every dump to prevent rolling of boulders and avoid any person from approaching the tip of the dump inadvertently.

The abandoned area shall be inspected at a regular interval by security personnel to determine any incident of illegal activity and once in a week by the Mining Engineer / Manager of the mine to determine any unsafe condition that may have developed during the period.

In the event of any temporary discontinuance of mining activity either due to any court order or statutory requirements or other unforeseen circumstances all efforts shall be made to ensure the following minimum services:

1 Uninterrupted power supply,
2 Uninterrupted drinking water supply and operation of drinking water treatment facilities,
3 Uninterrupted medical and ambulance services,
4 Uninterrupted security & firefighting services,
5 Environmental Monitoring as per the schedule,
6 Laboratory services for checking the quality of drinking water and water that is discharged after treatment,

Necessary staff for ensuring the operation and maintenance of the above services shall continue to remain on duty. The entire mine premises shall be regularly inspected in order to ensure that the workings are safe.

In case any unsafe or hazardous conditions are noticed, actions as enumerated above under the emergency plan shall be taken.

8.6 FINANCIAL ASSURANCE :

The amount of financial assurance to be deposited has been calculated based on the area proposed to be used for mining and allied activities at the rate of Rs. 25,000 / hectare. The area to be utilized has been evaluated on the basis of the land use pattern within applied RML area of 169.000 ha. at the end of the plan period, which is enclosed as drawing no MP/TMM/R3/12A/14. For this, the areas put to use for mining and allied activities and the area to be considered for financial assurance has been calculated as in the Table No. 8.10 to 8.12 given below.

Table 8.10

Table indicating break of areas in the Mining Lease for calculation of Financial Assurance (within applied RML area of 169.000 ha.)

Type of Use	As at Present	Additional requirement during plan period	As at end of plan period	Area considered as fully reclaimed	Net area considered for Calculation (in ha)
	A	B	C = A+B	D	E = C - D
Area Excavated	20.502	10.801	31.303	0	31.303
Storage of Top Soil	0	0	0	0	0
Waste Dump	19.78	21.664	41.444	0	41.444
Mineral Storage	9.321	1.000	10.321	0	10.321
Infrastructure(Workshop, Magazine etc)	0.3	0.100	0.4	0	0.4
Roads	2.536	0.517	3.053	0	3.053
Railways	0	0	0	0	0
Greenbelt	2.377	0	2.377	2.377	0
Tailing Pond	0	0	0	0	0
Effluent Treatment Plant	0	0	0	0	0
Mineral Separation Plant	0	0	0	0	0
Township Area	0	0	0	0	0
Others (to be specified)	0	0	0	0	0
Total Area considered for financial assurance	**54.816**	**34.082**	**88.898**	**2.377**	**86.521**
Area that remains untouched	114.184	-34.082	80.102		
Grand Total	169	0	169		

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Table 8.11

Table indicating break of areas in the Mining Lease for calculation of Financial Assurance (within applied ML area of 474.710 ha.)

Type of Use	As at Present	Additional requirement during plan period	As at end of plan period	Area considered as fully reclaimed	Net area considered for Calculation (in ha)
	A	B	C = A+B	D	E = C - D
Area Excavated	2.180	0	2.180	0	2.18
Storage of Top Soil	0	0	0	0	0
Waste Dump	4.160	0	4.160	0	4.16
Mineral Storage	0	0	0	0	0
Infrastructure(Workshop, Magazine etc)	0	0	0	0	0
Roads	0	0	0	0	0
Railways	0	0	0	0	0
Greenbelt	2.000	0	2	2	0
Tailing Pond	0	0	0	0	0
Effluent Treatment Plant	0	0	0	0	0
Mineral Separation Plant	0	0	0	0	0
Township Area	0	0	0	0	0
Others (to be specified)	0	0	0	0	0
Total Area considered for financial assurance	**8.340**	**0**	**8.340**	**2**	**6.34**
Area that remains untouched	466.370	0	466.370		
Grand Total	474.710	0	474.710		

Remarks :

These areas excavation and waste dump covering 6.340 ha has already been rehabilitated by plantation during 2006-07. Video for the same was submitted in compliance to Point no. 09 of the approval letter no. BBS/KJ/Mn/MS-147, dated. 28.04.2006. But the same area is yet to be certified as fully reclaimed & rehabilitated.

Table 8.12

Table indicating break of areas in the Mining Lease for calculation of Financial Assurance (within RML applied area of 169.00 ha. & ML applied area of 474.710 ha.)

Type of Use	As at Present	Additional requirement during plan period	As at end of plan period	Area considered as fully reclaimed	Net area considered for Calculation (in ha)
	A	B	C = A+B	D	E = C - D
Area Excavated	22.682	10.801	33.483	0	33.483
Storage of Top Soil	0	0	0	0	0
Waste Dump	23.940	21.664	45.604	0	45.604
Mineral Storage	9.321	1.000	10.321	0	10.321
Infrastructure(Workshop, Magazine etc)	0.300	0.100	0.4	0	0.4
Roads	2.536	0.517	3.053	0	3.053
Railways	0	0	0	0	0
Greenbelt	4.377	0	4.377	4.377	0
Tailing Pond	0	0	0	0	0
Effluent Treatment Plant	0	0	0	0	0
Mineral Separation Plant	0	0	0	0	0
Township Area	0	0	0	0	0
Others (to be specified)	0	0	0	0	0
Total Area considered for financial assurance	**63.156**	**34.082**	**97.238**	**4.377**	**92.861**
Area that remains untouched	580.554	-34.082	546.472		
Grand Total	643.710	0	643.710		

After subtracting the area already rehabilitated and reclaimed, the area to be considered for financial assurance is calculated to be 92.861 ha. The financial assurance for the above mentioned area @ Rs 25,000/- per ha. is calculated to be Rs 23,21,525 (Rupees Twenty three lakhs twenty one thousand five hundred and twenty five only).

PART – B

Certificate / Undertaking by Applicant (2 PAGES)

CERTIFICATE FROM RQP

The provisions of the Mineral Conservation and Development Rules 1988 have been observed in the preparation of the Scheme of Mining for Tiringpahar Manganese Mine over the original lease of 643.710 ha includes RML area over 169 ha of M/s Tata Steel Limited in villages Guruda, Palasa (Kha), Jadibahal, Khondbondh, Joruri, Jalahari, Jajanga and Baitarani Reserve Forest, P.O. Bamebari, Via : Joda, District : Keonjhar, State : Odisha and whenever specific permissions are required, the applicant will approach the concerned authorities of Indian Bureau of Mines.

The information furnished in the Scheme of Mining is true and correct to the best of our knowledge.

Place : Sukinda
Date : 18.02.2015

Name : Haridrumat Behera
RQP Registration No. RQP/BBS/093/2010-A

Haridrumat Behera
Regd.No.-RQP/BBS/093/2010-A