MINING PLAN OF SARKANDA MANGANESE DEPOSIT OVER AN AREA OF 19.60 HECTARES. IN BONAI SUB-DIVISION OF SUNDARGARH DISTRICT, ORISSA.

अनुमोदित
APPROVED

submitted under rule 22 of M.C.R., 1960

This Mining Plan is approved subject to the conditions/stipulations indicated in the Mining Plan approval letter No. CAL/SG/Mn/MP-318 dt. 25.9.94

Regional Controller of Mines,
Indian Bureau of Mines

Name of Consultant : Jagadish Misra

Date of Report : 28th March, 1994.

JAGADISH MISRA
B. Sc., B.E. (CIVIL), A.M.I.E. (MINING)
CHARTERED ENGINEER (INDIA)

PHONE : P.C.O.--EXTN. 1
(RAIRANGPUR EXCHANGE)
P.O. GORUMAHISANI
DIST. MAYURBHANJ
ORISSA

CERTIFICATE OF INDIAN BUREAU OF MINES

THIS IS TO CERTIFY THAT THE PROVISIONS OF MCDR ~~1988~~ HAVE BEEN OBSERVED IN THE MINING PLAN OF SARKANDA MANGANESE DEPOSIT AND WHEREVER SPECIFIC PERMISSION ARE REQUIRED, THE APPLICANT/MINE OWNER WIDL APPROACH THE CONCERNED AUTHORITIES OF INDIAN BUREAU OF MINES FOR GRANTING THE PERMISSION.

PLACE : BHUBANESWAR.

DATED : 28.03.1994.

(JAGADISH MISRA)
SIGNATURE OF CANSULTANT:
REGN. NO: RQP/CAL/042/87A.

ADDRESS : 55, KHARAVELA NAGAR
UNIT III.
P.O. BHUBANESWAR.
DIST. PURI, ORISSA.

PHONE NO: 402695
402519

APPROVED

This mining plan is approved subject to the conditions indicated in the Mining ... letter No. SA/15G/Mn/ 318.01 ... 25.9.94

Regional ... Bhubaneswar

JAGADISH MISRA
B.Sc., B.E. (CIVIL), A.M.I.E. (MINING)
CHARTERED ENGINEER (INDIA)

PHONE : P.C.O.—EXTN. 1
(RAIRANGPUR EXCHANGE)
P.O. GORUMAHISANI
DIST. MAYURBHANJ
ORISSA

GOVT. OF INDIA – INDIAN BUREAU OF MINES

ENDORSEMENT CERTIFICATE

1. THE PROVISIONS OF MINES ACT, RULES AND REGULATIONS MADE THEREUNDER HAVE BEEN OBSERVED IN THE MINING PLAN OF SARKANDA MANGANESE DEPOSIT, LEASE HOLD OF SRI JAGADISH MISRA AND WHEREVER SPECIFIC PERMISSION REGARDING MINING AND ALLIED ACTIVITIES ARE REQUIRED THE APPLICANT (SRI JAGADISH MISRA) WILL APPROACH D.G.M.S.

APPROVED

2. THE MINING PLAN OF 'SARKANDA MANGANESE DEPOSIT' OVER AN AREA OF 19.60 HECTS. IN BONAI SUB-DIVISION OF SUNDARGARH DISTRICT, ORISSA; IS SUBMITTED UNDER THE RULE 22 OF M.C.R. 1960 FOR THE FINAL APPROVAL. THIS MODIFIED PLAN INCORPORATED ALL THE DEFICIENCES AS OBSERVED BY INDIAN BAREAU OF MINES(IBM).

I SRI JAGADISH MISRA A RECOGNISED QUALIFIED PERSON OF I.B.M. CERTIFIED THAT ALL THE NECESSARY PARTICULARS FURNISHED IN THE ABOVE MENTIONED MINING PLAN ARE TRUE AND CORRECT TO THE BEST OF MY KNOWLEDGE AND BELIEF.

PLACE : BHUBANESWAR.

DATED : 28.03.1994.

(JAGADISH MISRA)
CONSULTANT & APPLICANT
REGN. NO: RQP/CAL/042/87A.

This ... the ... the M... No.....

Regional ... of Mines.
Indian Bureau of Mines

This Mining Plan is approved subject to ... contained in ...

Government of Orissa
Department of Steel & Mines

No. 10173 /SM Bhubaneswar, the 7-9.93
III(B)SM-113/92

From,

Shri A.K.Das,
Addl.Secretary to Govt.

To

Sri Jagadish Mishra,
At/P:O: Gorumahisani,
Dist: Mayurbhanj.

Sub: Application dt.16.7.79 of Sri Jagadish Mishra for grant of M.L. for manganese ore over an area of 19.60 Hects. in Sarkunda R.F. under Bonai Sub-Division of Sundergarh district.

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Sir,

I am directed to invite a reference to your letter No.SM/885/47/93 dt.1.7.93 on the subject noted above and to say that Government had decided to grant mining lease for manganese ore over an area of 41.60 Hects. as decided earlier in your favour in Sarkunda R.F. under Bonai Sub-Division. As you ~~interested~~ extend to reduce the area to 19.66 Hects., you are therefore intimated under proviso to Rule 22(3)(e) of the M.C.Rules 1960 to furnish the approved mining plan of the area proposed to be granted under mining lease within a period of six months from 1.7.93 as intimated to you in letter No.7712 dt.29.6.93. You are also requested to furnish approval of Government of India in respect of forest land as required under Forest(Conservation) Act, 1980 within the statutory period of six months failing which your application will be disposed of as per law.

Yours faithfully,

Addl. Secretary to Government

Regio
Ins
of Mines

Memo No. /SM, Bhubaneswar, the

Copy forwarded to the Collector, Sundergarh/Director of Mining and Geology, Orissa, Bhubaneswar/Deputy Director Mines, Koira for information and necessary action.

Addl.Secretary to Government

REGISTERED PARCEL

GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES.

No.CAL/SG/Mn/MP-318

234/4, AJC Bose Road,
Calcutta - 700 020.
Dated September 24, 1993.

To,

M/s. Jagadish Misra
At/P.O. : Gorumahisani
District: Mayurbhanj
Orissa
Pin : 757 042.

Sub. Mining Plan of Sarkunda Manganese Deposit over an area 41.60 Hects in Sundargarh district, Orissa, submitted under Rule 22 of MCR, 1960.

Sirs,

On receipt of your above mining plan on 11.6.93, the deposit/area was inspected on 7.8.93 by S/Sri D.Nag, Deputy Controller of Mines and M.Sengupta, Senior Mining Geologist when yourself was also present. On the basis of above inspection, the following deficiencies are observed in the mining plan. You are, therefore, advised to modify the mining plan accordingly and submit the modified mining plan duly bound in six copies within 60 days of this letter for further consideration at this end.

1. Para 3.3.1

The salient geological data of the trial pits along with its location on geological plan etc. carried out by the previous lessee if available should be incorporated.

On the geological plan, grid lines, bench mark with RL, location of the existing and proposed dumps, etc. have not been shown. Also the different litho units should be shown with proper colour scheme. There the plan should accordingly be modified by showing the details indicated above. The geological plan should be supported with GS and TS passing through strategic points.

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2. Para 3.3.2

Nothing has been proposed under the future exploration programme. Trial pits at a regular interval of 25-50

should be proposed phasewise/yearwise for site No.I and II for better understanding of the deposit and the exploration report should be submitted within the term of the mining plan i.e. five years.

3. Para 3.3.2

On the geological plan, the zone of proved and probable reserves should be demarcated. Further there is a variation on the ore reserve indicated in the summary are Tables no.3 & 3A and the same should be corrected. Cross sections indicating the proved and probable zones for Site I and II should be incorporated.

4. Rule under which the mining plan is submitted, name of the deposit, extent of the area (Ha), name of the Consultant and date of the report should be incorporated on the cover page and title page.

5. Para 2.6

Since the lease area is in forest land, legal status of the forest, namely reserved, unclassed etc. and name of the forest division, forest block, compartment etc. should be discussed under this para.

6. Plates

a) Key Plan should show all the features as required under MCDR 1988.

b) Surface Plan enclosed, does not show the grid lines, contours and other details as indicated, in Rule 28(1)(a), including different types of forest lands etc. Hence the surface plan should be suitably modified and enclosed with the mining plan.

c) Plates 4A, 4b, 4c, 4d

i) Plate 4d has not been enclosed with the draft mining plan.

ii) Plates 4a, 4b, 4c enclosed with the mining plan does not carry any meaning. Therefore, yearly pit design plans at the end of 1st year, 2nd year, 3rd year, 4th year as well as 5th year should be

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Indian Bureau of Mines

6.(c)ii) prepared showing various lithounits and position of the benches with their RLs, approach roads, contours at 3-5 m interval, grid lines etc. Accordingly separate pit design plans for each year should be submitted.

(d) At least 2 sections showing the yearly positions of the benches together with the litho units should be drawn and enclosed in the mining plan.

(e) Dump plans and sections of the proposed dump have not been incorporated in the mining plan.

(f) Environment plan has not been prepared as per the details as indicated in Rule 28(5)(b) of MCDR 1988.

7. In para 4.1, how the pits 1 & 2 will be developed by forming benches in overburden and ore need to be spelt out indicating number of benches to be worked every year in ore & O.B. Accordingly the paragraph should be modified.

8. Para 4.5.1

Detailed calculations regarding requirement of machinery should be included.

9. Para 5.0

Calculation of consumption of explosives etc. should be incorporated in the mining plan.

10. Para 7.0

Description regarding waste disposal given in para 7.0 does not include description regarding all the sub-headings given in the outline of mining plan including generation of sub-grade ore. Therefore, this chapter should be suitably modified.

11. Inventory of flora and fauna in the lease area and Buffer Zone should be obtained from forest department and given in the text, while doing so, number of trees available in different cluster of vegetation within the mining lease area and beyond 60m of the lease area should be counted. Also, number of trees likely to be felled during the next 5 years should be spelt out.

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Regional
Indian Bureau of Mines

(JAGADISH MISRA)

12. Saplings already planted every year in the past and those proposed to be planted every year during the next five years indicating the types of species, number, survival rate, fund earmarked etc. should be given in tabular form.

13. In a separate chapter, various conservation measures including recovery of sub-grade ore for blending as well as developmental problems and solutions thereto should be described.

14. In a separate chapter, the conceptual plan indicating the future development during the next 10 years and 20 years together with the envisaged reclamation measures should be described. This should cover the following aspects.

a) Ultimate extent and size of the pit/pits.
b) The final slope angle adopted.
c) The post mining reclamation and land use pattern.
d) Mineable reserves and anticipated life of the mine based on techno-economic factors.

15. Add a few representative colour photograph of the area to show the present condition of existing quarries, dumps, existing vegetation etc.

16. Since the area falls under reserve forest a separate E.M.P. should be prepared as per the D.O.E. guideline, by establishing suitable and adequate number of monitoring stations in core zone and buffer zone as per the direction of wind in different seasons for ambient quality monitoring of air, water, soild, noise level etc.

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17. The following certificates are to be incorporated in the modified mining plan :-

(a) DGMS
(b) Certificate of correctness of the mining plan from RQP
(c) IBM certificate as per enclosed format.

Encl : One copy of draft mining plan.

Yours faithfully,

Regional Controller of Mines, Indian Bureau of Mines

(T BISWAS)
Regional Controller of Mines
Indian Bureau of Mines

JAGADISH MISRA
REGN. No-RQP/CAL/042/87A.

1. Copy to Sri Jagadish Misra, RQP,
55, Kharvela Nagar, Unit III
P.O. : Bhubaneswar
Pin : 751 001
Orissa

for his information and necessary action.

Copy forwarded for kind information to :-

2. The Chief Controller of Mines, IBM, Nagpur

3. The Controller of Mines (CZ), IBM, Nagpur.

(T BISWAS)
Regional Controller of Mines
Indian Bureau of Mines.

JAGADISH MISRA
REGN. No-RQP/CAL/042/87A.

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Regional Controller of Mines.
Indian Bureau of Mines.

Comments made by Indian Bureau of Mines on the draft Mining Plan of Sarkanda Manganese Mine submitted by M/s Jagadish Misra. The said modifications have been incorporated in the final Mining Plan as under :

1. Para 3.3.1

The salient geological data of the trial pits along with its location on geological plan etc. carried out by the previous lessee if available should be incorporated.

On the geological plan, grid lines, bench mark with RL, location of the existing and proposed dumps, etc. have not been shown. Also the different litho units should be shown with proper colour scheme. There the plan should accordingly be modified by showing the details indicated above. The Geological plan should be supported with IS and TS passing through strategic points.

The geological data of the trial pits, their locations on the geological plan and other exploratory works carried out by previous lessee are not available from appropriate authority.

Modified geological plan (Fig. 2) incorporating all the mentioned items are included and described under the same para (3.3.1). The different lithology are marked on the geological plan by using different symbols and coloured. Longitudinal section and transverse section (Fig. 3) along two strategic points marked on geological plan (Fig. 3) are provided. Proposed dump sites are shown in Fig. 6.

2. Para 3.3.2

Nothing has been proposed under the future exploration programme. Trials pits at a regular interval of 25-50m should be proposed phasewise/yearwise for site No.1 and II for better understanding of the deposit and the exploration report should be submitted within the term of the mining plan i.e. five years.

The future exploration schedule carried out by lessee over the area described in details under the same para (3.3.2)

Contd..... P/2

and phasewise/yearwise programme over site No. 1 and site No. 2 tabulated in table No. 3.

3. Para 3.3.2

On the geological plan, the zone of proved and probable reserves should be demarcated. Further there is a variation on the ore reserve indicated in the summary are Tables No.3 & 3A and the same should be corrected. Cross sections indicating the proved and probable zones for Site I and II should be incorporated.

The proved and probable reserves zones for the deposit are demarcated on the geological map by different symbolic line and discussed under the para 3.3.2. The reserve calculation was checked and provided in table No. 4 and table No. 5. The proved and probable zones for site No. 1 and site No. 2 are demarcated by some symbolic line on geological sections, Fig. 3.

4. Rule under which the mining plan is submitted, name of the deposit, extent of the area (Ha), name of the Consultant and date of the report should be incorporated on the cover page and title page.

The mining plan is submitted under the rule 22 of M.C.R., 1960. The lessee intends to mine Manganese ore only. The extent of area is 19.60 hectares. The name of the consultant is M/s Jagadish Misra and date of submission March, 1994. All the above informations are incorporated in Mining Plan and also cover page and title page.

5. Para 2.6

Since the lease area is in forest land, legal status of the forest, namely reserved, unclassed etc. and name of the forest division, forest block, compartment etc. should be discussed under this para.

All the necessary informations available under item in No. 5 of your comments are provided in para 2.6.

Contd.... P/3

6. Plates.

a) Key Plan should show all the features as required under MCDR 1988.

The Key Plan (Fig. 1) is modified by including only those features which are appropriate for the site as mentioned in M.C.D.R. 1988.

b) Surface Plan enclosed, does not show the grid lines, contours and other details as indicated, in Rule 28(1)(a), including different types of forest lands etc. Hence the surface plan should be suitably modified and enclosed with the mining plan.

A modified surface plan (Fig.5) has enclosed with this mining plan incorporating all the deficiencies.

c) Plates 4A, 4b, 4c, 4d.

i) Plate 4d has not been enclosed with the draft mining plan.

ii) Plates 4a, 4b, 4c enclosed with the mining plan does not carry any meaning. Therefore, yearly pit design plans at the end of 1st year, 2nd year, 3rd year, 4th year as well as 5th year should be prepared showing various lithounits and position of the benches with their RLs, approach roads, contours at 3-5 m interval, grid lines etc. Accordingly separate pit design plans for each year should be submitted.

A details layout plans (design) after each year operation of the first five years plan are provided for both the producing quarries. In the yearwise pit design which obtained from General layout plan (Fig.6) by enlarging those parts of site No.1 and site No.2 only which will be effected during 1st. five years into 1 : 400 scale (see Fig.7 and 8). The yearvise designs incorporated mine approach road, position of benches, contours at 2m. interval, grid line etc. and other surface features (See Figs.9-13 for quarry No.1, and Figs.14-18 for quarry No.2) are provided in this revised mining plan.

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d) At least 2 sections showing the yearly position of the benches together with the litho units should be drawn and enclosed in the mining plan.

For five years layout of two quarries namely Quarry Nos. 1 & 2 two sections for each quarry showing yearly position of the benches with litho-units attested in Fig.11, Fig. 13 for quarry No. 1 and Fig. 16 and Fig. 18 for quarry No. 2 respectively.

e) Dump plans and sections of the proposed dump have not been incorporated in the mining plan.

Dump plan and sections for proposed dump sites are made and incorporated in this plan (See Fig.19) and discussed briefly in chapter VII.

f) Environment plan has not been prepared as per the details as indicated in Rule 28(5)(b) of MCDR 1988.

The environmental plan (Fig.20) has been prepared incorporating all the applicable informations provided in Rule 28 (5)(b) of M.C.D.R. 1988.

7. In para 4.1, how the pits 1 & 2 will be developed by forming benches in overburden and nre need to be spelt out indicating number of benches to be worked every year in ore & O.B. Accordingly the paragraph should be modified.

The required benches for 1st five years to reach the targeted production are discussed briefly in para 4.1 and number of benches in ore and overburden required for each year are obtained from table No. 12 and table No. 13 in this modified version.

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8. Para 4.5.1

Detailed calculations regarding requirement of machinery should be included.

In the modified plan an attempt has been made to drawn a details calculation regarding requirement of machineries are included under the para 4.5.1.

Contd....P/5

13. In a separate chapter, various conservation measures including recovery of sub-grade ore for blending as well as developmental problems and solutions thereto should be described.

For various conservation measures like recovery of sub-grade ore as well as developmental problems and their solution are critically delineated and illustrated briefly under separate chapter XIV.

14. In a separate chapter, the conceptual plan indicating the future development during the next 10 years and 20 years together with the envisaged reclamation measures should be described. This should cover the following aspects.

a). Ultimate extent and size of the pit/pits.
b). The final slope angle adopted.
c). The post mining reclamation and land use pattern.
d). Mineable reserves and anticipated life of the mine based on techno-economic factors.

A conceptual plan incorporating all the headlines as mentioned in serial No. 14 of your comments sheet are described in chapter XV of this revised mining plan.

15. Add a few representative colour photograph of the area to show the present condition of existing quarries, dumps, existing vegetation etc.

Seven number of representative colour photographs are incorporated in the modified mining plan in appropriate para of different chapters. These photographs are marked as Fig. 4, Fig. 5, Fig. 6, Fig. 9, Fig. 10, Fig. 26 and Fig. 27.

16. Since the area falls under reserve forest a separate E.M.P. should be prepared as per the D.O.E. guideline, by establishing suitable and adequate number of monitoring stations in core zone and buffer zone as per the direction of wind in different seasons for ambient quality monitoring of air, water, solid, noise level etc.

The Environment Management Plan (E.M.P.),Chapter XIII, of this revised version was prepared incorporating all the necessary particulars obtained from D.O.E. guideline. Special attentions was imparted on the ambient quality of air, water, solid and noise levels at different monitoring station over the core zone and buffer zone as per the direction of wind. Necessary analysis reports for ambient quality of air, water, noise have been furnished.

17. The following certificates are to be incorporated in the modified mining plan :-

(a) DGMS
(b) Certificate of correctness of the mining plan from RQP
(c) IBM certificate as per enclosed format.

All the mentioned certificates are furnished.

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Indian Bureau of Mines.

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PART - ONE

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Director of Mines.

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Indian Bureau of Mines.

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Fig. 19 - Aerial configaration of quarry No. 2 after the end of 1st year.

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LIST OF TABLES

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Regional Controller of Mines
Indian Bureau of Mines

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Annexure 4	-	Chemical analysis report of Manganese ore.

PART : ONE

CHAPTER - I

1. **INTRODUCTION :**

Manganese ores assume a high order of strategic importance because of its indispensable role in metallurgy on the fabric of which rests the national economy. It has ushered the development of these strategic minerals in our country since last few decades. Proper resource evalution of the minerals have been undertaken on priority basis by different Central and State agencies of the country. Modernisations of Iron and Steel Plants coupled with growth of different sponge iron units in the recent past has increased the consumption of this mineral also. Utilisation of Manganese minerals is extensively made in Battery Industry, Chemical Industry, Glass Industry and explosive units etc. in addition to prolific uses in Iron and Steel Industries.

Incidentally major manganese deposits of the state are associated with Banded Iron Formation of Precambrian age and are mainly confined to Jamda-Koira valley of the Iron ore belt of Orissa. A total reserve of about 21 million tonnes of Manganese ore with cut-off grade as 25% has been estimated by Geological Survey of India during 1975 in Orissa out of which 5.95 million tonnes, 5.78 millions and 19.25 million tonnes are categorised as measured, indicated and inferred.

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The area Sarkanda Manganese deposit of Sundargarh district for which the mining plan is being prepared, exposes rocks of Iron ore group. Manganese deposits of the area are noted to be intimately associated with low metamorphosed cherty shale/phyllite formations representing the lower stratigraphic sequence of Iron ore group.

The region, representing a part of the 'Iron Ore Belt' has been explored since 1934 by Jones and was subjected to detail exploration and exploitation by number of Central and State agencies specifically for Iron and Manganese Ores.

The applied area under reference, being explored and exploited for Manganese by previous lessee M/s Aryan Mining and Trading Corporation Ltd., has helped together sufficient informations on the occurence of manganese deposits, based on which Sri Jagadish Misra

has applied for mining lease over the same area for manganese ores of Sundargarh District Orissa and the lease was granted in favour of Mr. Jagadish Misra and the letter is enclosed with this mining plan. Several numbers of quarries and excavations (trial pits) are encountered in the applied area during the present investigation which has helped to have an explicit ideas regarding nature of disposition of ore bodies and has become the basis for preparation of this plan.

The applicant Sri Jagadish Misra, a A.M.I.E., Mining Engineering Certificate holder has enough experience in mining of Iron, China Clay deposits etc.

The Manganese mined from this mine are mainly marked to Iron and Steel Industries in our country. However, with the installation of several small scale Sponge Iron Plants in the neighbouring area and due to modernisation of several Steel Plants, it is imperative that the demand for manganese in the country will increase to a greater extent. This has become the main backdrop of the present applicant to operate a manganese mine over the said area.

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CHAPTER - II

2. **GENERAL :**

1. **Name and address of the applicant :**

M/s. Jagadish Misra
At/P.O. Gorumahisani
Dist. Mayurbhanj (ORISSA)
PIN - 757042.

2. **Status of applicant :**

The applicant, a qualified Mining Engineer, is a private individual, actively engaged in mining activities in the field of Iron Ore, China clay for over 20 years.

3. **Mineral which the applicant intends to mine :**

Manganese ores only.

4. **Name, Address and Registration Number of the person who prepared the Mining Plan :**

Sri Jagadish Misra, B.Sc. B.E. (Civil Engineer)
Chartered Engineer (India)
A.M.I.E. (Mining Engineer)
Residing at : 55, Kharvela Nagar, Unit III,
Bhubaneswar- 751001 (Orissa).

Registration No : RQP/CAL/042/87A, valid upto 10.12.1993
This mining plan was prepared with the co-operation of Geologist Mr. Ashoke Seth.

5. **Name and Address of the prospecting agency :**

The applicant has engaged experience Geologist and Surveyor to prospect the lease area of Sarkanda Manganese deposit.

6. **Details of the area :**

The lease area of Sarkanda Manganese Deposit is situated in Sarkanda State Forest under the Police Station Koira in Bonai Sub-Division of Sundargarh District, Orissa. The area comes within Survey of India topo sheet number 73 G/1 (Fig.1) within 85°10'- 85°15'E long. and 21°50'- 21°50' N lat.

The details of the land covered within the area are as follows :-

Dist. & State.	Taluk.	Ownership/Occupancy.	Area in Acres.
Sundargarh, Orissa.	Koira	Reserved Forest Land entirely under State Government.	48.412 Acres or 19.60 Hectares.

7. Period for which Mining Lease is required :

The applicant intends to work on a long term plan so as to have an effective optimum utilisation of the resources. Hence, it is necessary that the mining lease period is desirable for at least 30 years.

8. Infrustructure :

The lease block under reference covering an area 19.60 hectares or 0.196 Sq.Km. is located near south of Tensa and West west-south of Korapanipahar (RL 813 m) at a distances of about 2.5 Km. and 722 m. respectively. The P.W.D. metallic main road passing from Tensa to Koira is at a distance of about 1 Km. from northern side of lease area and is further connected by an unmetalled and fair weathered road from mine site to this main road. The nearest railhead is Barsuan, about 25 Km. from the mine site, which in turn connected to Bimlagarh Kiriburu branch of South Eastern Railways. There is no electricity facilities at the mine site, though Orissa State Electricity Board (O.S.E.B.) supplied electricity to the nearby place Tensa and electricity is also available at Dengula which is situated at a distance of about 4 Km. north-east from lease area. There are no villages and other related necessary infrastructural facilities available at the lease area as it occured entirely within the Sarmanda Reserve Forest. State buses, private buses and other transport facilities are available only from Tensa and Dengula.

It is proposed that opencast mining methods will be adopted and the mine will run manually. The transportation of ores from mine to railhead will entirely depend on truck/dumpers.

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CHAPTER -III

3. GEOLOGY AND RESERVE

3.1 LOCATION :

The Sarkanda Manganese Mine having lease area of 48.412 acres or 19.60 hectares is located between the co-ordinates 85°10' to 85°15' E longitude and 21°50' to 21°53' N latitude within Survey of India toposheet 73 G/1 (R.F. : 1:50,000) (Fig. 1).

3.1.1 PHYSIOGRAPHY :

Sarkanda Manganese deposits is situated on the north eastern slope of a hill (R.L. 720 m.) adjacent to the Korapani pahar. It is a hilly area comprising several hills and valleys in between. The present lease block is only 19.60 hectares area occupying north-eastern part of gradual slopping hill (RL 720 m.). A valley is situated in the western side beyond the lease area and is traversed by a seasonal nallah trending NNE-SSW, originated from two tributary of Korapani pahar (RL 813 m.) further southern part. This nallah flows along the valley and meets a another seasonal nallah named Janghat nallah which is flowing along the EC boundary of the lease block (trending roughly E-W) at the much lower level. These entire drainage system ultimately flows to Sarkanda Nadi, situated for southern side of the area (Fig. 1). Besides these, there are also some impersistent and seasonal nallahs in the depressions of the hill slope (northernly) created between neighbouring spur and mounds. In general gradient of the hill is gentler in north eastern part than the other sides of the lease area. The elevation differences in this block is 100 m. having lowest contour 600 m. above the mean sea level. Manganese ore deposition took place near the surface along the slope of the hill.

3.1.2 The lease block is located within Sarkanda Reserve Forest, as a result, there are no villages within the lease hold and also surrounding the lease area within a radius of about 3 Km. The nearest township is Koira about 10 Km. from mine site and the area is situated 3.00 Km. North of Sarkanda Nadi.

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3.2 GEOLOGY :

3.2.1 Regional Geology :

The slightly Metamorphosed volcanic and sedimentary sequence of rocks occuring in and around this lease area, belongs to the Iron ore series (Dharwar equivalent) of Precambrian age (Jones 1934). The stratigraphy of this region established by Jones (1934) from a part of western limb of the northernly plunging asymmetric synclinorium

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which is othervise known as famous 'Bonai Synclinorium' was modified by the later workers like Dunn (1940), Mishra (1961) and Sarkar and Saha (1983). Murty (1975) has suggested an altogether different lithostratigraphic succession based on his studies of the western limb and the southern part, near to the closure of the major synclinorium which is as follows :-

	Kolhan Group	
	Mixed facies formation	1. Banded shale member
	Upper shale formation	2. Black shale member
	Banded Iron formation	1. Chert shale member
Koira Group		3. Finely banded Jaspillite member
		2. Coarsely banded Jaspillite member
	Volcanic formation	1. Shaly member
		1. Basic lava member
		Basal Sandstone Quartzite.

Singhbhum and Bonai Granite with enclaves of metamorphosed sediments.

The regional stratigraphy as postulated by Sarkar and Saha (1983) is given below :-

	——— Unconformity ———
	Singhbhum granite (3000 Ma)
	——— Iron ore orogeny ———
	Epidiorite
Iron Ore Group	Upper shales with sandstone and volcanics
	B.H.J. with Iron ores
	Lower shales tuffs and acid volcanics
	Mafic lavas with tuffs
	Sandstone and conglomerate (local)
	——— Unconformity ———
	Older Metamorphic Tonalite Gneiss (OMTG 3800 Ma)
	——— Older Metamorphic orogeny ———
	Older metamorphic group (OMG)
	Maffic intrusive, Calc - Magnesian Metasediments, Quartzite etc.
	——— Basement (3800 Ma) ———

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From the stratigraphy, the lithounits of the region can be broadly catagorised into the followings :

i) Basic volcanic rocks, lavas - Dolerite etc.
ii) Iron ores formation, stratiform deposits such as BHQ/BHJ.
iii) Argillaceous suit of rocks (such as phyllite/shale) which are the host rock of manganese mineralisation too. Here, only no.(iii) is traceable in the leasehold area, i.e. lower number of Iron ore series.

3.2.1.1 The rocks are profusely weathered and are readily identifiable by the presence of lateritisation. Iron Ore bodies are generally located directly on shales. Such lower number shale occassionally contain the manganese mineralisation too. Manganese mineralisation as famous "Bonai Synclinorium". In general, it is concentrated in the trough of both regional and small scale synclinorium. Cross folds and superimposed folds shows the best site for economic concentration of Manganese deposits.

The essential factors required for the formation of manganese deposits as postulated by field observation are :-

i) Manganeferous argillaceous sediments (shale/phyllite),
ii) the extent, degree as well as the intensity of recrystallisation,
iii) the tectonic set-up of the host rocks, and
iv) the intensity and degree of weathering.

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3.2.2 LOCAL GEOLOGY (Geology of the leasehold) :

Within small extent of the lease area, lithological succession of the rocks and delineation of local structural variations (if any) which governed the manganese mineralisation is not possible. The lithotypes present in the leasehold are mainly alternation products, i.e. Laterite, silicified Phyllite/shale (mostly decomposed) and alluvium (soil). Laterites are recemented and compact (Conga) occured at the higher reaches of hill mainly. Sometimes these Conga composed of shale pebbles, lateritic masses, limonites etc. give rise to a conglomeratic products of recent origin. These conglomeratic deposits contains some exploitable manganese deposits and are exposed at the top of the hills. Conglomerate also occured at the lower part of the hill along with decomposed phyllite. It is very clear in the field that size of these boulders (Conga) reduced along the slope.

Alluvium soil though rare is recorded at the lower level beyond the lease block. Due to profused decomposition phyllite/shales have lost their physical characters, internal structures and ultimately given rise to soil with admixture of lateritic pebbles. Beside these rock types, quartzite is also present at the higher level where manganese minerals are also recognised. Different cited lithotypes are identified and properly marked on the geological plan (Fig. 2).

3.2.2.1 Manganese deposits occure within the recemented laterite (Congo) and also within phyllite/shale at variable depth. Lateritoid deposits of two types are present in this area which altogether contains about 30% of the total lease block. One of such type manganese deposit occuring within lateritic masses and other one is occurring within underlying silicified phyllitic shales. Of these, the deposits within lateritic capping are of lateritic origin but derived from the underlying manganiferous sediments. The deposits within the phyllitic shales may be of sedimentary origin as indicated by the conformity of the ore bodies with the host rocks and presence of continuous planner features within the deposits and the host rocks. Float ores of both types as mentioned are present in this region. Probably folds have played an important role in bringing the ore bodies to the surface or near surface. The lateritoid manganese ore deposits were produced probably due to metasomatic replacement at or near the surface of the country rocks and give rise float ore deposits. On the basis of trial pits, presence of float ores and geological knowledge, the manganese bearing zones are marked on the geological map (Fig. 2) and found that 5.84 hects. area within the leasehold is Mn ore bearing.

3.2.2.2 There are profuse evidences of suffacial weathering of this sediments in the lease area. Hence, the attitude of the beds within the leasehold is not possible. But attitude of the beds outside the lease block is possible and also the regional dip-strike of the bed is known from literature. Therefore, it can resonably be assumed that the general trend of the planner elements is NNE - SSW with 20° - 30° dipping westernly.

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3.2.2.3 The lithotypes and the mineralised zones are demarcated in Fig.2. The gradational boundaries among the lithounits are established on the basis of fieldwork during periods 1992-1993. Geological section (Fig. 3) along two strategic points AB and CD are made for establishing the lateral and vertical extension of the mineralized zones and other lithounits.

3.2.2.4 The manganese ore meet in the present investigated area is massive, hard ores consist of mainly pyrolusite and psilomelane minerals.

Hard ore : The ores are generally of steel black coloured, compact, massive sometimes finaly laminated. These ore lumps show botroydal structure having moderate specific gravity (3-4). Different shaped of these lumps occured in lateritic capping, as a float ore and also as dissipited masses within phyllite/shale.

3.2.3 Overburden and Rejects :

Overburden and rejects that will be produced during mining operation generally consist of laterite, silicified shale/phyllite quartzitic rock and decomposed soils. The laterite encountered during operation is mostly friable. The thickness of the overburden varies from 2.2m to 6 m. as determined from trial pits and geological informations. The maximum quantity of overburden will be generated from site II. Here the overburden mainly consists of decomposed silicified shale/phyllite with boulders of lateritic masses. Laterite (Conga) and silicified quartzite will be generated during course of mining operation from the site I. Overburden in site III encountered during operation is same as site II. Here ore body occured beneath a lateritic capping about 2 m. average thickness. Beside this, a huge quantity of interburden will also be generated during the course of mining operation.

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3.2.3.1 The present investigation was executed during the field season 1992-93 and the work was confined within the lease block of 0.196 KM^2 area. The ore bearing zones marked on the map as recorded from trial pits, quarries and geological knowledge, are divided into three sites mainly depending on the nature of ore bodies and overburden. One of such area occured at the higher level of NW hill slope of hill (RL 700m) and the other is situated on the same hill at lower level adjacent to the northern side of site No.1 (See Fig. 2). Site III is situated at the lowest contour of lease block at near B pillar. Among the six quarries named as quarry No. 1, quarry No. 2, quarry No. 3, quarry No. 4, quarry No. 5 and quarry No. 6. Quarry No.1 & 4 are situated in site I, quarry No. 2 in site II and quarry No. 5 & 6 are in site III (See Fig. 2). Ore bodies in quarry No. 1 occured within silicified quartzite and also beneath the quartzite of about 3.8 m. average thickness which can easily be traced in the field (see Fig. 4), whereas in other quarries, manganese ore mineralisation took place beneath an overburden of average 4.5 m. made up of laterite or lateritic soils. Manganese mineralisation also took place beneath a cemented lateritic masses at the quarry site 4 (Fig. 5). Manganese ores are also found at surface mixed with lateritic boulders (Fig. 6) at the higher level within leasehold.

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3.3 DETAILS OF EXPLORATION :

3.3.1 Already carried out in the area :

Discovery of Manganese ore occurrences in this leasehold area was done by the Aryan Mining & Trading Corporation (AMTC) Ltd., in the year 1963 and the mining lease (ML) was granted in favour of them. AMTC continued their mining and allied works till June 1965. During this working period, besides topographical survey and surface geological study, their exploratory works also carried out over 41.6 hectares area (Fig. 7) as observed during field works of present lessee. The work includes :

i) a total numbers of 36 trial pits were made over the entire leasehold (41.6 hects.) area for confirmation of reserve and grade of manganese ores. But details record of such pit data are not available from the appropriate authority.

ii) Total broken lands of 1.362 hectares was calculated during our own investigation over the same area. The break-up of the broken lands as obtained are as follows :

(a) six promising excavatory quarries which includes 0.41 hectares for quarry I, 0.02 hect. for quarry 2, 0.03 hects. for quarry 3, 0.20112 hects. for quarry 4, 0.0192 hects. for quarry 5 and 0.03 hects. for quarry 6.

(b) 0.79 hects. for mine haulage to transport of the manganese ore from quarry side to despatch side.

(c) for pits 0.012 hects. and

(d) for waste dump is only 0.05 hects. The position of quarries, pits, road etc. over 41.60 hects. is presented in Fig. 7.

M/s. Aryan Mining and Trading Corporation Ltd., carried out mining operation for a couple of years.

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3.3.1.1 During present investigation (1992-1993) by the lessee over the same area (41.6 hects.), it is found that only 19.60 hects. area out of 41.6 hects. originally applied area are observed Mn ore bearing. On the basis of this observation a mining lease over 48.412 acres or 19.60 hects. was applied to the appropriate authority and the same was granted in favour of the present lessee vide letter No. dated . Hence, it is

worth to mention that the mining plan of the reference has been prepared over an area 19.60 hects. only. The approved leasehold area was presented in Fig. No. 7.

The exploratory works carried out by present lessee includes the proper location of the trial pits, quarries, road Old dumps on the surface plan and also estimation of the broken lands encountered within the 19.60 hects. area which were made by AMTC and marked on surface plan map (Fig. 8). Photographs of trial pit and old dump made by AMTC are shown in Fig. 9 and Fig. 10 respectively. This work also includes the measurement of the existing quarries and pits and analyses of the samples collected from quarry faces and from respective pits. Along with these above mentioned data, the observations obtained from surface exposures, nallah sections, road cutting sections, escarpments and old excavated exposures, a geological plan in 1:2000 scale has been prepared where different lithological and structural data are plotted with a special reference to manganese deposits. This has helped in preparing Cross-sections i.e. transverse section (TS) and longitudinal section (LS) in 1:1000 and 1:2000 scale along stratigic points AB and CD respectively over the lease area (Fig. 3). Details of the pit logs, dimension of pits and quarries are provided in table No. 1. The analysis results of the Mn ore samples drawn from the quarries and pits are also presented in Table No. 2. It is clear that only 22 numbers of trial pits out of 36 Nos. trial pits made by AMTC and all the quarries are located within the present leasehold.

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3.3.2 Proposed to be carried out :

As cited in the earlier sections, during present investigation the data obtained over the lease area were made by AMTC. On the basis of these data the extent of the mineralised zone was marked on the map and found that only 5.84 hects. area out of total lease area of present lessee 19.6 hects. are manganese ore bearing.

Now it is proposed that the exploration works will be carried out over the entire area i.e. within the mineralised zone as obtained from the field studies and also beyond the mineralised zone in phasewise programme. These will no doubt give an better idea regarding the grade, recovery percentage of ore, vertical extension of the deposits and it also help to properly measure the barren land within leasehold. Course of this exploration it

will no doubt once again help to cross-check the reserve, grade and percentage of recovery factor etc.

The exploration schedule will be carried out mainly by trial pits made systometically at a regular interval of 25 m. (grid fashion) over the site I and site II initially for 1st. five years plan. Beside trial pits, measured of the recovery percent from each pit and grade of Mn ore computation will also carried out simultaneously. If necessary few trenches will also be made at suitable position for exploration and exploitation purpose. This entire programme will also be carried upon over the other area within the leasehold. A phasewise/yearwise programme schedule is presented in a tabular form within table No. 3.

TABLE No. 3

Site No.	Number of pit made.	Dimension X vol.(M^3)	Year of work.	Sample analysed
I	6 at the northern end.	2 x 2 x 3	1st	6
	1 trench at the eastern boundary.	10 x 6 x 4	,,	5
II	4 at western end.	3 x 2 x 4	2nd	2
	6 towards eastern end beyond the mineralised zone.	-do-	2nd	6
I	10 pits at the north eastern corner of the block & 1 trench.	1.5 x 2 x 2	3rd	6
		10 x 5 x 4		4
III	6 pits at a interval of 75m.	2 x 3 x 3.5	3rd	6
II	10 pits at the northern end of this block.	2 x 3 x 4	4th	6
III	10 pits at 25m. spacing starting from southern end.	3 x 3 x 4	5th	6

Total numbers of trial pits required for 1st five year are 52 and 2 trenches, sample will be analysed 47 numbers.

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3.4 METHOD OF ESTIMATION OF RESERVES :

3.4.1.1 During the course of investigation along the old pits and quarries the possible three dimensional extension of the ore deposits is noted. The total extent of the ore deposits is calculated in the conventional methods by multiplying strike length with width. The vertical depth of deposit is computed from the existing pits and from the associated geological and structural features. Mineralised area is segmented broadly into three zones as described earlier. Reserve estimation of these segments are calculated separately.

3.4.1.2 The proved reserve is mostly calculated from the data available on exposed area (i.e. TF and exposed quarry faces) and probable reserves of the deposits are estimated mainly from the inferred data and the data obtained from neighbouring Mn-mines. It will be seen in the following para that the total demostrated reserve of area is more than sufficient to meet the work requirements for several years to come. As such no figures has been indicated for possible categories.

3.5 GEOLOGICAL RESERVES AND GRADES :

3.5.1 The investigation conducted over the area has delineated the possible extension of tthe deposits. The reserve of manganese is estimated in the area based mainly on the exposed features on the surface and along different old excavation as well. Some parameters such as recovery factor, ore concentration etc. are computed from ten test measurements made in old quarries, which is on the other hand supported by the data obtained from neighbouring working mines. The bulk density of manganese in the area is obtained as 3.2 for low grade and 3.6 for medium grade ores. The recovery percent of ore obtained from pits centred around 80% and ore concentration is varying from 30-40%. Thus recoverable proved reserve of the manganese ore in the area is estimated and presented in table No. 4.

3.5.2 The probable manganese reserve is calculated assuming the extension of the deposits based on field geological knowledge and from neighbouring manganese mines. The detailed estimation of probable reserve give in Table No. 5.

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Summary of the reserve :

Total reserve for proved and probable categories of medium and low grade manganese ore deposits over 5.84 hectares mineralised area within the leasehold are as follows :-

TABLE No. 6

Total demostrated reserve.

	Proved Reserve in M.T.	Probable Reserve in M.T.	Total in M.T.
Medium grade Ore.	24,066	2,14,859	2,38,925
Low grade ore.	71,730	2,35,754	3,07,484
Total =	95,796	4,50,613	5,46,409

Hence, the demostrated reserve of manganese ore is 5,46,409 M.T. considering 15% ore of the total reserve is below 25% Mn content (cut of grade). The actual demostrated reserve is 4,64,448 M.T. or 4.64 lakhs tonnes (say).

From the geological observation it is expected that the demostrated reserve will be more than 4.64 lakhs tonnes because the area adjacent to the E R S of site II also contain Mn mineralisation. The extension of the deposit and their estimation with the present constrain is not possible due to lack of data. The estimation will be made after sufficient exploration works carried out over the mentioned area. This will be done after the 2nd year exploration programme as proposed in table No. 3.

3.5.3 Grade of manganese ore :

Chemical analysis of manganese samples shows the manganese content in the ore of the area vaeying from 27% Mn to 35.35% Mn, i.e. low to medium grade (See table No. 2).

3.6 MINERABLE RESERVES AND ANTICIPATED LIFE OF THE MINE :

It is proposed that the mine will run manually in a opencast method. It is also proposed that 40 tonnes of manganese ore will be mined daily or 12,000 tonnes annually from two quarries (initially). From the previous section it was calculated that demostrated reserve of manganese ore in the lease block is 5.46 lakhs tonnes. Hence, it is clear that the mine will run safely 30 years after commencement of mining.

Fig. 4 - Manganese ore (black coloured) occured within laterite and quartzitic rocks around the quarry No.1. Note the vertical face of the quarry (where the man is sitting).

Fig. 5 - A vertical face of quarry No.4, where manganese minerals are occured scatterly within the conglomeratic masses made up mainly of laterite.

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Fig. 6 - Manganese ores are present within the admixture of lateritic boulders near the surface (where the man is standing). Note the mine road (on which the man is sitting) passes adjacent to the deposit.

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Fig. 9 - A photograph of trial pit where men are standing. The excavated materials are mainly boulders of cemented lateritic materials (on which men are standing). Note the trial pit was made without disturbed the natural growth of vegetation.

Fig. 10 - A panoramic view of old dump. Note, the waste materials was dump in such a place where no vegetation is observed except seasonal bushes.

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TABLE No. 1

Description of pit and quarries :

Sl. No.	From Top overburden.	Below overburden Mn ore bearing.	Total depth in meters.	Dimensions L x B (in m^2).
1.	0.80 m.	3.90 m.	4.7 m.	2.35 x 1.85
2.	1.2 m.	1.2 m.	2.4 m.	2.10 x 1.80
3.	1.8 m.	1.0 m.	2.8 m.	2.40 x 2.00
4.	3.0 m.	x	3.0 m.	2.20 x 2.10
5.	Quarry.			
6.	3.2 m.	1.5 m.	4.7 m.	2.40 x 1.90
7.	3.5 m.	1.4 m.	4.9 m.	2.30 x 2.00
8.	4.0 m.	0.9 m.	4.9 m.	2.45 x 2.15
9.	1.0 m.	x	1.0 m.	2.35 x 1.70
10.	1.0 m.	x	1.0 m.	1.90 x 1.75
11.	1.0 m.	1.4 m.	2.4 m.	2.15 x 1.80
12.	0.9 m.	2.05 m.	2.95 m.	2.10 x 1.80
13.	x	1.5 m.	1.5 m.	1.95 x 1.80
14.	x	1.55 m.	1.55 m.	1.70 x 1.40
15.	0.90 m.	x	0.90 m.	2.00 x 1.80
16.	1.0 m.	0.65 m.	1.65 m.	1.90 x 1.90
17.	1.0 m.	x	1.0 m.	1.80 x 1.75
18.	1.0 m.	x	1.0 m.	2.00 x 1.70
19.	2.5 m.	x	2.5 m.	1.95 x 1.80
20.	x	1.7 m.	1.7 m.	2.20 x 2.10
21.	2.20 m.	x	2.20 m.	1.95 x 1.90
22.	1.4 m.	1.0 m.	2.4 m.	1.85 x 1.80
23.	1.0 m.	0.5 m.	1.5 m.	1.95 x 1.95
24.	2.3 m.	x	2.3 m.	2.20 x 1.90
25.	1.9 m.	x	1.9 m.	2.30 x 1.95
26.	2.4 m.	x	2.4 m.	1.95 x 1.95
27.	1.3 m.	x	1.3 m.	1.90 x 1.98
28.	2.8 m.	x	2.8 m.	2.10 x 1.85
29.	3.2 m.	x	3.2 m.	2.00 x 2.00
30.	3.5 m.	x	3.5 m.	2.20 x 0.90
31.	2.85 m.	x	2.85 m.	1.90 x 1.20
32.	3.1 m.	x	3.1 m.	1.35 x 1.30
33.	1.6 m.	x	1.6 m.	1.30 x 1.25
34.	3.0 m.	x	3.0 m.	x
35.	3.5 m.	x	3.5 m.	x
36.	3.2 m.	x	3.2 m.	x
				123.002 Sq.m.

Analysis of pits sample, see annexure 4a, b, c, & d for: Sample Nos. 5 to 9. = 0.0123 Hects.

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Dimension of the quarries:

	L	x	B	x	H	Remarks.
Quarry No. 1	100	x	40	x	5	Promising.
Quarry No. 2	20	x	10	x	5	Promising.
Quarry No. 3	30	x	10	x	10	Not promising.
Quarry No. 4	14	x	8	x	4	Ore bearing.
Quarry No. 5	24	x	8	x	2	Ore bearing.
Quarry No. 6	30	x	10	x	15	Ore bearing.

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TABLE NO. 2

Chemical analysis results of Mn ore drawn from the lease area :

Site No.	Sample No.	Constituent by %					
		Mn.	Fe	SiO2	Al_2O_3	P	S
1	1	30.2	26.30	10.62	5.44	0.144	
	2	38.7	18.60	3.10	5.24	0.072	0.006
	3	29.5	19.2	10.82	6.20	0.123	
	4	22.6	28.70	14.20	8.54	0.160	
	5	33.60	20.94	12.60	4.92	0.142	
Mn content varies from 30.2% Mn - 38.7% Mn mainly.							
II	6	28.0	19.6	11.10	6.30	0.13	
	7	26.0	21.20	13.60	6.66	0.19	
	8	31.2	17.6	11.20	5.36	0.145	
	9	24.02	28.2	14.46	7.20	0.190	
	10	25.7	27.63	12.20	5.52	0.139	
	11	28.3	18.70	10.90	5.98	0.142	
	12	31.1	18.56	12.20	5.44	0.142	
Mn content varies from / 24% Mn to 31% Mn mainly.							
III	13	26.7	22.10	13.40	6.52	0.19	
	14	20.98	28.30	14.74	8.92	0.172	
	15	30.1	26.7	11.01	5.63	0.144	

Others :

Ref. No.	Sample No.	Mn %	Fe %
1	1	35.35	14.24
2	2 (Red quoted)	17.00	16.20
3	3 (low grade)	31.13	15.78
4	4 (Marka type)	8.32	21.36

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TABLE No. 4

ESTIMATION OF PROVED RESERVE

Sites.	Area of Qr.1 (a) and Qr. 4 (b) (im Sq.m.).		Depth of the deposits. (in m.)	Total excavation required. (in cu.m.)	Volume of ore (in cu. m.)	Recovery % of ore 80%	Grade of ore.
I	a) 100 x 42	4200	4	16,800	6,720 (40%)		Medium grade to low grade.
	b) 62 x 22	1964	3	4,092	1,636.8	6,685	% of Mn. varies from 27% to 33%.
II	Northern boundary to O^1 C^1 line.	2028					
	Between C^1C^1 line to D^1D^1 lines.	6500	5	71,960	25,186.00(35%)	20.148.8	Low to medium grade, % of Mn varies from – 20% Mn to 32% Mn.
	D^1D^1 to southern boundary.	5864					
		14392					
III	Area of Northern block as marked on map 2.	1028	4	9,448	2,834.40(30%)	2,267.52	-do-
	Area of western block as marked on map No.2.	1334					
		2362					

Total volume of medium grade ore is – 6,685 m^3
Total volume of low grade ore is – 22,416 m^3
Total volume of minerable ore = 29,101 m^3
(Sp. gravity for medium grade manganese ore is 3.6 and for low grade ore is 3.2 as determined).
Therefore, proved reserve of medium grade Mn ore = 6,685 x 3.6 = 24,066 M.T.
Proved reserve of low grade Mn ore = 22,416 x 3.2 = 71,730 M.T.

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TABLE No. 5

ESTIMATION OF PROBABLE RESERVE.

Site Nos.	Area between the section lines. (in m^2).		Depth of ore bearing zone (in m.)	Total volume of excavation required. (in m^3).	VOLUME OF ORE (in m^3).	Recovery of ore 80%.	Grade of ore.
I	Eastern boundary to A^1 A^1 line.	8004					Average Medium Grade. See Table 2 for bulk composition of ores.
	Between A^1 A^1 – B^1 B^1	7936	10	2,07,400.00	82,960.00 (40%)	66,368.00	
	Between B^1 B^1 to western limit.	4800					
		20740					
II	From northern limit to C^1 C^1 line.	2860					Average low to medium grade. 20% Mn to 32% Mn. See table 2.
	From C^1 C^1 line to D^1 D^1	9660	12	2,96,400.00	88,920.00 (30%)	71,136.00	
	From D^1 D^1 line to south western boundary.	12180					
		24700					
III	L x B	12996	8	1,03,969.00	31,190.00 (30%)	24,952.00	Average low grade. See table 2.

Total mineralised area = 64,196 Sq.m. = 5.84 Hectares

Total volume of medium recoverable grade ore = 66,368.00 m^3
and low grade recoverable ore is = 96,088.00 m^3

(Specific gravity for manganese ores are taken 3.6 for medium grade ore and 3.2 for low grade ore).

Therefore, Volume of actual probable reserve for medium grade ore is (total probable reserve – porved reserve) 66,368.00 – 6,685) m^3 = 59,683 m^3 and Vol. of probable actual reserve of low grade ore (total probable reserve – proved reserve) is 96,088.00 – 22,416 = 73,673 m^3.

Hence, probable reserve of medium grade ore = 59,683 x 3.6 = 2,14,859 M.T.
probable reserve of low grade ore = 73,673 x 3.2 = 2,35,754 M.T.

CHAPTER - IV

4. MINING.

4.0.1 The General deposition of manganese ore, their mode of occurences and nature of the deposits favours for adopting surface mining by open cast methods with manual labours. Other factors like physical properties of rocks, the topography and hydrologic conditions of the area, also do favour for the opencast surface mining method. These factors are also to some extent influenced by certain other local conditions such as safety, availability of skilled and semi-skilled human resources and other infrastructures aredeciding for opencast mining.

4.0.2 As discussed, manganese deposits occured under capping of shale admixed with lateritic boulders and cemented lateritised materials. These considerable amounts of overburden can also be worked by the surfacial opencast methods through development of benches. The height and width of the individual banches are fixed at 2 meters and 2 meters respectively, thus the banch slope is maintained 45°. General gradient of the hill slope is 1:5 (approximately).

4.0.3 Production requirement :

The estimated target of production is around 12,000 MT/year at present. The ore quality varies from 27% - 35% Mn. Of course, the production will depend on then market demand. Layout of the quarry namely Quarry No.1 and Quarry No. 2 has been made in a way as to adjust the production accordingly. Details productions as projected from the mentioned quarries during the 1st five years planning is presented below :

Sl.No.	Description.		Production/Generation.
1	Annual requirement	:	12,000 M.T.
2	Daily production requirement, considering 300 working days/year.	:	40 M.T.
3	Total excavation required per day considering 35% ore concent-ration and 80% recovery. Sp.gravity of Mn ore is 3.3 (average).	:	40 MT/day or 12 M^3 ore/day. Actual vol. of ore required (80%R) 15 M^3. Total vol. of excavation required per day is 42.85 m^3 or 43 m^3 (35% ore conc.) (Say).
4	Overburddarequired to be handled from Quarry No. 1	:	Per day. 8 M^3 Per year. 23[illegible] M^3
	Quarry No. 2	:	14 M^3 42[illegible] M^3
5	Total rejects (overburden and interburden) required to be handle during five years from Quarry No. 1	:	11,883 M^3 / 20,172 M^3
	Quarry No. 2	:	21,381 M^3 / 19,570 M^3

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4.1 Yearwise development for first five years :

4.1.0 It is proposed to start the construction of different site services such as mine office, restshed, first-aid station, creche etc. as shown in Fig.11 during the 1st and 2nd year of operation. All these site services are installed adjacent to the mine roads and the existing mine road should be repaired by first year. Further preparation of new mine road and extension of the existing road as shown in layout plan (Fig.11) also prepared during first years operation.

4.1.1 The existing quarry position and dimension are shown in geological map and in table No. 1 respectively. Only quarry No.1 and 2 are choosen for production of ore for 1st five years. It is proposed to render the quarry floor even and brought to RL of 689 meters and RL 620 m. respectively. This will be achieved at the end of 5th year. The development of these quarries has been planned to be limited mostly within the proved ore zones with a maximum dimensions of 94 x 60 x 12 cu.m. and 120x75x8 cu.m. for Qr. 1 & 2 respectively. The development for the succeeding another ten years has been planned for mainly depth wise advancement. The details levelwise and yearwise development works required for the formation of benches to achieved the proposed rate of production for first five years is presented in table No. 7. The estimation of overburden to be handle during the targeted production and number of benches are required for the removal of overburden is also obtained from the same table. The aerial extent of the developmental works around the quarries and for other site services within the leasehold required during 1st five year of operation is given in table No. 8.

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4.2 Year wise production for the first five years :

Geological investigation in the area corroborated by the data obtained from adjacent mines suggests that since manganese is intricately associated with silicified shale/phyllite and/or cherty laterite beneath a lateritic shale and quartzite capping, there will be resonable amount of these waste rocks likely to be generated while mining the deposit. It has been experienced that about 35% average of the total volume excavated in the entire mineralised zone do contain manganese ores. Further it is observed

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that out of total manganese excavated manually about 80% can be recovered irrespective of grade. Hence, the production of manganese is calculated accordingly and a yearwise production plan is given in the table No. 9. It is proposed to mine about 12,000 MT of manganese ore annually from third year onwards and can be stabilised. It is calculated mainly on the basis of grade and the overburden encountered around quarries that to reach the proposed production of 60,000 MT for 5 years at least 9 number of benches will be required within mineralised zone for quarry No. 1 and 10 benches will be required in case of quarry No. 2. The numbers of benches from which required quantity of ore will be obtained for each year of the first five year plans of both the quarries are also calculated. The annual targeted production from the two quarries are 6,600 MT and 5,400 MT respectively.

TABLE No. 9

Yearwise production for first five years mining.

Period	Production of Mn. ore in M.T.		Total M.T.
	Around quarry No.1 (in M.T.)	Around quarry No. 2 (in M.T.)	
1st	4,000	2,000	6,000
2nd	5,500	3,500	9,000
3rd	6,000	9,000	15,000
4th	7,500	5,000	12,500
5th	7,500	5,500	13,000
Total =	30,500	25,000	55,500

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4.3 Proposed rate of production when the mine is fully developed.

The production of manganese from two quarries are proposed to be initiated with 4,000 M.T. and 2,000 M.T. from quarry 1 & 2 respectively in the first years which can be enhanced to 7,500 M.T. & 9,000 M.T. at third year with a provision to adjust the require rate of production in the succeeding years and stabilised onward with 7,500 M.T. & 5,500 M.T. per year respectively. Production schedule from the quarry given in the following table No. 10.

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TABLE No. 10

Production Schedule

Sl.No.	Quarry No.	Proposed production in M.T. Day	month	Year.	Total Reserve around the quarry sides in M.T.
1	1	25	625	7,500	2,38,924.50
2	2	15	375	4,500	2,27,635.00
Total -		40	1000	12,000	3,96,576.00 M.T. (Less 15% due to low grade).

4.4 Proposed method of mining :

As discussed earlier, the method of mining will be adopted by opencast surface mining with mannal labourers. This will no doubt within the economical cost limit. The removal of overburden and interburden can easily be made by manual operations using mining implements such as crowbar, hammer, spade, shovel, etc. Blasting may be required to remove the waste overburden at certain levels. It is also proposed that the mine will be worked in one shift operation of eight hours duration for 6 days a week or 300 days per year. The surface mining methods will be carried by the formation of benches. The height and width of each benches will be kept 2 m. each against a general slope of the area 1:5.

From the mining experience and data collected from the neighbouring manganese mine it was found that output per manshift (OMS) for the different quarries are more or less same. The required face length (minimum) per gang of two workers is 1.5 m. On the basis of OMS and face length, the miners required per day for the projected production is calculated and presented in the table below :

Table No. 11

Anticipated OMS, Face length and requirement of miner :

Sl. No.	Location	Desired production per day.	Anticipated OMS.	Requirement of Miners	Face length in M.
	Quarry No. 1				
	For ore excavation.	25 MT	0.55	46	31 M
	For overburden cutter.	14 M^3	0.82	17	12 M
	Quarry No. 2				
	For ore excavation.	15 MT	0.55	28	20 M
	For overburden cutter.	18 M^3	0.82	22	15 M
Total -				113	78 M

Considering 20% more labourers (due to their absency) will be required for smooth runs the mine. Hence, actual nos. labourers require 142 persons or 145 nos./day (Say).

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4.4.1 Opencast working :

The mining and overburden removal, as proposed will be made by manual methods. The method of working will be as follows :

i) During 1st year manganese deposit around the existing quarries named as quarry No. 1 and 2 are proposed to be worked out by extending the quarries in southern direction, i.e. across the quarry.

ii) The overburden waste having an average thickness of about 4.5 m. are to be removed by opening the two benches for both the quarries and are to be transported to the dumping yard located adjacent to the quarries at lower level (See Fig. 11).

iii) The soft phyllitic shale interburden generated from the quarry No. 2 in site II and also from quarry No. 1 are partly required to maintain and develop the mining approach roads of gradient not more than 1 in 16 and balance quantities are planned to be dumped in the nearby areas.

iv) At the end of fifth year onwards manganese ores from quarry No. 1 & 2 are proposed to be developed by opening the quarry in western direction and this will continue through out the lease period by suitably extending the quarries untill complete exploitation of manganese deposit.

v) After complete removal of economic manganese ore from the floor of the quarries, the quarries will be filled by dumping materials which produced then.

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4.4.2 General layout of the quarry :

For the mentioned mining quarries it is proposed to develop benches having height and width of 2 m. and 2 m. respectively. The existing quarry No. 1 in site I having a dimension of 40m x 10m x 5m is proposed to be developed initially by increasing the dimensions upto 65m x 20m and that of quarry No. 2 in site II, having dimension 20 x 10 x 5 m^3 will be increased to 80 x 20 m. respectively. The benches will be developed from the lower levels of the quarries and approaches

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to the higher levels. It was estimated that at least 3 benches will be required to reach the targeted production initially. This is proposed to be achieved by the end of 1st year, and further extension of the quarries is to be made mainly depth ward and also side wise so that the quarry dimensions reaches to 94 x 60 m^2 and 120 x 70 m^2 respectively after the end of fifth year. Yearwise layout of both quarries are prepared separately. The present position of quarry No.1 and quarry No. 2 are shown in Fig. No. 12 and Fig. No. 13 respectively with enlarge scale (1:400) drawn from general layout plan (Fig.11). The ultimate configation of quarry No.1, after first year, second year, third year, fourth year and fifth year with two representative sections are presented in Fig. No. 14 to 18. Similarly that of quarry No. 2 presented in fig. Nos. 19 to 23. The quantity of excavation required to reach the proposed production for both quarries after each year presented separately in table Nos. 12 & 13. The benches of the quarries are to be developed along the hill slope almost following the contour.

It is also proposed that another existing old quarry No. 3, near the B boundary pillar, also to be developed for mining to safely reach the targeted production whenever necessary.

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4.5.1 Extent of Mechanisation :

It is proposed that the mining in the area will be done by manual opencast methods by using common implements as crowbar, chisel, spade, hammer, shovel, busket etc. Besides these, other machineries that will be required during mining operation are as follows :-

(a) Portable air compressore 1, (b) Jack hummer 2,
(c) Exploder 1 , (d) Wheel mounted water tank 1,
(e) Drill rods 4, (f) Miner's protective equipments such as safety shoes, leg guard, goggles and gloves etc. according to need and (g) truck or trippers 2.

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4.5.2 Drilling :

The development of benches in hard lateritic masses or on silicified quartzite and also in massive manganese ore bodies, drilling of shallow depth holes will be required with a spacing of 1.5 m. and keeping hole length of 1 to 1.2 m. by the services of hand held rock drill popularly known as Jack hummer with matching air compressore. Secondary drilling will also be necessary for removal of larger boulders of rejects and also ore bodies from the mine site. The requirement of Jack hummer and matching compressore are calculated and represented in table No. 14 alongwith other mechineries.

TABLE No. 14

Requirement of Jack hummer Drills and portable compressore.

Sl. No.	Name of the site.	Qty.(M^3) required drilling/year.	No.of holes requi-red per year.	No.of holes requi-red per day.	No. of Jack hummer.		Requirement of Compressors.
					On operation.	With spare	
1	I	For overburden 2380 Within ore 5770 Total = 8150	3622	15	1	1	1 Tractor compressor

From experience it was observed that shallow depth holes (1 to 1.2m) with a spacing 1.5 m. (in grid fasion) will dislodge 2.25 m^3 materials after blasting. It was also observed that a Jack hummer can drilled 20 holes on an average per day with a depth of 1 m.

4.5.3 Loading :

Loading will be done manually by using baskets only.

4.5.4 Hauling/Transport :

Transportation of manganese ore from mine faces to railhead will be done by truck and trippers. It was proposed that production per day will be 40 MT. A truck carry 10 MT ore per trip. Hence for transportation of ore from pit site to despatch point 1 truck

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will be required. Again for transportation of overburden from mining side to the dumping sides one truck will be required, because interburden and overburden that will be generated per day is 35 m^3.

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TABLE No. 7

Levelwise overburden (OB) to be handle during 1st. five years plan.

Quarry No. 1 : Nature of overburden is mainly shale with lateritic and lateritic boulders.							Quarry No. 2 : Quartzite and shale mainly with cemented laterite.						
Year.	Level of operation (RL in m.)	Area in m^2		Volume of OB in m^3		Bench No.	Level of operation	Area in m^2		Volume of OB in m^3			Bench No.
1st.	689-692	9.6	x	84	= 806	2 benches	620-626	27.2	x	74	=	2013	3 benches.
2nd.	692-696	24	x	84	= 2016	2 benches	616-620	15.04	x	68	=	1022	2 benches.
3rd.	696-699	9.6	x	84	= 806	4 benches	626-634	83.84	x	80	=	6707	3 benches.
4th.	696-700	25.2	x	86	= 2167	8 & 9	628-636	44.8	x	84	=	3763	3 benches.
	700-702	30	x	88	= 2640	O.B.- 3							
5th.	702-704	22	x	88	= 1936	O.B.- 2	636-640	45.6	x	88	=	4012	O.B.- 1
	704-708	16.8	x	90	= 1512	O.B.- 1	640-646	42	x	92	=	3864	O.B.- 2
Total overuburden = 11,883 m^3							Total overburden = 21,381 m^3						

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TABLE NO. 8

Different developmental works required for the first five year plan.

Years	Surface area required for developmental works around the two operational quarries to reach the targeted production for each years of first five years.		Developmental works required for other site services with the leasehold.
	Quarry No. 1 Surface area required.	Quarry No. 2 Surface area required.	
1st	3360 m^2	2016 m^2	For mine road - 0.20 hect. For waste dump - 0.85 hect.
2nd	816 m^2	1334 m^2	For Stacking of different graded ores 0.10 hect.
3rd	452 m^2	1392 m^2	For other site services like, creche, restshed, canteen, office, station etc. as indicated in General layout plan. 0.08 hect.
4th & 5th.	890 m^2	2112 m^2	
Total Area :	5518 m^2	6864 m^2	Total = 1.23 hects.

or = 12382 m^2 = 1.2382 hects.

Total area required for development during the mining operation is 2.45 hects.

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TABLE No. 12

Details of yearwise production of Mn. ores, generation of interburden for 1st five years of operation.

Quarry No. 1 :

Daring year.	Bench No.	Area x length m^2 x m	Vol. m^3	RL in m.	Vol. in m^3 Ore 35%	Interburden	% of recovery. 80%	Ore in MT (Sp.Gr.3.6
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
1st.	1	12 x 80	960	894	336	624	268.8	967.68
	2	24 x 80	1920	692	672	1248	537.6	1935.36
	3	46 x 25	1150	690	402.5	747.5	322	1159.6
						2619.50		4062.00
2nd.	3	46 x 49	2254	690	788.9	1465.10	631.12	2272.00
	4	48 x 70	3360	688	1176	2184.00	940.8	3386.88
						3649.10		5658.88
3rd.	5	40 x 66	2640	686	924	1716	739.2	2661.12
	6	1045.44 x 2 (depth)	2090.88	684	731.80	1359	585.44	2107.58
	7	769.76 x 2 (depth)	1539.52	682	538.83	1000.68	431.06	1551.83
						4075.68		6320.00
4th.	9	10 x 86	860	698	301	559	240.8	866.88
	8	26 x 82	2132	696	746.2	1385.8	596.96	2149.00
	1	32 x 78	2496	694	873.6	1622.4	698.88	2515.968
	2	32 x 74	2368	692	828.8	1539.2	663.04	2386.94
						5106.40		7918.78
5th.	3	32 x 70	2240	690	784	1456	627.2	2257.92
	4	32 x 66	2112	688	739.2	1372.8	591.36	2128.89
	5	32 x 62	1984	683	694.4	1289.6	555.52	1999.87
	6	16 x 58	928	684	324.8	603.2	259.84	935.42
						4721.60		7322.00

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Total interburden = 20,172 m^3 Total vol. of Mn. ore = 8688 m^3

Total Mn. ore = 31,280 M.T. Ore : Interburden = 1 : 2.3

TABLE No. 13

Details of yearwise production o Mn. ores, generation of interburde for 1st five years of operation :

Quarry No. 2

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)
1st.	5	8 x 80	640	624	224	416	179.2	573.44
	4	8.4 x 78	655.2	622	229.32	425.88	183.45	587.05
	3	13.2 x 76	1003.2	620	351.12	652.08	280.89	898.86
						1493.96		2059.35
2nd.	2	17.6 x 70	1235	618	431.20	803.80	344.96	1104.00
	1	22.4 x 66	1478.4	616	517.44	960.96	413.95	1325.00
	A	26 x 60	1560	614	546	1014.00	436.8	1398.00
						2778.76		3827.00
3rd.	B	1367.68 x 2(depth)	2735.36	612	957.37	1777.99	765.90	2450.88
	C	1235.52 x 2 (")	2471.04	610	864.86	1606.18	691.89	2214.05
	D	917.4 x 2 (")	1834.8	608	642.18	1192.62	513.74	1644.00
	E	684 x 2 (depth)	1368	606	478.8	889.2	383.04	1226.00
	F	28 x 37.6	1052.8	604	368.48	684.32	294.78	943. 30
	6	12 x 88	1056	626	369.6	686.40	295.68	946. 00
	7	4.4 x 92	404.8	628	141.68	263.12	113.34	362.70
						7099.83		9787.00
4th.	5	17.6 x 91	1601.6	624	560.56	1041.04	448.448	1435.00
	4	17.6 x 86	1513.6	622	529.76	983.84	423.808	1356.00
	3	17.6 x 82	1443.2	620	505.12	938.08	404.096	1293.00
	2.	17.6 x 78	1372.8	618	480.48	892.32	384.384	1230.00
						3855.28		5314.00
5th.	10	8 x 108	864	634	302.4	561.6	241.92	774.00
	9	12 x 104	1248	632	436.8	811.2	349.44	1118.00
	8	14 x 100	1400	630	490	910.00	392	1254.00
	7	18 x 96	1728	628	604.8	1123.2	483.84	1548.00
	6	16 x 90	1440	626	504	936.00	403.2	1290.00
						4342.00	8428.54	5984.00

Total interburden = 19,570 m^3 Total vol. of Mn. ore = 8428 m^3

Total Mn. ore = 26,970 M.T. Ore : Interburden = 1 : 2.3

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CHAPTER - V

5. **BLASTING** :

5.0.1 For the removal of soft and cemented overburden in manganese deposits some amount of blasting will be required. It is estimated that total quantity of ore production required 12,000 M.T./year when the quarries are fully developed or 1000 tonnes per month. But advance estimation of total number of drill hole put in the mines is not possible due to nature of overburden encountered during mining. Hence the advance estimation regarding the quantity of explosives used are also not possible. Knowledge regarding total number of drill holes/ day and quantity of explosives required for mining/day will be best obtained after the commencement of blasting. Blasting programme will be carried out at the end of 1st year. Here a tentative estimation regarding the consumption of explosives and others is delineated depending on the nature of rocks encountered.

It was observed that about 36 sq.m. area will be required to reach the proposed production from site I and it is expected same other area also required initially for development purposes around quarries. It was envisaged that shallow depth drilling of about 1 to 1.2 m depth with a spacing of about 1.5 m will be required for the excavation and development works. Hence daily about 20 holes will be required for blasting. Considering 125 gm. explosive (fuse blasting) is required for a hole, the total explosive requirement per day will be 2.5 Kg. Other accessories like detonator, safety fuse etc. will be required 20 numbers and 20 numbers of safety fuse of 1.5 m length . Annual requirement is as follow :

Gelatine	=	750	Kg.
Detonator	=	6000	M.T.
Safety Fuse	=	9000	Mts.

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5.0.2 The holes are blasted by safety fuse firing. This method of blasting has an advantage to control the throw and vibration and is also economical. Normally Ammonium Nitrate with fuel oil mixture and special Gelatine of 60 to 80 percent can be used as explosives.

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5.0.3 Drilling and blasting operation is to be carried out with strict vigil as per the provisions of Metalliferous Mines Regulation Act, 1961 under the strict supervision of competent persons.

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CHAPTER - VI

6. MINE DRAINAGE :

6.0.1 The mining in the leasehold area is proposed to be done upto 12 m. depth during initial phase. However, an attempt has been made to study the local hydrological conditions. The annual rainfall in the area is observed to be average 2000 mm. The ground water level of the region is observed to be at a depth of about 14 m. from the lowest contour of the region. As mining at all probability is to be done upto a depth of 10 m. from the surface, hence it has no effect on existing ground water level. Moreover the region is a hilly terrain and the quarries are situated on the hill slopes.

6.0.2 As discussed the mine is proposed to be developed through opencast surface mining method and is also decided to continue the same for further development. As the quarries are located on the hill slopes and it is assumed that seepage of ground water may not create any problem during the mining operation.

6.0.3 The drainage system of the leaseblock as described under the physiography of the area in Chapter III, there is one prominent dry nallah along with another two impersistent dry nallahs on the hill slope (RL 700 m). Those are only seasonal nallahs to carry the surface run off during rainy days into the perennial nallah flowing along EC boundary of leaseblock which finally discharge into the Sarkanda Nadi at a distance of about 3 Km.west.

6.0.4 With these drainage pattern, an attempt has been made to review the local hydrological conditions. Although the exact details of the water table at the mine site is not available, the regional data suggests that the depth of the ground water table is below 12 to 14 m. from the surface. As envisaged, the mining operation will be carried out at least at a height of about 15 m. from the local ground level. Thus, the mining in the area may not disturb the ground water table. During monsoon period the surface run-off may hamper the mining to certain extent when devatering of the quarries will be required. Sufficient care should be taken to prevent the flow of loose materials alongwith the surface run off which is discussed in detail in the environmental management plan, Chapter XIII.

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CHAPTER - VII

7. DISPOSAL OF WASTE :

7.1 Nature of waste :

The manganese deposits are found to be associated with lateritised cherty shales, decomposed shales with recemented lateritic boulders, quartzitic sandstone and sometime only decomposed shale/phyllite. The thickness of these overburden varying from 2 m to 4.5 m on an average, will no doubt generated a substantial quantity of waste during targeted production of ore. Apart from overburden, a huge quantity of inter-burden will also be generated at the advancement of mining.

Besides, overburden and interburden, reasonable quantities of low grade manganese ores will be generated which from waste materials.

7.2 Selection of dumping site :

The waste generated during the mining will always create problem for its disppsal. Definitely the best solution is in pit dumping (back-filling). But it required sufficient space in pit. It is proposed that due to excavation of the minerals from the quarry floor, a sufficient space will be available which will be used as dump site in future; proper investigation will be made regarding the existance of ore mineralisation whether it took place further beneath the quarry floors, or the concentration of manganese mineralisation is not enough as to exploit the deposits economically. Such investigation will be carried out by digging few trial pits on newly created mine floor. Selection of external dump site are a paramount aspect in mining plan and it is governed primarily by land use pattern, economic and safety consideration.

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7.2.0 As envisaged the area adjucent to quarry No. 1, where old dump is present at the slope of hill, will be used as dumping yard for hard Quartzitic waste produced from the same quarry. It is found that the area is devoid of any economic deposits. Other dump sites for quarry No. 2 and also for quarry No. 1, choosen in those areas in the leasehold are found to be devoid of

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any economic mineral deposits. The site of dumping yards was choosen with the consideration of

i) There was no economic deposits present beneath the dumping ground.

ii) It is adjacent to operational site as to disposed the waste smoothly.

iii) Selected on the gentle slopping areas.

iv) Apart from any natural drainage, and

v) Care has been taken to use the minimum lands used . regarding the purposes.

All the sections of the dump yards and systematically stacking over the dumping ground presented in the Fig. 24. Stacking of waste material will be carried out from higher level to lower level in bench fashion. As a result of which the general gradient of the dumping floor gradual decreases and reached to a nearly horizontal of their top surfaces. After reaching the optimum height of each bench the filling will carried out over the newly created dump suffaces. In this way of dumping practice give a table land after achieving the optimum height which match with the existing contour of the area. The suitable sites for dumping yards are demarcated in Fig. 11.

7.3 Maximum height and spread of dumps :

Dumping of waste generated during mining has to be made in the slopping ground, as the available area is limited. It is proposed to initiate the dumping from different levels, preferably from the top. In order to maintain the slope stability the terracing of the dump will be made keeping the height of each dump at about 5 m. Each terrace is to be levelled and stabilised after completion of dump. At the bottom of the dumping yard, all along the peripheral zone, check dam (stone wall) in the form of lateritic wall of 2m. height should be made to prevent any wash-offs. Suitable plantation should be made to further stabilise the dumping

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7.6 **Height and spread of stacks :**

The stacks are maintained with a dimension of 3 m. height, the width of the stack is at least four times of the height and length is not less than 10 m. Trapizium shaped stacks are envisaged to avoid any rolling down the sized ore from stacks and it will also helps to measure the stacks readily.

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yard which is discussed in details in environmental management plan, Chapter XIII.

7.4 Stacking of Sub-grade Minerals :

It is proposed the subgrade ore (20 to 25% Mn) and fines will be produced at the time of mining and is stacked separately at suitable place in front of workout areas of the quarries (See Fig. 11).

7.5 Selection of site for stacking :

Stacking of manganese ore according to grade and size specifications of the buyer will be necessary. The sites for stacking of these ore is choosen with a preferences as follows :

i) Available of sufficient space within the lease area as to faciliate loading for two or more trucks at a time and also regarding transport.

ii) The place must be a plain land or very low gradient.

iii) The stacking site must be adjacent to mine road and at least two entry points from mine road to stacking side is required as to avoid any unseen conditions.

iv) Stacking site must be close to the mining pits but at a good distance from the working faces is preferred.

v) Stacking sites must be well above the local ground level. Hence, there will be no chances of groundwater contamination due to stacking.

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vi) It will be better if the site is found to be barren with respect to mineral deposit after proper exploration and select it for a permanent site within the leasehold. Otherwise the site for stacking ore is provided in such a place where mining will not encountered at least for first five year. For the present situation, site is situated that part of the mineralised zone where mining will not encountered for a period of five years. Such sites are demarcated on layout plan; Fig. 11.

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CHAPTER - VIII

8. USE OF MINERALS :

Manganese play an important role in deciding the country's economy because of its prolific uses in steel industries, battery industries, Chemical industries, Glass industries etc.

Manggnese ores in this region are mostly observed to be of medium to low grade (26.13% to 37.88% Mn), although low grade ore (20% Mn) can also be mined. On suitable blending and beneficiation, maximum quantity of manganese can be upgraded for utilisation in Ferro Manganese Plant. So Manganese ores of the area can be despatched mostly to Ferro-Manganese units of the State and subbstantial quantities can be marketed to nearby Iron and Steel Industries.

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CHAPTER - IX

9. MINERAL BENEFICIATION :

Crushing and specific beneficiations will not be required for upgrading the ore, because beneficiation works will be carried out day by day works by the miners mannually during mining. In the open cast surface mining, the work include after blasting, is breaking the ore lump by hammer and sort out according to size specification as required by buyers. The ores are stacked separately according to size and grades by manual picking practices. During course of working miners also separate the ore from undesirable materials and they shift their mining if the subgrade ores are encountered. Hence, further beneficiation will not be required to upgrade the ores.

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CHAPTER - X

10. SURFACE TRANSPORT :

The Manganese ore, thus mined from the applied area will be transported mannually to the stacking yard after sizing and hand screening from undesirable materials. Then the ore earmarked for despatch to the Steel Plant and other industries. Transport of thses ore will be made by trucks from stacking yards to the nearest railhead Barsuan which is located at a distance of about 10 K.Ms. from the area.

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CHAPTER - XI

11. SITE SERVICES :

The different site services as per specification such as mining office, store, rest shed, canteen, first-aid centre, magazine house, blasting shed, creche, drinking water, blacksmith shed, garage cum workshop, latrine etc. as indicated in Surface Plan, Fig. 8 will be provided. These site services are required to be constructed during initial stage of mining and proposed to be completed by 2nd year and also maintained properly for future.

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CHAPTER - XII

12. EMPLOYMENT POTENTIAL :

For the smooth and healthy management of the small scale mining, the manpower requirement such as different supervisory officer, skilled and semi-skilled personnel are required to be appointed as per the provisions of Metalliferous Mines Regulations Act 1961. The total member of employee that will be required when the mine fully developed is given in the following table :

Table No. 15

			Total Nos.
A.	At Mine Office :		
	Mine Manager	- -	1
	Mining Engineer/Geologist	- -	1
	Surveyor	- -	1 (Part time)
	Doctor	- -	1 (Part time)
	Office Assistant/ Store Keeper	- -	2
B.	At Mines :		
	Mining Foreman	- -	1
	Mining Mate	- -	2
	Compressore Operator	- -	1
	Blaster	- -	1
	Magazine-in-charge	- -	1
C.	Others :		
	Transport Assistant	- -	2
	Driver	- -	2
	Skilled, Semi-skilled workers/Mine workers	- -	145
		Total =	171 persons/day.

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SUMMARY OF MINING PLAN :

As mentioned earlier, Sarkanda Manganese Mine of 0.196 Km^2 lease area is located between the co-ordinate 85° 10' - 85° 15' long and 21°50' - 21°53' lat and marked on survey of India toposheet No. 73 G/I (R.P. 1:50,000) (See Key map Fig.1). Three sides of the lease block has a common boundary with Hindusthan Steel Limited and comprises a part of hill (700m) mound and spars. Two dry nallahs traversed the lease area and a nallah which flows along the BC boundary of the block also drics up during summer season. The water of this nallah flowing towards South and ultimately discharged into the main Sarkanda Nadi, which is flowing farther 3 KM south of lease block. The proposed mining leasehold area is situated about 3 KM South Tensa hill 803 m. and 700 m. WWS of Korapani pahar (813 m) (See Fig. 1), and having an elevationn difference of 100 m. with a heighest contour of 700 m. RL.
A fairweather unmetalled road runs from Tensa Dengula Koira main road to Bhutra (further south of present leasehold area) passes just 0.5 KM. away from the lease boundary. The lease block and the adjoining 500 m. area fall under the Sarkanda Reserve Forest of Bonai Sub-Division, Sundargarh District, Orissa.

To proper elucidate the environment management plan, the path of our thinking will be guided by some salient points as obtained from the Mining Plan chapters. These are :

a).	(i) Area of the lease block	:	19.6 Hects. or 0.196 KM^2
	(ii) Elevation difference above mean sea level.	:	100 m.
	(iii) Gradient of the area.	:	1 : 5
b).	(i) Nature of land.	:	Entire Forest land (Govt. Land).
	(ii) Surface right required for first 5 years.	:	1.362 hects.
c).	Ore to be mined.	:	Manganese ore
d).	(i) Proposed annual production of ore.	:	12,000 MT/year.
	(ii) Reserve of Mn ore.	:	4.64 Lakh Tons.
e).	Waste and overburden generated per year when the mine is fully developed.	:	9,000 m^3 (interburden) and 6,500 m^3 /year.

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f)	Proposed employment required	:	171 persons/day.
g)	Site of working.	:	On the slope of hill.
h)	Method of mining operation.	:	Opencase manual mining.
i)	Bench parameters.	:	Height 2 m. width 2 m.
j)	Transportation of ore from mine to railhead.	:	Truck/dumpers.
k)	Broken land.	:	1.362 hects. by previous lessee M/s Aryan Mining & Trading Corpn. Ltd.

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CHAPTER - XIII

13. ENVIRONMENT MANAGEMENT PLAN :

13.0 Prologue :

13.0.1 Minerals do constitute the vital raw materials for many basis industries with growing industrialisation. Exploitation of minerals assumes great importance keeping at par with the country's policy. In restoring the environment and ecobalanne, it should be noted that mining operations are carried out in an environmentally compatible manner. This very aspect is now dealt with much emphasis in the wake of increasing awareness for protection of the environment and certain legislation in this regard were introduced and the mining operations of any area should be accordingly planned for resorting a healthy and smooth mining environment.

13.0.2 Environmental pollution is a multifaceted one as it embraces air, water, lands, flora and fauna and many more. It is a complex aggregate of external conditions which affect the life, development and survival of all organisms. Hence it is the combination of health problem, as it effects human life, and economic problem as it affects poverty, an aesthetic problem as it affects land scapes. It is therefore required to have a multi-disciplinary planning to check the increasing rate of pollution. In view of this it is necessary to identify the specific environmental domains, those are likely to be disturbed during the course of mining, so that some effective planning can be imparted on them to encounter its impact on the mining environment. In order to have a proper planning over the applied area, it is desired to collect certain base line information on the existing problems within and around the leasehold.

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13.1 Baseline information :

13.1.0 During the course of mining operation there will be some adverse effects on ambient environments. The degree of these effects solely depend on the scale of mining operation and also the method adopted for mining. Mechanised large scale mining ssystems will produce much adverse effects on the existing environments than small scale manual mining method. The changes of these two

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environmental conditions i.e. present ambient environment and the effected environment due to mining operation and allied purposes will be best obtained if we have an adequate knowledge regarding the present environmental conditions which is otherwise known as base line information.

These environmental conditions can broadly be divided into three head lines.

a) Physical environment.
b) Ecological environment, and
c) Human environment (Settlement).

13.1.1 Physical Environment :

i) Existing land use pattern :

The region represents hilly terrain with open valleys in between the hills. There is no agricultural land within the lease area of 19.60 hects. The 'Core area' (lease area) and the region (with 500 m. from the lease area)(Fig. 25) are entirely comes with in reserved forest hence, there is no habitation within the lease area and also 500 m. surrounding the lease area. The proposed land use pattern of the 'Core area' may be summerised as below :

For further mine road	-	0.20 hects.
For dumps	-	0.85 hects.
For Stacking of ore & others	-	0.10 hects.
For quarries/pits	-	1.24 hects.
Surface right require	-	3.10 hects.

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ii) Water regime :

The deposit of the lease area lies on the gently hill slope, the lowest contour being 600 m. and heighest is 700 m. above mean sea level. There is no perennial nallah passing through the lease area. There are only two dry nallahs originating and passing through the lease area. There is no flow of water through these nallahs except during rainy days. It was found that the Ground Water Level in this

region is much lower than quarries levels. The effluent water from the nallahs was analysed during the field season 1993 and tthe result is appended in Annexure 1.

iii) Overburden and soil Charactaristic :

Outcrops of ferrugeneous laterites, congas and decomposed shales are abundant. The soil (Shale) cover is average 4.5 m. thick associated with wastes. These shale will be stored at suitable sites during mining operation for vegetation in future.

iv) Climatology :

Sarkanda manganese mine is situated above MSL 600 m. and has a salubrious climate. April to mid June are summer months, followed by Monsoon which last for about four months, generally from mid June to September, and rest is winter. The seasonal variation of maximum and minimum temperature, as recorded over past few years is stated below (Source - Barsuan Iron Mines of M/s. Steel Authority of India Ltd., (SAIL).

Year	Summer		Winter		Rainy	
	Max° F	Min°F	Max° F	Min° F	Max° F	Min°F
1986	109°	61°	75°	45°	94°	64°
1987	110°	59°	86°	46°	108°	64°
1988	110°	65°	83°	50°	100°	66°

It is observedd from above that, a days maximum recorded temp. has been 110°F and minimum 45°F. Hence, the winter is not severe.

Average annuall rainfall is about 200 Cms. The wind speed rises to 40 Kms./hr. with SE to NW direction. Average relative humidity varies from 60 to 80% in a year.

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v) Ambient air quality :

The ambient air is absolutely pure because there is no industries within 20 KM. radius from the leasehold. The metal road running from Tensa to Koira is situated about 1 KM. away from the lease area, hence, pollution due to transport is negligible. Only dust pollution occured due to natural flow of wind but the region mainly falls under the Sarkanda Reserve For est with a vegitation density 0.08, it has no effect on the air environment. The analysis of ambient air quality (Pollution) was made during April, 1993 and report of that is given in Annexure 2.

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13.1.2 Ecological environment :

The entire lease comes under Government forest land containing mainly sal trees of average girth 68 c.m. (Fig. 26) and seasonal bushes. The density of this reserve forest as obtained from the field studies during the year 1992-1993 is varies from 0.08 to 0.106. It was also observed that there is no remarkable density variation within the leasehold (Core area) and beyond 60 m. (region) of the 'Core area'. There is no founa observed in or around the lease hold area.

13.1.3 Human environment (Settlement) :

Within the region there is no human habitation and the entire region comes under reserved forest land. The industrial town Tensa situated about 3 KM. north of lease block, beside Tensa main residential huts, M.E. School, forest etc. are available at Bengula village which is 4 K.M. away from the area. The main livelihood of the surrounding population is mining and allied activities in adjacent mine and trade and commerce. A very small population in the aforesaid villages depend on agriculture. No special craft is conspicuous. It is found in observation that the Socio-economic and health condition is very deplorable.

13.2 Environmental impact :

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Impact due to proposed small scale manual mining and allied activities on the existing eco-system will not create any problems as we see from the following discussion :-

13.2.1 Relief and landscape alteration :

The mining operation and its various constraints related to mining will change the topography to the extent of causing only aesthetic impairment. In the present case alteration in relief and landscape will not be considerable as the excavation will be limited. But as the area is situated on slope, scares of mining and dumping will be visible.

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13.2.2 Impact on Hydrography :

The proposed working sites are much at higher levels than the water source. So the change in topography caused by mining will not create any impact on the hydrography of the region.

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13.2.3 Water contamination :

Rain water flowing through exposed mines cut may carry sediments of alluvium, laterites and other fines which are non toxic in nature. However, the surface run-off water has a high turbidity during monsoon. There will be no industrial affluent in the lease as the process involves no water due to crushing and beneficiation.

13.2.4 Air Pollution :

Air pollution will be occured due to mining in two ways i.e. by the addition of gaseous pollutants to the atomosphere and of the emission of particulates. Ambient air quality is disturbed to some extent due to drilling and blasting. Rather then drilling and blasting other mining activities causing dust nuisance are due to waste-dumping, loading, surface transport (haulage) etc. Noise pollution will also occure due to blasting of rocks. The ambient noise level of the area is given in Annexure 3.

13.2.5 Impact on flora and fauna :

Deforestation can not be avoided while operating a mine located in a reserve forest area. Moreover, deforestation will be necessary for the various purposes related to mining. However, there is no habitation and agricultural lands in and around mining area. Only seasonal bushes and sal trees (mainly) effected due to mining. But effect due to mining on natural growth will be very nominal. So faunal crisis and adverse change on the surrounding physical environment is not expected.

Since no wild animals are conspicuous in the area, noise and habitation which normally cause migration of wild life, do not have any impact, because mine will be run manually in a small scale without using any heavy machineries.

13.2.6 Impact on Climatology :

No impact is anticipated due to small scale of operation on existing climate.

13.2.7 Impact on human environment :

After opening of the mine and in course of its operation, there will be a beneficial impact on the socio-economic environment of the region by creating more employment

opportunities and establishment of trade and commerce. As a result as expected, a few sleepy villages will be established around the area.

13.2.8 Impact on forestry and land use :

13.2.8.1 The main impact due to this type of mining activity will be on existing land use pattern and forestry. Some felling of trees will be required for mining and ancilliary activity. The existing land will also be degraded gradually to a certain extent. However as the area is 'reserve forest land' and there is no agricultural and grazing land in the vicinity, impact on land use pattern will be minimum. The yearwise impact on existing land and on forest due to mining and allied purposes over the lease area are estimated on the basis of annual production for the first five years and represented in table No. 16 . It is clear from the table that about 12,382 sq.m. or 1.24 hects. surface area will be require around the two quarries to safely reached the targeted production. It was also calculated about 486 numbers of trees having average girth 68 cm. to be fell during first phase (five years) of mining operation around the quarries. During our own field work (1992-1993) number of trees was estimated by counting over an area of 20m x 20m in different cluster within the leasehold and also 60 m beyond the lease boundary. The result of which is accumulated and presented in table No. 17. Average 32 numbers of trees comes within the mentioned area.

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13.2.8.2 Since the mining operation will be commence after the approval of Mining Plan and there was no resonable land degradation occured due to the mining by exlessee, hence there is no question of saplings already planted. Agein it is worth to mention that the area is entirely covered by the vegetation. There is no barren land with respect to forest vegetation. So compensatory afforestation will be only performed over the those areas of pits where entirely explore the mineral deposits. Such areas will be available after fifth year from quarry No.1 and after 10th year from quarry No.2. So during the first five years of mining no plantation programme is envisaged.

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13.3 ENVIRONMENTAL MANAGEMENT PLAN :

In order to minimise the impact of mining on the ambient environment necessary preventive measures to be adopted by the lessee are as follows :-

i) During the course of mining operation a huge quantity of waste which includes decomposed shale/phyllite (soil) admixed with lateritic boulders, conga and also subgrade manganese ore and fines will be generated. After recovery of manganese ore, the soil will be seperated from other waste materials and stored in an appropriate site selected for it. These soil will be spread over the dumps after achieving its optimum height for suitable plantation (grass) which helps to prevent the erosion due to rain and wind and also from further rolling down of the dump materials. Beside these plantation will be made in a systematic manner to revert back the asthetic beauty too.

ii) As per proposed plan, due to advancement of the mining faces with time land degradation will occur. After pits have been extensively worked and there is hardly any presence of recoverable ore, it has been decided to reclaim this pit by filling fresh generation of waste produced from subsequent mining operation. This will prevent the use of any fresh land for dumping purpose there by in turn reducing the land requirement vis-a-vis degradation. More over proposed mining operation will be carried out mainly by back-filling processes. So by adopting this method of mining degree of land degradation will be minimum.

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iii) Deforestation cannot be avoided in a mine situated in a forest. The area required for deforestation due to mining and other allied activities within the lease, will be selected judiciously and should be kept to the minimum of 5.84 hects. Under the mining lease of 19.6 Hec.area 1.24 hects. and 0.25 hects. are selected for initial mining and allied activities respectively for first five years. Out of which only 0.42 hect. was broken by the previous lessee M/S AMTC. Therefore further 1.07 hect. of land will be degraded and vis-a-vis deforested during first five years.

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iv) Mining operations result in the increase in turbidity of the rain water falling directly over the active mine faces during the monsoon and gets charged with laterite, loose soils particles and ore fines. However it is not toxic in nature. The surface run off which become turbid during monsoon flows through drain and natural depressions provided for the purpose and meet with seasonal nallah flowing along BC boundary pillar and ultimately discharged into Sarkanda Nadi further 3 KM south of lease block. If required check dams will be prepared across the adjacent nallah to settle all the suspended particle within lease block. Proposed mining operation will never touch the ground water table. Hence, these will have no adverse effect on local water regime due to mining.

v) The surface mining method is not mechanised though drilling and blasting will be required. Other mining operation such as haulage on mine road, ore and waste excavations and dumping will also generate dust resulting in pollution. Following control measures will be taken to minimise these effect on environment.

a). Exhaust fumes from the internal combustion engines used on Trucks Dumpers, and other machineries will not allow to pollute the air by properly maintaining the engine in good condition by following regorus maintenance and timely overhaul schedules. Special care will be taken for regular tuning of engine to check harmful exhaust of unburnt fuel causing noxious fumes.

b). Whether the scale of mining operation it is not possible to complete elemination of dust. So adequate measures will be taken to reduce the dust nuisance. These are :

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i). It is observed, the volume of dust raised from out of dumping area by the action of wind mostly during dry season is not significant.

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ii) Haul roads are a major source of dust in the mines. Dust suppression in the haul roads and other working generated by using of dumpers and other heavy machineries will be reduced by sprinkling of water. This will be done by using water sprinklers constantly running during the working shift if necessary.

iii) The drilling machines are provided with dust collector to prevent the dust from becoming air borne. The workers who runs the drill machine are provided with dust mask.

Experience say, the Noise produced due to the mentioned machines using for mining operation has no effects on environment.

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iv) Generation of dust due to blasting can not be avoidod. Since there is no habitation or human settlement within the lease the effect of dust is practically insignificant.

VI) Labours are essential for operating a mine. About 170 labours/day will be required to run the mine smoothly. There will be job opportunity for 170 peoples which ultimately helps about 680 persons for better living health and sanitation condition. Labours are available from Tensa, Dengula and Koira. So, no permanent huts will be required for accomodating them. As the mining is proposed to be started in this remote area it will certainly have some positive bearing on the local people. As soon as the mining activities will start in this region, it will no doubt develope the communication facilities, medical facilities, educational facilities and other recreational activities in the adjoining area and thereby escalating the existing socio-economic and health environment of the region. This certain upliftment may create certain social disturbance, which are to be controlled by imparting periodic educational programmes at regular intervals.

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13.4 Epilogue :

Opencast mining of any dimension in general is likely to cause some sort of imbalance to the existing environment and bring some changes, either directly or indirectly in the surrounding vegitation, animal and human life. The compexity of assessing these parameter changes are increased by the fact that the group adversely affected by the project are often not the same as the groups who are benefited by it. It has become necessary to draw a balancing control between odds and the benefits from overall perspective of the project. From the discussion it is clear mining operation in the area has no impact on human life, vegetation and of course wild life. It creates no problem regarding atmospheric air and natural water regime also. Deforestation and degradation of land is required for mining and allied activities, but it is very small with respect to entire Sarkanda valley. Moreover, under these conditions mining in the area can not be a threat to environment as affected land can be reclaimed and afforestation can be initiated. Therefore, proper mining planning is the urgent pre-requirement of the day. On the other hand proper preventive methods will be adopted. So, adverse effects due to said parameters is also negligible. Besides these present project will give a job opportunity for about 170 persons per day directly. Which indirectly help the 680 heads for their better living aand sanitary condition.

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It is evident that the mining industry is indispensable for the economic and industrial progress of any country as technological development are dependent upon mineral wealth. Hence exploitation of nature gifted manganese mineral in Sarkanda valley has become necessary as the mineral has the demand in market. But mineral resources are non renewable, on the other hand, agriculture, forest, and water sources are to some degree renewable. Proper pre-exploitation investigations for planning and development should be made so that the mineral resources can be best utilised to improve the Country's economy with minimum disturbing the present eco-system.

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TABLE No. 16

Yearwise estimation of land use pattern due to mining around quarry No. 1 and 2 in site I & II respectively with numbers of trees (mainly Sal) likely to be fell during 1st five years operation.

During the year.	Surface area required for mining.	Number of trees to be fell.	Surface area required for mining.	Number of trees to be fell.
	Quarry No. 1, Site I		Quarry No. 2, Site II	
1st.	3360 m^2 60 m x 60 m (approx.)	96	2016 m^2 45 m x 45 m (approx.)	72
2nd.	816 m^2 28.5m x 28.5m (approx.)	45	1334 m^2 36.5m x 36.5m (approx.)	55
3rd.	452 m^2 21 m x 21 m (approx.)	30	1392 m^2 37 m x 37 m (approx).	65
4th & 5th.	890 m^2 30 m x 30 m (approx.)	48	2112 m^2 46 m x 46 m (approx.)	75
Total area :	5518 m^2	219	Total area = 6864 m^2	267

Total trees from both site I & site II likely to be fell 486.

TABLE No. 17

Number of trees available in different cluster of vegetation within the mining lease area and beyond 60m. the base area and their girth.

Cluster No.	Area in m.	No. of trees.	Girth in cm.
1.	20 m x 20 m	35	65, 100, 80cm, 95, 45, 30, 70, 96, 58, 130, 40, 85, 37, 78, 33, 67, 57 , 29, 32, 96, 75, 19, 23, 52, 59, 67, 70, 84, 96.
2.	,,	34	103, 56, 70, 93, 107, 48, 77, 67, 112, 50, 41, 68 , 94, 35, 43, 45, 47, 42, 36 , 69, 70, 56, 23, 19, 41, 51 , 62, 102, 109, 19.
3.	,,	28	97, 65, 69, 104, 70, 125, 18, 114, 118, 30, 27, 35, 26 , 42, 57, 29 ,36, 102, 92, 67 , 26, 43, 26, 67, 70, 16, 21.
Within Leasehold : Average number of trees 32, their girth = 67.5 cm.			
4.	,,	36	72, 67, 58, 55, 110, 66, 30, 24, 21, 48, 86, 49, 87, 71, 63, 19, 30, 42, 91, 96, 22, 32, 37, 48, 57,112, 85, 97, 101, 103, 26, 21, 16.
5.	,,	33	91, 108, 77, 116, 85, 68, 44, 36, 39, 33, 117, 103, 49, 57, 128, 130, 96, 119, 41, 32, 17, 23, 26, 30, 48.
Within 60m. from leasehold : Average number of trees = 24.00, their girth = 68.86 cm.			

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REGN. No. MQP/AL/040/87/A

CHAPTER - XIV

14.0 VARIOUS CONSERVATION MEASURES :

In this chapter an attempt has been made in briefly regarding the conservation measure over those domain which will be affected due to prolong steady mining. In foregoing parts of this objective dissertation entire gamut of the mining and their relative purposes was delinated and discussed accordingly. It is again necessary to mention that the proposed site of mining entirely fall within the Sarkanda Reserve Forest (Fig.26). In case of surface mining of any scale land degradation cannot ruled out. For the present case an additional effect on the existing environment will be happened i.e. deforestation as the operation side is reserve forest area along with land degradation, though the required deforestation is negligible with compare to the entire Sarkanda Forest. From the very begining i.e. from exploration works to the exploitation of entire economic Mn deposits and their despatch the physical and biological environment gradually effected. The various effected part due to exploration and exploitation and their appropriate conservation measures are jotted down below :

i) Initial exploration was carried out by exlessee M/S AMTC by digging several trial pits only. It was observed during our own field works that the pits were made without disturbance of the natural forest growth. Future exploration works will be also carried out by digging several pits and trenches on the same way done by AMTC.

ii) Mine haulage is essential for a mine. There is a mine road made by MMTC with a gradient of 1:16 (Fig. 27) and passes all the important sites which are proved as mineralised zones. These road is also connected to all quarries to the despatch point. Hence, further felling of trees due to mine road is not required. But with the advancement of mining further mine road will be necessary to stack the size ore, sub-grade ore and also carrying the waste materials from quarry sides to dumping places. This road plan was made in a such a way that the felling of trees for the purposes is negligible (See General Layout Plan).

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iii) Different site services are essential for operating a mine. The space for these site services (See Fig. 11) are planned where no forest vegitation will be disturbed. So there is no question regarding felling of trees and land degradation. But some area will be occupied due construction of permanent building which is very negligible compare to leasehold. Hence, it will cause no effect on the prevailing conditions.

iv) The mineralisation of the reference took place beneath a capping of overburden about 4.5 m. thick (average). A substantial quantities of this overburden has to be removed from the mining site before mining of the economic deposits. The developmental works also includes deforestation of the quarry sites. The removal of overburden and deforestation around the quarries certainly create some problems especially regarding disposal of huge overburden. Dumpsites for overburden are choosen over the barren area after proper investigation. Though mainly back filling (Pit filling) method will be adopted here, but sufficient space within the pits will be required for these purpose. Such space will be available after the end of fifth year mining operation when manganese ore fully explored from some part of the quarry floors. Before that overburden and interburden materials are removed from the quarries and dumped at appropriate site. The removal of overburden and deforestation schedule will be carried out phasewise as to impart gradual effect over the existing condition due to land degradation and deforestation. It is clear that at the end of fifth year some of the degraded land will reclaimed due to back-filling process. After achieving proper configeration of the pit by filling of waste (maintained general slope less than 37° from the horizontal). After spreading shalely materials, over the newly created area within the pits plantation schedule will be carried out phasewise. By adopting these practice certainly the land degradation, deforestation, area of dumping yard etc. will be minimized for subsequent works. The configeration of

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the dumping yards their sections are given in respective chapter. To minimized the deforestation felling of trees for dump sites will not be envisaged because there is no permanent bushes in the forest area. All the trees of these forest are tall and mainly sal. Hence, dumping the waste materials at the feet of forest growth following the contour will not create any problems. On the other hand, after compaction of these waste prevent the felling of trees due to heavy rain and storm.

v) Effect due to transportation, blasting, noise, dust generated from mine side, dumps water contamination etc. and their measure are discussed detailed in the Chapter XIII.

vi) It is estimated that about 15% of the total minerable Mn ore of this mine belong to 20-25% Mn content. Below which Mn ore (subgrade) not taken into consideration regarding reserve estimation. The Mn content of this region varying from 26% to 37% mainly i.e. low to medium grade ore (see tabbe No. 2). Less than 20% Mn content ore has no economic value. But from the mineral conservation point of view maximum utilisation of minerals is necessary. Again, the Mn ore of these region are suitable for Steel Industries. The required grade of these Steel Mills are 28-30% Mn. Hence, after proper blending of 20-25% Mn with the 30% Mn and above grade ore (medium), the resulting grade of the Mn ore will be obtained around 30% Mn. It is calculated that 1.5 (20-25% Mn) : 1 (26-37% Mn) ratio of two grade ore is necessary to yeilding 30% Mn by blending. In this way subgrade (20-25% Mn) ore can be properly utilised.

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Fig. 26 - A panoramic view of forest density. Trees are mainly Sal. Note there are also seasonal bushes at the feet of the large trees.

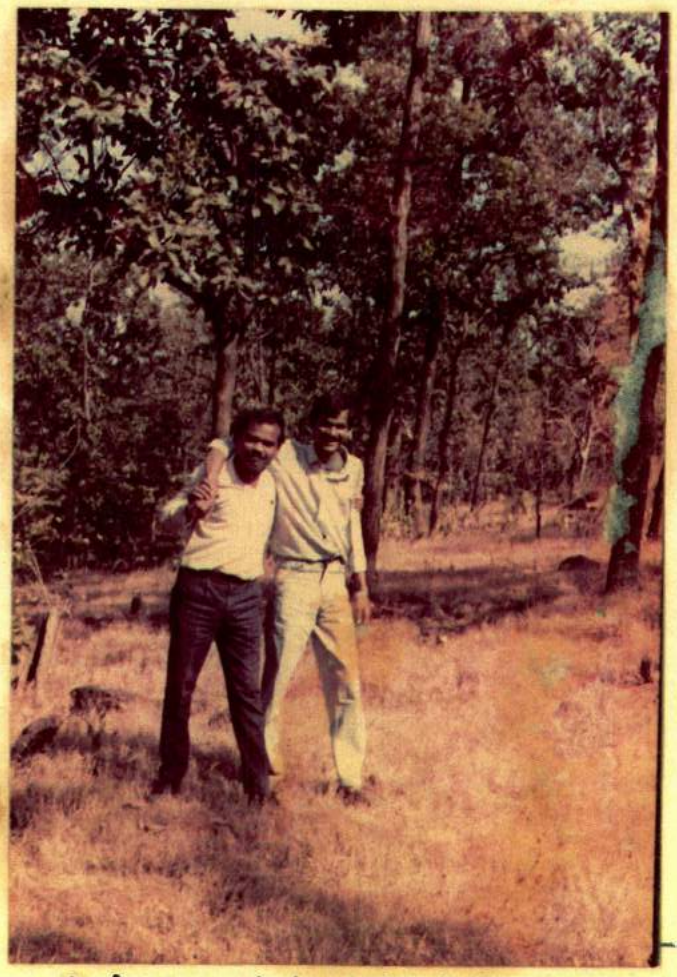

Fig. 27 - A close-up photograph of the mine road (men are walking) running back to front of the pictures with a bent just behind the men (right side) from where road runs almost east-west directions. Note the forest growth and aesthetic beauty.

CHAPTER - XV

15.0 **Conceptual Plan for future and their reclamation measures :**

Details layout, land degradation, deforestation etc. are required and the position of the producing quarries after 1st five years are described briefly in foregoing chapters. In this part of the dissertation emphasized has been given to drawn a comprehensive picture regarding the position of quarries, number of operative quarries total area of degradation and also deforestation side by side reclamation of degraded lands and compensatory afforestation over the excavated lands etc. during the end of 10 years and 20 years respectively on the basis of more or less steady rate of production (1200 MT/year).

15.1 Ultimate extent and sizes of the quarries :

15.1.1 It was estimated that with the proposed rate of production from the two quarries i.e. quarry No. 1 & 2, the pits will be runs safely for 20 years at least. The limit of the quarries though kept confined within the mineralised zones only which is marked on the map (Fig. 8). The limit of mineralised zones are determined on the basis of M/s AMTC exploration works. Hence, further existence of the mineralised zones can be possible beyond the area which will be confirmed by our own future exploration schedule (See table No.3). Within the mineralised zones the ultimate extent and size of the quarries after each year of first five years, after 10 years and after 20 years are planned and marked on the enlarged layout plan (see Figs. 12 & 13). Ultimate size of quarry No. 1, after fifty years, after ten years and after twenty years of operation are 87m x 60m ; 108m x 66m and 216m x 66m respectively. After 5th years the pits will be extended across the cross section YZ line. The sizes of the pits will be available from cross sections of layout plans. In case of quarry No. 2 which is also confined within the mineralised zones, their aerial extent after 5 year and after 10 years will be same because only depthwise excavation will be in practice. The maximum (after 10 yrs.) dimension is 120m x 74m. This will be increased upto 138mx92m at the end of 20 years. Here the quarry will be advanced along the section line WX with time.

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15.1.2 Due to advancement of mining from the end of fifth years to the end of ten years another 1908 m^2 area will be necessary from quarry side 1 and there will be no further land degradation required in case of quarry side 2. Hence, during these span of time it was calculated another 114 numbers of trees likely to be fell. From eleventh year to end of 20th year further land required for the production purposes around the both quarry sides are 7,128 m^2 and 3,816 m^2 respectively. The number of trees likely to be fell during these period are 425 and 228 respectively.

15.2 Final slope of the excavated lands :

After removal of all economically exploitable Mn ore from the pits floor, the vacated areas are used for dumping of waste (overburden + interburden) which will be generated by subsequent works. The time required to reach the floor of the quarries into the non-mineralised zone is five years. Hence, there is no question of pit dumping before fifth years of operation. After fifth years the excavated portion of the quarries will be filled systematically as to match the contour lines of that area and also to maintain the slope of the waste material those are dump into the pits is less than 37° from the horizontal. Once again it is to mention here, that the slope of the pits are confined to 45° with the horizontal against the general slope of the mining sites is 1:5.

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15.3 The post mining reclamation and land use pattern :

Once the mining operations will be over in some part of the pits, the land should be rehabiliated for productive uses like forestry, because the mining area entirely confined within the reserve forest area. After achieving optimum height of the waste materials the top surface of waste are levelled and maintained the general gradient of the dump material less than 37° from the horizontal. This can be done by keeping bench width greater than the height of the benches. Pit dumping should be advanced from lower level towards the higher level direction. This process will be gradually practiced till the entire exploitation of ores from the pit floors. The interburden (shale) are spread over the top of the dump materials and then it will be stabilized through proper

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vegitation. The plantation programmes will be carried out by planting same useful trees not less than twice the number of the trees destroyed due to mining operation.

15.4 Minerable reserve and anticipated life of mine based on techno-economic factors :

Minerable reserve of this mine is 4,64,450 M.T. The grade of the ore varies from 26% Mn to 37% Mn. The 20-25% Mn ore is also utilised by proper blending. The annual production is 12,000 MT/year which can be obtained from two quarries. Hence, the mine will runs safely about 38 years after commencement of mining.

15.4.1 From the experience in the field of natural resources and their utilisation it was observed that manganese ore has a steady demand atleast for last three decades. With the growth of several small scale industries along with the modernisation of the Steel Plants further enhance the demand of Mn ores in the market. It is expected that demand of the manganese minerals hold a good position in the market for future also with the country's industrial development. The ore of these area is specially suitable for the steel mills and Ferro-Manganese Plants. The other factors, like machineries, labours, mining implements etc. will create no problems with time regarding the economic aspect of the mining because it is small-scale working mine and runs manually without using any heavy mechine and other essential instruments regarding mining.

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REGN. No-RQP/CAL/042/87/A.

No. E-4900

R.V. BRIGGS & Co. PRIVATE LTD

ANALYTICAL CONSULTING AND TECHNICAL CHEMISTS

Telegraphic Address :
ANALYTICAL. CALCUTTA

9, BENTINCK STREET.
CALCUTTA
POST BOX No 279

Telephones : 28-3661
28-2698
28-7803

CERTIFICATE OF EXAMINATION

We hereby certify that a sample of "EFFLUENT WATER" drawn by our representative on the 6th April 1993 near Jarghat Nala at Sarkunda ..... Mg mines. Barbil., ~~xxxxx~~, in the presence of a representative of and on ~~xxxxxx~~ account of Messrs JAGADISH MISHRA. Barbil., Calcutta, has been analysed with the following results :

BEING DISCHARGED INTO

ANALYSIS :			RESULT	IS : 2490 (Part I) - 1981 Into Inland Surface Waters ~~EXTRACTION~~ LIMIT
1) Colour and Odour		...	Clear water white with traces of sediment, odour .. Nil	
2) Suspended solids		mg/l...	10.00	100 Max
3) Particle size of suspended solids		...	Passes through 850 micron sieve	L 850 micron
4) Dissolved solids (inorganic)		mg/l...	78.00	2100 Max
5) pH Value		...	7.00	5.5 to 9.0
6) Temperature °C		...	32°C	Max. 40°C
7) Oil and Grease		mg/l...	Trace	10 Max.
8) Total residual Chlorine		,, ...	NIL	1 ,,
9) Ammoniacal nitrogen	N	,, ...	NIL	50 ,,
10) Total kjeldahi nitrogen	N	,, ...	NIL	100 ,,
11) Free ammonia	NH_3	,, ...	NIL	5.0 ,,
12) Biochemical Oxygen Demand for 5 days at 20°C		...	3.00	30 ,,
13) Chemical Oxygen Demand		mg/l...	12.00	250 ,,
14) Arsenic	As	,, ...	NIL	0.2 ,,
15) Mercury	Hg	,, ...	NIL	0.01 ,,
16) Lead	Pb	,, ...	NIL	0.1 ,,
17) Cadmium	Cd	,, ...	NIL	2 ,,
18) Hexavalent chromium	Cr+6	,, ...	NIL	0.1 ,,
19) Total chromium	Cr	,, ...	NIL	2 ,,
20) Copper	Cu	,, ...	NIL	3 ,,
21) Zinc	Zn	,, ...	0.08	5 ,,
22) Selenium	Se	,, ...	NIL	0.05 ,,
23) Nickel	Ni	,, ...	NIL	3 ,,
24) Boron	B	,, ...	NIL	2 ,,
25) Percent Sodium		...	91.62	
26) Residual Sodium carbonate		mg/l...	-	
27) Cyanide	CN	,, ...	NIL	0.2 ,,
28) Chloride	Cl	,, ...	12.0	1000 ,,
29) Fluoride	F	,, ...	0.60	2.0 ,,
30) Dissolved Phosphates	P	,, ...	NIL	5 ,,
31) Sulphate	SO_4	,, ...	2.00	1000 ,,
32) Sulphide	S	,, ...	NIL	2 ,,
33) Phenolic compounds	C_6H_5OH	,, ...	NIL	1 ,,

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REMARKS : The above sample of effluent complies with IS 2490(Pt-1)/1981 for Industrial effluent discharged in the inland surface waters.

Annxure-1.

(K. P. DE)

No. RVB/PL/SJR/-38.

Barbil 27th May 1993.

R.V. BRIGGS & Co. PRIVATE LTD.

ANALYTICAL CONSULTING AND TECHNICAL CHEMISTS

Telegraphic Address :
ANALYTIGAL, CALCUTTA

9, BENTINCK STREET,
CALCUTTA
POST BOX NO. 279

Telephones : 28-3641
28-2698
28-7803

Branch : BARBIL
Telephone : 273

CERTIFICATE OF EXAMINATION

AMBIENT AIR QUALITY:

M/C. M/s. JAGADISH MISHRA., RAIRANGPUR.

Sarkunda Manganese Mines.

Instrument used : High volume sampler (Installed approx 2.5 mtrs above the ground level)., 10 mtrs from the source.

Date of sampling:	Location:	Actual duration of Monitoring (Min)	GROUND LEVEL CONCENTRATION		
			SPM $\mu g/m^3$	SO_2 $\mu g/m^3$	NOX $\mu g/m^3$
5.4.93.	Sarkunda Mn. Mines.	480.	127.16	8.8	65.88

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Marks : Clear Weather.

Method followed : As per IS : 5182.

R.V. BRIGGS & CO. PRIVATE LTD.

Asst. Area Manager

Tms:-ix.

Annexure-2.

Regional ..., Indian Bureau of Mines.

No. RVB/PL/SAR- 38-A.

Barbil 27th May 1993.

R.V. BRIGGS & Co. PRIVATE LTD.

ANALYTICAL CONSULTING AND TECHNICAL CHEMISTS

Telegraphic Address : ANALYTICAL, CALCUTTA

9, BENTINCK STREET,
CALCUTTA
POST BOX NO. 279

Branch : BARBIL
Telephone : 273

Telephones : 28-3661
28-2698
28-7803

CERTIFICATE OF EXAMINATION

Noise Result.

A/C. M/s. JAGADISH MISRA.

GORUMAHISANI.

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Noise Monitoring Study (db Level)

10 mtrs. from the ~~xxxxx~~ source.

Date.	Location.	db Level.	Temp°C.
~~xxxx~~ 05.04.93.	Sarkunda Mn. Mines	70 to 72	32°C.

Method followed - as per IS specification.

(B. GHOSH)
Manager.

Annesure-3.

Regional Controller of Mines
Indian Bureau of Mines

Mitra S. K. Mineral Inspection Private Ltd.

Cargo Inspectors, Analytical & Consulting Chemists

P. O. BARBIL, DIST. KEONJHAR, ORISSA

Head Office :-
P-11, C. I. T. ROAD, CALCUTTA-14.
Gram : ASSAYERS
Phones : 44-5485 44-1339
44-7482
Telex : 021-5587 MTRA-IN

Gram : MITRALAB
BARBIL STD CODE NO. : 06767
Phone : 209, 269, (Off)
469, 470. (Res)

CERTIFICATE OF ANALYSIS

Ref. No. 6486/93 SARKUNDA MANGANESE MINES Dated 29th Jan. 1993.

We hereby certify that 4 samples of Manganese Ore, SUBMITTED to us for examination on 27.01.93 have been analysed with the following results :-

Analysis on samples dried at 105°C.

Ref.No.	Sample Mark.	Mn.%	Fe.%
(1):	Sample No. 1:	35.35	14.24
(2):	Sample No. 2 (Red coated)	17.00	16.20
(3):	Sample No.3(Low Grade)	31.13	15.78
(4):	Sample No.4(Makra Type)	8.32	21.36

For MITRA SK MINERAL INSPECTION (P)LTD.

REGIONAL MANAGER.

SRI GHANASHYAM MISHRA,
GORUMAHISANI.

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Annexure - 4a

ANNEXURE - 4a

Regional Controller of Mines
Indian Bureau of Mines

Mitra S. K. Mineral Inspection Private Ltd.

Cargo Inspectors, Analytical & Consulting Chemists

P. O. BARBIL, DIST. KEONJHAR, ORISSA

Head Office :-
P-11 C. I. T. ROAD, CALCUTTA-14,
Gram : ASSAYERS
Phones : 244-5485, 244-1339
244-7482
Telex : 021-5587 MTRA-IN

CERTIFICATE OF ANALYSIS

Gram : MITRALAB
BARBIL STD CODE NO. : 06767
Phones : 209, 269, (Off)
469, 470. (Res)

Ref. No. 7023/93

SAMPLE NOT DRAWN BY US

Dated 9th June 19 93

We hereby certify that anxxxxxx sample of Manganese ore, submitted to us for examination on 5/6/93, has been analysed with the following results:-

Sarkunda Mn.Mines.

Sample Mark:-
JM/10/= 10 Mt.

Analysis on sample dried at 105°C

Manganese	(Mn)...	38.70%
Iron	(Fe)...	18.60%
Silica	(Sio2)...	3.10%
Alumina	(Al203)..	5.24%
Phosphorus	(P).....	0.072%
Sulphur	(S).....	0.006%

for Mitra S.K.Mineral Inspection(P)Ltd

(Regional Manager

M/s. Jagadish Mishra
Barbil.

sd/6

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Annexure 4b

Regional Mines.
Indian Bureau of Mines.

Mitra S. K. Mineral Inspection Private Ltd.

Cargo Inspectors, Analytical & Consulting Chemists

P. O. BARBIL, DIST. KEONJHAR, ORISSA

Head Office :-
P-11 C. I. T. ROAD, CALCUTTA-14,
Gram : ASSAYERS
Phones : 244-5485, 244-1339
244-7482
Telex : 021-5587 MTRA-IN

Gram : MITRALAB
BARBIL STD CODE NO. : 06767
Phones : 209, 269, (Off)
469, 470. (Res)

CERTIFICATE OF ANALYSIS

Ref. No. 7024/93

SAMPLE NOT DRAWN BY US

Dated 9th June 1993

We hereby cert[illegible] that one sample of Manganese ore, submitted to us for examination on 5/6/93, has been analysed with the following results:-

Sarkunda Mines.

Sample Mark SM/11 =10mt

Analysis on sample dried at 105°C

Manganese	(Mn)...	38.60%
Iron	(Fe)...	19.20%
Silica	(Sio2)....	2.40%
Alumina	(Al2O3)...	5.71%
Sulphur	(S).....	0.006%
Phosphorus(P)	--------	0.072%

for Mitra S.K.Mineral Inspection(P)Ltd

Regional Manager

M/s. Jagadish Mishra
Barbil.

अनुमोदित
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3/93/9000

Annexure 4c

Mines.

Regional
Barbil

Mitra S. K. Mineral Inspection Private Ltd.

Cargo Inspectors, Analytical & Consulting Chemists

P. O. BARBIL, DIST. KEONJHAR, ORISSA

Head Office :-
P-11 C. I. T. ROAD, CALCUTTA-14.
Gram : ASSAYERS
Phones : 244-5485, 244-1339
244-7482
Telex : 021-5587 MTRA-IN

CERTIFICATE OF ANALYSIS

Gram : MITRALAB
BARBIL STD CODE NO. : 06767
Phones : 209, 269, (Off)
469, 470. (Res)

Ref. No. 7022/93

SAMPLE NOT DRAWN BY US

Dated 9th June *19* 93

We hereby certify that 9 samples of Manganese ore, submitted to us for examination on 5th June 1993, ~~for examination~~ have been analysed with the following results:-

(Sarkunda Mines.)

Analysis on sample dried at 105°C

Sl.No.	St.No.	Mn%
1.	JM/ 1	29.5%
2.	JM/ 2	30.2%
3.	JM/ 3	28.00%
4.	JM/ 4	30.2%
5.	JM/ 5	28.7%
6.	JM/6	29.3%
7.	JM/ 7	28.7%
8.	JM/ 8	30.1%
9.	JM/9	31.2%

---

for Mitra S.K.Mineral Inspection(P)Ltd

Regional Manager

M/s. Jajadish Mishra
Barbil.

5/93/9000

Annexure 4c

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