FACOR

FERRO ALLOYS CORPORATION LIMITED

CHROME ORE MINING DIVISION

PROPOSED BHIMTANGAR CHROMITE MINES

MINING PLAN

ALONGWITH

PROGRESSIVE MINE CLOSURE PLAN

23.800 HECTARES OR 58.81 ACRES

VOLUME - 1
(TEXT)

23.09.2005

F-1

भारत सरकार
खान मंत्रालय
भारतीय खान ब्यूरो
खान नियंत्रण और खनिज संरक्षण प्रभाग
(मध्य अंचल)

GOVERNMENT OF INDIA
MINISTRY OF MINES
INDIAN BUREAU OF MINES
Mines Control & Conservation of
Minerals Division (Central Zone)

संख्या/No. 314(3)/2005-MCCM(C)/MP-18 दिनांक/Dated 6/10/2005

To,

Shri Ashok Agrawal,
Chief Executive (Mines),
M/s Ferro Alloys Corporation Ltd.,
Laxmi Bhawan,, Kuans,
Bhadrak-756100, Orissa.

Sub. :Approval of Mining Plan including Progressive Mine Closure Plan of Bhimtangar Chromite Deposit over an area of 23.800 hectares in Jajpur district of Orissa State in favour of M/s Ferro Alloys Corporation Limited, submitted under rule 22 of MCR, 1960.

Reference:- 1. Your letter No. KCM/A-3/2640/05 dated 29.7.2005.
2. This office letter of even no. dated 20.9.2005
3. Your letter No. KCM/SRGM/2987/2005 dated 24.9.2005
4. This office letter of even no. dated 4.10.2005.
5. Your letter No.OCM/G-4/863/05 dated 5.10.2005.

Sir,

In exercise of the powers conferred by Clause (b) of Sub-Section(2) of Section 5 of Mines & Minerals (Development & Regulation) Act, 1957 read with Government of India Order No.S.O.445(E) dated 26.4.1987, I hereby approve the Mining Plan including Progressive Mine Closure Plan of Bhimtangar Chromite Deposit over an area of 23.800 Hectares in Jajpur District of Orissa in favour of M/s Ferro Alloys Corporation Ltd. submitted by you, for grant of mining lease under Rule 22 of MCR 1960, on the following conditions :-

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

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

iii) It is further clarified that this approval of the mining plan is subject to the provision of Forest (Conservation) Act 1980, Forest Conservation Rule 1981 and other relevant statutes, order and guidelines as may be applicable to the lease area from time to time.

iv) It is further clarified that the approval of Mining Plan is subject to the provisions of the Mines Act 1952 and Rules & Regulations made there under including submission of notice of opening, appointment of Manager and other statutory officials.

6 वी मंजिल, 'डी' ब्लॉक 6th Floor, 'D' Block
इंदिरा भवन, सिविल लाइन्स, नागपुर-440 001
Indira Bhavan, Civil Lines, NAGPUR-440 001
दूरभाष/Phone : 2565603, फैक्स/Fax : (0712) 2565603
e-mail : com_cz@ibm.mah.nic.in
तार : खानब्यूरो/Gram : MINESBURO

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

vi) Your attention is invited to the Supreme Court interim order in W.P.(C) No.202 dated 12.12.96 for compliance. The approval of Mining Plan is, therefore, issued without prejudice to and is subject to the said directions of the Supreme Court as applicable.

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

viii) A copy of Environment Impact Assessment – Environment Management Plan (EIA-EMP) as approved by MOEF (Ministry of Environment & Forest) shall be submitted to IBM immediately after approval of MOEF.

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

x) A bench level study together with Pilot Plant level testing for low grade ore shall be carried out within six months from the date of execution of M.L. and the report of the same shall be submitted to the Regional Controller of Mines, IBM, Bhubaneswar.

Yours faithfully,

Encl: Two copies of approved mining plan.

(C.P.Ambesh)
Chief Controller of Mines

Copy for information to :

1. The Director of Mines Safety, Directorate General of Mines Safety, Bhubaneswar Region, 136/A, Saheed Nagar, Bhubaneswar, alongwith a copy of approved Mining Plan.

2. The Director of Mines, Directorate of Mines, Government of Orissa, Heads of Department Building, New Capital, Bhubaneswar-751001

3. Shri M.K. Pujari, Sr. General Manager & RQP, M./s FACOR Ltd., Kathpal Chromite Mines, Post-Kalarangiatta-775028, Dist. Jajpur.

(C.P.Ambesh)
Chief Controller of Mines

FACOR

PROPOSED BHIMTANGAR CHROMITE MINES

MINING PLAN

ALONGWITH

PROGRESSIVE MINE CLOSURE PLAN

(23.800 HECTARES OR 58.81 ACRES)

SUBMITTED FOR APPROVAL

(By competent authority, Indian Bureau of Mines)

UNDER RULE – 22 (4)

MINERAL CONCESSION RULES – 1960 (REVISED – 1988)

"This mining plan is approved subject to the conditions/stipulations indicated in the Mining Plan approval letter No. 314(3)/2005-MCCM(C)/MP-18 dated 6/10/05

FERRO ALLOYS CORPORATION LIMITED
CHROME ORE MINING DIVISION

अनुमोदित
APPROVED

23.9.2005

6/10/05

मुख्य खान नियंत्रक
Chief Controller of Mines
भारतीय खान ब्यूरो, नागपुर.
Indian Bureau of Mines, Nagpur.

FERRO
ALLOYS
CORPORATION
LIMITED

Laxmi Bhawan, Kuans
Bhadrak - 756100
Dist. Bhadrak, Orissa, India
Phone : 251312, 250598, 250311
Fax : 06784-251782
E-mail : bls_facor168@sancharnet.in

FACOR
CHROME ORE MINING DIVISION

23.9.2005

CONSENT LETTER FROM APPLICANT

The " **MINING PLAN**" in respect of '**BHIMTANGAR**' area for **23.800 Hectares**, Mineral, **"Chromite"**, District – Jajpur, State – Orissa, has been prepared by Sri M.K.Pujari, Regd.No. RQP/CAL/239/96/A.

We request Regional Controller of Mines, Bhubaneswar to make further correspondence regarding " **Mining Plan** " with the said recognized person in his following address : -

Sri M.K.Pujari
Sr.General Manager
M/s Ferro Alloys Corporation Limited
Kathpal Chromite Mines
Post : Kalarangiatta – 755 028
Via : J.K.Road
Dist. : Jajpur (ORISSA)

अनुमोदित
APPROVED

I hereby undertake that all the modifications so made in the '**Mining Plan**' by the recognized person be deemed to have been made with our knowledge and consent and shall be acceptable to us and binding on us in all respect.

Signature of the Applicant (in full)

Name in full (in Block letters)

(ASHOK AGRAWAL)

Address :

Chief Executive (Mines)
Ferro Alloys Corporation Limited
Laxmi Bhawan, Kuans,
BHADRK – 756 100.

FERRO
ALLOYS
CORPORATION
LIMITED

Laxmi Bhawan, Kuans
Bhadrak - 756100
Dist. Bhadrak, Orissa, India
Phone : 251312, 250598, 250311
Fax : 06784-251782
E-mail : bls_facor168@sancharnet.in

FACOR
CHROME ORE MINING DIVISION

CERTIFICATE

1. The " **MINING PLAN** " of proposed **Bhimtangar Chromite Mines** has been carried out for the Extraction of Chrome Ore from the BHIMTANGAR CHROMITE MINES, located in Sukinda Taluk of Jajpur District in ORISSA, in accordance with the guide lines issued by the INDIAN BUREAU OF MINES. This has been prepared by M/S FERRO ALLOYS CORPORATION LIMITED, by **SRI M.K.PUJARI.**

2. It is certified that, the provisions of Mineral Conservation and Development Rules, 1988 have been observed in the preparation of the " **MINING PLAN**" and wherever specific permissions are required, the applicant will approach INDIAN BUREAU OF MINES.

3. It is also certified that, provision of Mines Act, Regulation, Rules and order made there under have been taken into consideration while preparing the said " **MINING PLAN** ".

APPROVED

The informations furnished in the " **MINING PLAN** " are true and correct to the best of my knowledge.

Date: **23.9.2005**

(M.K.PUJARI)
Senior General Manager
Regd.No.RQP/CAL/239/96/A
Validity Date : 15th May 2010

SCRUTINY COMMENTS OF BHEMTANGAR CHROMITE DEPOSIT OF M/s. FACOR OVER AN AREA OF 23.800 HECTARES IN JAJPUR DIST. OF ORISSA SUBMITTED UNDER RULE 22 OF MCR 1960 ALONGWITH NECESSARY CLARIFICATIONS AGAINST THE SCRUTINY COMMENTS

Sl. No.	Ref. No.	Scrutiny comment	Clarification
1.	1	Xerox copy of the lease map, over an area of 23.800 ha. duly signed by the Chief Surveyor of Director of Mining, Govt. of Orissa is to be enclosed in each copy of the modified mining plan.	- XEROX COPY OF THE LEASE MAP OVER AN AREA OF 23.800 HA. DULY SIGNED BY THE CHIEF SURVEYOR OF DIRECTOR OF MINING, GOVT OF ORISSA NOW HAS BEEN ENCLOSED AS DRAWING NO.A-1 IN THE VOLUME - 2.
2.	2	In para 3(d), 8 exploratory Bore holes may be proposed 2 each along the section lines 1, 2, 3 & 4 on the Hang wall side of the anticipated disseminated band to intersect at different depths in the first 5 years for proper assessment of the disseminated chrome ore. Accordingly, they may be incorporated in the text and on the geological plan.	- EXPLORATORY BORE HOLES PROPOSED 2 EACH ALONG THE SECTION LINES 1, 2, 3 & 4 ON THE HANGWALL SIDE OF THE ANTICIPATED DISSEMINATED BAND TO INTERSECT AT DIFFERENT DEPTHS IN THE FIRST 5 YEARS FOR PROPER ASSESSMENT OF THE DISSEMINATED CHROME ORE NOW HAS BEEN INCORPORATED IN THE PARA NO. 3(d) AT PAGE NO. 36 & 36A AND ALSO NOW HAS BEEN MARKED IN THE GEOLOGICAL PLAN AS DRAWING NO. 3 & 5 IN THE VOLUME - 2.
3.	3	In table (5) at Page 39 the UNFC code for possible reserves may be given.	- UNFC CODE FOR POSSIBLE RESERVE I.E. 133 NOW HAS BEEN GIVEN IN THE TABLE NO. 5 AT PAGE NO. 39.
4.	4	PLATES : Dr.B-: Proposed lease area of FACOR and TISCO boundary may be shown for reference and other lease boundaries should be deleted.	- IN THE DRAWING NO. B IN VOLUME -2, PROPOSED LEASE AREA OF FACOR AND TISCO BOUNDARY HAS BEEN SHOWN FOR REFERENCE AND OTHER LEASE BOUNDARIES NOW HAS BEEN DELETED.

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Sl. No.	Ref. No.	Scrutiny comment	Clarification
5.	5	Surface Geological Plan: Dr.No.3: In many places soil cover/alluvium exists. On the Plan, the same may be shown sherever it exists.	- IN THE DRAWING NO.3 (SURFACE GEOLOGICAL PLAN) EXISTANCE OF SOIL COVER/ALLUVIUM NOW HAS BEEN MARKED.
6.	6	Geological Sec.Dr.4 : Ultimate pit limit may be shown in the sections.	- IN THE DRAWING NO. 4 & 5 (GEOLOGICAL SECTIONS) ULTIMATE PIT LIMIT NOW HAS BEEN SHOWN.
7.	7	Dr.8A - 8E : Colour of the ore to be shown in the section line x - x1 for chrome ore.	- IN THE DRAWING NO.8A - 8E, COLOUR OF THE ORE NOW HAS BEEN SHOWN IN THE SECTION LINE x - x1 FOR CHROME ORE.
8.	8	Year-wise dump plan and section to be given for 5 years.	- YEAR-WISE DUMP PLAN AND SECTION NOW HAS BEEN GIVEN IN DRAWING No.13 IN THE VOLUME - 2.
9.	9	Dr-11 : The land type of the 500 m radius from the proposed lease area may be shown in different colours.	- IN THE DRAWING NO.11, THE LAND TYPE OF THE 500 M RADIUS FROM THE PROPOSED LEASE AREA NOW HAS BEEN SHOWN IN DIFFERENT COLOURS.
10.	10	Environment plan Dr-12 : Provision of a retaining wall around the dump is required to be shown. The position of the dump in 5th year may be shown. Provisions of road for stacking of top soil may be shown.	- IN THE DRAWING NO. 12 - a) PROVISION OF RETAINING WALL AROUND THE DUMP NOW HAS BEEN SHOWN. b) THE POSITION OF THE DUMP IN 5TH YEAR NOW HAS BEEN SHOWN. c) PROVISION OF ROAD FOR STACKING OF TOP SOIL NOW HAS BEEN SHOWN.

M. K. Pujari,

AL/239/96/A

Sl. No.	Ref. No.	Scrutiny comments	Clarifications
		PROGRESSIVE MINE CLOSURE PLAN -	
11.	1	Page No. 222 : There are more agricultural land than what has been furnished. Therefore land status may be reviewed and exact figures are to be given (Point No.1(v) of progressive Mine Closure Plan).	- POINT No. 1(v) AT PAGE NO.222, LAND STATUS HAS BEEN REVIEWED AND THE FOLLOWING CHANGES NOW HAS BEEN DONE. (AGRICULTURAL LAND 2.136 INSTEAD OF 1.008 VIRGIN AREA 15.564 INSTEAD OF 16.692.)
12.	2	Page No.232 : Resources table at page 46 should be inserted after geological Reserve table at page 232.	- RESOURCES TABLE NOW HAS BEEN INSERTED AFTER GEOLOGICAL RESERVE TABLE AS TABLE NO. 30A AT PAGE No. 232.

M. [illegible] Pujari,

Regd. No. ROP/CAL/239/98/A

TEXT INDEX

M. K. Pujari,

Regd. No. ROP/CAL/239/98/A

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M. K. Pujari,

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M. K. Pujari,
Regd. No. ROP/CAL/239/96/A

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M. K. Pujari,

Encl No. FCBICAL/239/98/A

Text Index --

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M. K. Pujari,

Regd. No. ROP/CAL/239/96/A

ANNEXURE I N D E X

M. K. Pujari,
Regd. No. ROP/CAL/239/98/A

Annexure Index ... (viii)

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M. K. Pujari,

Regd. No. FCP/CAL/239/96/A

Annexure Index -- (ix)

APPROVED

M. K. Pajari,
Regd. No. ROP/CAL/239/98/A

(x)

DRAWINGS I N D E X

Sl. No.	Drawing No.	Description		Folder No.	Reference
1)	DR-A	Lease Map.	16" = 1 Mile	1	M.P.
1A	DR-A1	Xerox copy of the lease Map		1	"
2)	DR-B	Geological map of Sukinda Block - (collected from Sharma Committee Report).	1 : 11000	1	M.P.
3)	QR-1	Key Plan.	1 : 50000	2	M.P. & P.M.C.P.
4)	DR-2	Surface Plan.	1 : 2000	2	-do-
5)	DR-3	Surface Geological Plan.	1 : 2000	2	-do-
6)	DR-4	Bore Hole sections.	1 : 2000	2	M.P.
7)	DR-5	Transverse Sections.	1 : 2000	2	M.P. & P.M.C.P.
8)	DR-6A	Longitudinal Section showing geological reserve estimation.	1 : 2000	2	-do-
9)	DR-6B	Longitudinal section showing the parameters as considered for estimation of mineable reserve.	1 : 2000	2	-do-
10)	DR-7	Year-wise Excavation sec.	1 : 1000	3	M.P.
11) to 15)	DR-8(a)-8(e)	Individual year-wise excavation plan & section (for FIVE years).	1 : 1000	3	M.P.
16)	DR-9	Conceptual Plan.	1 : 2000	4	M.P. & P.M.C.P.
17)	DR-10	Conceptual section.	1 : 2000	4	-do-
18)	DR-11	Environment Plan.	1 : 5000	5	M.P.
19)	DR-12	Environmental Management Plan.	1 : 2000	5	M.P. & P.M.C.P.
20)	DR-13	Dump Plan & Section	1 : 2000	5	"

M.P. = Mining Plan

P.M.C.P. = Progressive Mine Closure Plan.

M. K. Pujari,

Regd. No. ROP/CAL/239/96/A

M-I N I N G P L A N

UNDER RULE 22 (4) OF
MINERAL CONCESSION RULES 1960

MINING PLAN

M. K. Pujari,
Regd. No. ROP/CAL/239/96/A

INTRODUCTION

M. K. Pujari,
Regd. No. ROP/CAL/239/96/A

INTRODUCTION

FERRO ALLOYS CORPORATION LIMITED has been struggling for years to get a Mining Lease area of CHROMITE as the production capacity of their existing mining lease areas, which are being worked to its fullest capacity, is far less quantitatively and qualitatively compared to the requirement of their captive plants, basically due to thin deposit, inferior grade, highly complicated geological structure and limited strike length of the existing lease hold areas. Therefore, FACOR had applied for mining lease area near KALARANGIATTA village (BHIMTANGAR) earlier held by TISCO. In pursuance of a SUPREME COURT Judgement, 39.318 hectares of area, out of the old TISCO lease area was earmarked to be granted to FACOR. To that effect FACOR received a letter No.12424/IV/(G)SM-12/2000 dated 3.11.2001 (copy is ENCLOSED as ANNEXURE - I-1 (Page No. 3-5) which requires submission of an approved MINING PLAN from Indian Bureau of Mines. In pursuance of the said letter, Mining Plan was approved from I B M, vide letter No.314(3)/2002/MCCM(C)/MP-9 dtd 17.10.02 (copy enclosed as ANNEXURE - I-2 (Page No. 6 & 7). Meanwhile, Steel & Mines department, Government of Orissa changed the boundary and hence a modified Plan was submitted to I B M for approval vide letter No.KCM/A-3/1410/2003 dated 29.9.2003 (copy of the same is enclosed herewith as ANNEXURE- I-3 (Page No. 8). Subsequently, it was noticed that about 5.726 hectares of forest land exists inside the 39.318 hects of lease area proposed to be granted. Since Forest De-reservation permission would take a long time, FACOR's urgent need of chromite ore for its Plants, it was decided to approach the Government for split up of the Mining lease between forest and non-forest area. Accordingly, an application vide letter No.KCM/88/BM/2004 dated 18.01.2004 (copy of which is enclosed herewith as ANNEXURE - I-4 (Page No. 9 & 10) was made to Steel & Mines department who vide letter No. IV(G)SM-1/2005-6028/SM dtd 10.6.2005 (copy of which is enclosed

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M. K. Pujari,
Regd. No. ROP/CAL/239/96/A

मुख्य खान नियंत्रक
Chief Controller of Mines
भारतीय खान ब्यूरो, नागपुर.
Indian Bureau of Mines, NGPUR.

as ANNEXURE - I-5 (Page No. 11) agreed for such split up.

In pursuance of the said letter, this MINING PLAN has been prepared and is being submitted to Indian Bureau of Mines for approval. Meanwhile, vide our letter No.KCM/A-3/2635/05 dated 28.7.2005 (copy of which is enclosed herewith as ANNEXURE - I-6 , page No. 12), we have sought withdrawal of our letter No.KCM/A-3/1410/2003 dtd 29.9.2003 seeking approval of Modified Mining Plan.

It may be noted that the MINING PLAN as approved by Indian Bureau of Mines for proposed Bhimtangar area vide letter No.314(3)/2002/MCCM(C)/MP-9 dtd 17.10.2002 had the provision to occupy only 21.640 hectares of land (out of 39.318 Hectares) within which opencast mining and waste dump and all other infrastructures including Road and Drain was designed. The virgin land of 17.678 hectares was left out since primarily it contained forest land. Now in the split up of the former proposed lease area of 39.318 hectares, 23.800 hectares is the one part, wherein earlier 21.640 hects. portion was kept intact just as such for various mining a n d allied activities. The additional 2.16 (23.800 - 21.640 = 2.16 hects) hectares over 21.640 hectares has been added on it and distributed in each item of occupation. Thus the left out area (39.318 -23.800 hects) i.e. 15.518 hectares forms the other part of split up area. Therefore, the present Mining Plan is more or less a REPLICA of the previous approved Mining Plan. This fact may kindly be considered while scrutiny of this Mining Plan.

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M. K. Pujari,
Regd. No. ROP/CAL/239/96/A

ANNEXURES

M. K. Pujari,
Regd. No. ROP/CAL/239/98/A

5 NOV 2001

ANNEXURE - I-1

Government of Orissa
Department of Steel and Mines
...

No. 12424 /SM, Bhubaneswar, the 3.11.2001

From:

Sri Ashok Kumar Sahu, OAS(S),
Joint Secretary to Government.

To

M/s. Ferro Alloys Corporation Ltd.,
G-U 2/10, Chandrasekharpur,
Bhubaneswar- 751023

Sub : Application dated 19.10.93 of M/s. FACOR Ltd. for Mining Lease for Chromite ore over an area of 1261.476 hects. in village Kalarangiata, Kansoi & etc. in the district of Jajpur.

Sir,

I am directed to enquire whether you accept the following terms and conditions that would govern the grant of Mining Lease in respect of the application read above over an area of 39.318 hects. in village Kalarangiata etc. of Jajpur district. Your reply as per enclosed proforma should reach Government on or before 2.12.2001 failing which it will be considered that you do not accept the conditions.

1. The lease will be subject to the general terms and conditions laid down in the Model Form of Mining Lease prescribed by the State Government and to the following conditions.

APPROVED

(i) Royalty and dead rent should be paid at rates prescribed in the Mines & Minerals (D&R) Act, 1957 and as amended from time to time.

(ii) Surface rent should be paid at the rate of Rs. 10.00 per hects. per annum of waste lands and at rates not exceeding the land revenue and cesses in respect of the cultivated area and water rate as may be fixed from time to time by Government.

(iii) The lease will be granted for a period of 30 (thirty) years subject to submission of duly approved mining plan within a period of six months from the date of issue of this letter. If the approved mining plan is not received within the stipulated period of six months then action will be taken to reject the application without further reference to you.

(iv) An amount of Rs. 10,000/- should be deposited towards security deposit for due observance of the terms & conditions stated above. The deposit shall be forfeited to the State if the conditions are not observed in addition to such other remedies or action as may be available under these presents.

M. K. Pujari.

Regd. No. ROP/CAL/239/96/A

...., P/2

(v) The assignment will be liable to cancellation i[illegible] be found that it was in excess of the limit of the autho[illegible] possessed by the State Government.

(vi) The assignment will be subject to the result o[illegible] any appeal or revision that may be preferred by any aggriev[illegible] party against the decision of the State Government granting you lease and in the event of the cancellation of the assig[illegible] ment or the decision of the Government of Orissa to lease o[illegible] the area to you either on such appeal or in revision you sh[illegible] not be entitled to compensation for anything done or attemp[illegible] to be done in pursuance of the order.

(vii) The grantee shall not cut any tree or clear the forest during the mining operation without prior approv[illegible] of the Central Government. They shall not also damage any objectionable land during mining operation.

(viii) The area should be surveyed and demarcated b[illegible] the State Government at the expense of the lessee as requir[illegible] under Rule 33 of the M.C. Rules, 1960. The party should [illegible] deposit the required amount of survey and demarcation fees within two weeks of the receipt of the grant order.

(ix) The mined out area shall be reclaimed to the [illegible] satisfaction of the State Government before the pit is aban[illegible] doned.

(x) The assignment is subject to the conditions tha[illegible] subject to the provisions of Article 226 of the Constitutio[illegible] of India, any suit of petition in relation to any dispute[illegible] arising out of the leased area should be filed in the Civil Courts in the State of Orissa.

(xi) The assignment is subject to the condition tha[illegible] the ore raised from the mines shall be exclusively used for the captive purpose to ensure steady supply of chrome ore [illegible] to the Ferro Chrome Plant and will fulfil all the condition of the open cast and under ground mining as per Sharma committee report.

(xii) The assignments are subject to the conditions that they shall have to obtain clearance/approval of Minist[illegible] of Environment & Forest, Government of India on diversion proposal of forest land and non-forest land having forest growth if required; as per the judgement of the Supreme Co[illegible] in W.P. No. 202 of 1995 included in the area for mining purpose as per the provisions of Sec. 2 of the Forest(Conser[illegible] tion Act, 1980 before grant of mining lease.

Yours faithfully

2.11.2001

Joint Secretary to Government

[illegible] /SM, Bhubaneswar, the

Copy forwarded to the Collector, Jajpur for [illegible] and necessary action.

Joint Secretary to Government

M. K. Pujari,
Regd. No. ROP/CAL/239/98/A

Memo No._____/SM, Bhubaneswar, the

Copy forwarded to the Director of Mines, Orissa, Bhubaneswar for information and necessary action with reference to his letter No. 6824 dated 18.6.2001 and No. 8240 dated 28.7.2001 / Deputy Director of Mines, Jajpur Road, Jajpur for information and necessary action.

Joint Secretary to Government

Memo No. 08/-

CERTIFIED APPROVED

M. K. Pujari,
Regd. No. RNP/CAL/239/98/A

BY HAND

भारत सरकार
कोयला और खान मंत्रालय
खान विभाग
भारतीय खान ब्यूरो
खनिज संरक्षण एवं खनिज संरक्षण प्रभाग
(मध्य क्षेत्र)

GOVERNMENT OF INDIA
MINISTRY OF COAL & MINES
DEPARTMENT OF MINES
INDIAN BUREAU OF MINES
Mines Control & Conservation of Minerals Division (Central Zone)

F. No. 314(3)/2002-MCCM(C)/MP-9

दिनांक/Dated, the 17/10/02

To
M/s Ferro Alloys Corporation Ltd.,
Lakshmi Bhawan Kuans,
P.O. - Bhadrak - 756 100,
District - Bhadrak (Orissa)

Subject: Approval of Mining Plan of Bhimtanga Chromite Deposit over an area of 39.318 Hect of M/s. M/s Ferro Alloys Corporation Ltd., in Jajpur district of Orissa submitted under rule 2 of MCR 1960.

Ref:- Your letter No. KCM/A-3/1562/2002 dated 12-10-2002.

Dear Sirs,

In exercise of the power conferred by Clause (b) of sub-section (2) of section 5 of the Mines and Minerals (Development and Regulation) Act 1957 read with Government of India Order No. S.O. 445(E) dated 28-4-87, I hereby approve the above Mining Plan. This approval is subject to the following conditions:-

APPROVED

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

ii) It is clarified that this approval of Mining Plan does not, in any way, imply the approval of the Government in terms of any other provisions of the Mines & Minerals (Development & Regulation) Act, 1957 or the rules framed thereunder or any other laws.

iii) It is further clarified that this approval of the Mining Plan is subject to the provisions of Forest (Conservation) Act 1980, Forest Conservation Rule 1981 and other relevant statutes, orders and guidelines as may be applicable to the lease area from time to time.

- 2 -

M. K. Pujari,
Regd. No. ROP/CAL/239/98/A

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

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

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

(viii) A bench level study together with pilot plant level testing for low-grade ore shall be carried out with in six months from the date of execution of M.L. and the report of the same shall be submitted to this office for further necessary action.

Encl:- Two copies of
approved Mining Plan

Yours faithfully,

अनुमोदित/Approved

(C.P.AMBESH)
Controller of Mines

Copy for information to :-

1. The Director of Mines Safety, Directorate General of Mines Safety, Bhubneswar region, 136/A, Saheed Nagar Bhubneswar, **alongwith a copy of approved Mining Plan**

2. The Director of Mines, Directorate of Mining & Geology, Head of the Department Building, Bhubneswar – 1

3. Shri M.K. Pujari, Senior General Manager, M/s Ferro Alloys Corporation Ltd. P.O. Kalarangeria – 755 028, via JK Road, District Jajpur (Orissa)

(C.P.AMBESH)
Controller of Mines

M. K. Pujari,
Read. No. ROP/CAL/239/96/A

FERRO ALLOYS CORPORATION LIMITED

KATHPAL CHROMITE MINES
Marvabil - 759039,
Badsuanio, Dhenkanal
Phones 06726-268729
FAX 06764 - 251782

FACOR
CHROME ORE MINING DIVISION

KCM/A-3/ 1410 /2003 29th Sept., 2003

To

The Regional Controller of Mines,
Indian Bureau of Mines,
Mahani Complex, 2nd Floor,
309, District Centre,
Chandrasekharpur,
BHUBANESWAR - 751 016

Dear Sir,

Sub : Modification as required under Rule 10 of MCDR in the approved Mining Plan, (approved vide IBM letter No.314(3)/2002-MCCH(C)/MP-9 dated 17.10.2002) for Bhimtangar Chromite Mines over an area of 39.318 Hectares, proposed to be granted by State Government.

With reference to above, we have to submit to your goodself that, subsequent to approval of the aforesaid Mining Plan, while resurveying the said area by Government Surveyor, jointly with FACOR's surveyor, some discrepancy was found between the field status and map of the old TISCO lease area, from which the proposed 39.318 Hectares of Bhimtangar lease area, was carved out. This called for minor changes, in the boundary of proposed lease area map, as given in the approved Mining Plan.

The revised map, due to minor alterations of the boundary, together with other modification required in write up as well as maps of the Mining Plan (approved), has been incorporated in the modified Mining Plan, which is enclosed herewith in DUPLICATE for your kind approval.

Thanking you,

Yours faithfully,
for Ferro Alloys Corporation Limited,

(M.K. PUJARI)
Sr. General Manager

Encl: Modified Mining Plan (2 copies)

RECEIVED
Indian Bureau of Mines
BHUBANESWAR

APPROVED

REGD. OFFICE : SHREERAM BHAWAN, TUMSAR - 441912, MAHARASHTRA, INDIA. PH : 232235, 232251, 233090 & 232241. E.Mail:facor@satyam.net.in FAX : 07183-2322/1
BHUBAN OFFICE : LAXMI BHAWAN, KUANS, BHADRAK 756100, ORISSA. PHONES : 251112, 250598. E. Mail:bls_facor168@sancharnet.in FAX : 06784-251782
BRANCHES : BHUBANESWAR, BOMBAY, CALCUTTA, MADRAS, NEW DELHI, NAGPUR, VISAKHAPATNAM

M. K. Pujari.

Regd. No. ROP/CAL/239/96-A

ANNEXURE - I-4

FERRO ALLOYS CORPORATION LIMITED

KATHPAL CHROMITE MINES
Marvabil - 759039
Badsuanio, Dhenkanal
Phones : 06726-268729
FAX : 06784 - 251782

FACOR
CHROME ORE MINING DIVISION

KCM/ 88 /SM/2004

18th Jan., 2004

To

The Joint Secretary to Government,
Government of Orissa,
Department of Steel & Mines,
BHUBANESWAR

Sir,

Sub : Application dtd 19.10.1993 by M/s. FACOR Ltd., for M.L. Over an area of 1271.476 Hectares in village, Kalarangiatta, Ransol & Etc., in the district of Jajpur.

Ref : Your letter No.IV(G)SM-12/2000-12424/SM dated 3.11.2001.

APPROVED

With reference to above subject, we would like to bring the following for favour of your kind perusal and consideration.

1) That, basing on our above application and "Sharma Committee" recommendation, subsequently endorsed by Hon'ble Supreme Court, Government has proposed to allot us 39.318 Hects. of land for grant of M.L. for exploitation of Chromite vide your letter No.12424 dtd 3.11.01, in village - Kalarangiatta etc., of Jajpur district.

2) That, the said area of 39.318 Hects. which includes 5.30 Hects of Forest Land, requires clearance from Indian Bureau of Mines (Mining Plan) and MOEF, as per terms and conditions laid down in your above referred letter. We have already obtained approval for Mining Plan from I B M and the same has been submitted to your goodself.

3) However, obtaining clearance from the MOEF for de-reservation of aforestated forest land is time consuming procedure and in this process our Chrome ore production from the said area will be considerably delayed.

Under the circumstances, we request your goodself to kindly split our proposed lease area of 39.318 Hects into two parts, comprising 23.806 Hects (PART - I) of Non-forest area and 15.512 Hects (Part - II) of forest area. We also request your goodself to issue grant order for Part - I, for early execution of M.L. so that, we can start mining operation soon after fulfilling other formalities to feed our Charge Chrome Plant and Ferro Chrome Plant, for which purpose only lease is proposed to be granted.

4) Upon issuance of grant order for 23.806 Hectares (Part - I), we shall take up to prepare/modify the Mining Plan accordingly and get the same approved by the I.B.M.

.. 2.

M. K. Pujari,
Regd. No. RQP/CAL/239/96/A

FERRO ALLOYS CORPORATION LIMITED

KATHPAL CHROMITE MINES
Marvabil 759039
Badsuanlo, Dhenkanal
Phones 06726-268729
FAX 06784 - 251782

FACOR
CHROME ORE MINING DIVISION

:: 2 ::

5) We are enclosing herewith map for Part - I (Non-forest land and Part - II (Forest land) as splitted by us for favour of your kind perusal and approval.

6) We shall prepare the necessary de-reservation proposal and submit to the State Forest Department, MOEF for the forest land of (Part - II), covering forest portion soon after receipt of your order to split.

Submitted for favour of your kind consideration and favourable orders.

Thanking you,

Yours faithfully,
for Ferro Alloys Corporation Limited.

(M.K. Pujari)
Sr. General Manager

Encl: a/s.

Copy to the Director of Mines, Orissa, BBSR for his kind information.

APPROVED

REGD. OFFICE : SHREERAM BHAWAN, TUMSAR - 441912, MAHARASHTRA, INDIA. PH : 232213, 232251, 232090 & 232341 E.Mail facor@satyam.net.in FAX : 07183-232271
BHADRAK OFFICE : LAXMI BHAWAN, KOANS, BHADRAK-756100, ORISSA. PHONES : 251312, 250598. E.Mail bls_facor@sancharnet.in. FAX : 06784-251782
BRANCHES : BHUBANESWAR, BOMBAY, CALCUTTA, MADRAS, NEW DELHI, NAGPUR, VISAKHAPATNAM

M. K. Pujari,
Regd. No. ROP/CAL/239/98/A

ANNEXURE - I-5

Government of Orissa
Department of Steel & Mines
..

No.IV(G)SM-1/2002- 6138 /SM. Bhubaneswar, the 16.6.04

From

Shri M. K. Sahu, OAS(S)
Joint Secretary to Government.

To

M/s. Ferro Alloys Corporation Ltd.,
GD-2/10, Chandrasekharpur,
Bhubaneswar-751023.

Sub: Application dt.19.10.93 of M/s. FACOR Ltd. for grant of mining lease for chromite over an area of 1271.476 hects. in village-Kalarangiatta, Kansol & etc. in the district of Jajpur.

Sir,

In inviting a reference to your letter No.88 Dt.18.6.04 on the above noted subject and to say that after careful consideration of your representation, State Government have been pleased to split up the proposed mining lease area of 39.318 hects. into two separate blocks i.e. 23.800 hects. & 15.518 hects. with a condition that the land recorded as "Rasta" shall continue as such and its use by the lessee shall not infringe the existing communal rights of the locality. (Terms & conditions issued vide this Department letter No.12424 dt.5.11.2001 will remain unchanged).

You are, therefore, requested to submit two separate mining plans duly approved by the Govt. of India, Indian Bureau of Mines for further necessary action at this end.

Yours faithfully,

[illegible]

Joint Secretary to Government.

Memo No. /Dt.

Copy forwarded to the Govt. of India, Ministry of Steel & Mines, Department of Mines, Shastri Bhawan, New Delhi with reference to their letter No.2/16/98-MIV dt.17.2.2000 for information.

Joint Secretary to Government.

Memo No. /Dt.

Copy forwarded to the Director of Mines, Orissa, Bhubaneswar/ Collector, Jajpur/Deputy Director of Mines, Jajpur Road, for information and necessary action.

Joint Secretary to Government.

p.t.o.

M. K. Pujari,
Regd. No. RGP/CAL/239/98/A

ANNEXURE - I-6

FACOR

FERRO ALLOYS CORPORATION LIMITED

GD - 2/10, Chandrasekharpur
Bhubaneswar - 751 023
(Orissa) India

Phone : PBX : 2302881, 2302882, 2302484
Fax : 0674-2302612
E-mail : facors@sancharnet.in

Ref: KCM/A-3/2635/05

Dated: 28.7.2005

The Controller (Central zone)
Indian Bureau of Mines
Indira Bhawan, 8th Floor
Civil Lines
NAGPUR 440 001

Sub:- Request for withdrawal of the modified Mining Plan for Bhimtangar Chromite Mines of M/s. FACOR Ltd over an area of 39.318 Hect. submitted for approval through the Regional Controller of Mines, Bhubaneswar dated 29.9.2003.

Ref: 1) Our letter No.KCM/A-3/1410/2003 dated 29.9.2003
2) Your letter dated 16.2.2004
3) Your letter dated 11.2.2005

Dear Sir,

Kindly refer to our above letter, vide which we had submitted a modified Mining Plan over an area of 39.318 Hect. for Bhimtangar Chromite Mines of M/s.FACOR Ltd for your kind approval. In this connection, we request you to withdraw the same and cancel it, as the State Government has already passed an Order to split-up the said lease area of 39.318 Hect. into two parts as Forest and Non-Forest for an area of 15.518 Hect. and 23.800 Hect. respectively, on our request.

We are soon going to submit a separate Mining Plan for approval for each area.

Thanking you,

Yours faithfully,
For FERRO ALLOYS CORPN LTD

(M.K. PUJARI)
Sr. General Manager
& R.Q.P.

M. K. Pujari,
Regd. No. ROP/CAL/239/98/A

Copy to The Regional Controller of Mines
Indian Bureau of Mines,
Bhubaneswar – for kind information & necessary action.

GENERAL

M. K. Pujari,
Regd. No. ROP/CAL/239/96/A

1.0. GENERAL :-

(a) NAME OF THE APPLICANT -

M/s. Ferro Alloys Corporation Limited.

Address -

Sri Ashok Agrawal,
Chief Executive (Mines),
M/s. Ferro Alloys Corporation Limited,
Laxmi Bhawan, Kuans,
Bhadrak - 756 100,
Orissa.

PHONE : 06784 - 250708, 250598, 250311, 251312

FAX : 06784 - 251782

E.MAIL: bls_facor168@sancharnet.in

NAME & ADDRESS OF THE BOARD OF DIRECTORS & NOMINATED OWNER -

Sri Uma Shankar Agarwal,
Chairman,
M/s. Ferro Alloys Corporation Ltd.,
Shreeram Bhawan,
TUMSAR - 441 912,
Dist.: Bhandara (Maharashtra)

Sri R.K. Saraf,
Vice Chairman,
M/s. Ferro Alloys Corporation Ltd.,
Shreerammagar - 535 101,
Dist. Vizianagaram (A.P.)

Sri Manoj Saraf,
Managing Director,
M/s. Ferro Alloys Corporation Limited,
Charge Chrome Plant,
D.P. Nagar,
Randia - 756 135,
Orissa.

Sri Vineet Saraf,
Joint Managing Director,
M/s. Ferro Alloys Corporation Limited,
E-334, East of Kailash,
Ground Floor,
New Delhi - 110 065.

Sri Rohit Saraf,
Joint Managing Director,
M/s. Ferro Alloys Corporation Limited,
Laxmi Bhawan, Kuans,
Bhadrak - 756 100
Orissa.

M. K. Pujari,
Regd. No. RQP/CAL/239/96/A

Sri Ashish Saraf,
Joint Managing Director,
M/s. Ferro Alloys Corporation Limited,
E-334, East of Kailash,
Ground Floor,
New Delhi - 110 065.

Sri S.C. Jain,
Nominee of Bank of India,
New Delhi - 110 001.

Sri A.S. Kapre,
The Industrial Credit & Investment
Corporation of India Limited,
163, Backbay Reclamation,
Mumbai - 400 020.

Sri V.J. Trivedi,
Trivedi Building,
Main Road,
Balaghat - 481 001 (M.P.).

Sri M.B. Thaker,
Giripeth,
Nagpur - 440 010.

Sri O.P. Banka,
Director (Finance),
M/s. Ferro Alloys Corporation Limited,
Shreeram Bhawan,
TUMSAR - 441 912,
Dist. : Bhandara (Maharastra).

Sri B.B. Singh,
Director (Technical),
M/s. Ferro Alloys Corporation Limited,
Charge Chrome Plant,
D.P. Nagar,
Randia - 756 135,
Orissa.

APPROVED

NAME & ADDRESS OF THE NOMINATED OWNER -

Sri B.B. Singh,
Director (Technical) & Nominated Owner,
M/s. Ferro Alloys Corporation Limited,
Charge Chrome Plant,
D.P. Nagar,
Randia - 756 135,
Orissa.

M. K. Pujari,
Regd. No. ROP/CAL/239/98IA

1 (b) STATUS OF THE APPLICANT -

The Applicant, a Public Limited Company is India's largest manufacturer of Ferro Alloys, Charge Chrome and Chrome Ore. The Applicant is actively engaged in mining of Chrome ore deposits with qualified Geologists and Mining Engineers to supervise the exploration and Mining operation.

1 (c) MINERAL/S WHICH ARE OCCURRING IN THE AREA AND WHICH THE APPLICANT INTEND TO MINE -

- The applicant intends to mine CHROMITE.

1 (d) PERIOD FOR WHICH THE MINING LEASE IS GRANTED/ RENEWED/PROPOSED TO BE APPLIED -

- THIRTY years.

1 (e) NAME OF RQP PREPARING MINING PLAN -

- Sri M.K. Pujari.

APPROVED

Address -

- Sr. General Manager,
M/s. Ferro Alloys Corporation Limited,
Kathpal Chromite Mines,
Po : Kalarangiatta - 755 028,
Via) J.K. Road,
Dt : Jajpur (Orissa).

Phone -

- 06726 - 268385 & 268754

Registration Number -

- RQP/CAL/059/88/A.

Date of Grant/Renewal -

- 15th May, 2000.

M. K. Pujari,
Regd. No. RQP/CAL/239/96/A

Valid Upto -

- 15th May, 2010.

1 (f) NAME OF PROSPECTING AGENCY & ADDRESS -

1) Geological Survey of India,
Government of India,
Operations Orissa,
Unit - VIII,
BHUBANESWAR - 751 012.
Orissa.

2) M/s. Ferro Alloys Corporation Limited,
Chrome Ore Mining Division,
Lakshmi Bhawan,
Kuans,
BHADRAK - 756 100,
Orissa.

1 (g) REFERENCE NUMBER AND DATE OF CONSENT LETTER FROM THE STATE GOVERNMENT -

- Letter No.IV(C)SM-1/ 2005/ 6028/SM, dated 10.6.2005 from the Joint Secretary to Government, Government of Orissa, Department of Steel & Mines, Bhubaneswar. (Refer ANNEXURE - I-5, Page No.11).

APPROVED

M.R. Pujari,
Regd. No. RQP/CAL/239/96

LOCATION & ACCESSIBILTY

M. K. Pajari,
Regd. No. ROP/CAL/239/96/A

2. LOCATION AND ACCESSIBILITY -

2.(a)(i) Details of Area (with Location Map) -

- Location Map is enclosed as DRAWING NO.DR-1. (Refer Vol.-2)

(ii) District & State -

- Jajpur District and Orissa State.

(iii) Taluk -

- Sukinda.

(iv) Village -

- Kalarangiatta.

(v) Khasra No./Plot No./Block Range/Felling Series etc. -

- Details are enclosed as ANNEXURE - LA - 1 (Page No. 19 & 20)

(vi) Lease Area -

- 23.800 Hectares.

(vii) Whether the area is recorded to be in forest -
(Please specify whether protected, reserved etc.)

- There is no forest land exists in the proposed lease area of 23.800 Hectares.

(viii) Ownership/Occupancy -

- Private Land	.. ..	1.008 Hectares
Government Non-forest land	..	22.408 Hectares
R o a d	.. ..	0.384 Hectares
T o t a l	..	23.800 Hectares

(ix) Existence of Public Road/Railway line, if any nearby and approximate distance -

- A Public Road from J.K. Road to Tomka Via Dubri, Mangalpur is running by the side of the Northern lease boundary and 220 metres West of Western lease boundary. JK Road is the nearest Railway station located at a distance of 55 Km.

(x) Topo-sheet No. -

- 73 G/12.

(xi) Longitude and Latitude -

- 21° 00' 58.7" North to 21° 01' 27.5" North
&
85° 44' 32.2" East to 85° 44' 51.5" East.

M. K. Pujari.
Regd. No. ROP/CAL/239/98/A

2(xii) Land Use Pattern (Forest, Agricultural, Grazing, Barren etc.) -

-	Government Forest Land	..	..	N i l
	Private Land ..	..	..	1.008 Hects.
	Government Non-forest Land -			
	R o a d	..	0.384	22.792 Hects.
	Anabadi	..	22.408	
			T o t a l ::	23.800 Hects.

-

2(b) ATTACH A GENERAL LOCATION AND VICINITY MAP SHOWING AREA BOUNDARIES AND EXISTING AND PROPOSED ACCESS ROUTES. IT IS PREFERRED THAT THE AREA BE MARKED ON A SURVEY OF INDIA TOPOGRAPHICAL MAP OR A CADESTRAL MAP OR FOREST MAP AS THE CASE MAY BE. HOWEVER, IF NONE OF THESE ARE AVAILABLE, THE AREA SHOULD BE SHOWN ON AN ACCURATE SKETCH MAP ON A SCALE OF 1 : 5000.

- Location Map is attached (Traced from Topographical map of SURVEY OF INDIA - Topo sheet No. Part of G/12, G/16, H/13 & H/19).

SCALE = 1 : 50000 .. (Refer DRAWING NO.DR - 1). (Refer Vol.2)

M. K. Pujari.
Regd. No. ROP/CAL/239/96/A

ANNEXURES

M. K. Pujari,

Regd. No. ROP/CAL/239/98/A

Boundary description of the (Splited) area over 23.80 hects.to be granted for M.L. for Chromite in village-Kalarangiatta in Sukinda Tahasil of Jajpur district of M/s FACOR Ltd. (Part-I)(Non-forest land).

Ref:- The station 'A' of M/s FACOR Ltd. is itself station-'A' of M/s TISCO Ltd M.L. area over 1261.49 hects. & Station 'E' of Kalarangi Mines of M/s OMC Ltd. which is situated at a distance of 2810 ft. or 856 - 488 mts. & with a F.B. of 152° 20' from the district boundary piller No.38 of old c Cuttack & Dhenkanal district which is near to trianjunction point of vill.-Chinguripal, Kalarangiatta in Jajpur district & Marurbil in Dhenkanal district. The starting station $J_{1(a)}$ is situated with a F.B of 88° 10' and for a distance of 1468 ft. or 447.45 mts. from the aforesaid station-'A'.

Western boundary - Starts from station $J_{1(a)}$ and runs up to station-'F' through station D_5, D_4, D_3, D_2, D_1 & E as follows:-

Station point From - To	M.B.	Included angles	Distances in ft.	in mts.
$J_{1(a)}$-D_5	97° 20'		987.40	300.96
D_5- D_4	-	232° 00'	221	67.36
D_4- D_3	-	272° 00'	695	211.14
D_3- D_2	-	192° 00'	457.34	139.40
D_2- D_1	-	99° 00'	919	280.11
D_1 - E	-	87° 00'	571.15	174.08
E - F	-	270° 00'	1157.70	351.03

Southern boundary:- Starts from station-'F' & runs up to station 'G' making an included angle 90° 00' & for a distance of 820' or 250.000 mts.

Eastern boundary:- Starts from station point 'G' & runs upto station-J through station H & I as follows.

Station From To	Included angles	Distances in ft.	in mts.	
G-H	90° 00'	1407.97	429.15	
H-I	270° 00'	426.51	130.00	TISCO
I-J	90° 00'	1239.67	377.85	

Northern boundary:- Starts from station J and runs up to station $J_{1(a)}$ making included angle 90°-00' & for a distance of 1102.00 ft. or 335.89 mts.

Lastly it makes an included angles 38°-00' at station-$J_{1(a)}$ & closed the traverse.

APPROVED

K. Pujari.

Regd. No. ROP/CAL/239/98/A

LAND SCHEDULE OF THE AREA PROPOSED FOR ALLOCATION OVER 23.806 HECTARES OR 58.83 ACRES IN FAVOUR OF M/S. FACOR IN VILLAGE : KALARANGIATTA IN SUKINDA TAHASIL OF JAJPUR DISTRICT, ORISSA:

(NON-FOREST LAND)

Khata No.	Name of Tenant	Plot No.	Kisam	Area in Acre	
6	Kalakar Mohanta & Others	215/1663/-	Sarad II	0.34	
37	Chaitanya Mohanta & Others	83/P	Biali	0.48	
82	Baidyanath Mohanta	48/-	Sarad III	0.64	
82	Baidyanath Mohanta	85/-	Biali	1.03	
116	Abad Ajogya Anabadi	258/P	Patharbani	3.85	
116	Abad Ajogya Anabadi	259/P	Patharbani	19.68	19.46
116	Abad Ajogya Anabadi	260/P	Patharbani	0.20	0.18
116	Abad Ajogya Anabadi	266/P	Patharbani	8.82	9.02
116	Abad Ajogya Anabadi	303/P	Patharbani	0.10	
116	Abad Ajogya Anabadi	304/P	Patharbani	0.28	0.30
116	Abad Ajogya Anabadi	214/P	Patharbani	0.52	
116	Abad Ajogya Anabadi	215/P	Patharbani	13.56	
116	Abad Ajogya Anabadi	47/P	Patharbani	8.38	
120	Nirman & Paribahan Bibhag	42/P	Rasta	0.95	

APPROVED

58.81 ~~58.83 Acres~~ or
23.800 ~~23.806 Hectares~~

29/12/04

M. K. Pujari.
Regd. No. ROP/CAL/239/98/A

DIRECTOR
ORISSA

GEOLOGY & EXPLORATION

APPROVED

M. K. Pujari,
Regd. No. BOP/CAL/239/96/A

PART - A

3. GEOLOGY AND EXPLORATION -

3(a)(i) TOPOGRAPHY AND GENERAL GEOLOGY AND LOCAL/MINE GEOLOGY OF THE MINERAL DEPOSIT INCLUDING DRAINAGE PATTERN -

A) REGIONAL TOPOGRAPHY -

On the Northern side of lease area, there are THREE prominent hill ranges namely Siarimundi, Kumburuni, Sukarkholamunda which are the part parcel of West-ward extension of Daitary Parbat Range. The highest peaks of these ranges are 770, 683 & 476 MRL respectively. These hill ranges are covered by dense, mixed deciduous forest, which comes under protected and reserved forest. This sector is free from mining activities. Hence, the original environmental conditions are preserved.

The NE side of the lease area is covered by THREE hill ranges namely Daitary Parbat, Bali Parbat, Bhagiatala Parbat ranges having h nos. of peaks in each hill ranges. The trend of hill range is NE - SW, ESE - WNW with a gradient of 5° - 30° and with a strike length of 10 Km each. The highest and lowest elevations are 868 & 268, 480 & 399, 560 & 240 MRL respectively. Out of the above THREE hill ranges in Daitary hill ranges, the Topography has slightly changed due to mining activities being carried out by O.M.C. for Iron Ore.

On the Southern side of lease area there is a major hill range namely Mahagiri range trending in ENE - WSW having six peaks. The highest and lowest peaks are having an elevation of 710 & 285 MRL. The slope of the hill range varies from 18° - 25°. The entire hill range is covered by forest. The Topography of the area has been changed

M. E. Pujari.

Regd. No. P/CAL/239/85/A

Due to hilly terrain dendritic pattern of drainage is well developed in Northern slope of Mahagiri range. All the drains of perennial and seasonal nalas are joining Damsala nala at various points.

B) DRAINAGE PATTERN OF LEASE AREA -

There is no natural drainage in the lease hold area as the terrain is flat. However, 5 nos. nalas have been constructed by earlier lessee for draining out quarry water and colony sewage water (Refer DRAWING NO.DR-3 of Vol.2.

- Nala No.1 -

It starts from western boundary of present Tisco lease area and passes through southern part of proposed FACOR's lease area. The nala is situated 20 to 50 M north west of existing quarry. The water flows towards west in the nala and on terminus of nala, part of water spreads over the flat lateritic terrain outside the south western lease boundary and then onto the paddy field, while another part flows into South Canal of Damsala nala directly. Average width and depth of nala is 0.90 M and 0.35 M respectively. Very little water is flowing in the nala.

- Nala No.2 -

This nala also starts from Tisco lease area and runs parallely but 1.5 M away from the proposed south eastern lease boundary of FACOR and ultimately joins with Nala No.1 side by the FACOR lease area. This nala was possibly constructed for draining storm water by previous lessee as no mine water is pumped out through this nala. Average width and depth of nala is 1.25 M and 0.95 M respectively. No water is flowing in winter season.

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- Nala No.3 -

It starts from Tisco lease area and enters into proposed FACOR's lease area at its south eastern boundary where the nala enters into a settling pond then runs towards north. About 140 M inside from the proposed eastern lease boundary of FACOR, water flow is bifurcated with one part flowing towards north which ultimately joins with Damsala nala and another part flows towards west and join again with Damsala via paddy field.

Average width and depth of nala is 0.60 M and 0.40 M respectively.

- Nala No.4 & 5 -

Both the nalas have been constructed by Tisco for draining colony sewage water. Both these nalas have entered into proposed FACOR lease area from its eastern lease boundary and flowing towards north over eastern part of lease area. Near northern boundary these join with nala no.3 from where water flows towards North and ultimately joins with Damsala nala.

Dimensions and quantity flowing in these nalas are as follows :-

TABLE NO.1

Nala No.	Average Width (M)	Average Depth (M)	Quantity of water flowing (M^3/Hour) Based on actual measurement
4	0.45	0.30	7
5	0.40	0.50	22

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3(a)(iii) GENERAL GEOLOGY -

A) LOCATION -

The Sukinda ultramafic field is distributed over an area of 50 Sq.Km. in Jajpur and Dhenkanal districts of Orissa State and is included in TOPOSHEET NO.73 G-12 and 73 G-16. The area is bounded by lattitude 21° 0' N to 21° 5' N and longitude 85° 40' E to 85° 53' E.

B) LITHOLOGY -

The ultramafics of Sukinda region, alongwith associated Chromite ore bodies are intrusive into the lower sequence of the basal group of the Iron - ore super group. It is made up of igneous rocks and constituted - lithologically, ultramafic intrusives of dunite - pyroxenite - peridotite and acid differentiates of granites and granophyre. All these rocks are traversed by dykes of dolerite.

C) ORE BODIES -

The ultramafic body extends to strike length of 15 Km in NE - SW direction (Kansa to Kalarangi) and width varies from 1 Km to 4 Km. The widest part of ultramafics are confined to south western part and gradually tapperring towards north - east and die out completely against quartzite.

The Chromite deposits of Sukinda ultramafic field occurs as six more or less parallel bands in serpentinite. These Chromite bands are locally named as BAND 1, 2, 3, 4, 5 & 6 and are separated from each other by serpentinite/pyroxenite ranging in thickness 120 to 600 M. These Chromite bands are exposed intermittently in quarries along strike length of 15 Km while major portion of these bands are concealed under laterite cap-

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The Chromite bands occur in northern limb of the folu show E - W to ESE - WNW strike dipping 10° - 50° towards south to SSW while those of southern limb show NE - SW to ENE - WSW strike having dip 45° - 85° towards NW to NNW. However, Band no.6 of southern limb show steep dip towards south. From the disposition and characteristic of chrome ore bodies, it suggest that the ore body is a stratiform type of deposit.

D) TYPES OF ORE -

On the basis of physical appearance, the Chromite ore has been classified as follows -

- Brown Ore -

This can be sub-divided into -

- Friable brown ore and Lumpy brown ore.

Both these types occur in the upper and lower brown ore zone but the friable type is more common. The lumpy brown ore zone occurs as pockets in the friable brown ore zone.

- Grey Ore -

This is lumpy variety grey ore which is found to occur in lower grey ore zone near Mahagiri quartzite. 90% of Chromite deposits of SUKINDA BELT falls under friable ore. Grade of ore varies from +10 to +52% Cr_2O_3 with Cr/Fe ratio more than 0.20 to 2.8.

- Genesis -

Magmatic differentiation in the ultramafic magma separated the Chromite, which segregated into lenticular boules having the same trend as the enclosing rocks. Due to autometamorphism the peridotite-dunite rocks were serpentinised. Further, changes were brought about by dynamothermal metamorphism, lateron granitic rocks were intruded, followed by the intrusion of dolarite.

The serpentinised Dunite - Peridotite members have been subjected to intense chemical weathering resulting in the formation of nickel rich limonite cover with relicts of serpentinite and talc schist. The primary chrome ore bodies confined to these serpentinite - limonitic horizons have also undergone weathering and given rise to friable chrome ore. The lateritised ultramafics have been silificied giving rise to distinct cherty horizons. G.S.I. exploration work reveals that the weathered and altered zone extends down to a depth of 70 M in some places while in other places it has extended down to a depth of 200 M from surface. However, some of the bore hole data (BTB 46) reveals that below 70 M depth there is possibility of meeting hard formation continuously downward.

Due to weathering some alteration has taken place in the original rock resulting in formation of brown serpentinite, green pyroxenite, yellowish brown to reddish brown nickeliferous limonite and dark brown to greyish brown dolerite. There has been large scale ferruginization of the rocks and chrome ore bodies and silicification of the rocks in the region. As a result ultramafics are highly limonitised and at places chertified. In certain places talc-serpentine schist have been converted into sticky clay. Granitic rock including granophyre are also exposed in many areas in this region.

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E) REGIONAL STRATIGRAPHIC SEQUENCE -

A generalised stratigraphic sequence of the Sukinda ultramafic complex is as follows -

Recent to pleistocene		Soil, Alluvium Laterites
- - - - - Unconformity - - - - - - - - - - - - -		
		Dolerite
		Granites & Granophyre
Pre-cambrian	Ultramafics	Pyroxenite
		Dunite-Peridotite with Chrome Ore
	Meta Sediments and Meta Volcanics	Quartzite
		Meta-volcanics
- - - - - Base not seen - - - - - - - - - - - -		

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F) REGIONAL STRUCTURE -

Structurally, the lower sequence of the Iron ore super group has been folded into a broad syndrome plunging at a low angle of 15 to 20°. Basing on the direction derived from cross-beddings, the Sukinda syndrome is established as asymmetrical syncline with apex of the fold centring around Kansa village. As a result, the ore bodies of the region represents a Horse Shoe shaped structure. The whole group of rocks were affected by two boundary faults running with the northern and southern margins of the ultramatic body. Rocks of the area have undergone tectonic deformation resulting to the development of asymmetrical syncline and realignment of chrome ore bodies dictated by pressure.

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This is also responsible for the development of intense shearing and several sets of joints in the rocks of the area.

3(a)(iv) LOCAL/MINE GEOLOGY -

A) LITHOLOGY -

The lease hold area is situated on the southern limb of Sukinda ultramafic complex and represents a highly weathered and altered product or ultramaric mass overlain by laterite, top part of which is further decomposed to soil due to extensive weathering. The different lithological units have been encountered in quarries and exposed on date and in G.S.I. Bore holes are as follows -

- Chromiferous Dunite - Peridotite (altered to serpentinite).
- Non-chromiferous Pyroxenite.
- Nickeliferous limonite (altered product of serpentinite).
- Chert.
- Laterite.
- Soil.
- Chrome Ore Lode.

- Serpentinite -

As revealed from Regional Geology, G.S.I. Bore Hole data, quarry exposure and ground surface examination, entire area is occupied by highly weathered serpentinite overlain by laterite capping, which is the host rock for Chrome ore mineralisation, trending ENE - WSW having dip 70° - 80° towards NNW (Refer DRAWING NO.DR-3)/ (Refer Vol.-2) it is soft with shades of Brown colour.

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- Pyroxenite -

There is no outcrop of pyroxenite within the lease area, however, it is exposed as small patch towards F/W side of upper brown ore zone in the quarry. On the basis of field observation made in the adjacent area it is found that it strikes ENE - SWS and dipping 70° - 80° towards NNW and at places has cut across the chromeore bands (Refer DRAWING NO. DR-3). (Refer Vol.2) / It is soft, dirty green to green in colour.

- Nickeliferous Limonite -

In the quarry, entire F/W side of the ore body is occupied by limonite zone associated with weathered serpentinite. However, exposures of H/W limonite could not be seen due to water logged quarry. Almost all the G.S.I. Bore holes have passed through limonite zone and invariably it forms both H/W and F/W of upper brown ore zone. Nickeliferous limonite is yellowish brown to reddish brown in colour. It is soft and sticky in wet condition while in dry condition it is powdery and brittle. The percentage of nickel content varies from 0.02% to 0.51% and Cobalt content varies from 0.005% to 0.20%. It is believed that enriched nickel and cobalt mineralisation in limonite zone has been derived from serpentinite (containing nickel and cobalt in its compocition) possibly due to weathering and leaching process of percolating water. As has been observed in adjacent areas, the attitude of nickeliferous zone is almost running parallel to the Chromite band i.e. it strikes ENE - WSW dipping 70° - 80° towards NNW. The thickness of this zone is about 135 M in H/W side and about 60 - 80 M in F/W side from the ore body. Thus it is apparant that both H/W and F/W side of the ore body is extremely soft. The nickeliferrous limonite reject of all grades which will be generated for first five years is going to be 0.50 Lakh M^3 as per details given in CHAPTER - 7 - Page No. 94 & 95.

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- Chert -

Small detached out crops of chert are seen both in H/W and F/W side of Chromite band and are found to occur associated with serpentinite and limonite zone (Refer DRAWING NO. DR-3). The Chert is very hard, compact and massive, brown to brownish white in colour. It contains veinlets of secondary silica which is usually colourless with vitreous lusture. Formation of chert is a result of serpentinization of Dunite-Peridotite prior to lateritisation process.

- Laterite -

Laterite is present in the entire lease hold area over the ultramafic rocks and their hydrothermal derivatives. The thickenss of laterite varies from 5 to 7 M which is exposed around existing quarry as well as near eastern flank of the lease hold area (Refer DRAWING NO. DR-3).

The laterite is hard and massive, yellowish brown to reddish brown in colour. Chromiferous laterite exposures are seen near eastern and northern flanks of the existing quarry.

- Soil -

Soil of the area has been classified as lateritic soil and occupies the entire area as thin layer ranging in thickness 0.25 to 2.50 M. It has been formed due to decomposition of laterite due to extensive weathering. They are sandy clay to clayey type soil and possess yellowish brown to reddish brown in colour. They are highly porous but slightly permeable having maximum capacity to retain water. Physical properties and

Chemical composition of the soil is shown as ANNEXURE - E-34 Page No. 220 in the EMP CHAPTER (PART - B, Point No.11).

The location of soil samples collected from the proposed lease hold has been marked on the surface geological plan (Refer DRAWING NO. OR-3).

- Chrome Ore Lode -

The Chrome ore body of the area is locally named as upper brown ore zone belonging to Band No.1 of the Regional Chromite Band. The ore body exposures seen in the adjacent quarries shows a general strike trend (N 60° E to S 60° W dipping 70° to 80° towards N 30° W). Since the quarry is water logged, the exposed ore body in the quarry can not be seen. As per G.S.I. Bore holes (BTB - 42, 43 & 55) drilled in the area and the mining done by the previous lessee, it is concluded that, the ore body in the lease hold area is available to a strike length of 253 M. Similarly, bore hole intersection also reveals that width of ore body varies from 18 to 33 M at a depthof -3 to +71 RL (Refer DRAWING NO. OR-4). The average width of ore body is 24 M, with average Cr_2O_3 content 49% having Cr/Fe ratio 2.6 (Refer ANNEXURE - GE-1, Page No. 47). The ore is friable in nature, chocolate brown to black in colour with metallic to sub-metallic lusture.

3(a)(v) STRUCTURE OF LEASE HOLD AREA -

No structural features like Fold, Fault, Shear zone, Slip plane etc., could be seen in the area because of the laterite cover and water logged quarry. However, 4 sets of joints could be observed in the exposed part of the wall rock (limonite) in the quarry towards F/W side.

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The joints are free from infill material. However, at places they are filled with seconcary mineral deposits like limonite, silica, magnesite etc., and their thickness vary from 1 to 5 mm. The joints are extending for a length of 1 to 5 M both along strike and dip direction. Following are the joint sets observed in the area.

TABLE NO. 2

Set No.	Strike	Angle of Dip	Dip Direction
1st set	E - W	45° - 80°	Due south
2nd set	NW - SE	45° - 72°	SW
3rd set	NE - SW	65° - 85°	NW
4th set	N - S	55° - 62°	Due West

3(a)(vi) PHYSICAL AND CHEMICAL CHARACTERISTICS OF ROCKS AND CHROME ORE -

Physical properties of Chrome ore and associated rock types are given in ANNEXURE - GE- 2 & GE- 3 - Page No.48 & 49 Chemical analysis of chrome ore and associated rocks are given in ANNEXURE - GE- 4 - Page No. 50 .

The location of samples collected for these studies has been marked on surface geological plan (Refer DRAWING NO.DR-3) (Volume - 2).

3(b) DETAILS OF EXPLORATION CARRIED OUT IN THE AREA -

A Topographical Plan on scale - 1 : 2000 with contour interval 3 M has been taken as base plan for the preparation of surface geological plan. The lease hold area has been mapped in detail on same scale by the geologist of FERRO ALLOYS CORPORATION LIMITED. There is only one Chrome ore band (Regional band no.-1) which occurs below the laterite cover in the southern part of lease area (Refer DRAWING NO. DR-3) drawn as per convention in 2nd schedule of MMR, 1961.

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Entire lease hold area is occupied by laterite and soil cover. Sub-surface geology was studied initially by GSI during the year 1977 to 1981 with the help of geo-physical prospecting followed by Bore holes drilled about 100 M interval along strike. Total 4 nos. Diamond Drilling holes have been drilled by GSI over the lease area which proved the existence of ore body both in strike side and in dip side. The bore hole locations have been marked in DRAWING NO. DR-3 in red colour as per convention prescribed under 2nd schedule of MMR, 1961. Aforesaid, exploration has proved the existence of ore body in the lease hold area for a strike length of 226 M hole to hole upto the depth of +71 to -3 MRL from surface.

At present there is an abandoned water logged quarry having dimension 300 M x 250 M with a depth 17 M (approx.) from surface (110 RL). The ore body has been mined by TISCO, the previous lessee. And, therefore, the ore as exposed in the quarry excavation has not been mapped by FACOR since the exposure is under water.

3(c) GEOLOGICAL SECTIONS ON A SCALE OF 1 : 2000 -

On the surface Geological Plan, the Southern lease boundary named as E.F. in the drawing has been considered as base line and section lines have been laid at 50 M interval (Refer DRAWING NO. DR-3). Four nos. Transverse sections along line no.1, 2, 3, 4 and one no. longitudinal section along XX' have been prepared on scale 1 : 2000 (Refer DRAWING NO.DR-5 & DR-6A). Besides 3 nos. transverse sections along Bore Holes (BTB 42, 43, 55 & 62) showing ore body intersections have also been prepared (Refer DRAWING NO. DR-4).

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3(d) YEAR-WISE FUTURE PROGRAMME OF EXPLORATION -

(Taking into consideration the future production programme planned in next five years) -

To establish Geo-technical parameters and Hydrogeological details as well as width, grade, dip continuity and geometrical disposition of ore body, total 14 Nos. Diamond Drill Holes covering 1910 M drilling have been planned.

During 2nd year, 4 nos. holes covering 270 M drilling will be donete gather information at +70 RL i.e. upto the depth of 40 M from Surface. These holes will be drilled over 4 different sections spaced at 50 M interval along strike. The following TABLE NO. 3 gives the details of programme of exploration during 2nd year -

TABLE - 3

Yr.	No. of Holes	Grid Location X w.r.t. Sec. line	Grid Location Y w.r.t. Base ling	Collar R.L. (M)	Bore hole angle (Degree)	Drilling meterage	RL of ore inter Sec. (MRL)	Depth of ore intersection from surface (i.e. 110 RL) (M)	Remarks
2nd	PBH-1	1/0	210	105	44	80	+70	40	Marked with green colour in drawing No.3 & 5.
	PBH-2	2/0	184	93	36	60	+70	40	
	PBH-3	3/0	170	93	38	60	+70	40	
	PBH-4	4/0	170	93	42	70	+70	40	
Sub-total	4					270			
2nd	PBH-5	1/0	220	105	53	100	+45	65	Marked with green colour in drawing No.3 & 5.
	PBH-6	2/0	193	93	53	90	+45	65	
	PBH-7	3/0	180	93	54	90	+45	65	
	PBH-8	4/0	180	93	56	90	+45	65	
Sub-total	4					370			
TOTAL		(8 Nos)				640			

NOTE :- There may be slight changes in bore hole location and inclination depending upon the availability of drill site.

Another 4 nos. holes covering 370 M of drilling will be done over same sections to gather information at +45 RL i.e. upto a depth of 65 M from surface as per details given in the above mentioned TABLE - 3.

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Thus, during 2nd year total 8 nos. holes at the rate of 2 holes per section willbe drilled over 4 aforesaid sections and total meterage to be covered will be 640 M.

In order to get informations at 0, -50 and -100 RL, total 6 nos. holes covering 1270 M drilling have been planned to drill druing 3rd, 4th and 5th year. Out of 6 nos. holes, 2 no. holes covering 300 metres drilling will be done during 3rd year over two alternate sections to get information at '0' RL i.e. upto the depth of 110 M from surface as per details given in the TABLE NO.4. Another 2 nos. holes covering 540 M drilling will be done during 5th year over same alternate sections to gather information at -100 RL i.e. upto a depth of 210 M from surface as per the details given in the TABLE NO.4. In order to get information at -50 RL i.e. upto the depth of 160 M from surface, the rest 2 nos. holes will be drilled during 4th year over the remaining sections and meterage to be drilled will be 430 M as per the TABLE NO.4.

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TABLE - 4

Year	No. of holes	Grid location X w.r.t. sec. line	Grid location Y w.r.t. sec. line	Collar RL (M)	Bore hole angle (Degree)	Drilling meterage (M)	RL of ore intersec. (MRL)	Depth of ore intersection from surface (i.e. 110 RL) (M)	REMARKS
3rd	PBH-9	2/0	240	99	53	150	0	110	Marked with yellow colour in Drw. No 3 & 5
	PBH-10	4/0	204	93	62	150	0	110	
SUB-TOTAL	2					300			
4th	PBH-11	1/0	280	110	60	230	-50	160	Marked with violet colour in Drg.No. 3 & 5
	PBH-12	3/0	240	99	63	200	-50	160	
SUB-TOTAL	2					430			
5th	PBH-13	2/0	282	110	60	270	-100	210	Marked with Orange colour in Drg. No. 3 & 5
	PBH-14	4/0	282	108	62	270	-100	210	
SUB-TOTAL	2					540			
TOTAL	6					1270			

NOTE :- There may be slight changes in bore hole location and inclination depending upon drill site.

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Further, additional 8 no. expleratery Diamond drill bore holes along section line 1,2,3 & 4 has been proposed to establish the strike, grade, dip continuity and geometrical position for the anticipated disseminated ore band adjacent to Southern lease boundary.

The following TABLE - 4 (A) gives the detailed programme of Expleration and also shown on the DRAWING NO.DR-3 & DR-5 (Volume 2).

TABLE - 4 (A)

Year	Bore Hole No.	Grid Location X w.r.t. sec. line	Grid Location Y w.r.t. sec. line	Collar RL (M)	Bore Hole angle Degree	Drilling meterage	Expected ore intersection (MRL)	REMARKS
4th	PBH-15	1/00	56	105	55	80	+50	Marked in violet colour on surface geological plan and section Drawing No. DR 3 & DR 5.
	PBH-16	2/00	70	99	60	110	+30	
	PBH-17	3/00	64	99	55	100	+40	
	PBH-18	4/00	56	99	60	90	+40	
SUB-TOTAL	4					380		
5th	PBH-19	1/00	96	105	60	160	-10	Marked in orange colour on surface geological plan and section Drawing no. DR 3 & DR 5.
	PBH-20	2/00	96	94	65	160	-30	
	PBH-21	3/00	95	93	60	160	-30	
	PBH-22	4/00	90	93	65	160	-15	
SUB-TOTAL	4					640		
TOTAL	8					1020		

The core thus obtained will be studied with respect to its physical, chemical and mechanical properties which will be required during planning and winning of ore by opencast and underground mining method. Details of the proposed Bore Holes are shown in DRAWING NO.DR-3 & DR-5 giving different colour for different year and ANNEXURE - GE-5 (P-51).

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3 (e) GEOLOGICAL & RECOVERABLE RESERVES AND GRADE -
CUT OFF GRADE -
AVAILABILITY OF RESOURCES IN THE LEASE HOLD AREA :-

3(e)(i) RESERVES :-

3(e)(i)(1) MAIN GRADE VEIN (I.E. PART OF THE REGIONAL BAND NO.1 WITHIN PROPOSED LEASE HOLD AREA) -

A) PROVED RESERVE (P_1) - (U.N.F.C. CODE - 111) -

Under this category, ore strike with in the proposed lease hold area has been measured as per inference made on ore body out crop in the Regional Geological Plan of GSI for Sukinda Region, as reflected in SHARMA COMMITTEE REPORT as direct measurement in the field could not be done as the ore exposure area excavated by previous lessee is fully waterlogged as stated earlier. The said out crop is occurring 5 to 7 M below ground level. 5 to 7 M is laterite capping. Dip extension limit under the proved category is considered as lowest level development in the mine. Based on this criterion the lowest level developed is 93 MRL as is seen in the T A B L E (Page No.297 of SHARMA COMMITTEE REPORT), a copy of which is enclosed as ANNEXURE - GE- 6 (Page No. 52). However, part of the ore body in Band No.1 within the proposed Bhimtangar lease area of 23.800 hectares has already been mined out by

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is not much, weighted average of 49% has been accepted as average grade. Accordingly proved reserve has been estimated R.L.-wise, block-wise, grade-wise, section-wise are shown in the TABLE NO. 5 . (Page No. 39)

B) PROBABLE CATEGORY (P_2) - (U.N.F.C. CODE - 122) :

Dip length of this category has been considered upto a limit of lowest drilling intersection i.e. -3 MRL while strike length is same as that proved category. Width and grade has been considered same as that Proved category. Accordingly reserve estimate has been made block-wise, section-wise, RL-wise, grade-wise are given in TABLE NO. 5 . (Page No. 39)

C) POSSIBLE CATEGORY (P_3) - (U.N.F.C. CODE - 133) :

Under this category, the accepted ore strike is same as Probable category, vein width and grade is treated as the same as that of Probable category. Dip length considered, beyond the limit of Probable category is 50% of Proved and Probable depth (i.e. from ore out crop 104 MRL to -3 MRL). Accordingly reserve estimate has been made, section-wise, block-wise, RL-wise, grade-wise are given in TABLE NO. 5 (Page No. 39)

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TABLE - 5

Sl. No.	U.N.F.C. Code	Category of Reserve	Depth Considered RL to RL	Section	Ore block No.	Strike (M)	Width (M)	Dip Length(M) Dip of Orebody (80°)	Tonnage Factor (Tonnes/M³)	Tonnage (Lakh MT)	Cr_2O_3 %	Cr/Fe	Remark
1(i)	111	PROVED(P_1)	+104 to +93	Western boundary to Sec. 3/30	1	72	18.00	11.2	3.3	0.54	49.54	2.64	Please Refer DRAWING - 6A
				3/30 to 1/30	2	100	21.00	11.2	3.3	0.77	51.22	2.27	
				1/30 to Eastern Boundary	3	81	33.00	11.2	3.3	0.93	49.27	2.83	
				SUB. TOTAL :		253 Say	23.99 24.00	11.2	3.3	2.24	49.65	2.62	
(ii)			Reserve already mined out by M.S.C. (+104 to +93 RL)			170	24.00	11.2	3.3	1.50	49.65	2.62	
(iii)			Balance reserve available			83	24.00	11.2	3.3	0.74	49.65	2.62	
2	122	PROBABLE(P_2)	+93 to -3 RL	Western boundary to Sec. 3/30	1	72	18.00	97.5	3.3	4.17	49.54	2.64	
				3/30 - 1/30	2	100	21.00	97.5	3.3	6.76	51.22	2.27	
				1/30 to Eastern boundary	3	81	33.00	97.5	3.3	8.60	49.27	2.83	
				Sub. Total :		253 Say	23.99 24.00	97.5	3.3	19.53	49.65	2.62	
3	133	POSSIBLE(P_3)	-3 to -52 RL	Western boundary to 3/30	1	72	18.00	54.8	3.3	2.54	49.54	2.64	
				3/30 - 1/30	2	100	21.00	54.8	3.3	3.80	51.22	2.27	
				1/30 to Eastern boundary	3	81	33.00	54.8	3.3	4.64	49.27	2.83	
				Sub. Total :		253 Say	23.99 24.00	54.8	3.3	10.98	49.65	2.62	
				Grand Total :		253	24.00	156	3.3	31.25	49.65	2.62	

ABSTRACT OF ORE RESERVE

Sl. No.	U.N.F.C. Code	Category of Reserve	Reserve (Lakh Tonnes)	Cr_2O_3 %	Cr/Fe
1)	111	PROVED (P_1)	0.74	49.65	2.62
2)	122	PROBABLE (P_2)	19.53	49.65	2.62
3)	133	POSSIBLE (P_3)	10.98	49.65	2.62
		TOTAL :	31.25	49.65	2.62

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3(e)(i)(2) - RESERVE OF LOW GRADE BAND LYING ADJACENT TO THE REGIONAL BAND NO.1 -

Bore hole No.BTB-55 of the proposed lease hold area indicates that towards F/W side of main vein there occurs two alternate bands of low grade ore separated from each other as well as from main vein by layers of limonite each of 2 M thickness.

One of the said band is of 2 M width having 17.96% Cr_2O_3 content and another one is of 1.5 M width having 31.06% Cr_2O_3 content. Their average grade is 23.57% over 3.5 M width excluding barren zone. (Refer ANNEXURE - GE-1 (Page No. 47) and DRAWING NO.4).

The said low grade bands have been intersected only in one bore hole (BTB-55). But such type of low grade band has not been intersected in other bore holes (BTB-42 & 43) of the proposed lease hold area as well as in the holes (BTB-41, 68 & 70) drilled adjacent to the proposed lease area. It clearly indicates that this low grade band is a localised one.

The mining of said low grade bands involve 4 M thick waste cutting either by opencast or by underground method and the average ROM grade would be 11% only. Therefore, its mining by underground method will not be economical. Even in case opencast mining some barren excavation will take place beyond the ore boundary when mechanical excavation will be carried out which will make ROM grade below 10% Cr_2O_3 and as such it will become less than cut off grade i.e. 10%. Therefore, it will not serve any fruitful purpose in estimating the reserve of said bands at this stage. Hence, its reserve has not been accounted, although we have been advised to do so in the scrutiny letter. However, after lease is obtained, the exploration will

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be carried out in the area basing on which the reserve of low grade band will be estimated.

The geological reserve of southern boundary band having 33% Cr_2O_3 content is excluded in this content, which has been described under separate para heading in PAGE NO. 44 .

3(e)(ii) RESERVES & GRADE -

A) GEOLOGICAL RESERVE FOR REGIONAL BAND NO.1-

Based on evaluation of exploration work carried out by G S I which were drilling intersection of ore bodies and Regional geological mapping of Sukinda Region and based on observations, of ore excavation in the neighbourhood mines, by FACOR's Geologist, in the area as indicated previously, a total reserve of 31.25 Lakh Tonnes in the category of Proved, Probable, Possible (P_1, P_2, P_3) having average grade of 49% Cr_2O_3 with Cr/Fe ratio 2.6 has been estimated for a depth of 167 M from surface (i.e. +110 MRL to -57 MRL (Refer , TABLE - 5 Page No. 39). As already stated in 3(e)(i), geological reserve estimation was made considering an width of 24 M which is the arithmatical average of the true width of ore body intersected in 3 drill holes by G S I namely, Drill Hole No.42, 43 & 55, within the proposed lease hold area of FACOR. The strike length of ore body was considered as 253 M, which was measured from the out crop as plotted in the Regional geological map of G S I, over the mining lease proposed to be given to FACOR between the eastern and western boundary of the lease area.

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Similarly, the dip length of ore body was considered upto lowest level development in the mine for proved category of reserve. The lowest level developed in the mine is 93 MRL.

For Probable category of reserve, the dip length was considered upto a limit of lowest drill hole intersection of G S I i.e. -3 MRL beyond the Proved boundary on the dip side.

For Possible category of reserve, the dip length was considered 50% of Proved & Probable depth (i.e. from ore out crop 104 MRL to -3 MRL) beyond the Probable boundary on the dip side.

However, the strike length for the Probable and Possible category, has been considered the same as Proved category, due to the fact that strike length over the lease area is too less i.e. 253 M compared to very long strike length already established for the particular ore band in issue i.e. Regional Band No.1, in Sukinda Region for more than 5,000 M covering other mines in the locality. In sharp contrast, the maximum dip length established in the Region through drill hole intersection only is 230 M and therefore different dip length was considered for Proved, Probable, Possible category. The bulk density factor considered is 3.3 based on our experience at Ostapal Chromite Mines.

In the backdrop of the criterion given above, the geological reserve estimation has been given in TABLE NO. - 5 (Page No. 39).

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B) MINABLE RESERVE - (U.N.F.C. CODE - 223)

Geological reserve as above can not be encompassed for mining whether we consider opencast method of mining or underground method of mining or both. In the opencast ore pillar have to be left for ensuring safe slope which has been laid down as 30° by DGMS upto 50 M depth and 25° beyond the said depth. In the underground barrier pillars have to be left between underground and opencast for a host of reasons. Pillars have to be left in the underground as Crown pillar/sill pillar/chute pillar/ remanant pillar/rib pillar/shaft pillar for various aim, ground support being upper most. Hence, the net available insitu ore for mining, after making the due allowances as above, will be, in this instance 45% against geological reserve upto opencast limit and 70% against underground reserve.

On the basis of the criterion stated above minable reserve will be as given below -

TABLE NO. 6

Sl. No.	TYPE OF RESERVE	Quantity Lakh MT
1.	i) Geological reserve upto the depth 161 M from ore out crop (+104 RL)(Proved+Probable+Possible).	32.75
	ii) Reserve already mined out by TISCO(+104 to +93 RL)	1.50
	iii) Geological Reserve available excluding reserve mined out by TISCO (i - ii).	31.25
2.	Geological reserve upto quarriable limit i.e. +40 MRL i.e. upto a depth of 70 M from surface (110 MRL)	11.58
3.	Mineable reserve upto quarriable limit (after deduction of ore block left on wall side due to maintenance of 30° & 25° slope from the horizontal for depth of upto 50 M and below 50 M respectively).	5.21
4.	Geological reserve from quarriable limit (+40 MRL) upto the limiting depth (-57 MRL) considered for ore reserve estimation (Proved+Porbable+Possible) (1(iii) - 2).	19.67
5.	Mineable Reserve for the portion of the insitu Reserve where u/gr mining is to be carried 70% of geological reserve assumed presently as no information on geotechnical/structural/hydrological aspects of insitu ore considering which underground pillar design will be done.	13.77
6.	TOTAL MINEABLE RESERVE (ADDITION OF Sl.NO.3 & 5)	18.98

Details of Calculations has been given in ANNEXURE - GE-7 (Page No.53).

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C) RECOVERABLE ORE RESERVE -

Whatever the ore reserve available after leaving all pillars in planned manner and sometimes unforeseen in the mine, (both in underground & opencast), mining is carried out on the balance of the insitu ore body but then some loss do take place at the excavation site, during transport, hoisting, loading, unloading, besides losses near fault, dyke and other geological disturbed places. And what is net available is knows as Recoverable reserve. We are assuming the same to be 90% of minable as we are yet to experience mining (opencast and underground) at the proposed lease hold. Accordingly total recoverable reserve for the proposed lease area will be minable reserve x 0.9 i.e. 17.08 Lakh MT.

D) GEOLOGICAL ORE RESERVE AGAINST SOUTHERN BOUNDARY BAND -

It is seen in the DRAWING NO.3, that just adjacent to southern boundary an ore band occurs. Only one drill hole of G S I have intersected this ore body within the proposed lease hold area and intersected grade is 33% Cr_2O_3 which is not a directly salable grade and can be commercially utilized only after beneficiation and therefore this ore can be termed as low grade ore. The ore band is 10 M away from the southern lease boundary and therefore quarrying opportunity will not arise as 7.5 M from the lease boundary has to be left as safety zone and the dip of the ore bodybeing 80° from the horizon, the scope of excavating some ore due to steepness of ore body by opencast method gets ruled out. Since no data is available on the hydrological/structural/geotechnical aspect forecasting on the prospect of underground mining at this stage is ruled out.

Considering the views stated above it is felt that it will not serve any purpose in estimating the ore reserve quantity at this stage for this ore body and such estimation will only be taken up after lease is granted and some exploration is carried out for this ore band for possible underground mining.

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3(e)(iii) CUT OFF GRADE -

For Geological ore reserve estimation all grades of ore occurring within the ore zone has been taken into consideration since we shall not be excluding any ore of the ore zone. At any case, as per G S I Bore hole data, there is no ore available over any width below 10% Cr_2O_3 content in the lease hold area, which is treated by us as cut off grade and therefore we do not have to carry out any selective mining to exclude grade below 10%.

3(e)(iv) AVAILABILITY OF RESOURCES ON THE LEASE HOLD AREA -

If the resource aspects is weighed out in the proposed lease hold area it is seen that distinctly 3 ore band occurs in the said lease area as per DRAWING NO.4, namely ;(1) Regional ore band no.1,(2) Disseminated band close to regional band no.1, (3) Disseminated ore band close to southern boundary. Our experience in the chrome field of ORISSA indicates that though the ore body swells and pinches in width and grade its continuity is never broken but merely suffers transverse displacement due to fault and longitudinal displacement with some gap to the extent of dyke thickness whose gap can be ignored by us for resources estimation purpose. Therefore for estimating resources, we can safely assume the strike length of ore bodies, the same as that of Regional Band No.1. We know that deepest intersection of ore body is 230 M from the surface for Regional band no.1, as per G S I bore hole data. At the same time in the neighbourhood opencast mine which has gone to 60 M depth and in our mines at Osthapal Chromite lease, we do not find any gap in the down dip continuity of the ore body and do not notice even transverse displacement due to strike fault. And, therefore, there is every reason to treat the dip length for all the three ore bodies as 230 M. For regional band no.1, width and grade considered

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will be arithmetical mean of all the ore body intersection within the proposed lease area whereas for the disseminated band, G S I hole intersection available within the lease hold area, being single ones, the said width and grade can be accepted for the concerned ore band. For bulk density factor 3.3 is for Band No.1 while it should be 2.5 for disseminated band as per our experience at Ostapal Chromite Mines.

Accordingly Resource of the proposed lease hold area is estimated as follows :-

TABLE NO. 7

Sl. No.	Band No.	Strike Length (M)	Dip Length (M)	Width (M)	Volume Lakh M^3	Bulk density factor	Lakh of MT	Grade Cr_2O_3%
1)	Regional Band No.1	253	230	24	13.96	3.3	46.07	49.65
2)	Disseminated band adjacent to southern boundary.	253	230	15	8.73	2.5	21.82	33.00
3)	Disseminated ore Band close to Regional Band No.1.	253	230	3.6	2.04	2.5	5.10	34.57
	TOTAL ::						72.99	42.85

THE U N F C CODIFICATION OF THE SAID RESOURCE IS 333.

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ANNEXURE - GE-1

STATEMENT SHOWING BORE HOLE INTERSECTION OF ORE ZONE

Sl. No.	B.H. No.	Depth Mtr. From - To	Run Mtr.	RL of Intersection (M)	Ore Width (M)		Cr2O3%		Cr / Fe	
1)	BTB 42	52.85 - 69.20 72.20 - 97.25	16.35 25.05	71 - 60 57.- 40	14.0 19.0	33.0	49.78 48.90	49.27	3.01 2.71	2.83
2)	BTB 43	142.20 - 150.80 150.80 - 164.90	8.70 14.10	13 - 8 8 - -3	8.0 13.0	21.0	47.40 53.58	51.22	1.95 2.47	2.27
3)	BTB 55	137.45 - 139.65 139.65 - 157.55	2.20 17.90	14 - 13 13 - 1	1.0 17.0	18.0	32.80 49.47	48.54	1.13 2.73	2.64
		159.80 - 162.60 167.65 - 169.35	2.80 1.80	-2 -6	2.0 1.5	3.50	17.96 31.06	23.57	0.47 1.03	0.71
4)	BTB 62	86.70 - 88.50 88.50 - 94.45 94.45 - 104.60	1.80 5.95 10.15	43 - 42 42 - 37 37 - 30	0.75 5.0 9.25	15.0	33.43 32.88 33.05	33.0	0.89 0.85 0.81	0.83

ANNEXURE - GE-1

PHYSICAL PROPERTIES OF CHROMITE

Sl. No.	Type and nature of Ore	C o l o u r	Lusture	Hardness	Specific Gravity	Magnetic suspepti-bility	Associated Gangue Minerals
1)	Massive Type of Friable nature	Chocolate brown to brownish black.	Sub-metallic to Metallic.	2 - 3	3.3	Feebly Magnetic	Serpentine, hematite & Limonite.
2)	Spotted type of Friable nature	Brown to brownish black.	Sub-metallic	2 - 3	3.3	Non-Magne-tic to feebly Magnetic	Serpentine, hematite & Limonite.
3)	Massive type of Lumpy nature	Brownish black to Steel Grey.	Metallic	4 - 5	4.0	Non-Magne-tic	Serpentine & hematite.
4)	Disseminated type of friable nature.	Brown to Brown black	Dull	1.5 - 2	2.97	Feebly Magnetic	Serpentine, Hematite & Limonite.

ANNEXURE - GE-2

PHYSICAL PROPERTIES OF ROCKS

Sl. No.	Name of Rock	Texture	Colour	Hardness (Mohs Scale)	Specific Gravity	Magnetic Susceptibility
1)	LATERITE	Coarse Grainular	Yellowish Brown to Reddish Brown.	3 - 4	2.41 - 2.78	Feebly Magnetic
2)	SERPENTINITE	Fine Grained	B r o w n	1.5 - 2	2.58 - 2.95	Feebly Magnetic
3)	NICKELIFEROUS LIMONITE	Fine Grained	Yellowish Brown to Reddish Brown.	1 - 1.5	2.58 - 2.89	Feebly Magnetic
4)	PYROXENITE	Fine to Medium grain-ed	Dirty Green to Green	1 - 2	2.13	Non-magnetic
5)	CHERT	Fine Grained	Brown to Brownish white.	5 - 6	2.46 - 2.71	Non-magnetic

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ANNEXURE - GE-4

CHEMICAL ANALYSIS OF DIFFERENT FORMATIONS

Sl. No.	Constituents (%)	LATERITE	SERPENTINITE	NICKELIFEROUS LIMONITE	CHERT	CHROMITE	DISSEMINATED CHROMITE
1)	Cr_2O_3	7.85	4.81	3.04	1.52	42.06	22.80
2)	FeO	35.50	61.77	23.43	8.52	32.66	36.92
3)	SiO_2	26.80	9.06	28.34	85.42	8.00	6.50
4)	CaO	2.01	4.43	16.93	1.61	2.82	4.64
5)	MgO	1.68	3.92	2.80	1.12	1.12	1.12
6)	Al_2O_3	13.06	11.99	17.08	1.02	10.20	14.02

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ANNEXURE - GE-4

ANNEXURE - GE-5

YEAR-WISE PROPOSED EXPLORATION PROGRAMME (BY DIAMOND DRILLING BORE HOLE

Year	Bore Hole No.	Grid Direction X w.r.t. base line	Grid Direction Y w.r.t. base line	Collar RL (M)	Bore hole angle Degree)	Drilling meterage (M)	RL of ore intersection (M)	Remarks
2nd	PBH-1	1/00	210	105	44	80	+70	Marked with Green Colour in Drg. No.3 & 5.
	PBH-2	2/00	184	93	36	60	+70	
	PBH-3	3/00	170	93	38	60	+70	
	PBH-4	4/00	170	93	42	70	+70	
	PBH-5	1/00	220	105	53	100	+45	
	PBH-6	2/00	193	93	53	90	+45	
	PBH-7	3/00	190	93	54	90	+45	
	PBH-8	4/00	190	93	56	90	+45	
SUB-TOTAL ::	(for 8 Nos.)					640		
3rd	PBH-9	2/00	240	99	53	150	00	Marked with Yellow Colour in Drg.3&5.
	PBH-10	4/00	240	93	62	150	00	
SUB-TOTAL ::	(for 2 Nos.)					300		
4th	PBH-11	1/00	280	110	60	230	-50	Marked with violet colour in Drg.3 & 5.
	PBH-12	3/00	240	99	63	200	-50	
	PBH-15	1/00	56	105	55	80	+50	
	PBH-16	2/00	70	99	60	110	+30	
	PBH-17	3/00	64	99	55	100	+40	
	PBH-18	4/00	56	99	60	90	+40	
SUB-TOTAL ::	(for 6 Nos.)					810		
5th	PBH-13	2/00	282	110	60	270	-100	Marked with Orange colour in Drg.3 & 5
	PBH-14	4/00	282	108	62	270	-100	
	PBH-19	1/00	96	105	60	160	- 10	
	PBH-20	2/00	96	94	65	160	- 30	
	PBH-21	3/00	95	93	60	160	- 30	
	PBH-22	4/00	90	93	65	160	- 15	
SUB-TOTAL ::	(for 6 Nos.)					1180		
TOTAL ::	(for 22 Nos.)					2930		

Note :- PBH-1 to PBH-14 for Band - 1
PBH-15 to PBH-22 for Anticipated disseminated band (adjacent to Southern boundary)

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ANNEXURE - GE-6

PAGE NO.297 OF SHARMA COMMITTEE REPORT :

DETAILS OF THE QUARRIES OF BALIAPASGAR CHROMITE MINES OF M/S TISCO

NAME OF THE QRY	BEING WORKED OR NOT	MECHANISED OR MANUAL	LENGTH	SIZE(M) WIDTH	DEPTH	SURFACE RL	FLOOR RL	NO. OF H/W	BENCHES F/W	SIZE OF BENCHES (Ht./Width in mts.)
OB I	YES	MECHANISED	600	250	15	111(N)	86	[illegible]	3	6/12
OB II	YES	-do-	1270	400	143(S) 49(N)	244(S) 135(N)	100	22(S)	8(N)	-do-
OB III	NO		220	120	24	173	NA	NA	NA	NA (*)
OB IX	NO	-	390	250	12	110(S)	93	3	3	6/12
OB X	YES	MECHANISED	1650	440	106(S) 64(N)	178(S) 135(N)	70	14(S)	10(N)	8/16
OB XIII	YES	-do-	490	260	35(S)	146(S)	110	8(S)	5(N)	6/12
OB VB	NO		200	100	12	120	108	2	2	6/12

(*) i) Not being worked for forest clearance & land side occurred in 1982.
ii) Depth below valley level is underlined.

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ANNEXURE - GE-7

MINABLE AND RECOVERABLE RESERVE OF BAND -I WITHIN THE PROPOSED LEASE HOLD AREA OF M/s.PAOCH Ltd.

Sl. No.	P A R T I C U L A R S	PARAMETERS (Strike x Width x Dip length x T.P.)	Quantity (Loc. MT)	R E M A R K S
01.i)	Geological reserve upto the depth of 161 Mtr. from Ore outcrop + 104 MSL to -57 M.L. (Proved + Probable + Possible)	253 x 24 x 163.5 x 3.3	32.75	Dip length arrived - 161 Mtr. ÷ Sin 80° = 163.5 Mtr. Where vertical depth (104 RL + 57 RL) = 161 Mtrs and Dip of Ore body = 80°
11)	Reserve already mined out by TISCO (From +104 to + 93 RL)	170 x 24 x 11.2 x 3.3	1.50	Dip length arrived - 11 Mtr. ÷ Sin80° = 11.2 Mtr. Where vertical depth (104 RL - 93 RL) = 11 Mtr. Dip of Ore body = 80° Strike measured from Drg No.62
iii)	Geological reserve available excluding reserve mined out by TISCO (i - ii)	32.75 - 1.50	31.25	
02. 02.	Geological reserve upto quarriable limit (from mean Ore bottom R.L. 497 RL Mtr. to +40 RL) i.e. upto a depth of 70 Mtr. from surface (110 RL), Ref.Drg.No.63	251 x 24 x 57.8 x 3.3	11.58	Dip length arrived - 57 Mtr. ÷ Sing 80° = 57.8 Mtr. Where Vertical depth (97 RL -40 RL) = 57 Mtr. Dip of Ore body = 80°
03.	Mineable reserve upto quarriable limit (after deduction of Ore block left on wall side due to maintenance of 30° & 25° slope from the horizontal for depth of upto 50 Mtr and below 50 Mtr. respectively) Ref. Drg.No.68) UNFC Code - 223	114 x 24 x 57.8 x 3.3	5.21	i.e. 45% of geological reserve available upto quarriable limit. Dip length - 57 Mtr. ÷ Sin 80° = 57.8 Mtr. Where - Vertical depth (97 RL - 40 RL) = 57 Mtr. Dip of Ore body = 80° Strike = (200 + 100 + 43) ÷ 3 = 114 Mtr.
04.	Geological reserve from quarriable limit (+40 RL) upto the limiting depth (- 57 RL) considered for Ore reserve estimation (Proved + Probable + Possible) (1(iii) - 2)	31.25 - 11.58	19.67	
05.	Mineable reserve for the portion of the inside reserve where U/G mining is to be carried 70% of the geological reserve assumed presently as no information on geotechnical/structural/hydrological aspects of inside Ore considering which underground pillar design will be done. UNFC code - 223	19.67 x 0.70	13.77	Crown pillar to be left from +40 to +20 RL = 20 Mtr. Boundary pillar = 7.5 + 7.5 = 15 Mtr., 5 Mtr wide ribe pillar to be left spaced at 55Mtr. i.e. total ribe pillar to be left = 5 x3 = 15 Mtr. Void strike = 253 -15 -15 = 223 Mtr. Dip length of void/ribe piller(+20 to -57RL) = 77 Mtr. ÷ Sin 80° = 78 Mtr. Area of void i.e. Ore to be excavated = 223 x 78 = 17394 M². Area of piller to be left = Crown piller = 253 x 20 = 5060 M² Rib pillar = 15 x 78 = 1170 M². Boundary pillar = 15 x 78 = 1170 M². Total area of pillar = 7400 M² Total area (void + Pillar from +40 to -57 RL = 17394 + 7400 = 24794 M² Recovery = 17394/24794 = 70 %
06.	Total mineable reserve (O/C + U/G)(3 + 5) Unfc code - 223	5.21 + 13.77	18.98	
07.	Recoverable reserve @ 90% recovery	18.98 x 0.90	17.08	

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ANNEXURE - GE-7

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MINEABLE AND RECOVERABLE RESERVE OF BAND-I WITHIN THE PROPOSED LEASE HOLD AREA OF M/s. FACOR Ltd.

Sl. No.	PARTICULARS	PARAMETERS (Strike x Width x Dip length x T.F.)	Quantity (Lac. MT)	REMARKS
01.i)	Geological reserve upto the depth of 161 Mtr. from Ore outcrop + 104 MRL to -57 R.L. (Proved + Probable + Possible)	253 x 24 x 163.5 x 3.3	32.75	Dip length arrived - 161 Mtr. ÷ Sin 80° = 163.5 Mtr. Where vertical depth (104 RL + 57 RL) = 161 Mtr. and Dip of Ore body = 80°
ii)	Reserve already mined out by TISCO (From +104 to + 93 RL)	170 x 24 x 11.2 x 3.3	1.50	Dip length arrived - 11 Mtr. ÷ Sin80° = 11.2 Mtr. Where vertical depth (104 RL - 93 RL) = 11 Mtr. Dip of Ore body = 80° Strike measured from Drg No.6B
iii)	Geological reserve available excluding reserve mined out by TISCO (i - ii)	32.75 - 1.50	31.25	
02.	Geological reserve upto quarriable limit (from mean Ore bottom R.L. +97 RL Mtr. to +40 RL) i.e. upto a depth of 70 Mtr. from surface (110 RL), Ref.Drg.No.6B	253 x 24 x 57.8 x 3.3	11.58	Dip length arrived - 57 Mtr. ÷ Sin 80° = 57.8 Mtr. Where Vertical depth (97 RL - 40 RL) = 57 Mtr. Dip of Ore body = 80°
03.	Mineable reserve upto quarriable limit (after deduction of Ore block left on wall side due to maintenance of 30° & 25° slope from the horizontal for depth of upto 50 Mtr and below 50 Mtr. respectively) Ref. Drg.No.6B [illegible]	114 x 24 x 57.8 x 3.3	5.21	i.e. 45% of geological reserve available upto quarriable limit. Dip length - 57 Mtr. ÷ Sin 80° = 57.8 Mtr. Where - Vertical depth (97 RL - 40 RL) = 57 Mtr. Dip of Ore body = 80° Strike = 200 + 100 + 43) ÷ 3 = 114 Mtr.
04.	Geological reserve from quarriable limit (+40 RL) upto the limiting depth [illegible] considered for Ore reserve estimation (Proved + Probable + Possible) (1(iii) - 2)	31.25 - 11.58	[illegible]	
05.	Mineable reserve for the portion of the insitu reserve where U/G mining is to be carried 70% of the geological reserve assumed presently as no information on geotechnical/structural/hydrological aspects of insitu Ore considering with underground pillar design will be [illegible] [illegible]	[illegible].67 x 0.70	13.77	Crown pillar to be left from +40 to +20 RL = 20 Mtr. Boundary pillar = 7.5 + 7.5 = 15 Mtr., 5 Mtr wide ribs pillar to be left spaced at 57 Mtr. i.e. total ribs pillar to be left = 5 x 3 = 15 Mtr. Void strike = 253 - 15 - 15 = 223 Mtr. Dip length of void/ribs pillar (+20 to -57 RL) = 77 Mtr. ÷ Sin 80° = 78 Mtr. Area of void i.e. Ore to be excavated = 223 x 78 = 17394 M². Area of pillar to be left = Crown pillar = 253 x 20 = 5060 M² Rib pillar = 15 x 78 = 1170 M² Boundary pillar = 15 x 78 = 1170 M². Total area of pillar = 7400 M² Total area (void + Pillar from + 40 to -57 RL) = 17394 + 7400 = 24794 M² Recovery = 17394/24794 = [illegible] %
06.	Total mineable reserve [illegible]	5.21 + 13.77	18.98	
07.	Recoverable reserve @ 90% recovery	18.98 x 0.90	17.08	

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MINING

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4. MINING -

4 (a) METHODS OF DEVELOPING/WORKING THE DEPOSIT -

MINING of Chrome ore shall be carried out by open cut method in the proposed lease hold area of 23.800 Hectares in the village Kalarangiatta, which was Western most part of the earlier TISCO lease area of 1261.476 Hectares to begin with. Within the proposed lease hold area a very shallow depth excavation was made by TISCO with an aim to win away the Chrome ore and the dimension of the quarry as it is occurring within the proposed lease hold area is 210 M length by 220 M width. The depth of the excavation can not be estimated directly as it is filled with water (Rain precipitate/ Static seepage water) but as per TABLE available in SHARMA COMMITTEE REPORT (Page No.297), the depth of the quarry is 17 M only. From the said Table, it is clearly evident that upper brown ore body or No.1 ore body of Sukinda Region was mined out by TISCO in this quarry. This also gets confirmed from the correlation of the lease map supplied by Govarnment wherein upper brown seam has been marked probably from the Regional map of Sukinda Region prepared by G.S.I. with the adjoining lease of TISCO area.

As per the inferred disposition of the ore body, based on G.S.I. drill hole data, Regional band No.1, known as upper brown, is the only ore band, available in the lease hold area proposed to be granted to FACOR and is striking EAST to WEST, with an average true width of 24 metres and an average grade of 49% Cr_2O_3 over the said width. As already stated above an excavation has been made to a depth of 17 M over an area of 210 M length x 220 M width within the proposed lease hold area over the aforestated ore Band No.1. It could be inferred on examining the TABLE given in the SHARMA COMMITTEE REPORT (Page No.52) (copy of which is enclosed as ANNEXURE - GP-6 /) that, there are 3 benches in the said excavation over the lease hold area

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proposed to be granted to FACOR, with one 5 metres bench in laterite and two 6 metres height benches in wall rocks. One ramp emnating from the ground surface at in 1 in 12 gradient is spanning all the THREE benches (Refer DRAWING NO.2)(Vol.2).

4(a)(i) JUSTIFICATION FOR THE CHOICE OF THE METHOD OF MINING - OPENCAST & UNDERGROUND THEREAFTER -

For any given ore body relative economy of mining is generally the consideration for choosing the method of mining between the underground mining and opencast mining. However, there does arise rigid situation where opencast mining becomes virtually impossible. Natural obstacle like hill or mountain or river fragile ecological set up or archeological excavation or National Sanctuary or similar such situation just can not be over come (irrespective of economy or no economy) and underground mining has to be resorted. While natural barrier may not exist, still economy of opencast mining of ore may become higher than market value or relatively higher than underground cost of production for the same scale of production like excessive ore/overburden ratio on account of opencast depth, flat slope of quarry (because of very soft ground), thin ore body compared to overburden or side burden, excessive haul distance where cost of hauling forms a big component in overburden cost or similar such situation. In certain situation, information may not be available on the Geo-technical/Hydrological/Mineralogical front and is likely to take few years before informations can be obtained and assessment is possible on the economy of mining by underground method at depth from the surface and it also takes 6 to 7 years to construct an underground mine for full-fledged production. In such circumstance, commencement of opencast mining of mineral, where preparatory period is few months instead of few years, as is the case at Bhimtangar lease area, can be taken up for few years while carrying out R & D work on the underground mining. Hence, it is reasonable and

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justified that opencast mining has been suggested for initially few years at the proposed lease hold area of FACOR. Even otherwise also opencast mining would be preferred upto certain depth considering the width of ore body though such economic advantage is sometimes given up as underground mining engineer prefers a virgin surface/strata vertically above his undergroud mines.

4(a)(ii) DESIGN PARAMETERS OF OPENCAST WORKING -

TABLE NO. 8

Sl. No.	PARTICULARS	Unit	Quantity	Remarks
1)	Bench Height	M	6.0	
2)	Bench Slope (individual)	Degree	70	
3)	Drain size & shape -			
	a) Top width	M	0.50	
	b) Bottom Width	M	0.30	
	c) Depth	M	0.30	
4)	Barrier size & Shape-			
	a) Top width	M	0.50	
	b) Bottom Width	M	1.25	
	c) Height	M	0.70	
5)	Ramp gradient -			
	a) Main ramp		1 in 14	
	b) Other ramps		1 in 12	
6)	Type of ramp		Switch Back	
7)	Width of Ramp -			
	a) Main ramp	M	14.0	
	b) Other ramps	M	11.5	

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Table No. 8 contd ..

Sl. No.	PARTICULARS	Unit	Quantity	Remarks
8)	Type of drilling -		Wagon Drill/Jack Hammer	
	a) Spacing	M	3.0	
	b) Burden	M	3.0	
	c) Depth (70° incline)	M	6.4	
9)	Depth of Mining from Surface :- (110 MRL)		Depth	R.L.
	a) Existing	M	17	93 M
	b) 1st year	M	20	90
	c) 2nd year	M	23	87
	d) 3rd year	M	26	84
	e) 4th year	M	29	81
	f) 5th year	M	32	78
	g) Ultimate (10th year)	M	70	40
10)	Overall pit slope -			
	a) upto 50 M depth from surface.	Degree	30	East, West & South.
	b) Below 50 M depth (50 to 70) from the surface.	Degree	25	
	c) On the North wall for all the depth	Degree	20	
11)	TOTAL BENCH WIDTH OTHER THAN RAMP/ACCESS (Refer ANNEXURE - M-5 (Page No. 86).			

TABLE - 9

Sl. No.	Particulars	Slope Width	Drain provision	Barrier Provision	Road width	Total width
1)	Upto 50 M depth of quarry (For Pit slope 30°)	8.2 M	0.5 M	1.25	0.15	10.4 M
2)	From 50 M to 70 M depth of quarry (for pit slope 25°)	9.2 M	0.5 M	1.25	0.15	12.9 M

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Table No. 8 contd ..

Sl. No.	PARTICULARS	Unit	Quantity	Remarks
8)	Type of drilling -		Wagon drill/Jack Hammer	
	a) Spacing	M	3.0	
	b) Burden	M	3.0	
	c) Depth (70° incline)	M	6.4	
9)	Depth of Mining from Surface :- (110 MRL)		Depth	R.L.
	a) Existing	M	17	93 M
	b) 1st year	M	20	90
	c) 2nd year	M	23	87
	d) 3rd year	M	26	84
	e) 4th year	M	29	81
	f) 5th year	M	32	78
	g) Ultimate (10th year)	M	70	40
10)	Overall pit slope -			
	a) upto 50 M depth from surface.	Degree	30	East, West & South.
	b) Below 50 M depth (50 to 70) from the surface.	Degree	25	
	c) On the North wall for all the depth	Degree	20	
11)	TOTAL BENCH WIDTH OTHER THAN RAMP/ACCESS (Refer ANNEXURE - M-5 (Page No. 86).			

TABLE - 9

Sl. No.	Particulars	Slope Width	Drain provn	Barrier Provision	Road Width	Total Width
1)	Upto 50 M depth of quarry (For Pit slope 30°)	3.2 M	0.5 M	1.25	5.45	10.4 M
2)	From 50 M to 70 M depth of quarry (for pit slope 25°)	3.2 M	0.5 M	1.25	5.45	12.9 M

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4(a)(iii) SEQUENCE OF OPENCAST DEVELOPMENT & DIRECTION OF DEVELOPMENT TOGETHER WITH BENCH RL AND QUANTITY OF EXCAVATION BENCH-WISE AND OTHER IMPORTANT DEVELOPMENT FEATURES -

Immediately after obtaining the permission for surface occupation, after ensuring dewatering and silt removal, the machines will be lowered through the above said ramp and the benches will be extended in Eastern direction till reaching Eastern lease boundary while simultaneously the ramp also will be extended with 1 in 14 gradient in the strike direction of the ore body till reaching the next lower bench and after sufficient extension of the next lower bench, again a ramp will be formed in 1 in 14 gradient over a distance of 84 metres to reach to the RL level of still lower bench and the process continues till reaching around 78 MRL only after which excavation at the top edge of quarry on foot-wall/hang-wall direction is necessary since the advance excavation has already been done by previous lessee considering the depth reached. The present profile of quarry is inferred from various data available as the quarry is full with water and direct observation is not possible. To the extent, actual profile will alter from the inferred one, to that extent, the present planning will be modified. At the Western lease boundary the depth of the Ramp from the ground will be 23 M, which will enable formationof a bench for chrome ore body between 17 & 23 M depth. Average ground level is 110 M and therefore, the RL of the benches will be 105 MRL, 99 MRL, 93 MRL and 87 MRL, 81 MRL, 75 MRL, 69 MRL, 63 MRL and so on. (Refer DRAWING NO.7). As chromite has already been mined out between 104 MRL and 99 MRL and also between 99 MRL and 93 MRL over an average strike length of 170 M chromite mined out upto 93 MRL is 170 x 24 x 11 = 44,880 M^3 x 3.3 (Tonnage factor) i.e. about 1.5 Lakh M.T.

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As already stated above, it is proposed to enlarge the area of excavation first upto Eastern lease boundary with the depth remaining at 17 M before extending the ramp. Such, enlargement all around would have meant normal chromite excavation of 24 M width x 220 M strike x 11 M depth = 58,080 M^3. However, as stated above, already 44,880 M^3 have been excavated and therefore, the balance available will be 58,080 - 44,880 = 13,200 M^3 x 3.3 (Tonnage factor) = 43,000 MT of ore. The overburden excavation in the process will be one Lakh M^3 (Refer Sections - DRAWING NO. 7) (Vol.2)

Subsequently, depression of quarry bottom by 6 M (i.e. quarry bottom reaching at 87 MRL) will yield 24 x 179 x 6 = 25,776 M^3 x 3.3 (Tonnage factor) i.e. about 85,000 MT Chromite with an overburden excavation of 2 Lakh M^3. (Refer TABLE NO. 10). The quarry bottom depression will continue as such with ramp going down in 1 in 14 gradient, keeping the avg ultimate slope angle of foot-wall at 28° untill the Southern edge of the quarry all most touches the Southern boundary when the quarry bottom will reach 40 MRL i.e. with one laterite bench of 5 M height and 11 benches of Chromite with 6 M height. The total tonnage and overburden excavation will thus become as follows till reaching the limits of opencast working -

TABLE NO. 10

Sl. No.	Chromite Benches	MRL	Quantity in M.T.	Overburden excavation in cu.M
1)	First Bench	105 - 99	21,000	1.00
2)	Second Bench	99 - 93	34,000	1.00
3)	Third Bench	93 - 87	86,000	2.00
4)	Fourth Bench	87 - 81	79,000	1.90
5)	Fifth Bench	81 - 75	68,000	1.75
6)	Sixth Bench	75 - 69	58,000	1.40
7)	Seventh Bench	69 - 63	54,000	1.60
8)	Eigth Bench	63 - 57	48,000	1.35
9)	Nineth Bench	57 - 51	38,000	1.00
10)	Tenth Bench	51 - 45	27,000	0.80
11)	Eleventh Bench	45 - 40	20,000	0.75
	TOTAL :: ::	105 - 40	5,21,000	14.75

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The entire mining working would necessarily have to be carried out with as much mechanisation and automotation as would be feasible considering the infrastructural facilities available around the Sukinda Region.

For opencast mining operation, longitudinal drains will be maintained at every bench floor to enable the rain precipitate and seepage water to flow to the western most quarry bottom and where a sump of 30 M x 30 M x 3 M will be excavated which will have the capacity of 2,700 M^3 of water. The annual rain fall is considered 1.3 M and the quarry area is 54400 M^2 and hence rain precipitate over quarry is 54400 x 1.3 = 70720 M^3 in beginning period of mining operation, however 80% of such rain fall is in rainy season i.e. 57000 M^3 water to be tackle in 153 days i.e. from June to October and per day rain precipitate over quarry area will be 370 M^3. Assuming rain precipitate over the lease surface area is 238000 M^2 less quarry area 54400 M^2 i.e. around 183600 M^2 x 1.3 M (rain fall) = 238680.

Assuming 20% (CENTRAL GROUND WATER BOARD REPORT - 18% infiltration factor) as ground infiltration, as 80% is over rainy season of the non quarry surface area 238680 x 0.8 x 0.2 = 38200 M^3 will be infiltrated in 153 days i.e. June to October. Hence, infiltrated quantity/day is 250 M^3. Assuming 10% of infiltrated water as seepage water, ground water seepage into quarry/day is 25 M^3. Again assuming another 50 M^3/day as over flow from garland drain, the total pumping/day will be around 445 M^3/day. However, assuming that peak in flow into quarry sump will be 3 times of estimated figure, per day pumping will be 1350 M^3/day. The sump capacity is 2700 M^3 i.e. more than 2 days capacity. The above details will change as quarry will be expanded.

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The afore-stated details are given in brief in the following TABLE - 11.

TABLE NO.11

Sl. No.	SOURCE	ANNUAL	QUANTITY (M3) For rainy season only (July - October. 80% of annual	QUANTITY (M3) Per day in rainy season (153 days)	Water accumulation in to the quarry in rainy season per day (M3)
1)	Rain fall (Assume)	1.30 M	1.04 M	-	
2)	Rain precipitated over quarry area (54400 M2)	70.720 M3	56.576 M3	370 M3	370
3)	a) Ground infilteration 20% of rain precipitated over lease hold area excluding quarry area. (183600 M2)	20% of 238680 = 47736 M3	20% of 190944 = 38189 M3	250 M3	
	b) Seepage water into the quarry (assume 10% infiltrated quantity i.e. 250 M3)				25
4)	Water overflow from garland drain (assumed)				50
	TOTAL ::	::	::	::	445 M3
				SAY ::	450

Expected pumping water (assume 3 times of estimated quantity = 400 x 3 = 1350 M3.

Sump Capacity = 2700 M3 (i.e. more than 2 days)

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The first requirement upon getting permission will be to dewater the quarry, remove the silt and expose the ore body which had been excavated by TISCO. Channel sampling will be taken at 25 M interval and grade values will be given across the width of ore body.

The disposition of the ore body on the plan view (slice plan) will be marked out which will enable to lay down the limiting line on the Hang wall and foot wall for a 3 M depth ore slice depending on the working slope of quarry walls. Assuming that on average 210 M strike length will be available, the production against 3 M slice 210 (strike) x 24 (width) x 3 (Depth) x 3.3 (Sp.gr.) = 50,000 MT. Assuming 80% recovery it will be 40,000 MT/Annum of saleable ore and 10,000 MT/Annum of low grade ore. Similar slice will be excavated in descending order. However, the depth of slice will be increasing with the increase in depth due to reduction in available strike length on account of side slopes.

Assuming that first geological slice plan has been made at 17 M to 20 M depth from the surface i.e. 93 MRL, subsequent major slice plan will be 70 MRL for which 1st set of holes at 50 M interval will be drilled from surface to intersect at the said RL.

The slice plan showing disposition of ore body to be drawn at 12 M interval together with section will be utilized to predict the quarry excavation outline at the surface. Presently an inference, has been made based on strike/dip direction of the ore body in neighbouring mines and slice plan have been drawn at the 93 MRL which is expected RL of quarry bottom currently.

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Expansion of existing excavation will be carried out commencing from Eastern boundary to Western boundary and for 3 M of quarry depression, a shifting of near about 4.5 M and 5.5 M of the outer edge of quarry will take place at foot wall and hang wall respectively. And, this extent of quarry edge shifting will be followed up by shifting of successive lower benches, in descending order whole over the quarry perimeters, till reaching the quarry bottom. However, in intermittent year, quarry edge shifting will be more than what is stated above to retain ramp and haul benches for period longer than one year.

As already given in the opencast design parameter,(Page- 56) in Southern, Eastern and Western wall, 30° will be overall slope upto 50 M depth and thereafter it will be 25° upto 70 M depth (40 MRL) which is ultimate quarry depth, and on the Northern wall 20° slope will be made right upto ultimate depth.

4(a)(iv) POSSIBILITY OF STEEPENING THE QUARRY SLOPE AT THE ULTIMATE DEPTH -

It is seen that with 6 M height and 10.5 M width on the foot-wall, overall slope is 30° which can be maintained as such at the ultimate depth of opencast mining i.e. upto 40 MRL whereas on the hangwall where the ground is relatively weak and as the access to quarry bottom will also be provide on H/W side, the overall slope will be maintained at 25°. But then, it is to be noted that through-out the opencast life of 10 years, the overall working slope will be less than 30° on the foot-wall side and less than 25° on the hang-wall side, due primarily to the ramps and haul benches required to be formed whose shifting shall not necessarily be carried out at interval of one year and may have to be done at greater interval considering time and cost of such construction.

Therefore, predicted quarry outline year to year will not necessarily be intune with overall ultimate slopes of quarry as stated above, which status will only be reached at the ultimate depth of quarry. In order to maintain near about 30° on the foot-wall side sufficient ground drainage work in the form of garland drain and network of channels and sub-channels will be created on the foot-wall side of the ore body besides carrying out Bore hole pumping of water from the surface as well as on benches with an ultimate aim of maintaining the quarry slopes in a dry state. Added to the precaution as stated above, monitoring of the ground slope shall be carried out to detect possible micro movement of the slope with the help of tape extensometer, bore hole extensometer, precise level and electronic distance measuring instrument during the life of opencast excavation. Simultaneously ground water level and hydrostatic pressure in the quarry slope shall be determined by pizeometers. At any case as noticed in the quarry of Ostapal Chromite Mines of FACOR and that of Kalarangi Chromite mines of OMC with increasing depth mechanical strength parameters of ground is increasing and there is no reason why at dry quarry slope, the factor of safety of foot wall at 30° slope will be less than 1.5. At exploratory drilling stage drill core will be utilized to find out Mechanical strength parameters. And if the strength parameters are found to be higher than estimated, quarry slopes will be steepened and ultimate quarry bottom will be lower than 40 MRL i.e. quarry life will be extending beyond 10th year.

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4(a)(v) TRANSPORT METHOD IN ORE AND OVERBURDEN -

10 M.T. TELCO Tippers will be utilized for transporting of the overburden as well as the chromite ore. These tippers are well suited with 0.9 M^3 (Bucket capacity) hydraulic Shovel/Back-hoe and does not cause any spillage from the bucket of the Shovel into the body of tipper. These Telco tippers are very sturdy, can climb steep gradient, can negotiate acute curves, can move in narrow width and it is simple to operate with safety and easy to maintain. These can also be utilized for transport in National high-way/State high way/Ordinary road. Therefore, all transport outside the pit will be carried out through these tippers. No form of conveyor or rope way or tramway will be utilized for transport.

4(b)(i) QUANTUM OF DEVELOPMENT AND TONNAGE AND GRADE OF PRODUCTION EXPECTED PIT-WISE -

TABLE NO. 12

Year	Pit No.	Over-burden M^3	ROM Ore MT	Salable Ore MT	Low-grade ore MT	Nickeli-ferrous limonite M^3	Ore to over-burden ratio
1st	-	150000	44000	35200	8800	7500	4.26
2nd	-	170000	50000	40000	10000	8500	4.25
3rd	-	170000	50000	40000	10000	8500	4.25
4th	-	170000	50000	40000	10000	8500	4.25
5th	-	170000	50000	40000	10000	8500	4.25
TOTAL ::		830000	244000	195200	48800	41500	4.25

Refer ANNEXURE - M-1 (Page No. 81) for yearly bench slice-wise expected quantum of production programme for first five years.

Refer ANNEXURE - M-2 (Page No. 82) for yearly quantum, sequence and direction of development programme for first five years.

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4(b)(ii) BASIS OF CALCULATION OF ORE AND OVERBURDEN -

The chromite ore excavation per year has been assessed based on multiplication of ore strike length in each working sector of quarry to be worked in a given year with the weighted average width (24 M) and with the weighted average depression of ore exposure (as projected in year-wise plan view of quarry) which will take place in the particular year in the particular sector. The volume thus obtained was multiplied with the bulk density factor, for an average grade of ore that is likely to be available, based on experience of Ostapal Chromite Mines of FACOR.

Similarly quantity of overburden/waste for each year in term of M^3 excavation was estimated by measuring the area from the projected quarry plan, as measured in the planimeter, sector-wise and reduced level-wise and multiplying the same with the average depression that will take place in the quarry bottom and other benches in the particular year. The average will normally be 6 metre, which is the bench height, over any sector on the quarry plan.

4(b)(iii) METHOD OF ARRIVING AVERAGE ORE WIDTH OF 24 M -

The ore width of 24 M is considered for calculation of year-wise production, is derived by weighted average method as per the calculation details given below -

TABLE No.13

Sl. No.	Bore Hole No. *	Influence strike *	Width *	Strike x Width	Weighted Average: Total of(5) ÷ Total of(3)
1	2	3	4	5 (3 x 4)	6
1)	BTB-42	81 M	33 M	2673 M^2	
2)	BTB-43	100 M	21 M	2100 "	6069 ÷ 253 *
3)	BTB-55	72 M	18 M	1296 "	
	TOTAL :	253 M		6069 M^2	23.99 M
		So, weighted Width = 24 M.			

*Refer DRAWING NO.4 & 6A.

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4.(b)(iv) :

LIST OF PRE-PRODUCTION DEVELOPMENT ACTIVITIES
THE SCHEDULE

Sl. No.	Pre-production development activities	Time required	PERIOD															
			1st month				2nd month				3rd month				4th month			
			1st week	2nd week	3rd week	4th week	1st week	2nd week	3rd week	4th week	1st week	2nd week	3rd week	4th week	1st week	2nd week	3rd week	4th week
1)	Layout of pipe line and installation of pumps	1 week	////															
2)	Drain and ETP construction	1 month	////	////	////	////												
3)	Dewatering the quarry	2 months					////	////	////	////	////	////	////	////				
4)	Cleaning of vegitation	1 week	////															
5)	Road construction from quarry to waste dump, and stack yards.	1 week		////														
6)	Top and sub-soil removal	1 week			////													
7)	Relaying ramps into the quarry	1 week				////												
8)	Silt removal	2 weeks													////	////		
9)	Overburden removal to expose the ore body	2 month									////	////	////	////	////	////	////	////
10)	Construction of essential infrastructures	3 month	////	////	////	////	////	////	////	////	////	////	////	////				
11)	Connection of road from stack yard to public road and other internal road construction.	1 month					////	////	////	////								

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4(c) INDIVIDUAL YEAR-WISE PLANS & SECTIONS -

Individual year-wise Plans & Sections are enclosed as DRAWING NO. 7 and 8(a) to 8(e). Estimation of yearly bench slice-wise expected quantum of production programme for first five years, shown in ANNEXURE - M-1(P-81) and estimation of yearly quantum, sequence and direction of development programme for first five years shown in ANNEXURE - M-2 (Page No. 82)

4(d) COMPOSITE PLAN AND SECTION SHOWING PIT LAYOUTS, DUMPS, STACKS OF LOW-GRADE MINERAL -

Refer DRAWING NO.9 and 10.

4(e) PROPOSED RATE OF PRODUCTION AND EXPECTED LIFE -

Thus, the total chromite ore of 5,24,000 MT will be excavated over a period of 10 years @ of 50,000 MT/Annum and total overburden excavation of 14.75 Lakh M^3 say about 15 Lakh M^3 will be excavated at the rate of 1.7 Lakh M^3/m. The opencast mining will cease on the completion of 10th year since by then lease boundary will coincide with excavation boundary at foot-wall (Refer PLAN & SECTION - DRAWING NO.9 &10). However, this is with the expectation that rock competency on the foot-wall will be as per prediction. But any improvement in rockmass competency will be followed by steepening of over-all slope and economic depth of quarry will further increase.

The dimension of quarry bottom at the end of the 10th year will become 43 M along strike and 35M across strike while the dimension of quarry top will be 235M along strike and 352 M across the strike (Refer PLAN & SECTIONS - DRAWING NO. 9 & 10). However, from 11th year onwards production will continue at

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the rate of 40,000 MT/Annum by underground till reaching the expected depth i.e. 250 M which will make overall life of the lease area to be 50 years.

4(f) CONCEPTUAL MINING PLAN -

4(f)(i) UNDERGROUND WORKINGS -

From 11th year onwards underground mining will take place at the rate of 40,000 MT per annum. And to effect the underground mining at the stipulated year, preparatory development work will be initiated from the commencement of 5th year of the opening of the opencast mining operation. Therefore, Diamond drilling work for commencement of preparatory development work will be initiated from 3rd year itself both for establishing control point in the development drives to be undertaken as well for carrying out Hydro-geological and Geo-technical studies to design the method of stoping and development and/for designing the geometry of excavation to be adopted including design of support, working dimensions, void dimension, all types of pillar dimension, like sill pillar/crown pillar/remanent pillar/barrier pillar/rib pillar/shaft pillar and estimation of advance pumping requirement, surface (abandoned quarry) pumping requirement, drain design on the surface to ensure drainage of rain precipitate without any ponding with negligible infiltration. And precisely for the purpose stated, 3 to 4 holes will be drilled from Hanging wall side to intersect the ore body at 100 M depth i.e. at about '0' MRL. Out of the 4 holes, one will be drilled vertically to carryout the pumping test for determining hydro-geological parameters. Balance holes will be drilled at 65° angle of inclination.

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The UNDERGROUND MINING method may be -

- Cut & Fill.
- Sub-level stoping.
- Sub-level Caving.
- Block Caving.

depending on the competency of the wall rock and chromite, which inturn will be a function of ground strength parameters, structural defects of the ground and the water pressure in the Rock mass surrounding the underground void areas.

4(f)(ii) JUSTIFICATION FOR TREATING 40 MRL AS THE ULTIMATE PIT BOTTOM FOR OPENCAST MINING -

In order to maximize the availability of ore front on the strike direction for ore excavation, no ramp formation is being planned on the eastern and western wall of the quarry, for any ramp formation on these walls will mean blocking additional ore pillar on the side slope of eastern and western wall, thereby reducing the ore front in the strike direction of the quarry. It is precisely for the same reason no ramp is proposed on the southern wall since any ramp formation would flatten the slope leading to the intersection of the said wall or the ore body at a relatively higher elevation, when the sloping wall will be made from the southern boundary which is a distance of 150 M from the ore out crop. This would reduce the scope of lowering the ultimate pit bottom RL which would end at an elevation higher than proposed 40 MRL. Besides formation of ramps on the southern wall will create the exit problem for the dumper as the dumpers can not be taken out of the quarry to the surface for waste/ore removal since that will mean crossing lease boundary on the southern, eastern or western side for which free land access is not available.

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Therefore, all switch back ramp are proposed to be formed on the northern wall which is also hangwall side of the ore body and quarry and in which direction, i.e. north direction, there is no area limitation for quarry advancement as the lease boundary is 450 M beyond the quarry out line even when the quarry is at the 40 MRL which is considered bottom most limit of quarrying operation below which quarrying operation : can not be continued because of the reason given below. The over all slope on the northern wall has become 20° because of provision of switch back ramps to take down the machine to lower level. To that effect on the northern slope of the quarry it is proposed to form 4 ramps in 1 in 14 gradient each of 85 M long and one ramp of 72 M long with 1 in 12 gradient. And the overall slope on the east western and southern wall will be kept at 30° upto 50 M depth and thereafter it will be 25° slope upto 40 MRL.

Specific reason for treating 40 MRL as ultimate bottom of the quarry -

With the overall slope of the quarry wall, as mentioned above, when brought down from the eastern, western and southern boundary of the lease area, east to west width is 43 M at 40 MRL. 43 M Width is considered as minimum width below which efficiency of Shovel/Dumper combination working will be impaired. This is because of the fact that length of the 0.9 M^3 shovel together with boom in horizontal position will occupy 13 M width. And when full circle will be made from the centre of shovel, the dia meter will be about 22 M. The minimum radius of curvature of TATA 1210 Tipper is 14 M. Atleast 5 metre space should be left from either wall at the bottom of quarry. And while cutting the benches from eastern and western boundary of the lease area at the proposed overall slope of 30° upto 50 M depth and 25° thereafter, practical working indicates that slope becomes

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flatter and hence the said 43 M width will further reduce. Some space will also get occupied for creating an water sump for regular storage and pumping of water to keep the Shovel/Dumper working floor dry. Considering all the aspects as mentioned above, the 43 M width at the ultimate bottom is considered as minimum for mechanised excavation work efficiently. Since 43 M width is achieved at 40 MRL only, 40 MRL has been considered as ultimate bottom of the opencast working.

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4(f)(iii) CONCEPTUAL PLAN OF THE QUARRY AND ULTIMATE PIT SLOPE -

DGMS has set a limit of overall slope of 30° upto a depth of 50 M and 25° thereafter for all chromite mines of Orissa. However, if one can establish the ground parameter, namely strength properties and hydro geological status is such that overall slope against a given depth will be stable even at steeper angle, then permission for steeper is also been given by DGMS. Conversely if the ground condition against a given depth is bad enough it warrants a flatter slope which should not be lost sight of. However, D G M S stipulation is on the limiting slope or ultimate slope while day to day working is carried out at a relatively flatter slope known as an working slope. In case of Bhimtangar mines, it is expected that ground parameter will improve with depth as it has been the case at our Ostapal Chromite mines where prorata improvement in ground strength values in respect of U.C.A., Cohesion, Friction angle, Unit weight, takes place with increasing depth. And, therefore, it is felt that it is reasonable to make efforts for an overall slope of 30° for a depth of 70 M from surface on the Eastern and Western wall of the quarry, where space limitation justifies the need of higher slope. A overall slope estimation, based on the Ostapal mines ground strength parameters as determined at Boula Soil Mechanics Laboratory at the present depth from surface i.e. 50 M from surface at a depth of 70 M at Bhimtangar lease area, indicates factor of safety 1.6 on the so-called Eastern and Western wall of the quarry which justifies the ultimate slope of 30°. However, presently we have made all estimates based on maximum 30° slope upto 50 M depth and 25° slope thereafter. But in case of Northern wall, we have considered 20° slope only.

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4(f)(iv) EXPLORATION AND OTHER STUDIES REQUIRED FOR UNDERGROUND MINING -

Primary objective of the exploration in an ore band like Regional No.1 band travefsing across the proposed lease area, is primarily meant to establish the necessary control point, so that underground drivages will proceed smoothly with knowledge of ore geometry and in the process width and grade of the ore body will be known besides the knowledge of geotechnical parameters like U.C.A., Cohesion, Friction Angle, Bulk medulus of rigidity, material constant to evaluate t h e stability of the void and to determine the extent and form of support to wall e.g. filling or waste pillar or chromite pillar etc. All these drill hole for underground mining purpose and the computational work on void stability has to be completed by 5th year and no such R & D work will be kept pending, beyond 5 years period as from Sixth year onwards, access for underground mining work will be commenced other-wise soon after cessation of opencast mining after 10th year, production from underground mines at the same scale as is being proposed for opencast mining i.e. about 40000 MT/Annum will not be possible and there will be serious gap in the continuity of production during transfer from opencast to underground.

4(f)(v) QUANTUM OF OVERBURDEN, ORE, RATIO & DUMP STACKING YARD AND ADEQUACY OF THE SAME -

While the quantum of overburden is 8.3 Lakh M^3 in the first five years period, the same figure rises to 14.75 Lakh M^3 over the conceptual plan period. The area occupied for overburden storage is 4.830 Hectares. This area is sufficient to store the required quantity of overburden which will be placed in two successive benches each of 15 M height making the overall slope to 33° which is a stable slope considering mechanical

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strength property of waste dump. This area has been selected since it is Government land and is encroachment free and also forest free area. The dumping site is farthest distance from the dwelling houses in the lease area and no dwelling houses are seen within 100 M of the overburden position. There is no public water source bearby which may get contaminated. There is no public road nearby. Distance from the quarry edge at the ultimate position of the quarry is 80 M.

A) Overburden -

Upto 40 MRL quarry bottom is 70 M depth from surface. (As derived from Transverse section & longitudinal section - Refer DRAWING NO.DR-7 of Volume - 2).

- Cross sectional area (from T-Section No.2) = 10,441 M^2
- Cross sectional area (from T-section No.4) = 10,335 M^2
- Average cross sectional area .. .. = 10,388 M^2
- Average strike length (from longitudinal section) = $\frac{230 \text{ (top)} + 43 \text{ (bottom)}}{2}$ = 136.5 M
- Volume of Overburden : 10388 M^2 x 136.5 M = 14,17,962 M^3
- Add 15% extra for bends, access etc.. = 2,12,694 M^3
- TOTAL QUANTITY .. .. = 16,30,656 M^3
- Less Quarriable ore volume (521864 MT ÷ 3.3 = 1,58,140 M^3
- ULTIMATE QUANTUM OF OVERBURDEN .. = 14,72,515 M^3

SAY : 14.75 Lac M^3

B) Quarriable Ore -

(As derived from Longitudinal Section DRAWING NO.DR-6(8) and ANNEXURE - GE-7 (Page No.53). After deduction of ore block left of wall side due to maintenance of 30° and 25° slope from the horizontal for depth of upto 50 M and below 50 M depth respectively.

Quantity = 114 (Avg.Strike) x 24 (Width) x 57.8 (Dip length) x 3.3 (Tonnage factor)

= 5,21,868 MT SAY : 5.21 Lac MT.

C) Ore to Overburden Ratio -

Ore = 5.21 Lac MT Overburden = 14.75 Lac M^3

Ratio = 1 : 3

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4(f)(vi) NICKELIFERROUS LIMONITE REJECT AND ITS STOCKING -

The Nickeliferrous limonite reject of all grades which will be generated for first five years is going to be 0.45 Lakh M^3. The area earmarked for nickeliferrous limonite is 0.746 hectares and occurs in an irregular hexagonal shape where the overall slope has been assumed to be 33° and as per calculation the storage capacity of the area is 1 Lakh M^3. During the Conceptual plan period, calculation made on t h e same basis as five year plan period (see CHAPTER - 7, page No. 95) indicates the maximum stock piling is likely to be 1 Lakh M^3 of nickeliferrous limonite over 10 year period of opencast life and hence the said area is sufficient for the quarry life at Bhimtangar area.

4(f)(vii) ENVIRONMENTAL CONSIDERATION OF CONCEPTUAL PLAN PERIOD -
Environmental Monitoring -

Over the entire life of the mine, monitoring at periodical interval, will be carried out on a quarterly basis each year, for possible environmental pollution of Air quality, Water quality, Noise level, Soil quality, Ground vibration, both in Core zone as well as in Buffer zone. (Schedule given in Page No. 167). Ground water regime monitoring shall be carried out in pre-monsoon session and post-monsoon session. The objective of such monitoring will be to keep a check on the mining activities like drilling, blasting, loading, transport, pumping, ore extraction, overburden dumping etc., does not cause deterioration of quality of air, water, soil and ground water regime as per the prescribed standards laid down by appropriate authorities. Any deviation from the standards will call for review of precautionary measures forming part of inbuilt system itself to prevent adverse effect, so that further action plan can be identified and implemented to neutralize the adverse effect. However, at the proposed lease hold area, considering the level of working being planned and

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also considering the environmental monitoring (both in core zone and buffer zone) experience of F A C O R in their other two mines, namely KATHPAL CHROMITE MINES (Opencast and underground) and OSTAPAL CHROMITE MINES (Opencast) at a distance of 3/4 Km from the proposed mining lease, no adverse effect is visualized on any aspects of environment through out the mine life at the porposed mining lease area.

- The Reclamation, rehabilitation and environmental protection measures have been discussed in detail in the ENVIRONMENTAL MANAGEMENT PLAN (PARA 11 C(ii) to 11C(vi) .- Page No.150 to 159)

4(g) OPENCAST MINES -

4(g)(i) SAILENT FEATURES OF THE MODS OF WORKING -

It is seen that out of total excavation work of 1.7 Lac M^3 per annum, chromite ore excavation will be to the tune of 15,000 M^3 (leaving aside disseminated chromite on the foot wall to a minor extent) which will form 10% of total excavation. However, speed of excavation of machine in chromite will be less than overburden, because blasting will be avoided to as much extent as possible to prevent spillage and even where blasting will be carried it will be very careful operation to prevent dilution at the contact of ore and overburden boundary plane. Also, for the reason given above, chromite mining will be carried out only in day light i.e. in the morning shift. Therefore, one Hydraulic Shovel of 0.9 M3 bucket together with 7 nos. of 10 MT TELCO Tippers with Scoope type body with automatic dumping arrangement operated by Hydraulic means will be engaged in the chromite excavation process in 70 to 80 shifts in an year. And, therefore, one number excavating machine, out of the two Shovels listed in the list of Machinery (Refer page No. 85) will be earmarked solely for chromite excavation.

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Depending on the chromite requirement, shovel will be deployed for ore excavation. However, no such allocation will be carried out at the quarry bottom during rainy season when keeping quarry bottom dry for machine running will be difficult. However, some chromite mining over the width of ore body (very small front compared to ore front available at the bottom in first five years) can be carried out in rainy season, on higher benches with Shovel to push the ore face in the strike direction in Eastern and Western wall.

Front End Loader with 2/3, 10 MT TELCO Tippers generally be used only on the surface for handling excavated ore on the surface for ensuring quality control of despatchable chromite ore. Loading of high way trucks for despatching chromite to railway siding and to the charge chrome plant at Randia, Bhadrak will be carried out through front end loaders.

Front end loader will also be utilized for handling of low grade ore, sub-grade ore and mineral reject. The bucket capacity of the front end loader will be 1.6 M^3.

Other than utilization of Shovel, in the 70/80 shift in the year in ore as stated above, in the balance period of the year on a two shift basis one shovel will be deployed for overburden excavation, alongwith 8 nos. of TELCO 10 MT tippers, in the quarry. 50% of the benches in overburden will require drilling blasting and therefore an Atlas Copco Wagon Drill (with down the hammer drilling arrangement) requiring about 300 cft will be deployed for drilling 100 mm drill hole in the quarry overburden benches for drilling.

A Dozer will be deployed alongwith Shovel/Dumper combination for 2/3 hours every shift for bench floor shaping and also for maintaining the proper heap of broken overburden after blasting. The same Dozer will also be utilized

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for compaction of overburden in the waste dump and for shaping the haul road in quarry and waste overbufden dump.

Two nos. 10 MT TELCO tippers will be deployed all most on a daily basis for manual loading of broken chromite inside the quarry and also for manual losding of heaped chromite at ore stack yard as all the chromite can not be loaded mechanically in trucks/tippers and some broken/heaped chromite will invariably be left on the floor which will be lost once for all unless arrangement is made for manual loading into truck/tipper. Water sprinklers will be utilized on the haul roads and over the broken heaps of ore/waste inside the quarry as well as on the surface, waste dump areas, despatch yard area and ore stockpile areas.

4(g)(ii) LAYOUT OF MINE WORKINGS - LAYOUT OF FACES AND SITES FOR DISPOSAL OF OVERBURDEN/WASTE -

Layout of mine workings shown in DRAWING NO.8(a) to 8(e) and sites for disposal of overburden/waste are shown in DRAWING NO. 9 & 10, of volume - 2.

4(h) UNDERGROUND MINES -

This aspect has been discussed in the CONCEPTUAL MINING PLAN paragraph under point no.4(f)(i) of page No. 69 of this report.

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4(i) EXTENT OF MECHANISATION -

Besides the machinery specified above i.e. two no. of Hydraulic Shovels with 0.9 M^3 bucket with maximum boom height of 8 M and with an indicated Horse Power of 120 (with one as Back Hoe and another as Dipper Shovel) one 1.2 M^3 Pay loader and 4.5 M^3 bucket capacity dumper (16 Nos.) and Two Dozers of 80 H.P. each alongwith Wagon-drill, Jack Hammer drill, Compressor, Water Sprinkler, Explosive Van, Ambulance Van, de-watering pumps, Light vehicle (Jeeps) will be required for operating the mines. In addition an work-shop with small Lathe machine, Planner machine, Radial Drill Machine, Pipe Bending machine, Electric Welding machine, Gas welding equipment alongwith sufficient tools and tackles will be needed. Calculation of requirement of Excavator, Loader and Dumper based on yearly excavation handling quantity are enclosed as ANNEXURE - M-3 (Page No. 83& 84) and list of number and specification of mining machinery are enclosed as ANNEXURE - M-4 (Page No. 85).

For Power supply to colony, work-shop, office establishment, Stores, Dispensary, VT Centre, Creche, Canteen and for mine pumping work, an agreement will be made for supply of power from Orissa State Electricity Board through the supply agencies for which electrical machinery and equipments like Transformers, oil circuit breaker and air circuit breaker (with protective devices), Busbars, other switch gears, starters, cable, joint box, conductors etc will be required.

Miscellaneous -

Miscellaneous operation in the mining lease area will be pumping of seepage water from the quarries, Diamond drilling operation, development of nursery, plantation in the dump yard, road construction and maintenance, garland drain construction and maintenance and work-shop & garage for machinery maintenance.

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ANNEXURES

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(FACOR)

YEARLY BENCH SLICE WISE EXPECTED QUANTUM OF PRODUCTION PROGRAMME
FOR FIRST FIVE YEAR.

YEAR	Location	Bench Slice			Strike	Width *	Tonnage	Quantity	Recovery	Main Grade	Grade	Low grade	Grade
		From RL	To RL	Depth M	M	M	Factor	(MT)	Factor	Ore(MT)	Cr_2O_3% (Avg.)	mineral (MT)	Cr_2O_3% (Avg.)
FIRST	BOTTOM	93	90	3	124	24	3.3	29462					
	EAST	99	90	9	14	24	3.3	9979					
	EAST	99	93	6	10	24	3.3	4752					
								44193	80%	35,500	49	8,800	25
SECOND	Bottom	90	87	3	161	24	3.3	38254					
	East	93	90	3	16	24	3.3	3801					
	East	99	93	6	17	24	3.3	8078					
								50133	80%	40,000	49	10,000	25
THIRD	Bottom	87	84	3	150	24	3.3	35610					
	East	90	84	6	20	24	3.3	9504					
	East	93	87	6	11	24	3.3	5227					
								50341	80%	40,000	49	10,000	25
FOURTH	Bottom	84	81	3	164	24	3.3	38966					
	East	87	81	6	4	24	3.3	1900					
	East	93	87	6	10	24	3.3	4752					
	East	99	93	6	10	24	3.3	4752					
								50370	80%	40,000	49	10,000	25
FIFTH	Bottom	81	78	3	160	24	3.3	38016					
	East	87	81	6	10	24	3.3	4752					
	East	93	87	6	8	24	3.3	3801					
	East	99	93	6	8	24	3.3	3801					
								50370	80%	40,000	49	10,000	25

* Note:- Ore width considered for calculation of year-wise production is weighted average with the influence strike length of 3 Nos. of ore intersected bore holes namely BTB-42, BTB-55 as shown in drawing No.4 and 6(A)

ANNEXURE - M-1

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YEARLY QUANTUM, SEQUENCE AND DIRECTION OF DEVELOPMENT PROGRAMME FOR FIRST FIVE YEAR

ANNEXURE -M-2

Year	Sequence	Bench R.L	Direction wise quantum of development				Remarks
			North Sector (line 'A' to B)	East Sector (Line 'B' to 'C')	South Sector (line 'C' to 'A')	T o t a l	
FIRST	1	105	12,930	7,800	-	20,730	Derived from Drawing No.8(a)
	2	99	20,060	6,840	-	26,900	
	3	93	6,300	9,580	-	15,960	
	4	90	44,215	9,570	32,655	86,440	
			TOTAL			1,50,030	Say 1.50 lac m3
SECOND	1	105	-	37,640	-	37,640	Derived from Drawing No.8(b)
	2	99	-	24,400	-	24,400	
	3	93	16,550	20,040	6,130	42,720	
	4	87	31,020	-	33,810	64,830	
			TOTAL			1,69,590	Say 1.70 lac m3
THIRD	1	105	6,330	-	-	6,330	Derived from Drawing No.8(C)
	2	99	9,080	6,070	5,310	20,460	
	3	93	2,700	8,010	27,620	38,330	
	4	87	29,420	6,450	17,740	53,610	
	5	84	27,415	-	23,625	51,040	
			TOTAL			1,69,770	Say 1.70 lac m3
FOURTH	1	105	-	15,620	-	15,620	Derived from Drawing No.8(d)
	2	99	1,300	8,350	-	9,650	
	3	93	2,050	7,860	-	9,910	
	4	87	31,610	13,340	-	44,950	
	5	81	30,070	3,650	29,900	89,630	
			TOTAL			1,69,760	Say 1.70 lac m3
FIFTH	1	99	-	4,970	-	4,970	Derived from Drawing No.8(C)
	2	93	-	7,660	13,180	20,840	
	3	87	6,110	8,030	20,120	34,250	
	4	81	18,620	6,350	25,650	52,620	
	5	78	29,090	-	27,690	56,780	
			TOTAL			1,69,460	Say 1.70 lac m3

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ANNEXURE - M-3

1) REQUIREMENT OF EXCAVATOR -

Excavation Quantity per Annum = 1,70,000 M^3 (Overburden)
15,150 M^3 (Ore)
1,85,150 M^3 by Hydraulic Excavator.

Bucket Capacity = 0.9 M^3. Rate of Excavation per loading hour.

$$= \phi = \frac{C \times F \times T \times Bf \times Mef}{TC \times Cf}$$

ϕ = Per Hour handling of Excavation in M^3.
C = Bucket Capacity in CuM .. .. 0.9 M^3
F = Bucket fill factor 0.8
T = Time in Seconds/Hour .. .. 3600 Sec.
Bf = Bench Height Factor 0.90
TC = Time Cycle per pass at 90° Swing .. .. .. 30 Sec.
Cf = Loose insitu conversion factor 1.4
Mef = Management efficiency Factor 0.90

$$\phi = \frac{0.9 \times 0.8 \times 3600 \times 0.90 \times 0.90}{30 \times 1.4} = 49.98 \text{ SAY } 50 \ M^3$$

OUTPUT - Out of 300 working days per Annum -

Working days considered for dry season		200 days
Working days considered for rainy season 50% remaining (As efficiency will be 50% of dry season)	100 days	50 days
	Total ..	250 days

The work will be done in 2 shift operation basis consisting 5 hours of effective working per shift.

So, output per annum (250 Working days) = 50 M^3 x 250 days x 2 shift x 5Hr
= 1,25,000 M^3

Therefore, no. of Excavators required -

$$= \frac{\text{Total handling per annum including ore}}{\text{Handling by Excavator/Annum}}$$

$$= \frac{1,70,000 M^3/B + 15,150 M^3 \text{ Ore}}{1,25,000 M^3} = 1.48.$$

Providing 30% Standby capacity the EXCAVATOR Requirement comes to

1.92 SAY 2 Nos.

2) REQUIREMENT OF WHEEL LOADER -

Loader will be utilised for handling the Machinery excavated ore mainly by Dumper combination. The quantity of ore extraction would be around 15,000 M^3 and other miscellaneous rehandling, say total quantity would be around 40,000 M^3/Annum.

Bucket capacity of Loader = 1.20 M^3

$$\phi = \frac{C \times F \times T \times Mef}{TC \times ef} = \frac{1.25 \times 0.8 \times 3600 \times 0.9}{70 \times 1.4} = 33 \ M^3$$

Annual output = 33 x 250 x 2 x 5 = 82,500 M^3

No. of Loader required = $\frac{40,000}{82,500}$ = 0.48

Providing 30% Standby capacity of Loader requirement comes to

0.48 x 1.30 = .63 SAY 1 No.

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3) REQUIREMENT OF DUMPER :-

Estimation of Cycle time :-

a) Loading Time :-

b) Material Hauling time and return time.

$$\text{Loading time} = \frac{\text{Rated Capacity of Dump Truck } (M^3)}{\text{Bucket capacity } M^3 \times \text{Bucket fill factor}}$$

$$= \frac{4.5}{0.9 \times 0.8} = 6.25 = 7 \text{ Passes.}$$

Time required for loading one Dumper = 7 x 30 Sec. = 210 Seconds or 3.5 Minutes.

Cycle time for a Dumper (cmt) in minute = $n\,cms + \frac{D}{V1} + t1 + \frac{D}{V2} + t2$

Loading Time + Hauling Time + Dumping Time + Return Time + Spot and Delay time.

Where :

n = No. of Passes required for excavator to fill dump trucks.

cms = Cycle time of loader (min) = 0.5 Min.

D = Hauling distance of dump truck = 1 Km.

V1 = Average speed of loaded truck = 20 Km/Hr.

V2 = Average speed of empty truck = 25 Km/Hr.

t1 = Time required for dumping is started = 1 min.

t2 = Time required for truck to be positioned for loader to start loading = 1 min.

No. of Dumpers required for each Excavator :-

$$M = \frac{cmt}{n\ cms} \text{ or } 7 \times 0.5 \times \frac{1}{20} \text{ min.} + 1 \text{ Min} + \frac{1.0}{25} \text{ min} + 1 \text{ m}$$

Therefore $M = \frac{12.50}{3.50} = 3.57$

Considering 30% Extra = 3.57 x 1.3 = 4.64 = 5 Nos.

For 2 Nos. Excavator 5 x 2 = 10 Nos. Dumpers.

Dumper requirement for loader :- $M = \frac{cmt}{n\ cms}$ cms = 1 min.

$$n = \frac{4.5}{1.2 \times 0.8} = 4.7$$

cmt = (4.7 x 1) M + 3 + 1 + 2.5 + 1 = 12.10

$$M = \frac{cmt}{n\ cms} = \frac{12.10}{4.7 \times 1} = 2.57$$

Considering 30% Extra = 2.57 x 1.3 = 3.34 or 4 Nos.

TOTAL DUMPER REQUIREMENT = 10 + 4 + 2 STANDBY = 16 Nos.

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ANNEXURE -M-4

LIST OF MINING MACHINERY WITH NUMBER AND SPECIFICATION

Sl. No.	Name of Machinery	HP of Unit	No. of Units	Specification
1)	HYDRAULIC SHOVEL	143	2	0.9 M^3 Bucket Capacity.
2)	PAY LOADER	110	1	1.2 M^3 Bucket Capacity.
3)	DOZER	200	2	
4)	COMPRESSOR	180	2	435 Cfm
5)	DUMPER	100	16	10 MT Capacity
6)	WATER SPRINKLER	100	1	8 K.L. Capacity
7)	WAGON DRILL	-	2	110 mm Dia
8)	JACK HAMMER	-	3	32 mm Dia
9)	DEWATERING PUMP	75	1	30 Ltr/Sec.
		38	2	20 Ltr/Sec.
		16	1	10 Ltr/Sec.
10)	EXPLOSIVE VAN	100	1	0.8 Ton Capacity.
11)	DIAMOND DRILL		1	

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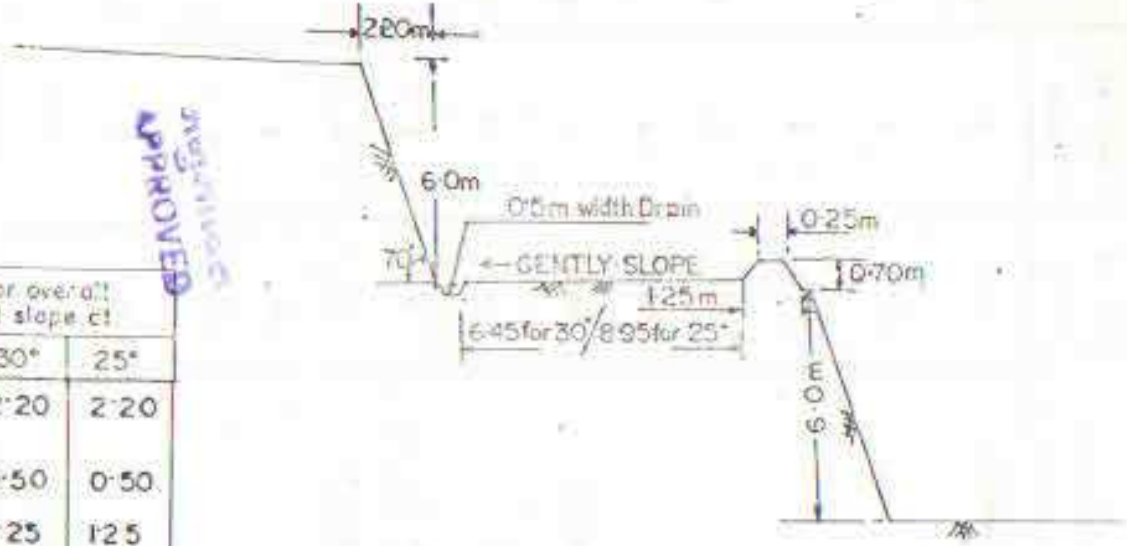
OVERBURDEN BENCH DESIGN (MACHINERY)



Width particulars	For overall pit slope of	
	30°	25°
Width occupied for 70° individual bench slope	2·20	2·20
For drain	0·50	0·50
For barrier	1·25	1·25
Balance width for carriage way	6·45	8·95
Total width	10·40	12·90

Height (for 30° & 25° benches) = 6·0mtrs

Width i) for 30° benches = $\frac{6}{\tan 30^\circ}$ = 10·4mts

ii) for 25° benches = $\frac{6}{\tan 25^\circ}$ = 12·9mts

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ANNEXURE - M - 5

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BLASTING

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Regd. No. ROP/CAL/239/98/A

5. BLASTING -

5(a) BLASTING PARAMETERS -

Drilling blasting will be required at 50% of the working from surface upto 75 MRL and thereafter 100% drilling blasting will be required till reaching the pit bottom, judging by the quality of ground as seen in the neighbouring Kalarangi Mines.

While excavating the overburden, many a time bench width will be kept at 10.40 M considering inclusion of drain, barrier, bench slope and an width of 6.45 M for to and fro movement of Dumpers (see Design details shown in ANNEXURE - M-5) (Page No. 86). However, barrier and drain may not be required at every bench nor the slope is required to be given on the lower elevation benches when 8 M width can be maintained.

Drilling shall be carried out with two row of holes drilled in a staggered manner. Generally, one row of holes will be blasted with 3 M burden and 3 M spacing to make an advance across the bench width to the extent of 3 M to 4 M over 30 M bench strike when 10 deep holes will be blasted sequentially from the end with two free faces with a short delay element between the deep holes which will be drilled with 10% sub-grade drilling beyond the bench height to avoid formation of toe. However, situation might arise where the width to be excavated at a time may be 6 M when two rows of holes will be drilled with 3 M spacing and 2.5 M burden. 2/3 of the holes will be filled with explosive which may be slurry explosive or opencast gelatin or Prillem Ammonium Nitrate with 6% fuel oil. In case Ammonium Nitrate is used one/two booster charge of small diameter catridges shall be used with electric detonator. Against 20 holes the breakage will be 30 M x 8 M x 6.5 M (in case of two rows) when sufficient width is available, which will yield about 1600 M^3 while explosive consumption is about 240 kgs which mean 6 to 7 M^3 per kg of explosive.

M.K. Pujari,

As already stated above where sufficient width is not available, blasting will be carried with one row of holes but the burden and spacing will be as given for single row. As a matter of fact, with double row of holes, opportunity does exist to increase the burden and spacing marginally and in the process to get higher powder factor. But opportunity for developing such wide benches will normally not arise for that will mean development much in advance than required for yearly production (and consequently extra investment), though some amount of advance development will be carried in the initial year when the quarry is at a shallow depth since Ore : Overburden ratio will be less than the average figure for the said ratio over the opencast mine life i.e. over the period of 10 years from the date of commencement of excavation.

5(b) TYPE OF EXPLOSIVES -

O.C.G. 83 mm dia	..	I.C.I.
Toe blast & Energel 75 mm dia	..	I.D.L.

In future, ANFO will be used in column charge alongwith one of the primer charges. ANFO will be prepared at the approved site as per process. It will be prepared by thoroughly mixing prilled ammonium nitrate with 6 - 8% by weight of 'B' class diesel oil. Necessary safety measures will be followed and tools, tackels and accessories will be provided for the purpose of preparing, transporting and charging of holes for blasting prupose.

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5(c) POWDER FACTOR -

TABLE - 14

Sl. No.	Particulars	Powder factor M^3/Kg.
1.	Ore	4 to 5
2.	Overburden/Waste	6 to 7
3.	Development	3
4.	Heading	3
5.	Stope	3

5(d) NEED FOR SECONDARY BLASTING -

Secondary blasting will have to be resorted to often in the top laterite benches which will give rise to boulders which will be difficult to handle in 0.9 M^3 bucket and therefore the boulders is to be blasted with plaster gelatine to prevent formation of fly rock.

5(e) STORAGE OF EXPLOSIVES -

As already stated earlier, powder factor is 6 to 7 M^3/kg and about 50% of the excavation will require blasting i.e. 85000 M^3/A will have to be blasted i.e. 14,000 kg of explosive per annum i.e. about 1.5 MT of explosive will be consumed per month. No Magazine will be constructed in the mine lease area. Instead explosive will be transported from Kathpal Chromite Mines (FACOR) Magazine which is at a distance of 5 Km from the proposed lease and where a 10 MT capacity magazine is located with the licence to supply explosive to FACOR's other mines at Sukinda Region.

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MINE DRAINAGE

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6. MINE DRAINAGE -

6(a) DEPTH OF WATER TABLE -

In Winter season, the depth of water table within the proposed lease area as seen one pond, two open well and the opencast excavation (made by TISCO in the proposed lease area), the water level is 6 M below the ground level. In fact, during summer season i.e. pre-monsoon season, the water level will go down by further 3 M i.e. it will be at 9 M below ground level. Since surfacial ground over the proposed lease hold area is laterite of 6 M thickness underlained with weathered ultramafic mass and the area is porous enough with lot of fissures and channel, this ground mass to a depth of 40 M from surface is a repository of water, where in rain precipitate easily percolates down, with about 20% of rain fall infiltrating into the ground. Since the ground surface below the water level in the quarry, pond and well are not impervious, even the rain fall precipitate over the quarry, pond and well slowly percolates down till reaching level of the phreatic surface in the locality. Even 60 M below the surface, the aquifer zone continues as such but remains in an unsaturated state. However, at a depth of 65 M below ground surface, it is believed that the quantity of water in the ground will be too less (unsaturated status) and as such can not be termed as an aquifer (C E N T R A L G R O U N D W A T E R B O A R D R E P O R T by Sri KAR).

6(b) WORKING LEVEL VS. WATER TABLE LEVEL -

The abandoned quarry workings made in the proposed lease area by TISCO has already gone below the Water Table of the locality. Further, working will be continued on the down dip extension of the ore body by opencast method till reaching the opencast limits restrained by Southern lease boundary, at 40 MRL which is 70 M depth below the ground level. However, the mine working in opencast mines do not come vertically below the water table, since the water table profile, maintains a slope parallel to quarry slope due to draw down effet with the pumping of quarry water.

M. K. Puj

6(c) QUANTITY AND QUALITY OF WATER TO BE ENCOUNTERED -

The quantity of water required to be pumped out will be -

i) part of rain fall infiltrate over the lease area and beyond area into the ground some of which will seep back into the quarry,

ii) rain precipitate over the quarry surface area,

iii) part of surface run off which might over flow the garland drains and flows into the quarry via the quarry benches.

The anticipated rain fall will be 1300 mm. Ultimately, the quarry excavation area will be about 9 hectares i.e. 0.90 Lakh M^2 and hence rain precipitate falling into the quarry will be 1.17 Lakh M^3.

Assuming that 10% of water infiltrate of 50 hectares of land around the 10 hectares of opencast void will seep into the quarry of the proposed lease area and assuming rain fall of 1300 mm which is the usual rain fall in the area and considering 20% of rain fall as ground infiltration (infiltrate percentage is 18 - CENTRAL GROUND WATER BOARD REPORT), the volume of water seeping into the quarry will be another 0.13 Lakh M^3. And about 0.9 Lakh M^3 from surface run off (20% of Periphery over lease area) will flow into the quarry due to choking and overflowing of garland drain and bund, making the total pumping water to be pumped from the opencast mines as 2.4 Lakh M^3 of water. 80% of this quantity will be encountered in the rainy season i.e. June to October and balance 20% of the water will be required to be pumped in non-rainy season.

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That is about 1300 M^3 of water on an average will be pumped out in rainy season per day when quarry bottom will reach 40 MRL i.e. 110 MRL to 40 MRL = 70 M depth. Assuming Peak pumping to be 1.5 times, per day pumping willbe 1800 M^3. Water pumping per hour assuming 15 hours pumping will be 120 M^3 and per minute pumping will be about 2 M^3. It will be desirable to have two multistage turbine pumps of 60 litres per second capacity against a static head of 65 M and total head of 85 M which will mean 90 H.P. Motor with an average efficiency of 75%. The inlet diameter of the pump will be 7 inches and the outlet diameter will be 6 inches. Normally in rainy season one pump will be run. As an additional precaution two 30 H.P. pumps can be kept as a standby.

In non-rainy season water seepage into the quarry will be less due to reduction in hydraulic gradient and the pumping hours willbe much less i.e. about 20% of rainy season hours of pumping i.e. 3 hours/day will be sufficient. But then what is stated above is for the limiting position of opencast life which would be case for last 3 years of opencast life. In shallower depth i.e. in first 4½ years, 2 nos. of 30 H.P. will be sufficient after which one no. of 90 H.P. together with one no. of 30 H.P. will be added. As already stated above for last 4½ years of opencast life (which will be only 10 years @ 50,000 MT production), one 90 H.P. pump will be running with two 30 H.P. pumps remaining as a standby.

As already stated earlier a sump of 2700 M^3 will be maintained at one end of the quarry preferably on the North - west corner of the quarry where floor excavation to the required extent will be carried out beyond the limit of orebody and where the quarry slope walls can be expanded without space constraint as is the case on the Southern side.

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STACKING OF MINERAL REJECT AND DISPOSAL OF WASTE

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7.0. STACKING OF MINERAL REJECTS AND DISPOSAL OF WASTE :-

7(a)(i) REJECTS OF FIVE YEAR ALONGWITH TOP SOIL AND SUB-SOIL -

TABLE NO.15

Year	Top-soil & sub-soil	Over-burden/ Waste	Low grade chromite rejects	Rejection of Nickeliferrous Limonite
	M3	M3	MT	M3
FIRST	2,800	1,50,000	8,800	7,500
SECOND	2,800	1,70,000	10,000	8,500
THIRD	2,800	1,70,000	10,000	8,500
FOURTH	2,800	1,70,000	10,000	8,500
FIFTH	2,800	1,70,000	10,000	8,500
TOTAL :: ::	14,000	8,30,000	48,000	41,500

Year-wise dumping programme for 1st 5 years is shown in Drg.DR-13.

7(a)(ii) NICKELIFERROUS LIMONITE AND ITS STACKING -

Nickeliferrous limonite within the ultra basic adjacent to chromite band is quite common in the Sukinda Region. In Ostapal chromite mines (FACOR) approximately 5% of total quarry excavation area constitutes nickeliferrous limonite. Going by the same analogy (since Ostapal Chromite Mines is not very far from Bhimtangar mines) total excavation in the quarry for first 5 years period is going to be 9.04 Lac M^3 out of which 8.30 Lac M^3 will be overburden and 0.76 Lac M^3 will be chromite. Therefore, 5% of the said overburden is about 0.41 Lac M^3 which will be nickeliferrous limonite is to be stockpiled. However, threshold value of nickeliferrous limonite is 0.50% and values with less than 0.50% will be thrown in overburden. Regular analysis shall be carried out.

If, we examine the neighbourhood Kalarangi working of OMC, which is western most exposed segments of Band I, the said percentage is approximately 5. Hence, the estimation of nickeliferrous limonite quantity for first five years period for Bhimtangar will be more or less correct. The area earmarked for nickeliferrous limonite is 0.612 hectares and occurs in an irregular rectangular shape where the overall slopes has been assumed to be

33° and as per calculation (given below) the storage capacity of the area is 0.70 Lac M^3. During the Cocenptual Plan period, calculation made on the same basis as five year plan period indicates the maximum stock piling is likely to be 0.70 Lac M^3 of Nickeliferrous limonite over 10 years period of opencast life and hence the said area is sufficient for the quarry life at Bhimtangar area.

DUMP CAPACITY OF NICKELIFERROUS LIMONITE

TABLE NO.16

Sl. No.	Particulars	Length M	Width (Avg)	Area
1)	Bottom	100	61.20	6120 M^2 or 0.612 Hects
2)	T o p	60	21.00	1260 M^2

Height of the Dump = 19 M.

Volume of the Nickel dump =

= ½ x (6120 M^2 + 1260 M^2) x 19 M

= 70,110 M^3

SAY = 0.70 Lac M^3

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33° and as per calculation (given below) the storage capacity of the area is 0.70 Lac M^3. During the Cocenptual Plan period, calculation made on the same basis as five year plan period indicates the maximum stock piling is likely to be 0.70 Lac M^3 of Nickeliferrous limonite over 10 years period of opencast life and hence the said area is sufficient for the quarry life at Bhimtangar area.

DUMP CAPACITY OF NICKELIFERROUS LIMONITE

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7 (b) LAND CHOOSEN FOR DISPOSAL OF WASTE WITH PROPOSED JUSTIFICATION :-

- The land choosen for waste overburden dumping is free of mineral bearing area. This is evident from the fact that no quarry excavation has been made any where near the proposed site by the previous lessee of the area namely TISCO, who have carried out an opencast working on the projected strike continuation of upper brown seam which is being mined out currently in TISCO adjacent to FACOR's proposed lease area. The Regional Map of Sukinda Region does not indicate existence of any ore body on the north of upper brown seam where overburden is proposed to be dumped. No trees or bushes exist in the area where waste overburden is proposed to be dumped. No water body exist within a distance of 100 metres from waste dump area. The residential area of village Kalarangiatta and Bhimtangar will be atleast a distance of 300 metres away from the proposed waste dumping yard. Nearest public roadway is 50 metres away from the proposed site. The predominent wind direction of the locality is in South Western side of the waste dump yard where no village is exist.

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7(c) STACKING OF MINERAL REJECTS AND DISPOSAL OF WASTE -

The overburden excavation over 10 years it will be a 14.75 Lac M^3. Out of this 14.75 Lac M^3, top soil and sub-soil generation will be -

- Expension of quarry area over 10 years working

- Yearly average generation of top & sub-soil =

= 28,215 ÷ 10 = 2821.5

SAY = 2,800 M^3

Therefore, top soil and sub-soil generation will be 2,800 M^3 per annum and over 10 years it will be 28,000 M^3 for which a separate dumping yard shall be earmarked by the side of waste dump. For storage of 15,000 M^3 of soil (though the soil storage will not reach at any time the upper limit). 0.58 hectares area (5,800 M^2) is sufficient and its position has been earmarked where the bench height will be 3 M.

For storage of 13.77 Lac M^3 (total overburden 14.75 Lac M^3 - 0.70 Lac M^3 (Nickel) - 0.28 Lac M^3 (Top & sub-soil) of waste, an area of 6.580 hectares with 2 benches of 15 M height with the overall slope of 33° will be more than sufficient where in first stage of overburden will be 15 M height which be laid down by making a ramp at 1 in 14 (210 M length) to establish a roadway of 12 M width upto 15 M height, all around the periphery (i.e. 1100 M) of the area earmarked for over-burden dumping to establish the dead slope of the first bench, after dumping of 2.00 Lac M^3 subsequent to which vacant space within the peripherial embankment will be filled up to the extent of 6.75 Lac M^3. This dead slope can then be terraced to 1 M x 1 M bench for (plantation purpose) which the top soil and

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sub-soil will be required to be withdrawn from the soil yard for about 5,000 number of plants (at the rate of one plant per 4 sq.m.) against the base area of 20,000 sq.M. and in the process top soil and sub-soil generation per annum will be utilised next year itself. It may be worthwhile to wait for a period of 4 years to enable the waste dump to get consolidated during which period the top soil and sub-soil generated from the excavation will be stored in the soil yard dump. However, there may be places within the proposed excavated area where soil depth islikely to be more than 0.95 M and hence it will be safe to earmark an area of 0.58 hectares area though upper limit of the storing capacity of the top soil and sub soil may never be reached during the life time of opencast mines.

Over the bench surface of the waste dump yard, longitudinal and transverse drain shall be cut at a gradient of 1 in 200 to enable the water to flow which be withdrawn to the drain of next lower bench through plastic pipe which will be convenient to fix up on the ground. This will not only prevent erosion of waste dump material but also ensure stability of the waste dump by preventing development of hydrostatic pressure inside the waste dump and proper channelisation of rain water for plantation purpose .

With 5000 trees/bench and with maximum of 2 benches, the sapling and plantation on the slope area will be 10,000 and on the dump terrace area it will be 5,000 . Those saplings which will rot or wilt or damage will be replaced with fresh one and hence ultimately the waste dump will be covered with 1500 trees out of which about 75% will be of indigenous variety with an wide diversity covering pollution abating plants, medicinal plants, nitrogen fixing plants, economical plants and ornamental plants. The remaining 25% will be quick growing exotic variety plants to cover the landscape developed by the waste dump and to ensure dump stabilization with root mass in

earliest possible time to prevent erosion. Besides giving a canopy cover of dense leafymass over the waste dump, a carpet cover of grass will be grown over the waste dump yard for development of neutritive values in the ground mass to ensure fast growth of plant and to give a aesthetic beauty to the waste dump yard, which will also be growth center for all variety of fauna like micro fauna, soil fauna, avi fauna and mamalic fauna.

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USE OF MINERAL

APPROVED

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8. USE OF MINERAL -

8(a) END USE OF THE MINERAL -

End use of the mineral is for captive consumption at FACOR's Charge Chrome Plant, Nandia, Bhadrak, Orissa and at Ferro Chrome Plant, Garividi, Vizianagaram District, Andhra Pradesh. Bulk production from both the Plants is meant for Export, while simultaneously carrying out domestic sale.

8(b) MINERAL SPECIFICATIONS STIPULATED BY BUYER -

Since the production from the proposed lease hold area is fines with some exceptions the question of physical specification does not arise. However, feed beyond 75 mm size is not acceptable to the captive plants i.e. Charge Chrome Plant at Nandia and Ferro Chrome Plant at Garividi. Though the Chrome ore from the proposed lease hold area is predominantly fines, yet certain amount friable lump will be generated which size should not exceed 75 mm. However, friable lump, by the time, it will reach the final smelting site, size reduction will take place, below upper limit size. But then it is at Sukinda Retion that the upper brown seam as it travels towards Western direction and closer to Kathpal area, the ore body as well as the parent rock tends to consolidate, as seen in Kalarangi mines of O M C to certain extent and if similar tendency is seen in the proposed lease area which is immediately adjacent to Kalarangi mines, then certain amount of sizing operation will have to be resorted to, for ensuring that feed size does not exceed 75 mm.

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As far as Chemical specifications are concerned, Chemical specifications of the ore required by both the Plants are as follows :-

TABLE NO. 17

Sl. No.	Name of the Plant and Product	Chemical Specifications of ore				
		Cr_2O_3 %	Iron %	Cr:Fe ratio	SiO_2 max.	MgO
1)	Charge Chrome Plant, Bandia, Bhadrak, Orissa.					
	Charge Chrome	41	18	2	14	14
2)	Ferro Chrome Plant at Garividi, Vizianagaram District, Andhra Pradesh.					
	Low carbon Ferro Chrome	48	15	2.8	5	8
	High carbon Ferro Chrome	44	16	2.4	8	-

8(a) BLENDING OF ORE -

However, as the company is not in a position to procure total requirement 3 Lakh MT from their captive sources of the required quantity and quality they have to necessarily purchase 50% of their requirement from the open market, which is selectively purchased with respect to quality to blend with chromite ore produced from their captive mines which are generally of inferior quality Cr_2O_3 wise and Cr : Fe ratio wise in FACOR mines namely, BOULA, OSTAPAL & KATHPAL to produce the feed for the furnace of the aforestated quality of specification, at right proportion depending on the market demand.

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OTHERS

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9. OTHER -

9(a) SITE SERVICES -

Some discussion has been made on site services at page 8C and other details of the same is as follows :-

- INDUSTRIAL INFRASTRUCTURE -

- Work-shop/Garage.
- Power sub-station.
- Stores including Fuel depot.
- Canteen.
- First-aid room/Dispensary.
- Creche.
- Rest shelter.
- Vocational Training Centre.
- Chemical Laboratory.
- Mines office including Survey office.
- Ammonium Nitrate/Fuel oil mixing shed.
- Diesel Generator set.
- Nursery.
- E.T.P.

- OFF SITE SERVICES -

- School.
- Club.
- Staff/Officer's colony.

i) Work-shop/Garage -

For ensuring regular repair/maintenance of Shovel/Dumper/Dozers/Wagon Drills/Compressors/Jack Hammers/Pumps/Light vehicles it is necessary to have an Work-shop/Garage with a -

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- Machine-shop with small Lathe, Planing machine, Radial Drill, Grinding Machine.
- An Welding shop with Arc welding and Gas welding arrangement.
- A Blocksmith shop.
- A Tyre Vulcanising shop.
- Pump, Drill and Compressors repairing shop.

ii) Power Sub-station -

Pumps will be the major electrical load when opencast mining is going for which 200 KVA load is necessary. Besides quarry illumination, lighting in industrial infrastructure like Office/Stores/Canteen/Creche/Dispensary/Waste Dump yard. Power requirement is Work-shop/Garage will be around 100 KVA. Hence, a contact demand is to be made for 300 KVA.

Sub-station will be [illegible] Power line at 33 KV and therefore the Electrical Sub-station will have main oil circuit breaker with protective devices with a 33 KV/440 volts step down transformer followed by Busbar with separate oil circuit breaker/air circuit breaker for the three circuits going out of busbar by overhead conductors at 440 volts. Two of these are for mines pumping load and work-shop/garage load. Third one will be two phase overhead lines through a lightening transformer for use of two phase current in the industrial infrastructure site and to the waste dump yard.

A 300 KVA Diesel Generator set to give an effective output of 270 KW shall be set up in the lease premises to generate power at 440 Volts as a replacement to CESCO power in the event of shut-down/break-down/low voltage/single phasing/ load shedding of Government power.

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iii) Store -

The inventory in the Store will include spare parts for Heavy Earthmoving machines, various pumps, compressors, Pneumatic equipments like Wagon drill, Jack Hammers, Diesel -Engines, Light vehicles, Hardwares, Fuel & Lubricants, Paint and Grease, Safety wear and other protective equipment, Electrical spares and machine auxillaries like Tyre, Drill rod, Drill bits and Stationary and Printings.

- STATUTORY FACILITIES -

i) Canteen -

A Canteen for providing Tea/Snacks/Lunch/Dinner to 75 personnel shall be provided in the Canteen with a Dining Hall, Kitchen, Stores and Washing yards for running on a no loss, no profit basis.

ii) First-Aid Room -

A First-Aid room with all the facilities as specified in Schedule - II of Mines Rules, besides medicines for normal diseases met across the chromite belt is to be stored in the dispensary which will have a compounder, dresser, a nurse with a Registered Medical Practioner as the overall incharge.

iii) Creche -

Though where is no chance of employment of woman labourers as the chrome ore excavated from the mine will be salable just as such without any treatment still provision of a 'D' type Creche as per Creche Rules is being maintained as some women workers will be engaged in repair/construction of Road, Building, Sampling etc.

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iv) Rest Shelter -

An adequate Rest shelter with good sitting arrangement shall be provided for resting of 75 employees.

v) Vocational Training Centre -

For the Training and Re-training of workers under Vocational Training Rules, a V.T. Centre shall be established with necessary visual and audio aid, models, equipments, instruments, Class-room, store-room and staffed by Vocational Training Instructor, Vocational Training Clerk and part time V.T. Officer.

vi) Chemical Laboratory -

A Chemical Laboratory for the analysis of the ore and water shall be provided, containing balance, muffle furnace, titration equipment, flame burners, chemical and spectrophotometer together with instrument accessories required in Laboratory like Test tubes, beakers, funnel, stirrer, blow lamp, fusion arrangements, stand, wash basins etc., manned by competent scientists and environmentalist.

9(b) EMPLOYMENT POTENTIAL -

9(b)(1) HIGHLY SKILLED -

Against two Shovels and two Dozers for two shift running 8 highly skilled operators are required. Similarly, highly skilled mechanical crew designated as Mechanical Foreman and Assistant Mechanical Foreman are required, besides 4 nos. of Senior Electricians making [illegible] 1 no. of highly skilled category personnel as JO. In addition site service like, Nursery, Laboratory, Dispensary, Survey office will have another 10 highly skilled personnel, making the total number to 30 apart

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from Statutory Blaster/Mate/Foreman whose number will be 15, thus making overall total of highly skilled personnel is 40.

9(b)(ii) SKILLED -

Skilled category against the two shift operation of dumper/wagon drill/pumps/compressor/generator will be 50, Besides maintenance crew on Mechanical/Electrical side will be 25. Site Service personnel in dispensary/nursery/canteen/ laboratory/VT centre etc., in the category of skilled personnel will be about 15. Hence, total number in these category i.e. skilled personnel will be 90.

9(b)(iii) SEMI-SKILLED -

Semi-skilled personnel on the operational/maintenance/ site service area will not be more than 30.

9(b)(iv) UN-SKILLED -

No. of un-skilled personnel will be basically in site service area whose number will not be more than 10.

Hence, total number of workmen (I.D. Act) level personnel will be 40 (highly skilled) 90 (Skilled) + 30 (Semi-skilled) + 10 (un-skilled) = 170 (total). 10 clerical staff will be engaged in office/work-shop/mine in the category of Skilled, taking skilled category number to 100 and increasing the over-all workmen category personnel to 180. Besides, Manager, Asst. Manager, Electrical Engineer, Mechanical Engineer, Surveyor, Welfare officer, Administrative officer, Environmental Officer, Doctor, Stores Officer, Accounts officer etc., willbe another 20, which will also include a whole time Degree holder Mining Engineer as per Rule 42(1)(6)(i). Hence, total direct employment

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potential will be 200. However, number of indirect employment is generated in the form of Truck drivers for despatch of mineral, loading and unloading gang in truck transport of chromite, requirement of personnel in Tea-shop/Tyre vulcanizing shop/hotel/road maintenance work etc., will be about 300. And therefore, overall total potential of employment will be around 500.

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MINERAL PROCESSING

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10.0 MINERAL PROCESSING :-

No mechanical installation shall be established in the proposed lease hold for handling 10,000 MT of low grade R O M of 25% Cr_2O_3 grade and instead, it will be despatched to the neighbouring OSTAPAL CHROMITE MINES of F A C O R where the existing Chrome Ore Beneficiation Plant is running.

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ENVIRONMENTAL MANAGEMENT PLAN

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PART - B

11. ENVIRONMENTAL MANAGEMENT PLAN :-

11(a) BASE LINE DATA -

11(a)(i) EXISTING LAND USE PATTERN -

The Land Use pattern in the proposed lease hold area 23.800 hectares, earlier held by TISCO, as a part of their original lease area of 1206 hectares, is as follows -

EXISTING LAND USE PATTERN

TABLE - 18

Sl. No.	I T E M	Area in Hects.
1)	Quarry area	5.440
2)	Roads	0.384
3)	Agricultural Land	1.008
4)	Drain	0.276
5)	Virgin Area	16.692
	TOTAL : : : : :	23.800

11(a)(ii) WATER REGIME -

- Ground Water.
- Surface Water.
- Hydraulic Gradient.
- Ground porosity and hydraulic conductivity.
- Ground water recharge.
- Rainfall recharge for monsoon and non-monsoon season.
- Ground water out flow in monsoon months.
- Annual mine seepage.
- Total water recharge.
- Water Withdrawal.

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Ground Water -

The lease area forms a part of Sukinda Region. Study of ground water resources of the region has already been carried out by Mr. A.Kar, Scientist of CENTRAL GROUND WATER BOARD for this area in considerable detail.

Rain fall is the principle source of ground water, which percolates down to the water table through the top soil. The weathered lateritised - limonitised mantle as well as the underlying semi weathered and fractured country rocks from the repository of ground water in the area. The nature, extension and yield potentials of the ground water reservoir are controlled by wide lithological variations, structural set up and weathering characteristics of the rock formations. The laterite - limonite - chert and laterite - weathered and fractured ultramafics with intermittent limonite - chert from potential aquifers in the area. The ground water generally occurs underphreatic conditions and occassionally under semi-confined to confined conditions in deeper horizons. During the course of field investigations a total of 51 dug wells, 66 tube wells and 4 piezometers drilled by DMG, Orissa, were inventoried (FIGURE - 1)(Page No. 111) to study the ground water situations in the area by Mr. Kar. The study of the hydro-geological characteristics have been limited upto the depth of 60 M below ground level as deeper bore hole records barring two bore holes drilled by CENTRAL GROUND WATER BOARD, are not available. The Hydro-geological set up in the area is depicted in FIGURE - 2 (Page No. 112). The occurrence of aquifers and their hydraulic characteristics are briefly described as follows :-

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FIGURE - 1

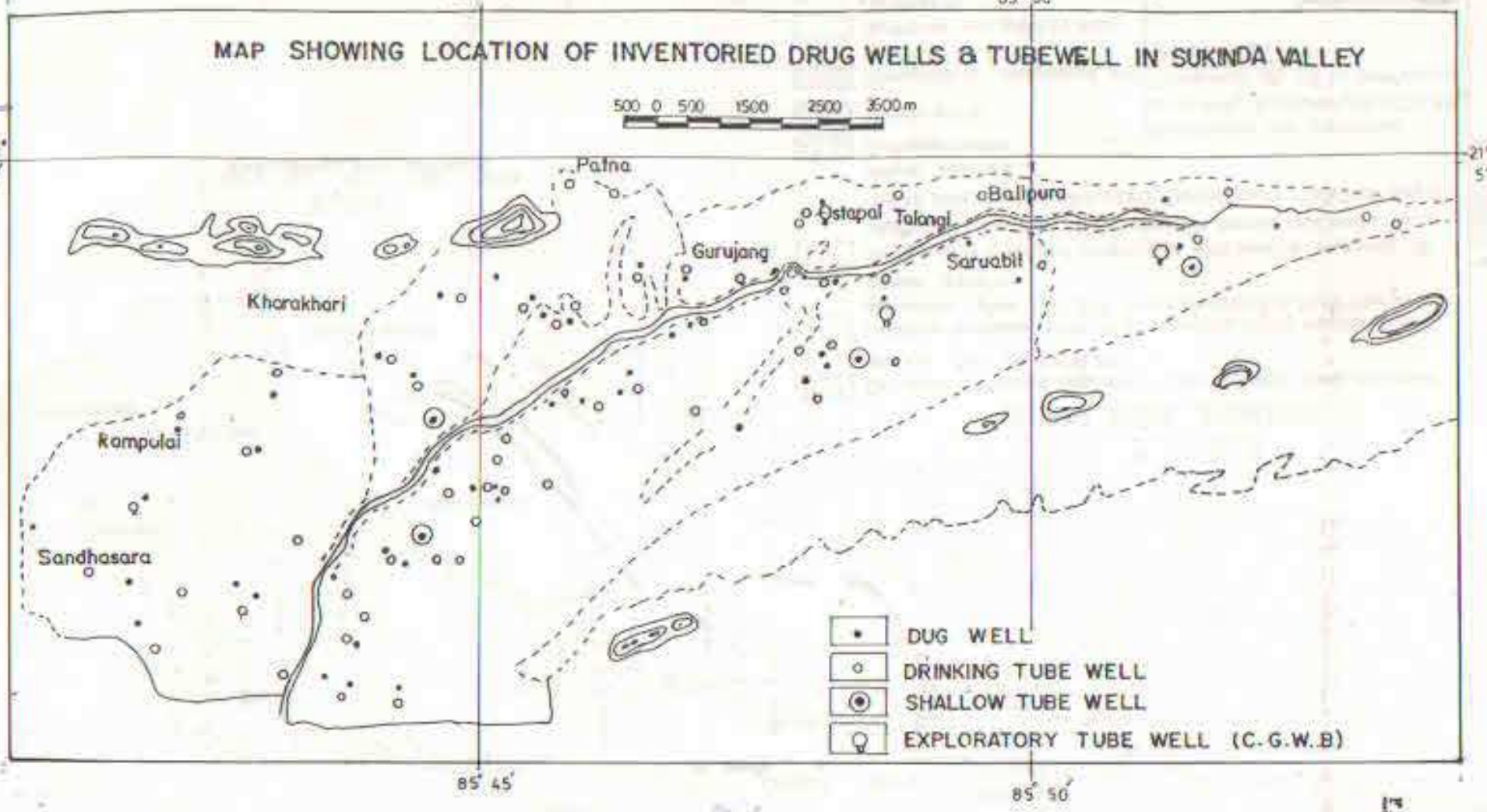

FIGURE - 1

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HYDROLOGICAL MAP OF SUKINDA CHROMITE VALLEY

FIGURE - 2

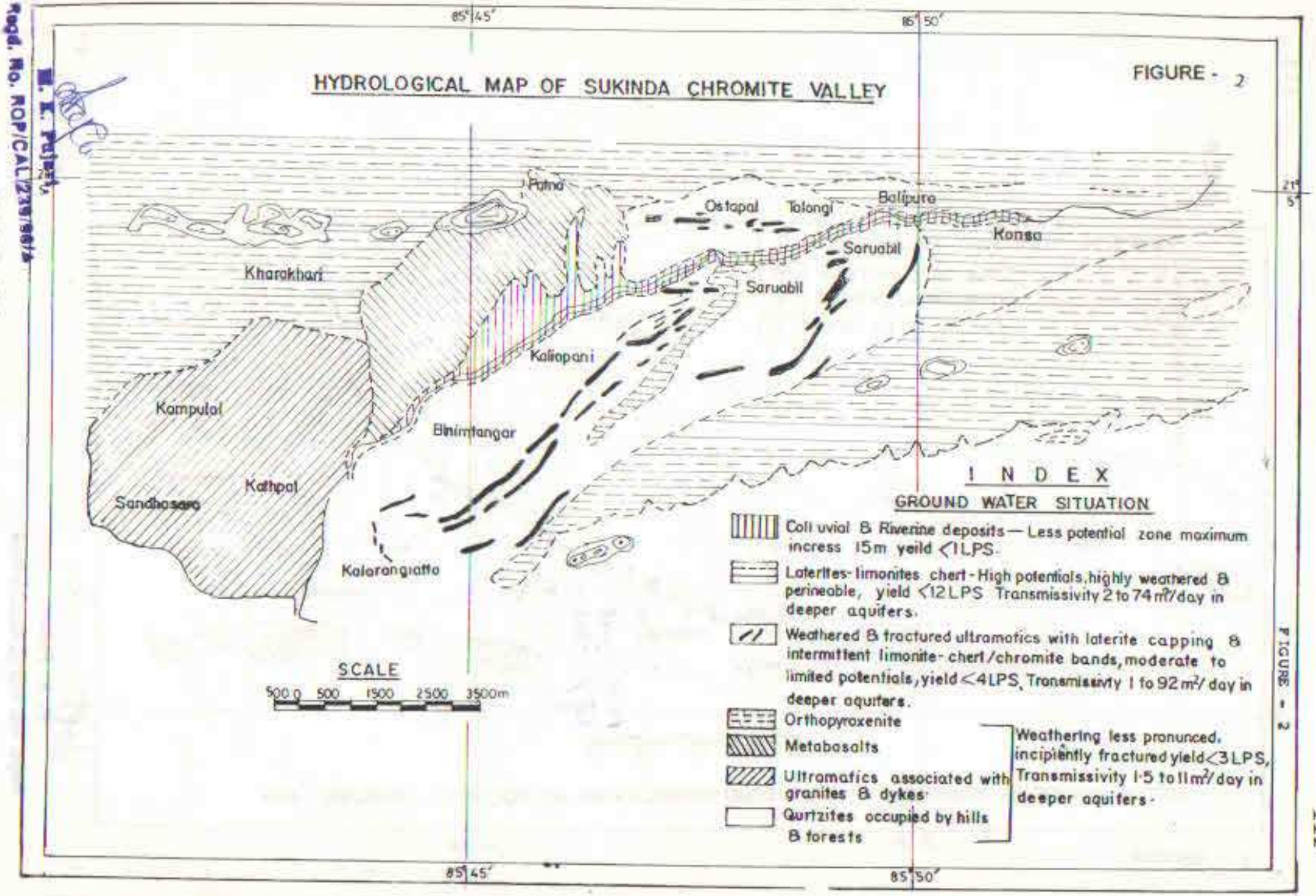

FIGURE - 2

Surface Water -

The study area i.e. the area within radius of 10 KM from the centre of core area has got, number of water bodies in the form of pond and nala (ANNEXURE - E-1, Page No. 168), and also one rivulet known as Damsala nala through which storm water of the valley and mine pumpage water is drained out. The nala which sustains perennial flow and generally follow a westerly course and finally joins with the river Brahmini. The nala and in its tributaries exhibit a dendritic drainage pattern. The annual average flow of Damsala nala is about 2.331 M^3/Sec. Generally surface water is not utilised for the mining activity. Mine water is disposed into the Damsala nala after treatment.

EXISTING MINE DRAINAGE PATTERN OF THE PROPOSED LEASE AREA -

There is no natural drainage in the lease hold area as the terrain is flat. However, 5 nos. nalas have been constructed by earlier lessee for draining out quarry water and colony sewage water (Refer DRAWING NO.DR-3)(Vol-2)

Nala No.1 -

It starts from Western boundary of present TISCO lease area and passes through southern part of proposed FACOR's lease area. The nala is situated 20 to 50M north west of existing quarry. The water flows towards west in the nala and on terminus of nala, part of water spreads over the flat lateritic terrain outside the south western lease boundary and then onto the paddy field, while another part flows into south canal of Damsala nala directly. Average width and depth of nala is 0.90 M and 0.35 M respectively. Very little water is flowing in the nala.

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Nala No.2 -

This nala also starts from TISCO lease area and runs parallely but 1.5 M away from the proposed south eastern lease boundary of FACOR and ultimately joins with Nala No.1 side by the FACOR lease area. This nala was possibly constructed for draining storm water by previous lessee as no mine water is pumped out through this nala. Average width and depth of nala is 1.25 M and 0.95 M respectively. No water is flowing in winter season.

Nala No.3 -

It starts from TISCO lease area and enters into proposed FACOR's lease area at its south eastern boundary where the nala enters into a settling pond then runs towards North. About 140 M inside from the proposed eastern lease boundary of FACOR, water flow is bifurcated with one part flowing towards north which ultimately joins with Damsala nala and another part flows towards west and join again with Damsala via paddy field.

Average width and depth of nala is 0.60 M and 0.40 M respectively.

Nala No.4 & 5 -

APPROVED

Both the nalas have been constructed by TISCO for draining colony sewage water. Both these nalas have entered into proposed FACOR lease area from its eastern lease boundary and flowing towards north over eastern part of lease area. Near northern boundary these join with nala no.3 from where water flows towards north and ultimately joins with Damsala nala.

Dimensions and quantity flowing in these nalas are as follows :-

TABLE NO. 19

NALA No.	Average Width (M)	Average Depth (M)	Quantity of water flowing (M3/Hour) based on actual measurement
4	0.45	0.30	7
5	0.40	0.50	22

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Broadly the following major Hydro-geological units occur in the area -

A) Laterite - Limonite Chert.

B) Laterite - weathered and fractured ultramafics associated Limonite and Chert.

C) Colluvial and channel fill deposits.

D) Other Hydro-geological units including ortho-pyroxenites.

The pre-monsoon and post-monsoon depth of water levels in laterite-limonite-chert belt region (FIGURE - 3 & 4)(Page 116 & 117) range between 3.36 to 11.89 M and 0.62 to 7.01 M below ground level respectively. The seasonal fluctuation of water level varies from 1.67 M to 4.8 M. The yield of this zone is 79 LPM. In the deeper horizons the yield of the Tube wells upto a depth of 66 M ranges upto 12 LPS. The depth of water level during pre and post monsoon in weathered and fractured ultramafics associated with limonite and chert bands region, varies from 2.73 M to 9.61 M and 1.23 to 8.19 M below ground level. The seasonal fluctuation of water level varies from 0.6 M to 4.30 M and the yield of this zone varies from 40.0 LPM to 240.0 LPM. The depth of water level for colluvial and channel fill deposits area varies from 4.42 M to 8.63 M below ground level in post monsoon and 7.4 M to 12.48 M below ground level in the pre monsoon periods with an average fluctuation of 3.80 M. The yield of the aquifers is less than 1 LPS.

The yield of "Other Hydro-geological units including Pyroxenites" formation is upto 3 LPS. The yield of deeper aquifers in the formation vary from 2.4 LPM to 125.9 LPM.

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FIGURE - 3

DEPTH TO WATER LEVEL MAP OF SUKINDA VALLEY, CUTTACK DISTRICT, ORISSA.
(MAY- JUNE-1991)

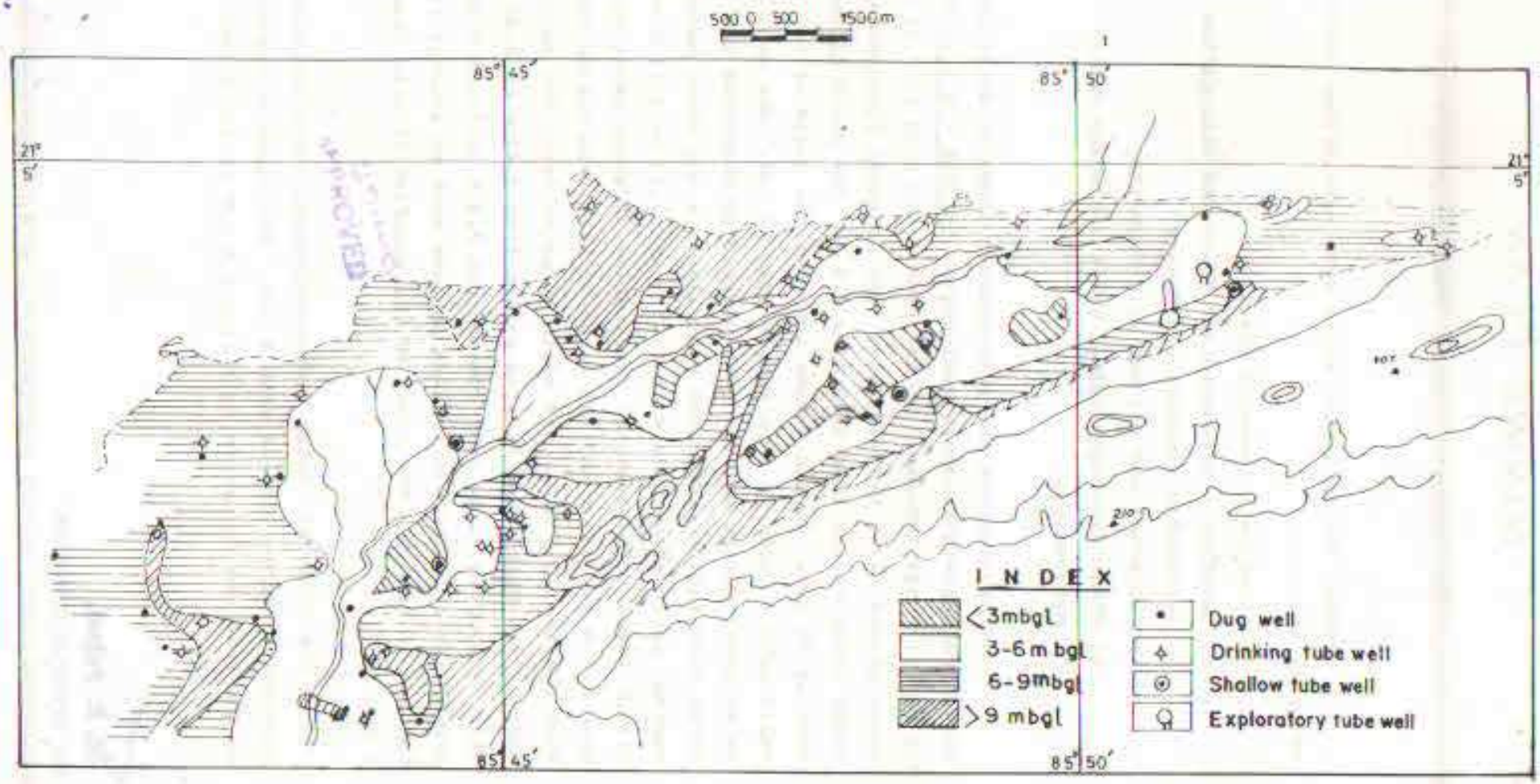
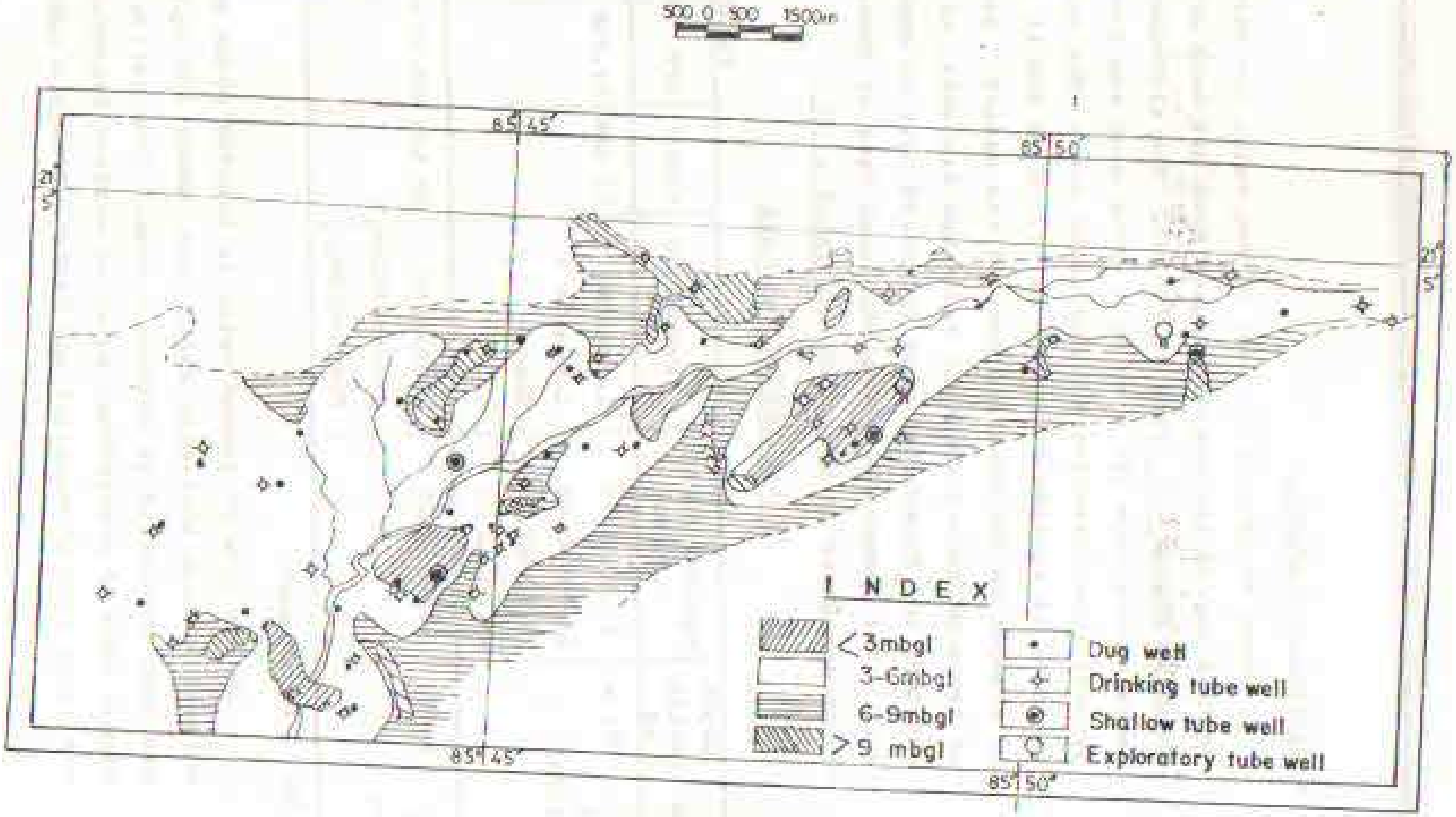


FIGURE - 4

DEPTH TO WATER LEVEL MAP OF SUKINDA VALLEY, CUTTACK DISTRICT, ORISSA.



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Hydraulic Gradient -

Based on data of 51 nos. of dug wells the water table contour map of the Sukinda region area has been prepared, as shown in FIGURE - 5 (Page No.119). The altitude of water table varies from 195 M to 80 M above mean sea level with general flow direction towards south west. The water table gradient is varying from 4.95 to 11.1 M/Km and it is generally steeper in the southern part of the valley. Based on test of two exploratory wells at Kansa and Saruabil, it was observed that the formations were saturated down to depth of 66 M only. The summarised hydrogeological data of these two bore holes are given in the following TABLE - 20 .

HYDRO-GEOLOGICAL DATA

TABLE NO. 20

Location	Depth drilled	Aquifer zones tapped	Formation	Yield	D/D	Duration of pumping
Kansa (85° 52'E 21° 3' 10"N)	251 M	9.00-20.00 24.00-30.00 37.00-42.00 57.00-66.00	Laterite Limonite & Chert.	12 LPS	21.64M	52 Hours
Saruabil (85°49'0" 25°03'10")	54.25M	5.00-30.00	Weathered Serpentinite & Pyroxenite.	50 LPS	23.10 M	24 Hours

Note :- DD :- Draw down.

As the flow of ground water is towards south west direction under pheraatic conditions, about 165 Sq.Km area has been considered as catchment area. Considering divisional line of precipitual water on surface topography i.e. the ridge line of Mahagiri and Daitari mountain range.

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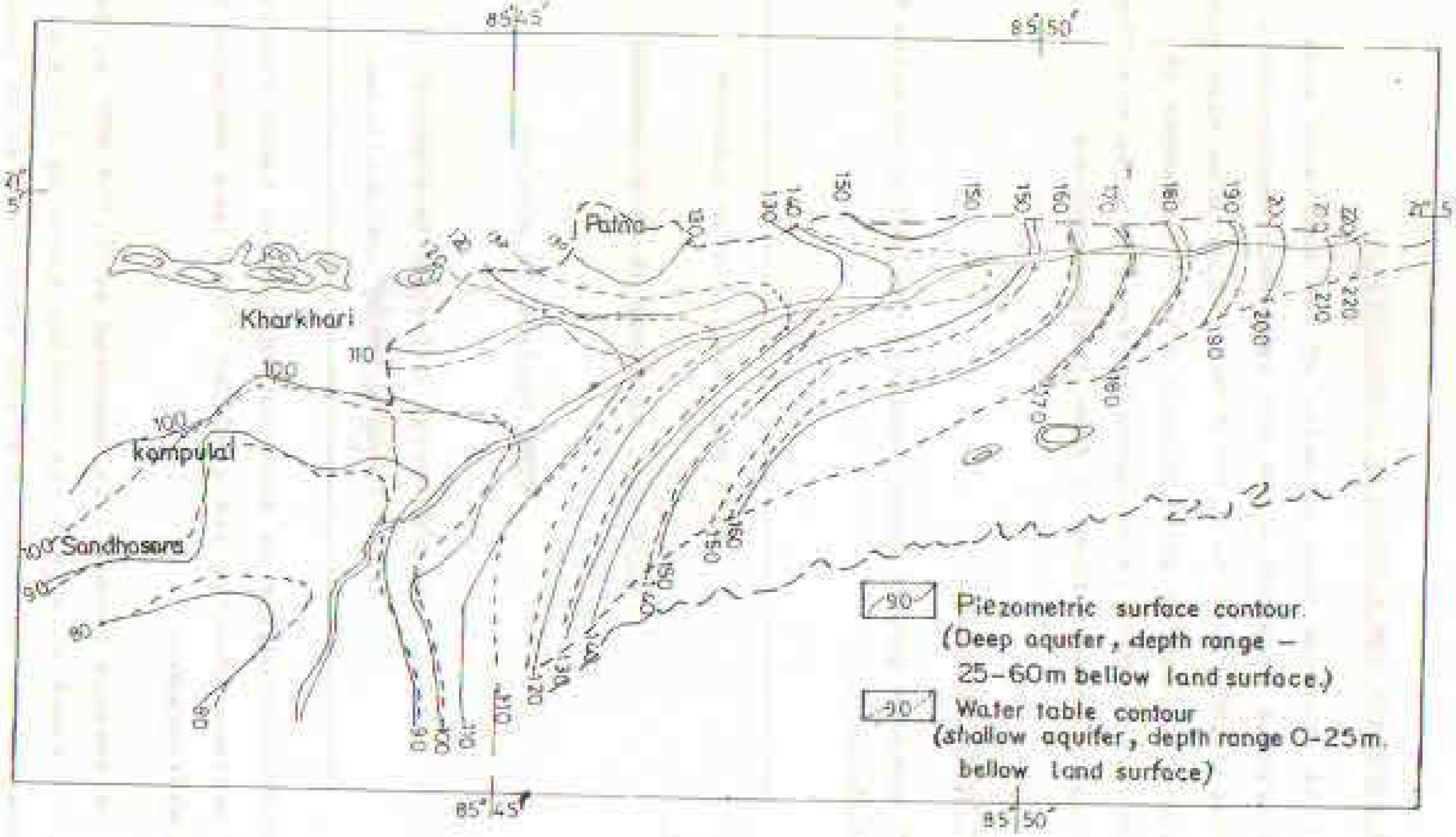
FIGURE 5

MAP OF SUKINDA VALLEY SHOWING POST MONSOON WATERTABLE CONTOURS AND PIEZOMETRIC SURFACE CONTOURS (DEEPER AQUIFERS) MAY-JUNE, 1991



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Ground Porosity and Hydraulic Conductivity -

It is observed that porosity of the weathered mass (aquifer) varies from 53% - 60% and hydraulic conductivity varies from 0.390 M/day to 0.105 M/day. They show high porosity but poor hydraulic conductivity due to fine-ness of texture because ground is occupied by sandy clay to clay type material and possess medium to fine grained texture.

Ground Water Recharge -

To compute ground water recharge following relation has been considered :-

RAIN FALL RECHARGE IN MONSOON
+
RAIN FALL RECHARGE IN NON-MONSOON
+
MINE SEEPAGE IN MONSOON
+
GROUND WATER OUT-FLOW IN MONSOON
(Other factors being insignificant)

Rainfall recharge is assessed from water table fluctuation and average specific yield of the formations computed from the well hydrographs.

Mine seepage (Annual) is computed as 20.656 MCM by considering 1.6 times more than the quantity given by C.G.W.B. in 1992 because of the increase in mining activities as on date. There is hardly any ground water draft in the area other than pumpage in mines.

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Ground out-flow is computed using DARCY'S LAW :

$Q = KIA$

Where ; Q = Out-flow,

K = Hydraulic Conductivity,

I = Hydraulic Gradient,

and

A = Area of Cross section through wich flow occurs.

Non-monsoon recharge is assessed using rainfall records of rain gauge station at KATHPAL (Maintained by M/s. FERRO ALLOYS CORPORATION LIMITED), infiltration factor computed through analysis of Hydrographs.

Rain fall recharge for monsoon and non-monsoon seasons -

1) Catchment area for rainfall recharge (A)	= 165 Sq.Km.
2) Water table fluctuation (ΔS)	= 1.560 M
3) Specific Yield (SY)	= 0.036
4) Non-monsoon rainfall (Rf)(Nov-May,2004)	= 0.262 M
5) Rainfall infiltration Factor (If)	= 0.07
6) Monsoon rainfall (June to Oct.,2004)	= 0.875 M

MONSOON RAINFALL RECHARGE $= \Delta S \times SY \times A \times 10^6$

$= 1.56 \times 0.036 \times 165 \times 10^6$ CuM

$= 9266400\ M^3$.

RAINFALL RECHARGE IN NON-MONSOON $= Rf \times If \times A \times 10^6$

$= 0.262 \times 0.07 \times 165 \times 10^6$

$= 3026100\ M^3$

ANNUAL RECHARGE DUE TO RAINFALL = 9.266 + 3.026

= 12.292 MCM .. (A)

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Ground Water out-flow in Monsoon Months (June - October) -

Thickness of aquifer : 65 M

K = 5.03 M/day

A = Width of Cross section 8.5 Km x Thickness (65)

I = 5.37 M/Km

Q = KIA x 153 days = 2.28 MCM .. .. (B)

Annual Mine Seepage (Estimated from Mine Pumpage)-

= 12.91 MCM x 1.6 = 20.656 MCM .. .. (C)

Total Water Recharge -

= A + B + C = 12.292 + 2.28 + 20.656 = 35.228 MCM.

Water Withdrawal -

A tentative calculation of annual ground water abstraction based on District Statistical Data for Live Stock, 1991 Census data for population and land use and industries details as per field survey is as follows :-

Total water requirement for the live stock within the study Area -

TABLE NO. 21

Type of species	No. of species	Water requirement per day per animal @ (l/day)	Total water consumption (l/day)
Cow, Buffalo & Cattle	1365	68.0	92820
Sheep	62	13.6	843
Goat	291	13.6	3958
Poultry	586	0.09	53
Pig	10	18.2	182
TOTAL ::			97856

Annual water requirement for live stock of the area =

= 97856 * 365 = 35717 M3/Year

SAY 0.035 MCM.

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Water requirement by the total human population within the study area -

Density of the population : @ 100.7 Sq.Km.

Total study area : 314.28 Sq.Km.
(10 Km radius around lease area)

Total population : 31650
(As per Census 2001)

Water consumption per person : 135 L/day
(Source : IS 1172), 1993

Total water consumption per day within the study area : 135 x 31650 = 4272750 L
= 4272.750 M^3

Annual Water Consumption = 1559554 M^3 (4272.750 M^3 x 365)
= 1.560 MCM.

Total water consumption by the Irrigation activities -

Hardly any irrigation is noticed in the area. However, it is assumed that 0.606 MCM water is withdrawn due to tube well irrigation.

Water withdrawal by Industries/Mine within study area :-

= 20.656 MCM.

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ANNUAL WATER CONSUMPTION

IN THE STUDY AREA

TABLE - 22

Annual Ground water recharge in catchment area (165 Km^2)
35.228 MCM

- During Monsoon (9.266 MCM)
- During non-monsoon (3.026 MCM)
- Seepage into Mine (20.656 MCM)
- Ground Water Outflow in Monsoon (2.28 MCM)

Annual Ground water competing users in study area (22.857 MCM)

- Domestic (1.560 MCM)
- Industries (20.656 MCM)
- Irrigation (0.606MCM)
- Live stock (0.035 MCM)

Daily water consumption in industries in CuM

Sl. No.	Industries in study area	Total water consumption per day in the year	
		1992 (As per C.G.W.B.)	(Projected)
1)	TISCO	12119.68	19391
2)	BC MOHANTY	204.16	327
3)	MISRILAL & SONS	549.21	879
4)	O M C LTD	22177.36	35484
5)	FACOR	319.59	511
	TOTAL :: ::	35370.00 (12.91 MCM/Y)	56592 (20.656 MCM/Y)

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Total water withdrawal -

For Live stock	..	..	0.035 MCM
For Domestic	..	..	1.560 MCM
For Irrigation	..	..	0.606 MCM
For Industries and Mines		..	20.656 MCM
Monsoon Outflow	..	..	2.280 MCM
		TOTAL ::	25.137 MCM

Water Balance of Catchment Area - (165 Km^2) -

Total Water Recharge	..	..	35.228 MCM (Refer Table - E-5 in page No.124)
Total water withdrawal (Refer Para - Water withdrawal by Industries/Mine within study area)(Page No.123)	...		25.137 MCM
Balance water available for Users		..	10.091 MCM

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11(a)(iii) FLORA & FAUNA -

A) Flora of Core Zone -

The proposed lease area (23.800 hectares) is non-forest land. The land in the lease area can be classified into 3 categories viz.,

- Agricultural land.
- Waste land.
- Broken waste land.

The agricultural land which is about 4% of lease area is in northern sector of the said area having sparse tree growth. The land is low yielding without any irrigation facility and only rainfed crops are cultivated. The waste land which is about 50% of lease area is degraded with exrophytic bushes and shrubs in patches in south - eastern sector. The broken land which is about 26% of lease area is in southern sector was occupied by previous lessee.

The different types of Flora such as trees, shrubs, Climbers/Creeps, Herbs, Grasses and other types of species existing in the Core zone is given in ANNEXURE - E-2. (Page No. 169 to 171)

B) Flora of Buffer zone -

On the basis of the land use pattern and vegetation types, the Buffer zone (10 Km radius) is studied under the following heads -

- Agricultural land -

The Agricultural land in the Buffer zone of 10 Km radius is covering about 29.01% of the area, as measured from the topo sheet wherein agricultural land has been indicated distinctly. Out of the said 29.01% around 8% is in forest area and the balance 21% is in non-forest area.

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Agriculture in this region is primitive and under-developed, as modern agro-techniques are not adopted. Irrigation facilities are insufficient. Paddy is the main crop of the region. Besides, pulses, cereals, mustard, ground-nut etc., are also cultivated. Seasonal vegetables are also grown in the home hole lands.

- Waste land -

The waste land, which does not give economic return, is uncultivated, uninhabited land and barren rocky land lacking in moisture (mainly on steep slopes) covers an area of 12.96% in the Buffer zone. Out of which 8.5% comes under forest land and balance 4.46% is under non-forest land. In this waste land where soil is not sufficient for development of vegetation, shows scattered patches of xerophytic plant species like -

BOTANICAL NAME	LOCAL NAME
Ziziphus numularia	Kantai koli
Flacourtia indica	Kantai koli
Butea superba	Polash lota/ Polas lai
Bauhinia vahlii	Sialipatra
Sid acordata etc.	Bajramuli

- Grass land -

Patches of grass lands are commonly found in forest and non-forest areas in the Buffer zone of the region. The grass lands are formed after degradation of forest cover. Grasses replace the earlier forest growth of the land ; hence these are secondary in origin with one or two trees and small patches

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of bushes growing at plafes.

These grass lands are dominant at human settlements, foot hills of forest land and road sides. The common grass species noticed are as follows -

BOTANICAL NAME	LOCAL NAME
Commelina benghalensis	Kanesiri
Cynodon dactylon	Dubo
Cyperus rotundus	Mutha
Celosia cristata	Eswarjata
Saccharum munja	Saunsa truna
Saccharum spontaneum	Tandi
Aristida setacea etc.	Khadika ghasa

The occassional trees growing in the Grass lands are -

BOTANICAL NAME	LOCAL NAME
Diospyros melanoxylon	Kendu
Madhuca indica	Mohul
Shorea robusta	Sal
Terminalia tomentosa etc	Asan

- Bushy land -

Bushy lands are common in the areas starting from the project to the base of Mahagiri forest hill range, in the western and north eastern parts of the Daitari forest also and at places in the non-forest areas. These lands are interspersed with big trees. The species of bushy nature plants found in these areas are given as follows -

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BOTANICAL NAME	LOCAL NAME
Adhatoda zeylanica	Basanga
Anisomeles indica	Bhutomari
Datura stramonium	Dudura
Flacourtia indica	Kantai koli
Vitex neaundo	Begunia

- Forest land (area under rich vegetation cover) -

In general the characteristic nature of the forest is tropical moist deciduous and covers about 50.39% of the Buffer zone. The forest is rich in wide varieties of lower to higher flora including Bryophyles, Gymnosperms, Angiosperms, Pteridophytes, Epiphytes and some terrestrial Algae and Fungi also. The details of species observed during survey of the forest area in the month of July, 2001 is given in ANNEXURE - E-3, (Page No. 172 to 179)

The forest land in north west is RANJAGARH RESERVE FOREST in north east is DAITARI PROTECTED FOREST and in south-south-east to south east is MAHAGIRI PROTECTED FOREST. The distribution of plant species in all directions is uniform except steep slopes towards the hill tops as the moisture is unfavourable. The predominant and principle tree species is SAL (Shorea robusta) occurring in almost all parts of the forest area. This is because of its adaptability to adverse climate conditions like high temperature, drought, strong wind and high regeneration capability vide stumps.

The vegetation of middle parts i.e. between the peak and base of the hills is more dense and with standing in a competitive manner as noticed in the form of the straight growth of the trees. Grasses and herbs are rare in these portions due to

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close canopy and lack of sunshine. The vegetation near plain foot hills is partly damaged due to cultivation and grazing of animals of local inhabitants. In such deforestated areas a semi-evergreen shruby under growth of tree species indicates the high regeneration potenciality of the forest.

- Some typical features noticed during survey are as follows :-

- Bamboos are very rare.
- Damage to Sal crops by wood borer (Haplodermaby spinicornis).
- Distribution of species of Ferns, Cycas, Epiphytes and parasites like Cuscuta etc.
- The waste land and degraded forest land is occupied by the most dominant shrub Holarrena antidysenterica (this plant is used to cure dysentry).
- Minor forest products are Kendu leaves, Sal seeds, Mahua flowers and Seeds, Jhuna, Broom grass etc.

From the overall study of the forest it is observed that the forest cover consists around 187 plant species covering trees, shrubs, herbs, creepers, grasses etc., which indicates greater degree of species diversity. The stratification of the forest found in four distinct vertical strata such as -

- Sub-terranian forest floor consisting of roots, rich humus with soil, micro flora and fauna.
- Herbaceous vegetation like grass, herbs and creepers.
- Shrubs, bushes and climbers.
- Trees.

To study the quantitative structure of plant community (Trees), quadrant method was followed in the field by inhouse

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experts to assess the frequency (F), Density (D), Abundance (AB), Relative Frequency (RF), Relative Density (RD), Relative Dominance (RDO), IVI (Importance Value Index) and Index of Diversity of the tree species of girth more than 30 Cm at breast height (1.5 M) by marking quadrant size of 20 M x 20 M at different locations. The quadrant size of 20 M x 20 M has been chosen as it is found that most of the species are being covered in the quadrant and also the size is more convenient to assess the number and frequency. The locations of the quadrants are selected in such a way that the vegetation of all types of topography in forest areas such as Hills, Slopes, Foot-hills and Plain areas can be covered. Five quadrants in each location are found enough to study the said aspects and accordingly in 10 directions the study was conducted to cover the total Buffer zone. The Bushes/Shrubs, Climbers, Creepers, Herbs/Grasses etc., coming under the quadrants are not considered because of their small size. Tree species having girth more than 30 Cm are only counted. The abstracts of these quadrants studies by inhouse team is given in ANNEXURE - E.4. (Page No. 180 to 184)

The study of quantitative structure of plant community (Trees) indicates the richness of biomass (IVI) and index of diversity, which inturn reflects the stability of the forest eco-system of the area although mining is being run since last 50 years in the Region.

In the forest area of Buffer zone, the quadrants studied in all directions show existence of altogether total 39 types of tree species, whereas, in the general study of Buffer zone (including forest area and non-forest area), it indicates 79 nos. The reason of this difference is because of the fact that the quadrants are studied in forest part only whereas during noting of plant species of total Buffer zone locations like villages,

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Schools and Institutions in non-forest areas also covered alongwith forest area, where more numbers of migrated species are found.

The Index of Diversity is calculated following the formula given by SHANNON and WEAVER (1949) -

$$\bar{H} = \sum pi \ \text{Log} \ pi$$

Where $\bar{H}$ = Shannon's Index

pi = ni/N

ni = Biomass or IVI (Importance Value Index) of each species.

N = Biomass or IVI (Importance Value Index) of total species.

Ref : Plant ecology by R.S. Ambashat, Manual of Plant ecology by K.C. Mishra and working plan of Sukinda forest Range, Department of Forests, Government of Orissa.

C) FAUNA OF STUDY AREA -

The study of existing fauna in the Buffer zone, particularly the Wild animals were carried out by interviewing the local tribals of the forest and villagers. Further, the innouse team also noticed some of the Wild animals, aves, amphibia, arthropods and soil fauna etc., during their forest survey.

As the project is surrounded by forest in all directions, frequent visit of animals are reported. Various kinds of Fauna and micro organisms present in the water bodies and soil strata are shown in ANNEXURE - E-5. (Page No.185 - 189).

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presence of such wide varieties of FLORA and FAUNA in water bodies indicates the quality of water bodies is excellent for the habitat of aquatic organisms with better food chain and the rate of Eutrophication is negligible. The soil strata also provides habitat to a wide range of organisms as shown in the list.

The present of arthropods (insets), reptiles, bird's mammal in the forest area indicates that the link of food chain is maintained. The above status of the area proved that the biotic (Flora and Fauna) and abiotic (soil, water and climatic conditions) factors are well maintained.

11(a)(iv) QUALITY OF AIR, AMBIENT NOISE LEVEL AND WATER -

A) Ambient Air Stations -

The Ambient Air Station reading as measured by FACOR within 5 Km/10 Km of the Core zone, as part of routine measurement of Buffer zone station, for 4 seasons, against Bhimtangar Chromite Mines lease of FACOR at 5 stations is enclosed in ANNEXURE - E-6 (Page No. 190). The readings indicate that all the pollutants such as RPM, SPM, SO_2, & NO_x in the Buffer zone stations are below 41%, 18%, 4% & 12% of the prescribed limit respectively. The readings are low as the mining and transporting activities on the Western sector of Buffer zone i.e. Kalarangiatta/Kathpal, Western side of TISCO lease towards BHIMTANGAR area is at a low key. But the stations on the eastern sector of the Buffer zone where major mining activities at south Kaliapani/Tisco/Imfa lease area is also taking place does not indicate the high level of pollution.

One Air station reading have been taken near old quarry of the south side for the core zone i.e. proposed lease hold area. The readings indicate that all the pollutants are below 5% of the prescribed limit, which is enclosed as ANNEXURE - E - 7 (Page No. 191).

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Sampling & Analysis Procedure -

AAQ monitoring was doen using High Volume Air Sampler, SPM was collected on Glass Micro Fibre Filter paper and weighed. Gaseous Pollutants (SO_2, NO_x) were collected by impinger bubbling method and analysed with the help of Spectro-Photometer (i.e. SO_2, determined by Ultra Violet Fluorescence method and NO_x is by Sodium Arsenate method), so that the least count upto 0.001 could be calculated. CO was monitored by using M S A detector tubes. RPM was done by using Respirable Dust Sampler, RPM was collected on Glass Micro Fibre Filter paper and weighed.

B) Ambient Noise Level -

In order to have an idea of the present background noise level of the project site a detailed measurement of noise level was carried out in centre of core zone and at 5 buffer zone locations and the same locations are shown in DRAWING NO. 1 & 11 of volume - 2.

Noise Measuring Instruments -

For measurement of Noise, precision LUTRON integrated sound level meter (Type SL - 4001) of TAIWAN make was used.

The Noise levels data recorded at all the stations of Core zone and Buffer zone are well within the prescribed limits and the details of results obtained is shown in ANNEXURE - E-8 & E-9 (Page No. 192 & 193 - 194)

C) W a t e r -

Monitoring stations, mode of sampling & monitoring schedule -

FACOR has collected water samples in core zone, at 4 stations, i.e. quarry water, pond water, project area surface run off water and TISCO discharge water and in

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Buffer zone 11 sampling stations are selected as shown in the DRAWING NO.1 & 11 of volume - 2. The samples collected by FACOR analysed with the help of Spectro Photo meter upto the least count of 0.001 value. The details of results are shown in ANNEXURE - E-10 to E-24 (Page No. 195 to 209).

The ANNEXURE includes two set up analysis of Damsal River water -

- Sample collected and analysed 100 M upstream and down stream - from the point of mix up of local drain bringing water of proposed Bhimtangar lease area. The detailed results shown in ANNEXURE - E-14 & E-15 (Page No.199 & 200).

- Sample collected and analysed exactly 100 M upstream and down stream of Damsal nala from the east west lease boundary of proposed Bhimtangar lease area (i.e. an imaginary line extension of east and west boundary touching the Damsal river.

Results & Discussions -

The ground water quality (Bore well water) was compared with IS 10500 and the surface water quality was compared with IS 2296(C). The mine discharge water (the water already accumulated in the pre-mined quarrying which will be discharged at the time of mining) quality (effluent water) was compared with E.P. Act Norms and also follow IBM guide lines.

In quarry water, all the parameters except Hexavalent chromium are well within the prescribed limits.

B.O.D. is only 3.4 mg/L maximum against norm of 30 mg/L which shows that bio-degradable pollutant is negligible in quarry water.

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Ground Water (Bore Well water) -

The Ground water analysis in Buffer zone indicates that all parameters are much below the prescribed limit.

Toxicity due to various metals like Cd, As, Cu, Pb, Hg, Mn are absent i.e. below 0.01 mg/l. There cannot be any contamination due to the metals as stated above as the ground rock/mineral is totally devoid of these metals except Mn, which is present in traces. Though, Ni and Fe are present in the ground, there is no leaching of Ni due to its insolubility in water, whereas Iron occuring as Iron silicate is carried away as suspended solid and the Iron is detected to the extent of 0.03 mg/l against the norm 0.3 mg/l.

The low values of total hardness in the water i.e. 236 mg/l maximum, against standard of 300 mg/l and the maximum concentration of sulphates, chlorides and nitrates are 5 mg/l, 40 mg/l and 6 mg/l against the norms 150 mg/l, 250 mg/l and 45 mg/l respectively, indicates that the ground water is soft and free of toxicity.

Coliform organism is non-existent in ground water. The Hexavalent Chromium in the ground water is found below detectable level i.e. 0.005 mg/l as against norm of 0.05 mg/l. It is because of the fact that bore wells were over non-chromite bearing zone and far away from the chromite bands.

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1](a)(v) CLIMATIC CONDITIONS -

A) CLIMATE AND METEOROLOGY -

Analysis of the Climate of the area has been made on the basis of data collected from meteorological centre of our (FACOR) Kathpal Chromite Mines which is located at a distance of 2 Km from the proposed lease area, as crow flies. The Climate of the study area in general is not hot. The Annual average of per month maximum and minimum temperature recorded during 2004 is 38°C maximum and 20°C minimum and the Relative Humidity for the year 2004 recorded is 73%. The details are given in ANNEXURE - E-25 & E- 26 (Page No.210 & 211).

The average annual precipitation recorded for the last 13 years is 1578.06 mm, out of which about 88.2% (i.e. 1392 mm) precipitation takes place during the period June to October.

Very often, Bay depressions and Cyclones in the Bay of Bengal cross over this area, which affects the weather causing wide spread rains. It is seen that rain occurs almost over 9 months in a year which the precise reason for low air pollutants and good vegetative cover.

Wind speed generally is light to moderate. High-speed winds occur during monsoon and post-monsoon seasons as recorded in our (FACOR) Kathpal Chromite Mines meteorological stations.

B) TEMPERATURE -

The month-wise temperatures for the year, 2004 is shown in ANNEXURE - E-25 (Page No. 210). The month of May being hottest of all the months, the highest temperature recorded is 46°C in the year, 2004 and the lowest temperature recorded during the year, 2004 is 13°C.

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C) RAIN FALL -

The month-wise and year-wise rain fall for the last 13 years are shown in ANNEXURE - E-27 (Page No.212). July being the heavy rain fall month, in all the years, the highest rain fall recorded is 713.4 mm during July, 2000. About 88.2% of rain fall takes place during the period JUNE to OCTOBER (i.e. 5 months). During monsoon season i.e. (July to September) 62.6% of rain fall takes place. T h e details of the rain fall during monsoon and the balance periods are given in the following TABLE.

TABLE NO.23

Sl. No.	S e a s o n s	PRECIPITATION	
		mm	percentage
1)	Monsoon (3 months) July to September.	988	62.6
2)	Balance period (9 months)	590	37.4
	TOTAL ::::	1578	100.0

D) RELATIVE HUMIDITY -

The month-wise relative humidity details for the last year i.e. 2004 is presented in ANNEXURE - E-26 (Page No.211). During monsoon season in the month of August, the average Relative humidity is gone upto 86.82% which is high in comparison with other months. DuringWinter, in the month of January, it comes down to 50.62%. The highest reading is recorded in August, 2004 as 92% and in January, 2004, it is lowest i.e. 45%.

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11(a)(vi) HUMAN SETTLEMENTS -

On the north western corner of the lease area, a village exist where total population is around 150 (30 - 35 families), are residing to maintain their income as Mining workers as well as from cultivation.

In Buffer zone around 50 nos. of villages are falling having a population of 100 nos/Sq.Km., mostly belonging to ST/SC. 25% of the population is migrant. 45% of the population are mine workess and 30% population depands on agriculture. Rest depends upon house hold industry and as daily wage workers.

11(a)(vii) PUBLIC BUILDINGS, PLACES OF WORSHIP AND MONUMENTS -

TABLE NO. 24

Sl. No.	Important Place	Name of Place	Distance from the lease area (Km)
1.	Railway Station	J.K. Road	45
2.	Township	J.K. Road	45
3.	National Highway	N.H. - 5	55
4.	Irrigation project	Ragda Dam	10
5.	Industries	- Ferro Chrome Plant IDC, Jajpur	45
		- Charge Chrome Plant, Brahminipal	30
6.	Nala	Damsal Nala	1
7.	River	Brahmani	35
8.	Temples	- Mahadev Temple, Kalarangi	1
		- Kali Temple, Birasal	10
		- Lord Jagannath Temple, Kaliapani, Tisco Camp.	3
		- Lord Sive Temple, Kaliapani.	8
		- Lord Sive Temple, Kapilas	60

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11(a)(viii) PLANS SHOWING THE LOCATIONS OF SAMPLING STATIONS -

A Plan showing location of water sampling stations, noise measuring stations, soil sample stations of Core zone and Buffer zone is enclosed herewith as DRAWING NO.1 & 1(Vol-2) Besides the said Plan also reflects Ambient Air stations of Buffer zone and Meteorological stations located at Buffer zone.

11(a)(ix) DOES THE AREA (PARTLY OR FULLY) FALL UNDER NOTIFIED AREA UNDER WATER (PREVENTION & CONTROL OF POLLUTION) ACT, 1974 -

The area falls under notified area under Water Act, 1974. As soon as mining lease will be granted, consent for Air and Water will be obtained from State Pollution Control Board, under Section (21) of the Air (Prevention & Control of Pollution) Act, 1976 and Section (25) of Water (Prevention and Control of Pollution) Act, 1974.

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11(b) ENVIRONMENTAL IMPACT ASSESSMENT :-

11(b)(i) LAND AREA INDICATING THE AREA LIKELY TO BE DEGRADED DUE TO QUARRYING, PITTING, DUMPING, ROADS, WORK-SHOP ETC. :-

TABLE - 25

Unit : Hectares

Sl. No.	PARTICULARS	For initial 5 years	Upto Conceptual period
1)	Opencast Quarry	6.810	8.410
2)	Structure for underground workings	-	0.704
3)	Waste Dump	*6.580	6.580
4)	Stack Yard	2.100	1.380
5)	Low-grade mineral stack yard	1.510	0.906
6)	Nickel Dump	0.612	0.612
7)	Top soil dump	0.580	0.580
8)	Colony and essential infrastructure	1.680	0.700
9)	E.T.P. with settling Tank	0.416	0.416
10)	D r a i n	0.604	0.604
11)	R o a d	1.165	1.165
12)	Peripheral area	1.743	1.743
	TOTAL :: ::	23.800	23.800

* not completely filled up.

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11(b)(ii) AIR QUALITY -

The concentration of Air Quality parameters i.e. RPM, SPM, SO_2 & NO_x as given for the Buffer zone in Base line data indicate that the pollutants are less than 41%, 18%, 4% & 12% respectively of the prescribed limit as per E.P. Act, 1986, which is also the Norms of MOEF/CPCB.

As already stated earlier, there is no chance of increasing opencast mining and allied activities on the western sector of the Buffer zone, in the coming years because opencast mining instead of expanding will shrink, due to switching over to underground mining. In western sector- i.e. Kathpal/Kalarangi area the nature of ground is Hard rock and therefore there is no scope of increase in air born dust of Buffer zone. The Core zone mining activity will be too small (1.8 Lakh M^3 excavation/ annum) when compared to what is going on all around i.e. 14,75 Lac M^3 to have any noticeable influence on the Air Pollution status of Buffer zone. However, some increase may be considered for Buffer zone Ambient Air pollution say 2 - 3% assuming that opencast mining will marginally rise. But then, intensity of activities of opencast mining by other lessees on the hard rock area of Sukinda Region is bound to decrease and therefore there will not be any rise of Air Pollutant in Buffer zone even on the eastern sector. Ofcourse, whatever the current Air pollution status in Core zone exist, it is bound to increase once Core zone mining is commenced in full swing on the opencast front which will continue for 9 years, after which, opencast mining will be replaced with underground mining which is eco-friendly mining technology then the Air Pollution will substantially fall down compared to opencast mining period in the Core Zone.

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11(b)(iii) WATER QUALITY -

Surface water body exists in Core zone in the form of pond/open well and contamination of water in the core zone could occur due to -

- Discharge of water from mine, work-shop, garage and domestic area.
- Rain water overflowing from dumps.

The only polluting element in mine discharge water is Hexavalent Chromium. This may contaminate the other surface water body if systematic discharge through an adequately laid drainage net work is not provided, which should be kept at far away distance from openwell and ponds, to prevent mixing of mine discharge water with surface water bodies.

The discharge water from work-shop and garage will be led via an oil trap and then it will be led to drain net work. Suitable garland drain with provisions for arresting soil and suspended solid will ensure that rain water passing through does not contaminate surface water bodies. Once underground mining commences, the pollution in the underground discharge water will be even less than what is expected in the quarry discharge water except Hexavalent Chromium.

Since, due care will be taken by installation of effluent treatment plant which will not only reduce the Hexavalent Chromium percentage but also the suspended solids. Hence, there will not be any deterioration in quality of surface and underground water of Buffer zone due to discharge of water from the project area.

Therefore, there is no chance of deterioration in the quality of surface water body and underground water of core zone during the first five year period and subsequently during the conceptual period.

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The quality of drinking water i.e. Tube well water (ground water) on the proposed lease area and study area will remain same as it is today.

11(b)(iv) NOISE LEVELS -

Noise in the Mining Complex is generated due to ground excavation by machinery, and transport by machinery, due to blasting operations and due to mechanical loading and unloading.

Present Noise level in the lease area is less than 75 dB(A) for 8 hours exposure as per E.P. Act. The increased excavation and dumping activities will increase the back ground Noise level slightly for which adequate measures have been suggested in ENVIRONMENT MANAGEMENT PLAN, under point no. 11(c)(-ix)(C)Existing Noise levels at nearby villages are found well within the limits when compared with E.P. Act. This states will remain same during the period of opencast mining. When only underground mine operations will continue the impact of Noise due to machinaries and blasting will be very less. Hence, the noise levels in future i.e. during 5 year period and during conceptual period, will not be higher than the present level both at Core zone as well as Suffer zone.

11(b)(v) VIBRATION LEVELS (DUE TO BLASTING) -

A) Ground Vibration -

The damage that results from vibration depends on the nature of source, transmission characteristics of the intervening medium/strata, inherent strength of the subject structure, height and rigidity of the structure and foundation design etc.

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Damage caused by ground vibration is dependent on the amplitude of the ground velocity and on the frequency of the ground motion. Low frequency waves cause more damage to structure.

Different countries adopt different standards of safe limits of vibration in terms of Peak Particle Velocity (PPV) for various types of structures. A few standards widely accepted are given in ANNEXURE - E-28 (Page No.213&214) In INDIA, D G M S - has prescribed 10 - 12.5 mm/sec. PPV values as the safe limit for ground vibration. It is appropriate to mention here that DGMS prescription is based on observations of Coal measure strata where predominant frequencies lie between 13 - 15 H_Z.

B) Empirical Relation-ship between Ground Vibration distance & Explosive Charge -

Applying the method of lease square regression analysis with the data of trial blasts at nearby Kaliapani manual chromite mine (where similar kind of rocks are encountered) empirical equations are established relating Peak Particle Velocity (V) (mm/sec.), the distance of blasting site from the point of monitoring (D)(M) and maximum charge per delay (Q)(kg).

The derived empirical equations (32 mm hole dia) are given below -

Present level of vibration (PPV) at various structures (at ground level) has been calculated using equation (1) and presented in the ANNEXURE - E-29 (Page No. 215).

$$V = 353 (D/\sqrt{Q})^{-1.856} \quad \ldots \quad \text{Equation - 1.}$$

Co-efficient of correlation = -0.98.

PPV values have been calculated for the sensitive structure only which are nearby to quarry. Values of Q have been taken to be 6 kg delay. This is the maximum charge of explosive per delay considered.

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Similarly, values of RPPV for Deep Hole Blasting (110 mm dia) are calculated basing on the ground constants derived by Indian School of Mines during their studies on Vibration at TISCO mines quartzite zone in Sukinda Valley considering 35 kg/delay (Though only 20 kg will be used/hole).

The results are given in ANNEXURE - E-29 (Page No.215) All values mentioned in the ANNEXURE are well within the DGMS, USBM and GERMAN standards. However, the ground strata of Bhimtangar mines is not as hard as TISCO quartzite zone. In soft zone waves attenuate much earlier than hard rock and hence actual RPPV at Bhimtangar mines will be much less than estimated.

Similarly, values of RPPV for underground blasting are calculated basing on the ground conatants derived at our Kathpal mines with 4 kg/delay, is shown in ANNEXURE - E-30 (Page No. 216). All values are well within the DGMS Standards.

11(b)(vi) **WATER REGIME -**

Due to the ongoing mining activities in the Valley depletion of ground water is not noticed. As such, the impact on the ground water due to this mine is, insignificant. In future, due to the projected mining activities, it is expected that, 1.5 Lakh M^3/Annum water pumping will take place from opencast mine which will increase overall ground water withdrawal of the area by 6 to 7%. However, the ground water storage is so high that, impact on water table is expected to be very less. More over, substantial amount of mine discharge water will be

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led (after treatment) to the natural drainage system so that recharge can take place in the adjoining area from the natural drainage system. At any case greater the discharge takes place from aquifer, ground saturation falls down resulting in the increase in the amount of infiltration and decrease in surface run off. When underground mining will take place, the zone of working will be below the aquifer depth (0 MRL) and where the ground will be unsaturated and seeps into underground will be very less.

Under the circumstances narrated above, there will be impact on water regime during 5 years period and conceptual period due to the mining activities over said 23.800 Hectares.

11(b)(vii) SOCIO-ECONOMICS -
(Buffer Zone)

Atpresent migrant-non-migrant ratio is about 1 : 4. In Buffer zone More people are expected to be migrated towards the central region of the study circle (Chromite bearing zone) in the years to come. This will happen because of the following reasons -

- Better employment opportunities in chromite bearing zone.
- Relatively unproductive land in absence of lift irrigation.
- Marginality of land holding size/quality shows that around 53.5% people have NIL to less than 3 acres of land.

Atpresent 47.5% of the total employment is in chromite mines in Sukinda area it is expected that, the figure will further increase and share of cultivation will decrease. Selling of the wood will also decrease due to better level of environmental awareness and anti-deforestation drive. However, a little increase in employment under mixed category is expected due to increase of secondary activities alongwith mining. Average income level which is the indicator of Socio-economic status of House-hold, is

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expected to increase with greater dependancy on industrialization in the form of mining. It is expected that, in a better environment, people will take help of banking and other saving systems which will further uplift the economic standard.

Health facilities have improved several folds since the mining projects have come up. The mine owners operate family planning services, health camps on specific diseases, eye operation camps etc., in nearby villages. This will further increase with the opening of FACOR's mine in the proposed lease area.

Increasing literacy and education is one of the important parameters of social development. The people in this region are educationally back-ward. The scenario is changing gradually due to setting up of extensive educational facilities by the mine owners, a part of which is being shared by M/S. FERRO ALLOYS CORPORATION LIMITED. There will be greater impetus in this direction, once mining commences in the said lease.

Due to coming up of the mining projects in Sukinda area, communication facilities have improved several folds, where M/S. FERRO ALLOYS CORPORATION LIMITED is already playing an important role in uplifting the SOCIO-ECONOMIC STATUS of the inhabitants. This situation will improve further with the opening of the mine in the proposed lease area by FACOR.

Due to proposed project near about 150 to 200 direct employment and around 1000 nos indirect employment generation due to allied activities like, Shops, Transport, Downstream industries will be expected.

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11(b)(iix) HISTORICAL MONUMENTS ETC. -

Existance of Historical Monuments in the visinity of the proposed mine is nil and therefore the question of impact of this project on Historical Monuments does not arise.

11(c) ENVIRONMENTAL MANAGEMENT PLAN -

11(c)(i) TEMPORARY STORAGE AND UTILISATION OF TOP SOIL -

The generation of top soil per year will be 2800 M^3. The top soil will be dumped separately in an area of 0.580 Hectares at the location shown in the DRAWING NO.9. The details of year wise generation and utilisation of top soil is shown in ANNEXURE - E-31 (Page No. 217). Soil sample analysis shown in ANNEXURE - E- 34 (Page No. 220 & 221)

The top soil will be consumed for plantation purposes like (i) seedlings development in the Nursery by filling with mixture of cow dung and fertilizer, (ii) in the pits dug for plantation in vacant space in lease area and as a thick layer (30 cm) over the dump surface to help in growing of sapling species as well as natural plants.

As there will be simultaneous operations of generation and utilisation of the top soil, the same will not get accumulated in the allotted area for longer periods. However, in first four years, top soil will continue to be accumulated, as overburden dump face (dead face) will be under construction for plantation. However, two feet height of barrier will be provided around this dump to avoid soil loss.

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11(c)(ii) YEAR-WISE PROPOSAL FOR RECLAMATION OF LAND AFFECTED BY ABANDONED QUARRIES AND OTHER MINING ACTIVITIES DURING FIRST FIVE YEARS (AND UPTO CONCEPTUAL PLAN PERIOD) :

During the first five years, the quarry will not be abandoned hence question of reclamation will not arise as per as opencast mine is concerned. However, other areas like waste dump, dead face, peripheries around road, colony areas etc., will be available for reclamation and the same will be reclaimed by afforestation as per programme given in ANNEXURE - E-32 (Page No. 218). After cessation of opencast mining i.e. after 10th year the opencast quarry will be left as such because underground workings will continue below the opencast workings. The water in the quarry will be kept dry to avoid inundation to underground workings. Only the upper benches of the quarry will be reclaimed by afforestation. Further, details of area getting degraded due to mining operation and the reclamation measures to be adopted with justification are as follows :-

The land that will be affected by each of the mining and allied activity has been reflected on an yearly basis in the enclosed TABLE - 26 (Page No. 151) and will be reclaimed/ restored/rehabilitated depending on the time period when opportunity arises for taking action on mitigating the adverse impact on the land, which has been reflected in TABLE - 27 (Page No. 152).

Improvement in land scar due to mining and allied activities has been brought out basically by providing -

- # Avenue plantation.
- # Waste dump area plantation.
- # Colony area plantation.
- # Peripherial plantation in the form of green belt.
- # Carpet cover of grass over waste dump.
- # Provision of Park/Garden in colony with ornamental trees.
- # Provision of bee hives and birds nest in trees to attract avifauna
- # Water Reservoir in the excavated quarry for irrigation as well as for pisi-culture development and for attracting avi fauna.

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AREA TO BE DEGRADED (YEAR WISE FOR FIRST FIVE YEARS, 10TH YEAR AND CONCEPTUAL PERIOD

Drawing No.9 in volume-2

Area in Hectares.

Sl. No.	PARTICULARS	AREA TO BE DEGRADED TILL THE PARTICULAR Y E A R						
		1st	2nd	3rd	4th	5th	10th (ultimate quarry working	Upto Conceptual period
1)	Opencast Area (Existing 5.44 Hectares)	6.450	6.650	6.700	6.780	6.810	8.410	8.410
2)	Infrastructure for u/gr working	-	-	-	-	-	0.704	0.704
3)	Waste Dump	2.450	3.680	4.810	5.720	6.580	6.580	6.580
4)	Ore Stack Yard	1.400	1.900	2.100	2.100	2.100	1.380	1.380
5)	Low Grade Stack yard	0.900	1.300	1.510	1.510	1.510	0.906	0.906
6)	Nickel Dump	0.300	0.400	0.450	0.560	0.612	0.612	0.612
7)	Top and sub soil stack yard	0.200	0.260	0.320	0.470	0.580	0.580	0.580
8)	Essential infrastructure	1.200	1.680	1.680	1.680	1.680	0.700	0.700
9	ETP with settling pond	0.416	0.416	0.416	0.416	0.416	0.416	0.416
10)	Drain	0.400	0.480	0.510	0.580	0.604	0.604	0.604
11)	Road (including existing 0.384 Hect.)	1.200	1.400	1.650	1.650	1.165	1.165	1.165
12)	Peripherial Area	8.884	5.634	3.654	2.334	1.743	1.743	1.743
13)	T O T A L :::	23.800	23.800	23.800	23.800	23.800	23.800	23.800

TABLE - 1.26

TABLE - 27

RECLAMATION PROGRAMME (YEAR-WISE FOR FIRST FIVE YEARS AND FIVE YEARLY UPTO CONCEPTUAL PERIOD)

AREA IN HECTARES — Refer DRAWING NO.9 in Vol.-2.

Sl. No.	Particulars	1st	2nd	3rd	4th	5th	Total upto 5th year (1)	10th (2)	15th (3)	20th (4)	25th (5)	30th (6)	Total upto 30th year (1) to(6)	Upto Conceptual period
A)	RECLAMATION BY AFFORESTATION :-													
1)	Opencast mine (Top 3 benches)	-	-	-	-	-	-	-	-	-	1.10	2.10	3.200	3.200
2)	Space for u/gr workings.	-	-	-	-	-	-	-	-	-	-	-	-	0.704
3)	Waste Dump	-	0.54	0.54	0.50	0.35	1.95	1.69	1.21	1.75	-	-	6.580	6.580
4.	Ore Stack Yard	-	-	-	-	-	-	-	-	-	-	-	-	1.380
5.	Low Grade Stack Yard	-	-	-	-	-	-	-	-	-	-	-	-	0.906
6.	Nickel Dump	-	-	-	-	-	-	0.20	0.20	0.212	-	-	0.612	0.612
7.	Top and sub soil stack yard									0.200	0.380	-	0.580	0.580
8.	Essential infra-structure	-	-	-	-	-	-	-	0.20	-	-	-	0.200	0.700
9.	ETP with settling pond	-	-	-	-	-	-	-	-	-	-	-	-	0.416
10.	Drain	-	-	-	-	-	-	-	-	-	-	-	-	0.604
11.	Road	-	-	-	-	-	-	0.10	-	0.10	-	0.10	0.300	0.781
12.	Peripherial area	0.50	-	-	0.10	0.25	0.85	0.25	0.25	0.25	0.143	-	1.743	1.743
	TOTAL (A)	0.50	0.54	0.54	0.60	0.60	2.78	2.24	1.860	2.512	1.623	2.20	13.215	18.206
	No. of Plants @ 2500 nos/Hect.	1250	1350	1350	1500	1500	6950	5600	4650	6300	4050	5500	33050	45500 Nos
B)	BALANCE OPENCAST AREA :: (8.41 - 3.20) = 5.21 Hectares to be reclaimed as reservoir for irrigation, pisi culture, Atraction of Avi-fauna.													5.210
C)	UN-DISTURBED ROAD AREA (As per Govt. of Orissa, Department of Steel & Mines letter No.IV(G)SM-1/2005-6028 dtd 10.6.05													0.384
D)	TOTAL (A + B + C) :: (18.206+5.21+0.384)													23.800

11(c)(iii) PROGRAMME OF AFFORESTATION YEAR-WISE FOR THE INITIAL FIVE YEARS (AND UPTO CONCEPTUAL PLAN PERIOD) :

Programme of afforestation for the initial five years enclosed as ANNEXURE - E-32 (Page No. 218) and upto conceptual plan period is given in ANNEXURE - E-33 (Page No. 219).

11(c)(iv) STABILISATION AND VEGETATION OF DUMPS ALONGWITH WASTE DUMP MANAGEMENT YEAR-WISE FOR THE FIRST FIVE YEARS AND UPTO CONCEPTUAL PLAN PERIOD -

A total area of 6.58 Hectares has to be occupied for overburden dumps of opencast mine in the coming 10 years, which is the life of opencast mine. Total generation of waste from quarry expansion will be around 14 Lakh M^3 in loose condition.

Peak RL of dump at north eastern side will be 120 MRL after five years whereas the ground levels are 110 MRL and MRL respectively. The ultimate Peak RL will be 140 MRL after 10 years.

Dumps are located at north eastern side of quarry leaving minimum of 50 M gap between quarry top edge at ultimate position and dump bottom edge. Garland drain and barriers will be provided all along the dumps and quarry. Dumping will be done by making 2 benches (each 15 M height) and maintaining an overall slope of 33°. Geo-technical studies on dump slope stability carried out by FACOR's in-house team reveals that the dumps overall slope angle can be maintained at 38° without any danger of sliding. The details are mentioned as below -

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role in dump slope stability. Therefore, shear strength parameters of serpentinite has been considered for computing the slope safety factor. As it has not possible to find out the Cohesion and friction angle of the serpentinite of this lease area, the corresponding figures, as is tested for Ostapal Chromite mines of FACOR has been considered for BHIMTANGAR mine also where naked eye observation indicates better values than that of Ostapal Chromite Mines of FACOR.

Dump slope stability of this mines has been determined for the proposed dumps under dry and wet condition using Circular Failure method. Basing on the studies made at our Ostapal Chromite Mines, in which the same type of waste overburden is being removed. From the analysis it is observed that future dump slopes will be stable both under dry and wet condition having favtor of safety more than 1.37 which is considered as safety factor for stable slope of temporary benches. It is also observed that individual benches of 10 M height with 45° slope angle can remain stable. In the same material 45 M height dump with overall slope angle 28° would be stable.

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- Protection measures for the waste dump -

In order to protect the dumps from erosion, the following measures will be adopted -

- The dump will be adequately benched with bench height 15 M.
- The overall slopes of the dumps will be maintained at 33°.
- Individual bench slope is to be 42°.
- Dump bench slopes will be vegetated with grasses for binding soil and to arrest soil erosion. Later on bushes and shrubs will be grown on the dump slopes alongwith tree species.

The same measures will also be followed in the Conceptual plan period.

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In this mine, major part of the waste dump will be composed of soft loose serpentinite mixed with boulders and fragments of hard laterite. Hence, Cohesion and Friction angle of serpentinite of waste dump will play an important role in dump slope stability. Therefore, shear strength parameters of serpentinite has been considered for computing the slope safety factor. As it has not posaible to find out the Cohelson and Friction angle of the serpentinite of this lease area, the corresponding figures, as is tested for Ostapal Chromite mines of FACOR has been considered for BHIMTANGAR mine also where naked eye observation indicates better values than that of Ostapal Chromite Mines of FACOR.

Dump slope stability of this mines has been determined for the proposed dumps under dry and wet condition using Circular Failure method. Basing on the studies made at our Ostapal Chromite Mines, in which the same type of waste overburden is being removed. From the analysis it is observed that future dump slopes will be stable both under dry and wet condition having favtor of safety more than 1.37 which is considered as safety factor for stable slope of temporary benches. It is also observed that individual benches of 10 M height with 45o slope angle can remain stable. In the same material 45 M height dump with overall slope angle 34° would be stable.

APPROVED

- Protection measures for the waste dump -

In order to protect the dumps from erosion, the following measures will be adopted -

- The dump will be adequately benched with bench height 15 M.
- The overall slopes of the dumps will be maintained at 33°.
- Individual bench slope is to be 42°.
- Dump bench slopes will be vegetated with grasses for binding soil and to arrest soil erosion. Laterite bushes and shrubs will be grown on the dump slopes alongwith tree species.

The same measures will also be followed in the Conceptual plan period.

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11(c)(v) NICKELFERROUS LIMONITE DUMP AND STACKING AND PROTECTION MEASURES TO BE ADOPTED -

The nickeliferrous limonite reject of all grades which will be generated for first five years is going to be 0.41 Lakh M^3. The area earmarked for nickeliferrous limonite is 0.612 hectares and occurs in an irregular rectangular shape where the overall shape has been assumed to be 33° and as per calculation the storage capacity of the area is 0.70 Lac M^3. During the conceptual plan period, calculation made on the same basis as five year plan period (See CHAPTER - 7, Page No. 95) indicates the maximum stock piling is likely to be 0.70 Lac M^3 of nickeliferrous limonite over 10 years period of opencast life and hence the said area is sufficient for the quarry life at Bhimtangar area.

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Protection measures for nickeliferrous limonite reject dump -

In order to protect the dumps from erosion, the following measures will be adopted -

- The overall slopes of the dumps will be maintained at 33°.
- Dump bench slopes will be vegetated with grasses for binding soil and to arrest soil erosion. Lateron bushes and shrubs will be grown on the dump slopes alongwith tree species.
- Construction of garland drains around dump.
- Stone barriers will be made in between the dump and drain side to restrict the solid particles from dump slope during flow of water.

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III(c)(vi) a) Precautions to be taken to prevent Air Pollution -

- Air Pollution control -

The existing level of air pollution in the project area is generally low. Due to increased mining activities in future the level of air pollutants are expected to rise little more. The following measures will be taken to avoid air pollution -

Control of dust due to mining operations -

While complete elimination of dust due to mining operation is not possible, control measures as indicated below will be taken to reduce dust nuisance -

- Drilling -

Jack Hammer and Wagon Drills will be used for drilling. The drilling speeds will be maintained as recommended by manufacturer. Wet drilling shall be practiced i.e. a jet of water shall be continuously directed at the cutting edge, Correct water pressure shall be maintained. The drill operators will be provided with dust masks, if necessary.

- Blasting -

Generation of dust as a result of blasting can not be avoided. However, its spread will be some what checked by avoiding over charging of blast holes.

- Loading and unloading -

By water sprinkling during loading and unloading of excavated material, dust will be prevented to become air borne.

-Dumping -

The volume of dust raised from dump area, by action of wind will be significantly reduced by planting of grasses and creeper species on the dumps.

- Haul road -

Haul roads are the major sources of dust in a mine. To overcome the problem of dust generation in mine haul roads the following actions will be taken up:

- The practice of construction of haul roads with the layers of hard stones overlained by laterite fines and subsequently compacted by road rollers will be Practiced

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- The haul roads will be made compact and water spraying will be done in a number of runs using only a small quantity of water each time just sufficient to wet the surface.
- Ensuring transport equipment to be leakproof.
- Over loading of the transport equipment will be prevented in order to avoid spillage.

- ORE STACK YARD -

Water sprinkling will be adopted atleast thrice a day in ore stack yards to bring down the air borne dust. Peripheral plantation around the stack yard will also be taken up to arrest the air borne dust if any.

- Control of pollution due to fumes from mining machinery -

Exhaust fumes in the internal combustion engines used in Excavator, Dumpers, Dozers and other machinery will be minimised by ensuring vigorous maintenance and stringent overhaul schedules. The repair work shop and maintenance garage will be equipped with all necessary facilities such as lathe, hydraulic jack, hand hold grinders and water servicing station to ensure upkeep and maintenance of engines.

Waste lubricants and grease will be placed in separate containers and will be burnt regularly in specified yard meant for the same.

11(c)(vi)(b) NOISE CONTROL -

Noise level in the proposed lease area is less than 85 dB(A) (for 8 hours continuous exposures). It is expected that due to increased mining activities noise level in the work zone will increase slightly. As general precautions against noise pollution to reduce the effect to high noise level the following ameliorating measures will be taken.

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- Protective Devices -

Provision of sound proof cabins for the workers deployed on machines producing higher level of noise like Dozers, Shovels, Dumpers etc., where ever noise level is high.

- Maintenance -

- Proper maintenance of noise generating machinery including transport vehicles will be ensured.

- Plantation over the peripheral area of the working area.

- Provision for peripheral plantation in the form of green belt to control the noise level.

- Reduction of exposure time -

Reducing the exposure time of the workers, wherever required. Even though the noise level arising due to blasting operation is for very short period, the general precautions have to be adopted as given under blasting hazards.

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- Protective Devices -

Provision of sound proof cabins for the workers deployed on machines producing higher level of noise like Dozers, Shovels, Dumpers etc., where ever noise level is high.

- Maintenance -

- Proper maintenance of noise generating machinery including transport vehicles will be ensured.

- Plantation over the peripheral area of the working area.

- Provision for peripheral plantation in the form of green belt to control the noise level.

- Reduction of exposure time -

Reducing the exposure time of the workers, wherever required. Even though the noise level arising due to blasting operation is for very short period, the general precautions have to be adopted as given under blasting hazards.

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11(c)(vi) MEASURES TO CONTROL EROSION/SEDIMENTATION OF WATER COURSES -

Soil Conservation Management Scheme suggested for this project is as follows -

- Construction of garland drains around quarry, dumps and other infrastructures viz., work-shop/garage etc.
- Plantation of small grass and bushes in drains to hold back solid particles from draining away (act as filters).
- Provision of small stone barriers across the drains at intervals to check the water current and to arrest solid particles.
- Stone pitching will be made on the drain sides to restrict collapse of drain walls during flow of water.
- Drains will be cleaned up periodically.

11(c)(vii) TREATMENT AND DISPOSAL OF WATER FROM MINE -

A) Treatment of Mine pumped out water -

In the quarry water except Hexavalent Chromium all parameters are well within the prescribed limits. For neutralising Hexavalent Chromium in mines pumped out water before discharge to outside lease hold, we have studied two processes -

- REDUCTION PROCESS and
- ELECTROLYSIS PROCESS

out of these we will adopt the Reduction Process.

- Reduction Process -
- Principle -

Hexavalent Chromium is a strong oxidising agent and can readily be reduced to Trivalent chromium by means of adding

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reducing agent i.e. ferrous sulphate ($FeSO_4$). After proper mixing with Ferrous Sulphate the Hexavalent Chromium (Cr^{+6}) is reduced to Trivalent Chromium (Cr^{+3}) while Ferrous Iron (Fe^{+2}) will be oxidised to Feric Iron (Fe^{+3}). In the next stage, by adding alkaline reagent i.e. Sodium Hydroxide (NaOH) the Ferric Iron will be precipitated as Ferric Hydroxide ($Fe(OH)_3$) and the Trivalent Chromium will be precipitated as Chromium Hydroxide ($Cr(OH)_3$). Both the precipitates will be coagulated alongwith other suspended solids and ultimately settles down in a settling tank.

- Reactions as examples -

1) A) If Water contain chromates (CrO_4^{-2}) with sodium

$$2Na_2CrO_4 + 6\,FeSO_4 + 6H_2O = 2Na_2O + Cr_2O_3 + 3Fe_2O_3 + 6H_2SO_4$$

B) If water contain Dichromates ($Cr_2O_7^{-2}$) with sodium

$$Na_2Cr_2O_7 + 6FeSO_4 + 6H_2O = Na_2O + Cr_2O_3 + 3Fe_2O_3 + 6H_2SO_4$$

2) $$Cr_2O_3 + 6\,NaOH = 2\,Cr(OH)_3 \downarrow + 3\,Na_2O$$

$$Fe_2O_3 + 6\,NaOH = 2\,Fe(OH)_3 \downarrow + 3\,Na_2O$$

- Procedure -

The treatment units will essentially consist of the following -

a) Intake tank cum primary settling tank.
b) Mixing Tank.
c) Filtration chamber.
d) Drain for carrying supernated water to main discharge nala.
e) Bypass discharge drain to remove the sludge from the bottom of the filtration chamber to sludge pond from where it is cleaned time to time.

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B) Effluent water from Work-shop/Garage etc. -

Oil & Grease Trap -

In the Mechanical garage and work-shop the minor repairings will be done for heavy and light vehicles on a cement concrete plat-form. A pucca drain around the plat-form will be provided to collect the spillage oil and servicing water into a cement tank of capacity 8 M^3. In the oil and water collection tank two out-lets will be provided. One out-let will be provided 0.30 M below the surface of the tank for collection of the oil. The excess oil will be drained out from the bottom of the tank. The oil collected in the oil collection tank will be kept in a separate containers and to be sold to the authorised parties.

C) Domestic Sewage -

Toilet sewage will be collected into a soak pit via septic tank, after biological degradation under anerobic condition. Other domestic sewage will also collected into a soak pit via open drain.

11(c)(viii) MEASURES FOR MINIMISING ADVERSE EFFECTS ON WATER REGIME -

A) Prevention of Surface water contamination -

Surface water management scheme suggested for this project is as follows :

- Construction of garland drains around quarry, dumps and other infrastructures viz., work-shop, garage etc., and provision of oil trap.
- Plantation of small grass and bushes in drains to hold back solid particles from draining away (act as filters).

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- Provision of small stone barries across the drains at intervals to check the water current and to arrest solid particles.
- Stone pitching will be made on the drain sides to restrict collapse of drainwalls during flow of water.
- Drains will be cleaned up periodically.
- Provision of pitting at interval in the drain for deposition of sediments.
- Regular analysis of water discharge at the lease boundary to detect contamination and subsequent precautionary measures to neutralise the same.

The object is to regulate the surface water of the mining area in such a manner as to cause minimum contamination and alteration of drainage system. Devalopment of quarries and waste dump in future will not interfere with the course of water flowing down the area as drains will be provided all around the dumps and quarries to guide the water down to join the natural water courses (outside the lease area) after necessary treatment wherever required.

Drains will be made on the top flat region and channels on the slope to carry the precipitated water to the garland drain around the dumps.

B) Water Table and Ground Water contamination -

Ground water Table may be slightly affected by quarry working due to water percolation into the quarries leading to heavy pumping and discharge of water. However, discharge of this water into the natural drainage system will help in regaining the water table to some extent due to recharge from the natural drain.

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But, then, it is to be noted that greater the water seepage into the quarry, will mean, reduction in the ground saturation level and hence greater will be infiltration into the ground and lesser will be surface run off. Therefore, the net effect on the water table will be negligible after development of quarry. After the end of mining activities, water table will rise considerably. Regular monitoring water level on the open well/ pond/tube well in the study area will be carried out to detect rise/fall of water table so that adequate precautionary measures can be taken.

Contamination of ground water due to infiltration of leached water from waste dumps, if any, will be checked considerably by putting a good green cover and developing a good drainage system over the overburden dumps. Regular monitering of ground water quality from nearby open well sources will be carried out to ensure that infiltration of leached water has not polluted ground water.

11(c) (ix) PROTECTIVE MEASURES FOR GROUND VIBRATIONS/AIR BLAST CAUSED BY BLASTING -

A / Control of Ground Vibration -

Assuming a safe level of ground vibration as 10 mm/sec. The permissible charge in Kg per delay for various distance from the blast site are estimated using U.S.B.M. equation $V = 353 (D/\sqrt{Q})^{-1.856}$ and are tabulated and given in ANNEXURE - E-29 & E-30 (Page No. 215 & 216).

The abeve charge limits should not exceed while designing the blast parameters. The permissible charge per delay for any other given distance at any specified vibration level can be estimated with the help of aforestated equation. The speficied ground vibration, interm of Resultant Peak Particle Velocity in mm/sec. will be 10 mm/sec. as stated above.

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B) Controlled blasting techniques as given below will be adopted to reduce ground vibration -

- The distribution ratio of booster to column charge will be at 1 : 5.
- Detonating Cords is used for connections and for initiation of charges in holes.
- Delay Detonators are to be used for providing delay timings between rows (25 ms to 50 ms) and with in rows of between holes (15 ms or 25 ms duration).
- Number of rows in a blast to be restricted to less than THREE to get good fragmentation and to reduce fly-rock and ground vibration.
- Using long stemming columns in blast holes (Stemming column greater than burden should be practised).
- Stemming material - Drill cutting in dry holes and river sand free of clay in watery holes.

C) Control of Noise and Air overpressure -

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Since blasting is a short-lived phenomenon and frequency of blast does not exceed one or two per day there is apparently no danger of noise exposures to workers and inhabitants. However, air overpressure and noise will be reasonably controlled by adopting the following precautions -

- Using long stemming columns in blast holes (stemming column greater than burden should be practised).
- Covering the detonating fuse with atleast 150 mm thick cover of sand/soil, drill cutting.
- No blasting will be done when strong winds are blowing towards the residences.

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After ceasation of the opencast workings and during underground mining, the effect of vibration as calculated based on Kathpal mines (FACOR) underground blasting parameters shown in ANNEXURE - E-30 (Page No. 216) will become very less. The Noise exposures to workers and nearby inhabitants will become almost NIL.

Control of Fly rock Generation - A combination of muffling and maintaining the stemming column length greater than the burden in all holes will be adopted for effective control of fly rock.

11(c)(x) MEASURES FOR PROTECTING HISTORICAL MONUMENTS AND FOR REHABILITATION OF HUMAN SETTLEMENTS LIKELY TO BE DISTURBED DUE TO MINING ACTIVITY -

There are no Historical Monuments in the area and due to mining there will be no rehabilitation of human settlements.

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11(c)(xi) SOCIO-ECONOMIC BENEFITS ARISING OUT OF MINING -

FACOR has two Mining leases in this valley i.e. Kathpal Chromite Mines and Ostapal Chromite mines which are 4 Km and 9 Km distance from the proposed Mining project respectively and extending the following Socio-economic developments in the nearby villages since 1972.

- HEALTH -

FACOR is maintaining two dispensaries with qualified paramedical team and providing free medical treatment and ambulance facility to the nearby villagers. Free eye operational camps, family planning camps, general medical camps are organised by the Company.

- EDUCATION -

TWO no. schools upto Vth standard and VII standard are being maintained with free educational facility.

- For drinking water purposes, tube wells were installed in the nearby villages.

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- Repairing and maintenance of the roads leading to the nearby villages, construction of cause ways and culverts are being made in the nearby villages.

- FACOR is organising cultural activities regularly in both their mines and extending donations to the nearby villages for organising cultural activities.

- Seedlings are being supplied on free of cost from the company's nurseries maintained in both the mines to the nearby villages for development of afforestation.

Further, apart from introducing eco-friendly mining and generating employment, FACOR will take care and will pay special attention in upliftment of Socio-economic conditions of the nearby villagers of this project, by providing facilities towards -

- Health.
- Education.
- Roads Development.
- Drinking Water facility.
- Cultural and Recreational activities.
- Afforestation and Environment.

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11 - d) :

TABLE - 28

MONITORING SCHEDULE FOR DIFFERENT ENVIRONMENT COMPONENTS

Sl. No.	I t e m	Period of Monitoring	Location of Monitoring Stations
1)	Ground Vibration Study	One year from the commencement of project.	1) Colony, 2) Near by village, 3) Public Road 4) Near by Mines structures.
2)	Air Quality	Winter, Summer, Monsoon, Post-monsoon.	1) Core Zone:- a) Centre of quarry, b) Residential Area 2) Buffer zone :- a) Bhimtangar, b) Birasal, c) Sandasar, d) Ostia, e) Ransol.
3)	Water Quality	Winter, Summer, Monsoon, Post-monsoon.	1) Core zone :- a) Mine pumped out water, b) Mine discharge water after treatment, c) Tube well water, d) Dug well water. 2) Buffer zone :- a) Damsal nala 100 M upstream where mine discharge water joins. b) Damsala nala 100 M down stream from joining point of mine discharge water. c) Tube well water of village Kalarangi, Kathpal, Ramsol, Kusumunda, Kaliapani etc. d) Dug well water of village Kalarangi, Kathpal, Ramsol, Kusumunda, Kaliapani etc.
4)	Soil Quality	Winter Season	1) Core Zone :- a) Quarry area, b) Plantation area, c) Dump area. 2) Buffer zone :- a) Agricultural land, b) Forest area, c) Barren land.
5)	Noise	Winter, Summer, Monsoon, Post-monsoon.	1) Core Zone :- a) Centre of the quarry, b) Machinery location, c) Residential area. 2) Buffer zone :- a) Village Kalarangi, Kaliapani, Kusumundia, Ramsol, Bhimtangar.

ANNEXURES

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ANNEXURE - E-1

DETAILS OF SURFACE WATER BODIES

Sl. No.	Name/ Location	Type of Water body	Numbers existing	Type of use
1-	Damsal Nala (1 Km north of lease area)	Perennial nala	01	Agriculture. Domestic & for animals
2-	Nangalkanta nala	Seasonal nala	01	- do -
3-	Kharkhari	Reservior	01	- do -
4-	Pirasal	Pond	02	Bathing, Agriculture & fishing
5-	Kamrulei	Pond	01	Bathing & Agriculture
6-	Kakudia	Pond	01	- do -
7-	Bhalukipatal	Pond	01	- do -
8-	Anal	Pond	04	- do -
9-	Majhipal	Pond	01	- do -
10-	Badakatia	Pond	01	- do -
11-	Chungidipal	Pond	01	Bathing
12-	Patna	Pond	01	- do -
13-	Saruabil	Pond	01	Bathing & Agriculture
14-	Kusumundia	Pond	01	- do -

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ANNEXURE - E-2

PLANT SPECIES FOUND IN CORE ZONE

TREE :

Sl. No.	FAMILY	Sl. No.	BOTANICAL NAME	Local Name
1)	Apocynaceae	1)	Alstonia scholaris	Chatiana
2)	Annonaceae	2)	Annona squamosa	Ata
3)	Anacardiaceae	3)	Mangifera indica	Amba
		4)	Spondias pinnata	Ambada
4)	Caesalpiniaceae	5)	Cassia siamea	Chakunda
		6)	Tamarindus indica	Tentuli
5)	Combretaceae	7)	Terminalia bellirica	Bahada
		8)	Terminalia tomentosa	Asan
		9)	Terminalia chebula	Harida
6)	Dipterocarpaceae	10)	Shorea robusta	Sal
7)	Ebenaceae	11)	Diospyros melanouylon	Kendu
8)	Meliaceae	12)	Azadirachta indica	Neem
9)	Moraceae	13)	Artocarpus heterophyllus	Panas
		14)	Ficus religiosa	Asta
		15)	Ficus benghalensis	Baro
10)	Myrtaceae	16)	Syzygium cumini	Jamun
11)	Papilionaceae	17)	Delonix regia	K. Chuda
		18)	Delonix elata	R. Chuda
12)	Rhamnaceae	19)	Ziziphus jujuba	Barkoli
13)	Rutaceae	20)	Chloroxylon swietenia	Bharu
14)	Sapindinaceae	21)	Schleichera olease	Kusuma
15)	Sapotaceae	22)	Mudhuca indica	Mohul
16)	Simarubaceae	23)	Ailanthus excelsa	Mahala

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ANNEXURE - E-2

PLANT SPECIES FOUND IN CORE ZONE

TREE :

Sl. No.	FAMILY	Sl. No.	BOTANICAL NAME	Local Name
1)	Apocynaceae	1)	Alstonia scholaris	Chatiana
2)	Annonaceae	2)	Annona squamosa	Ata
3)	Anacardiaceae	3)	Mangifera indica	Amba
		4)	Spondias pinnata	Ambada
4)	Caesalpiniaceae	5)	Cassia siamea	Chakunda
		6)	Tamarindus indica	Tentuli
5)	Combretaceae	7)	Terminalia bellirica	Bahada
		8)	Terminalia tomentosa	Asan
		9)	Terminalia chebula	Harida
6)	Dipterocarpaceae	10)	Shorea robusta	Sal
7)	Ebenaceae	11)	Diospyros melanouylon	Kendu
8)	Meliaceae	12)	Azadirachta indica	Neem
9)	Moraceae	13)	Artocarpus heterophyllus	Panas
		14)	Ficus religiosa	Asta
		15)	Ficus benghalensis	Baro
10)	Myrtaceae	16)	Syzygium cumini	Jamun
11)	Papilionaceae	17)	Delonix regia	K. Chuda
		18)	Delonix elata	R. Chuda
12)	Rhmnaceae	19)	Ziziphus jujuba	Barkoli
13)	Rutaceae	20)	Chloroxylon swietenia	Bharu
14)	Sapindinaceae	21)	Schleichera olease	Kusuma
15)	Sapotaceae	22)	Mudhuca indica	Mohul
16)	Simarubaceae	23)	Ailanthus excelsa	Mahala

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SHRUBS :

Sl. No.	F A M I L Y	Sl. No.	BOTANICAL NAME	Local Name
1)	Alangiaceae	1)	Alangium chinese	Ankula
2)	Apocynaceae	2)	Holarrhena antidysenterica	Kurai
3)	Asclepiadaceae	3)	Calotropis procera	Arakha
4)	Euphorbiaceae	4)	Breynia rhamnoides	Jajango
5)	Lamiaceae	5)	Flacourtia indica	Kantaikoli
6)	Papilionaceae	6)	Tephrosia purpurea	Nalipohora
7)	Rhamnaceae	7)	Ziziphus numularia	Kantoikoli
8)	Rubiaceae	8)	Gardenia turgida	Kurudo
9)	Solanaceae	9)	Datura stramonium	Dudura
10)	Verbanaceae	10)	Lantana camara	Nagoboiri
CLIMBERS/CREEPERS :				
1)	Combretaceae	1)	Calyropteris floribunda	Atundi
2)	Convolvulaceae	2)	Evolvulus alsinoides	Bichamelia
3)	Euphorbiaceae	3)	Tragia involucrata	Bichuati
4)	Cucurbitaceae	4)	Trichosanthes bracteata	Mahakala
		5)	Trichosanthes cucumerina	Banopo tala
5)	Papilionaceae	6)	Mucuna pruriens	Baidanka
6)				
HERBS :				
1)	Amaranthaceae	1)	Achyranthes aspera	Apamarang
2)	Caesalpiniaceae	2)	Cassia occidentalis	Ghoda chakunda
		3)	Casela sophera	Nali chakunda
3)	Compositae			
4)	Convolvulaceae	4)	Ipomoea maxima	Musakani
5)	Euphorbiaceae	5)	Euphorbia nerifolia	Patra siju
6)	Malvaceae	6)	Sid acordata	Bajramuli
7)	Minosaceae	7)	Minosa pudica	Lajakulilata
8)	Urticaceae	8)	Laportea interrupta	Bichuati
9)	Acanthaceae	9)	Andrographis paniculatus	Chireeta
10)	Amaran thaceae	10)	Alternathera sessilis	Madaranga
11)	Boraginaceae	11)	Heliotropium indicum	hatisundha
12)	Caesalpiniaceae	12)	Cassia tora	Chakundi
13)	Compositae	13)	Ageratum conyzoides	Fokasungha
14)	Papilionaceae	14)	Blumea lacera	Badipokasungha
15)	Solanaceae	15)	Sesbania aculeata	Dhanicha
16)		16)	Solanum surattense	Bhajibaigana

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GRASS :

Sl. No.	FAMILY	Sl. No.	BOTANICAL NAME	Local Name
1)	Cyperaceae	1)	Cyperus rotundus	Mutha
2)	Gramineae	2)	Aristida setacea	Khadikha ghasa
		3)	Cynodon dactylon	Dubo
		4)	Saccharum spon taneum	Tandi
		5)	Tribulus terretris	Gokhara
3)	Zygophyllaceae			
4)	Amaranthaceae	6)	Aerva lanata	Pausia
5)	Commelinaceae	7)	Commelina benghalensis	Kanesiri
6)	Gramineae	8)	Oplismenus burmanii	Kaugodia

EPIPHYTES	PARASITES
1) Vanda spe	1) Viscum monoicium (Malang)
2) Jussiea spe	2) Cuscuta reflexa (Nirmuli)

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CLASSIFICATION OF BUFFER ZONE FLORA.

A. FUNGI

1. Mucor
2. Rhizophus
3. Lichen

B. BRYOPHYTES (MOSS)

1. Funaria
2. Polytrichum
3. Barbula

C. PTERIDOPHYTES (FERNS)

1. Polypodium
2. Pteris
3. Dryopteris
4. Adiantum

D. GYMNOSPERMS (CYCAS)

1. Cycas circinalis

E. EPIPHYTES

1. Vanda sps
2. Jussiea sps.

F. PARASITES

1. Visicum monoicum (Malang)
2. Dendrophthoe falcata (Malang)
3. Cuscuta reflexa (Nirmuli)

G. ANGIOSPERMS

ENCLOSED THE LIST OF SPECIES.

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CLIMBERS AND GRASS SPECIES) OF *BUFFER ZONE*

Sl. No	FAMILY	Sl. No	BOTANICAL NAME	LOCAL NAME
TREE				
01	Anacardiaceae	1.	Anacardium occidentale	Cashew
		2	Buchanania lanzan	Charo
		3.	Lannea coromandelica	Mohi
		4.	Mangifera indica	Mango
		5.	Semecarpus anacardium	Bhalia
		6.	Spondias pinnata	Ambada
02	Annonaceae	7.	Alphonsea lutea	Ghanta
		8.	Annona squamosa	Ata
		9.	Miliusa tomentosa	Gandhapolash
03	Apocynaceae	10.	Alstonia scholaris	Chatiana
04	Arecaceae	11.	Borassus flabellifer	Talo
05	Bombacaceae	12.	Bombax ceiba	Simili
06	Caesalpiniaceae	13.	Bauhinia purpurea	Kanchan
		14.	Cassia auriculiformis	Badochakunda
		15.	Cassia fistula	Sunari
		16.	Cassia siamea	Chakunda
		17.	Saroca asoca	Ashok
		18.	Tamarindus indica	Tentuli
07	Capparaceae	19.	Crateva nurvala	Boruna
08	Celastraceae	20.	Cassine glauuca	Mukha
09	Combretaceae	21.	Anogeissus accuminata	Dhou
		22.	Terminalia chebula	Harida
		23.	Terminalia belirica	Bahada
		24	Terminalia ariuna	Arjun
		25	Terminalia tomentosa	Asan

contd

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Sl. No.	FAMILY	Sl. No.	BOTANICAL NAME	LOCAL NAME
10.	Dipterocarpaceae	26.	Shorea robusta	Sal
12.	Dilleniaceae	27.	Dillenia pentagyna	Rai
		28.	Dillenia indica	Oau
13.	Ebenaceae	29.	Diospyros sylvatica	Kochila
		30.	Diosphros melanoxylon	Kendu
		31.	Diospyros macrophylla	Mankada Kendu
		32.	Diospyros tomentosa	Bidikendu
14.	Euphorbiaceae	33.	Bridelia retusa	Kasi
		34.	Emblica officinalis	Amla
		35.	Macaranga peltata	Gandhagaran
15.	Fabaceae	36.	Pongamia pinnata	Karanj
		37.	Pterocarpus marsupium	Piasal
16.	Lytheraceae	38.	Lagerstroemia parviflora	Sidho
		39.	Lagerstroemia reginae	Paatoli
17.	Lecythidaceae	40.	Barring tonia acutangula	Hingolo
18.	Meliaceae	41.	Azadi rachta indica	Neem
		42.	Melia composita	Batra
19.	Mimosaceae	43.	Albizia lebbeck	Siris
		44.	Pithecellobium dulce	Bilati kayan
		45.	Samanea saman	Nirabati
20.	Moraceae	46.	Artocarpus heterophyllus	Panas
		47.	ficus benghalensis	Baro
		48.	Ficus benjamina	Kuji Baro
		49.	Ficus hispida	Dimiri
		50.	Ficus religiosa	Asta
		51.	Streblus asper	Sahada
21.	Moringaceae	52.	Moringa oleifera	Sajana
22.	Myrtaceae	53.	Psidium guajava	Guava
		54.	Syzygium cerasoides	Kadua jamu
		55.	Syzygium cumini	Jamun
23.	Papilionaceae	56.	Butea monosperma	Polash
		57.	Dalbergia lanceolaria	Sitanapati
		58.	Dalbergia sissoo	Sissoo
		59.	Delonix regia	Krushnachuda
		60.	Delonix elata	Radhachuda
		61.	Ougenia oojeinensis	Bandhan

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24.	Rhamnaceae	62.	Ziziphus jujuba	Barokoli
25.	Rubiaceae	63.	Adina cordifolia	Kurumo
		64.	Anthocephalus cadamba	Kadamba
		65.	Gardenia gummifera	Gurudu
		66.	Gardenia latifolia	Damakurudu
		67.	Morinda tinctoria	Achu
		68.	Mitragyna parviflora	Kalikadamba
		69.	Xylia xylocarpa	Tingini
26.	Rutaceae	70.	Aegle marmelos	Bael
		71.	Limonia acidissima	Koitho
27.	Sapotaceae	72.	Madhuca indica	Mohul
28.	Sapindinaceae	73.	Manicare hexandra	Khirokoli
		74.	Schleichera oleosa	Kusuma
29.	Simarubaceae	75.	Ailanthus excelsa	Mahala
30.	Sterculiaceae	76.	Pterospermum canescens	Giringo
		77.	Sterculia urens	Ganduli
31.	Symplocaceae	78.	Sympiocos racemosa	Lodha
32.	Verbanaceae	79.	Gmelina arborea	Gambar

S. No.	FAMILY	Sl No.	BOTANICAL NAME	LOCAL NAME
SHRUBS				
01.	Acanthaceae	1.	Adhatoda zeylanica	Basang
02.	Alangiaceae	2.	Alangium chinense	Ankula
03.	Apocynaceae	3.	Holarrhena antidysenterica	Kurai
		4.	Nerium indicum	Karobiro
		5	Rauvolfia serpentina	Patal gorud
04	Asclepiadaceae	6.	Calotropis procera	Arakha
05	Euphorbiaceae	7	Breynia rhamnoides	jajangi
06	Flacourtiaceae	8.	Flacourtia cataphracta	Banicha
07	Lamiaceae	9	Flacourtia indica	Kantaikoli
		10	Anisomeles indica	Bhutomari
08	Meliaceae	11	Naregamia alata	Pitamari
09	Menispermaceae	12	Anamirta cocculus	Kakomari
10	Myrtaceae	13	Psidium cattleyanum	Pahadi pijuli
11	Nyctaginaceae	14	Nyctanthes arbortristis	Gangasiuli
12.	Papilionaceae	15	Flemingia chappar	Singhapuma
		16.	Tephrosia purpurea	Nalipohora
13.	Plumbaginaceae	17.	Plumbago indica	Raktachita
14.	Rhamnaceae	18.	Ziziphus numularis	Kantoikoli
15.	Rubiaceae	19.	Gardenia turgida	Kurudo
16.	Rutaceae	20.	Murrsaya koenigii	Bhurusunga
17.	Solanaceae	21.	Datura stramonium	Dudura
18	Verbanaceae	22.	Lantana camara	Nagoboiri
		23	Vitex negundo	Bagunia

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Sl. No	FAMILY	Sl No	BOTANICAL NAME	LOCAL NAME
CLIMBERS/CREEPERS (Long Lived)				
01.	Amaryllidaceae	1.	Agave americana	Sudarsan lahi
02.	Apocynaceae	2.	Aganosoma dichotoma	Malati
		3.	Carissa inermis	Caranda lata
03.	Caesalpiniaceae	4.	Bauhinia vahlii	Sialipatra
		5.	Caesalpinia decapetala	Gilo
04.	combretaceae	6.	Calycopteris floribunda	Atundi
05.	Convolvulaceae	7.	Evolvulus alsinoides	Bichamalia
06.	Euphorbiaceae	8.	Bridelia retusa	Lotakosi
		9.	Tragia involucrata	Bichuati
07.	Liliaceae	10.	Smilax macrophylla	Muturi
08.	Malpighiaceae	11.	Hiptage benghalensis	Madhabilata
09.	Menispermaceae	12.	Tinospora cordifolia	Guguchilata
10.	Oleaceae	13.	Jasminum arborescens	Banomali
		14.	Jasminum auriculatum	Juhi
11.	Papilionaceae	15.	Butea superba	Polashlota
	(Short Lived)			
01	Cucurbitaceae	1.	Momordica dioica	Kankada
		2.	Momordica charantia	Tusikolara
		3.	Trichosanthes bracteata	Mahakala
		4.	Trichosanthes cucumerina	Banopo tala
02	Dioscoreaceae	5.	Dioscorea glabra	Kantaalu
		6.	Dioscorea pentaphylla	Bano alu
		7.	Dioscorea wallichii	Pita alu
03	Liliaceae	8.	Asparagus recemosus	Satabari
04	Papilionaceae	9.	Abrus precatorius	kaincha
		10	Clitoria ternatea	Aparajita
		11	Mucuna pruriens	Baidanka
05	Vitaceae	12.	Cayratia auriculata	kanjikanjia

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Sl.No	FAMILY	Sl.No	BOTANICAL NAME	LOCAL NAME
HERBS (Long lived)				
01.	Amaranthaceae	1.	Achyranthes aspera	Apamarang
02.	Caesalpiniaceae	2	Cassia occidentalis	Ghoda chakunda
		3	Cassia sophera	Nali chakunda
03.	Composi tae	4	Eclipta alba	Kesadura
04	Convolvulaceae	5	Ipomoea maxima	Musakani
05	Euphorbiaceae	6	Euphorbia neriifolia	Patra siju
06.	Labiatae	7	Ocimum basilicum	Banatulasi
		8	Ocimum sanctum	Tulasi
07	Malvaceae	9	Sid acordata	Barancali
08	Mimosaceae	10	Mimosa pudica	Lajakatilary
09	Papilionaceae	11	Uraria lagopoides	Akua
10.	Piperaceae	12	Peperomia pullucida	usuripano
11.	Urticaceae	13	Laportea interrupta	Bichuati
HERBS.(Short Lived)				
01.	Acanthaceae	1	Andrographis paniculatus	Chireeta
		2	Hygrophila auriculata	Koelekha
02.	Aizoaceae	3	Glinus oppositifolius	Pitasaga
03.	Amaran thaceae	4.	Alternanthera sessilis	Madaranga
		5.	Amaranthus viridis	Bano neutia
		6.	Amaranthus spinosus	Kantaneutia
04.	Apoaceae	7	Centella asiatica	Thalkudi
05.	Araceae	8.	Amorphophallus campanulatus	Oluo
		9.	Colocasia sps	Banosaru
06.	Boraginaceae	10	Heliotropius indicum	hatisundha
07.	Caesalpiniaceae	11.	Cassia tora	Chakundi
08.	Capparaceae	12.	Cleome gynandra	Anosorisha
09.	Compositae	13.	Ageratum conyzoides	Pokasungha
		14.	Blumea lacera	Badipokasungha
		15.	Gnaphalium indicum	Nak achinkuni
		16.	Verionia cinerea	Kukursungha
		17.	Tridax procumbens	Bisalyakarani
10.	Convolvulaceae	18	Ipomoea maxima	Musakani
11	Euphorbiaceae	19	Phyllanthus niruri	Bhuinanla
		20	Acalypha indica	Nakichana
12.	Labitae	21	Lecus aspera	Gayashi
		22	Leonotis nepetifolia	Kantasia
13	Malvaceae	23	Abelmoschus manihot	Banobhendi
		24	Abutilon indicum	Padipadica
14	Nyctaginaceae	25	Boerhavia diffusa	Purum
		26.	Mirabilis jalapa	Banophulo
15	Papilionaceae	27.	Flemingia macrophylla	Banokandulo
		28.	Melilotus indicus	Banomethi
		29.	Sesbania aculeata	Dhanicha
16	Solanaceae	30	Solanum surattense	Bhajibaigana

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S.No	FAMILY	S.No.	BOTANICAL NAME	LOCAL NAME
GRASS (LONG LIVED)				
01.	Cyperaceae	1.	Cyperus rotundus	Mutha
		2.	Lipocarpha sphacelata	Mutha ghasa
02.	Gramineae	3.	Aristida setacea	Khadikha ghasa
		4.	Bambusa arundinacea	Kanta bausa
		5.	Bambusa tulda	Telengi bausa
		6.	Bambusa valgaris	Bausa
		7.	Cynodon dactylon	Dubo
		8.	Desmostachya bipinnata	Kuso
		9.	Saccharum munja	Bausatruna
		10.	Saccharum spon taneum	Tandi
		11.	Thysanolaena maxima	Phulo chanchuni
03.	Zygophyllaceae	12.	Tribulus terretris	Gokhara
	(Short lived)			
01.	Amaranthaceae	1.	Aerva lanata	Pausia
		2.	Celosia cristata	Eswarjata
02.	Commelinaceae	3.	Commelina benghalensis	Kanosiri
03.	Gramineae	4.	Dactyloctenium-aegyptium	Kakuria ghasa
		5.	Oplismenus burmanii	kangodia
04.	Zingiberaceae	6.	Curcuma aromatica	Banohaladi

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AQUATIC FLORA (MACRO)		
1)	Eleccharis	(Marginal)
2)	Cyperus	(Marginal)
3)	Ipomoea	(Marginal)
4)	Marsilia	(Marginal)
5)	Monochoria	(Marginal)
6)	Utricularia	(Submersed)
7)	Hydrilla	(Submersed)
8)	Potamogeton	(Submersed)
9)	Najas	(Submersed)
10)	Chara	(Submersed)
11)	Nelumbo	(Submersed)
12)	Nymphaea	(Submersed)
13)	Spirodela	(Floating)
14)	Eichhornia	(Floating)
15)	Azolla	(Floating)
16)	Lemna	(Floating)
17)	Pistia	(Floating)
18)	Trapa	(Submersed)

APPROVED

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Regd. No. ROP/CAL/239/98/A

QUANTITATIVE STRUCTURE OF PLANT COMMUNITY (TREE) OF BUFFER ZONE

LOCATION : 7 Km from the project - Western Direction

Sl. No.	Name of Species	F	D	AB	RF	RD	RDO	IVI
1)	Anogeissus latifolia (Dhou)	40	1.4	3.5	5.6	5.8	5.2	16.6
2)	Azadirachta indica (Neem)	40	1.2	3.0	5.6	5.0	4.3	14.9
3)	Bridilia retusa (Kasi)	40	0.8	2.0	5.6	3.3	2.8	11.7
4)	Careya arborea (Kumbi)	40	1.4	3.5	5.6	5.8	5.1	16.5
5)	Dillenia pentagyna (Rai)	60	1.0	1.7	8.4	4.2	3.6	16.2
6)	Madhuca indica (Mad Mohul)	100	3.6	1.6	14.0	15.0	17.7	46.7
7)	Pongamia pinnata (Karanj)	60	2.0	3.3	8.4	8.3	7.3	24.0
8)	Scheichera trijuga (Kusum)	40	1.2	3.0	5.6	5.0	4.2	14.8
9)	Syzygium cumini (Jamun)	40	0.8	2.0	5.6	3.3	2.2	11.1
10)	Shorea robusta (Sal)	80	4.8	6.0	11.2	20.0	22.9	54.1
11)	Terminalia tomentosa (Asan)	60	3.2	5.3	8.4	13.3	15.8	37.5
12)	Terminalia bellirica (Bahada)	40	1.2	3.0	5.6	5.0	4.3	14.9
13)	Xylia xylocarpa (Tingini)	60	1.4	2.3	8.4	5.8	4.6	18.8

REMARKS : Total no. of individual species encountered = 120 and Total no. of occurrence = 36.

Diversity Index = 1.13

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Regd. No. RDP/CAL/220/98/A

APPROVED

ANNEXURE : E-4

QUANTITATIVE STRUCTURE OF PLANT COMMUNITY (TREE) OF BUFFER ZONE

LOCATION : 5 Km from the project in South-Eastern direction

Sl. No.	Name of species	F	D	AB	RF	RD	RDO	IVI
1)	Aegle marmelos (Bael)	40	0.8	2.0	5.8	3.8	2.1	11.7
2)	Anogeissus acuminata (Dhau)	40	1.2	3.0	5.8	5.7	4.2	15.6
3)	Bauhinia purpurea (Kanchan)	40	1.0	2.5	5.8	4.8	3.2	13.8
4)	Bridelia retusa (Kasi)	60	1.0	1.7	8.7	4.8	4.3	17.8
5)	Dillenia pentagyna (Rai)	60	1.6	2.6	8.7	7.6	6.2	22.5
6)	Diospyros melanoxylon (Kendu)	80	1.8	2.25	11.6	8.6	9.5	29.7
7)	Madhuca indica (Mohul)	80	4.2	5.25	11.6	20.0	22.3	55.9
8)	Mangifera indica (Mango)	60	1.2	2.0	8.7	5.7	7.2	21.6
9)	Shorea robusta (Sal)	100	5.0	5.0	14.5	23.8	27.3	65.6
10)	Terminalia tomentusa (Asan)	60	1.2	2.0	8.7	5.7	7.2	21.6
11)	Tamarindus indica (Tentuli)	40	0.8	2.0	5.8	3.8	3,4	13.0
12)	Ziziphus jujuba (Barkoli)	40	1.2	3.0	5.8	5.7	3.3	14.8

REMARKS : Total nos. of individual species encountered - 105 and Total nos of occurrance - 35.

Diversity Index = 1.06

Annx. E-4

QUANTITATIVE STRUCTURE OF PLANT COMMUNITY (TREE) OF BUFFER ZONE

LOCATION : 6 Km from project in SW

Sl. No.	N a m e of species	F	D	AB	RF	RD	RDO	IVI
1)	Anogeissus latifolia (Dhou)	40	0.6	1.5	4.4	2.1	1.9	8.4
2)	Buchannia latifolia (charo)	60	1.6	2.7	6.6	5.6	4.3	16.5
3)	Bridelia retuga (Kasi)	40	1.2	3.0	4.4	4.2	3.6	12.2
4)	Diospyros melanoxylon (Kendu)	80	2.8	3.5	8.8	9.8	11.9	14.8
5)	Dillenia pentagyna (Rai)	40	1.6	4.0	4.4	5.6	4.8	14.8
6)	Madhuca indica (Mohul)	100	3.6	3.6	11.0	12.6	14.7	38.3
7)	Phyllanthus imblica (Amla)	60	1.6	2.7	6.6	5.6	3.4	15.6
8)	Pongamia pinnata (Karanj)	60	0.8	1.4	6.6	2.8	1.6	11.0
9)	Shorea robusta (Sal)	100	5.2	5.2	11.0	18.3	21.4	50.7
10)	Schleichera trijuga (Kusum)	40	1.6	4.0	4.4	5.6	4.3	13.9
11)	Terminalia bellirica (Bahada)	60	1.2	2.0	6.6	4.2	2.9	13.7
12)	Terminalia tomentosa (Asan)	60	3.0	5.0	6.6	10.6	12.3	29.5
13)	Terminalia arjuna (Arjun)	60	1.8	3.0	6.6	6.3	8.8	21.7
14)	Xylia xylocarpa (Tingini)	60	1.0	1.7	6.6	3.5	2.8	12.9
15)	Ziziphus jujuba (Barkoli)	40	0.8	2.0	4.4	2.8	1.3	8.5

REMARKS : Total no. of individual species encountered - 142 and Total no. of occurrance - 45.

Diversity Index = 1.13.

ANNEXURE - E-4

QUANTITATIVE STRUCTURE OF PLANT COMMUNITY (TREE OF BUFFER ZONE)

LOCATION : 6 Km from Project area in ENE direction

Sl. No.	Name of species	F	D	AB	RF	RD	RDO	IVI
1)	Bridelia retusa (Kasi)	60	0.6	1.0	8.1	2.8	2.6	13.5
2)	Butea monosperma (Polash)	40	0.6	1.5	5.4	2.8	2.3	10.5
3)	Cassia fistula (Sunari)	40	0.6	1.5	5.4	2.8	2.2	10.4
4)	Careya arborea (Kumbi)	40	0.8	2.0	5.4	3.7	2.4	11.5
5)	Diospyros melanoxylon (Kendu)	80	3.6	4.5	10.8	17.0	19.7	47.5
6)	Madhuca indica (Mohul)	80	3.2	4.0	10.8	15.1	18.3	44.2
7)	Pongamia pinnata (Karanj)	40	1.2	3.0	5.4	5.6	4.7	15.7
8)	Semecarpus anacardium (Bhalia)	40	0.8	2.0	5.4	3.7	2.8	11.9
9)	Shorea robusta (Sal)	100	4.4	4.4	13.5	20.8	18.3	52.6
10)	Spondias pinnata (Ambada)	40	0.8	2.0	5.4	3.7	3.5	12.6
11)	Syzygium cumini (Jamun)	40	1.6	4.0	5.4	7.5	8.6	21.5
12)	Terminalia tomentosa (Asan)	60	1.2	2.0	8.1	5.6	6.7	20.4
13)	Terminalia arjuna (Arjun)	40	1.0	1.5	5.4	4.7	5.6	15.7
14)	Xylia xylocarpa (Tingini)	40	0.8	2.0	5.4	3.7	2.3	11.4

REMARKS :- Total nos. of induvidual species encountered - 106 and Total nos of occurrance - 37.

Diversity Index : 1.05

ANNEXURE - E-4

QUANTITATIVE STRUCTURE OF PLANT COMMUNITY (TREE) OF BUFFER ZONE

LOCATION : 5 km from the project in Northern Direction

Sl. No.	Name of Species	F	D	AB	RF	RD	RDO	IVI
1)	Alstonia scholaris (chatiana)	60	1.2	2.0	6.9	4.9	4.2	16.0
2)	Annona squamosa (Ata)	60	1.6	2.7	6.9	6.5	5.9	19.3
3)	Bouhinia purpurea (Kanchan)	60	0.6	1.0	6.9	2.5	1.7	11.1
4)	Cassia fistula (Sundri)	60	1.0	1.7	6.9	4.1	3.3	14.3
5)	Diospyros melanoxylon (Kendu)	80	3.0	3.75	9.2	12.3	13.8	35.3
6)	Madhuca indica (Mohul)	100	2.8	2.8	11.5	11.5	14.7	37.7
7)	Manicara hexandra (khirkoli)	40	0.6	1.5	4.6	2.5	1.6	8.7
8)	Ougeinia oojeinsis (Bandhan)	40	0.8	2.0	4.6	3.3	2.7	10.6
9)	Shorea robusta (Sal)	80	4.4	5.5	9.2	18.0	22.6	49.8
10)	Syzygium cumini (Jamun)	60	1.6	2.7	6.9	6.5	7.2	20.6
11)	Tamarindus indica (Tentuli)	60	1.2	2.0	6.9	4.9	3.6	15.4
12)	Terminalia bellirica (Bahada)	60	1.4	1.17	6.9	5.7	3.4	15.3
13)	Terminalia tomentosa (Asan)	60	2.2	3.7	6.9	9.0	9.6	16.5
14)	Terminalia chebula (Harida)	60	1.8	3.0	6.9	7.4	5.7	20.0

REMARKS : Total no. of individual species encountered = 122 and Total no. of occurrence = 44

Diversity Index : 1.08

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Annx. E-4

ANNEXURE - E-5

LIST OF WILD LIFE AVAILABLE IN BUFFER ZONE WITH REFERENCE OF SCHEDULE NUMBERS AS PER WILD LIFE (PROTECTION) ACT,1972

MAMMALS

S.No.	Local Name	English Name	Zoology Name	Schedule
1.	Banabilei	Jungle cat	Felis chaus affinis	SII/PII
2.	Bilua	Jackal	Canis aurens-indicus	SV SII/PII
3.	Gunduchimusa	Squirrel	Funumbulus palmarum palmarum	SV
4.	Heta (Gadhia)	Hyena	Hyena hyaena	SIII
5.	Jhinka	Porcupine	Hystrix indica indica	SIV
6.	Katas (Dali Odha)	Toddy cat	Paramours hermaphroditus	SV
7.	Kattas	Large Indian civet	Viverra zibetha	
8.	Kutura	Barking deer	Muntiacus muntjak malabaricus	SIII
9.	Mankad (Hanu)	Monkey	Presbytis entellus entellus	SII
10.	Mankad (Pati)	Rhesus macaque	Macaca mullata	SII
11.	Musa	Rat	Rattus raftus	SV
12.	Neula	Mongoose (Common)	Herpestes edwardsi	SIV
13.	Neula (Kuji)	Small Indian mongoose	Herpestes auropunctatus	SIV
14.	Sambar	Sambar	Cervus unicolor	SIII
15.	Thekua	Hare	Lepus nigricollis ruficaudatos	SIV

Contd....

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BIRDS

SL.NO	Local Name	English Name	Zoology Name	Schedule
1.	Bani		Aeridothares tristis tristis	SIV
2.	Baja -	Weaver bird	Ploceus philippinus	SIV
3.	Bayapakhi		Astur badius	SIV
4.	Bana Kukuda	Jungle fowl (red)	Gallus gallus murghi	SIV
5.	Baga	Little egrel	Ergetta garzetta	SIV
6.	Bhadbhadalia		Coracias benghalensis benghalensis	SII
7.	Bhrungaraj	Racket tailed drango	Dicrurus grandis	SIV
8.	Chataka	House shift	Micropus affinis	
9.	Common kora		Aegithina tiphia tiphia	SIV
10.	Dahuka		Amauronix phoenicurus phoenicurus	SIV
11.	Deuntipara		Columba livia intermedia	SIV
12.	Gentalia	Open bill strok	Anastomusus oscitans	SIV
13.	Gharchhatia		Passor domesticus	SIV
14.	Gobar chadheri		Molpastes cafer	SIV
15	Haladibasanta		Oriolus xanthornus maderaspatanus	SIV
16	Katalpati		Dicrurus adsimilis macrocercurs	
17	Kau (Pati)		Cervus splendens splendens	SV
18.	Kau (Damara)		Cervus macrorhynechos cuminaus	SV
19.	Koili	Indian Koel	Eudynamys scolopacea scolopacea	SIV
20.	Kumbhatua		Contropus sinensis parroti	SII
21.	Macharanka	King fisher	Caryle rudis leucomelanura	SIV
22	Panikua	Little cormorant	Phalacrocora niger	SIV
23	Pecha	Sothern spotttol owlet	Athena brama brama	SIV
24	Sari		Grakula religiosa peninsuslaris	SIV
25.	Saguan	Black or king vulture	Sacrcogyps calvus	SIV
26.	Sankhachilla	Brahminly Kite	Hailstorm indus indus	SIV
27	Teetri	Indian black partridge	Francolinus prancolinusasiac	SIV
28	White browed bulbul		Pycnonouts luteotus luteotus	SIV
29	Whisting teel		Dendrocygna javanica	SIV

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BIRDS

SL.NO	Local Name	English Name	Zoology Name	Schedule
1.	Bani		Aeridothares tristis tristis	SIV
2.	Baya -	Weaver bird	Ploceus philippinus	SIV
3.	Bayapakhi		Astur badius	SIV
4.	Bana Kukuda	Jungle fowl (red)	Gallus gallus murghi	SIV
5.	Baga	Little egrel	Ergetta garzetta	SIV
6.	Bhadbhadalia		Coracias benghalensis benghalensis	SII
7.	Bhrungaraj	Racket tailed drango	Dicrurus grandis	SIV
8.	Chatake	House shift	Micropus affinis	
9.	Common iora		Aegithina tiphia tiphia	SIV
10.	Dahuka		Amauronix phoenicurus phoenicurus	SIV
11.	Deuripara		Columba livia intermedia	SIV
12.	Gendalia	Open bill strok	Anastomusus oscitans	SIV
13.	Gharchhatia		Passor domesticus	SIV
14.	Gobar chadhei		Motpastes cafer	SIV
15.	Haladibasanta		Oriolus xanthornus maderaspatanus	SIV
16.	Kajalpati		Dicrurus adsimilis macrocercurs	
17.	Kau (Pati)		Cervus spiendens spiendens	SV
18.	Kau (Damara)		Cervus macrorhynechos cuminaus	SV
19.	Koili	Indian Koel	Eudynamys scolopacea scolopacea	SIV
20.	Kumbhatua		Contropus sinensis parroti	SII
21.	Macharanka	King fisher	Caryle rudis leucomelanura	SIV
22.	Panikua	Little cormorant	Phalacrocora niger	SIV
23.	Pecha	Sothern spotttol owlet	Athena brama brama	SIV
24.	Sari		Grakula religiosa peninsuslaris	SIV
25.	Saguan	Black or king vulture	Sacrcogyps calvus	SIV
26.	Sankhachilla	Brahminly Kite	Hailstorm indus indus	SIV
27.	Teetri	Indian black partridge	Francolinus prancolinusasiac	SIV
28.	White browed bulbul		Pycnonouts luteotus luteotus	SIV
29.	Whistling teel		Dendrocygna javanica	SIV

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REPTILES & AMPHIBIANS

Sl No.	Local Name	English Name	Zoology Name	Schedule
1.	Boda	Russell's viper	Vipara russelli	SII
2.	Chiti	Common Indian Krait	Bangarus caerulieus	SIV
3.	Dhanda	Rat snake	Ptyas mucosus	SII/PII
4.	Domundia	Common land boa	Eryx conicus	SIV
5.	Laudonkia	Common vine ondke	Ahaetulla nasutus	SIV
6.	Naga	Cobra	Naja naja	SII/PII
7.	Rana	Banded krait	Bungarus fasistus	SIV
8.	Tampa		Naja kauthia	SII/PII
9.	Telisapa		Ramphotyphlops	SIV
10.	Godhi	Indian monitor	Varanus bengalensis	SII
11.	Jhitipiti	Common Indian House geiko	Homydoctylus flevirudis	
12.	Jhitipiti	Spotted Indian House Geiko	H. brookii	
13.	Brahmuini Benga	Indian Bull Frog	Rana tigerina	SIV
14.	Katha Benga	Common Indian Toad	Bufo melanostictus	
15.		Indian Skipping Frog	Rana cynophlyctis	SIV
16.	Gochua Benga	Common Tree Frog	Ploypedates maculatus	
17.		Small Frog	Microphyla ornata	
18.	Bilo Benga	Paddy Field Frog / Indian Cricket Frog	Rana limnocharis	SIV

SOIL FAUNA

1. Tullus terrestria
2. Scolopendra sps
3. Neris virens
4. Drawida calebi
5. Drawida wilisi
6. Lampito mauritii
7. Peryonix excavatus

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AQUATIC FAUNA (Fishes)

Sl. No	Local Name	Zoological Name
1.	Balia	Wellgonia etru
2.	Baligenda	Glossogobius glusis
3.	Bhakura	Catla catla
4.	Changa	Notoperus chital
5.	Dandakhiri	Esomus dondrica
6.	Jalange	Pargasius pargasius
7.	Kantia	Myotus cavasins
8.	Kerondi	Barbus ambassis
9.	Kou	Anabas testudineus
10.	Magura	Clarias batrachus
11.	Mirkali	Cirrhina mrigala
12.	Mohurali	Amblyupharngodon mola
13.	Pohala	Cirrhina reba
14.	Phali	Notopterus notopterus
15.	Rohi	Labeo rohita
16.	Serana	Barbus serana
17.	Seula	Ophiocephalus striatus
18.	Singi	Heterophnaustes fossilis
19.	Todi	Mastacombelus armetus
20.	Apple snail	Pila globasa
21.	Fresh water mussel	Unio sps.
22	Fresh water mussel	Lamellidens sps.
23	Leech	Hirudinaria sps.
24.	Crab	Cancer sps.
25.	Prawn/	Paleomon sps.
26.	One eyed gaint	Cyclops sps.
27.	One eyed gaint	Ramatra sps.
28.	Waterbug	Belostoma sps.
29.	Back swimmer	Notcnecta sps.
30.	Terrapian	Lissemys punctata
31	Terrapian	Chitra indica
32.	Water snake	Natrin piscatan

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ARTHROPODS

Sl. No.	Local Name/English Name	Zoological Name
1.	Grass hopper	Locusta sps
2.	Honey bee	Asps sps
3.	Spider	Ageiena sps
4.	Common millipede	Julus sps
5.	Common silver fish	Lepisma sps
6.	Common colembola	Isotome sps
7.	Stick insect	Carausius sps
8.	Dragon fly	Agrian sps
9.	Kallikatara	Gryllotalpa sps
10.	Praying mantis	Mantis sps
11.	Cancer (Bichha)	Scorpion sps
12.	Silkmoth	Bombyx sps
13.	Lady bird beetle	Coccinella sps
14.	Beetle	Acalymma sps
15.	Termites	Microtermes sps
16.	Termites	Odontoermes sps

APPROVED

M. K. Pujari,

Regd. No. ROP/CAL/239/98/A

AMBIENT AIR QUALITY

PROJECT : BHIMTANGAR CHROMITE MINES, M/s.FACOR Ltd.
PERIOD : JANUARY TO DECEMBER - 2004
SURVEY CONDUCTED BY ENV.ENGG.LABORATORY, FACOR

UNIT : $\mu g/m^3$

Sl. No.	STATION	SEASONS	PARAMETERS				
			RPM	SPM	SO_2	NOx	CO
01.	Village - Bhimatangar	I	61.04	85.16	5.62	12.08	<1000
		II	58.32	82.34	3.76	13.74	<1000
		III	24.46	43.18	1.84	6.26	<1000
		IV	30.18	78.32	2.78	8.16	<1000
02.	Village - Biresal	I	36.08	67.39	2.01	6.94	<1000
		II	34.16	60.34	1.93	3.14	<1000
		III	18.52	35.46	0.97	2.58	<1000
		IV	31.02	56.48	1.37	3.05	<1000
03.	Village - Sendamar	I	29.14	51.39	1.89	5.67	<1000
		II	24.52	46.35	1.32	3.58	<1000
		III	17.82	34.37	0.92	2.34	<1000
		IV	24.31	42.39	1.45	4.94	<1000
04.	Village - Ostta	I	31.08	56.25	3.65	8.60	<1000
		II	28.86	54.16	3.42	7.54	<1000
		III	16.68	35.82	0.82	2.76	<1000
		IV	26.02	47.13	2.16	5.14	<1000
05.	Village - Kansol	I	36.18	68.32	2.64	5.72	<1000
		II	34.20	64.08	1.92	5.26	<1000
		III	16.92	30.14	0.64	2.02	<1000
		IV	25.97	47.85	1.36	3.28	<1000

STANDARD	AMBIENT AIR
RPM	150 (C.C5)
SPM	500 (-do-)
SO_2	120 (-do-)
NOx	120 (-do-)
CO.	5.00 (-do-)

Monitoring Schedule :- Weekly twice 24 hourly continuous month of a season.

M. K. Pujari,
Regd. No. ROP/CAL/220/98/A

FACOR
BHIMTANGAR

M. K. Pujari,
Regd. No. POP/CAL/239/98/A

AIR QUALITY

PROJECT : BHIMTANGAR CHROMITE MINES, M/s.FACOR LTD.
PERIOD : JANUARY TO DECEMBER - 2004
SURVEY CONDUCTED BY ENV.ENGG.LAB., FACOR

UNIT : µg/M³

Sl. No.	STATION	SEASONS	PARAMETERS				
			R P M	S P M	SO_2	NOx	CO
01.	Southside of the near old quarry	I	62.84	88.28	3.71	13.42	∠1000
		II	57.32	83.17	3.52	12.81	∠1000
		III	28.63	49.08	1.92	6.76	∠1000
		IV	52.47	81.36	2.66	10.14	∠1000

STANDARD — WORK ZONE AIR

R P M —

S P M 2000 (ACGIH)

SO_2 5000 (IFA-1987, Sch-II)

NOx 6000 (- do -)

CO 40,000 (- do -)

MONITORING SCHEDULE :- Weekly twice 8 hourly continuous for a month of a season.

FACOR
HIRIYANGAR

ANNEXURE - E-8

SOUND PRESSURE LEVEL MEASUREMENT - 2004 (CORE ZONE)

HIRIYANGAR CHROMITE MINES, M/s.FACOR LTD.

SURVEY CONDUCTED BY ENV.ENGG.LAB.,FACOR

Sl. No.	SOURCE/LOCATION	Limit in dB(A)	SEASON WISE RESULTS IN dB(A)			
			WINTER (Jan. - Mar.)	SUMMER (Apr. - June)	MONSOON (July - Sept.)	POST MONSOON (Oct. - Dec.)
01.	Centre of lease hold area (day time)	75	45.30	46.24	47.12	46.38
02.	Centre of lease hold area (Night time)	70	42.81	44.16	46.35	43.86
03.	Near to old Quarry (day time) South side	75	47.40	49.58	50.07	48.12
04.	Near to old Quarry (Night time) South side	70	43.23	45.65	47.39	45.94

ANNEXURE - E-8

M. K. Patel,

Regd. No. ROP/CAL/239/98/A

ANNEXURE - E-9

SEASONAL VARIATION OF AMBIENT NOISE LEVEL - 2004 (SUMMER 2004)

PROJECT : ELDORADO CHEMICAL WORKS, M/s. PACOS LTD.

SURVEY CONDUCTED BY ENVIRO LAB., PACOS

ANNEXURE - E-9

Sl. No.	Location	Season	Equivalent Sound Pressure Level in dB(A)																						
			6 -7 AM	7 -8 AM	8 -9 AM	9 -10 AM	10-11 AM	11-12 AM	12-1 PM	1 -2 PM	2 -3 PM	3 -4 PM	4 -5 PM	5 -6 PM	6 -7 PM	7 -8 PM	8 -9 PM	9 -10 PM	10-11 PM	11-12 PM	12-1 AM	1 -2 AM	2 -3 AM	3 -4 AM	4 -5 AM	5 -6 AM
1	Village - [illegible]	I	41.8	43.2	47.1	51.2	51.4	52.5	55.6	53.6	54.7	53.5	51.8	48.8	43.2	45.6	45.2	43.1	41.8	41.0	39.6	38.2	37.4	36.9	36.8	37.1
		II	37.2	43.4	46.8	51.4	50.8	52.7	53.4	53.8	54.2	53.2	51.0	48.6	47.1	45.2	44.8	44.0	41.6	41.2	39.6	38.1	37.6	36.4	36.3	36.3
		III	40.6	42.8	45.9	50.6	51.2	51.8	54.2	53.6	54.0	52.8	51.3	47.6	44.3	44.8	44.6	44.2	40.5	40.1	38.5	38.2	37.1	36.2	37.0	38.9
		IV	42.1	43.2	47.2	51.6	51.9	52.7	53.7	52.8	54.6	53.4	51.7	49.7	47.4	45.7	45.1	43.2	41.6	40.6	39.2	38.0	37.1	36.1	36.1	36.9
2	Village - [illegible]	I	34.2	36.1	39.0	40.4	41.7	42.3	43.1	43.2	42.6	42.0	41.8	41.6	40.8	40.2	39.2	37.6	39.2	38.8	38.6	36.2	37.0	35.2	35.1	36.1
		II	37.7	36.2	38.6	39.8	40.6	41.6	42.8	43.0	42.4	42.3	41.6	41.2	41.0	40.3	39.0	36.8	38.7	38.2	38.0	36.2	35.8	35.1	35.4	36.1
		III	34.8	36.2	37.8	41.2	42.0	42.3	44.1	44.3	43.4	42.8	42.1	41.2	40.6	40.2	39.7	39.2	38.6	38.3	38.2	37.4	36.2	35.1	35.8	37.2
		IV	39.2	39.6	40.1	41.4	42.2	43.8	45.2	45.4	43.8	42.7	42.2	42.0	41.4	40.8	39.9	39.3	39.0	38.5	38.1	37.3	36.1	35.0	35.2	37.4
3	Village - Pandaua	I	39.7	40.2	42.6	44.5	44.7	45.2	46.5	46.3	46.3	46.2	45.6	45.8	46.2	45.1	44.3	41.3	40.3	39.4	37.7	35.8	34.6	34.1	35.1	37.1
		II	39.6	40.1	42.4	44.6	44.8	45.0	45.6	46.0	46.2	45.0	44.8	44.6	44.1	42.8	42.0	40.4	39.6	38.8	36.1	35.8	35.1	34.1	34.6	36.4
		III	38.2	40.3	41.8	43.6	45.2	45.6	46.2	46.6	46.7	45.6	45.2	44.3	44.0	42.4	42.1	41.1	38.7	38.2	35.4	35.1	34.2	34.2	35.3	37.4
		IV	39.2	40.1	40.4	45.1	45.1	45.5	46.3	46.7	46.2	46.2	45.6	45.1	44.8	44.1	42.2	42.8	38.6	37.1	34.3	36.0	35.4	36.7	35.1	37.1
4	Village - Outla	I	40.1	41.4	43.4	45.3	46.0	45.8	48.3	48.2	50.7	49.1	47.6	46.9	45.2	44.1	42.3	41.1	39.8	39.3	38.8	37.1	34.8	34.7	35.2	36.7
		II	43.2	41.5	44.1	45.6	45.5	48.7	48.7	49.7	50.9	50.2	48.1	47.3	46.4	44.3	42.5	41.7	40.1	39.4	38.9	37.3	34.9	34.3	35.2	36.6
		III	39.6	41.2	43.8	45.8	45.8	46.0	48.6	50.0	50.8	50.8	47.9	47.4	46.8	44.5	42.8	41.6	40.2	40.2	38.8	37.4	35.0	34.4	35.6	37.8
		IV	40.1	41.0	44.1	45.3	45.7	45.8	48.0	48.8	50.6	50.3	47.8	47.6	46.7	44.6	42.4	41.2	40.3	39.8	38.6	37.6	34.8	35.0	35.1	36.0
5	Village - Barwai	I	39.2	39.8	40.4	42.8	43.8	44.8	45.4	46.3	48.6	49.2	48.3	46.0	45.2	45.3	44.8	42.1	41.8	40.1	39.1	36.1	35.1	35.0	35.4	37.1
		II	39.4	40.2	41.8	43.4	44.7	45.1	45.7	47.8	49.2	49.4	48.2	45.1	45.0	44.8	44.7	41.2	40.3	40.0	38.4	35.4	35.2	35.2	35.1	36.5
		III	38.6	39.8	40.4	42.1	43.8	45.2	45.1	45.8	47.2	47.8	47.1	46.2	45.1	44.2	42.1	41.0	40.1	39.8	39.2	36.1	35.0	34.8	34.8	36.9
		IV	38.4	40.0	41.1	43.2	44.6	45.4	46.2	46.7	48.2	48.7	48.2	46.3	46.0	45.2	43.8	2.0	41.3	41.8	40.2	37.8	35.4	35.2	35.8	37.1

NOISE NORMS

DAY TIME (6AM to 9 PM) 55 dB(A)

NIGHT TIME (9 PM to 6 AM) 45 dB(A)

FACOR
BHITARGARH

ANNEXURE - E-9

SEASONAL VARIATION OF HOURLY NOISE LEVEL - 2004 (BUFFER ZONE)
PROJECT : BHITARGARH CHROMITE MINES, M/s. FACOR LTD.
SURVEY CONDUCTED BY ENV. ENGG. LAB., FACOR

DURATION AND SOUND PRESSURE LEVEL IN dB(A)

Sl. No.	LOCATION	SEASONS	6-7 AM	7-8 AM	8-9 AM	9-10 AM	10-11 AM	11-12 AM	12-1 PM	1-2 PM	2-3 PM	3-4 PM	4-5 PM	5-6 PM	6-7 PM	7-8 PM	8-9 PM
01.	Village – Bhitargarh	I	41.8	43.2	45.9	50.2	51.4	52.5	55.6	55.6	54.7	55.3	51.8	48.8	47.2	49.6	45.2
		II	41.2	43.4	45.8	51.6	50.8	50.2	55.4	55.8	54.7	53.2	57.0	49.6	47.1	45.2	44.8
		III	41.6	42.8	45.9	50.6	51.2	51.8	53.2	55.6	54.0	52.3	51.3	47.4	44.3	44.8	44.6
		IV	42.1	42.1	47.7	51.8	51.9	52.1	53.1	55.8	54.6	53.4	51.7	48.7	47.4	45.2	45.1
02.	Village – [illegible]	I	38.2	39.1	39.2	40.4	41.2	42.3	43.1	41.2	40.8	42.0	41.8	41.6	40.8	40.2	38.2
		II	37.1	38.2	39.6	39.8	40.8	43.6	42.8	43.0	40.4	42.3	41.6	41.2	41.0	40.3	39.0
		III	38.8	39.2	39.0	41.2	40.0	42.3	44.1	44.5	43.1	42.8	42.1	41.2	40.6	40.4	39.7
		IV	38.2	39.6	40.1	41.8	40.9	43.6	45.2	43.2	43.8	42.7	42.2	42.0	41.4	40.8	39.9
03.	Village – Sundargarh	I	39.7	40.2	42.5	44.5	44.7	45.2	45.5	49.3	49.3	49.2	45.4	45.8	45.2	45.1	44.5
		II	39.6	40.1	42.8	44.6	44.8	45.0	45.6	49.0	48.2	45.0	44.6	44.6	44.1	42.8	42.0
		III	38.2	40.3	41.8	45.8	45.2	45.6	46.2	48.8	49.7	49.6	45.7	44.3	44.0	42.6	42.1
		IV	39.2	40.1	42.4	45.1	45.1	45.5	46.3	48.7	49.2	49.2	45.6	45.1	44.8	44.1	42.8
04.	Village – Ostia	I	40.1	41.4	45.9	45.3	46.0	45.6	49.3	49.2	50.7	49.1	47.8	46.9	46.2	44.1	42.5
		II	40.2	41.5	44.1	45.6	45.9	45.7	49.7	49.7	50.9	50.2	48.1	47.3	46.4	44.3	42.5
		III	39.8	43.2	45.8	45.8	45.8	46.0	48.0	50.0	50.6	50.8	47.9	47.4	45.8	44.5	42.6
		IV	40.1	41.0	44.1	45.3	45.7	45.8	49.0	49.8	50.6	50.3	47.8	47.6	46.7	44.6	42.4
05.	Village – Bansol	I	39.2	39.9	40.4	42.8	43.8	44.8	45.4	46.3	48.6	49.2	49.3	46.0	45.2	45.3	44.8
		II	39.4	40.2	41.8	43.4	44.7	45.1	45.7	47.8	49.2	49.4	46.2	45.1	45.0	46.8	44.7
		III	38.6	39.8	40.4	42.1	43.8	45.2	45.1	46.8	49.2	49.6	47.1	46.2	45.1	44.2	42.1
		IV	39.4	40.0	41.1	43.2	44.6	45.4	46.2	46.7	49.2	49.7	49.2	45.3	46.0	45.2	43.8

Sl. No.	LOCATION	SEASONS	9-10 PM	10-11 PM	11-12 PM	12-1 AM	1-2 AM	2-3 AM	3-4 AM	4-5 AM	5-6 AM
01.	Village – Bhitargarh	I	43.1	41.6	41.0	39.6	38.2	37.4	36.8	36.2	39.1
		II	44.0	41.8	41.2	39.6	38.1	37.6	36.4	36.5	39.3
		III	44.2	40.5	40.1	39.5	37.8	37.1	36.2	37.4	39.7
		IV	43.2	41.4	40.4	39.2	39.0	37.1	36.7	36.4	39.6
02.	Village – [illegible]	I	39.6	39.2	38.8	38.1	38.2	37.0	35.4	35.9	36.2
		II	39.8	38.7	38.2	38.0	38.2	35.9	35.1	35.4	36.4
		III	39.2	38.6	38.5	38.2	37.6	36.2	35.6	35.0	37.1
		IV	39.3	39.0	38.5	38.1	37.5	36.1	35.8	36.2	37.0
03.	Village – Sundargarh	I	41.3	40.3	39.4	37.1	35.8	34.6	34.2	35.7	37.1
		II	40.4	39.6	36.0	36.1	35.8	35.7	34.5	35.6	36.9
		III	41.1	38.7	35.2	36.6	35.1	34.0	34.2	35.3	37.4
		IV	40.8	38.0	37.1	36.3	36.0	35.4	34.7	35.6	37.1
04.	Village – Ostia	I	41.1	39.8	39.3	38.8	37.1	34.8	34.7	35.5	36.2
		II	41.7	40.1	39.4	38.9	37.5	34.9	34.5	35.7	36.4
		III	41.6	40.2	40.2	38.8	37.4	35.0	34.6	35.4	37.8
		IV	41.2	40.3	39.8	38.6	37.6	34.8	35.0	35.1	36.0
05.	Village – Bansol	I	42.1	41.8	40.1	39.1	36.1	35.1	35.9	35.4	37.2
		II	41.2	40.3	40.0	36.4	39.4	35.2	35.2	36.1	36.8
		III	41.0	40.1	39.8	37.2	36.3	35.0	34.8	35.8	36.6
		IV	2.0	41.3	40.8	40.2	37.8	35.4	35.2	35.8	37.1

	MOEF NORM
DAY TIME (6AM to 9 PM)	55 dB(A)
NIGHT TIME (9 PM to 6 AM)	45 dB(A)

M. K. Pujari,
Regd. No. BOP/CAL/289/98/A

FACOR
BHITARGARH

ANNEXURE – E-9

SEASONAL VARIATION OF HOURLY NOISE LEVEL – 2004 (BUFFER ZONE)

PROJECT : BHITARGARH CHROMITE MINES, M/s. FACOR LTD.

SURVEY CONDUCTED BY ENV. ENGG. LAB., FACOR

DURATION AND SOUND PRESSURE LEVEL IN dB(A)

Sl. No.	LOCATION	SEASONS	6-7 AM	7-8 AM	8-9 AM	9-10 AM	10-11 AM	11-12 AM	12-1 PM	1-2 PM	2-3 PM	3-4 PM	4-5 PM	5-6 PM
01.	Village – Bhitargarh	I	41.0	43.2	41.1	50.7	51.4	52.5	55.0	55.6	54.7	55.5	51.8	48.8
		II	41.2	43.4	45.8	51.4	51.8	50.7	55.4	55.9	54.7	53.2	51.0	48.6
		III	40.6	42.8	45.9	50.6	51.2	51.8	55.4	53.6	54.0	52.9	54.3	47.4
		IV	42.3	42.1	47.7	51.8	51.9	52.7	53.7	52.8	54.6	53.4	51.7	48.7
02.	Village – Kirmani	I	38.2	39.7	39.7	40.4	41.2	42.3	43.1	43.8	42.8	42.0	41.8	41.6
		II	37.1	38.2	39.6	39.8	40.6	43.4	42.8	43.0	42.4	42.3	41.6	41.2
		III	38.8	39.2	39.8	41.2	42.0	42.3	44.1	44.5	43.1	42.8	42.1	41.2
		IV	39.2	39.6	40.1	43.8	42.9	43.6	45.2	43.8	43.8	42.7	42.2	42.0
03.	Village – Sundiapur	I	39.7	40.2	42.6	44.5	44.7	45.2	45.3	47.3	47.3	48.2	45.4	45.8
		II	39.6	40.1	40.8	44.6	44.8	45.0	45.6	49.0	48.2	45.0	44.8	44.6
		III	38.2	40.3	41.8	45.8	45.2	45.6	46.5	48.6	49.7	43.6	45.7	44.3
		IV	39.2	40.3	44.4	45.1	45.1	45.5	46.3	48.7	49.2	48.2	45.6	45.1
04.	Village – Oetia	I	40.1	41.4	43.9	45.3	45.0	45.6	49.3	49.2	50.7	49.1	47.6	46.9
		II	40.2	45.5	45.1	45.6	45.9	48.1	48.7	49.7	59.9	50.9	48.1	47.3
		III	39.8	43.2	43.8	45.8	45.8	46.0	48.0	50.0	50.6	50.6	47.9	47.4
		IV	40.1	41.0	44.1	45.3	45.7	45.8	49.0	49.8	50.6	50.3	47.6	47.6
05.	Village – Bonsoi	I	39.2	39.9	40.4	42.8	43.8	44.8	45.4	45.3	49.6	49.2	49.5	46.0
		II	39.4	40.2	41.8	43.4	44.7	45.1	45.7	47.8	49.2	49.4	46.2	45.1
		III	38.6	39.8	40.4	42.1	45.8	45.2	45.1	45.8	49.2	49.8	47.1	46.2
		IV	39.4	40.0	41.1	43.2	44.6	45.4	46.2	46.7	49.2	49.7	49.2	46.3

Sl. No.	LOCATION	SEASONS	6-7 PM	7-8 PM	8-9 PM	9-10 PM	10-11 PM	11-12 PM	12-1 AM	1-2 AM	2-3 AM	3-4 AM	4-5 AM	5-6 AM
01.	Village – Bhitargarh	I	47.3	45.6	45.2	43.1	41.8	41.0	39.6	38.2	37.4	36.0	36.2	35.3
		II	47.1	45.2	44.8	44.0	41.6	41.2	39.6	38.1	37.6	36.4	36.5	35.5
		III	44.3	44.8	44.6	44.2	40.5	40.1	39.5	35.8	37.1	36.2	37.4	35.7
		IV	47.4	45.2	45.1	45.2	41.6	40.4	39.2	39.0	37.1	35.7	35.4	35.6
02.	Village – Kirmani	I	40.8	40.2	38.2	38.8	39.2	38.8	38.5	38.2	37.0	35.2	35.9	36.3
		II	41.0	42.5	39.0	38.3	38.7	38.2	36.8	35.8	35.5	35.1	35.4	36.4
		III	40.6	40.4	39.7	37.2	36.6	36.5	35.2	37.6	36.2	35.4	35.8	37.1
		IV	41.4	40.8	39.0	39.5	39.0	38.5	38.1	37.3	36.1	35.0	36.2	37.6
03.	Village – Sundiapur	I	45.2	43.1	44.3	41.5	40.3	39.4	37.1	35.0	36.6	36.2	35.7	37.1
		II	44.1	42.8	42.0	40.4	39.6	36.8	36.1	35.8	35.7	36.5	35.8	36.9
		III	44.0	42.4	42.1	41.1	38.7	35.2	35.4	35.1	34.2	34.2	35.3	37.4
		IV	44.8	44.1	43.2	40.8	38.6	37.1	36.3	36.0	35.4	34.7	35.6	37.1
04.	Village – Oetia	I	46.2	44.1	42.3	41.1	39.8	39.3	38.8	37.1	34.8	34.7	35.5	38.2
		II	46.4	44.3	42.5	41.7	40.1	39.4	38.9	37.3	34.9	34.3	35.7	36.4
		III	45.8	44.5	42.8	41.6	40.2	40.2	38.8	37.4	35.0	34.4	35.4	37.8
		IV	46.7	44.6	42.4	41.2	40.3	39.8	38.6	37.6	34.8	35.0	35.1	36.0
05.	Village – Bonsoi	I	45.2	45.3	44.8	42.1	41.8	40.1	39.7	36.1	35.1	35.9	36.4	37.2
		II	45.0	46.8	44.7	41.2	40.3	40.0	36.4	37.4	35.5	35.2	36.1	36.8
		III	45.1	44.2	42.1	41.0	40.1	39.8	37.2	36.3	35.0	34.8	35.8	36.6
		IV	46.9	45.2	43.8	2.0	41.3	41.6	40.2	37.8	35.6	35.2	36.8	37.1

	MOEF NORM
DAY TIME (6AM to 9 PM)	55 dB(A)
NIGHT TIME (9 PM to 6 AM)	45 dB(A)

M. K. Pujari,
Regd. No. BOP/CAL/289/98/A

FACOR
BHUJANGAR

ANNEXURE - E-10

EFFLUENT WATER ANALYSIS REPORT AFTER MOEF NORM

PROJECT : BHUTANGAR CHROMITE MINES - LOCATION : OLD MINES QUARRY WATER
PERIOD : JANUARY TO DECEMBER - 2004
SURVEY CONDUCTED BY ENVIRONMENTAL ENGINEERING LABORATORY, FACOR

Sl. No.	Characteristics	Limit as per MOEF Norm	RESULTS			
			1st Season Jan.-Mar.	2nd Season Apr.-June	3rd Season July-Sept.	4th Season Oct.-Dec.
1)	Colour, Hazen units	All efforts Should be made to remove colour & unpleasent Odours as far practicable	Colourless	Colourless	Colourless	Colourless
2)	Odour		Un-objectionable	Unobjectionable	Un-objectionable	Unobjectionable
3)	Suspended solids, mg/l	100	Nil	Nil	10	Nil
4)	Particle size of suspended solids	Shall pass 850 micron IS Sieve	-	-	100% passed	-
5)	Dissolved solids, mg/l	2100	148	160	132	140
6)	pH Value	5.5 - 9.0	7.6	7.7	7.5	7.5
7)	Oil & Grease, mg/l	10	<0.01	<0.01	<0.01	<0.01
8)	Total Residual Chlorine(Cl), mg/l	1.0	Absent	Absent	Absent	Absent
9)	Ammonical Nitrogen(N), mg/l	50	1.2	1.4	1.6	1.3
10.	Total Kjeldahl Nitrogen(N), mg/l	100	3.4	3.7	4.6	3.6
11)	Free ammonia(NH_3), mg/l	5.0	<0.05	<0.05	<0.05	<0.05
12)	B.O.D.(O_2)(5 days at 20°C)	30	2.8	3.1	3.4.	3.0
13)	C.O.D. (O_2), mg/l	250	4.6	5.2	5.8	4.9
14)	Arsenic (As), mg/l	0.2	<0.001	<0.001	<0.001	<0.001
15)	Mercury (Hg), mg/l	0.01	<0.001	<0.001	<0.001	<0.001
16)	Lead (Pb), mg/l	0.1	<0.01	<0.01	<0.01	<0.01
17)	Cadmium (Cd), mg/l	2.0	<0.005	<0.005	<0.005	<0.005
18)	Hexavalent Chromium (Cr^{+6}), mg/l	0.1	0.30	0.38	0.21	0.24
19)	Total Chromium (Cr), mg/l	2.0	0.43	0.52	0.32	0.36
20)	Copper (Cu), mg/l	3.0	<0.01	<0.01	<0.01	<0.01
21)	Zinc (Zn), mg/l	5.0	<0.01	<0.01	<0.01	<0.01
22)	Selenium (Se), mg/l	0.05	<0.005	<0.005	<0.005	<0.005
23)	Nickel (Ni), mg/l	3.0	<0.01	<0.01	<0.01	<0.01
24)	Boron (B), mg/l	2.0	<0.01	<0.01	<0.01	<0.01
25)	Cyanide (CN), mg/l	0.2	<0.01	<0.01	<0.01	<0.01
26)	Fluoride (F), mg/l	2.0	<0.01	<0.01	<0.01	<0.01
27)	Chloride (Cl), mg/l	1000	24	28	20	22
28)	Dissolved Phosphates(P), mg/l	5.0	<0.01	<0.01	<0.01	<0.01
29)	Sulphate (SO_4), mg/l	1000	6.72	6.94	5.86	6.51
30)	Sulphide(S), mg/l	2.0	<0.1	<0.1	<0.1	<0.1
31.	Phenolic Compounds(C_6H_5OH)	1.0	<0.001	<0.001	<0.001	<0.001
32.	Manganese (Mn), mg/l	2.0	<0.01	<0.01	<0.01	<0.01
33.	Vanadium (V), mg/l	0.2	<0.01	<0.01	<0.01	<0.01
34.	Nitrate Nitrogen(N), mg/l	10	0.88	0.82	1.02	0.96
35.	Iron (Fe), mg/l	3.0	0.034	0.036	0.032	0.034
36.	Bioassay test	90% survival of fish after 96 Hrs in 100% effluent	100% Survived	100% Survived	100% Survived	100% Survived
37.	Manganese	Absent	Absent	Absent	Absent	Absent

M. K. Pujari,
Regd. No. ROP/CAL/239/96/A

ANNEXURE - E-11

SURFACE WATER ANALYSIS REPORT AS PER IS -2296(C) -1982

PROJECT : BHALITANGAR CHROMITE MINES
LOCATION : POND WATER (POND WITHIN THE PROJECT AREA)
PERIOD : JANUARY TO DECEMBER - 2004
SURVEY CONDUCTED BY ENV.ENGG.LAB.,FACOR

Sl. No.	CHARACTERISTICS	Limit as per IS-2296(C) 1982	RESULTS 1st Season Jan.-March	2nd Season Apr.-June	3rd Season July-Sept.	4th Season Oct.-Dec.
01.	pH Value	6.5 - 8.5	7.6	7.7	7.5	7.6
02.	Dissolved oxygen (O_2), mg/l, Min.	4.0	6.0	5.9	6.0	6.0
03.	B.O.D. (O_2)(5 days at 20°C), mg/l	3.0	2.1	2.3	2.4	2.2
04.	Total coliform organisms, MPN/100 ml	5000	140	160	170	160
05.	Colour, Hazen units, max.	300	Colourless	Colourless	Colourless	Colourless
06.	Fluorides (F), mg/l, max.	1.5	<0.01	<0.01	<0.01	<0.01
07.	Cadmium (Cd), mg/l, max.	0.01	<0.005	<0.005	<0.005	<0.005
08.	Chloride (Cl), mg/l, max.	600	30	36	24	28
09.	Hex valent Chromium (Cr^{6+}), mg/l, max.	0.05	0.12	0.16	0.08	0.13
10.	Cyanide (CN), mg/l, max.	0.05	<0.01	<0.01	<0.01	<0.01
11.	Total dissolved solids, mg/l, max.	1500	172	184	158	164
12.	Selenium (Se), mg/l, Max.	0.05	<0.005	<0.005	<0.005	<0.005
13.	Sulphates (SO_4), mg/l, max.	400	6.8	7.2	5.4	6.1
14.	Lead (Pb), mg/l, max.	0.1	<0.01	<0.01	<0.01	<0.01
15.	Copper (Cu), mg/l, max.	1.5	<0.01	<0.01	<0.01	<0.01
16.	Arsenic (As), mg/l, max.	0.2	<0.001	<0.001	<0.001	<0.001
17.	Iron (Fe), mg/l, max.	50	0.026	0.028	0.022	0.024
18.	Phenolic Compounds (C_6H_5OH), mg/l, max.	0.005	<0.001	<0.001	<0.001	<0.001
19.	Zinc (Zn), mg/l, max.	15	<0.01	<0.01	<0.01	<0.01
20.	Insecticides	Absent	Absent	Absent	Absent	Absent
21.	Anionic detergents (MBAS), mg/l max.	1.0	Absent	Absent	Absent	Absent
22.	Oil & grease, mg/l, max.	0.1	<0.01	<0.01	<0.01	<0.01
23.	Nitrate (NO_3), mg/l, max.	50	0.62	0.54	0.72	0.66

M. R. Pujari,
Regd. No. RQP/CAL/229/98/A

FACOR
BHIMTANGAR

ANNEXURE - E-12

SURFACE WATER ANALYSIS REPORT AS PER IS - 2296(C) - 1982

PROJECT : BHIMDANGAR CHROMITE MINES
LOCATION : PROJECT AREA SURFACE RUN OFF WATER
PERIOD : JULY TO SEPTEMBER - 2004
SURVEY CONDUCTED BY ENVIRONMENTAL ENGINEERING LABORATORY, FACOR

Sl. No.	CHARACTERISTICS	Limit as per IS-2296(C) 1982	RESULTS III - Season July - Sept.
1)	P^H Value	6.5 - 8.5	7.7
2)	Dissolved Oxygen, mg/l, Min.	4.0	6.0
3)	B.O.D. (O_2) (5 days at 20°C), mg/l	3.0	1.6
4)	Total Coliform organisms, MPN/100 ml, Max.	5000	190
5)	Colour, Hazen units, max.	300	Colourless
6)	Fluorides (f), Mg/l, max.	1.5	<0.01
7)	Cadmium (Cd), mg/l, max.	0.01	<0.005
8)	Chloride (Cl), mg/l, max.	600	20
9)	Hexavalent Chromium (Cr^{+6}), mg/l, max.	0.05	0.03
10)	Cyanide (CN), mg/l, max.	0.05	<0.01
11)	Total dissolved solids, mg/l, max.	1500	92
12)	Selenium (Se), mg/l, max.	0.05	<0.005
13)	Sulphates (So_4), mg/l, max.	400	2.86
14)	Lead (Pb), mg/l, max.	0.1	<0.01
15)	Copper (Cu), mg/l, max.	1.5	<0.01
16)	Arsenic (As), mg/l, Max.	0.2	<0.001
17)	Iron (Fe), mg/l, max.	50	0.024
18)	Phenolic compounds (C_6H_5OH), mg/l, max.	0.005	<0.001
19)	Zinc (Zn), mg/l, Max.	15	<0.01
20)	Insecticides	Absent	Absent
21)	Anionic detergents (MBAS), mg/l, max.	1.0	Absent
22)	Oil & Grease, mg/l, max.	0.1	<0.01
23)	Nitrate (NO_3), mg/l, max.	50	2.28

APPROVED

M. K. Pujari,
Regd. No. ROP/CAL/239/98/A

FACOR
BHIMTANGAR

EFFLUENT WATER ANALYSIS REPORT AS PER MOEF NORM

PROJECT : BHIMTANGAR CHROMITE MINES
LOCATION : TISCO MINES DISCHARGE WATER PASSES OVER THE NORTH SIDE OF PROJECT AREA
PERIOD : JANUARY TO DECEMBER - 2004

SURVEY CONDUCTED BY ENV.ENGG.LAB., FACOR

Sl. No.	CHARACTERISTICS	Limit as per MOEF NORM	RESULTS 1st Season Jan.-March	2nd Season Apr.-June	3rd Season July-Sept.	4th Season Oct.-Dec.
01.	Colour, Hazen units	All efforts should be made to remove colour and unpleasant odours as for as practicable	Colourless	Colourless	Colourless	Colourless
02.	Odour		Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
03.	Suspended solids, mg/l	100	22	26	34	28
04.	Particle size of suspended solids	Shall pass 850 micron IS Sieve	100% passed	100% passed	100% passed	100% passed
05.	Dissolved solids, mg/l	2100	220	228	208	216
06.	pH Value	5.5 - 9.0	8.0	8.1	8.0	7.9
07.	Oil & grease, mg/l	10	<0.01	<0.01	<0.01	<0.01
08.	Total residual chlorine(C), mg/l	1.0	Absent	Absent	Absent	Absent
09.	Ammoniacal Nitrogen(N),mg/l	50	1.1	1.4	1.2	1.3
10.	Total Kjeldahl Nitrogen(N),mg/l	100	3.6	4.6	3.8	4.1
11.	Free ammonia (NH_3), mg/l	5.0	<0.05	<0.05	<0.05	<0.05
12.	B.O.D.(BOD_3) (3 days at 27°C), mg/l	30.0	2.6	3.1	2.8	2.2
13.	C.O.D. (O_2), mg/l	250.0	6.2	7.1	6.4	5.8
14.	Arsenic (As), mg/l	0.2	<0.001	<0.001	<0.001	<0.001
15.	Mercury (Hg), mg/l	0.01	<0.001	<0.001	<0.001	<0.001
16.	Lead (Pb), mg/l	0.1	<0.01	<0.01	<0.01	<0.01
17.	Cadmium (Cd), mg/l	2.0	<0.005	<0.005	<0.005	<0.005
18.	Hexavalent Chromium (Cr^{+6}), mg/l	0.1	0.22	0.26	0.14	0.18
19.	Total chromium (Cr), mg/l	2.0	0.29	0.40	0.18	0.21
20.	Copper (Cu), mg/l	3.0	<0.01	<0.01	<0.01	<0.01
21.	Zinc (Zn), mg/l	5.0	<0.01	<0.01	<0.01	<0.01
22.	Selenium (Se), mg/l	0.05	<0.005	<0.005	<0.005	<0.005
23.	Nickel (Ni), mg/l	3.0	<0.01	<0.01	<0.01	<0.01
24.	Boron (B), mg/l	2.0	<0.01	<0.01	<0.01	<0.01
25.	Cyanide (CN), mg/l	0.2	<0.01	<0.01	<0.01	<0.01
26.	Fluoride (F), mg/l	2.0	<0.01	<0.01	<0.01	<0.01
27.	Chloride (Cl), mg/l	1000	40	42	32	36
28.	Dissolved phosphates(P), mg/l	5.0	<0.01	<0.01	<0.01	<0.01
29.	Sulphate (SO_4), mg/l	1000	6.32	7.86	5.42	6.08
30.	Sulphide (S), mg/l	2.0	<0.1	<0.1	<0.1	<0.1
31.	Phenolic Compounds(C_6H_5OH),mg/l	1.0	<0.001	<0.001	<0.001	<0.001
32.	Manganese (Mn), mg/l	2.0	<0.01	<0.01	<0.01	<0.01
33.	Vanadium (V), mg/l	0.2	<0.01	<0.01	<0.01	<0.01
34.	Nitrate Nitrogen(N), mg/l	10	0.72	0.06	1.26	0.98
35.	Iron (Fe), mg/l	3.0	0.032	0.036	0.028	0.032
36.	Bio-assay test	90% Survival of fish after 96 Hrs in 100% effluent	100% Survived	100% Survived	100% Survived	100% Survived
37.	[illegible]	Absent	Absent	Absent	Absent	Absent

अनुमोदित
APPROVED

FACOR
SULTANGAR

ANNEXURE - E-14

SURFACE WATER ANALYSIS REPORT AS PER IS - 2296 (C) - 1982

PROJECT : SULTANGER CHROMITE MINES
LOCATION : LAMSALA NALLAH UP-STREAM WATER (100 Mtr.UP)
PERIOD : JULY TO SEPTEMBER - 2004
SURVEY CONDUCTED BY ENVIRONMENTAL ENGINEERING LABORATORY, FACOR

Sl. No.	CHARACTERISTICS	Limit as per IS 2296 (C) 1982	RESULTS II I Season July -Sept.
1)	pH Value	6.5 - 8.5	8.1
2)	Dissolved Oxygen, mg/l, min.	4.0	6.0
3)	B.O.D.(O_2), mg/l, Max.(5days at 20°C)	3.0	2.1
4)	Total coliform organisms, MPN/100ml, max.	5000	290
5)	Colour, Hazen units, max.	300	Colourless
6)	Fluorides (F), mg/l, Max.	1.5	<0.01
7)	Cadmium (Cd), mg/l, max.	0.01	<0.005
8)	Chloride (Cl), mg/l, max.	600	30
9)	Hexavalent Chromium (Cr^{+6}), mg/l, max.	0.05	0.16
10)	Cyanide (CN), mg/l, max.	0.05	<0.01
11)	Total dissolved solids, mg/l, max.	1500	144
12)	Selenium (Se), mg/l, max.	0.05	<0.005
13)	Sulphates (SO_4), mg/l, max.	400	4.98
14)	Lead (Pb), mg/l, max.	0.1	<0.01
15)	Copper (Cu), mg/l, max.	1.5	<0.01
16)	Arsenic (As), mg/l, max.	0.2	<0.001
17)	Iron (Fe), mg/l, max.	50	0.034
18)	Phenolic compounds (C_6H_5OH), mg/l, max.	0.005	<0.001
19)	Zinc (Zn), mg/l, max.	15	<0.01
20)	Insecticides	Absent	Absent
21)	Anionic detergents (MBAS), mg/l, max.	1.0	Absent
22)	Oil & Grease, mg/l, max.	0.1	<0.01
23)	Nitrate (NO_3), mg/l, max.	50	4.56

M. M. Pujari,
Read. No. ROP/CAL/239/98TA

FACOR
BHUSTANGAR

ANNEXURE - B-15

SURFACE WATER ANALYSIS REPORT AS PER IS 2296(C) - 1982

PROJECT : BHUSTANGAR CHROMITE MINES
LOCATION : DAMSALA NALLAH DOWN-STREAM WATER (100 Mtr. DOWN)
PERIOD : JULY TO SEPTEMBER - 2004
SURVEY CONDUCTED BY ENVIRONMENTAL ENGINEERING LABORATORY, FACOR

Sl. No.	CHARACTERISTICS	Limit as per IS - 2296(C) 1982	RESULTS III Season July - Sept.
i)	pH Value	6.5 - 8.5	8.0
ii)	Dissolved Oxygen, mg/l, min.	4.0	6.0
iii)	B.O.D. (O_2) (5 days at 20°C) mg/l, max.	3.0	2.0
iv)	Total coliform organisms, MPN/100 ml	5000	280
v)	Colour, Hazen units	300	Colourless
vi)	Fluorides (F), mg/l, max.	1.5	<0.01
vii)	Cadmium (Cd), mg/l, max.	0.01	<0.005
viii)	Chloride (Cl), mg/l, Max.	600	28
ix)	Hexavalent Chromium (Cr^{+6}), mg/l, max.	0.05	0.12
x)	Cyanide (CN), mg/l, max.	0.05	<0.01
xi)	Total dissolved solids, mg/l, max.	1500	132
xii)	Selenium (Se), mg/l, max.	0.05	<0.005
xiii)	Sulphates (SO_4), mg/l, max.	400	4.36
xiv)	Lead (Pb), mg/l, max.	0.1	<0.01
xv)	Copper (Cu), mg/l, max.	1.5	<0.01
xvi)	Arsenic (As), mg/l, max.	0.2	<0.001
xvii)	Iron (Fe), mg/l, max.	50	0.03
xviii)	Phenolic Compounds (C_6H_5OH), mg/l, max.	0.005	<0.001
xix)	Zinc (Zn), mg/l, max.	15	<0.01
xx)	Insecticides	Absent	Absent
xxi)	Anionic detergents (MBAS), mg/l, max.	1.0	Absent
xxii)	Oil & Grease, mg/l, max.	0.1	<0.01
xxiii)	Nitrate (NO_3), mg/l, max.	50	4.08

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FACOR
BHIMTANGAR

ANNEXURE - E-16

SURFACE WATER ANALYSIS REPORT AS PER IS 2296 (C) - 1982

PROJECT : BHIMTANGAR CHROMITE MINES
LOCATION : DAMSALA NALLAH WATER NEARER TO PROJECT AREA
PERIOD : JANUARY TO JUNE - 2004 & OCTOBER TO DECEMBER - 2004
SURVEY CONDUCTED BY ENVIRONMENTAL ENGINEERING LABORATORY, FACOR

Sl. No.	CHARACTERISTICS	Limit as per IS -2296(C) 1982	RESULTS 1st Season Jan - Mar.	2nd Season Apr - June	4th Season Oct - Dec.
1)	P^H Value	6.5 - 8.5	8.1	8.2	8.1
2)	Dissolved Oxygen, mg/l min.	4.0	6.0	6.0	6.0
3)	B.O.D.(O_2) (5 days at 20°C) mg/l, max.	3.0	1.8	2.2	2.0
4)	Total Caliform organisms, MPN/100 ml, max.	5000	290	280	310
5)	Colour, Hazen units, max.	300	Colourless	Colourless	Colourless
6)	Fluorides (F), mg/l, max.	1.5	<0.01	<0.01	<0.01
7)	Cadmium (Cd), mg/l, max.	0.01	<0.005	<0.005	<0.005
8)	Chloride (Cl), mg/l, max.	600	26	28	26
9)	Hexavalent Chromium (Cr^{+6}), mg/l, max.	0.05	0.16	0.14	0.18
10)	Cyanide (CN), mg/l, max.	0.05	<0.01	<0.01	<0.01
11)	Total dissolved solids, mg/l, max.	1500	142	146	138
12)	Selenium (Se), mg/l, max.	0.05	<0.005	<0.005	<0.005
13)	Sulphates (So_4), mg/l, max.	400	5.48	5.62	5.16
14)	Lead (Pb), mg/l, max.	0.1	<0.01	<0.01	<0.01
15)	Copper (Cu), mg/l, max.	1.5	<0.01	<0.01	<0.01
16)	Arsenic (As), mg/l, max.	0.2	<0.001	<0.001	<0.001
17)	Iron (Fe), mg/l, max.	50	0.034	0.036	0.032
18)	Phenolic compounds (C_6H_5OH), mg/l, Max.	0.005	<0.001	<0.001	<0.001
19)	Zinc (Zn), mg/l, max.	15	<0.01	<0.01	<0.01
20)	Insecticides	Absent	Absent	Absent	Absent
21)	Anionic detergents (MBAS), mg/l, Max.	1.0	Absent	Absent	Absent
22)	Oil & Grease, mg/l, max.	0.1	<0.01	<0.01	<0.01
23)	Nitrate (NO_3), mg/l, max.	50	4.06	4.18	3.98

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Read. No. ROP/CAL/239/98/A

FACOR
BHIMDANGAR

ANNEXURE - E-17

DRINKING WATER ANALYSIS REPORT AS PER IS 10500

PROJECT : BHIMDANGAR CHROMITE MINES
LOCATION : OPEN WELL WATER OF VILLAGE BHIMDANGAR
PERIOD : JANUARY TO DECEMBER - 2004
SURVEY CONDUCTED BY ENVIRONMENTAL ENGINEERING LABORATORY, FACOR

Sl. No.	CHARACTERISTICS	Limit as per IS 10500	RESULTS 1st Season Jan.-Mar.	2nd Season Apr - June	3rd Season July-Sept.	4th Season Oct-Dec.
1)	Colour, Hazen units	10	Colourless	Colourless	Colourless	Colourless
2)	Odour	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
3)	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4)	Turbidity NTU	10	Transparent	Transparent	Transparent	Transparent
5)	Dissolved solids, mg/l	500	98	102	92	96
6)	PH Value	6.5 - 8.5	7.3	7.4	7.2	7.2
7)	Total hardness($CaCO_3$), mg/l	300	46	50	38	42
8)	Calcium (Ca), mg/l	75	9.6	10.4	8.0	8.8
9)	Magnesium (Mg), mg/l	30	5.28	5.76	4.32	4.8
10)	Copper (Cu), mg/l	0.05	<0.01	<0.01	<0.01	<0.01
11)	Iron (Fe), mg/l	0.3	0.022	0.024	0.020	0.02
12)	Manganese (Mn), mg/l	0.1	<0.01	<0.01	<0.01	<0.01
13)	Chloride (Cl), mg/l	250	30	34	24	28
14)	Sulphate (SO_4), mg/l	150	1.58	1.66	1.46	1.52
15)	Nitrate (NO_3), mg/l	45	1.52	1.74	1.32	1.36
16)	Fluoride (F), mg/l	0.6 - 1.2	<0.01	<0.01	<0.01	<0.01
17)	Phenolic compounds(C_6H_5OH), mg/l	0.001	<0.001	<0.001	<0.001	<0.001
18)	Mercury (Hg), mg/l	0.001	<0.001	<0.001	<0.001	<0.001
19)	Cadmium (Cd), mg/l	0.01	<0.005	<0.005	<0.005	<0.005
20)	Selenium (Se), mg/l	0.01	<0.005	<0.005	<0.005	<0.005
21)	Arsenic (As), mg/l	0.05	<0.001	<0.001	<0.001	<0.001
22)	Cyanide (CN), mg/l	0.05	<0.01	<0.01	<0.01	<0.01
23)	Lead (Pb), mg/l	0.1	<0.01	<0.01	<0.01	<0.01
24)	Zinc (Zn), mg/l	5.0	<0.01	<0.01	<0.01	<0.01
25)	Anionic detergents (MBAS), mg/l	0.2	Absent	Absent	Absent	Absent
26)	Chromium (Cr^{+6}), mg/l	0.05	<0.005	<0.005	<0.005	<0.005
27)	Residual Chlorine(Cl), mg/l	0.2	Absent	Absent	Absent	Absent
28)	Pesticides	Absent	Absent	Absent	Absent	Absent
29)	Mineral Oil, mg/l	0.01	<0.01	<0.01	<0.01	<0.01
30)	Coliform organisms, MPN/100ml	Absent	Absent	Absent	Absent	Absent

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ANNEXURE - E-18

FACOR
BHIMTANGAR

DRINKING WATER ANALYSIS REPORT AS PER IS -10500

PROJECT : BHIMTANGAR CHROMITE MINES
LOCATION : TURE WELL WATER OF VILLAGE BHIMTANGAR
PERIOD : JANUARY TO DECEMBER - 2004
SURVEY CONDUCTED BY ENVIRONMENTAL ENGINEERING LABORATORY, FACOR

Sl. No.	CHARACTERISTICS	Limit as per IS -10500	RESULTS 1st Season Jan - Mr.	2nd Season Apr. -June	3rd Season July-Sept.	4th Season Oct -Dec.
1)	Colour, Hazen units	10	Colourless	Colourless	Colourless	Colourless
2)	Odour	Unobject-ionable	Unobject-ionable	Unobject-ionable	Unobject-ionable	Unobject-ionable
3)	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4)	Turbidity, NTU-	10	Transpar-ent	Transpar-ent	Transpar-ent	Transpar-ent
5)	Dissolved solids, mg/l	500	174	180	160	168
6)	pH Value	6.5 - 8.5	7.8	7.8	7.6	7.7
7)	Total hardness($CaCO_3$), mg/l	300	150	158	138	144
8)	Calcium (Ca), mg/l	75	24.0	25.6	20.8	21.6
9)	Magnesium (Mg), mg/l	30	21.60	22.56	20.64	21.6
10)	Copper (Cu), mg/l	0.05	$<$0.01	$<$0.01	$<$0.01	$<$0.01
11)	Iron (Fe), mg/l	0.3	0.026	0.029	0.022	0.024
12)	Manganese (Mn), mg/l	0.1	$<$0.01	$<$0.01	$<$0.01	$<$0.01
13)	Chloride (Cl), mg/l	250	22	26	18	20
14)	Sulphate (SO_4), mg/l	150	1.52	1.86	1.27	1.48
15)	Nitrate (NO_3), mg/l	45	3.54	3.36	3.42	3.64
16)	Fluoride (F), mg/l	0.6 - 1.2	$<$0.01	$<$0.01	$<$0.01	$<$0.01
17)	Phenolic compounds(C_6H_5OH), mg/l	0.001	$<$0.001	$<$0.001	$<$0.001	$<$0.001
18)	Mercury (Hg), mg/l	0.001	$<$0.001	$<$0.001	$<$0.001	$<$0.001
19)	Cadmium (Cd), mg/l	0.01	$<$0.005	$<$0.005	$<$0.005	$<$0.005
20)	Selenium (Se), mg/l	0.01	$<$0.005	$<$0.005	$<$0.005	$<$0.005
21)	Arsenic (As), mg/l	0.05	$<$0.001	$<$0.001	$<$0.001	$<$0.001
22)	Cyanide (CN^-), mg/l	0.05	$<$0.01	$<$0.01	$<$0.01	$<$0.01
23)	Lead (Pb), mg/l	0.1	$<$0.01	$<$0.01	$<$0.01	$<$0.01
24)	Zinc (Zn), mg/l	5.0	$<$0.01	$<$0.01	$<$0.01	$<$0.01
25)	Anionic detergents(MBAS), mg/l	0.2	Absent	Absent	Absent	Absent
26)	Chromium (Cr^{+6}), mg/l	0.05	$<$0.005	$<$0.005	$<$0.005	$<$0.005
27)	Residual Chlorine(Cl), mg/l	0.2	Absent	Absent	Absent	Absent
28)	Pesticides	Absent	Absent	Absent	Absent	Absent
29)	Mineral oil, mg/l	0.01	$<$0.01	$<$0.01	$<$0.01	$<$0.01
30)	Coliform organisms, MPN/100ml	Absent	Absent	Absent	Absent	Absent

APPROVED

M. K. Pujari,
Regd. No. ROP/CAL/239/98/A

FACOR
BHIRTANGAR

ANNEXURE - E-19

DRINKING WATER ANALYSIS REPORT AS PER IS 10500

PROJECT : BHIRTANGAR CHROMITE MINES
LOCATION : TUBE WELL WATER VILLAGE KALARANGE
PERIOD : JANUARY TO DECEMBER - 2004
SURVEY CONDUCTED BY ENVIRONMENTAL ENGINEERING LABORATORY, FACOR

Sl. No.	CHARACTERISTICS	Limit as per IS 10500	RESULTS			
			1st Season Jan.-Mar.	2nd Season Apr.-June	3rd season July-Spt.	4th Season Oct.-Dec.
1)	Colour, Hazen units	10	Colourless	Colourless	Colourless	Colourless
2)	Odour	Unobject-ionable	Unobject-ionable	Unobject-ionable	Unobject-ionable	Unobject-ionable
3)	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4)	Turbidity, NTU	10	Transpar-ent	Transpar-ent	Transpar-ent	Transpar-ent
5)	Dissolved Solids, mg/l	500	110	114	98	106
6)	pH Value	6.5 - 8.5	7.5	7.6	7.5	7.6
7)	Total Hardness($CaCO_3$), mg/l	300	124	132	108	120
8)	Calcium (Ca), mg/l	75	20.8	22.4	19.2	20.0
9)	Magnesium (Mg), mg/l	30	17.28	18.24	14.4	16.8
10)	Copper (Cu), mg/l	0.05	<0.01	<0.01	<0.01	<0.01
11)	Iron (Fe), mg/l	0.3	0.022	0.022	0.018	0.02
12)	Manganese (Mn), mg/l	0.1	<0.01	<0.01	<0.01	<0.01
13)	Chloride (Cl), mg/l	250	20	22	16	18
14)	Sulphate (SO_4), mg/l	150	2.64	2.82	2.08	2.32
15)	Nitrate (NO_3), mg/l	45	3.27	3.38	3.82	3.64
16)	Fluoride (F), mg/l	0.6 - 1.2	<0.01	<0.01	<0.01	<0.01
17)	Phenolic compound (C_6H_5OH), mg/l	0.001	<0.001	<0.001	<0.001	<0.001
18)	Mercury (Hg), mg/l	0.001	<0.001	<0.001	<0.001	<0.001
19)	Cadmium (Cd), mg/l	0.01	<0.005	<0.005	<0.005	<0.005
20)	Selenium (Se), mg/l	0.01	<0.005	<0.005	<0.005	<0.005
21)	Arsenic (As), mg/l	0.05	<0.001	<0.001	<0.001	<0.001
22)	Cyanide (CN), mg/l	0.05	<0.01	<0.01	<0.01	<0.01
23)	Lead (Pb), mg/l	0.1	<0.01	<0.01	<0.01	<0.01
24)	Zinc (Zn), mg/l	5.0	<0.01	<0.01	<0.01	<0.01
25)	Anionic detergents(MBAS), mg/l	0.2	Absent	Absent	Absent	Absent
26)	Chromium (Cr^{+6}), mg/l	0.05	<0.005	<0.005	<0.005	<0.005
27)	Residual Chlorine (Cl), mg/l	0.2	Absent	Absent	Absent	Absent
28)	Pesticides	Absent	Absent	Absent	Absent	Absent
29)	Mineral Oil, mg/l	0.01	<0.01	<0.01	<0.01	<0.01
30)	Coliform organisms, MPN/100ml	Absent	Absent	Absent	Absent	Absent

APPROVED

M. E. Pujari,
Regd. No. ROP/CAL/239/96/A

FACOR
BHIMTANGAR

ANNEXURE - E-20

DRINKING WATER ANALYSIS REPORT AS PER IS 10500

PROJECT : BHIMTANGAR CHROMITE MINES
LOCATION : TUBE WELL WATER OF VILLAGE RANSOL
PERIOD : JANUARY TO DECEMBER - 2004
SURVEY CONDUCTED BY ENVIRONMENTAL ENGINEERING LABORATORY, FACOR

Sl. No.	CHARACTERISTICS	Limit as per IS 10500	RESULTS			
			1st Seagon Jan -March	2nd Season Apr -June	3rd Season July-Sept.	4th Seagon Oct.-Dec.
1)	Colour, Hazen units	10	Colourless	Colourless	Colourless	Colourless
2)	Odour	Unobject-ionable	Unobject-ionable	Unobject-Ionable	Unobject-ionable	Unobject-ionable
3)	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4)	Turbidity, NTU	10	Transpar-ent	Transpar-ent	Transpar-ent	Transpar-ent
5)	Dissolved solids, mg/l	500	116	122	104	112
6)	P^H Value	6.5 - 8.5	7.5	7.6	7.4	7.5
7)	Total Hardness ($CaCO_3$), mg/l	300	126	134	112	120
8)	Calcium (Ca), mg/l	75	21.6	23.2	19.2	20.0
9)	Magnesium (Mg), mg/l	30	17.28	18.24	15.36	16.8
10)	Copper (Cu), mg/l	0.05	<0.01	<0.01	<0.01	<0.01
11)	Iron (Fe), mg/l	0.3	0.024	0.026	0.020	0.022
12)	Manganese (Mn), mg/l	0.1	<0.01	<0.01	<0.01	<0.01
13)	Chloride (Cl), mg/l	250	24	26	18	22
14)	Sulphate (SO_4), mg/l	150	3.34	3.36	3.18	3.32
15)	Nitrate (NO_3), mg/l	45	3.70	3.82	4.12	3.92
16)	Fluoride (F), mg/l	0.6 - 1.2	<0.01	<0.01	<0.01	<0.01
17)	Phenolic compound (C_6H_5OH), mg/l	0.001	<0.001	<0.001	<0.001	<0.001
18)	Mercury (Hg), mg/l	0.001	<0.001	<0.001	<0.001	<0.001
19)	Cadmium (Cd), mg/l	0.01	<0.005	<0.005	<0.005	<0.005
20)	Selenium (Se), mg/l	0.01	<0.005	<0.005	<0.005	<0.005
21)	Arsenic (As), mg/l	0.05	<0.001	<0.001	<0.001	<0.001
22)	Cyanide (CN), mg/l	0.05	< 0.01	<0.01	<0.01	<0.01
23)	Lead (Pb), mg/l	0.1	<0.01	<0.01	<0.01	<0.01
24)	Zinc (Zn), mg/l	5.0	<0.01	<0.01	<0.01	<0.01
25)	Anionic Detergents (MBAS), mg/l	0.2	Absent	Absent	Absent	Absent
26)	Chromium (Cr^{+6}), mg/l	0.05	<0.005	<0.005	<0.005	<0.005
27)	Residual chlorine (Cl), mg/l	0.2	Absent	Absent	Absent	Absent
28)	Pesticides	Absent	Absent	Absent	Absent	Absent
29)	Mineral oil, mg/l	0.01	<0.01	<0.01	<0.01	<0.01
30)	Coliform organisms, MPN/100 ml	Absent	Absent	Absent	Absent	Absent

M. K. Pujari,
Regd. No. ROP/CAL/239/98/A

FACOR
BHUPATNAGAR

DRINKING WATER ANALYSIS REPORT AS PER IS 10500

PROJECT : BHUPATNAGAR CHROMITE MINES
LOCATION : TUBE WELL WATER OF VILLAGE KUSUMUNDIA
PERIOD : JANUARY TO DECEMBER - 2004
SURVEY CONDUCTED BY ENVIRONMENTAL ENGINEERING LABORATORY, FACOR

Sl. No.	CHARACTERISTICS	Limit as per IS 10500	RESULTS			
			1st season Jan.-March	2nd Season Apr.-June	3rd Season July-Sept.	4th Season Oct-Dec.
1)	Colour, Hazen units	10	Colourless	Colourless	Colourless	Colourless
2)	Odour	Unobject-ionable	Unobject-ionable	Unobject-ionable	Unobject-ionable	Unobject-ionable
3)	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4)	Turbidity, NTU	10	Transpar ent	Transpar-ent	Trabspar-ent	Transpar-ent
5)	Dissolved solids, mg/l	500	114	118	104	108
6)	P^H Value	6.5 - 8.5	7.6	7.6	7.5	7.5
7)	Calcium (Ca), mg/l	75	20.8	22.4	18.4	20.0
8)	Magnesium (Mg), mg/l	30	16.8	17.76	15.64	16.32
9)	Copper (Cu), mg/l	0.05	<0.01	<0.01	<0.01	<0.01
10)	Iron (Fe), mg/l	0.3	0.02	0.022	0.018	0.02
11)	Manganese (Mn), mg/l	0.1	<0.01	<0.01	<0.01	<0.01
12)	Chloride (Cl), mg/l	250	20	22	18	20
13)	Sulphate (So_4), mg/l	150	3.16	3.22	3.08	3.10
14)	Nitrate (NO_3), mg/l	45	3.24	3.26	3.42	3.34
15)	Fluoride (F), mg/l	0.6 - 1.2	<0.01	<0.01	<0.01	<0.01
16)	Phenolic compounds (C_6H_5OH), mg/l	0.001	<0.001	<0.001	<0.001	<0.001
17)	Total Hardness ($CaCO_3$), mg/l	300	122	130	112	118
18)	Mercury (Hg), mg/l	0.001	<0.001	<0.001	<0.001	<0.001
19)	Cadmium (Cd), mg/l	0.01	<0.005	<0.005	<0.005	<0.005
20)	Selenium (Se), mg/l	0.01	<0.005	<0.005	<0.005	<0.005
21)	Arsenic (As), mg/l	0.05	<0.001	<0.001	<0.001	<0.001
22)	Cyanide (CN), mg/l	0.05	<0.01	<0.01	<0.01	<0.01
23)	Lead (Pb), mg/l	0.1	<0.01	<0.01	<0.01	<0.01
24)	Zinc (Zn), mg/l	5.0	<0.01	<0.01	<0.01	<0.01
25)	Anionic detergents(MBAS), mg/l	0.2	Absent	Absent	Absent	Absent
26)	Chromium (Cr^{+6}), mg/l	0.05	<0.005	<0.005	<0.005	<0.005
27)	Residual chlorine(Cl), mg/l	0.2	Absent	Absent	Absent	Absent
28)	Pesticides	Absent	Absent	Absent	Absent	Absent
29)	Mineral oil, mg/l	0.01	<0.01	<0.01	<0.01	<0.01
30)	Coliform organisms, MPN/100 ml	Absent	Absent	Absent	Absent	Absent

M. K. Pujari,
Regd. No. CORICAL/230/96/A

FACOR
BHIMTANGAR

ANNEXURE - E-22

DRINKING WATER ANALYSIS REPORT AS PER IS 10500

PROJECT : BHIMTANGAR CHROMITE MINES
LOCATION : 'K' TYPE COLONY BORE WELL WATER OF KATHPAL CHROMITE MINES
PERIOD : JANUARY TO DECEMBER - 2004
SURVEY CONDUCTED BY ENVIRONMENTAL ENGINEERING LABORATORY, FACOR

Sl. No.	CHARACTERISTICS	Limit as per IS 10500	RESULTS			
			1st Season Jan.-Mar	2nd Season Apr -June	3rd Season July-Sept.	4th Season Oct.- Dec.
1)	Colour, Hazen units	10	Colourless	Colourless	Colourless	Colourless
2)	Odour	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
3)	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4)	Turbidity, NTU	10	Transparent	Transparent	Transparent	Transparent
5)	Dissolved solids, mg/l	500	210	218	192	206
6)	pH Value	6.5 - 8.5	7.5	7.6	7.4	7.5
7)	Total Hardness ($CaCO_3$), mg/l	300	228	236	206	220
8)	Calcium (Ca), mg/l	75	51.2	52.8	48.0	48.8
9)	Magnesium (Mg), mg/l	30	24.0	24.96	20.64	23.52
10)	Copper (Cu), mg/l	0.05	<0.01	<0.01	<0.01	<0.01
11)	Iron (Fe), mg/l	0.3	0.022	0.024	0.02	0.022
12)	Manganese (Mn), mg/l	0.1	<0.01	<0.01	<0.01	<0.01
13)	Chloride (Cl), mg/l	250	36	40	30	34
14)	Sulphate (SO_4), mg/l	150	4.02	4.14	3.78	3.86
15)	Nitrate (NO_3), mg/l	45	4.84	4.78	5.06	4.92
16)	Fluoride (F), mg/l	0.6 - 1.2	<0.01	<0.01	<0.01	<0.01
17)	Phenolic compound (C_6H_5OH), mg/l	0.001	<0.001	<0.001	<0.001	<0.001
18)	Mercury (Hg), mg/l	0.001	<0.001	<0.001	<0.001	<0.001
19)	Cadmium (Cd), mg/l	0.01	<0.005	<0.005	<0.005	<0.005
20)	Selenium (Se), mg/l	0.01	<0.005	<0.005	<0.005	<0.005
21)	Arsenic (As), mg/l	0.05	<0.001	<0.001	<0.001	<0.001
22)	Cyanide (CN), mg/l	0.05	<0.01	<0.01	<0.01	<0.01
23)	Lead (Pb), mg/l	0.1	<0.01	<0.01	<0.01	<0.01
24)	Zinc (Zn), mg/l	5.0	<0.01	<0.01	<0.01	<0.01
25)	Anionic detergents(MBAS), mg/l	0.2	Absent	Absent	Absent	Absent
26)	Chromium (Cr^{+6}), mg/l	0.05	<0.005	<0.005	<0.005	<0.005
27)	Residual chlorine(Cl), mg/l	0.2	Absent	Absent	Absent	Absent
28)	Pesticides	Absent	Absent	Absent	Absent	Absent
29)	Mineral oil, mg/l	0.01	<0.01	<0.01	<0.01	<0.01
30)	Coliform Organisms, MPN/100 ml	Absent	Absent	Absent	Absent	Absent

M. R. Pujari,

Regd. No. ROP/CAL/239/98TA

FACOR
BHUBANESWAR

ANNEXURE - E-23

DRINKING WATER ANALYSIS REPORT AS PER IS 10500

PROJECT : BHUBANGAR CHROMITE MINES
LOCATION : TUBE WELL WATER OF VILLAGE OSTIA
PERIOD : JANUARY TO DECEMBER - 2004
SURVEY CONDUCTED BY ENVIRONMENTAL ENGINEERING LABORATORY, FACOR

Sl. No.	CHARACTERISTICS	Limit as per IS 10500	RESULTS			
			1st Season Jan -March	2nd Season April-June	3rd Season July-Sept.	4th Season Oct.-Dec.
1)	Colour, Hazen units	10	Colourless	Colourless	Colourless	Colourless
2)	Odour	Unobject-ionable	Unobject-ionable	Unobject-ionable	Unobject-ionable	Unobject-ionable
3)	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4)	Turbidity, NTU	10	Transpar-ent	Transpar-ent	Transpar-ent	Transpar-ent
5)	Dissolved solids, mg/l	500	108	112	98	106
6)	pH Value	6.5 - 8.5	6.8	6.8	6.7	6.8
7)	Total hardness($CaCO_3$), mg/l	300	112	116	104	108
8)	Calcium (Ca), mg/l	75	17.6	18.4	16.8	17.6
9)	Magnesium (Mg), mg/l	30	16.32	16.8	14.88	15.36
10)	Copper (Cu), mg/l	0.05	<0.01	<0.01	<0.01	<0.01
11)	Iron (Fe), mg/l	0.3	0.02	0.02	0.018	0.02
12)	Manganese (Mn), mg/l	0.1	<0.01	<0.01	<0.01	<0.01
13)	Chloride (Cl), mg/l	250	18	20	16	18
14)	Sulphate (SO_4), mg/l	150	2.58	2.64	2.58	2.72
15)	Nitrate (NO_3), mg/l	45	4.86	4.72	4.96	4.90
16)	Fluoride (F), mg/l	0.6 - 1.2	<0.01	<0.01	<0.01	<0.01
17)	Phenolic compound(C_6H_5OH), mg/l	0.001	<0.001	<0.001	<0.001	<0.001
18)	Mercury, (Hg) mg/l	0.001	<0.001	<0.001	<0.001	<0.001
19)	Cadmium (Cd), mg/l	0.01	<0.005	<0.005	<0.005	<0.005
20)	Selenium (Se), mg/l	0.01	<0.005	<0.005	<0.005	<0.005
21)	Arsenic (As), mg/l	0.05	<0.001	<0.001	<0.001	<0.001
22)	Cyanide (CN), mg/l	0.05	<0.01	<0.01	<0.01	<0.01
23)	Lead (Pb), mg/l	0.1	<0.01	<0.01	<0.01	<0.01
24)	Zinc (Zn), mg/l	5.0	<0.01	<0.01	<0.01	<0.01
25)	Anionic detergents(MBAS), mg/l	0.2	Absent	Absent	Absent	Absent
26)	Chromium (Cr^{+6}), mg/l	0.05	<0.005	<0.005	<0.005	<0.005
27)	Residual chlorine (Cl), mg/l	0.2	Absent	Absent	Absent	Absent
28)	Pesticides	Absent	Absent	Absent	Absent	Absent
29)	Mineral Oil, mg/l	0.01	<0.01	<0.01	<0.01	<0.01
30)	Coliform Organisms, MPN/100ml	Absent	Absent	Absent	Absent	Absent

M. R. Pujari,
Regd. No. BOP/CAL/[illegible]/2004

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BHUBANESWAR

ANNEXURE - E-24

DRINKING WATER ANALYSIS REPORT AS PER IS 10500

PROJECT : BHUBANESWAR CHROMITE MINES
LOCATION : TUBE WELL WATER NEAR TARINI TEMPLE OF TISCO MARKET AREA
PERIOD : JANUARY TO DECEMBER - 2004
SURVEY CONDUCTED BY ENVIRONMENTAL ENGINEERING LABORATORY, FACOR

Sl. No.	CHARACTERISTICS	Limit as per IS 10500	RESULTS			
			1st Season Jan.-Mar	2nd Season Apr.-June	3rd Season July-Sept.	4th Season Oct.-Dec.
1)	Colour, Hazen units	10	Colourless	Colourless	Colourless	Colourless
2)	Odour	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
3)	Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
4)	Turbidity, NTU	10	Transparent	Transparent	Transparent	Transparent
5)	Dissolved Solids, mg/l	500	110	118	102	106
6)	pH Value	6.5 - 8.5	7.6	7.7	7.5	7.5
7)	Total hardness($CaCO_3$), mg/l	300	126	134	114	120
8)	Calcium (Ca), mg/l	75	21.6	23.2	18.4	20.0
9)	Magnesium (Mg), mg/l	30	17.28	18.24	16.32	16.8
10)	Copper (Cu), mg/l	0.05	<0.01	<0.01	<0.01	<0.01
11)	Iron (Fe), mg/l	0.3	0.022	0.024	0.018	0.022
12)	Manganese (Mn), mg/l	0.1	<0.01	<0.01	<0.01	<0.01
13)	Chloride (Cl), mg/l	250	20	24	16	18
14)	Sulphate (SO_4), mg/l	150	3.24	3.62	2.76	3.08
15)	Nitrate (NO_3), mg/l	45	3.80	4.26	3.24	3.62
16)	Fluoride (F), mg/l	0.6 - 1.2	<0.01	<0.01	<0.01	<0.01
17)	Phenolic compounds, (C_6H_5OH), mg/l	0.001	<0.001	<0.001	<0.001	<0.001
18)	Mercury (Hg), mg/l	0.001	<0.001	<0.001	<0.001	<0.001
19)	Cadmium (Cd), mg/l	0.01	<0.005	<0.005	<0.005	<0.005
20)	Selenium (Se), mg/l	0.01	<0.005	<0.005	<0.005	<0.005
21)	Arsenic (As), mg/l	0.05	<0.001	<0.001	<0.001	<0.001
22)	Cyanide (CN), mg/l	0.05	<0.01	<0.01	<0.01	<0.01
23)	Lead (Pb), mg/l	0.1	<0.01	<0.01	<0.01	<0.01
24)	Zinc (Zn), mg/l	5.0	<0.01	<0.01	<0.01	<0.01
25)	Anionic determents(MBAS), mg/l	0.2	Absent	Absent	Absent	Absent
26)	Chromium (Cr^{+6}), mg/l	0.05	<0.005	<0.005	<0.005	<0.005
27)	Residual Chlorine (Cl), mg/l	0.2	Absent	Absent	Absent	Absent
28)	Pesticides	Absent	Absent	Absent	Absent	Absent
29)	Mineral Oil, mg/l	0.01	<0.01	<0.01	<0.01	<0.01
30)	Coliform organisms, MPN/100 ml	Absent	Absent	Absent	Absent	Absent

M. K. Pujari,
Regd. No. ROP/CAL/239/98/A

TEMPERATURES RECORDED DURING THE YEAR

2004

Sl. No.	Month	TEMPERATURE °C	
		Maximum	Minimum
1)	January	31	13
2)	February	37	14
3)	March	43	18
4)	April	45.5	23
5)	June	41	26
6)	July	38	25
7)	August	37	24
8)	September	37	24
9)	October	35	19
10)	November	34	16
11)	December	31	13
	Average year	37.96	20.08
	SAY	38	20

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ANNEXURE - 26

RELATIVE HUMIDITY RECORDED DURING THE YEAR

2004

Sl. No.	Month	Relative humidity (%)
1)	January	50.62
2)	February	56.82
3)	March	65.32
4)	April	72.68
5)	May	77.83
6)	June	79.45
7)	July	81.64
8)	August	86.82
9)	September	83.56
10)	October	79.86
11)	November	68.02
12)	December	70.92
	YEARLY AVERAGE :	72.79

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Regd. No. ROP/CAL/239/98/A

ANNEXURE - E-27

RAIN FALL DATA

UNIT : MM

YEAR	JANUARY	FEBRUARY	MARCH	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER	NOVEMBER	DECEMBER	TOTAL
1992	4.60	58	4.4	Nil	1.77	156.1	411.2	211.3	219.6	69.4	Nil	Nil	1136.4
1993	Nil	Nil	11.9	80.50	45.2	370.6	330.2	278.4	295.0	65.4	Nil	Nil	1477.2
1994	32	23.2	2.8	103.6	66.8	406.0	340.4	461.4	277.9	57.8	2.0	Nil	1773.9
1995	36.3	22.4	6.0	19.4	273.6	179.6	423	337.2	226.2	76	98.8	Nil	1698.5
1996	Nil	28.4	21.6	16.8	92.0	266.4	382.5	291.5	212.2	167	Nil	2.20	1480.60
1997.	6.30	4.20	32.2	24	42.3	158.60	306.7	272.8	316.4	182.40	26.40	Nil	1372.30
1998	Nil	Nil	42.6	48.0	28.4	313.4	297.6	173.2	280.2	126.4	29	Nil	1338.8
1999	Nil	Nil	Nil	Nil	217.1	291.4	356.2	464.2	157.5	401.6	130	Nil	2018
2000	Nil	12	Nil	3.5	144.0	202	713.4	355.4	130	28.0	Nil	Nil	1588.3
2001	Nil	Nil	Nil	Nil	19	388	698	505	341.8	129.6	6.0	Nil	2087.4
2002	Nil	Nil	Nil	113.8	64	283.1	152.9	449.0	320.4	22.9	Nil	Nil	1406.1
2003	Nil	Nil	3.8	71.0	Nil	225.4	623.3	250.2	311.3	478.0	16.3	20.9	2000.3
2004	106.1	8.4	4.6	73.8	69.3	78.2	176.9	284.6	219.0	116.2	Nil	Nil	1137.1
AVERAGE	14.25	12.05	10.0	42.65	81.8	255.3	400.92	333.4	254.43	147.75	23.73	1.78	1578.06

ANNEXURE- E-27

ANNEXURE - E- 28

USBM AND DIN 4150 STANDARDS FOR VIBRATION

USBM STANDARD:

SL. No	TYPE OF STRUCTURE	PEAK PARTICLE VELOCITY (mm/Sec).	
		Frequency 40 H_z	Frequency 40 Hz
1	Modern homes, dry wall interior	50	20
2	Older homes plaster or wood etc.	50	12.5

GERMAN STANDARDS DIN 4150 OF1983:

TYPE OF STRUCTURE	Peak particle velocity at foundation level frequency range (H_z)			PPV (mm/sec.) At floor level of top most storey (all frequencies)
	10	10-50	50-1000	
Buliding used as offices & Industrial structures	20	20-40	40-100	40
Domestic houses and associated Constructions. Structures with plasters	5	5-15	5-15	15
Building which do not fail under (I) & (ii) and objects of historic interst of structures.	3	3-8	8-10	8

M. K. Pujari,
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DETAILS OF EXPERIMENTAL BLAST PARAMETERS AT SUKINDA VALLEY

Sl. No.	Blast No.	Name of Mine Location & Rock Type	Hole Dia (mm)	No. Of Hole	Hole depth (m)	AVG Burden (m)	AVG Spacing (m)	Max. Explosive (Kg)			Stemming Column HT (m)	Dist of Instrum Blast (M)		RPPV (mm/SEC)		Explosive Type	Frequency (Hz)	Peak Noise Level dB(A) Norms 5000
								Per Hole	Per Round	Per Delay		VS 1600	Norms 5000	VS 1600	Norms 5000			
		OMC Kalipani Manual Quarry (Contact between Chromite and laterite)	32	24	4.1	1-1.2	1.2	0.39	9.36	9.36	0.5-7	35	79	3.08	0.6	Sp Gelegnite	1	135
13	2	OMC Kaliapani Manual quarry (Contact between Chromite and laterite)	32	36	4.5	1-1.2	1.1	0.39	14.04	14.04	0.5-7	30	75	8.4	1.6	Sp. Gelegnite	12	140

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ANNEX. E-28

ANNEXURE - S-29

DETAILS OF BLAST VIBRATION STUDIES

$$\text{FORMULA :-} \quad V = K \left\{ \frac{D}{\sqrt{Q}} \right\}^{-\beta}$$

Where V = Peak Particle Velocity.

PARTICULARS	KALIAPANI MINES	TISCO QUARTZITE AREA
K	353	942.700
β - Ground Constant	1.856	1.994
Q - Explosive Charge kg/delay	6	35

RPPV - VALUES FOR DEEP HOLES (35 kg/delay) FOR PROPOSED PROJECT

APPROVED

Sl. No.	Place	Distance	PEAK PARTICLE VELOCITY(mm/Sec)	
			Based on Kaliapani Mines	Based on TISCO Quartzitezone
1)	Public Road	220	0.430	0.700
2)	Residential Area	310	0.227	0.352

RPPV - VALUES FOR SHORT HOLE (6 kg/delay) FOR PROPOSED PROJECT

Sl. No.	Place	Dis-tance	PEAK PARTICLE VELOCITY (mm/sec.)	
			Based on Kaliapani Mines	Based on TISCO Quartzite zone
1)	Public Road	220	0.084	0.120
2)	Residential Area	310	0.044	0.060

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ANNEXURE - E-30

VALUES FOR UNDERGROUND BLASTING FOR PROPOSED PROJECT

FORMULA :- $V = K \left\{ \frac{D}{\sqrt{Q}} \right\}^{-\beta}$

Based on actual study conducted by R.E.C., Rourkela at Kathpal Mines, M/s. Ferro Alloys Corporation Limited (FACOR) -

$K = 5377$

$\beta = 1.9268$

$Q = 4$ kg/delay

Sl. No.	P l a c e	Distance	PPV (mm/sec.)
1)	Public Road	280	0.394
2)	Residential Area	370	0.230

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Regd. No. ROP/CAL/220/98/A

ANNEXURE - E-31

GENERATION AND UTILISATION OF TOP SOIL & SUB SOIL

Sl. No.	Year	GENERATION Quantity in M^3	Utilisation in M^3			
			Nursery	Filling in plantation pits	*Balance Qty. in M^3	Spreading over plantation area
1.	FIRST	2,800	14	450	1,336	1,000
2.	SECOND	2,800	16	600	1,184	1,000
3.	THIRD	2,800	14	460	1,326	1,000
4.	FOURTH	2,800	15	570	1,215	1,000
5.	FIFTH	2,800	14	450	1,336	1,000
	TOTAL	14,000	73	2,530	6,396	5,000

*The Balance Quantity of Top Soil 6,396 M^3 will be utilised for Plantation after the FIFTH year plantation programme.

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ANNEXURE - E-32

AFFORESTATION PROGRAMME FOR INITIAL FIVE YEARS

(Reference - DRAWING NO.DR-12)

Sl. No.	Year	Peripherial Area (Hect.)	Waste Dump Area (Hect.)	TOTAL Area (Hect.)	No. of seedlings to be planted
1)	1st Year	0.50	-	0.50	1,250
2)	2nd year	-	0.54	0.54	1,350
3)	3rd year	-	0.54	0.54	1,350
4)	4th year	0.10	0.50	0.60	1,500
5)	5th year	0.25	0.35	0.60	1,500
	TOTAL ::	0.85	1.93	2.78	6,950

REMARKS :-

Cassia, Siamea, Ailanthus excelsa, Acacia nilotica, A. Suriculiformis, Madhuca indica, Mangifera indica, Syzygium cumini, Dalbergia sissoo, Delonix elata, D.regia, Tectona grandis, Terminalia tomentosa, T. Chebula, Emblica officinalis, Aeglemarmelas, Tamarindus indica, Spondias pinnata etc.

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ANNEXURE - E-33

AFFORESTATION PROGRAMME FOR THE CONCEPTUAL PERIOD

Unit : Area in Hects.

(Refer Drawing No. DR-9)

Sl. No.	Particulars	Area to be Reclaimed (Years)				
		6th year-10th year	11th year-15th year	16th year-20th year	21st year-25th year	26th year-30th year
1)	Opencast M i n i n g	-	-	-	1.10	2.10
2)	Waste Dump	1.69	1.21	1.75	-	-
3)	Infrastructures for underground workings	-	-	-	-	0.715
4)	Stack Yard	-	-	-	-	0.920
5)	Low Grade material dump	-	-	0.99	-	-
6)	Nickel dump	0.20	0.20	0.212	-	-
7)	Top soil dump and sub soil dump	-	-	0.20	0.38	-
8)	Essential infrastructure	-	0.20	-	-	0.500
9)	E T P	-	-	-	-	0.140
10)	Drain	-	-	-	-	0.250
11)	Road	0.10	-	0.10	-	0.100
12)	Peripherial Area	0.25	0.25	0.25	0.143	-
	T O T A L :::	2.24	1.865	2.512	1.623	2.200
	No. of seedlings to be planted.	5600	4650	6300	4050	5500

TYPE OF SEEDLINGS TO BE PLANTED :-

Cassia, Siamea, Ailanthus excelsa, Acacia nilotica, A. auriculiformis, Madhuca indica, Mangifera indica, Syzygium cumini, Delbergia sissoo, Delonix eleta, D. regia, Tectona grandis, Terminalis tomentosa, T. arjuna, T. bellirica, T. chebula, Emblica officinalis, Aeglemarmelas Tamarindus indica, spondias pinnata etc.

M. K. Pujari,

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ANNEXURE - E-34

SOIL SAMPLE ANALYSIS REPORT

LOCATION : BHINTANGAR CHROMITE MINES.

DATE OF SAMPLING : 5.01.2004.

DATE OF ANALYSIS : 5.01.2004 TO 10.01.2004.

SURVEY CONDUCTED BY : ENVIRONMENTAL ENGINEERING LABORATORY, FACOR.

Sl. No.	Particulars	SAMPLES		
		S_1	S_2	S_3
1)	Colour	Reddish	Reddish Brown	Brown
2)	Texture	Sandy	Sandy Clay	Sandy Clay
3)	Moisture (%)	8.2	8.1	14.3
4)	P^H Value	7.1	7.6	7.7
5)	Electrical conductivity/ umho/cm	33.42	38.68	37.62
6)	Bulk Density, g/cm^3	1.61	1.43	1.72
7)	Porosity (%)	30.08	32.18	31.24
8)	Nitrate Nitrogen (N), Lbs/Acre	4.0	9.0	9.0
9)	Ammoniacal Nitrogen (N), Lbs/Acre	$\angle 13$	$\angle 13$	$\angle 13$
10)	Available Phosphates ((P_2O_5) Lbs/Acre	Nil	Nil	Tracess
11)	Available Potassium (K), Lab/Acre	$\angle 100$	$\angle 100$	175
12)	Organic Carbon (%)	0.5	0.75	0.75
13)	Organic Matter (%)	0.8	1.29	1.29
14)	Water holding capacity (%)	35.6	39.2	37.9
15)	Hexavalent Chromium (Cr^{+6}) ppm	0.15	0.06	0.16

S_1 = Adjacent area to old mine quarry, South side.

S_2 = Barren land, centre of the lease hold area.

S_3 = Agricultural land, North side.

M. E. Pujari,

Regd. No. ROP/CAL/239/99/A

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SIEVE ANALYSIS OF SOIL SAMPLES

LOCATION : BHIMTANGAR CHROMITE MINES.

DATE OF SAMPLING : 5.01.2004.

DATE OF ANALYSIS : 6.01.2004.

SURVEY CONDUCTED BY : ENGINEERING ENVIRONMENTAL LABORATORY, FACOR.

Sl. No.	Sieve Size (in mm)	S_1	S_2	S_3
1)	- 25 + 10	5.4	7.6	8.2
2)	- 10 + 2	46.9	47.8	45.6
3)	- 2 + 1	14.8	30.2	19.2
4)	- 1 + 0.25	11.2	10.6	12.3
5)	- 0.25 + 0.15	15.8	1.8	7.6
6)	- 0.15 + 0.053	3.6	0.7	3.9
7)	-0.053 + 0.037	1.3	0.8	1.3
8)	-0.037	1.0	0.5	1.9
	TOTAL :::	100	100	100

S_1 = Adjacent area to old mine quarry, South side.

S_2 = Barren land, centre of the lease hold area.

S_3 = Agricultural land, North side.

M. K. Pujari,

Regd. No. ROP/CAL/239/99/A

PROGRESSIVE MINE CLOSURE PLAN

APPROVED

UNDER RULE – 23 B (1) OF

MINERAL CONSERVATION & DEVELOPMENT (AMENDMENT) RULES,2003

PROGRESSIVE MINE CLOSURE PLAN

M. R. Pujari,

Regd. No. ROP/CAL/220/98/A

INTRODUCTION

1.0. INTRODUCTION :-

1.(i) NAME OF THE LESSEE -

- Bhimatangar Chromite Mines,
M/s. Ferro Alloys Corporation Limited.

(ii) LOCATION -

- Sukinda Sub-division, Jajpur District, Orissa in Sukinda Chromite Valley.
(Please refer DRAWING NO.A, B & 1 of Volume - 2)

(iii) EXTENT OF LEASE AREA -

- 23.800 Hectares.

(iv) TYPE OF LEASE AREA (Forest, Non-forest etc.) -

Non-Forest : 23.800 Hectares.
Forest : Nil

(v) PRESENT LAND USE PATTERN -

TABLE - 29

Sl.No.	Description	Area in Hects.
1)	Quarry A r e a	5.440
2)	R o a d s	0.384
3)	Agricultural Land	2.136
4)	D r a i n	0.276
5)	Virgin Area	15.564
	T O T A L ..	23.800

NOTE :- Please refer DRAWING NO. 2 of volume - 2.

(vi) METHOD OF MINING -

Please refer to para No.4(a) from page No. 54 to Page No. 65 of MINING PLAN in this booklet.

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(vii) MINERAL PROCESSING OPERATIONS -

- It is not applicable.

1.1. REASONS FOR CLOSURE :-

Theoritically there is no possibility of the mine getting closed as the various factors which lead to mine closure, will not normally apply to BHIMTANGAR CHROMITE MINE. These factors are analysed as given below. However, for the sake of MINE CLOSURE PLAN, Mine Closure date will be considered to be the completion of THIRD TERM OF LEASE. First term of lease is likely to be granted by 2006 and will continue till 2036 i.e. for 30 years. Subsequently, it will be extended in second term upto 2056 for a period of 20 years. A third term will extend the mine life to 2076. Hence, MINE CLOSURE DATE will be considered 2076.

1.1.1. EXHAUSTION OF MINERAL -

For achieving ore of 0.4 Lac MT, annual rate of depression of quarry bottom has been 5.3 M over 250 M strike. If the bottom is depressed at the targetted rate in 10 year quarry bottom will go deep by another 53 M. Quarry bottom currently is at 93 MRL and the depth from surface is 17 M. With further 53 M deepening, depth of working will be 70 M. It is well known fact that G.S.I. has intersected the ore upto 200 M depth in Sukinda Mines of former TISCO lease area in several holes and in two holes it has intersected to a depth of 250 M. At Kathpal Chromite Mines, FACOR has intersected the ore to a depth of about 200 M (Refer MINING SCHEME - Page No.20 of Kathpal Mines). The ore bodies are subvertical dipping at an angle of 65 degrees to 70 degrees There is no reason of its vanishing beyond 250 M depth, when the host rock serpentinite is more than one kilometre wide and without any signs of narrowing down at depth. And there is no reason why depth continuity will not be maintained in whole of Sukinda Valley as is the case at Sukinda Mines or Kathpal Chromite Mines.

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Under the circumstances, with depth mining, question of mineral exhaustion does not arise in the type of Chromite deposit occurring at Sukinda Valley in the coming 100 years. For the stipulated production, the rate of depression of ore strike will be 3.5 M/annum in underground mining, since it will be possible to work on the full strike length of ore body by then, including excavation of chromite left on the quarry slope with 30 M depression of ore strike. For underground mining after 10 years of opencast mining mine life will be around 100 years, assuming continuity of ore depth for 250 M from surface. And, there is no reason why dip continuity will not persist beyond 250 M.

1.1.2. LACK OF DEMAND -

It does not appear that any time demand for Chromite will fall with expanding requirement in the Globe for stainless steel consumption with ever expanding development work to meet the aspiration of a rising Global population. There may be rise and fall of demand but the requirement can not get eliminated both on the domestic front as well as in International arena leading to permanent closure of Mines.

1.1.3. UN-ECONOMIC OPERATION -

The opencast mining will cease in 10 years of time and will be replaced with underground mining. Since there is no other Chromite deposit in the Country, underground mining will have to be continued at Sukinda Valley as imported Chromite cost will be very high considering the strategic importance of mineral and the ocean freight cost in transport.

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1.1.4. NATURAL CALAMITY -

No natural calamity is expected as the area is not prone to earth quake, nor there is any river or water body which may cause inundation. Nor there is likely to be slide of ground all around as topography does not lend to such scope. The only problem, that can take place, will be due to cyclonic wind and rain. Enough precaution will be taken by providing pumps and garland drain to prevent submergence of mines due to rain. There is no risk of any mass epidemic developing which may lead to permanent closure of mine.

1.1.5. DIRECTIVE FROM STATUTORY ORGANIZATION, COURT -

Any such directive is for temporary stoppage till the directive is complied with and hence there is no risk of Closure on this count. Under the circumstances, there can be a temporary stoppage due to natural calamity or directive from Statutory Organization, but there is no scope of permanent stoppage unless the lease is not renewed for a 2nd & 3rd term. The first term will expire on 2036 assuming that lease will be granted in 2006, the Second term will expire on 2056 and third term will expire by 2076. After 10 years, 1st term of lease and over the entire second term of lease underground mining will be carried out. And, in the third term of mining lease also underground mining will be carried out. Even after expiry of third term, lease will be thrown open for receiving mining lease application from prospective mine owners and FACOR will have the opportunity to get the lease on first priority and underground mining will be carried out as such for several lease terms. And, incase, FACOR is not getting lease, some one else will carry out the underground mining. And the terminus of ore dip continuity may not come before 100 years, assuming 250 M depth continuation. However, as already stated above, we will treat expiry of third term of mining lease i.e. 2076 as MINE CLOSURE DATE. Second term lease will commence in 2036. Therefore,

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with 30 years term of first lease period and 20 years life of 2nd & 3rd terms of lease period, the expiry date will be 2076.

1.2. STATUTORY OBLIGATION :-

1.2.1. MINING LEASE CONDITION -

Since, mining lease is yet to be executed, special conditions are not known.

1.2.2. MINING PLAN -

As Mining Plan is yet to be approved special conditions are not known.

1.2.3. DIRECTIVE ISSUED BY INDIAN BUREAU OF MINES -

Not yet applicable.

1.2.4. CONDITIONS IMPOSED BY M O E F -

Not yet applicable.

1.2.5. CONDITIONS IMPOSED BY THE STATE OR CENTRAL POLLUTION CONTROL BOARD -

Not yet applicable.

M. K. Pujari,
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1.3. CLOSURE PLAN PREPARATION :-

1.3.1. NAME AND ADDRESS OF THE APPLICANT -

- M/s. Ferro Alloys Corporation Limited.

Address -

- Sri Ashok Agrawal,
- Chief Executive (Mines),
M/s. Ferro Alloys Corporation Limited,
Lakshmi Bhawan,
Kuans,
Bhadrak - 756 100,
Orissa.

PHONE : 06784 - 250708, 250598, 250311, 251312.

FAX : 06784 - 251782.

E.MAIL: bls_facor168@sancharnet.in

NAME & ADDRESS OF THE BOARD OF DIRECTORS & NOMINATED OWNER -

- Sri Uma Shankar Agarwal,
Chairman,
M/s. Ferro Alloys Corporation Ltd.,
Shreeram Bhawan,
TUMSAR - 441 912,
Dist.: Bhandara (Maharashtra).

Sri R.K. Saraf,
Vice Chairman,
M/s. Ferro Alloys Corporation Ltd.,
Shreeramnagar - 535 101,
Dist. Vizianagaram (A.P.)

Sri Manoj Saraf,
Managing Director,
M/s. Ferro Alloys Corporation Ltd.,
Charge Chrome Plant,
D.P. Nagar,
Randia - 756 135,
Orissa.

Sri Vineet Saraf,
Joint Managing Director,
M/s. Ferro Alloys Corporation Ltd.,
E-334, East of Kailash,
Ground Floor,
New Delhi - 110 065.

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Sri Rohit Saraf,
Joint Managing Director,
M/s. Ferro Alloys Corporation Limited,
Laxmi Bhawan, Kuans,
Bhadrak - 756 100
Orissa.

Sri Ashish Saraf,
Joint Managing Director,
M/s. Ferro Alloys Corporation Ltd.,
E-334, East of Kailash,
Ground Floor,
New Delhi - 110 065.

Sri S.C. Jain,
Nominee of Bank of India,
New Delhi - 110 001.

Sri A.S. Kapre,
The Industrial Credit & Investment
Corporation of India Limited,
163, Backbay Reclamation,
Mumbai - 400 020.

Sri V.J. Trivedi,
Trivedi Building,
Main Road,
Balaghat - 481 001 (M.P.)

Sri M.B. Thaker,
Giripeth,
Nagpur - 440 010.

Sri C.P. Banka,
Director (Finance),
M/s. Ferro Alloys Corporation Ltd.,
Shreeram Bhawan,
TUMSAR - 441 912,
Dist.: Bhandara (Maharastra).

Sri B.B. Singh,
Director (Technical),
M/s. Ferro Alloys Corporation Ltd.,
Charge Chrome Plant,
D.P. Nagar,
Randia - 756 135,
Orissa.

NAME & ADDRESS OF THE NOMINATED OWNER -

Sri B.B. Singh,
Director (Technical) & Nominated Owner,
M/s. Ferro Alloys Corporation Ltd.,
Charge Chrome Plant,
D.P. Nagar,
Randia - 756 135,
Orissa.

M. R. Pujari,

Regd. No. ROP/CAL/229/98/A

1.3.2. NAME & ADDRESS OF THE R.Q.P. WHO PREPARED THE PROGRESSIVE MINE CLOSURE PLAN -

Name :

Sri M.K. Pujari.

Address :

Sr. General Manager,
M/s. Ferro Alloys Corporation Ltd.,
Kathpal Chromite Mines,
Post.: Kalarangiatta - 755 028,
Dist.: Jajpur,
Orissa.

PHONE : 06726 - 268385 & 268754.

R.Q.P. NO. :

RQP/CAL/239/96/A

VALID UPTO :

15.05.2010.

1.3.3. COPY OF THE RESOLUTION OF THE BOARD OF DIRECTORS OR ANY OTHER APPROPRIATE ADMINISTRATIVE AUTHORITY -

Since, there is no decision regarding the date of CLOSURE OF MINE, question of Resolution of the Board of Directors or any other appropriate Administrative Authority does not arise in this respect.

M. K. Pujari,
Regd. No. RQP/CAL/239/96/A

MINE DESCRIPTION

M. R. Pujari,
Regd. No. SOP/GAL/239/98/A

2.0. MINE DESCRIPTION :-

2.1. GEOLOGY :-

2.1.1. TOPOGRAPHY -

Entire lease hold area is a flat terrain having gentle slope 2° towards North West. The highest contour in the lease hold at the South East corner of the lease boundary is 111 MRL and reduces gradually towards North-West upto 103 MRL. The lowest elevation of the quarry bottom as on date is 93 MRL.

The Topographical plan of the lease area on scale of 1 : 2000 with contour interval of 3 metres is enclosed as DRAWING NO.DR-2 of Volume - 2.

2.1.2. GENERAL GEOLOGY -

The lease hold area is situated on the Southern limb of Sukinda ultramafic complex and represents a highly weathered and altered product of ultramafic mass overlain by laterite, top part of which is further decomposed to soil due to extensive weathering. The different lithological units have been encountered in quarries and exposed on date and in GSI bore holes are as follows -

(a) Chromiferous Dunite - Peridotite (altered to Serpentinite).
(b) Non-chromiferous Pyroxenite.
(c) Nickeliferous Limonite (altered product of Serpentinite).
(d) Chert.
(e) Laterite.
(f) Soil.
(g) Chrome Ore Lode.

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2.1.3. ROCK TYPE -

The lithological units occurring in the lease hold area, are peridotite, pyroxenite, nickeliferous limonite, chert, laterite, soil, chrome ore lode. Host rock for the chromite is serpentinite. The ultrabasic mass has weathered to form a laterite capping 5 to 7 M thickness all over the lease area. (Please refer DRAWING NO. DR - 4 of volume - 2.

2.1.4. CHEMICAL CONSTITUENT -

The ultrabasic rock of serpentinite contain around 9% SiO_2 and about 4% MgO. Other constituents are iron, alumina, chromite. Trace element in the ultra basic rock is Nickel, Cobalt, Copper. Chemical constituent of laterite is Iron, Alumina, Silica, Chromite and Magnesium Oxide. Chemical constituents of chromite is Cr_2O_3, SiO_2, Al_2O_3, MgO & FeO.

2.1.5. TOXIC ELEMENTS -

Toxic elements such as Nickel, Cobalt has been encountered in Nickeliferous Limonite zones of the quarry, which is in insoluable state because the same is not found in mine seepage water. Another toxic element present in associated with chromite ore is Hexavalent Chromium which is found in mines pumped out water. However, the hexavalent chromium will be reduced to below 0.1 mg/ltr (the prescribed standard) in effluent treatment plant before discharge to out side lease hold area.

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2.2. (A) R E S E R V E S :-

TABLE - 30

Category	UNFC Code	Quantity in Lac MT	Grade Cr2O3%	Ratio Cr/Fe	Remarks
PROVED (P_1)	111	0.74	49.65	2.62	For estimation of reserves please refer TABLE NO.5 (P-39 of Mining Plan chapter of this book-let.
PROBABLE (P2)	122	19.53	49.65	2.62	
POSSIBLE (P_3)	133	10.98	49.65	2.62	
TOTAL ::		31.25	49.65	2.62	

2.2.(B) RESOURCES OF THE PROPOSED LEASE HOLD AREA :- (UNFC CODE - 333)

(As given in page no.46 of this report) TABLE - 30 A

Sl. No.	B A N D	Strike length (M)	Dip length considered (M)	Width (M)	Volume in Lac M^3	Tonnage factor MT/M^3	Quantity in Lac MT	Grade Cr2O3%
1)	Regional Band No.1	253	230	24	13.96	3.3	46.07	49.65
2)	Disseminated Band adjacent to Southern boundary.	253	230	15	8.73	2.5	21.82	33.00
3)	Disseminated ore Band close to Regional Band No.1.	253	230	3.5	2.04	2.5	5.10	23.57
	T O T A L ::						72.99	42.85

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2.3. MINING METHOD :-

Opencast mining with Shovel/Dumper/Dozer combination together with deep hole drilling blasting with benches of 6 M height, 10.5 M width and with ramps of 1 in 14 gradient, connecting the benches for machinery movement. Blasting will be done to the extent of 50% of total excavation. Overall average slope will be maintained at maximum of 30 degrees on the southern, eastern and western slope and 20 degrees on the northern slope. Present depth, as stated earlier is 17 M from the surface. Pumping will be done in single stage for pumping water to surface.

2.3.1. EXTENT OF MECHANISATION -

As already stated, 100% of overburden will be excavated by mechanized method and 100% of chromite will be exploited mechanically, with machinery combination as stated above.

2.3.2. MINING MACHINERY DEPLOYED -

TABLE NO.31

Sl. No.	Description	Unit	Quantity
1)	Shovel	No.	2
2)	Dozer	"	1
3)	Front end Loader	"	1
4)	Dumpers	"	16
5)	Wagon Drill	"	2
6)	Compressor (450 cfm)	"	2
7)	Jack Hammers	"	3
8)	Pumps (127 HP, 75 HP, 40 HP, 15 HP) (Both Elect. & Diesel)	"	4
9)	Diamond Drill Machine	"	1
10)	Light Vehicles	"	3
11)	Ambulance	"	1
12)	Lathe Machine	"	1
13)	Drill Machine	"	1
14)	Transformer (300 KVA & 100 KVA)	"	2
15)	Welding Transformer	"	1

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2.3.3. PRODUCTION LEVEL PER ANNUM -

0.4 Lac MT of Chromite of average grade of 49% and 0.1 Lac MT of average grade of 25% Cr_2O_3.

2.4. MINERAL BENEFICIATION -

No mechanical installation shall be established in the proposed lease hold for handling 10,000 MT of low grade R O M of 25% Cr_2O_3 grade and instead, it will be despatched to the neighbouring OSTAPAL CHROMITE MINES of FACOR where the existing Chrome Ore Beneficiation Plant is running.

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Regd. No. ROP/CAL/[illegible]

REVIEW OF IMPLEMENTATION OF MINING PLAN/SCHEME

M. R. Pujari,
Regd. No. ROP/CAT-[illegible]

3.0. REVIEW OF IMPLEMENTATION OF MINING PLAN/SCHEME OF MINING INCLUDING FIVE YEARS PROGRESSIVE CLOSURE PLAN UPTO THE FINAL CLOSURE PLAN OF MINE :-

3.1. PROPOSALS COMMITTED IN THE APPROVED MINING SCHEME FOR PROTECTION OF ENVIRONMENT -

APPROVED

Not yet applicable.

M. K. Pujari.

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PROGRESSIVE MINE CLOSURE PLAN

M. K. Pujari,
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4.0. PROGRESSIVE MINE CLOSURE PLAN :-

4.1. MINED OUT LAND -

Presently the mined out land which had been excavated by previous lessee TISCO is of 17 M depth and 200 x 210 M width and length respectively will be made active on all front i.e. wall of quarry will be expanded in all direction and base of quarry will be deepened since the ore body is sub vertical. The quarry faces will expand in all direction till the edge of quarry touches the southern boundary of the lease area. Ever after opencast quarry limit is reached, underground mining will be continued below the quarry after leaving suitable barrier for protection of underground working. However, there will not be any scope of filling the quarry void with waste or water after cessation of opencast mining activity. Waste dumps afe fine silt which will be highly porous and permeable material through which rain water will permeate into the pore space and then behave like slurry and will flow into underground working in the event of any damage to barrier pillar, between underground and opencast, with consequent risk to the safety of the workers employed in the underground. Neither it will be possible to fill the quarry with water after cessation of opencast mining activities because of the danger of inundation of underground workings. Therefore, until the underground workings are over, the excavated opencast mine will remain as such and quarry water will be pumped out on regular basis to keep the quarry bottom in a dry status. Quarry void can not be filled up with waste or water even otherwise since superjacent working may have to be connected to the surface, in addition to one vertical shaft and one decline, for various other purposes like ventilation, raise, pumping, material lowering e.c. in course of time until stoppage of underground mining. Such opening into underground will be through

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quarry benches as has been done at Boula Mines and Kathpal Mines of FACOR.

However, necessary steps will be taken to ensure that no local failure will take place i.e. stability of the individual benches where such failures are noticed, the underlying causes of such bench failure will be identified and remedial measures will be taken. Generally, considering the ground strength parameters and sub-surface water profile i.e. Hydrostatic pressure, the stability of the individual benches are determined by estimating factor of safety against individual benches in the similar manner as that of overall slope. However, it is accepted that with the passage of the time ground strength parameters on the surface of the quarry bench may deteriorate due to weathering factor and hence ground parameter monitoring including hydrostatic pressure monitoring will be a regular feature till completion of underground workings. To maintain stability of the benches adequate drainage of the surface water as well as sub surface water will be carried out. If required the benches will be reinforced with grouted bolting. Where required suitable design of wire-netting shall be utilized with proper anchoring to prevent individual bench failure.

As already iterated by us, the ore body will continue to a great depth (250 M and above) as per our understanding of Geology and there will not be any scope of closure of chromite mine which can at best change hands but will not lead to closure. However, as we have repeatedly stated above that, we will treat the terminus date of THIRD TERM of mining i.e. 2076 as the MINE CLOSURE DATE.

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Two of the quarry benches at the top (floor and wall) can be reclaimed with special type of plantation to abate the land scar to some extent and to absorb Air/Noise pollution, to some extent. (Lateron these plantation should be replaced with Aquatic Plantation). But this will have the demerit that in the event of an opening being made from quarry benches, into the underground, these plantation will be potential source of fire in summer and may lead to smoke being drawn into underground working. It should also be understood that we have to have continued access to the bottom of quarry for regular pumping after opencast limit is reached and vegetation may obstruct such passages. Even then top two benches will be covered with special type sapling, leaving some gap around road way, ramp, pipe lines etc. The necessary plan and section is enclosed as DRAWING NO. DR - 12 & DR-10 of volume - 2. Hence, there is no scope for carrying out any reclamation/restoration/ rehabilitation programme in quarry in the coming five years.

In the first five years, 1200 M length of waste dump having 19,300 M^2 of surface area i.e. 1.93 hectares of surface area will be made available wherein 4,800 nos. of trees will be planted in five years period together with 10,000 nos grass cover to provide the green carpet.

Similarly, over storm drains and garland drain stone pitching will be done on the side of the drain and on the base of the drain with cement, sand fill into the joints between stones, for a length of 250 M @ 40 M/year.

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Also on the Southern side of the quarry, where southern edge will remain dead without any further progress after 10 years since the limit would have reached by now, a stone wall of 0.5 M thick and 250 M long will be erected as safety measure to prevent unauthorized entry to the quarry, beyond the limit as stated above.

In order to prevent land damage by excavation and by dumping, in-house report, after due laboratory testing will be submitted to D G M S, for steepening permission from 25 degree to 30 degree on the southern side upto the bottom of quarry i.e. +40 MRL.

4.2. WATER QUALITY MANAGEMENT :-

4.2.1. EXISTING SURFACE WATER BODIES AVAILABLE IN THE LEASE AREA -

There is no natural water body within the lease hold area. However, artificial water sump is created inside the quarry where sub-surface seepage and surfacial rain water over the catchment area of the quarry will be collected & pumped out. There will be one sump of 30 M x 30 M x 3 M i.e. of 2700 M^3 capacity. The water quantity will vary within the sump. Generally in summer, quantity will be less but in rainy season the sump will be / full to the brim. Besides the sump as described, there are 5 man made drains constructed by previous lessee i.e. TISCO. Out of 5 drains 3 are constructed to drain out storm water and 2 drains are made for drainage of sewage water of TISCO colony.

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4.2.2. EXISTING GROUND WATER BODIES AVAILABLE IN THE LEASE AREA -

The laterite capping of around 7 M thickness over the lease together with 10 M of weathered serpentinite below the laterite capping, is a repository of infiltrated water of rain precipitate over the lease area and is known as primary aquifer. A part of this flows out as subsurface seepage into the adjacent Damsal nala occurring at low RL. Some of this

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water further infiltrates into the secondary aquifer below the primary aquifer. The infiltrability and transmissivity of the ground varies from portion to portion and in many portion transmissivity is almost negligible.

4.2.3. CONTROL OF EROSION -

There is no chance of ground erosion in the surface water body like that of quarry sump. The artificial drains will be designed and constructed to arrest suspended solid in rain precipitate from the catchment area flowing out of lease surface area, by provision of ponding in the drain, by provision of plantation in the drain and by ensuring streamline flow in the drain. There is no chance of sub-surface water causing erosion.

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4.2.4. PREVENTION SEDIMENTATION AND SILTATION -

The quarry sumps and drains will be regularly cleaned of solid material in the form of silt and sedimentation by manual and mechanical process.

4.2.5. WATER TREATMENT -

Surfacial pumped out water going out of the lease area will be treated in an effluent treatment plant to treat the water in a manner that discharge water is within the limit prescribed in E.P. Act. Water samples taken from storm drain in rainy season does not indicate hexavalent chromium beyond the prescribed limit.

4.2.6. DIVERSION OF WATER COURSE -

There is no water course in the lease area which might mean diversion of water course.

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4.2.7. MEASURES FOR PROTECTION OF CONTAMINATION OF GROUND WATER FROM LEACHING -

Sub-surface water in contact with chromite does contain hexavalent chromium as seen in the quarry water. However, sub-surface water, as is encountered in the bore hole within the lease area is either devoid of hexavalent chromium or is below the permissible limit of hexavalent chromium. This negligible percentage of hexavalent chromium might have been due to sub-surface transmission of ground water in contact with chrome ore body or due to percolation of surface rain precipitate through laterite ground which also contains chromite. But the latter possibility is remote since the chromite in lateritic body is lumpy ore which on contact with water does not give rise to hexavalency. At any case in many bore holes sub-surface natural water itself is contaminsted. Quarry pumped out water flowing in drains will be containing some hexavalent chromium but the rate of flow will be such that percolation into the ground will be very poor. Under the circumstances, there is no scope of taking any special precaution to prevent contamination of ground water since mining or no mining, contamination is taking place by natural means.

4.2.8. QUANTITY & QUALITY OF SURFACE WATER BODIES -

As stated earlier there is no natural water body in the lease hold area. Artificial water body will be created in the form of -

- quarry sump.
- surface drain for drainage of rain precipitate in rainy season.

The quantity of water to be pumped out from the quarry sump, per annum will be 6 Lac M^3. Surface drainage system will function only in rainy season otherwise it will remain dry. The quality of water in all the sources as stated above i.e. quarry sump and drains will be maintained within the norms prescribed for

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surface water body except for hexavalent chromium which is higher than prescribed ones.

4.2.9. CORRECTIVE MEASURE PROPOSED FOR ENSURING THAT WATER BODIES MEETS THE PRESCRIBED LIMIT -

These artificially made water bodies which are not stationary but constantly flowing out and fresh water is flowing in, all for recirculation purposes, can not be treated for correcting hexavalent chromium problem as no such arrangement can be incorporated in the circuit considering the practical problem. Nor such incorporation will give any tangible result since the water will again get contaminated. However, an E T P will be installed to ensure that quarry water flowing out of the mine during rainy season and non rainy season will be treated in the E T P before discharging outside the mine boundary. As already stated above, there is no scope of taking any corrective measure for hexavalent chromium for sub surface since it is occurring naturally below ground level, irrespective of Mining or non mining.

4.2.10. HYDROLOGICAL REPORT -

Hydrological Report is given in page No. 110 to 125 of MINING PLAN chapter of this book-let.

4.2.11. WATER BALANCE CHART -

The Water Balance Chart of the water shed area of the Sukinda Valley within which Bhimtangar Chromite mines located is enclosed herewith as ANNEXURE NO.MC-1 (Page No. 281). Water Balance Chart of Bhimtangar Chromite Mines alone can not be found out as the sub surface water i.e. aquifer is pervasive all around, beyond lease boundary of Bhimtangar Chromite Mines.

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4.2.12. ACID MINE DRAINAGE IF ANY -

There is no problem of Acid Mine drainage in this mines. The existing mines quarry water quality analysis as is enclosed herewith as ANNEXURE NO. E-10 of MINING PLAN Page No. 195 of this book-let, indicates that P^H value varies from 7.5 to 7.7 hence, the water is alkaline in nature. The mineralogical analysis of the ground rock is enclosed herewith as ANNEXURE NO. GE-4 of MINING PLAN page no. 50 of this book-let shows that the mineral contain alkali metal such as Ca, Mg, Na, K which are being neutralised by acidic group radicals like SO_4, NO_3, CO_3 & Cl present in it.

4.2.13. WATER POLLUTION MANAGEMENT FACILITIES PLAN -

4.2.13.1. SURFACE DRAINAGE LAYOUT PLAN -

A surface drainage layout plan is enclosed herewith as DRAWING NO. 12 of volume - 2. Critical examination of the drainage layout plan indicates that the Mine/ Dump layout/other infrastructure is not likely to disturb the drainage system nor it is going to disturb the natural flow or alignment of the water course. All these infrastructures and the drains will be above the highest flood level of the area.

4.2.13.2. STORM WATER DRAINS -

A Plan is enclosed (Refer DRAWING NO. 12 of volume - 2) drawing showing Storm water drains alongwith channel and sub-channels for feeding the rain precipitate to the storm water drains. On the plan separate drain have also been shown for mine effluent water which indicates that there is no scope of mixing up of the two drains.

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4.2.13.3. SEWAGE TREATMENT PLANT/EFFLUENT TREATMENT PLANT/SEDIMENTATION TANK -

A map has been attached herewith (Refer DRAWING NO. 12 in volume - 2 showing Effluent Treatment Plant and Sedimentation Tanks alongwith their capacities.

4.2.13.4. POLLUTION CONTROL DAMS, CHECK DAMS AND EVAPORATION DAMS - The location and design of the pollution control dams are shown in the plan enclosed herewith as DRAWING NO. 12 in volume - 2.

4.2.13.5. PROPER LINING OF PLANTS -

Effluent Treatment Plants are provided with proper lining.

4.2.13.6. POTABLE WATER PLANT -

There is no potable water plant within the lease hold area hence Bore holes will be drilled for drimking water purpose in future. The analysis of the bore hole water will be carried out periodically to confirm the potability of the said water.

4.2.13.7. WATER QUALITY & QUANTITY MONITORING STATIONS -

Enclosed herewith a Plan as DRAWING NO. 12 in volume - 2 showing monitoring stations of water quality and quantity.

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4.3. AIR QUALITY MANAGEMENT -

4.3.1. EXISTING AIR QUALITY STATUS -

The existing Air quality in the various ambient stations around the mining lease is given in the enclosed format as ANNEXURE - E-6 & E-7 of MINING PLAN (Page No. 190 to 191). It will be seen that level of pollutants in the ambient air stations is below 18% of the prescribed limit with respect to SPM, NO_x, SO_2 and CO when readings are taken with an High Volume Air Sampler and Respirable Dust Sampler over 24 hours twice in an week and for one month in every season. The reading when taken for R P M indicates the respirable dust content to be 41% of the permissible. The Noise level reading in the industrial zone and residential area is well below the prescribed norm as per the NOTIFICATION under E.P. Act. All the relevant data is enclosed herewith as ANNEXURE NO. E-8 to E-9 of MINING PLAN (Page No. 192 to 194) of this book-let.

4.3.2. MEASURES FOR PREVENTION OF DUST POLLUTION -

4.3.2.1. NATURALLY WET GROUND -

Due to the moisture content in the soil mass and in excavated material, the soil particles become too heavy to be air-borne, resulting in low values in dust fall. Besides, rains over almost 9 months bring down the atmospheric dust.

4.3.2.2. PREVENTING OVERLOADING OF DUMPERS -

Spillage will be controlled by restricted loading of materials in dumper to 3 M^3 against, a capacity of 4.5 M^3 and as such air-borne dust due to spillage will be avoided.

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4.3.2.3. REGULAR SPRAYING OF WATER -

Regular spraying of water on haul roads, sorting yards and despatch yards will be carried out to suppress the dust particles and to avoid dust generation.

4.3.2.4. SOUND CONSTRUCTION OF HAUL ROADS -

Construction of haul roads will be done with layers of hard stones overlained by laterite fines and subsequently compacted by road roller which will give hard road surface and avoid dust generation.

4.3.2.5. WET DRILLING -

Wet drilling with sharp tools and dust traps will be adopted to suppress the dust generation in drilling operations.

4.3.2.6. DENSE AFFORESTATION -

Massive afforestation within the lease hold area on dump slopes and industrial infrastructure will arrest the dust and result in low level of dust fall.

4.3.2.7. PUCCA ROADS -

Construction of pucca roads in place of katcha road (i.e. Tomka to Mangalpur road), is resulting in low level of dust generation in regional area due to vehicle transport.

4.3.2.8. WATER SPRAYING -

Regular spraying of water on roads by the mine owners is also a reason for low level of dust generation in regional area.

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4.3.3. MEASURES FOR PREVENTION OF GASEOUS POLLUTION -

The following practice will be adopted for prevention of gaseous pollution -

(a) Exhaust control by regular maintenance of all the engines.

(b) Change of lubricants as per the recommendation of the manufacturer.

(c) Regular spraying of water on the working faces immediately after blasting to absorb NO_x fumes.

(d) Proper calibration of fuel injection pumps and regular cleaning of diesel tanks.

4.3.4. MEASURES FOR PREVENTION OF NOISE POLLUTION -

The following precautions will be taken to lower the Noise level -

(a) Proper maintenance of the machines and change of lubricants in time will be followed up.

(b) The operator's cabin of the surface machinery will be sealed off accustically.

(c) Machinery installed on surface will be properly placed on foundations to avoid noise due to vibration during running of the machinery and the rooms and cabins will be sealed off accustically.

(d) Temporary installed machines will be covered by straw mats to attenuate noise level.

(e) Workers exposed to noise levels will be provided with ear plugs and ear muffs and will be engaged rotational duty.

(f) Machines producing noise more than the prescribed limit will be run intermittently.

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(g) Rows of thick green belt will be developed around the machines installed on the surface, residential colony and work zone.

(h) Noise generating machines will be fitted with silencers to attenuate noise level.

4.4. - WASTE MANAGEMENT -

4.4.1. TYPE, QUALITY & QUANTITY OF OVERBURDEN AVAILABLE -

The waste baskally will comprise of 5 to 7 M of laterite capping and the serpentinite/limonite ground below the laterite. Out of the total overburden excavation laterite will be 5% and limonite will be 5%. 45% of the rest of the waste overburden will be weathered serpentinite which will not require any blasting since it occurs in an weathered state, almost in clay form. The remaining 45% of serpentinite waste overburden, though it is in a weathered state, will be still hard enough requiring blasting and will give rise to small boulders after blasting. The laterite capping invariably will require blasting. The serpentinite will occur in two qualities known as brown serpentinite and green serpentinite. and the former is harder compared to green serpentinite The softer ground is nickelliferous limonite. The waste overburden does not have any commercial utilization and is heaped over the barren land of lease area as waste dump.

4.4.2. TYPE, QUANTITY & QUALITY OF MINERAL REJECTS AVAILABLE -

Based on Bore Hole data of GSI in TISCO area it is estimated that out of 50,000 MT of ROM mined out from brown seam, 10,000 MT will be of low grade, which will be regularly shifted to Ostapal Chrome ore Beneficiation Plant of FACOR and therefore question of stacking of mineral rejects in the lease area does not arise.

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4.4.3. OVERBURDEN DISPOSAL PRACTICE -

The laterite overburden is 70% bouldery to lumpy. Size is varying from 1 M to 0.1 M. Nickeliferous limonite overburden is almost in dust form. While green serpentinite is loose, weathered and break into chips a n d powder while brown serpentinite will have 50% lumpy with sizes varying from 0.5 to 0.05 M. The quantity of overburden till opencast life period i.e. 2016 from 2006 will be about 14 Lac M^3. Benching and terracing will be carried in the waste overburden dump. The waste dump will have 2 nos. benches of 15 Mtr. each with slope angle of 37 degrees to 43 d.grees while overall slope angle will be 30 degrees to 33 degrees.

4.4.4. WASTE MATERIAL STABILIZATION -

The waste dump will be stabilized by tree plantation in each of the dead benches after carrying out suitable terracing in each of the bench.

The year-wise plan area available on the dead face of the terraces and slopes which are to be vegetated has been given in a tabular form given as ANNEXURE - E-32& E-33 (Please refer page no. 218 & 219 of MINING PLAN of this book-let). The figures of the table matches with the Environmental Management Plan given as DRAWING NO.ER-12 In Volume - 2.

4.4.5. PROTECTIVE MEASURES TO BE TAKEN FOR PREVENTION OF SILTATION, EROSION & DUST GENERATION -

Drains will be made on the bench to allow the rain precipitate to drain out smoothly without furrowing dump surface here and there causing erratic drainage and erosion. Stone walls will be provided all around the waste dump to prevent silt from the waste dump going out. Suitable garland drains will be made all around the waste dump for smooth drainage of rain precipitate falling over the waste dump area.

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The excavated waste material contains water in its pore spaces through out the year because of the quarry insitu itself contains 12% to 14% moisture, even in leam season too. This moisture causes agglomeration of earth particles with limonite, chlorite and clay as binding material, which becomes too heavy to be air borne. Hence, generation of dust during excavation, transporting to dumping site loading and unloading is negligible.

However, after collecting the waste materials in form of dumps with proper benches, green carpet will be developed by planting grasses and later on plant species will be planted. The volumminous root system and inter spreading growth system of the grasses will bind the soil particles by providing an hard exterior cover, so as to prevent the waste material to be air borne.

4.4.6. TOXIC AND HAZARDOUS ELEMENTS PRESENT IN THE WASTE MATERIAL -

There is no toxic and hazardous elements in the waste material.

4.5. TOP SOIL MANAGEMENT -

4.5.1. TOP SOIL AVAILABLE AT THE SITE AND UTILISATION -

Top soil and sub soil generated in the excavation will be preserved in an area of 0.580 Hectares, which will be utilized for plantation purposes every year.

The top soil and sub soil generated will be preserved by constructing laterite barrier all around the stack. Leguminous plants will be planted every year to prevent soil erosion due to rain fall and wind.

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4.6. TAILING DAM MANAGEMENT :-

THERE WILL NOT BE ANY CHROME ORE BENEFICIATION PLANT INSIDE THE MINE LEASE AREA AND THEREFORE THE QUESTION OF TAILING DISPOSAL DOES NOT ARISE IN BHIMTANGAR MINING LEASE AREA.

4.7. INFRASTRUCTURE :-

4.7.1. R O A D -

210 M of road way exists over the lease area with 10 M width, However, 1100 M road ways will be developed in the lease area. Further, 1500 M roadways will be developed inside the waste dump and the quarry of t h e 7.5 M width (excluding drain and barrier). These roads will be maintained regularly by spreading 20 cm iron stones covered with 15 cm laterite fines and compacting with Dozer.

4.7.2. ROPE WAY -

There is no rope way in the lease hold area.

4.7.3. CONVEYOR BELT -

There is no conveyor belt any where in the mines or mines surface.

4.7.4. POWER LINES -

About 2 Km of 11 KV line and 440 Volts line with 3 phase power station with 4 conductors support over bracket with insulator will be fixed onto steel pole, will be installed in the mining lease area for power supply.

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4.7.5. BUILDING STRUCTURES -

No residential building will be made inside the mining lease area.

4.7.6. TRANSPORT -

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For company's store and spare transport, two trucks will be provided for carrying out the transport from neighbouring town, which are purchasing centres of the company. For transport of Officer/Staff jeeps and buses will be provided by the company. Ambulance and jeeps will be provided for transport of sick personnel from the mines to neighbouring hospitals. Workers will come from neighbouring villages from a radius of 1 to 5 Km by cycle. Mineral produced at the mines will be transported to Port/Railway station by contractor's trucks. Other industrial requirement of mines and plant for transport will be met by contractor's trucks.

4.7.8. WATER SUPPLY SOURCES -

Water required for drinking/domestic consumption will be met by bore holes pumping. Other industrial consumption like water spraying at Road, Waste dump, quarry area, ore despatch centres, plantation work will be met from quarry pumping water.

4.7.9. OTHER INFRASTRUCTURE -

Administrative office, Chemical laboratory, Rock Mechanics laboratory, Survey room, Creche, Canteen, Rest shelter, Dispensary, Work-shop, Store covering 1000 sq.mtr plinth will be located within the lease hold area.

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4.7.10. FUTURE UTILIZATION -

All these infrastructures will continue to be utilised till 2076, when the third term of lease will expire. Movable infrastructure like work-shop equipments, power line, water pumps, surface transport machinery, water treatment plant etc., will be removed. However, Road and industrial infrastructure buildings like Office, Creche, Stores, Dispensary, Canteen, Rest shelter etc., will remain as such in the lease land which can be utilised by subsequent lessee or by neighbouring villagers. The waste dump will be reclaimed with suitable plantation. The detailed programme of dump plantation is enclosed herewith as ANNEXURE -E-32&33 of MINING PLAN (Page No.218 & 219 of this book-let).

4.8. DISPOSAL OF MINING MACHINERY :-

The fleet of heavy earth moving machinery belongs to contractor who will withdraw the same to the various other excavation sites under his contractor ship. Those machinery required even when underground mining commences will be disposed off at the mining site like pumps, compressors, wagon drills (after conversion for underground use), Jack hammers, work-shop equipments, miscellaneous mobile equipments like Jeeps, Trucks, Ambulance Van. However, as stated by us earlier, in an mineral like Chromite, which almost dips vertically and it is established that Chrome vein continues even after 250 M question of mineral exhaustion will not arise. Opencast mining will be carried out by us by depressing the strike length 5 M only per annum presently but the average over 30 years will be 3 M. As a matter of fact, with commencement of underground mining, such depression per annum in underground will be come 2.5 M only. And, therefore, life of the mine will definitely be around 100 years based on our assumption that the ore bodies will continue to a depth of 250 M and more. This is again based on our-

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experience that ore body had been struck at 400 M depth from surface at our BOULA CHROMITE MINES. There is no sign or symptom of narrowing down of the ultramafic width at depth in Sukinda valley and the contact with quartzite rock is almost vertical. However, as stated earlier for the purpose of mine closure plan, we will treat expiry date of third term of MINING LEASE PERIOD as the date of MINE CLOSURE.

4.9. SAFETY & SECURITY -:-

The scenario at the time of mine closure or after the date of expiry of third term of mining lease period which will be 2076 or whenever that will be happening at BHIMTANGAR Chromite mines will comprise an waste dump covering 6.58 Hects covered with green carpet and green canopy together with an opencast mines of 70 M depth with side slopes at 27 to 30 degrees covering an area of 8.41 hectares and remaining in a dewatered state, with an opening of one or two access over the benches into underground work for ventilation (may or may not) besides an decline access and a shaft covering the surface area of 0.704 hectares.

The underground mining will be carried out by leaving pillar or by sand, cement waste rock filling and therefore, there will not be any scope of subsidence. The decline mouth shaft mouth and ventilation access, in the benches after quarry excavation, will be sealed with brick wall all around. This is because the entry passage will not be filled up with any type of fill and hence that will get filled with water. Similarly, the quarry will gradually get filled up with water soon after abandonment. Adequate sign boards of permanent fixture, will be displayed at those places where there will be danger of falling into pit, excavation and decline exist, besides putting up the fencing, barricades, gates, wall as described. With tree plantation all around the quarry edge.

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bird will be flocking up in the artificial lake so formed and in the trees all around. With human activities ceasing in the area (except those in neighbouring village) animals will also be flocking up in the area in large number. The water from the artificial lake can also be utilised for irrigation and cultivation will be possible round the season. Even if this artificial lake is not utilized for irrigation, the water table in the neighbourhood will go up and all season cultivation will take place in the field. Damsala nallah which is seasonal today will become perennial with sub surface flow of water into nallah all through the year, from several such artifical lake that will develop all around due to filling up of water in abandoned excavations of other mines of Sukinda Valley.

Under the circumstances, with the implementation of precautions as described above there will be no safety/security risk.

4.10. DISASTER MANAGEMENT AND RISK ASSESSMENT :-

4.10.1. LAND SLIDES -

As already stated earlier, the slope stability has been computed for the opencast quarry depth i.e. upto 70 M and factor of safety at 70 M depth with 30 degrees slope is found adequate. However, monitoring of geotechnical parameters including hydrostatic pressure will be carried regularly and stability status will be computed and if any time, it appears that slide may take place, the slopes will be auequately flattened. Besides ground movement monitoring shall be carried out at fixed pillars at quarry edge as well as at intermediate depth with electronic distance measuring instrument and precise level, effort will be made to withdraw water from bore hole drilled on surface during rainy season, to keep the ground in a dry status.

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4.10.2. SUBSIDENCE -

As already stated earlier, in the underground excavation either pillar will be left for support of the void or the same will be filled to prevent any possibility of surface subsidence. Ground movement will be monitored to detect indication of any subsidence that may take place so that precautionary measures can be taken up. Mine planning for underground with subsidence prediction, which will come up, only after 20 years, is considered premature at this stage. However, some outline for the same is given in page no. 69 of this book-let.

4.10.3. FLOOD AND INUNDATION -

There is no natural nallah or river or water course or lake within the lease area which may create danger of inundation and flooding of mines. Damsal nallah which is at a distance of 650 M from lease hold boundary has its highest flood level at 100 M whereas the general ground surface is at 110 MRL which is the quarry edge and where from all access for underground working will be made on the North Eastern and North Western edge of quarry. Hence, there is no scope of endangering the mines due to flood in damsal nallah. Besides, enough pumping arrangements will be made considering the quantity of water intake into the underground workings based on hydraulic gradient, co-efficient of permeability, rate of sub-surface transmission, thickness of aquifer and exposed surface area through which seepage will take place. Theoritical calculation will be matched with actual result to make precise planning of water pumping for future.

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4.10.4. F I R E -

Since surface infrastructure will be made minimum at mine site, stores containing oil depot and combustible material will be outside the lease area, and therefore, there will not be any risk to the mine due to fire on that account. Other, sources of mine fire is likely to be from power line, machinery, belt conveyor, timber depot. Adequate maintenance of machinery and electrical apparatus will prevent any such danger of fire, besides to deal with fire, fire extinguishers will be provided in work-shop, oil depot, store, transformer house, mobile machinery. Besides water line hydrant with hose pipe will be maintained at sufficient number of stations to deal with fire. It may be noted that the underground mines will be a naturally wet mine and hence risk of fire will not occur.

4.10.5. SEISMIC ACTIVITIES -

The mine lease area does not fall in seismic zone nor there has been any history of earthquake in the area. Resultant Peak Particle Velocity of the ground vibration due to blasting does not exceed 10 mm/sec. and therefore no danger exists on that ground.

4.10.6. EMERGENCY ACTION PLAN -

Mines will have a dispensary with well trained paramedical staff and with necessary drugs and medical equipment to take care of emergency, under a qualified and experienced Medical Practitioner.

The mine will also have an ambulance van beside 3 jeeps wherein stretcher can be fitted to transfer the injured personnel to hospital, in a supine position.

Besides, it should be possible to organise DOZEN of ambulance vans within 15/20 minutes including that from Kathpal Chromite Mines of FACOR.

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There is a fullfledged hospital in TISCO Sukinda Chromite Mines and O M C South Kaliapani Chromite mines within the distance of 2 Km from the lease area.

In addition, Government hospital is located at Sukinda, Dubri and Jajpur Road within a distance of 20 - 35 Km from the mines.

There is an out post 1½2 Km away from where police-force can arrive within 5 - 10 minutes to prevent public chacos and to maintain discipline.

4.11. CARE AND MAINTENANCE DURING TEMPORARY DISCONTINUANCE :-

4.11.1. MEASURES OF CARE, MAINTENANCE AND MONITORING STATUS OF UNPLANNED DISCONTINUED MINING OPERATION -

4.11.1.1. Ground Monitoring -

The mine benches shall be periodically inspected to ensure that no collapse or slide is taking place which may impede the haul road or may result in waste accumulation in sump leading to inundation. For this purpose ground monitoring on fixed pillar with instrumentation will be a regular feature.

4.11.1.2. FIRE-FIGHTING DEVICES -

All fire-fighting devices, over the mine premises i.e. near oil depot, consumable stores, near machinery, electrical sub-station, work-shop, like fire extinguishers, firehindrant, water pipe lines will be periodically checked up for its efficiency.

4.11.1.3. REGULAR CHECKING OF PUMPS -

The pumps working inside the quarry will have to be run on a regular basis to prevent inundation of opencast mines and underground mines. For this purpose the pumps have to be regularly oiled, lubricated, greased and spare parts replaced when required.

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4.11.1.4. PERIODICAL CHECKING OF STATIONERY MACHINERY -

Other stationery machinery and equipments, including electrical machinery will be periodically opened, cleaned, lubricated and painted if required.

4.11.1.5. REGULAR CHECKING OF ELECTRICAL CIRCUITS -

Electrical circuits will be regularly checked to ensure that all protective devices including earth leakage are operating. All motors have to be run at periodical interval to drive off moisture to prevent short cirtuiting and burning of winding coils.

4.11.1.6. CLEANING OF VEGETATIVE MATERIAL -

Electrical sub-station, magazines, store etc., have to be cleaned of vegetative material within a distance of 15 M to prevent eruption of fire in dry vegetative material during summer.

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4.11.1.7. E T P -

Quarry pumped out water will be regularly sampled at lease boundary after treatment with E T P to ensure that contaminations are within permissible limit.

4.11.1.8. REGULAR CHECKING OF STORM WATER -

Storm water from the storm water drain will be tested regularly to cross verify that contamination of precipitate due to waste/ore dump do not exceed the permissible limit.

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ECONOMIC REPERCUSSIONS

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5.0. ECONOMIC REPERCUSSIONS OF CLOSURE OF MINE AND MANPOWER RETRENCHMENTS :-

As stated earlier, there will not be any scope of permanent mine closure since the down dip continuity of ore will continue at least for 250 M depth and beyond upto 400 M depth as has been intersected by us at Boula Chromite Mines and thereafter it should continue as such since there is no sign and symptom that the ultrabasic width is contracting. This will mean continuation of mines for about 100 years during which period education will spring up sufficiently to make workmen vocationally very strong to fetch new job or to take up independent vocation in and around the area. However, for the purpose of this report we will treat the expiry of THIRD TERM OF MINING LEASE as the MINE CLOSURE DATE i.e. 2076.

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5.1. NUMBER OF LOCAL RESIDENTS EMPLOYED IN THE MINE :-

Out of the total direct employees of 200, likely to be engaged, local employees will be 160 nos. of which 80% carry on their traditional occupation of land cultivation, pottery, tailoring, carpentry, masonry, weaving, petty trading, while simultaneously working in the mine. In the event of the mine closure they will be switching on to their traditional occupation on a full time basis instead of part time.

5.2. COMPENSATION GIVEN TO EMPLOYEES UPON CLOSURE OF MINES :-

Compensation which will be given to employees will be 15 days salary per year of completed service, besides gratuity payment, leave salary, contributory provident fund, super annuation amount, 3 months notice pay in lieu of notice. All these benefits will be sufficient to sustain himself and dependent members of family. However,

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every member of the family (other than children) do take up jobs as a tradition in mining areas and dependence on the retrenched employee is minimal.

5.3. SATELLITE OCCUPATIONS CONNECTED TO THE MINING INDUSTRY AND ITS CHANCES OF CONTINUATION :-

Presently the satellite occupation is mostly petty business in the form of small scale trading, hoteliering, vehicle repairing apart from traditional business, like weaving/pottery making, carpentry, masonry, tailoring, poultry farming, animal husbandry etc. etc. Since large number of mines are running, there is no chance of closure of all mines at a time. Besides, Beneficiation Plants will continue to operate in the mining area which will be engaging people always since huge quantity of low grade and sub grade chromite will be generated in the excavation process. As a matter of fact even today many of the dumps in Sukinda Retion, marked as waste, will have at least 15% Cr2O3, which can be beneficiated economically by mechanised/ semi-mechanised/manual method.

5.4. CONTINUED ENGAGEMENT OF EMPLOYEES IN THE REHABILITATED STATUS OF MINING LEASE AREA AND ANY OTHER REMNANT ACTIVITIES :-

With increased irrigation facilities (from artificial lakes) and better ground water control, cultivation will be taken up by villages in an intensified manner covering all varieties of crops. The land abandoned by mines owner can be utilised for additional cultivation of main crop as well as subsidary crops. Cold storage and other facilities will crop up in the area by then (i.e. 2076) for storage/selling of vegetable products. Animal husbandry will flourish because of the artificial greenary all around. Agro-economic level will substantially rise in the area including increased scope of fish cultivation.

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5.5. ENVISAGED REPERCUSSIONS ON THE EXPECTATION OF THE SOCIETY AROUND DUE TO CLOSURE OF MINE :-

No adverse repercussions is anticipated since the Socio-economic status in the area, will be in a much improved status, even though, mines might close, due to following important activities, which will not get discontinued normally with the mine closure.

i. Beneficiation activities will continue unabated due to huge quantity of low grade and sub grade mineral available in the area, which will continue to engage people in beneficiation work.

ii. Pyroxenite and Serpentinite which are the bulk of waste overburden will be utilised in the steel furnace and other furnace as low grade flux.

iii. Nickelliferous limonite now piled up as huge dump would by then will be utilized to produce Nickel metal and other precious metal like Cobalt.

iv. Due to availability of large number of artificial lakes, irrigation would substantially improve and modern cultivation technique will be developed.

v. With improved vegetation in the region as a result of plantation in the waste dump area and other areas, rain precipitation will increase.

vi. With regular implementation of environmental steps like prevention of soil erosion and other measures adopted, a fertile layer of soil will accumulate which will yield better agricultural product than being produced now.

vii. With artificial lake, ground water level will rise, leading to better cultivationof cash crops and khariff crops.

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viii. With increase in vegetation and water bodies, Animal husbandry and fishery cultivation will substantially rise in the area.

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SCHEDULE FOR ABANDONMENT

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6.0. SCHEDULE FOR ABANDONMENT :-

LIST OF ABANDONMENT ACTIVITIES -

- TIME SCHEDULE FOR PLANTATION AT DUMPS AND OTHER NON DUMPING AREA (CARPET & CANOPY).
- TIME SCHEDULE FOR PERMANENT BARRICADING OF EXCAVATION/DEPRESSION/WATER RESERVOIR.
- TIME SCHEDULE FOR WALLING/COVERING OF UNDERGROUND OPENINGS.
- TIME SCHEDULE FOR STABILISING DRAIN.
- TIME SCHEDULE FOR DEMOLISHING OF INFRASTRUCTURE.
- TIME SCHEDULE FOR ENSURING BIO-GROWTH OF WATER RESERVOIR.
- TIME SCHEDULE FOR WITHDRAWAL OF MACHINERY AND EQUIPMENTS.
- TIME SCHEDULE FOR CONSTRUCTION OF STONE EMBANKMENT AROUND WASTE DUMP.
- TIME SCHEDULE FOR WITHDRAWAL OF LOW GRADE (DISSEMINATED) DUMP MEANT FOR COB FEEDING.
- TIME SCHEDULE FOR MANPOWER & OTHER RESOURCES REQUIRED FOR COMPLETION OF PROPOSED JOB.

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6.1. TIME SCHEDULE FOR PLANTATION AT DUMPS AND OTHER NON DUMPING AREAS (CARPET AND CANOPY) -:-

6.1.1. FINAL RECLAMATION OF 6.0 HECTARES OF INFRASTRUCTURES AREA -

Besides waste dump, on the northern side, there will remain some vacant area to the tune of 6.0 Hectares, covering 3.3 hectares of industrial infrastructure, 0.70 hectares of essential infrastructure, 0.3 hectares of road infrastructure and 1.70 hectares of other miscellaneous area wherein 15000 saplings can be planted and half of it is to be carried out i.e. about 7000 saplings one year before expiry of second term lease i.e. by 2056 and the balance plantation will be done by 2076 i.e. at the end of third term of lease period.

The details of Time Schedule for demolishing infrastructure is as follows :-

TABLE NO.32

INFRASTRUCTURE	YEAR 2056	YEAR 2076
Building demolition	30%	70%
Digging to remove foundation	30%	70%
Breakage of floor area and pavement	30%	70%
Removing stones laid over the road way	-	100%

6.1.2. DUMP PLANTATION - TIME SCHEDULE -

TABLE NO.33

Sl. No.	Sub activities	Unit	YEAR			
			2011	2016	2021	2026
1.	Benching & terracing	Hect	1.93	1.69	1.21	1.7
2.	Formation of gullies	M	100	100	100	100
3.	Sowing of grass	M^2	10000	8000	6000	9000
4.	Planting of sapling	No.	4800	4200	3000	4500

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6.2. TIME SCHEDULE FOR PERMANENT BARRICADING OF EXCAVATION/ DEPRESSION/WATER RESERVOIR -

6.2.1. Around quarry excavation, stone wall of 0.5 M thick and 1 M height will be erected all around i.e. 1200 M length and such walling will be commenced from 2016 at the 45 M/month i.e. 450 M/annum and to be completed by 2020.

6.2.2. Around settling pond stone wall barricading of 0.5 M thick and 1 M height will be built over 200 M length by 2072 @ 70 M per annum and to be completed by 2076.

6.2.3. Around E T P, similar barricading as stated above to the extent of 200 M will be carried out in 2072 @ 50 M/annum and is to be completed by 2076.

6.2.4. Stone wall barricading of the waste dump on either side of dump yard to the extent of 1400 M running length. This barricade will be 0.5 M wide and 1 M length. This will be carried out from 2010 till reaching 2016 at the rate of 300 M/annum.

6.2.5. E T P demolishing and filling will be done only after 2076 i.e. after expiry of the third term of mining lease, since E T P will be utilised till the last working day of the lease.

All the above barricading programme is as follows -

TABLE NO.34

Sl. No.	PARTICULARS	Total running metres	YEAR 2011 to 2016	YEAR 2072 to 2076
1)	Opencast edge	1200	-	1200
2)	Settling Pond	200	-	200
3)	Effluent Treatment Plant	200	-	200
4)	W a s t e dump	1400	1400	-

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6.3. TIME SCHEDULE FOR WALLING/COVERING OF UNDERGROUND OPENINGS :-

(i) Walls to be erected closing the entry to the decline just before expiry of the third term of lease i.e. 2076. Wall thickness will be 0.3 M made of brick masonry.

(ii) Shaft opening to be plugged with horizontal RCC slab of 0.25 M thick, load over the opening of the shaft after the expiry of third term of mining lease i.e. 2076.

(iii) Similarly, access mouth which might have been made within the open pit in the form of Raise/Winze will be covered by RCC slab as given in (ii).

Programme of walling/covering of underground opening/ bore holes are as follows :-

TABLE NO.35

Sl. No.	Particulars	Period (year)
1)	Decline mouth	2076
2)	Shaft top	2076
3)	Winze - 1 mouth	2076
4)	Winze - 2 mouth	2076
5)	10" dia Bore hole-1	2076
6)	-do- -2	2076

6.4. TIME SCHEDULE FOR STABILIZING DRAIN :-

Total length of two storm drains today is 550 M (250 + 200). Besides there will be a garland drain of 800 M length. This garland drain will automatically become storm drain at the time of closure of mine ie. after the expiry of the third term of lease, since all depression including quarry depression will be filled up, additional

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rain precipitate/annum will have to be pass through the existing drain. The stream flow in drain will prevent soil erosion which would have otherwise taken place if sheet flow would have been permitted in the absence of stream flow in drains. Therefore, it is essential to stabilize all drain by pitching both side with stone and also by layer of stone at the base. The gap between stone to stone are to be filled with cement concrete to ensure permanent bondage which will not require subsequent maintenance.

With onset of underground mining after 2016 of Bhimtangar chromite mines lease, additional quantity of water will be required to be pumped from underground after 2016, for which about 500 M of additional drain will be required and these drains will be constructed with stone pitching all around with cement concrete filling in the joint between stones. To begin with 200 M of stabilization will be carried out from 2014 @ 100 M/annum. Just before the expiry of the third term of mining lease, another 200 M of drain, which will be constructed during third term itself, will be strengthened with stone pitching.

6.5. TIME SCHEDULE FOR DEMOLISHING OF INFRASTRUCTURE :-

6.5.1. FOLLOWING INFRASTRUCTURE WILL BE DEMOLISHING BEFORE COMPLETION OF OPENCAST AND RE-ERECTION WITHIN LEASE AND OUT SIDE AREA -

TABLE NO.36

Sl. No.	Infrastructure	Year of demolition
1.	Creche & Store	2076
2.	Work-shop and dispensary	2076
3.	Intake Pond	2076
4.	Power transmission line	2076

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6.6. TIME SCHEDULE FOR ENSURING BIO-GROWTH OF WATER RESERVOIR :-

Opencast mines will be discontinued by 2016. Even then quarry water will be pumped out till 2076 because of underground workings. After then, breeding of good variety of fish, tortoise, prawn, crab will be carried out in the water which will grow significantly with leafy mass and birds all around.

Aqueous plantation will be grown on the side of benches to improve the bio diversity of water. It is believed that by 2076 growth of fish and other aquatic product will increase substantially.

Detailed activities will be as follows -

- Before pumps are withdrawn aquatic flora will be planted over the benches.
- After the quarry is filled up with water other varieties of floating aqua flora will be developed in the water.
- Necessary bio-chemical treatment of water shall be carried out for propitious growth of aqua fauna.
- Breeding will be done for fish and prawn.
- Other variety of aqua fauna like crab/tortoise will be grown in the reservoir water.
- Period to period bio feed and required medicine will be spread over the water body.
- A boat shall be kept over the water body to move over the reservoir water for ensuring bio-growth.

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6.7. TIME SCHEDULE FOR WITHDRAWAL OF MACHINERY AND EQUIPMENTS :-

6.7.1. HEAVY EARTH MOVING MACHINERY :-

85% of all the surface heavy earth moving machinery will be belongs to contractor. And the same will be withdrawn after completion of opencast mining i.e. 2016. The remaining 15% of heavy earth moving fleet will remain as such for handling of ROM for quality control and despatch purpose at ore yard and will be withdrawn only after 2076.

6.7.2. WORK-SHOP AND GARAGE -

Work shop will be demolished by 2076, when all Lathe machine, drill machine, grinding machine, bending machine, welding transformer and light vehicles will be withdrawn, after cessation of underground mining activities at the end of third term of lease.

6.7.3. WITHDRAWAL OF WINDING ENGINE/HOIST AND UNDERGROUND MACHINERY -

The underground machinery which will be utilized in the underground mining will consist of LHD, Dump truck, EIMCO loaders, Ring hole drill machine, Wagon drill, Mine car, Track, Locomotive, Jack Hammer drill, Jim Crow, Screw props, Cross bars, Mine Pumps, Pneumatic chipper, Mine Cables, Switch gears, illumination bulb/bar light etc.

All the above equipments can only be withdrawn after the expiry of the third term of mining lease by 2076.

6.7.4. SURFACE PIPE LINE FOR DEWATERING THE UNDERGROUND MINES AND PUMPS OF ETP PLANT -

These equipments can also be withdrawn only at the end of third term of mining lease i.e. 2076.

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6.7.5. SURFACE SUB-STATION -

Surface sub station will be demolished and conductor, switch gears, busbars, OCB's, ACB's, Transformer, overhead lines, Cables will be withdrawn only after the end of third term of mining lease i.e. after 2076.

6.7.6. TIME SCHEDULE FOR WITHDRAWAL OF MACHINERY AND EQUIPMENTS -

TABLE NO.37

Sl. No.	MACHINE & EQUIPMENT	Year of withdrawn
1)	Heavy earthmoving machinery of the quarry.	2016
2)	Surface Loader/dumpers for quality control.	2076
3)	Opencast pumps	2076
4)	Electrical equipment in the quarry	2076
5)	Other surfacial electrical equipment including transmission line.	2076
6)	Underground drilling/loading/transporting/hoisting machinery.	2076
7)	Surface winding installation	2076
8)	Underground pumping	2076
9)	Underground Electrical	2076
10)	F a n	2076

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6.8. TIME SCHEDULE FOR CONSTRUCTION OF STONE EMBANKMENT AROUND WASTE DUMP :-

Total run length of ultimate waste dump will be 1400 M. Every year 150 M length stone embankment will be laid around waste dump to complete the job by 2016.

6.9. TIME SCHEDULE FOR MANPOWER AND OTHER RESOURCES REQUIRED FOR COMPLETION OF PROPOSED JOB :-

All the abandonment jobs being taken up prior to final closure i.e. 2076 like Stones barricading, plantation, other industrial infrastructure demolition will be carried by mining personnel with the help of heavy earth moving equipments during the period when mine is running and subsequently i.e. after closure in 2076, a skeleton staff together with HEM of contractor, balance activities of abandonment will be completed.

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ABANDONMENT COST

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7.0. ABANDONMENT COST :-

7.1. COST OF PLANTATION :-

As already stated earlier, 31,500 trees will be planted at waste dump and non-dumping area for the purpose of reclamation. The cost of sapling, planting and subsequent treatment and care for two years will be Rs.35/tree. Hence total cost of PLANTATION will be Rs.11 Lacs.

Further, apart from aforestated plantation expenses, additional expenses of about Rs.10 Lacs will be incurred for benching, terracing and making gullies at dumps required for plantation.

7.2. COST OF PERMANENT BARRICADING OF EXCAVATION/DEPRESSION/WATER RESERVOIR -

7.2.1. AROUND OPENCAST WITH STONE WALL -

Length of barricade	.. ..	1200 M
Cost/Metre length of (0.5 M thick x 1 M height)		= Rs.280/-
Total Cost	.. ..	Rs.3.36 Lacs.

7.2.2. AROUND SETTLING POND WITH STONE WALL -

Length of barricade	.. ..	200 M
Cost/Metre length of (0.5 M thick x 1 M height)		= Rs.280/-
Total cost	.. ..	Rs.0.56 Lacs.

7.2.3. AROUND E T P WITH STONE WALL -

Length of barricade	.. ..	200 M
Cost/Metre length of (0.5 M thick x 1 M height)		Rs.280/-
Total cost	.. ..	Rs.0.56 Lacs

7.2.4. EITHER SIDE OF WASTE DUMP WITH STONE WALL -

Length of barricade	.. ..	1400 M
Cost/Metre length of (0.5 M thick x 1 M height)		Rs.280/-
Total Cost	.. ..	Rs.3.92 Lacs

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7.2.5. EARTH FILLING OF STEELING POND AND E T P -

Quantity of earth required for filling	..	4000 M^3
Loading, transporting & unloading cost/M^3	..	Rs.100/-
Total Cost	..	Rs.4 Lacs.

7.2.6. BARRICADING FOR UNDERGROUND WORKING AREA -

(i) Cost of plugging of 2 shafts and 2 winzes with 0.25 M - thick R C C slab of 14 Sq.M. for shaft and 9 Sq.M. for Winze -

Total quantity of RCC slab (28 + 18)		= 46 Sq.M. = 12 M^3
Cost/M^3 of RCC slab	..	= Rs.6,000/-
Total cost ..	..	= Rs.0.72 Lacs.

(ii) Cost of erection of underground pillar to prevent subsidence -

Total strike length of ore body = 235 M.

6 M rib pillars will be left after every 30 M strike length i.e. about 8 nos. of pillars will be required to be left. Out of these pillars, it is believed that hard ground will be encountered in half the strike length of ore body with hard and competent foot wall and hang wall. Along with rib pillar as stated above, sill pillar of 5 M thick will also be left 30 M apart. In this process 25% ore will be left in the underground. However, 50% of the pillars may be weak enough to provide any kind of support to wall. Hence, the same shall be replaced with artificial pillars which will be constructed of rock pieces along with cement sand mixture. During the third term of mining lease, ore depression will only be for one level of 30 M depth in which 8 nos. of artificial pillars of 5 M x 6 M x 30 M will be constructed i.e. 900 M^3 (Stone : Sand : Cement). Cost of placement will be Rs.560/M^3 and therefore the cost of pillar will be around Rs.5 Lacs. Eight such pillars erection during third term of lease will mean an expenditure of Rs.40 Lacs (approximately). These support pillars will be in addition to

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barrier pillar of 40 M that may have to be left between ultimate quarry bottom and commencement of first working level in the underground working.

7.3. COST OF STRENGTHENING OF STORM DRAIN & GARLAND DRAIN :-

As stated earlier, total running length of storm drain and garland drain will be about 800 M. It is expected that during third term of mining lease, another 200 M length will be added to enable the underground pumped water to be drained. The cost of such stone pitching with cement jointing as described above will be Rs.1000/Metre length and the total cost against 1000 metres running length is expected to be Rs.10 Lacs.

7.4. COST OF BIO-GROWTH OF WATER RESERVOIR (PISI-CULTURE) :-

The aquatic fauna proposed for breeding in the water reservoir of Bhimtangar quarry after the expiry of the third term of lease period, namely fish, tortoise, prawn, crab, water duck together with aquatic flora for developing a vibrant bio-diversity in the quarry area of nearly 8.5 hectares will cost about Rs.10,000/- per hectare which will mean an expenditure of Rs.0.85 Lacs.

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7.5. SUMMARY DETAILS OF ABANDONMENT COST IS GIVEN IN A TABLE MENTIONED BELOW :-

TABLE NO.38

Sl. No.	Particulars	Unit	Quantity of work	COST	
				Rate/Unit (Rs.)	Total Cost (Rs.inLacs
1.	Plantation work (No. of Plants)	Nos.	31500	35	11.00
1(a)	Benching, Terracing and making gullies for plantation work	Lump sum			10.00
2.	Permanent Barricading-				
2(a)	Around opencast with stone wall.	M	1200	280	3.36
2(b)	Around settling pond with stone wall.	M	200	280	0.56
2(c)	Around ETP and part of tailing pond with stone wall.	M	200	280	0.56
2(d)	Either side of waste dump with stone wall.	M	1400	280	3.92
2(e)	Earth filling of setting pond and ETP Plant.	M^3	4000	100	4.00
2(f)	Barricading for u/gr. working area -				
	- Plugging of shaft & winze with 0.25 M thick RCC slab.	M^3	12	6000	0.72
	- Erection of u/gr. pillar with stone wall to prevent sibsidence.	M^3	7200	560	40.00
3.	Strengthening of storm drain and garland drain with boulder pitching & cement, sand jointing.	M	1000	1000	10.00
4.	Bio-growth of water reservoir (pisiculture)	Hect.	8.5	10000	0.85
	T O T A L :::				84.97

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FINANCIAL ASSURANCE

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8.0. FINANCIAL ASSURANCE :-

As far as Financial Assurance is concerned, the entire surface area of the mining lease will be put to use i.e. 23.800 hectares or 58.81Acres and no land area out of the said lease area os considered as fully reclaimed and rehabilitated. Hence, Financial Assurance will be 23.800 hectares and at the rate of Rs.25,000 per hectare, total Financial Assurance cost will be Rs.5.95 Lacs.

(Please refer Page No. 278 to this effect necessary TABLE is enclosed, as Area for Financial Assurance.

अनुमोदित
APPROVED

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Chief Controller of Mines
भारतीय खान ब्यूरो, नागपुर.
Indian Bureau of Mines, Nagpur.

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FACOR BHRATANGAR

A r e a for FINANCIAL ASSURANCE

Sl. No.	H e a d	Area put on use at start of plan	Expansion area	Contraction of present virgin area (S.No.13)	Total area to be put on use by end of plan period(2072)	Area considered as fully reclaimed/rehabilitated	Net area considered for calculation
1.	Area to be excavated	5.440	2.970	-	8.410	-	8.410
2.	Storage of top & sub soil	-	0.580	-	0.580	-	0.580
3.	Overburden/Waste dump	-	6.580	-	6.580	-	6.580
4.	Mineral storage & handling yard.	-	1.380	-	1.380	-	1.380
5.	Infrastructure (Work-shop, Garage etc.)	-	0.700	-	0.700	-	0.700
6.	R o a d s	0.384	0.781	-	1.165	-	1.165
7.	Peripherial (Misc) area	-	1.743	-	1.743	-	1.743
8.	Nickel Dump	-	0.612	-	0.612	-	0.612
9.	Space for underground workings	-	0.704	-	0.704	-	0.704
10.	Low grade stack yard	-	0.906	-	0.906	-	0.906
11.	D r a i n	0.276	0.328	-	0.604	-	0.604
12.	E T P with settling pond	-	0.416	-	0.416	-	0.416
13.	Virgin Area	17.700	-	17.700	-	-	-
		23.800	17.700	17.700	23.800	-	23.800

FERRO ALLOYS CORPORATION LIMITED

M. K. Pujari,

Regd. No. ROP/CAL/239/96/A

CERTIFICATE

M. K. Pujari,
Regd. No. RQP/CAL/239/96

FERRO
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E-mail : bls_facor168@sancharnet.in

FACOR
CHROME ORE MINING DIVISION

23.9.2005

CERTIFICATE

This is to certify that the Mine closure plan of BHIMTANGAR CHROMITE MINES complies all statutory rules, regulations, orders made by the State or Central Government, Statutory Organisations, Court etc., have been taken into consideration and whenever any specific permission is required the lessee will approach the concerned authorities. The lessee should also give an undertaking to the effect that all the measures proposed in this closure plan will be implemented in a time bound manner as proposed.

APPROVED

(ASHOK AGRAWAL)
Chief Executive (Mines)
Ferro Alloys Corporation Limited

PLANS & SECTIONS

S. R. Pujari,
Regd. No. ROP/CAL/

10.0. PLANS & SECTIONS ETC. :-

Necessary Plans & Sections prepared for Chapters 1,2,3 & 4 are shown in VOLUME - 2.

APPROVED

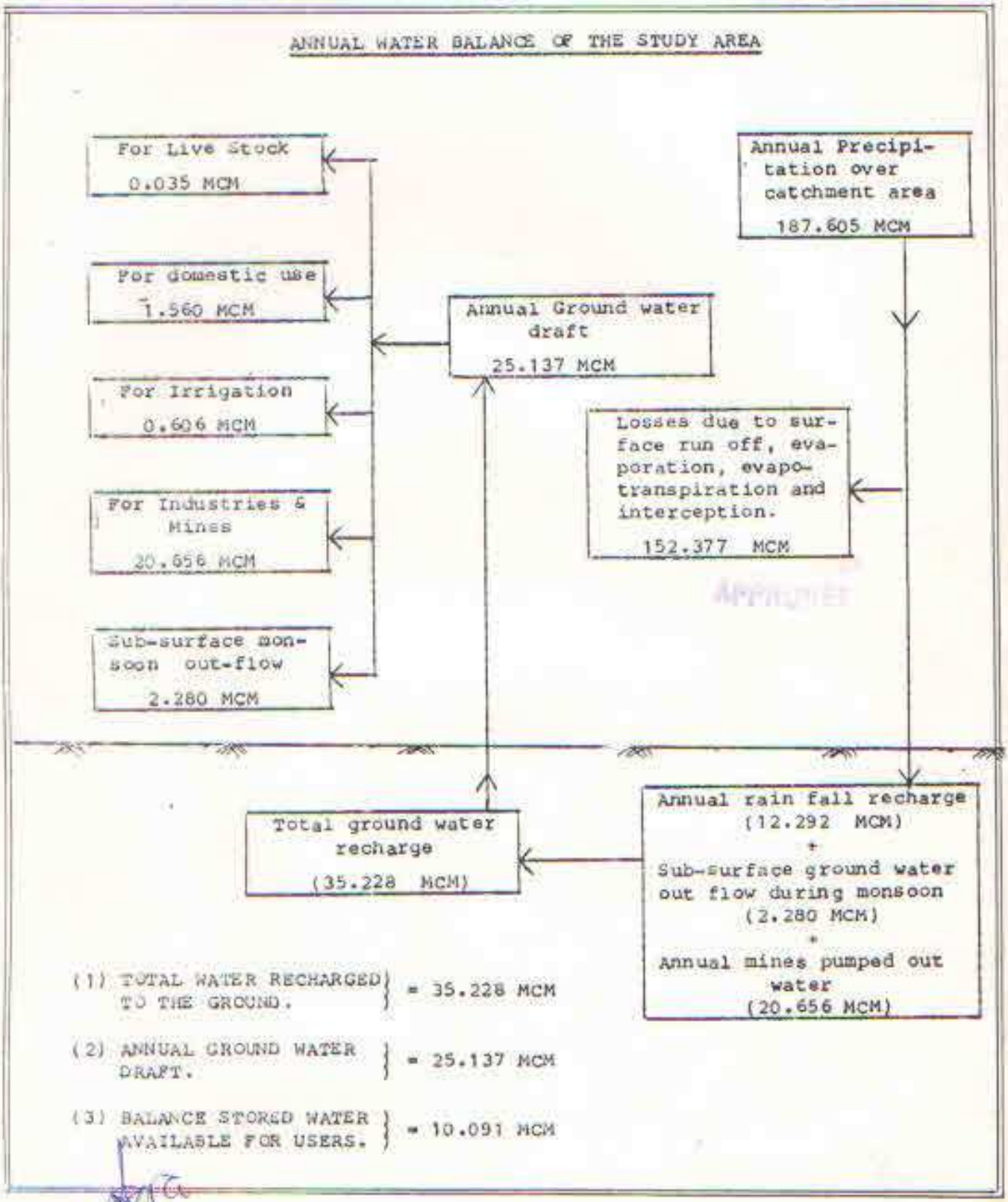
M. K. Pujari,
Regd. No. ROP/CAL/239/98/A

ANNEXURES OF MCP

M. K. Pujari,
Regd. No. RQP/CAL/239/98

ANNEXURE - MC - 1.

ANNUAL WATER BALANCE OF THE STUDY AREA



(1) TOTAL WATER RECHARGED TO THE GROUND. = 35.228 MCM

(2) ANNUAL GROUND WATER DRAFT. = 25.137 MCM

(3) BALANCE STORED WATER AVAILABLE FOR USERS. = 10.091 MCM

M. R. Pujari,
Regd. No. ROP/CAL/239/98/A