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MINING PLAN

(Submitted Under Rule 17(2) Of MCR, 2016 and Under Rule 23 of MCDR , 2017)

(INCLUDING PROGRESSIVE MINE CLOSURE PLAN)

For

"UBBALAGUNDI IRON ORE MINE"

(M/s Mysore Minerals Ltd., M.L. No. 995)

Village: Ubbalagundi

Taluka: Sandur, District: Ballari, State: Karnataka

(Category 'A'(Fully Mechanized)/Opencast/Private/Captive Mine)

Type of Land: Forest

Lease Area: 32.89Ha

Of

M/s. JSW STEEL LTD.

IBM Registration No.: IBM/432/2011

Prepared by

B.P. Pandey
B.Tech. (Mining)
Qualified Person

VOLUME – I (TEXT)

Mining plan of

"UbbalagundiIron Ore Mine"

(M/s Mysore Minerals Ltd., M.L. No. 995)

Village: Ubbalagundi

Taluka: Sandur, District: Ballari, State: Karnataka

M/s JSW STEEL LTD.

(Submitted Under Rule 17(2) of MCR, 2016)

MINE DESCRIPTION

Introduction:

UbbalagundiIron Ore Mine (M/s Mysore Minerals Ltd., M.L. No. 995) is located in Ettinahatti range of Sandur Schist Belt, Sandur taluka, Ballari district, Karnataka state..The mining lease area falls under Survey of India Toposheet No.57 A/12. It lies between Latitude $15^0$02'52.20" - $15^0$03'37.08" N and Longitude $76^0$38'33.40"- $76^0$38'58.07".The location of ML is shown in Key Plan **(Plate-1).**

Initially, the mining lease was granted for 20 years *w.e.f*. 29/09/1970 over an extent of 80.94 Ha by Govt. of Karnataka *vide* Notification No. CI/269/MMM/2005 dated 08-02-2006.Subsequently it is renewed for a period of 20 years with effect from 29-08-90 over an extent of 33.60 Ha for which FC was granted. However, *vide* notification No.CI/293/MMM/2010 dated 29-10-2010, Government of Karnataka renewed the ML area as 80.94 Ha. Though FC was not granted for additional area of 47.34 Ha. After the expiry of the lease period in 2010, two working permissions for six months each from 11.11.2010 and 10.05.2011 respectively. The mine lease area has an extent of 33.60 Ha as per mining lease deed. Central empowered Committee after carrying out joint survey & digitization, has issued lease sketch **(Plate No. 2),** according to which total extent of lease area is 32.89 Ha.Forest Clearance was obtained from MOEFCC *vide* letter No.4-KRC032/2004-BAN/178, dated 5thMay 2006 and enclosed as **Annexure - VI**

Further, the Hon'ble Supreme Court in its orders dated 5th August 2011 and 26th August 2011 had directed the Government of Karnataka to submit the Reclamation and Rehabilitation(R&R) Plan(s) for the districts of Ballari, Tumkur and Chitradurga within three months of the judgment. Subsequently, the Government of Karnataka vide letter dated 29th September, 2011 assigned the task of preparation of R & R Plan to the Indian Council for Forest Research and Education (ICFRE).

Hon'ble Supreme Court had directed Government of Karnataka to commence the auction of 15 'C' category iron ore mines in which, only the end-user engaged in production of Sponge Iron and / or Pig Iron and/or Steel and/or Pellets will be eligible to take part in the auction. The end users will include Public Sector Undertakings.

To ensure raw material self-sufficiency, JSW Steel Limited, having its integrated steel plant with an installed capacity of 18 Million Tons (i,e 12 Million Tons at Vijayanagar, Karnataka, 5 Million Tons at Dolvi, Maharashtra & 1 Million Ton at Salem, Tamilnadu), also decided to take part in aforesaid auction. JSW Steel Limited was awarded this mining block vide **LOI** no. DMG/MLS/AUC/'C'-995/2018-19, Dtd.06.10.2018 **(Annexure I).**

As per letter No.1-26/CEC/SC/2013-Pt XXXXXIV dated 24-10-2014; the CEC is of the view that before finalizing the R & R plans of any of the Category 'C' mining leases, it may be appropriate to avail the details of mineral reserves based on the exploration data undertaken by the State Government. Accordingly, the Government. of Karnataka has provided the exploration work to M/s. Mineral Exploration Corporation Limited (MECL), a Government of India Enterprise, Nagpur, to assess the mineral reserves in all "C" category mines in Bellary, Chitradurga and Tumkur Districts of Karnataka State.

M/s. MECL has conducted exploration in this Mining Lease area of UBBALAGUNDI IRON ORE MINES, ML No. 995 by Geological mapping, core drilling and RC drilling etc. As per report submitted by MECL the total geological reserves are 9.708 Million tonnes.

The Department of Mines & Geology, in its LOI dated 06.10.2018, directed M/s JSW Steel Limited to obtain all consents, approvals, permits, no objections etc as may be required under applicable law before signing the MDPA. The Hon'ble Supreme court vide its judgment dated 30.07.2015 ordered to transfer the existing statutory clearances of previous lessees in favor of new lessees, who have obtained the blocks in the auction. The Director of Mines and Geology has made available the Forest Clearance **(Annexure VI)** and Environmental clearance **(Annexure VII)** of previous lessee. The Mining Plan is being submitted for 0.340 MTPA, as recommended in R & R Plan prepared by ICFRE and duly concurred by Central Empowered Committee. Further monitoring Committee has also issued a letter vide letter no. NO;MC/R&R/CCA/2019-20/123/198, Dated 12-04-2019. **(Annexure II)** prescribing the aforesaid permissible annual production limit of iron ore.

The Mining Plan is prepared based on the new lease boundary finalized by joint survey team constituted by CEC and is being submitted to IBM Bengaluru, as per Rule 16 of MCR, 2016, in compliance of clause no 3.2 (a)(iv) of Letter of Intent (LOI) issued by Government of Karnataka and also prescribed under sec.5 (2)(b) of MMDR amendment act,2016 for grant of Mining Lease.

List of mining leases held by M/s. JSW STEEL Ltd.

Sl. No.	Lease reference no.& date	Area in Ha	Postal address / Location	Type of Minerals	Status of Mining plan/ scheme	Working/ Non-working	Date of execution and Dt of expiry
1.	MINE CODE - 30KAR03181ML NO -0004	32.68	JSW Steel Limited (Mines Division), Near Talur Cross, Vidyanagar, 583275 Taluk: Sandur	IRON ORE	Approved For Period 2017-18 to 2021-22	Working	17.01.2018 Valid up to 16.01.2068
2.	MINE CODE - 30KAR03182ML NO -0005	21.03		IRON ORE	Approved For Period 2018-19 to 2022-23	Working	21.03.2018 Valid up to 20.03.2068
3.	MINE CODE - 30KAR03183ML NO -0006	100.54		IRON ORE	Approved For Period 2018-19 to 2022-23	Working	26.12.2018 Valid up to 25.12.2068
4.	ML - 2365(old) Lease execution is pending	130.53		IRON ORE	Approved (execution is pending)	Not Working	Lease execution is pending
5.	ML - 2621(old) Lease execution is pending	32.56		IRON ORE	Approved (execution is pending)	Not Working	Lease execution is pending

1.0 GENERAL

a)	**Nameoflessee**	**M/s JSW Steel Limited** Dr. Vinod Nowal Nominated Owner, Copy of Photo id of Lessee is enclosed as **Annexure V**
	Mine Code **Rule45registrationNo.**	Not allotted yet IBM/432/2011 The copy of Certificate is Enclosed as **Annexure IV**
	Address	JSW STEEL LIMITED, JSW Steel Limited (Mines Division), Near Talur Cross, Po: Vidyanagar, 583275 Taluk: Sandur
	District	Ballari
	Phone	08395-245956
	Fax	08395-250132
	Mobile No.	+919480694531
	E-mail id	vinod.nowal@jsw.in
b)	**Status of lessee**	Listed Public Limited Company, Copy of Registration of Company & Memorandum of Association is attached as **Annexure XVII & XVIII.** List of board of directors, Resolution to appoint nominated owner, Letter of authorization to represent the company is enclosed as **Annexure XXI.**
c)	**Mineral which is included in the prospecting License**	Not Applicable
d)	**Mineral which is included in the Letter of Intent**	Iron Ore
e)	**Mineral which the lessee intends to mine**	Iron Ore
f)	**Name of the Person responsible for preparation of Mining Plan**	**Mr. B.P. Pandey** (Qualification and Experience certificate attached as **Annexure III)**
	Address	JSW Steel Limited (Mines Division), Near Talur Cross, Po: Vidyanagar, 583275 Taluk: Sandur
	Phone No.	08395-245956
	Email	pandey.binay@jsw.in
	Mobile No.	+91-9448286155

2. LOCATION AND ACCESSABILITY

a)	**Lease Details (Existing Mine)**	
	Name of the Mine: Lat/Long of Boundary Point :	**UbbalagundiIron Ore Mine** **(M/s Mysore Minerals Ltd., M.L. No.995)** There are 18 corner pillars and lat/long values of these pillars are given in Surface Plan enclosed as **Plate No. 3 and Mahazar -Annexure IX**
	Date of Grant of Lease	LoI grant date (06/10/2018)
	Period/ Expiry Date	50 Years as per MMDR (Amendment) Act-2015
	Name of the Lease Holder	M/s JSW Steel Ltd.
	Postal Address	JSW STEEL LTD., JSW Steel Limited (Mines Division), Near Talur Cross, Vidyanagar, 583275 Taluk: Sandur
	Telephone	08395-245956
	Fax	08395-250132
	Email Id	pandey.binay@jsw.in
	Mobile No.	+91-9448286155
b)	**Details of lease with location Map**	
	Forest	
	Forest: Area (Ha)	Ettinahatti Range, Sandur Schist Belt 32.89Ha As per CEC Sketch **(Plate No. 2)** CEC Mahazarcopy enclosed as **Annexure-IX**

Forest		**Non- Forest**	
Forest	Area (Ha)	Non-forest	Area
Ettinahatti Range	32.89	i) waste land ii) Grazing Land iii) Agriculture Land iv) Others	-

Total Lease area	32.89Ha
District	Ballari
State	Karnataka
Taluka	Sandur
Village	Ubbalagundi
Whether the area falls under Coastal Regulation Zone (CRZ)	Not Applicable

Existence of public road/ railway line, if any nearby and approximate distance	A Public Road connecting Bannihatti to Ubbalagundi is around 2.50 km from mine boundary. The nearest railway station is Bannihatti Railway Siding is around 15 km from mine boundary.
Topo Sheet No.	57 A/12

Latitude & Longitude of All Corner Boundary pillars as per CEC Survey

Boundary pillar No.	Latitude	Longitude
LBC-A	N15°03'40.19042"	E76°38'53.89918"
LBC-B	N15°03'32.27936"	E76°38'54.09702"
LBC-C	N15°03'31.67715"	E76°38'57.30506"
LBC-D	N15°03'15.30075"	E76°38'57.02902"
LBC-E	N15°03'15.45899"	E76°38'55.69403"
LBC-F	N15°03'21.85212"	E76°38'53.97045"
LBC-G	N15°03'23.13870"	E76°38'52.00026"
LBC-H	N15°03'21.93732"	E76°38'50.88250"
LBC-I	N15°03'19.89471"	E76°38'52.14835"
LBC-J	N15°03'17.73209"	E76°38'51.91784"
LBC-K	N15°03'18.08691"	E76°38'48.57359"
LBC-L	N15°03'19.72377"	E76°38'48.14419"
LBC-M	N15°03'20.05080"	E76°38'44.55235"
LBC-N	N15°03'24.81686"	E76°38'43.08080"
LBC-O	N15°03'25.14869"	E76°38'41.83557"
LBC-P	N15°03'28.73920"	E76°38'40.89835"
LBC-Q	N15°03'28.90548"	E76°38'37.34609"
LBC-R	N15°03'41.47917"	E76°38'35.53538"

The following are the details of Ground Control Points:

Ground control points co-ordinates, Datum WGS-84			
GCP to MLB	**Distance in m.**	**Latitudes**	**Longitudes**
GCP-1- LBC-A	432	15°03'35.087"	76°39'07.387"
GCP-2- LBC-B	396	15°03'34.286"	76°39'07.195"
GCP-3 -LBC-C	280	15°03'30.354"	76°39'06.599"

The CEC sketch is also enclosed as **Plate No. 2** for ready reference. As per the earlier lease deed, the lease area is 33.60Ha and as per the CEC sketch, the lease area is 32.89Ha. For all practical purpose, 32.89Ha is considered and incorporated in Mining plan.

c)	**General Location & Vicinity Map**
	General location map showing mine lease area, neighbouring leases, lease boundaries and existing and proposed access routes is attached as **Key plan (Plate no. 1)**, **Administrative Map (plate 1A).** CEC Sketch is enclosed as **Plate No. 2**

3.0 DETAILS OF APPROVED MINING PLAN

3.1 Date and reference of earlier approved Mining Plan/Schemes

Not applicable as this is first Mining Plan after lease grant proposal to JSW Steel Ltd.

3.2 Details of last modifications if any (for the previous approved period) of approved MP/SOM, indicating date of approval, reason for modification

Not applicable as this is first Mining Plan after lease grant proposal to JSW Steel Ltd.

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

Not applicable as this is first Mining Plan after lease grant proposal to JSW Steel Ltd.

3.4 Status of compliance of violations pointed out by IBM

Not applicable as this is first Mining Plan after lease grant proposal to JSW Steel Ltd.

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

Not applicable as this is first Mining Plan after lease grant proposal to JSW Steel Ltd.

3.6 In case the MP/SOM is submitted under rule 11 of the MCDR 17 or under rule 17(3) of the MCR' 2016 for approval of modification, specify reason and justification for modification under these rules.

Not applicable.

PART- A

1.0 GEOLOGY AND EXPLORATION

a) Description of the topography, drainage pattern, vegetation, climate, and rainfall data of the mining lease area.

(i) Topography

The Lease area of Ubbalagundi **Iron ore mine (M/s Mysore Minerals Ltd., ML No. 995)** is covered under Survey of India topo-sheet no.57A/12 and bound by latitude $15^0$02'52.20" to $15^0$03'37.08" and longitude $76^0$38'33.40" to $76^0$38'58.07". The mine lease area has the strike extension of about 1077 m length along the NNW-SSE within the wide area of about 510 m. The mine lease area includes quite extensive slope area. The area has Sub-dendritic pattern of drainage. The lease area is surrounded by forest lands. Majority of the land with-in the buffer-zone consists of hilly tract with ultimate spurs and valleys.

The proposed lease area falls in „Ethinahatti Range' of iron deposits under Sandur schist belt in Sandur taluk of Bellary district. The Ubbalagandi village is located at the South-East of the lease area on the foot hills and the lease area is surrounded by hills on the western side. The mining area consists of two ridges running parallel along the lease running North 150 West and sloping towards East. Two seasonal nalas originating from the lease, one is from west and another from east and both are emptying into Avinamadugukere. The highest contour observed on the Northern side of the lease area is 994 m above MSL. The general contours vary from 730 m to 994 m above MSL.

3**(ii) Drainage Pattern**

No rain water accumulates in the lease area, naturally. The rain water flows from hill slopes and it does not accumulate till it reaches the lower valleys. The drainage pattern of the area is sub-dendritic in nature. Half of the run-off with-in the buffer zone drains towards north and the other half flows towards SW. Mining activity will be carriedout on a hilly terrain, wherein there is no possibility of encountering ground water as the mining operations will be carried out on plateau and sloping hill with highest and lowest elevation of 890 m and 770 m above MSL, respectively. The ground water table is about 50 m to 60 m below the general ground level and the mining operations are conducted along the hill slope. Mining may reach up to 795 m above MSL. Therefore, no groundwater shall be encountered in the mine workings. There are two nalas originating from the

lease area, out of which, one is from western side and another is from the eastern side. Both the nalas are emptying into the tank Avinamadugukere.

(iii) Vegetation

Even though the mining lease is in the forest, there is no growth of trees worth the name. Only small bushes, shrubs and trees are seen in the area here and there. The impact on forest due to proposed mining is very minimal. The exposure of hard laterites is partially seen in the mine lease area and the vegetation around the area is mixed open jungle of neither commercial nor medicinal value.

(iv) Climate

The Sandur Schist Belt area of Ballari district experience dry semi-arid climate with meanannual rainfall varying from 40cm to 80cm. The monsoon begins in June first week and continues up to September and winter from the month of October to January is somewhat pleasant however, hot to very hot summer is from the month of February to May.

(v) Rainfall Data

The annual rainfall in Sandur varies from 40cm to 80cm. The rainfall is mostly (60.22%) confined to the period from June to September. During south west monsoon (October to November) 22.21% of the annual rainfall is received, and another 17.57% of rainfall occurs as sporadic in other months of the year.

b)Brief description of Regional Geology with Reference to Location of lease

Lease area of **UbbalagundiIron Ore Mine (M/s Mysore Minerals Ltd., M.L. No. 995)** falls on Ettinahatti range of Sandur Schist Belt, at a distance of about 29 kms from Sandur. The lease area lies between Longitudes $76^0$38’33.40” and $76^0$38’58.07” and Latitudes $15^0$02’52.20” and $15^0$03’37.08”. The area is covered in Survey of India Toposheet No.57 A/12 **(Plate-1)**. The mine lease area has the strike extension of about 1077 m length along the NNW-SSE within the wide area of about 510 m.

The Ballari-Hospet region forms a part of the ‘Sandur Schist Belt’ referable as the “Dharwars” a group of Precambrian schistose rocks of Mysore. The lithological units include green stones which are the metamorphosed into basic igneous rocks occupying the valley regions, with phyllite-quartzites forming the canoe-shaped amphitheatre of hill, trending NNW-SSE and enclosing Sandur.

The phyllites are locally shale and the quartzites are of the nature of banded hematite jaspers (BHJ), and banded hematite quartizites, interbanded with each other. The banded hematite jaspers, the important source rocks for the iron ores in the area are prominent in the northern and western part of the ranges, whereas the associated shales become prominent in the southern and eastern parts of the area. The iron ores form a capping over the quartizites and shales and overlie a sequence of manganiferous phyllitic rocks. Lateralization is widespread in most of the flat topped ridges.

Structurally, the Sandur hills form a tightly folded synclinorium, plunging gently to NNW and the hill ranges broadly delineate the folded limbs of synclines, with close repetition of strata due to minor folds. The strike of the ore bodies is generally parallel to the trend of the hill ranges, the dips are often steep, and being vertical in a number of places posing dips towards NE and SW are found as in the Ramandurg and NEB ranges respectively.

Geology of the Area

The Sandur Schist Belt is known for its economics deposits of iron and manganese and studied in details by many prominent workers like New Bold (1838), Foote (1895), Roy and Biswas (1983), Martin and Mukhopadhyay (1987 and 1993), Naqvi et.al. (1987) on various aspects like depositional environment, structure and depositional process etc. Geo-chemical data study by Manikyamba et. al. (1993) inferred that the iron formations were the result of submarine hydrothermal venting at the mid-oceanic ridge, ferruginous volcanic sedimentation and biogenic activity.

The litho-stratigraphy of the volcanic and sedimentary rocks under the new term are defined as “Sandur Group” which are as follows:

- **Yeshwantnagar Formation:** This formation is dominated by metamorphosed ultramafic rocks, metagabbro and amphibolites on the south western margin of the schist belt.
- **Deogiri Formation:** The sedimentary sequence overlies the amphibolites of the Yeshwanth nagar formation. The lowest part of the formation is mostly greywacke and the top most part are manganiferous grey wacks which immediately underlie the lowest banded chert of Ramanmala Formation. The greywacks are commonly calcareous. Much of the manganiferous greywacks occur as secondary concentrations of oxides or hydroxides in the form of nodules or encrustations on fractures.

- **Ramanmala Formation:** The lower part of the Ramanmala formation is dominated by banded ferruginous cherts and inter bedded amphibolites. The chert layers increase in number along the strike of the formation from north-west to south-east. Many of these chert layers are banded iron formations which are host to economic deposits of secondary haematite on the top of the Ramanmala and Deogiri hill ranges.
- **Donimalai Formation:** This formation comprises amphibolites and banded ferruginous cherts with subordinate polymict conglomerate and greywacks. Numerous banded units of chert characterise the Donimalai Formation. They vary in thickness from 10 to 100m. The banded haematite-enriched types of rocks have magnetite, Jasper and pyrite rich cherts to non-ferruginous grey cherts.
- **Taluru Formation:** The formation mostly comprises of schistose amphibolites and pillow structured metabesalts, which are host to thin, but persistent intercalations of
- banded cherts and local pods of coarse grained grey carbonates. The lower part of the formation comprises inter bedded banded ferruginous cherts, schistose chlorite carbonate rich amphibolites and siliceous schist.
- **Vibhutigudda Formation:** The hill ranges northeast of Donimalai range includes formations comprising sedimentary and volcanic rocks such as greywacks and banded ferruginous chert that immediately overlies the amphibolites of the Taluru formations.

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

The rock formations belong to the iron ore stage of Dharwar system. The general sequence of rock formations found in the area is as given below,

- Soil Cover/ Float Ore
- Banded Hematite Quartzite (BHQ)
- Iron Ore Formation
- Shale/ Phyllites

Soil Cover/ Float Ore

Since the mine has been in operation for several decades before falling into 'C' category, hence area is already considered as broken up. There is no likelihood of generation of topsoil. However, if, some

quantity is generated during the mining operations from lease area, at the same time it will be used for afforestation purpose.

Banded Hematite Quartzite's (BHQ)

The Banded Hematite Quartzite's is exposed in the area of ML block in the form ofdiscontinuous bands at places along the hill slopes. The BHQ exposed in patches over the iron ore formation, is banded in nature and following the trend of the iron ore formation with dip of 55˚ to 68˚ towards west. The BHQ in the area is considered as waste due to low Fe content and exhibit, fine grained, cherry red in color and has metallic luster.

Iron Ore Formation

The general trend of the iron ore formation is N10°-20°W – S10°-20°E with steep westerly dip of 55-75° (Plate-III). Few intervening clay bands were noticed. Few BHQ bands occurs which run almost parallel to main iron ore band in the western as well as eastern part of the lease area. Occasionally, the BHQ band gets enriched into ore as could be visualized in boreholes.

The iron ore formation occurs in the form of reef having reddish brown in color and hard metallic luster. Ore in the form of lumps and fines having average ratio of 30: 70 is observed at many places. The quality of iron ore is good with the grade varies ranging from 45% to + 65% Fe content.

Shale/ Ferruginous Clay

Shale /Ferruginous Clayare exposed as wall rocks at places and exposed within the iron ore formation, as intercalated waste. It is light yellow to light pinkish red in color.

d) Details of Exploration Agency

Name of Exploration agency	**M/s Mineral Exploration Corporation Limited**
Address	Dr.Babasaheb Ambedkar Bhawan, Highland Drive Road, Seminary Hills, Nagpur, Maharashtra 440006
Phone No.	0712 251 0310

e) Details of Prospecting/Exploration Already Carried Out

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

Exploration of the lease area was carried out by M/s MECL. No pitting or trenching was carried out by M/s MECL. As it was a working mine earlier, most of the ore body has been exposed, wherein pits were already available. The MECL is categorised only G1 and G2, and Surface Area of the Same is shown in below table. And same is marked in the Geological plan and Geological Cross sections.

Categorised by Surface Geology

Category	Area in Ha
G1	1.2
G2	1.8
G3	-
G4	-
Non mineralized Zone	29.89
Total area	32.89

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

M/s MECL has drilled 4 nos. of Core drill holes (215.70m) and 19 nos. of RC drill holes with a depth of 1038 meters during 2014. These Bore holes are marked in Geological Plan and borehole logs are enclosed as **Annexure-XI.**

TABLE-1.1
Quantum of Work Executed by MECL in
Ubbalagundi Iron ore Mine (ML No. 995)

Sl. No	Activity	Quantity
1	Topographical Survey - on 1:1000 scale.	32.89 Ha
2	Geological Mapping	0.3289 sq. km
3	**Survey**	
	i) Triangulation/Traversing	32.89 Hectares
	ii) BH Fixation	23 nos.
	iii) Determination of RL and Co-ordinates	23 nos.
4	**Exploratory Drilling**	
	i) Core Drilling	215.70m (4 Bhs)
	ii) RC Drilling	1038.00 m (19 Bhs)
5	**Geological Activities**	
	i) Core Logging	1253.70m (23 BHs)
	ii) Primary Samples	1113 Nos
	iii) Check Samples	55 Nos.
	i) Lump and Fine(Pits)	3 Nos
	ii) Bulk Density determinations	3 Nos
6	**Chemical Analysis :**	
	i) Primary (Fe,Sio_2 andAl_2O_3)	1113 Nos.
	ii) Check Sample Analysis	55 Nos
	iii) Specific Gravity determination	5 Nos.
7	**Physical Analysis**	
	i) PetrographicStudies	2 No.
	ii) Mineragraphic Studies	2 No.

Surface features & Topography of the mine lease area are shown in Surface plan **(Plate 3).**

Geological features of the lease area, Location of Boreholes, Extent of Mineralization are shownin Surface Geological Plan& Geological cross sections**(Plate 4&5)**.

Surface Survey

The survey work has been carried by using Differential Global Positioning System (DGPS) of Tremble make having an accuracy of 0.10 m with WGS 1984 datum. They surveyed map of the mining lease area has been provided by DMG, Karnataka. The boreholes have been fixed and RL determined by triangulation method. The triangulation stations details and co-ordinates and borehole header details have been provided as **Annexure-VIII and X.**

The base map has been provided by DMG, Karnataka as surveyed by NITK, Suratkal, Karnataka. The co-ordinates, both National and UTM, of triangulation stations and boundary pillars of the base map

were provided by DMG, Karnataka. Topographical survey was carried out using the Electronic Total station (Sokkia make).Surface features & Topography of the mine lease area are shown in Surface plan **(Plate 3).**

Geological Mapping

The geological mapping was carried out with the help of tape and compass over an area of 0.3289 sq.km on 1:1000 scale. The survey stations fixed on the cross sections line were used as reference points.

During the exploration, the benches formed were also studied carefully to decipher and delineate the nature and behavior of iron ore bands. Other formations as well as surface geological features were also incorporated in the topographical and geological map. Structural features viz. attitude, different formations, joints, foliation etc. were also recorded and provided in Surface geological plans & cross sections **(Plate 4&5).**

Exploratory Drilling

The boreholes have been drilled by MECL and closed in consultation with DMG officials at Ballari. In order to assess total potential of iron ore in the mine area, a total of 4 nos of boreholes for core drilling and 19 nos of boreholes for RC drilling have been drilled involving of 215.70 m and 1038.00 m respectively. Thus, a total of 1253.70 m exploratory drilling has been completed in Mine Lease Area (ML No. 995). During the period of execution, due to the finer nature of ore, utmost care has been taken while drilling, so as to achieve maximum core recovery. In the mineralized zone, the overall recovery has been 85-90% and above.Photos of boreholes located in the lease area are show in **Annexure XV.**

Details of Borehole's are given below Table no 1.1a

Sl. no	BH-No	Type	Grid Interval	Latitude	Longitude	Reduced Level	Angle	Bearing	Depth	Date of Start	Date of Close
1	MMRL-1	RC	100 X100	1665198	676896.9	886.108	90		30	06-03-2016	06-03-2016
2	MMRL-2	RC	100 X100	1665428	676974.3	811.719	90		87	06-03-2016	06-03-2016
3	MMRL-3	RC	100 X100	1665641	676998.2	848.956	90		30	06-03-2016	06-03-2016
4	MMRL-4	RC	100 X100	1665289	676887.5	868.327	90		35	06-03-2016	06-03-2016
5	MMRL-5	RC	100 X100	1665722	677050.9	857.523	90		95	06-03-2016	07-03-2016
6	MMRL-6	RC	100 X100	1665490	676845.1	873.862	90		65	07-03-2016	07-03-2016
7	MMRL-7	RC	100 X100	1665440	677025.7	832.101	90		45	07-03-2016	07-03-2016
8	MMRL-8	RC	100 X100	1665660	677081.4	854.714	90		95	07-03-2016	08-03-2016
9	MMRL-9	RC	100 X100	1665175	677205.2	798.87	90		30	07-03-2016	07-03-2016
10	MMRL-10	RC	100 X100	1665068	677254.7	790.78	90		30	07-03-2016	07-03-2016
11	MMRL-11	RC	100 X100	1665257	677123.2	809.123	90		50	08-03-2016	08-03-2016
12	MMRL-12	RC	100 X100	1665664	676949.5	844.04	90		50	08-03-2016	08-03-2016
13	MMRL-13	RC	100 X100	1665533	677008.7	842.233	60	N75°E	60	07-03-2016	08-03-2016
14	MMRL-14	RC	100 X100	1665662	676825	888.49	90		81	08-03-2016	08-03-2016
15	MMRL-15	RC	100 X100	1665277	677197.6	771.016	90		30	08-03-2016	08-03-2016
16	MMRL-16	RC	100 X100	1665594	676839.3	884.084	90		65	09-03-2016	09-03-2016
17	MMRL-17	RC	100 X100	1665137	677092	860.503	60	N75°E	40	09-03-2016	09-03-2016
18	MMRL-18	RC	100 X100	1665228	677028.1	843.845	90		60	10-03-2016	10-03-2016
19	MMRL-19	RC	100 X100	1665168	677020.6	863.004	90		60	10-03-2016	10-03-2016
20	MML-20	CORE	100 X100	1665397	676834.1	872.076	90		21.3	21-03-2016	23-03-2016
21	MML-21	CORE	100 X100	1665327	676989.3	809.337	90		64	21-03-2016	23-03-2016
22	MML-22	CORE	100 X100	1665528	676960.5	822.946	90		49	25-03-2016	29-03-2016
23	MML-23	CORE	100 X100	1665712	676930.7	856.309	90		81.4	25-03-2016	29-03-2016

iii) Details of samples analysis indicating type of sample (surface/sub-surface from pits/trenches/borehole etc)

Core Logging

The core and powdery materials recovered from drilling were logged systematically to demarcate various litho-units. The logging of run wise cores and the powdery materials as well as the cuttings from boreholes have helped in discerning physical characters like colour, shape and size besides the nature of ore (laminated, massive, lumpy, and siliceous etc). Besides these, the qualitative analytical data were helped in delineating the ore types and non-ore. Among the non-ore, ferruginous shale, shale banded hematite quartzite has also been demarcated. The upper portion of ore body has been covered invariably by laterite / lateritic ore. However, imp-persistent remnant banded hematite quartzite have been observed a few places. Based on these observations, ore zones and non-ore horizon were distinguished and delineated after chemical analysis. In order to prepare graphic lithologs, concise lithologs were generated **(Annexure-XI)** and presented in **Plate- 4&5**.

Primary Sampling

The core recovered by drilling was divided into two longitudinal halves. One half was taken for sampling, whereas the second half was kept for future reference [with DMG, Karnataka]. The first half was subjected to uniform size reduction of 1mm size. It is thoroughly mixed pounded and powdered to (-) 100 mesh size by pestle and mortar and then coned and quartered. 3 sample packets of 100 gram each have been prepared; out of the three, one packet was handed over to DMG, Karnataka and the other one has been labeled and sent to MECL laboratory for Fe, SiO_2 and Al_2O_3 analyses, whereas the third packet has preserved for future reference. Generally, one-meter length of the core has been considered as a sampling unit, provided no change in lithology or else, the length corresponds to particular lithology has been taken into consideration for sampling purposes. The analytical details of the samples have been given in **Annexure XI.**

The entire lot of chips and powder material were collected from boreholes drilled by Reverse Circulation drill. 50% mostly of chip samples have been thoroughly mixed to have the desired quantity of 500-600 gms. and pounded to (-)100 mesh size by progressive reduction, 3 sample packets of 200 gram each has been prepared; out of the three, one has been labeled and sent to MECL lab. for Fe, SiO_2 and Al_2O_3 analyses and the other packet was handed over to DMG, Karnataka, and the 3rd packet of the sample has been preserved for further studies at camp.

Chemical Analysis: All the primary samples were analyzed for Fe, SiO2, Al_2O_3 at MECL laboratory by classical method and at JNRDC laboratory by XRF method. NABL certificate of accreditation of MECL laboratory is enclosed, **Annexure XX.**

(iv) Expenditure Incurred in various Prospecting Operations

Entire prospecting operation of the lease area has been carried out by M/s MECL. The actual expenses incurred by the Government of Karnataka on mine exploration, preparation of Provisional R&R Plans, survey, construction of pillars and DGPS survey.

f) Surface Plan

The Surface Plan has been prepared on a scale of 1:2000 R.F with contour interval of 5mtr and is enclosed as **Plate No.3.**

g) Geological Plan

The Geological Plan has been prepared on a scale of 1:2000 R.F, incorporating already carried out and proposed exploration data, mineralized zone, lithologs, and structural features and is enclosed as **Plate No.4.**

h) Geological Cross Sections

Based on the Geological Plan, geological Cross Sections has been drawn at an interval of avg 100 m on a scale of 1:2000 R.F. and enclosed as **Plate No. 5**.

i) Future Exploration Programme

An additional 12 Boreholes have been proposed to be drilled by RC drilling in the plan period to further access the extent of ore body. The year-wise proposed bore holes to be drilled during plan period is given in table 1.2**(Plate no. 4&5).**

Table 1.2 Year wise Future Exploration Programme

Year	No. of Boreholes (RC)	Grid Interval	Total Meterage	No. of Pits, Dimensions and Volume	No. of Trenches, Dimensions and Volume	Remarks
I	-	-	-	-	-	-
II	8	100 m	715 m	-	-	-
III	4	100 m	320 m	-	-	
IV	-	-	-	-	-	
V	-	-	-	-	-	
Total	**12**		**1035 m**	**-**	**-**	

Table 1.2a Year Wise Future Exploration Programme

Sl. no	BH-No	Type	Latitude	Longitude	Reduced Level from MSL	Depth in Mts	Angle
1	PBH-1	RC	1665133.20	677005.35	886.00	50	90
2	PBH-2	RC	1665193.50	676998.56	859.50	110	90
3	PBH-3	RC	1665254.10	676986.82	830.00	70	90
4	PBH-4	RC	1665281.05	676938.60	846.30	120	90
5	PBH-5	RC	1665369.45	676912.71	851.70	155	90
6	PBH-6	RC	1665378.95	676986.11	808.80	50	90
7	PBH-7	RC	1665463.22	676899.85	850.10	90	90
8	PBH-8	RC	1665468.86	676960.19	806.50	70	90
9	PBH-9	RC	1665564.60	676883.68	853.90	110	90
10	PBH-10	RC	1665574.39	676949.07	830.50	50	90
11	PBH-11	RC	1665655.70	676890.78	878.10	70	90
12	PBH-12	RC	1665745.51	676903.66	885.40	90	90

j) Reserves and Resources Calculations

A. Reserve estimated by M/s MECL

(i)Mineralization

All the materials analyzing more than 45% and above have been considered as ore. The ore exhibits vide variations of physical properties ranging from compact, hard and massive ore to soft, flaky, laminated, granular, unconsolidated sandy blue dust or reddish brown powdery ore.

However, categorization/classification of ore based on quantitative data such as hard, soft, laminated, powdery etc., have been possible based on mine data (size range or granulometry). It is based on physical properties like colour, presence or absence of weakness, cohesiveness of the grains etc. This lithological classification helped in revealing a stratigraphical picture of the relative preponderance of different ore types.

The iron ore in nature is not homogeneous, but consists of a mixture of many ore types. Hence, practical approach of demarcating the ore zones based on predominant nature of the lithology/ore substantiated with analytical data have been applied.

(ii) Types of Ore

Various types of iron ores are derived from hematite viz. massive ore, laminated ore, and blue dust.

Table 1.3 Ore Characteristics

TypeofOre	CharacteristicFeatures
Lateritic	Porousandcavernousinnature
Laminated	Closelyspacedlaminae,whichgiverisetobiscuityores.
Bluedust(-)10mesh	Oreconstitutingofhematiteandmartite
Massive(Hematitic)	Noplanarstructure

The blue dust consists of 10-15% of (-) 100 mesh size fractions and above 80% of (-)100 to (-)325 mesh size.

Besides the float ore gets accumulated along the slope and foot hills which are of more pure in iron content. In Ballari-Hospet region also the float ore occurs with >64% Fe. The gangue materials are of shale pieces, banded hematite quartzite, dolerite and clay. If lateralization is extensive, the alumina to silica ratio will be high. The present mine lease area is having alumina to silica ration in ranges between 0.03 and 4.20 with an average of 0.383.

(iii) Grade Classification

The exploration efforts in 70's were mainly for lumpy ores. Fines were not given economic importance. Similarly, exploration will also be required to categorize the ore reserves based on end user's grade classifications. At threshold cutoff of 45% Fe as stipulated by IBM and at 55% Fe cutoff, the mineralized zones within the lease hold area have been delineated and presented in the **Table-1.4**.

Table 1.4
DETAILSOFIRONOREZONEINTERSECTEDINTHE BOREHOLES (AT45%FeCUT-OFF)

BH. No.	From (m)	To (m)	Thickness (m)	True Thick. (m)	Fe (%)	SiO_2 (%)	Al_2O_3 (%)
MMLR-2	0.00	87.00	87.00	83.52	64.11	4.96	2.38
MMLR-12	0.00	9.00	9.00	8.64	63.70	2.88	5.33
	17.00	25.00	8.00	7.68	48.63	22.43	1.31
MMLR-13	53.00	54.00	1.00	0.96	53.49	18.78	4.13
MMLR-14	6.00	10.00	4.00	3.84	60.37	5.49	6.16
	18.00	29.00	11.00	10.56	48.06	25.79	4.53
	39.00	78.00	39.00	37.44	61.21	9.76	1.42
MMLR-16	57.00	59.00	2.00	1.92	48.08	27.65	1.54
MMLR-18	0.00	10.00	10.00	9.60	47.40	25.72	4.60
MMLR-19	0.00	16.00	16.00	15.36	58.47	10.61	4.92
	25.00	31.00	6.00	5.76	48.05	27.17	1.82
	35.00	37.00	2.00	1.92	60.86	7.11	1.64
	41.00	60.00	19.00	18.24	51.13	20.06	1.68
MML-21	0.00	17.70	17.70	16.99	61.24	8.10	3.00
	21.70	44.60	22.90	21.98	57.72	14.22	1.46
	52.70	54.30	1.60	1.54	45.56	28.62	0.76
	56.70	60.55	3.85	3.70	49.61	24.35	0.90
MML-22	0.00	33.00	33.00	31.68	62.03	4.67	4.32
MML-23	1.00	54.35	53.35	51.22	63.34	3.52	5.19

(iv) Mineralization Factor

Mineralization factor is the ratio of net ore bearing area to gross area. It is referred as the co-efficient of impurities. Out of the mining lease area of 0.3289 sq. km., the mineralized area is 0.03 Sq.km.

(v) Physical Characteristics of the Iron Ore

The ore is massive, laminated, soft-laminated and blue-dust.Principal ore minerals are hematite, magnetite ,goethite and limonite. Their on contentrangesfrom62.7%to65.5%inbluedust.However,

in M/s Mysore Minerals Limited (ML No.995) soft laminated ore has also been encountered.

(vi) Chemical Characteristics of the Iron Ore

In the entire deposit, the high grade ore is almost free from lateralization and the laterite area is very less (2-3.6%). The haematitic ore persists even beyond the level of exploration as could be visualize from the geological cross sections **(Plate-V).**Silica to Alumina ratio ranges between 0.03 and 4.2 with the average of 0.383 indicating low level of lateralization. The iron ore, in general is, rich in iron (>45%Fe), but they also contain 3-7% Al_2O_3 and the ore deposits normally have Al_2O_3: Fe ratio varies between 0.02 and0.74.

(vii) Method of Reserve Estimation

Ore reserves have been estimated by geological cross section method. In order to delineate the ore and non-ore, the grade or threshold value of 45% Fe has been adopted, thus non ore above and below ore zones has been demarcated. The rule of gradual change or law of linear function has been applied [Constantine C. Popoff, 1965] along with the rule of nearest points for application of influence of half way between successive boreholes.

At threshold cutoff of 45% Fe as stipulated by IBM, the mineralized zone within the lease hold area and the ore reserves are estimated.

A total of cross sections serially numbered S1-S1' to S9-S9' inclusive of S8a from east to west along N75°E-S75°W have been prepared **(Plate-V),**based on the interpretation of sub surface borehole qualitative data along with surface geological data, which is perpendicular to general strike of the ore body. Following parameters have been considered for estimation of the mineral reserves:

a) Bulk density of 3.5 T/M3
b) Cut-off grade of 45% Fe.
c) Call factor of 10% reduction and correction factor of 1.035 and 0.96 based on the true thickness of the ore body obtained during drilling.
d) Configuration of the ore body has been done based on the exploration data and the cross sections were prepared accordingly.
e) 50 m on either side of the iron ore intersection of the bore holes has been placed under (G1) and the next 50 m under (G2) of UNFC.

(viii) Estimation of Reserves and Grade

- After delineating the limit of non-ore (45%) and boundaries of different lithounits, the geometry of the ore body have been demarcated. Thus, the sectional area or volume has been computed by the software using Auto-cad.
- Ore resource tonnage has been estimated by multiplying the volume with the tonnage factor of specific gravity of 3.50. The sum has been considered as geological in-situ reserves.
- At the back drop of iron ore extraction from the Sandur schist belt of Ballari – Hospet area since independence has been quite predominant. Moreover iron ore has been extracted from Kumaraswamy range not only by NMDC but also by SMIORE. However, Dalmia International had extracted the ore from NEB range for export for quite sometime.
- The UNFC code pertains to geological axis of (G1& G2) have been assigned. The Geological reserves estimated by cross section method at 45% Fe cut off are given in **Table -1.6.**
- A total of 9.708 MT. of net reserves with average grade of 55.96 % Fe, 13.39 % SiO_2 and 3.20 % Al_2O_3 has been estimated.
- The behavior of ore bands has been studied along NW-SE direction as well as along the foliation plane in N10°W-S10°E reveals that the ore body persistence and tendency of folding nature of the iron ore. The ore persists even beyond the explored depth of 724.719m RL(BH.No.MMRL-2).
- Though the ore zone thickness is quite impressive at 45% Fe cut-off, an attempt has also been made to evaluate the ore resources at a planning cut-off of 35% Fe. The mineralized zone has been quite persistence over the entire strike length of 585.00m along the wide area of 48.00m – 498.00m with an average thickness of 46.22m and the ore resources estimated is 12.087 million tonnes with the grade of 56.35 % Fe, 15.38% SiO_2 and 3.51%Al_2O_3.

A summary of the category wise Geological reserve estimated for this mine is given in **table 1.6:**

Table-1.6: Geological Reserves (As per MECL Report)

Category	UNFC	Geological Reserves (tonnes)
Proved(G1)	111	8601187.144
Probable(G2)	121 &122	2185433.740
Total Geological Reserves		10786620.884
Net Geological Reserves		9707958.796
Fe%		55.96

Area explored under different level of exploration has been marked on the Surface geological plan **(Plate No. 4)**

As detailed exploration has been carried out by M/s MECL, following data is furnished based on M/s MECL report. Section Wise, Borehole Wise, as well as UNFC Category wise reserves are furnished in **table 1.6** of Fe 45% Cutoff.

TABLE-1.6

1. SECTION-WISE - BOREHOLE-WISE ORE RESERVES BY CROSS SECTION METHOD (at 45 % Fe cut-off)

M/s MYSORE MINERALS LIMITED (ML No.995)

S.No.	BH.No.	Intersection (m)		Diff (m)	True Width (m)	Average sectional influence (m)	Area (Sq. m)	Area (Sq. m)	Reserves (Tonnes)		Total Reserves (Tonnes)	Grade (%)		
		From	To				G-1	G-2	G-1	G-2		Fe.	SiO_2	Al_2O_3
S-3	MMRL-19	0.00	16.00	16.00	15.36	52.30	1432.1667	17.2578	260480.3043	3138.8224	263619.1268	48.07	27.17	1.82
		25.00	31.00	6.00	5.76	52.30	481.8276	42.6678	87634.0715	7760.3546	95394.4261	60.86	7.11	1.64
		35.00	37.00	2.00	1.92	52.30	158.4860	19.2941	28825.1928	3509.1816	32334.3744	51.13	20.06	1.68
		41.00	60.00	19.00	18.24	52.30	1498.4054	272.1666	272527.6966	49501.2475	322028.9441			
	Influence			0.00	25.00	52.30		2124.0580	0.0000	386320.4405	386320.4405			
S-4	MMRL-18	0.00	10.00	10.00	9.60	80.70	1450.1837	165.8574	406982.9180	46546.6055	453529.5235	47.40	25.72	4.60
S-5	MML-21	0.00	17.70	17.70	16.99	101.30	1023.3307		360499.8395	0.0000	360499.8395	61.24	8.10	3.00
		21.70	44.60	22.90	21.98	101.30	1983.6782	102.4988	698811.9019	36108.3675	734920.2694	57.72	14.22	1.46
		56.70	60.55	3.85	3.70	101.30	352.6537	90.9926	124233.1558	32054.9532	156288.1090	49.61	24.35	0.90
S-6	MMRL-2	0.00	87.00	87.00	83.52	97.65	7016.4282	2642.2481	2382692.2937	897274.7966	3279967.0902	64.11	4.96	2.38
S-7	MML-22	0.00	33.00	33.00	31.68	97.40	3122.7961	1150.2431	1057747.9989	389608.3184	1447356.3173	62.03	4.67	4.32
S-8	MMRL-16	57.00	59.00	2.00	1.92	100.00	167.6538		58303.2855	0.0000	58303.2855	48.02	27.65	1.54
S-8a	MMRL-12	0.00	9.00	9.00	8.64	63.65	664.8017		147153.3510	0.0000	147153.3510	63.70	2.88	5.33
		17.00	25.00	8.00	7.68	63.65	797.9733		176630.7835	0.0000	176630.7835	48.63	2.88	5.33
S-9	MML-23	1.00	54.35	53.35	51.22	70.15	4688.5185	418.1307	1143781.1543	102004.5063	1245785.6605	63.34	3.52	5.19
	MMRL-14	6.00	10.00	4.00	3.84	70.15	255.2082	518.8522	62258.9693	126575.8828	188834.8522	60.37	5.49	6.16
		18.00	29.00	11.00	10.56	70.15	669.6619		163366.4581	0.0000	163366.4581	48.06	25.79	4.53
		39.00	78.00	39.00	37.44	70.15	4792.9507	430.5337	1169257.7696	105030.2633	1274288.0329	61.21	9.76	1.42
							Total Insitu Reserves				**10786620.8844**	**55.96**	**13.39**	**3.20**
							Net Reserves (Tonnes)				**9707958.7960**			
							Net Reserves (Million Tonnes)				**9.708**			

Reliability of Estimation

i) Frequency distribution

The entire primary sample data has been subjected to statistical evaluation and it is inferred that the frequency distribution is highly skewed.

The statistical parameters estimated for primary sample (entire) data (1113 no. of samples) is as follows:

No. of Samples	Fe	SiO_2	Al_2O_3
Mean	32.00	30.00	4.80
Standard deviation	0.063	0.129	0.192
Variance	0.039	0.016	0.036
Upper limit Lower limit confidence interval at 90%	1.011 0.9895	1.007 0.9927	1.011 0.9895
Sichel's "T" estimator	1.020	0.101	0.020

The statistical parameters estimated for primary sample (zone) data

(321 no. of samples) is as follows:

No. of Samples	Fe	SiO_2	Al_2O_3
Mean	56.00	11.00	2.70
Standard deviation	0.023	0.122	0.239
Variance	0.005	0.014	0.057
Upper limit Lower limit Confidence interval at 90%	1.000 1.000	1.007 0.9927	1.013 0.9872
Sichel's "T" estimator	1.010	1.010	1.030

The sample data 321 nos. pertain to the ore zone (>45% Fe) have been subjected to statistical evaluation, the iron value distribution is log- normal as could be seen from The Sichel's "t" estimator is 57.01%, 12.01% and 3.73% respectively for Fe, SiO_2 and Al_2O_3

ii) Accuracy of analytical procedure

- Grade: The grade estimates of the deposit are based on the results of core samples. Each sample under goes the process of sample preparation and analysis. Since, sampling and analysis are two complimentary links of quality estimation chain ,the possible source of errors, if any, could be from the bias in sample preparation and inaccuracies in assaying or both.

- Mean: The mean value obtained by statistical method as well as calculated values for three variables is given below:

Between S1-S13	**Fe%**	**SiO_2%**	**Al_2O_3%**
Statistical Method (entire data)	56.00	11.00	2.70
Calculated (45% Fe)	55.96	13.95	3.20
Sichel's "t" estimator (entire data)	57.01	12.01	3.73
Calculated (55% Fe)	60.96	6.82	3.44

It reveals from the above table that the estimated values of Fe, SiO2andAl2O3 are more reliable.

Feasibility study & Economic Evaluation of the deposit) Method of reserve & resource estimation

Ore reserves have been estimated by geological cross section method. In order to delineate the ore and non-ore, the grade or threshold value of 45% Fe has been adopted, thus non ore above and below ore zones has been demarcated. The rule of gradual change or law of linear function has been applied [Constantine C. Popoff, 1965] along with the rule of nearest points for application of influence of half way between successive boreholes.

At threshold cutoff of 45% Fe as stipulated by IBM, the mineralized zone within the lease hold area and the ore reserves are estimated.

A total of 9 cross-sections have been prepared and following parameters have been considered for estimation of the mineral reserves:

- Bulk density of 3.5 T/M3
- Cut-off grade of 45% Fe.
- Call factor of 10% reduction and correction factor of 1.035 and 0.96 based on the true thickness of the ore body obtained during drilling.
- Configuration of the ore body has been done based on the exploration data and the cross sections were prepared accordingly.
- 50 m on either side of the iron ore intersection of the bore holes has been placed under (G1) and the next 50 m under (G2) of UNFC.

ii) Cut off Grade

As per the IBM corrigendum circular No. 3/2010 issued by office of the Chief Controller of Mines vide No. M-11012/1/2009 – CCM dated 05.03.2012. The cut off grade taken as +45% Fe for iron ore.

iii) Percentage of Recovery

The percentage of recovery is considered based on the past mining data in the mine, its average is given below:

CATEGORY	GRADE (Fe%)	PERCENTAGE
Saleable	+45%	100%

iv) Analysis report

M/s MECL has carried out core logging and sample analysis at its Nagpur Laboratory. Sample collected have been analyzed for Fe, Sio_2& Al_2O_3 Content. Analytical details of the samples have been given in **ANNEXURE XI.**

v) Bulk Density

The specific gravity of different types of ores has been determined on samples by Walker's Steelyard Balance method in the MECL laboratory. The results are given below:

Sl. No.	Sample No.	Lithology	Specific Gravity
1	MML-2	Haematitic Ore	4.30
2	MML-3	Haematitic Ore	4.55
3	MML-7	Massive Haematitic Ore	4.52
4	MML-9	Laminated Ore	3.57
5	MML-10	Massive Haematitic Ore	3.70

Over all Bulk Density after considering all the deposits is taken as 3.50.

Geological and net geological reserves have been estimated by M/s. MECL by cross-sectional and longitudinal sectional methods. The difference between the reserves estimated by these two methods is marginal and within the accepted limit. As reserves estimated by cross sectional method are more accurate, the same are considered for estimation of mineable reserves. Bulk density of 3.5 t/m^3 considered by MECL is high. Considering physical characteristics and grade of the ore, a bulk density of 3.3 t/m^3 and 95% of the net geological reserves have been assumed for estimation of mineable reserves due to ore getting blocked in UPL.

Exploration work has been carried out by M/s MECL up to G1, G2 stage. As such the reserves under different remaining categories are nil.

The Geological reserves and resources are re-estimated by ICFRE team in order to establish mineable reserves, present in the lease area. Details of mineable resources are as follows:

B. Mineable Reserve -Based on ICFRE Report:

Government of Karnataka has provided the estimated geological reserves based on exploration data carried out by M/s. MECL. Geological plans and cross sections have been prepared by M/s. MECL. Nine cross sections have been prepared considering the following parameters estimation of reserves has been done:

- Cut-off grade of 45% Fe (However, the reserves estimated at45% Fe cut-off grade only has been considered for reserve estimation as per the threshold limit of Fe stipulated by IBM).
- Bulk density of 3.5 T/M^3 based on field tests conducted from 3 pits in thin laminated ore, hard compact massive ore and laminated ore.
- 50 m on either side of the ore intersection of the bore holes under G1 level and the next 50 m under G2 level of exploration as per UNFC.
- Correction factor of 1.035 and 0.96 in strike and dip directions to derive horizontal and true thickness of ore body respectively.
- Call factor of 10% deduction from *in-situ* geological reserves to arrive at net geological reserves.
- Buffer zone (Safety zone) of 7.5 m from the lease boundary.
- Considering the intercalated litho units such as ferruginous shale, siliceous iron ore, etc. which cannot be mined separately and have to be mined along with ore.

Thus, reserves estimated by M/s. MECL are as below at 45% Fe cut-off grade (**Table 1.8**).

Table 1.8*:* Details of Reserves

Quantity in Million Tonnes

Category	**UNFC**	**In situ Geological Reserves**	**Net Geological Reserves**
Proved	111 (G1)	8.601	7.741
Probable	122 (G2)	2.185	1.967
Total		10.786	9.708
Fe 55.96%			

During the inspection of the mine, it was noticed that the mining has almost reached its lowest level

with little cushion for developing the benches further down for scientific and systematic mining. So, some quantities of net geological reserves estimated by M/s. MECL get blocked in UPL. Hence, 95% of the net geological reserves can be considered as mineable reserves. Further, 3.5 T/M^3 of bulk density estimated from 3 pits in hard ore and laminated ore for estimation of reserves cannot be considered for the entire deposit in view of the fact that the deposit also comprises soft laminated ore, blue dust, siliceous ore etc which will have slightly lower bulk density. Taking this into account, an average bulk density of 3.3 T/M^3 is considered for estimation of reserves. Accordingly, at 3.3 T/M^3 of bulk density and 95% of net geological reserves have been considered for arriving at the mineable reserves which works out as below (**Table1.9**).

Table 1.9: Details of Mineable Reserves

Quantity in Million Tonnes

Category	**UNFC**	**Net geological reserves by M/s.MECL**	**Mineable reserves at 95% recovery and 3.3 T/M^3**
Proved	111	7.741	6.934
Probable	122	1.967	1.762
Total		9.708	8.696 or say 8.70

Thus, 8.70 Million Tonnes can be considered to arrive at the permissible annual production capacity for next 20 years.

k) Ore Reserve estimation as per UNFC with respect to the threshold value notified by IBM

UNFC Classification

All the materials analyzing more than 45% and above have been considered as ore. In between + 35% of Fe is also considered for Estimation of Reserves. The ore exhibits vide variations of physical properties ranging from compact, hard and massive ore to soft, flaky, laminated, granular, unconsolidated sandy blue dust or reddish brown powdery ore. However, categorization/classification of ore based on quantitative data such as hard, soft, laminated, powdery etc., have been possible based on mine data (size range or granulometry). It is based on physical properties like colour, presence or absence of weakness, cohesiveness of the grains etc. This lithological classification helped in revealing a stratigraphically picture of the relative preponderance of different ore types.

The iron ore is not homogeneous in nature, but consists of a mixture of many ore types. Hence, practical approach of demarcating the ore zones based on predominant nature of the lithology/ore substantiated with analytical data have been applied.

As per the UNFC classification, economic viability axis, feasibility axis and geological axis are considered for reserves and resources estimation. The feasibility study report has been prepared and enclosed as **ANNEXURE-XIX.**

Section Wise, UNFC Category wise Geological reserves are furnished below in **table 1.7a** of Fe 45% Cutoff.

Table no 1.7a: Geological Reserve

GEOLOGICAL RESERVE SECTION WISE							
		Proved (G - 1)			Proved (G - 2)		
Section Number	Sectional influence	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.
m	m	m2	m3	Tonnes	m2	m3	Tonnes
S1-S1'	0	0	-	-	0	-	-
S2-S2'	50	0	-	-	0	-	-
S3-S3'	52.3	4844	2,53,341	7,22,022	0	-	-
S4-S4'	97.65	558	54,489	1,55,293	0	-	-
S5-S5'	100.15	3113	3,11,767	8,88,536	0	-	-
S6-S6'	97.65	6100	5,95,665	16,97,645	0	-	-
S7-S7'	97.4	3586	3,49,276	9,95,438	0	-	-
S8-S8'	100	0	-	-	0	-	-
S8a-S8a'	97.65	1747	1,70,595	4,86,194	0	-	-
S9-S9'	70.15	10861	7,61,899	21,71,413	2269	1,59,170	4,53,635
Total Ore				***71,16,541***			***4,53,635***

Total Geological Reserves as UNFC - 7570176 Tonnes say 7.57 MMT

Section Wise, UNFC Category Wise **Mineable reserves (G1 and G2)** are furnished below in **table 1.7b** of Fe 45% Cutoff. And Geological cross sections are enclosed as **plate no-5** and longitudinal section is enclosed as **plate no 5A**

Table 1.7b : Mineable reserves as per UNFC

MINEABLE RESERVES OF UBBALAGUNDI IRON ORE MINE													
		Proved (G - 1)			Intercalated	Probable (G - 2)			ntercalate	WASTE			
Section	Sectional	Sectional	Volume	Quantity @	waste @	Sectional	Volume	Quantity @	waste @	Sectional	Volume	Quantity @	TOTAL
Number	influence	area		3 b.d	2 b.d	area		3 b.d	2 b.d	area		2 b.d	WASTE
				with 95% Rec.	with 5% rec			with 95% Rec.	vith 5% rec				
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
S1-S1'	0	0	-	-	-	0	-	-	-	0	-	-	-
S2-S2'	50	0	-	-	-	0	-	-	-	0	-	-	-
S3-S3'	52.3	898	46,965	1,33,851	4,697	0	-	-	-	820	42,886	85,772	90,469
S4-S4'	97.65	558	54,489	1,55,293	5,449	0	-	-	-	2570	2,50,961	5,01,921	5,07,370
S5-S5'	100.15	2677	2,68,102	7,64,089	26,810	0	-	-	-	4098	4,10,415	8,20,829	8,47,640
S6-S6'	97.65	5011	4,89,324	13,94,574	48,932	0	-	-	-	11292	11,02,664	22,05,328	22,54,260
S7-S7'	97.4	3586	3,49,276	9,95,438	34,928	0	-	-	-	5047	4,91,578	9,83,156	10,18,083
S8-S8'	100	0	-	-	-	0	-	-	-	5817	5,81,700	11,63,400	11,63,400
S8a-S8a'	97.65	1747	1,70,595	4,86,194	17,059	0	-	-	-	4548	4,44,112	8,88,224	9,05,284
S9-S9'	70.15	7155	5,01,923	14,30,481	50,192	2269	1,59,170	4,53,635	15,917	3223	2,26,093	4,52,187	5,02,379
		0	-	-	-	0	-	-	-	0	-	-	-
Total				**53,59,921**	**1,88,067**			**4,53,635**	**15,917**		**35,50,408**	**71,00,817**	**72,88,884**
					Total Ore			***58,13,556***			***Total waste***		***72,88,884***

Total ore in MMT	**5.81**
Total Ore	**5813556**
Total waste	**7288884**
Ore to waste Ratio	**1 : 1.25**

Mineral Reserves/ Resources

Based on level of exploration, mineral reserves with reference to threshold value of Iron ore declared by IBM are as follows:

Level of Exploration	**Resources in million tons**	**Grade**
G1- Detailed Exploration	5.35	+45% Fe
G2- General Exploration	0.45	+45% Fe
G3-Prospecting	-	-
G4- Reconnaissance	-	-

Following data is based on exploration data provided by M/s MECL and Re-calculated as per UNFC Guidelines

Classification	**UNFC Code**	**Quantity in million tonnes**	**Grade (%Fe)**
1	2	3	4
A)Total Mineral Reserve		**5.813**	**+45%**
1.ProvedMineral reserves	111	5.359	+45%
2.ProbableMineral Reserve	121 &122	0.454	+45%
B. Total	-	-	-
1. Feasibility Mineral Resource	211	1.757	-
2.Prefessilibility Mineral resource	211&222	-	-
3.MeasuredMineral resource	331	-	-
4.IndicatedMineral resource	332	-	-
5.InferredMineral resource	333	-	-
6.Reconnaissance Mineral resource	334	-	-
Total Reserves & Resources		**7.570**	**+45%**

m) Ratio of Lumps and fines

The iron ore formation occurs in the form of reef having reddish brown in color and hard metallic luster. Ore in the form of lumps and fines having average ratio of 30: 70 is observed at many places. The quality of iron ore is good with the grade varies ranging from 45% to + 65% Fe content.

Proposed Year wise production of Lumps and Fines ratio are given below.

Year	Production of ROM in tonnes	Production of Fines in tonnes	Production of Lumps in tonnes	Mineral storage area in Ha
I	3,40,000	2,38,000	1,02,000	1.30
II	3,40,000	2,38,000	1,02,000	1.30
III	3,40,000	2,38,000	1,02,000	1.30
IV	3,40,000	2,38,000	1,02,000	1.30
V	3,40,000	2,38,000	1,02,000	1.30

2.0 MINING

A. Open Cast Mining

Proposed Iron Ore Production in the plan period, as communicated by Department of Mines & Geology/ Monitoring committee would be 0.340MTPA.At a stripping ratio of 1:1.20corresponding waste generation during the plan period will be 3.349 Million Tonnes. The reserves estimated as per the UNFC Classification is 8.70 million tonnes. At the given annual production of 0.340MTPA and an average stripping ratio of 1:1.33, the life of the mine would be 20 years.

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

i) Existing method of Excavation

Before being declared as "C" category mine, fully mechanized open cast method of mining was carried out in the mine by drilling and blasting and by deploying HEMM equipment's like hydraulic excavators, wheel loaders, tippers, etc. The mine has been developed by forming one mine pit comprising of 8 benches. Existing Mine pit dimension is 701x249m.

The bench height and width were 8m each with overall pit slope of $<45^0$form horizontal. For drilling operations, DTH drilling machines in conjunction with truck mounted diesel driven compressor were deployed. Rock breakers were deployed to avoid secondary blasting, to reduce the size of oversize boulders. Excavated ore was loaded into 20 tonnes tippers and transported to crushing & screening plant. Photos of existing pit, waste dumps stacks and infrastructure present in ML area are enclosed as **Annexure XVI.**

ii) Proposed Method for Excavation

Mining will be done by fully mechanized open cast method by using HEMM equipment like excavators/loaders and tippers.The height and width of the benches will be maintained at 8 m each with a bench slope of 80^0 to the horizontal. The ultimate slope angle of the pit will be 45^0 from the horizontal.

In order to achieve the targeted production, the different mining activities in this mine will be carried out during the daylight hours (from 6 AM to 6 PM).

The operations involve mining of the ore and waste by drilling and blasting. Ore excavated from the mine will be taken to the crushing and screening plant in the ML area for processing and the waste generated will be dumped in the designated places. Further ancillary machinery like water sprinklers, motor graders, dozers, weighing machine etc., will also be deployed. The finished products, i.e. lump ore and fine ore will be loaded into tippers and will be stacked at the ore stockyard. As this mine will be used for captive purpose only, entire quantity of finished product from stockyards will be dispatched to JSW Steel Plant by railway wagons (Rakes), trucks. In future pipe conveyor may also be used after carrying out necessary feasibility studies.

The total Mining lease area will be covered by one single major pit having the dimension given below:

Dimension LXWX D	Top RL	Bottom RL	No. of benches
701 X 249 X 60	880	820	9

b) Year-wise tentative Excavation in Cubic Meters indicating development, ROM, pit wise

(i) In situ Tentative Excavation

As per the Production and development Plan and Section **(Plate no. 6A to 6E & 7)**drawn for the designed parameters, the year wise tentative excavation both in Cum. and tonnage is given below:

Table 2.1 Proposed year-wise tentative Excavation in Cum

Year	Pit No.	Total tentative Excavation (m^3)	Top Soil (m^3)	OB/SB/IB (m^3)	ROM(m^3)		Total Mineral Reject (m^3)	ROM/ waste Ratio
					Ore (m^3)	Intercalated Waste (m^3)		
I	I	3,34,768	-	2,15,465	1,13,333	5970	-	1:1.95
II	I	3,63,004	-	2,43,704	1,13,333	5967	-	1:2.20
III	I	4,13,926	-	2,94,634	1,13,333	5959	-	1:2.65
IV	I	4,56,200	-	3,36,902	1,13,333	5965	-	1:3.02
V	I	1,57,297	-	37,996	1,13,333	5968	-	1:0.38
Total		17,25,195	-	11,28,701	5,66,665	29,829	**-**	**1:2.04**

Table 2.2 Proposed year-wise tentative Excavation in Tonnes

Year	Pit No.	Total tentative Excavation (tonnes)	Top Soil (tonnes) @bd 1.4	OB/SB/IB (tonnes) @bd 2	ROM (tonnes)		Total Mineral Reject (tonnes)	ROM/ waste Ratio
					Ore (tonnes) @bd 3	Intercalated Waste (Tonnes) @bd 2		
I	I	7,82,870	-	4,30,930	**3,40,000**	11940	-	**1:1.30**
II	I	8,39,349	-	4,87,415	**3,40,000**	11934	-	**1:1.47**
III	I	9,41,185	-	5,89,267	**3,40,000**	11918	-	**1:1.77**
IV	I	10,25,734	-	6,73,804	**3,40,000**	11930	-	**1:2.01**
V	I	4,27,928	-	75,992	**3,40,000**	11936	-	**1:0.26**
Total		40,17,066	-	22,57,408	**17,00,000**	59658	-	**1:1.36**

As the entire ROM (up to threshold value of +45% Fe) is consumed by the JSW steel plant, no mineral rejects are generated. From ROM, recovery of iron ore is 95% and 5% of intercalated waste is calculated, and same is mentioned in the table no 2.2.

a) First year development & production

From the maps prepared for production and development **Plate No. 6A & its cross-Section Plate No. 7**, the benches are proposed to be formed between 878 and 814m from AMSL with 9 benches of width and height of 8 m each. For 1st year the total area Proposed for dumping is 0.99Ha. The average ore to waste ratio works out to be 1:1.19 (in cum) and 1: 1.30 in tonnes. The total saleable ore amounts to 3,40,000 tonnes, while, the total waste of 4,42,870 tonnes likely to be generated will be stocked in the dump yard designated for the purpose.

b) Second year development & production

From the maps prepared for development and production **Plate No. 6B & its Section Plate No.7**, the benches are proposed to be formed between 886 and 838m from MSL with 7 benches of width and height of 8 m each. For 2nd year the total area Proposed for dumping is 1.36Ha The average ore to waste ratio works out to be 1:2.20 (in cum) and 1:1.47 in tonnes. The total saleable ore amounts to 3,40,000 tonnes, while, the total waste of 4,99,349 tonnes likely to be generated will be stocked in the dump yard designated for the purpose.

c) Third year development & production

From the maps prepared for development and production **Plate No. 6C & its Section Plate No.7**, the benches are proposed to be formed between 870 and 806m from MSL with 9 benches of width and

height of 8 m each. For 3rd year the total area Proposed for dumping is 3.70Ha The average ore to waste ratio works out to be 1:2.65 (in cum) and 1:1.77 in tonnes. The total saleable ore amounts to 3,40,000 tonnes, while, the total waste of 6,01,185 tonnes likely to be generated will be stocked in the dump yard designated for the purpose. The proposed dump is overlapping the existing approach road, hence we will apply for necessary forest clearance for diversion of approach road.

d) Fourth year development & production

From the maps prepared for development and production **Plate No. 6D & its Section Plate No. 7**, The benches are proposed to be formed between 870 and 798m from MSL with10benches of width and height of 8 m each. For 4th year the total area Proposed for dumping is 1.37Ha The average ore to waste ratio works out to be 1:3.02 (in cum) and 1: 2.01 in tonnes. The total saleable ore amounts to 3,40,000 tonnes, while, the total waste of 6,85,734 tonnes likely to be generated will be stocked in the dump yard designated for the purpose.

e) Fifth year development & production

From the maps prepared for development and production **Plate No. 6E & its Section Plate No.7**, the benches are proposed to be formed between 870 and 790m from MSL with 10 benches of width and height of 8 m each. For 5th year the total area Proposed for dumping is 0.54HaThe average ore to waste ratio works out to be 1:0.38 (in cum) and 1: 0.26 in tonnes. The total saleable ore amounts to 3,40,000 tonnes, while, the total waste of 87,928 tonnes likely to be generated will be stocked in the dump yard designated for the purpose.

Bench-wise, Section-wise Production & development Plan is given below:

PRODUCTION AND DEVELOPMENT PLAN - I YEAR

SECTION - 6-6'

Section Number	Sectional influence	Proved (G - 1) Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	Intercalated waste @ 2 b.d with 5% rec	WASTE Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+870	97.65	0	-	-	-	0	-	-	-
+862	97.65	0	-	-	-	46	4,492	8,984	8,984
+854	97.65	0	-	-	-	160	15,624	31,248	31,248
+846	97.65	0	-	-	-	210	20,507	41,013	41,013
+838	97.65	0	-	-	-	355	34,666	69,332	69,332
Total				**-**	**-**			**1,50,576**	**1,50,576**
Total Ore				***-***	***Total waste***				***1,50,576***

SECTION - 7-7'

Section Number	Sectional influence	Proved (G - 1) Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	Intercalated waste @ 2 b.d with 5% rec	WASTE Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+870	97.4	0	-	-	-	42	4,091	8,182	8,182
+862	97.4	0	-	-	-	99	9,643	19,285	19,285
+854	97.4	0	-	-	-	187	18,214	36,428	36,428
+846	97.4	6	584	1,666	58	210	20,454	40,908	40,966
+838	97.4	121	11,785	33,588	1,179	220	21,428	42,856	44,035
+830	97.4	380	37,012	1,05,484	3,701	218	21,233	42,466	46,168
+822	97.4	515	50,161	1,42,959	5,016	110	10,714	21,428	26,444
+814	97.4	204	19,870	56,628	1,987	0	-	-	1,987
Total				**3,40,325**	**11,941**			**2,11,553**	**2,23,494**
Total Ore				***3,40,325***	***Total waste***				***2,23,494***

SECTION - 8-8'

Section Number	Sectional influence	Proved (G - 1) Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	Intercalated waste @ 2 b.d with 5% rec	WASTE Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+886	100	0	-	-	-	0	-	-	-
+878	100	0	-	-	-	1	100	200	200
+870	100	0	-	-	-	26	2,600	5,200	5,200
+862	100	0	-	-	-	78	7,800	15,600	15,600
+854	100	0	-	-	-	89	8,900	17,800	17,800
+846	100	0	-	-	-	150	15,000	30,000	30,000
Total				**#REF!**	**#REF!**			**68,800**	**68,800**
Total Ore				***-***	***Total waste***				***68,800***

TAL ORE IN MT	**0.340**
Total Ore	**340325**
Total waste	**442870**
Ore to waste Ratio	**1 : 1.30**

PRODUCTION AND DEVELOPMENT PLAN - II YEAR

SECTION - 8-8'

Section Number	Sectional influence	Proved (G - 1) Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	Intercalated waste @ 2 b.d with 5% rec	WASTE Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+878	100	0	-	-	-	29	2,900	5,800	5,800
+870	100	0	-	-	-	66	6,600	13,200	13,200
+862	100	0	-	-	-	75	7,500	15,000	15,000
+854	100	0	-	-	-	173	17,300	34,600	34,600
+846	100	0	-	-	-	238	23,800	47,600	47,600
+838	100	0	-	-	-	599	59,900	1,19,800	1,19,800
Total				#REF!	#REF!			2,36,000	2,36,000
Total Ore				-	***Total waste***				***2,36,000***

SECTION - 8a-8a'

Section Number	Sectional influence	Proved (G - 1) Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	Intercalated waste @ 2 b.d with 5% rec	WASTE Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+886	63.65	0	-	-	-	0	-	-	-
+878	63.65	0	-	-	-	9	573	1,146	1,146
+870	63.65	0	-	-	-	49	3,119	6,238	6,238
+862	63.65	0	-	-	-	78	4,965	9,929	9,929
+854	63.65	0	-	-	-	129	8,211	16,422	16,422
+846	63.65	136	8,656	24,671	866	232	14,767	29,534	30,399
+838	63.65	510	32,462	92,515	3,246	86	5,474	10,948	14,194
Total				**1,17,186**	**4,112**			**74,216**	**78,328**
Total Ore				***1,17,186***	***Total waste***				***78,328***

SECTION - 9-9'

Section Number	Sectional influence	Proved (G - 1) Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	Intercalated waste @ 2 b.d with 5% rec	WASTE Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+886	70.15	0	-	-	-	153	10,733	21,466	21,466
+878	70.15		-	-	-	280	19,642	39,284	39,284
+870	70.15	0	-	-	-	320	22,448	44,896	44,896
+862	70.15	32	2,245	6,398	224	300	21,045	42,090	42,314
+854	70.15	234	16,415	46,783	1,642	187	13,118	26,236	27,878
+846	70.15	619	43,423	1,23,755	4,342	23	1,613	3,227	7,569
+838	70.15	230	16,135	45,983	1,613	0	-	-	1,613
Total				**2,22,919**	**7,822**			**1,77,199**	**1,85,021**
Total Ore				***2,22,919***	***Total waste***				***1,85,021***

TAL ORE IN MT	**0.340**
Total Ore	**340105**
Total waste	**499348**
Ore to waste Ratio	**1 : 1.47**

PRODUCTION AND DEVELOPMENT PLAN - III YEAR

SECTION - 5-5'

Section Number	Sectional influence	Proved (G - 1) Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	Intercalated waste @ 2 b.d with 5% rec	WASTE Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+862	101.3	0	-	-	-	0	-	-	-
+854	101.3	0	-	-	-	24	2,431	4,862	4,862
+846	101.3	0	-	-	-	45	4,559	9,117	9,117
+838	101.3	0	-	-	-	143	14,486	28,972	28,972
+830	101.3	0	-	-	-	135	13,676	27,351	27,351
+822	101.3	0	-	-	-	141	14,283	28,567	28,567
+814	101.3	22	2,229	6,352	223	179	18,133	36,265	36,488
+806	101.3	320	32,416	92,386	3,242	83	8,408	16,816	20,057
Total				**98,737**	**3,464**			**1,51,950**	**1,55,414**
Total Ore				***98,737***	***Total waste***				***1,55,414***

SECTION - 6-6'

Section Number	Sectional influence	Proved (G - 1) Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	Intercalated waste @ 2 b.d with 5% rec	WASTE Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+870	97.65	0	-	-	-	17	1,660	3,320	3,320
+862	97.65	0	-	-	-	67	6,543	13,085	13,085
+854	97.65	0	-	-	-	79	7,714	15,429	15,429
+846	97.65	0	-	-	-	79	7,714	15,429	15,429
+838	97.65	0	-	-	-	79	7,714	15,429	15,429
+830	97.65	0	-	-	-	250	24,413	48,825	48,825
+822	97.65	0	-	-	-	320	31,248	62,496	62,496
+814	97.65	52	5,078	14,472	508	320	31,248	62,496	63,004
+806	97.65	320	31,248	89,057	3,125	330	32,225	64,449	67,574
Total				**1,03,529**	**3,633**			**3,00,957**	**3,04,590**
Total Ore				***1,03,529***	***Total waste***				***3,04,590***

SECTION - 7-7'

Section Number	Sectional influence	Proved (G - 1) Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	Intercalated waste @ 2 b.d with 5% rec	WASTE Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+870	97.4	0	-	-	-	61	5,941	11,883	11,883
+862	97.4	0	-	-	-	86	8,376	16,753	16,753
+854	97.4	0	-	-	-	88	8,571	17,142	17,142
+846	97.4	0	-	-	-	90	8,766	17,532	17,532
+838	97.4	0	-	-	-	91	8,863	17,727	17,727
+830	97.4	0	-	-	-	93	9,058	18,116	18,116
+822	97.4	0	-	-	-	94	9,156	18,311	18,311
+814	97.4	495	48,213	1,37,407	4,821	97	9,448	18,896	23,717
+806	97.4	0	-	-	-	0	-	-	-
Total				**1,37,407**	**4,821**			**1,36,360**	**1,41,181**
Total Ore				***1,37,407***	***Total waste***				***1,41,181***

TAL ORE IN MT	**0.340**
Total Ore	**339673**
Total waste	**601186**
Ore to waste Ratio	**1 : 1.77**

PRODUCTION AND DEVELOPMENT PLAN - IV YEAR

SECTION - 5-5'

Section Number	Sectional influence	Proved (G - 1) Sectional area	Proved (G - 1) Volume	Proved (G - 1) Quantity @ 3 b.d with 95% Rec.	Intercalated waste @ 2 b.d with 5% rec	WASTE Sectional area	WASTE Volume	WASTE Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+862	101.3	0	-	-	-	62	6,281	12,561	12,561
+854	101.3	0	-	-	-	115	11,650	23,299	23,299
+846	101.3	0	-	-	-	131	13,270	26,541	26,541
+838	101.3	0	-	-	-	135	13,676	27,351	27,351
+830	101.3	0	-	-	-	137	13,878	27,756	27,756
+822	101.3	0	-	-	-	140	14,182	28,364	28,364
+814	101.3	0	-	-	-	182	18,437	36,873	36,873
+806	101.3	0	-	-	-	267	27,047	54,094	54,094
+798	101.3	488	49,434	1,40,888	4,943	175	17,728	35,455	40,398
Total				**1,40,888**	**4,943**			**2,72,294**	**2,77,238**
Total Ore				***1,40,888***	***Total waste***				***2,77,238***

SECTION - 6-6'

Section Number	Sectional influence	Proved (G - 1) Sectional area	Proved (G - 1) Volume	Proved (G - 1) Quantity @ 3 b.d with 95% Rec.	Intercalated waste @ 2 b.d with 5% rec	WASTE Sectional area	WASTE Volume	WASTE Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+870	97.65	0	-	-	-	27	2,637	5,273	5,273
+862	97.65	0	-	-	-	57	5,566	11,132	11,132
+854	97.65	0	-	-	-	57	5,566	11,132	11,132
+846	97.65	0	-	-	-	57	5,566	11,132	11,132
+838	97.65	0	-	-	-	57	5,566	11,132	11,132
+830	97.65	0	-	-	-	95	9,277	18,554	18,554
+822	97.65	0	-	-	-	95	9,277	18,554	18,554
+814	97.65	0	-	-	-	95	9,277	18,554	18,554
+806	97.65	0	-	-	-	95	9,277	18,554	18,554
+798	97.65	526	51,364	1,46,387	5,136	150	14,648	29,295	34,431
Total				**1,46,387**	**5,136**			**1,53,311**	**1,58,447**
Total Ore				***1,46,387***	***Total waste***				***1,58,447***

SECTION - 7-7'

Section Number	Sectional influence	Proved (G - 1) Sectional area	Proved (G - 1) Volume	Proved (G - 1) Quantity @ 3 b.d with 95% Rec.	Intercalated waste @ 2 b.d with 5% rec	WASTE Sectional area	WASTE Volume	WASTE Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+814	97.4	0	-	-	-	0	-	-	-
+806	97.4	190	18,506	52,742	1,851	0	-	-	1,851
+798	97.4	0	-	-	-	0	-	-	-
Total				**52,742**	**1,851**			**-**	**1,851**
Total Ore				***52,742***	***Total waste***				***1,851***

SECTION - 8-8'

Section Number	Sectional influence	Proved (G - 1) Sectional area	Proved (G - 1) Volume	Proved (G - 1) Quantity @ 3 b.d with 95% Rec.	Intercalated waste @ 2 b.d with 5% rec	WASTE Sectional area	WASTE Volume	WASTE Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+830	100	0	-	-	-	420	42,000	84,000	84,000
+822	100	0	-	-	-	426	42,600	85,200	85,200
+814	100	0	-	-	-	395	39,500	79,000	79,000
Total				**#REF!**	**#REF!**			**2,48,200**	**2,48,200**
Total Ore				**-**	***Total waste***				***2,48,200***

TAL ORE IN MT	**0.340**
Total Ore	**340017**
Total waste	**685735**
Ore to waste Ratio	**1 : 2.01**

PRODUCTION AND DEVELOPMENT PLAN - V YEAR

SECTION - 5-5'

Section Number	Sectional influence	Proved (G - 1) Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	Intercalated waste @ 2 b.d with 5% rec	WASTE Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+790	101.3	455	46,092	1,31,361	4,609	15	1,520	3,039	7,648
Total				**1,31,361**	**4,609**			**3,039**	**7,648**
Total Ore				***1,31,361***	***Total waste***				***7,648***

SECTION - 6-6'

Section Number	Sectional influence	Proved (G - 1) Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	Intercalated waste @ 2 b.d with 5% rec	WASTE Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+790	97.65	470	45,896	1,30,802	4,590	10	977	1,953	6,543
Total				**1,30,802**	**4,590**			**1,953**	**6,543**
Total Ore				***1,30,802***	***Total waste***				***6,543***

SECTION - 7-7'

Section Number	Sectional influence	Proved (G - 1) Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	Intercalated waste @ 2 b.d with 5% rec	WASTE Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+814	97.4	0	-	-	-	0	-	-	-
+806	97.4	281	27,369	78,003	2,737	0	-	-	2,737
Total				**78,003**	**2,737**			**-**	**2,737**
Total Ore				***78,003***	***Total waste***				***2,737***

SECTION - 8-8'

Section Number	Sectional influence	Proved (G - 1) Sectional area	Volume	Quantity @ 3 b.d with 95% Rec.	Intercalated waste @ 2 b.d with 5% rec	WASTE Sectional area	Volume	Quantity @ 2 b.d	TOTAL WASTE
m	m	m2	m3	Tonnes	Tonnes	m2	m3	Tonnes	Tonnes
+806	100	0	-	-	-	250	25,000	50,000	50,000
+798	100	0	-	-	-	105	10,500	21,000	21,000
+790	100	0	-	-	-	0	-	-	-
Total				**#REF!**	**#REF!**			**71,000**	**71,000**
Total Ore				***-***	***Total waste***				***71,000***

TAL ORE IN MT	**0.340**
Total Ore	**340166**
Total waste	**87928**
Ore to waste Ratio	**1 : 0.26**

II) Dump Re-handling during plan period (for the purpose of recovery of mineral)

Dump no	Year wise Handling (in Cum)	Estimated recovery of saleable mineral (in Cum)	Reject (in Cum)
ID-1	Not proposed	Not applicable	Not applicable

There is no such dump is available within the lease area from which mineral can be recovered from waste dump. However, on SE side of the ML area, one ROM/sub-grade dump is depicted in R&R plan, which is proposed for e-auction as indicated by CEC/DMG and same is analysed in laboratory, test report is enclosed as Annexure XXIII.

c) Enclosed Year-wise Production &Development Plans and Sections

The year wise Production & development plans and sections showing pit layouts, dumps, and stocks of mineral rejects are marked and enclosed as **Plate No. 6A to 6E &Plate No.7** respectively.

d) Salient Features of Proposed Mining Method

The method of working is by opencast fully mechanized **(A- FM)** method. The cycle of mine operation for production and development will be Drilling→Blasting→Excavation→Loading/Hauling of ROM/Waste to the pre-designated processing / dumping yard and processing of ROM is done by Screening, Crushing & Screening Plant mechanically. All the mining and allied activities will be carried out by either departmentally or through outsourcing agencies. The height and width of the benches will be maintained at 8.0 M each, with a bench slope of 80^0 to the horizontal. The ultimate slope angle of the pit will be less than 45^0 from the horizontal.

(i)Drilling & Blasting

The actual requirement of drilling and blasting is about 60% of the total mining. As per the Monthly Production Plan, the designated drilling area will be leveled with help of Dozer and loaders. Blast design parameters are fixed depending on the type of strata. The drill plan will be prepared prior to the systematic drilling. Drilling will be carried out with the help of DTH drills. Spacing, Burden, Depth of holes, explosive charge, stemming etc... For each hole will be as per the strata conditions. In general, spacing and Burden of 3X2.5m and depth of 9m (including sub drill) will be followed. Loading of holes with explosives and hooking up of holes with millisecond relays/delays will be carried out as per the Blast design to minimize the charge per delay and reduce the total firing time. Rectangular pattern will be generally used for designing the blast and proper hook up. To control the ground vibration, fly rock, better fragmentation and to increase the safety standards nonel (excel)

and delay detonators will be used. Slurry/ Emulsion Cartridge explosives (83 mm) will be used as primer and emulation cartridges or prills of ammonium nitrate (with diesel as fuel in the ratio of 94:6) will used as column charge for efficient blasting.

(ii) Handling of Ore/Waste

In-situ Ore/Waste and Blasted Ore/Waste will be excavated by 1.6 Cum Bucket excavators and shifted by using 20 T dumpers to the Crushing and Screening plant for processing. Waste material will be dumped in the proposed Temporary dump and the Ore will be fed either directly to the screen or to the crushers depending on the type of ore. In the Crushing & Screening unit two fraction of products will be segregated and (-)10mm is treated as fines and (+)10 to 40 mm is treated as calibrated lump ore.

In soft zone the ore will be excavated by excavator/loader, loaded into 20 tonnes tippers, and transported to screening plant. The oversize product will be transported to the crushing unit for crushing. The fines and C-ore are stocked separately and based on the plant demand the Iron Ore products will be dispatched.

Finished products will be dispatched to the JSW Steel Plant, as the entire production is being consumed by the plant itself, where further beneficiation and up gradation of ore will be carried out inside the plant.

(iii) Production & Development Plan

Based on the availability of Mineral reserves, dump capacity and volume of traffic, annual production of 0.340MT. is considered as the feasible production level based on the capacity of reserves which is approved by CEC.

In the entire mine production and development benches in the waste and ore zone are oriented and worked along the strike of the ore body. The slicing method from top downwards will be followed for year wise production & development work. The present position of working /pit layout dumps are shown in surface plan **(Plate no. 3)**and Geological Plan **(Plate no. 4)**and It is proposed to work in the sections from S4-S4' to S9-S9' during the plan period. The benches will be properly developed for a height of 8m & width of at least 8m.

The year wise benches proposed to be worked in both ore and overburden are shown in P&D plans and Cross Sections **(Plate No. 6A to 6E & Plate No. 7)** for the plan period.

e) The layout of mine workings, pit road layout, the layout of faces and sites for disposal of overburden/waste along with ground preparation prior to disposal of waste, reject etc.

The total Mining lease area is covered by one single major pit having the dimension given below:

Dimension LXWX D	Top RL	Bottom RL	No. of benches
701 X 249 X 60	880	820	9

The height and width of the benches will be maintained at 8.0m each, with a bench slope of 80^0 to the horizontal. The ultimate slope angle of the pit will be 45^0 from the horizontal. The layout of the faces is planned along the strike. Ore Mined and over burden removed will be transported by using Tippers with the combination of loader and excavator to the respective yards. The disposal of waste is planned at eastern side of workings about 500m away, as suggested in R&R plan. No ground preparation before dumping is envisaged.

The method of working will be opencast fully mechanized. The cycle of mine operation for production and development will be Drilling→Blasting→Excavation→Loading/Hauling→Crushing & Screening of ROM. The waste generated will be dumped at the designated place.

During the first five years, it is proposed to produce 0.340 million tonnes of iron ore per annum at a stripping ratio of 1:1.33. About 2.31 Million tonnes of waste is required to be handled during the five-year plan period.

During the plan period waste material will be dumped in proposed dump (PD). The proposed waste dump is located towards eastern corner of the lease area. The total area earmarked for the proposed waste dump is 5.83Ha which is enough for accommodating the waste generated during the plan period. During the conceptual stage of mining the backfilling will be proposed.

Removal of over burden/side burden:

The overburden/side burden constitutes, BHQ, shale/phylites. Presently, the soft strata waste will be directly excavated and loaded by the excavator into tipper, for hard strata deep hole drilling and blasting will be adopted, blasted material will by excavators into 20 tones dumper/10 tonnes

tippers and transported/ unloaded at the designated dumping sites. Over burden benches will be taken in advance for maintaining proper sequences of the production benches in the ore zone. This will help in avoiding the mixture of waste rocks with Iron Ore.

Mining of Ore:

The basic operations involved in the mining of ore are deep hole drilling, controlled blasting, Excavation, Hauling, Crushing and Screening, Sizing and Sorting, Grading and Loading the ore into tippers and transportation of the same to JSW Steel plant. In the soft ore zone the ore will be loaded directly by excavator/loader into the tipper and transported to either mobile screening plant, or mobile crushing plant, to meet the required product sizes. In hard ore zone, primary drilling will be done and blasted in conjunction with ANFO and slurry explosives. The blasted ore will be transported to the Mobile crushing plant for further processing.

Mine Layout

The mine layout is based on the geo-Technical parameters, viz., geological formation of the ore body occurring/persistence along the hill ridge slope, the extent of mine lease area available, mining technique, the available infrastructure facilities and the mine ingress and egress. The entire mine production and development benches in the waste and ore zone are oriented and worked along the strike of the ore body. The slicing method from top downwards will be followed for year-wise production & development work. The height and width of the benches will be maintained at 8.0 M each. The present position of working /pit layout dumps are shown in year wise production and Development Plan & sections as **Plate No. 6A to 6E & Plate no. 7.** Details of year-wise production & development are discussed in chapter 2A(b)**.**

f) Conceptual mining plan

i) Mine Profile

UbbalagundiIron Ore Mine (M/s Mysore Minerals Ltd., M.L. No. 995), with 32.89Ha of mining lease area, is situated in Ettinahatti range, Sandur schist belt, Ubbalagundi village, Sandur taluka, Karnataka.

The general occurrence of iron ore formation in the mine is laterite, lateritic ore, soft laminated ore, powdery ore/ Blue Dust with intrusions of BHQ, shale and phyllites.

Proposed method of excavation is open cast fully mechanized with a bench height and width of 8m each. With a bench slope of 80^0 to the horizontal. The ultimate slope angle of the pit will be 45^0 from the horizontal.Mining operations will be fully mechanized with the deployment of blast hole drills (102mm dia.), hydraulic excavators (1.6 cum), front end loaders and tippers (20 and 25 tonne capacity). ROM from the mine will be processed in two stage crushing plant (100-250 TPH capacity) and screening plants (200-250 TPH capacity) to produce calibrated Lump ore (+10-40mm size) and Fines (-10mm).

ii) Salient Features of Present Mining Method

The method of working is by opencast fully mechanized method. The cycle of mine operation for production and development will be Drilling→Blasting→Excavation→Loading/Hauling of ROM/Waste to the pre designated processing / dumping yard and ROM will be processed in Primary Screening and Crushing Plant mechanically. ROM from the mine will be processed in two stage mobile crushing plant (100-250 TPH capacity) and screening plants (200-250) TPH capacity) to produce calibrated Lump ore (+10-40mm size) and Fines (-10mm).

As per the requirement of the steel plant it is proposed to transport the ROM directly to the plant for further processing. Alternatively, ROM could also be sent to the stockyard located outside the lease area for processing and further transportation to the steel plant by prevailing system of transportation. Such as road, Rail, Belt conveyor depending on the infrastructure available.

iii) Back filling details during conceptual period

In the conceptual plan period 6.82Ha is proposed for backfilling and same is proposed for afforestation and necessary protective measures like Fencing, Coir Matting, retaining wall, gully plugs etc will be constructed. Details of conceptual land use pattern is given in Table no – 2.4 and conceptual land use plan is enclosed on Plate no –10.

iv) Future Exploration programme:

An additional 12 no. of Boreholes have been proposed to be drilled by RC drilling in the plan period to further access the extent of ore body. The year-wise proposed bore holes to be drilled during plan period is given in table no 1.2

v) Ultimate Pit Limit:

The entire Mining Operation will be worked along the strike length of the ore body and will advance from Northern direction to Southern direction in the pit during the conceptual period. We will follow the pitting method from top downwards for year wise production & development. Due to the nature of the ore body, the benches are designed along and across the strike direction. The height and width of the benches will be maintained at 8.0meach.

Taking into consideration, the geological, mining and economic aspects the bottom most RL is fixed at 744 MSL with ultimate pit slope of 45^0. The ultimate pit dimensions are 754X296X110m. Ultimate pit limit drawn at $45^0$from the bottom of ore body is shown in all relevant plans and sections and in the conceptual Land use plan at **Plate No.10**

vi) Adequacy of Land for Disposal of Waste:

Production & Development during Mining Plan Period

Proposed production for next five-year period is as follows.

Year	Production (Tonnes)	Waste generated (Tonnes)	Stripping Ratio	Location of production Site	Location of dumping Site
I	340000	4,42,870	**1:1.30**	Section no. S6-S6'to S8a-S8a', Bench Level 814m to 878m	Section no. S8-S8'to S9-S9', Stage Level 811m to 854m
II	340000	4,99,349	**1:1.47**	Section no. S8-S8' to S9-S9', Bench Level 838m to 886m	Section no. S6-S6' to S7-S7', Stage Level 787m to 862m
III	340000	6,01,185	**1:1.77**	Section no. S5-S5' to S7-S7', Bench Level 806m to 870m	Section no. S4-S4' to S5-S5', Stage Level 744m to 808m
IV	340000	6,85,734	**1:2.01**	Section no. S5-S5' to S9-S9' Bench Level 798m to 870m	Section no. S5-S5' Stage Level 770m to 808m
V	340000	87,928	**1:0.26**	Section no. S5-S5' to S9-S9' Bench Level 790m to 862m	Section no. S4-S4, Stage Level 778m to 810m
Total	**1700000**	23,17,066	**1:1.36**		

a) It is proposed to extract entire mineable reserves during the life of the mine. Mineable reserves which are being considered for annual production limit, are based on ICFRE report. Extent of mineral reserves in the lease area will be further calculated after detailed exploration to establish the mineable reserves more accurately.

During the first five years, it is proposed to produce 0.340 million tonnes of iron ore per annum at a stripping ratio of 1:1.36.About 2.31 Million tonnes of waste is required to be handled during the plan period. This waste will be dumped in proposed dump (PD), located towards eastern corner of the lease area. The total area earmarked for the proposed waste dump is 5.83Ha.

During the 2nd Five years up to the conceptual plan period, it is proposed to maintain the same rate of production i.e., maximum 0.340 MTPA of iron ore (for balance 15 years.) It is estimated that, in the conceptual plan period, the balance of waste is required to be handled at a stripping ratio of 1:1.The necessary protective measures like retaining wall, garland drain, Gully Plugs, Coir matting etc. will be undertaken as protective measures for Waste dumps and backfilling area at the conceptual stage, and the entire lease area which covers about 32.89Ha will be afforested. The details of the Conceptual land user are given in Conceptual Land use plan (**Plate no. 10)**

b) Handling of waste and dump management during the proposed plan period as per approved R&R plan:

The waste consists of BHQ, shale, clay etc. Totally 2.31 Million Tonnes of waste is likely to be generated in Plan period and will be dumped at designated places, as specified in R & R plan and shown in **Plate No. 6A to 6E**.

The area required for waste dumping is calculated as under:

Total generation of waste = 23,17,066T

Total volume = 2317066/ 2.0 (loose bulk density) = 1158533 m^3

Area required for dump = 1152566.5 m3 / 30m = 38617 m^2 or 3.86Ha

Total extent of area required for handling of waste is 3.86Ha Area considered for dumping. Dumping shall be done in bench like configuration in ascending order starting from the lower most level to top level. At lower most level, a strong retaining wall will be constructed to check the rolling off or washing off silt. The height of dump shall be maintained at 60 m with step of 10 m height.

Details of land use at present and at the end of five years plan period and conceptual period are given below:

Table 2.4 Land use Pattern

Sl. No.	Land Particulars	Existing land Use Area (Ha)	Plan Period Area (Ha)	Conceptual period Area (Ha)
1.	Area of Mining	14.66	15.88	9.08
2.	Overburden Dumps	4.14	10.49	18.59
3.	Roads	0.50	0.50	0.50
4.	Green Belt/ Safety zone	2.22	2.22	2.22
o5.	Retaining wall/ Garland drain	-	0.30	0.30
6.	Crushing & Screening, Weigh bridge	-	0.30	0.30
7.	Area for Magazine	-	0.10	0.10
8	Mineral Storage	1.30	1.30	0.00
9	Infrastructure	0.00	0.10	0.10
8.	Virgin/ Unbroken Area	10.07	1.70	1.70
	Total	**32.89**	**32.89**	**32.89**

As mentioned above entire mine lease area will be afforested during conceptual plan period. A detailed plan consisting of progressive mining, utilization of mineral dump, sub-grade ore management, exploration and progressive reclamation and rehabilitation programme is shown in Financial Area Assurance plan, **Plate No.11**and Conceptual Land Use Plan& Sections, **Plate No.-10**

Reclamation & Rehabilitation Programme as per approved R & R Plan areshown in Environment plan **(Plate No. 9).**

vii)Environment aspects with specific reference to Reclamation Measures

As suggested in R & R Plan, prepared by ICFRE, Environment aspects with reference to Reclamation & Rehabilitation Measures are described below:

A. RECLAMATION AND REHABILITATION (R&R) PLAN

In the process of opencast mining, several changes occur in the physical, chemical and biological properties of the environment (Kundu and Ghose, 1998; Singh and Singh, 2006; Padmavathiamma and Li, 2007; Sheoran et al., 2009 and 2010) and the magnitude of the impacts mainly depends on the ambient environmental characteristics with regard to topography, soil and its nature, stability, nutrient quality, productivity, vegetation cover, etc. By and large mining leaves a large area of natural forest into fragmented and unprotected waste lands. The degradation of environment due to mining can be prevented to a great extent by implementing site-specific bio-engineering

measures. The objective of the proposal is to suggest suitable site specific engineering and biological measures for management of encroached areas, OB dumps and surface water runoff and over all land use of the area devastated by mining.

B.RECLAMTION AND REHABILITATION MEASURES

i. Reclamation and Rehabilitation Plan for Area under Encroachment

An area of 9.01 ha has been identified by the CEC as encroachment under categories such as mining pit, over burden dumps and others in the ML area and it should be reclaimed and rehabilitated by afforesting with suitable plant species as well as constructing engineering measures as explained below. The cost of afforestation of the area under encroachment at the rate of Rs. 1.74 Lakhs per hectare is worked to **Rs.15.68** Lakhs (Table 5.1).

Table 5.1: Indicative cost of afforestation for the encroachment area

ii. Measures for the management of OB dumps (Dump Management Plan)

Particulars of plantation	Area (ha)	Cost @ Rs. 1.74 Lakhs/ha
Mine pit	0.27	0.47
Over Burden Dumps	5.44	9.47
Others	3.30	5.74
Total	9.01	15.68

In order to stabilize waste dumps, toe wall at its toe and catch water drains (garland drains) and Silt Traps (ST) should be constructed as per design. The height of the dumps and its terraces should be strictly maintained as per the design suggested for the purpose in the statutory clearances. Dumping should be carried out by adopting retreating method starting from bottom and reaching to the top by creating terraces of 10 m height and 8 m width. Berms should be provided at the toe of each terrace to avoid water flow over the dump slopes. Wherever necessary, garland drains should be provided and connected to the vertical drains and finally through the check dams followed by Silt Settling Tanks (SSTs). Inactive dumps should be vegetated with suitable local plant species immediately after the terraces are made and the active dumps should be protected from erosion by planting with **suitable** grass/legumes. All the plantation activities should preferably be taken up during monsoon seasons to enjoy the benefit of rainwater for the same. Geo-textile/coir mat may be opted for the dumps which have adverse conditions like steep slopes, poor soil fertility, and

instability of soil and lack of moisture. This will also enable to achieve good growth of vegetation cover over the dump slopes. Enriched plantation may also be adopted on top flat area and sloping area depending upon the condition. Rills and gullies should be treated with different types of gully plugs as suggested in the engineering measures.

iii. Waste/OB Dumps

OB dumps: One inactive dump with encroachment towards outside (ID-1/EID-1) is located on NW side of the lease area at RL 888 m top and 760 m bottom over an area of 10.94 Ha. It is severely eroded and almost half of its material is fallen into the nala. The slope angle of the dump in the lower side varies from 35-40 degrees and that of its upper side varies from 60-70 degrees. The subsided OB material of the dump has blocked the water flow of the natural nala. At many places, several deep rills and gullies have been formed on the dump slopes. Some part of the dump slope is sparsely vegetated with Agave americana at its southern side. No other bioengineering measures for the protection of the dump and management of surface water have been observed in the ML area.

iv. Proposed Dump (PD)

The proposed waste dumping area is on a gently sloppy and undulating terrain and is having moderate natural vegetation. The height of the dump and its terraces should be strictly maintained as per the design suggested. It is located towards eastern side spreading from NE to SE direction over an area of 5.83 ha within the lease area. A total volume of 1.01 MCum can be accommodated on this area. Waste dumping has to be made to a maximum height of 60 m in retreating method from bottom to top by providing terraces at every 10 m height and 8 m width and providing adequate engineering measures. Berms should be provided at the toe of each terrace to avoid water flow over the dump slopes. The details of the engineering measures proposed for the management of waste dump in the ML area

V. Engineering measures for the waste dumps

a. Toe Wall: Toe Walls are proposed at the toe of the waste dumps primarily to protect the waste from sliding of its bottom. These are of two kinds – (1) Stone masonry (Random Rubble-RR) Dry and (2) Stone masonry cement sand mortar. On the body of the cement sand mortar toe walls, weep holes should be provided at 1x1m grid points for facilitating **seepage of** water. Three TWs (1 RR Dry & Two Stone masonry) are proposed for the management of waste dumps in the ML area(Design-1).

b. Garland Drains (Catch Water Drains): The GDs are proposed 1-2 m below the toe wall to collect the discharging runoff water at the toe of dump and to carry it safely to settling tanks followed by natural water courses. It should preferably have 2.0 m top width, 1.0 m bottom width and 1.0 m depth. 3 GDs are proposed for the management of waste dumps and the haulage road in the ML area (Design-2).

c. Geo-textile/ Coir mat: As the waste dump EID-1 is too large and is located on a steeply sloping terrain, there is an ample chance of further deterioration of the dump. Therefore, it is proposed to protect the dump from further erosion by employing geo-textile/coir mat over an approximate area of 3.0 Ha on the dump slope.

The indicative cost of reclamation and rehabilitation measures for Waste Dumps is enumerated in the table below:

Table-2.5: Proposed engineering measures for waste dump management (ML No.995)

Location	Items	Particulars of works	No	Dimension in m				Qty.	Unit	Rate/ Unit (Rs.)	Amount (Rs. In Lakhs)
				Length	Width		Height				
					Top	Bottom					
EID-1	TW-1: Toe Wall at the toe of the dump	Foundation in hard soil mixed with boulders including hard rock	1	480	2.15		0.6	619.3	cum	111	0.687
		Plain cement concrete (1:4:8) in foundation	1	480	2.15		0.15	154.8	cum	1860	2.879
		RR Stone masonry in cement sand mortar (1:6)	1	480	1	2	2.5	1800	cum	1232	22.176
	GD-1	Garland drain below the toe wall	1	350	3	1.5	1.5	1181.25	cum	111	1.311
	TW-2: Toe Wall at the middle of the dump	Foundation in hard soil mixed with boulders including hard rock	1	480	2.15		0.6	619.2	cum	111	0.687
		Plain cement concrete (1:4:8) in foundation	1	480	2.15		0.15	154.8	cum	1860	2.879

		RR Stone masonry	1	405	1	2	1.5	911.25	cum	400	3.645
ID-1	Geo-textile/coir-mat	Manualterracing followed by Geo textile/coir matting and plantation may be done on high steep sliding part of the OB dump	_	_	_	_	_	3	Ha	1000000	30
PD	TW-3: Toe Wall at the toe of the dump	Foundation in hard soil mixed with boulders including hard rock	1	740	2.15		0.6	954.6	cum	111	1.06
		Plain cement concrete (1:4:8) in foundation	1	740	2.15		0.15	238.65	cum	1860	4.439
		RR Stone masonry in cement sand mortar (1:6)	1	740	1	2	2.5	2775	cum	1232	34.188
	GD-2	Garland drain below the toe wall	1	747	2	1	1	1120.5	cum	111	1.244
Road	GD-3	Garland drain all along the haul road	1	589	2	1	1	883.5	cum	111	0.981
TOTAL											**106.18**

Surface Water Management:

Two nalas are originating from the lease area, out of which, one is from the western side and another is from the eastern side. Both the nalas are emptying into the tank Avinamadugu kere. Naturally, no rain water accumulates in the lease area. The rain water flows from hill slopes and it does not accumulate till it reaches the lower valleys. Hence, the drainage pattern is subdendritic in nature and is typical of the hilly area. Control of erosion is important for both during mining and post mining period as the waste materials emanating from the fragmented areas such as mine pit and waste dumps can cause several damages to the local environment including soil, water, air, agriculture, etc. The main objective of the surface water management plan is to suggest suitable site specific bioengineering measures for the protection of nalas, waste dumps, mine pits, sub-grade dumps, etc., from erosion/runoff due to rain. Erosion/runoff of waste materials through natural water channels should be arrested/controlled by constructing silt retaining and grade stabilization structures like gabion check dams, stone masonry check dams, silt settling tanks, etc. All these structures retain silt behind it and allow only relatively clear water to flow towards downstream. Due to retention of silt, channel gradient, flow velocity and consequently carrying capacity of the water course will be reduced. Engineering measures are the first line of defense in controlling erosion and they also facilitate quick re-establishment of vegetation over the disturbed areas. The proposed engineering measures for the surface water management of the ML area

Gully Plugs:

i. L**oose Boulder Check Dam (LBCD):** (Random Rubble dry stone masonry): The LBCDs are proposed for gullies having a width of about 5-10 m and their bed slope less than 10%. A total number of 3 LBCDs are proposed for the nalas, while 30 LBCDs are proposed for the gullies in EID and ID in the lease area at the conceptual stage.

ii. **Gabion (Wire crate) Check Dam (GCD):** This structure is usually proposed for gullies having a bed slope of more than 10% and a high discharge rate. Gabion check dams are very useful in the areas where sediment load is very high and are very cost effective for the reclamation of mine areas and waste lands. Altogether, 2 GCDs of a length varying from 10 to 12 m are proposed for the nalas in the ML area.

iii. **Stone Masonry Check Dam (SMCD**): cement sand mortar (1:6): This is usually considered as a key structure at the end of all the gully control structures like LBCD, GCD, etc. One SMCD is proposed for the nalas in the lease area.

iv. **Silt Settling Tank (SST):** This is particularly important for the water channels having a high discharge lo aded with heavy sediments. The water in these natural courses should be allowed to flow out only after treatment through the silt settling tanks. One SST of a dimension of 20 x 10 x 3 is proposed for the nala N-1 in the ML area.

v. **Hume Pipe Culvert (HPC):** Two HPCs of a length of 12.5 m each are proposed across the approach for draining of surface water in the lease area.

vi. **Log Wood Check Dam (LWCD):** This structure is proposed to be constructed in narrow gullies having a width of about 3-6 m. Wooden logs of sprouting species such as Lannea coromandelica, Bombax ceiba, Erythrina suberosa, E. indica, Ficus benghalensis, etc., needs be inserted up to a depth of about 30 cm on the dump terrace in series at distance of about 30 cm from center to center. Boulders of 40 cm size and above may be hand packed between risers and logs up to 1.0 m depth. A total number of 60 LWCDs are proposed for gullies in EID and ID in the lease area at the conceptual stage.

vii. **Brush Wood Check Dam (BWCD):** It is proposed for narrow gullies of about 1-3 m wide and is suitable for the areas where boulders are not available. It is essentially like logwood check dam and in this, brushwood such as branches, twigs, climbers, etc., are used instead of wooden logs. Altogether, 150 BCDs are proposed for gullies in EID and ID in the lease area at the conceptual stage.

Table : 2.6 Proposed bio-engineering measures for surface water management								
Location	Items	No.	Dimension in m				Qty	Units
			Length	Width		Height		
				Top	Bottom			
EIDs & IDs	BWCD	60.0	3.00	-	1.50	1.00	180.00	m
	BWCD	50.0	4.00	-	1.50	1.00	200.00	m
	BWCD	40.0	5.00	-	1.50	1.00	200.00	m
	LWCD	30.0	4.00	-	2.00	1.00	120.00	m
	LWCD	20.0	5.00	-	2.00	1.00	100.00	m
	LWCD	10.0	6.00	-	2.00	1.00	60.00	m
	LBCD	8.0	5.00	1.00	2.00	1.00	60.00	cum
	LBCD	10.0	6.00	1.00	3.00	1.50	180.00	cum
	LBCD	12.0	8.00	1.00	3.00	2.00	384.00	cum
N-1	LBCD-1	1.0	8.00	1.00	2.00	1.00	12.00	Cum
	LBCD-2	1.0	10.00	1.00	2.00	1.50	22.50	Cum
	GCD-1	1.0	12.00	1.00	2.00	2.00	36.00	Cum
	SMCD-1	1.0	23.00	1.00	2.00	2.00	23.00	m
	SST-1	1.0	20.00	10.00	-	3.00	1.00	No.
N-2	LBCD-3	1.0	10.00	1.00	2.00	1.00	15.00	Cum
	GCD-2	1.0	10.00	1.00	2.00	2.00	30.00	Cum
Hume Pipe Culvert	HPC-1	1.0	12.50	2.00	2.00	1.00	1.00	No.
	HPC-2	1.0	12.50	2.00	2.00	1.00	1.00	No.

Afforestation

Afforestation of the mined out and other available areas which are not fragmented but are degraded due to mining activity is the main component of re-vegetation process to mitigate the negative impacts of the mining on environment. By afforestation, restoration of the ecosystem almost similar to pre-mining period is possible and will be accomplished.

The total extent of the area outside the CEC lease sketch observed and considered as encroachment in respect of ML- 995, by the Joint Team, constituted for the purpose by the CEC is 9.01Ha. This area has been identified as encroachment under categories such as mining pit, over burden dumps and others in the ML area and it should be reclaimed and rehabilitated by afforesting with suitable vegetation as well as engineering measures.

The afforestation covering 1000 trees and 2500 shrubs per Ha, inclusive of maintenance for five year has been worked out as per the norms of State Forest Department, Karnataka. The estimate for plantation per Ha, is given based on R&R plan prepared by ICFRE.

Work of afforestation will be carried out in close connection with the State Forest Department, Karnataka, utilizing local people and the periodical monitoring will also be carried out, in co-ordination with state agencies.

Afforestation will be made through:

- Propagules (seeds, lignotubers, corms, bulbs, rhizomes and roots) stored in the topsoil and sowing seed.
- Planting nursery-raised seedlings
- By seed dibbling
- Silt accumulated in silt settling tanks/check dams etc. can be removed and could be used after mixing with FYM and sand in the ratio 2:1:1. This mixture could be used for plantation.

Greenbelt development plan

In order to minimize the impact of mining on environmental components outside the mine lease area, greenbelt zone of 7.5m width will be established in safety zone inside mine lease area. The establishment of Green belt will help wild life movement, and also human health. The greenbelt will act as a barrier to trap the suspended dust particles and also suppresses air pollutants. As per ICFRE R&R plan, it is proposed to create a green belt with tall seedlings (>1 m height) of fast growing species to hasten the process of greening the area. No greenbelt has been raised by the lessee within the lease area. It is suggested that wherever natural growth is available gap filling with species suggested to be done in safety zone.

Indicative cost of developing Green belt is given in the table below:

Sl. No.	Mine Lease No.	Area of Greenbelt (Ha)	Rate/Ha (in lakhs)	Total Amount (in lakhs)
1	ML-995	2.22	2.57	5.70

The proposed cost is only indicative and the work pertaining to various engineering and biological measures may vary subject to Scheduled rates of Karnataka State. The final dimensions of the engineering structures may be modified depending on the suitability of the local field conditions.

Plans & Sections

All the Reclamation & rehabilitation measures listed above are shown on Reclamation plan **(Plate no. 8)** & Environment plan **(Plate no. 9).**

g)Extent of Mechanization

As proposed above, fully mechanized method of working will be adopted for this mine. For the plan period, production of Iron ore of 0.340 MTPA has been planned. This envisages handling of 0.463MTA(Average during the plan period) of waste per year.

In order to achieve the targeted production, the different activities of mining operations in this mine will be done during the daylight hours (from 6 AM to 6 PM). The recovery of ore involves removal of over–burden/side burden removal and processing of ROM. For different products, a combination of Drilling, Excavation, Hauling, Crushing & Screening, Loading and Transporting machinery will be used. Further ancillary machinery like water sprinklers, road graders, dozers, weighing machine etc., will also be used. The following are the list of machinery being used in the mines.

(1) Drilling Equipment

Type	Nos.	Dia. of hole (mm)	Motive power	H.P.
Self-propelled Hydraulic Drill with Top Hammer	1	100-115	Diesel	250

(2) Loading Equipment

Type	Nos.	Bucket capacity Cum	Motive power	H.P.
Front end Loader	2	2.6	Diesel	150
Excavator	3	1.4-1.6	Diesel	242
Excavator	1	0.9-1.1	Diesel	180

(3) Haulage and Transport Equipment

(a) Haulage within the Mining Leasehold

Type	Nos.	Body capacity Cum	Motive power	H.P.
Tippers/Dumpers	11	16-18	Diesel Engine	250-280

(b) Transport from Mine Head to the Destination

The transportation of Iron ore from mine head to JSW STEEL PLANT is carried out through tipper/trucks by road. 30% of the trucks are owned by company rest 70% of the trucks will be hired on a contractual basis. Above listed machineries in the mine are in good condition and as and when machine breakdown, such machine will be repaired on site by the department engineers.

(4) Details of Auxiliary Operations and Related Machineries

Details of Machineries deployed for auxiliary operations are as follows:

Type	Nos.	capacity	Unit	Motive power	H.P.
Dozer	1	-	-	Diesel	200
Road Grader	1			Diesel	200
Mobile Crushing plant	1	100-150	TPH	-	250
Screening Unit	1	250-300	TPH		100
Weigh Bridge	4	60	T	-	-
Water Tanker	7	10,000	Ltrs.	-	250
Mobile Tower Lights	2	4	KVA	-	-
D.G Sets	5	100	KVA	-	-
Bus	1	40 Seater			75
Jeeps	3	5 Seater			
Diesel Tankers	1	4 KL			
Explosive Van	1	-			

Calculations:

a) Drilling Equipment

In the plan period, the maximum quantity to be handled is 0.340 MMT of Ore and 0.673 MMT(maximum out of five years) of waste totaling to approximately 1.02 Mil.T. 60% of the total quantity requires drilling and blasting.

Particulars	Value	Unit
Maximum Quantity to be handled per annum	10,25,734	T/year
Quantity to be handled per month	85478	T/month
Quantity to be Drilled & Blasted (@ 60%)	6,15,440	T/year
Spacing	3.0	M
Burden	2.5	M
Average Bulk Density	2.5	T/Cum
Yield per Mtr	19	T/mtr
Meterage to be drilled	32392	mtr
Sub grade drilling (@ 10%)	3200	mtr
Total meterage to be drilled	35592	mtr
Working Days	300	Nos.
Shifts	1	Nos.
Working Hours per Shift	7	Hrs
Working Hours per year	2100	Hrs
Drilling Rate	40	m/Hr
Drill Capacity per annum	84000	mtr
No. of Drills required @ 85% availability	1	No.

No. of Drills required to meet the Drilling taking into consideration availability, utilization and the operator efficiency is **One**.

b) Excavation

Particular	Value	Unit
Envisaged Annual Production	3,40,000	T
Waste Handling	6,85,734	T
Total Material to be Handled	10,25,734	T
Bucket capacity	1.6	Cum
Fill factor	85%	
Density	2.5	T/Cum
Swing cycle	45	Sec.
Production per bucket	3.40	T
Production per minute	4.50	T/min.
Production per Hour	272	T/hr.
No. of Shifts	1	Nos.
Working Hours per Shift	7	Nos.
Working Day per annum	300	Nos.
Total Working Hours per annum	2100	Nos.
Production per annum per one excavator	571200	T
No. of Excavators required for the total handling of 1.2 MTPA	2	No.
Excavator Fleet required (@ 80 % availability)	3	No.

No. of Excavators required to meet the excavation taking into consideration availability, utilization and the operator efficiency is **Three**.

**Another one excavator of smaller capacity will be added to the existing fleet for feeding the mobile Crushing and Screening plant.*

c) Tippers:

Particular	Value	Unit
Envisaged Annual Production	3,40,000	T
Waste Handling	6,85,734	T
Total Material to be Handled	10,25,734	T
Average Tipper capacity	20.00	T
Loaded tipper speed	15	KMPH
Empty tipper speed	20	KMPH
Average lead Distance	1.50	Km.
Time required for one cycle (Loaded Tipper)	4.50	Min.
Time required for one cycle (Empty Tipper)	6.00	Min.
Waiting time (at the excavator)	2.50	Min.
Spotting time (at the excavator)	2.50	Min.
Loading time (at the excavator)	2.50	Min.
Waiting time (at the Crusher)	1.00	Min.
Spotting time (at the Crusher)	1.50	Min.
Dumping time (at the Crusher)	1.00	Min.
Cycle Time for One trip	**21.5**	**Min.**
No. of Trips per Hour	2.8	Nos.
Tonnage handled by one tipper per hour	56.0	T/hr.
No. of Shifts	1	Nos.
Working Hours per Shift	7	Nos.
Working Day per annum	300	Nos.
Total Working Hours per annum	2100	Nos.
Total tonnage handled per annum for one tipper	1,17,600	T
No. of Tippers required for the total handling of 1.2 MTPA	9	Nos.
Tipper Fleet required (@ 80 % availability)	10	Nos.

No. of Tippers required to meet the excavation taking into consideration availability, utilization and the operator efficiency is **Ten.**

d) Wheel Loaders

Particular	Value	Unit
Envisaged Annual Production	3,40,000	T
Waste Handling	6,85,734	T
Total Material to be Handled	10,25,734	T
Bucket Capacity	2.6	Cum
Cycle time	45	Sec.
No. of cycles to load a 20 ton tipper	5	Nos.
Time required by one loader to load a 20 ton tipper	3.75	Min.
No. of Shifts	1	Nos.
Working Hours per Shift	7	Nos.
Working Day per annum	300	Nos.
Total Working Hours per annum	2100	Nos.
Trips per day by one loader	112	Nos.
Tonnage loaded per day by one loader	2240	T
Tonnage loaded per annum per loader	672000	T
No. of Wheel loaders required for the total handling of 0.867 MTPA	1.8	No.
Wheel Loaders required (@ 85 % availability)	2	No.

No. of Wheel Loaders required to meet the excavation taking into consideration availability, utilization and the operator efficiency is **Two.**

Calculations:

DRILLING AND BLASTING

a) Drilling

Most of the formations are soft, the actual requirement of drilling and blasting is only 60% of the total mining. As per the Monthly Production Plan, the designated drilling area will be leveled with

the help of Dozer and loaders. Blast design parameters are fixed depending on the type of strata. The drill plan will be prepared prior to the systematic drilling. Drilling will be carried out with the help of DTH drills.

b) Blasting

Broad blasting parameters like charge per hole, blasting pattern, charge per delay and maximum number of holes blasted in a round, manner and sequence of firing, etc. are discussed below keeping a scenario of handling a maximum 1.013 MT of ROM and waste production:

Bulk Density (In-situ)	**Ore**	3.0 t/cum
	Waste	2.0 t/cum
Spacing	3.0 m	
Burden	2.5 m	
Average Depth	9m (including subdrill)	
Powder Factor	7 t/kg	

Particular	Value	Unit
Quantity of material to be handled per annum	10,25,734	Ton/Year
Material to be Blasted (60% of total capacity)	6,15,440	Ton/Year
Total Explosives required (powder factor of 7 t/kg)	87,920	Kgs
Quantity of ANFO (column charge 80%)	70,336	Kgs
Quantity of Slurry (Prime charge 20%)	17,584	Kgs
Volume to be blasted (with average in-situ bulk density of 2.5)	2,46,176	Cum
Total depth of drilling	32392	mtr
Sub grade drilling (at 10%)	3200	mtr
Total meterage	35,592	mtr
No. of Holes (Avg. depth 10 m)	3559	Nos.
Detonating cord required (9 m per hole)	32,031	Nos.
Cord relays required (1 per 6 holes)	593	Nos.
No. of blasts in a year (4 per month)	48	Nos.
Quantity of explosives required per blast	1832	Kgs.
Quantity of explosives to be used per hole	25	Kgs.
No. of Holes per Blast	74	Nos.
No. of detonators required (2 per blast)	96	Nos.
Safety Fuse required (3m per blast)	144	M.
Nonel required (1 per hole)	3559	Nos.
Trunk line detonators (3 per blast)	144	Nos.

Blasting Pattern:

Spacing, Burden, Depth of holes, explosive charge, stemming etc... For each hole will be decided as per the strata conditions. In general, spacing and Burden of 3X2.5 and depth of 9m (including sub-grde drilling) will be followed. Loading of holes with explosives and hooking up of holes with millisecond relays/delays will be carried out as per the Blast design to minimize the charge per delay and reduce the total firing time. **Rectangular pattern** will be generally used for designing the blast and proper hook up. To control the vibration and fly rock excel, delay detonators will be used as shock-tube (NONEL) initiation system to achieve better fragmentation and to increase the safety standards in the mines.

In order to reduce vibration generated in the course of blasting operations, millisecond delay detonators will be used. Hole to hole delay is 17 ms, while row to row delay is 42 ms. In the hole itself DTH delay of 200-450 ms is given.

Type of Explosives to be used

Loading of holes with explosives and hooking up of holes with millisecond relays/delays will be carried out as per the Blast design to minimize the charge per delay and reduce the total firing time. Rectangular pattern will be generally used for designing the blast and proper hook up. To control the ground vibration, fly rock, better fragmentation and to increase the safety standards nonel (excel) and delay detonators will be used. Slurry/ Emulsion Cartridge explosives (83 mm) will be used as primer and emulation cartridges or prills of ammonium nitrate (with diesel as fuel in the ratio of 94:6) will used as column charge for efficient blasting.

Storage of Explosives

It is proposed to procure explosives and services from licensed vendors, till the time JSW steel Ltd. obtains requisite permission for storage, transport and use of Explosive.

M/s JSW Steel LTD. has been awarded multiple mines following the auction process, which are located in vicinity to each other. In order to maximize the utilization of resources Centralized/ individual magazine is being planned. Necessary permissions regarding the establishment of magazine will be taken

3.0 MINE DRAINAGE

a) Minimum and maximum depth of water table based on observations from nearby wells and water bodies

The depth of water table on the observation from nearby wells and water bodies at about 600 m above MSL. In the Conceptual period, mine workings are expected to reach 746 m above MSL, which is 146 mt above water table at the end of the life of the mine. In the plan Period, the workings are expected to reach up to 790 mt above MSL, which is 190 mt above the ground water table. Hence, there is no possibility of encountering ground water source.

b) Maximum and Minimum depth of Workings

In the Plan Period, the lowest working proposed is 790 mt above MSL which is about 190 mt above the ground water table. In the Conceptual period, mine workings are expected to reach 746 mt above MSL, which is 146 mt above water table.

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

There is no chance of encountering underground water in the proposed workings. Hence, the requirement for pumping and discharging of the quantity and quality of water does not arise.

d) Describe regional and local drainage pattern. Also indicate annual rain fall, catchments area, and likely quantity of rain water to flow through the lease area, arrangement for arresting solid wash off etc.

Due to hilly terrain, no rain water accumulates in the lease area. The rain water flowing from hill slopes usually does not accumulate till it reaches the lower valleys. Hence, the drainage pattern is sub-dendritic in nature and is typical for the hilly areas of this regionA total of 2 nalasare originating from the lease area, out of which, one is from the western side and another is from the eastern side. Both the nalas are emptying into the tank Avinamadugukere.

We proposed the engineering measures (R & R) like toe walls, gully plugs, Garland Drains, silt settling tanks are proposed in Mining lease area as well as outside the lease area for arresting the Solid wash off, and the details of engineering measures are described in the para 2(f)(vi)(B).

4.0 STACKING OF MINERAL REJECTS AD DISPOSAL OF WASTE

During the course of mining operation, the excavated material consists of both mineral and waste material. The total quantity of waste expected from this mine is 2.31 MMT during the plan period.

a) Nature of and Quantity of Top Soil, Overburden/Waste and Mineral reject

Waste material consists of mainly Shale and Phyllite. Shale and Phyllite is a fine grained sedimentary formation and having a density of 1.6. In the waste Fe% will be around 10 – 18%. Silica is up to 30%.

i)Top soil generation

Since the mine has been in operation for several decades before falling into 'C' category, majority of area is already broken up. As per proposed mining programme over next five years, there is no likelihood of generation of topsoil. However, if, some quantity is generated during the mining operations from lease area, the same will be used for afforestation purpose.

ii) Mineral reject/ Waste Dump

From the present calculation the ore to over burden ratio works out to be 1:1.33. The waste of 2.31 million tonnes is likely to be generated in the plan period for the production of 0.340 MTPA.

Year wise quantity of waste generated along with the dumping location is given below Table no 4a

Year	Waste generation (Tonnes)	Dumping Location
I	4,42,870	Section no. S8-S8'to S9-S9', Stage Level 811m to 854m
II	4,99,349	Section no. S6-S6' to S7-S7', Stage Level 787m to 862m
III	6,01,185	Section no. S4-S4' to S5-S5', Stage Level 744m to 808m
IV	6,85,734	Section no. S5-S5' Stage Level 770m to 808m
V	87,928	Section no. S4-S4, Stage Level 778m to 810m
Total	23,17,066	

b) Selection of dumping site

During the plan period, it is proposed to produce 0.340million tonnes of iron ore per annum at a stripping ratio of 1:1.36. About 2.31 Million tonnes of waste is required to be handled during the

five-year plan period. Dumping will be carried out in proposed dump (PD). The proposed waste dump is located towards eastern side of the lease area. It is evident from the borehole no MMRL-8, MMRL-5, MMRL-13, MML-11, MMRL-15 that, proposed dumping area is non-mineralized zone (geological plan & Geological Cross sections). The total area earmarked for the proposed waste dump is 5.83 ha and the total volume of waste generated that could be accommodate in this earmarked dump area.

The corresponding plan indicating the Proposed Dump, is marked on the Reclamation plan **Plate No. 8** and Production and Development Plan **Plate Nos. 6A to 6E.**

c) Manner of disposal of waste, configuration and sequence of year wise build-up of dumps along with the proposals for protective measures

The waste generated during the plan period will be dumped at Proposed Dump (PD) as indicated in Plan **(Refer Plate Nos. 6A to 6E& Plate No. 8).**

Details of dumps including their location, capacity etc. is indicated in the table below:

Year-wise Build-up of Dumps is furnished below table no 4b

Year	Dump no.	OB Quantity Proposed	Area in Ha	No. of Stages	Dump Elevation		Location Co-ordinates		Slope angle
					Top RL (m)	Bottom RL (m)	latitude	longitude	
I	1	4,42,870	0.99	4	854	811	1665744 to 1665616	677050 to 677154	28^0
II	1	4,99,349	1.36	5	862	787	1665630 to 1665225	677150 to 677270	28^0
III	1	6,01,185	3.70	3	808	744	1665450 to 1665318	677200 to 677080	28^0
IV	1	6,85,734	1.37	3	808	770	1665744 to 1665616	677050 to 677154	28^0
V	1	87,928	0.54	3	778	810	1665250 to 1665325	677200 to 677080	28^0

Waste Dump Management

Proposed waste dump (PD) is located towards eastern side of the lease area. The total area earmarked for the proposed waste dump is 5.83 ha and the total volume of waste that could be accommodate in this dump is 2.31 million cum,. Total height of the proposed dump is 60 m (from bottom to top), with maximum height being 45 m (from ground level). Overall slope of the dump is 28^0. This dump is to be terraced with average bench height of 10m and width of 10 m, with overall terrace slope of 40^0 to 44^0. A retaining wall and garland drain is to be constructed at the toe of the dump.

Details of protective measures for proposed dump are as follows:

Location	Items	Particulars of works	No	Dimension in m				Qty.	Unit
				Length	Width		Height		
					Top	Bottom			
EID-1	TW-1: Toe Wall at the toe of the dump	Foundation in hard soil mixed with boulders including hard rock	1.0	480.00	2.15		0.60	619.20	cum
		Plain cement concrete (1:4:8) in foundation	1.0	480.00	2.15		0.15	154.80	cum
		RR Stone mansonry cement sand mortar (1:6)	1.0	480.00	1.00	2.00	2.50	1800.00	cum
	GD-1	Garland drain below the toe wall	1.0	350.00	3.00	1.50	1.50	1181.25	cum
	TW-2: Toe Wall at the middle of the dump	Foundation in hard soil mixed with boulders including hard rock	1.0	480.00	2.15		0.60	619.20	cum
		Plain cement concrete (1:4:8) in foundation	1.0	480.00	2.15		0.15	154.80	cum
		RR Stone mansonry dry	1.0	405.00	1.00	2.00	1.50	911.25	cum
ID-1	Geo-textile/ Coir-mat	Mannual terracing followed by Geo-textile/coir matting and plantation may be done on high steep sliding part of the OB dump	--	--	--	--	--	3.00	ha
PD	TW-3: Toe Wall at the toe of the dump	Foundation in hard soil mixed with boulders including hard rock	1.0	740.00	2.15		0.60	954.60	cum
		Plain cement concrete (1:4:8) in foundation	1.0	740.00	2.15		0.15	238.65	cum
		RR Stone mansonry cement sand mortar (1:6)	1.0	740.00	1.00	2.00	2.50	2775.00	cum
	GD-2	Garland drain below the toe wall	1.0	747.00	2.00	1.00	1.00	1120.50	cum
Road	GD-3	Garland drain all along the haul road	1.0	589.00	2.00	1.00	1.00	883.50	cum

5.0 USE OF MINERAL

a) Requirement of end-use industry specifically in terms of physical and chemical composition.

Since this mine is captive, entire production will be utilized in the JSWS teel Plant.

The Plant specification offered is given below:

Name of the Firm Company	Chemical Specification	Physical Specification
M/s JSW Steel Ltd.	+45% Fe	Lumps 10-40 mm
	+45% Fe	Fines 0-10 mm

b) Brief requirement of intermediate industries involved in up gradation of mineral before its end-use.

Since this mine is captive, entire production will be utilized in the JSW Steel Plant. Hence no intermediate industries are involved in up gradation of mineral.

c) Detail requirements for other industries, captive consumption, export, associated industrial use etc.

i) Entire quantity of Iron ore mined (as captive) from this mine will be utilized in JSW steel plant.

Name of the Company	Chemical Specification	Physical Specification
M/s JSW Steel Ltd.	+45% Fe	Lumps 10-40 mm
	+45% Fe	Fines 0-10 mm

ii) As per the requirement of the steel plant there is also a proposal to transport the RoM directly to the steel plant as ore beneficiation Unit is already existing and is operational in the plant. Alternately RoM could also be sent through stockyard by appropriate prevailing system of transportation.

d**) Precise physical and chemical specification stipulated by buyers**

Presently the material produced will be transported to M/s JSW Steel Plant for its own captive use, so there are no stipulated buyers.

e) Details of processes adopted to upgrade the ROM to suit the user requirements.

The high grade and low-grade mineral will be blended proportionally to meet the requirement of steel plant and It will benefit to mineral conservation. Further up gradation of material will be carried out in Ore beneficiation plant situated inside JSW Steel plant.

Details of proposed Crushing and Screening unit.

Type	Nos.	capacity	Unit	H.P.
Mobile Crushing plant(primary, secondary & tertiary)	1	100-150	TPH	250
Screening Unit	1	250-300	TPH	100

6.0PROCESSING OF ROM AND MINERAL REJECT

a) Nature of processing / beneficiation of RoM or Mineral Reject, indicating size and grade of feed material and concentrate (finished marketable product), recovery etc.Processing of Mineral Reject

No beneficiation of RoM or mineral reject will be carried out in the lease area during the plan period. However, sorting and sizing will be carried out by crushing and screening of the ore to the required physical specification. The crusher will process the mineral to different sizes of 0-10 (fines) and 10-40mm (c-ore), which will be stacked separately in the lease area shown in plate nos 6A to 6E.

Year wise production details fines and lumps

Year	Production of ROM in tonnes	Production of Fines in tonnes	Production of Lumps in tonnes	Mineral storage area in Ha
I	3,40,000	2,38,000	1,02,000	1.30
II	3,40,000	2,38,000	1,02,000	1.30
III	3,40,000	2,38,000	1,02,000	1.30
IV	3,40,000	2,38,000	1,02,000	1.30
V	3,40,000	2,38,000	1,02,000	1.30

Processed ore stacked separately will be transported to JSW Steel Plant, as entire production of Iron ore mined from this mine will be consumed by the plant for its captive uses.

The beneficiation process flow chart at JSW STEEL is shown in **Annexure-XII.**

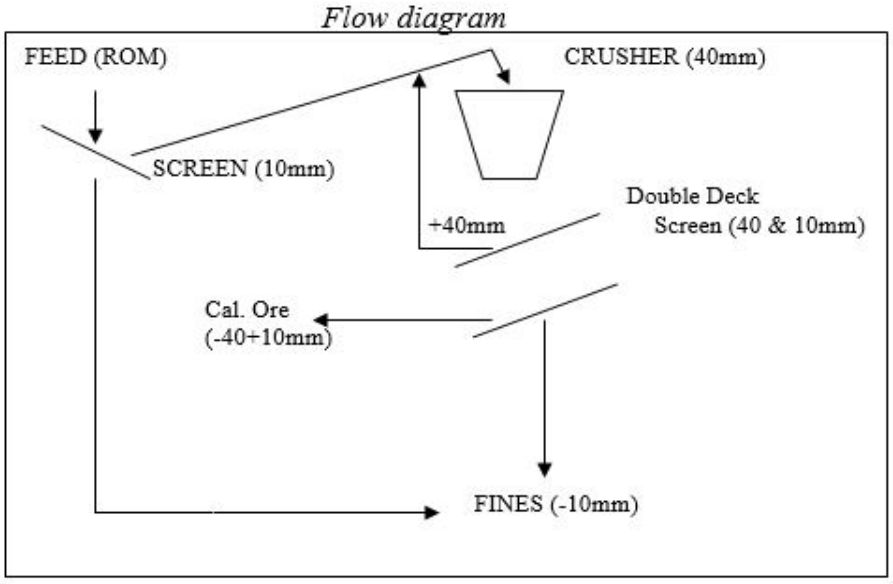
b) Material balance chart with a flow sheet or schematic diagram of the processing procedure

A mobile crushing plant of 100-150 tonnes/hour and screening unit of 250-300 tonnes/hour capacity will be established in the mine, to process the ROM up to 500 mm sizes. The crusher will process the mineral to different sizes of 0-10 (fines) and 10-40mm (c-ore) or total 0-10 mm(fines) by using tertiary crusher, as per requirement of steel plant. which will be stacked separately at the designated stock yard in the lease area for further transportation to JSW Steel plant. Generally, the RoM comprises of 70% of 0-10mm, 25% of 10-40mm & 5% of F+40 mm.

Material balance chart along with schematic diagram is furnished below:

Table 6.1: Likely material balance sheet

Description	Rate
Feed (+10 mm ROM)	100 tph
Cal. Ore (+10 to -40 mm)	30 tph
Fines (-10mm)	70 tph



c) The disposal method for tailings or reject from the process Plant.

Not applicable.

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

Not applicable.

e) Quality and type of chemicals to be stored on site/plant.

Not applicable.

f) Quantity and type of chemicals to be stored on site/plant.

Not applicable.

g) Water usage of the mine, disposal of waste water

Approximately 250Cum is daily water requirement for dust suppression, afforestation purpose, canteen and other general requirements, for this mine. Water will be drawn from company bore wells dug in nearby mining areas.

Crushing & Screening process does not have any water requirement as C&S units will be fitted with dust suction system.

Activity wise breakup of the requirement of water is given in below table.

- Approximately 205 Cum is daily water requirement for domestic use, dust suppression and afforestation / green belt purpose. The break-up of water requirement is provided in the table below. For the domestic use, we intend to use ground water while for the rest of the purposes, we intend to use surface water.

Table No.6.1.1

	Category of Water Utilization	Quantity (in Cubic Meter) of water proposed
1.	Crushing and screening area*	12 CUM
2.	Afforestation / Green Belt	14 CUM
3.	Domestic Use (wash rooms/ canteen/ drinking)	17 CUM
4.	Dust Suppression (internal Haul road, Approach road and Mine benches)	58 CUM
5.	Dust Suppression (dispatch Haul road)	72 CUM
6.	Temporary dump wetting	20 CUM
	R & R Structures wetting	12 CUM
		205 CUM

** Fog Cannon Dust Suppression system: 16 lit/min. 11520 lit /12 hours.*

7.0 OTHER INFORMATION

a) Site Services

All minor repairs including schedule maintenance and servicing of mining equipment and machinery will be carried out at the mine workshop. The workshop is provided with all essential facilities under following sections:

i. Heavy vehicles section
ii. Medium and light vehicles section
iii. Auto-Electrical section
iv. Welding and blacksmith section
v. Machinery and lathe section

All activities of the workshop are carried out under the control of qualified Mechanical and Electrical engineers with the employment of experienced mechanics and electricians. An independent store for all essential spare parts is also maintained at the mine workshop.

Power Supply

All HEMM, C&S plants are mobile in nature driven with diesel engines or it will be operated by the DG sets which consumes HSD. However once the capacity of the mines increases there is a proposal to commission 11/22 KVA HT line.

Water Supply

The requirement of water supply, both for drinking and mine will be drawn from the company bore wells dug in nearby mining area.

Canteen:

A small mobile canteen has been planned near the mine office to cater the needs of mining staff.

Dispensary:

A dispensary/ cum-clinic is maintained at Toranagallu, where from all basic medical needs of workers and staff can be fully met. The company has undertaken various health camps and also strengthened the existing primary health centers located in the surrounding villages.

b) Employment Potential

Sr.Vice president, Mines (JSW STEEL LTD.) heads the central mine organization followed by Mines Manager holding 1st class Certificate of competency. This mine will provide permanent and direct

employment to 13 People and will also generates indirect employment to around 60 people. Much of the work force employed by the lessee falls under skilled category.

Further, Category wise employment is given below:

Category: Highly Skilled

Sl. No.	Designation	No. of Persons
1.	Mines Manager	1
2.	Asst. Mines Manager	1
3.	Mining Engineer	1
4.	Environment Engineer	1
5.	Geologist	1
6.	Mechanical Engineer	1
7.	Electrical Engineer	1
8.	Mine Surveyor	1
9.	Mining Foreman	2
10.	Mining Mate cum Blaster	1
11.	Welfare officer	1
12.	IT officer	1
	Total	**13**

Category: Skilled

Sl. No.	Designation	No. of Persons
1.	HEMM operator	8
2.	Drivers	12
3.	Maintenance Staff	6
4.	Office Staff	5
	Total	**31**

Category: Semi-skilled

Sl. No.	Designation	No. of Persons
	Helpers	12
	LMV Drivers	3
	Total	**15**

Category: Unskilled

Sl. No.	Designation	No. of Persons
	Workmen	10
	Total	**10**

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

8.1 Environment Baseline Information

This mine is recently reallocated to JSW Steel Ltd., through an E-Auction process, conducted in accordance with the Mineral (Auction) Rules, 2015. The transfer of statutory clearances is under process. This has restricted our access to the core as well as buffer zones of mining lease. After the commencement of mining operations, a detailed EIA/EMP will be carried out.

The Mining lease area for Iron ore will be worked by opencast fully mechanized method. Limited amount of deep-hole drilling and blasting operations are envisaged for production of the ore and waste. This is estimated to be about 40% of the total mining operations and resorted only if hard rock formation is encountered during mining operations. It is a known fact that any mining activity will alter the existing ecology. The following chapter discuss in detail the effects of mining on the existing environment and the proposed measures to mitigate the same.

8.1.1 Existing Land Use Pattern

The mining lease area is in forest land. The land exhibits a highly rugged topography with only thorny bushes and shrubs.

The 10 km area around the mining lease area termed here as the buffer zone, characteristically comprises of valleys with an average altitude of about 600 m above MSL, surrounded by rugged hills, marked by discrete, NW-SE trending ridges, separated by flat, or gently sloping land. The flat tops of hill ranges are quite wide.

The existing land use pattern (**Plate No. 8**) in the mine is as follows:

Table-8.1 Land use pattern of ML No. 995

Sl. No.	Land Particulars	Existing land Use Area (Ha)
1.	Area of Mining	14.66
2.	Overburden Dumps	4.14
3.	Roads	0.50
4.	Green Belt/ Safety zone	2.22
5.	Retaining wall/ Garland drain	-
6.	Crushing & Screening, Weigh bridge	-
7.	Area for Magazine	-
8	Mineral Storage	1.30
9	Infrastructure	0.00
8.	Virgin/ Unbroken Area	10.07
Total		32.89

8.1.2 Water Regime

A total of 2 nalas are originating from the lease area, out of which, one is from the western side and another is from the eastern side. Both the nalas are emptying into the tank Avinamadugukere. Naturally, no rain water accumulates in the lease area. The rain water flows from hill slopes and it does not accumulate till it reaches the lower valleys. Hence, the drainage pattern is sub-dendritic in nature and is typical of the hilly area.

The ground water in the buffer-zone area is tapped for irrigation and drinking water purpose. There is no ground water occurrence within the lease area. Mine area is subjected to moderate annual rainfall of 40 to 80 cm.

8.1.3 Flora & Fauna

A). Flora; The area is situated on the continuous hill top which is devoid of much vegetation as the area is disturbed by opening of mine pit and depositing the mine overburden. The unopened areas on the slope of hillock has some vegetation belongs to Southern tropical dry deciduous forests and dry scrubs according to revised classification of forest types of India (Champion and Seth, 1968) with grassy undergrowth with short trees. The tree vegetation in this area is open with low canopy densities; the mining activities affected the whole topography and the vegetation.

Vegetation observed in the mine lease area

Some of the tree species growing in the mine lease area include Acacia horrida, Acacia suma, Albizia amara, Anogeissus latifolia, Azadirachta indica, Boswellia serrata, Buchanania lanzan, Cassia fistula, Chloroxylon sweitenia, Dalbergia paniculata, Diospyros melanoxylon, Dolichandrone atrovirens, Ficus arnottiana, Ficus gibbosa, Gardenia gummifera, Givotia rottleriformis, Hardwickia binata, Lannea coromandelica, Soymida febrifuga and Ziziphus xylopyrus. Shrubs which are found in the area include species like Anisomeles indica, Anisomeles malabarica, Calotropis gigantea, Canthium parviflorum, Capparis sp., Carissa carandas, Cassia auriculata, Cipadessa baccifera, Dodonaea viscosa, Maytenus emarginata and Phoenix loureirii etc. Several herbs are found in the mine lease area which includes Cassia occidentalis, Hyptis suaveolens, Indigofera linifolia, Hydyotis corymbosa, Trianthema portulacastrum, Vicoa indica and Waltheria indica,etc.

Some tree species like Acacia auriculiformis, A. holosericea, A. nilotica, Albizia lebbeck, Azadirachta indica, Cassia siamea, Dalbergia sissoo, Delonix regia, Eucalyptus sp., Leucaena

leucocephala, Muntingia calabura, Pithecellobium dulce, Pongamia pinnata, Prosopis juliflora, Samanea saman, (Rain Tree), Tamarindus indica, Terminalia catappa and Thespesia populnea have been planted on stabilized waste dumps.

Grasses growing in the area include Cymbopogon martini, C. nardus, Chrysopogon fulvus, Hackelochloa granularis, Heteropogon contortus, Rhynchelytrum villosum etc. The common climbers are recorded in the area are Sarcostemma acidum, Rivea hypocrateriformis, Wattakaka volubilis, Naravelia zeylanica, Tylophora indica, Cryptolepis buchananii. Mine lease area is dominated by weed and invasive species. Weedy and invasive species include shrubs like Lantana camara, Tecoma stans and Chromolaena odorata and herbs like Argemone Mexicana and Parthenium hysterophorus which are very common in the area.

Vegetation occurring outside the Mine lease area

Mine lease area is surrounded by fairly thick vegetation with Trees which are chiefly of deciduous type combined with Herbs, shrubs and climbers. Dominant species of trees include Acacia horrida, Acacia suma, Albizia amara, Anogeissus latifolia, Azadirachta indica, Boswellia serrata, Bridelia retusa, Buchanania lanzan, Cassia fistula, Chloroxylon sweitenia, Dalbergia latifolia, Dalbergia paniculata, Diospyros melanoxylon, Dolichandrone atrovirens, Ficus arnottiana, Ficus gibbosa, Gardenia gummifera, Givotia rottleriformis, Hardwickia binata, Lannea coromandelica, Mallotus philippensis, Soymida febrifuga and Ziziphus xylopyrus. Shrubs like Anisomeles indica, Anisomeles malabarica, Calotropis gigantea, Canthium parviflorum, Capparis sp., Carissa carandas, Cassia auriculata, Cipadessa baccifera, Dodonaea viscosa, Maytenus emarginata and Phoenix loureirii and are found as scattered species in the forests.

Climbers that are found in the area include Aristolochia indica, Cocculus hirsutus, Cryptolepis buchanani, Rivea hypocrateriformis, Sarcostemma acidum, Tylophora indica and Wattakaka volubilis are major elements in the forests. The herbaceous plants in the area include Cassia occidentalis, Hyptis suaveolens, Indigofera linifolia, Lavandula bipinnata, Hedyotis corymbosa, Polycarpaea aurea, Trianthema portulacastrum, Vicoa indica and Waltheria indica. Grasses make appearance in open lands. Some of the important grass species occurring in the area are Cymbopogon martini, C. nardus, Chrysopogon fulvus, Hackelochloa granularis, Heteropogon contortus, Oplismenus compositus and Rhynchelytrum villosum.

B). Fauna; The mine lease is a forest area, and there is regular movement of different species of animals common to this area. Some important species present in the Mine Lease and its surrounding areas are given below:

Butterflies: Euthalia nais (Baronet), Junonia orithiya (Blue Pansy), Hasora chromus (Common Banded Awl), Euploea core (Common Crow), Delias eucharis (Common Jezebel), Papilio polytes form romulus and stichius (Common Mormon), Atrophaneuraaristolochiae (Common Rose), Atrophaneura hector (Crimson Rose), Euploea sylvester (Double-branded Crow), Colotis fausta (Large Salmon Arab), Belenois aurota (Pioneer), Caprona agama (Spotted Angle), Sarangesa purendra (Spotted Small Flat), Danaus genutia (Striped Tiger), Graphium agamemnon (Tailed Jay), Acraea violae (Tawny Coster), Zizula hylax (Tiny Grass Blue), Ixias Marianne (White Orange Tip), Leptotes plinius (ZebraBlue).

Herpetofauna: Euphlyctis cyanophlyctis (Skittering Frog), Psammophilus dorsalis (South Indian rock agama), Python molurus (Indian rock python), Ahaetulla nasuta (Common Vine Snake, Oligodon arnensis (Banded Kukri Snake), Ptyas mucosa (Indian ratsnake).

Birds: Pavo cristatus (Indian Peafowl), Perdicula asiatica (Jungle Bush-Quail), Perdicula aegoondab (Rock Bush Quail), Merops orientalis (Green Bee-eater), Merops Philippinus (Blue- tailed Bee-eater), Eudynamys scolopacea (Asian Koel), Centropus sinensis (Greater Coucal), Psittacula krameri (Rose-ringed Parakeet), Accipiter badius (ShikhraP), Circaetus gallicus (Short-toed Snake Eagle), Dendrocitta vagabunda (Rufous Treepie), Pericrocotus cinnamomeus (Small Minivet), Oriolus oriolus (Eurasian Golden Oriole), Tephrodornis pondicerianus (Common Woodshrike), Cyornis tickelliae (Tickell's Blue-Flycatcher), Parus major (Great Tit), Hirundo daurica (Red-rumped Swallow), Artamus fuscus (Ashy Wood swallow), Prinia sylvatica (Jungle Prinia), Prinia socialis (Ashy PriniaP), Zosterops palpebrosus (Oriental White- eye), Orthotomus sutorius (Common Tailorbird), Chrysomma sinense (Yellow-eyed Babbler), Ammomanes

phoenicurus (Rufous-tailed Lark), Nectarinia asiatica (Purple Sunbird), Nectarinia zeylonica (Purple-rumpedSunbird).

Mammals: Macaca radiata (Bonnet Macaque), Semnopithecus entellus (Hanuman Langur), Melursus ursinus (Sloth Bear), Canis aureus (Jackal), Panthera pardus (Common Leopard), Felis chaus (Jungle Cat), Lepus nigricollis (Indian Hare), Hystrix indica (Indian Porcupine),

8.1.4 Quality of air, Ambient noise level and Water

Ambient Air Quality: Since the existing mine is not in operation since 2011, we do not envisage any change in the ambient air quality from the baseline environmental parameters. As the mine is not in operation, ambient air quality for both the core zone (mining lease area) and buffer zone (within 10 km from the boundary of mining lease) is expected to be within the prescribed standards.

However, once the mining becomes operational, regular monitoring of air quality for the core and buffer zone will be undertaken. Air quality will be closely monitored, data collected will be analysed to understand the quality of air. In case, the air quality does not meet the norms parameters, adequate measures will be taken to contain the air quality parameters well within the prescribed limits.

Location of air monitoring stations is shown in location plan **(Plate no. 1).**

Noise Levels: Since the existing mine is not in operation since 2011, change in the ambient noise levels is not envisaged.

However, once the mining becomes operational, regular monitoring of noise levels for the core and buffer zone will be undertaken. Data collected will be analysed to understand the sources for excessive noise levels. In case, the noise levels do not meet the norms for certain parameters, adequate measures will be taken to contain the noise level parameters well within the prescribed limits.

Location of noise sampling stations is shown in **location plan (Plate no. 1).**

8.1.5 Climatic Conditions

- The area has an average rainfall of 550 mm spreading from the month of June- September.
- The area forms a part of region dominated by tropical climate with hot summer days, moderately cool winter and moderate monsoon. The maximum temperature rises to about $44^{o}C$ during the peak summer and remains the same for about a week. There is a steep temperature gradient during winter season, the night temperature falls down to about $11^{o}C$. During daytime winter season, the night temperature will be around $30^{0}C$.
- Moderate humidity prevails throughout the year.
- The maximum wind velocity in the region is about 20 Kmph. The predominant wind direction is West-East.

8.1.6 Human Settlement

Under the mining area, 5 villages fall in the core zone (at 5km radius) and 16 villages in buffer zone (at 10 km radius). The mining staff and workers are from surrounding villages. No displacement of families is expected because of mining activity. Hence no question of rehabilitation arises.

The demographic details pertaining to these villages are given in table:

Sl. No.	Nameofthevillage	Arial distance (km)	Population
1	Ubbalagandi	1.23	1280
2	Lingadahalli	6.42	1137
3	Kodalu	8.86	1680
4	Koracharahatti	7.68	620
5	Anthapur	9.07	1523
6	Avinamodugu	9.56	1255
7	Mallapur	4.59	425
8	Ramapur	8.64	486
9	Hanumapur	8.22	470
10	Rajapur	5.36	1922
11	Bandaravi	8.26	2408
12	Appenahalli	7.28	713
13	Tonasigiri	8.89	1094
14	Deogiri	6.01	3224
15	Navaluti	4.01	679
16	NMDC Colony	2.28	1535
17	Nandhihalli	8.45	450
18	Ranjithpur	4.37	874
19	Narasingapur	5.16	1733
20	Bhujanganagar	5.59	4355
21	Taranagar	9.29	4865
	Total		**32728**

8.1.7 Public Buildings, Places of Worship & Monuments

There are no public buildings, natural parks, places of worship & monument within the core zone or within the vicinity of the mine area.

8.1.8 Sanctuary located in the vicinity

No sanctuaries exist within the lease area or in the vicinity.

8.2 Environmental Impact Assessment

8.2.1 Land Environment

Proposed mine has been operational for several decades and the entire lease area has been under use for various mining operations. Because of the proposed mining activity, there will be impact on present landscape. However, in the closing stages of the mining activity the land will be restored by backfilling the waste material, generated during the subsequent years of mining.

Proposed land use pattern at the end of the plan period is as follows:

Table No. 8.2 Degradation of Land at the end of plan period

Sl. No.	Land Particulars	Land use Plan at the end of Plan period (Area in Ha)
1.	**Area of Mining**	15.88
2.	**Overburden Dumps**	10.49
3.	**Roads**	0.50
4.	**Green Belt/ Safety zone**	2.22
5.	**Retaining wall/ Garland drain**	0.30
6.	**Crushing & Screening, Weigh bridge**	0.30
7.	**Area for Magazine**	0.10
8	**Mineral Storage**	1.30
9	**Infrastructure**	0.10
8.	**Virgin/ Unbroken Area**	1.70
Total		**32.89**

8.2.2 Air Quality

Mining of Iron ore involves limited deep hole drilling and blasting. Heavy earth moving machinery is being deployed for lodging the ore and the waste. These activities contribute towards the degradation of air quality. During loading and transportation of material, some quantity of dust is generated. The impact of mining activity on air quality also depends on the topography, nature of material handled and climatological parameters like wind speed, wind direction and stability classification of the area viz. , location of buffer zone villages. From all these angles, it can be expected that the pollutants like SO_2, NO_X, CO, SPM and RPM could be higher locations such as mine haul roads, loading and unloading points, Drilling & Blasting sites.

Proposed corrective and preventive measures are detailed as below:

- Water spraying on transport road in the buffer zone about 3 km stretch up to the main road.
- Construction of well-designed haulage roads with side drains and avenue plantation on both sides.
- Haul roads and service roads will be graded regularly to cover pot holes and to clear accumulation of any loose material.
- Green belt will be created with tall growing trees all around the lease boundary, which will act as a dust barrier.
- Overloading of trucks will be avoided to avoid spillage on the roads.
- Tipper engaged in carrying ROM/ore will be regularly checked for vehicular emission. Periodical maintenance will also be carried out.
- ROM/ore carrying tippers will be covered with tarpaulin to avoid escape of air borne dust into the atmosphere.
- Regular monitoring of existing air quality to take mid-course necessary steps to keep the pollution with-in the permissible limits.

8.2.3 Water Quality

There are no toxic or poisonous discharges into the drains from mining operations. So, the quality of water shall not be affected. The surface water in the area is only rain water. Rain water is likely to percolate into the ground by leaching the chemicals in the deposit. However, no harmful ingredients are produced from the mine deposit. The mine area being located in the hilly region, the ground water table at the mine is met at a depth of greater than 200 m. Hence, the leaching of the chemicals and carry over to this depth is not envisaged.

However, once the mine becomes operational, regular monitoring of surface as well as ground water quality for the core and buffer zone will be undertaken. Data collected will be analysed to understand the sources for contaminants. In case, the water quality does not meet the norms for certain parameters, adequate measures will be taken to contain the water quality parameters well within the prescribed limits. Location of water sampling stations is shown in **Key plan (Plate no. 1).**

Wash-off from the dumps and soil erosion could affect the surface water quality. However suitable site specific Bio- engineering measures will be adopted, as discussed in R&R measures under Environment plan**(Plate No. 9)**. Erosion/runoff of waste materials through natural water channels will be arrested/ controlled by constructing silt retaining and grade stabilization structures like check dams, silt traps, silt settling tanks, etc. All these structures help to prevent silted water from entering outside as they retain silt and allow only relatively clear water to flow towards downstream.

8.2.4 Noise Levels

Mine is located on the hill range at a distance of 4.0 km from the human settlements. Since heavy earth moving equipment's are being deployed certain noise is expected to be caused. However, once the mine becomes operational, regular monitoring of noise levels for the core and buffer zone will be undertaken. Data collected will be analysed to understand the sources for excessive noise levels. In case, the noise levels do not meet the norms for certain parameters, adequate measures will be taken to contain the noise level parameters well within the prescribed limits.

Personnel protective equipment will be provided to all the personnel employed in the mine, in order to avoid exposure to higher level of noise for a longer duration.

8.2.5 Vibration Levels (due to blasting)

As deep hole drilling and blasting would be conducted, certain impact on ground vibration is likely to be caused. However, well designed blasting pattern, use of shock tube initiation system, use of M.S. delay detonators, will be used to minimise the ground vibration levels.

8.2.6 Water Regime

The existing seasonal nallas in the buffer zone remain dry and become active during rainy season. Since the watercourse are shallow and the workings are situated at higher elevations, water will not pose any problem. Since rainfall is comparatively low, there will not be much siltation or run-off problem. However, suitable engineering measures are proposed, as mentioned in the Environment plan(Plate no.9), to avoid any impact on water regime.

The mining operations are conducted at hill top which is at much higher level than ground water level. Mining activities will not intersect the groundwater, as the groundwater table is 190m below the pit bottom.

8.2.7 Acid Mine Drainage

Not applicable.

8.2.8 Surface Subsidence

Not applicable.

8.2.9 Socio Economics

Under this mining area, 13 villages fall in the core zone (at 5km radius) and buffer zone (at 10 km radius). The demographic details pertaining to these villages are given in table:

Sl. No.	Nameofthevillage	Arial distance (km)	Population
1	Ubbalagandi	1.23	1280
2	Lingadahalli	6.42	1137
3	Kodalu	8.86	1680
4	Koracharahatti	7.68	620
5	Anthapur	9.07	1523
6	Avinamodugu	9.56	1255
7	Mallapur	4.59	425
8	Ramapur	8.64	486
9	Hanumapur	8.22	470
10	Rajapur	5.36	1922
11	Bandaravi	8.26	2408
12	Appenahalli	7.28	713
13	Tonasigiri	8.89	1094
14	Deogiri	6.01	3224
15	Navaluti	4.01	679
16	NMDC Colony	2.28	1535
17	Nandhihalli	8.45	450
18	Ranjithpur	4.37	874
19	Narasingapur	5.16	1733
20	Bhujanganagar	5.59	4355
21	Taranagar	9.29	4865
Total	**32728**		

**Source: Revenue Department, Census 2011*

The mine area does not cover any habitation. Hence, the mining activity does not involve any displacement of human settlement. The people of surrounding villages are engaged in seasonal agricultural activities and employed in mining activities. Some persons will be directly employed while others will be employed on contractual basis depending on the nature and period of the mining activities. Job opportunities for many service related with the total population shall be

opened up, within the scope of this mine. Thus, the impact of this mining project is beneficial. This project will also result in direct benefits to the Government in the form of royalty and other taxes.

8.2.10 Historical Monuments

There are no monuments or structures of historical significance in the vicinity of Lease area.

8.3 Progressive Reclamation Plan

8.3.1 Mined Out Land

The proposed land use pattern is as follows:

No. 8.2 PROPOSED LAND USE PATTERN

Sl. No.	Land Particulars	Land use Plan at the end of Plan period (Area in Ha)
1.	**Area of Mining**	15.88
2.	**Overburden Dumps**	10.49
3.	**Roads**	0.50
4.	**Green Belt/ Safety zone**	2.22
5.	**Retaining wall/ Garland drain**	0.30
6.	**Crushing & Screening, Weigh bridge**	0.30
7.	**Area for Magazine**	0.10
8	**Mineral Storage**	1.30
9	**Infrastructure**	0.10
8.	**Virgin/ Unbroken Area**	1.70
Total		**32.89**

Active mining activity is yet to start in the area. The proposed area to be worked during the plan period is shown in the year-wise production and development plans and Sections **(Plate 6A to 6E, Plate 7)**. The worked out areas are required for mining activity. Hence, only reclamation by afforestation of encroached area, Active dumps, Green belt development along the lease boundary will be carried out. During the first five years a waste quantity of about2.24million tonnes will be generated. This is being dumped in the area allotted for this. This material will be used to refill the worked out areas in the final stage of mining subject to the concurrence from IBM Bangalore.

The environmental protective works such as afforestation, avenue plantation, settling tank, geo-textile matting, green belt development, dump management, check dam, retaining wall will be taken up in the mine effectively as per the ICFRE R & R Plan.

Environmental protective works proposed in the approved R & R Plan along with the year wise action plan is given in **Table 1.1**. Details of same are also discussed in **chapter 2(f)**

Salient features of R&R plan indication environment management measures are described below:

a) Afforestation Programme

Afforestation of the mined out and other available areas which are not fragmented but are degraded due to mining activity is the main component of re-vegetation process to mitigate the negative impacts of the mining on environment. By afforestation, restoration of the ecosystem almost similar to pre-mining period is possible and will be accomplished.

The total extent of the area outside the CEC lease sketch observed and considered as encroachment in respect of ML- 995, by the Joint Team, constituted for the purpose by the CEC is 9.01 Ha. This area has been identified as encroachment under categories such as mining pit, over burden dumps and others in the ML area and it should be reclaimed and rehabilitated by afforesting with suitable vegetation as well as engineering measures.

The afforestation covering 1000 trees and 2500 shrubs per Ha, inclusive of maintenance for five year has been worked out as per the norms of State Forest Department, Karnataka. The estimate for plantation per Ha, is given based on R&R plan prepared by ICFRE.

Work of afforestation will be carried out in close connection with the State Forest Department, Karnataka, utilizing local people and the periodical monitoring will also be carried out, in co-ordination with state agencies.

Afforestation will be made through:

- Propagation of seeds, tubers, corms, bulbs, rhizomes and roots stored in the topsoil and sowing seed.
- Planting nursery-raised seedlings
- By seed dibbling
- Silt accumulated in silt settling tanks/check dams etc. can be removed and could be used after mixing with FYM and sand in the ratio 2:1:1. This mixture could be used for plantation.

In order to minimize the impact of mining on environmental components outside the mine lease area, greenbelt zone of 7.5m width will be established in safety zone inside mine lease area. The establishment of Green belt will help wild life movement, and also human health. The greenbelt will act as a barrier to trap the suspended dust particles and also suppresses air pollutants. As per ICFRE R&R plan, it is proposed to create a green belt with tall seedlings (>1 m height) of fast growing species to hasten the process of greening the area. Green belt available in the safety zone of this mine has been partly planted, without altering the natural green belt.

Indicative cost of developing Green belt is given in the table below:

Table 8.5 Greenbelt Development

Sl. No.	Mine Lease No.	Area of Greenbelt (Ha)	Rate/Ha (in lakhs)	Total Amount (in lakhs)
1	ML-995	2.22	2.57	5.70

The species chosen for green belt development are fast growing with good canopy cover and dense leaf density, and some ornamental plants to give aesthetic look.

Considering the importance of the forest ecosystem in terms of its environmental services suitable floral species have been recommended by ICFRE for restoration of the mined out areas for timber, fodder, fuel wood and medicinal plant to meet the community requirement and overall ecosystem development. All suggested measures will be complied. Details of plant species are enclosed in **Annexure XIII**.

Year-wise afforestation programme is furnished below and same has been marked on year-wise Production and Development plans **(Plate No. 6A to 6E).**

Year	Area in Ha	Type	Quantity (Nos)	Location	Survival Rate (%)	Cost (in Lakhs)
I	0.23	*Acacia catechu* *Acacia nilotica* *Aegle marmelos* *Albizia lebbeck* *Cassia occidentalis* *etc.*	805	Greenbelt area	80%	0.5911
II	0.37		1295	Gap Filling & Greenbelt area	80%	0.9509
III	0.41		1435	Gap Filling & Greenbelt area & Old Dumps	80%	1.0537
IV	0.26		910	Gap Filling & Greenbelt area & Old Dumps	80%	0.6682
V	0.19		665	Gap Filling & Greenbelt area & Old Dumps	80%	0.4883
Total	1.46		5110			3.7522

b) Bio-Diversity Conservation Plan

The zone in which this mine is situated, has comparatively rich vegetation especially in the zones adjoining the mine lease area.

Biodiversity policies will be formulated to adopt 'biodiversity friendly' practices. The practices include:

- improving the coherence of and access to information on biodiversity;
- reviewing and improving protected-area categorisation and classification systems;
- engaging in joint conservation and sustainable development projects;
- working towards more effective land use planning systems

Flora

Considering the importance of the forest ecosystem in terms of its environmental services suitable floral species have been recommended for restoration of the mined out areas for timber, fodder, fuel wood and medicinal plant to meet the community requirement and overall ecosystem development **(Annexure XIII).**

Fauna

Following suggestions of R&R plan will be implemented to improve the faunal population:

- **Habitat protection -** The diversity of animal species and their abundance is largely dependent on the availability of suitable habitats. All measures as suggested in Biological measures will be followed to achieve success in Biodiversity Conservation plan. No natural materials (Both physical and biological) will be displaced from the natural habitat. The natural habitat area outside the mining lease area will be declared as non-human interference area.

- **Providing a corridor for the dwelling and movement of Herpetofauna -** A corridor will be created among the fragmented habitat by planting trees, shrubs, herbs, and grasses to allow the movement of Herpetofauna.

- **Creation of Habitat for Avifauna -** Fruit, fodder and shelter providing trees such as Alaegiumsolvifolium, Annona squamosa, Bombaxceiba, Erythrinasuberosa, Eugenia jambolana, Ficusbenghalensis, Ficusracemosa, Ficusreligiosa, Madhucalongifolia, wild Mangiferaindica, Syzigiumcumini and Ziziphusmaurtiana will be planted to attract birds as well as other wildlife.

- **Reducing anthropogenic pressure -**
    - No mining activity will be allowed after 6 pm.
    - Bright lights will not be used after 6 pm.
    - Vehicular traffic would be banned between 6 pm and 6 am.

Aquatic Fauna

Water along with silt originating from the mine areas may contaminate the freshwater sources and increased flow of suspended solids and sediments into the streams and *nalas* down stream will affect the aquaticfauna.

Two *nalas* are originating from the lease, one is from west and another is from east. Both the *nalas* are emptying into Avinamadugukere. The mine drainage during rainy season definitely will be contaminating the streams and the reservoir in a big way. Hence, it is proposed that water should be let out through a series of biological and engineering measures as suggested in the earlier chapters of the present report.

The bio-engineering measures such as plantation of grasses along slopes, contour drains, mine boundaries and backfilled areas and gabion structure; check dams, rock fill dams as recommended by ICFRE should be adopted to regulate sediment flow and water run-off. All the existing drains arising from the mine area should be well connected to natural streams/*nalas* only after passing through bio-engineering structures. Garland trenches should be provided all along the ore and sub grade ore dumps of mine area to prevent soil erosion which may result in siltation of the streams. By adopting the above measures, the aquatic faunal diversity may not get affected from the mining activity.

c) Management Plan for Fauna

The habitat management in and around the mine lease areas will be adopted by planting suitable fodder species to enable wild herbivores to thrive upon. Following suggestions as per ICFRE, will be implemented to encourage the native fauna to return to the areas cleared for mining:

- A dense green belt consisting of shrubs and trees of different species will be created around the mine lease areas and also along the haul roads which will also act as a dust and noise barrier.
- Awareness programs amongst the local people as well as mining staff, regarding the importance of biodiversity, wildlife, their habitats, should be organized so as to improve their

participation in protection of wildlife in mine area.

- Awareness programs amongst the local people as well as mining staff, regarding the importance of wild life, their habits and habitats, will be organized so that stray and displaced fauna (due to degradation and defragmentation of their habitat) is not killed.
- Rock fill dams and check dams will to be constructed in the mine lease areas to prevent the soil erosion. This will be able to store sufficient quantity of filtered water in the area and will act as water holes for the faunal life present in the region.
- The green cover loss due to construction of haul roads and heavy vehicular movements will restrict the animal movements to the adjoining areas. Therefore, development of a green belt and massive afforestation programme of fruit bearing and shade bearing plant species around the mine lease areas will provide food and shelter for them.
- Fire plays hazardous role in the destruction of habitat. Preventive measures in 2 sq.km area around the mine will be taken up to protect the forest from fire. Fire preventing squad will be formed to fight the fire. Training will be provided to the squad members through the State Forest Department.
- All the mining and transportation operations after the sunset will remain stopped.

d) Creation of awareness on biodiversity

A small booklet containing details on the biodiversity components (Plants, birds and butterflies etc.) of the area along with attractive colour photographs will be published and to be distributed to school and college students. They will be encouraged to visit the area for a field visit on holidays to create awareness in them on biodiversity and its importance.

e) SUPPLIMENTARY ENVIRONMENTAL SAFEGUARDS (SES)

The following Supplementary Environmental Safeguards (SES) will be implemented immediately after the commencement of mining operations.

- Increased frequency of water sprinkling on temporary haul roads at least from two to four trips per shift. Water sprinkling system, especially mist sprinkling without damaging the roads, will be made permanent.

- Trucks carrying finished product outside the lease area will be kept in good condition at all time to prevent spillages on the roads, will be covered with good quality tarpaulins to avoid spillages and prevent entry of water.
- The trucks used for transportation of ore would be 10 Wheel or higher capacity multi-axle vehicles fitted with steel wagon cover with sliding doors and proper base plate with Tarpaulin fixed at bottom and placed on top of the ore which prevents leakage of dust and with hydraulic Tipping facility. This will reduce number of vehicular trips, control dust and pollution, reduce wastage of water by sprinkling and ensure that only permissible quantity is transported. If any old trucks are engaged in transportation, they will be replaced in a phased manner within three year.
- Drains along the roads will be provided and maintained to keep the roads in good condition and properly graded.
- Site workshop and main workshop will be equipped with HEMM washing ramp, settling tanks and oil and grease traps with provision for recycling of treated effluent and collection and proper disposal of settled silt and oil / grease.
- The plantation schedule will be strictly followed, as to coincide with monsoon period.
- All the conditions stipulated by various statutory agencies, viz., MoEF, SPCB, IBM, DGMS, DMG, etc. in their various approvals will be complied and clearance accorded, if required, accordingly before commence of mining.

8.3.2Top Soil Management

Since the mine has been operation for several years before going into 'C' category, entire area is already broken up. As per proposed mining programme over next five years, there is no likelihood of generation of topsoil. The soil is also not conducive for agricultural purpose. However, if, some quantity is generated from cavities the same will be stacked and used for afforestation purpose. However, following soil management plan will be adopted (as suggested in ICFRE approved R&R plan):

Soil Management Plan

The microbes play an important role in maintaining the biological equilibrium of the ecosystem. Among different microbes, there is a symbiotic group of fungi called 'mycorrhizae'. They are

extremely important as they help in transport of phosphorous and other essential elements to the plant system from the soil. These mycorrhizal fungi also protect the plants against soil borne and root borne diseases. Other than mycorrhizal fungi, the beneficial microbes such as Plant Growth Promoting Rhizobacteria (PGPR) viz., *Azotobacter, Azospirillum*, *Rhizobium* and Phosphobactreria (species of *Bacillus* and *Pseudomonas*) involved in breakdown of organic matter, N_2 fixation, and production of plant growth hormones and increase of available mineral nutrients in soil. They are also helpful to build up other beneficial micro-flora and in turn improve soil health (Mohan and Karthikeyan, 2011). These beneficial microbes are considered as bio-inoculants or bio-fertilizers and they improve the growth and quality of the seedlings in nursery and also help the plants for better survival and establishment in problematic areas like mined out areas and maintain soil structure. The type of bio-fertilizers and the application rate will vary according to the site, soil type and post-mining land use.

The most practical way to increase the nitrogen capital of ecosystems is to establish nitrogen-fixing plants, usually legumes, which can quickly increase the nitrogen levels in the system. The easiest method is to broadcast large quantity of seeds of Horse gram (*Macrotylomauniflorum*) immediately after first showers to act as cover the exposed areas. Vesicular Arbuscular Mycorrhizal (VAM) fungi and Plant Growth Promoting Rhizobacteria (PGPR) can be applied along with fully composted farmyard manure and vermin compost to increase the growth of the plants as well as fertility of the soil.

The following measures in respect of soil management will be adopted in reclamation and rehabilitation of mined areas:

- Beneficial microbes are present in the top soil of mining areas. Since this mine has been operational for several years before being declared a 'C' category, presence of top soil is negligible. The top soil found, if any, will be collected at the time of mining and dumped separately at a predetermined area and will be used for reclamation and rehabilitation of mined areas.
- Necessary precautions will be taken to preserve the fertility and shelf life of the micro flora in the top soil by adopting suitable height of the top soil dumps and preventing losses due to erosion during the phase of temporary storage.

- The top soil containing beneficial micro flora and seeds of plant species of the site will be spread over the mined out areas including on OB dumps and back filled areas during the process of mined land rehabilitation.

In addition, the following management techniques will be adopted with the use and application of beneficial microorganisms as bio-inoculants (bio-fertilizers) along with organic fertilizers, which will be very effective during the mine spoil reclamation and rehabilitation programme:

- The beneficial microorganisms will be introduced as bio-fertilizers during afforestation in the overburden dumps and other mined out areas through planting of suitable fast growing native plant species (inoculated with bio-fertilizers and organic fertilizers) like grasses, herbs, shrubs and trees.
- The seedlings will be inoculated with Vesicular Arbuscular Mycorrhizal (VAM) fungi and other beneficial microorganisms like PGPRs (*Azotobacter*, *Azospirillum, Phosphobacterium, Rhizobium*) along with the bio-manures/ organic manures like fully composted farmyard manure, vermi-compost, and leaf compost in the nursery.
- The bio-fertilizer inoculated seedlings/saplings will be planted during the process of rehabilitation of mined areas.
- The pits dug out for planting of saplings for afforestation will be filled with the mixture of bio-fertilizers and organic manures (preferably 15 gm bio-fertilizers + 750gm to 1kg organic manure per pit).

****The quality of the material used for implementation of R&R including planting material, geo-mat and others will be ensured. The material used will be a certified material by the National reputed organization having experience in the field of R&R.***

Monitoring station for Environment parameters in Core and Buffer -Zone are given below,

location of Air Monitoring Stations

A-1	Mining Pit
A-2	Halage Road
A3	Crushing area
A-4	Ubbalagundi Village
A-5	Rajapur

location of water Monitoring Stations

SW-1	near Ubbalagundi
SW-2	near Mallapur
GW-1	Mallapur Bore Hole
GW-2	Ubbalagundi Bore Hole
GW-3	Rajapur Bore Hole

location of Noise Monitoring Stations

N-1	Mining Pit
N-2	Halage Road
N-3	Crushing area
N-4	Ubbalagundi Village
N-5	Rajapur

location of Soil Monitoring Stations

N-1	Mining area
N-2	Ubbalagundi Ag.land
N-3	mallapur Ag.land
N-4	Lingadalli Ag. Land
N-5	Forest area

8.3.3 Tailing Dam Management

No Tailing Dam is proposed in the mining plan.

8.3.4 Acid Mine Drainage

Not applicable

8.3.5 Surface Subsidence Mitigation Measures

Not applicable

SUMMARY OF YEARWISE PROPOSAL (Progressive Reclamation Plan)

Items	Details	Year-wise Proposed measures					Remarks
		Ist	IInd	IIIrd	IVth	Vth	
Dump Management	Area afforestation in (Ha)	-	-	-	-	-	All the proposed dumps will remain active during plan period.
	No. of saplings	-	-	-	-	-	N.A.
	Cumulative no. of plants	-	-	-	-	-	N.A.
	Cost including watch and ward care during the year	-	-	-	-	-	N.A.
Management of worked out benches	Area available for rehabilitation (Ha)	-	-	-	-	-	Mining operations are yet to resume. No worked out abandoned benches. Rehabilitation not proposed.
	Afforestation done	-	-	-	-	-	N.A.
	No. of saplings planted in the year	-	-	-	-	-	N.A.

	Cumulative no. of plants	-	-	-	-	-	N.A.
	Cost including watch & care	-	-	-	-	-	N.A.
R&R by backfilling	Void available for backfilling	-	-	-	-	-	The mineral reserves / resources are still persisting. No proposal reclamation and rehabilitation by backfilling.
	Void Filled by waste/ tailing	-	-	-	-	-	N.A.
	Afforestation on the backfilled area	-	-	-	-	-	N.A.
	Rehabilitation by making water reservoir	-	-	-	-	-	N.A.
Rehabilitation of waste land within lease	Area available (Ha)	-	-	-	-	-	N.A
	Area rehabilitated	-	-	-	-	-	N.A.
	Method of rehabilitation	-	-	-	-	-	N.A.
Others	Area for Greenbelt Development (Ha)	0.23	0.37	0.41	0.26	0.19	Greenbelt development in the 7.5 m safety zone all along the mine boundary

*It is fresh auctioned block, mining operations are yet to be resumed

environmental parameters in the core & buffer zone with their respective locations and number of samplings proposed in core and buffer zone. (Table no – 8.3.1)

- Once the mining becomes operational, regular monitoring of environmental parameters will be undertaken for the core and buffer areas. The environmental monitoring criteria along with parameters, its relative position (Core or Buffer), sampling locations and number of samples per year is tabulated here.
- In case of exceedances, management measures such as additional water sprinkling, Personal Protective Equipment (PPEs), etc will be pressed into the action to ensure the levels are well within the prescribed limits.
- Location of environmental monitoring stations is shown in location plan (Plate no. 1)

Table no – 8.3.1

Sl.No	Environmental Quality	Parameters	Core area	Buffer area	Sampling location	Number of Samples / year
1.1	Air Quality	PM-10;PM-2.5; SO2;NOx & CO	• Mining Pit • Crushing & Screening area	• Haulage Road • Ubbalagandi village • Rajapur village	5	480
1.2	Noise Quality	24 Hourly basis LEQ (Day Time equivalent & Night Time equivalent basis) dB(A)	• Mining Pit • Crushing & Screening area	• Haulage Road • Ubbalagandi village • Rajapur village	5	60
1.3	Soil Quality	pH, EC, TDS, Available N, P, K, CA, Mg, Chlorides, Organic carbon and texture	• Mining lease area	• Ubbalgandi agri. land • Mallapur agri. land • Lingadhalli agri. land • Forest area	5	10
1.4	Personal Dust sampling	Crystalline silica (% free silica), Particulate Matter (PM10) (Dust con. Mg/M3)	• Mine Pit • Crushing & screening		2	12
1.5	Personal exposure to Noise	Personal exposure to Noise using Quest Noise Dosimeter 8 hr basis	• Mine Pit • Crushing & screening		2	12
1.6	Surface water Quality	pH, TSS, DO, BOD, COD, Oil & Grease, Sulphates, Dissolved Phosphates, Chlorides, Residual free Chlorine, Ammonical Nitrogen, Total kjeldhal, Total Choliforms.		• Lake near Ubbalagandi • Lake near Mallapur	2	12
1.7	Ground water quality	Odour, Colour, pH, Turbidity, Total Hardness, Iron, Chlorides, Total Dissolved Soilids, Calcium, Magnesium, Sulphate, Nitrate, Fluoride, Total Alkalinity, Boron, Sodium, Potassium, Aluminium, Copper, Manganese, Selenium, Zinc, Cadmium, Lead, Mercury, Total Arsenic,Cyanide, Total Chromium, Total Coliforms		• Bore well near Mallapur • Bore well near Ubbalagandi Bore well near Rajapur	3	18
1.8	Dust fall	Total Dissolved Matter, Total Undissolved Matter,Total Suspended Solids, Ash	• Mine gate		1	6

8.4 Disaster Management & Risk Management

The aim of disaster management is to identify potential dangers associated with the mining operations. An important element of mitigation is emergency planning i.e., recognizing that accidents are Possible, assessing the consequences of such possible accidents and deciding on the emergency procedures, in advance, both on-site and off-site, that would need to be implemented in the event of an emergency, systematically and without delays and confusion.

The risk and disasters that could be foreseen in opencast mines may arise from:

i. Failure of external overburden dumps
ii. Failure of mine bench slopes
iii. Fly-rock from blasting operations
iv. Chemical spills
v. Fire in the bulk fuel storage and forest fire
vi. Plying of trucks and other vehicles on public roads

Maintenance of proper bench geometry, observing safety precautions for transport, proper storage, safe handling and use of explosives and fuel etc., good maintenance of roads and transport units, fire prevention measures, good dump management, shall go a long way in preventing accidents/disasters. No chemicals are used in mining operations or beneficiation process. Hence, there is no risk involved due to chemical spills.

Mining will be carried-out strictly as per MMR 1961 and all other rules and regulations. Project proponent is having mobile and walkie-talkie communication system for quick passing of information if need arises. Proper training will also be given to the work persons periodically, as per DGMS rules.

The management is committed to identify possible causes for the potential disasters and draw a code of emergency measures and procedures to deal with such disasters, which is otherwise also advised by DGMS through their periodic circulars.

Safety and Security

Around the ultimate pit limit, a peripheral wall will be constructed as per the norms prescribed by the DGMS, to fence off the entry of stray animals and persons to the mine area. Where such effective blocking is not possible, watch & ward Posts will be established. Periodical inspection of all

such arrangements will be carried out. The visitors will be allowed to enter the mine area only with permission.

Risk Management

In case of any emergency, evacuation of affected people will be undertaken immediately. Injured person(s) will be shifted to the hospital by departmental ambulance to Sanjeevani Hospital and Government hospital located at 25 km. &5 Km from mine head respectively. Using cell phone service and walkie-talkies, monitoring of relief services will be carried out.

8.5 Care & Maintenance during temporary discontinuance

An emergency plan to deal with the situation of temporary discontinuance or incomplete programme due to Court order/due to statutory requirements or any other unforeseen circumstances will be drawn by the technical & managerial personnel to suit the specific situation of this mine.

This will be reviewed & modified to suit the varying conditions. This would involve preventing access to dangerous places, pits and preventing accidental fall into the pit of animals & men. Safety measures, such as firefighting equipment, switchgear etc., will be placed at readily accessible locations.

The following measures will be implemented:

(i) Proper and adequate security at the entrance/exit to the mine to prevent entry of unauthorized person.

(ii) Top edges of the quarry will be fenced off.

(iii) Entrance to the toe of dumps will be blocked.

(iv) Special security and fire preventing measures will be taken at dangerous places/explosive magazine etc.

(v) All the above will be examined by mines manager once in a week to ensure that they are in order.

8.6 Salient Features of Approved R & R Plan:

The proposed R & R Plan has been aimed at topographic reconstruction and with engineering and biological measures for erosion control, re-vegetation with adequate soil amendments for re-establishment of nutrient cycling for sustainability of restoration.

Engineering measures in the restoration process have been proposed based on the hydrological condition on the macro watershed basis and compatibility of the surrounding area stability and drainage density. The plan includes the enlisting of the existing and proposed engineering structure with cost.

Biological measures for the management of overburden dumps, drainage system, mine pit area, haul roads etc. with reconstruction of suitable technique to improve the ability of and to support the vegetation growth with the application of organic matter, animal manure and use of geo textile/ geo matting.

As a biodiversity conservation measure, it has been suggested considering the vegetation found predominantly around this lease area, especially *Ailanthus Excelsa, Gmeilna Arborea, Hardwickia binnata … etc..* The fundamental aim of the restoration programme is to restore natural eco system. So, creation of fauna habitats and corridors, using logs, stumps and other natural material has been suggested. Also fauna corridors are suggested to connect the nearby forests to encourage smaller species of mammals and reptiles and to colonize in the restored areas. Ecological processes such as nutrient cycling, litter decomposition, soil aeration, seed dispersal, seed predation and plants ability to survive fire or set seed so that they can re-establish after fire.

The R & R plan will also provide the essential insight into environmentally safe planning of mining activities in future. The engineering and biological measures have been proposed in this connection like, retaining walls at the toe of waste dumps, garland drain all terraces, fixing geo textile in outer surfaces of waste dumps. As a part of water surface management, gully plugs, masonry check dams, rock filled check dams, stone masonry settling tanks are being proposed. Afforestation for stabilization of waste dumps, green belt in safety zone has been also suggested.

R & R programme is aimed to produce an ecosystem which fulfills and encourages the development of flora, fauna and soil characteristics similar to that of the pre mining stage. Regular monitoring of the all the measures taken in the lease area is essential for achieving the true spirit of Reclamation and Rehabilitation.

Based on the availability of Mineral reserves, dump capacity, volume of traffic and further planning for the resources, annual production levels are fixed. In case of this lease, an annual production level of 0.340 MTPA is considered as the feasible production level based on the dump capacity, which is lowest amongst all the criteria considered. Accordingly, the waste generated will be accommodated in active dump and stabilization of the dump will be as per R & R plan. Criteria for estimation of permissible production limit are as below:

No.	Criteria	Permissible Production (MTPA)
1	Reserves	0.435
2	**Dump Capacity**	**0.340**
3	Road Capacity	0.950

The indicative cost estimate for the implementation of engineering and biological measures for reclamation and rehabilitation plan is 199.31 Lakh Rs. (Approx.). The cost for implementation of social management plan, bio diversity management plan, monitoring and implementation of R & R Plan, capacity building of the person involved, infrastructure etc. shall be met from allocating of 10% of the annual sale proceeds from the mines.

The indicative cost proposed for engineering structures and others may increase or decrease based on the common scheduled rates of Karnataka State Government and availability of material and local conditions.

The summary of the various measures suggested in the R &R Plan is given in below **Table 8.6**

Type	Particulars of work	Years																			
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Dump Management																					
EID-1	Toe wall at the toe of waste dump	√																			
	Garland drain	√																			
Active/proposed	Toe wall at the toe of waste dump	√	√																		
	Garland drain	√	√																		
	Geo-textile-coir matting	√	√	√	√	√															
Plantation on Encroached area as per CEC		√	√	√	**(II[nd] and III[rd] year includes gap plantation and Maintenance)**																
Surface water management																					
Gully plugs (Conceptual period)	Logwood Check Dams	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Brushwood Check Dam	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Loose Boulder Check Dam	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Check dams	Wire crate (gabion) Check Dam	√																			
	Stone Masonry Check Dam	√																			
	Loose Boulder Check Dam	√																			
	Culvert	√																			
	SST	√																			
Greenbelt development		√	**(II[nd] and III[rd] year includes gap plantation and Maintenance)**																		
Afforestation		√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Avenue plantation on roads		√	√	√	**(II[nd] and III[rd] year includes gap plantation and Maintenance)**																
Environmental monitoring & watch –ward		√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√

Note- Maintenance of all engineering and biological measures should be done in subsequent year

Table 8.6.1 : YEAR WISE IMPLEMENTATION PLAN OF R&R MEASURES AS PER ICFRE APPROVED R&R PLAN

8.6 Financial Assurance

Table Indicates the Breakup of areas in the Mining Lease for Calculation of Financial Assurance**(**Refer Financial Assurance **Plan Plate No. 11)**.

Sl. No.	Head	Area of land use (in Ha)			The area considered as fully reclaimed and rehabilitated (In Ha)	Net area considered for calculation (In Ha) C- D = E
		Area put on use at start of Plan (In Ha)	Additional Requirement during Plan Period (In Ha)	Total (In Ha) A+B=C		
		A	B	C	D	E
1.	Area under Mining	14.66	1.22	15.88	-	15.88
2.	Storage for top soil	-	-	-	-	-
3.	Waste dump site	4.14	6.35	10.49	-	10.49
4.	Mineral Storage	1.30	-	1.30	-	1.30
5.	Infrastructure (workshop, Crushing & Screening Plant, Administrative Buildings) & Magazine	0.00	0.50	0.50	-	0.50
6.	Roads	0.50	0.00	0.50	-	0.50
7.	Railways	-	-	-	-	-
8.	Tailing Pond	-	-	-	-	-
9.	Effluent treatment plant	-	-	-	-	-
10.	Mineral Separation Plant	-	-	-	-	-
11.	Township area		-	-	-	-
12.	Others					
a.	Green Belt & Safety zone / Plantation	2.22	0.00	2.22	-	2.22
b.	Area for Engineering measures (Retaining wall& Garland Drain, settling tank etc,)	0.00	0.30	0.30	-	0.30
c.	Area which will remain untouched	10.07	0.00	1.70	-	1.70
Grand Total		**32.89**	**8.37**	**32.89**	**-**	**31.19**
Therefore, net area considered for financial assurance is 31.19 Ha						

As per the provision of Rule 27(1) of MCDR, 2017, Financial Assurance is not applicable "for a mining lease granted through the auction or the mining lease granted under the provisions of clause (b) or clause (c) of sub-section (2) of section 10A", wherein the mine Development and production Agreement will be signed between the lessee and the State Government." After obtaining all the requisite statutory clearances.

Prepared by

Mr. B P Pandey
Qualified Person