Annexure 6

# CALCULATION OF RESOURCE BY GSI

**Borehole No MNG 6**

Located on the western part of the central block in $W_{50}N_{20}$ angle of the borehole in 45° bearing due North. Mn ore has been intersected between 320 and 310 RL and the true thickness of the intersected ore is 4.58m (apparent thickness is 6.42m) RL of the collar is 348.2m. From the longitudinal vertical section the strike influence of the borehole is 80m, and dip length is 60m

Average grade of the ore (13+16 = 29 samples)

| Apparent width (intersected length in the borehole) (m) | True Width (m) | Mn% | $P_2O_5$% | $SiO_2$% | $Fe_2O_3$ % |
|---|---|---|---|---|---|
| 2.93 | 2.09 | 30.3 | 1.08 | 20.75 | 8.68 |
| 3.49 | 2.49 | 29.78 | 1.09 | 21.40 | 8.86 |

Strike length extension of these two bands is 120 m (50m on the western and 70m on the eastern side)

Dip length is 55 m (up dip direction 35 m and towards down dip direction 20 m)

Reserve calculation
Strike Length x Dip Length x True width x Specific gravity
120m x 55m x 4.58 x 3.1 = 93707 tonnes $= R_1$

**Borehole No MNG 8**

Located on the western part of the central block in $W_{40}N_{10}$ angle of the borehole in 45° bearing due north. Manganese ore has been intersected at 305 RL, and the true thickness of the intersected ore is 0.73m (apparent thickness is 1.03m) RL of the collar is 342.m. From the longitudinal vertical section the strike length of influence of the borehole is 120m and dip length is 55m.

Average grade of the ore (4 samples)

| Apparent width (intersected length in the borehole) (m) | True Width (m) | Mn% | $P_2O_5$% | $SiO_2$% | $Fe_2O_3$% |
|---|---|---|---|---|---|
| 1.03 | 0.73 | 32 | 1.12 | 23.21 | 8.28 |

Strike length extension of the band is 140 m (70m on the western and 70m on the eastern side)
Dip length is 57 m (up dip direction 37 m and towards down dip direction 20 m)

Reserve calculation
Strike Length x Dip Length x True width x Specific gravity
140m x 57m x 0.75 x 3.1 = 18554 tons $=R_2$

**Borehole No MNG 7**

Located on the western part of the central block in $W_{30}N_0$ angle of the borehole in $45^0$ Bearing due North. Mn ore has been intersected at 309m. RL and the true thickness of the intersected ore is 1.92m (apparent thickness is 2.70) RL of the collar is 341.02m. From the longitudinal vertical section the strike length of influence of the borehole is 140m. dip length is 45m.

Average grade of the ore (8 samples)

| **Apparent width (intersected length in the borehole) (m)** | **True Width (m)** | **Mn%** | **$P_2O_5$%** | **$SiO_2$%** | **$Fe_2O_3$%** |
|---|---|---|---|---|---|
| 2.70m | 1.92 | 26.02 | .80 | 30.23 | 8.4 |

Strike length extension of the band is 120 m (70m on the western and 50m on the eastern side)

Dip length is 75 m (up dip direction 50 m and towards down dip direction 25 m)

Reserve calculation
Strike Length x Dip Length x True width x Specific gravity
120m x 75m x 1.92x 3.1 = 53568 tons $=R_3$

**Borehole No MNG 2**

Located on the western part of the central block in $W_{20.1}N_{30.6}$ angle of the borehole in 45° bearing due North. Mn ore has been intersected at 315 RL, and the true thickness of the intersected ore is 1.14m (apparent thickness is 1.60m) RL of the collar is 344.2m. From the longitudinal vertical section the strike length of influence of the borehole is 60m and dip length is 45m

Average grade of the ore (17 samples)

| Apparent width (intersected length in the borehole)(m) | True Width (m) | Mn% | $P_2O_5$% | $SiO_2$% | $Fe_2O_3$ % |
|---|---|---|---|---|---|
| **1.60** | **1.14** | **29.06** | **0.19** | **25.73** | **8.97** |

Strike length extension of the band is 100 m (50m on the western and 50m on the eastern side)

Dip length is 45 m (up dip direction 30 m and towards down dip direction 15 m)

Reserve calculation
Strike Length x Dip Length x True width x Specific gravity
100m x 45m x 1.14 x 3.1 = 15903 tons $=R_4$

**Borehole No MNG 3**

Located on the central part of the central block in $W_{10}N_{15.4}$ angle of the borehole in 45° Bearing due North. Mn ore has been intersected at 324 RL, and the true thickness of the intersected ore is 0.90m (apparent thickness is 1.30m) RL of the collar is 353.8m. From the longitudinal vertical section the strike length of influence of the borehole is 100m and dip length is 40m

Average grade of the ore (15 samples)

| **Apparent width (intersected length in the borehole)** | **True Width (m)** | **Mn%** | **$P_2O_5$%** | **$SiO_2$%** | **$Fe_2O_3$ %** |
|---|---|---|---|---|---|
| **1.3** | **0.93** | **29.7** | **0.37** | **31.6** | **6.89** |

Strike length extension of the band is 100 m (50m on the western and 50m on the eastern side)

Dip length is 60 m (up dip direction 40 m and towards down dip direction 20 m)

## TABLE SHOWING THE MANGANESE ORE RESOURCE CALCULATED FOR THE ZONES INTERESECTED IN BOREHOLE

| Bore hole No | True Width(m) | Mn% | $P_2O_5$% | $SiO_2$% | $Fe_2O_3$% | Dip length | Strike length | R= SL x DL x TW x SG |
|---|---|---|---|---|---|---|---|---|
| MNG-6 | 2.09 | 30.3 | 1.08 | 20.75 | 8.68 | 120 m | 55 m | 140m x 40m x 4.58 x 3.1 = 93707 tons |
| | 2.49 | 29.78 | 1.09 | 21.40 | 8.86 | | | |
| MNG-8 | 0.73 | 32 | 1.12 | 23.21 | 8.28 | 140 m | 57 m | 140m x 57m x 0.75 x 3.1 = 18554 tons |
| MNG 7 | 1.92 | 26.02 | .80 | 30.23 | 8.4 | 120 m | 75 m | 120m x 75m x 1.92x 3.1 = 53568 tons |
| MNG 2 | 1.14 | 29.06 | 0.19 | 25.73 | 8.97 | 100 m | 45 m | 100m x 45m x 1.14 x 3.1 = 15903 tons |
| MNG 3 | 0.93 | 29.7 | 0.37 | 31.6 | 6.89 | 100 m | 60 m | 100m x 60m x 0.93 x 3.1 = 17298 tons |
| MNG 1 | 0.94 | 32.05 | 0.14 | 22.72 | 9.10 | 100 m | 75 m | 90m x 75m x 0.94 x 3.1 = 19670 tons |
| $\Sigma \frac{R_1 Mn\% + R_2 Mn\% + R_3 Mn\% + R_4 Mn\% + R_5 Mn\% + R_6 Mn\%}{R_1 + R_2 + R_3 + R_4 + R_5 + R_6}$ = Weighted av. Grade | | | | | | | | **218700 tons (0.218 million tons) and the average grade is 29.28% of Mn** |

ANNEXURE-6

# REPORT ON EXPLORATION AND ASSESSMENT FOR MANGANESE, IN GUGULDOH BLOCK IN RAMTEK TAHSIL, NAGPUR DISTRICT, MAHARASHTRA

(Item No 062/MIE/CR/MAH/1999/011)
FSP 1999-2001

By
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## 1.INTRODUCTION

In pursuance of the annual field season programme of Geological Survey of India for the year 1999-2000 and 2000-2001, Item No MIE/CR/MAH/1999/011 exploration for manganese ore in Guguldoh block of Ramtek Tehsil, Nagpur district was carried out with the objective of assessing the manganese ore reserve in the block. Mansar Kandri belt forms an important source of low to medium grade manganese ore suitable for steel industries.

Rocks of the Sausar Group occur in broad arcuate shape with convexity towards south. Manganese ore is confined to the contact between Mansar and Chorbaoli formation. Exploration for manganese in this belt commenced since early seventy on the recommendation by Ministry of Mines to prove ferro-manganese ore in deeper horizon in existing mines and in their extension area.

Hence, investigation of manganese ore in this belt by large scale mapping (L.S.M) and then identifying promising blocks for detailed work was carried out. A 10 km x 3 km E. W trending Mn belt between Manegaon in the west and Hivra in the east through Guguldoh in Nagpur district, Maharashtra occurs flanking the southern Sausar supracrustals. Numerous abandoned Mn quarries dot the entire belt in two E-W trending parallel zones with particular concentrations at Guguldoh, Bhimaltola, Bhandarbodi and Hivra.

The Guguldoh block (55 0/7) was studied and mapped in detail on 1:2000 scale to cover 1 sq.km. area. Rock types exposed in the project area include gametiferous mica schist, quartz mica schist, stratified Mn ore and gonditic ores, quartzite, often manganiferous, autoclastic conglomerate / breccia and feldspathic quartzite. Pegmatite and quartz veins locally occur as intrusive.

There are four conformable bands of stratified Mn are in the mapped area of Guguldoh block. From south to north, the bands have strike-lengths of 250 m, 720 m, 640m and 50 m respectively. They define an arcuate outcrop pattern with strike ranging from NW -SE to E- W to ENE-WSW with steep to subvertical dips to the south. Abandoned quarries (up to 40m wide x 400m long) are present which speak of extensive mining activity in the past. The thickness of the bands varies from 1m to about 4m. The abandoned quarries discontinuously extend both to the east and west of the present block for over 1.9 km in total strike length. Litho logically, the Mn ore is inter stratified at the interface of garnetiferous mica schist and quartz mica schist and also within the quartzite. Both $S_1$ and $S_2$ planes have developed in the rocks. The southward convexity of the bands is possibly due to N-S trending $F_4$.

## 1.1 LOCATION AND ACCESSIBILITY

The area under study falls in the Survey of India Toposheet no. 55O/7 and bounded by Lat 21°25' to 21°25 N and long 79° 23' to 79° 23E forming part of Ramtek tehsil, Nagpur district, Maharashtra. The area is well approachable from Nagpur by Nagpur- Jabalpur road NH7. Mansar Township is situated about 45 km from Nagpur. The Nagpur- Ramtek broad gauge line of SE has a terminus at Ramtek station, which is about 4 km from Mansar and 2 km. from Ramtek Township. Good all weather road takes off from SH 243 towards north for about 15 km and connects Manegaon village to Ramtek. Guguldoh block is adjacent to Manegaon village in the north.

## 1.2 PHYSIOGRAPHY AND DRAINAGE

The area of investigation lies in the hilly region north of Ramtek Township. It has an undulating terrain. The highest peak in the area is 458m and lowest is 320m.The hill trends E-W and only the geomorphic units are marked.

**Residual hills**: - where the present drilling is in progress.

**Pediment**: - low lying area where BH MNG-1 and MNG-2 were drilled.

**Pediplain**: - Soil derived from residual hill and pediment, particularly north of Manegaon village.

**Older flood plain**: - Area around Kandri and Panchala Buzurg where cultivation is being done.

The area is drained by nala and stream, which flow in NE-SW or E-W direction and finally merge with Khindsi Lake.

### 1.3 PREVIOUS WORK

Sausar rocks were first studied by Jenkins (1833) and Voysey (1833) Mallet-1879 and Fermor (1906). Fermor in 1909 did systematic mapping and coined the term Sausar Series for the succession exposed in Sausar tahsil of Chhindwara district, Madhya Pradesh. He introduced the term Gondite for quartz-spessartite manganese silicate rock of Sausar Series. A detailed stratigraphy of entire Sausar belt was proposed by Straczek et al (1956) and was later modified by Narayanswamy et al (1963) and Basu (1958). Basu and Sarkar (1966) proposed a stratigraphy based on their detailed work of Ramtek-Junawani block.

Fermor (1909) Dunn (1936) Basu 1964) Deshpande (1960) Roy (1961) 66, 68) D. J. Dasgupta et al (1984) Pal and Bhowmik (1995) and others have discussed the mineralogical and para genetic aspect of Mn ore and Gondite. Khan et al (1999) have studied the area under specialized thematic mapping project.

### 1.4. PRESENT WORK

A one year extension has been granted by the MTR committee for completing the mapping and drilling in the extension area for the field season 1999-2000. Overall work schedule is as given below.

| Nature of work | Total work envisaged FS 1998-2000 | **Achievement** |
|---|---|---|
| DM (1:2000) | 1 sq km | 1.04 sq km |
| SMPL | | |
| a) BR | 70 nos | 70nos |
| b) CS | As required | 243 nos |
| Drilling | 1600 m | 1590.45 m |

Reserve calculation
Strike Length x Dip Length x True width x Specific gravity
100m x 60m x 0.93 x 3.1 = 17298 tons $=R_5$

**Borehole No MNG 1**

Located on the eastern part of the central block in $W_{13}N_3$ angle of the borehole in 45° Bearing due North. Mn ore has been intersected at 315 RL, and the true thickness of the intersected ore is 0.9m (apparent thickness is 1.30m) RL of the collar is 347.5m. From the longitudinal vertical section the strike length of influence of the borehole is 100m. and dip length is 60m

Average grade of the ore (12 samples)

| Apparent width (intersected length in the borehole) | True Width | Mn% | $P_2O_5$ % | $SiO_2$ % | $Fe_2O_3$ % |
|---|---|---|---|---|---|
| 1.32 | 0.94 | 32.05 | 0.14 | 22.72 | 9.10 |
| | | | | | |

Strike length extension of the band is 90 m (50m on the western and 40m on the eastern side)

Dip length is 75 m (up dip direction 50 m and towards down dip direction 25m)

Reserve calculation

Strike Length x Dip Length x True width x Specific gravity
90m x 75m x 0.94 x 3.1 = 19670 tons $=R_6$

The average weighted grade (Mn%) is calculated as follows

$$\frac{R_1 Mn\% + R_2 Mn\% + R_3 Mn\% + R_4 Mn\% + R_5 Mn\% + R_6 Mn\%}{R_1 + R_2 + R_3 + R_4 + R_5 + R_6} = \text{Weighted average Grade}$$

**The total reserve estimated in this block is $R_1 + R_2 + R_3 + R_4 + R_5 + R_6$ = 218700 tons (0.218 million tons) and the average grade is 29.28% of Mn**

## 1.5 ACKNOWLEDGEMENT

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# 2. GEOLOGY

## 2.1 REGIONAL GEOLOGY

Synsedimentary stratiform manganese ore deposits of this area are mainly associated with the psammo-pelitic rocks of the Sausar group. The Sausar group comprises mainly quartz mica schist, quartzite, calc-granulite and gneiss with calcite and dolomite marble. The basement for this group of rocks is the Tirodi gneiss. The entire Sausar belt is intensively deformed and metamorphosed. The basement gneiss here also participated in all the deformational episodes of Sausar orogeny along with the rocks of Sausar Group. The gneisses, migmatite, syn and post tectonic granite plutons, pegmatite, vein quartz also occur intruded within Sausar Supra crustal rock. The rocks of the Lameta Formation of late cretaceous age and overlying Deccan Trap basalt lie over the Sausar group far from the area of investigation to the south of Mansar.

The general geological succession in the area is briefly stated in Table-1 after Narayanswamy et al(1963). The rocks of the Sausar Group show polyphase deformation and metamorphism. The folds are generally overturned towards the north with axial plane steeply dipping towards south along the southern part of the belt

The regional structure of the Sausar Group is divisible into four belts after Narayanswamy et al 1963.

a) Southern belt of isoclinal folding
b) Northern belt of recumbent fold thrust blocks and nappes
c) Central belt of Gneissic formation with narrow folded schist.
d) Region of cross folding and refolding.

Regional distribution of cross fold along the belt seems to indicate that the maximum intensity of late stage deformation was confined to a Central axis, extending NE from Ramtek to Pusada and Tirodi.

The important fold in the southern belt of isoclinal folding found around the present study area Junawani – Murda-Guguldoh folds. These are also affected by Musevadi-Junawani fault with strike E-W and dip due south.

Table-1

| | | |
|---|---|---|
| Bichua stage | | Dolomite marble and associated cal silicate rock. |
| Junawani stage | | Biotite Muscovite schist, Quartz biotite, granulite with characteristic Quartz sillimanite tabloids |
| Chorbaoli stage | | Quartzite, Quartz schist, Quartz muscovite schist feldspathised, Quartz sillimanite tabloid at time with stretched pebbles of quartz also autoclastic conglomerate |
| Horizon I | | Manganese ore and Gondite |
| Mansar stage | | Muscovite schist, muscovite biotite schist, Sericite schist often sillimanite bearing |
| HorizonII | | Manganese ore within muscovite schist |
| Horizon III | | Manganese ore band with Gondite |
| | a) Lohangi sub stage | Pink and white calcite dolomite and piedmontite marble with lenticular bands and lenses of Mn ore |
| | b) Utekata substage | Calc silicate rock, calc granulite gneiss often garnetiferouss epodotite bearing epidote-quartzite, epidosite |
| Lohangi stage | | |
| | c) Kadbiikera substage | Quartz biotite granulite with magnetite and epidote intercalated with quartz biotite schist, often found to be gradational with Lohangi stage rocks and often with Tirodi gneiss. |
| Sita Saongi stage | | Quartz biotite gneiss gritty quartzite (impersistent, less developed in the area) |
| | ----------Disconformity ?---------- | |
| | | Tirodi biotite gneiss with inclusions of basic rock |

In the present area of investigation in the Guguldoh block, the rocks are folded isoclinally but the beds have flattening to moderate dip towards south, along the central part where the isoclinal fold have overturned to recumbent fold, due to this reason the manganese bands have shown repetition as seen in boreholes of the investigated area.

Towards northeastern part the folds are flat and recumbent and are overturned to south with axial plane having low dip to north. Regional structure also shows that isoclinal folds of southern part and recumbent fold and thrust sheet of northern part are disposed in an *en echelon* pattern with fold system shifting toward north as we go towards east. Similarly major strike fault and thrust also show similar pattern with thrust or fault gets shifting to north as we proceeds to east or west. These structures are further complicated by refolding or cross folding of earlier fold in the area by varying degree of intensity. There have also been emplacements of granite pluton along the axis of latter fold.

## 2.2 GEOLOGY OF THE AREA

The Guguldoh manganese prospect forms the eastern continuity of the manganiferous sediment forming the entire Manegaon- Guguldoh belt of Mn ore. The rock type found in this area are muscovite schist with sillimanite, garnet magnetite, quartzite, manganiferous quartzite, auto-clastic conglomerate, quartz muscovite schist, gondite, pegmatite, Mn ore, deformed granite, and impure dolomitic marble. The rocks in this area swerve in strike from WNW-ESE to ENE-WSW and E-W with dips to the south often reaching vertical. Structurally Mn ore bearing horizon in Manegaon –Guguldoh belt represents a tight syncline with a easterly plunge. The keel of the synclinal fold represented by hill 403m north- east of Musawadi.

The tentative litho-stratigraphy as inferred from borehole intersection and geological mapping is as follow-

| | |
|---|---|
| | Soil and overburden |
| Intrusives | Vein quartz |
| | Pegmatite |
| | Intrusive granite |
| Chorbaoli | Auto clastic brecciated conglomerate |
| | Quartzite/Mn ferrous quartz |
| Mansar | Mn ore |
| | Quartz mica schist |
| | Mica schist/with impure dolomite bands |

Both $S_1$ and $S_2$ planes have developed in the rocks. The foliation ($S_1$) and bedding ($S_o$) strike N 70° E to S 70° W and dip steeply towards south. The cleavage (crenulation cleavage, $S_2$) strikes NE-SW with southerly dip of 55°

## 2.3 ABANDONED MINES/ PIT

There are number of rectangular deep pits in ENE -WSW direction for over a length of 2.5 km. These are mostly the ancient abandoned mines and trial pits and trenches. Low-grade ore isexposed in these pits. Numerous ore dumps are also found in and around the abandoned mines. The Central block has the largest

abandoned quarry for over 700 m in length. The western block has 3-abandoned quarries indicating lateral extension of the ore for 200m, and in the eastern block there are numerous small quarries arranged in a linear fashion indicating lateral extent of the ore for more than a km in length.

## 2.4 MANGANESE ORE HORIZONS

Manganese ore horizons are represented by manganiferous quartzite, gondite and low grade Mn ore. Mn ore horizon is 4 to 6 m thick and is traceable for a strike length of 900 m in Central block. Four conformable Mn bands were identified, during detailed mapping and drilling. From south to north the bands have a strike length of 250m, 720m, 640m,and 50m respectively. They define an arcuate pattern with strike ranging from NW-SE to E-W to ENE-WSW with steep to subvertical dip to south. The abandoned quarries discontinuously extend both to east and west for over a strike length of 1.9 km. Lithologically, Mn ore occurs at the interface of garnetiferous mica schist and quartz mica schist as well as within the quartzite. The Mn ore band has a southern convexity due to N-S trending F4 fold.

In eastern block Mn ore occur discontinuously over 900 m strike length in ENE direction. Two conformable stratified Mn ore band have been mapped. In western block two bands have been identified based on the presence of two abandoned Mn quarry. The strike length is about 100 m with widths varying from 1 to 3 m. Detailed mapping of the area has revealed that the different Mn ore bands in the block belong to the same stratigraphic horizon and repeated due to folding.

# 3. EXPLORATION

## 3.1 DETAILS OF EXPLORATION

The abandoned quarries discontinuously extend from Manegaon to Guguldoh village for about 2.4 km in WNW-ESE direction, the individual quarry diameter is roughly 40m x 40 m and depth is about 20 m. The abandoned quarries were mapped on 1:2000 scale. Drilling commenced in Guguldoh block on 15th November 1999 and the investigation was closed end of September 2001. A total of 1586.45m was drilled in eighteen boreholes. The entire exploration block is divided into 3 blocks namely western block, eastern block and central block.

**EASTERN BLOCK**

Abandoned quarries of Mn ore occur discontinuously over a strike length of 900 m in eastern block. Two conformable Mn ore bands within mica schist have been identified. Nine boreholes (MNG-9-MNG-16) have been drilled in this block. MNG-12 was abandoned; hence borehole MNG-12A was drilled adjacent to it. No significant Mn mineralisation was intersected in any of the boreholes, MNG-9, 10,12A, 13 and 14 intersected minor Mn ore bands and Gondite, rests of boreholes were barren.

**CENTRAL BLOCK**

Work was initially taken up in the central block which has huge abandoned quarries, based on detailed mapping and surface exposures, eight bore holes have been drilled (MNG-1-MNG-8) spaced at 100 m interval. Seven boreholes intersected Gondite, manganese ore with thickness ranging from 20 cm to 13.14 m. Borehole No MNG-5 was barren; 4 conformable Mn bands have been traced based on surface mapping and bore hole intersection. The strike lengths of these bands range from 50 m to maximum 720 m. A total of 748 m has been drilled in 8 boreholes in these blocks.

**WESTERN BLOCK**

Mapping in Western block indicated presence of two level of abandoned Mn quarry for a total strike length of over 220 m. Two conformable stratified Mn ore bands have been mapped at the interface of quartz-mica schist and quartzite. Northern band extends for over 125 m in strike length while southern band is about 120m in strike length located 40 m to south of northern band. Widths of individual

band varies from 1 to 3 m. . To confirm the strike and dip extension of ore horizon exposed in old working drilling machine was deployed. Boreholes were planned and drilled to intersect the ore body at expected depth. Based on the attitude of the ore horizon boreholes were drilled vertical or inclined, so as to intersect the ore horizon around its true width. Generally the angle ranges from 40° to 60°, borehole are spaced at equal interval depending on the strike continuity of ore zone. Two boreholes have been drilled (MNG-17-MNG-18) in this block. Both the boreholes have not intersected any of the Mn ore horizons except for streak and thin bands of Mn ore

### 3.2 CORE LOGGING

The recovered cores from each borehole are placed in the core box either in book pattern or staggered pattern. The core is studied run wise and they are logged in a register noting down its lithological description, depth wise mineralisation and structural features if any. The length of core recovered, is measured and recovery percentage is calculated. In this way run wise logging is carried out for all the boreholes drilled. Run wise litholog of all the 18 boreholes have been furnished in Annexure I and summarized litholog in annexure II.

### 3.3 MANGANESE ORE HORIZON

Out of 19 boreholes drilled in Guguldoh block, manganese ore with Gondite and manganiferous quartzite were intersected. Table-II shows the depth wise intersection of Mn ore, manganiferous quartzite, Gondite in each borehole.

### 3.4 SAMPLING

Sampling was carried out for mineralized core and also bedrock. Using a core splitter core was split longitudinally into two half. One half was preserved and other half was crushed to -200 mesh size. Conning and quartering was carried out for getting the minimum amount required for sampling.

Minimum length of sample was 4 cm while maximum length was 60 cm. Depending on the nature of ore and width of barren zone sample spacing was decided. Table-III shows the number of samples drawn and analyzed from each borehole. Similarly bedrock samples were split into two. One half was powdered and same sampling procedure was adopted and the other sample was kept as a duplicate.

**Table-II**

| Borehole no. | No. of sample | Total no. of sample generated from borehole |
|---|---|---|
| MNG-1 | 27 | 243 |
| MNG-2 | 24 | |
| MNG-3 | 55 | |
| MNG-4 | 20 | |
| MNG-6 | 58 | |
| MNG-7 | 20 | |
| MNG-8 | 19 | |
| MNG-9 | 8 | |
| MNG-10 | 3 | |
| MNG-12A | 9 | |

A total of 243 samples have been sent to Chemical Laboratory for analysis, of which only few have been received. A critical review of the analytical report indicate as follows

**Table III**

| Bh .no | No of sample | Mn% | P% | $SiO_2$ | $Fe_2O_3$ |
|---|---|---|---|---|---|
| MNG-1 | 27 | 6.5 - 40.72 | 0.05 - 0.38 | 20 - 59 | 3 - 17 |
| MNG-2 | 24 | 1.22 – 40 | 0.09 -0.52 | 9 - 45 | 4 - 12 |
| MNG-3 | 55 | 5 - 40 | 0.1 - 0.7 | 23 - 80 | 1.5 - 16 |
| MNG-6 | 58 | 30 | 1.08 | 11-38 | 4.5-12 |
| MNG-7 | 20 | 26 | 0.3 - 1.5 | 20-42 | 5-11 |
| MNG-8 | 19 | 32 | 1.12 | 25-37 | 6-9 |
| MNG-9 | 8 | - | - | - | - |
| MNG-10 | 3 | 25.55 | 1 | 21-25 | 10-12 |
| MNG-12A | 9 | 26.6 | 0.6-1.7 | 21-50 | 7-12 |

**Table IV Showing details of boreholes drilled in Guguldoh block**

| | Borehole no. | Location /bearing | Angle | RL at collar (m) | Depth of Intersection (m) | RL Intersection of ore Horizon | Depth of borehole( m) | RL at bottom | Thickness along the borehole (m) | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|
| CENTRAL BLOCK | MNG-1 | N | 45° | 347.6 | 58.73-61.89 | 303 | 125 | 255 | 3.06 | Manganiferous Quartzite |
| | MNG-2 | N | 45° | 344.2 | 38.35-38.97 39.59-41.00 | 315 | 79.5 | 288 | 2.03 | Gonditic Mn ore |
| | MNG-3 | N | 45° | 353.8 | 37.95-41.40 | 324 | 80.25 | 298 | 3.45 | Mn ore |
| | MNG-4 | N | 45° | 363.22 | 20.35-22.90 | 350 | 80.5 | 310 | 2.55 | Mn ore |
| | MNG-5 | N | 45° | 361.5 | - | - | 100.00 | 292 | - | |
| | MNG-6 | N | 45° | 348.2 | 44.57-47.50 52.91-53.15 53.96-57.45 | - | 100.00 | 282 | - | Gonditic Mn ore |
| | MNG-7 | N | 45° | 341.02 | 48.75-54.75 | 309 | 75015 | 292 | 6.00 | Gonditic Mn ore |
| | MNG-8 | N35°E | 45° | 342.00 | 51.55-55.25 | 313 | 108.5 | 265 | 3.70 | Mn ore |
| EASTERN BLOCK | MNG-9 | N20°W | 45° | 353.165 | 26.00-27.20 41.70-45.30 | 334,323 | 90.00 | 288 | 1.2, 3.60 | Gondite |
| | MNG-10 | N20°W | 45° | 360.400 | - | 335 | 76.5 | 308 | 1.60 | Gonditic Mn ore |
| | MNG-11 | N20°W | 45° | 350.045 | - | - | 70.00 | 320 | - | |
| | MNG-12 | N20°W | 45° | 361.53 | - | - | - | - | - | |
| | MNG-12A | N20°W | 45° | 361.53 | 38.62-41.50 | 335 | 78.65 | 309 | 4.83 | Gonditic Mn ore |
| | MNG-13 | N20°W | 45° | 382.295 | - | - | 85.00 | 322 | - | |
| | MNG-14 | N20°W | 60° | 369.80 | - | - | 107.10 | 277 | - | |
| | MNG-15 | N20°W | 45° | 361.200 | - | - | 80.55 | 306 | - | |
| | MNG-16 | N20°E | 45° | 352.60 | - | - | 80.55 | 295 | - | |
| WESTERN BLOCK | MNG-17 | N20°E | 45° | 344.565 | - | - | 88.00 | 282 | - | |
| | MNG-18 | N20°E | 45° | 370.88 | - | - | 85.20 | 310 | - | |

### 3.5 ESTIMATION OF ORE RESERVES

As seen from analytical report, MNG-8, MNG-2, MNG-3, MNG-1, MNG-6, and MNG-7 has intersected the same Mn ore horizon at different depth and these Mn value ranges between 25 to 30% which can be categorized into **Low grade high silica ore (LGHS).** They also have low phosphorous content. MNG-10 and MNG-12A 300m west of MNT 1 have also intersected Mn horizon. They are also categorized as **Low grade high silica ore** and has low phosphorous. Cross section of the entire above borehole was drawn to estimate the reserves. From the borehole plan the strike influence of each borehole was calculated. The boreholes have intersected the ore horizon at about 30 to 35m vertical depth from ground level and below the bottom of the quarry. Up dip wise extension was defined on the basis of correlation with surface / old working. Down dip direction being half of the up dip length, strike extension was considered on the basis of positive intersection in adjacent bore. In this way area of influence was calculated for each borehole and reserves estimated. The average dip of ore body is 70°. For each borehole true thickness of the ore body was calculated from apparent thickness. Average specific gravity of manganese was taken as 3.1 gm/cm$^2$

Estimation of the ore reserve is summarized as follows

**Borehole No MNG 6**

Located on the western part of the central block in $W_{50}N_{20}$ angle of the borehole in 45° bearing due North. Mn ore has been intersected between 320 and 310 RL and the true thickness of the intersected ore is 4.58m (apparent thickness is 6.42m) RL of the collar is 348.2m. From the longitudinal vertical section the strike influence of the borehole is 80m, and dip length is 60m

Average grade of the ore (13+16 = 29 samples)

| Apparent width (intersected length in the borehole) (m) | True Width (m) | Mn% | $P_2O_5$% | $SiO_2$% | $Fe_2O_3$% |
|---|---|---|---|---|---|
| 2.93 | 2.09 | 30.3 | 1.08 | 20.75 | 8.68 |
| 3.49 | 2.49 | 29.78 | 1.09 | 21.40 | 8.86 |

Strike length extension of these two bands is 120 m ( 50m on the western and 70m on the eastern side)

Dip length is 55 m (up dip direction 35 m and towards down dip direction 20 m)

Reserve calculation

Strike Length x Dip Length x True width x Specific gravity

80m x 40m x 4.58 x 3.1 = 93707 tons $=R_1$

**Borehole No MNG 8**

Located on the western part of the central block in $W_{40}N_{10}$ angle of the borehole in 45° bearing due north. Manganese ore has been intersected at 305 RL, and the true thickness of the intersected ore is 0.73m (apparent thickness is 1.03m) RL of the collar is 342.m. From the longitudinal vertical section the strike length of influence of the borehole is 120m and dip length is 55m.

Average grade of the ore (4 samples)

| Apparent width (intersected length in the borehole) (m) | True Width (m) | Mn% | $P_2O_5$% | $SiO_2$% | $Fe_2O_3$% |
|---|---|---|---|---|---|
| 1.03 | 0.73 | 32 | 1.12 | 23.21 | 8.28 |

Strike length extension of the band is 140 m (70m on the western and 70m on the eastern side)

Dip length is 57 m (up dip direction 37 m and towards down dip direction 20 m)

Reserve calculation

Strike Length x Dip Length x True width x Specific gravity

140m x 57m x 0.75 x 3.1 = 18554 tons $=R_2$

**Borehole No MNG 7**

Located on the western part of the central block in $W_{30}N_0$ angle of the borehole in 45° Bearing due North. Mn ore has been intersected at 309m. RL and the true thickness of the intersected ore is 1.92m (apparent thickness is 2.70) RL of the collar is 341.02m. From the longitudinal vertical section the strike length of influence of the borehole is 140m. dip length is 45m.

Average grade of the ore (8 samples)

| Apparent width (intersected length in the borehole) (m) | True Width (m) | Mn% | $P_2O_5$% | $SiO_2$% | $Fe_2O_3$% |
|---|---|---|---|---|---|
| 2.70m | 1.92 | 26.02 | .80 | 30.23 | 8.4 |

Strike length extension of the band is 120 m (70m on the western and 50m on the eastern side)

Dip length is 75 m (up dip direction 50 m and towards down dip direction 25 m)

Reserve calculation

Strike Length x Dip Length x True width x Specific gravity

120m x 75m x 1.92x 3.1 = 53568 tons $=R_3$

**Borehole No MNG 2**

Located on the western part of the central block in $W_{20.1}N_{30.6}$ angle of the borehole in 45° bearing due North. Mn ore has been intersected at 315 RL, and the true thickness of the intersected ore is 1.14m (apparent thickness is 1.60m) RL of the collar is 344.2m. From the longitudinal vertical section the strike length of influence of the borehole is 60m and dip length is 45m

Average grade of the ore (17 samples)

| Apparent width (intersected length in the borehole)(m) | True Width (m) | Mn% | $P_2O_5$% | $SiO_2$% | $Fe_2O_3$% |
|---|---|---|---|---|---|
| 1.60 | 1.14 | 29.06 | 0.19 | 25.73 | 8.97 |

Strike length extension of the band is 100 m (50m on the western and 50m on the eastern side)

Dip length is 45 m (up dip direction 30 m and towards down dip direction 15 m)

Reserve calculation

Strike Length x Dip Length x True width x Specific gravity

100m x 45m x 1.14 x 3.1 = 15903 tons $=R_4$

**Borehole No MNG 3**

Located on the central part of the central block in $W_{10}N_{15.4}$ angle of the borehole in 45° Bearing due North. Mn ore has been intersected at 324 RL, and the true thickness of the intersected ore is 0.90m (apparent thickness is 1.30m) RL of

the collar is 353.8m. From the longitudinal vertical section the strike length of influence of the borehole is 100m and dip length is 40m

Average grade of the ore (15 samples)

| Apparent width (intersected length in the borehole) | True Width (m) | Mn% | $P_2O_5$% | $SiO_2$% | $Fe_2O_3$% |
|---|---|---|---|---|---|
| 1.3 | 0.93 | 29.7 | 0.37 | 31.6 | 6.89 |

Strike length extension of the band is 100 m (50m on the western and 50m on the eastern side)

Dip length is 60 m (up dip direction 40 m and towards down dip direction 20 m)

Reserve calculation

Strike Length x Dip Length x True width x Specific gravity

100m x 60m x 0.93 x 3.1 = 17298 tons $=R_5$

**Borehole No MNG 1**

Located on the eastern part of the central block in $W_{13}N_3$ angle of the borehole in 45° Bearing due North. Mn ore has been intersected at 315 RL, and the true thickness of the intersected ore is 0.9m (apparent thickness is 1.30m) RL of the collar is 347.5m. From the longitudinal vertical section the strike length of influence of the borehole is 100m. and dip length is 60m

Average grade of the ore (12 samples)

| Apparent width (intersected length in the borehole) | True Width | Mn% | $P_2O_5$% | $SiO_2$% | $Fe_2O_3$% |
|---|---|---|---|---|---|
| 1.32 | 0.94 | 32.05 | 0.14 | 22.72 | 9.10 |

Strike length extension of the band is 100 m (50m on the western and 50m on the eastern side)

Dip length is 75 m (up dip direction 50 m and towards down dip direction 25m)

Reserve calculation

Strike Length x Dip Length x True width x Specific gravity

90m x 75m x 0.94 x 3.1 = 19670 tons $=R_6$

The average weighted grade (Mn%) is calculated as follows

$$\Sigma \frac{R_1 Mn\% + R_2 Mn\% + R_3 Mn\% + R_4 Mn\% + R_5 Mn\% + R_6 Mn\%}{R_1 + R_2 + R_3 + R_4 + R_5 + R_6} = \text{Weighted average Grade}$$

The total reserve estimated in this block is $R_1 + R_2 + R_3 + R_4 + R_5 + R_6 =$ 218700 tons (0.218 million tons) and the average grade is 29.28% of Mn

**TABLE SHOWING THE MANGANES3 ORE RESERVE CALCULATED FOR THE ZONES INTERESECTED IN BOREHOLE**

| Borehole No | True Width(m) | Mn% | $P_2O_5$% | $SiO_2$ % | $Fe_2O_3$ % | Dip length | Strike length | R= SL x DL x TW x SG |
|---|---|---|---|---|---|---|---|---|
| MNG-6 | 2.09 | 30.3 | 1.08 | 20.75 | 8.68 | 120m | 55m | 140m x 40m x 4.58 x 3.1 = 93707 tons |
| | 2.49 | 29.78 | 1.09 | 21.40 | 8.86 | | | |
| MNG-8 | 0.73 | 32 | 1.12 | 23.21 | 8.28 | 140 m | 57 m | 140m x 57m x 0.75 x 3.1 = 18554 tons |
| MNG 7 | 1.92 | 26.02 | 80 | 30.23 | 8.4 | 120 m | 75 m | 120m x 75m x 1.92x 3.1 = 53568 tons |
| MNG 2 | 1.14 | 29.06 | 0.19 | 25.73 | 8.97 | 100 m | 45 m | 100m x 45m x 1.14 x 3.1 = 15903 tons |
| MNG 3 | 0.93 | 29.7 | 0.37 | 31.6 | 6.89 | 100 m | 60m | 100m x 60m x 0.93 x 3.1 = 17298 tons |
| MNG 1 | 0.94 | 32.05 | 0.14 | 22.72 | 9.10 | 100 m | 75 m | 90m x 75m x 0.94 x 3.1 = 19670 tons |
| $\Sigma \frac{R_1 Mn\% + R_2 Mn\% + R_3 Mn\% + R_4 Mn\% + R_5 Mn\% + R_6 Mn\%}{R_1 + R_2 + R_3 + R_4 + R_5 + R_6}$ =Weighted av. Grade | | | | | | | | 218700 tons (0.218 million tons) and the average grade is 29.28% of Mn |

**Revised Estimation by DGM.**

The above resource for the block was estimated by GSI taking into consideration 20% as the cut off for Mn. As the IBM has revised the threshold value for Manganese as10%, the resource was re-estimated by DGM. Thus the total resource for Guguldoh Manganese block is 0.440 million tone (indicated resource 332)with an average grade of 22.70% Mn. A total of 18 bore holes were drilled in the Guguldoh area, out of 18 boreholes, 6 boreholes were drilled in

central block(Plate no D ) are consider for resource estimation. Rest of the bore holes intersected minor Mn ore bands and Gondite.

TABLE SHOWING THE MANGANES3 ORE RESOURCE CALCULATED FOR THE FOR THE CENTRAL PART OF THE BLOCK

**Geological Cross Section Wise Indicated Manganese Resource (332) at threshold value of 10% Mn.**

| BH. No. | True width(m) | Mn% | P2O5 | SiO2 | Fe2O3 | Dip Length | Strike Length | R= SL X DL X TW X SG |
|---|---|---|---|---|---|---|---|---|
| MNG-6 | 2.43 | 21.92 | 1.28 | 22.98 | 8.62 | 55mm | 120m | R1=120X55X7.39X3.1=151199 |
| | 4.96 | 24.94 | 1.35 | 33.9 | 8.06 | | | |
| MNG-8 | 2.18 | 22.59 | 1.18 | 37.8 | 7.85 | 57m | 140m | R2=140X57X2.18X3.1=53929 |
| MNG-7 | 2.9 | 24.96 | 0.88 | 30.35 | 8.44 | 75m | 120m | R3= 120X75X3.85X3.1=107415 |
| | 0.95 | 14.44 | 1.41 | 50.29 | 5.76 | | | |
| MNG-2 | 2.06 | 27.72 | 0.21 | 27.2 | 10.1 | 45m | 100m | R4=100X45X2.06X3.1=28737 |
| MNG-3 | 0.69 | 18.22 | 0.49 | 51.4 | 10.17 | 60m | 100m | R5=100X60X2.53X3.1=47058 |
| | 1.84 | 25.14 | 0.37 | 33.97 | 11.7 | | | |
| MNG-1 | 2.23 | 24.39 | 0.18 | 31.7 | 9.63 | 75m | 100m | R6=100X75X2.23X3.1=51847 |
| ∑R1Mn%+R2Mn%+R3Mn%+R4Mn%+R5Mn%+R6Mn% / R1+R2+R3+R4+R5+R5 = Weighted average grade | | | | | | | | 440185 tons(0.440 million tons) and the average grade is 22.70% of Mn |

## 4. CONCLUSION AND RECOMMENDATION

The investigation continued for 2 years during FS 1999-2000 and 2000-01. Detailed mapping of about 1 sq km in 1:2000 and drilling carried out have revealed no significant Mn ore horizon in Mansar formation/ Chorbaoli Formation. The Mn ore horizons are confined to the Mansar formation at or near contact of Chorbaoli Formation and Mn ore belongs to low-grade ore having Mn % between 20 to 30 %.

Mapping has proved that the Mn ore horizon in Guguldoh block extends over a strike length of 2 km, but drilling has proved that the down dip extension is very limited. Surface Mn ore grades to Gondite at depth as seen in many of borehole intersections. Whatever enriched Mn ore was present in the area;

earlier exploiting agencies have exploited it. Here the zone of oxidation is limited to up to the depth of 5 to 10m below ground surface.

DGM observation:

The total resource for Guguldoh Manganese block is 0.440 million (indicated 332) tone with an average grade of 22.70% Mn. A total of 18 bore holes were drilled in the Guguldoh area,and out of 18 boreholes, 6 boreholes drilled in central part of the area were considered for resource estimation. Rest of the bore holes intersected minor Mn ore bands and Gondite

## 5. LOCALITY INDEX

| Villages | Latitude | Longitude |
|---|---|---|
| Bhanderbori | 21°36': | 79°54' |
| Guguldoh | 21° 25': | 79 ° 26' |
| Junawani | 21° 29': | 79 ° 18' |
| Mandri | 21° 25' | :79 ° 24' |
| Manegaon | 21° 26': | 79 ° 28' |
| Mansar | 21° 24' | :79 ° 16' |
| Murda | 21° 27' | 79 ° 25' |
| Musewadi | 21° 26' | :79 ° 22' |
| Ramtek | 21° 24' | :79 ° 20' |

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## TABLE SHOWING THE MANGANESE ORE RESOURCE CALCULATED BY THE DGM FOR THE CENTRAL PART OF THE MINE

### Geological Cross Section Wise Indicated Manganese Resource (332) at threshold value of 10% Mn.

| BH. No. | True width(m) | Mn % | P2O5 | SiO2 | Fe2O3 | Dip Length | Strike Length | R= SL X DL X TW X SG |
|---|---|---|---|---|---|---|---|---|
| MNG-6 | 2.43 | 21.92 | 1.28 | 22.98 | 8.62 | 55m | 120m | R1=120X55X7.39X3.1=151199 |
| | 4.96 | 24.94 | 1.35 | 33.9 | 8.06 | | | |
| MNG-8 | 2.18 | 22.59 | 1.18 | 37.8 | 7.85 | 57m | 140m | R2=140X57X2.18X3.1=53929 |
| MNG-7 | 2.9 | 24.96 | 0.88 | 30.35 | 8.44 | 75m | 120m | R3= 120X75X3.85X3.1=107415 |
| | 0.95 | 14.44 | 1.41 | 50.29 | 5.76 | | | |
| MNG-2 | 2.06 | 27.72 | 0.21 | 27.2 | 10.1 | 45m | 100m | R4=100X45X2.06X3.1=28737 |
| MNG-3 | 0.69 | 18.22 | 0.49 | 51.4 | 10.17 | 60m | 100m | R5=100X60X2.53X3.1=47058 |
| | 1.84 | 25.14 | 0.37 | 33.97 | 11.7 | | | |
| MNG-1 | 2.23 | 24.39 | 0.18 | 31.7 | 9.63 | 75m | 100m | R6=100X75X2.23X3.1=51847 |
| **∑R1Mn%+R2Mn%+R3Mn%+R4Mn%+R5Mn%+R6Mn% = Weighted average grade R1+R2+R3+R4+R5+R6** | | | | | | | | **440185 tons(0.440 million tons) and the average grade is 22.70% of Mn** |

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# Annexure 2

## CHEMICAL ANALYSIS OF CORE SAMPLES

### BOREHOLE NO. MNG-1

TOTAL NO. OF SAMPLES-27

| Sample no. | Drilling run (M) | | Length of run | Length of core recovered | % Of core recovery | Section sampled | | Sample length (CM) | Analytical data % | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | From | To | | | | From | To | | Mn | $P_2O_5$ | $SiO_2$ | $Fe_2O_3$ | $Al_2O_3$ | Mn% x L |
| CS-1 | 57.90 | 60.95 | 3.05 | 2.97 | 97 | 58.73 | 58.82 | 9 | 17.10 | 0.31 | 42.09 | 11.93 | 4.90 | 153.9 |
| CS-2 | | | | | | 58.82 | 58.91 | 9 | 16.29 | 0.40 | 40.37 | 7.34 | 9.76 | 147.61 |
| CS-3 | | | | | | 58.91 | 59.00 | 9 | 19.54 | 0.38 | 23.82 | 11.10 | 6.75 | 175.86 |
| CS-4 | | | | | | 59.00 | 59.09 | 9 | 24.03 | 0.26 | 20.04 | 11.75 | 60.40 | 216.27 |
| CS-5 | | | | | | 59.09 | 59.17 | 8 | 23.62 | 0.13 | 22.91 | 11.64 | 4.70 | 188.96 |
| CS-6 | | | | | | 59.17 | 59.23 | 6 | 8.14 | 0.12 | 58.80 | 12.33 | 4.70 | 48.84 |
| CS-7 | | | | | | 59.48 | 59.55 | 7 | 13.84 | 0.10 | 51.40 | 8.83 | 4.85 | 96.88 |
| CS-8 | | | | | | 59.55 | 59.63 | 8 | 1.22 | 0.21 | 67.27 | 2.96 | 9.70 | 9.76 |
| CS-9 | | | | | | 59.63 | 59.73 | 10 | 24.84 | 0.19 | 32.00 | 9.85 | 3.16 | 248.40 |
| CS-10 | | | | | | 59.73 | 59.81 | 8 | 26.88 | 0.14 | 34.94 | 9.45 | 3.46 | 215.04 |
| CS-11 | | | | | | 59.31 | 59.93 | 12 | 36.24 | 0.18 | 24.19 | 9.20 | 2.10 | 434.88 |
| CS-12 | | | | | | 59.93 | 60.03 | 10 | 30.95 | 0.12 | 26.14 | 9.90 | 3.20 | 309.50 |
| CS-13 | | | | | | 60.03 | 60.18 | 15 | 34.61 | 0.10 | 21.027 | 10.30 | 2.55 | 519.15 |
| CS-14 | | | | | | 60.18 | 60.30 | 12 | 32.17 | 0.16 | 22.47 | 10.40 | 3.55 | 386.04 |
| CS-15 | | | | | | 60.30 | 60.46 | 16 | 28.10 | 0.17 | 21.30 | 9.00 | 5.20 | 449.60 |
| CS-16 | | | | | | 60.46 | 60.53 | 7 | 19.14 | 0.14 | 20.08 | 8.60 | 4.40 | 133.98 |
| CS-17 | | | | | | 60.53 | 60.62 | 9 | 40.72 | 0.08 | 20.89 | 4.46 | 2.40 | 366.48 |
| CS-18 | | | | | | 60.62 | 60.74 | 12 | 40.32 | 0.11 | 19.51 | 10.75 | 2.82 | 483.84 |
| CS-19 | | | | | | 60.74 | 60.86 | 12 | 32.98 | 0.17 | 18.18 | 9.73 | 2.20 | 395.76 |
| CS-20 | | | | | | 60.86 | 60.95 | 9 | 20.77 | 0.21 | 21.69 | 7.55 | 5.00 | 186.93 |
| CS-21 | 60.95 | 64.00 | 3.05 | 3.05 | 100 | 60.95 | 61.07 | 12 | 13.03 | 0.11 | 44.25 | 11.55 | 5.52 | 156.36 |
| CS-22 | | | | | | 61.07 | 61.27 | 10 | 16.29 | 0.16 | 31.66 | 11.70 | 7.80 | 162.90 |
| CS-23 | | | | | | 61.17 | 61.29 | 12 | 10.99 | 0.14 | 46.49 | 10.02 | 9.50 | 131.88 |
| CS-24 | | | | | | 61.29 | 61.42 | 13 | 14.25 | 0.16 | 38.77 | 11.00 | 9.50 | 185.25 |
| CS-25 | | | | | | 61.62 | 61.69 | 8 | 7.74 | 0.14 | 46.11 | 10.40 | 10.34 | |
| CS-26 | | | | | | 61.69 | 61.82 | 13 | 6.52 | 0.05 | 44.96 | 14.20 | 15.30 | |
| CS-27 | | | | | | 61.82 | 61.89 | 7 | 8.96 | 0.09 | 51.76 | 16.85 | 12.30 | |

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## CHEMICAL ANALYSIS OF CORE SAMPLES
## BOREHOLE NO. MNG-2

TOTAL NO. OF SAMPLES-24

| Sample no. | Drilling run (M) | | Length of run | Length of core recovered | % Of core recovery | Section sampled | | Length of sample (CM) | Analytical data % | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | From | To | | | | From | To | | Mn | $P_2O_5$ | $SiO_2$ | $Fe_2O_3$ | $Al_2O_3$ | Mn%x L |
| CS-1 | 35.75 | 38.60 | 2.85 | 2.60 | 91 | 38.35 | 38.50 | 15 | 14.42 | 0.15 | 47.00 | 12.20 | 50.10 | |
| CS-2 | | | | | | 38.50 | 38.60 | 10 | 17.30 | 0.19 | 45.47 | 6.90 | 4.70 | |
| CS-3 | 38.60 | 40.30 | 1.70 | 1.55 | 91 | 38.60 | 38.69 | 9 | 30.48 | 0.28 | 14.10 | 20.80 | 5.50 | |
| CS-4 | | | | | | 38.69 | 38.75 | 6 | 12.77 | 0.35 | 30.03 | 11.95 | 12.40 | |
| CS-5 | | | | | | 38.75 | 38.84 | 9 | 28.08 | 0.12 | 9.63 | 8.70 | 5.20 | 252.72 |
| CS-6 | | | | | | 38.84 | 38.97 | 13 | 31.74 | 0.16 | 19.86 | 11.50 | 3.60 | 412.62 |
| CS-7 | | | | | | 39.59 | 39.66 | 7 | 21.98 | 0.18 | 45.52 | 6.55 | 4.30 | |
| CS-8 | | | | | | 39.66 | 39.55 | 9 | 28.49 | 0.36 | 21.97 | 7.60 | 6.40 | 256.41 |
| CS-9 | | | | | | 39.75 | 39.87 | 12 | 24.42 | 0.19 | 33.72 | 8.00 | 5.20 | 293.04 |
| CS-10 | | | | | | 39.87 | 39.99 | 12 | 26.05 | 0.26 | 27.19 | 9.00 | 7.50 | 312.60 |
| CS-11 | | | | | | 39.99 | 40.04 | 5 | 1.22 | 0.52 | 47.74 | 4.55 | 18.75 | |
| CS-12 | | | | | | 40.04 | 40.10 | 6 | 21.16 | 0.36 | 30.46 | 10.75 | 9.50 | |
| CS-13 | | | | | | 40.10 | 40.16 | 6 | 38.66 | 0.10 | 27.76 | 3.75 | 2.15 | 126.96 |
| CS-14 | | | | | | 40.16 | 40.25 | 9 | 37.04 | 0.10 | 22.87 | 11.35 | 3.00 | 333.036 |
| CS-15 | | | | | | 40.25 | 40.30 | 5 | 37.85 | 0.18 | 21.19 | 11.80 | 3.60 | 189.25 |
| CS-16 | 40.30 | 41.00 | 0.70 | 70 | 100 | 40.30 | 40.34 | 4 | 34.59 | 0.16 | 29.97 | 8.70 | 5.00 | 138.36 |
| CS-17 | | | | | | 40.34 | 40.38 | 4 | 33.78 | 0.16 | 21.68 | 12.60 | 3.15 | 135.12 |
| CS-18 | | | | | | 40.34 | 40.43 | 5 | 28.81 | 0.25 | 24.75 | 12.20 | 5.40 | 114.05 |
| CS-19 | | | | | | 40.43 | 40.50 | 7 | 40.29 | 0.15 | 20.12 | 11.70 | 3.20 | 282.03 |
| CS-20 | | | | | | 40.50 | 40.64 | 11 | 33.78 | 0.09 | 30.95 | 9.75 | 4.70 | 371.58 |
| CS-21 | | | | | | 40.61 | 40.75 | 17 | 39.88 | 0.11 | 25.97 | 11.80 | 2.00 | 558.32 |
| CS-22 | | | | | | 40.75 | 40.82 | 7 | 33.78 | 0.09 | 13.83 | 10.35 | 2.30 | 236.46 |
| CS-23 | | | | | | 40.82 | 40.91 | 9 | 24.83 | 0.18 | 13.40 | 9.40 | 8.40 | 223.47 |
| CS-24 | | | | | | 40.91 | 41.00 | 9 | 25.23 | 0.23 | 28.02 | 9.30 | 6.00 | 227.07 |

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## CHEMICAL ANALYSIS OF CORE SAMPLES
## BOREHOLE NO. MNG-3

TOTAL NO. OF SAMPLES-55

| Sample no. | Drilling run (M) | | Length of run | Length of core recovered | % Of core recovery | Section sampled | | Length of sample (CM) | Analytical data % | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | From | To | | | | From | To | | Mn | $P_2O_5$ | $SiO_2$ | $Fe_2O_3$ | $Al_2O_3$ | Mn% x L |
| CS-1 | 32.30 | 33.85 | 1.55 | 0.55 | 35 | 33.47 | 33.66 | 17 | 3.30 | Tr | 81.54 | 4.73 | 4.45 | |
| CS-2 | | | | | | 33.66 | 33.85 | 17 | 4.53 | Tr | 81.74 | 8.07 | 0.90 | |
| CS-3 | 33.85 | 34.20 | 0.35 | 0.10 | 28 | 33.85 | 34.20 | 35 | 13.18 | Tr | 54.80 | 13.72 | 9.40 | |
| CS-4 | 34.20 | 34.40 | 0.20 | 0.16 | 80 | 34.20 | 34.27 | 7 | 0.26 | 0.11 | 88.72 | 1.50 | 3.90 | |
| CS-5 | | | | | | 34.27 | 34.40 | 13 | 5.35 | 0.17 | 46.93 | 7.77 | 3.50 | |
| CS-6 | 34.40 | 35.50 | 0.10 | 0.10 | 100 | 34.40 | 34.50 | 10 | 3.30 | 0.13 | 84.79 | 6.86 | 0.98 | |
| CS-7 | 34.50 | 35.35 | 0.85 | 0.80 | 94 | 34.50 | 34.59 | 9 | 11.94 | 0.84 | 44.47 | 13.78 | 8.62 | |
| CS-8 | | | | | | 34.59 | 34.68 | 9 | 13.59 | 0.71 | 35.61 | 22.00 | 10.30 | |
| CS-9 | | | | | | 34.68 | 34.78 | 10 | 14.00 | 0.60 | 42.67 | 15.75 | 7.75 | |
| CS-10 | | | | | | 34.78 | 34.84 | 6 | 39.55 | Tr | 27.07 | 4.04 | Tr | |
| CS-11 | | | | | | 34.84 | 34.90 | 6 | 25.95 | 0.32 | 34.96 | 8.88 | 7.25 | |
| CS-12 | | | | | | 34.90 | 34.57 | 7 | 4.12 | 0.60 | 53.41 | 10.96 | 9.50 | |
| CS-13 | | | | | | 34.97 | 35.03 | 6 | 0.70 | 0.74 | 61.30 | 6.13 | 9.50 | |
| CS-14 | | | | | | 35.03 | 35.11 | 8 | 0.43 | Tr | 93.70 | 2.81 | Tr | |
| CS-15 | | | | | | 35.11 | 35.26 | 15 | 9.47 | 0.27 | 50.32 | 14.78 | 8.50 | |
| CS-16 | 37.75 | 38.60 | 0.85 | 0.76 | 89 | 37.93 | 38.00 | 7 | 15.65 | 0.40 | 51.62 | 9.17 | 5.50 | |
| CS-17 | | | | | | 38.00 | 38.07 | 7 | 14.83 | 0.64 | 48.95 | 13.21 | 5.70 | |
| CS-18 | | | | | | 38.07 | 38.12 | 5 | 7.40 | 0.67 | 58.49 | 5.69 | 8.50 | |
| CS-19 | | | | | | 38.12 | 38.22 | 10 | 8.24 | 0.52 | 56.43 | 8.14 | 6.94 | |
| CS-20 | | | | | | 38.22 | 38.37 | 15 | 10.30 | 0.55 | 60.64 | 7.02 | 5.65 | |
| CS-21 | | | | | | 38.37 | 38.46 | 9 | 2.06 | 0.24 | 69.84 | 4.25 | 8.04 | |
| CS-22 | | | | | | 38.46 | 38.51 | 5 | 0.41 | 0.18 | 70.62 | 5.19 | 7.87 | |
| CS-23 | | | | | | 38.51 | 38.60 | 9 | 1.23 | 0.22 | 69.22 | 5.28 | 8.36 | |
| CS-24 | 38.60 | 39.20 | 0.60 | 0.53 | 88 | 38.60 | 38.68 | 8 | 8.65 | 0.25 | 60.88 | 9.30 | 5.56 | |
| CS-25 | | | | | | 38.68 | 38.77 | 9 | 0.41 | 0.32 | 70.89 | 3.45 | 8.39 | |
| CS-26 | | | | | | 38.97 | 38.83 | 6 | 8.85 | 0.20 | 71.23 | 7.15 | 2.85 | |
| CS-27 | | | | | | 38.83 | 38.94 | 11 | 0.82 | 0.55 | 66.27 | 3.47 | 10.30 | |
| CS-28 | | | | | | 38.94 | 39.05 | 11 | 7.82 | 0.18 | 68.48 | 14.87 | 2.78 | |
| CS-29 | | | | | | 39.05 | 39.15 | 10 | 0.41 | 0.69 | 68.50 | 3.14 | 9.40 | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CS-30 | | | | | | 39.15 | 39.20 | 5 | 1.20 | 1.03 | 61.05 | 4.58 | 8.55 | |
| CS-31 | 39.20 | 40.40 | 1.20 | 1.10 | 92 | 39.20 | 39.33 | 13 | 0.60 | 0.71 | 65.26 | 3.24 | 9.91 | |
| CS-32 | | | | | | 39.33 | 39.46 | 13 | 0.62 | 0.73 | 70.77 | 3.49 | 6.74 | |
| CS-33 | | | | | | 39.44 | 39.56 | 10 | 5.76 | 0.75 | 56.62 | 6.45 | 9.00 | |
| CS-34 | | | | | | 39.56 | 39.61 | 5 | 21.42 | 0.46 | 45.01 | 7.75 | 4.83 | 107.10 |
| CS-35 | | | | | | 39.61 | 39.71 | 10 | 23.02 | 0.32 | 45.74 | 7.50 | 4.04 | 230.70 |
| CS-36 | | | | | | 39.71 | 39.82 | 11 | 19.36 | 0.34 | 50.78 | 6.80 | 4.27 | 212.96 |
| CS-37 | | | | | | 39.82 | 39.93 | 11 | 29.25 | 0.76 | 22.29 | 11.50 | 2.64 | 321.75 |
| CS-38 | | | | | | 39.93 | 40.03 | 10 | 32.54 | 0.60 | 24.54 | 11.30 | 3.09 | 325.40 |
| CS-39 | | | | | | 40.03 | 40.12 | 9 | 26.78 | 0.20 | 51.11 | 3.30 | 11.55 | 241.09 |
| CS-40 | | | | | | 40.12 | 40.18 | 6.5 | 32.54 | 0.40 | 27.18 | **9.80** | 3.24 | 211.51 |
| CS-41 | | | | | | 40.18 | 40.25 | 6.5 | 38.72 | 0.20 | 22.40 | 8.80 | 2.19 | 251.68 |
| CS-42 | | | | | | 40.25 | 40.30 | 5 | 40.37 | 0.28 | 16.04 | 10.50 | 2.47 | 201.85 |
| CS-43 | | | | | | 40.30 | 40.40 | 10 | 32.96 | 0.32 | 25.14 | 1.80 | 2.17 | 329.60 |
| CS-44 | 40.40 | 41.40 | 1.00 | 1.00 | 100 | 40.40 | 40.56 | 16 | 30.07 | 0.32 | 23.78 | 11.75 | 4.40 | |
| CS-45 | | | | | | 40.56 | 40.61 | 5 | 30.90 | 0.28 | 27.30 | 8.90 | 2.07 | |
| CS-46 | | | | | | 40.61 | 40.69 | 8 | 25.95 | 0.36 | 30.86 | 9.80 | 4.10 | |
| CS-47 | | | | | | 40.69 | 40.81 | 12 | 34.19 | 0.28 | 22.99 | 10.10 | 3.22 | |
| CS-48 | | | | | | 40.81 | 40.86 | 5 | 21.83 | 0.44 | 33.72 | 13.00 | 6.68 | |
| CS-49 | | | | | | 40.86 | 40.94 | 8 | 14.83 | 0.32 | 46.08 | 10.10 | 7.71 | |
| CS-50 | | | | | | 40.94 | 41.02 | 8 | 17.30 | 0.56 | 42.54 | 11.10 | 7.55 | |
| CS-51 | | | | | | 41.02 | 41.09 | 7 | 16.89 | 0.55 | 39.74 | 14.08 | 11.25 | |
| CS-52 | | | | | | 41.09 | 41.18 | 9 | 10.71 | 0.13 | 45.15 | 10.56 | 11.65 | |
| CS-53 | | | | | | 41.18 | 41.28 | 10 | 10.71 | 0.14 | 48.07 | 19.21 | 14.21 | |
| CS-54 | | | | | | 41.28 | 41.33 | 5 | 21.07 | 0.67 | 23.67 | 12.56 | 1.70 | |
| CS-55 | | | | | | 41.33 | 41.40 | 7 | 21.84 | 0.25 | 33.33 | 11.32 | 10.15 | |

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## CHEMICAL ANALYSIS OF CORE SAMPLES
## BOREHOLE NO. MNG-4

SAMPLES-20 TOTAL NO. OF

| Sample no | Drilling run (M) | | Length of run | Length of core recovered | % Of core recovery | Section sampled | | Length of sample (CM) | Analytical data % | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | From | To | | | | From | To | | Mn | $P_2O_5$ | $SiO_2$ | $Fe_2O_3$ | $Al_2O_3$ | Mn % x L |
| CS-1 | 19.90 | 20.90 | 1.00 | 0.45 | 45 | 20.35 | 20.46 | 11 | 2.92 | 0.18 | 80.14 | 2.37 | 9.32 | |
| CS-2 | | | | | | 20.46 | 20.68 | 22 | 1.90 | 0.25 | 84.97 | 1.60 | 0.15 | |
| CS-3 | | | | | | 20.68 | 20.90 | 22 | 16.89 | 0.32 | 51.12 | 5.62 | 7.46 | |
| CS-4 | 20.90 | 21.20 | 0.30 | 0.30 | 100 | 20.90 | 20.97 | 7 | 21.01 | 0.53 | 47.69 | 6.02 | 6.10 | |
| CS-5 | | | | | | 20.97 | 21.56 | 9 | 17.30 | 0.18 | 48.34 | 6.20 | 8.23 | |
| CS-6 | | | | | | 21.06 | 21.11 | 5 | 23.48 | 0.60 | 33.80 | 8.88 | 7.56 | |
| CS-7 | | | | | | 21.11 | 21.20 | 9 | 23.89 | 0.32 | 58.08 | 7.90 | 8.80 | |
| CS-8 | 21.20 | 22.90 | 1.70 | 1.37 | 80 | 21.20 | 21.34 | 14 | 13.18 | 0.20 | 34.64 | 6.25 | 8.70 | |
| CS-9 | | | | | | 21.34 | 21.48 | 14 | 6.18 | 0.46 | 46.03 | 7.10 | 15.65 | |
| CS-10 | | | | | | 21.48 | 21.62 | 14 | 6.59 | 0.71 | 63.82 | 4.10 | 9.07 | |
| CS-11 | | | | | | 21.62 | 21.73 | 11 | 2.25 | 0.32 | 82.87 | 1.89 | 5.20 | |
| CS-12 | | | | | | 21.73 | 21.89 | 16 | 2.25 | 0.40 | 82.69 | 2.04 | 5.17 | |
| CS-13 | | | | | | 21.89 | 22.12 | 23 | 2.00 | 0.20 | 79.76 | 2.23 | 4.97 | |
| CS-14 | | | | | | 22.12 | 22.26 | 14 | 5.89 | 0.32 | 70.28 | 3.87 | 6.06 | |
| CS-15 | | | | | | 22.26 | 22.37 | 11 | 6.37 | 0.20 | 71.96 | 3.09 | 5.02 | |
| CS-16 | | | | | | 22.37 | 22.53 | 16 | Tr | 0.25 | 69.95 | 0.30 | 0.62 | |
| CS-17 | | | | | | 22.53 | 22.64 | 11 | 4.28 | 0.30 | 78.15 | 2.44 | 5.04 | |
| CS-18 | | | | | | 22.64 | 22.73 | 9 | 6.45 | 0.60 | 71.34 | 4.15 | 6.07 | |
| CS-19 | | | | | | 22.73 | 22.80 | 7 | 7.80 | 0.70 | 66.32 | 3.51 | 5.97 | |
| CS-20 | | | | | | 22.80 | 22.90 | 10 | 9.12 | 0.72 | 65.71 | 3.70 | 3.79 | |

## CHEMICAL ANALYSIS OF CORE SAMPLES
## BOREHOLE NO. MNG-6

TOTAL NO. OF SAMPLES-57

| Sample no. | Drilling run (M) | | Length of run | Length of core recovered | % Of core recovery | Section sampled | | Length of sample (CM) | Analytical data % | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | From | To | | | | From | To | | Mn | $P_2O_5$ | $SiO_2$ | $Fe_2O_3$ | $Al_2O_3$ | Mn%x L |
| CS-1 | 41.50 | 44.50 | 3.00 | 3.00 | 100 | 44.00 | 44.15 | 15 | 4.39 | 0.62 | 64.02 | 5.68 | 12.51 | |
| CS-2 | | | | | | 44.15 | 44.44 | 29 | 0.81 | 0.51 | 79.02 | 2.82 | 9.11 | |
| CS-3 | | | | | | 44.44 | 44.50 | 6 | 5.04 | 0.49 | 59.31 | 4.85 | 11.68 | |
| CS-4 | 44.50 | 45.60 | 1.10 | 0.90 | 81.8 | 44.50 | 44.57 | 7 | 15.14 | 2.07 | 33.91 | 9.72 | 11.72 | |
| CS-5 | | | | | | 44.57 | 44.75 | 18 | 26.21 | 0.62 | 19.94 | 9.98 | 1.91 | 471.78 |
| CS-6 | | | | | | 44.75 | 44.90 | 15 | 24.91 | 1.19 | 24.27 | 11.72 | 3.15 | 373.65 |
| CS-7 | | | | | | 44.90 | 45.10 | 20 | 21.02 | 1.92 | 29.01 | 4.56 | 5.34 | 420.4 |
| CS-8 | | | | | | 45.10 | 45.21 | 11 | 24.91 | 1.78 | 19.57 | 7.61 | 5.34 | 274.01 |
| CS-9 | | | | | | 45.21 | 45.33 | 12 | 37.93 | 0.64 | 17.93 | 5.86 | 1.68 | 455.16 |
| CS-10 | | | | | | 45.33 | 45.45 | 12 | 32.56 | 1.21 | 18.02 | 5.86 | 3.46 | 390.72 |
| CS-11 | | | | | | 45.45 | 45.60 | 15 | 32.72 | 0.65 | 23.22 | 5.37 | 2.15 | 490.8 |
| CS-12 | 45.60 | 46.00 | 0.40 | 0.40 | 100 | 45.60 | 45.80 | 20 | 30.28 | 0.94 | 17.57 | 10.76 | 3.23 | 605.6 |
| CS-13 | | | | | | 45.80 | 46.00 | 20 | 25.72 | 1.22 | 18.23 | 8.78 | 5.02 | 514.4 |
| CS-14 | 46.00 | 46.10 | 0.10 | 0.10 | 100 | 46.00 | 46.10 | 10 | 26.37 | 1.25 | 25.19 | 10.91 | 3.66 | 263.7 |
| CS-15 | 46.10 | 47.50 | 1.40 | 1.40 | 100 | 46.73 | 47.02 | 29 | 37.77 | 1.09 | 16.99 | 10.55 | 2.02 | 1095.33 |
| CS-16 | | | | | | 47.02 | 47.30 | 28 | 35.01 | 0.9 | 15.18 | 10.71 | 2.015 | 980.28 |
| CS-17 | | | | | | 47.03 | 47.50 | 19 | 33.54 | 0.93 | 24.67 | 10.13 | 2.48 | 637.26 |
| CS-18 | 47.50 | 48.50 | 1.10 | 0.70 | 63 | 47.50 | 47.57 | 7 | 15.46 | 2.81 | 41.11 | 6.75 | 6.15 | |
| CS-19 | | | | | | 47.57 | 48.00 | 43 | 4.55 | 1.31 | 60.98 | 4.98 | 9.88 | |
| CS-20 | | | | | | 48 | 48.60 | 60 | 8.14 | 1.84 | 47.84 | 6.63 | 11.71 | |
| CS-21 | 48.60 | 50.50 | 1.90 | 1.90 | 100 | 48.60 | 48.77 | 17 | 6.67 | 0.86 | 62.24 | 3.71 | 7.45 | |
| CS-22 | | | | | | 48.77 | 48.94 | 17 | 7.01 | 0.78 | 66.48 | 4.88 | 4.34 | |
| CS-23 | | | | | | 48.94 | 49.19 | 25 | 1.46 | 1.37 | 59.86 | 6.34 | 13.08 | |
| CS-24 | | | | | | 49.19 | 49.36 | 17 | 1.31 | 1.05 | 66.84 | 3.22 | 12.48 | |
| CS-25 | | | | | | 49.36 | 49.59 | 23 | 1.63 | 1.02 | 67.11 | 3.31 | 11.45 | |
| CS-26 | | | | | | 49.59 | 49.00 | 9 | 2.93 | 1.24 | 64.71 | 3.21 | 12.32 | |
| CS-27 | 49.68 | 50.09 | | | | 49.68 | 50.09 | 41 | 0.65 | 0.84 | 67.82 | 3.48 | 12.28 | |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CS-28 | | | | | | 50.09 | 50.50 | 41 | 25.23 | 1.17 | 28.71 | 7.31 | 3.17 | |
| CS-29 | 50.50 | 53.00 | 2.50 | 2.50 | 100 | 50.50 | 50.63 | 13 | 11.88 | 1.42 | 51.87 | 5.9 | 7.43 | |
| CS-30 | | | | | | 52.66 | 52.91 | 25 | 5.53 | 0.92 | 63.02 | 4.62 | 9.04 | |
| CS-31 | | | | | | 52.91 | 53.00 | 9 | 19.72 | 1.37 | 42.54 | 9.22 | 4.88 | 177.48 |
| CS-32 | 53.00 | 53.15 | 0.15 | 10 | 66 | 53.00 | 53.09 | 9 | 29.34 | 0.86 | 29.02 | 9.62 | 4.57 | 264.06 |
| CS-33 | | | | | | 53.09 | 53.15 | 6 | 25.11 | 1.97 | 28.14 | 16.48 | 6.83 | 150.66 |
| CS-33A | 53.15 | 54.30 | 1.15 | 0.84 | 73 | 53.15 | 53.20 | 5 | 1.31 | 3.62 | 60.94 | 4.89 | 11.98 | |
| CS-34 | | | | | | 53.20 | 53.34 | 14 | 13.53 | 1.11 | 61.38 | 5.75 | 5.84 | |
| CS-35 | | | | | | 53.34 | 53.50 | 16 | 10.59 | 1.76 | 56.61 | 5.11 | 8.71 | |
| CS-36 | | | | | | 53.50 | 53.53 | 13 | 6.68 | 2.79 | 49.87 | 4.45 | 11.95 | |
| CS-37 | | | | | | 53.69 | 53.81 | 18 | 6.52 | 2.79 | 66.98 | 5.35 | 7.81 | |
| CS-38 | | | | | | 53.81 | 53.96 | 16 | 13.21 | 0.44 | 58.97 | 6.93 | 7.14 | |
| CS-39 | | | | | | 53.96 | 57.04 | 8 | 30.64 | 0.68 | 25.13 | 11.54 | 5.02 | 245.12 |
| CS-40 | | | | | | 54.04 | 54.09 | 5 | 22.33 | 0.89 | 44.81 | 7.44 | 3.08 | 111.65 |
| CS-41 | | | | | | 54.09 | 54.30 | 21 | 24.45 | 1.05 | 34.98 | 7.22 | 3.62 | 513.45 |
| CS-42 | 54.30 | 56.50 | 2.20 | 2.20 | 100 | 54.30 | 54.58 | 28 | 20.86 | 1.02 | 37.73 | 7.71 | 4.98 | 584.08 |
| CS-43 | | | | | | 54.58 | 54.78 | 20 | 30.64 | 0.99 | 26.17 | 7.76 | 4.95 | 612.8 |
| CS-44 | | | | | | 54.78 | 54.96 | 18 | 32.44 | 0.68 | 21.33 | 7.27 | 3.77 | 583.92 |
| CS-45 | | | | | | 54.96 | 55.24 | 28 | 24.94 | 1.12 | 17.25 | 10.49 | 4.65 | 698.32 |
| CS-46 | | | | | | 55.24 | 55.51 | 27 | 31.78 | 1.28 | 14.17 | 6.15 | 4.44 | 858.06 |
| CS-47 | | | | | | 55.51 | 55.76 | 25 | 30.15 | 0.98 | 11.94 | 7.91 | 3.75 | 753.75 |
| CS-48 | | | | | | 55.76 | 55.98 | 22 | 29.83 | 0.81 | 20.02 | 7.61 | 3.25 | 656.26 |
| CS-49 | | | | | | 55.98 | 56.34 | 36 | 37.98 | 0.76 | 15.96 | 8.23 | 1.82 | 1367.28 |
| CS-50 | | | | | | 56.34 | 56.50 | 16 | 33.25 | 1.17 | 13.91 | 9.81 | 5.61 | 532 |
| CS-51 | | | | | | 56.50 | 56.68 | 18 | 29.51 | 1.48 | 13.11 | 10.14 | 7.68 | 531.18 |
| CS-52 | | | | | | 56.68 | 56.98 | 30 | 35.04 | 0.76 | 11.12 | 6.27 | 2.58 | 1051.2 |
| CS-53 | | | | | | 56.98 | 57.20 | 22 | 29.01 | 1.29 | 19.51 | 12.13 | 5.03 | 838.22 |
| CS-54 | | | | | | 57.20 | 57.45 | 25 | 26.24 | 1.97 | 16.03 | 12.18 | 4.56 | 656 |
| CS-55 | | | | | | 57.45 | 57.68 | 23 | 18.09 | 1.69 | 43.95 | 6.11 | 2.17 | |
| CS-56 | | | | | | 57.68 | 57.88 | 20 | 2.77 | 1.24 | 52.22 | 6.36 | 12.61 | |
| CS-57 | | | | | | 57.88 | 58.10 | 22 | 1.95 | 1.06 | 62.66 | 4.89 | 13.26 | |

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## CHEMICAL ANALYSIS OF CORE SAMPLES
## BOREHOLE NO. MNG-7

TOTAL NO. OF SAMPLES-20

| Sample no. | Drilling run (M) | | Length of run | Length of core recovered | % Of core recovery | Section sampled | | Length of sample (CM) | Analytical data % | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | From | To | | | | From | To | | Mn | $P_2O_5$ | $SiO_2$ | $Fe_2O_3$ | $Al_2O_3$ | Mn% x L |
| CS-1 | 47.55 | 50.55 | 3.00 | 2.74 | 91 | 48.75 | 49.40 | 65 | 20.14 | 0.79 | 42.03 | 8.84 | 6.86 | 1309.10 |
| CS-2 | | | | | | 49.90 | 49.80 | 46 | 32.35 | 0.77 | 19.51 | 11.27 | 3.15 | 1488.10 |
| CS-3 | | | | | | 49.86 | 50.55 | 69 | 27.56 | 1.41 | 22.77 | 8.92 | 5.67 | 19.01.64 |
| CS-4 | 50.55 | 51.00 | 0.45 | 0.45 | 100 | 50.55 | 50.70 | 15 | 22.28 | 0.02 | 30.21 | 6.80 | 6.65 | 334.20 |
| CS-5 | | | | | | 50.70 | 50.85 | 15 | 28.23 | 0.12 | 24.61 | 9.45 | 3.17 | 423.45 |
| CS-6 | | | | | | 50.85 | 51.00 | 15 | 23.60 | 0.98 | 41.88 | 10.35 | 2.05 | 354.00 |
| CS-7 | 51.00 | 52.15 | 1.15 | 1.15 | 100 | 51.00 | 51.25 | 25 | 31.86 | 0.82 | 21.84 | 6.76 | 3.28 | 796.50 |
| CS-8 | | | | | | 51.25 | 51.45 | 20 | 20.96 | 1.64 | 39.02 | 5.27 | 4.87 | 419.20 |
| CS-9 | | | | | | 51.45 | 51.65 | 20 | 17.66 | 1.38 | 31.28 | 8.31 | 8.53 | |
| CS-10 | | | | | | 51.65 | 52.07 | 42 | 6.11 | 1.40 | 60.72 | 6.11 | 10.93 | |
| CS-11 | 52.15 | 52.75 | 0.60 | 0.60 | 100 | 52.27 | 52.42 | 15 | 9.24 | 0.58 | 62.67 | 6.65 | 5.13 | |
| CS-12 | | | | | | 52.42 | 52.60 | 18 | 8.91 | 0.47 | 65.98 | 4.41 | 4.55 | |
| CS-13 | | | | | | 52.60 | 52.75 | 15 | 0.82 | 1.15 | 60.63 | 4.58 | 13.69 | |
| CS-14 | 52.75 | 53.50 | 0.75 | 0.75 | 100 | 53.45 | 53.50 | 5 | 3.46 | 0.29 | 67.71 | 13.55 | 1.23 | |
| CS-15 | 53.50 | 54.40 | 0.90 | 0.90 | 100 | 53.50 | 53.68 | 18 | 10.23 | 1.97 | 61.02 | 8.82 | 2.47 | |
| CS-16 | | | | | | 53.68 | 53.95 | 27 | 25.42 | 0.95 | 26.86 | 7.55 | 6.19 | |
| CS-17 | | | | | | 53.95 | 54.10 | 15 | 4.78 | 1.55 | 57.39 | 6.78 | 13.18 | |
| CS-18 | | | | | | 54.10 | 54.40 | 30 | 11.88 | 1.28 | 47.98 | 7.51 | 7.67 | |
| CS-19 | 54.40 | 56.50 | 2.40 | 2.35 | 98 | 54.40 | 54.60 | 20 | 10.23 | 1.32 | 58.24 | 5.71 | 6.47 | |
| CS-20 | | | | | | 54.60 | 54.75 | 15 | 9.24 | 0.71 | 59.56 | 6.54 | 6.32 | |

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## CHEMICAL ANALYSIS OF CORE SAMPLES
## BOREHOLE NO. MNG-8

TOTAL NO. OF SAMPLES-19

| Sample no. | Drilling run (M) | | Length of run | Length of core recovered | % Of core recovery | Section sampled | | Length of sample (CM) | Analytical data % | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | From | To | | | | From | To | | Mn | $P_2O_5$ | $SiO_2$ | $Fe_2O_3$ | $Al_2O_3$ | Mn% x L |
| CS-1 | 50.35 | 52.40 | 2.05 | 1.48 | 72 | 51.55 | 51.66 | 11 | 5.05 | 1.56 | 60.45 | 7.31 | 12.27 | |
| CS-2 | | | | | | 51.66 | 51.81 | 15 | 6.03 | 0.51 | 64.52 | 6.02 | 8.95 | |
| CS-3 | | | | | | 51.81 | 52.21 | 40 | 15.48 | 1.15 | 37.32 | 9.57 | 10.61 | |
| CS-4 | | | | | | 52.21 | 52.40 | 19 | 10.59 | 1.29 | 50.25 | 8.02 | 12.25 | |
| CS-5 | 52.40 | 53.80 | 1.40 | 1.34 | 96 | 52.40 | 52.63 | 23 | 16.62 | 1.58 | 38.52 | 9.25 | 9.91 | |
| CS-6 | | | | | | 52.63 | 52.78 | 16 | 5.21 | 1.13 | 51.09 | 5.84 | 12.41 | |
| CS-7 | | | | | | 52.79 | 52.87 | 8 | 5.54 | 1.49 | 53.05 | 5.44 | 14.03 | |
| CS-8 | | | | | | 52.87 | 53.14 | 27 | 32.76 | 1.08 | 19.11 | 10.03 | 3.23 | 884.52 |
| CS-9 | | | | | | 53.14 | 53.48 | 34 | 28.69 | 1.11 | 23.73 | 7.62 | 4.31 | 975.46 |
| CS-10 | | | | | | 53.48 | 53.80 | 32 | 37.01 | 1.02 | 18.22 | 9.33 | 2.22 | 1184.32 |
| CS-11 | 53.80 | 54.70 | 0.90 | 0.90 | 100 | 53.80 | 53.90 | 10 | 25.75 | 1.03 | 31.81 | 6.17 | 3.75 | 257.5 |
| CS-12 | | | | | | 53.90 | 54.07 | 17 | 13.85 | 0.84 | 54.91 | 7.23 | 7.12 | |
| CS-13 | | | | | | 54.07 | 54.33 | 26 | 7.33 | 1.43 | 60.34 | 5.94 | 10.78 | |
| CS-14 | | | | | | 54.33 | 54.54 | 21 | 1.31 | 1.13 | 65.61 | 3.77 | 12.47 | |
| CS-15 | | | | | | 54.54 | 54.70 | 16 | | | | | | |
| CS-16 | 54.70 | 55.50 | 0.80 | 0.80 | 100 | 54.70 | 54.90 | 20 | | | | | | |
| CS-17 | | | | | | 54.90 | 55.04 | 14 | | | | | | |
| CS-18 | | | | | | 55.04 | 55.18 | 14 | | | | | | |
| CS-19 | | | | | | 55.18 | 55.25 | 7 | | | | | | |

## CHEMICAL ANALYSIS OF CORE SAMPLES
## BOREHOLE NO. MNG-9

TOTAL NO OF SAMPLES-8

| Sample no. | Drilling run (M) | | Length of run | Length of core recovered | % Of core recovery | Section sampled | | Length of sample (CM) | Analytical data % | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | From | To | | | | From m | To | | Mn | $P_2O_5$ | $SiO_2$ | $Fe_2O_3$ | $Al_2O_3$ | Mn% x L |
| G-1 | 26.00 | 26.35 | 0.35 | 0.25 | 70 | 26.00 | 26.35 | 0.35 | 22.62 | 1.27 | 32.43 | 7.94 | 8.92 | |
| G-2 | 26.35 | 26.80 | 0.45 | 0.35 | 80 | 26.35 | 26.80 | 0.45 | 14.26 | 2.67 | 48.20 | 7.31 | 13.31 | |
| G-3 | 26.80 | 27.20 | 0.40 | 0.35 | 80 | 26.80 | 27.20 | 0.40 | 19.18 | 2.64 | 29.21 | 8.95 | 14.24 | |
| G-4 | 41.70 | 42.30 | 0.60 | 0.60 | 100 | 41.70 | 42.30 | 0.60 | 8.85 | 1.51 | 53.84 | 7.77 | 9.17 | |
| G-5 | 42.30 | 43.05 | 0.75 | 0.72 | 97 | 42.30 | 43.05 | 0.75 | 9.67 | 1.25 | 56.71 | 6.82 | 6.82 | |
| G-6 | 43.05 | 43.80 | 0.75 | 0.72 | 97 | 43.05 | 43.80 | 0.75 | 11.97 | 1.96 | 49.16 | 5.66 | 8.53 | |
| G-7 | 43.80 | 44.55 | 0.75 | 0.73 | 97 | 43.80 | 44.55 | 0.75 | 25.08 | 1.07 | 26.93 | 9.86 | 9.04 | |
| G-8 | 44.55 | 45.30 | 0.75 | 0.73 | 97 | 44.55 | 45.30 | 0.75 | 15.74 | 0.98 | 41.76 | 10.11 | 10.94 | |

## CHEMICAL ANALYSIS OF CORE SAMPLES
## BOREHOLE NO. MNG-10

TOTAL NO. OF SAMPLES-3

| Sample no. | Drilling run (M) | | Length of run | Length of core recovered | % Of core recovery | Section sampled | | Length of sample (CM) | Analytical data % | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | From | To | | | | From | To | | Mn | $P_2O_5$ | $SiO_2$ | $Fe_2O_3$ | $Al_2O_3$ | Mn% x L |
| M-1 | 34.03 | 34.15 | 0.12 | 0.10 | 78 | 34.03 | 34.15 | 0.12 | 23.93 | 1.83 | 25.53 | 10.45 | 4.47 | 397.44 |
| M-2 | 34.51 | 34.63 | 0.12 | 0.10 | 78 | 34.51 | 34.63 | 0.12 | 33.12 | 1.25 | 23.54 | 11.72 | 2.52 | 438.72 |
| G-1 | 33.50 | 35.10 | 1.36 | | | 33.50 | 35.10 | 1.36 | 36.56 | 0.97 | 21.08 | 11.08 | 2.55 | 3254.48 |

## CHEMICAL ANALYSIS OF CORE SAMPLES
## BOREHOLE NO. MNG-12A

TOTAL NO. OF SAMPLES-9

| Sample no. | Drilling run (M) | | Length of run | Length of core recovered | % Of core recovery | Section sampled | | Length of sample (CM) | Analytical data % | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | From | To | | | | From | To | | Mn | $P_2O_5$ | $SiO_2$ | $Fe_2O_3$ | $Al_2O_3$ | Mn% x L |
| G-1 | 38.62 | 39.10 | 0.48 | 0.25 | | 38.62 | 39.10 | 0.48 | 21.64 | 1.86 | 27.64 | 11.82 | 9.02 | 1038.72 |
| G-2 | 39.10 | 39.50 | 0.40 | 0.37 | | 39.10 | 39.50 | 0.40 | 21.31 | 2.14 | 38.02 | 10.31 | 3.67 | 852.4 |
| G-3 | 39.50 | 39.90 | 0.40 | 0.38 | | 39.50 | 39.90 | 0.40 | 28.03 | 1.47 | 29.87 | 8.71 | 3.05 | 1121.2 |
| G-4 | 39.90 | 40.80 | 0.90 | | | 39.90 | 40.80 | 0.90 | 28.21 | 1.74 | 23.71 | 11.65 | 5.41 | 2538.9 |
| M-1 | 40.80 | 40.94 | 0.14 | | | 40.80 | 40.94 | 0.14 | 29.67 | 1.38 | 20.36 | 11.02 | 2.33 | 415.38 |
| G-5 | 40.94 | 41.50 | 0.56 | | | 40.94 | 41.50 | 0.56 | 30.31 | 1.34 | 21.21 | 11.48 | 7.42 | 1697.36 |
| G-6 | 41.50 | 42.15 | 0.65 | 0.35 | | 41.50 | 42.15 | 0.65 | 8.19 | 1.43 | 50.18 | 11.57 | 9.93 | |
| G-7 | 42.15 | 42.75 | 0.60 | 0.25 | | 42.15 | 42.75 | 0.60 | 7.71 | 0.69 | 50.34 | 7.02 | 12.41 | |
| G-8 | 42.75 | 43.45 | 0.70 | 0.20 | | 42.75 | 43.45 | 0.70 | 15.24 | 0.64 | 50.35 | 7.13 | 5.44 | |

## STATEMENT SHOWING CALCULATION OF PRODUCTION AND DEVELOPMENT FOR MINERAL MANGANESE ORE, AREA 105 HA FOR FIVE YEAR PERIOD

Production and Development will be achieved from area marked on Plate no 6.1 to 6.5 in along cross sections C1 C1' to C5 C5, as shown in plate 6A for individual year. In first year first bench will be opened for a height 6m at 385m. Then second third and so on bench of six metre high will be worked in descending order following hill slope.. Width of bench will be minimum six metre. Cross sectional area for calculation of Mn ore production has been considered. The cross sectional area multiplied by lateral distance in a particular year and further multiplied by bulk density 3.1 t/m$^3$ give Mn ore production in that particular year.

### A) PRODUCTION MANGANESE ORE, ROM

Calculation for year wise production is as below:

**FIRST YEAR**

**Cross section: C2 C2'**

During the year production will be achieved from C1 & C2 ore bodies for consecutive eight benches from RL 385 m to 337m of six metre high for respective length of individual ore bodies.

'C1' ore body, First bench Floor RL 379m: Cross sectional area 10.84m$^2$ x lateral distance 33.87 m x 3.1BD = 1138.17 tonne

'C2' ore body, First bench Floor RL 379m: Cross sectional area 10.30m$^2$ x lateral distance 45.0m x 3.1BD = 1436.85 tonne

'C1' ore body, second bench Floor RL 373m: Cross sectional area 11.50m$^2$ x lateral distance 33.87 m x 3.1BD = 1207.47 tonne

'C2' ore body, second bench Floor RL 373m: Cross sectional area 15.30m$^2$ x lateral distance 45.0m x 3.1BD = 2134.35 tonne

'C1' ore body, Third bench Floor RL 367m: Cross sectional area 11.51m$^2$ x lateral distance 33.87 m x 3.1BD = 1208.52 tonne

'C2' ore body, Third bench Floor RL 367m: Cross sectional area 15.29m$^2$ x lateral distance 45.0m x 3.1BD = 2132.96 tonne

'C1' ore body, Fourth bench Floor RL 361m: Cross sectional area 11.51m$^2$ x lateral distance 33.87 m x 3.1BD = 1208.52 tonne

'C2' ore body, Fourth bench Floor RL 361m: Cross sectional area 15.29m$^2$ x lateral distance 45.0m x 3.1BD = 2132.96 tonne
'C1' ore body, Fifth bench Floor RL 355m: Cross sectional area 11.51m$^2$ x lateral distance 33.87 m x 3.1BD = 1208.52 tonne
C2' ore body, Fifth bench Floor RL 355m: Cross sectional area 15.29m$^2$ x lateral distance 45.0m x 3.1BD = 2132.96 tonne
'C1' ore body, Sixth bench Floor RL 349m: Cross sectional area 11.51m$^2$ x lateral distance 33.87 m x 3.1BD = 1208.52 tonne
C2' ore body, Sixth bench Floor RL 349m: Cross sectional area 15.29m$^2$ x lateral distance 45.0m x 3.1BD = 2132.96 tonne
'C1' ore body, Seventh bench Floor RL 343m: Cross sectional area 11.51m$^2$ x lateral distance 33.87 m x 3.1BD = 1208.52 tonne
C2' ore body, Seventh bench Floor RL 343m: Cross sectional area 15.29m$^2$ x lateral distance 45.0m x 3.1BD = 2132.96 tonne
'C1' ore body, Eight bench Floor RL 337m: Cross sectional area 11.51m$^2$ x lateral distance 33.87 m x 3.1BD = 1208.52 tonne
C2' ore body, Eight bench Floor RL 337m: Cross sectional area 15.29m$^2$ x lateral distance 45.0m x 3.1BD = 2132.96 tonne

Total Production during First year: 1138.17+1436.85+1207.47+2134.35+ 2132.96+ 1208.52+ 1208.52 + 2132.96 + 1208.52+2132.96 + 1208.52 + 2132.96 + 1208.52 + 2132.96+1208.52+ 2132.96 tonnes =25965.72 or say **25966.0 tonnes**

**SECOND YEAR**

During the year production will be achieved from C1, C2, B1, A1 & A2 ore bodies from RL 355 m and 331m of six metre high for respective length of individual ore bodies.

**Cross section: C2 C2'**

'C1' ore body, Ninth bench Floor RL 331m: Cross sectional area 11.51m$^2$ x lateral distance 33.87 m x 3.1BD = 1208.52 tonne

'C2' ore body, Ninth bench Floor RL 331m: Cross sectional area 15.29m$^2$ x lateral distance 45.0m x 3.1BD = 2132.96 tonne

**Cross section: C4 C4'**

'C4' ore body, First bench Floor RL 331m: Cross sectional area 32.27m$^2$ x lateral distance 139.9m x 3.1BD = 13995.18 tonne

**Cross section: C1 C1'**

'B1' ore body, First bench Floor RL 331m: Cross sectional area 11.91$m^2$ x lateral distance 231.22m x 3.1BD = 8536.87 tonne

'A1' ore body, First bench Floor RL 331m: Cross sectional area 24.31$m^2$ x lateral

distance 33.43m x 3.1BD = 2519.32 tonne

'A2' ore body, First bench Floor RL 331m: Cross sectional area 11.50$m^2$ x lateral

distance 14.48m x 3.1BD = 516.21 tonne

Total Production during Second year: 1208.52+2132.96+13995.18+8536.87+

2519.32 + 516.21 tonnes = 28909.06 or say **28909.0 tonnes**

**THIRD YEAR**

During the year production will be achieved from C4 ore body alone for from RL 349 m to 337m of six metre high each for 139.9 length of the ore body.

**Cross section: C4 C4'**

'C4' ore body, Second bench Floor RL 349m: Cross sectional area 26.32$m^2$ x lateral distance 139.9 m x 3.1BD = 11414.72 tonne

'C4' ore body, Third bench Floor RL 343m: Cross sectional area 26.32$m^2$ x lateral distance 139.9 m x 3.1BD = 11414.72 tonne

'C4' ore body, Fourth bench Floor RL 337m: Cross sectional area 26.32$m^2$ x lateral distance 139.9 m x 3.1BD = 11414.72 tonne

Total Production during Third year: 11414.72 +11414.72 +11414.72 tonnes =

34244.16 or say **34244.0 tonnes**

**FOURTH YEAR**

During the year production will be achieved from ore bodies C4, B2, from RL 331 to 325 & C5 from RL 346 m and 340m of six metre high for respective length of individual ore bodies.

**Cross section: C4 C4'**

'C4' ore body, Fifth bench Floor RL 331m: Cross sectional area 26.32$m^2$ x lateral distance 139.9 m x 3.1BD = 11414.72 tonne

'C4' ore body, Sixth bench Floor RL 325m: Cross sectional area 26.32$m^2$ x lateral distance 139.9 m x 3.1BD = 11414.72 tonne

'B2' ore body, First bench Floor RL 331m: Cross sectional area 13.64m$^2$ x lateral distance 106.74m x 3.1BD = 4513.39 tonne

'B2' ore body, First bench Floor RL 325m: Cross sectional area 14.27m$^2$ x lateral distance 106.74m x 3.1BD = 4721.86 tonne

**Cross section: C5 C5'**

'C5' ore body, First bench Floor RL 346m: Cross sectional area 3.22m$^2$ x lateral distance 228.0 m x 3.1BD = 2275.90 tonne

'C5' ore body, Second bench Floor RL 340m: Cross sectional area 12.95m$^2$ x lateral distance 228.0 m x 3.1BD = 9153.06 tonne

Total Production during Fourth year: 11414.72+11414.72 +4513.39+4721.86+2275.90+9153.06 = 43493.65 or **43494.0 tonnes**

**FIFTH YEAR**

**Cross section: C5 C5'**

During the year production will be achieved from C1, C2, C4,C5, B1, B2, A1 & A4 ore bodies from RL 334 m and 292m of six metre high for respective length of individual ore bodies.

'C5' ore body, Third bench Floor RL 334m: Cross sectional area 13.58m$^2$ x lateral distance 228.0 m x 3.1BD = 9598.34 tonne

'C5' ore body, Fourth bench Floor RL 328m: Cross sectional area 13.58m$^2$ x lateral distance 228.0 m x 3.1BD = 9598.34 tonne

'C5' ore body, Fifth bench Floor RL 322m: Cross sectional area 13.58m$^2$ x lateral distance 228.0 m x 3.1BD = 9598.34 tonne

'C5' ore body, Sixth bench Floor RL 316m: Cross sectional area 13.58m$^2$ x lateral distance 228.0 m x 3.1BD = 9598.34 tonne

'C5' ore body, Seventh bench Floor RL 310m: Cross sectional area 13.58m$^2$ x lateral distance 228.0 m x 3.1BD = 9598.34 tonne

C5' ore body, Eight bench Floor RL 304m: Cross sectional area 13.58m$^2$ x lateral distance 228.0 m x 3.1BD = 9598.34 tonne

C5' ore body, Ninth bench Floor RL 298m: Cross sectional area 13.58m$^2$ x lateral distance 228.0 m x 3.1BD = 9598.34 tonne

C5' ore body, Tenth bench Floor RL 292m: Cross sectional area 13.58m$^2$ x lateral distance 228.0 m x 3.1BD = 9598.34 tonne

C5' ore body, Eleventh bench Floor RL 286m: Cross sectional area 13.58$m^2$ x lateral distance 228.0 m x 3.1BD = 9598.34 tonne

C5' ore body, Twelfth bench Floor RL 280m: Cross sectional area 13.58$m^2$ x lateral distance 228.0 m x 3.1BD = 9598.34 tonne

C5' ore body, Thirthteenth bench Floor RL 274m: Cross sectional area 13.58$m^2$ x lateral distance 228.0 m x 3.1BD = 9598.34 tonne

C5' ore body, Fourteenth bench Floor RL 271m: Cross sectional area 6.8$m^2$ x lateral distance 228.0 m x 3.1BD = 4806.24 tonne

Total production from cross section C5 C5' =9598.34+9598.34+9598.34+9598.34+9598.34+9598.34+9598.34+9598.34+9598.34+9598.34+4806.24 = **110387.98 tonnes**

**Cross section: C4 C4'**

'C4' ore body, Seventh bench Floor RL 319m: Cross sectional area 26.32$m^2$ x lateral distance 139.9 m x 3.1BD = 11414.72 tonne

'C4' ore body, Eight bench Floor RL 313m: Cross sectional area 26.32$m^2$ x lateral distance 139.9 m x 3.1BD = 11414.72 tonne

'C4' ore body, Ninth bench Floor RL 307m: Cross sectional area 26.32$m^2$ x lateral distance 139.9 m x 3.1BD = 11414.72 tonne

'C4' ore body, Tenth bench Floor RL 301m: Cross sectional area 26.32$m^2$ x lateral distance 139.9 m x 3.1BD = 11414.72 tonne

'C4' ore body, Eleventh bench Floor RL 295m: Cross sectional area 26.32$m^2$ x lateral distance 139.9 m x 3.1BD = 11414.72 tonne

'C4' ore body, Twelfth bench Floor RL 292m: Cross sectional area 13.16$m^2$ x lateral distance 139.9 m x 3.1BD = 5707.36 tonne

'B2' ore body, Second bench Floor RL 319m: Cross sectional area 14.27$m^2$ x lateral distance 106.74m x 3.1BD = 4721.86 tonne

'B2' ore body, Third bench Floor RL 313m: Cross sectional area 14.27$m^2$ x lateral distance 106.74m x 3.1BD = 4721.86 tonne

'B2' ore body, Fourth bench Floor RL 307m: Cross sectional area 14.27$m^2$ x lateral distance 106.74m x 3.1BD = 4721.86 tonne

'B2' ore body, Fifth bench Floor RL 301m: Cross sectional area 14.27$m^2$ x lateral distance 106.74m x 3.1BD = 4721.86 tonne

'B2' ore body, Sixth bench Floor RL 295m: Cross sectional area 14.27$m^2$ x lateral distance 106.74m x 3.1BD = 4721.86 tonne

'B2' ore body, Seventh bench Floor RL 289m: Cross sectional area 7.13m$^2$ x lateral distance 106.74m x 3.1BD = 2359.27 tonne

Total production from cross section C4 C4' =11414.72+11414.72+11414.72+11414.72+11414.72+5707.36+4721.86+4721.86 +4721.86+4721.86+4721.86+2359.27 = **88749.53 tonnes**

**Cross section: C1 C1'**

'B1' ore body, Second bench Floor RL 325m: Cross sectional area 14.80m$^2$ x lateral distance 231.22m x 3.1BD = 10608.37 tonne

'B1' ore body, Third bench Floor RL 319m: Cross sectional area 14.80m$^2$ x lateral distance 231.22m x 3.1BD = 10608.37 tonne

'B1' ore body, Fourth bench Floor RL 313m: Cross sectional area 14.80m$^2$ x lateral distance 231.22m x 3.1BD = 10608.37 tonne

'B1' ore body, Fifth bench Floor RL 307m: Cross sectional area 14.80m$^2$ x

lateral distance 231.22m x 3.1BD = 10608.37 tonne

'B1' ore body, Sixth bench Floor RL 301m: Cross sectional area 14.80m$^2$ x lateral distance 231.22m x 3.1BD = 10608.37 tonne
'A1' ore body, Second bench Floor RL 325m: Cross sectional area 30.21m$^2$ x lateral distance 33.43m x 3.1BD = 3130.75 tonne
'A1' ore body, Third bench Floor RL 319m: Cross sectional area 30.21m$^2$ x

lateral distance 33.43m x 3.1BD = 3130.75 tonne

'A1' ore body, Fourth bench Floor RL 313m: Cross sectional area 30.21m$^2$ x lateral distance 33.43m x 3.1BD = 3130.75 tonne

'A1' ore body, Fifth bench Floor RL 307m: Cross sectional area 30.21m$^2$ x lateral distance 33.43m x 3.1BD = 3130.75 tonne

'A1' ore body, Sixth bench Floor RL 301m: Cross sectional area 30.21m$^2$ x lateral distance 33.43m x 3.1BD = 3130.75 tonne

'B1' ore body, Seventh bench Floor RL 295m: Cross sectional area 14.80m$^2$ x lateral distance 231.0m x 3.1BD = 10598.28 tonne

'B1' ore body, Eight bench Floor RL 289m: Cross sectional area 7.40m$^2$ x lateral distance 2310m x 3.1BD = 5299.14 tonne

'A1' ore body, Seventh bench Floor RL 295m: Cross sectional area 30.21m$^2$ x lateral distance 33.43m x 3.1BD = 3130.75 tonne

'A1' ore body, Eight bench Floor RL 289m: Cross sectional area 15.11$m^2$ x lateral distance 33.43m x 3.1BD = 1565.89 tonne

Total production from cross section C1 C1' =10608.37+10608.37+10608.37+10608.37+10608.37+3130.75+3130.75+3130.75+3130.75+3130.75+10598.28+5299.14+3130.75+1565.89= **89289.66tonnes**

**Cross section: C2 C2'**

'C1' ore body, Tenth bench Floor RL 325m: Cross sectional area 11.51$m^2$ x lateral distance 33.87 m x 3.1BD = 1208.52 tonne

'C1' ore body, Eleventh bench Floor RL 319m: Cross sectional area 11.51$m^2$ x lateral distance 33.87 m x 3.1BD = 1208.52 tonne

'C1' ore body, Twelfth bench Floor RL 313m: Cross sectional area 11.51$m^2$ x lateral distance 33.87 m x 3.1BD = 1208.52 tonne

'C1' ore body, Thirteenth bench Floor RL 307m: Cross sectional area 11.51$m^2$ x lateral distance 33.87 m x 3.1BD = 1208.52 tonne

'C1' ore body, Fourteenth bench Floor RL 301m: Cross sectional area 11.51$m^2$ x lateral distance 33.87 m x 3.1BD = 1208.52 tonne

'C2' ore body, Tenth bench Floor RL 325m: Cross sectional area 15.29$m^2$ x lateral distance 45.0m x 3.1BD = 2132.96 tonne

'C2' ore body, Eleventh bench Floor RL 319m: Cross sectional area 15.29$m^2$ x lateral distance 45.0m x 3.1BD = 2132.96 tonne

'C2' ore body, Twelfth bench Floor RL 313m: Cross sectional area 15.29$m^2$ x lateral distance 45.0m x 3.1BD = 2132.96 tonne

'C2' ore body, Thirteenth bench Floor RL 307m: Cross sectional area 15.29$m^2$ x lateral distance 45.0m x 3.1BD = 2132.96 tonne

'C2' ore body, Fourteenth bench Floor RL 301m: Cross sectional area 15.29$m^2$ x lateral distance 45.0m x 3.1BD = 2132.96 tonne

Total production from cross section C2 C2' =1208.52+1208.52+1208.52+1208.52+1208.52+2132.96+2132.96+2132.96+2132.96+2132.96 = **16707.40 tonnes**

**Cross section: C3 C3'**

'A4' ore body, First bench Floor RL 331m: Cross sectional area 6.93$m^2$ x lateral distance 5.78m x 3.1BD = 124.17 tonne

'A4' ore body, Second bench Floor RL 325m: Cross sectional area 9.0$m^2$ x lateral distance 5.78m x 3.1BD = 161.26 tonne

'A4' ore body, Third bench Floor RL 319m: Cross sectional area 9.0$m^2$ x lateral distance 5.78m x 3.1BD = 161.26 tonne

'A4' ore body, Fourth bench Floor RL 313m: Cross sectional area 9.0$m^2$ x lateral distance 5.78m x 3.1BD = 161.26 tonne

'A4' ore body, Fifth bench Floor RL 307m: Cross sectional area 9.0$m^2$ x lateral distance 5.78m x 3.1BD = 161.26 tonne

'A4' ore body, Sixth bench Floor RL 301m: Cross sectional area 9.0$m^2$ x lateral distance 5.78m x 3.1BD = 161.26 tonne

Total production from cross section C3 C3' =124.17+161.26+161.26+161.26+161.26+161.26 = **930.47 tonnes**

Total production during the Fifth year =110387.98+ 88749.53 + 89289.66+16707.40+930.47 = 306065.04 **or 306065.0 tonnes**

## B) DEVELOPMENT FOR MANGANESE ORE

### FIRST YEAR

**Cross section: C2 C2'**

'C1' ore body Soil: H.W. Cross sectional area 88.23$m^2$ x lateral distance 33.87 m = 2991.39$m^3$

'C1' ore body OB: H.W. OB Cross sectional area 828.87$m^2$ x lateral distance 33.87 m = 31460.82$m^3$

C1' ore body Soil: F.W. Cross sectional area 81.55$m^2$ x lateral distance 33.87 m = 2762.09$m^3$

'C1' ore body OB : F.W. OB Cross sectional area 700.15$m^2$ x lateral distance 33.87 m = 23714.08$m^3$

'C1' ore body Soil: I. B. Cross sectional area 4.82$m^2$ x lateral distance 33.87 m = 163.25$m^3$

'C1' ore body : I. B. OB Cross sectional area 85.59$m^2$ x lateral distance 33.87 m = 2898.93$m^3$

'C2' ore body: H.W. OB Cross sectional area 1017.10$m^2$ x lateral distance 10.3 m = 10476.13$m^3$

'C2' ore body : F.W. OB Cross sectional area 781.70$m^2$ x lateral distance 10.3 m = 8051.51$m^3$

'C2' ore body : I.B. OB Cross sectional area 90.40$m^2$ x lateral distance 10.3 m = 931.12$m^3$

Total Soil removal during First year: 2991.39 + 2762.09 + 163.25 = 5916.73 or **5917.0$m^3$**

Total OB removal during First year: 31460.82+23714.08+2898.93+10476.13+8051.51+931.12 = 77532.59 or **77533.0$m^3$**

**SECOND YEAR**

**Cross section: C2 C2'**

'C1' ore body : H.W. OB = Nil

'C1' ore body Soil: F.W. Cross sectional area 6.75$m^2$ x lateral distance 33.87 m = 228.62$m^3$

'C1' ore body : F.W. OB Cross sectional area 202.69$m^2$ x lateral distance 33.87 m = 6865.11$m^3$

'C1' ore body : I.B. OB Cross sectional area 11.61$m^2$ x lateral distance 33.87 m = 393.23$m^3$

'C2' ore body: H.W. OB Cross sectional area 9.33$m^2$ x lateral distance 45 m = 419.85$m^3$

'C2' ore body : F.W. OB Cross sectional area 6.95$m^2$ x lateral distance 45 m = 218.25$m^3$

'C2' ore body : I.B.. OB Cross sectional area 58.75$m^2$ x lateral distance 45 m = 2643.75$m^3$

'B1' ore body : H.W. OB Cross sectional area 9.33$m^2$ x lateral distance 231.22 m = 2157.28$m^3$

'B1' ore body : F.W. OB Cross sectional area 6.95$m^2$ x lateral distance 231.22 m = 1606.98$m^3$

'B1' ore body : I.B. Nil

**Cross section: C1 C1'**

'B1' ore body : H.W. Nil

'B1' ore body : F.W. OB Cross sectional area 1.87$m^2$ x lateral distance 231.22 m = 432.38$m^3$

'B1' ore body : I.B. OB Cross sectional area 27.8$m^2$ x lateral distance 231.22 m = 6427.91$m^3$

'A1' ore body : H.W. OB Cross sectional area 1.87$m^2$ x lateral distance 24.31 m = 45.45$m^3$

'A1' ore body : F.W. Nil

'A1' ore body : I.B. Nil

**Cross section: C3 C3'**

'B1' ore body : H.W. OB Cross sectional area 11.0$m^2$ x lateral distance 231.22 m = 2543.42$m^3$

'B1' ore body : F.W. OB Cross sectional area 6.42$m^2$ x lateral distance 231.22 m = 1484.43$m^3$

'B1' ore body : I.B. Nil

**Cross section: C4 C4'**

'C4' ore body Soil: H.W. Cross sectional area 7.15$m^2$ x lateral distance 139.9 m = 1000.28$m^3$

'C4' ore body : H.W. OB Cross sectional area 7.00$m^2$ x lateral distance 139.9 m = 979.3$m^3$

'C4' ore body Soil: F.W. Cross sectional area 1.23$m^2$ x lateral distance 139.9 m = 172.07$m^3$

'C4' ore body : F.W. OB Cross sectional area 15.31$m^2$ x lateral distance 139.9 m = 2141.86$m^3$

'C4' ore body : I.B. Nil

Total Soil removal during Second year : 228.62 +1000.28 +172.07 = 1400.97 or **1401.0m$^3$**

Total OB removal during Second year: 6865.11+393.23+419.85+312.75+2643.75+2157.28+1606.98+432.38+6427.91+ 45.45+2543.42+1484.43 +979.30+2141.86 = **28453.70 or 28454.0m$^3$**

**THIRD YEAR**

**Cross section: C4 C4'**

'C4' ore body Soil: H.W. Cross sectional area 56.97m$^2$ x lateral distance 139.9 m = 7970.10m$^3$

'C4' ore body : H.W. OB Cross sectional area 304.32m$^2$ x lateral distance 139.9 m = 42574.36m$^3$

'C4' ore body Soil: F.W. Cross sectional area 1.23m$^2$ x lateral distance 139.9 m = 172.07m$^3$

'C4' ore body : F.W. OB Cross sectional area 149.25m$^2$ x lateral distance 139.9 m = 20880.07m$^3$

Total Soil removal during Third year: 7970.10 + 172.07 = 8142.17 or **8142.0m$^3$**

Total OB removal during Third year: 42574.36+20880.07 =63454.43 or **63454.0m$^3$**

**FOURTH YEAR**

**Cross section: C4 C4'**

'C4' ore body : H.W. OB Cross sectional area 302.30m$^2$ x lateral distance 139.9 m = 42291.77m$^3$

'C4' ore body Soil: F.W. Cross sectional area 21.03m$^2$ x lateral distance 139.9 m = 2942.09m$^3$

'C4' ore body : F.W. OB Cross sectional area 175.525m$^2$ x lateral distance 139.9 m = 24555.25m$^3$

'B2' ore body : H.W. OB Cross sectional area 75.94m$^2$ x lateral distance 106.74 m = 8105.83m$^3$

'B2' ore body : F.W. OB Cross sectional area 38.30m$^2$ x lateral distance 106.74 m = 4088.14m$^3$

**Cross section: C5 C5'**

'C5' ore body : H.W. OB Cross sectional area 12.77$m^2$ x lateral distance 228 m = 2911.56$m^3$

'C5' ore body : F.W. OB Cross sectional area 10.0$m^2$ x lateral distance 228 m = 2280.0$m^3$

Total Soil removal during Fourth year : 2942.09 or **2942.0$m^3$**

Total OB removal during Fourth year:

42291.77+24555.25+8105.83+4088.14+2911.56+2280.0 = 84232.55 or

**84233.0$m^3$**

**FIFTH YEAR**

**Cross section: C1 C1'**

'B1' ore body : H.W. Nil

'B1' ore body : F.W. OB Cross sectional area 2223.78$m^2$ x lateral distance 231.22m = 514182.41$m^3$

'B1' ore body : I.B. OB Cross sectional area 235.17$m^2$ x lateral distance 231.22m = 54376.01$m^3$

'A1' ore body Soil: H.W. Cross sectional area 138.13$m^2$ x lateral distance 33.43m = 4617.68$m^3$

'A1' ore body : H.W. OB Cross sectional area 1701.68$m^2$ x lateral distance 33.43m = 56887.16$m^3$

'A1' ore body : F.W. Nil

**Sub Total Soil :** 4617.68 $m^3$

**Sub Total OB :** 514182.41+54376.01+56887.16= 625445.58 $m^3$

**Cross section: C2 C2'**

'C1' ore body : H.W. Nil

'C1' ore body Soil: F.W. Cross sectional area 50.18$m^2$ x lateral distance 33.87m = 1699.59$m^3$

'C1' ore body: F.W. OB Cross sectional area 3204.37$m^2$ x lateral distance 33.87m = 108532.01$m^3$

'C1' ore body : I.B. OB Cross sectional area 58.0$m^2$ x lateral distance 33.87m = 1964.46$m^3$

'C2' ore body : H.W. OB Cross sectional area 1160.78$m^2$ x lateral distance 45m = 52235.10$m^3$

'C2' ore body : F.W. Nil

'B1' ore body : H.W. OB Cross sectional area 594.60$m^2$ x lateral distance 231.22m = 137483.41$m^3$

'B1' ore body : F.W. Nil

**Sub Total Soil :** 1699.59$m^3$

**Sub Total OB:** 108532.01+1964.46+52235.10+137483.41 = 300214.98$m^3$

**Cross section: C3 C3'**

'B1' ore body : H.W. OB Cross sectional area 805.72$m^2$ x lateral distance 231.22m = 186298.58$m^3$

'B1' ore body : F.W. OB Cross sectional area 1454.23$m^2$ x lateral distance 231.22m = 336247.10$m^3$

'A4' ore body : H.W. OB Cross sectional area 1381.52$m^2$ x lateral distance 5.78m = 7985.18$m^3$

'A4' ore body : F.W. OB Cross sectional area 569.44$m^2$ x lateral distance 5.78m = 3291.36$m^3$

**Sub Total :** 186298.58+336247.10+7985.18+3291.36 = 533822.22$m^3$

**Cross section: C4 C4'**

'C4' ore body Soil : H.W. Cross sectional area 44.76$m^2$ x lateral distance 139.90m = 6261.92$m^3$

'C4' ore body : H.W. OB Cross sectional area 929.19$m^2$ x lateral distance 139.90m = 129993.68$m^3$

'C4' ore body : F.W. OB Cross sectional area 1020.36$m^2$ x lateral distance 139.90m = 142748.40$m^3$

'B2' ore body : H.W. OB Cross sectional area 1959.0$m^2$ x lateral distance 106.74m = 209103.66$m^3$

'B2' ore body : F.W. Nil

**Sub Total Soil :** 6261.92$m^3$

**Sub Total OB :** 129993.68+142748.40+209103.66 = 481845.74 $m^3$

**Cross section: C5 C5'**

'C5' ore body Soil : H.W. Cross sectional area 83.72$m^2$ x lateral distance 228.0m = 19088.16$m^3$

'C5' ore body : H.W. OB Cross sectional area 3529.54$m^2$ x lateral distance 228.0m = 804735.12$m^3$

'C5' ore body Soil : F.W. Cross sectional area 233.65$m^2$ x lateral distance 228.0m = 53272.2$m^3$

'C5' ore body : F.W. OB Cross sectional area 4203.67$m^2$ x lateral distance 228.0m = 958436.76$m^3$

**Sub Total Soil:** 19088.16 + 53272.2 = 72360.36$m^3$

**Sub Total OB:** 804735.12+958436.76 = 1763171.88$m^3$

Total Soil removal during Fifth year: 4617.68 + 1699.59 + 6261.92 + 72631.36 = 85210.55 or **85211.0$m^3$**

Total OB removal during Fifth year: 625445.58 + 300214.98+ 533822.22+ 481845.74+ 1763171.88 = 3704500.40 or **3704500.0 $m^3$**

**SUMMARY OF PRODUCTION & DEVELOPMENT**

| Year | Production (Tonnes) | Development ($m^3$) | |
|---|---|---|---|
| | | Soil | OB |
| I | 25,966.0 | 5917.0 | 77533.0 |
| II | 28,909.0 | 1401.0 | 28454.0 |
| III | 34,244.0 | 8142.0 | 63454.0 |
| IV | 43,494.0 | 2942.0 | 84233.0 |
| V | 3,06,065.0 | 85211.0 | 3704500.0 |
| **Total** | **4,38,678.0** | **103613.0** | **3958174.0** |

## CONCEPTUAL PERIOD

As per DGM' estimate, there is a resource of 4, 40,185 tonnes, out of which the lessee will mine 4,38,678 tonnes during the ensuing mining plan period. The balance left out resource for conceptual period would be 1507 tonnes. Hence, no conceptual mining is being planned due to meagre balance resource. However, proposed exploration if establishes additional reserve, the conceptual plan will be modified accordingly.

xxxxxx

ANNEXURE - 18/1

खनन योजना तैयार करने के लिए अर्हता प्राप्त व्यक्ति के रूप में मान्यता प्रमाण-पत्र

# CERTIFICATE OF RECOGNITION AS QUALIFIED PERSON TO PREPARE MINING PLANS

(खनिज रियायत नियमावली, 1960 के नियम 22 सी के अन्तर्गत)

(Under Rule 22 C of Mineral Concession Rules, 1960)

श्री श्रीराम वाघमरे का पुत्र श्री एम.एस.वाघमरे

Sri M.S.Waghmare S/o Sriram Waghmare

एमआर 26/ बी, एमआईजी हौसेस, नंदिनि लेआउट, बेंगलूर - 560 096

MR 26/B, MIG Row Houses, Nandini Layout, Bangalore – 560 096

को उनकी योग्यताओं तथा अनुभवों के संतोषजनक प्रमाण देने के एवज में एतद्द्वारा खनिन

having given satisfactory evidence of his qualifications and experience is hereby

रियायत नियमावली, 1960 के नियम 22 सी के अन्तर्गत खनन योजनाएँ तैयार करने के लिए

granted recognition under Rule 22 C of the Mineral Concession Rule, 1960 as a

अर्हता प्राप्त व्यक्ति के रूप में मान्यता दी जाती है।

qualified person to prepare Mining Plans.

उनका पंजीकरण क्रमांक
His Registration No. is

आरक्यूपी / बि एनजी /285/2011/ए RQP/BNG/285/2011/A

यह मान्यता दस वर्ष की अवधि के लिए वैध है जो कि दिनांक 04/12/2021 को समाप्त होगी.

*This recognition is valid for a period of ten years ending 04/12/2021.*

05/12/11

(B.RAM MOHAN)
क्षेत्रीय खान नियंत्रक
Regional Controller of Mines

स्थान / Place :बेंगलूर/Bangalore
दिनांक / Date :05/12/2011

ANNEXURE : 10/2

# Nagpur University

SEAL OF NAGPUR UNIVERSITY

## अभियांत्रिकी स्नातक
## (Bachelor of Engineering)

—✻✻—

*This is to certify that*

*Shri Manohar Shriram Waghmare*

*obtained the degree of* अभियांत्रिकी स्नातक (Bachelor of Engineering) *in this University in the Examination held in March-April, 1987 and was placed in the First Division, in Mining Engineering branch.*

*Nagpur :*

*Vice-Chancellor*

ANNEXURE: 11

## GUGULDOH- MINERALIZED AREA

ANNEXURE: 11

PHOTOGRAPHS SHOWING BOUDARY POINTS OF THE LEASE