M/S MAHARASHTRA STATE POWER GENERATION COMPANY LIMITED

"Prakashgad" Plot No. G-9, Anant Kanekar Marg, Bandra (East); Mumbai, Maharashtra-400051
Ph: 022 – 26476231; 022-26474211; E-mail: md@mahagenco.in

MINING PLAN AND MINE CLOSURE PLAN
FOR
GARE PALMA SECTOR-II COAL MINE
(MAND RAIGARH COALFIELD)
AT
VILLAGES: TIHLI RAMPUR, KUNJEMURA, GARE, SARAITOLA, MUROGAON, RADOPALI, PATA, CHITWAHI, DHOLNARA, JHINKA BAHAL, DOLESARA, BHALUMURA, SARASMAL AND LIBRA
DISTRICT: RAIGARH, CHHATTISGARH
(Under Rule 22 (4) of Mineral Concessions (Amendment) Rules, 1994

BLOCK AREA/ PROJECT AREA/APPLIED ML AREA : 2583.486 HA.
{TOTAL CAPACITY = 23.6 MTPA (22.0 MTPA OC + 1.6 MTPA UG)}

[Re-submitted after Incorporation of Clarifications to Observations of Technical Members of the Standing Committee Constituted under MMDR Act, 1957 vide MOC Letter no. 34011/16/2016-CPAM dt. 03-05-2016]

(VOLUME I : TEXT & ANNEXURES)

JUNE 2016

आई०पी० नागपाल / I.P. NAGPAL
अवर सचिव / Under Secretary
भारत सरकार / Govt. of India
कोयला मंत्रालय / Ministry of Coal
शास्त्री भवन / Shastri Bhawan
नई दिल्ली / New Delhi

Prepared by:

B.D.SHARMA
(Recognised Qualified Person)
(No. 34012/03/2014-CPAM Dt 29th May 2015, valid upto May 2025)

MIN MEC CONSULTANCY PVT. LTD.
A-121, Paryavaran Complex, IGNOU Road, New Delhi – 110 030
Ph : 29534777, 29532236, 29535891 ; Fax: +91-11-29532568
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Estb. 1983
An ISO 9001:2008 approved company

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RQP No. 34012/03/2014-CPAM

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31.8.16

No.34011/16/2016-CPAM
Government of India
Ministry of Coal

Shastri Bhawan, New Delhi
the 12th August, 2016

To,

M/s Maharashtra State Power Generation Co. Ltd,
Prakashgad, Plot No. G-9, Prof. A.K. Marg, Bandra(E),
Mumbai-400051
Email :md@mahagenco.in/mdmspgcl@gmail.com

Subject :	Mine Plan And Mine Closure Plan of Gare Palma Sector-II Coal Mine, Distt Raigarh, Chhattisgarh State of M/s Maharashtra State Power Generation Company Limited.

Sir,

I am directed to refer to your letter No. Mahagenco/ED (Fuel/Coal) dated 26-02-2016 for approval of Mine Plan And Mine Closure Plan of Gare Palma Sector-II Coal Mine for approval of the Central Government and to state that the Mining Plan & Mine Closure Plan of Gare Palama Sector II Coal Mine (June 2016) of Mand-Raigarh Coalfield, Distt Raigarh, State- Chattisgarh of M/s. Maharastra State Power Generation Company Limited to be read alongwith company's letter No. Mahagenco/ED (Fuel/Coal)/34C/196 dated 07-07-2016 incorporating clarifications dated 07.07.2016 has been considered and the approval of the Central Government thereon is hereby conveyed under Section 5(2)(b) of the Mines & Minerals (Development & Regulation) Act, 1957 subject to the following conditions:-

I. The Mining company shall take all necessary precautions regarding safety of mine workings and persons deployed therein;

II. Mining lease of this block shall not encroach into any other adjacent block;

III. The cost of abandonment for carrying out the closure activities envisaged in the Mine closure plan is indicative; the actual cost for carrying out the activities at the time of final closure may be higher. The actual cost of abandonment will have to be borne by the project proponent for carrying out the closure activities;

IV. The approval of the mine plan and mine closure plan is without prejudice to the requirement of approvals from competent /prescribed authority under the relevant rules/ regulations etc;

Two copies of the approved mining plan duly signed by the competent authority are returned herewith with the request that a copy of the approved mining plan may be submitted to the concerned State Government for necessary action and also a photocopy of the approved mining plan may be sent to the Coal Controller for monitoring the block.

Yours Faithfully

(I P Nagpal)
Under Secretary to the Govt. of India.

Encl: As Above

Vikas Jaideo
Executive Director (Coal / Fuel)

MAHAGENCO
Maharashtra State Power Generation Co. Ltd.

Ref. No: Mahagenco/ED(Fuel/Coal)/ 34C/ 196

Date: 07.07.2016

To,

Under Secretary,
Ministry of coal,
Shastri Bhawan,
New Delhi-110 001

Sub:- Mining Plan and Mine Closure Plan of Gare Palma Sect- II Coal Mine , Distt Raigarh, Chhattisgarh State – Compliance to the observations of MOC.

Ref: 1) Mahagenco letter no. Mahagenco/ED(Fuel/Coal), Dtd. 26/29.02.2016.
2) MoC letter no. 34011/16/2016-CPAM, Dtd. 3/05/2016.

Dear Sir,

Gare Palma Sect- II Coal Mine has been allotted to Maharashtra State Power Generation Co. Ltd. vide allotment order no. 103/30/2015/NA, Dtd. 31.08.2015.

Vide letter under ref. (1) above, Mahagenco has submitted the Mining Plan and Mine Closure Plan of Gare Palma Sect- II Coal Mine and thereafter Mahagenco official along with Recognised Qualified Person (RQP) has delivered the Presentation on Mining Plan to MoC on date 29.04.2016.

MoC vide letter under ref.(2), conveyed the observations of Technical Members of the committee on Mining Plan and Mine Closure Plan of Gare Palma Sector II coal mine. Accordingly the point wise compliance in the tabular form (with proper reference) prepared by Mr B. D. Sharma (RQP No. 34012(03)/2014-CAPM Dt. 29.05.2015).

Mahagenco submitting four copies of Text and Plates (Hard and soft format) duly stamped and signed by the RQP. The point wise compliance in the tabular form (with proper reference) are also enclosed for your kind approval.

Thanking you.

Yours faithfully,

V.M. Jaideo
Executive Director (Fuel/Coal)

COMPLIANCE TO OBSERVATIONS ON MINING PLAN & MINE CLOSURE PLAN OF GARE PALAMA SECTOR II COAL MINE (FEBRUARY 2016) OF MAND-RAIGARH COALFIELD, DISTT RAIGARH, STATE- CHATTISGARH OF M/S. MAHARASTRA STATE POWER GENERATION COMPANY LIMITED VIDE MOC LETTER NO. 34011/16/2016-CPAM DT 03-05-2016

Sl. No.	Refer Para	Observations	Compliance
1.	Cover Page	Project area and Block area should be indicated.	Project area/ Block area/ Applied ML area are the same (2583.486 Ha) which have been incorporated on cover page. Both OC and UG operations are envisaged. Though OC mine coverers the entire block area of 2583.486 Ha., a part of the area on western side is not workable by UG and the same has not been considerd for UG mining and the UG project area is only 2208.18 Ha. (Ref. para 3.2 and also Fig. 3.1 of Chapter 3)
2	Para 1.9	The allotment order for the block indicates a coal requirement of 12.76 Mt/annum for the specified end-use plants. The Mining Plan proposes to mine at a capacity of 23.6 Mt/annum, utilize the coal from seams with less than 34% ash (in the specified plants without washing and is silent about the balance coal. This aspect may kindly be addressed in detail.	The coal requirement of End Use Plants of MSPGCL vis-à-vis coal production from Gare Sector-II mine is given below (refer Table 1.3 of MP).

COAL REQUIREMENT OF EUPs AS PER VESTING ORDER

Particulars	Power Plant	Reject based Power plant	Blast Furnace
Coal availability from this project "MTPA"	23.6	0	0
Washed coal availability "MTPA"	NA	0	0
Rejects "MTPA"	NA	0	0
Thermal Power Plant "KW"/ Sponge Iron "MTPA"	3230X1000 KW	NA	NA

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नई दिल्ली / New Delhi

<table>
<tr><th>Sl. No.</th><th>Refer Para</th><th>Observations</th><th>Compliance</th></tr>
<tr><td></td><td></td><td>Details have to be presented for the full production capacity.
<table>
<tr><th>#REF!</th><th>Power Plant "kW"</th><th>Reject based Power plant "kW"</th><th>Blast Furnace "Mtpa"</th></tr>
<tr><td>Coal availability from this project "MTPA"</td><td></td><td></td><td></td></tr>
<tr><td>Washed coal availability "MTPA"</td><td></td><td></td><td></td></tr>
<tr><td>Reject "MTPA"</td><td></td><td></td><td></td></tr>
<tr><td>Thermal Power Plant / Spong Iron</td><td></td><td></td><td></td></tr>
<tr><td>Station Heat Rate "K Cal/Kwhr</td><td></td><td></td><td></td></tr>
<tr><td>Avg Calorific Value of Coal "Kcal/Kg"</td><td></td><td></td><td></td></tr>
<tr><td>Specific consumtion "Kg/Kwhr"</td><td></td><td></td><td></td></tr>
<tr><td>Plant Load Factor/ Capacity Utilisation</td><td></td><td></td><td></td></tr>
<tr><td>Coal Requirement "MTPA"</td><td></td><td></td><td></td></tr>
</table>
The quantum of CIL likely to be surrendered needs to be envisaged. Further possibility of providing washing arrangement should also be looked into.</td><td>
<table>
<tr><td>Station Heat Rate "K Cal/KWhr</td><td>2308 (Av)</td><td>0</td><td>0</td></tr>
<tr><td>Avg. Calorific Value of Coal "Kcal/Kg"</td><td>4350 (AV)</td><td>0</td><td>0</td></tr>
<tr><td>Specific consumption "Kg/ Kwhr"</td><td>0.5306 (Av)</td><td>0</td><td>0</td></tr>
<tr><td>Plant Load Factor/ Capacity Utilisation</td><td>85%</td><td>0</td><td>0</td></tr>
<tr><td>Coal Requirement "MTPA"</td><td>12.761</td><td>0</td><td>0</td></tr>
<tr><td>Coal Availability from this project "MTPA"</td><td>23.6</td><td>0</td><td>0</td></tr>
<tr><td>Linkages/ E-auction from CIL "MTPA" (for these specified EUPs)</td><td>Nil</td><td>0</td><td>0</td></tr>
<tr><td>Other block of the Company "MTPA"</td><td>Mahajanwari UG coal block recently allotted to MAHAGENCO for power plants other than in the VO. Production not yet decided but will be less than 2MTPA</td><td>0</td><td>0</td></tr>
<tr><td>Percentage of end use requirement to be met from this mine</td><td>100%</td><td></td><td></td></tr>
</table>
As may be seen from the above table, out of the 23.60 MTPA coal proposed to be produced from this mine, 12.761 MTPA will be used in the 3 nos of TPPs specified in the Vesting Order. However, now it has been decided that coal will be supplied after washing (to comply with MOEF</td></tr>
</table>

<table>
<tr><th>Sl. No.</th><th>Refer Para</th><th>Observations</th><th>Compliance</th></tr>
<tr><td></td><td></td><td></td><td>
notification of <34% Ash) and provision for space for washery has been made within the ML area. The balance 10.839 MTPA will be used in other existing and proposed thermal power stations of Mahagenco as given in Tables 1.4 and 1.5 of MP.

The total requirement of the company is summarised in Table 1.6 of the MP as reproduced below:

SUMMARY OF OVERALL COAL REQUIREMENT FOR MAHAGENCO
<table>
<tr><th>Sl. No.</th><th>Type of TPP of Mahagenco</th><th>Total Capacity. MW</th><th>Coal Requirement, MTPA</th><th>Existing Linkage, MTPA</th><th>Source of linkage</th></tr>
<tr><td>1
(ref. Table 1.3)</td><td>End use Plants (existing) linked to Gare Sector-II</td><td>3230</td><td>12.761</td><td>0</td><td>Gare Sector-II</td></tr>
<tr><td>2
(ref. Table 1.4)</td><td>Other existing TPPs</td><td>7560</td><td>42.41</td><td>46.328</td><td>CIL</td></tr>
<tr><td>3 (ref. Table 1.5)</td><td>Proposed TPPs</td><td>1980</td><td>7.626</td><td>0</td><td>Mahajan wadi</td></tr>
<tr><td colspan="2">Total</td><td>12770</td><td>62.797</td><td>46.328</td><td></td></tr>
</table>

A perusal of above Table shows that the total requirement of coal of the company is 62.797 MTPA, out of which existing linkage from CIL is 46.328 MTPA.
</td></tr>
</table>

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Sl. No.	Refer Para	Observations	Compliance
			The existing linkages to the extent of any surplus (above the requirement of EUPs as per VO) coal will be surrendered when such surpluses are generated. Taking the above into consideration, the Mining Plan has been prepared for the full capacity of the mine, i.e. 23.6 Mtpa as given in Chapter 5. (The above matter has been incorporated under para 1.8.2 of Chapter 1)
3		Details of HEMM needs to be reconciled.	HEMM have been reconciled. Front End Loaders which are to be used in combination with dumpers for coal cut by Surface Miners have now been listed under "Coal Equipment" instead of under "Auxiliary Equipment" listed earlier. The size of Front end loaders has been increased to 10-16 cum and 6-8 cum, as against 8 cum and 5cum respectively proposed earlier for ease of loading into 150 T/100T dumpers. Number of RBH drlls for OB has been increased to 31 to match with the number of shovels. (The above matter has been incorporated in Table 5.11 under para 5.3.11.2 of Chapter 5 of MP)
4	Para 5.3.7	Jjustification for having a production rate of 23.6 Mty (22 Mty – OC, 1.6 Mty – UG) may be brought out. Further, the reason for tapering the OC production, when the contribution from UG operations start, may also be justified.	Justification of rated production has been covered in Para 5.1 of Chapter 5 under the Heading "OPTIMISATION OF TARGETED CAPACITY". Considering the multiple seam working, high initial depth and other geo-mining parameters, the mine has been planned for maximum sustainable production, i.e. 22 Mtpa from opencast plus 1.6 Mtpa from UG. Thus the total targeted capacity becomes 23.6 Mtpa. Though both

Sl. No.	Refer Para	Observations	Compliance
			OC and UG would be in production simultaneously from 12th year onwards, for safety reason, the sequence of development in UG would have a lag wrt OC operations. As the gestation period in UG is long and UG operation will reach its peak production level only in 15th year, it has been proposed to reach the total targeted production level of the mine earlier by OC only, i.e. from 7th year, which is feasible due to lower depth and stripping ratio in early years of OC operation. Thus only from 7th year to 14th year, OC operation would make up for UG production for achieving the overall mine target of 23.6 Mtpa. As UG operation builds up to the targeted level of 1.6 Mtpa, the OC production is brought down to its sustainable level, i.e. 22 MTPA. The OC mine can technically produce at a rated capacity of 20 to 25 MTPA but considering that the opencastable reserves are only 553.177 MT, the OC mine has been planned at 22 MTPA (as explained above) to give the project a nominal life of about 28 years including build up period. Target of 1.6 Mtpa for UG operation has been decided considering that a lag is to be maintained taking into account the advancement of operation in overlying seams through opencast. The 1.6 MTPA target for an UG mine is considered fairly high under Indian conditions. (The above matter has been incorporated under para 5.1 of Chapter 5 of MP).
5	Sum E (d) &	The Mining Plan proposes to work out the coal block upto Seam VI by opencast	There are 18 nos. of coal seams (including splits) occurring below seam VI (proposed quarry floor). Excepting seam-I Combined, all other seams

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<tr><td></td><td>Para 5.1.2</td><td>method in two quarries separated by the Kelo river. Assessment may kindly be presented to show at what stripping ratios the incremental coal can be made available from the lower seam(s), if proposed to be worked by opencast method.</td><td>have more than 1 m thickness in localized area only. Even Seam-I Combined has split in major part. The total depth of quarry upto seam-I floor, if considered by opencast, will be more than 450m against the presently proposed depth of upto 190m (Seam VI floor). The incremental stripping ratio for the lower seams considering the batters will be around 20 -25 cum per tonne of coal.

Further in case of Gare Sector-II, additional space is not available for OB disposal as the OB generated upto Seam VI has been adjusted within the ML area with great difficulty and meticulous planning of rehandling schedule. Considering the available area with constraints of dumping space, opencastability is ruled out for lower seams.

(The above matter has been incorporated under para 5.1 of Chapter 5 of MP)</td></tr>
<tr><td>6</td><td>Sum E (d)</td><td>The OBR quantities for the Years 16-29 have not been shown in the Table showing the Combined Calendar Program on Page ES-12. The same may please be incorporated.</td><td>The quantity for years 16-29 have been filled as shown in the following table
<table>
<tr><th>Year</th><th>Opencast (MT)</th><th>OBR MCUM</th><th>OBR Including Rehandling MCUM</th><th>Stripping ratio Cum/ t</th><th>SR incl. rehandaling CUM/ T</th><th>Under Ground</th><th>Total (MT)</th></tr>
<tr><td>1</td><td>0.250</td><td>5.000</td><td>5.000</td><td>20.00</td><td>20.00</td><td>0</td><td>0.25</td></tr>
<tr><td>2</td><td>1.550</td><td>14.100</td><td>14.100</td><td>9.10</td><td>9.10</td><td>0</td><td>1.55</td></tr>
<tr><td>3</td><td>3.000</td><td>30.000</td><td>30.000</td><td>10.00</td><td>10.00</td><td>0</td><td>3.00</td></tr>
<tr><td>4</td><td>6.000</td><td>45.000</td><td>45.000</td><td>7.50</td><td>7.50</td><td>0</td><td>6.00</td></tr>
<tr><td>5</td><td>9.500</td><td>80.000</td><td>80.000</td><td>8.42</td><td>8.42</td><td>0</td><td>9.50</td></tr>
</table></td></tr>
</table>

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Sl. No.	Refer Para	Observations	Compliance								
			6	21.300	135.000	135.000	6.34	6.34	0	21.3
			7	23.600	135.000	156.740	5.72	6.64	0	23.6
			8	23.600	135.000	156.740	5.72	6.64	0	23.6
			9	23.600	135.000	156.740	5.72	6.64	0	23.6
			10	23.600	135.000	156.520	5.72	6.63	0	23.6
			11	23.600	135.000	140.220	5.72	5.94	0	23.6
			12	23.200	130.000	135.220	5.60	5.83	0.40	23.6
			13	22.800	130.000	135.220	5.70	5.93	0.80	23.6
			14	22.400	130.000	135.220	5.80	6.04	1.20	23.6
			15	22.000	99.000	103.750	4.50	4.72	1.60	23.6
			16	22.000	99.000	120.740	4.50	5.49	1.6	23.6
			17	22.000	99.000	120.740	4.50	5.49	1.6	23.6
			18	22.000	99.000	120.740	4.50	5.49	1.6	23.6
			19	22.000	99.000	120.740	4.50	5.49	1.6	23.6
			20	22.000	99.000	118.500	4.50	5.39	1.6	23.6
			21	22.000	99.000	99.000	4.50	4.50	1.6	23.6
			22	22.000	99.000	99.000	4.50	4.50	1.6	23.6
			23	22.000	99.000	99.000	4.50	4.50	1.6	23.6
			24	22.000	99.000	99.000	4.50	4.50	1.6	23.6
			25	22.000	99.000	99.000	4.50	4.50	1.6	23.6
			26	22.000	99.000	163.350	4.50	7.43	1.6	23.6
			27	21.997	99.000	163.350	4.50	7.43	1.6	23.597
			28	22.000	95.020	172.850	4.32	7.86	1.6	23.600
			29	17.180	5.000	82.770	0.29	4.82	1.6	18.780
			30			44.183			1.6	1.6
			31			44.183			1.6	1.6
			32-77			44.183			72.375	72.375
			Total	553.177	2761.120	3396.800	4.99	6.14	101.975	655.152

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<table>
<tr><th>Sl. No.</th><th>Refer Para</th><th>Observations</th><th>Compliance</th></tr>
<tr><td></td><td></td><td></td><td>The above values have been incorporated in Page ES-12, ES-13 and can also be seen in Table 5.7 at Page 5-21 of MP.</td></tr>
<tr><td>7</td><td>Para 5.3.12</td><td>The MP proposes to extract 553.177 Mt of coal and remove about 2761 Mcum of Overburden at a stripping ratio of 4.99 cum/t. It also proposes to rehandle around 636 Mcum of OB (218.83 Mcum for surface dump rehandling and 417 Mcum of crown dump rehandling), increasing the effective strip ratio to 6.14 cum/t from 4.99 cum/t, whereas, Table 5.12 shows the Stripping ratio as 5.75 cum/t.</td><td>The stripping ratio figure in Table 5.12 under para 5.3.12 of Chapter 5 has been reconciled as given below.
<table>
<tr><td>Stripping Ratio without re-handling</td><td>Cum/ t</td><td>4.99</td></tr>
<tr><td>Stripping Ratio with re-handling of surface dumps</td><td>Cum/ t</td><td>5.39</td></tr>
<tr><td>Stripping Ratio with re-handling of surface dumps and crown dump</td><td>Cum/ t</td><td>6.14</td></tr>
</table></td></tr>
<tr><td>8</td><td>Para 5.3.11.2</td><td>The MP proposes to handle about 135 Mcum of solid OB per year during steady state operations excluding the quantity for rehandling of surface dumps. It also proposes to deploy 348 dumpers within the project in addition to the contractors trucks deployed for contractual rehandling. Safety issues related to a huge fleet of dumpers may kindly be addressed.
Possibility of providing conveying arrangement through belt should be looked into.</td><td>1. Safety issues and safety Measures to be Adopted for the Large Fleet of Dumpers have been furnished under para 12.2.6 of this Mining Plan and Mine Closure Plan.
2. With multi seam operation, the excavation, loading, and hauling operation will be carried out at different places, minimum 4 main hauling routes will be available exclusively for dumpers through quarry floor and flanks at different horizons, for transport of coal to CHP and stockyard and OB to internal and external OB dump sites. The average distance between two dumpers with minimum 4 routes comes to about 120 m and a minimum distance (while hauling) would not be permitted less than 30m thus providing adequate safety for which relevant instructions will be issued to the dumper operators.</td></tr>
</table>

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Sl. No.	Refer Para	Observations	Compliance
			3. Because of production contribution from 12 no. of seams at different horizons, dumper transport would be ideally suited. Further, due to dumping constraints, virtually no space will be available at quarry floor. The working faces will be moving fast at 200-300 m per year and it will be difficult to maintain multiple loading points and undertake frequent shifting of loading points in case the conveyor arrangement is to be considered instead of presently proposed dumper system. (The above matter (2 and 3) has also been covered under Para 5.3.11.2 of Chapter 5 at Page 5-33 of MP.)
9	Chapter 5	The embankment against the Kelo river should be designed keeping in view the HFL levels and other protective measures against flooding may be addressed.	The matter of embankment against the Kelo river has been covered under para 12.2.1 of Chapter 12 of MP as given under. The mine working will be protected from the river inundation by providing embankments on either side of the Kelo river. The embankments will be designed with 3m height above HFL and 10m width. The slope of the sides will be 1 in 3 on river side and 1 in 2 on quarry side. Core of the embankment will be constructed from impervious clay. Both sides of embankment will be clad/ paved with stones. Adequate measures to protect the mine workings from surface water flow during the rains will be taken by way of providing garland drains around the mine excavations and also by providing suitable drainage gradients for mine benches. Sumps of adequate capacity will be provided on the quarry floor. The coal excavation and transport machinery are organised to be sited over the coal bench top during rainy season and will not be affected by water

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			accumulation from rains or strata seepage on the quarry floor. No water accumulation in OC mine workings will be permitted to remain when the UG mining operations are in progress.
10	Para 5.3.10.1	RQP may reconfirm the dump space availability for internal and external dumps to meet the desired coal production as proposed in the Calendar Plan. Further optimization is desired in mine planning to improve the viability of the project.	As the surrounding area of the mine is coal bearing and belonging to other coal blocks, availability of external dumping space other than within the block is not foreseen. The entire block area is coal bearing and dump locations, schedule for dumping and rehandling have been envisaged accordingly, which will cater to the dump space requirement for the project. The proposed design layout has been arrived after also considering the simultaneous operation of OC and UG. (The above has been incorporated under para 9.3.i at page 9-2 of Chapter 9)
11	Chapter 5	The CHP design parameters are not in conformity with large capacity mines. The coal flow diagram is too sketchy. The coal flow diagram shows the coal to be truck loaded for sending it to the railway siding, which may not be the desired option from environmental point of view.	The CHP design parameters have been relooked and modified. The CHP has been elaborated in Plate XLI showing its plan view, elevation view and coal flow. As coal is to be produced through Surface Miners, additional crushing of coal in the CHP is not required. The alignment of railway corridor passing through the coalfield has yet to be frozen after addressing concerns of different stake holders by the Govt. The loading system will be decided in totality, once the parameters like alignment of the siding and its distance and its corridor from the mine etc. are available.

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			The truck transport system is proposed as an option till the alternative system takes a shape. The dispatch from the off take point is now modified in the CHP layout which will enable to evacuate coal by three means. i. Coal could be sent to washery from transfer points. Washed coal is brought back to transfer points for despatch through railways or trucks, ii. Coal could be directly sent to silos for railway despatch, bypassing the washery circuits, so that the despatch is not affected in case of any problem in washery. iii. Coal being loaded into trucks in case of need and also till the period of CHP and washery construction. (The above has been incorporated under para 10.1 at page 10-1 of Chapter 10)
12	Chapter 5	It has been proposed to extract coal seams by deployment of Continuous Miners having minimum cutting height of 1.8m. However, in the projection plans the minimum extraction height has been shown as 1.5m.	The compatibility of the CM has been relooked into w.r.t. the seam thickness and the specifications of the proposed CM have been modified. The equipment to be selected would have the specification to cover a seam height range in single lift varying from 1.50m to 3.5m (Continuous Miner model CAT: CM 340 (Mining Range 1.37 m to 4.00m, 70 tonnes, 697 KW or other similar CM.)

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			(The above has been incorporated under para 5.4.6.I.a) at page 5-46 of Chapter 5 of MP)
13	Chapter 5	Transport system in underground for coal and material may be given	Transport system in underground for coal and material has been incorporated under para 5.4.6.II (j) and (k) respectively of Chapter 5 and explained below: ***i) Conveyor*** A 1200mm "fire resistant" conveyor at around 3m/s with a duty equivalent to average 500T per hour (TPH) would be installed in the centre roadway (as shown in all stage plans) to ensure equal distances and cable lengths on each side of the loading point. The system will absorb the peaks of 750 TPH. The conveyor will be equipped with a loop take-up of sufficient capacity to hold belt stretch for one week and preferably to hold one roll (usually 300m) of conveyor belting for extension and retreat of the conveyor. At the in-bye end of the conveyor, a sledge mounted and guarded return pulley frame, graduated loading section (at least 3m in length) equipped with impact rollers, and anchor chains will be provided. The "head" end of the conveyor will be equipped with a suitable loading section on to the trunk conveyor, dust suppression equipment, belt alignment, belt slack and belt slip detectors. The "gate" belt should be electrically interlocked with the "trunk" conveyor to automatically stop the gate belt.

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			Communication and continuous signaling and "stop pulls" will be provided along the length of the conveyor. The conveyor will also be provided with an effective bottom belt scrapper.
			One side of the conveyor will be designated as the "man walkway" into the district. To prevent "Tripping and Falling" accidents, this walkway will be kept clear of any supplies, materials, be clean, level and well illuminated.
			District materials will not, as far as possible, be transported along the conveyor belt route.
			The transport system within a Continuous Miner Panel has been shown vide fig. No.5.7 in Chapter 5
			ii) Material Transport
			Materials such as timber, roof bolts, grouts/resins, spare parts, cables, lubricants, ventilation stopping materials etc. are to be transported by mine tubs to within one split of the gate belt "tail end".
			Familiar method such as an endless rope haulage system using 15 kg track with a 0.6m gauge may be used. The track and return wheel should lag no more than 2 pillars behind the conveyor tail end. The rail track will

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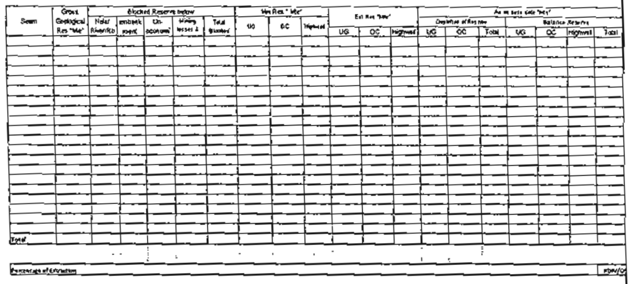
			be laid in the incline (other than the conveyor incline) extending to all the UG workings.
14	Para D (s) & Para 5.1.1	Seam–wise geological and corresponding extractable reserve should be indicated in the following table 	Seam- wise geological and corresponding extractable reserve, as per the specified formats has now been Furnished as Table 5.1A (for Opencast), 5.1B (for underground) and 5.1C (OC + UG combined Summary) under para 5.1.1 of Chapter 5. As these tables are large (wide), they could not be accommodated here.
15	Para 5.1.2	It appears that about 10 Mt of coal is getting blocked under Kelo river, is there any plan to divert Kelo river, if so then the action plan for the same should be envisaged.	Due to the prevailing topography, shape of the block and presence of other coal blocks all around, Kelo river cannot be diverted. In future if the possibility of diversion of the river is worked out, a revised mining plan will be submitted to MOC. (The above has been incorporated under para 5.1.2 in Chapter 5)
16	Para 5.1.2	Some reserve is likely to be locked below infrastructure and batter, is there any action plan to liquidate the same?	The reserves blocked under facilities viz. incline, CHP, office, Shaft Pillar etc. in northern corner of west part of block will be 21.301 Mt.

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			These facilities will be required for supporting the OC operations as well as UG operations. Though the OC operations will exhaust by the end of 29th year, the UG operations have long life and will continue till 77th year. The issue, whether some locked coal under the facilities could be mined, will be examined at the fag end of UG operation under prevailing conditions at that time. As far as the reserves under the batter are concerned, the matter has been studied in detail as follows. The fast advance of mining operations followed closely by the backfilling operations, especially due to dearth of space for disposal of OB on the surface, application of High Wall mining during the operating life of OC mine has been ruled out. It is only at the end of the OC mining operations that the HW mining can be considered. Then also, there will be restriction of application due to practicality of deployment of the equipment as it must operate from the same level as of the bench to be mined by HW mining. After exhausting the mine by the end of 29th year, it will be technically possible to deploy the system at the bottom of the quarry i.e. at the floor of Seam VI and VII combined. The upper seams mining by HW will not be possible because of non-availability of space adequate to install and operate this system. Thickness of seam VI is between 0.5m and 0.75m in the reference region. It will not be feasible to deploy the HW system. However, seam –VII combined has a thickness of around 5m in the reference region, application of HW mining could be feasible.

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			In this regard, it is important to note that HW mining has been operational in only two mines in India as follows: 1. **Sharda Coal OC Mine, SECL, M.P.:** Cuprum Bagrodia Ltd, Kolkata has been operating coal extracting machine for High Wall Mining in this mine. The Seam thickness is 1.2-1.5 m and the production is 0.5 MTPA. The drivages are of 2.9m width with 1.2m ribs; and after every 8-10 cuts/drivages, a rib pillar of about 3m is left. The length of each hole (penetration) is 250m. 2. **Medpalli OC Coal mine of SCCL, Telangana:** M/s Advanced Mining Technology Pvt Ltd., Hydrerabad is operating HW system in this mine which has exhausted its reserves after operating normal mine of 4MTPA production. Now coal is being extracted by HW mining. The operation has been on for last 3-4 years (since 2011-12). The thickness of seam is 5.5 m. The HW system which was operational, took one lift of 2.4m thickness while the rest thickness of seam was left unmined. The overall extraction was recorded at about 20% of the whole seam. However, the operating company has developed expertise over time and now it has brought a new machine which can take 2 lifts, each of 2.4m thickness. This operation is expected to start from August 2016. It is anticipated that the extraction percentage with respect to total seam thickness will be about 35%.

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			Accordingly, the calculations have been made for coal which can be extracted from Seam-VII combined assuming 2 lift operation giving 35% extraction. The coal reserves extractable by HW system come to 1.52 MT. Assuming a production rate of about 0.5 MTPA, the said reserves can be mined in 3 years. However, this HW proposal may not be feasible at that stage because the HW drivages will get filled up with water (as the specific location is towards dip side) and the underground operations of lower seams as proposed in the mining Plan will be endangered. It may be noted that it will not be possible to physically inspect the HW drivages for the presence of water irrespective of pumping provision. Eventually, the HW could be carried out only after the exhaustion of UG reserves (after 77th year). The decision regarding mining the coal locked in batter of OC mine may be taken at the end of the UG operations considering the technologies (High wall or otherwise) available at that time and if the application of Highwall mining at that time is found to be feasible, a revised mining plan will be submitted. (The above matter has been covered under para 5.1.3 of Chapter 5.)
17	Sum Para E	Distance of end use power plant to be envisaged required in line with the guidelines for formulation of mining plan at summary para " End use of Coal/ Lignite"	Distance of end use power plant was already mentioned in 2nd column of the table under the heading EUP/ Location/ Address. Now it is being shown under a separate column

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<table>
<tr><th>Sl. No.</th><th>Refer Para</th><th>Observations</th><th>Compliance</th></tr>
<tr><td></td><td></td><td></td><td>

EUPs as per Allotment Order dt. 31-08-2015

<table>
<tr><th>Sl. No.</th><th>EUP/ Location/ Address</th><th>Configuration</th><th>Distance of EUP KM</th></tr>
<tr><td>1.</td><td>Chandrapur Thermal Power Station Unit 8 & Unit 9
Nirman Bhavan, Urja Nagar, Chandrapur- 442404.</td><td>2x500 MW</td><td>800</td></tr>
<tr><td>2.</td><td>Koradi Thermal Power Station Unit 8, Unit 9 and Unit 10
Chindwara Road, Koradi-441111, Distt. Nagpur, Maharashtra.</td><td>3x660 MW</td><td>595</td></tr>
<tr><td>3.</td><td>Parli Thermal Power Station Unit 8 Vaijnath, Dist. Beed- 431520, Maharashtra</td><td>250 MW</td><td>1147</td></tr>
<tr><td></td><td>Total</td><td>3230 MW</td><td></td></tr>
</table>

</td></tr>
<tr><td>18</td><td>Sum Para F (d)</td><td>What will be the ash % of the ROM Coal?
Whether washery is being provisioned to comply with the MoEF restriction on transportation of coal with more than 34% ash for power stations located at 500 km and away from the pitheads from June 2016?</td><td>i) The average ash content of total extractable reserves comes to between 37 and 38% based on insitu parameters. However, the Ash % of ROM coal will fluctuate from year to year (34.05 % to 41.42%) as is evident from Table 5.9.
ii) In the Mining Plan, provision for space for a washery has been made. The decision regarding capacity and layout of washery will be reached after thorough investigation. MSPGCL has approached CMPDIL (Copy enclosed as Annexure 1-3) for generation of data (washability tests, cleaning possibilities etc) and report preparation.
(The above matter has now been covered under para 10.2 of Chapter 10.)</td></tr>
</table>

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<table>
<tr><th>Sl. No.</th><th>Refer Para</th><th>Observations</th><th>Compliance</th></tr>
<tr><td>19</td><td>Para 15.3.2</td><td>Table 15.10 & 15.11 needs to be reconciled and Post closure land management needs to be elaborated</td><td>The tables have been reconciled.
Post Closure Land Management has now been covered under Para 15.10 as given below.
After the closure of mine, the reclaimed leasehold area and any structure thereon, which is not to be utilized by the mine owner, shall be surrendered to the State Govt. concerned following a laid down procedure as in vogue at that point of time.</td></tr>
<tr><td>20</td><td>Water</td><td>Hydro-geological Study & Water Balance Chart should be provided.</td><td>Hydro-geological Study has not yet been done. It will be commissioned shortly and the study submitted to MOC.
Water Balance Chart has already been given in table 15.13 and reproduced below.
<table>
<tr><th>i. Potable water</th><th>Daily requirement, cum</th></tr>
<tr><td>Drinking at working place @ 45 lpd/head for 3400 workers etc. (Total 3400)</td><td>153.00</td></tr>
<tr><td>*Colony (for 50% employees)= 3400/2=1700*4 members in family @ 135 lpd</td><td>986</td></tr>
<tr><td>For peripheral villages</td><td>100.00</td></tr>
<tr><td>**Total of (i)**</td><td>**1239**</td></tr>
</table></td></tr>
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<tr><th>Sl. No.</th><th>Refer Para</th><th>Observations</th><th>Compliance</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><td>ii. Industrial water</td><td></td></tr>
<tr><td>Sprinkling @ 30 m^3/km of road length (10km)</td><td>300.00</td></tr>
<tr><td>Plantation @ 20 cum/ ha {1509.12 ha/ 22.5 years = 59.18 ha (say 60 ha)</td><td>1200.00</td></tr>
<tr><td>Vehicles washing @ 2.0 m^3/ vehicle/ day {washable vehicles about (400X2 times a weak)/ 7 days = 115 veh/ day (Water required 115x2-80%*230 re-circulation=46)</td><td>46.0</td></tr>
<tr><td>Total (ii)</td><td>1546</td></tr>
<tr><td>Grand total (i + ii)</td><td>2785</td></tr>
<tr><td>Reclaimed water from STP of colony (80% of 986 cum) which can be used in watering the plantation</td><td>790</td></tr>
<tr><td>Net water requirement</td><td>1995</td></tr>
</table>
(The above matter has now been covered under para 15.4.1 of Chapter 15.)</td></tr>
<tr><td>21</td><td>Top soil</td><td>Year wise top soil utilization should be furnished</td><td>Year/stage wise top-soil generation, utilization and balance to be stacked is given in the following table.

YEAR WISE TOP-SOIL GENERATION AND UTILISATION (MCUM)
<table>
<tr><th>Year</th><th colspan="2">Top soil Genration</th><th colspan="2">Top soil Utilisation</th><th>Balance Stack</th></tr>
<tr><th></th><th>Progressive</th><th>Cumulative</th><th>Progressive</th><th>Cumulative</th><th>Cumulative</th></tr>
<tr><td>const. (0)</td><td>0.00</td><td>0.00</td><td>0.00</td><td>0.00</td><td>0.00</td></tr>
<tr><td>1st year</td><td>0.16</td><td>0.16</td><td>0.00</td><td>0.00</td><td>0.16</td></tr>
</table></td></tr>
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<tr><th>Sl. No.</th><th>Refer Para</th><th>Observations</th><th>Compliance</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><td>2nd to 3rd year</td><td>0.62</td><td>0.78</td><td>0.00</td><td>0.00</td><td>0.78</td></tr>
<tr><td>4th to 5th year</td><td>1.50</td><td>2.28</td><td>0.00</td><td>0.00</td><td>2.28</td></tr>
<tr><td>6th to 10th year</td><td>4.31</td><td>6.60</td><td>2.05</td><td>2.05</td><td>4.54</td></tr>
<tr><td>11th to 15th year</td><td>3.89</td><td>10.48</td><td>2.41</td><td>4.46</td><td>6.02</td></tr>
<tr><td>16th to 20th year</td><td>1.22</td><td>11.70</td><td>2.25</td><td>6.72</td><td>4.98</td></tr>
<tr><td>21st to 25th year</td><td>1.94</td><td>13.63</td><td>2.19</td><td>8.90</td><td>4.73</td></tr>
<tr><td>26th year to of OC mine/ 29th year</td><td>1.01</td><td>14.64</td><td>3.83</td><td>12.74</td><td>1.91</td></tr>
<tr><td>closure plan 32th</td><td>0.00</td><td>14.64</td><td>1.90</td><td>14.64</td><td>0.00</td></tr>
<tr><td>Total</td><td>14.64</td><td></td><td>14.64</td><td></td><td></td></tr>
</table>
(The above matter has now been covered in Table 15.17 under para 15.4.4.iii of Chapter 15.)</td></tr>
<tr><td>22</td><td>Disposal</td><td>Disposal of Mining machineries should be provided as per Mine Closure Plan Guidelines issued by MOC, New Delhi dated 07.01.2013</td><td>Disposal of Mining machineries will be done as follows:

Some machinery having, remaining life will be utilised in the other coal mines of the company if operative at that time. The other machineries will be e-auctioned after decommissioning (ref para 15.6.i).

The tentative cost of dismantling has been given in table 15.21 under para 15.7 in Chapter 15 and also in Annexure 15-3. The relevant portion is reproduced below.</td></tr>
</table>

<table>
<tr><th>Sl. No.</th><th>Refer Para</th><th>Observations</th><th>Compliance</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th colspan="2">Activities</th><th>Total amt., Rs. Lakh</th></tr>
<tr><td colspan="3">01. Dismantling of Infrastructure, disposal/ rehabilitation of mining machinery</td></tr>
<tr><td>a)</td><td>Dismantling of workshop</td><td>300.00</td></tr>
<tr><td>b)</td><td>Dismantling of CHP</td><td>500.00</td></tr>
<tr><td>c)</td><td>Dismantling of facilities</td><td>1000.00</td></tr>
<tr><td>d)</td><td>Dismantling of pumps and pipes</td><td>45.00</td></tr>
<tr><td>e)</td><td>Dismantling of UG facilities including main fan</td><td>100.00</td></tr>
<tr><td>f)</td><td>Dismantling of UG Conveyors</td><td>300.00</td></tr>
<tr><td>g)</td><td>Dismantling of UG Rail tracks</td><td>150.00</td></tr>
<tr><td>h)</td><td>Dismantling of UG equipment</td><td>200.00</td></tr>
<tr><td>i)</td><td>Re-arranging of water pipelines to dump top, park</td><td>15.00</td></tr>
<tr><td>j)</td><td>Dismantling of power line</td><td>30.00</td></tr>
<tr><td>k)</td><td>Rehabilitation over area of dismantled facilities</td><td>203.76</td></tr>
</table>
</td></tr>
<tr><td>23</td><td></td><td>Manpower requirement for carrying out mine closure activities should be furnished in the para for Time scheduling for abandonment with bar chart & manpower requirement for implementation</td><td>The year wise abandonment activities details have been furnished in the Bar Chart given as Annexure 15-3 under the para 15.6 (Chapter 15) for time scheduling of Abandonment. Year wise Man days requirement for carrying out progressive and final mine closure activities have also been given in that Annexure.</td></tr>
</table>

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24		Infrastructure to be retained and to be demolished to be provided in a tabular form.	Infrastructure to be retained and to be demolished to be demolished/ dismantled has been given in a tabular form as Table 15.20 under para 15.6 of Chapter 15 and is reproduced below.

FACILITIES/ INFRASTRUCTURE TO BE RETAINED AND DISMANTLED

Sl. No.	Particulars	To be Retained (Area in Ha)	To be Dismantled (Area in Ha)
I	**Facilities to be retained**		
i	Office, VT Center, Canteen, dispensary, Parking, Essential quarters near the shaft and inclines	5.00	
ii	Diverted Road	30.30	
	Total-I (To be Retained)	**35.30**	
II	Facilities to be Dismantled		
III	C.H.P		5.00
IV	Facilities including inclines, shaft, Store, Security post, weigh bridge		1.50
V	Settling pond		5.0

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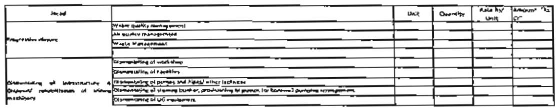
<tr><th>Sl. No.</th><th>Refer Para</th><th>Observations</th><th>Compliance</th></tr>
<tr><td></td><td></td><td></td><td><table>
<tr><td>VI</td><td>Coal stack yard</td><td></td><td>4.00</td></tr>
<tr><td>VII</td><td>Road</td><td></td><td>0.14</td></tr>
<tr><td></td><td>Total-II
(To Be Dismantalled)</td><td></td><td>15.64</td></tr>
<tr><td></td><td>Total-I and II</td><td>35.30</td><td>15.64</td></tr>
<tr><td></td><td>Grand Total</td><td colspan="2">50.94</td></tr>
</table></td></tr>
<tr><td>25</td><td>15.7</td><td>The Mine closure activities required to be taken should be in coherence with the guidelines of the Mine Closure plan.

The basis of assessment of indicative cost should be envisaged.

</td><td>The Mine closure activities have now been listed as per the specified format as given in Table No. 15.21 and also in Annexure 15-3.

Indicative costs for Mine closure activities are based upon data collected from various sources including discussion with actual mine operators, internet, quotations from vendors.

(The above matter has been covered under para 15.7 in Chapter 15)</td></tr>
<tr><td>26</td><td>15.6</td><td>Bar chart for the activities to the taken up for the period life of the mine plus 3 year should be provided indicating activity-wise breakup of the abandonment cost.</td><td>Bar chart for the activities has been provided vide Annexure 15-3 alongwith the abandonment cost.</td></tr>
<tr><td>27</td><td>15.7</td><td>i. WPI as on the base date should be considered for assessment of amount to be deposited in escrow account as a</td><td>i. Base date of the WPI has been considered as January 2016 for calculation of Escrow Amount as mentioned in para 15.7b of Chapter 15.</td></tr>
</table>

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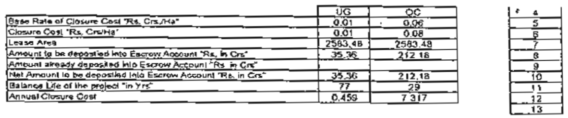
<tr><th>Sl. No.</th><th>Refer Para</th><th>Observations</th><th>Compliance</th></tr>
<tr><td></td><td></td><td>security against the mine activities to be carried out for the closure of the mine.
<table>
<tr><th></th><th>UG</th><th>OC</th><th>4</th></tr>
<tr><td>Base Rate of Closure Cost "Rs. Crs./Ha"</td><td>0.01</td><td>0.06</td><td>5</td></tr>
<tr><td>Closure Cost "Rs. Crs/Ha"</td><td>0.01</td><td>0.08</td><td>6</td></tr>
<tr><td>Lease Area</td><td>2583.48</td><td>2583.48</td><td>7</td></tr>
<tr><td>Amount to be deposited into Escrow Account "Rs. in Crs"</td><td>35.36</td><td>212.18</td><td>8</td></tr>
<tr><td>Amount already deposited into Escrow Account "Rs. in Crs"</td><td></td><td></td><td>9</td></tr>
<tr><td>Net Amount to be deposited into Escrow Account "Rs. in Crs"</td><td>35.36</td><td>212.18</td><td>10</td></tr>
<tr><td>Balance Life of the project "in Yrs"</td><td>77</td><td>29</td><td>11</td></tr>
<tr><td>Annual Closure Cost</td><td>0.459</td><td>7.317</td><td>12</td></tr>
<tr><td></td><td></td><td></td><td>13</td></tr>
</table></td><td></td></tr>
<tr><td></td><td></td><td>ii. From the plan it is not clear to what extent there is the superimposition of OC and UG.</td><td>ii. The superimposition of OC and UG has now been shown vide Fig. No. 3.1, as also explained in Para 15.7 b.
A part of the area on western side is not workable by UG and the same has not been considerd for UG mine.</td></tr>
<tr><td></td><td></td><td>iii Since the total project area of 2583.48 Ha has been taken into consideration for mine closure cost calculation of OC, the cost calculation for Escrow fund for UG i.e for 2208.18 Ha should be done from 30th year i.e after closure of the OC mine. Rs. 43.81 lakhs in Table 15.21 for the UG mine should be escalated to the value in the 30th year (i.e the first year for Escrow fund for UG mine). For UG, fund depositing should start from the 30th year.</td><td>iii. The cost calculation for Escrow fund for UG i.e. for 2208.18 Ha has been now done from 30th year i.e. after closure of the OC mine. The Table No. 15.23 showing Amount to be deposited into Escrow Account Annually has been accordingly modified.
For derivation of escrow amount the suggested format has been adopted and given in Table 15.22. The same is reproduced below.<table>
<tr><td>Monthly Wholesale Price Index "Aug. 2009"</td><td>129.600</td></tr>
<tr><td>WPI as on base date "January 2016"</td><td>175.400</td></tr>
<tr><td>Escalation rate of Closure cost</td><td>1.3534</td></tr>
<tr><td>Rate of compounding of Annual Closure Cost</td><td>5.00%</td></tr>
<tr><td>Amount to be deposited into Escrow Account after compounding @ of 5% "Rs. in Crs"</td><td>932.7141</td></tr>
</table></td></tr>
</table>

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कोयला मंत्रालय / Ministry of Coal
शास्त्री भवन / Shastri Bhawan
नई दिल्ली / New Delhi

NAGPAL
Secretary
of India
of Coal

<table>
<tr><th>Sl. No.</th><th>Refer Para</th><th>Observations</th><th>Compliance</th></tr>
<tr><td></td><td></td><td></td><td>
<table>
<tr><th></th><th>OC</th><th>UG</th></tr>
<tr><td>Base Rate of Closure Cost "Rs. Crs./Ha"</td><td>0.0600</td><td>0.0100</td></tr>
<tr><td>Closure Cost "Rs. Crs/Ha" on Base dt.</td><td>0.08120</td><td>0.01353</td></tr>
<tr><td>Lease Area Ha.</td><td>2583.48</td><td>2208.18</td></tr>
<tr><td>Amount to be deposited into Escrow Account "Rs. in Crs"</td><td>209.788</td><td>29.89</td></tr>
<tr><td>Amount already deposited into Escrow Account "Rs. in Crs"</td><td>0.00</td><td>0.00</td></tr>
<tr><td>Net Amount to be deposited into Escrow Account "Rs. in Crs"</td><td>209.79</td><td>29.89</td></tr>
<tr><td>Starting Year</td><td>1</td><td>30</td></tr>
<tr><td>End Year</td><td>29</td><td>77</td></tr>
<tr><td>Balance Life of the project For Escro Account "in Yrs"</td><td>29</td><td>48</td></tr>
<tr><td>Annual Closure Cost on Base Date, Rs. Cr.</td><td>7.2341</td><td>0.6226</td></tr>
<tr><td>Annual Closure Cost escalated @ 5% as on first year of deposit, Rs. Cr</td><td>7.2341</td><td>2.5628</td></tr>
</table>
(Above Matter has been covered under Chapter 15)</td></tr>
<tr><td>28</td><td>Para 15.8</td><td>Financial Assurance para should be described as per Mine Closure Plan Guidelines issued by MOC, New Delhi dated 07.01.2013</td><td>Financial Assurance Para has now been described as suggested under para 15.8 as given below:

FINANCIAL ASSURANCE
i) For financial Assurance the mining company shall open an Escrow account, with any Scheduled Bank, with the Coal Controller Organisation (on behalf of the Central Govt.) as exclusive beneficiary. The mining company shall cause payments to be</td></tr>
</table>

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Sl. No.	Refer Para	Observations	Compliance
			deposited in such Escrow account at the rate computed as indicated in table given above. The owner of the company may select the Scheduled Bank where the Escrow account is to be opened and inform the same to Coal Controller, Kolkata. The Escrow amount has to be opened as per the Guidelines of the Mine Closure Plan. The amount being deposited will be reviewed with such periodicity as deemed fit by Coal Controller. ii) Up to 80% of the total deposited amount including interest accrued in the Escrow Account may be released after every 5 years in line with the periodic examination of the Closure Plan. Amount released shall be equal to the expenditure incurred on the progressive mine closure in the past 5 years or 80% which ever is less. The balance amount at the end of final mine closure shall be released to mine owner on compliance of all statutory Rules, Regulations, Orders made by Central or State Govt., Statutory Organisations, Courts, etc. and duly certified by the Coal controller. iii. An agreement, outlining the detailed terms and conditions of operating the Escrow account, shall be executed between the Mining company, Coal Controller and the concerned bank in order to give effect to this. The agreement will be executed before the grant of the permission by the Coal Controller to open the mine.
29		Para 15.9 and 15.10 should be as per Mine Closure Plan Guidelines issued by MOC, New Delhi dated 07.01.2013	Para 15.9 of MCP regarding Responsibility of the Mine Owner has been further elaborated by including text from Para 9 of the Guidelines as given below:

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Ministry of Coal
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New Delhi

Sl. No.	Refer Para	Observations	Compliance
			RESPONSIBILITY OF THE MINE OWNER It is the responsibility of the mine owner to ensure that the protective measures contained in the Mine Closure Plan including reclamation and rehabilitation works have been carried out in accordance with the approved mine Closure Plan and Final Mine Closure Plan. The owner shall submit yearly report to the Coal Controller before 1st July of every year setting forth the extent of protective and rehabilitative works carried out as envisaged in the approved Mine Closure Plan (Progressive and Post mine Closure Plan). The prime responsibility of mine closure shall always lie with the mine owner, and incase the funds deposited are found to be insufficient to cover the cost of final mine closure, the mine owner undertakes to provide additional fund equivalent to gap in funding before five years of mine closure. The para 15.10 regarding Provision for Mine Closure has been further elaborated to include Text from Para 8.2 and 8.3 of the Guidelines as given below: **PROVISION FOR MINE CLOSURE** The mine owner will be required to obtain a mine closure certificate from Coal Controller to the effect that the protective, reclamation and

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			rehabilitation works in accordance with the approved mine closure plan/ Final mine Closure Plan have been carried out by the mine owner for surrendering the reclaimed land. After the closure of mine, the reclaimed leasehold area and any structure thereon, which is not to be utilized by the mine owner, shall be surrendered to the State Govt. concerned following a laid down procedure as in vogue at that point of time.
	Annexure (to be attached)		**Annexures have been attached as follows**
30		Certificate of acceptance of the RQP to formulate the mining plan on behalf of the project proponent.	The certification was covered in the Certificate attached on page No. C-5.
31		A certificate by the RQP that he has been duly authorized by the mining company to prepare Mining plan on their behalf and that he has a valid recognition from MOC under MCR, 1960 to prepare the Mining plan and that provisions of all relevant rules and regulations made there under have been observed in the preparation of mining plan. The Mining plan has been prepared considering the guidelines pertaining to mining plan issued by MoC, GOI & wherever specific permission will be	The certificate has been modified as specified and attached on page No. C-5.

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		required the applicant will approach the concerned authorities	
32		Certificate from empowered representative of / or Block allottee / applicant that the mine will be developed as per the approval of the mining plan from Ministry of coal and all other approvals, as required will be obtained from relevant authorities	Certification was already given vide Annexure 15-2 with extracts from Board Resolution (Para 1) certified by Company Secretary as reproduced below: That the Gare Palma Sector-II Coal Mine will be developed as per the approval of the mining plan from Ministry of coal and all other approvals, as required will be obtained from relevant authorities'
33		Certificate from empowered representative of / or Block allottee / applicant that the reclamation & rehabilitation work shall be carried out in accordance with the approved mine closure plan and any modification /amendments which may be made in the mine Closure Plan by Ministry of Coal, from time to time	Certification was already given vide Annexure 15-2 with extracts from Board Resolution (Para 2) certified by Company Secretary as reproduced below: 'That the Protective Measures and Mine Closure activities including reclamation & rehabilitation work shall be carried out in accordance with the approved Mining Plan and Mine Closure plan and any modification /amendments which may be made in the mine Closure Plan by Ministry of Coal, from time to time.'
34		Copy of the document to establish that the geological report has been duly purchased from CMPDI, GSI/ MECL as the case may be	GR was made available as part of the Auction Process., An amount of Rs. 43,48,16,953.00 was paid to MoC vide our letter dt 13.7.2015 inclusive of cost of GR (copy of fund transaction enclosed as Annexure 4-1) and thereafter original copy of GR was received from prior allottee i.e. M/s. Mahatamil on 24.11.2015.
		Plates (to be attached)	
35		Progressive mine closure plan/ stage plan indicating stages at 1st,3rd, 5th, 10th, and 20th interval (showing area, volume, dump	Stage plans indicating stages at 1st, 3rd, 5th, 10th, 20th etc intervals showing all the required details are given vide Plate No. XIV to Platte No XXI.

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		height etc for OC and seam-wise layout projects and ventilation system in UG)	Underground ventilation can be seen in Plate XIX and XXIV.
36		Post mining land use & Reclamation plan	Post mining land use & Reclamation plan is given at the end of 32nd year for OC and 80th Year for UG vide Plate No, XXXVI
37		The plan indicating the lease boundary and block boundary & Mine boundary superimposed over it in distinct colour.	Project boundary, Block boundary and ML boundary are the same (2583.486Ha), which are shown in all the plates. It may be noted that the boundaries are coinciding with each other and cannot be shown in different colours in a plan. (This matter has been covered under para 3.2 in Chapter 3 of MP)
38		Ventilation system may be provided in the seam-wise projection plans	The ventilation system is shown in Plate XIX and XXIV.
39		Support system & Transport system layout plan should be provided.	Support System for Junction and galleries has been shown in Figure no 5.6. The relevant write-up is given under para 5.4.6.I. (b) and (c), and 5.4.6.II.(f) and (h) Transport system has been incorporated under para 5.4.6.II (j) and (k) respectively of Chapter 5 and has been shown in all stage plans and also in Fig 5.7.

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M/S MAHARASHTRA STATE POWER GENERATION COMPANY LIMITED

"Prakashgad" Plot No. G-9, Anant Kanekar Marg, Bandra (East); Mumbai, Maharashtra-400051
Ph: 022 – 26476231; 022-26474211; E-mail: md@mahagenco.in

MINING PLAN AND MINE CLOSURE PLAN
FOR
GARE PALMA SECTOR-II COAL MINE (MAND RAIGARH COALFIELD)
AT
VILLAGES: TIHLI RAMPUR, KUNJEMURA, GARE, SARAITOLA, MUROGAON, RADOPALI, PATA, CHITWAHI, DHOLNARA, JHINKA BAHAL, DOLESARA, BHALUMURA, SARASMAL AND LIBRA
DISTRICT: RAIGARH, CHHATTISGARH

(Under Rule 22 (4) of Mineral Concessions (Amendment) Rules, 1994

BLOCK AREA/ PROJECT AREA/APPLIED ML AREA : 2583.486 HA
{TOTAL CAPACITY = 23.6 MTPA (22.0 MTPA OC + 1.6 MTPA UG)}

[Re-submitted after Incorporation of Clarifications to Observations of Technical Members of the Standing Committee Constituted under MMDR Act, 1957 vide MOC Letter no. 34011/16/2016-CPAM dt. 03-05-2016]

(VOLUME I : TEXT & ANNEXURES)

ISSUE 1 REV. 0 FEBRUARY, 2016
ISSUE 1 REV. 1 JUNE 2016

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अवर सचिव / Under Secretary
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नई दिल्ली / New Delhi

Prepared by:

B.D.SHARMA
(Recognised Qualified Person)
(No. 34012/03/2014-CPAM Dt 29th May 2015, valid upto May 2025)

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Estb. 1983
An ISO 9001:2008 approved company

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Secretary
of India
Bhawan
Delhi

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ABBREVIATIONS

AMSL - Above Mean Sea Level
bgl - Below ground level
CV - Calorific Value
CSM - Continuous Surface Miner
CMPDIL - Central Mine Planning and Design Institute Ltd.
cum - Cubic metre
DGMS - Directorate General of Mine Safety
DGM - Directorate of Geology and Mining
EIA - Environmental Impact Assessment
EMP - Environmental Management Plan
E&M - Electrical and Mechanical
FE Loader - Front End Loader
FC - Fixed Carbon
GT - Grand Trunk
GR - Geological Report
GSI - Geological Survey of India
HFL - High Flood Level
HEMM - Heavy Earth Moving Machinery
Ha - Hectare
IB - Interburden
IMD - India Meteorological Department
K.Cal/kg - Kilo Calorie per Kilogram
Ltd. - Limited
LTPA - Lakh Tonne Per Annum
LHD - Load Haul Dump
MTPA - Million Tonne Per Annum
MCPA - Million Cubic Metre Per Annum
M cum - Million cubic metre
MBCM - Million Bank Cubic Metre
m - Metre
Mt - Million tonne
ML - Mining Lease
Mty - Million tonne per year
MOC - Ministry of Coal

H.P. NAGPAL

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Mil. cum.	-	Million cubic metre
Mil. Te.	-	Million Tonne
MoEF&CC	-	Ministry of Environment, Forest and Climate Change
NTU	-	Units of measurement
NH	-	National Highway
OC	-	Opencast
OB	-	Overburden
PA	-	Per Annum
R&R	-	Rehabilitation & Resettlement Plan
RQP	-	Recognised Qualified Person
ROM	-	Run of Mine
RH	-	Relative Humidity
RPM	-	Respirable Particulate Matter
SDL	-	Side Discharge Loader
SPM	-	Suspended Particulate Matter
SC	-	Scheduled Cast
SH	-	State Highway
ST	-	Scheduled Tribe
TPD	-	Tonne Per Day
TS	-	Topsoil
UG	-	Under Ground
UHV	-	Useful Heat Value
VM	-	Volatile Matter

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CERTIFICATE : I

BY SPEED POST

No. 34012/03)/2014-CPAM
Government of India
Ministry of Coal

New Delhi, the 29th May, 2015

To **Shri B. D. Sharma** (Renewal)
A-121, Paryavaran Complex,
IGNOU Road,
New Delhi-110030
(FAX : 29532568 (Ph.011-29532236 /Mob:9811030881
(E-mail:min_mec@vsnl.com, minmec@bol.net.in)

Subject Grant of recognition as competent person to prepare Mining Plan for Coal/Lignite block.

Sir,

I am directed to refer to your letter No. MM/BD/RQP/21534 dated 29.11.2013 on the above cited subject and to convey approval of the Central Government to the grant of recognition under Rule 22 (c) of Mineral Concession Rule, 1960 in your favour as competent person to prepare Mining Plan/Mine closure Plan for Coal/Lignite block(s) up to 10 years from the date of issue of this letter.

2. RQP is required to comply with the provisions of all the concerned statutes and guidelines / circulars of the Govt. issued from time to time in regard to preparation of Mining Plans.

Yours faithfully

(I.P. Nagpal)
Under Secretary to the Govt. of India

Copy to : TD, NIC, Ministry of Coal for including in the list of RQP in Ministry of Coal's Web Site.

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CERTIFICATE : II

Vikas Jaideo
Executive Director (Coal / Fuel)

MAHAGENCO
Maharashtra State Power Generation Co. Ltd.

Mahagenco/ED(Fuel/Coal)/ 46 Date 17-2-16

To,
Shri. B.D.Sharma,
A-121, Paryavaran Complex,
IGNOU Road,
New Delhi-110030

Sub:- Authorisation as Recognized Qualified Person for the Preparation of Mining Plan and Mine Closure Plan for Gare Palma Sector-II Coal Mine in District Raigarh of Chhattisgarh State-Reg.

Dear Sir,

We hereby authorize you as “Recognized Qualified Person” for the Preparation of Mining Plan and Mine Closure Plan w.r.t. Gare Palma Sector-II Coal Mine. You may participate in the discussion with the Ministry of Coal if any, required for the purpose of approval of Mining Plan and Mine Closure Plan for the above coal mine.

Place:-Mumbai.
Date:- 16/02/16

Executive Director (Fuel/Coal)
Mahagenco

आई०पी० नागपाल / I.P. NAGPAL
अवर सचिव / Under Secretary
भारत सरकार / Govt. of India
कोयला मंत्रालय / Ministry of Coal
शास्त्री भवन / Shastri Bhawan
नई दिल्ली / New Delhi

3rd Floor, 'Prakashgad', Plot No. G-9, Prof. A. K. Marg, Bandra (E), Mumbai - 400 051.
Tel.(P) : 2647 4758, (O) : 2647 4211 Ext.: 2215, Fax : 2658 1466, E-mail : edfuel@mahagenco.in, Website : www.mahagenco.in

B.D. SHARMA
RQP NO. 34012/03/2014-CPAM

CERTIFICATE : III

Vikas Jaideo
Executive Director (Coal / Fuel)

MAHAGENCO
Maharashtra State Power Generation Co. Ltd.

CERTIFICATE

It is certified that, while preparing the Mining Plan and Mine Closure Plan of Gare Palma Sector- II Coal Mine, in District Raigarh of Chhattisgarh State, all the statutory provisions including Regulations, Rules and Orders passed by the Central and State Governments, Statutory Organisations, Courts etc. have been taken into considerations.

An undertaking is also given herewith that all measures proposed in the Mining Plan and Mine Closure Plan will be implemented in a time bound manner as proposed.

Place:-Mumbai.
Date:- 16/02/16

Executive Director (Fuel/Coal)
Mahagenco

आई०पी० नागपाल / I.P. NAGPAL
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B.D. SHARMA
RQP NO. 34012/03/2014-CPAM

CERTIFICATE : IV

CERTIFICATE FROM RQP STATING THAT THE APPLIED MINE AREA LIES WITHIN THE BOUNDARY OF ALLOTTED COAL BLOCK AND THAT THE APPLIED AREA DOES NOT ENCROACH INTO AREA OF OTHER BLOCKS

This is to certify that I have verified the area of “Gare Pelma Sector-II Coal Mine” allotted to M/s Maharashtra State Power Generation Co Ltd. located in district Raigarh of Chhattisgarh state with the certified plan supplied by CMPDIL alongwith letter no. CMPDIL/B.D./C(886)/118 dt 26-02-2016 enclosed as Annexure 3-2 in Mining Plan) and the area covered by the Mining Plan (within applied ML) does not encroach on any other coal block and the area applied for Mining Lease is 2583.486 ha.

B.D. SHARMA
RECOGNISED QUALIFIED PERSON

RQP no. 34012/03/2014-CPAM dt 29-05-2015

आई०पी० नागपाल / I.P. NAGPAL
अवर सचिव / Under Secretary
भारत सरकार / Govt. of India
कोयला मंत्रालय / Ministry of Coal
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B. D

B.D. SHARMA
RECOGNISED QUALIFIED PERSON

RQP no. 34012/03/2014-CPAM dt 29-05-2015

आई॰पी॰ नागपाल / I.P. NAGPAL
अवर सचिव / Under Secretary
भारत सरकार / Govt. of India
कोयला मंत्रालय / Ministry of Coal
शास्त्री भवन / Shastri Bhawan
नई दिल्ली / New Delhi

B.D. SHARMA
RQP NO. 34012/03/2014-CPAM

CERTIFICATE : VI

Vikas Jaideo
Executive Director (Coal / Fuel)

MAHAGENCO
Maharashtra State Power Generation Co. Ltd.

UNDERTAKING

I Vikas Jaideo S/o Madhukar Jaideo, aged about 58 years R/o Bldg. No. 19 Flat No 34 MSEB Officers Quarters, K.C.Marg Bandra Reclamation, Bandra (West) -400 050 and Power of Attorney holder/ Authorized Signatory of M/s Maharashtra State Power Generation Company Limited (Mahagenco) having its registered office at Prakashgad, 2nd Floor, Plot No. G9, Prof. Anant Kanekar Marg Bandra (East) Mumbai- 400 051do solemnly affirm and state as that there is no any court case pending or any legal dispute against Gare Palma Sector- II Coal Mine after allocation to Mahagenco.

Authorized Signatory

Place: Mumbai
Date: 16/02/16

I.P. NAGPAL
Under Secretary
Govt. of India
Ministry of Coal
Shastri Bhawan
New Delhi

3rd Floor, 'Prakashgad', Plot No. G-9, Prof. A. K. Marg, Bandra (E), Mumbai - 400 051.
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B.D. SHARMA
RQP NO. 34012/03/2014-CPAM

EXECUTIVE SUMMARY OF MINING PLAN AND MINE CLOSURE PLAN

A. SUMMARISED DATA

1.	GENERAL	
a)	Name and address of the Applicant Company	M/s Maharashtra State Power Generation Company Limited (MSPGCL, also known as Mahagenco) "Prakashgad" Plot No. G-9, Anant Kanekar Marg, Bandra (East), Mumbai, Maharashtra- 400051 Phone: 022 – 26476231; 022-26474211 Fax: 022 – 26581400 E-mail: md@mahagenco.in
b)	Name and address of the Block Allottee	MSPGCL (Same as 1(a))
c)	Relationship between the applicant and allottee company	The block was allotted to the Applicant
d)	Status of the Applicant Company : Central /Public Sector Undertaking/State Government Undertaking/JV Company/ Pvt. Company/Public Co/Others (Specify)	Maharashtra State Power Generation Company Limited (MSPGCL) is a State owned PSU of Govt. of Maharashtra engaged in power generation with total Installed capacity of 12077 MW as on 31.01.2016.
e)	Name of the Coal Block together with name of Coalfield & State where located	"Gare Palma Sector – II Coal Mine (Block) in Mand Raigarh Coalfield of Raigarh district in Chhattisgarh State.
f)	Date of allotment	Allotment Order by MOC no.103/30/2015/NA, dated 31-08-.2015
g)	End Use of Coal/Lignite as per approval by the Competent Authority	**EUPs as per Allotment Order dt. 31-08-2015**

Sl. No.	EUP/ Location/ Address	Configu-ration	Distance of EUP KM
1.	Chandrapur Thermal Power Station Unit 8 & Unit 9 Nirman Bhavan, Urja Nagar, Chandrapur- 442404.	2x500 MW	800
2.	Koradi Thermal Power Station Unit 8, Unit 9 and Unit 10 Chindwara Road, Koradi-441111, Distt. Nagpur, Maharashtra.	3x660 MW	595

3.	Parli Thermal Power Station Unit 8 Vaijnath, Dist. Beed-431520, Maharashtra	250 MW	1147
	Total	**3230 MW**	

Subsequently, MSPGCL requested MOC/NA vide letter No. CMD/Mahagenco/ ED(Coal/Fuel)/34c dt. 17.2.2016 (**Annexure 1-2**) proposing to extract coal from Gare Palma Coal Mine up to its full capacity, i.e. 23.6 Mty, and utilise extra coal for other thermal plants of Mahagenco and surrender an equal amount of linkage coal from CIL to the extent the demand for other EUPs will be met from the coal mine.

MOC/NA vide letter no.103/32015/ NA dt. 19.02.2016 communicated that the issue of diversion arises after the commencement of production and that Mahagenco may submit the Mining Plan to Ministry of Coal for approval and tender intimation towards proposed diversion as per clause 8.4 of Allotment Agreement as and when required.

The total requirement of coal of the company is 62.797 MTPA, out of which existing linkage from CIL is 46.328 MTPA as mentioned below.

Sl. No.	Type of TPP of Mahagenco	Total Capacity, MW	Coal Requirement, MTPA	Existing Linkage, MTPA	Source of linkage
1	End use Plants (existing) linked to Gare Sector-II (ref. Table 1.7)	3230	12.761	0	Gare Sector-II
2	Other existing TPPs	7560	42.41	46.328	CIL
3	Proposed TPPs	1980	7.626	0	Mahjan wadi
	Total	**12770**	**62.797**	**46.328**	

The existing linkages to the extent of any surplus (above the requirement of EUPs as per VO) coal will be surrendered when such surpluses are generated.

B.D. SHARMA
RQP NO. 34012/03/2014-CPAM

<table>
<tr><td></td><td></td><td>Taking the above into consideration, the Mining Plan has been prepared for the full capacity of the mine, i.e. 23.6 Mtpa as given in Chapter 5.</td></tr>
<tr><td>h)</td><td>ROM Quantity proposed to be produced as per Mining Plan</td><td>23.6 Mtpa</td></tr>
<tr><td>i)</td><td>Norms adopted for calculating ROM quantity requirement in case it differs from the quantity indicated in the Allotment Order.</td><td>The ROM coal quantity was not indicated in the allotment order, however, the following norms have been considered for calculations of coal requirement
i) GCV of Coal : 4350 Kcal/Kg (refer Chapter-5)
iii) P.L.F of Plant : 85%
iv) For Station heat rate on the basis of benchmarks uploaded on MSTC's website for auction has bee referred.
<table>
<tr><th rowspan="2">Sl. No.</th><th rowspan="2">Particulars</th><th colspan="3">Name of power plant</th><th>Total</th></tr>
<tr><th>Chandrapur</th><th>Koradi</th><th>Parli</th><th></th></tr>
<tr><td>1.</td><td>Capacity, MW</td><td>2x500 =1000</td><td>3x660 =1980</td><td>1x250</td><td>3230</td></tr>
<tr><td>2.</td><td>Station Heat Rate "KCal/KWhr"</td><td>2375</td><td>2250</td><td>2375</td><td>2308</td></tr>
<tr><td>3.</td><td>Avg Calorific value "KCal/kg)"*</td><td>4350</td><td>4350</td><td>4350</td><td>4350</td></tr>
<tr><td>4.</td><td>Specific consumption "Kg/kWhr"</td><td>0.5460</td><td>0.5172</td><td>0.5747</td><td>0.5306</td></tr>
<tr><td>5.</td><td>Plant Load Factor</td><td>85%</td><td>85%</td><td>85%</td><td>85%</td></tr>
<tr><td>6.</td><td>Total Coal Requirement "MTPA"</td><td>2x2.0327 = 4.065</td><td>3x2.5419 = 7.626</td><td>1X1.12 = 1.070</td><td>12.761</td></tr>
<tr><td>7.</td><td>Coal availability from this project "MTPA"</td><td>4.061</td><td>7.626</td><td>1.070</td><td>12.761</td></tr>
<tr><td>8.</td><td>Linkage/e-Auction from CIL"MTPA"</td><td>Nil</td><td>Nil</td><td>Nil</td><td>Nil</td></tr>
<tr><td>9.</td><td>Other blocks of the company "MTPA"</td><td>Nil</td><td>Nil</td><td>Nil</td><td>Nil</td></tr>
<tr><td>10.</td><td>Percentage of end use requirement to be met from this mine</td><td>100%</td><td>100%</td><td>100%</td><td>100%</td></tr>
</table>
</td></tr>
<tr><td>j)</td><td>Beneficiation required – Yes/No</td><td>Yes</td></tr>
<tr><td>k)</td><td>Requirement of Beneficiated Coal & expected availability thereof.</td><td>MSPGCL has approached CMPDIL for generation of data (washability tests, cleaning possibilities etc) and report preparation. Requirement of Beneficiated Coal & expected availability can be</td></tr>
</table>

Under Secretary
Govt. of India
Ministry of Coal
Shastri Bhawan
नई दिल्ली / New Delhi

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		estimated after receipt of the report. Requirement in this Mining Plan has been assessed based on ROM coal.
l)	Period for which Mining Lease has been granted/is to be renewed/ is to be applied for.	30 years after the date of executing the Mining Lease
m)	Date of Expiry of earlier Mining Lease, if any	Not applicable
n)	RQP who has prepared the Mining Plan Name Address Phone No. Fax Email ID Web site Registration No & date till valid Date of grant/Renewal of RQP Status Validity	 Mr. B. D. Sharma A-121, Paryavaran Complex, IGNOU Road, New Delhi – 110030 29534777, 29532236, 29535891 091-011-29532568 min_mec@vsnl.com; minmec@bol.net.in; minmec@gmail.com http://www.minmec.co.in 13016/18/2004-CA 10 years from last recognition dated 29.05.2015

B.	**INFORMATION REGARDING EARLIER APPROVED MINING PLANS, IF ANY. N/A (FIRST SUBMISSION)**		
a)	Approval Letter no. and Date	Not applicable as no earlier mining plan has been approved by MOC for this mine/ block	
b)	Lease Area		
c)	Date of grant of Lease		
d)	Date of Expiry of Lease		
e)	Targeted Production	**Old Plan**	**New Plan**
f)	Proposed date of start of Production		
g)	Proposed date of achieving the targeted production level		
h)	Envisaged life of the mine (in years)		
i)	Date of actual commencement of Mining Operations, if operations already started		
j)	Likely date of Mining Operations, if operations not yet started & reasons for non-commencement of operations		
k)	Planned production and actual levels achieved in last 3 years		
l)	Coal :- U/G O/Cast OB		
m)	Reasons for difference between the planned and actual production levels		
n)	Reason for revision of the Mining Plan		

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o)	Details of changes in the new mining plan compared to earlier approval (i) Lease Area (ii) Block Boundary (iii) Production level (iv) Reserves (v) Mining Technology(Additional sheets to be used, if required)		

C. LOCATION		
a)	Location of the Block Taluka/ Village/ Khasra/ Plot / Block Range / etc. District / State	The block is located in villages Tihli Rampur, Kunjemura, Gare, Saraitola, Murogaon, Radopali, Pata, Chitwahi, Dholnara, Jhinka Bahal, Dolesara, Bhalumura, Sarasmal and Libra in Raigarh district of Chhattisgarh state.
b)	Name of the Coalfield/ Coal belt	Mand Raigarh Coalfield
c)	Particulars of adjacent blocks: North, South, East, West	North - Bhalumura Coal Block of NTPC South - Gare Palma-I of GSECL East - Gare Palma-III of CMDC; Gare IV/7 of MIEL; Gare IV/6 of JSPL; IV/2&3, IV/1 of SCCL; West - Bhalumura Coal Block of NTPC
d)	Area of the Allotted Block (hectares) i Geological block area ii Mining Block Area	i. 25.83 Sqkm ii. 2583.486 ha
e)	Reference no. of plan of block boundary issued by CMPDI/ SCCL/ NLC (A copy of the Plan also to be annexed)	The block boundary issued by CMPDI vide letter no. CMPDI/BD/C(886)/118 dt 26-02-2016. (Refer Annexure 3-2 of Mining Plan)
f)	Whether the lease boundary/ required boundary is same as demarcated by CMPDI/ SCCL/ NLC for delineating block/sub-block	Yes
g)	Existing mining Lease Area in case of existing mines, (hectares)	N/A
h)	Applied/ required Lease Area as per the Mining Plan under consideration (hectares)	2583.486 Ha

i) Whether the applied lease area falls within the allotted block	Yes
j) Area (hectares) of lease which falls outside the block/sub-block delineated by CMPDI/SCCL/NLC.	Nil
k) Details of outside area: - Whether forms part of any other coal block - Whether it contains any coal/lignite reserves - Purpose for which it is required, e.g. roads/ OB dumps/ service buildings/ colony/ safety zone/ others (specify)	Not applicable
l) Whether some part(s) of the allotted block has not been applied for mining lease. - Total area in Ha. of such part(s). - Total reserves in such part(s). - Brief reasoning for leaving such part(s),	The whole allotted block area has been applied for mining lease.
m) Type of Land involved in Hectares	

Sl. No.	Village	Private Land	Govt. Land	Total Area (Private + Govt. Land)
A. As per Revenue Departments Records				
1.	Tihli Rampur	160.587	67.149	227.736
2.	Dholnara	59.640	13.314	72.954
3.	Murogaon	302.393	37.353	339.746
4.	Libra	129.037	23.973	153.010
5.	Kunjemura	199.715	66.295	266.010
6.	Jhinkabahal	3.844	0.000	3.844
7.	Radopali	351.676	34.311	385.987
8.	Dolesara	20.748	1.242	21.990
9.	Bhalumura	16.297	1.326	17.623
10.	Sarasmal	66.027	20.131	86.158
11.	Pata	329.230	48.639	377.869

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12.	Chitwahi	142.461	9.272	151.733
13.	Gare	157.224	28.276	185.500
14.	Saraitola	169.950	47.431	217.381
Total of A		**2108.829**	**398.712**	**2507.541**
B. As per Forest Departments Record				
Government Forest Land				75.945
Total A+B				**2583.486**

n) Broad Land Use Pattern (Forest, Township, Industrial, Agricultural, Grazing, Barren etc.)

PRESENT (PRE-MINING) LAND USE OF THE ML AREA
GARE PALMA SECTOR-II (HA.)

Sl. No.	Village	Private Land			Govt. Land					Total Area (Private + Govt. Land)
		Agricul-ture	Non Agricul-ture	Total Area	Populated	Water body	Other	CBJ**	Total Area	
1	Tihlirampur	97.902	62.685	160.587	6.83	21.225	39.094	0	67.149	227.736
2	Dholnara	59.64		59.64	6.833	0.376	3.317	2.788	13.314	72.954
3	Murogaon	302.393		302.393	8.256	1.303	4.29	23.504	37.353	339.746
4	Libra	121.416	7.621	129.037	2.897	0.439	4.694	15.943	23.973	153.01
5	Kunjemura	199.715		199.715	14.221	13.596	8.308	30.17	66.295	266.01
6	Jhinkabahal	3.844		3.844	0	0	0	0	0	3.844
7	Radopali	351.676		351.676	8.336	5.895	19.955	0.125	34.311	385.987
8	Dolesara	20.748		20.748	0	0	1.242	0	1.242	21.99
9	Bhalumura	16.297		16.297	0	0	0.704	0.622	1.326	17.623
10	Sarasmal	56.869	9.158	66.027	0	1.332	3.563	15.236	20.131	86.158
11	Pata	316.064	13.166	329.23	13.314	5.529	14.47	15.326	48.639	377.869
12	Chitwahi	142.461		142.461	0.252	0.867	8.153	0	9.272	151.733
13	Gare	157.224		157.224	10.482	4 241	11.596	1.957	28.276	185.5
14	Saraitola	156.228	13.722	169.95	8.395	1.364	7.969	29.703	47.431	217.381
Total of A		2002.477	106.352	2108.829	79.816	56.167	127.355	135.374	398.712 *	2507.541
B. As per Forest Departments Record										
Government Forest Land										*75.945
Grand Total										2583.486

Note: * *75.945 Ha of Protected Forest land and 135.374 Ha of Revenue Forest land is present within the mine lease area, which needs to be diverted for mining purpose after obtaining forestry clearance from the Ministry of Environment and Forest, Govt. of India under the Forest (Conservation) Act 1980.*

** *Chhote Bade Jhar / Jungle (Small/ big trees forest)*

o) Proximity of public road / railway line/major water body if any and approximate distance

Public Road: - Roads from Bajarmura to Ghargoda (approx 11.6 KMs) and Milupara to Tamnar (approx 3 Kms) is passing through the block.

Water body: Kelo River is flowing across the coal block.

Railway: The Gare Palma area is situated around 35 km away from Raigarh Township, which is also the nearest railway station on Mumbai-Howrah main line of SE Railway.

p) Toposheet No. with latitude and longitude

The area is covered in the Survey of India Toposheet No. 64 N/8 & 12 (R.F. 1:50,000) and is bounded by*:

Latitude	:	22° 06' 24.215" to 22° 30' 49.891" N
Longitude	:	83° 26' 15.433" to 83° 31' 12.632" E

*WGS 84 System

<table>
<tr><th colspan="3">D. GEOLOGY AND EXPLORATION</th></tr>
<tr><td>a)</td><td>Name of the Geological Block and area in hectares</td><td>i. Name of Block: Gare Palma Sector-II Coal Block.
Area as per GR = 25.83 Sqkm</td></tr>
<tr><td>b)</td><td>Name of the Geological Report (GR) with year of preparation</td><td>Geological report on detailed exploration for coal Gare Palma Sector-II coal block
Mand Raigarh Coalfield, District: Raigarh, Chhattisgarh; 2012</td></tr>
<tr><td>c)</td><td>Name of the agency which conducted exploration and prepared GR</td><td>Mineral Exploration Corporation</td></tr>
<tr><td>d)</td><td>Period of conducting exploration</td><td>27.04.2011 to 26.2.2012</td></tr>
<tr><td>e)</td><td>Details of drilling (by all agencies)</td><td><table><tr><th>Name of Agency</th><th>No. of boreholes</th><th>Meterage Drilled</th></tr><tr><td>MECL</td><td>188</td><td>73,997.80m</td></tr></table></td></tr>
<tr><td>f)</td><td>No. of boreholes drilled within the block</td><td>188</td></tr>
<tr><td>g)</td><td>Overall borehole density within the block (no./ sq. km)</td><td>Overall borehole density within the bloc is 7.3 sq. km. Excluding 8 bh drilled by GSI.

MECL carried out the exploration work for GP-II coal block based on which G.R. has been prepared and MECL was completely satisfied with it. The Geology of the area being uniform, consistent and relatively with low level of disturbance, MECL was satisfied with the present bore hole densities and did not feel the necessity of additional boreholes.

Due to the above reasons, MECL has successfully completed the GR.

However, during actual mining operations if required, “fill-in” boreholes shall be undertaken.
Some of the area approx. 160 acres, where MECL could not do the drilling, is presently occupied by JSPL colony.</td></tr>
<tr><td>h)</td><td>Area covered by ‘detailed’ exploration within the block (hectares)</td><td>25.83 sq.km</td></tr>
<tr><td>i)</td><td>Area covered by ‘detailed’ exploration outside the block</td><td>NIL</td></tr>
</table>

B.D. SHARMA
RQP NO. 34012/03/2014-CPAM

(hectares) - No. of boreholes drilled outside the block - Bore hole density for outside area (no./sq. km)	
j) Whether entire lease area has been covered by 'detailed' exploration.	Yes
k) Whether any further exploration is required or suggested and timeframe in which it is to be completed	No
l) Number of coal/lignite seams/horizons - Thickness range of coal seams - Mean Thickness of total coal horizon - Standard Deviation of thickness - Minimum & maximum depth of coal seams	

Sl. No.	Coal Seam	Coal Thickness range, m	Av. Thickness of coal, m	St. Deviation of thickness, m	Depth from Surface, m
1	X-BOT	0.68-6.26	2	0.81	6.67 to 93.70
2	IX	2.66-7.34	4	0.56	28.10 to 141.93
3	VIII	0.31-6.50	2	1.58	45.05 to 153.50
4	VIII-L	0.10-2.25	1	0.64	59.10 to 165.40
5	VII-TOP	1.50-6.15	4	0.90	65.90 to 186.07
6	VII-BOT	0.16-3.84		0.46	70.90 to 190.10
7	VII-COMB	2.06-8.39		1.12	67.15 to 174.10
8	VI	0.25-7.74	4	1.87	76.80 to 198.83
9	VB-1	0.10-1.47	1	0.26	105.82 to 235.50
10	VC-1	0.12-2.40	1	0.31	115.30 to 241.50
11	VD-1	0.05-1.40	1	0.24	119.13 to 247.10
12	IV	0.10-3.70	2	0.82	161.15 to 281.05
13	III	0.10-3.50	2	0.65	234.80 to 348.35
14	II	0.05-7.05	3.5	2.45	288.40 to 451.90
15	I-L1	0.10-2.89	1.8	0.68	371.10 to 440.75
16	I-TOP	0.11-3.80	1.8	0.78	335.65 to 466.80
17	I-BOT	0.19-4.49	2	0.90	346.50 to 463.52
18	I-COMB	2.15-7.87		1.64	361.66 to 449.13

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अवर सचिव / Under Secretary
भारत सरकार / Govt. of India
कोयला मंत्रालय / Ministry of Coal
शास्त्री भवन / Shastri Bhawan
नई दिल्ली / New Delhi

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m) Gross Calorific Value (GCV in K Cal/kg) and Useful Heat Value (UHV in K.Cal / Kg), of coal as per GR :

Range
Mean

Seam	UHV (k.Cal/Kg		GCV (k.Cal/Kg	
	Min	Max	Min	Max
X-LA/un	1434	3877	3440	4690
X-TOP/un	1518	3229	3100	4600
X- BOT	1794	4222	2550	4970
IX-L2/un	1365	4829	4280	5050
IX-L1	2235	3891	3650	5240
IX	3063	4871	4280	5320
VIII	1366	2953	2990	4300
VIII-L	1614	4291	3180	4730
VII-Top	1407	3628	3100	4650
VII-Bot	1656	4071	2960	4980
VII-Com	1834	3587	3170	4670
VI	1407	4111	3100	5160
VI-L/un	1352	2097	3500	4410
VA-1	1380	4236	3170	5210
VA-2/un	1545	3201	4240	4980
VB-1	1545	5229	3990	5100
VB-2/un	2566	5947	4100	5490
VC-1	1752	4677	3400	5380
VC-2	2497	4788	3690	6620
VD-1/un	3256	3463	3950	4840
VD-2	1338	2539	3040	4760
IV	1710	5243	3550	5980
III-L2	1959	3753	3690	5320
III	2147	5326	3270	7000
II-L/un	2470	3284	4220	5370
II	2318	7217	5514	6820
I-L1	4719	7341	5560	7250
I-L/un	3352	7492	4610	4610
I-Top	2461	6872	4010	6940
I-Bot	1685	7452	3880	7070
I-Com	3532	6168	4580	6270

The values in above table are in line with Chapter VI "Quality Parameters" of GR. Also refer Table 4.10 of MP&MCP.

n) Quality (Grade) of coal as per GR :

Range
Mean

Seam	UHV Grade	GCV Grade
X-LA/un	G to E	G13- G9
X-TOP/un	G to F	G14- G10
X- BOT	G to D	G17 - G8
IX-L2/un	G to D	G11- G8
IX-L1	G to E	G13-G7

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IX	F to D	G11-G7
VIII	G to F	G15-G10
VIII-L	G to D	G14-G9
VII-Top	G to E	G14-G9
VII-Bot	G to E	G15-G8
VII-Com	G to E	G14-G9
VI	G to E	G14-G8
VI-L/un	G	G13-G10
VA-1	G to D	G14-G7
VA-2/un	G to F	G11-G8
VB-1	G to C	G12-G8
VB-2/un	F to B	G11-G7
VC-1	G to D	G13- G7
VC-2	F to D	G13-G2
VD-1/un	F to E	G12- G9
VD-2	G to F	G15-G9
IV	G-C	G13-G5
III-L2	G to E	G13-G7
III	G to C	G14-G1
II-L/un	F	G11-G7
II	G-A	G17-G2
I-L1	D to A	G6-G1
I-L/un	F to A	G9
I-Top	F to A	G11-G2
I-Bot	G to A	G12-G1
I-Com	E to B	G10-G4

o)	Total geological reserves in the block	Geological reserves: 1059.298 MT
p)	Depletion of reserves (in case of running mine)	N/A
q)	Additional reserves established (if any for running mine)	N/A
r)	Geological reserves considered for mining: by opencast by Underground	

Opencast	**Reserve, MT**
>0.9m thickness	682.569
<0.9m thickness but >0.5m thickness	53.536
Sub-Total OC	**736.105**
Underground	**Reserve, MT**
>1.5m thickness	235.954
<1.5m but >0.9m thickness	87.239
Sub-Total UG	**323.193**
Total	**1059.298**

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s)	Corresponding Extractable reserves: by opencast by Underground	 553.177 MT 101.975 MT
t)	Percentage of recovery w.r.t. geological reserves: by opencast by Underground	 75.15% 31.55 %

E.	**MINING**	
a)	Existing and proposed method of mining (Opencast for OB & coal separately with dragline/ shovel/ surface miners/ manual/ etc.) (underground by longwall/ bord & pillar/ continuous miners/LHD/ SDL/ manual/ etc.)	It is a new mine proposed to be worked by OC as well as UG method. i. In OC method drill machines, loaders, shovels and dumpers will be used for OB while Surface Miners in combination with Front End Loaders will be used in coal. ii. In UG method Continuous Miners, Shuttle cares, Feeder breakers and conveyors will be used.
b)	Targeted capacity in MTPA when the mine is fully developed and the year in which proposed to be achieved By Underground : By opencast : Total :	1) Target capacity of block to be achieved as 23.6 MT in 7th year as follows: OC = 22.00 MT UG = 1.60 MT **Total = 23.60 MT**
c)	Life of the mine Underground workings: Opencast workings : Overall :	 69 years including 3 years of development 29 Years 77 Years
d)	Indicate quantum of production and expected grade* as in table below:-	

COMBINED CALENDAR PROGRAMME OF COAL MINING AND OBR FROM OPENCAST AND UNDERGROUND

Year	Opencast (MT)	OBR MCUM	OBR Including Rehandling	Stripping Ratio CUM/ T	SR incl. Rehandling of Surface dump and crown dump. Cum/ t	Under Ground (MT)	Total (MT)
0	0.00	0.00	0.00	-	-	0.00	0.00
1	0.250	5.000	5.000	20.00	20.00	0	**0.25**
2	1.550	14.100	14.100	9.10	9.10	0	**1.55**
3	3.000	30.000	30.000	10.00	10.00	0	**3.00**

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Year	Opencast (MT)	OBR MCUM	OBR Including Rehandling	Stripping Ratio CUM/ T	SR incl. Rehandling of Surface dump and crown dump. Cum/ t	Under Ground (MT)	Total (MT)
4	6.000	45.000	45.000	7.50	7.50	0	6.00
5	9.500	80.000	80.000	8.42	8.42	0	9.50
6	21.300	135.000	135.000	6.34	6.34	0	21.3
7	23.600	135.000	156.740	5.72	6.64	0	23.6
8	23.600	135.000	156.740	5.72	6.64	0	23.6
9	23.600	135.000	156.740	5.72	6.64	0	23.6
10	23.600	135.000	156.520	5.72	6.63	0	23.6
11	23.600	135.000	140.220	5.72	5.94	0	23.6
12	23.200	130.000	135.220	5.60	5.83	0.40	23.6
13	22.800	130.000	135.220	5.70	5.93	0.80	23.6
14	22.400	130.000	135.220	5.80	6.04	1.20	23.6
15	22.000	99.000	103.750	4.50	4.72	1.60	23.6
16	22.000	99.000	120.740	4.50	5.49	1.6	23.6
17	22.000	99.000	120.740	4.50	5.49	1.6	23.6
18	22.000	99.000	120.740	4.50	5.49	1.6	23.6
19	22.000	99.000	120.740	4.50	5.49	1.6	23.6
20	22.000	99.000	118.500	4.50	5.39	1.6	23.6
21	22.000	99.000	99.000	4.50	4.50	1.6	23.6
22	22.000	99.000	99.000	4.50	4.50	1.6	23.6
23	22.000	99.000	99.000	4.50	4.50	1.6	23.6
24	22.000	99.000	99.000	4.50	4.50	1.6	23.6
25	22.000	99.000	99.000	4.50	4.50	1.6	23.6
26	22.000	99.000	163.350	4.50	7.43	1.6	23.6
27	21.997	99.000	163.350	4.50	7.43	1.6	23.597
28	22.000	95.020	172.850	4.32	7.86	1.6	23.600
29	17.180	5.000	82.770	0.29	4.82	1.6	18.780
30			44.183			1.6	1.6
31			44.183			1.6	1.6
32-77			44.183			72.375	72.375
Total	**553.177**	**2761.120**	**3396.800**	**4.99**	**6.14**	**101.975**	**655.152**

* *Seam wise and year/stage wise Grade (in GCV) has been provided in Table 5.8A; Seam wise and year/stage wise coal produced is given under Table 5.8B and Seam wise and year/stage wise ash %ge is given under Table 5.9 of Chapter 5.*

Furnish the detailed calendar programme of coal production year wise and seam wise along with OB removal in the relevant chapter	Pl. refer Table 5.8B of Chapter 5.
e) Whether the proposed external OB dump site is coal/ lignite bearing: - If so, whether coal/lignite below waste disposal area is extractable.	Yes, the OB during the initial years will be dumped over the coal bearing area within ML but will be rehandled, backfilled and the entire coal will be extracted from underneath.

f)	Whether negative proving for coal / lignite in the proposed site for OB dump/ infrastructure has been done.	Negative proving under surface dump is not required as the area has been proven as coal bearing. However, entire OB dump placed out side the quarry has been proposed to be rehandled and backfilled.
g)	Proposed configuration of HEMM for OC (Coal & OB) and Major Equipment for UG (Coal Production UG 1.6 MTPA + OC 22.0 MTPA)	**i. Proposed configuration of MEMM for OC (Coal & OB)**

Sl. No.	Particulars	Quantity
I.	**Heavy Earth Moving Machinery**	
A.	**Coal (22 Mtpa)**	
a)	100 T.R.D.(CB) dumpers for 3800SM(W) CSM	5
b)	150 T.R.D.(CB) Dumpers for 4200SM(W) CSM	20
c)	0.9 m^3 hydraulic backhoe	2
d)	Dozer 275-320 HP	4
e)	Dozer 410 HP with ripper	2
f)	Surface miner 3800 SM (W)	1
g)	Surface miner 4200SM (W)	2
h)	10-16 m^3 Front End Loader (Coal)	5
i)	6-8 m^3 Front End Loader (Coal)	4
	Sub-Total for Coal	**45**
B.	**Overburden**	
a)	Hydraulic shovel 5/5.5cum	4
b)	Hydraulic Shovel 12 m^3	7
c)	Hydraulic Shovel 20 m^3	20
d)	50 Tonne Dump Truck for 5/5.5 m^3 shovels	20
e)	150 Tonne Dump Truck for 12 m^3 shovels	63
f)	150 Tonne Dump Truck for 20 m^3 shovels	240
g)	R.B.H drills 200/250 mm	31
h)	Dozer 410 HP	30
i)	Dozer 275-320 HP	10
	Sub-Total for OB	**425**
II.	**Common, Auxiliary & Service Equipment**	
a)	Graders 230 HP	4
b)	Diesel Bouser	6
c)	Construction backhoe -0.9 CUM	2
d)	Water sprinkler (26 KL)	12
e)	Tow truck on 50T truck chassis	2
f)	100 T tractors (Diesel Operated)	2
g)	Rough Terrain Crane - 40T	4
h)	Rough Terrain crane 70 T	2
i)	Service trucks:	
	- Fuel trucks	6
	- Wash trucks	6
	- Mobile maintenance trucks	6
	- Lube trucks	6
	- Fire trucks	2
	- Explosive van	4

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j)	Portable air compressor	4
k)	Tyre handler	4
	Sub-Total for Auxiliary & Service Equipment	**72**
	Reclamation	
a)	2.5 cum Front End Loader	4
b)	10 T Truck	10
c)	0.9-1.2 cum hydraulic Excavator	4
	Sub-Total for reclamation	**18**
	Total (Coal+OB+Aux+Reclamation)	**560**

ii. Major Equipment for UG (Coal Production UG

Sl. No.	Name of equipment	No.	Broad Specification
1.	Continuous Miner	4	Remote controlled machine similar to CAT: CM 340 (Mining Range 1.37 m to 4.00m, 70 tonnes, 697 KW
2.	Shuttle Cars	8	2.5 cum capacity
3.	Twin Mast Roof Bolter	4	Rotary wet flush drilling
4.	LHD with Electric cable reel	4	1.2-1.4 cum
5.	Feeder/Breaker	4	Crushing coal (-) 150mm
6.	Load centre and transformer	4	3.3kV/1130 V 1500kVA TX

h)	Mode of entry for underground mines (shaft, incline, adit,):	Shafts and Inclines
i)	Operations that are proposed to be outsourced	All operations, excluding statutory operations
j)	Proposed coal evacuation facilities Face to Surface Surface to end use plants	The ROM coal from SMs will be transported by dumpers/trucks to the coal receiving pit, from there to ground bunkers (GB) via Transfer Point-1 (TT-1). The coal will reach (TT-2) after being reclaimed from GB. TT-2 will be connected to washery as well as to railway siding by separate conveyors as a result, it will be capable of sending ROM coal or washed coal to the railway siding. The railway siding will be equipped with appropriate Rail Loading System. Coal can also be diverted to a 3rd conveyor line from TT-2 for loading coal into trucks

	in case of need and also till the period of CHP and washery construction (Refer Plate XLI). From O/H bunkers for loading trucks for dispatch to nearest available railway siding for further transport to EUPs. For Underground production, conveyor transport is envisaged for bringing coal to surface. FE loader will be used for loading coal from coal stack.

<table>
<tr><th colspan="2">F. END USE OF COAL/ LIGNITE</th></tr>
<tr><td>a) Capacity of the approved end use plants</td><td rowspan="3">EUPs as per Allotment Order dt. 31-08-2015
<table>
<tr><th>Sl. No.</th><th>EUP/ Location/ Address</th><th>Configu-ration</th></tr>
<tr><td>1.</td><td>Chandrapur Thermal Power Station Unit 8 & Unit 9
Nirman Bhavan, Urja Nagar, Chandrapur-442404.
Distance from mine 800 km</td><td>2x500 MW</td></tr>
<tr><td>2.</td><td>Koradi Thermal Power Station Unit 8, Unit 9 and Unit 10
Chindwara Road, Koradi-441111, Distt. Nagpur, Maharashtra.
Distance from mine 595 km</td><td>3x660 MW</td></tr>
<tr><td>3.</td><td>Parli Thermal Power Station Unit 8
Vaijnath, Dist. Beed- 431520, Maharashtra
Distance from mine 1147 km</td><td>250 MW</td></tr>
<tr><td></td><td>Total</td><td>3230 MW</td></tr>
</table>
100% requirement of above will be met from the mine.
Subsequently, MSPGCL requested MOC/NA vide letter No. CMD/Mahagenco/ ED(Coal/Fuel)/34c dt. 17.2.2016 (Annexure 1-2) proposing to extract coal from Gare Palma Coal Mine up to its full capacity, i.e. 23.6 Mty, and utilise extra coal for other thermal plants of Mahagenco and surrender an equal amount of linkage coal from CIL to the extent the demand for other EUPs will be met from the coal mine.
MOC/NA vide letter no.103/32015/ NA dt. 19.02.2016 communicated that the issue of diversion arises after the</td></tr>
<tr><td>b) Coal/ lignite requirement for end use plant with grade/ quality</td></tr>
<tr><td>c) % age of end use requirement to be met from this mine</td></tr>
</table>

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	commencement of production and that Mahagenco may submit the Mining Plan to Ministry of Coal for approval and tender intimation towards proposed diversion as per clause 8.4 of Allotment Agreement as and when required. Taking the above into consideration, the Mining Plan has been prepared for the full capacity of the mine, i.e. 23.6 Mtpa as given in Chapter 5.
d) If washing / beneficiation of the coal/ lignite is planned to be conducted on site or adjacent to the extraction area, briefly describe the nature of the beneficiation and recovery rate.	Washery will be required for which provision of space has been made within ML but the extent of beneficiation will only be decided after CMPDI study on washability is concluded which is still under preparation.
e) Proposed Use of Rejects/ Middlings	The washery rejects shall be within the normative limits and will be disposed off strictly as per rules and regulation framed by Ministry of Environment, Forests and Climate Change and change from time to time.

G. ENVIRONMENTAL MANAGEMENT	
a) Existing land use pattern	Given in Table 13.1 of Chapter 13
b) Land area indicating the area likely to be degraded due to mining, dumping, roads, workshop, washery, township etc.	

Landuse	**At the end of 5TH Year**	**At the end of 25TH Year**	**At the end of OC mining (29TH Year)**
Excavation	380.70	2272.42	2440.55
Backfill	0.00	1535.00	2248.77
Void	380.70	737.42	191.78
Surface dump#	380.00	0.00	0.00
Bund	5.20	5.20	5.20
Green Belt	36.07	36.07	36.07
Top Soil Dump*	60.00	00.00	0.00
Settling Pond##	10.00	5.00	5.00
Road diversion<	30.30	30.30	30.30
Facilities (West Part: CHP, Inclines, Shaft Pit, Office, Lamp room, Attendance Office, Rest Room, Parking, First aid room, Sub Station etc.)**	50.94	50.94	50.94
Facilities (East Part: Office, Workshop, magazine, washery	68.54	0.00	0.00

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etc)			
Under Kelo river	15.42	15.42	15.42
Dismantling	0.00	0.00	0.00
Disturbed area	**1017.17**	**2415.35**	**2583.48**
Undisturbed	1566.31	168.13	0.00
Total	**2583.48**	**2583.48**	**2583.48**

* *Top soil dump will be over the backfilled area towards the end of mine life.*

** *Main colony will be located away from the ML area.*

\# *The OB dump lying over the coal bearing area will be fully rehandled and backfilled by 20th year.*

\#\# *The settling ponds in 5th year will comprise of 5 ha for mine water and 5 ha for surface dump but the later will not remain after 20th year as surface dump will be rehandaled and become non-existent.*

< *Diverted road is for public use.*

c) Surface features over the block area	Fourteen villages are lying within the block as shown below in para D below. Roads from Bajarmura to Ghargoda (approx 11.6KMs) and Milupara to Tamnar (approx 3 Kms) are passing through the block. Kelo River is flowing across the coal block. 75.945 Ha of Protected Forest land and 135.374 Ha of Revenue Forest land is present within the mine lease area.
d) No. of villages/Houses to be shifted	(see table below)
e) Population to be affected by	9598
f) Year wise proposal for reclamation of land affected by mining activities, ha	(see table below)

d) No. of villages/Houses to be shifted

Sl	Villages	Population (%)
1	Libra	757 (7.89)
2	Bhalumuda	314 (3.27)
3	Dholnara	408 (4.25)
4	Chitwahi	747 (7.78)
5	Dolesara	1061 (11.05)
6	Radopali	688 (7.17)
7	Kunjemura	1054 (10.98)
8	Gare	741 (7.72)
9	Pata	1189 (12.39)
10	Murogaon	520 (5.42)
11	Saraitola	564 (5.88)
12	Sarasmal	508 (5.29)
13	Tihli Rampur	448 (4.67)
14	Jhinka Bahal	599 (6.24)
	Total	**9598* (100)**

f) Year wise proposal for reclamation of land affected by mining activities, ha

Upto the End of Year	Area Mined	Backfilled Area	Remark
1st year	26.16	0.00	No backfilling
3rd year	129.97	0.00	No backfilling
5th year	380.70	0.00	No backfilling
10th year	1099.37	358.27	Part Direct Backfilling and part from rehandled

15TH year	1747.06	673.05	Part Direct Backfilling and part from rehandled surface Dump
20th year	1949.85	1122.31	Part Direct Backfilling and part from rehandled surface Dump
25th year	2272.42	1536.00	Part direct backfilling and part from rehandled surface dump
End of mine 29th year	2440.55	2109.49	Part direct backfilling and part from rehandled crown dump
Post mine closure stage 32nd year	2440.55	2440.55	*Backfilling from rehandled crown dump**

* ***During the post mine closure period (30th to 32nd year), part of the crown dump will be fully rehandaled and backfilled into the residual void (below surface level) while part of the crown dump (with an extent of 138 ha) will be reduced in height from 100m to 80m and backfilled.***

g) Monitoring schedules for different environmental components after the commencement of mining and other related activities.	Ambient air quality twice a week, water once a season, soil once a year, noise once a year

H. PROGRESSIVE AND FINAL MINE CLOSURE PLAN: Separate Chapter no. 15 given	
a) Estimated total capital expenditure for mine closure activities	Rs 1484.5376 Crore
b) Major closure activities with proposed capital expenditure	

Major closure activities with proposed capital expenditure are given below:

Heads	Activities	Unit	Vol. of work	Rate, Rs./Unit	Total amt., Rs. Lakh
PROGRESSIVE CLOSURE					
02. Safety and Security	a) Barbed wire fencing	M	39668	212	84.10
	f) Toe wall around the dump	m	9010	1000	90.10
	g) Garland drain around the dump	m	9028	500	45.14
	h) Drainage channel from main OB dump and main sump to nala	m	6010	5000	300.50
	i) Settling pond	Lakh Cum	4	2000000	80.00
	j) Securing Air Shaft and installation of bore well pump		2	1000000	20.00
	k) Securing of Incline 1 &2		2	500000	10.00
	l) Fire stoppings	Lakh Cum	1898	70000	1328.60
04. Top soil management		Lakh Cum	112.56	5000000	5628.00
05. Technical and	a1) Reclamation	Ha.	2221	400000	8884.00

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and OB dump	West pit				
06. Plantation over virgin area including Green Belt	a) Plantation/ Green Belt over Virgin Area	Ha.	35.86	400000	143.44
09. Water quality management		LS	0		340.00
10. Air quality management		LS	0		340.00
11. Subsidence monitoring for		LS			19.09
12. Manpower cost and supervision		LS	0		163.50
FINAL CLOSURE					
01. Dismantling of Infrastructure, disposal/ rehabilitation of mining machinery	a) Dismantling of workshop	LS	0		300.00
	b) Dismantling of CHP	LS	0		500.00
	c) Dismantling of facilities	LS	0		1000.00
	d) Dismantling of pumps and pipes	LS	0		45.00
	f) Dismantling of UG facilities including main fan		0		100.00
	g) Dismantling of UG Conveyors		0		300.00
	h) Dismantling of UG Rail tracks		0		150.00
	i) Dismantling of UG equipment		0		200.00
	j) Re-arranging of water pipelines to dump top, park	LS	0		15.00
	k) Dismantling of power line	LS	0		30.00
	l) Rehabilitation over area of dismentaled facilities	Ha.	50.94	400000	203.76
04. Top soil management		Lakh Cum	19.10	5000000	955.00
05. Technical and biological reclamation of mined out land and OB dump	a1) Reclamation	Ha.	414.78	400000	1659.12
	a2) Rehandling of crown dump to East Pit	Lakh Cum	1027.40	3000000	30822.00
	b2) Rehandling of crown dump to West pit	Lakh Cum	298.10	3000000	8943.00
07. Landscaping and plantation	a) Peripheral road, gates, view point, cemented steps on bank		0		40.00
	b) Beautification and landscaping over dump	LS	0		20.00
	c) Plantation				35.00
08. Power cost		LS	0		40.00
09. Water quality management		LS	0		12.00
10. Air quality management		LS	0		12.00
11. Subsidence monitoring for		LS	0		0.91
12. Manpower cost and supervision		LS	0		4.50
13. Others	a) Entrepreneurship development (vocational skill development, training for sustainable income of affected people	LS	0		100.00

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	d) One time financial grant to society/ institution/ organisation which is dependent upon the project	LS	0		50.00
	f) Continuation of other services like running of schools etc	LS	0		150.00
	Grand Total				**148453.76**

* *All persons are proposed to be absorbed in other units of the company, hence no provision for Golden handshake has been make.*

c. Escrow amount calculation **i. Concept of calculation**	Escrow amount for OC operations has been calculated from 1st year to 29th year (last year of OC mine life). Though the UG mining operations start from 9th year and last upto 77th year including the initial 3 construction years but the calculation of Escrow amount has been done from 30th year (i.e. after the end of OC mine life) upto 77th year for a span of 77-29=48 years.
ii. Basis of calculation	A security money will be yearly deposited in Escrow Account. The amount in the 1^{st} year at WPI of January 2016 (base date) will be Rs. 7.2341 Crore updated for OC and Rs. 2.5628 Crore for UG payable during the 30^{th} year as per calendar. In the every subsequent year, the amount will be deposited after escalation of 5% over the previous year. Total amount to be submitted in ESCROW account will be Rs 932.7123 Crores (450.8471 Crores for OC and Rs 481.8652 Crores. For UG mining). Details are given in Table 15.23 in Chapter 15.
iii. Annual Escrow deposit	As shown in following table

AMOUNT TO BE DEPOSITED IN ESCROW ACCOUNT ANNUALLY

Year	Amount, Rs. Crore		
	OC	UG	Total
1	7.2341	-	7.2341
2	7.5958	-	7.5958
3	7.9756	-	7.9756
4	8.3743	-	8.3743
5	8.7931	-	8.7931
6	9.2327	-	9.2327
7	9.6944	-	9.6944
8	10.1791	-	10.1791
9	10.6880	-	10.6880
10	11.2224	-	11.2224
11	11.7835	-	11.7835

	12	12.3727	-	12.3727
	13	12.9914	-	12.9914
	14	13.6409	-	13.6409
	15	14.3230	-	14.3230
	16	15.0391	-	15.0391
	17	15.7911	-	15.7911
	18	16.5806	-	16.5806
	19	17.4097	-	17.4097
	20	18.2801	-	18.2801
	21	19.1942	-	19.1942
	22	20.1539	-	20.1539
	23	21.1616	-	21.1616
	24	22.2196	-	22.2196
	25	23.3306	-	23.3306
	26	24.4971	-	24.4971
	27	25.7220	-	25.7220
	28	27.0081	-	27.0081
	29	28.3585	-	28.3585
	30	-	2.5628	2.5628
	31	-	2.6909	2.6909
	32	-	2.8255	2.8255
	33	-	2.9667	2.9667
	34	-	3.1151	3.1151
	35	-	3.2708	3.2708
	36	-	3.4344	3.4344
	37	-	3.6061	3.6061
	38	-	3.7864	3.7864
	39	-	3.9757	3.9757
	40	-	4.1745	4.1745
	41	-	4.3832	4.3832
	42	-	4.6024	4.6024
	43	-	4.8325	4.8325
	44	-	5.0741	5.0741
	45	-	5.3278	5.3278
	46	-	5.5942	5.5942
	47	-	5.8739	5.8739
	48	-	6.1676	6.1676
	49	-	6.4760	6.4760
	50	-	6.7998	6.7998
	51	-	7.1398	7.1398
	52	-	7.4968	7.4968
	53	-	7.8716	7.8716

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	54	-	8.2652	8.2652
	55	-	8.6784	8.6784
	56	-	9.1124	9.1124
	57	-	9.5680	9.5680
	58	-	10.0464	10.0464
	59	-	10.5487	10.5487
	60	-	11.0761	11.0761
	61	-	11.6299	11.6299
	62	-	12.2114	12.2114
	63	-	12.8220	12.8220
	64	-	13.4631	13.4631
	65	-	14.1363	14.1363
	66	-	14.8431	14.8431
	67	-	15.5852	15.5852
	68	-	16.3645	16.3645
	69	-	17.1827	17.1827
	70	-	18.0418	18.0418
	71	-	18.9439	18.9439
	72	-	19.8911	19.8911
	73	-	20.8857	20.8857
	74	-	21.9300	21.9300
	75	-	23.0265	23.0265
	76	-	24.1778	24.1778
	77	-	25.3867	25.3867
	Total*	**450.8471**	**481.8652**	**932.7123**

I. Others	
a) Base date of Mining Plan	April 2016 for reserve estimation and balance life January 2016 for WPI.
b) Calendar year from which the production will start	2018-19
c) Results of any investigation carried out for scientific mining, conservation of minerals and protection of environment; future proposals.	No
d) Signature of RQP Date Place	05/07/2016 N. Delhi.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF THE BLOCK

Gare Palma Sector- II (also Known as Gare Pelma Sector- II) Coal Block, located in Mand Raigarh Coalfield, Chhattisagarh was earlier allotted to M/s MAHATAMIL in 2006. Later, this allotment of the block was cancelled by Honourable Supreme Court along with other blocks in September 2014.

Subsequently, M/s Maharashtra State Power Generation Company Limited (MSPGCL, also known as Mahagenco) has been allotted Gare Palma Sector-II Coal Mine (GP-II Coal Mine) vide Ministry of Coal (MOC) Allotment order no.103/30/2015/NA, dated 31-08-2015 under clause (c) of sub-rule (2) of Rule 13 (Copy enclosed as **Annexure 1-1**).

MSPGCL will develop the GP-II Coal mine and supply the coal to their thermal power plants.

1.2 NAME OF APPLICANT WITH COMPLETE ADDRESS

The name and address of the Company (the applicant seeking Mining Plan Approval) is given in Table 1.1 below:

TABLE 1.1
NAME AND ADDRESS OF THE COMPANY

Particulars	Information
Name of the Company	Maharashtra State Power Generation Company Limited
Address	"Prakashgad" Plot No. G-9, Anant Kanekar Marg, Bandra (East), Mumbai, Maharashtra-400051.
Phone	022 – 26476231; 022-26474211
Fax	022 – 26581400
E- mail	md@mahagenco.in
Official Website	http://www.mahagenco.in

1.3 STATUS OF THE APPLICANT

Maharashtra State Power Generation Company Limited (MSPGCL) is a State owned PSU of Govt. of Maharashtra, incorporated under Company's Act 1956 with Corporate Identity no. U400100MH2005SGC153648.

1.4 BACKGROUND OF THE COMPANY

Maharashtra State Power Generation Company Limited (MSPGCL) is engaged in power generation with total Installed capacity of 12077 MW as on 31.01.2016, as below:

Thermal	:	8640 MW
Gas Turbine	:	672 MW
Hydro	:	2585 MW
Solar	:	180 MW
Total	**:**	**12077 MW**

The company has 2570 MW of ongoing projects and 7870 MW in planning stage, and is also planning to install 2500 MW of solar power projects in 5 years.

Ministry of Coal vide, letter no. 13016/ 26/2004-CA-I/CA-III(Pt.)(Vol.II) Dt. 24.02.2016 also allotted Mahajanwadi Coal Block to Mahagenco for captive use only under Rule 4 of the Auction by Competitive Bidding.

1.5 MINERALS WHICH ARE OCCURING IN THE AREA AND WHICH THE APPLICANT INTENDS TO MINE

Coal

1.6 PERIOD FOR WHICH MINING LEASE IS REQUIRED

30 years.

1.7 REFERENCE NO. AND DATE OF LETTER FROM THE MINISTRY OF COAL

Gare Palma Sector-II mine has been allotted by MOC vide Allotment order no.103/30/2015/NA, dated 31-08-2015 under clause (c) of sub-rule (2) of rule 13. (Copy enclosed as **Annexure 1-1**).

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1.8 LOCATION OF END USE PLANTS (EXISTING AND/OR PROPOSED), THEIR REQUIREMENT AND SOURCE TO FILL THE GAPS

1.8.1 Existing end use plants

As per the allotment letter, coal produced from this coal block shall be utilised in the power plants existing at three locations in Maharashtra with details given in Table 1.2 below.

TABLE 1.2
NAME WITH LOCATION AND REQUIREMENT OF COAL AS PER ALLOTMENT ORDER DT 31-08-2015

Sl. No.	Name of specified End Use Plant	Location/ Address	Configuration	Capacity
1.	Chandrapur Thermal Power Station Unit 8 & Unit 9	Chandrapur Thermal Power Station Unit 8 & 9 (2x500 MW), Expansion Project, Nirman Bhavan, Urja Nagar, Chandrapur-442404. Distance from mine 800 km	2x500 MW	1000 MW
2.	Koradi Thermal Power Station Unit 8, Unit 9 and Unit 10	Koradi Complex, Chindwara Road, Koradi-441111, Distt. Nagpur, Maharashtra. Distance from mine 595 km	3x660 MW	1980 MW
3.	Parli Thermal Power Station Unit 8	Taluka parli Vaijnath, Dist. Beed-431520, Maharashtra Distance from mine 1147 km	250 MW	250 MW
	Total			**3230 MW**

1.8.2 Proposed end use plants

Subsequently, MSPGCL requested MOC/NA vide letter No. CMD/Mahagenco/ED(Coal/Fuel)/34c dt. 17.2.2016 (**Annexure 1-2**) proposing to extract coal from Gare Palma Coal Mine up to its full capacity, i.e. 23.6 Mty, and utilise extra coal for other thermal plants of Mahagenco and surrender an equal amount of linkage coal from CIL to the extent the demand for other EUPs will be met from the coal mine.

MOC/NA vide letter no.103/32015/ NA dt. 19.02.2016 (**Annexure 1-4**) communicated that the issue of diversion arises after the commencement of production and that Mahagenco may submit the Mining Plan to Ministry of

Coal for approval and tender intimation towards proposed diversion as per Clause 8.4 of Allotment Agreement as and when required.

The coal requirement of End Use Plants of MSPGCL vis-à-vis coal production from Gare Sector-II mine is given in Table 1.3 below:

TABLE 1.3
COAL REQUIREMENT OF EUPS OF MAHAGENCO VIS-À-VIS COAL PRODUCTION FROM GARE SECTOR-II MINE
(DETAILED TPP-WISE COAL REQUIREMENT CALCULATION BASED ON NORMS CAN BE SEEN IN TABLE 1.7)

Particulars	Power Plants	Reject based Power plant	Blast Furnace
Coal availability from this project "MTPA"	23.6	0	0
Washed coal availability "MTPA"	NA	0	0
Reject "MTPA"	NA	0	0
Thermal Power Plants "KW"/ Sponge Iron Plant "MTPA"/ Blast Furnace "MTPA"	3230X1000 KW (3 TPPs, ref. Table 1.7)	NA	NA
Station Heat Rate "K Cal/Kwhr	2308 (Av)	0	0
Avg Calorific Value of Coal "Kcal/Kg"	4350 (Av)	0	0
Specific consumption "Kg/Kwhr"	0.5306 (Av)	0	0
Plant Load Factor/ Capacity Utilisation	85%	0	0
Coal Requirement "MTPA"	12.761	0	0
Coal Availability from this project "MTPA"	**23.6**	**0**	**0**
Linkages/ E-auction from CIL "MTPA" (for these specified EUPs)	Nil	0	0
Other block of the Company "MTPA"	Mahajanwari UG coal block recently allotted to MAHAGENCO for power plants other than in the VO. Production not yet decided but will be less than 2 MTPA	0	0
Percentage of end use requirement to be met from this mine	100%		

As may be seen from the above table, out of the 23.6 MTPA coal proposed to be produced from this mine, 12.761 MTPA will be used in the 3 nos of TPPs specified in the Vesting Order. Coal will be supplied after washing (to comply with MOEF notification of <34% Ash) and provision for space for a washery has been made within the ML area. The balance 10.839 MTPA will be used in other existing and proposed thermal power stations of Mahagenco as given in following Table 1.4 and 1.5.

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TABLE 1.4
EXISTING THERMAL POWER PLANTS OF MAHAGENCO

TPS	Unit No.	MW	Target Generation in MU's	MERC Approved Heat Rate	Coal factor	Coal requirement in Mt/ ann. (as Per CEA at 4100 Kcal/KG)	Coal Sources	Coal Linkage (MT)	Distance in kms. From coal siding to TPS		Distance from Gare Palma Coal Mine Sect. II (Km)
				(Kcal/ KWh)					Max.	Min.	
Nashik	3	210	1839.6	2764	0.67	1.24	WCL	3.689	783	658	1240
	4	210	1839.6	2764	0.67	1.24	SECL	1.011	1223	1053	
	5	210	1839.6	2764	0.67	1.24					
Total		**630**	**5518.8**			**3.72**		**4.700**			
Chandrapur	3	210	1839.6	2688	0.66	1.21	WCL	10.365	288	7	800
	4	210	1839.6	2688	0.66	1.21	MCL	1.525	750	744	
	5	500	4380.0	2688	0.66	2.87	SECL	0.910	666	654	
	6	500	4380.0	2688	0.66	2.87					
	7	500	4380.0	2688	0.66	2.87					
Total		**1920**	**16819.2**			**11.03**		**12.800**			
Khaparkheda	1	210	1839.6	2606	0.64	1.17	WCL	0.932	50	24	610
	2	210	1839.6	2606	0.64	1.17	MCL	3.067	620	613	
	3	210	1839.6	2606	0.64	1.17	SECL	1.001	538	513	
	4	210	1839.6	2606	0.64	1.17					
	5	500	4380.0	2375	0.58	2.54	MCL	0.812			
							WCL	0.500			
							SECL	1.000			
Total		**1340**	**11738.4**			**7.22**		**7.312**			
Parli	3	210	1839.6	2859	0.70	1.28	WCL	2.500	1093	420	1147
	4	210	1839.6	2859	0.70	1.28	SCCL	2.260	688	574	
	5	210	1839.6	2859	0.70	1.28					

P. NAGPAL
Secretary
Govt. of India
Ministry of Coal
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TPS	Unit No.	MW	Target Generation in MU's	MERC Approved Heat Rate	Coal factor	Coal requirement in Mt/ ann. (as Per CEA at 4100 Kcal/KG)	Coal Sources	Coal Linkage (MT)	Distance in kms. From coal siding to TPS		Distance from Gare Palma Coal Mine Sect. II (Km)
				(Kcal/ KWh)					Max.	Min.	
	6	250	2190.0	2450	0.60	1.31					
	7	250	2190.0	2450	0.60	1.31	WCL	1.028			
Total		**1130**	**9898.8**			**6.46**		**5.788**			
Bhusawal	2	210	1839.6	2761	0.67	1.24	WCL	2.800	531	407	985
	3	210	1839.6	2761	0.67	1.24					
	4	500	4380.0	2375	0.58	2.54	MCL	2.312			
	5	500	4380.0	2375	0.58	2.54	SECL	2.312	977	742	
Total		**1420**	**12439.2**			**7.56**		**7.424**			
Paras							WCL	1.800	322	288	865
	3	250	2190.0	2450	0.60	1.31	MCL		890	883	
	4	250	2190.0	2450	0.60	1.31	MCL	1.204			
Total		**500**	**4380.0**			**2.62**		**3.004**			
Koradi	5	200	1752.0	2864	0.70	1.22	WCL	0.615	244	37	595
	6	210	1839.6	2864	0.70	1.29	MCL	1.580	619	592	
	7	210	1839.6	2864	0.70	1.29	SECL	3.105	725	510	
Total		**620**	**5431.2**			**3.80**		**5.300**			
Grand total		**7560.0**	**66225.6**			**42.41**		**46.328**			

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TABLE 1.5
PROPOSED THERMAL POWER PLANTS

TPS	Unit No.	MW	Total capacity, MW	Coal requirement @85% PLF, MTPA	Coal Sources
Nashik	6	1 X 660 MW	660	2.542	Mahajanwadi Coal Block Nagpur
Bhusawal	6	1 X 660 MW	660	2.542	
Uran		1 X 660 MW	660	2.542	
Total			**1980**	**7.626**	

The total requirement of the company is as summarised in Table 1.6 below:

TABLE 1.6
SUMMARY OF COAL REQUIREMENT FOR MAHAGENCO

Sl. No.	Type of TPP of Mahagenco	Total Capacity, MW	Coal Requirement, MTPA	Existing Linkage, MTPA	Source of linkage
1	End use Plants (existing) linked to Gare Sector-II (ref. Table 1.7)	3230	12.761	0	Gare Sector-II
2	Other existing TPPs	7560	42.41	46.328	CIL
3	Proposed TPPs	1980	7.626	0	Mahjanwadi
Total		**12770**	**62.797**	**46.328**	

A perusal of above Tables shows that the total requirement of coal of the company is 62.797 MTPA, out of which existing linkage from CIL is 46.328 MTPA.

The existing linkages to the extent of any surplus (above the requirement of EUPs as per VO) coal will be surrendered when such surpluses are generated.

Taking the above into consideration, the Mining Plan has been prepared for the full capacity of the mine, i.e. 23.6 Mtpa as given in Chapter 5.

1.9 COAL REQUIREMENT CALCULATION WITH NORMS USED FOR COMPUTING CONSUMPTION

The norms of calculation are given in Table 1.7.

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TABLE 1.7
NORMS USED FOR COMPUTING CONSUMPTION

Sl. No.	Particulars	Name of power plant			Total
		Chandrapur	Koradi	Parli	
1.	Capacity, MW	2x500 =1000	3x660 =1980	1x250	**3230**
2.	Station Heat Rate "KCal/KWhr"	2375	2250	2375	**2308**
3.	Avg Calorific value "KCal/kg)"*	4350	4350	4350	**4350**
4.	Specific consumption "Kg/kWhr"	0.5460	0.5172	0.5747	**0.5306**
5.	Plant Load Factor	85%	85%	85%	**85%**
6.	Total Coal Requirement "MTPA"	2x2.0327 = 4.065	3x2.5419 = 7.626	1X1.12 = 1.070	**12.761**
7.	Coal availability from this project "MTPA"	4.061	7.626	1.070	**12.761**
8.	Linkage/e-Auction from CIL"MTPA"	Nil	Nil	Nil	**Nil**
9.	Other blocks of the company "MTPA"	Nil	Nil	Nil	**Nil**
10.	Percentage of end use requirement to be met from this mine	100%	**100%**	**100%**	**100%**

** Refer Chapter 5 for average GCV.*

The total coal requirement for already linked power plants as per allotment order and as per specific heat consumption norms comes to 12.761 MTPA. The balance coal out of the total production of 23.6 MTPA will be used for other thermal plants of MSPGCL / MAHAGENCO as explained in the paragraph 1.8.2.

1.10 COAL BENEFICIATION

A perusal of para 5.3.7 and Table 5.9 shows that the average ash content of total extractable reserves works out to 37 to 38 %. However, the Ash % of ROM coal will fluctuate from year to year (34.05% to 41.42%).

In the Mining Plan, the provision of space for locating a washery has been made. The decision regarding capacity and layout of washery will be reached after thorough investigation. MSPGCL has approached CMPDIL (Copy enclosed as **Annexure 1-3**) for generation of data (washability tests, cleaning possibilities etc) and report preparation.

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1.11 NAME OF RQP PREPARING MINING PLAN

Name : Mr. B. D. Sharma
Address
(i) Office : A-121,
Paryavaran Complex,
IGNOU Road,
New Delhi – 110030
Phone : 29534777, 29532236, 29535891
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Web site : http://www.minmec.co.in
Registration Number : 13016/18/2004-CA
Date of grant / renewal : 01.06.2004
(ii) Residence : A-121,
Paryavaran Complex,
IGNOU Road,
New Delhi – 110030
Phone : +91-11-29534777, 29535891

(Photo copy of certificate is attached as **Certificate I**)

1.12 STATUS OF THE PROJECT

The status of the project/ mine is as follows:

i. The coal block is virgin

ii. Allotment Order for the mine has been issued to MSPGCL

iii. Mining Lease application submitted on 09-12-2015

iv. Mining Plan and Mine Closure Plan has been prepared and submitted to MOC.

The Mining Plan and Mine Closure Plan (Version February 2016) was presented to the Technical Committee constituted under MMDR Act, 1957 on 29-04-2016, the observations issued vide MOC letter no. 34011/16/2016-CPAM dt 03-05-2016 are attached as **Annexure 1-5**. All observations of the letter have been duly addressed and incorporated in this Mining Plan and Mine Closure Plan (June 2016 version).

CHAPTER 2

DETAILS OF EARLIER APPROVED MINING PLAN

2.1 APPROVAL LETTER/ REFERENCE OF MOC

No Mining Plan for this coal mine/ block has been approved in the past by MOC.

The Mining Plan in respect of Gare Palma Sector- II Coal Mine submitted by the prior allottee, did not receive the approval of Ministry of Coal. In view of this, MSPGCL needs to apply afresh as per the Guidelines laid for seeking approval of the Mining Plan. (Refer MOC letter no. 103/30/2015-NA dt. 11.1.2016 at **Annexure 2-1**).

CHAPTER 3

LOCATION, TOPOGRAPHY & COMMUNICATION

3.1 LOCATION

The "Gare Palma Sector – II Coal Block area lies in Mand Raigarh Coalfield in Raigarh district of Chhattisgarh state. The mine site is located in Tihli Rampur, Kunjemura, Gare, Saraitola, Murogaon, Radopali, Pata, Chitwahi, Dholnara, Jhinka Bahal, Dolesara, Bhalumura, Sarasmal and Libra villages. The area is covered in the Survey of India Toposheet No. 64 N/8 & 12 (R.F. 1:50,000) and is bounded by:

As per Allotment Order no. 103/30/2015/NA dt. 31.08.2015:

Latitude : 22° 06’ 23.55” N to 22° 10’ 37.04” N
Longitude : 83° 26’ 22.18” E to 83 ° 31’ 19” E

As per CMPDI data vide letter no. CMPDI/BD/C(810)/307 dt 04-06-2012 based on modified Everest datum (Copy at Annexure 3-2):

Latitude : 22° 06’ 22.33” to 22° 10’ 48” N
Longitude : 83° 26’ 21.85” to 83° 31’ 19.1” E

As per Nominated Authority letter F.No.104/28/2015/NA dt 13-10-2015 (Copy at Annexure 3-2A), the coordinates in WGS 84 system are given below. As mentioned in the letter, the earlier coordinates were using reference system based on modified Everest datum but presently CMPDI is following WGS 84 System which is the standard reference system followed globally. It is to be noted that the respective position of any point does not change physically on the ground.

Latitude : 22° 06’ 24.215” to 22° 30’ 49.891” N
Longitude : 83° 26’ 15.433” to 83° 31’ 12.632” E

(Refer Location plan and Key plan - Plate I & II)

3.2 MINING LEASE BOUNDARY

Project boundary, Block boundary and ML boundary are the same (2583.486Ha), The block boundary of Gare Sector-II area forms a zigzag line especially its southern limit, hence the geographical co-ordinates of different corners of the Gare Palma Sector-II coal block as per CMPDI letter no CMPDI/BD/C(810)/307 dt 04-06-2012 (Annexure 3-2) are given in Table 3.1A.

TABLE 3.1A
GEOGRAPHICAL CO-ORDINATES OF BOUNDARY POINTS OF GARE PALMA SECTOR-II COAL BLOCK BASED ON MODIFIED EVEREST DATUM

Sl. No.	Co-ordinates in Coal Grid		Geographical Coordinates					
	X-Easting	Y-Northing	Longitude – (E)			Latitude – (N)		
			D	M	S	D	M	S
1.	2944260.496	908797.963	83	27	33.06	22	10	48
2.	2944881.753	908010.918	83	27	54.86	22	10	22.48
3.	2946862.355	905714.486	83	29	4.32	22	9	8
4.	2946924.235	905611.798	83	29	6.49	22	9	4.67
5.	2946955.205	905560.391	83	29	7.57	22	9	3.00
6.	2947341.925	904918.329	83	29	21.16	22	8	42.16
7.	2948148.176	903579.825	83	29	49.47	22	7	58.71
8.	2948244.924	903639.409	83	29	52.84	22	8	0.65
9.	2948327.432	903676.878	83	29	55.72	22	8	1.89
10.	2949586.636	901875.524	83	30	39.90	22	7	3.43
11.	2950175.489	901391.242	83	31	0.52	22	6	47.74
12.	2950705.132	900608.351	83	31	19.1	22	6	22.33
13.	2950049.435	900913.669	83	30	56.17	22	6	32.19
14.	2949509.904	901062.823	83	30	37.31	22	6	36.98
15.	2949109.860	901220.191	83	30	23.33	22	6	42.06
16.	2947308.154	902275.283	83	29	20.30	22	7	16.18
17.	2947326.949	901851.692	83	29	21.01	22	7	2.40
18.	2947347.00	901414.186	83	29	21.76	22	6	48.17
19.	2946682.952	901799.851	83	28	58.53	22	7	0.64
20.	2942212.288	905166.093	83	26	22.00	22	8	49.61
21.	2942216.766	907431.158	83	26	21.85	22	10	3.29
22.	2944260.496	908797.963	83	27	33.06	22	10	48

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The WGS 84 coordinates vide letter of NA dt 13-10-2015 are attached as **Annexure 3-3** and are reproduced below in Table 3.1B.

TABLE 3.1B
GEOGRAPHICAL CO-ORDINATES OF BOUNDARY POINTS OF GARE PALMA SECTOR-II COAL BLOCK BASED ON WGS 84 SYSTEM

Cardinal points	Latitude, N	Longitude, E
A	22 ° 08' 51.495"	83 ° 26' 15.480"
B	22 ° 30' 05.178"	83 ° 26' 15.433"
A	22 ° 10' 49.891"	83 ° 27' 26.624"
D	22 ° 09' 09.892"	83 ° 28' 57.871"
E	22 ° 08' 03.774"	83 ° 29' 49.271"
F	22 ° 06' 24.215"	83 ° 31' 12.632"
G	22 ° 07' 18.066"	83 ° 29' 13.857"
H	22 ° 06' 50.059"	83 ° 29' 15.318"

The approved southern boundary of Gare Palma Sector-II depicts zigzag nature formed by Barren Measure / Barakar contact and also due to earlier interpreted fault lines protruding like cones. The limits of the block i.e. the extreme rectangle coordinates are as given under para 3.1 above.

Both OC and UG operations are envisaged. Though OC mine covers the entire block area of 2583.486 Ha., a part of the area on western side is not workable by UG and the same has not been considerd for UG mining and the UG project area is only 2208.18 Ha. (Refer Fig 3.1 at the end of this Chapter).

3.3 COMMUNICATION

The Gare Palma area is situated around 35 km towards north from Raigarh Township, which is also the nearest railway station on Mumbai-Howrah main line of SE Railway. The block is connected by road from Raigarh via Punjipathara by State Highway. Punjipathara village is situated on Raigarh-Ghargoda main road. The distance from Raigarh to Ghargoda is around 40 Km. The road distance between Raigarh to Punjipathara is about 20 Km and Punjipathara to Ghargoda is 20 Km towards north. From Punjipathara the road leads to the Gare Palma area via Tamnar TPP area situated at a distance of 10 Km on Punjipathara- Milupara road which passes through the block. Tamnar is situated in the south-western part of the Gare Palma Sector-I area in the sub block 'F'. A network of roads is present within the block.

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3.4 PHYSIOGRAPHY AND DRAINAGE

The coalfield is characterised by undulating and rolling topography, consisting of hills interspersed with broad valleys. The general elevation in the block area ranges from 242 m to 303 m above MSL and the surrounding area (upto10 km) varies from 240 m to 640 m above MSL. The slope is towards south. The hills are relict type and rise about 450m above MSL. The southerly flowing perennial Mand River with its tributaries constitute the main drainage of the area. The Kelo River, a tributary of Mahanadi, drains the eastern part of the coalfield.

The topography of Gare-Palma Area is mostly covered by softer horizon and in general represents an undulating terrain, more resistant sedimentary rocks stand out as ridges, rising as high as 580m above MSL (Silot Pahar) in the north west and 600m above MSL (Morga Pahar) in the north east.

The block exhibits undulating topography. Kelo Nadi flows from north to south through the south eastern part of the block. A few ponds are present within the block.

3.5 CLIMATE & RAINFALL

The climate of the study area is of subtropical type, and is characterised by an oppressive hot summer, a mild winter and well distributed rainfall during the south western monsoon season. The year may be divided into four seasons. The summer season lasts from March to the middle of June, and the period from June to September is the south west monsoon season. October and November constitute the post monsoon season and the cold season is from December to February. The nearest meteorological station of IMD is at Raigarh.

Temperature

As per the monthly average of daily maximum and minimum temperatures for the period 1996 to 2005, collected from IMD Station, Raigarh, the monthly mean of minimum temperatures ranges from 12.04°C in January to 27.57°C in May. The monthly mean of maximum temperature ranges from 27.56°C in January to 42.08°C in May.

Rainfall

The rainfall does not show any cyclic occurrences and shows wide and erratic variations, ranging from as low as 144.9 mm in 2004 to 1852.4 mm in 2003. The average annual rainfall for the period 1996 to 2005 was 1216.4 mm. The monsoon season is spread over the months from June to September.

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Wind speed and wind direction

The wind speed and direction for long term period from 1976-1991 have been studied through the Windrose diagrams supplied by IMD, Raigarh, for 8.30 hrs and 17.30 hrs respectively. An observation of the morning Windrose shows that the predominant wind direction is from NE during winter season (October to March) and SW during summer and monsoon seasons.

As per the evening Windrose, the predominant wind direction is from NE between October and January, NW between February and May and SW between June and September. The general wind speed ranges form 1 to 5 km/hr throughout the year. However winds in the speed ranging from 6-11 kmph and 12-19 kmph also occur.

Relative humidity

The relative humidity varies from 27% in (May) to 82% (August) during evening and 42% (May) to 86 % (August) during morning.

3.6 LAND USE AND OWNERSHIP / OCCUPANCY

The present land use of the area required for the project is given below in Table 3.2 (Refer Revenue Plan Plate III) and details is given in **Annexure 3-1.**

TABLE 3.2
PRESENT (PRE-MINING) LAND USE OF THE ML AREA GARE PALMA SECTOR-II (HA.)

Sl. No.	Village	Private Land			Govt. Land					Total Area (Private + Govt. Land)
		Agriculture	Non Agriculture	Total Area	Populated	Water body	Other	CBJ**	Total Area	
1	Tihlirampur	97.902	62.685	160.587	6.83	21.225	39.094	0	67.149	227.736
2	Dholnara	59.64		59.64	6.833	0.376	3.317	2.788	13.314	72.954
3	Murogaon	302.393		302.393	8.256	1.303	4.29	23.504	37.353	339.746
4	Libra	121.416	7.621	129.037	2.897	0.439	4.694	15.943	23.973	153.01
5	Kunjemura	199.715		199.715	14.221	13.596	8.308	30.17	66.295	266.01
6	Jhinkabahal	3.844		3.844	0	0	0	0	0	3.844
7	Radopali	351.676		351.676	8.336	5.895	19.955	0.125	34.311	385.987
8	Dolesara	20.748		20.748	0	0	1.242	0	1.242	21.99
9	Bhalumura	16.297		16.297	0	0	0.704	0.622	1.326	17.623
10	Sarasmal	56.869	9.158	66.027	0	1.332	3.563	15.236	20.131	86.158
11	Pata	316.064	13.166	329.23	13.314	5.529	14.47	15.326	48.639	377.869

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Sl. No.	Village	Private Land			Govt. Land					Total Area (Private + Govt. Land)
		Agriculture	Non Agriculture	Total Area	Populated	Water body	Other	CBJ**	Total Area	
12	Chitwahi	142.461		142.461	0.252	0.867	8.153	0	9.272	151.733
13	Gare	157.224		157.224	10.482	4.241	11.596	1.957	28.276	185.5
14	Saraitola	156.228	13.722	169.95	8.395	1.364	7.969	29.703	47.431	217.381
	Total of A	**2002.477**	**106.352**	**2108.829**	**79.816**	**56.167**	**127.355**	**135.374**	**398.712 ***	**2507.541**
B. As per Forest Departments Record										
Government Forest Land										*75.945
Grand Total										**2583.486**

*Note: * 75.945 Ha of Protected Forest land and 135.374 Ha of Revenue Forest land is present within the mine lease area, which needs to be diverted for mining purpose after obtaining forestry clearance from the Ministry of Environment and Forest, Govt. of India under the Forest (Conservation) Act 1980.*

*** Chhote Bade Jhar / Jungle (Small/ big trees forest)*

3.7 IMPORTANT SURFACE FEATURES

3.7.1 Important surface features (Refer Plate-I and IV)

i. Habitation of following villages is lying within the block (refer Table 3.3.

TABLE 3.3
HABITATION OF FOLLOWING VILLAGES IS LYING WITHIN THE BLOCK

Villages	Population
Libra	757 (7.89%)
Bhalumuda	314 (3.27%)
Dholnara	408 (4.25%)
Chitwahi	747 (7.78%)
Dolesara	1061 (11.05%)
Radopali	688 (7.17%)
Kunjemura	1054 (10.98%)
Gare	741 (7.72%)
Pata	1189 (12.39%)
Murogaon	520 (5.42%)
Saraitola	564 (5.88%)
Sarasmal	508 (5.29%)
Tihli Rampur	448 (4.67%)
Jhinku Bahal	599 (6.24%)
Total	**9598 (100%)**

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A perusal of Plate IV shows the location of all the above village habitations within the block.

ii. The following road network is lying within the block:

Roads from Bajarmura to Ghargoda (approx 11.6 Km) and Milupara to Tamnar (approx 3 Km) is passing through the block.

iii. The following network of drainage and canals is lying within the block:

Kelo River is flowing across the coal block.

iv. Forest within Block:

75.945 Ha of Protected Forest land and 135.374 Ha of Revenue Forest land is present within the mine lease area.

3.7.2 Surface reorganization required (Refer Plate IV)

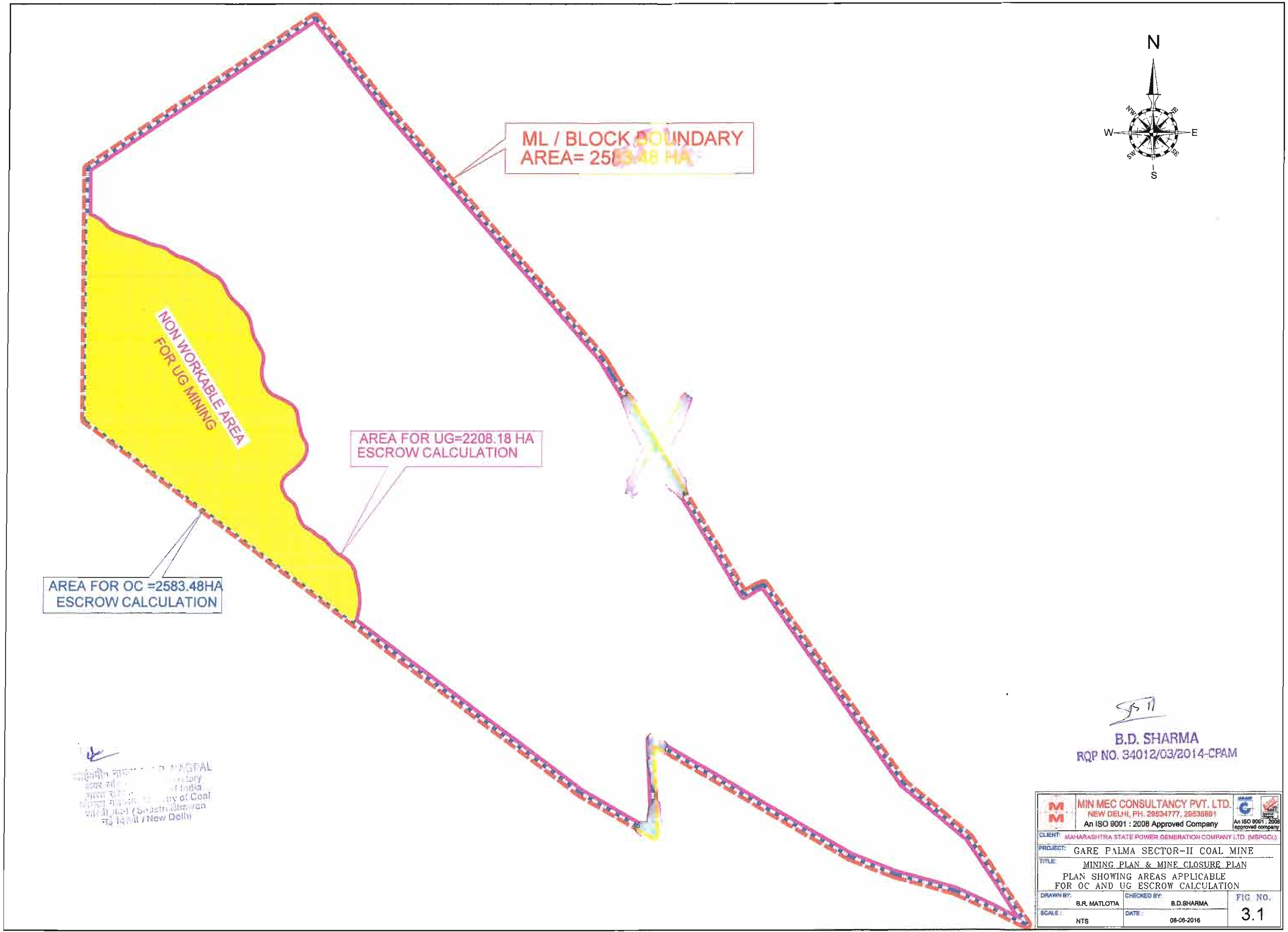
a. Roads from Bajarmura to Ghargoda (approx 11.6 KMs) and Milupara to Tamnar (approx 3 Kms) will be diverted. Diverted alignment is proposed along the northern periphery of the block and along the embankment of the river Kelo passing through the block. A safety barrier of 45m has been kept for the diverted road as per statutory norms.

b. Kelo River, flowing south, is passing through the eastern part of the block- Diversion is not proposed, will be protected by leaving statutory barriers.

c. 75.945 Ha of Protected Forest land and 135.374 Ha of Revenue Forest land is present within the mine lease area, which needs to be diverted for mining purpose after obtaining forestry clearance from the Ministry of Environment and Forest, Govt. of India under the Forest (Conservation) Act 1980.

d. Project affected families will be 1679 of fourteen villages which need rehabilitation. The relevant R&R study is being conducted separately.

e. **Proposed Railway Line:** A prosed alignment of railway line is passing though the block. The length of railway line passing through the block is 4.7 km. The width of the corridor for proposed railway line is 90 m (45 m on either side of tracks). During Public hearing held on 29.01.2016, MSPGCL has given the proposal for re-routing the alignment along periphery out side the block boundary citing the reason of blocking of 30 Mt of coal reserves. (Refer **Annexure 3-4**)



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[illegible] / New Delhi

MIN MEC CONSULTANCY PVT. LTD.
NEW DELHI, PH. 29534777, 29536891
An ISO 9001 : 2008 Approved Company
An ISO 9001 : 2008 approved company

CLIENT: MAHARASHTRA STATE POWER GENERATION COMPANY LTD. (MSPGCL)

PROJECT: GARE PALMA SECTOR-II COAL MINE

TITLE: MINING PLAN & MINE CLOSURE PLAN

PLAN SHOWING AREAS APPLICABLE
FOR OC AND UG ESCROW CALCULATION

DRAWN BY:	CHECKED BY:	FIG NO.
B.R. MATLOTIA	B.D.SHARMA	3.1
SCALE : NTS	DATE : 08-06-2016	

CHAPTER 4

EXPLORATION, GEOLOGY, SEAM SEQUENCE, COAL QUALITY AND RESERVES

4.1 REGIONAL GEOLOGY

4.1.1 General

Mand-Raigarh coalfield forms the southern part of Mahanadi valley and it is situated mostly in Raigarh district and a smaller part lying in Korba district of Chattisgarh state. Exploration in this vast coalfield is continuing since long and may continue in future also mainly by MECL, G.S.I. and C.M.P.D.I.L.

4.1.2 Geology of Mand-Raigarh Coalfield

The extensive occurrences of Barakar and Supra-Barakar rocks amidst isolated Talchir outcrops spanned between latitudes N 21°45' to 22°42' and longitudes E 83°01' to 83°44', constitutes Mand-Raigarh Coalfield. It is situated between Ib-River Coalfield in the southeast and Korba Coalfield in the west with more or less similar stratigraphic and tectonic setting. The coal measures in the Mand-Raigarh basin are exposed in three well defined patches due to erosion of the overlying Kamthi rocks along the drainage of the prominent rivers. The Geological plan is given in Plate V.

The generalised stratigraphy of Mand-Raigarh Coalfield is enumerated below in Table 4.1.

TABLE 4.1
GENERALISED STRATIGRAPHIC SUCCESSION

Age	Formation	Thickness (m)	Lithology
Recent	Soil Alluvium	3 m	Alluvial soil pebbly to bouldery bed with silty clay band, laterite etc.
Cretaceous to Eocene	Deccan Traps	-	Basalt flows & dolerite dykes.
Lower to Middle Triassic	Kamthi	2851	Poorly sorted, frequently ferruginous, coarse to very coarse grained, locally graded to pebbly, mega cross bedded sandstone containing, brownish grey to buff coloured clay clasts. A fossiliferous red claystone to

Age	Formation	Thickness (m)	Lithology
			siltstone bed occurs at the base.
Upper Permian to Lower Permian	Raniganj	180	Mostly fine to medium grained, grayish white, micaceous sandstone and siltstone with claystone, shale, minor coarse grained sandstone and two coal seams of inferior grade.
	Barren Measure	300	Dominantly grey claystone/grey shale with siltstone and iron stone bands; interbanded sequence of fine to medium grained sandstone and shale.
	Barakar	425 - 800	Medium to coarse and very coarse grained even gritty, sandstone at the lower part followed upward by fine to medium grained assemblage with grey claystone/shale which become predominant towards the upper part, number of coal seams and carbonaceous shale.
	Karharbari (?)	23	Mottled at places carbonaceous sandstone, frequently associated with pebbles of quartzite granite etc. of various shapes and sizes.
Upper Carboniferous to Lower Permian	Talchir	150+	Very fine to fine grained sandstone with siltstone and shale, occasionally greenish in nature, at places with matrix based variegated polymictic conglomerate.
Precambrian			Granitic gneisses, mica-schists quartzites, intruded by pegmatites and quartz veins.

The geological formations of Mand-Raigarh Coalfield are briefly described below: (Bull. GSI, Ser-A, No.45, Vol.-III, 1983).

Precambrian: The Precambrian rocks comprising Granite Gneiss, mica schist, Phyllites and Quartzites along with Quartz veins & Pegmatites occur along the northern, northeastern periphery. The strike of the foliation varies from E-W to N70°W – S70°E with 50° to 70° dip towards west.

Talchir formation: The Talchir sequence begins with tillite at the base and overlies the basement unconformably. It occurs as a continuous strip along the northern periphery of the basin. Along the southern boundary, Talchirs crop out as narrow, elongated discontinuous strips disrupted by faults. The

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Mand-Raigarh basin shows widespread development of basal tillite pointing to advancement of ice from the surrounding Precambrian uplands.

Karharbari Formation: Karharbari formation is developed in a limited area. It consists of mottled, at places carbonaceous sandstone, frequently associated with pebbles of quartzite, granite etc. of various shapes and sizes.

Barakar Formation: The Barakar formation conformably overlies the Talchir sediments over the major part of coalfield and covers a large tract within the coalfield. It is represented predominantly by multistoried cross-bedded feldspathic sandstones which are highly kaolinised and friable with subordinate shales, carbonaceous shales and coal seams. The sandstones are mostly medium to very coarse grained and milky white to greyish white in colour. The sandstones are arkosic in nature and often shows pronounced kaolinisation. Exposures of fine-grained sandstone and grey to greyish black shale are very limited.

Barren Measure Formation: Barren Measure formation overlies conformably over Barakar formation. Barren Measure formation can be traced in the south eastern part between Gharghoda and Gare, besides sporadic occurrence in vicinity of Chhal and Kuremkela. This formation comprises of predominantly grey claystone/grey shale with siltstone and iron stone bands and interbanded occurrence of fine to medium grained sandstone & shale.

Raniganj Formation: Raniganj formation has been demarcated in south-eastern and south-western part, besides patchy occurrence in north-western part. It is represented by mostly fine to medium grained sandstone, siltstone with clay stone, shale, fine to coarse grained sandstone and coal seams / bands of inferior grade.

Kamthi Formation: The rocks of Kamthi formation are well exposed at higher contours of the flat topped hills. They not only occur in the intervening area between Mand Valley and Hasdo-Arand on the one side and the Raigarh Coalfield on the other, but also occur as irregular patches along the axial region of the Mand Valley. It is represented dominantly by coarse, friable, porous, brownish to red cross bedded sandstone and argillaceous beds. The nature of the contact between Kamthis & Barakars is variable and is somewhat discordant and at places the Kamthi strata overlap the older units.

Intrusives / Deccan Trap: A number of basic dykes, sills and flows have been observed in the Uprora-Porea area in the northern part of the coalfield. The basic rock comprises fine-grained Basalts to coarse-grained Gabbroid type. The flows at places have been altered to laterite. A dyke exposed north of Amaldih has been traced over a distance of 26.5 Km. in an east-

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west direction and another dyke exposed 0.8 Km. south of Porea is over 6 km length.

4.1.3 Coal seams

The regional exploration so far conducted & continuing till date in Mand-Raigarh Coalfield especially in the western part along the eastern bank of Mand river and northern part of Dharamjaygarh-Khargaon, Ongana - Potia as well as Chhal area, has revealed the presence of a number of coal seams. Exploration in the north-western and western part of the coalfield reveals number of coal seams and these have been numbered as I to XXII and so on in ascending order.

Coal of this coalfield is generally banded in nature and it is not devolatilised. In general coal is low in rank, high in volatile matter and non-coking type.

4.1.4 Regional structure

The Mand-Raigarh Coalfield is an asymmetrical basin with an approximately NW-SE axis. It is a part of Ib-Mand-Korba master basin lying within the Mahanadi Graben. It displays a typical half-graben configuration, with the southern boundary marked by a major NW-SE zone of faulting coinciding with the trend of the Mahanadi Graben and the northern boundary not faulted over the major part. In the Mand Valley proper, the coal measures lying between Kharsia & Dharamjaygarh display a broad synclinal structure with its axis running just south of Sithra. The northern limb of the Mand river basin is exposed to the north of the Sithra-Dharamjaygarh area where the Barakar beds are found to strike broadly in NW-SE direction. The beds dip at low angle of 5° to 7° towards south-west. In the southern limb, the strike is approximately NW-SE with minor variations and the beds dip towards north-east.

The other structural element in this basin belt comprises normal Gravity faults. The available surface and sub-surface data indicate that the area lying on both sides of Mand river is traversed by number of sub-parallel faults of considerable linear extent, though the surface expressions of faults are very limited or entirely lacking. Two sets of faults trending WNW-ESE to NW-SE and N-S occur. The former generally has down throws against the dip i.e. towards north while the latter has easterly throw. The amount of throw varies from 10m to 150m.

4.2 GEOLOGY OF GARE-PALMA SECTOR- II BLOCK

Gare Palma Sector- II Coal Block is located in the south-eastern part of Mand-Raigarh Coalfield. The Geology of the block is in conformity with the regional set up. Major part of Gare Palma Sector-II Coal Block is covered by Barakar Formation.

4.2.1 Geological succession in Gare Palma Sector-II coal block

The geological succession evolved on the basis of exploration data generated in the block is given in the Table 4.2 below. While calculating the thickness of different stratigraphic formations, all the data generated by the boreholes in the block are considered.

TABLE 4.2
GEOLOGICAL SUCCESSION IN GARE PALMA SECTOR-II COAL BLOCK

Age	Formation	Thickness (m)	Lithology
Recent	Recent	0.50 to 15.00	Soil, alluvium
Lower Permian	Barakar	203.00 to 477.20	Fine, medium and coarse grained felspathic, grey sandstone, micaceous and laminated at places. Grey shale, fire clay, intercalation of shale and sandstone and carbonaceous shales with Coal Seams
Upper carboniferous to Permian	Talchir	0.30 to 45.90	Boulder bed, rhythmite, fine grained greenish sandstone, greenish to purple shales, Khaker coloured siltstones
----------------------------- Unconformity ---------------------------------			
Archaeans	Pre-cambrian	0.10 to 12.50	Mica-schists, gneisses and quartzite.

Note: Thickness as intersected in boreholes.

Soil & Alluvium: A major part of the block is covered by a thin layer of soil and alluvium horizon. The weathering has affected all the strata below soil to a varying extent. The thickness of soil ranges from 0.50m (MMT-20) to 15.00 m (MMT-166). The depth of weathered zone varies from 0.50 m (MMT-124 & MMT-176) to 30.32 m (MMT-33).

Intrusive: The block is free from any intrusive.

4.2.2 Structure of the block

1. The structural interpretation is mainly based on the sub-surface data obtained during the course of exploratory drilling.
2. The general strike of coal horizons is NW-SE in the major part of the block with minor swings. The dip of beds varies from 2° to 4° towards south-west.
3. The block does not show major tectonic disturbances.

4.3 STATUS OF EXPLORATION

In the South-eastern part of Mand-Raigarh coalfield lies Gare Palma Sector-II Coal Block in which GSI had drilled very wide spaced 8 regional boreholes, during the field seasons 1984-85 to 1987-88 involving 3378m drilling in an area of 25.83 sq. km and assessed 789.17 million tonnes of coal reserves of indicated to inferred category upto a depth range of 400m. The coal grade in general varies from 'D' to 'F'.

4.3.1 Previous work

W.T. Blanford examined a part of Mand-Raigarh coalfield in 1870. Shortly afterwards V. Ball (1882) surveyed the coalfield in some detail. This was followed by exploratory drilling carried out under the supervision of W. King assisted by Lala Hiralal (1886) and the result was unattractive for furtrher investigation. Later C.S. Fox (1934) worked out the limits of the coalfield. S.M. Mathur (1949), A.B. Dutt (1953), M.S. Venkatraman, J. Narayana Moorthy and B.N. Sinha (1959) examined part of the coalfield. The Mand Valley area of this belt was geologically mapped on 1:63,360 scale maps between 1961 and 1966 by V.D. Puri, G.P. Deshmukh, A. K. Dey etc. who located the various coal outcrops and worked out the structural frame work of the basin. A concise account of work carried out by different workers in this coalfield was presented by Raja Rao (1983) in his Bullitins. Systematic geological mapping with special attention on coal resources in parts of North Raigarh coalfield, specially around Gare Palma area, was carried by Bandyopadhyay (1984 & 85). In the area adjoining Gare Palma area, regional exploration for coal was carried out in Kurumkela (Ray, 1988), Chimtapani (Ray and Roy, 1991), Gare (Ray & Roy – 1992) and Palma (Ray et. al. 1994) areas during the field seasons 1981-82 to 1989-90.

In the field season 1984-85 to 1987-88, 37 boreholes (8 bh falling in GP-II Block) were drilled by GSI in Gare Area involving meterage of 12,488.50m and the report on the regional exploration for coal was submitted in 1992.

Subsequently, MECL carried out regional exploration in this coalfield in the Trans-Mand Sector located to the west of Mand river from December 1997 to May 2000, over an area of about 435 sq. km. Extending from Syang in the north to Batati-Kolga in the south. The geological report of Syang-Boro block was submitted in June 2000, Chirra-Jabga block in November 2000 covering about 120 sq. km. area. In south-eastern part of Mand-Raigarh Coalfield, MECL has also carried out / is carrying out priority regional exploration in Banai, Bhalumuda, Dolesara and Karichhapar. MECL has submitted Geological report of Tilaipali Coal Block for NTPC and that of Gare-Palma Sector-I for CMDCL. CMPDIL has submitted a number of geological reports and exploration is still in progress in different Coal Blocks.

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4.3.2 Recent Exploration

Ministry of Coal (MOC) had earlier allocated Gare-Palma Sector-II Coal Block to Mahatamil Collieries Ltd. (A joint venture between Tamil Nadu Electricity Board & Maharashtra State Mining Corporation Ltd.). The area required detailed exploration prior to any exploitation activities. M/s MTCL engaged MECL to carry out detailed exploration in the block by drilling boreholes at 400m x 400m grid interval, involving around 70000m, so as to convert the indicated / inferred category of coal reserves assessed in this sector to Proved category.

MECL commenced the task of detailed exploration for coal in Gare-Palma Sector- II Coal block on behalf of MTCL, on 27.04.2011 and the drilling operation was completed on 26.2.2012. Besides the 8 boreholes drilled earlier by GSI involving 3378 m of drilling, a total of 73,997.80m of drilling was done in 188 boreholes by MECL.

The scope of the recent exploration by MECL was to estimate the opencast and underground reserves from the regionally persistent and workable coal seams occurring in Gare Palma Sector-II Coal block. The opencast reserves have been estimated on I-100 thickness and quality while the underground reserves are assessed based on I-30 thickness and quality. The data processing, statistical analyses and graphics plotting have been carried out by using MINEXP software developed by MECL.

The structural interpretation like drawing of floor contour plan and its interpretation, folio plans, reserve estimation etc. have been carried out by sophisticated MINEX Software Programme at MECL, I.T. Centre. The drawing is based on 3 dimensional software packages, which is very accurate. The 2 dimensional manual divisions between 2 borehole points may not be exactly similar.

i. General

Mineral Exploration Corporation Ltd. has carried out detailed exploration in Gare Palma Sector-II Coal Block involving various activities like geological mapping, surveying, drilling, lithological logging, coal sampling, geophysical logging, data interpretation, data processing, its presentation, graphics, 3D ore modeling, reserves estimation, documentation of geological report etc. Geological Report has been purchased, the cost of which is included in the amount of Rs 43.4816953 Crore transferred to Nominated Authority, MOC vide our letter dt 13-07-15 (**Annexure 4-1**)

The quantum of work done under different activities by MECL is summarized in Table 4.3.

TABLE 4.3
QUANTUM OF WORK DONE BY MECL IN GARE PALMA SECTOR-II COAL BLOCK

Sl. No.	Item of work	Work done
1.	Area of the block	25.83 Sq.km. (Approx)
2.	Geological Mapping	25.83 Sq.km. (Approx)
3.	Surveying	
	i) Triangulation	25.83 Sq.km. (Approx)
	ii) R.L. of MECL BHs	188 BHs (MMT series)
	iii) Co-ordinates of MECL BHs.	188 BHs (MMT series)
4.	Exploratory Drilling (MECL)	73,997.80m in 188 Bhs (MMT Series)
5.	Geological Core logging	73,998.20m in 188 Bhs (MMT Series)
6.	Geophysical Logging	19,971.60m in 51 Bhs (MMT Series)
7.	Preparation of Coal Samples	10,782 Nos. (186 BHs)
8.	House keeping of BH Samples	10,782 Nos. (186 BHs)
9.	**Chemical Analysis (MECL Lab)**	
	i) Band by Band	6505.66m (10,782 Nos.), 186 BHs
	ii) Full Proximate analysis Moisture at 60% RH and 40°C	1792 Nos. (114 BHs)
	iii) Gross calorific value	1792 Nos. (114 BHs)
	iv) Total Sulphur	189 Nos.
	v) Ultimate Analysis.	189 Nos.
	vi) HGI	59 Nos.
	vii) Ash Fusion Temp.	53 Nos.
	viii) Ash Analysis	53 Nos.
10.	Geo-Technical Studies (Physico Mechanical) (Outside lab) : CMFRI Dhanbad	839.70m, 2 BHS (MMT-85 & 95)
11.	Dove Tailing of Old data, GSI	3378.00 (8 BHs)
12.	Computerisation processing, Digitization : IT Centre, MECL, Nagpur	Plates and complete geological report by using MINEXP and MINEX software

ii. Geological Mapping

The entire area of Gare Palma Sector-II Coal Block is mostly covered with soil and at a few places only, outcrops of sandstone & shale can be seen. The geology of the block is, therefore, interpreted based mainly on the subsurface data obtained from MECL boreholes. The geological information i.e. strike & dip of the strata and outcrops wherever available in the block have been mapped and a geological plan structural fractures viz. faults etc. and other surface geological features have been prepared.

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iii. Surveying

- The survey work at Gare Palma Sector-II Coal block has been carried out in the 25.83 sq. km area by closed traverse using “Electronic Total Station”. Intermittent closed traverses were run for connecting the boreholes and for contouring by using E.D.M, Theodolite and Electronic Total Station.

- The location & coordinate of Survey of India / National Pillar from where the coordinates are carried out are (i) Kusmi Bhana Hills - N-919601.36 E-2936373.98 and RL 413.00 m. (ii) Gharghodi Hills - N-915293.59, E-2925757.94.

- The coordinate & R.L. of national grid pillar near Barodh Colliery, which is about 65 km. SW from the exploration block, from where the R.L. has been carried out is given below:

  1) N - 919530.91 E - 2932538.33, RL - 310.029 m
  2) N - 919474.71 E - 2932534.17, RL - 309.828 m
  3) N - 919449.61 E - 2932518.33, RL - 309.445 m

- The baseline has been laid at traverse stations T1 and T2. The distance between T1 and T2 was observed with Total Station and it is 474.2064 m. The bearing from T1 to T2 is 280° 28’ 51”

- The co-ordinates of T1 is 906440.789 m: Northing (Latitude) and 2943745.0301 m: Easting (Departure).

- The co-ordinates and R.Ls of all the boreholes and traverse stations were determined with the above reference points by running the closed traverse method by using the Total Station/E.D.M./Theodolite and Auto Level.

- The surface contouring has been done at 1.0 m contour interval over the entire 25.83 sq. Km area and all surface features were picked.
- The R.L. of T-1 has been carried with reference to the Survey of India GTS pillar on the top of the Silot Pahar R.L. 580.00 m. and checked with National Grid Pillar near Barodh Colliery.

iv. Lithological logging

- The drill cores of both coal and non coal strata obtained from boreholes were systematically logged visually, with detailed description of litho-units like grain size, colour, mineral constituent etc. The structural details such as bedding, slicken sides, fractures, core dip etc. were also recorded wherever possible. Runwise lithologs of all the boreholes drilled by MECL are presented in Annexure-IIA of GR. Graphic logs on R.F 1:500 plotted with the help of computer are presented in Plates IV-A to IV-S of GR. Runwise lithologs of 8 boreholes drilled by GSI are presented in Annexure-IIB. Graphic logs of these boreholes on R.F 1:500 plotted with the help of computer are presented in Plates IV-T of GR.

- The visual roof and floor depth delineation of coal seams and their thickness suitably were corrected after the study of the coal quality data of band by band analysis in respect of 186 boreholes for which chemical analysis received.

v. Geophysical logging

Out of 188 boreholes drilled by MECL, geophysical logging was carried out in 51 boreholes involving 19971.60 m. geophysical logging using multi parameter probes. The details of Geophysical logging, probes used etc. are given separately in Chapter-VII.

vi. Sampling and analysis

- The carbonaceous horizons (coal, shaly coal and carbonaceous shale) of all correlatable coal seams with thickness (>0.50 m) from the boreholes drilled by MECL in this block were sent for band by band analysis to chemical laboratory, MECL, Nagpur. Before sending it to the laboratory, the samples were prepared after crushing at (-) 72 mesh sizes, coning and quartering, packing etc. at project level.

- A total of 10782 Nos. of coal samples from 186 boreholes were prepared and sent for band-by-band analysis. The band-by-band analytical results are presented in Annexure-IIIA and that of GSI boreholes are presented in Annexure-IIIB of GR.

- After obtaining band-by-band analysis, the seam overall analysis at 60% RH & 40 °C for all correlatable coal seams having thickness >0.50 m. were advised for BCS and I-100/I-30 thicknesses of seams. A few unworkable coal seams / bands were also, subjected to overall analysis at 60% RH and 40°C. In addition to the seam overall analysis, special tests such as Ultimate analysis, GCV, AFT, Ash analysis, HGI, and Total Sulphur have also been conducted as per the stipulated norms.

- The analytical results of band by band analysis are incorporated in Annexure-III & Annexure-IIIB of GR, whereas results of seam overall at 60% RH & 40°C are presented in Annexure-IV. The coal analyses of MECL boreholes for band by band for 186 boreholes and seam overall & G.C.V for 114 boreholes have been carried out. Ultimate analysis, Ash analysis, Ash fusion temperature, Total Sulphur and HGI were analysed as included in Annexures –VIIA, VIIB, VIIC & VII D of GR.

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vii. Exploratory drilling

- The year wise breakup of meterage drilled by MECL in the Gare-Palma Sector-II Coal Block is as follows.

Period	Drilling meterage
Year 2010 - 11	29841.30
Year 2011 - 12	44156.50
Total	**73997.80 in 188 boreholes**

- The entire drilling operation was conducted by conventional drilling method aided by wire lines equipments using Drill Max, Vol 300 drill machines. Controlled speed, adequate pressure, circulation of bentonite mud with other chemicals etc. were resorted to maximize the core recovery in both coal & non-coal horizons. The entire drilling has been carried out in NX/NQ Core size except in the top overburden zone where HX/HQ core size has been used. The recovery in the coal seam have been maintained at more than 90% and in the non coal portion at more than 80% except in areas of structurally weak and disturbed zones and weathered/ friable formations. The depth range of the boreholes drilled in this block by MECL varies from 206.00m (MMT-59) to 484.70 m. (MMT-112).

- The earlier drilled data of 8 boreholes of GSI involving 3378.00 m are also considered.

4.4 GEOLOGICAL SECTIONS

For the purpose of geological correlation and assessment of reserves, geological cross sections were prepared with the help of adjoining bore holes from north to south. Different number of boreholes considered for making cross section is given in Table 4.4. The Geological cross section is given in Plate VI.

TABLE 4.4
GEOLOGICAL CROSS-SECTION WISE NUMBERS OF THE BORE HOLES IN GARE-PALMA SECTOR-II BLOCK

Sections	Bore Hole Nos.
A-A'	MMT-10, 94, 2, 88, 4,11, 6, 39, 66, 90
B-B'	Mmt-145,17, 55, 63, 69, 53,177, RGP-9
C-C'	MMT-143,108,188

The lithologs are given in Plate VIIA and VIIB.

4.5 FUTURE PROGRAMME OF EXPLORATION

The Block has been adequately explored. No more exploration is envisaged.

4.6 PATTERN OF FAULTING

The block does not show major tectonic disturbances. A total 10 numbers of faults have been deciphered. The deciphering of fault is mainly attributed to differences in FRL values in boreholes. The throw of faults varies from 0 – 20 m. All the faults dip towards north-east except fault F6, F9 & F10 which dip towards south-west. The dip of the fault is assumed 70°. Minor slips at places cannot be ruled out as evidenced by variation in gradient which has been reflected in floor contour plans. The faults details are furnished in Table 4.5.

TABLE 4.5
DESCRIPTION OF FAULTS INTERPRETED IN GARE PALMA SECTOR-II COAL BLOCK

Fault No.	Location	Nature	Strike & Dip	Fault Intersection		Throw (m)	Evidences
				BH. No.	Depth (m)		
F_1 F_1	Located near north western boundary of the block	Strike to oblique fault	Trending in NW-SE direction dipping due north-east	--	--	0 to 5	Extends from Bhalumuda, the adjacent block
F_2 F_2	Located in north western part. Fault extends for about 4 k.m.	Strike to oblique fault	NW-SE dipping due north-east	--	--	0 to 10	Interpreted based on FRL difference.
F_3 F_3	It extends for about 5 Km., northern-western to southern boundary.	Strike to oblique fault	NW-SE slightly dipping due north-east.	--	--	2 to 10	Interpreted based on FRL difference
F_4 F_4	Extends for 6 km. from south of borehole MMT-9 to south-eastern boundary	Strike to oblique fault	NW-SE slightly dipping due north-east.	--	--	0 to 10	Interpreted based on FRL difference
F_5 F_5	Located in south-eastern part of the block	Strike to oblique fault	NW-SE slightly dipping due north-east.	--	--	0 to 15	Interpreted based on FRL difference
F_6 F_6	Located in central to south-eastern part of the block	Strike to oblique fault	NW-SE dipping towards south-west.	--	--	0 to 10	Interpreted based on FRL difference

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Fault No.	Location	Nature	Strike & Dip	Fault Intersection		Throw (m)	Evidences
				BH. No.	Depth (m)		
F_7 F_7	Located in northern part of the block	Strike to oblique fault	W-NW-E-SE dipping towards north.	-	--	5 to 15	Interpreted based on FRL difference
F_8 F_8	Located in northern part of the block	Strike to oblique fault	W-NW-E-SE dipping towards north.	MMT-119 MMT-16	48.50 226.00	5 to 20	i. Seam IX and roof of seam-VIII faulted. ii. Parting reduction both III-L2 & III.
F_9 F_9	Located in northern part of the block	Strike to oblique fault	W-NW-E-SE dipping towards south.	MMT-164	122.00	10	Seam V B-1, V B-2 faulted
F_{10} F_{10}	Located in northern part of the block	Strike to oblique fault	W-NW-E-SE dipping towards south.	MMT-122	97.00	15	Seam VI faulted

4.7 COAL SEAMS

(a) Sequence of all coal seams and partings

The details of partings and coal seams in descending order are given in Table 4.6.

TABLE 4.6
SEQUENCE OF COAL SEAMS AND PARTINGS IN GARE PALMA SECTOR-II COAL BLOCK

Sequence of Seams/Parting	Range of Seam Thickness (m)		Range of Parting Thickness (m)		No. of Full Intersections
	Minimum	Maximum	Minimum	Maximum	
X-LA	0.10 (MMT-109)	0.89 (MMT-188)			119
Parting			1.60 (MMT-108)	16.95 (RGP-22	111
X-TOP	0.10 (MMT-186)	2.11 (MMT-57)			128
Parting			0.47 (MMT-141)	10.89 (MMT-14)	128
X-BOT	0.68 (MMT-77)	6.26 (MMT-90)			156
Parting			9.4 (MMT-163)	31.45 (MMT-160)	143
IX-L2	0.06 (MMT-128)	0.92 (MMT-59)			158

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Sequence of Seams/Parting	Range of Seam Thickness (m)		Range of Parting Thickness (m)		No. of Full Intersections
	Minimum	Maximum	Minimum	Maximum	
Parting			2.50 (MMT-77)	20.24 (MMT-167)	149
IX-L1	0.10 (MMT-187)	1.04 (MMT-160)			177
Parting			8.00 (MMT-51)	34.26 (MMT-122)	177
IX	2.66 (MMT-53)	7.34 (MMT-140)			195
Parting			3.37 (MMT-140)	15.63 (MMT-120)	192
VIII	0.31 (MMT-131)	6.50 (MMT-94)			192
Parting			1.09 (MMT-162)	21.90 (MMT-54)	77
VIII-L	0.10 (MMT-107)	2.25 (MMT-62)			78
Parting			7.61 (MMT-157)	23.55 (MMT-86)	54
VII-TOP	1.50 (MMT-108)	6.15 (MMT-174)			116
Parting			0.72 (MMT-167)	4.00 (MMT-105)	115
VII-BOT	0.16 (MMT-125)	3.84 (MMT-119)			115
VII-COMB	2.06 (RGP-9)	8.39 (MMT-140)			80
Parting			3.30 (MMT-88)	24.13 (MMT-154)	80
VI	0.25 (MMT-107)	7.74 (MMT-182)			194
Parting			0.80 (MMT-104)	6.50 (MMT-176)	156
VI-L	0.06 (MMT-42)	1.70 (MMT-51)			157
Parting			10.90 (MMT-105)	24.38 (MMT-114)	154
VA-1	0.10 (MMT-107)	1.43 (MMT-80)			191
Parting			1.12 (MMT-14)	10.71 (MMT-105)	118
VA-2	0.08 (MMT-105)	1.28 (MMT-186)			119

Sequence of Seams/Parting	Range of Seam Thickness (m)		Range of Parting Thickness (m)		No. of Full Intersections
	Minimum	Maximum	Minimum	Maximum	
Parting			0.65 (MMT-98)	8.15 (MMT-29)	111
VB-1	0.10 (MMT-118)	1.47 (MMT-112)			120
Parting			0.98 (MMT-16)	15.15 (MMT-140)	118
VB-2	0.09 (MMT-150)	1.90 (MMT-162)			191
Parting			1.00 (MMT-140)	7.50 (MMT-179)	189
VC-1	0.12 (MMT-179)	2.40 (MMT-92)			193
			0.40 (MMT-166)	3.45 (MMT-158)	193
VC-2	0.09 (MMT-17)	1.30 (MMT-81)			194
			0.93 (MMT-60)	6.27 (MMT-148)	171
VD-1	0.05 (MMT-59)	1.40 (MMT-12)			172
			0.36 (MMT-3)	3.05 (MMT-108)	149
VD-2	0.06 (MMT-5)	1.34 (MMT-134)			164
			30.82 (MMT-69)	43.46 (MMT-127)	161
IV	0.10 (MMT-177)	3.70 (MMT-12)			191
			15.01 (MMT-156)	25.37 (MMT-112)	107
III-L2	0.07 (MMT-113)	1.55 (MMT-83)			107
			32.80 (MMT-16)	60.53 (MMT-14)	101
III	0.10 (MMT-6)	3.50 (MMT-102)			171
Parting			0.68 (MMT-79)	62.00 (MMT-73)	18
II-L	0.08 (MMT-6)	1.94 (MMT-102)			20
Parting			0.94 (MMT-171)	61.37 (MMT-79)	20

Sequence of Seams/Parting	Range of Seam Thickness (m)		Range of Parting Thickness (m)		No. of Full Intersections
	Minimum	Maximum	Minimum	Maximum	
II	0.05 (MMT-109)	7.05 (MMT-93)			141
Parting			16.67 (MMT-178)	38.03 (MMT-110)	112
I-L1	0.10 (MMT-27)	2.89 (MMT-119)			123
Parting			13.57 (MMT-77)	28.60 (MMT-41)	9
I-L	0.07 (MMT-57)	1.16 (MMT-155)			13
Parting			1.43 (MMT-29)	7.19 (MMT-57)	8
I-TOP	0.11 (MMT-164)	3.80 (MMT-43)			98
Parting			0.42 (MMT-46)	17.43 (MMT-179)	71
I-BOT	0.19 (MMT-162)	4.49 (MMT-152)			71
I-COMB	2.15 (MMT-63)	7.87 (MMT-139)			30

It is mentioned in Final GR that Seam X Bottom, IX, VIII, VIII-L, VII-Top, VII-Bottom, VII Combined and VI together form the opencast proposition while Seam - VI-L, VA-1, VA-2, VB-1, VB-2, VC-1, VC-2, VD-1, VD-2, IV, III-L2, III, II, IL-1, I Top, I Bottom and I combined are proposed to be mined by underground method.

(b) Sequence of workable Coal Seams

The sequence of workable coal seams is furnished below in Table 4.7 along with their thickness.

TABLE 4.7
SEQUENCE OF WORKABLE COAL SEAMS OF GARE-PALMA SECTOR-II AS PER GR BLOCK

Sl. No.	Coal Seam	Coal Thickness range, m	Av. Depth from Surface, m	Workability of seam as per GR
1.	X-BOT	0.68-6.26	90.185	Workable
2.	IX	2.66-7.34	125.015	Workable
3.	VIII	0.31-6.50	139.275	Workable
4.	VIII-L	0.10-2.25	152.25	Workable
5.	VII-TOP	1.50-6.15	165.985	Workable

Sl. No.	Coal Seam	Coal Thickness range, m	Av. Depth from Surface, m	Workability of seam as per GR
6.	VII-BOT	0.16-3.84	170.5	Workable
7.	VII-COMB	2.06-8.39	160.625	Workable
8.	VI	0.25-7.74	177.815	Workable
9.	VB-1	0.10-1.47	208.66	Workable*
10.	VC-1	0.12-2.40	218.4	Workable
11.	VD-1	0.05-1.40	223.115	Workable*
12.	IV	0.10-3.70	261.1	Workable
13.	III	0.10-3.50	331.575	Workable
14.	II	0.05-7.05	410.15	Workable
15.	I-L1	0.10-2.89	445.925	Workable
16.	I-TOP	0.11-3.80	441.225	Workable
17.	I-BOT	0.19-4.49	445.01	Workable
18.	I-COMB	2.15-7.87	445.395	Workable

* *Though, in GR these seams are shown workable, their maximum thickness is less than 1.5 m and mean thickness less than 1m (Seam VB1=0.79m, Seam VD1=0.35 m; Reserves of >0.9m thickness of seam VB1= 3.119 Mt, the seam is converted to carbonaceous shale around borehole RGP-22, 19 & RP-11 ; Seam VD1=0. 0.236 Mt), hence for mining they have been considered "not workable".*

(c) Strike and dip

The general strike of coal horizons is NW-SE in the major part of the block which entire block with minor swings. The dip of beds varies from 2 to 4 degrees towards south-west.

4.8 COAL RESERVES & OVERBURDEN

4.8.1 Reserves

The extent of coal bearing area in the block is 2583.486 Ha and the whole block area can be considered as coal bearing area.

The procedure adopted for estimation of coal reserves in Gare Palma Sector-II Coal Block is fundamentally based on the specific geological factors which determine the extent to which correlation, interpolation of data can be projected for building up a stratigraphic and structural model of the lay and disposition of the coal seams and this concept applied to generate various plans to estimate coal reserves through Minex Software.

From the structural 3-D model, various plans viz. vertical cross sections and floor contour plans have been generated. Similarly from the model quality overall data are presented in the individual seam folio plan.

The detailed exploration in Gare Palma Sector-II coal block, revealed the existence of 31 correlatable Barakar coal seams. These seam in descending order are XL-A, X Top, X Bottom, IX-L2, IX-L1, IX, VIII, VIII-L, VII Top, VII Bottom, VII Combined, VI, VI L, VA-1, VA-2, VB-1, VB-2, VC-1, VC-2, VD-1, VD-2, IV, III L2, III, II L, II, I-L1, I-L, I Top, I Bottom & I combined. Out of these 18 seams viz. X Bottom, IX, VIII, VIII L, VII Top, VII Bottom, VII combined, VI, VB-1, VC-1, VD-1, IV, III, II, IL1, I Top, I Bottom and I Combined are workable. Remaining seams are almost unworkable in major part of the block. Seam X Bottom, IX, VIII, VIII-L, VII-Top, VII-Bottom, VII Combined & VI together form the opencast proposition in major part of the block while in a small area located in the south eastern part of the block where seam –VI becomes unworkable, seam VII has been considered base seam for open cast. Seam- VI-L, VA-1, VA-2, VB-1, VB-2, VC-1, VC-2, VD-1, VD-2, IV,III-L2, III, II, IL-1, I Top, I Bottom & I combined can be mined by underground method. The floor and folio plan of all above seams are given in Fig 4.1 to 4.16 respectively at the end of Chapter.

The reserves of the coal seams have been estimated sector-wise. For this purpose, the block has been divided into sectors A, B, C, D, E, F, G, H & I based on disposition of faults and Kelo river.

4.8.2 Basic assumptions and norms followed

The following norms have been taken into account for reserves calculation:

i) The reserves have been estimated for opencast proposition on I-100 thickness for 8 seams i.e. X Bottom, IX, VIII, VIII L, VII Top, VII Bottom, VII Combined & VI in the major part of the block. However, in a small area located in the south-eastern part of the block that of for 7 seams up to VII Bottom/ VII Combined as the seam VI is unworkable in this part and on I-30 thickness for 17 seams viz. seam VI-L, VA-1, VA-2, VB-1, VB-2, VC-1, VC-2, VD-1, VD-2, IV,III-L2, III, II, IL-1, I Top, I Bottom & I combined.

ii) Isochores, Isograde are drawn for I100 / I-30 thickness of seams for open cast and underground proposition.

iii) The minimum workable thickness considered for the estimation of reserves of the individual seams/sections for OC/ underground proposition is 0.90m. However, reserves for thickness 0.50m to 0.90m have also been estimated and kept under resource.

iv) The isochores have been drawn on the basis of the principle of gradual and uniform change over the area. It is assumed that the variation between any two points of observations is uniform and gradual.

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v) The limits of non-development zones of seams have been marked by taking half of the influence of the borehole with positive seam intersection. These limits have also been considered to be the line of zero seam thickness.

vi) The limit of zone of basement high has been drawn half way of distance between two boreholes.

vii) Areas falling within the heave zones of faults have been excluded from the estimation of reserves.

viii) Coal reserves are estimated for superior & inferior grade coal available in the block and as per opencast and underground norms and hence for 0.90 m and above seam thickness & at 0.90-1.2m, 1.20-1.50m, 1.50-3.00m, 3.00-5.00, 5.00-10.00 and >10.00m thickness interval.

ix) The reserves of workable seams have been estimated based on I100/ I-30 thickness & quality and have been estimated seam-wise, sector-wise, coal to overburden ratio-wise, depth-wise (at 50m interval), barrier-wise, forest-wise, thickness-wise & grade-wise. The depth-wise reserves for underground property have also been given for depth <300m & >300m by drawing 300m depth line.

x) 60 m barrier has been drawn both side of metalled road and Kelo river.

xi) A barrier of 45m has been kept for the diverted road as per statutory norms.

xii) Reserves have also been estimated within village, infrastructure and forest.

xiii) Volume of coal is estimated by Minex Software Model and reserves are by empirical formula of

Gross Reserves = Area X Thickness X Sp. Gravity of coal
(Thousand Tonnes) = (Sq.m) (m) (Grade-wise)

xiv) A 10% reduction in Gross Geological Reserves for arriving at Net Geological Reserves has been kept as in the GR and as per the accepted practice.

4.8.3 Calculation of specific gravity

The specific gravity has been calculated seam-wise for each grade by the procedure outlined below:

1) The mean of ash percentage is assessed found for each grade and for each seam.

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2) From this mean ash percentage, average specific gravity was calculated by the

Formula:
Specific Gravity = 1.28 + 0.01 x Ash

The grade-wise specific gravity considered for all the coal seams are given in Table 4.8 below.

TABLE 4.8
GRADE-WISE AVERAGE SPECIFIC GRAVITY OF COAL SEAMS

Grade	Specific Gravity
A	1.42
B	1.45
C	1.50
D	1.55
E	1.60
F	1.68
G	1.76

4.8.4 Method of grade estimation

The proximate analysis on 60% R.H. & at 40°C of the seams form the basis for grade estimation. Wherever such analyses are not available, the same have been calculated on M-100 basis.

The non-coking coals have been classified into seven grades on the basis of the useful heat value (UHV) and seventeen grades on the basis of Gross Calorific Value. The grades of the coal are as given in Table 4.9 and 4.9A respectively.

TABLE 4.9
GRADES OF NON-COKING COAL BASED ON UHV
(GOI Notification no. 28012/80/CA dated 13.02.1981)

Grade	Ash% +Moisture % (on 60% RH & 40°C	Useful heat value (UHV) (In K.cal/Kg)
A	< 19.6	> 6200
B	19.6 - 23.9	>5600 - 6200
C	24.0 - 28.6	>4940 - 5600
D	28.7 - 34.0	>4200 - 4940
E	34.1 - 40.1	>3360 - 4200
F	40.2 - 47.1	>2400 - 3360
G	47.2 - 55.0	>1300 - 2400

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TABLE 4.9A
GRADES OF NON-COKING COAL BASED ON GCV IN INDIA
(GAZETTE NOTIFICATION NO.22021/1/2008-CRC-II, DT.30.12.2011)

GCV (Kcal/Kg)		Grade
From	To	
Above 7000		G1
6701	7000	G2
6401	6700	G3
6101	6400	G4
5801	6100	G5
5501	5800	G6
5201	5500	G7
4901	5200	G8
4601	4900	G9
4301	4600	G10
4001	4300	G11
3701	4000	G12
3401	3700	G13
3101	3400	G14
2801	3100	G15
2501	2800	G16
2201	2500	G17

4.8.5 Grades of coal in the Block

The grades of coal in the Block are given in Table 4.10.

TABLE 4.10
SEAMWISE GRADES AND GCV RANGE IN GARE SECTOR-II

Seam	UHV (k.Cal/Kg		GCV (k.Cal/Kg)		New Grade based on GCV	
	Min	Max	Min	Max	Min	Max
X-LA/un	1434	3877	3440	4690	G13	G9
X-TOP/un	1518	3229	3100	4600	G14	G10
X- BOT	1794	4222	2550	4970	G16	G8
IX-L2/un	1365	4829	4280	5050	G11	G8
IX-L1	2235	3891	3650	5240	G13	G7
IX	3063	4871	4280	5320	G11	G7
VIII	1366	2953	2990	4300	G15	G11
VIII-L	1614	4291	3180	4730	G14	G9
VII-Top	1407	3628	3100	4650	G14	G9
VII-Bot	1656	4071	2960	4980	G15	G8

Seam	UHV (k.Cal/Kg		GCV (k.Cal/Kg)		New Grade based on GCV	
	Min	Max	Min	Max	Min	Max
VII-Com	1834	3587	3170	4670	G14	G9
VI	1407	4111	3100	5160	G14	G8
VI-L/un	1352	2097	3500	4410	G13	G10
VA-1	1380	4236	3170	5210	G14	G7
VA-2/un	1545	3201	4240	4980	G11	G8
VB-1	1545	5229	3990	5100	G12	G8
VB-2/un	2566	5947	4100	5490	G11	G7
VC-1	1752	4677	3400	5380	G13	G7
VC-2	2497	4788	3690	6620	G13	G3
VD-1/un	3256	3463	3950	4840	G12	G9
VD-2	1338	2539	3040	4760	G15	G9
IV	1710	5243	3550	5980	G13	G5
III-L2	1959	3753	3690	5320	G13	G7
III	2147	5326	3270	7000	G14	G2
II-L/un	2470	3284	4220	5370	G11	G7
II	2318	7217	5514	6820	G6	G2
I-L1	4719	7341	5560	7250	G6	G1
I-L/un	3352	7492	4610	4610	G9	G9
I-Top	2461	6872	4010	6940	G11	G1
I-Bot	1685	7452	3880	7070	G12	G1
I-Com	3532	6168	4580	6270	G10	G4

4.8.6 Opencast proposition

RQP has identified that seam X Bottom, IX, VIII, VIIIL, VII Top, VII Bottom, VII Combined and VI together form the open cast proposition in the major part of the block. However, in a small area located in the south-eastern part of the block, seam VII has been considered base seam for open cast, as the seam VI becomes unworkable in this part. The cumulative thickness of coal packet of above said seams in general varies from 12 m to 22 m. The coal to overburden ratio in general varies from 1:3 to 1:10 in the block. The depth of quarry varies from 80 m to 200 m.

4.8.7 Overburden

Nature of overburden: Overburden consists predominantly sandstone with minor amount of shale, carbonaceous shale, ungraded coal and thin coal bands (< 1m in thickness). Besides, the overburden also includes soil, weathered rocks, obvious bands of any thickness and dirt bands of >1m thickness. Sector-wise, depth-wise, ratio-wise volume of over burden and stripping ratio.

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4.8.8 Calculation of overburden

To arrive at total volume of overburden upto base of seam VI/VII following procedures has been adopted. The Iso-excavation plan and coal to overburden ratio plan have been prepared by using MINEX Software programme.

The volume of overburden has been calculated by applying the formula:

V = A x Th. where

V = Volume of overburden in cu.m.

A = Area in sq. m.

Th = Average thickness of iso-pachytes of overburden in m. / isopachytes of parting.

4.8.9 Stripping Ratio

Stripping ratio is obtained after dividing total volume of overburden by tonnage of coal available in the same area.

4.8.10 Categorisation of reserves

Borehole density is 7.3 boreholes/ sq km (excluding 8 bh drilled by GSI)., hence the entire reserves of all the coal seams from seam X-Bot to I Bottom / I Combined are grouped under Proved category which corresponds to digit 1 of geological axis of UNFC.

4.8.11 Area considered for reserves estimation

i. For the purpose of reserves calculation for the all seams northern, southern boundary eastern & western boundary of block is considered.

ii. In the block, total of 1006.225 million tonnes have been estimated for 25 workable coal seams in the block of effective thickness 0.90 to 10.00m, out of which 682.569 million tonnes of reserves occur in opencast and 323.656 million tonnes are found in underground area.

iii. A majority of 409.903 million tonnes (40.7% of total reserves) fall in F grade. In underground area 102.193 million tonnes (31.6% of total reserves) occur in superior grade.

iv. 299.419 million tonnes (43.8%) & 293.084 million tonnes (43.0%) of total reserves are estimated in depth range of 100m to 150m and 150m to 200m respectively in opencast area.

A. For seam thickness more than 0.9m

A.i. For opencast:

The details of the opencastable reserves (as per GR) are reproduced below in Table 4.11 to Table 4.15 for coal thickness more than 0.9m:

TABLE 4.11
SEAM-WISE AND BARRIER-WISE RESERVES (THICKNESS >0.90 M) OPENCAST (RESERVES IN '000 TONNES)

Seam	Outside	JSPL Colony*	River	Forest	Village	Road	Total
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
X-TOP	2077	207	1	0	0	58	2343
X-BOT	64247	1523	1323	2663	2977	12929	85662
IX-L2	13	0	0	0	0	0	13
IX-L1	163	0	0	4	0	43	210
IX	115046	4498	2686	5837	4572	23545	156184
VIII	59094	1073	457	5766	2686	12064	81140
VIII-L	8647	0	281	358	404	2384	12074
VII-TOP	61514	1292	2094	3427	2649	17968	88944
VII-BOT	15190	430	602	936	858	4730	22746
VII-COMB	65055	4133	1035	2961	1928	7193	82305
VI	113779	139	986	6625	4637	24782	150948
Total	**504825**	**13295**	**9465**	**28577**	**20711**	**105696**	**682569**

** Existing colony of Jindal Steel and Power Ltd.*

TABLE 4.12
SEAM-WISE AND RATIO-WISE RESERVES (THICKNESS > 0.90 M) OPENCAST (RESERVES IN '000 TONNES)

Seam	1:2-1:3	1:3-1:4	1:4-1:5	1:5-1:6	1:6-1:7	1:7-1:8	1:8-1:9	1:9-1:10	>1:10	Total
X-TOP	0	0	0	121	419	690	606	314	193	2343
X-BOT	63	6222	8626	10343	12573	17817	20831	5237	3950	85662
IX-L2	0	9	1	3	0	0	0	0	0	13
IX-L1	0	29	0	28	0	45	108	0	0	210
IX	169	13121	14045	16841	22203	30872	37296	11318	10319	156184
VIII	195	15866	14383	11021	11449	12314	10770	2877	2265	81140
VIII-L	0	42	100	0	248	3059	6658	1442	525	12074
VII-TOP	0	5587	6484	6005	8203	15579	30324	9636	7126	88944
VII-BOT	0	1911	1574	1211	1546	3386	8651	2695	1772	22746
VII-COMB	196	7598	6932	11789	17033	19168	12210	3084	4295	82305
VI	129	14242	15806	17272	21273	32575	39250	7814	2587	150948
Total	**752**	**64627**	**67951**	**74634**	**94947**	**135505**	**166704**	**44417**	**33032**	**682569**

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TABLE 4.13

SEAM-WISE AND DEPTH-WISE RESERVES (THICKNESS > 0.90M) OPENCAST (RESERVES IN '000 TONNES)

Depth	50-100	100-150	150-200	Total
X-TOP	11	633	1699	2343
X-BOT	9327	39642	36693	85662
IX-L2	10	3	0	13
IX-L1	29	28	153	210
IX	18810	71021	66353	156184
VIII	20595	39968	20577	81140
VIII-L	142	122	11810	12074
VII-TOP	7256	35496	46192	88944
VII-BOT	2254	8478	12014	22746
VII-COMB	12316	40258	29731	82305
VI	19316	63770	67862	150948
Total	**90066**	**299419**	**293084**	**682569**

TABLE 4.14

SEAM-WISE AND THICKNESS-WISE RESERVES (THICKNESS > 0.90M) OPENCAST (RESERVES IN '000 TONNES)

Thickness	0.9-1.2	1.2-1.5	1.5-3.0	3.0-5.0	5.0-10.0	Total
X-TOP	1253	352	738	0	0	2343
X-BOT	775	5454	69208	9735	490	85662
IX-L2	13	0	0	0	0	13
IX-L1	210	0	0	0	0	210
IX	0	0	62	147022	9100	156184
VIII	6366	10426	30152	19013	15183	81140
VIII-L	1815	3579	6680	0	0	12074
VII-TOP	0	3	4761	83711	469	88944
VII-BOT	9845	8234	4646	21	0	22746
VII-COMB	0	0	226	32305	49774	82305
VI	1873	1062	7215	66675	74123	150948
Total	**22150**	**29110**	**123688**	**358482**	**149139**	**682569**

TABLE 4.15

SEAM-WISE AND GRADE-WISE RESERVES (THICKNESS > 0.90M) OPENCAST (RESERVES IN '000 TONNES)

Seam	D	E	F	G	Total
X-TOP	0	32	2123	188	2343
X-BOT	3	10269	67771	7619	85662
IX-L2	0	3	10	0	13
IX-L1	0	65	76	69	210
IX	19338	135817	1029	0	156184
VIII	0	0	16647	64493	81140
VIII-L	52	3482	6859	1681	12074
VII-TOP	0	2202	65753	20989	88944
VII-BOT	0	1216	16517	5013	22746
VII-COMB	0	1224	67607	13474	82305
VI	0	42521	100257	8170	150948
Total	**19393**	**196831**	**344649**	**121696**	**682569**

A.ii. For Underground:

The details of the reserves mineable by underground (as per GR) are given below in Table 4.16 to Table 4.19 for coal thickness more than 0.9m.

TABLE 4.16
SEAM-WISE AND BARRIER- (THICKNESS > 0. 90 M) UNDERGROUND (RESERVES IN '000 TONNES)

Seam	Outside	JSPL	River	Forest	Village	Road	Total
VI-L	340	3	0	0	0	154	497
VA-1	2257	2	0	280	139	441	3119
VA-2	237	0	0	0	0	17	254
VB-1	7264	0	0	126	360	1226	8976
VB-2	269	0	0	0	0	0	269
VC-1	21851	307	418	1407	1005	4849	29837
VC-2	5588	0	0	1291	67	1410	8356
VD-1	160	0	0	0	2	74	236
VD-2	460	0	0	39	52	16	567
IV	46637	1472	768	2670	1898	8915	62360
III-L2	1146	0	0	11	3	67	1227
III	49117	2488	1318	3530	2051	10788	69292
II	38909	0	79	3549	2426	6787	51750
I-L1	18669	137	302	1525	633	3357	24623
I-TOP	16610	740	323	973	738	3766	23150
I-BOT	14247	460	647	1151	500	2855	19860
I-COMB	15777	0	85	0	1017	2404	19283
Total	**239538**	**5609**	**3940**	**16552**	**10891**	**47126**	**323656**

TABLE 4.17
SEAM-WISE AND DEPTH-WISE RESERVES (THICKNESS > 0.90 M) UNDERGROUND (RESERVES IN '000 TONNES)

Depth	<50	50-100	Total
VI-L	497	0	497
VA-1	3119	0	3119
VA-2	254	0	254
VB-1	8976	0	8976
VB-2	269	0	269
VC-1	29837	0	29837
VC-2	8356	0	8356
VD-1	236	0	236
VD-2	567	0	567
IV	62360	0	62360

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Depth	<50	50-100	Total
III-L2	1227	0	1227
III	37814	31478	69292
II	5026	46724	51750
I-L1	0	24623	24623
I-TOP	0	23150	23150
I-BOT	0	19860	19860
I-COMB	0	19283	19283
Total	**158538**	**165118**	**323656**

TABLE 4.18
SEAM-WISE AND THICKNESS-WISE RESERVES (THICKNESS > 0.90M) UNDERGROUND (RESERVES IN '000 TONNES)

Thickness	0.9-1.2	1.2-1.5	1.5-3.0	3.0-5.0	5.0-10.0	Total
VI-L	402	90	5	0	0	497
VA-1	3036	83	0	0	0	3119
VA-2	234	20	0	0	0	254
VB-1	8670	306	0	0	0	8976
VB-2	172	97	0	0	0	269
VC-1	23769	5685	383	0	0	29837
VC-2	8166	190	0	0	0	8356
VD-1	233	3	0	0	0	236
VD-2	564	3	0	0	0	567
IV	2997	6171	47537	5655	0	62360
III-L2	1101	119	7	0	0	1227
III	1291	2651	62473	2877	0	69292
II	1440	1762	5095	11618	31835	51750
I-L1	2682	3938	18003	0	0	24623
I-TOP	2849	4075	16209	17	0	23150
I-BOT	1510	2930	13322	2098	0	19860
I-COMB	0	0	1065	9355	8863	19283
Total	**59116**	**28123**	**164099**	**31620**	**40698**	**323656**

TABLE 4.19
SEAM-WISE AND GRADE-WISE RESERVES (THICKNESS > 0.90 M) UNDERGROUND (RESERVES IN '000 TONNES)

Seam	A	B	C	D	E	F	G	Total
VI-L	0	0	0	0	57	226	214	497
VA-1	0	0	0	7	1361	1593	158	3119
VA-2	0	0	0	0	12	153	89	254
VB-1	0	0	20	128	6971	1748	109	8976
VB-2	0	0	0	80	189	0	0	269
VC-1	0	0	0	359	10692	18146	640	29837
VC-2	0	0	0	267	5246	2843	0	8356
VD-1	0	0	0	0	162	74	0	236

Seam	A	B	C	D	E	F	G	Total
VD-2	0	0	0	0	0	42	525	567
IV	0	0	648	20332	36430	4782	168	62360
III-L2	0	0	0	0	170	814	243	1227
III	0	0	344	5573	28964	33012	1399	69292
II	952	2735	25504	19378	2591	573	17	51750
I-L1	22681	970	730	121	73	48	0	24623
I-TOP	10941	5384	2094	2487	1639	605	0	23150
I-BOT	1634	5757	5148	3850	2738	595	138	19860
I-COMB	0	4821	11830	2385	247	0	0	19283
Total	**36208**	**19667**	**46318**	**54967**	**97542**	**65254**	**3700**	**323656**

B. For seam thickness 0.50 m to 0.90 m:

B.i. For Opencast

The details of the opencastable reserves (as per GR) are given below in Table 4.20 to Table 4.24 for coal thickness between 0.50 m and 0.90 m.

TABLE 4.20
SEAM-WISE AND BARRIER-WISE RESERVES (0.50 M TO 0.90 M) OPENCAST (RESERVES IN '000 TONNES)

Seam	Outside	JSPL	River	Forest	Village	Road	Total
X-LA	8233	215	346	271	46	1789	10900
X-TOP	5205	660	168	97	295	1004	7429
X-BOT	105	8	0	0	0	0	113
IX-L2	8893	260	211	350	381	2134	12229
IX-L1	10114	42	80	716	373	2426	13751
VIII	1698	136	252	0	85	320	2491
VIII-L	1302	5	48	79	76	219	1729
VII-BOT	2113	0	43	85	27	443	2711
VI	1382	629	53	0	47	72	2183
Total	**39045**	**1955**	**1201**	**1598**	**1330**	**8407**	**53536**

TABLE 4.21
SEAM-WISE AND RATIO RESERVES (0.50 M TO 0.90 M) OPENCAST (RESERVES IN '000 TONNES)

Seam	1:2-1:3	1:3-1:4	1:4-1:5	1:5-1:6	1:6-1:7	1:7-1:8	1:8-1:9	1:9-1:10	>1:10	Total
X-LA	0	628	979	1515	2001	1824	2358	747	848	10900
X-TOP	0	0	16	518	1326	1073	2355	830	1311	7429
X-BOT	0	0	18	0	14	9	0	0	72	113
IX-L2	0	660	1194	1705	1854	1831	2872	1075	1038	12229
IX-L1	17	1042	388	921	1522	3109	5082	1228	442	13751
VIII	0	0	0	0	43	108	1243	525	572	2491
VIII-L	0	6	80	23	20	391	721	170	318	1729
VII-BOT	0	17	179	448	442	660	428	256	281	2711
VI	0	0	0	127	151	409	373	312	811	2183
Total	**17**	**2353**	**2854**	**5257**	**7373**	**9414**	**15432**	**5143**	**5693**	**53536**

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TABLE 4.22
SEAM-WISE AND DEPTH-WISE RESERVES (0.50 M TO 0.90 M) OPENCAST (RESERVES IN '000 TONNES)

Depth	50-100	100-150	150-200	Total
X-LA	952	6470	3478	10900
X-TOP	71	2885	4473	7429
X-BOT	0	41	72	113
IX-L2	1059	6670	4500	12229
IX-L1	1160	3877	8714	13751
VIII	11	721	1759	2491
VIII-L	87	190	1452	1729
VII-BOT	96	1391	1224	2711
VI	0	717	1466	2183
Total	**3436**	**22962**	**27138**	**53536**

TABLE 4.23
SEAM-WISE AND THICKNESS-WISE RESERVES (0.50 M TO 0.90 M) OPENCAST (RESERVES IN '000 TONNES)

Thickness	0.5-0.9	Total
X-LA	10900	10900
X-TOP	7429	7429
X-BOT	113	113
IX-L2	12229	12229
IX-L1	13751	13751
VIII	2491	2491
VIII-L	1729	1729
VII-BOT	2711	2711
VI	2183	2183
Total	**53536**	**53536**

TABLE 4.24
SEAM-WISE AND GRADE-WISE RESERVES (0.50 M TO 0.90 M) OPENCAST (RESERVES IN '000 TONNES)

Seam	C	D	E	F	G	Total
X-LA	0	0	1612	5735	3553	10900
X-TOP	0	0	396	3950	3083	7429
X-BOT	0	0	0	104	9	113
IX-L2	0	1042	7812	2935	440	12229
IX-L1	139	3331	7460	1764	1057	13751
VIII	0	0	3	668	1820	2491
VIII-L	0	0	5	735	989	1729
VII-BOT	0	0	305	1594	812	2711
VI	0	0	50	511	1622	2183
Total	**139**	**4373**	**17643**	**17996**	**13385**	**53536**

B.ii. For underground

The details of the reserves mineable by underground (as per GR) are given below in Table 4.25 to Table 4.28 for coal thickness between 0.50 m and 0.90m.

TABLE 4.25
SEAM-WISE AND BARRIER-WISE RESERVES
(0.50 M TO 0.90 M) UNDERGROUND (RESERVES IN '000 TONNES)

Seam	Outside	JSPL	River	Forest	Village	Road	Total
VI-L	5487	41	0	296	243	983	7050
VA-1	14124	204	406	630	515	3233	19112
VA-2	3003	0	0	114	96	523	3736
VB-1	4861	0	0	585	217	1111	6774
VB-2	7445	115	153	713	330	1794	10550
VC-1	5492	477	217	81	168	1041	7476
VC-2	35047	1569	638	1107	1475	7191	47027
VD-1	1409	76	0	54	100	218	1857
VD-2	4010	254	164	258	215	578	5479
IV	2097	10	170	188	143	617	3225
III-L2	3392	0	0	176	184	532	4284
III	361	0	0	0	12	102	475
II	2292	83	31	9	19	216	2650
I-L1	2088	28	116	5	54	393	2684
I-TOP	1121	191	35	324	54	139	1864
I-BOT	656	173	0	44	29	106	1008
Total	**92885**	**3221**	**1930**	**4584**	**3854**	**18777**	**125251**

TABLE 4.26
SEAM-WISE AND DEPTH-WISE RESERVES
(0.50 M TO 0.90 M) UNDERGROUND (RESERVES IN '000 TONNES)

Depth	<300	>300	Total
VI-L	7050	0	7050
VA-1	19112	0	19112
VA-2	3736	0	3736
VB-1	6774	0	6774
VB-2	10550	0	10550
VC-1	7476	0	7476
VC-2	47027	0	47027
VD-1	1857	0	1857
VD-2	5479	0	5479
IV	3225	0	3225
III-L2	4284	0	4284
III	173	302	475
II	0	2650	2650
I-L1	0	2684	2684
I-TOP	0	1864	1864
I-BOT	0	1008	1008
Total	**116743**	**8508**	**125251**

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TABLE 4.27
SEAM-WISE AND THICKNESS-WISE RESERVES
(0.50 M TO 0.90 M) UNDERGROUND (RESERVES IN '000 TONNES)

Thickness	0.5-0.9	Total
VI-L	7050	7050
VA-1	19112	19112
VA-2	3736	3736
VB-1	6774	6774
VB-2	10550	10550
VC-1	7476	7476
VC-2	47027	47027
VD-1	1857	1857
VD-2	5479	5479
IV	3225	3225
III-L2	4284	4284
III	475	475
II	2650	2650
I-L1	2684	2684
I-TOP	1864	1864
I-BOT	1008	1008
Total	**125251**	**125251**

TABLE 4.28
SEAM-WISE AND GRADE-WISE RESERVES
(0.50 M TO 0.90 M) UNDERGROUND (RESERVES IN '000 TONNES)

Seam	A	B	C	D	E	F	G	Total
VI-L	0	0	0	3	219	3985	2843	7050
VA-1	0	0	0	836	10848	6344	1084	19112
VA-2	0	0	0	7	1829	1896	4	3736
VB-1	0	0	17	75	3394	3108	180	6774
VB-2	0	291	4896	4115	1139	109	0	10550
VC-1	0	0	0	63	3537	3688	188	7476
VC-2	0	0	0	747	29634	16300	346	47027
VD-1	0	0	0	38	979	619	221	1857
VD-2	0	0	0	0	77	907	4495	5479
IV	0	0	19	980	1401	776	49	3225
III-L2	46	24	23	107	1069	2811	204	4284
III	0	0	0	36	191	248	0	475
II	1556	408	288	214	112	61	11	2650
I-L1	2347	211	89	0	0	37	0	2684
I-TOP	813	242	366	266	117	60	0	1864
I-BOT	135	362	83	30	153	200	45	1008
Total	**4897**	**1538**	**5781**	**7517**	**54699**	**41149**	**9670**	**125251**

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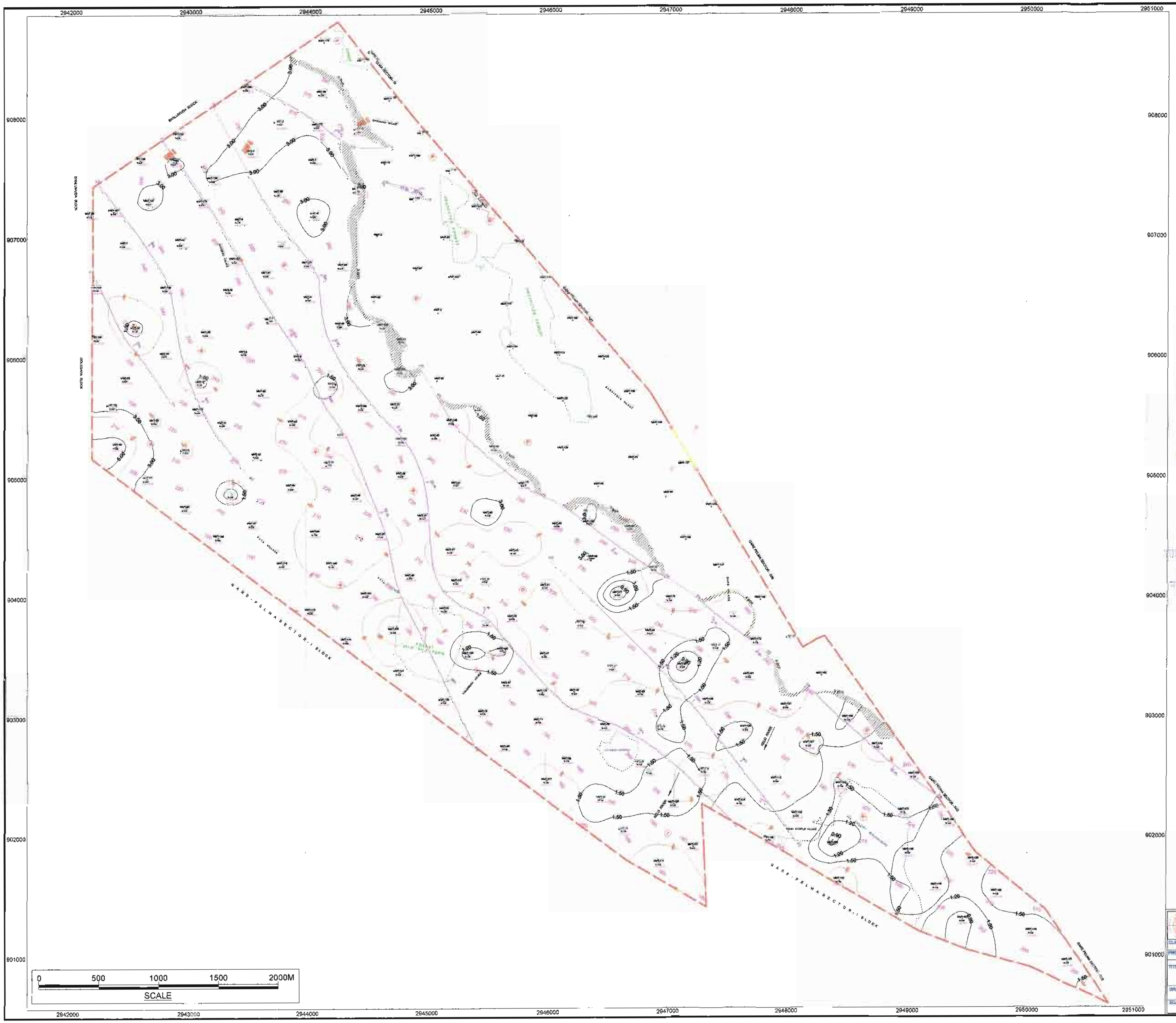

LEGEND :-	
	BLOCK BOUNDARY
	BOREHOLE DRILLED BY MECL
	BOREHOLE DRILLED BY G.S.I
	EFFECTIVE THICKNESS IN METRES
	FLOOR REDUCED LEVEL
	FAULT WITH THROW
1.50	THICKNESS CONTOUR
	GRADE LINE
KELO RIVER	RIVER / NALA
▨	INCROP OF COAL SEAM
	VILLAGE
	FLOOR CONTOUR
	FOREST BOUNDARY
	15M HARDCOVER LINE

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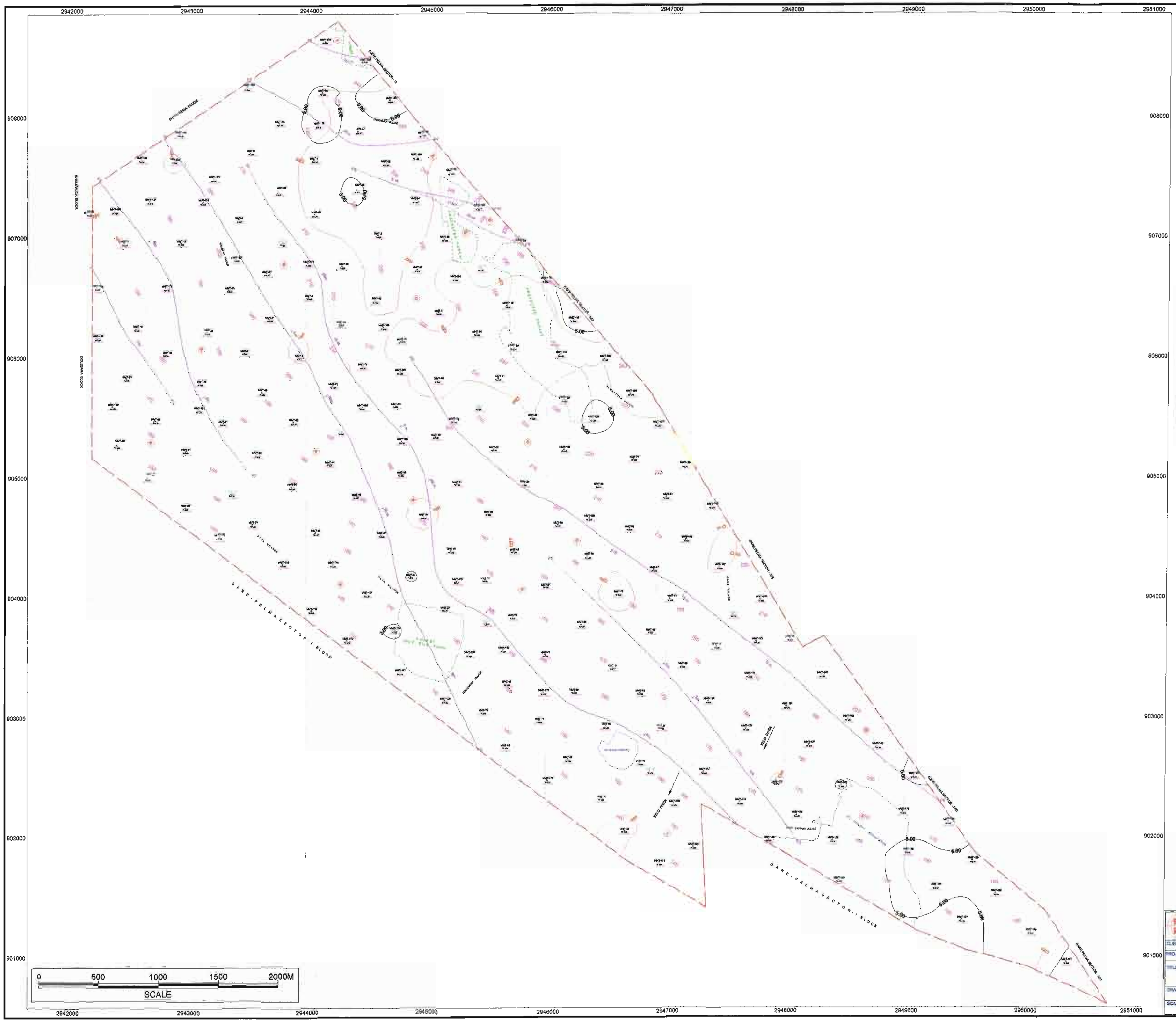
CLIENT:	MAHARASHTRA STATE POWER GENERATION COMPANY LTD. (MSPGCL)
PROJECT:	GARE PALMA SECTOR-II COAL MINE
TITLE:	MINING PLAN & CLOSURE PLAN FLOOR & FOLIO PLAN OF SEAM-X BOT.

DRAWN BY:	CHECKED BY:	FIG. NO.
B.R. MATLOTIA	B.D.SHARMA	4.1
SCALE: AS SHOWN	DATE : 25-02-2016	



LEGEND :
- BLOCK BOUNDARY
- BOREHOLE DRILLED BY MECL
- BOREHOLE DRILLED BY G.S.I
- EFFECTIVE THICKNESS IN METRES
- FLOOR REDUCED LEVEL
- FAULT WITH THROW
- THICKNESS CONTOUR
- GRADE LINE
- RIVER / NALA
- VILLAGE
- FLOOR CONTOUR
- FOREST BOUNDARY

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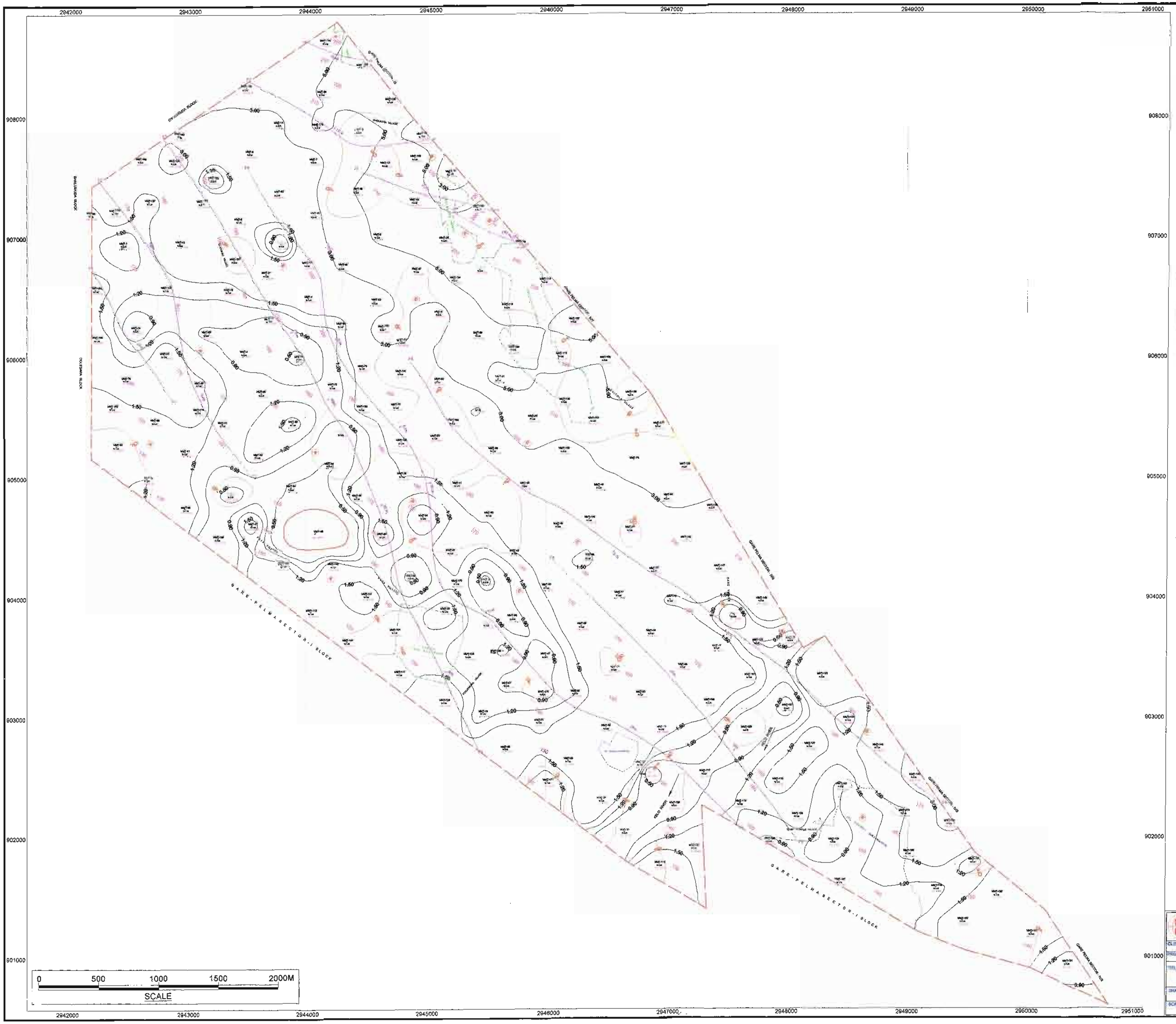
PROJECT:	GARE PALMA SECTOR-II COAL MINE
TITLE:	MINING PLAN & CLOSURE PLAN FLOOR & FOLIO PLAN OF SEAM-IX

DRAWN BY:	CHECKED BY:	FIG. NO.
B.R. MATLOTIA	B.D.SHARMA	4.2
SCALE : AS SHOWN	DATE : 30-06-2016	



LEGEND :-	
▬ ▬	BLOCK BOUNDARY
MGT-71	BOREHOLE DRILLED BY MECL
	BOREHOLE DRILLED BY G.S.I
	EFFECTIVE THICKNESS IN METRES
	FLOOR REDUCED LEVEL
	FAULT WITH THROW
1.50	THICKNESS CONTOUR
	GRADE LINE
KELO RIVER	RIVER / NALA
	VILLAGE
	FLOOR CONTOUR
	FOREST BOUNDARY

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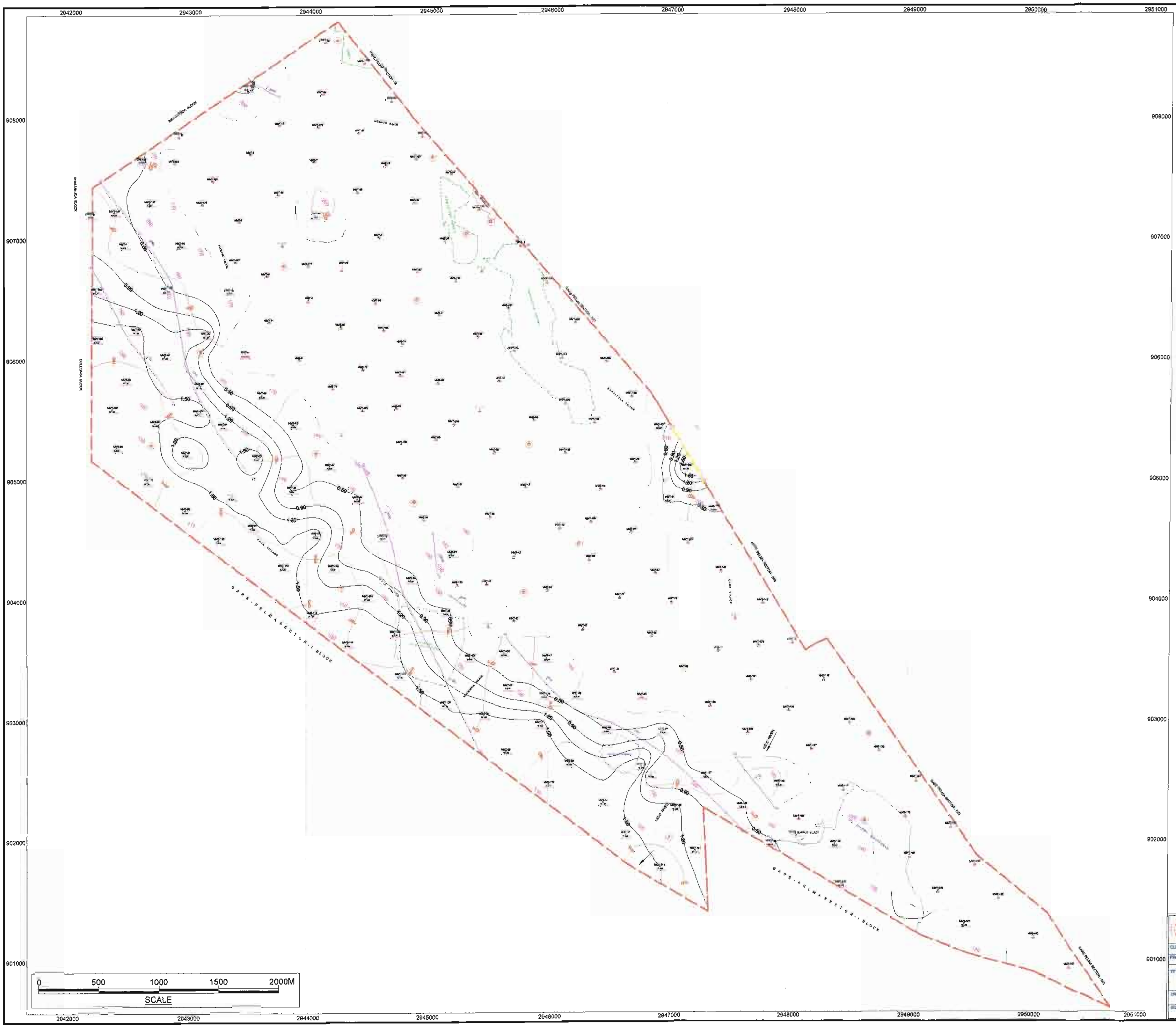
PROJECT:	GARE PALMA SECTOR-II COAL MINE
TITLE:	MINING PLAN & CLOSURE PLAN FLOOR & FOLIO PLAN OF SEAM-VIII

DRAWN BY:	CHECKED BY:	FIG. NO.
S.R. MATLOTIA	B.D.SHARMA	4.3
SCALE: AS SHOWN	DATE: 25-02-2016	



LEGEND :-

	BLOCK BOUNDARY
MVT-73	BOREHOLE DRILLED BY MECL
	BOREHOLE DRILLED BY G.S.I
	EFFECTIVE THICKNESS IN METRES
	NOT DEVELOPED
	FLOOR REDUCED LEVEL
	FAULT WITH THROW
1.50	THICKNESS CONTOUR
	GRADE LINE
KELO RIVER	RIVER / NALA
	VILLAGE
	FLOOR CONTOUR
	FOREST BOUNDARY

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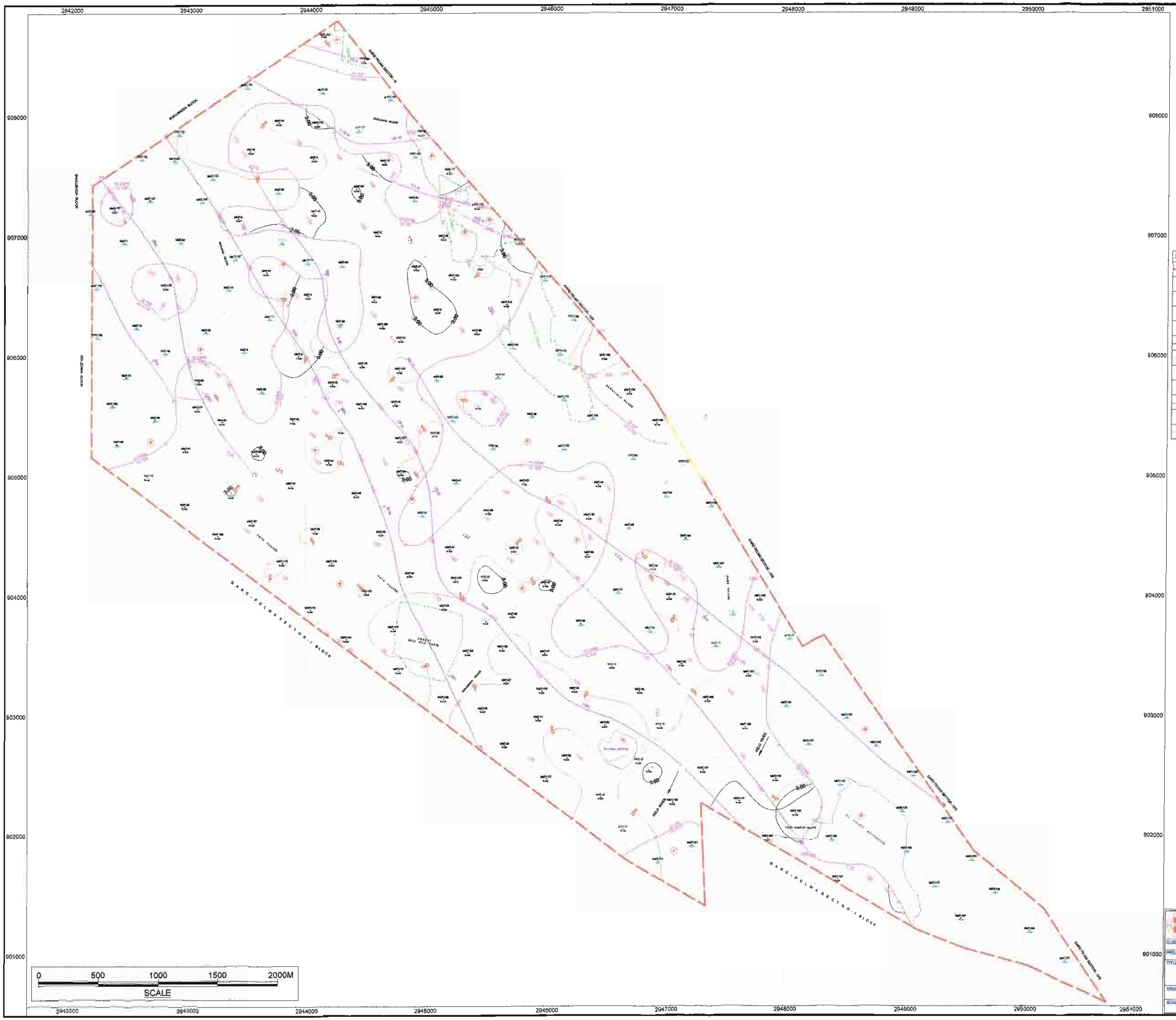
CLIENT:	MAHARASHTRA STATE POWER GENERATION COMPANY LTD. (MSPGCL)
PROJECT:	GARE PALMA SECTOR-II COAL MINE
TITLE:	MINING PLAN & CLOSURE PLAN FLOOR & FOLIO PLAN OF SEAM-VIII L

DRAWN BY:	CHECKED BY:	FIG. NO.
B.R. MATLOTIA	B.D.SHARMA	4.4
SCALE: AS SHOWN	DATE: 25-02-2016	



LEGEND :-

▬ ▬	BLOCK BOUNDARY
	BOREHOLE DRILLED BY MECL
	BOREHOLE DRILLED BY G.S.I
	EFFECTIVE THICKNESS IN METRES
	FAULT WITH THROW
3.00	THICKNESS CONTOUR
	GRADE LINE
KELO RIVER	RIVER / NALA
	VILLAGE
	SPLIT LINE
	FLOOR CONTOUR
	FOREST BOUNDARY

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भारत सरकार / [illegible] India
कोयला मंत्रालय / [illegible] Coal
[illegible]
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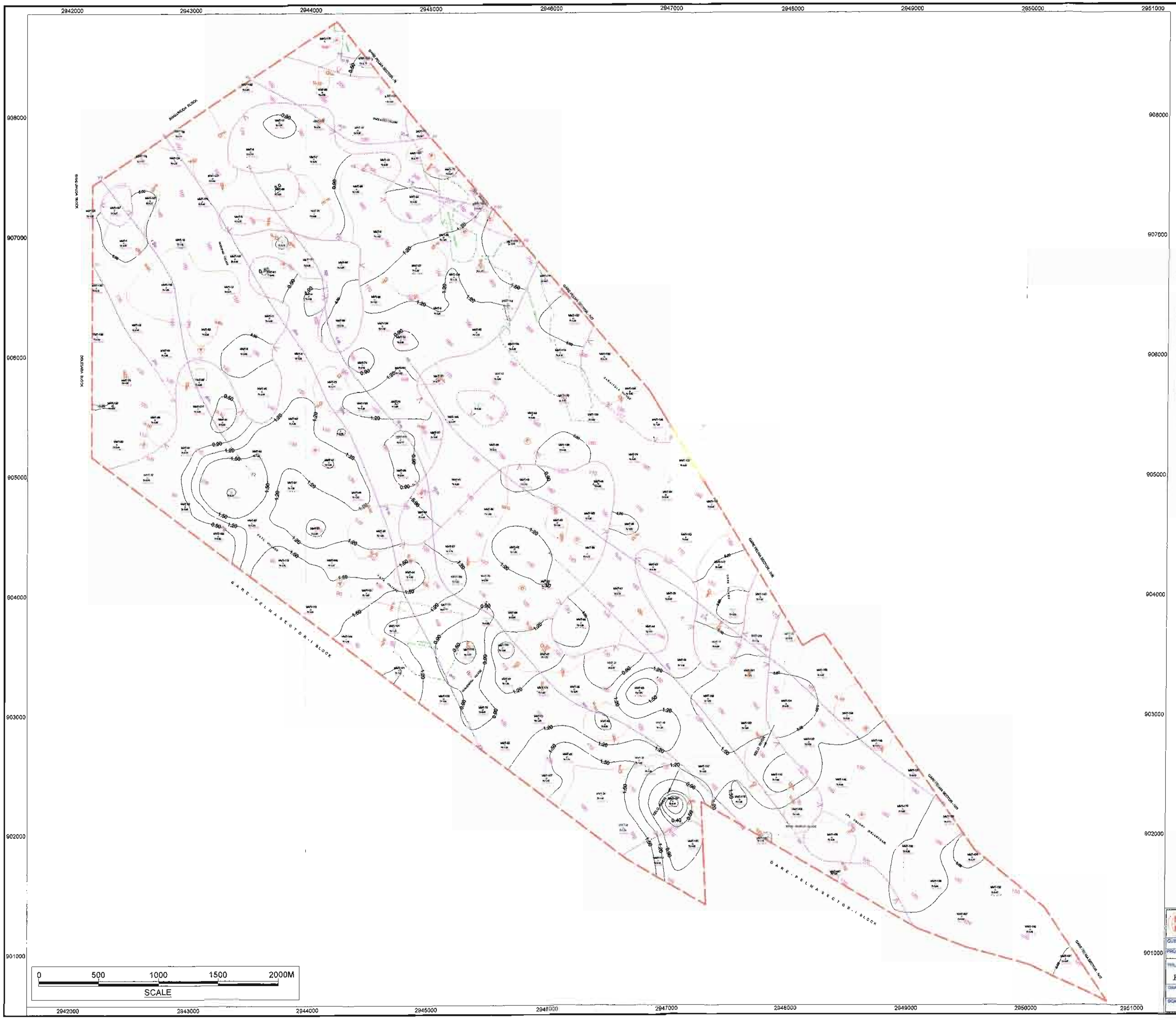
CLIENT	MAHARASHTRA STATE POWER GENERATION COMPANY LTD (MSPGCL)	
PROJECT	GARE PALMA SECTOR-II COAL MINE	
TITLE	MINING PLAN & CLOSURE PLAN FLOOR & FOLIO PLAN OF SEAM-VII TOP	
DRAWN BY: B.R. MATLOTIA	CHECKED BY: B.D.SHARMA	FIG. NO. 4.5
SCALE: AS SHOWN	DATE: 26-02-2018	



LEGEND :-	
▬ ▬	BLOCK BOUNDARY
MMT-73	BOREHOLE DRILLED BY MECL
	BOREHOLE DRILLED BY G.S.I
Th 1.56	EFFECTIVE THICKNESS IN METRES
	FAULT WITH THROW
1.50	THICKNESS CONTOUR
	GRADE LINE
KELO RIVER	RIVER / NALA
	VILLAGE
	SPLIT LINE
	FLOOR CONTOUR
- - - -	FOREST BOUNDARY

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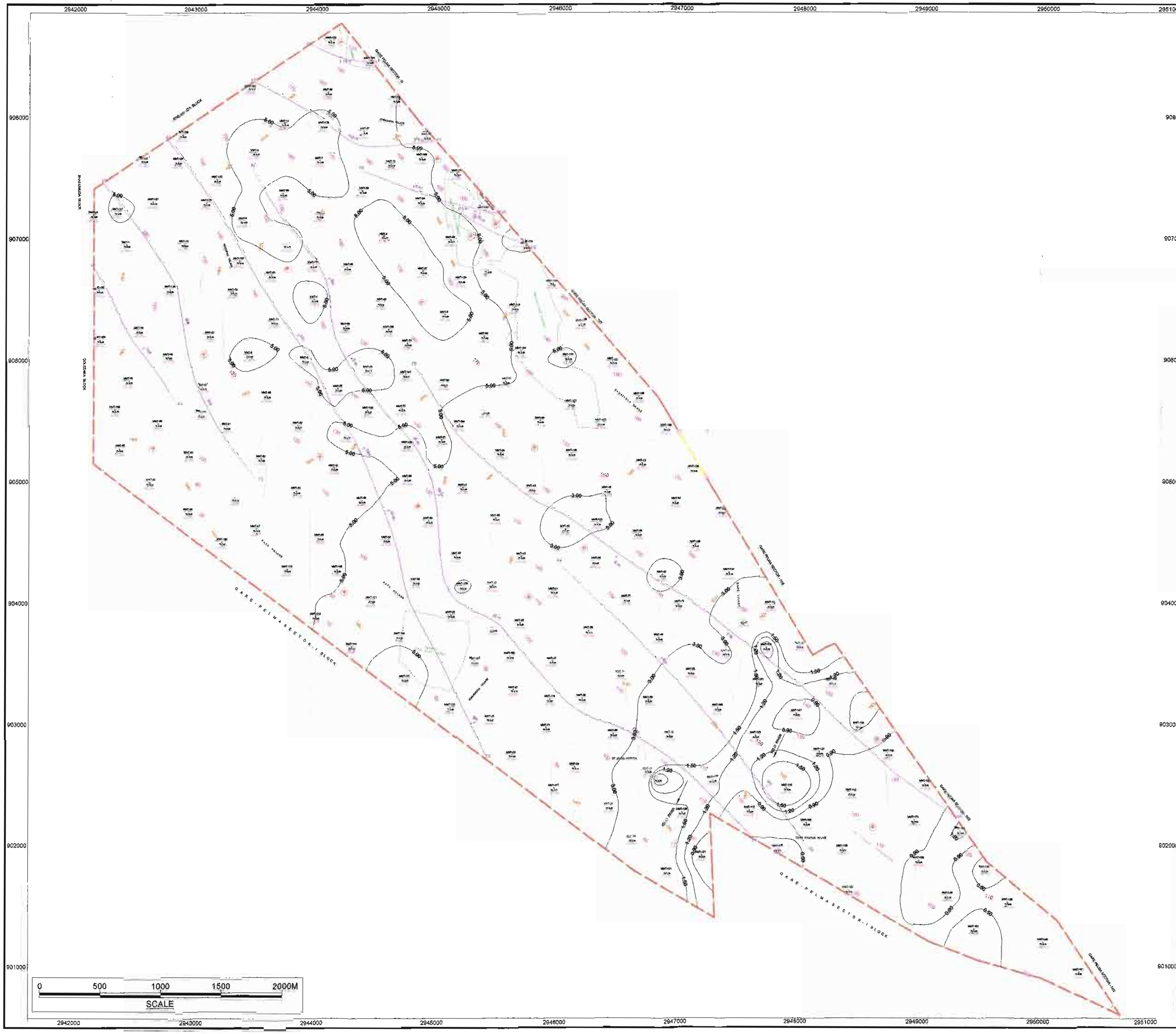
CLIENT:	MAHARASHTRA STATE POWER GENERATION COMPANY LTD. (MSPGCL)
PROJECT:	GARE PALMA SECTOR-II COAL MINE
TITLE:	MINING PLAN & CLOSURE PLAN FLOOR & FOLIO PLAN OF SEAM-VII (BOT.) & (COMB.)
DRAWN BY: B.R. MATLOTIA	CHECKED BY: B.D.SHARMA
SCALE: AS SHOWN	DATE: 25-02-2016
FIG. NO.	4.6



N

LEGEND :-	
▬ ▬ ▬	BLOCK BOUNDARY
	BOREHOLE DRILLED BY MECL
	BOREHOLE DRILLED BY G.S.I
	EFFECTIVE THICKNESS IN METRES
	FLOOR REDUCED LEVEL
	FAULT WITH THROW
1.50	THICKNESS CONTOUR
	GRADE LINE
ARLO RIVER	RIVER / NALA
	VILLAGE
	FLOOR CONTOUR
	FOREST BOUNDARY

I.P. NAGPAL
Under Secretary
Govt. of India
Ministry of Coal
New Delhi

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PROJECT:	GARE PALMA SECTOR-II COAL MINE
TITLE:	MINING PLAN & CLOSURE PLAN FLOOR & FOLIO PLAN OF SEAM-VI

DRAWN BY:	CHECKED BY:	FIG. NO.
B.R. MATLOTIA	B.D.SHARMA	4.7
SCALE: AS SHOWN	DATE: 25-02-2015	

LEGEND :-

▬ ▬	BLOCK BOUNDARY
	BOREHOLE DRILLED BY MECL
	BOREHOLE DRILLED BY G.S.I
	EFFECTIVE THICKNESS IN METRES
	FLOOR REDUCED LEVEL
	FAULT WITH THROW
1.50	THICKNESS CONTOUR
	GRADE LINE
KELO RIVER	RIVER / NALA
	VILLAGE
	FLOOR CONTOUR

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Under Secretary
Govt. of India
Ministry of Coal

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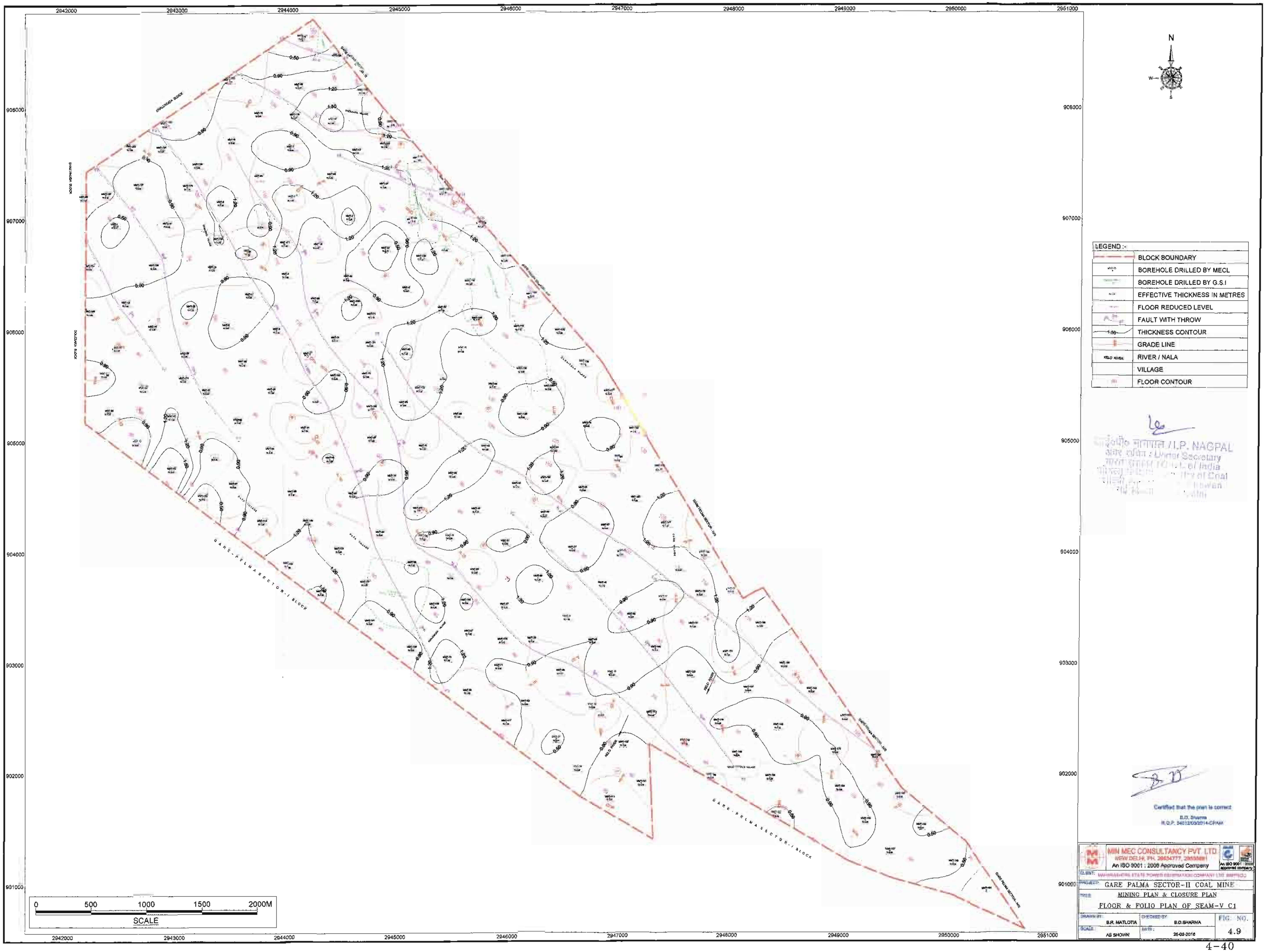
CLIENT:	MAHARASHTRA STATE POWER GENERATION COMPANY LTD. (MSPGCL)	
PROJECT:	GARE PALMA SECTOR-II COAL MINE	
TITLE:	MINING PLAN & CLOSURE PLAN FLOOR & FOLIO PLAN OF SEAM-V B1	
DRAWN BY: B.R. MATLOTIA	CHECKED BY: B.D.SHARMA	FIG. NO.
SCALE: AS SHOWN	DATE: 25-02-2016	4.8



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भारत सरकार / Govt. of India
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...Bhawan
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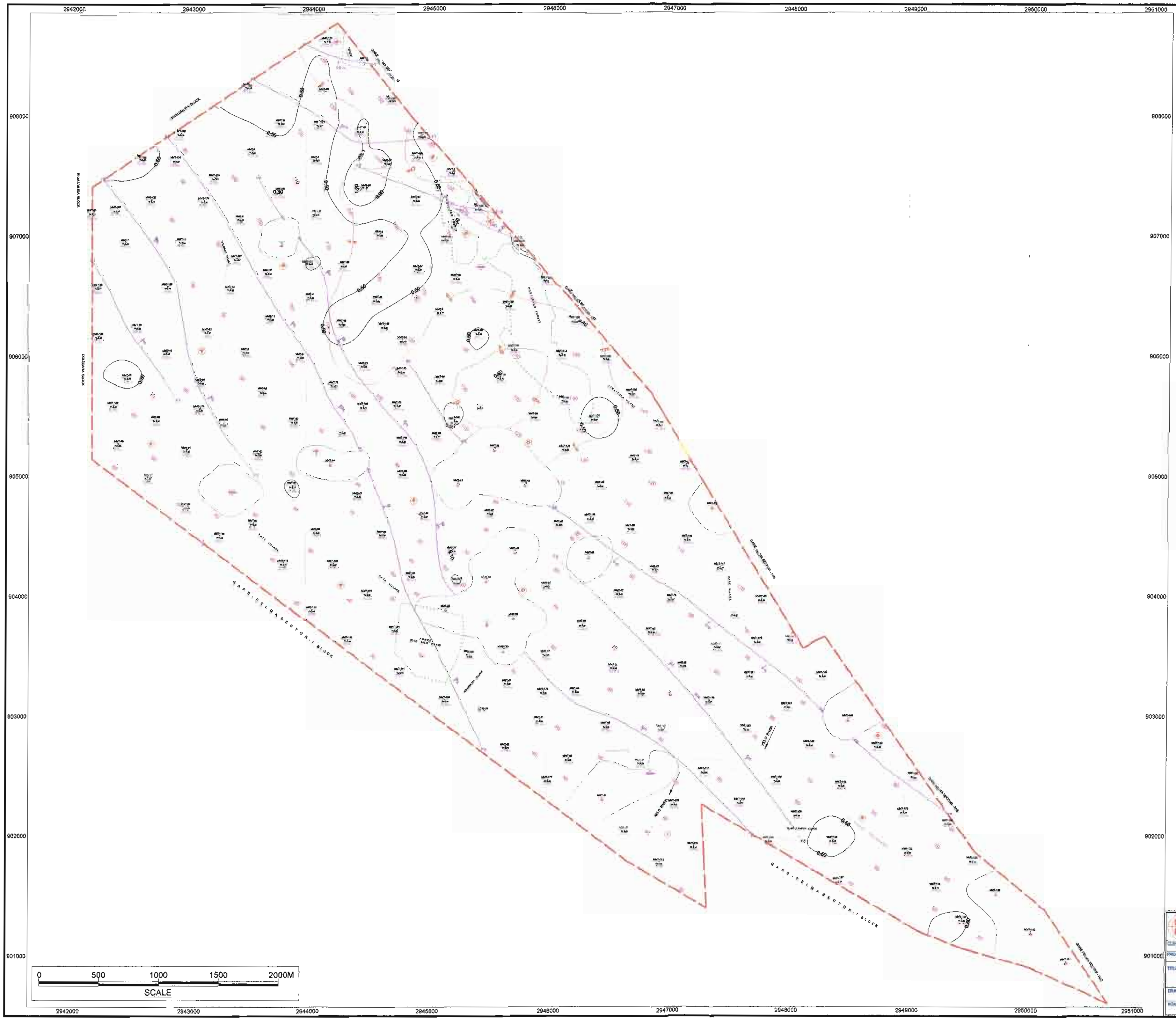
CLIENT: MAHARASHTRA STATE POWER GENERATION COMPANY LTD. (MSPGCL)

PROJECT: GARE PALMA SECTOR-II COAL MINE

TITLE: MINING PLAN & CLOSURE PLAN

FLOOR & FOLIO PLAN OF SEAM-V C1

DRAWN BY: B.R. MATLOTIA	CHECKED BY: B.D.SHARMA	FIG. NO.
SCALE: AS SHOWN	DATE: 26-02-2016	4.9



LEGEND :-

	BLOCK BOUNDARY
	BOREHOLE DRILLED BY MECL
	BOREHOLE DRILLED BY G.S.I
	EFFECTIVE THICKNESS IN METRES
	FLOOR REDUCED LEVEL
	NOT DEVELOPED
	FAULT WITH THROW
1.50	THICKNESS CONTOUR
	GRADE LINE
KELO RIVER	RIVER / NALA
	VILLAGE
	FLOOR CONTOUR

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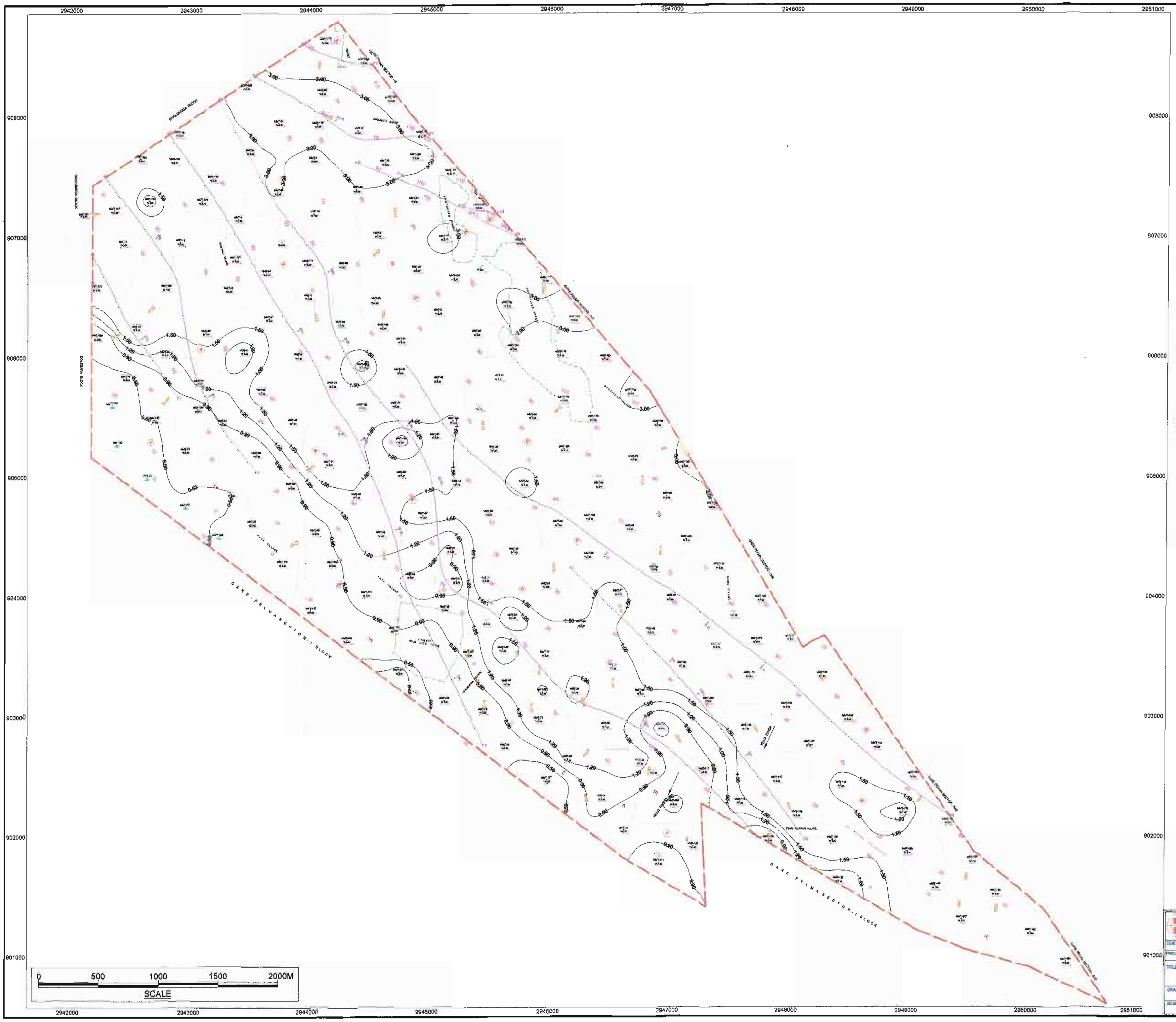
CLIENT:	MAHARASHTRA STATE POWER GENERATION COMPANY LTD. [illegible]
PROJECT:	GARE PALMA SECTOR-II COAL MINE
TITLE:	MINING PLAN & CLOSURE PLAN FLOOR & FOLIO PLAN OF SEAM-V D1

DRAWN BY:	CHECKED BY:	FIG. NO.
B.R. MATLOTIA	B.D.SHARMA	4.10
SCALE : AS SHOWN	DATE : 25-02-2016	



LEGEND :-	
▬ ▬	BLOCK BOUNDARY
	BOREHOLE DRILLED BY MECL
	BOREHOLE DRILLED BY G.S.I
	EFFECTIVE THICKNESS IN METRES
	FLOOR REDUCED LEVEL
	FLOOR CONTOUR
	FAULT WITH THROW
1.50	THICKNESS CONTOUR
	GRADE LINE
KELO RIVER	RIVER / NALA
	VILLAGE
------	FOREST BOUNDARY

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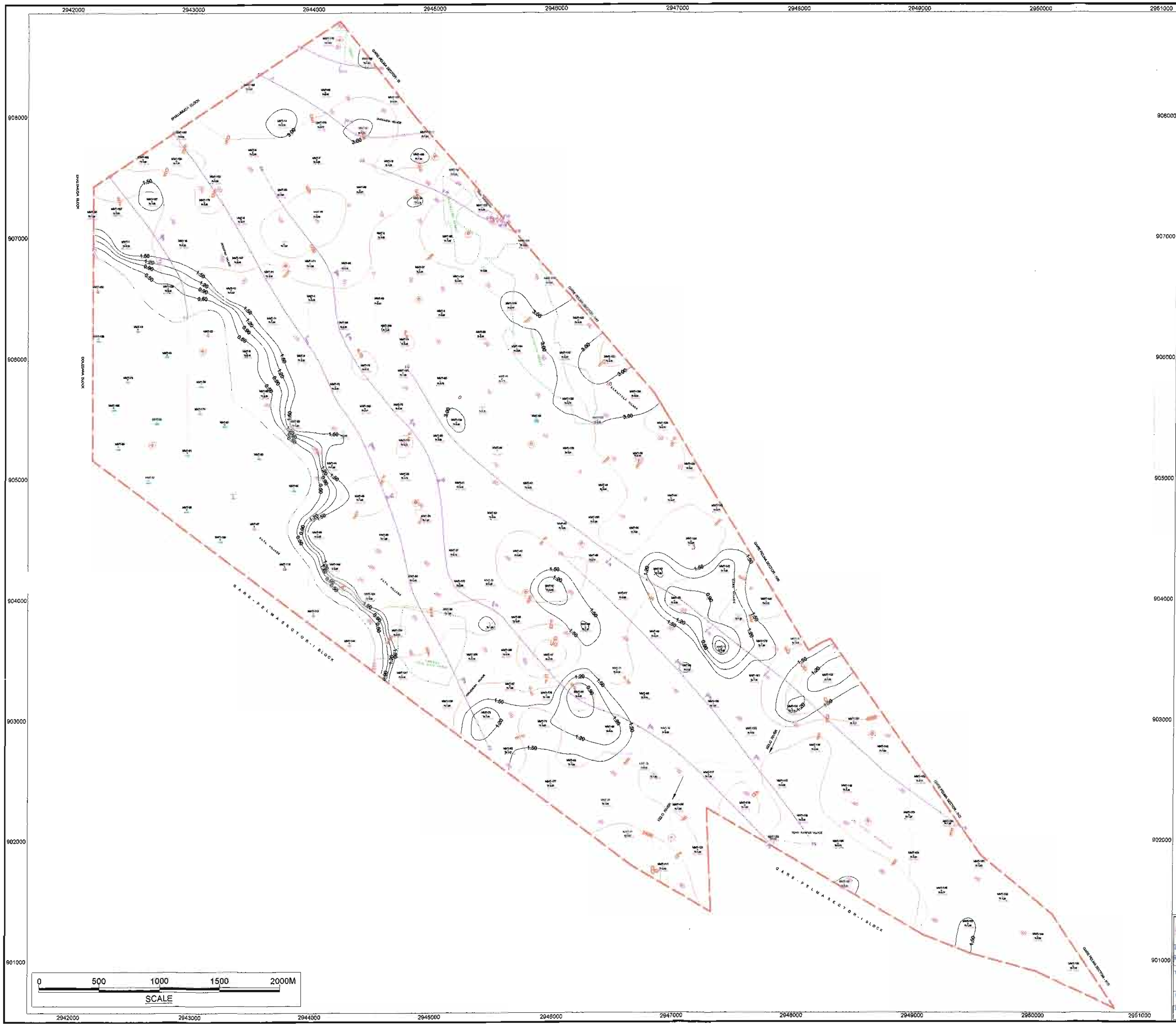
PROJECT:	GARE PALMA SECTOR-II COAL MINE
TITLE:	MINING PLAN & CLOSURE PLAN FLOOR & FOLIO PLAN OF SEAM-IV

DRAWN BY:	CHECKED BY:	FIG. NO.
B.R. MATLOTIA	B.D.SHARMA	4.11
SCALE: AS SHOWN	DATE: 25-02-2016	



LEGEND :-	
	BLOCK BOUNDARY
	BOREHOLE DRILLED BY MECL
	BOREHOLE DRILLED BY G.S.I
	EFFECTIVE THICKNESS IN METRES
	FLOOR REDUCED LEVEL
	FLOOR CONTOUR
	FAULT WITH THROW
1.50	THICKNESS CONTOUR
	GRADE LINE
KELO RIVER	RIVER / NALA
	VILLAGE
	FOREST BOUNDARY

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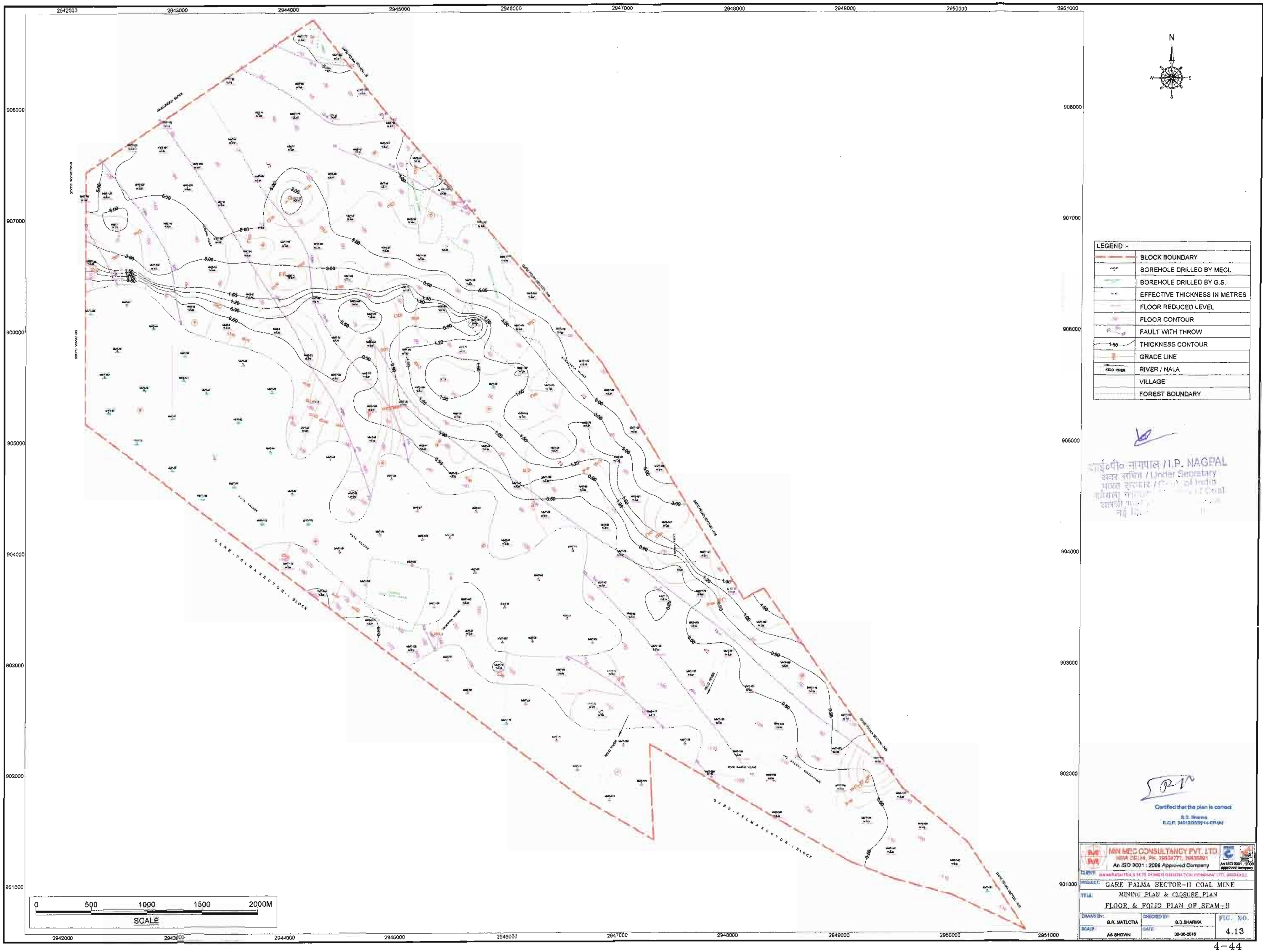
PROJECT:	GARE PALMA SECTOR-II COAL MINE
TITLE:	MINING PLAN & CLOSURE PLAN FLOOR & FOLIO PLAN OF SEAM-III

DRAWN BY:	CHECKED BY:	FIG. NO.
B.R. MATLOTIA	B.D.SHARMA	4.12
SCALE : AS SHOWN	DATE : 25-02-2016	



LEGEND :-

	BLOCK BOUNDARY
	BOREHOLE DRILLED BY MECL
	BOREHOLE DRILLED BY G.S.I
	EFFECTIVE THICKNESS IN METRES
	FLOOR REDUCED LEVEL
	FLOOR CONTOUR
	FAULT WITH THROW
1.50	THICKNESS CONTOUR
	GRADE LINE
KELO RIVER	RIVER / NALA
	VILLAGE
	FOREST BOUNDARY

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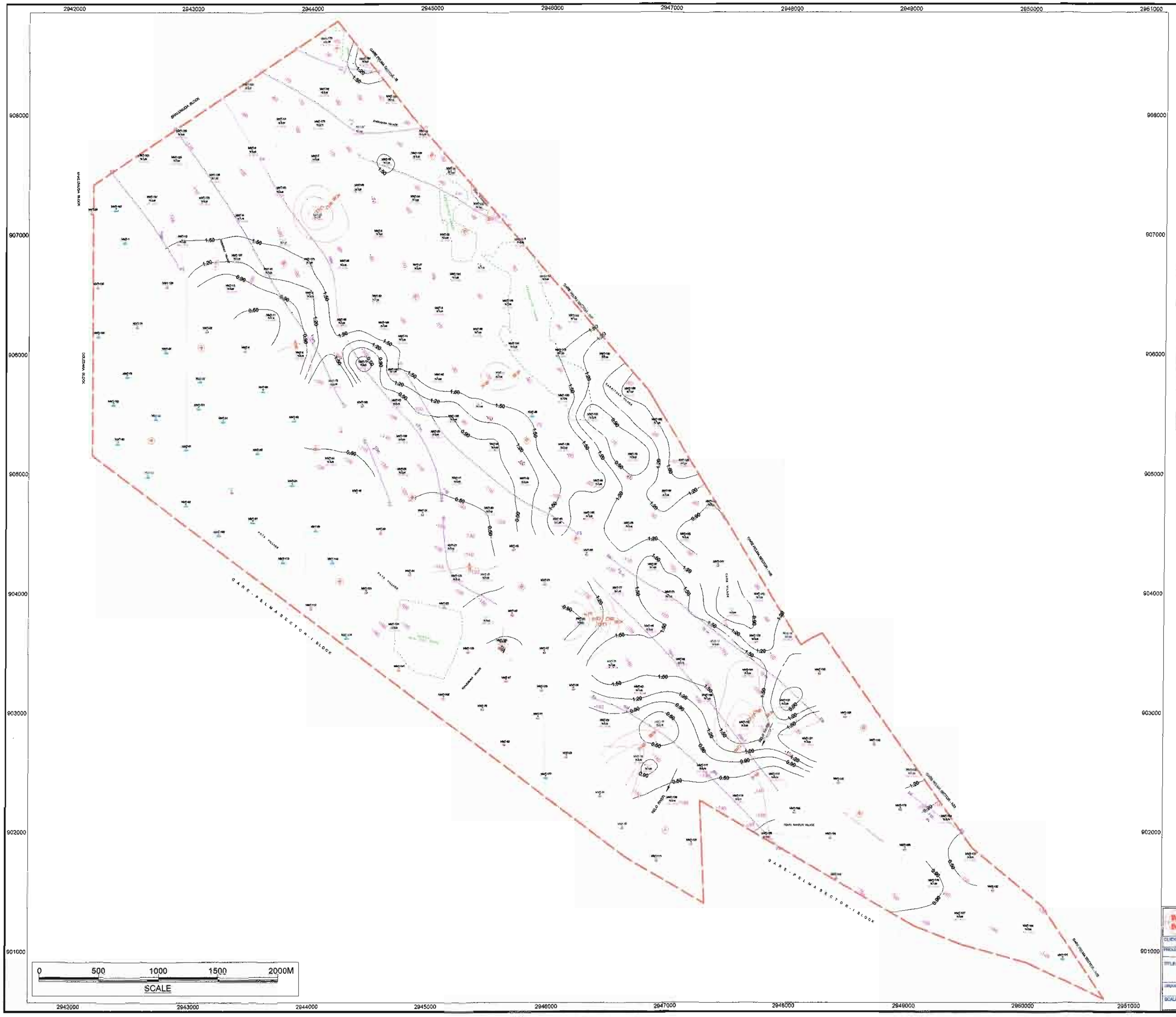
CLIENT:	MAHARASHTRA STATE POWER GENERATION COMPANY LTD. (MSPGCL)
PROJECT:	GARE PALMA SECTOR-II COAL MINE
TITLE:	MINING PLAN & CLOSURE PLAN FLOOR & FOLIO PLAN OF SEAM-II

DRAWN BY: B.R. MATLOTIA	CHECKED BY: B.D.SHARMA	FIG. NO.
SCALE: AS SHOWN	DATE: 30-06-2016	4.13



LEGEND :-	
▬ ▬	BLOCK BOUNDARY
	BOREHOLE DRILLED BY MECL
	BOREHOLE DRILLED BY G.S.I
	EFFECTIVE THICKNESS IN METRES
	FLOOR REDUCED LEVEL
	FAULT WITH THROW
1.50	THICKNESS CONTOUR
	GRADE LINE
KELO RIVER	RIVER / NALA
	VILLAGE
	FLOOR CONTOUR
⋯⋯	FOREST BOUNDARY

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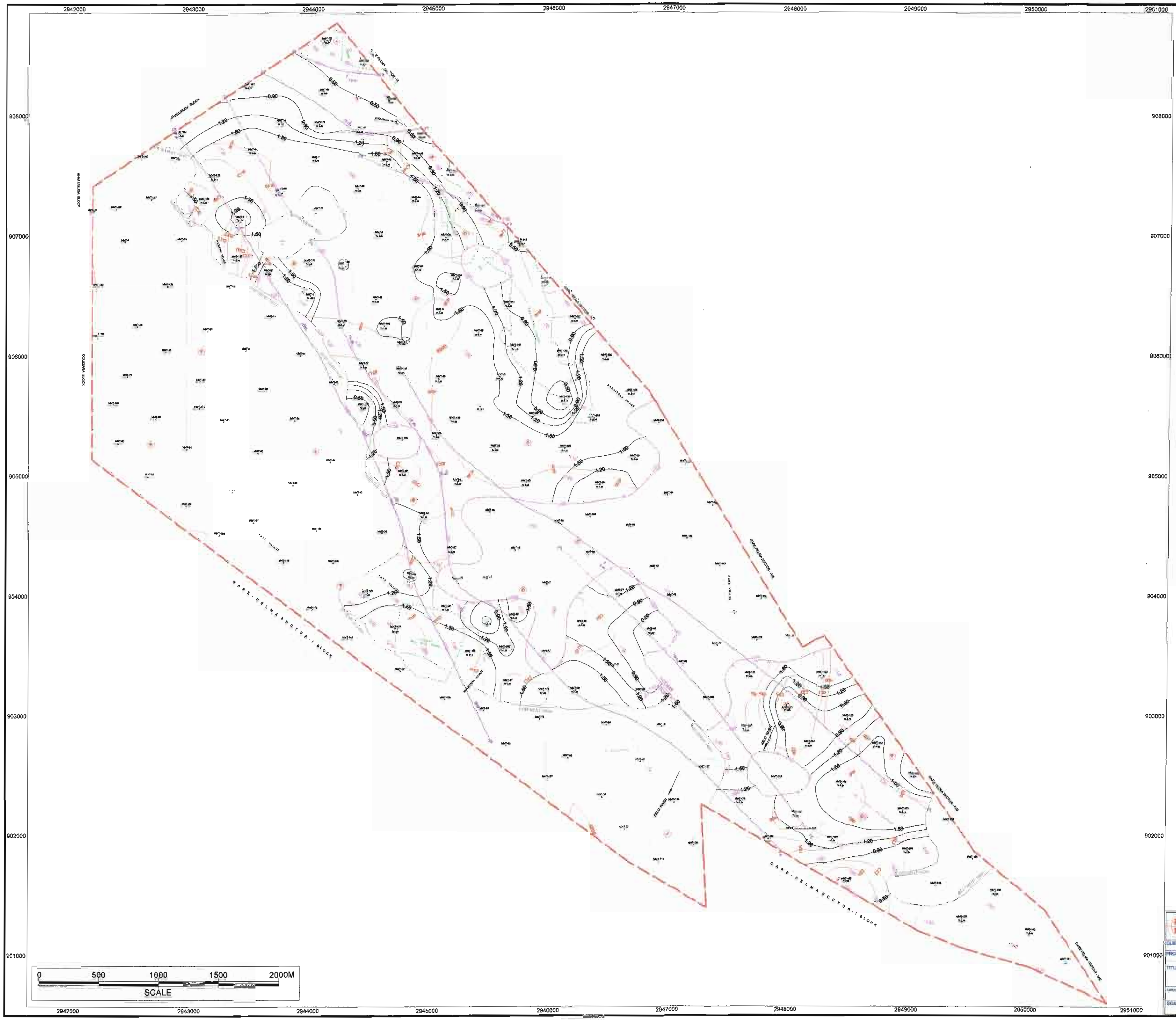
CLIENT:	MAHARASHTRA STATE POWER GENERATION COMPANY LTD (MAHAGENCO)
PROJECT:	GARE PALMA SECTOR–II COAL MINE
TITLE:	MINING PLAN & CLOSURE PLAN FLOOR & FOLIO PLAN OF SEAM–IL1

DRAWN BY:	CHECKED BY:	FIG. NO.
B.R. MATLOTIA	B.D.SHARMA	4.14
SCALE: AS SHOWN	DATE: 30-06-2016	



N

LEGEND :-	
	BLOCK BOUNDARY
	BOREHOLE DRILLED BY MECL
	BOREHOLE DRILLED BY G.S.I
	EFFECTIVE THICKNESS IN METRES
	FLOOR REDUCED LEVEL
	FAULT WITH THROW
1.50	THICKNESS CONTOUR
	GRADE LINE
KELO RIVER	RIVER / NALA
	VILLAGE
	SPLIT LINE
	FLOOR CONTOUR

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B.D. Sharma
R.Q.P. 34012/03/2014-CPAM

MIN MEC CONSULTANCY PVT. LTD.
NEW DELHI, PH. 29534777, 29535681
An ISO 9001 : 2008 Approved Company
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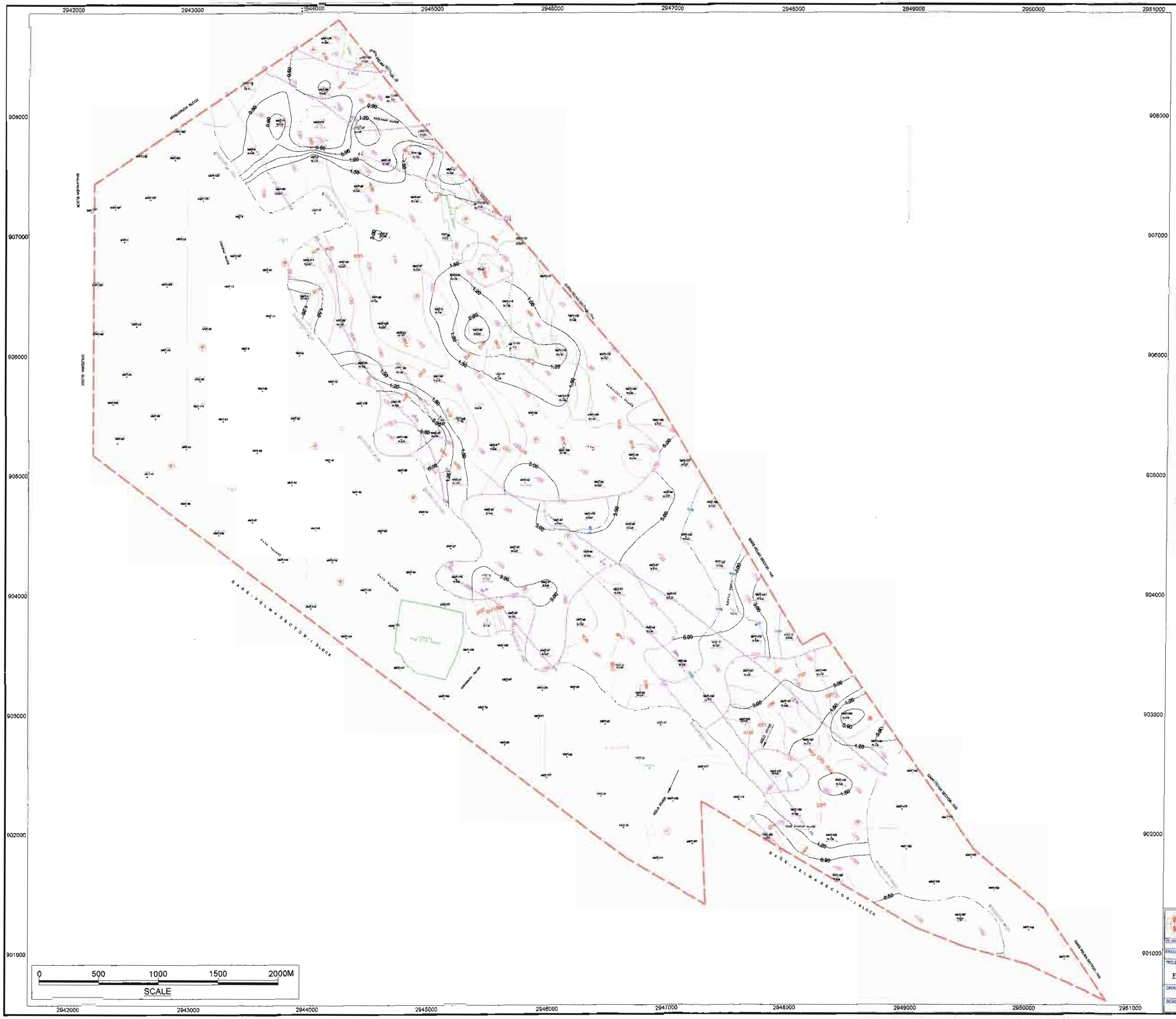
CLIENT:	MAHARASHTRA STATE POWER GENERATION COMPANY LTD. (MSPGCL)
PROJECT:	GARE PALMA SECTOR-II COAL MINE
TITLE:	MINING PLAN & CLOSURE PLAN FLOOR & FOLIO PLAN OF SEAM-I TOP

DRAWN BY:	CHECKED BY:	FIG. NO.
B.R. MATLOTIA	B.D.SHARMA	4.15
SCALE: AS SHOWN	DATE: 30-06-2018	



LEGEND :-
- BLOCK BOUNDARY
- BOREHOLE DRILLED BY MECL
- BOREHOLE DRILLED BY G.S.I
- EFFECTIVE THICKNESS IN METRES
- FLOOR REDUCED LEVEL
- FLOOR CONTOUR
- FAULT WITH THROW
- THICKNESS CONTOUR
- GRADE LINE (I BOT.)
- GRADE LINE (SEAM-I COMB.)
- RIVER / NALA
- VILLAGE
- SPLIT LINE
- FOREST BOUNDARY

आई०पी० नागपाल / I.P. NAGPAL
अवर सचिव / Under Secretary
भारत सरकार / Govt. of India
कोयला मंत्रालय / Ministry of Coal
शास्त्री भवन / Shastri Bhawan
नई दिल्ली / New Delhi

Certified that the plan is correct
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MIN MEC CONSULTANCY PVT. LTD.
NEW DELHI, PH. 29534777, 29538891
An ISO 9001 : 2008 Approved Company
An ISO 9001 : 2008 approved company

CLIENT: MAHARASHTRA STATE POWER GENERATION COMPANY LTD. (MSPGCL)
PROJECT: GARE PALMA SECTOR-II COAL MINE
TITLE: MINING PLAN & CLOSURE PLAN
FLOOR & FOLIO PLAN OF SEAM-I (BOT.) & (COMB.)

DRAWN BY:	CHECKED BY:	FIG. NO.
B.R. MATLOTIA	B.D.SHARMA	4.16
SCALE: AS SHOWN	DATE : 30-06-2016	

CHAPTER 5

MINING

5.1 OPTIMISATION OF TARGETED CAPACITY

Considering, the available reserves, seam disposition, depth, available strike length for opencast mining and feasibility to deploy large size equipment in opencast operation, feasibility of simultaneous underground operation, the optimum capacity of the mine has been estimated at 23.6 MTPA.

The mine has been planned for maximum sustainable production, i.e. 22 Mtpa from opencast and 1.6 Mtpa from UG. Thus the total targeted capacity becomes 23.6 Mtpa. Though both OC and UG would be in production simultaneously from 12th year onwards, for safety reason, the sequence of development in UG would have a lag wrt OC operations. As the gestation period in UG is long and UG operation will reach its peak production level only in 15th year, it has been proposed to reach the total targeted production level of the mine earlier by OC only, i.e. from 7th year, which is feasible due to lower depth and stripping ratio in early years of OC operation.

Thus only from 7th year to 14th year, OC operation would make up for UG production for achieving the overall mine target of 23.6 Mtpa. As UG operation builds up to the targeted level of 1.6 Mtpa, the OC production is brought down to its sustainable level, i.e. 22 Mtpa.

The OC mine can technically produce at a rated capacity of 20 to 25 MTPA but considering that the opencastable reserves are only 553.177 MT, the OC mine has been planned at 22 MTPA (as explained above) to give the project a nominal life of about 28 years including built up period.

There are 18 nos. of coal seams (including splits) occurring below seam VI (proposed quarry floor). Excepting seam-I Combined, all other seams have more than 1 m thickness in localized area only. Even Seam-I Combined has split in major part. The total depth of quarry upto seam-I floor, if considered by opencast, will be more than 450m against the presently proposed depth of upto 190m (Seam VI floor).

The incremental stripping ratio for the lower seams considering the batters will be around 20 -25 cum per tonne of coal.

Further, in case of Gare Sector-II, additional space is not available for OB disposal as the OB generated upto Seam VI has been adjusted within the ML area with great difficulty and meticulous planning of rehandling schedule. Considering the available area with constraints of dumping space, opencatability is ruled out for lower seams.

Target of 1.6 Mtpa for UG operation has been decided considering that a lag is to be maintained taking into account the advancement of operation in overlying seams through opencast. The 1.6 Mtpa target for an UG mine is considered fairly high under Indian conditions.

It may be worthwhile to mention here that the earlier allotee of the coal block had also submitted a mining plan to MOC in which the RQP had assessed the capacity as 23.6 Mtpa as above.

5.1.1 Derivation of extractable reserves from geological reserves

As per the practice in vogue for OC mine planning, the minimum coal seam thickness for mining is adopted as 1m. However, in this specific case a huge quantity of reserve (53.536 Mt) falls in a thickness range between 0.5m-0.9m. Giving due consideration to conservation of resource,

The RQP has calculated the Opencastable reserves by assuming minimum mining seam thickness of upto 0.5m irrespective of the fact that mining of such thickness will require extra efforts as well as lower efficiency of equipment. However the reserves mineable by underground method have been assumed as upto a minimum thickness of 1.5m, though the reserves of lower thicknesses have been mentioned alongside.

The overall reconciliation of reserves in the block is as given in following tables

Table 5.1A: Derivation of extractable reserves by OC from net geological reserves.

Table 5.1B: Derivation of extractable reserves by UG from net geological reserves.

Table 5.1C: Summary of derivation of total extractable reserves (OC+UG) from net geological reserves.

TABLE 5.1A

DERIVATION OF EXTRACTABLE RESERVES BY OC FROM NET GEOLOGICAL RESERVES (MT)

Seam	Vertical Seamwise Geological Reserves (>0.5m Thickness) upto Seam-VI for OC within ml/block	West: blocked under facilities including inclines at north corner, shaft near Kelo river and 75m (30m road & 45m safety) barrier along Kelo river	West: blocked in 7.5m barrier along SW boundary	West: blocked in Bajarmura-Ghargoda road diversion along Northern boundary and Milupara-Tamnar road Diversion along north-east boundary	East: blocked under 15m barrier along Kelo river and 7.5m barrier along quarry boundary	Blocked under Kelo river	Total coal blocked in Barriers & Facilities	Coal blocked in Batter	Total coal blocked in Barriers, Facilities and batter	Mineable reserves	Mining Losses 5%	Extractable reserves
	Reserve	Reserve	Reserve	Reserve	Reserve	Reserve	Reserve	Reserve	Reserve	Reserve	Reserve	Reserve
X-LA	10.900	0.136	0.016	0.055	0.061	0.346	0.614	0.232	0.846	10.054	0.503	9.551
X-TOP	9.772	0.151	0.017	0.131	0.172	0.169	0.640	0.698	1.338	8.434	0.422	8.012
X-BOT	85.775	0.852	0.131	0.631	0.220	1.323	3.157	15.112	18.269	67.506	3.375	64.131
IX-L2	12.242	0.105	0.016	0.115	0.068	0.211	0.515	0.509	1.024	11.218	0.561	10.657
IX-L1	13.961	0.441	0.042	0.257	0.063	0.080	0.883	0.513	1.396	12.565	0.628	11.937
IX	156.184	4.559	0.202	1.954	0.889	2.686	10.290	28.206	38.496	117.688	5.884	111.804
VIII	83.631	2.903	0.076	1.595	0.292	0.709	5.575	13.506	19.081	64.550	3.228	61.323
VIII-L	13.803	0.098	0.116	0.207	0.035	0.329	0.785	0.457	1.242	12.561	0.628	11.933
VII-TOP	88.944	1.857	0.241	0.546	0.186	2.094	4.924	13.222	18.146	70.798	3.540	67.258
VII-BOT	25.457	0.279	0.073	0.168	0.075	0.645	1.240	5.215	6.455	19.002	0.950	18.052
VII-COMB	82.305	3.145	0.003	1.389	0.657	1.035	6.229	14.248	20.477	61.828	3.091	58.737
VI	153.131	5.375	0.238	1.437	0.174	1.039	8.263	18.780	27.043	126.088	6.304	119.783
Total	**736.105**	**19.901**	**1.171**	**8.485**	**2.892**	**10.666**	**43.115**	**110.698**	**153.813**	**582.292**	**29.115**	**553.178**

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TABLE 5.1B
DERIVATION OF EXTRACTABLE RESERVES BY UG FROM NET GEOLOGICAL RESERVES (MT)

Seam	Vertical Total UG Geological Reserve Within ML/Block	UG Reserve >0.50M to <0.90M	Total UG Reserve >0.9M Thickness	>0.9M TO <1.5M Thickness Reserve	Net Geo Reserve >1.5M Thickness	Blocked Under Facilities and Incline & Shaft Area	Blocked Under Along 75m (30m Road+45m Safety Barrier) in Kelo River	Blocked In Safety Barriers 25m on Either Side Of Fault	Blocked Under Half Pillar Along ML Boundary	Blocked Under Kelo River	Reserve Not Economically Viable Reserve	Total Blocked Coal	Net Reserve Ex. Blocked	Ex. Panel pillars 80%	In Panel Extraction, mt	Workability of seam
VI-L	7.547	7.050	0.497	0.492	0.005	0.000	0.000	0.000	0.000	0.000	0.005	0.005	0.000	0.000	0.000	Not Workable
VA-1	22.231	19.112	3.119	3.119	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Not Workable
VA-2	3.990	3.736	0.254	0.254	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Not Workable
VB-1	15.750	6.774	8.976	8.976	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Not Workable
VB-2	10.819	10.550	0.269	0.269	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Not Workable
VC-1	37.313	7.476	29.837	29.454	0.383	0.000	0.000	0.068	0.000	0.000	0.315	0.383	0.000	0.000	0.000	Workable
VC-2	55.383	47.027	8.356	8.356	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Not Workable
VD-1	2.093	1.857	0.236	0.236	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Not Workable
VD-2	6.046	5.479	0.567	0.567	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Not Workable
IV	65.585	3.225	62.360	9.161	53.199	1.475	0.323	5.073	1.167	0.638	0.000	8.677	44.522	35.618	23.625	Workable
III-L2	5.511	4.284	1.227	1.227	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	Not Workable
III	69.767	0.475	69.292	3.942	65.350	1.419	0.555	6.378	1.556	1.152	0.000	11.060	54.290	43.432	27.797	Workable
II	54.400	2.650	51.750	3.202	48.548	1.884	0.000	4.091	0.952	0.002	0.023	6.952	41.596	33.277	21.297	Workable
I-L1	27.307	2.684	24.623	6.620	18.003	1.010	0.058	1.047	0.421	0.097	0.157	2.790	15.213	12.170	7.546	Workable
I-TOP	25.014	1.864	23.150	6.924	16.226	0.038	0.128	1.297	0.073	0.193	0.904	2.634	13.593	10.874	6.742	Workable
I-BOT	20.868	1.008	19.860	4.440	15.420	0.067	0.372	0.974	0.206	0.647	0.670	2.936	12.485	9.988	6.192	Workable
I-COMB	19.283	0.000	19.283	0.000	19.283	0.270	0.037	0.884	0.310	0.043	0.046	1.590	17.694	14.155	8.776	Workable
Total	448.907	125.251	323.656	87.239	236.417	6.163	1.473	19.812	4.685	2.771	2.120	37.025	199.392	159.514	101.975	

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TABLE 5.1C

SUMMARY OF DERIVATION OF TOTAL EXTRACTABLE RESERVES (OC+UG) FROM NET GEOLOGICAL RESERVES FIGURES IN MILLION TONNES

Seam	Vertical Total UG Geological Reserve within ML/Block	UG Reserve >0.50M to <0.90M	Total UG Reserve >0.9M Thickness	>0.9M to <1.5M Thickness Reserve	Net Geo. Reserve >1.5M Thickness	Total Blocked Uneconomical and Low Thickness Blocked and Uneconomical Reserves	Net Reserves Excluding Blocked, Un Economical, Low Thickness etc.	Mining Losses including Panel Barriers	Extractable Reserves
OPENCAST:									
X-LA	10.900					0.846	10.054	0.503	9.551
X-TOP	9.772					1.338	8.434	0.422	8.012
X-BOT	85.775					18.269	67.506	3.375	64.131
IX-L2	12.242					1.024	11.218	0.561	10.657
IX-L1	13.961					1.396	12.565	0.628	11.937
IX	156.184					38.496	117.688	5.884	111.804
VIII	83.631					19.081	64.550	3.228	61.323
VIII-L	13.803					1.242	12.561	0.628	11.933
VII-TOP	88.944					18.146	70.798	3.540	67.258
VII-BOT	25.457					6.455	19.002	0.950	18.052
VII-COMB	82.305					20.477	61.828	3.091	58.737
VI	153.131					27.043	126.088	6.304	119.783
Sub Total OC	736.105					153.813	582.292	29.115	553.178
UNDERGROUND:									
VI-L	7.547	7.050	0.497	0.492	0.005	7.547	0.000	0.000	0.000
VA-1	22.231	19.112	3.119	3.119	0.000	22.231	0.000	0.000	0.000
VA-2	3.990	3.736	0.254	0.254	0.000	3.990	0.000	0.000	0.000
VB-1	15.750	6.774	8.976	8.976	0.000	15.750	0.000	0.000	0.000

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Seam	Vertical Total UG Geological Reserve within ML/Block	UG Reserve >0.50M to <0.90M	Total UG Reserve >0.9M Thickness	>0.9M to <1.5M Thickness Reserve	Net Geo. Reserve >1.5M Thickness	Total Blocked Uneconomical and Low Thickness Blocked and Uneconomical Reserves	Net Reserves Excluding Blocked, Un Economical, Low Thickness etc.	Mining Losses including Panel Barriers	Extractable Reserves
VB-2	10.819	10.550	0.269	0.269	0.000	10.819	0.000	0.000	0.000
VC-1	37.313	7.476	29.837	29.454	0.383	37.313	0.000	0.000	0.000
VC-2	55.383	47.027	8.356	8.356	0.000	55.383	0.000	0.000	0.000
VD-1	2.093	1.857	0.236	0.236	0.000	2.093	0.000	0.000	0.000
VD-2	6.046	5.479	0.567	0.567	0.000	6.046	0.000	0.000	0.000
IV	65.585	3.225	62.360	9.161	53.199	21.063	44.522	20.897	23.625
III-L2	5.511	4.284	1.227	1.227	0.000	5.511	0.000	0.000	0.000
III	69.767	0.475	69.292	3.942	65.350	15.477	54.290	26.494	27.797
II	54.400	2.650	51.750	3.202	48.548	12.804	41.596	20.299	21.297
I-L1	27.307	2.684	24.623	6.620	18.003	12.094	15.213	7.667	7.546
I-TOP	25.014	1.864	23.150	6.924	16.226	11.422	13.593	6.851	6.742
I-BOT	20.868	1.008	19.860	4.440	15.420	8.384	12.485	6.292	6.192
I-COMB	19.283	0.000	19.283	0.000	19.283	1.590	17.694	8.918	8.776
Sub Total UG	**448.907**	**125.251**	**323.656**	**87.239**	**236.417**	**249.515**	**199.392**	**97.417**	**101.975**
Grand Total	**1185.012**	**125.251**	**323.656**	**87.239**	**236.417**	**403.328**	**781.684**	**126.532**	**655.153**

The derivation of the extractable reserves by OC as well as UG has been explained in the following paragraphs.

5.1.2 Reserves extractable by OC method

The total reserves of the block have been divided into two parts (east of Kelo river and west of Kelo river) due to the reason that Kelo river passes through the coal block. Due to the prevailing topography, shape of the block and presence of other coal blocks all around, Kelo river cannot be diverted. In future if the possibility of diversion of the river is worked out, a revised mining plan will be submitted to MOC.

Therefore, the reserves will be mined by two pits, one pit on either side of Kelo river - East pit and West Pit. The reserves extractable by OC method from both the Pits are given in Table 5.2.

TABLE 5.2
DERIVATION OF EXTRACTABLE OPENCAST RESERVES (PIT WISE) FROM NET GEOLOGICAL RESERVES (MT)
UP TO SEAM VI AS QUARRY BOTTOM OF COAL THICKNESS > 0.5M

Sl. No.	Particulars	East Pit (Mt)	West Pit (Mt)	Total Coal (Mt)
1	Net Geological reserves within vertical block boundaries	82.911	653.194	736.105
2	OB/IB within vertical block boundaries (Mcum)	415.526	2706.348	3121.874
3	OB:Coal ratio (vertical) for above (cum:t)	5.012	4.143	4.241
4	Blocked under incline, CHP, facility, etc. in north corner of west part of block		12.605	12.605
5	Blocked in shaft pillar area near Kelo river		2.533	2.533
6	(i) **West of Kelo river**: Blocked in 75m barrier along Kelo river (30m road and 45m statutory barrier from quarry edge)		4.763	5.695
	(ii) **East of Kelo river**: 15m barrier along eastern bank of Kelo river and quarry boundary	0.932		
7	**West of Kelo river**: Blocked under Bajarmura- Ghargoda road diversion along northern boundary and Milupara- Tamnar road diversion along north east boundary	0.000	8.485	8.485
8	**West of Kelo river**: Blocked in 7.5m barrier along SW boundary.		1.171	3.131
	East of Kelo river: Blocked in 7.5m barrier along south boundary of quarry	1.960		

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Sl. No.	Particulars	East Pit (Mt)	West Pit (Mt)	Total Coal (Mt)
9	Blocked under kelo river (9.465MT >0.9m + 1.201 MT < 0.90m to >0.5m)	5.333	5.333	10.666
10	Total blocked Reserves in barriers (sl no 4 to 9)	8.225	34.890	43.115
11	Reserves blocked in batters	25.011	85.687	110.698
12	Mineable reserves (sl no 1- sl no 10-sl no 11)	49.675	532.617	582.292
13	Mining losses (5%)	2.484	26.631	29.115
14	Extractable reserves (sl no. 12 - sl no 13)	47.191	505.986	553.177
15	OB/IB for by Carlson s/w	375.270	2385.850	2761.120
16	OB:Coal ratio for above (cum:t)	7.952	4.715	4.991

Extraction of coal blocked in barriers with adjacent coal blocks and dip side batters will be examined in consultation with the allottees of adjoining blocks for its possible extraction.

5.1.3 Reserves extractable by UG method

The reserves extractable by UG method for both the parts (one on either side of Kelo river) are given below in Table 5.3.

TABLE 5.3
DERIVATION OF EXTRACTABLE UNDERGROUND RESERVES (MT) (ON EITHER SIDE OF KELO RIVER) FROM NET GEOLOGICAL RESERVES BELOW SEAM VI OF COAL THICKNESS > 0.9M

Sl. No.	Particular	West	East	Total Coal Mt
1	Total Net UG reserves >0.9m thick	295.053	28.603	323.656
2	Reserves of thickness from 0.9m to 1.5m	76.807	10.432	87.239
3	Balance Net geological reserves of >1.5m thickness	218.246	18.171	236.417
4	**West of Kelo river**: Blocked under half pillar along ML boundary		1.214	4.685
	East of Kelo river: Blocked in half pillar in UG mineable area below pit	3.471		
5	Blocked in 25m barrier on either side of fault	18.673	1.139	19.812
6	Blocked under incline, CHP, facility, etc. in north corner of west part of block	5.248	0	5.248
7	Blocked in shaft pillar area near Kelo river	0.915	0	0.915

Sl. No.	Particular	West	East	Total Coal Mt
8	Blocked under Kelo river coal of thickness > 1.5m	1.386	1.385	2.771
9	**West of Kelo river**: blocked in 75m barrier along Kelo (30m road and 45m statutory barrier from quarry edge)		0.368	1.473
	East of Kelo river: 25m barrier along eastern bank of Kelo river and quarry boundary	1.105		
10	Reserve not economically viable for UG mining	0.320	1.800	**2.120**
11	Total blocked (sl no. 4 to sl no.10)	**31.118**	**5.907**	**37.025**
12	Net reserve excluding all blocked reserve (sl no. 3- sl no. 11)	187.128	12.264	**199.392**
13	Excluding panel pillars 80% (sl no. 12 X 80%)	149.702	9.812	**159.514**
14	In panel extraction (depending upon pillar size based on regulation	**95.605**	**6.370**	**101.975**

Note: ***The third digit after decimal may not exactly match in totaling due to rounding of components.***

The reserves blocked under facilities viz. incline, CHP, office, Shaft Pillar etc. in northern corner of west part of block will be 21.301 Mt. These facilities will be required for supporting the OC operations as well as UG operations. Though the OC operations will exhaust by the end of 29th year, the UG operations have long life and will continue till 77th year. The issue, whether some locked coal under the facilities could be mined, will be examined at the fag end of UG operation under prevailing conditions at that time.

As far as the reserves under the batter are concerned, the matter has been studied in detail as follows.

The fast advance of mining operations followed closely by the backfilling operations, especially due to dearth of space for disposal of OB on the surface, application of High Wall mining during the operating life of OC mine has been ruled out. It is only at the end of the OC mining operations that the HW mining can be considered. Then also, there will be restriction of application due to practicality of deployment of the equipment as it must operate from the same level as of the bench to be mined by HW mining. After exhausting the OC mine by the end of 29th year, it will be technically possible to deploy the system at the bottom of the quarry i.e. at the floor of Seam VI and VII combined.

The upper seams mining by HW will not be possible because of non-availability of space adequate to install and operate this system. Thickness of seam VI is between 0.5m and 0.75m in the reference region. It will not be feasible to deploy the HW system. However, seam –VII combined has a thickness of around 5m in the reference region, application of HW mining could be feasible.

In this regard, it is important to note that HW mining has been operational in only two mines in India as follows:

Sharda Coal OC Mine, SECL, M.P.:

Cuprum Bagrodia Ltd, Kolkata has been operating coal extracting machine for High Wall Mining in this mine. The Seam thickness is 1.2-1.5 m and the production is 0.5 MTPA. The drivages are of 2.9m width with 1.2m ribs; and after every 8-10 cuts/drivages, a rib pillar of about 3m is left. The length of each hole (penetration) is 250m.

Medpalli OC Coal mine of SCCL, Telangana:

M/s Advanced Mining Technology Pvt Ltd, Hydrerabad is operating HW system in this mine which has exhausted its reserves after operating normal mine of 4MTPA production. Now coal is being extracted by HW mining. The operation has been on for last 3-4 years (since 2011-12). The thickness of seam is 5.5 m. The HW system which was operational, took one lift of 2.4m thickness while the rest thickness of seam was left unmined. The overall extraction was recorded at about 20% of the whole seam.

However, the operating company has developed expertise over time and now it has brought a new machine which can take 2 lifts, each of 2.4m thickness. This operation is expected to start from August 2016. It is anticipated that the extraction percentage with respect to total seam thickness will be about 35%.

Accordingly, the calculations have been made for coal which can be extracted from Seam-VII combined assuming 2 lift operation giving 35% extraction. The coal reserves extractable by HW system come to 1.52 MT. Assuming a production rate of about 0.5 MTPA, the said reserves can be mined in 3 years.

However, this HW proposal may not be feasible at that stage because the HW drivages will get filled up with water (as the specific location is towards dip side) and the underground operations of lower seams as proposed in the mining Plan will be endangered. It may be noted that it will not be possible to physically inspect the HW drivages for the presence of water irrespective of pumping provision.

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Eventually, the HW could be carried out only after the exhaustion of UG reserves (after 77th year). The decision regarding mining the coal locked in batter of OC mine may be taken at the end of the UG operations considering the technologies (High wall or otherwise) available at that time and if the application of Highwall mining at that time is found to be feasible, a revised mining plan will be submitted.

5.2 CHOICE OF METHOD OF MINING

There are basically two mining methods viz. Opencast (OC) and Underground (UG). Techno-economically, Underground method is adopted only if the OB: Coal ratio in OC becomes so high that the cost of production by OC method becomes higher than the prevailing price of coal in local market in area surrounding the project site.

In this specific case OC method has been adopted for the upper seams down upto seam-VI and UG method has been adopted for the lower seams.

Opencast mining method has been adopted for the upper seams down upto seam-VI (Seam XL1, XT, XB, IX, VIII, VII and VI) due to following reasons:

- The coal seams are incropping,
- The OB : Coal ratio is favourable (4.991 : 1) for opencast mining
- The mining by opencast method will be economical against underground method
- The opencast mining operations are comparatively safer and ensure higher recovery of coal resource.
- The extraction percentage by OC is fore more than the UG.
- The uppermost seam will also have disadvantage of restriction of mining due to weathered mantle at surface below which at least 15 m hard cover is required for UG mining. The weathered mantle varies from 5.8 m (BH No. MMT-13) to 30.32 m (BH No. MMT-23)

5.3 OPENCAST METHOD

5.3.1 Recoverable reserves, waste quantity and stripping ratio

Net geological reserves of coal as per Geological Report (GR) are 1056.298 MT comprising of 736.105 MT (having thickness more than 0.5m proposed for OC mining down upto seam-VI) and 323.193 MT (having thickness more than 0.9m proposed for UG mining below seam-VI). These reserves have been cross checked by Min Mec (RQP) and have been found in order.

The extractable reserves come to 553.177 MT by OC method after considering coal blocked in barrier, batters and mining losses and the corresponding waste quantity will be 2761.120 million cum resulting into an OB coal ratio of 4.991 : 1 (cum : t).

The extractable reserves by UG method come to 101.975 MT after deducting the coal blocked under peripheral pillars, around faults, safety barriers from rivers, roads etc.

Thus, the total extractable reserves by OC and UG come to 655.152 MT.

5.3.2 Selection of OC mining technology

There are following types of equipment systems available for opencast mining:

a) Bucket wheel mining
b) Dragline mining
c) Shovel dumper combination
d) Surface Miners (SM)

Each of them has been explained below:

(a) The bucket wheel alternative has not been considered due to following reasons:

- There are faults in the property
- The stratum below the upper most weathered mantle is hard and strong requiring blasting.
- Presence of large number of seams and interburden layers of mostly of small thickness which will be uneconomic in this alternative.
- Requirement of precision selective mining which will not be possible by bucket wheels especially for thin seams, partings and dirt bands.

(b) The dragline (DL) has not been recommended mainly due to following reasons:

1. Multiplicity of seams
2. Lower most opencastable seam (VI) is highly variable in thickness (0.25m to 24.13m) which should be ideally uniform for DL mining
3. The OB parting above the lowermost seam is also highly variable (3.30m to 17.43m) which should be ideally uniform for DL mining
4. The faulted property will further add to the non viability.
5. Dragline being a high capacity machine will become under utilised.

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(c) Shovel-Dumper Combination:

Keeping in mind that there are 8 workable seams including splits (from Seam XB to Seam VI in ascending order) and equal nos. of inter burden layers to be tackled, an equipment system which is capable of dealing many layers at a time (flexibility of operations) has been recommended as shovel dumper combination. The quality problem can be handaled with the help of hydraulic excavators which have three dimensional movement of bucket. They are capable of carrying out selective mining. Further more, to tackle about 130-135 Mcum OB (upto 1st 14 years) and 99 Mcum in later years and 22 mil tonne of coal at many locations in the OC mine, comparatively large size shovels with 10-20 m3 bucket capacity for OB have been envisaged along with 150 tonne rear dumpers.

Flexibility in operation will be available due to such equipment system.

(d) Surface Miners:

Surface Miners (SM) are capable of cutting the coal precisely and selectively. Mining of thin coal by surface miners and ripping has also been now investigated by the RQP besides the drilling/ blasting considered earlier and it has been concluded that the coal mining will be carried out totally by Surface Miners however, 2 nos. rippers will be provided which could be utilized in those corners/ locations which are difficult to approach by CSMs.

In the light of investigations by RQP, the models as well as capacities of CSMs have been recalculated and now 3 nos. CSMs have been proposed as follow:

- 2 nos CSM 4200 with 10 Mtpa capacity each = 20 Mtpa
- 1 no. CSM 3800 with 4 Mtpa capacity = 4 Mtpa

Totaling to 24 Mtpa capacity against the production requirement of 23.6 Mtpa when the UG is not operational and 22 Mtpa when the UG mine is operation at its full capacity of 1.6 Mtpa.

Main parameters for few typical surface miners are noted below in Table 5.4.

TABLE 5.4
TYPICAL PARAMETERS OF SOME SURFACE MINERS

Particulars	3800SM (W), Windrow	4200 SM (W), Conveyor loading
Cutting width in meter	3.8m	4.2m
Cutting Depth in meter av.	0.250m	Up to 0.800

Particulars	3800SM (W), Windrow	4200 SM (W), Conveyor loading
Coal production t/hr	700	2000
Daily Coal production (t) 18 hrs.	12600	36000
Annual Capacity (330 days), Mt	4158000	11880000
Say	**4.00 Mtpa**	**10.00 Mtpa**

The above types of machines are continuous cutting and loading machines, therefore the material produced by the machines needs to be continuously evacuated. One way of making it possible is by designing conveying system through shifting conveyor systems. Such mix of surface miner and shovel-dumper combination for working the block in different time frame make very complicated and difficult to use conveyor system for evacuation of coal.

Therefore, a more flexible approach for material evacuation is considered, and this is possible through application of off the highway Dumpers of suitable size and numbers, along with the SM. Experience indicates that effective hours of SM on the average with dumpers combination can be taken as 18 hours of SM per day and 330 working days per year.

The main objectives of mine development have been

i. to design an economical production of required coal quality for the life of mine
ii. to minimise transportation distance for coal and waste
iii. to minimise adverse effects on environment and
iv. non-sterilization of the remaining potential reserves for future mining

As already mentioned in Chapter- 4, there are 18 workable seams including their splits (from up downwards seam XB to I-Combined).

The equipment selection and operating methods have been designed considering the volume and nature of overburden and disposition of coal seams.

Mining of thin coal by ripping has also been now investigated by the RQP besides the drilling/ blasting considered earlier. It has been envisaged that the coal mining will be carried out totally by Surface Miners which are capable of easily taking coal seam/bands of 0.5m. Further, 2 nos. rippers have been provided which could be utilized in those corners/ locations which are difficult to be approached by CSMs.

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5.3.3 Standardisation of equipment for Overburden removal and coal production

The equipment for OB removal has been standardized. Only two types of hydraulic shovels are proposed to be used in the larger size range viz. 12 cum and 20 cum bucket capacity in combination with 150T capacity dumpers. In the smaller capacity range, the 5/5.5 cum shovel will be used for relatively thinner partings between seams themselves in combination with 50T dumpers.

5.3.4 Coal production

It is necessary to conceive the contribution of each seam in the total reserves so as to visualize the proportional %age of production contribution so that the relevant equipment can be designated and marched to the pre-determined seams /locations for mining.

The seam wise coal reserves in tonne and their % contribution is given in the following Table 5.5.

TABLE 5.5

SEAM WISE COAL, PERCENTAGE CONTRIBUTION BY SEAMS IN RESERVES

Seam	Total Extractable Reserve, MT	% contribution of seams in total reserves	% Production by 2 nos. 4200SMs	% Production by 1 nos. 3800SMs
X-LA	9.551	1.73	0	1.73
X-TOP	8.012	1.44	0	1.45
X-BOT	64.131	11.59	11.59	0.0
IX-L2	10.657	1.93	0	1.93
IX-L1	11.937	2.16	0	2.16
IX	111.804	20.21	20.21	0.0
VIII	61.323	11.09	11.09	0.0
VIII-L	11.933	2.16	0	2.16
VII-TOP	67.257	12.16	12.16	0.0
VII-BOT	18.052	3.26	0	3.26
VII-COMB	58.737	10.62	10.62	0.0
VI	119.783	21.65	21.66	0.0
Total	**553.177**	**100.00**	**87.33**	**12.67**

As can be seen from the above table, the coal of thicker 6 seams, viz. XB, IX, VIII, VIIT, VII Combined and VI together accounts for 87.33% while that of other thinner seams accounts for only 12.67%.

The tentative location of deployment of larger and smaller size surface miners and their contribution to the annual production is given in Table 5.6.

TABLE 5.6
TENTATIVE LOCATION OF DEPLOYMENT OF LARGER AND SMALLER SIZE SURFACE MINERS AND THEIR CONTRIBUTION TO THE ANNUAL PRODUCTION

Seam	% Production by 2 nos. 4200SMs	% Production by 1 nos. 3800SMs	Production by 2 nos. 4200SMs @20 Mtpa	Production by 1 nos. 3800SMs@4 Mtpa	Total production Mtpa
X-LA	0	1.7	0	0.4	0.4
X-TOP	0	1.5	0	0.3	0.3
X-BOT	7.6	4.0	1.8	1.0	2.8
IX-L2	0.0	1.9	0.0	0.5	0.5
IX-L1	0.0	2.2	0.0	0.5	0.5
IX	20.2	0.0	4.9	0.0	4.9
VIII	11.1	0.0	2.7	0.0	2.7
VIII-L	0.0	2.2	0.0	0.5	0.5
VII-TOP	12.2	0.0	2.9	0.0	2.9
VII-BOT	0.0	3.3	0.0	0.8	0.8
VII-COMB	10.6	0.0	2.5	0.0	2.5
VI	21.7	0.0	5.2	0.0	5.2
Total	**83.3**	**16.7**	**20.0**	**4.0**	**24.0**

The 2 nos. 4200SM machines will be mostly busy in the above mentioned thicker 6 seams. The rest 6 nos. thinner seams will be dealt with by the smaller size 3800SM machine. Two ripper machines will also be available for use at isolated locations, small patches etc. The total annual output projected being 23.6 MT upto 11th year, the provision of SM's (2nos. 4200SMs and 1 nos. 3800SMs) has been made for capacity of 24 MT with some cushion.

It is proposed to deploy 100T and 150T dumpers for coal with surface miners 3800SMs (1 no.) and 4200SMs (2 nos.) respectively. Bench design for the application of SM in coal has been considered. The benches will generally be kept 40 and 100m wide for coal in case of 3800SMs and 4200SMs respectively. As 4200SM gives better results with still wider benches, the width has been kept more than 100m wherever possible. For the operation of large size equipment of 12/20 cum bucket capacity shovels in OB in combination with 150T, operational benches of 30-40m will be kept.

5.3.5 Sequence of OC mining

It has been assumed that the mining operations in the block will be started after rehabilitating the villages to the extent required with time as well as getting the forestry clearance. Therefore, the mining operations have been planned to be started from rise side (NW side) and to advance towards dip side (south side) and towards eastern side.

The block is surrounded by coal bearing areas on east and south direction. The strategy is to divide the block into two parts along Kelo river. The two parts are planned to be mined in sequence by dovetailing. The western part which contains larger reserve will be mined 1st by opening it at the north-western portion and advancing the operations towards dip side (south side) and towards eastern side.

The eastern part containing far less reserves within a small triangular portion will be mines towards the end of the operations. As there is no non-coal bearing area available for accommodating the initial cut OB till the back filling can start, the OB will be accommodated over the coal bearing area within the ML area upto 6th year, after which backfilling will be possible concurrent with mining. Ultimately, the whole OB accommodated over the dip side area will be rehandled and backfilled in the void created in the West Pit. After the West Pit nears exhaustion, the mining operations will be smoothly changed over to the East Pit and OB generated from East Pit will be concurrently backfilled in the West Pit. When the East Pit exhausts, high crown dumps will be formed over the West Pit by accommodating the OB generated from the East Pit due to the reason that backfilling of East Pit concurrent with mining virtually will not be possible due to limited dimensions of the created void.

However, after the last year of operation of the mine, the operations of the Post Mine Closure will start which have been planned in such a way that the remainder crown dump of the West Pit will be rehandaled and backfilled into the East Pit. Thus, all the OB will be accommodated within the excavated area and there will be no requirement of land for OB dumping outside the block. The ultimate landscape of the backfilled area over both the pits will be brought almost to the pre-mining scenario except the crown dump of 138 ha, the height of which will be reduced to 80m from earlier 100m.

5.3.6 Year/ stage wise development

The development works during the first year include making access road to sites of activities, removing and rehabilitating the villages lying over the parts of the block, obtaining 1st set of mining equipment, diversion of local roads, top-soil removal, driving box-cut and taking up other construction activities. The mode of transporting the coal to TPP will be through rail from the nearest available siding.

The mining will begin with an aim of producing 11.80 Mtpa from 5th year and peak capacity of 23.6 Mtpa by 7th year onwards from OC. The total coal production in the first five years will be 20.30 MT. However, the production from OC will be reduced from 12th year with the start of UG mining operations such that the total production from the mine is maintained at 23.6 Mtpa. A higher production of 23.6 Mtpa from opencast operation is feasible in some early years when the depth of mine and the lead is lesser as compared to the sustained production of 22.0 Mtpa envisaged from opencast operation. The UG mine is proposed to achieve a peak capacity of 1.6 MT of coal from the 15th year onwards. Accordingly the production from the OC will be kept steady at 22 Mtpa from 15th year onwards. The year wise development of the mine upto 29th years is shown in Plate XIV, XV, XVI, XVII, XVIII, XX, XXII and XXVI.

Year 1

The initial mine entry will be made in Seam X(B) during which its upper seam XT will also be encountered. The entry mouth will be at 297m RL located in SE direction, about 612m from the northern corner of block boundary and at about 576m perpendicular distance from NW boundary line and 258 m perpendicular distance from NE boundary line. The initial mine entry (haul road) will be aligned along SE direction for a distance of about 250m along the Inclines safety barrier after which it will reach 280m RL at a gradient of 1:16. The lowest bench to be worked in the 1st year is 270m RL which will be approached by a ramp from 280m RL bench.

The depth of pit will be 10m to 30m which will be worked in 1 to 3 benches. Coal production during this year will be 0.25 MT with following quality:

The corresponding OB (5 Mcum) will be disposed off in Surface Dump over the coal bearing area (to be rehandaled later) in the dip side of the West Pit. There will be no backfilling activities in this year and no activity related to UG mining.

2nd to 3rd Year

The working benches will be advanced parallel to the already existing benches. The length of the haul road will become 1072m along the safety barrier of the incline landing at 230 m RL. The lowermost levels will go down to about 215 m RL which will be approached by ramps on the benches. The mining operations will reach the seam IX floor during the 3rd year. Coal produced in two years will be 4.55 MT @ 1.55 MT and 3.00 MT respectively during 2nd and 3rd year. The related OB amounting to 44.10 Mcum (14.10 Mcum during 2nd and 30.00 Mcum during 3rd year will be disposed of in Surface Dump in the dip side over the coal bearing area of West Pit as during previous year. A maximum depth of about 82m will be achieved by the end of the 3rd year. There will be no activity related to UG mining or coal production in this year.

4th to Year 5

The working benches will be advanced parallel to the already existing benches in the previous year. The length of the haul road will become 1558m which will approach the floor of the Seam VIII having exposed floor from 205m RL to 230m RL. Coal produced in two years will be 15.50 MT @ 6.00 MT in 4th year and 9.50 MT in 5th year respectively. The related OB (45 Mcum and 80.00 Mcum) will be disposed of in Surface Dump proposed to be located over the coal bearing area (to be rehandaled later) at a distance of over 500m from the uppermost bench. The area required for stacking top soil will be 60 ha for restricting the height to 6 m and the provision of 60 ha has accordingly been made beyond the surface dump. There will be no activity related to UG mining or coal production in this year.

6th to 15th year

The working benches will be advanced parallel to the already existing benches in the previous years. The SW corner of the advancing working benches will just abut against the batter of Kelo river.

Coal produced in ten years (6th to 15th) will be 229.7 MT. The related OB will be disposed of in Surface Dump during a part of the 6th year (47.07 McumB) after which total OB will be accommodated within the backfill of the West Pit. As the decoaled area on the northern side of the West Pit will be required for backfilling the haul road will be shifted and aligned just along the NE batter with its entry mouth located just at the SE end of the incline safety barrier. The mouth will be located at 288m RL. By the end of the 15th year, the length of the haul road will be 3.45 km and it will reach the lowermost seam VI, mineable by OC method. The floor of the seam exposed will vary from 120m to 160m and the depth of the exposed floor will lie between 100m and 170m. The uppermost 5 benches from 220m RL upwards will be advanced by 580m to 870m in order to match with the OB removal requirement as per calendar programme of excavation and in order to accommodate the benches of 100m or more for the operation of CSMs as required for their successful operation. This will also give possibility of operating at well spaced locations within the pit reducing congestion of operation and plying HEMM.

The whole surface dump constructed during the 1st 6 years will be rehandaled and backfilled into the void during the period from 7th year and 20th year (both years including).

16th to 25th year

The above benches of West Pit will be further advanced towards south direction till they abut against the boundary of the West Pit of the block along the Kelo river. The East Pit will also be opened from 20th year.

Therefore the coal production and OB generation will take place from West Pit as well as from East pit from 20th year onwards. All the OB generated from West as well as East Pit will be backfilled into the West Pit decoaled area concurrent with mining. The backfill area will advance upto and abut against the NW end batter of the West Pit by the end of 25th year. A 100m high crown dump will have to be created above the backfill area of West Pit to accommodate the OB generated in the past as will become surplus from the backfill. The coal extracted upto the end of 25th year will be 470 MT and OB generated as 2463.1 Mcum from both the pits with following bifurcation.

Particulars	West Pit	East Pit	Total from both pits
Coal, MT	466.40	3.60	470.00
OB, Mcum	2315.13	147.97	2463.10

26th year to End of OC Mining

The total OB waste to be dealt with (generation and disposal) during 26th to 29th year is explained in the following table.

OB generated from E & W Pits, Mcum (B)	Direct back filling, Mcum(B)			Backfilling from crown rehandling			Total backfilling from direct and cown rehandling into W&E pit voids
	Into West pit void	Into East pit void	Total direct backfilling into W&E pit voids	Into West pit void	Into East pit void	Total backfilling from cown into W&E pit voids	
296.99	148.50	148.49	296.99	241.43	42.86	284.30	581.29

West Pit will finish in 26.5 years (refer Plate XXII and XXVI) keeping intact the shaft pillar near the Kelo river as well as the area under safety pillars of inclines and facilities located in the northern portion of the West block. These areas will be mined after the mining of eastern part of the block during the following years and will be retained till the coal from UG mining in the western part is exhausted.

The total OB produced from both the Pits will be 2761.1 Mcum(B) including Top Soil (14.64 Mcum Bank or 16.84 Mcum Loose). The TS will be accommodated over the dip side coal bearing area of West Pit upto 15th year end after which whatever TS will be required to be preserves, it will be stacked over the backfilled area. The height of the TS stack will be restricted to 6m.

Most of the area 2280.17 ha (see Chapter 13 and 15) in the post mine closure stage will be converted into an agriculture area.

There will not remain any void within the block after the post mine closure.

5.3.7 Calendar program of excavation

Year wise production for the life of the mine is tabulated in Table 5.7.

TABLE 5.7

COMBINED (OC AND UG) CALENDAR PROGRAMME WITH OBR FROM OPENCAST INCLUDING REHANDLING

Year	Opencast (Mt)	OBR MCUM	OBR Incl. Rehandling of Surface & Crown Dump M Cum	Stripping Ratio Cum/ t	SR incl. Rehandling of Surface & Crown Dump Cum/ t	Under Ground	Total (MT)
0	0.00	0.00	0.00	-	-	0.00	0.00
1	0.250	5.000	5.000	20.00	20.00	**0**	**0.25**
2	1.550	14.100	14.100	9.10	9.10	**0**	**1.55**
3	3.000	30.000	30.000	10.00	10.00	**0**	**3.00**
4	6.000	45.000	45.000	7.50	7.50	**0**	**6.00**
5	9.500	80.000	80.000	8.42	8.42	**0**	**9.50**
6	21.300	135.000	135.000	6.34	6.34	**0**	**21.3**
7	23.600	135.000	156.740	5.72	6.64	**0**	**23.6**
8	23.600	135.000	156.740	5.72	6.64	**0**	**23.6**
9	23.600	135.000	156.740	5.72	6.64	**0**	**23.6**
10	23.600	135.000	156.520	5.72	6.63	**0**	**23.6**
11	23.600	135.000	140.220	5.72	5.94	**0**	**23.6**
12	23.200	130.000	135.220	5.60	5.83	**0.4**	**23.6**
13	22.800	130.000	135.220	5.70	5.93	**0.8**	**23.6**
14	22.400	130.000	135.220	5.80	6.04	**1.2**	**23.6**
15	22.000	99.000	103.750	4.50	4.72	**1.6**	**23.6**
16	22.000	99.000	120.740	4.50	5.49	**1.6**	**23.6**
17	22.000	99.000	120.740	4.50	5.49	**1.6**	**23.6**
18	22.000	99.000	120.740	4.50	5.49	**1.6**	**23.6**
19	22.000	99.000	120.740	4.50	5.49	**1.6**	**23.6**
20	22.000	99.000	118.500	4.50	5.39	**1.6**	**23.6**
21	22.000	99.000	99.000	4.50	4.50	**1.6**	**23.6**
22	22.000	99.000	99.000	4.50	4.50	**1.6**	**23.6**
23	22.000	99.000	99.000	4.50	4.50	**1.6**	**23.6**
24	22.000	99.000	99.000	4.50	4.50	**1.6**	**23.6**
25	22.000	99.000	99.000	4.50	4.50	**1.6**	**23.6**
26	22.000	99.000	163.350	4.50	7.43	**1.6**	**23.6**
27	21.997	99.000	163.350	4.50	7.43	**1.6**	**23.597**
28	22.000	95.020	172.850	4.32	7.86	**1.6**	**23.600**
29	17.180	5.000	82.770	0.29	4.82	**1.6**	**18.780**
30			44.183			**1.6**	**1.6**
31			44.183			**1.6**	**1.6**
32-77			44.183			**72.375**	**72.375**
Total	**553.177**	**2761.120**	**3396.800**	**4.99**	**6.14**	**101.975**	**655.152**

Pit/ Quarry wise Calendar programme of OC mine excluding rehandling is given in Table 5.7A.

TABLE 5.7A
PIT/QUARRY WISE CALENDAR PROGRAMME OF OC COAL MINING AND OB REMOVAL EXCLUDING REHANDLING (COAL IN MT, OB IN MBCUM)

CALENDAR PROGRAMME OF COAL MINING AND OB (INCLUDING TS) EXCAVATION FROM EAST AND WEST PIT (COAL IN MT, OB IN MBCUM)

Year	WEST PIT						EAST PIT						TOTAL EAST + WEST PIT					
	Coal Prgr.	Coal Cumul.	OB Progr.	OB Cumul.	SR Progr.	SR Cumul.	Coal Prgr.	Coal Cumul.	OB Progr.	OB Cumul.	SR Progr.	SR Cumul.	Coal Prgr.	Coal Cumul.	OB Progr.	OB Cumul.	SR Progr.	SR Cumul.
1	0.25	0.250	5.00	5.00	20.000	20.000							0.250	0.250	5.000	5.000	20.000	20.000
2	1.55	1.800	14.10	19.10	9.097	10.611							1.550	1.800	14.100	19.100	9.097	10.611
3	3.00	4.800	30.00	49.10	10.000	10.229							3.000	4.800	30.000	49.100	10.000	10.229
4	6.00	10.800	45.00	94.10	7.500	8.713							6.000	10.800	45.000	94.100	7.500	8.713
5	9.50	20.300	80.00	174.10	8.421	8.576							9.500	20.300	80.000	174.100	8.421	8.576
6	21.300	41.600	135.000	309.100	6.338	7.430							21.300	41.600	135.000	309.100	6.338	7.430
7	23.600	65.200	135.000	444.100	5.720	6.811							23.600	65.200	135.000	444.100	5.720	6.811
8	23.600	88.800	135.000	579.100	5.720	6.521							23.600	88.800	135.000	579.100	5.720	6.521
9	23.600	112.400	135.000	714.100	5.720	6.353							23.600	112.400	135.000	714.100	5.720	6.353
10	23.600	136.000	135.000	849.100	5.720	6.243							23.600	136.000	135.000	849.100	5.720	6.243
11	23.600	159.600	135.000	984.100	5.720	6.166							23.600	159.600	135.000	984.100	5.720	6.166
12	23.200	182.800	130.000	1114.100	5.603	6.095							23.200	182.800	130.000	1114.100	5.603	6.095
13	22.800	205.600	130.000	1244.100	5.702	6.051							22.800	205.600	130.000	1244.100	5.702	6.051
14	22.400	228.000	130.000	1374.100	5.804	6.027							22.400	228.000	130.000	1374.100	5.804	6.027
15	22.000	250.000	99.000	1473.100	4.500	5.892							22.000	250.000	99.000	1473.100	4.500	5.892
16	22.000	272.000	99.000	1572.100	4.500	5.780							22.000	272.000	99.000	1572.100	4.500	5.780

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CALENDAR PROGRAMME OF COAL MINING AND OB (INCLUDING TS) EXCAVATION FROM EAST AND WEST PIT (COAL IN MT, OB IN MBCUM)																		
Year	WEST PIT						EAST PIT						TOTAL EAST + WEST PIT					
	Coal Prgr.	Coal Cumul.	OB Progr.	OB Cumul.	SR Progr.	SR Cumul.	Coal Prgr.	Coal Cumul.	OB Progr.	OB Cumul.	SR Progr.	SR Cumul.	Coal Prgr.	Coal Cumul.	OB Progr.	OB Cumul.	SR Progr.	SR Cumul.
17	22.000	294.000	99.000	1671.100	4.500	5.684							22.000	294.000	99.000	1671.100	4.500	5.684
18	22.000	316.000	99.000	1770.100	4.500	5.602							22.000	316.000	99.000	1770.100	4.500	5.602
19	22.000	338.000	99.000	1869.100	4.500	5.530							22.000	338.000	99.000	1869.100	4.500	5.530
20	22.000	360.000	58.500	1927.600	2.659	5.354	0.000	0.000	40.500	40.500			22.000	360.000	99.000	1968.100	4.500	5.467
21	21.280	381.280	77.500	2005.100	3.642	5.259	0.720	0.720	21.500	62.000	29.861	86.111	22.000	382.000	99.000	2067.100	4.500	5.411
22	21.280	402.560	77.500	2082.600	3.642	5.173	0.720	1.440	21.500	83.500	29.861	57.986	22.000	404.000	99.000	2166.100	4.500	5.362
23	21.280	423.840	77.500	2160.100	3.642	5.096	0.720	2.160	21.500	105.000	29.861	48.611	22.000	426.000	99.000	2265.100	4.500	5.317
24	21.280	445.120	77.500	2237.600	3.642	5.027	0.720	2.880	21.500	126.500	29.861	43.924	22.000	448.000	99.000	2364.100	4.500	5.277
25	21.280	466.400	77.530	2315.130	3.643	4.964	0.720	3.600	21.470	147.970	29.819	41.103	22.000	470.000	99.000	2463.100	4.500	5.241
26	21.280	487.680	35.360	2350.490	1.662	4.820	0.720	4.320	63.640	211.610	88.389	48.984	22.000	492.000	99.000	2562.100	4.500	5.208
27	18.306	505.986	35.360	2385.850	1.932	4.715	3.691	8.011	63.640	275.250	17.242	34.359	21.997	513.997	99.000	2661.100	4.501	5.177
28							22.000	30.011	95.020	370.270	4.319	12.338	22.000	535.997	95.020	2756.120	4.319	5.142
29							17.180	47.191	5.000	375.270	0.291	7.952	17.180	553.177	5.000	2761.120	0.291	4.991
30																		
31																		
32																		
Total	505.986		2385.850				47.191		375.270				553.177		2761.120			

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Calendar Programme for opencast mine with details of Waste Disposal (OBR) including rehandling is given in Table 5.7B.

TABLE 5.7B
CALENDAR PROGRAMME OF OC COAL MINING WITH DETAILS OF OB REMOVAL INCLUDING REHANDLING (COAL MT, OB IN MCUM)

Year	Total (East + West Pit)						Surface dump rehandling from west to west		Crown dump rehandling west to west		Crown dump rehandling west to east		Total OB disposal (direct + rehandaled)		SR Progr. Incl. rehandl.		Rehandeled contractually	
	Coal Prgr.	Coal Cumul.	OB Progr.	OB Cumul.	SR Progr.	SR Cumul.	Progr.	Cumul.	Progr.	Cumul.	Progr.	Cumul.	Progr.	Cumul.	Progr.	Cumul.	Progr.	Cumul.
1	0.250	0.250	5.000	5.000	20.000	20.000	0.000	0.000	0.000	0.000	0.000	0.000	5.000	5.000	20.000	20.000		0.000
2	1.550	1.800	14.100	19.100	9.097	10.611	0.000	0.000	0.000	0.000	0.000	0.000	14.100	19.100	9.097	10.611		0.000
3	3.000	4.800	30.000	49.100	10.000	10.229	0.000	0.000	0.000	0.000	0.000	0.000	30.000	49.100	10.000	10.229		0.000
4	6.000	10.800	45.000	94.100	7.500	8.713	0.000	0.000	0.000	0.000	0.000	0.000	45.000	94.100	7.500	8.713		0.000
5	9.500	20.300	80.000	174.100	8.421	8.576	0.000	0.000	0.000	0.000	0.000	0.000	80.000	174.100	8.421	8.576		0.000
6	21.300	41.600	135.000	309.100	6.338	7.430	0.000	0.000	0.000	0.000	0.000	0.000	135.000	309.100	6.338	7.430		0.000
7	23.600	65.200	135.000	444.100	5.720	6.811	21.740	21.740	0.000	0.000	0.000	0.000	156.740	465.840	6.642	7.145	21.740	21.740
8	23.600	88.800	135.000	579.100	5.720	6.521	21.740	43.480	0.000	0.000	0.000	0.000	156.740	622.580	6.642	7.011	21.740	43.480
9	23.600	112.400	135.000	714.100	5.720	6.353	21.740	65.220	0.000	0.000	0.000	0.000	156.740	779.320	6.642	6.933	21.740	65.220
10	23.600	136.000	135.000	849.100	5.720	6.243	21.520	86.740	0.000	0.000	0.000	0.000	156.520	935.840	6.632	6.881	21.520	86.740
11	23.600	159.600	135.000	984.100	5.720	6.166	5.220	91.960	0.000	0.000	0.000	0.000	140.220	1076.060	5.942	6.742	5.220	91.960
12	23.200	182.800	130.000	1114.100	5.603	6.095	5.220	97.180	0.000	0.000	0.000	0.000	135.220	1211.280	5.828	6.626		91.960
13	22.800	205.600	130.000	1244.100	5.702	6.051	5.220	102.400	0.000	0.000	0.000	0.000	135.220	1346.500	5.931	6.549		91.960
14	22.400	228.000	130.000	1374.100	5.804	6.027	5.220	107.620	0.000	0.000	0.000	0.000	135.220	1481.720	6.037	6.499		91.960
15	22.000	250.000	99.000	1473.100	4.500	5.892	4.750	112.370	0.000	0.000	0.000	0.000	103.750	1585.470	4.716	6.342		91.960
16	22.000	272.000	99.000	1572.100	4.500	5.780	21.740	134.110	0.000	0.000	0.000	0.000	120.740	1706.210	5.488	6.273		91.960

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Year	Total (East + West Pit)						Surface dump rehandling from west to west		Crown dump rehandling west to west		Crown dump rehandling west to east		Total OB disposal (direct + rehandaled)		SR Progr. Incl. rehandl.		Rehandeled contractually	
	Coal Prgr.	Coal Cumul.	OB Progr.	OB Cumul.	SR Progr.	SR Cumul.	Progr.	Cumul.	Progr.	Cumul.	Progr.	Cumul.	Progr.	Cumul.	Progr.	Cumul.	Progr.	Cumul.
17	22.000	294.000	99.000	1671.100	4.500	5.684	21.740	155.850	0.000	0.000	0.000	0.000	120.740	1826.950	5.488	6.214		91.960
18	22.000	316.000	99.000	1770.100	4.500	5.602	21.740	177.590	0.000	0.000	0.000	0.000	120.740	1947.690	5.488	6.164		91.960
19	22.000	338.000	99.000	1869.100	4.500	5.530	21.740	199.330	0.000	0.000	0.000	0.000	120.740	2068.430	5.488	6.120		91.960
20	22.000	360.000	99.000	1968.100	4.500	5.467	19.500	218.830	0.000	0.000	0.000	0.000	118.500	2186.930	5.386	6.075		91.960
21	22.000	382.000	99.000	2067.100	4.500	5.411	0.000	218.830	0.000	0.000	0.000	0.000	99.000	2285.930	4.500	5.984		91.960
22	22.000	404.000	99.000	2166.100	4.500	5.362	0.000	218.830	0.000	0.000	0.000	0.000	99.000	2384.930	4.500	5.903		91.960
23	22.000	426.000	99.000	2265.100	4.500	5.317	0.000	218.830	0.000	0.000	0.000	0.000	99.000	2483.930	4.500	5.831		91.960
24	22.000	448.000	99.000	2364.100	4.500	5.277	0.000	218.830	0.000	0.000	0.000	0.000	99.000	2582.930	4.500	5.765		91.960
25	22.000	470.000	99.000	2463.100	4.500	5.241	0.000	218.830	0.000	0.000	0.000	0.000	99.000	2681.930	4.500	5.706		91.960
26	22.000	492.000	99.000	2562.100	4.500	5.208	0.000	218.830	64.350	64.350	0.000	0.000	163.350	2845.280	7.425	5.783	28.350	120.310
27	21.997	513.997	99.000	2661.100	4.501	5.177	0.000	218.830	64.350	128.700	0.000	0.000	163.350	3008.630	7.426	5.853	28.350	148.660
28	22.000	535.997	95.020	2756.120	4.319	5.142	0.000	218.830	77.830	206.530	0.000	0.000	172.850	3181.480	7.857	5.936	37.850	186.510
29	17.180	553.177	5.000	2761.120	0.291	4.991	0.000	218.830	34.910	241.440	42.860	42.860	82.770	3264.250	4.818	5.901		186.510
30	0.000	553.177	0.000	2761.120	0.000	4.991	0.000	218.830	0.000	241.440	44.183	87.043	44.183	3308.433		5.981		186.510
31	0.000	553.177	0.000	2761.120	0.000	4.991	0.000	218.830	0.000	241.440	44.183	131.227	44.183	3352.617		6.061		186.510
32	0.000	553.177	0.000	2761.120	0.000	4.991	0.000	218.830	0.000	241.440	44.183	175.410	44.183	3396.800		6.141		186.510
Total	553.177		2761.120		4.991		218.830		241.440		175.410		3396.800		6.141		186.510*	

* This quantity will be handled contractually and no provision of equipment has been made for it.

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Year/Stage wise progressive insitu GCV of coal seams as calculated though MINEX software and the corresponding coal extraction are given below in Table 5.8A and 5.8B respectively.

TABLE 5.8A
YEAR/ STAGE WISE PROGRESSIVE GCV OF COAL SEAMS

I. OC	YEARS								
SEAM	1st	2nd-3rd	4th-5th	6th-10th	11th-15th	16th-20th	21st-25th	26th-29th	1st to 29th
X_LA	0	0	3698	3926	4413	4261	3854	3964	4056
X_TOP	2662	0	3948	3488	3848	3518	4152	5003	3902
X_BOT	4308	4337	4347	4387	4362	4360	4268	3959	4328
IX_L2	0	5041	5011	0	0	4854	4404	4562	4674
IX_L1	0	0	4740	4951	4921	5145	3825	4866	4892
IX	0	5352	5102	4987	4992	4976	4824	5215	4987
VIII	0	0	3869	3824	3784	3699	3461	3755	3766
VIII_L	0	0	0	4201	4323	4988	2765	4236	4293
VII_TOP	0	0	0	4174	4266	4236	4038	4073	4110
VII_BOT	0	0	0	4041	4138	4378	4143	4073	4134
VII_COM	0	0	0	4257	4142	3823	4155	4326	4198
VI	0	0	0	4528	4532	4446	4336	4319	4454
WEIGHTED AVG. OC	**4065**	**4744**	**4509**	**4413**	**4431**	**4476**	**4231**	**4353**	**4387**
II. UG									
IV					4978	4929	4795	4745	4864
III					0	5015	4762	4742	4832
WEIGHTED AVG. UG					**4978**	**4967**	**4778**	**4743**	**4851**
OC+UG	**4065**	**4744**	**4509**	**4413**	**4449**	**4509**	**4268**	**4387**	**4409**

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TABLE 5.8B
YEAR/STAGE WISE PROGRESSIVE MINABLE COAL PRODUCTION GARE PALMA SECTOR-II

Seam	Years								
OC	1st	2nd-3rd	4th-5th	6th-10th	11th-15th	16th-20th	21st-25th	26th-29th	Total
X_LA	0.000	0.000	0.040	0.850	0.060	3.620	1.590	3.391	**9.551**
X_TOP	0.040	0.000	1.260	0.390	0.530	3.800	0.670	1.322	**8.012**
X_BOT	0.230	2.710	4.120	18.460	10.830	9.720	16.040	2.021	**64.131**
IX_L2	0.000	0.010	0.180	0.000	0.000	4.960	1.980	3.527	**10.657**
IX_L1	0.000	0.000	0.180	0.340	0.340	5.150	1.100	4.827	**11.937**
IX	0.000	1.810	5.300	24.800	26.980	29.200	15.560	8.154	**111.804**
VIII	0.000	0.000	4.240	19.740	16.990	14.600	2.940	2.813	**61.323**
VIII_L	0.000	0.000	0.000	0.310	1.470	3.490	1.410	5.253	**11.933**
VII_TOP	0.000	0.000	0.000	8.830	7.000	7.260	27.720	16.447	**67.257**
VII_BOT	0.000	0.000	0.000	3.090	1.450	3.360	7.800	2.352	**18.052**
VII_COM	0.000	0.000	0.000	10.570	15.880	3.360	12.790	16.137	**58.737**
VI	0.000	0.000	0.000	28.680	32.990	20.540	21.290	16.283	**119.783**
Total OC	**0.270**	**4.530**	**15.320**	**116.060**	**114.520**	**109.060**	**110.890**	**82.527**	**553.177**
UG Mine									
IV					4.000	4.500	4.000	4.000	**16.500**
III					0.000	3.500	4.000	4.000	**11.500**
Total UG					**4.000**	**8.000**	**8.000**	**8.000**	**28.000**
Total OC+UG	**0.270**	**4.530**	**15.320**	**116.060**	**118.520**	**117.060**	**118.890**	**90.527**	**581.177**

Note : Due to 2nd place rounding, the individual seam contribution and total may show a slight mismatch.

A perusal of above tables shows that average insitu GCV of coal from all workable seams from Opencast is 4387 KCal/Kg and that of Underground mine 4851 KCal/Kg during the period when opencast mine remains in operation (upto 29 years). The weighted average GCV of insitu coal based on the production contribution from OC and UG combined is 4409 KCal/Kg (refer Table 5.8A). The GCV of ROM coal has been considered as 4350 KCal/Kg for calculating coal requirements for EUPs.

The year/stage wise progressive ash% of coal seams is given in Table 5.9 below.

TABLE 5.9
YEAR/STAGE WISE PROGRESSIVE ASH % OF SEAMS

SEAM	YEARS								
	1st	2nd-3rd	4th-5th	6th-10th	11th-15th	16th-20th	21st -25th	26th-29th	1st to 29th
OPENCAST MINE									
X_LA	0.00	0.00	45.46	41.76	49.54	38.15	42.79	40.75	40.27
X_TOP	56.43	0.00	42.51	35.60	43.53	48.13	25.17	34.18	42.15
X_BOT	38.81	37.85	37.24	35.81	37.50	38.13	36.87	40.03	37.03
IX_L2	0.00	29.62	29.51	0.00	0.00	30.77	36.77	34.46	33.08
IX_L1	0.00	0.00	33.05	28.25	30.68	29.04	35.92	31.22	30.64
IX	0.00	28.39	28.98	29.58	29.90	31.75	29.46	32.54	30.38
VIII	0.00	0.00	43.71	43.93	44.20	46.28	43.17	47.98	44.70
VIII_L	0.00	0.00	0.00	39.54	38.72	33.10	52.38	39.57	39.09
VII_TOP	0.00	0.00	0.00	39.84	39.69	42.04	41.73	41.67	41.29
VII_BOT	0.00	0.00	0.00	41.68	41.96	40.08	40.88	41.67	41.06
VII_COM	0.00	0.00	0.00	39.64	40.61	43.70	40.23	41.10	40.66
VI	0.00	0.00	0.00	36.54	36.70	38.25	38.16	39.30	37.54
WEIGHTED AVG. OC	**41.42**	**34.05**	**35.82**	**36.87**	**37.12**	**37.42**	**38.33**	**37.33**	**37.64**
UG MINE									
IV	0.00	0.00	0.00	0.00	30.93	30.96	33.00	32.55	31.83
III	0.00	0.00	0.00	0.00	0.00	31.05	33.69	31.13	32.00
WEIGHTED AVG. UG	**0.00**	**0.00**	**0.00**	**0.00**	**30.93**	**31.00**	**33.45**	**31.84**	**31.93**
OC+UG	**41.42**	**34.05**	**35.82**	**36.87**	**36.91**	**36.98**	**38.00**	**36.84**	**37.37**

It is evident from Table 5.9 that the average ash content of total insitu extractable reserves is between 37 and 38 %. However, the Ash % fluctuates from year to year between 34.05 % and 41.42%. There will be some further deterioration in ROM coal quality due to dilution during mining operations.

5.3.8 Proposed rate of production when the mine is fully developed

Coal production peak for OC when UG mine not operational (upto 11th year)	23.6 Mtpa
Coal production peak for OC when UG mine is operational at targeted capacity (from 15th year)	22.00
Overburden excavation without rehandling (cum;t)	135.00 mm^3 peak
Stripping ratio without rehandling (cum;t)	4.99 : 1
Stripping ratio with rehandling of Surface Dumps 218.81 Mcum during 7th to 20th year (cum:t)	5.39 : 1
Stripping ratio with rehandling of S. Dumps during 7th to 20th year and Crown dumps 284.30 Mcum during 27th to 29th year (cum:t)	6.14 : 1

Note: During the period between 7th and 20th year and 27th to 29th year whole surface dump and part of crown dump will be rehandled and backfilled into the void and no separate provision for the same has been done for the equipment in this Mining Plan as this has been assumed to be tackled by hiring additional equipment over and above the equipment planned for normal direct excavation of OB.

5.3.9 Mineable reserves and anticipated life of the mine

The recoverable (extractable) reserves are already given in Table 5.2 and Table 5.3 above as 653.47 Mt.

Sl. No.	Particulars	East	West	Total
1.	Extractable reserves by OC (in East and West Pits), Mt	47.191	505.986	553.177
2.	Extractable reserve by UG (on East and West side of Kelo river), Mt	95.605	6.370	101.975
	Total, Mt	**142.796**	**512.356**	**655.152**

The life of the OC mine will be about 29 years at annual production rate of 22 Mt as per the calendar programme of production.

The underground production is envisaged to start from 12th year and end in 77th year. Thus, including 3 years of construction (incline drivage and shaft sinking etc.) the life of underground mine will be 69 year at production rate of 1.6 Mtpa.

5.3.10 Proposed method of working

Opencast method of mining has been adopted alongwith shovel/ dumper combination as well as Continuous Surface Miners as detailed under para 5.3.2 above.

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5.3.10.1 Opencast working

(i) Overburden removal: Trucks and shovels

The overburden comprises of soil cover underlain by weathered mantle which is, in turn, underlain by comparatively stronger OB strata.

8 m to 10 m high benches will be developed to excavate the OB. To start with, the topsoil material (0.6m thick) will be excavated by 0.9/1.2 cum hydraulic shovel and transported to a designated area by dumpers. Two types of topsoil storages will be made-one permanent type near the external OB dump and another temporary stack on the backfilled area for immediate use within the same year before the onset of monsoon.

This topsoil will be eventually re-used for reclamation. It is estimated that a total of 14.64 Mcum(B) of top soil will be generated during the entire period of mining operations i.e. 29 years.

The 8 m to 10 m bench in soil and weathered mantle will not require any drilling/blasting where as the underlying stronger strata of OB will be drilled by rotary blast hole drill using a bit size of 200-250mm. The blast hole will be loaded with explosive and blasted. Hydraulic excavators equipped with 12 cum and 20 cum bucket will be used for OB while hydraulic excavator of 5/5.5 m^3 will be used for thin interburden/ parting. The dumpers will haul the material either to the surface waste dump or to previously mined pit section for backfilling. At the dump site, dozer will be used for the purpose of grading the dumps. Transport will be affected by 150/100T rear dumpers for larger shovels and 50T for smaller shovel of 5/5.5 cum bucket.

(ii) Coal mining

All the coal production will be done by Surface Miners while two rippers will be provided for use in isolated locations or thinner seams where deployment of CSMs may not be advisable due to time factors and economic factors.

Three Surface Miners will also be used for selective mining of coal. Coal from surface miner will be loaded into the dumpers of 100T (windrow from 3800SM) and 150T.

All haul roads and roads on dumps will be maintained at a gradient of 1 in 16. (Refer Plate XIV, XV, XVI, XVII, XVIII, XX, XXII and XXVI).

5.3.11 Extent of mechanisation

Mining and transport of coal and OB will be fully mechanised.

5.3.11.1 Lead for coal and OB transportation

As the population of transportation equipment will depend upon the lead, the same was calculated and found to be about 4.50 km on an average for coal as well as for OB. Therefore a lead of 4.50 km has been assumed for calculations of transportation equipment requirement.

Average one way lead adopted as 4.5 km for both OB and coal.

5.3.11.2 Extent of manual/ machine mining

Fully mechanized system of mining has been proposed, as elaborated in this chapter.

The annual productivity of various shovel/ dumper combinations is as follows:

TABLE 5.10
ANNUAL PRODUCTIVITY OF VARIOUS SHOVEL/ DUMPER COMBINATIONS AND THEIR POPULATION

Equipment	Capacity of the machine based on 330 days/year	Population	Total Output,
I. Over burden			
20 cum Hydraulic Elect. Shovel with 12 nos.150T dumpers for 4.5 km lead	5.35 Mcum; OB	20 shovels + 240 dumpers	107 Mcum
12 cum Hydraulic Elect. Shovel with 9 nos.150T dumpers for 4.5 km lead	3.42 Mcum; OB	7 shovels + 63 dumpers	23.94 Mcum
5/5.50 cum Hydraulic Elect. Shovel with 10 nos. 50T dumpers for 4.5 km lead	1.45 Mcum; OB	4 shovels + 40 dumpers	5.8 Mcum
Total (I) OB			**136.74 Mcum**
II. Coal			
Surface miner (3800SM)	4.00 Mt	1 SM + 5 nos. 100T dumpers (CB)	4.00 Mt
Surface miner (4200SM)	10.00	2 SM + 20 nos. 150T dumpers (CB)	20.00 Mt
Total (II) Coal			**24.00 Mt**

The equipment calculation has been done assuming 330 days/year operation and 4.5 km average lead.

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The list of production and auxiliary equipment is given in Table 5.11.

TABLE 5.11
LIST OF PRODUCTION AND AUXILIARY EQUIPMENT

Sl. No.	Particulars	Quantity
I.	**Heavy Earth Moving Machinery**	
A.	**Coal (22 Mtpa)**	
a)	100 T.R.D.(CB) dumpers for 3800SM(W) CSM	5
b)	150 T.R.D.(CB) Dumpers for 4200SM(W) CSM	20
c)	0.9 m^3 hydraulic backhoe	2
d)	Dozer 275-320 HP	4
e)	Dozer 410 HP with ripper	2
f)	Surface miner 3800 SM (W)	1
g)	Surface miner 4200SM (W)	2
h)	10-16 m^3 Front End Loader (Coal)	5
i)	6-8 m^3 Front End Loader (Coal)	4
	Sub-Total for Coal	**36**
B.	**Overburden**	
a)	Hydraulic shovel 5/5.5cum	4
b)	Hydraulic Shovel 12 m^3	7
c)	Hydraulic Shovel 20 m^3	20
d)	50 Tonne Dump Truck for 5/5.5 m^3 shovels	20
e)	150 Tonne Dump Truck for 12 m^3 shovels	63
f)	150 Tonne Dump Truck for 20 m^3 shovels	240
g)	R.B.H drills 200/250 mm	31
h)	Dozer 410 HP	30
i)	Dozer 275-320 HP	10
	Sub-Total for OB	**425**
II.	**Common, Auxiliary & Service Equipment**	
a)	Graders 230 HP	4
b)	Diesel Bouser	6
c)	Construction backhoe -0.9 CUM	2
d)	Water sprinkler (26 KL)	12
e)	Tow truck on 50T truck chassis	2
f)	100 T tractors (Diesel Operated)	2
g)	Rough Terrain Crane - 40T	4
h)	Rough Terrain crane 70 T	2
i)	Service trucks:	
	- Fuel trucks	6

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Sl. No.	Particulars	Quantity
	- Wash trucks	6
	- Mobile maintenance trucks	6
	- Lube trucks	6
	- Fire trucks	2
	- Explosive van	4
j)	Portable air compressor	4
k)	Tyre handler	4
	Sub-Total for Auxiliary & Service Equipment	**79**
	Reclamation	
a)	2.5 cum Front End Loader	4
b)	10 T Truck	10
c)	0.9-1.2 cum hydraulic Excavator	4
	Sub-Total for reclamation	**18**
	Total (Coal+OB+Aux+Reclamation)	**558**

However the quantity of 218.81 Mcum(B) or 251.63 Mcum(L) of rehandling from surface dumps and 186.51 Mcum from crown dump will be got done contractually between 7th and 11th year and 26th and 28th year respectively for which no provision of HEMM has been made in the above table. It is assumed that as this is relatively a smaller period job, it can therefore better be contracted out. It is estimated that deployment of 4/8 nos. 20/10cum bucket capacity hydraulic shovels in combination with 48 nos. 150/100T dumpers will be adequate to do the job for the 1st part and double of these equipment for 2nd part. Rehandling of overburden will be outsourced. Contractor will be permitted to use standard equipments of high capacity which will be available at that time. Indian contractors already have 100T dumpers and 10 cum bucket shovels. Progressively the size of equipments (HEMM) with the contractors may also increase.

Because of production contribution from 12 no. of seams at different horizons, dumper transport would be ideally suited.

Further, due to dumping constraints, virtually no space is available at quarry floor. The working faces will be moving at 200-300 m per year and it will be difficult to maintain multiple loading points and undertake frequent shifting of loading points in case the conveyor arrangement is to be considered instead of presently proposed dumper system.

5.3.11.3 Drilling

Crawler-mounted pneumatically operated down the hole drilling rigs with hole diameter of 200-250 mm and those rigs are capable to meet the future requirement of 8 m/hr will be deployed for OB.

5.3.11.4 Loading

The FELs of 6-8 cum and 10-16 cum bucket will be used for loading coal cut by 3800SM and 4200SM (operating in windrow mode) respectively and will be loaded into the 100T and 150T dumper., The OB will be dealt with the help of hydraulic shovel in combination with dumpers after drilling and blasting.

5.3.11.5 Haulage/Transport

The OB will be transported by 150 T and 50 T R.D. trucks to surface dumps and later on, as soon as decoaled area is available suitable for backfilling, to the site of back-filling. The coal from SM will be transported by 100T/150T coal body trucks and will not require any crushing. A coal stack facility has also been provided for accommodating about 3 days production. FE loading machines with 8 m^3 coal bucket will load the coal into trucks from coal heaps created by the Surface Miners to transport upto the hoppers within the mine while 5cum bucket capacity FELs will be used for handling coal from the coal stack on the surface. This system will offer mobility or flexibility.

The production from each seam will be mined in the ratio's to ensure near consistency of quality over the life of the mine.

The main haul roads will be 30m wide and laid at a gradient of 1 in 16. The haul roads, other than the main haul road, will also be laid at 1 in 16 gradient but local ramps can be negotiated at 1 in 10 gradient. The drainage of the road will be affected by a specially built drain, usually along the high wall, towards which the road level will be slightly tilted (1 in 100) for easy water collection.

5.3.12 Geo-mining Characteristics for OC

The geo-mining characteristics are given in Table 5.12.

TABLE 5.12
GEO-MINING CHARACTERISTICS OF OC MINING

Particulars	Unit	West of Kelo River	East of Kelo River
Extractable Reserve	Mt	655.152	
i) By opencast mining	Mt	505.986	47.191
		553.177	
ii) By underground mining	Mt	95.605	6.370
		101.975	
Overburden	MCum	**2385.850**	**375.270**
		2761.120	
Stripping Ratio without	Cum/t	7.952	4.715

Particulars	Unit	West of Kelo River	East of Kelo River
rehandling		4.99	
Overburden Including Rehandling of surface dumps		2979.95	
Stripping Ratio with rehandling of surface dumps	Cum/t	5.39	
OB including rehandling of surface dumps & Rehandling of Crown Dump		3396.80	
Stripping Ratio with rehandling of surface dumps & crown dump		6.14	
Total number of seams	Nos.	31 nos. (including splits) from XL to IL in descending order	
Workable Seams	-	18 nos. including splits (Seam – XL1 to Seam- VI by OC and Seam IV to I- Comb. by UG)	
Seam and partings thickness range, m		Refer Table 4.6 in Chapter 4	
Area of Excavation	Ha	2081.76	358.79
		2440.55	
Perimeter	m	18838	1192
Angle of dip	degrees	2-4 SW (1 in 14 to 1 in 28)	
Dip-rise length along floor			
i) Minimum	m	2163	178
ii) Maximum	m	3429	1332
iii) Average	m	2796	755
Dip-rise length along surface:			
i) Minimum	m	2485	467
ii) Maximum	m	3809	1584
iii) Average	m	3147	1025.5
Quarry depth:			
i) Minimum	m	92	105
ii) Maximum	m	190	165
iii) Average	m	141	135
Strike length along floor:			
i) Minimum	m	5257	616
ii) Maximum	m	6776	2752
iii) Average	m	6016.5	1684
Strike length along surface:			
i) Minimum	m	5714	854
ii) Maximum	m	7162	3384
iii) Average	m	6438	2119

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5.4 UNDERGROUND MINING

5.4.1 General

i. Underground mining method has been adopted for mining coal of lower seams viz. Seam IV, III, II, IL1 and I.

Though the reserve of thickness lying between 0.9m and 1.5m has been separately indicated but for the purpose of present Mining Plan, only thickness of more than 1.5m has been considered.

ii. The extractable reserves by underground have been derived in Table 5.1B and are 101.975 MT. The distribution of reserves on west and east of Kelo river, seam wise are given below in Table 5.13 to 5.17.

TABLE 5.13
ECONOMICALLY EXTRACTABLE RESERVE BY UNDERGROUND (MT)

Seam	Economically Extractable Reserve		
	West of Kelo River	East of Kelo River	Total West and East of Kelo River
VI-L	0.000	0.000	0.000
VA-1	0.000	0.000	0.000
VA-2	0.000	0.000	0.000
VB-1	0.000	0.000	0.000
VB-2	0.000	0.000	0.000
VC-1	0.000	0.000	0.000
VC-2	0.000	0.000	0.000
VD-1	0.000	0.000	0.000
VD-2	0.000	0.000	0.000
IV	21.049	2.576	23.625
III-L2	0.000	0.000	0.000
III	24.004	3.793	27.797
II	21.297	0.000	21.297
I-L1	7.546	0.000	7.546
I-TOP	6.742	0.000	6.742
I-BOT	6.192	0.000	6.192
I-COMB	8.776	0.000	8.776
Total	**95.605**	**6.370**	**101.975**

TABLE 5.14
UNDERGROUND WEST SIDE NET AND EXTRACTABLE COAL (MT)

Seam	Total UG Reserve >0.9M Thickness	< 1.5M Thickness Reserve	Net Geo. Reserve >1.5M Thickness	Total Blocked Coal	Net Reserve excluding Blocked	Extraction Panel Pillars 80%	In Panel Extraction, MT
VI-L	0.494	0.489	0.005	0.005	0.000	0.000	0.000
VA-1	3.111	3.111	0.000	0.000	0.000	0.000	0.000
VA-2	0.254	0.254	0.000	0.000	0.000	0.000	0.000
VB-1	8.976	8.976	0.000	0.000	0.000	0.000	0.000
VB-2	0.269	0.269	0.000	0.000	0.000	0.000	0.000
VC-1	28.166	27.783	0.383	0.383	0.000	0.000	0.000
VC-2	7.937	7.937	0.000	0.000	0.000	0.000	0.000
VD-1	0.236	0.236	0.000	0.000	0.000	0.000	0.000
VD-2	0.388	0.388	0.000	0.000	0.000	0.000	0.000
IV	53.593	6.526	47.067	7.400	39.667	31.734	21.049
III-L2	1.227	1.227	0.000	0.000	0.000	0.000	0.000
III	58.470	2.491	55.979	9.097	46.882	37.506	24.004
II	51.273	2.778	48.495	6.899	41.596	33.277	21.297
I-L1	23.842	6.083	17.759	2.546	15.213	12.170	7.546
I-TOP	YEKLL	5.383	15.077	1.485	13.593	10.874	6.742
I-BOT	17.120	2.876	14.244	1.760	12.485	9.988	6.192
I-COMB	19.237	0.000	19.237	1.544	17.694	14.155	8.776
Total	**274.593**	**76.807**	**218.246**	**31.118**	**187.129**	**149.703**	**95.605**

TABLE 5.15
UNDERGROUND EAST SIDE NET AND EXTRACTABLE COAL (MT)

Seam	Total UG Reserve >0.9m Thick.	< 1.5M Thick. Reserve	Net Geo. Res >1.5m Thickness	Total Blocked and Not Minable Reserve	Net Reserve Ex. Blocked Reserve	Ex. Panel Pillars 80%	In Panel Extraction
VI-L	0.0030	0.003	0.000	0.000	0.000	0.000	0.000
VA-1	0.0080	0.008	0.000	0.000	0.000	0.000	0.000
VA-2	0.0000	0.000	0.000	0.000	0.000	0.000	0.000
VB-1	0.0000	0.000	0.000	0.000	0.000	0.000	0.000
VB-2	0.0000	0.000	0.000	0.000	0.000	0.000	0.000
VC-1	1.6710	1.671	0.000	0.000	0.000	0.000	0.000
VC-2	0.4190	0.419	0.000	0.000	0.000	0.000	0.000
VD-1	0.0000	0.000	0.000	0.000	0.000	0.000	0.000

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Seam	Total UG Reserve >0.9m Thick.	< 1.5M Thick. Reserve	Net Geo. Res >1.5m Thickness	Total Blocked and Not Minable Reserve	Net Reserve Ex. Blocked Reserve	Ex. Panel Pillars 80%	In Panel Extraction
VD-2	0.1790	0.179	0.000	0.000	0.000	0.000	0.000
IV	8.767	2.635	6.132	1.277	4.855	3.884	2.576
III-L2	0.000	0.000	0.000	0.000	0.000	0.000	0.000
III	10.822	1.451	9.371	1.963	7.408	5.927	3.793
II	0.477	0.424	0.053	0.053	0.000	0.000	0.000
I-L1	0.781	0.537	0.244	0.244	0.000	0.000	0.000
I-TOP	2.690	1.541	1.149	1.149	0.000	0.000	0.000
I-BOT	2.740	1.564	1.176	1.176	0.000	0.000	0.000
I-COMB	0.046	0.000	0.046	0.046	0.000	0.000	0.000
Total	**28.603**	**10.432**	**18.171**	**5.907**	**12.264**	**9.811**	**6.370**

TABLE 5.16
UNDERGROUND EAST SIDE SEAM WISE BLOCKED COAL RESERVES OF >0.5M THICKNESS (MT)

Seam	Blocked in Facility and Incline Area	Blocked in Shaft Side Area	Blocked 75m Barrier in Kelo River	Blocked 25m Fault Barrier	Blocked Under Half Pillar Along ML Boundary	Blocked under Kelo River	Reserve Not Economically Viable Reserve*	Total Blocked Coal
VI-L	0.000	0.000	0.0	0.0	0.0	0.0	0.005	0.005
VA-1	0.000	0.000	0.0	0.0	0.0	0.0	0.000	0.000
VA-2	0.000	0.000	0.0	0.0	0.0	0.0	0.000	0.000
VB-1	0.000	0.000	0.0	0.0	0.0	0.0	0.000	0.000
VB-2	0.000	0.000	0.0	0.0	0.0	0.0	0.000	0.000
VC-1	0.000	0.000	0.0	0.1	0.0	0.0	0.315	0.383
VC-2	0.000	0.000	0.0	0.0	0.0	0.0	0.000	0.000
VD-1	0.000	0.000	0.0	0.0	0.0	0.0	0.000	0.000
VD-2	0.000	0.000	0.0	0.0	0.0	0.0	0.000	0.000
IV	1.228	0.247	0.213	4.672	0.721	0.319	0.000	7.400
III-L2	0.000	0.000		0.000			0.000	0.000
III	1.175	0.244	0.394	5.822	0.886	0.576	0.000	9.097
II	1.835	0.049	0	4.091	0.923	0.001	0.000	6.899
I-L1	1.010	0.000	0.058	1.030	0.421	0.027	0.000	2.546
I-TOP	0.000	0.038	0.108	1.190	0.052	0.0965	0.000	1.485
I-BOT	0.000	0.067	0.295	0.916	0.158	0.3235	0.000	1.760
I-COMB	0.000	0.270	0.037	0.884	0.31	0.0425	0.000	1.544
Total	**5.248**	**0.915**	**1.105**	**18.673**	**3.471**	**1.386**	**0.320**	**31.118**

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TABLE 5.17
UNDERGROUND WEST SIDE SEAM WISE BLOCKED COAL RESERVES OF >0.5M THICKNESS (MT)

Seam	Blocked in 25 m fault on Either Side	Blocked under half pillar along ML boundary barrier	Blocked in 25m River Barrier	Blocked Under Kelo River	Reserve Not Economically Viable Reserve*	Total Blocked and Not Minable Reserve
VI-L	0.000	0.000	0.000	0.000	0.000	0.000
VA-1	0.000	0.000	0.000	0.000	0.000	0.000
VA-2	0.000	0.000	0.000	0.000	0.000	0.000
VB-1	0.000	0.000	0.000	0.000	0.000	0.000
VB-2	0.000	0.000	0.000	0.000	0.000	0.000
VC-1	0.000	0.000	0.000	0.000	0.000	0.000
VC-2	0.000	0.000	0.000	0.000	0.000	0.000
VD-1	0.000	0.000	0.000	0.000	0.000	0.000
VD-2	0.000	0.000	0.000	0.000	0.000	0.000
IV	0.401	0.446	0.110	0.319	0.000	1.277
III-L2	0.000	0.000	0.000		0.000	0.000
III	0.556	0.670	0.161	0.576	0.000	1.963
II	0.000	0.029	0.000	0.001	0.023	0.053
I-L1	0.017	0.000	0.000	0.070	0.157	0.244
I-TOP	0.107	0.021	0.020	0.097	0.904	1.149
I-BOT	0.058	0.048	0.077	0.324	0.670	1.176
I-COMB	0.000	0.000	0.000	0.000	0.046	0.046
Total	**1.139**	**1.214**	**0.368**	**1.386**	**1.800**	**5.907**

* *The reserves as are not economically viable due to various reasons are shown vide Fig. 5.1, 5.2, 5.3, 5.4 and 5.5 in respect of Seam VC1, II, IL1, I Top and I Bot. & Combined respectively. It is enclosed at the end of Chapter.*

iii. The mineable seams have following thicknesses.

IV	0.10-3.70
III	0.10-3.50
II	0.05-7.05
I-L1	0.10-2.89
I-TOP	0.11-3.80
I-BOT	0.19-4.49
I-COMB	2.15-7.87

iv. A designed production capacity of around 1.6 Mty will provide life of about 69 years (including 3 years of construction: incline drivage and shaft sinking) of the below ground workings.

v. For working belowground seams, the various technology choices available are.

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5.4.2 Underground methods of mining

The methods for underground mining are described below.

a) Longwall mining with caving

The advance of the UG mining faces in this specific case is dictated by the location of the operational faces of OC mining as both the method are used during the 1st 30 years simultaneously. A clear distance of over 500m between the faces of two methods will be required to be kept which will put a restriction on the layout of the longwall faces. Hence for the 1st 30 years, longwall system has not been considered. More deliberations on the matter are given under para 5.4.5 and 5.4.6 of this chapter.

b) Bord & Pillar mining with caving

Mechanised Bord and Pillar mining with low height continuous miner and shuttle cars could be one of the suitable systems for an annual coal production of 1.60 Mtpa by underground method inspite of disadvantage of high capital cost. In underground, development and depillaring will be done with the help of Continuous Miners only, requiring no blasting. So explosives will be required only for drifting and drivages of access inclines in stone or drivages in seams with less than 1.8m thickness for heightening. The average daily requirement will be about 0.50 T and that also during the initial years of UG drivages and shaft sinking. It may be noted that only permitted explosives will be used in underground coal mines.

Four nos. of CM will be deployed each producing @ 0.4 Mtpa. They will be appropriately engaged in development and depillaring depending upon the situation. Continuous miner, shuttle car combination along with one LHD and support attachment is proposed.

As the parting between seam VI and seam IV is 79.10m (min) and 98.37m (max). It will be prudent to have min 500m lag between the opencast face and the underground face to avoid impact of heavy blasting of opencast working onto the parting between seam IV and seam VI. Accordingly the planning has been done. However, the suggested lag distance of UG mining operations will be subject to DGMS approval. Continuous miner, shuttle car combination along with one LHD and support attachment is proposed.

The following precautions will be adopted to facilitate simultaneous operation of OC and UG mining:

i) The OB will be layer-wise compacted with rollers to prevent absorption of excessive water.

ii) The backfill dumps will be kept well drained.

The quarry sump will always be kept dewatered.

5.4.3 Entries for Underground Mining and their Development schedule

a) Entries for underground mining:

Two Inclines (one pair) having cross-section 4.8m x 3m and 2 shafts (Exhaust shaft-1 with 6m dia and Intake shaft-2 with 5m dia), all from surface to the lowermost seam-I Combined are planned to be located in the NW portion of the western part of block. As the two inclines are not adequate to supply the intake air to sustain the proposed 1.60 Mtpa production, an additional Shaft-2 (dia 5m) as mentioned above, is proposed near the inclines which can also be equipped with men/materials winding facilities if required (accordingly ventilation calculations have been carried out in Chapter 8). (Refer Plate XIX for UG development of Seam-IV). The bar chart showing development and production is given in Plate XXXIX.

Both the inclines are started from a point located at 100m distance from the NW boundary line of the block. The surface RL at the mouth of inclines will be 299m AMSL and the inclines will be driven at a gradient of 1:4.5 parallel to the NE block boundary at a distance of 100m and 150m respectively. That means that the inclines will be 50m apart. The details related to intersection of various seams with shafts and inclines is given below in Table 5.18.

TABLE 5.18
INTERSECTIONS OF SHAFTS AND INCLINES WITH DIFFERENT SEAMS

Seam	Return Shaft No-1 (6m dia)		Intake Shaft No-2 (5m dia)		Inclines		
	FRL, m	Depth, m	FRL, m	Depth, m	FRL, m	Depth, m	Length of incline upto seam, m
Surface RL	**288.5**		**292**		**299**		
IV	111	177.5	103	189	98	201	904.5
III	40	248.5	29	263	45.28	253.72	1141.74
II	(-) 17	305.5	(-) 27	319	(-) 15	314	1413
IL1	(-) 39	327.5	(-) 48	340	(-) 36	335	1507.5
I (Top)	(-) 67	355.5	(-) 65	357	(-) 62	361	1624.5
I (Bot. & Comb.)	(-) 76	364.5	(-) 87	379	(-) 81	380	1710

A perusal of the Table shows that the length of each of the 2 inclines is 1710m in section (1668m length on plan). A safety barrier of 100m is further kept between the southern incline and the NE quarry boundary. The RLs at which the 2 inclines will intersect floors of seams-IV, III, II, IL1, I and finally the lower most seam-I Bot & Comb are given in the last column of the above Table. It may be particularly noted that the location and alignment of the inclines has been selected in such a way that they intersect all the seams.

b) Development schedule of the entries to UG:

The development schedule of the entries to UG mine workings is given in Table 5.19 below:

TABLE 5.19
ASSESSMENT OF TIME SCHEDULE FOR SINKING OF SHAFTS AND INCLINES AND COAL PRODUCTION

Sl. No.	Particulars	Drivage/ sinking Length/ depth (m)	Progress m/month	Time required in months	Remark
1	Drivage of Incline No.1 from surface SRL 299M to Seam-IV at floor FRL 98m at Gradient 1 in 4.5 (4.8mX3.0m).	904.5	45	20.1	During 9th and part of 10th year
2	Drivage of Incline No.2 from surface SRL 299M to Seam-IV at floor FRL 98m at Gradient 1 in 4.5 (4.8mX3.0m).	904.5	45	20.1	do
3	Return Ventilation Shaft-1 sinking from a point having 288.8m RL near incline to Seam-IV at FRL (+) 111m	177.5	12	14.8	do
4	Intake Ventilation Shaft-2 sinking from a point having 292m SRL near incline to seam-IV at FRL (+) 103m	189	12	15.8	do
5	Drivage of Incline No. 1 from Seam-IV FRL 98M to Seam-III at FRL 45.28m at Gradient 1 in 4.5 (4.8mX3.0m).	237.24	45	5.3	During 10th and part of 11th year
6	Drivage of Incline No. 2 from Seam-IV FRL 98M to Seam–III at FRL 45.28m at Gradient 1 in 4.5 (4.8mX3.0m).	237.24	45	5.3	do

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Sl. No.	Particulars	Drivage/ sinking Length/ depth (m)	Progress m/month	Time required in months	Remark
7	Return Ventilation Shaft-1 sinking from Seam IV at FRL 111m to Seam-III at FRL (+) 40m	71	12	5.9	During 10th year
8	Intake Ventilation Shaft-2 sinking from Seam IV at FRL 103m to seam-III at FRL (+) 29m	74	12	6.2	do
9	Developing the bottoms of shafts and inclines including armouring, equipping to make ready for production			13	During part of 10th year and full 11th year
10	Production from development and depillaring from seam-IV				From 12th to 40th year
11	Production from development and depillaring from seam-III				16th to 47th year
12	Drivage of Incline No. 1 from Seam-III FRL 45.28m to Seam-I Bot & Comb at FRL (-) 81m at Gradient 1 in 4.5 (4.8mX3.0m).	568.26	45	12.6	During part of 42nd and full 43rd year
13	Drivage of Incline No. 2 from Seam-III FRL45.28m to Seam–I Bot & Comb at FRL (-) 81m at Gradient 1 in 4.5 (4.8mX3.0m).	568.26	45	12.6	During part of 42nd and full 43rd year
14	Return Ventilation Shaft-1 sinking from Seam III at FRL (+) 40m to seam-I Bot & Comb at FRL (-) 76m	116	12	9.7	During part of 43rd year
15	Intake Ventilation Shaft-2 sinking from Seam III at FRL (+) 29m to seam-I Bot & Comb at FRL (-) 87m	116	12	9.7	During part of 43rd year
16	Production from development and depillaring from seam-II and IL1, I Top, I Bot & Comb				From 44th to 70th year

5.4.4 Working sequence

1. Seams will be depillared from top to bottom.
2. Boreholes from lower to upper seam for dewatering water from goaved out area should be done, as per DGMS permission.

5.4.5 Production from underground mines

a) *Computation of production from UG*

The production from one continuous miner will be 0.4 Mtpa. There will be four continuous miners operational at any time with following capacity.

Production from four set of standard = 4 x 0.40 MT	=	1.60 Mtpa

The main drives in coal connecting to inclines, shafts as well as all dip drives will be also driven with continuous miners. All the workable seams will be developed and depillared with continuous miners along with two shuttle cars in each set of continuous miner.

Accordingly, this mining plan has proposed 1.60 Mtpa production from underground mining which could be easily achieved.

b) *Detailing of Bord & Pillar / Room & Pillar Technology*

Accordingly Bord & Pilar (B&P) or Room & Pillar (R&P) Methods are proposed for this block.

Because of the prevailing mining parameters, need for economic exploitation of the multiple seams with maximum percentage of extraction possible, optimum production and productivity two proven B&P technology methods are considered suitable for application.

1. Mechanized R&P method with application of continuous miner without blasting.
2. Semi mechanized B&P method with application of blasting with explosives and LHD.

c) *Advantages and disadvantages of R&P method with application of continuous miner without blasting*

Advantages of R&P method with application of continuous miner without blasting are given below:

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- Very successful and economical to date in Indian applications
- Universal acceptance of the technology
- Higher percentage of extraction both in first extraction and final extraction is achievable
- Pillar extraction achieved successfully
- Production levels being maintained till the life of the machine by involving manufacturers in maintenance of the equipment
- Huge potential to improve performance
- Does not require blasting and as such better roof control
- Since no blasting is required, this method is preferable in working underneath populated surface features like villages, highways etc.
- Dispensation from DGMS have been available in India for developing coal seams with gallery widths up to 6.5m and heights up to 4.5m where mining conditions permit, thus allowing much higher percentage of extraction in first extraction which is particularly advantageous in developing coal seams below surface features like villages provided adequate long term factor of safety in maintained.

The disadvantages are

- Productivity decreases rapidly with increases in gradient above 1 in 5.5 and the limiting gradient is 1 in 4.
- The continuous miner equipment approved for use in India by DGMS has a working height range of 2m to 4.5m. For a different working height range, fresh approval will be required which may require some time.
- This method requires an adequately trained and competent term to operate and maintain the equipment and high level of management skill for effective utilization and optimum productivity.
- A globally recognized mining method with very high potential production rates up to 1 million tones per month (in China – with Western equipment).
- Some Seams can only be extracted by longwall method which is most suitable for depths exceeding 450 m.
- High capital cost.

5.4.6 Proposed U/G mining method

I. Mechanized Continuous Miner Technology–Development & Depillaring

a) Application of Room and Pillar Mining in India

Indian coal mines have a long history of successfully applying Room & Pillar mining methods. Until recently labour intensive "hand got" methods were universally applied. Mechanization to improve productivity by the application of "Side Dump Loaders" (SDL), Load Haul Dump (LHD) and now continuous miner (CM) has been successful and is being widely practiced in the CIL mines.

A mechanized room and pillar mining culture therefore already exists. The Indian coal mining industry has also introduced with limited success fully mechanised longwall mining.

The mechanization program is now aimed to increase the tonnage produced from each district with minimum capital expenditure with the obvious resultant saving in new mine development cost, utilization of developed coal standing in pillars and a further improvement in productivity.

The district layout to introduce one fully mechanized room and pillar mining district may use a combination of 5 heading pillar development and pillar extraction using continuous miners and ancillary equipment.

It is proposed to employ mechanized R&P technology for extraction of all seams in this coal block on contract mining basis to ensure highest economy and productivity throughout the life of the equipment. The production equipment package will comprise of one continuous miner, two shuttle cars, one twin boom roof bolter equipment, one LHD, one feeder breaker and associated electrical accessories. The equipment to be selected would have the specification to cover a seam height range in single lift varying from 1.50m to 3.5m (Continuous Miner model CAT: CM 340 (Mining Range 1.37 m to 4.00m, 70 tonnes, 697 KW or other similar CM).

The development will be carried out in a height range of seam thickness to maximum up to 3.00m. The DGMS has already approved the application of Continuous Miner in a thickness range of 2m to 4.50m for use in India. During depillaring it should be possible to extract up to a height of at least 5.0m with these equipment.

The development may be carried with gallery height of up to 4.5 m and widths up to 6.5 m which may be permitted by DGMS under special dispensation allowed for mechanized extraction by CM in India. We are

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proposing the gallery size of 3.00m height and 4.8m width. The centre to centre pillar dimensions shall be as per Regulation no. 99 of CMR, 1957.

The five heading dip drives will be also developed with continuous miner. The method of development and depillaring with Continuous Miner technology is discussed in detail later. The general specification of the equipment is given in para 5.6.

In this coal block, the winning of coal is proposed to be carried out with continuous miner technology. For the seam height above 5.5m winning is not feasible by this equipment and hence will be left intact.

One set of continuous miner equipment package can achieve an annual production capacity of about 0.40 Mtpa on an average.

The calculations are given in Table 5.20 below.

TABLE 5.20
CAPACITY CALCULATION OF CONTINUOUS MINERS USED IN DIFFERENT THICKNESS RANGES OF COAL SEAMS

Seam thickness, m	Crossection area @4.8m width, sqm	Advancing Speed of CMs while cutting, m/hr*	Hourly Coal Volume, cum/hr	Daily Coal Volume, cum/ day assuming only 8 effective hrs/day, cum	Coal production, TPD	Annual Coal production, MT	Annual production assuming a factor of 0.75, MT
2.5-5 (Av 3.75)	18	8.5	153	1224	1958	0.587	0.44
1.8-3.5 (Av 2.65)	12.72	10	127	1017	1627	0.488	0.37
						Average assumed	0.40

* *Speed assumed based on actual operating CMs*

** *8 effective hrs adopted based on actual pert net of time distribution activities through 24 hours (working hrs of CM and Shuttle car 8+ Maintenance 4 hrs + Marching time for CM, FB and RB 8 hrs + Break down 2 hrs+ others electrical faults etc 2 hrs)*

*** *@ 1.6t/cum sp density*

There will be four continuous miners operational at any time with following capacity.

Production from four sets of CMs= 4 x 0.40 MT	=	1.60 Mtpa

Accordingly, this mining plan has proposed 1.60 Mtpa production from underground mining which will be easily achieved.

b) Support

In the mechanized R&P technology area, all the supports will be carried out with full column resin grouted roof bolts installed by mechanized roof bolter which is supplied as a part of the continuous miner package. Depillaring support is also carried with resin roof bolts.

Scientific studies will need to be carried out to assess the support requirement and design by measurement for the pattern of roof bolting and their specifications. During both development and depillaring monitoring of effectiveness of supports will have to be carried out by actual measurements.

c) Typical face equipment

Typically the face will be equipped with the following:

- One of suitable "Continuous Miner" equipped with radio/umbilical core remote control, dust scrubber and methane monitor approved by the Director General of Mine Safety (DGMS) for use in Indian Coal Mines. The continuous miner cuts and loads the coal in a single operation.
- Two approved "Shuttle Cars", one left and one right hand including service jacks and side boards. The shuttle cars transport the cut coal from the continuous miner loading conveyor to the feeder breaker.
- One "Twin Roof bolter" track mounted mobile roofbolting machine with two roof drilling rigs, equipped with a "Temporary-Roof-Support" (TRS) system and set up for wet drilling operations.
- One Load-Haul-Dump (LHD) with electric cable reel to be dedicated to the face operation is a multi-purpose vehicle and is essential for the efficient of the district by maintaining the panel floor to the high standard required to sustain high performance. Other uses include but are not restricted to cleaning up spillages in the district from the shuttle cars, to assist with transport for materials to site (from the end of the haulage), to spread stone dust, to lift items and assist with the repair of equipment during break downs and to carry spare parts from the haulage to the equipment. This vehicle is also used to carry out electrical move ups of the load centre/transformer complex.
- One "Feeder/Breaker" mounted on tracks to size and feed the tipped coal from the shuttle car on to the conveyor at a consistent controlled rate. The feeder/breaker has a hopper sufficient to hold a complete shuttle car load. The shuttle car is capable of tipping at two speeds. With a feeder/breaker in the system the shuttle car can tip at high speed into the hopper, the feeder/breaker (or with just a breaker plate) then sizes the coal (possibly to 150mm) and feeds the conveyor at a controlled even rate thus preventing belt damage, maximizing conveyor capacity and allowing the shuttle car to travel back to the continuous miner for loading in the shortest time possible.

- Complete set of special maintenance tools with secure storage box.
- Hand tools, shovels, picks, brushes, pinch bars for scaling roof and an assortment of pulling, jacks and lifting tools.

II. Typical Development Mining Method

a) Strike Development

It is proposed that the "strike" or "near strike" development and bulk tonnage producing areas be mined by continuous miners and ancillary equipment where the face equipment is installed, maintained and operated. The standard layout consists of a five road development, with the main conveyor and feeder breaker positioned in the Central roadway.

b) Place Changing

Place changing is where the continuous miner cuts for a specific distance beyond the last row of support (up to a maximum 15m called a "Place') using radio remote control of the continuous miner. The workforce at all times operates under supported roof. A lesser distance may be advanced depending on DGMS approvals. The time to cut a place is largely dependant upon the efficiency or shuttle car operation (wheeling"). Once a "Place" is cut the continuous miner is trammed to an adjacent heading to commence the cutting cycle over again. A roof bolting machine then supports the area mined by the continuous miner as a separate operation then the roadway is cleaned by LHD and ventilation extended in preparation for the continuous miner returning. The machines therefore operate independently and hence with greater flexibility for both cutting and roof bolting operations.

The work of the LHD cannot be understated. The quality of floor is one of the keys to success in place changing. A clean and well maintained floor provides a safer working environment, enables shuttle cars to operate at fast speeds, lessens the potential for cable damage and allows for unhindered continuous miner and bolter relocations.

c) Mining Geometry

The continuous miner typically has a cutting head 3.3m to 3.5m wide. The machine is usually "sumped in" between 0.5m and 0.75m at roof level, the rear stab jack on the machine lowered and the head sheared down to floor level. This cycle is repeated 3 to 4 times, the roof and floor trimmed and the operation repeated.

"Bord Width"- Indian Coal Mines Regulations restrict "bord", "room" or "roadway" width to a maximum of 4.8m. The continuous miner and all

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ancillary equipment is able to operate at this dimension however productivity and safety around moving equipment is greatly enhanced with wider roads.

Since the coal is cut and not blasted, the pillar sides are far stronger. It is estimated that blasting effectively increases the bord width by at least 0.5m on each side of the drive due to the shattering effect of the explosives on the pillar sides. Blasting would therefore effectively create a bord width of 5.8m in a nominal 4.8m wide bord driven using drill and blast methods. It is proposed to work generally with a 6.0m bord width and to optimize the system based on the technical study by a scientific consultant and envisages that DGMS will be approached for an exemption to regulations to permit a bord width up to 6.5m wide. The effect of increasing bord width would be to.

- Increase production and productivity of the mining system (Plate XLII)
- Improve safety of men and machines since there would be greater clearances for equipment to operate and for people to travel in the district.

d) Mining height

Indian Coal Mines Regulations restrict the mining height during development to 3m. This is understandable for traditional systems of drill, blast and support where access to the roof for support and manual drilling holes etc. in thick seams is onerous and extremely difficult. With the equipment and systems proposed coal winning and support and achieved mechanically and can be undertaken safely and efficiently within the operating range of the equipment. The mining height should therefore be restricted by the operating range of the equipment which in most cases exceeds 3m. It is good practice to mine and support as one phase. Removal of support, particularly cement or resin grouted roof bolts is not possible without blasting. This then further weakens the roof and exposes the work force to unnecessary exposure to unsupported roof.

The impact on strata control of working at increased height will be assessed by the scientific consultant and it is envisaged that the DGMS will be approached for exemption to permit the mining height during the development phases be restricted by the operating range of the equipment or seam height which ever the greater.

e) Pillar Dimensions

Indian Coal Mines Regulations define pillar dimensions in terms of depth of workings and bord width. In the case where the bord width is 4.8m the distance between the centres of any two adjacent pillars shall not be less than:

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Depth	Centres
Not exceeding 60m	19.5m
Exceeding 60m but not exceeding 90m	21.0m
Exceeding 90m but not exceeding 150m	24.5m
Exceeding 150m but not exceeding 240m	34.5m
Exceeding 240m but not exceeding 360m	45.0m
Exceeding 360m	48.0m

It is likely that the continuous miner will be operating at depths around 165 to 465m. The pillar sizes, under current Indian regulations should therefore be 34.5m to 48m (centre to centre) with 4.8m bord width to comply with the Indian Coal Mines Regulations. Scientific studies and practices to date in India indicate that the legislated design criteria are very conservative. These pillar dimensions are considered excessive for the desired Factor of Safety and it is envisaged that application will be made to DGMS to reduce the pillar dimensions in order to increase the productivity of the purposed system. Optimization of the bord width, mining height and pillar sizing may be carried out by calculating and using safety factors from established formulae.

f) Typical method of support

A typical support system consists of 4 X 1.8m full column resin grouted roof bolts, the roof bolts being installed and tensioned by the roof bolter. It is anticipated that with bord widths exceeding 4.8m an additional bolt would be required.

Design for Resin Bolt System for junction and gallery support is given in Fig. 5.6.

During Development Spacing and distance between rows and bolts will be 1.2 m.

Pillar extraction generates additional roof stresses and the additional support applied before bed separation can take place, during the development phases, would be beneficial in the long term.

g) Typical Pillar Extraction Methods

Pillar removal plans are an important part of the continuous miner operations and must be fully considered prior to the mining of the advancing panel. There are many different methods of pillar removal and these must be assessed to determine the most appropriate to suit the conditions at the mine. This requires full assessment of the mining height, depth, roof strata, floor strata, immediate roof and floor properties, rib stability, pillar size and roadway width.

The size of pillar and the roadway width depends on the depth and geological conditions, as well as the proposed method of de-pillaring. The safety factors, method of operation and layout of de-pillaring have a marked effect on the choice of roadway width and pillar size on development.

Knowledge of the composition of the overburden is important in deciding whether to carry out retreat mining. This affects pillar dimensions, roof control plans and selection of the technique. The overburden should be strong enough, given the pillar sizes and temporary support, to allow the development work to be carried out safely, yet weak enough to fall at the proper time during retreat. If this is not the case, then variations to the pillaring plan, such as increasing or decreasing pillar dimensions or utilizing a different sequence of cuts must be employed.

The composition of the floor under the coal is another important consideration. The floor is often weaker than the roof and if mixed with water can create mud and poor mining conditions. Plastic flow of the floor can cause instability in the pillars. A full geological survey and interpretation of the conditions is necessary to establish the pillar sizing, roadway width and retreat mining sequence of extraction.

The seam gradient is another factor that requires careful consideration, with slight grades affecting haulage effort and time for operations, which in turn affects the productivity. Also the gradient may have an effect on the shape of the pillars and layout and direction of the panel with main working along the line of strike and cross cuts angled to reduce the angle of apparent dip.

There are many different methods of pillar removal and these must be assessed to determine the most appropriate to suit the conditions at the mine.

h) Operating Methods for De-pillaring

The standard operating method in India is to fully develop the panel, with typically 5 entries on advance, to the panel boundary. At the boundary, the panel may be connected to other 'bleeder' ventilation roadways depending on the mine layout. Height of development and extraction is usually the full seam section or 4.6m (the maximum extraction height of the only approved continuous miner operating in India).

During retreat from the panel, the pillars are split, depending on panel size and caving conditions) and extracted on their side or at angles to take the ribs in an arranged and safe extraction method. Extra roof bolting is used at the edges of the pillars to provide an effective 'breaker line' and ensure that

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after the extraction sequence is complete the roof collapses in a controlled manner up to the roof bolt breaker line. It is suggested that 3 additional rows of bolts will be put to support goaf edge, with distance and spacing of 0.4 m.

During retreat mining/pillar removal the aim is to keep active working places (where the continuous miner is operating) away from the caved areas. Also the length of time that openings are maintained must be kept to a minimum and workplaces should be concentrated in a limited area.

The infrastructure, conveyors, material transport system, power, water, pumping and ventilation are in place from the development phase.

The same equipment is required for pillar extraction as for development.

Pillar extraction techniques may follow the traditional 45° "stooping" line, or the preferred straight line method employed with continuous miners.

Two pillars are mined simultaneously using either system.

The disadvantage of the traditional "45° System" with FULLY mechanized equipment is the creation of excessive tramming distances which effectively restricts production.

The protection afforded by the 45° line was originally developed for a hand loading scenario due to the long time period the pillar had to stand whilst being extracted and the number of working places required by the cyclic, drill, blast and hand load method.

The straight line method reduces both tramming distances and cable lengths to a minimum whilst optimizing tramming routes.

i) Percentage extraction

The "IN PANEL" extraction is estimated with both the 45° and straight line methods as shown above to typically be 80% by area, this may increase by "robbing snooks" (pillar remnants) whilst retreating from the pillar.

j) Conveyor

A 1200mm "fire resistant" conveyor at around 3m/s with a duty equivalent to average 500T per hour (TPH) would be installed in the centre roadway (as shown in all stage plans) to ensure equal tramming distances and cable lengths on each side of the loading point. Peaks of 750 TPH are expected.

The conveyor will be equipped with a loop take-up at least of sufficient capacity to hold belt stretch for one week and preferably to hold one roll (usually 300m) of conveyor belting for extension and retreat of the conveyor. At the in bye end of the conveyor, a sledge mounted and guarded return pulley frame, graduated loading section (at least 3m in length) equipped with impact rollers, and anchor chains will be provided.

The "head" end of the conveyor should be equipped with a suitable loading section on to the trunk conveyor, dust suppression equipment, belt alignment, belt slack and belt slip detectors. The "gate" belt should be electrically interlocked with the "trunk" conveyor to automatically stop the gate belt.

Communication and continuous signaling and "stop pulls" will be provided along the length of the conveyor. The conveyor will also be provided with an effective bottom belt scrapper.

One side of the conveyor will be designated as the "man walkway" into the district. To prevent "Tripping and Falling" accidents, this walkway will be kept clear of any supplies, materials, be clean, level and well illuminated.

District materials should not as far as possible be transported along the conveyor belt route.

5 Heading Development by Continuous Miner showing Bord & Pillar Layout with Transport has been shown vide Fig 5.7.

k) Material Transport

Materials such as timber, roof bolts, grouts/resins, spare parts, cables, lubricants, ventilation stopping materials etc. are to be transported by mine tubs to within one split of the gate belt "tail end".

Familiar method such as an endless rope haulage system using 15 kg track with a 0.6m gauge may be used. The track and return wheel should lag no more than 2 pillars behind the conveyor tail end. The rail track will be laid in the incline (other than the conveyor incline) extending to all the UG workings.

l) Pumping

Water made in the district shall be pumped out via at least a 100 mm pump range running along side of the conveyor. This district range shall be connected to intermediated sumps in the district and ultimately in the mine main sump.

The pump range, intermediate sumps and pumps shall be provided, installed and maintained by the mine. The pump range shall at all times be advanced or retreated to the gate belt tail end and provided with a 100 mm valve at each end. The CM district will require two mobile face pumps, cables, switchgear, flexible hoses and manifold to connect to the 100 mm valve provided by the mine.

Should more “permanent” or intermediate pump installations be required within the district as a result of “hitting” water, “permanent / intermediate pumps” shall always be kept supplied, installed, maintained and operated by the mine (including all electrical and pipe connections) to appropriate standards.

m) Clean water

In the case of CM districts clean water at neutral pH and minimum suspended solids is required to be provided at the rate of 250 l/min at 2000 kpa for cooling motors, drilling and dust suppression of the CM system. In all cases drinking water need to be provide in the district inbye.

The clean water shall be supplied by means of a 100 mm pipe range installed in the conveyor road. A 100 mm valve shall be provided at each end of the district clean water range. Fire hydrants shall be installed along the clean water range at intervals not exceeding 200m. At each hydrant in box containing fire hoses (sufficient for 200 m), nozzles etc. shall be provided.

The clean water range to the gate belt “tail end”, valves, fire hydrants hoses etc. shall be supplied, installed and maintained by the mine.

n) Power supply

Power is to be supplied to the districts at a tension of 3.3 KV. The main feed cable to the district transformers (HT) shall be supplied and installed along the No 4 roadway. This would be required whichever technology is employed. It is required to have an installed capacity of 1500 KVA to supply the face equipment in the mechanized R&P district from the conveyor tail end inbye.

The face equipment will operate at 1100V. The CM package will include all electrical equipment, transformer (3.3 to 1.1 KV), switchgear, cables sockets etc. for the face equipment. It is necessary to provide separate HT cable and section isolator to the face transformer and between the district transformer and the face switchgear.

o) Communications

A suitable communication system shall be provided between the district gate belt tail end, mid-point of the conveyor run, gate belt head end and the office on the surface of the mine (or control centre if available) by the mine.

p) Safety management

Safe is paramount to all operations. A project management plan will be developed specific to the continuous miner operations. The plan will include standards and procedures for the safe and efficient undertaking of all activities and tasks within the project scope. Standards will, as an absolute minimum, comply with the Coal Mines Regulations 1957.

q) Development of panels

The pattern of panel formation and likely number of faces as available during initial stage is shown in Plate XIX, XXI, XXIII and XXIV. Underground working plans for Seam-IV, Seam-III, Seam-II, Seam IL-1, Seam-I (Top) and Seam I (Bot.& Comb.) are given in Plate VIII to XIII). The Conveyor and haulage are kept in inclines which also serves the purpose of intake for the panels. The same extends in the seam with four headings dip drives. The idea is to keep two panels operating. The panels shall be laid out on apparent gradient, thus reducing the gradient of the headings and to be self draining.

III. List of equipments for UG mining

The following are the main equipments required for fully mechanised bord and pillar method deployed with Continuous Miner in Table 5.21.

TABLE 5.21
EQUIPMENT CONFIGURATION FOR FULLY MECHANISED PANELS

Sl. No.	Name of equipment	No.	Broad Specification
1.	Continuous Miner	4	Remote controlled machine similar to CAT: CM 340 (Mining Range 1.37 m to 4.00m, 70 tonnes, 697 KW
2.	Shuttle Cars	8	2.5 cum capacity
3.	Twin Mast Roof Bolter	4	Rotary wet flush drilling
4.	LHD with Electric cable reel	4	1.2-1.4 cum
5.	Feeder/Breaker	4	Crushing coal (-) 150mm
6.	Load centre and transformer	4	3.3kV/1130 V 1500kVA TX
7.	Special Maintenance tools along with Hand tools, shovels, picks, brushes, pinch bars & jacks etc.	Complete Set with secure storage box for each miner	-

The general strategy will be to drive five main heading to the dip most points about (1.5 m to 2.0 km) and then make 5 heading panels (150 m wide) on both wings along strike. Fortunately gradient is not a constraint in orientation of panels. Considering all the pros and cons, it is considered that B & P mining will be more prudent choice here. To start with level of mechanization could be semi mechanized one (side discharge loader / load haul dumper) but with some mining experience fully mechanized B & P (Continuous miner) could be best option, to reduce human drudgery and for improved ventilation and faster production.

The coal from underground will come up the incline mouth by conveyors which will unload the same to hopper of the coal handling plant and then to the dispatch bunker of the cross country conveyor.

5.5 PRECAUTIONS FOR SIMULTANEOUS OPERATION BY OC AS WELL AS UG METHOD WITHIN THE BLOCK

Normally the UG development and depillaring operations will lag by at least 500m, hence no problem is expected to arise during simultaneous operation by OC and UG method. However, the safe distance will require approval of DGMS.

5.6 PROPOSAL FOR WORKING UNDERGROUND MINE AFTER COMPLETION OF OPERATIONS OF OPENCAST MINE

Underground mining operations have been designed keeping in view the top seams extraction through OC method which will entail heavy blasting at the rate of about 120 TPD. The UG operations are maintained at a distance of over 500m away from the actual operations of the OC mine, thus the planning and the equipment design for UG mine have been adopted completely in view of the above fact.

The continuous miner has been found to be the best option to maintain a reasonable level of high production and productivity without resorting to blasting. This system is quite flexible. It is planned to continue with such process of operation at least for 1st 30 years till the OC operations conclude (Refer Plate XXVII and XXVIII). Final pit floor can be seen in Plate XXV.

It may be noted that mine area is very long extending to over 9km from one end to the other. It is, therefore, desirable that around 25th year of mine operation, the mine planning should be relooked into for the following (Refer Plate XXIII and XXIV).

a) Additional shaft entry for production as well as for movement of men and material with a view to cut down the long haulage and travelling from the existing entry point and also for lowering mine resistance to improve the ventilation in the lower seams. Indicative location of the shaft for

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consideration is shown on the western bank of Kelo river (Refer Plate IV).

b) Almost all the lower seams (to be worked by UG) have coal grade varying between A to F as compared to top seams which are of grade between E to G as being worked by OC. It is, therefore, desirable to maximize the extraction percentage by further realistic planning and better technology input. Examination at this stage may be necessary to consider the application of LWPS system wherever feasible. Though use of LWPS may not be completely ruled out, its applicability will be restricted in view of the fact that there are 10 faults and varying seam thickness in two seams (II and I Comb.) upto 7 m. The initial 15 to 18 years of the UG mining operations will provide realistic input for further detailed planning of the remaining working area of UG after the OC mining operation comes to complete closure. At that stage it is suggested that a re-examination of the Mining Plan may be carried out.

The underground mining stage plans from 40th to 77th year are given in Plate XXIX to XXXIV respectively.

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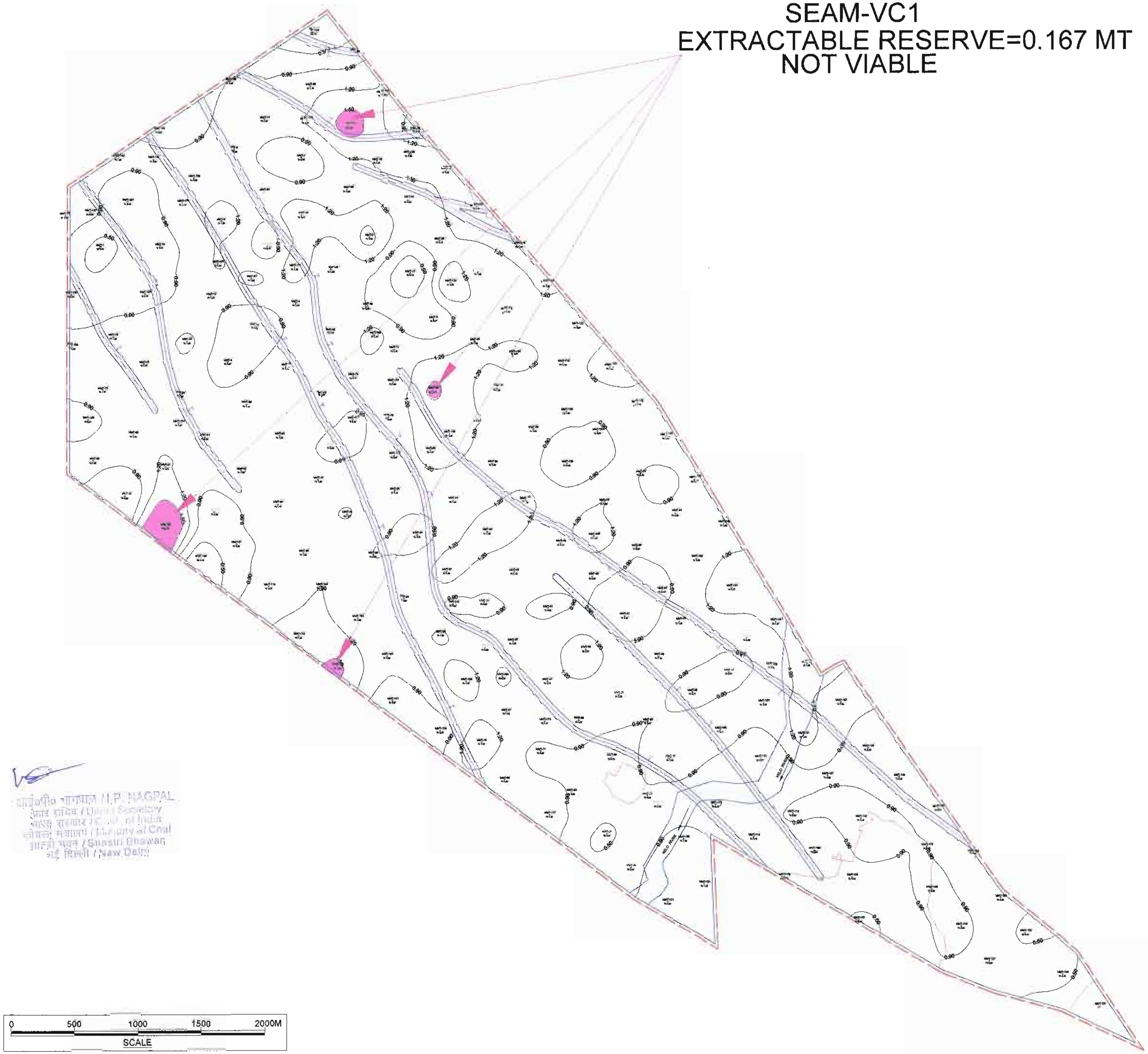
SEAM-VC1
EXTRACTABLE RESERVE=0.167 MT
NOT VIABLE



LEGEND :-

	BLOCK BOUNDARY
MMT-110	BOREHOLE DRILLED BY MECL
	BOREHOLE DRILLED BY G.S.I
1.31	EFFECTIVE THICKNESS IN METRES
1.50	THICKNESS CONTOUR
	FAULT WITH THROW
KELO RIVER	RIVER / NALA
	BARRIER

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भारत सरकार / Govt. of India
कोयला मंत्रालय / Ministry of Coal
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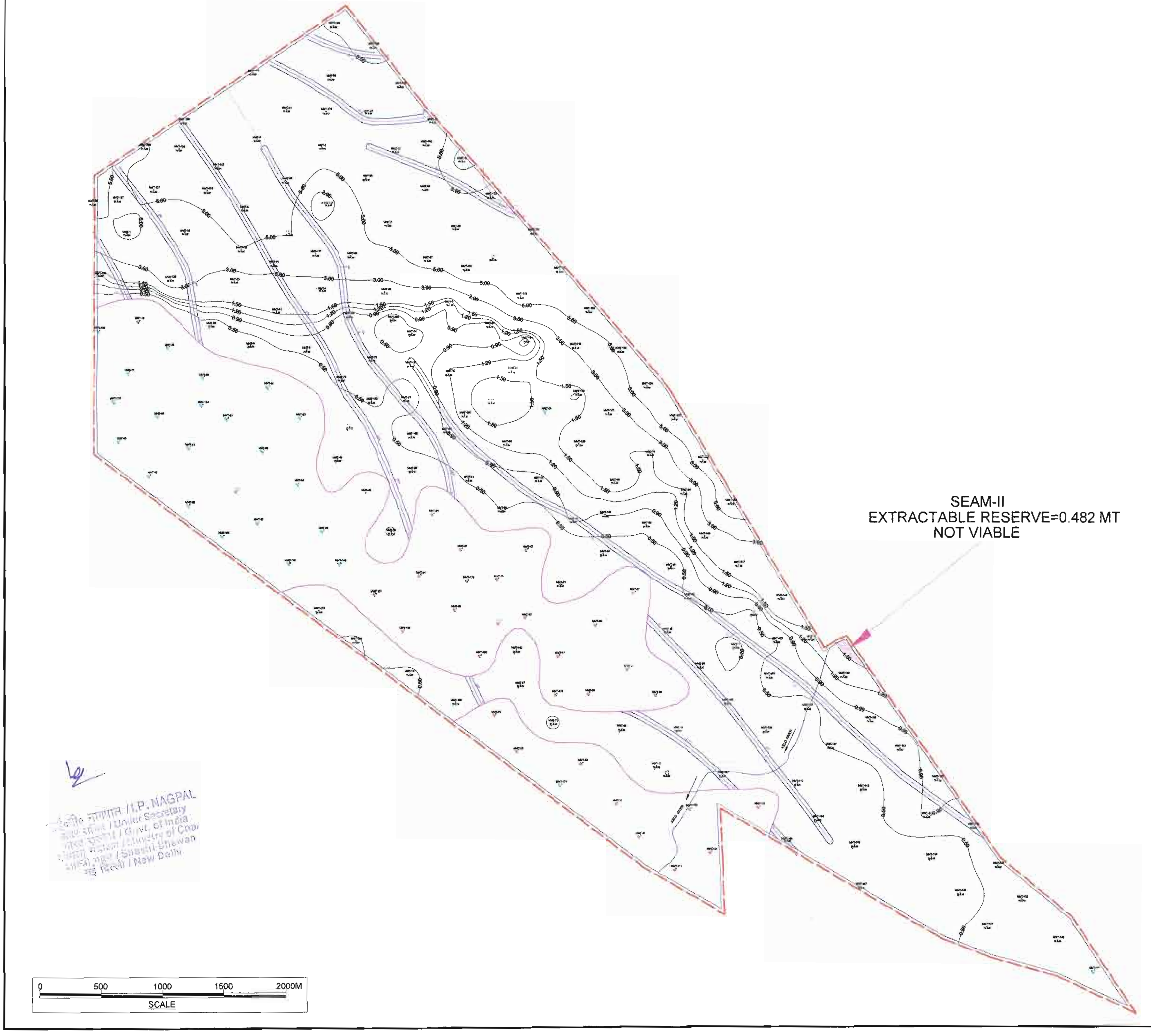
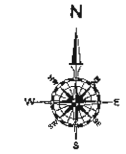
CLIENT:	MAHARASHTRA STATE POWER GENERATION COMPANY LTD. (MSPGCL)
PROJECT:	GARE PALMA SECTOR-II COAL MINE
TITLE:	MINING PLAN & CLOSURE PLAN RESERVE NOT ECONOMICALLY NOT VIABLE (SEAM-V C1)

DRAWN BY:	CHECKED BY:	FIG. NO.
B.R. MATLOTIA	B.D.SHARMA	5.1
SCALE : AS SHOWN	DATE : 30-06-2016	



SEAM-II
EXTRACTABLE RESERVE=0.482 MT
NOT VIABLE



LEGEND :-

	BLOCK BOUNDARY
MMT-118	BOREHOLE DRILLED BY MECL
	BOREHOLE DRILLED BY G.S.I
Th 1.31	EFFECTIVE THICKNESS IN METRES
1.50	THICKNESS CONTOUR
	FAULT WITH THROW
KELO RIVER	RIVER / NALA
	BARRIER

I.P. NAGPAL
Under Secretary
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Ministry of Coal
Shastri Bhawan
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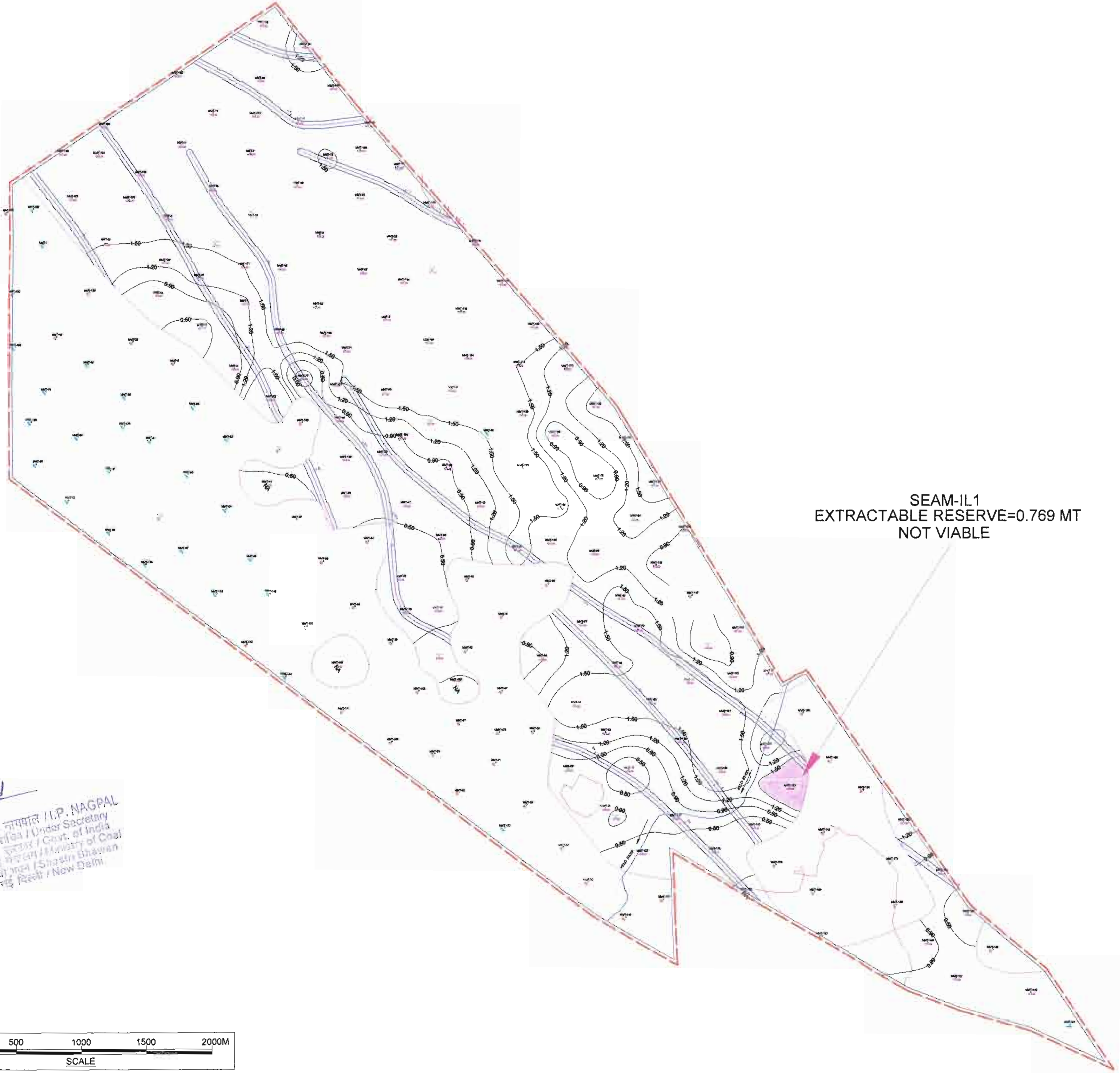
CLIENT: MAHARASHTRA STATE POWER GENERATION COMPANY LTD. (MSPGCL)

PROJECT: GARE PALMA SECTOR-II COAL MINE

TITLE: MINING PLAN & CLOSURE PLAN
RESERVE NOT ECONOMICALLY NOT VIABLE
(SEAM-II)

DRAWN BY:	CHECKED BY:	FIG. NO.
B.R. MATLOTIA	B.D.SHARMA	5.2
SCALE: AS SHOWN	DATE: 30-08-2016	



SEAM-IL1
EXTRACTABLE RESERVE=0.769 MT
NOT VIABLE

N

LEGEND :-

▬ ▬ ▬	BLOCK BOUNDARY
MMT-115	BOREHOLE DRILLED BY MECL
	BOREHOLE DRILLED BY G.S.I
	EFFECTIVE THICKNESS IN METRES
1.50	THICKNESS CONTOUR
	FAULT WITH THROW
KELO RIVER	RIVER / NALA
──	BARRIER

0 500 1000 1500 2000M
SCALE

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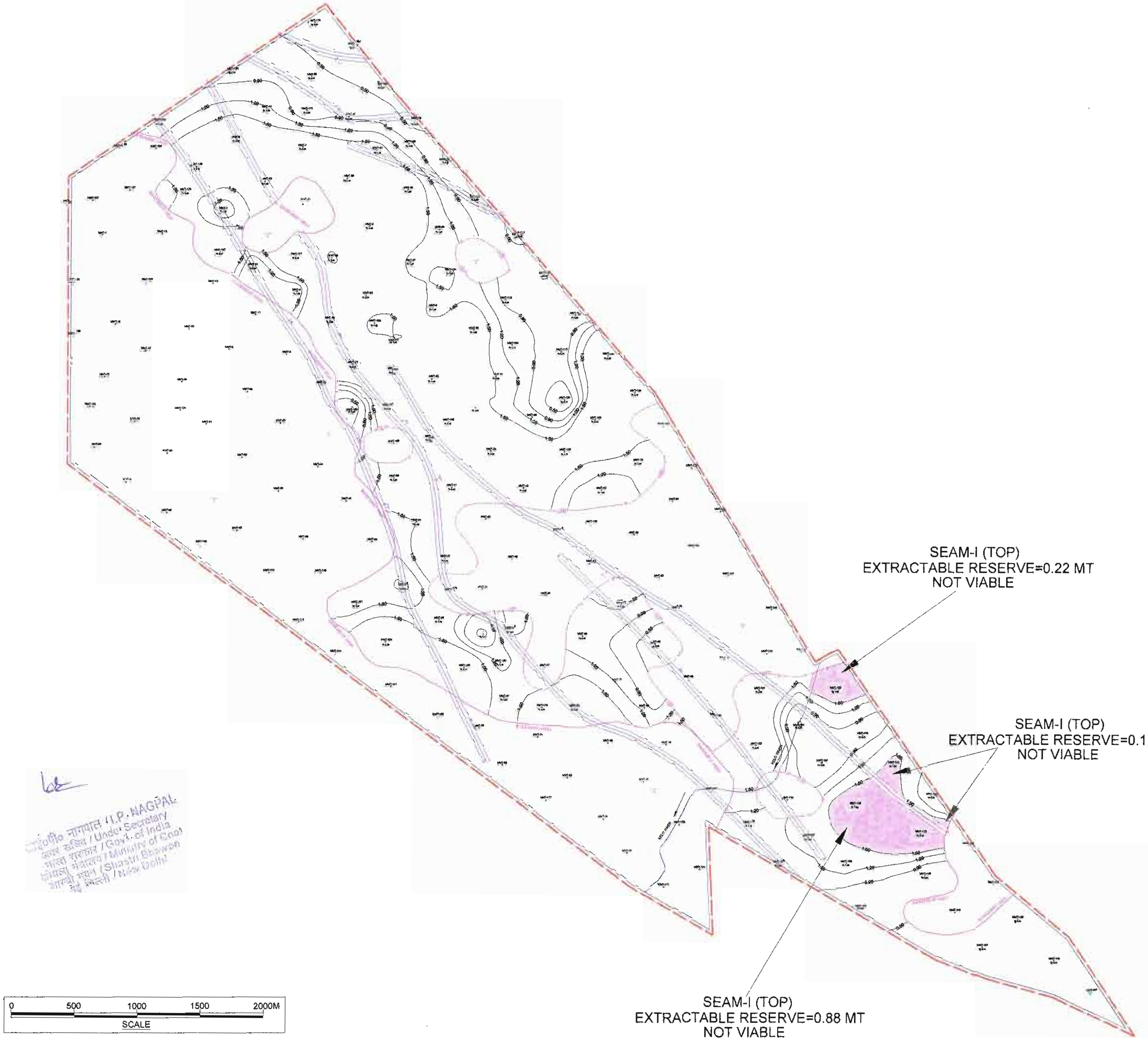
PROJECT: GARE PALMA SECTOR-II COAL MINE		
TITLE: MINING PLAN & CLOSURE PLAN RESERVE NOT ECONOMICALLY NOT VIABLE (SEAM-IL1)		
DRAWN BY: B.R. MATLOTIA	CHECKED BY: B.D.SHARMA	FIG. NO. 5.3
SCALE: AS SHOWN	DATE: 30-06-2016	



SEAM-I (TOP)
EXTRACTABLE RESERVE=0.22 MT
NOT VIABLE

SEAM-I (TOP)
EXTRACTABLE RESERVE=0.118 MT
NOT VIABLE

SEAM-I (TOP)
EXTRACTABLE RESERVE=0.88 MT
NOT VIABLE

LEGEND :-

▬ ▬	BLOCK BOUNDARY
MMT-116	BOREHOLE DRILLED BY MECL
	BOREHOLE DRILLED BY G.S.I
Th.1.31	EFFECTIVE THICKNESS IN METRES
1.50	THICKNESS CONTOUR
	FAULT WITH THROW
KELO RIVER	RIVER / NALA
	BARRIER

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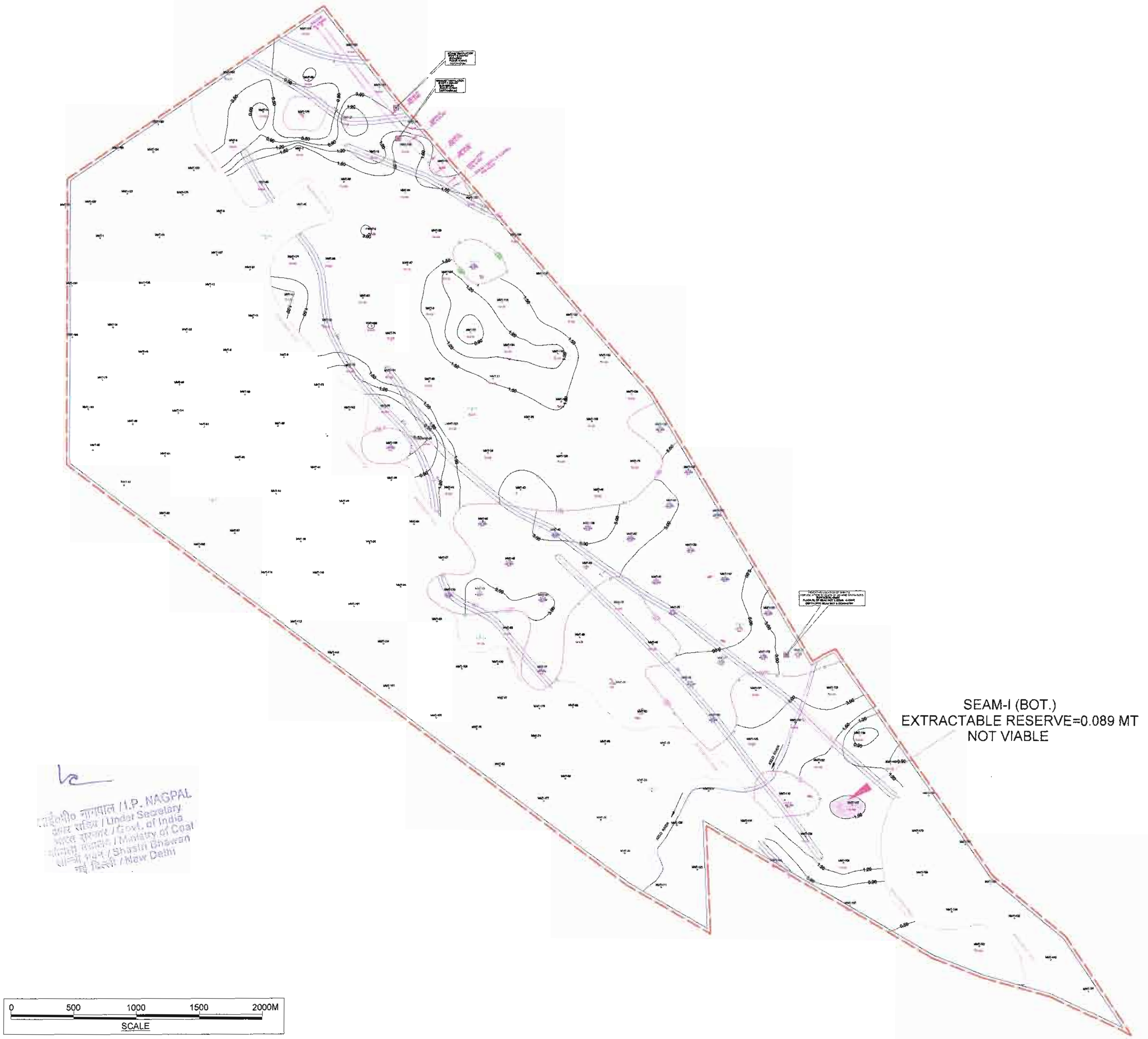
PROJECT: GARE PALMA SECTOR–II COAL MINE

TITLE: MINING PLAN & CLOSURE PLAN
RESERVE NOT ECONOMICALLY NOT VIABLE
(SEAM–I TOP)

DRAWN BY: S.R. MATLOTIA	CHECKED BY: B.D.SHARMA	FIG. NO.
SCALE: AS SHOWN	DATE : 30-06-2016	5.4



LEGEND :-

🟥	BLOCK BOUNDARY
MMT-119	BOREHOLE DRILLED BY MECL
	BOREHOLE DRILLED BY G.S.I
Th 1.21	EFFECTIVE THICKNESS IN METRES
1.50	THICKNESS CONTOUR
5m	FAULT WITH THROW
KELO RIVER	RIVER / NALA
	BARRIER

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CLIENT: MAHARASHTRA STATE POWER GENERATION COMPANY LTD. (MSPGCL)
PROJECT: GARE PALMA SECTOR-II COAL MINE
TITLE: MINING PLAN & CLOSURE PLAN
RESERVE NOT ECONOMICALLY NOT VIABLE
(SEAM-I BOT. & COMB.)

DRAWN BY: B.R. MATLOTIA	CHECKED BY: B.D.SHARMA	FIG. NO.
SCALE: AS SHOWN	DATE: 30-06-2016	5.5

FIG 5.6: DESIGN FOR RESIN BOLT SYSTEM FOR JUNCTION AND GALLERY SUPPORT

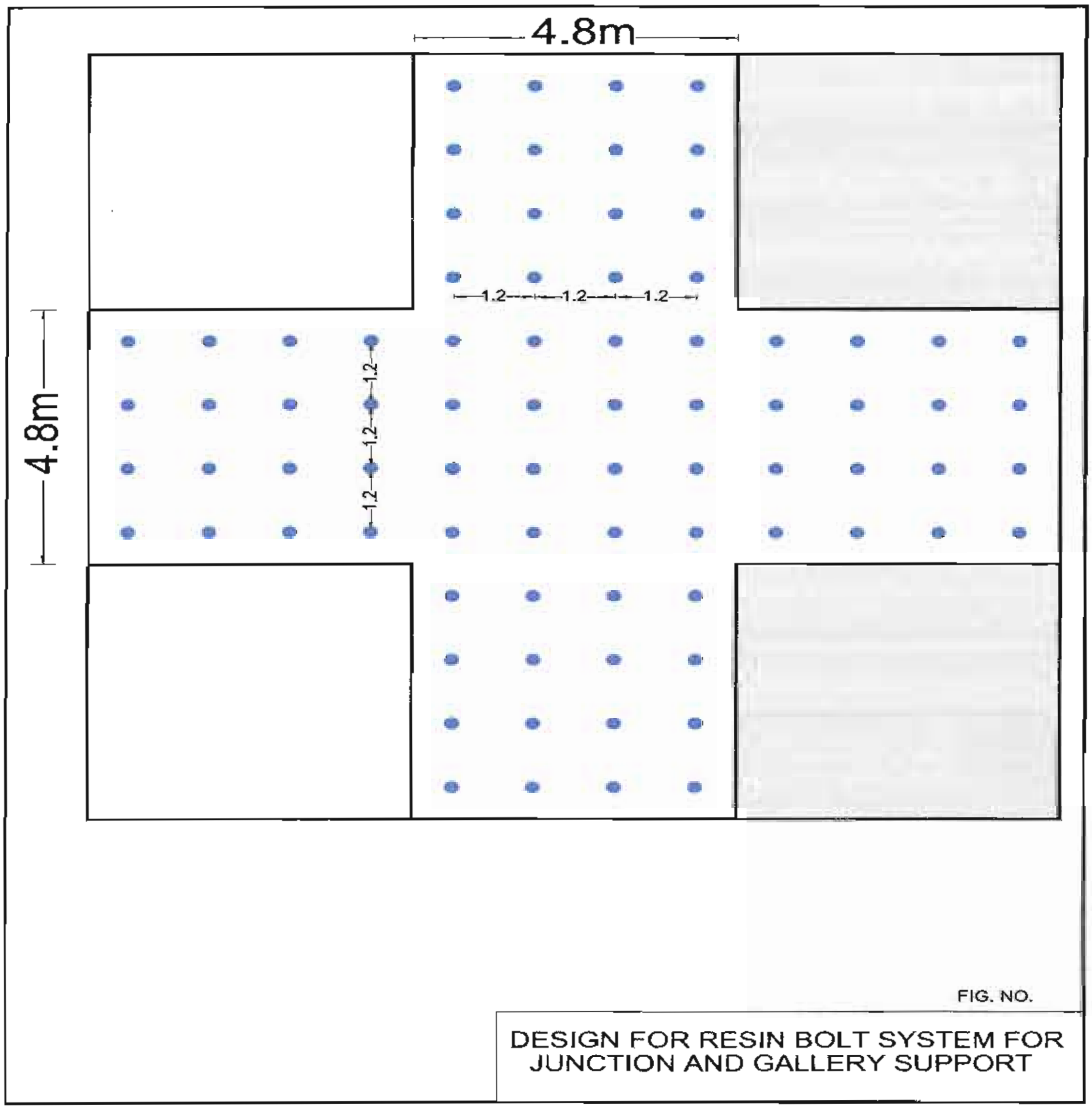

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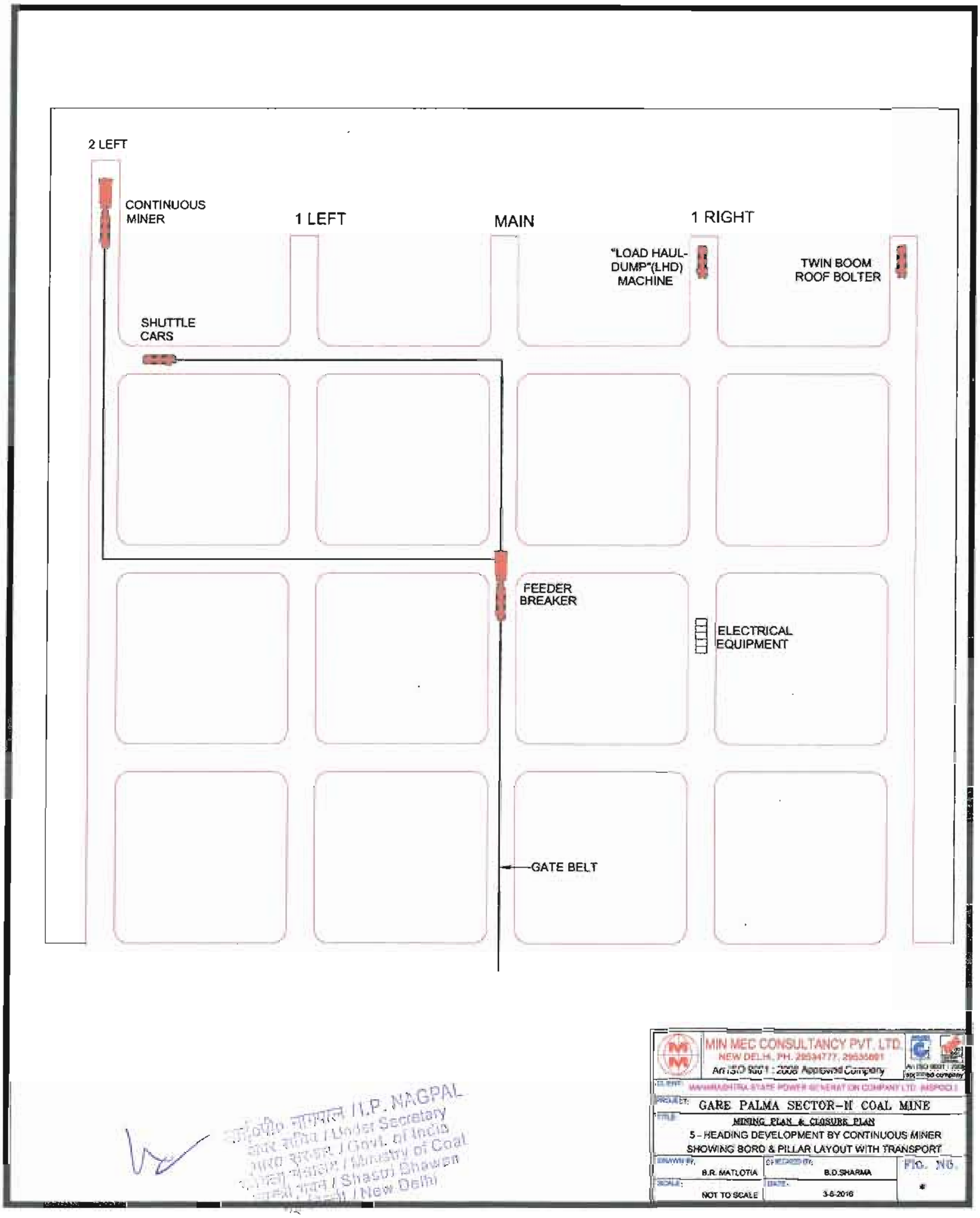
FIG 5.7: 5 HEADING DEVELOPMENT BY CONTINUOUS MINER SHOWING BORD & PILLAR LAYOUT WITH TRANSPORT



CHAPTER 6

DRILLING AND BLASTING

6.1 INTRODUCTION

This mine will be operated both by OC as well as by UG method. The method of blasting and requirement of the explosives has, therefore been separately described below.

The total coal production planned is 23.6 MT. The equipment configuration for winning coal envisages deployment of 3 nos. surface miners which does not require drilling/ blasting. However, the total OB is proposed to be mined deploying shovel dumper combination requiring drilling/ blasting. After shot holes are drilled into the horizontal bench of OB cut by the shovel, the faces are blasted using explosives and detonators.

6.2 OPENCAST MINING

All of the coal 23.6 MT will be produced by OC mining during the initial years as the UG mining operations will start contributing to the coal production only from 12th year (including) onwards.

After shot holes are drilled into the horizontal bench cut by the shovel, the OB benches are blasted using ANFO/SME/SMS with booster explosives and detonators or TLD and DTH combination. In this mine, main waste is overburden in the form of top soil, alluvium and weathered mantle. Only 0.60 m average thickness of top soil has been considered for separate removal and stacking for use in mine reclamation later.

6.2.1 Broad blasting parameters

The drill is deployed on the horizontal bench cut by the shovel. From this level, blast holes are drilled down to the floor of the seam or bench, the length of holes will be 10% longer than the height of the bench. Easy access to the drill is provided via the waste bench.

In the blasting operations, shaking blast practices are proposed using low powder factor. This method will generate a set of cracks in the blasted strata with material movement reduced to minimum.

It has been assumed that 10% of the OB may not require blasting due to weathered mantle.

Medium dia. holes of 200/250mm will be drilled in order to excavate on an average of 135 million BCM (Bank Cubic Meter of OB) per year upto 11th year and later reducing to 130 mcum(B) per year. A powder factor of 0.30 to 0.35 kg per BCM has been adopted for overburden. The highest production of coal is 23.6 MTPA from OC mine by CSMs (when UG is not under operation).

Short delay detonators shall be used. The control blasting techniques will be adopted whereever required to reduce noise, ground vibrations and fly rocks.

6.2.2 Type of explosives to be used

The open cast mine production is envisaged as 23.6 MTPA. ANFO/SME/SMS explosive is proposed to be used for heavy blasting and the daily requirement will be as follows for 23.6 MTPA coal production with maximum 135 mcum annual OB removal.

TABLE 6.1
REQUIREMENT OF EXPLOSIVES

		Te/day
For peak OB 135 Mill.cum. x 10^6 x 0.32 powder factor in kg/Te x 90%* ÷ 330 days ÷ 1000	=	117.82
For coal	=	0.00
Total	=	117.82

* *Assumed that 10% of Overburden does not require the blasting.*

6.3 UNDERGROUND MINING

The mine is also envisaged to be worked with underground system. The mine is targeted for an annual coal production of 1.6 MTPA by underground method. In underground, development and depillaring will be done with the help of Continuous Miners only, requiring no blasting. So explosives will be required for drifting and drivage of access inclines in stone or drivage in seams with less than 1.8 m thickness for heightening and for odd connections between galleries. The average daily requirement will be about 0.50 T and that also during the initial years of UG drivages and shaft sinking. It may be noted that only permitted explosives will be used in underground coal mines.

Four nos. of CM will be deployed each producing @ 0.4 MTPA on an average. One will be deployed in driving the dip drivages, two in developing the western flank panel and one in the eastern side panels. One set of CM will be deployed in each separate panel. Later, two CMs will be engaged in depillaring and two remain in development operations.

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6.3.1 Broad blasting parameters

Mine is planned to be worked by board & pillar underground mining method. The width of the development galleries will be 4.8 m and height of such gallery will be maximum 3 m. It will be not less than 1.8 m where the seam thickness is less than 1.8 m. All these galleries are driven with the help of continuous miner. Hence no blasting is required for winning coal except drifting in stone.

The drilling pattern has to be evolved for best results on the basis of hardness and other parameters. However, wedge cut is generally practiced and in section of 4.8X2.0 by putting around 18 holes, a pull of 1.5 m could be obtained getting muck around 32 tonnes in one round of blast, charging the holes between 0.5 to 0.6 kg each with permitted explosive like Soligex etc. Blasting efficiency could be achieved to over 3 tonnes/ kg.

6.3.2 Storage of explosives to be used

Manufacturers and suppliers of permitted explosives are few and a large numbers of holes are to be blasted frequently in OC, which required considerable quantity of booster explosives and considering that there could be delays in supplies for several reasons, a 2X20 tonnes magazine capacity for 2 to 3 weeks of storage of permitted explosive, detonators primers and fuse etc has been provided.

SMS will be prepared at site immediately before blasting is required to be carried out for which an SMS plant of suitable capacity will be installed.

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CHAPTER 7

DRAINAGE, PUMPING, POWER SUPPLY & ILLUMINATION

7.1 DRAINAGE & PUMPING

7.1.1 General

The coalfield is characterised by undulatory and rolling topography, consisting of hills interspersed with broad valleys. The general elevation of the ground ranges from 270m to 340m above MSL. The slope is either towards southwest or southeast. The hills are relict type and rise about 450m above MSL. The southerly flowing perennial Mand River with its tributaries constitute the main drainage of the area. The Kelo River, a tributary of Mahanadi, drains the eastern part of the coalfield.

The topography of Gare-Palma Area is mostly covered by softer horizon and in general represents an undulating terrain, more resistant sedimentary rocks stand out as ridges, rising as high as 580m above MSL (Silot Pahar) in the north west and 600m above MSL (Morga Pahar) in the north east. The general ground elevation of the Sector-II area under investigation varies between 242 m and 303m above MSL. The block exhibits undulating topography. Kelo Nadi flows from north to south through the south eastern part of the block. A few ponds are present within the block.

The summer season lasts from March to the middle of June, and the period from June to September is the south west monsoon season. The rainfall does not show any cyclic occurrences and shows wide and erratic variations, ranging from as low as 144.9 mm in 2004 to 1852.4 mm in 2003. The average annual rainfall for the period 1996 to 2005 was 1216.4 mm. The monsoon season is spread over the months from June to September.

No water accumulation in OC mine workings will be allowed to remain when the UG mining operations are in progress. There are two sources of water accumulation in the mine pit during open cast mining operation. The first source is direct rainfall and second source is mine seepage. As far as surface water sources are concerned, Kelo is flowing through the eastern portion of ML.

The mine working will be protected from the river inundation by providing embankments on either side of the river. The embankments will have 3m height and 10m width. Adequate measures to protect the mine workings from surface water flow during the rains will be taken by way of providing garland drains around the mine excavations and also by providing suitable drainage gradients for mine benches. Sumps of adequate capacity will be provided on the quarry floor. The coal excavation and transport machinery are organised to be sited over the coal bench top and will not be affected by water accumulation from rains or strata seepage.

The Hydrogeological study is under preparation.

The matter regarding the water make .and its evacuation has been separately discussed in the following paragraphs.

7.1.2 Opencast mine

a. Planning of Mine Drainage

The ultimate depths of the West OC Pit will reach around 200m. It will be planned to intercept the rain water as well as the seepage water at upper benches to the extent possible so that the water can be accumulated in sumps at 2-3 different elevations and the pumping can be accordingly planned with pumps of appropriate capacity and head.

Pontoons mounted pumps will usually be installed in main sumps to prevent their submergence in the unexpectedly heavy rainfall.

b. Make of Water

There are two sources of water accumulation in the mine pit during open cast mining operation. The first source is direct rainfall and second source is mine seepage. The rainwater accumulation is estimated for two options.

i. For normal pumping
ii. For emergency pumping

Each case has been described below separately.

i. For normal pumping

The normal pumping has been calculated based on the average rainfall of monsoon season for which data of Raigarh meteorological station has bee utilized as given in Table 7.1 below.

TABLE 7.1
METEOROLOGICAL DATA OF RAIGARH (1996-2005)

Month	Average monthly rainfall, mm
January	14.2
February	9.3
March	9.1
April	37.9

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Month	Average monthly rainfall, mm
May	23.5
June	202.5
July	324.3
August	371.6
September	220.0
October	35.6
November	7.4
December	13.7
Total (annual)	**1216.4**

The total rainfall in four monsoon months (June, July, August and September) is 1118.4 and dividing this by 120 days, the daily average rainfall comes to 9.32 mm.

The make of water is calculated in the following Table 7.2.

TABLE 7.2
CALCULATION OF PUMPING REQUIREMENT IN NORMAL CIRCUMSTANCES

Stage	Excavated Area (Ha)	Void left after backfilling (ha)	Rainwater volume within void @9.32mm (Ham)	Balance Rainwater accumulated after 50% losses for evacuation (cum/ day)	Seepage assumed, cum/day	Hourly pumping requirement @18 hrs /day in 1 days (cum/hr)
1st year	26.16	26.16	0.24	1219.1	500	95.50
3rd year	129.97	129.97	1.21	6056	1000	392
5th year	380.7	380.7	3.55	17741	2000	1096.70
15th year	1747.06	1066.26	9.94	49688	5000	3038.21
25th year	2272.42	702.39	6.55	32731	5000	2096.19
End of mine (29th year)	2440.55	191.78	1.79	8936.9	2000	607.61

ii. For emergency pumping

Using peak 24 hours rainfall observed at Raigarh (Source IMD data) as 315.2 mm on 25th of August 1970, the water accumulation is as follows in Table 7.3.

TABLE 7.3
RAINWATER ACCUMULATION

Stage	Excavated Area (Ha)	Void left after backfilling (Ha)	Rainwater falling over the void @315.2mm (Ham)	Balance Rainwater accumulated after 50% losses for evacuation (cum/ day)	Seepage assumed, cum/day	Hourly pumping requirement @18 hrs /day in 3 days (cum/hr)
1st year	26.16	26.16	8.25	41228.16	500	791.26
3rd year	129.97	129.97	40.97	204833	1000	3848.75
5th year	380.7	380.70	120.00	599983.2	2000	11221.91

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Stage	Excavated Area (Ha)	Void left after backfilling (Ha)	Rainwater falling over the void @315.2mm (Ham)	Balance Rainwater accumulated after 50% losses for evacuation (cum/ day)	Seepage assumed, cum/day	Hourly pumping requirement @18 hrs /day in 3 days (cum/hr)
15th year	1747.06	1066.26	336.09	1680425.76	5000	31396.77
25th year	2272.42	702.39	221.39	1106966.64	5000	20777.16
End of mine (29th year)	2440.55	191.78	60.45	302245.28	2000	5708.25

* *30% operation losses and 20% infiltration*

c. *Pumping requirements criteria*

To calculate the pumping requirements and for selecting the pumps, following points should be considered:-

1. Climatic conditions of the area.
2. Account must be taken of maximum rainfall as 315.2 mm in 24 hours.
3. Inflow from seepage water is assumed as 5000 cum/day (max) 4.
4. Pumping requirements are assessed on the basis that the make of water on the day of maximum rainfall will be pumped out in next three days.

For smooth working during monsoon:

1. Coal and OB working faces and the haul roads will be maintained free of water as far as possible.
2. Within the quarry, the faces will be so laid that water from the working areas shall flow into sump by gravity. From the sump, water would be pumped out to the surface, stagnated in a settling pond, utilised for the mine activities and then discharged to the nearest streamlet.
3. Water garland drains will be developed in advance for each stage of mine working so that water is collected by the garland drains collected in a settling tank, utilised for the mine activities and then discharged to the nearest streamlet.

Main Sump: Main Sump will have adequate capacity to store enough water as the entire rain water of the excavated mine area / catchment area will be flowing into the sump.

For the sake of calculation, effective pumping hours per day are taken as 18 during peak period. Adequate number of standby pumps will be provided for unforeseen hazards.

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d. *Requirement of pumps*

i. For normal pumping

Based on the data of Table 7.2, the requirement of pumps has been worked out as follows to deal at any stage of mining.

1	Pump capacity	75LPS (1000GPM)	38 LPS (500GPM)	15 LPS (200GPM)
2	No. of units	4	9	15

However, any convenient combination of pump capacities can be deployed to deal with the total water volume indicated. At least 30% of the main sump pumps will be Pontoons mounted to prevent their submergence in the unexpectedly heavy rainfall.

ii. For emergency pumping

The data of Table 7.3 shows that under heaviest rainfall conditions, the water volume to be tackled can be as high as 10 times the normal situation. Hence, adequate nos. of relevant capacity should be kept in the store or kept identified with any source around the area which can be made use of in case of emergency.

Requirement of pumps has been calculated on the basis of the following assumptions:

i. Total accumulation of rain water in the sump has been calculated on the assumption of 315.2 mm rain in 24 hours for emergency situation and based on 9.32 mm per day average rainfall for normal conditions. The catchment area of the mine will be determined between the garland drains constructed over the surface of the opencast mine to protect inrush of water from outside.

ii. The pumps should be able to de-water the sump, with this rainfall, in three days.

iii. At least 30% of the main sump pumps will be Pontoons mounted to prevent their submergence in the unexpectedly heavy rainfall.

iv. In addition to above, spare pumps will also be kept in the workshop/stores to meet the emergency.

Pumps of 15/ 38 / 75 lps or other convenient capacity having sufficient head will be procured in the required numbers.

Water stagnated on the haul roads, near the working faces and from undesirable water pockets will be handled by separate pumps, to discharge into the main sump.

The installed pumps will discharge water to the surface for the entire life of the mine.

Other Pumps

During rainfall, the water inflow into the sump contains clay & silt as well. To handle slurry, one number pump of slurry has been provided. In addition to above-mentioned pumps, adequate number of diesel pumps have also been envisaged.

Delivery Range

The delivery ranges will be laid along the batter of the mine as per the site of the main sump.

Also, additional pipe lines from surface to the sumps of adequate throughput should be always kept laid so that they can be made use of in emergency and can be directly connected to the pumps arranged in that situation without any loss of time.

7.1.3 Underground mine

The probable source of water to be taken care as mine drainage in any mine could be either accumulation of rain/surface water in working area or contribution of groundwater as mine seepage. The proposed mine will be worked out through underground as well as open cast mining techniques. Hence accumulation of rain / surface water is primarily considered for open cast mines. Only the groundwater seepage will form the source of water for underground mine drainage. The make of water in the underground mine will be from following sources.

a) Normal seepage / leakage from overlying sandstone of Barakar formation.

b) Inflow of water from Barakar sandstone roof during underground mining.

c) Part of water percolated from the OC excavated and backfilled area.

The water will be automatically drained to the sump in underground working at the lower most part of the mine. Adequate provision for draining out the seepage water from the sump will be provided and the working face will be kept dry. The face pumps will pump the water to the intermediate stage sumps from where the pumps will be finally pumping the water to the surface reservoir. Though the quantity of water make will be available from the project specific hydro-geological study based on which the capacity and number of pumps will be decided, the present estimates are based on the nearby operational mine at Milupara described below.

Hydrogeological data collected from neighboring underground mine block IV/5 of M/s Monnet Ispat Ltd. idicated that total make of water from the underground working inseam-II is of the order of 1 m^3/min in dry season and 3 m^3/min in monsoon season with extension of workings over an area of 4 sq km. As the area of Gare Sector-II UG workings is likely to be about double the above area and 2 seams can be operational at a time, volumes of water to be tackled could be 4 time higher than these.

The daily water for evacuation, therefore could be assumed as follows:

Units	Dry summer	Monsoon
cum/min	4	12
GPM	881.06	2643.17
cum/hr	240	720
GPH	52863.44	158590.31
cum/day	5760	17280
GPD	1268722.47	3806167.40

It has been assumed that on an average about 2000 GPM evacuation will be adequate, pending the establishing exact availability of volume of water after the hydrogeological Study is completed.

The delivery ranges can initially be laid along the inclines while drifting but later on a proper delivery pipes will be laid through the shafts once the development is started in the coal seams. Normally 2 ranges of 8" pipe lines will be laid through the intake shaft which can evacuate about 2000 GPM. These can be accordingly modified later once the hydrogeological study indicates the actual make of water.

7.2 REQUIREMENT OF WATER FOR SERVICE BUILDINGS & DUST SUPPRESSION

The total water requirement will be 1995 cum/day (Refer Table 10.1 in Chapter 10). The requirement of water for dust suppression, plantation, dump trucks washing workshop etc. is estimated to be about 1546 cum/day. The requirement of potable water for other site services i.e. Canteen, Rest shelter, Offices is estimated at about 1239 cum/day out of which 790 cum/day will be reclaimed from the STP of colony.

The total water requirement will be met by bore-wells at site during the initial 2-3 years after which the mine water will be used after appropriate treatment as required.

7.3 POWER SUPPLY & ILLUMINATION

7.3.1 Source of supply

The power will be fed to the project by an 11 KV overhead line from the existing grid sub-station at Tamnar.

7.3.2 Electric load

Most of the HEMM Equipment will be diesel operated except the high capacity shovels. Electrical power supply will be needed for Coal Handling Plant, illumination, Pumping, Workshop and residential colony.

The estimated connected load comes to the tune of 70000 KW as broadly calculated below.

TABLE 7.4
TENTATIVE POWER REQUIREMENT

Sl. No.	Particulars	Quantity	Unit power KW	Total power KW
I.	**Opencast**			
A.	**Coal**		nil	0
B	**Overburden**			
a)	Hydraulic shovel 5/5.5cum	4	350	1400
b)	Hydraulic Shovel 12 m^3 (electric)	7	600	4200
c)	Hydraulic Shovel 20 m^3 (electric)	20	1300	26000
g)	R.B.H drills 200/250 mm	24	100	2400
II.	**Others**			
i)	CHP etc			2000
ii)	Workshop			5000
iii)	Pumping combined OC+UG (2*350KW+2*200KW+4*160KW+13*40KW+20*11KW+4*50)			2680
iv)	Colony			2000
v)	Quarry and dump lighting			2000
vi)	Miscellaneous			1000
	Total (I+II)			**48680**
III.	**Underground**			
a)	Continuous miner 12CM27D	4	750	3000
b)	Shuttle car	8	219	1752
c)	Roof bolter	4	112	448

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Sl. No.	Particulars	Quantity	Unit power KW	Total power KW
d)	Feeder breaker	4	110	440
e)	Main fan	1	2250	2250
f)	LHD	4	160	640
g)	Conveyors(3*250 KW + 3*200 KW +9*50 KW +6*150 KW +9*60 KW +6*120 KW)			4000
h)	Rope haulage (2*100KW+2*80KW+2*60KW+1*20KW,) winder 400KW and manriding 100 KW			1000
	Total (III)			**13530**
IV.	**Misc. like overland conveyor to TPP**			**6000**
	Total (III+IV)			**19530**
	Grand Total OC, UG and others			**68210**
	Say			**70 MW**

7.3.3 Voltages & system earthing

The various voltages proposed to be used at the project are:

Incoming Supply	-	33 KV
Pumping	-	6.6/3.3 KVA & 415 Volts
Workshop	-	415 Volts
CHP	-	6.6/3.3 KV & 415 Volts
Lighting inside the quarry	-	220 Volts
Lighting outside the quarry	-	220 Volts

It has been proposed to adopt restricted earth neutral system for all equipment. An effective earthing system is planned to ensure safety to personnel as well as to prevent shock hazards. There will be an earthing grid surrounding the main substation. Its combined resistance shall be preferably kept below 2 ohms.

7.3.4 Illumination

Quarry illumination has been planned as under:

Power to the light shall be fed through transformers of 10 KVA 3.3/0.415 kV capacity. The working areas of the quarry shall be illuminated by a system of 4 x 400 W HPSV Lamps mounted on 15 m high mobile masts.

Transformers will be backed by DG Sets of suitable capacities arranged on hire basis.

Entire haul roads will be illuminated by 250 W HPSV Lamps mounted on steel poles erected along the haul roads. Power to these lamps would be supplied at 240 Volts from 100 KVA, 3.3/0.415 kV transformers.

OB dump and soil dumps will be illuminated by 1000 W metal halide lamps mounted on steel tubular poles with 10 KVA, 3.3/0.415 kV transformers.

7.3.5 Emergency lighting

Provision has been made for portable emergency lights during power failures for illumination of important locations such as project office, sub-station, store, hospital, time office etc.

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CHAPTER 8

VENTILATION

8.1 VENTILATION INCLINES AND SHAFTS DETAILS

Two Inclines (one pair) having crossection 4.8m X 3m and 2 shafts (Exhaust shaft-1 with 6m dia and Intake shaft-2 with 5m dia), all from surface to the lowermost "Seam-I Bot & Combined" are planned to be located in the NW portion of the western part of block. As the two inclines are not adequate to supply the intake air to sustain the proposed 1.60 MTPA production, an additional Shaft-2 (dia 5m) as mentioned above, is proposed near the inclines to augment the Intake Air which will be provided with proper Winding arrangements for regular use as man winding and material supplies and the same has been considered in the calculation. (Refer Plate VIII for UG development of Seam-IV).

Both the inclines are started from a point located at 100m distance from the NW boundary line of the block. The surface RL at the mouth of inclines will be 299m AMSL and the inclines will be driven at a gradient of 4.5:1 parallel to the NE block boundary at a distance of 100m and 150m respectively. That means that the inclines will be 50m apart and will have a length of 1709m in section (1668m length on plan). A safety barrier of 100m is further kept between the southern incline and the NE quarry boundary. The inclines and shafts will intersect floors of seams-IV, III, II, IL1, I and finally the lowermost seam-I Bot. & Comb. at RLs as given in Chapter 5 (Table 5.18).

It may be particularly noted that the location and alignment of the inclines has been selected in such a way that it intersects all the seams.

The exhaust fan will be installed at the shaft through a properly constructed evacuee. The sinking of the shaft is so scheduled that the drivage from incline and shafts reaches at the same time in seam-IV. The assessment of time required for drivages of inclines and sinking of shafts can be seen in Chapter 5 (Table 5.19).

8.2 REQUIREMENT OF QUANTITY OF AIR

The requirement of air is calculated and given in Table 8.1 below:

TABLE 8.1

REQUIREMENT OF AIR FOR VENTILATION OF MINE AND FACES AND COMPLIANCE WITH SPEED LIMITS (GARE SECTOR-II)

Particulars	Annual Production MTPA	Daily tonnage	Manpower in general shift	Daily Gas emission for Deg-II mine @10 cum/T (cum)	Air required cum/min	Air incl. elect. SS, pump house, drifting work etc assumed 10% (cum/min)	Total Intake Air with 30% leakage assumed, cum/min	Total Quantity with 10% extra assumed/ Velocity	Remark
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
A. **Requirement of Air on Production Basis**									
i) Requirement of air for the **Mine** @2.5 cum/T	1.6	4848.48			12121.21	13333.33	15757.58	17333.33	
ii) Requirement of air for the **District** in the Mine @2.5 cum/T	0.4	1212.12			3030.30	NA	3939.39	NA	
B. **Requirement of Air on Manpower Basis (Largest Shift)** @6cum/ person			600		3600	3960.00	4680.00	5148.00	
C. **Requirement of Air on Gas Basis**						0.00			
i) Requirement of air for the total Mine (inflammable gas basis) to dilute down to 0.75%		4848.48		48484.85	4489.34	4938.27	5836.14	6419.75	Degree of gassiness assumed Deg-II, liberates max gas @10cum/T of coal produced
ii) Requirement of air for the District in the Mine (gas basis)		1212.1		12121.21	1122.33		1459.03		Same as above
D. **Compliance to speed Limits.** Minimum air required in CM district as per A.ii above (@2.5 cum/min) for 4.8m wide and 3.0m high face.		1212.1			3030.303	NA	3939.39	NA	Max. 4.0 m/s & min 0.5m/s vide DGMS circular No. 8674-94 dated 29.5.74 for CM working district
Thus, the velocity of air current in CM face (3030.303/(4.8*3*60)								3.51	Complies with <4m/s

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Hence, considering all the options from "A" to "D", the option "A" is selected i.e. 12121.21cum/min. After considering 30% leakage during circulation and requirement of panels individually, total air requirement works out to 15757.58 m^3/min. After considering 10% extra air for ventilating other locations (electrical sub-station, pump house, drifting work etc), total air requirement works out to 17333cum/min.

The UG mine operation extends over 9 km length and the working life of the UG mine is 77 years, as such another indicative shaft location has been suggested (to be firmed only after fresh study after about 25 years of the mine operation) to reduce mine resistance and cut down transportation distance of men materials etc. With this in view, it is proposed to install 1 nos. mechanical Ventilator of total capacity of 17350 m^3/min. One fan (exhaust) will be installed at ventilation shaft-1 (Return) having 6m dia on surface through evacuee. The exhaust fan will have the provision of variable pitch of blades to improve the quantity of air required in future.

Accordingly intake air is planned to be sent through 2 nos. inclines each having crossection of 4.8mX3m along with a 5m dia ventilation shaft-2 (with facilities for men and materials winding), all to be located in the NW portion of the block. It is to be specifically noted that the Intake inclines and shafts have been provided with such dimensions as will permit expansion in production in future.

The calculations for cross checking the speed in shafts and inclines for ascertaining the adequacy of air (being supplied or exhausted) are as follows:

TABLE 8.2
CALCULATIONS FOR CROSS CHECKING THE SPEED IN SHAFTS AND INCLINES FOR ASCERTAINING THE ADEQUACY OF AIR (BEING SUPPLIED OR EXHAUSTED)

Particulars	Annual Prodn. MTPA	Daily tonnage	Air required in cum/min @ 2.5 cum/t	Air required in cum/ min considering 30% leakage	Total Intake air required (cum/sec)	Vol through particular working, cum/sec	Incline/ Shaft dimensions, m	Area of Incline/ shaft crossection, sqm	Actual Speed kept m/s	Max permitted speed m/s	Remark
Overall air volume required	1.6	4848.48	12121.21	17333.33	288.89						
INTAKES											
Incl No.1 with conveyor						57.6	4.8*3	14.4	4	4	
Incl No. 2 without conveyor						115.2	4.8*3	14.4	8	8	
Vent shaft-2 intake with manwinding/ material system						116.09	5	19.63	5.92	8	OK, it has extra cap of over 35% and will serve future expn plans of 2MT
Total in Intakes (inclines + Shaft)	1.6	4848.48	12121.21	17333.33	288.89	288.89					
RETURNS											
Vent. Shaft-1 (Exhaust) without man winding							6	28.26	10.22	12	OK, has 17% extra to keep future in mind for 2MT

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The above table shows that the Intake and Return air ways are adequate to fulfill the ventilation requirement.

8.3 SIZE AND CAPACITY OF MAIN FAN

Air pressure (p) required for the mine works out on the basis of the following formula:

$$P = RQ^2$$

Where

- P is pressure (gauge) in pascal,
- R is resistance in Gaul and
- Q is volume of air in m^3/sec

The value of R has been calculated as 0.117 Gauls

Therefore pressure has been calculated as follows:

P = 0.085x 288.89 x 288.89 =7094 pascals = 723mm of wg
(as 1 Pascal=0.1019 mm of water gauge or 1 mm of wg = 9.81 pascals).

Fan HP=(Q in cum/sec*100)/(75*0.8)

HP=288.89*850)/(75*0.8)	3014
KW @0.746HP/KW	2248

Say 2250 KW

The main mechanical ventilator of following specification will be installed at the Exhaust (Return) ventilation shaft-1 through evacuee.

TABLE 8.3
SPECIFICATIONS OF MAIN VENTILATOR

Type	Axial flow fan at Shaft (serving for 1.60 MTPA coal production)
KW	3000
RPM	600
Air flow (cum/sec)	290
W.G.	1002 mm

Evacuee of suitable design will be constructed for improving the efficiency of the mechanical ventilators.

8.4 DESCRIPTION OF VENTILATION ROUTE

The main mechanical ventilator will be installed at surface for exhaust ventilation system for all the seams. Both the inclines will be kept as air intakes besides the Shaft-2 with 5m dia will help in augmenting the volume to adequacy. The inclines and the shaft will be connected by 3 drives in each coal seam. The five heading dip drives will serve the purpose of ventilation for each of the seams. The three inner dip drives connected to panels will be kept as air intakes and outer side dip drives will work as return from the panels. The air route will be maintained by erecting proper air crossings in the panels (Refer Plate XXXVIII). Underground ventilation can be seen in Plate XIX and XXIV.

From the very beginning all the 2 inclines with one shaft-2 (5m dia) will be used for intake and shaft-1 with 6m dia will be used for return air ways.

Auxiliary fans with suitable ducts will be used for blind headings of more than 30 meters length for a sufficient supply of air.

Following objectives are to be attained by adequate ventilation:-

a) The inflammable gas does not exceed 0.75% in return air of any ventilating district and 1.25% in any place in the mine.

b) The velocity of air at immediate out bye connection from the face should not be less than 30m/minute.

For other places it should be as follows:

TABLE 8.4
VELOCITY OF AIR CURRENT REQUIRED AT VARIOUS PLACES IN UG MINE WORKINGS

Degree of Gassiness	Places where velocity of air is to be measured	Velocity of Air
1st, 2nd, 3rd degree	Immediate out bye ventilation connection from the face.	30 m/min.
1st & 2nd degree	i) 4.5m from any face in intake side of brattice or partition ii) 7.5m outbye of the discharge end of air pipe	30 m/min
3rd degree	i) 4.5 m from any face on intake side of brattice or partition	45 m/min
	ii) 7.5m outbye of the discharge end of an air pipe	25 m/min.

c) In case of solid blasting, a minimum of 284 m^3/min of air should be circulated to every face.

d) If wet bulb temp at any working place exceeds 30.5^{0}C, the air current should be less than 60m/min and more.

e) Provision and transport of the ventilation stopping materials (including access doors), building of the walls, air crossings etc. shall be the responsibility of the mine. Nowadays a range of pre-fabricated pressure rated ventilation structures may also be used which can offer significant savings in installation time and cost and also in materials transport.

f) Ventilation monitoring, measurements, updating of plans etc. and all legal responsibilities as required by the Indian Coal Mines Regulations shall be the responsibility of the mine. Exemption from existing quantity requirements as specified in the Indian Coal Mines Regulations would be required.

The Block coal seams are considered as degree 2nd gassiness for all purposes of calculation of ventilation.

8.4.1 Ventilation in mine panels

Mechanized Bord and Pillar mining generally results in a high quantity/low pressure ventilation system due to the large cross section and the number of driven roadways.

The ventilation system will be finalized in conjunction with the mining design work. It may utilize flanking returns whereby intake ventilation reaches the face along the centre drives of the district, coursed by brick (Breeze Block, IBR sheeting etc.) ventilation stopping with the other central roadways used as return airways. The number of intakes and returns will take into account not only the quantity of air at the face but also the air velocity within the roadways to prevent "dead ends/ blind headings".

Stoppings shall be maintained within a maximum 2 splits of the conveyor "tail end". Leakage through the last split is controlled by temporary ventilation stoppings usually made from hanging strips of old conveyor belting bolted to the roof.

Two auxiliary fans with a minimum duty of 10 cum/sec discharging into the return airways are to be installed with reinforced flexible ventilation ducting between the face and fans or should be used and hung from the roof bolts on straining wires.

8.4.2 Section ventilation requires

- One operating auxiliary exhaust fans with a capacity each to deliver 10m^3/sec. at the working face.

- Standby auxiliary fans to maintain efficient ventilation management during panel advance and relocations.
- Cables and switchgear.
- Sufficient staining wire reinforced flexible ventilation tubing etc. as necessary (at least 200 m) and 'T" pieces etc. to ventilate all blind ends.

8.4.3 Precautions against coal dust explosions

Precautions against coal dust explosions such as the application of stone dust, stone dust/water barriers in districts, haulage & conveyor should be installed as per CMR, regular sampling and analysis of dust shall be according to the requirements of the Indian Coal Mines Regulations. These precautions shall be the responsibility of the mine.

Stone dust etc. shall be applied by the mine during periods outside of district production shift times. Stone dusting of the district shall at all times be at least to the last split.

CHAPTER 9

STACKING OF MINERAL REJECTS AND DISPOSAL OF WASTE

9.0 WASTE GENERATED DURING OPENCAST AND UNDERGROUND MINING

A. WASTE GENERATED DURING OPENCAST MINING

9.1 NATURE OF TOP SOIL AND OVERBURDEN/ WASTE

Overburden consists predominantly sandstone with minor amount of shale, carbonaceous shale, ungraded coal and thin coal bands. Besides, the overburden also includes soil, weathered rocks, obvious bands of any thickness and dirt bands of >1m thickness. 0.60 meter average thickness of top soil has been considered for separate removal and stacking for use in mine reclamation later.

9.2 YEAR/STAGE WISE WASTE GENERATION

The waste generation year/stage wise is given in Table 9.1.

TABLE 9.1
WASTE GENERATION (TOPSOIL & OVERBURDEN) IN M.CUM (BANK) PROGRESSIVE

Year	Excavation Area	OB+TS Removal	Topsoil Generated From Excavation	Pure OB From Excavation, Mcum
	Progressive	Progressive	Progressive	Progressive
Const. (0)	0.00	0.00	0.00	0.00
1st year	26.16	5.00	0.16	4.84
2nd-3rd year	103.81	129.97	0.62	43.48
4th - 5th year	250.73	152.60	1.50	123.50
6th - 10th year	718.67	675.00	4.31	670.69

Year	Excavation Area	OB+TS Removal	Topsoil Generated From Excavation	Pure OB From Excavation, Mcum
	Progressive	**Progressive**	**Progressive**	**Progressive**
11th - 15th year	647.69	624.00	3.88	620.11
16th - 20th year	202.79	495.00	1.22	493.78
21st - 25th year	322.57	495.00	1.94	493.06
26th - 29th End of mine	168.13	298.00	1.01	296.99
Closure plan 30th - 32nd	0.00	0.00	0.00	0.00
Total	**2440.55**	**2761.10**	**14.64**	**2746.46**

9.3 WASTE DISPOSAL SITES

There are different waste disposal sites located within the ML as follows:

i. The surface dumps

There is only one surface dump proposed which will be located over the coal bearing area in the southern portion of the West pit area. This dump will be spread over a maximum area of 380 ha (5th year) and will accommodate 218.81 Mcum (B) OB waste. The Dumping will start from 1st year and continue upto 6th year, however the exclusive dumping into this surface dump will be upto 5th year after which part (47.07) of the OB will be backfilled in 6th year.

The full height of the dump will be 90m in 6th year. No OB will be required to be disposed over the surface dump after 6th year.

As the surrounding area of the mine is coal bearing and belonging to other coal blocks, availability of external dumping space other than within the block is not foreseen. The entire block area is coal bearing and dumping location, schedule and rehandling have been envisaged accordingly which will cater to the dump space requirement for the project.

The proposed design layout has been arrived after also considering the simultaneous operation of OC and UG.

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ii. Backfill dump

Backfilling will start from 6th year of the project operation with a quantity of 87.068 mcum(B). During 6th year partial backfilling will be done and then upto final year full backfilling will take place concurrent with mining.

In the Mining Plan, provision for space for a washery has been made. The decision regarding capacity and layout of washery will be reached after thorough investigation. The rejects generated from the washery could also be backfilled into the quarry voids after taking permission from the relevant authorities. However, quantification of rejects is not possible at this stage as the washability study is still under preparation.

iii. Top soil dump

The total topsoil generated will be 14.64 mcum (B) during the life of the mine. Unutilised part of the same will be stacked separately in a soil stack pile located beyond the surface dump over the coal bearing area within West Pit area of 60.00 Ha (max). It will be used for growing plants along the fringes of the site roads and reclamation of surface dump and backfilled area.

The top soil stockpile will be low height not exceeding 6 m and will be grassed to retain fertility. Besides this, there would be temporary stacks near the excavation area and area to be reclaimed which will be made use of for concurrent filling without bringing the topsoil to the soil stack near the OB dump.

9.4 THE VOID

The remaining void area of 331.06 ha (195.15 ha in east pit with 170m depth upto pit floor + 135.91 ha in west pit with reduced depth of 60m as a result of partial backfilling) of the excavated pits will be at the end of mine life 29th year. The voids will be completely backfilled during post mine closure period 30th to 32nd both in East as well as West pit.

Plate XXVI shows the final stage at the end of mine operations with external dump rehandled and final void. The generation and disposal of total waste quantities for the life of the mine are shown in Table 9.1 and Table 9.2 respectively.

TABLE 9.2
WASTE DISPOSAL (TOP SOIL & OB) IN MCUM (BANK)
CALENDAR PROGRAMME OF WASTE DISPOSAL (DIRECT AND REHANDELED) IN EAST AND WEST PIT (COAL MT, OB IN MBCUM)

Year	Total East + West Pit		Surface Dump Rehandling from West to West		Crown Dump Rehandling West to West		Crown Dump Rehandling West To East		Total OB Disposal (Direct + Rehandeled)	
	OB Progr.	OB Cumul.	Progr.	Cumul.	Progr.	Cumul.	Progr.	Cumul.	Progr.	Cumul.
1	5.00	5.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	5.00
2	14.10	19.10	0.00	0.00	0.00	0.00	0.00	0.00	14.10	19.10
3	30.00	49.10	0.00	0.00	0.00	0.00	0.00	0.00	30.00	49.10
4	45.00	94.10	0.00	0.00	0.00	0.00	0.00	0.00	45.00	94.10
5	80.00	174.10	0.00	0.00	0.00	0.00	0.00	0.00	80.00	174.10
6	135.00	309.10	0.00	0.00	0.00	0.00	0.00	0.00	135.00	309.10
7	135.00	444.10	21.74	21.74	0.00	0.00	0.00	0.00	156.74	465.84
8	135.00	579.10	21.74	43.48	0.00	0.00	0.00	0.00	156.74	622.58
9	135.00	714.10	21.74	65.22	0.00	0.00	0.00	0.00	156.74	779.32
10	135.00	849.10	21.52	86.74	0.00	0.00	0.00	0.00	156.52	935.84
11	135.00	984.10	5.22	91.96	0.00	0.00	0.00	0.00	140.22	1076.06
12	130.00	1114.10	5.22	97.18	0.00	0.00	0.00	0.00	135.22	1211.28
13	130.00	1244.10	5.22	102.40	0.00	0.00	0.00	0.00	135.22	1346.50
14	130.00	1374.10	5.22	107.62	0.00	0.00	0.00	0.00	135.22	1481.72
15	99.00	1473.10	4.75	112.37	0.00	0.00	0.00	0.00	103.75	1585.47
16	99.00	1572.10	21.74	134.11	0.00	0.00	0.00	0.00	120.74	1706.21
17	99.00	1671.10	21.74	155.85	0.00	0.00	0.00	0.00	120.74	1826.95
18	99.00	1770.10	21.74	177.59	0.00	0.00	0.00	0.00	120.74	1947.69

Year	Total East + West Pit		Surface Dump Rehandling from West to West		Crown Dump Rehandling West to West		Crown Dump Rehandling West To East		Total OB Disposal (Direct + Rehandeled)	
	OB Progr.	OB Cumul.	Progr.	Cumul.	Progr.	Cumul.	Progr.	Cumul.	Progr.	Cumul.
19	99.00	1869.10	21.74	199.33	0.00	0.00	0.00	0.00	120.74	2068.43
20	99.00	1968.10	19.50	218.83	0.00	0.00	0.00	0.00	118.50	2186.93
21	99.00	2067.10	0.00	218.83	0.00	0.00	0.00	0.00	99.00	2285.93
22	99.00	2166.10	0.00	218.83	0.00	0.00	0.00	0.00	99.00	2384.93
23	99.00	2265.10	0.00	218.83	0.00	0.00	0.00	0.00	99.00	2483.93
24	99.00	2364.10	0.00	218.83	0.00	0.00	0.00	0.00	99.00	2582.93
25	99.00	2463.10	0.00	218.83	0.00	0.00	0.00	0.00	99.00	2681.93
26	99.00	2562.10	0.00	218.83	64.35	64.35	0.00	0.00	163.35	2845.28
27	99.00	2661.10	0.00	218.83	64.35	128.70	0.00	0.00	163.35	3008.63
28	95.00	2756.10	0.00	218.83	77.83	206.53	0.00	0.00	172.83	3181.46
29	5.00	2761.10	0.00	218.83	34.91	241.44	42.86	42.86	82.77	3264.23
30	0.00		0.00	218.83	0.00	241.44	44.18	87.04	44.18	3308.41
31	0.00		0.00	218.83	0.00	241.44	44.18	131.23	44.18	3352.60
32	0.00		0.00	218.83	0.00	241.44	44.18	175.41	44.18	3396.78
Total	**2761.10**		**218.83**		**241.44**		**175.41**		**3396.78**	

The year/stage wise surface dump area and backfill area are given below in Table 9.3 and 9.4 respectively.

TABLE 9.3
PROGRAMME OF EXCAVATED AND BACKFILLED AREA, CUMULATIVE (HA)

Upto the end of year	Area mined	Backfilled area	Remark
1st year	26.16	0.00	No backfilling
3rd year	129.97	0.00	No backfilling
5th year	380.70	0.00	No backfilling
10th year	1099.37	358.27	Part Direct Backfilling and Part from rehandled surface Dump
15th year	1747.06	673.05	Part Direct Backfilling and Part from rehandled surface Dump
20th year	1949.85	1122.31	Part Direct Backfilling and Part from rehandled surface Dump
25th year	2272.42	1536.00	Part direct backfilling and part from rehandled surface dump
End of mine 29th	2440.55	2109.49	Part direct backfilling and part from rehandled crown dump
Post mine closure stage **32ND**	2440.55	2440.55	Backfilling from rehandled crown dump*

* *During the post mine closure period (30th to 32nd year), part of the crown dump will be fully rehandaled and backfilled into the residual void (below surface level) while part of the crown dump (with an extent of 138 ha with 72.37 mcum B) will be reduced in height from 100m to 80m and backfilled.*

TABLE 9.4
YEAR / STAGE WISE DUMPED CUMULATIVE AREA AND HEIGHT

Year	Surface Dump	
	Area, Ha	Height, m
1st	36.19	20.00
3rd	173.33	60.00
5th	380.00	90.00
10th	292.72	90.00
15th	190.59	90.00
20th	0.00	0.00
25th	0.00	0.00
At the end of final year (29th)	0.00	0.00
Closure stage (32nd)	0.00	0.00

* *The surface dump constructed during the initial 6 years over the coal bearing area will be rehandled between 7th and 20th year and backfilled.*

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B. WASTE GENERATED DURING UNDERGROUND DEVELOPMENT AND MINING

B.1 Waste generated from shaft sinking and drivage of inclines

The waste generated from shaft sinking and drivage of inclines is given below in Table 9.5.

TABLE 9.5
WASTE GENERATED FROM SHAFT SINKING AND DRIVAGE OF INCLINES

Particulars	Surface level, m RL	Deepest level reached at floor of seam- I Bot & Comb, m RL	Total depth, m	Actual Length along section @4.5:1, m	Length in plan, m	Cross-section area, sq. m	Volume of rock generated, cum
INTAKES							
INCL NO.1 with conveyor (4.8m*3m)	299	-81	380.00	1710.00	1626.70	14.40	24624.00
INCL N.2 without conveyor (4.8m*3m)	299	-81	380.00	1710.00	1626.7	14.40	24624.00
Vent shaft-2 intake with man winding/ material system (dia 5m)	292	-87	379.00	379.00	0.00	19.625	7437.875
Total in Intakes (inclines + Shaft)							56685.88
RETURNS							
VENT Shaft-1 (Exhaust) without man winding (dia 6m)	288.5	-76	364.50	364.50	0.00	28.26	10300.77
Total (inclines + Shaft)							**66986.65**

B.2 Waste generated from drift drivage (for crossing the faults)

The detailed calculations drift-wise have been given in Annexure 9-1 and the same is summarized below:

Volume of waste material from drifts in seam IV = 32860.8 cum
Volume of waste material from drifts in seam III = 41659.2 cum
Volume of waste material from drifts in other seams = 75480.0 cum
Total Volume of waste material from drifts in all seams = 150000 cum

This material will be hauled through the inclines (using mine tubs or conveyor as applicable) or shaft (using mine tubs) to the pit top from where loaded into dumpers through appropriate arrangement and disposed of on to the surface dumps (constructed for OC operations) or backfilled into the de-coaled area if available.

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CHAPTER 10

COAL HANDLING, WASHING & MODE OF DISPATCH

10.1 COAL HANDLING PLANT

A Coal Handling Plant with design capacity of 23.6 million tonnes per annum will be established.

As coal is to be produced through surface miners from OC, additional crushing of coal in the CHP is not required. OC Coal will be transported by 100/150T dumpers directly to the ground Bunker of 70000 tonne capacity via unloading platform, reclaim conveyor and Transfer Point (TP1). UG coal produced by Continuous miners will also not require additional crushing. This coal will be directly fed to the ground bunker through the conveyor emanating from the incline.

The alignment of railway corridor passing through the coalfield has yet to be frozen after addressing concerns of different stake holders by the Govt. The loading system will be decided in totality, once the parameters like alignment of the siding and its distance and its corridor from the mine etc. are available.

The truck transport system is proposed as an option till the alternative system takes a shape.

The coal from ground bunker can be sent to three directions through Transfer Point (TP2) as follows.

i. To and from washery,
ii. To silos for railway despatch of washed coal or unwashed coal bypassing the washery circuits, so that the despatch is not affected in case of any problem in washery.
iii. To bins/hoppers for truck despatch of washed coal or unwashed coal.

Plate No. XLI shows plan view, elevation view and coal flow of the Coal Handling Arrangement.

The salient features of the CHP are as under:

a. A 1800/2000 mm wide Belt Conveyors System designed to run at upto 3500 TPH to meet the 23.6 MTPA design output.

b. A Belt Weigher and an on-line Coal Ash Analyser will be located on the conveyor to get the tonnage and on line indication of ash and moisture prior to feeding into bunker or the stockpile.

c. A suspended magnet will be provided to remove tramp iron at appropriate location.

The truck transport system is proposed as an option till the alternative system takes a shape.

10.1.1 Ground Stock and Bunkerage

Ground stock yard to accommodate about 0.2 Mt of coal production of the mine will be located near the coal handling plant and coal from this ground stock will be loaded into trucks with the help of pay loaders. The stock pile will be created by trucks bringing coal from surface miners in emergencies as normally surface miner coal will be discharged into the ground bunker of 70000 t capacity through the dumper unloading platform equipped with 8 nos. grizzlies.

10.1.2 Weighment

One electronic weigh bridge, of 100 tonne capacity, has been proposed to be installed near to the stock pile. Tare and Gross Weight of the trucks shall be recorded for dispatch of coal leaving the premises.

10.2 COAL WASHERY

The average ash content of total insitu extractable reserves works out to 37 to 38 % (refer Table 5.9 of Chapter 5). However, the Ash % fluctuates from year to year between 34.05 % and 41.42%. There will be some further deterioration in ROM coal quality due to dilution during mining operations.

In the Mining Plan, provision for space for a washery has been made. The decision regarding capacity and layout of washery will be reached after thorough investigation. MSPGCL has approached CMPDIL (Copy enclosed as Annexure 1-3) for generation of data (washability tests, cleaning possibilities etc) and report preparation.

The washery rejects shall be within the normative limits and will be disposed off strictly as per rules and regulation framed by Ministry of Environment, Forests and Climate Change and change from time to time.

10.2.1 Transportation of coal to the EUPs

Coal will be transported to the TPPs through rail from the nearest available railway siding. A coal stack facility has been provided for accommodating three days production.

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CHAPTER 11

MINE INFRASTRUCTURE

11.1 GENERAL

The following Infrastructure will be developed for smooth operations of the mine to ensure un-interrupted supply of coal to the End Use Plants:

1. Coal handling plant and Washery (Covered in previous Chapter 10).
2. Mine site infrastructure.
3. Residential colony outside the ML area.

The details about the Coal handling Plant have been provided in Chapter 9. This Chapter deals with the balance two packages of the Mine Infrastructure.

A Master Plan indicating the Coal Block, CHP Area, Mine Site Infrastructure Area etc. is given as Plate IV.

The infrastructure facilities have been proposed to be located over the coal bearing area as there is no non-coal bearing area available for this purpose.

11.2 MINE SITE INFRASTRUCTURE

The Mine Site Infrastructure will consist of the following facilities:

(i) Light Vehicle Workshop
(ii) Lubricants & Oil Storage
(iii) Main Office
(iv) Training Centre
(v) Workers Canteen
(vi) Fuel Tank Farm
(vii) Explosives Magazine for storage of Detonators & Safety Fuses.
(viii) Coal Quality Monitoring Laboratory
(ix) Infrastructure Roads
(x) Hard Standing Areas for HEMM
(xi) Miscellaneous Storage Areas

(xii) First Aid Room

(xiii) Pithead bath

11.2.1 Light vehicle workshop

A Light Vehicle Workshop will be provided to maintain light trucks and vehicles. The workshop will be equipped with standard equipments like overhead crane, lathe machines etc along with other facilities.

11.2.2 Lubricants & oil storage

A Lubricants & Oil Storage facility will be provided for Heavy Earthmoving Machinery complete with rapid fill devices.

It will be constructed adjacent to the filling pad with adequate storage capacities. Stock equivalent to one months' consumption shall be normally maintained.

11.2.3 Main office complex

The Office complex comprising of Mine Managers Office, other offices and meeting rooms of varying sizes, partitioned offices and cubicles, store rooms, a kitchen and toilets will be constructed. It will house the Survey Room, First Aid Room, Medical check up room and safety and Personnel Departments.

11.2.4 Vocational training centre

The Training Centre complex with sufficient floor space comprising offices of varying sizes, theory training class rooms, practical training rooms, Pantry and toilet. The Vocational Training Centre is required for imparting training for workers / engineers on various operational safety issues.

11.2.5 Worker canteen

The canteen & recreational area, toilets & shower facilities will be constructed as per statutory requirement.

11.2.6 Fuel tank farm

A diesel filling station with rapid fill arrangement will be provided for Heavy Earthmoving Machinery. A piping and pump injection system from the tanks will facilitate rapid filling of machinery from the filling Pad. The filling Pad will have dimensions 10 m x 20 m. The top surface will be sloped to ensure any loose hydrocarbons drain into the slab edge drains which will direct the hydrocarbons flow to a fuel-oil interceptor.

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11.2.7 Explosive magazine

It is proposed to use Site Mix Slurry (SMS) Explosives for blasting in the Mine. This will obviate the need for a regular explosive Magazine for conventional explosives.

However, for storage of required amount of detonator fuses, safety cords etc a 2X20 Tonne Capacity Explosive Magazine will be constructed in the block area falling in east of the Kelo river which is proposed to be mined after about 2 decades in sequence to the West portion of the block. The magazine will, however, be shifted over to the backfilled area of the West Pit later.

11.2.8 Coal quality monitoring laboratory

For quality assurance and control, it is proposed to establish a Coal Laboratory with all the necessary equipment for daily analysis of the coal quality at Mine end.

11.2.9 Internal infrastructure roads

Internal roads leading to Coal Handling Plant and other service facilities will be developed during development of the Mine Site Infrastructure.

11.2.10 Hard standing areas

Hard Standing Areas are required to be provided to facilitate parking as well as for undertaking minor repairs / inspections of the heavy mining equipment. The Areas are required to be constructed by laying Reinforced Cement Concrete. It is proposed to establish two separate Hard Standing Areas suitably located on the pit top.

11.2.11 Miscellaneous storage areas

Open miscellaneous storage areas will be constructed at suitable locations by laying RCC to facilitate storage of materials like tyres, construction steel, pipes etc. It is proposed to construct two separate storage areas suitably fenced for this purpose.

11.3 RESIDENTIAL COLONY

The Gare Palma area is situated around 35 km away from Raigarh Township. The block is connected by road from Raigarh via Punjipathara by State Highway. Punjipathara village is situated on Raigarh-Ghargoda main road. The distance from Raigarh to Ghargoda is around 40 km. The road distance between Raigarh to Punjipathara is about 20 Km and Punjipathara to Ghargoda is 20 Km towards north. From Punjipathara the road leads to the Gare Palma area via Tamnar TPP area situated at a distance of 10 Km on Punjipathara- Milupara road, which passes through the block.

Considering the above, it is proposed to establish only some essential quarters within the ML for the Mine Personnel to cater to essential services. Remaining persons will be accommodated at a suitable site outside the ML area. The Residential Colony will be equipped with fully serviced accommodation units for different class of employees. All the units will be provided with power, communication, potable water supply, and sewerage and garbage collection facilities.

The Residential Colony will also contain the Bachelor's Hostel as well as Recreation Facility for all employees. The layout of the Residential Colony will have provision of garden and green belt along the periphery.

The Mine Infrastructure will be established in synchronization with each other for timely implementation of the Coal Mining Project.

The manpower required is 3400 and it is planned to provide accommodation to 50% of the employees, the rest are expected to be local.

11.4 WATER SUPPLY

Industrial water required for washing, sprinkling on mine roads for dust suppression and for watering the mine site plantations, will be supplied from pumping installation at mine sump and its surface reservoir after adequate water is available in the mine. However, in the initial stage, the requirement will have to be met from the ground water through bore wells.

The drinking water will be supplied from bore well and stored in overhead tank near the facilities area and distributed through pipe lines to different facilities area for drinking and domestic purposes.

Total net requirement of water for mining and allied activities are estimated as 1995 m^3/day. Out of this 1239 m^3/day will be potable water and the rest 756 KLD will be required for industrial use in addition to the 790 cum/day reclaimed water from colony STP which will be reused.

The break up of the required water for different activities is as follows:

TABLE 11.1
WATER REQUIREMENT

i. **Potable water**	**Daily requirement, cum**
Drinking at working place @ 45 lpd/head for 3400 workers etc. (Total 3400)	153.00
*Colony (for 50% employees)= 3400/2=1700*4	986

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members in family @ 135 lpd	
For peripheral villages	100.00
Total of (i)	**1239**
ii. Industrial water*	
Sprinkling @ 30 m^3/km of road length (10km)	300.00
Plantation @ 20 cum/hac {1509.12 ha/22.5 years=59.18 ha (say 60 ha)	1200.00
Vehicles washing @ 2.0 m^3/vehicle/day {washable vehicles about (400X2 times a weak)/7 days=115 veh/day(Water required 115x2-80%*230 re-circulation=46)	46.0
Total (ii)	**1546**
Grand total (i + ii)	**2785**
Reclaimed water from STP of colony (80% of 986 cum) which can be used in watering the plantation	**790**
Net water requirement	**1995**

* *It does not include requirement of water for washery as the size of washery and washery circuit have not been decided yet pending the study in progress by CMPDIL.*

As the make of water into the OC mine workings is expected to be more than the requirement from 5th year onwards (Refer table 7.2 in Chapter 7), the water requirement projected above can be easily met from the mine water after 5th year.

CHAPTER 12

MANPOWER, SAFETY AND SUPERVISION

12.1 MANPOWER AND SUPERVISION REQUIREMENT

A number of local personnel including land losers would be recruited in unskilled and semi skilled categories. These personnel need training and orientation before project starts. Besides, some I.T.I. qualified young people from the region can be recruited for operation and maintenance job of plant and machinery after proper training. The employment of local people in primary and secondary sectors of project shall upgrade the prosperity of the region. But, many skilled and highly skilled personnel have to be brought from outside as there is no industrial culture in the locality.

It is proposed to outsource the major equipment required for OB & Coal removal. Also some of the services like Security, Canteen etc are recommended to be out sourced for better management and improved results. The company will engage only the statutory manpower required for mining including for blasting. The manpower for operating the hired equipment will be arranged by the contractor.

It is estimated that manpower of 60 will be required for operating and maintaining Coal Handling Plant.

However, the details of the total employment potential of Project including Departmental Manpower, Contractor Manpower and Manpower required for other allied works are provided in Table 12.1.

TABLE 12.1
TOTAL TENTATIVE EMPLOYMENT POTENTIAL

Sl. No.	Particulars	No. of workers
I.	**Heavy Earth Moving Machinery**	
A.	**Coal**	
a)	100 T.R.D.(CB) dumpers (Diesel Operated) for 3800SM(W)	15
b)	150 T.R.D.(CB) Dumpers (Diesel Operated) for 4200S(W) CSM	60
c)	0.9 m3 hydraulic backhoe (diesel operated)	6
d)	Dozer 275-320 HP	12
	Dozer 410 HP (Diesel Operated) with ripper	6
e)	Surface miner 3800 SM(W)	6
f)	Surface miner 4200S (W)	12
	Sub-Total for Coal	117

Sl. No.	Particulars	No. of workers
B.	**Overburden**	
a)	Hydraulic shovel 5/5.5cum	12
b)	Hydraulic Shovel 12 m3 (electric)	21
c)	Hydraulic Shovel 20 m3 (Electrical)	60
d)	50 Tonne Dump Truck for 5/5.5 m3 shovels	60
e)	150 Tonne Dump Truck for 12 m3 shovels	189
f)	150 Tonne Dump Truck for 20 m3 shovels	720
g)	R.B.H drills 200/250 mm (Diesel Operated)	144
h)	Dozer 410 HP (Diesel Operated)	90
i)	Dozer 275-320 HP (Diesel Operated)	30
	Sub-total for OB	**1326**
II.	**Auxiliary & Service Equipment**	
a)	8 m3 Front End Loader (Coal) (Diesel Operated)	15
b)	5 m3 Front End Loader (Coal) (Diesel Operated)	12
c)	Graders 230 HP (Diesel Operated)	8
d)	Diesel Bouser	18
e)	Construction backhoe -0.9 CUM (Diesel Operated)	4
f)	Water sprinkler (26 KL) (Diesel Operated)	36
g)	Tow truck on 50T truck chassis (Diesel Operated)	4
h)	100 T tractors (Diesel Operated)	4
i)	Rough Terrain Crane - 40T mobile (Diesel Operated)	4
j)	Lattice crane 70 T	2
k)	**Service trucks**	0
	Fuel trucks (Diesel Operated)	18
	Wash trucks (Diesel Operated)	18
	Mobile maintenance trucks (Diesel Operated)	18
	Lube trucks (Diesel Operated)	12
	Fire trucks (Diesel Operated)	6
	Explosive van (Diesel Operated)	4
l)	Portable air compressor	12
m)	Tyre handler	12
	Sub Total for Auxiliary & Service Equipment	**207**
	Reclamation	
a)	2.5 cum Front End Loader	8
b)	10 T Truck	20
c)	0.9-1.2 cum hydraulic Excavator	8
	Sub Total for reclamation	36
	Total (coal+OB+Aux+Reclamation)	1674
a)	Excavation	74
b)	CHP etc	60
c)	Mining, safety, Qualiy, Despatch	100
d)	Store, Purchase	16
e)	Water supply	12
f)	Environment	10

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Sl. No.	Particulars	No. of workers
g)	Personnel	5
h)	Finance	2
i)	Workshop	60
j)	Pumping	14
k)	Communication	7
l)	Mine pumping	14
m)	Survey	11
n)	training	5
o)	Miscellaneous	13
p)	Others (Drivers for fire tender, Cash van and Ambulance	7
	Grand Total	2096
	Provision for Sick and leave (16%)	334
	Grand Total including sick and leave	**2430**
III.	**Underground @ 5 OMS**	**970**
	Grand Total (OC+UG)	**3400**

12.2 SAFETY ASPECTS AND DISASTER MANAGEMENT

All types of industries face certain types of hazards which can disrupt normal activities abruptly and lead to disaster like fires, inundation, failure of machinery, explosion to name a few. Similarly coal mines also have impending dangers or risk which need be investigated addressed, disaster management plan formulated with an aim of taking precautionary steps to avert disaster and also to take such action after the disaster which limits the damage to the minimum.

12.2.1 Inundation

There is only one prominent water course passing through the eastern part of the block i.e. Kelo river.

An action plan is needed to be drawn as a contingency measure to guard against danger from inundation.

A stand by diesel generator will be provided for un-interrupted supply of power to the pumps in the event of failure of power.

The mine working will be protected from the river inundation by providing embankments on either side of the river. The embankments will be designed with 3m height above HFL and 10m width. The slope of the sides will be 1 in 3 on river side and 1 in 2 on quarry side. Core of the embankment will be constructed from impervious clay. Both sides of embankment will be clad/paved with stones. Adequate measures to protect the mine workings from surface water flow during the rains will be taken by way of providing garland drains around the mine excavations and also by

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providing suitable drainage gradients for mine benches. Sumps of adequate capacity will be provided on the quarry floor. The coal excavation and transport machinery are organised to be sited over the coal bench top during rainy season and will not be affected by water accumulation from rains or strata seepage on the quarry floor.

No water accumulation in OC mine workings will be permitted to remain when the UG mining operations are in progress.

12.2.2 Disaster due to failure of pit slope

The proposed OC mine is planned for future 29 years period operation. The ultimate depth at the end of mining operation will be upto about 205m, the general surface level varies between 190 and 200 m RL.

Slopes of pits (opencast mine) with such depth can cause pit slope failures thus endangering the safety of the mine. This problem has been overcome by changing over to inside dumping (backfilling) at the early stage from 6th year of mine operation. All of the OB waste has been planned to be backfilled combined with rehandling which will act as support to the pit slope.

Strict vigil will be kept by reconnaissance surveys specially in rainy season to detect any impending danger so that the men and equipment can be accordingly moved out of danger area in time.

12.2.3 Disaster due to failure of waste dump

There are two types of waste dumps which are discussed below:

i. Surface dump

Sliding of surface waste dump is an equally severe risk compared with quarry slope failure. Hence, it is imperative that the degree of hazard against potential failure of waste dump slope should be identified and that precautionary measures are to be adopted, if required.

The surface waste dump will be located within the ML area over the dip part of the block. The temporary dumping is proposed to be carried out upto 100 m height. The waste dump will be rehandled between 7th and 20th year however a part of it will be stabilised by tree plantations and other arrangements as detailed below:-

1. Drains will be made on the top of waste dump to arrest uncontrolled descent of water to drain away during rainy season through specially made chutes. Besides gullies (chutes) will be cut for flow of water from the waste dump slowly to channelise it to garland drain. This

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precaution is necessary to prevent erosion of waste dump here and there due to erratic flow of rainwater.

2. On the slope of the dump, small pits of 0.3 x 0.3 x 0.3 m will be cut and seedlings will be planted and also over the 1.5 m width of top from edge of the bench similar plantation shall be done so that the top of the waste dump slope will get stabilized.
3. A stone toe wall will be made all around the waste dump to prevent waste dump material being carried out of the dump area and mixing with the general drainage system of the area.
4. A garland drain will be constructed all around the waste dump area for smooth flow of water.
5. The overall slope of dump sides will be kept below 28°, each their being at 37°.
6. Though the height of the surface dumps will be 100 m, with the help of additional precautions being taken as mentioned above, there is no dangers of the slope failure of the surface dumps.

ii Backfill dump

The height of the backfill dump will be maximum upto about 180 m which will, though, be supported at the sides by quarry batters but the main advancing front of the backfill dump towards dip side will be amenable to slope failure. No danger is anticipated for the equipment or manpower because the backfilling will start only after total coal evacuation from the Quarry. The dump will be planted as soon as ultimate height (surface level) is achieved. It is planned not to have overall gradient of the dump more than 28°.

A systematic study will be commissioned to study the various slope stability parameters to reach at the optimum slope angle during the mine operation period. Appropriate factor of safety will be adopted supported by sensitivity analysis of critical parameters. It is also proposed to monitor the backfill dump with latest geo-technical/surface/equipment e.g. Bore hole extensometer, tape extensometer, EDM, Piezometers, Theodolites etc. The monitoring will commence as a part of safety measures.

12.2.4 Disaster due to surface fire/coal stack fires

Sufficient fire extinguishers will be installed at selected locations on surface like Electrical Sub-stations, work-shop, Garage, Diesel Depot, Stores etc. Besides, sufficient number of water hydrants with sufficient hose pipes will be made available in the surface for fire protection.

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In order to prevent fire hazards in coal stock piles, following types of precaution shall be taken.

(i) Prevent the happening or presence of any external source of fire in the vicinity of coal stockpiles i.e.
- naked fire
- electric fire
- fuel oil fire

In case of electric equipment operating in the vicinity of fuel oil being used or stored in the vicinity of the coal stock piles, appropriate types of fire extinguishers will be provided on or near such equipment in order to extinguish the fire at the very start.

(ii) Restrict the stacking height of the coal to below two meters. Higher height may only be attempted for shorter interval of stacking.

The time and height shall be established with respect to spontaneous combustion which will help in restricting to safe parameters.

(iii) Appropriate arrangement will be made by inserting pipes in the stack to monitor the internal temperature of coal. In case, temperature is found to shoot above safe limits, the coal from the part of stack shall be immediately dug out and disposed safely.

(iv) In certain mines, the insitu coal exposed in coal bench catches fire due to spontaneous heating which has to be kept under vigil. Under such circumstances the affected area of coal shall be separately dug up and disposed off safely.

12.2.5 Possible dangers due to storage of explosives in the magazine

Since site mixed slurry will be used, there will be no requirement of large storage facilities. However a 2 X 20 T capacity magazine is to be provided for the storage of primers. detonators, fuse etc.

The explosive magazine is designed in such a manner that normal chances of fire inside the magazine ruled out. Still following precaution are taken:

- Clearance of dried vegetation within 15 m of Magazine House.
- Installation of lightening arresters on the Magazine to prevent damages in the event of an explosion.
- Provision of fire extinguishers, water and sand filled buckets.
- Arrangement of mounds around the magazine to mitigate damage in the event of an explosion.

- Keeping a safety zone margin around the Magazine as per the guidelines given in Schedule VIII of The Explosives Rules, 1983. The safety distance of 605m will be maintained from the public establishments.

12.2.6 Safety Measures to be adopted Considering Large Fleet of Dumpers

The high production and the large dumper fleet would require proper management, maintenance and operation of dumper fleet and observation of safety measures as dumpers and trucks have been the cause of most of the accidents in opencast mines. To deal with the issue following measures are suggested.

i) Managers shall ensure that all Dumpers are properly maintained and safe to operate.

ii) Only people with appropriate skills, knowledge and training are allowed to drive dumpers.

iii) Drivers should also be trained in the safe operation of the specific dumpers that they are required to drive.

iv) Dumper operator shall not drive too fast, shall avoid distractions, and drive defensively, not attempt to overtake another vehicle unless he can see clearly far enough distance ahead to be sure that he can overtake it safely and sound the audible warning signal before overtaking.

v) When approaching a stripping or loading equipment, Dumper Operator shall sound the audible warning signal and not attempt to pass the stripping equipment until he has received proper audible signal in reply;

vi) No unauthorised person(s) shall be allowed to ride on the Dumper.

vii) All roads for trucks, dumpers or other mobile machinery shall be designed, constructed and maintained in such condition as to be fit for their use.

viii) Where practicable, all roads from the opencast working shall be arranged to provide for one-way traffic and where not practicable, no road shall be of a width less than three times the width of the largest vehicle plying on that road unless definite turnouts and waiting points are designated.

ix) All corners and bends in road shall be made in such a way that the operators and drivers of vehicles have a clear view upto a distance not less than 30 metres along the road. Provided that where it is not possible to ensure visibility upto a distance of not less than 30 metres, there shall be provided two roads for the incoming and outgoing traffic or an alternative system.

x) Standard traffic signs shall be displayed at conspicuous places along the haul road.

xi) All roads shall be provided with side drains to prevent water logging and damage to the road.

xii) The portion of roads where there is heavy traffic of men and machine shall have separate lane properly fenced off from haul road for use by pedestrians and two wheelers.

xiii) Loaded trucks, dumpers or other vehicles shall not be reversed on gradient.

xiv) A berm of height at least half the diameter of the wheel of the largest dumper plying or one meter whichever is greater and of adequate width shall constantly be provided and maintained at the edge of the spoil or coal dump.

xv) Sufficient number of stop-blocks shall be provided at every discharge point and it shall be used every time material is dumped from the truck, dumper or other such vehicle.

xvi) The manager shall formulate traffic rules for movement of trucks, dumpers or other vehicles which shall be prominently displayed at the relevant places in the opencast working and truck/dumper roads.

xvii) Separate roads shall be provided for small vehicles.

xviii) Only authorised small vehicles shall be allowed in opencast working which have a raised red flag in day time and a red light in the night which shall be visible to a dumper operator from a distance of at least 30 metres.

xix) All heavy earth moving machinery including light motor vehicle permitted to ply on the haul road shall be provided with flasher lights on top, indicator lights in front and rear sides of the vehicle as approved by the Chief Inspector.

xx) Anti-Collision and Proximity Detection Device shall be installed on every Heavy Earth Moving Machinery.

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With multi seam operation, the excavation, loading, and hauling operation will be carried out at different places. Minimum 4 main hauling routes will be available exclusively for dumpers through quarry floor and flanks at different horizons, for transport to internal and external OB dump sites, CHP, stockyards etc. The average distance between two dumpers comes to about 120 m and the minimum distance while hauling would not be less than 30m providing adequate safety for which relevant instructions will be issued to the dumper operators.

CHAPTER 13

LAND REQUIREMENT

13.1 LAND REQUIREMENT & LEASEHOLD AREA BREAK-UP

The present land use of the area required for the project is given below in Table 13.1. It may be noted that all facilities will be located within the ML area except the colony.

TABLE 13.1
PRESENT/PRE-MINING LAND USE OF THE ML AREA GARE PALMA SECTOR-II (HA.)

Sl. No.	Village	Private Land			Govt. Land					Total Area (Private + Govt. Land)
		Agriculture	Non Agriculture	Total Area	Populated	Water body	Other	CBJ**	Total Area	
1	Tihlirampur	97.902	62.685	160.587	6.83	21.225	39.094	0	67.149	227.736
2	Dholnara	59.64		59.64	6.833	0.376	3.317	2.788	13.314	72.954
3	Murogaon	302.393		302.393	8.256	1.303	4.29	23.504	37.353	339.746
4	Libra	121.416	7.621	129.037	2.897	0.439	4.694	15.943	23.973	153.01
5	Kunjemura	199.715		199.715	14.221	13.596	8.308	30.17	66.295	266.01
6	Jhinkabahal	3.844		3.844	0	0	0	0	0	3.844
7	Radopali	351.676		351.676	8.336	5.895	19.955	0.125	34.311	385.987
8	Dolesara	20.748		20.748	0	0	1.242	0	1.242	21.99
9	Bhalumura	16.297		16.297	0	0	0.704	0.622	1.326	17.623
10	Sarasmal	56.869	9.158	66.027	0	1.332	3.563	15.236	20.131	86.158
11	Pata	316.064	13.166	329.23	13.314	5.529	14.47	15.326	48.639	377.869
12	Chitwahi	142.461		142.461	0.252	0.867	8.153	0	9.272	151.733
13	Gare	157.224		157.224	10.482	4.241	11.596	1.957	28.276	185.5
14	Saraitola	156.228	13.722	169.95	8.395	1.364	7.969	29.703	47.431	217.381
Total of A		**2002.477**	**106.352**	**2108.829**	**79.816**	**56.167**	**127.355**	**135.374**	**398.712**	**2507.541**
B. As per Forest Departments Record										
Government Forest Land										*75.945
Grand Total										2583.486

*Note: * 75.945 Ha of Protected Forest land and 135.374 Ha of Revenue Forest land is present within the mine lease area, which needs to be diverted for mining purpose after obtaining forestry clearance from the Ministry of Environment and Forest, Govt. of India under the Forest (Conservation) Act 1980.*

*** Chhote Bade Jhar ka Jungle (Small/ big trees forest)*

आई.पी. नागपाल / I.P. NAGPAL
अवर सचिव / Under Secretary
भारत सरकार / Govt. of India
कोयला मंत्रालय / Ministry of Coal
शास्त्री भवन / Shastri Bhawan
नई दिल्ली / New Delhi

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13.2 PROPOSED 'DURING- MINING' LAND USE IN HA

The total land area of the block is required for Mining Lease. The requirement for additional land required for mining purpose for approach road to the block and approach to railway siding etc. will be assessed after finalisation of railway alignment passing through Gare Palma Coalfield and considering limited availability of land, as the block is surrounded by other coal blocks. The colony will be located away from the block non coal bearing area to be identified in consultation with local authorities.

The 'during-mining' stage land use is given in Table 13.2.

TABLE 13.2
DURING MINING LAND USE (HA) WITHIN ML AREA

Landuse	At the end of 5TH Year	At the end of 25TH Year	At the end of OC mining (29TH Year)	OC Post mine closure 30th to 32nd year	End of OC and UG mining (77th year)
Excavation	380.70	2272.42	2440.55	2440.55	2440.55
Backfill	0.00	1535.00	2248.77	2440.55	2440.55
Void	380.70	737.42	191.78	0.00	0.00
Surface dump#	380.00	0.00	0.00	0.00	0.00
Bund	5.20	5.20	5.20	5.20	5.20
Green Belt	36.07	36.07	36.07	36.07	36.07
Top Soil Dump*	60.00	00.00	0.00	0.00	0.00
Settling Pond##	10.00	5.00	5.00	5.00	5.00
Road diversion<	30.30	30.30	30.30	30.30	30.30
Facilities (West Part: CHP, Inclines, Shaft Pit, Office, Lamp room, Attendance Office, Rest Room, Parking, First aid room, Sub Station etc.)**	50.94	50.94	50.94	50.94	5.00
Facilities (East Part: Office, Workshop, magazine, washery etc)	68.54	0.00	0.00	0.00	0.00

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Landuse	At the end of 5TH Year	At the end of 25TH Year	At the end of OC mining (29TH Year)	OC Post mine closure 30th to 32nd year	End of OC and UG mining (77th year)
Under Kelo river	15.42	15.42	15.42	15.42	15.42
Dismantling	0.00	0.00	0.00	0.00	45.94
Disturbed area	**1017.17**	**2415.35**	**2583.48**	**2583.48**	**2583.48**
Undisturbed	1566.31	168.13	0.00	0.00	0.00
Total	**2583.48**	**2583.48**	**2583.48**	**2583.48**	**2583.48**

* *Top soil dump will be over the backfilled area towards the end of mine life.*

** *Main colony will be located away from the ML area.*

\# *The OB dump lying over the coal bearing area will be fully rehandled and backfilled by 20th year.*

\#\# *The settling ponds in 5th year will comprise of 5 ha for mine water and 5 ha for surface dump but the later will not remain after 20th year as surface dump will be rehandaled and become non-existent.*

< *Diverted road is for public use.*

13.3 FOREST LAND

Approval of Govt. of India, MoEF will be obtained for diversion of 211.319 Ha (*75.945 Ha of Protected Forest land and 135.374 Ha of Revenue Forest land*) of Forest Land for mining under the Forest (Conservation) Act 1980.

13.4 REHABILITATION POLICY

Policy of Govt. of Chhattisgarh for resettlement & rehabilitation of displaced persons/families, in case of mining projects, shall be followed. R&R Colony will be accordingly planned and established.

CHAPTER 14

ENVIRONMENTAL MANAGEMENT PLAN

14.1 INTRODUCTION

The environmental management plan has been prepared for the proposed "Gare Palma Sector – II coal block of M/s Maharashtra State Power Generation Company Limited (MSPGCL) located in villages Tihli Rampur, Kunjemura, Gare, Saraitola, Murogaon, Radopali, Pata, Chitwahi, Dholnara, Jhinka Bahal, Dolesara, Bhalumura, Sarasmal and Libara of District Raigarh in Chhattisgarh as per the requirement of Ministry of Environment & Forest, Government of India. The coal block is proposed to produce coal at the rate of 23.60 MTPA (22.00 MT from OC + 1.6 MT from UG) though the peak capacity of OC will be 23.6 MTPA before the UG becomes operational. Opencast mining and to some extent under ground mining in the block is related to land, air, water and its inter-relationship with inhabitants and organic life in the immediate surroundings. The operations have also a direct bearing on the socio-economic environment of the area. Therefore, as an essential part of the mining plan, an environmental management plan has been incorporated which includes a study covering the following major aspects:

- Collection of baseline information related to relevant environmental aspects for establishment of prevailing environmental status.
- Assessment of environmental impacts due to mining activities.
- Management plan stipulating control measures to mitigate possible environmental hazards resulting from mining.

The environmental management plan includes the evaluation of total impacts after superimposing the predicted impacts over baseline data. This helps in incorporating proper mitigation measures wherever necessary for preventing deterioration in environmental quality. The mining lease area constitutes the 'core zone' and the area falling within 10 km radius of the leasehold area has been considered as the 'buffer zone' for general information. Both are together referred to as the 'study area'. The key map (Plate II) and location map (Plate I) depicts the situation of the core area and location of the mine site with respect to the surrounding region. The salient features of the mine that have been taken into consideration while planning the study are described below briefly:

a)	ML Area	2583.486 Ha
b)	Nature of land	Agricultural & forest land
c)	Mineral to be mined	Coal
d)	Scale of operation	23.60 million tonnes per annum (MTPA)

		(22.00 MT by OC + 1.6 MT by UG).
e)	Anticipated life of mine	Total 75 years (Life of OC mine - 29 years and UG mine - 64 years starting from 12th year onwards).
f)	Method of mining	Opencast and underground
g)	Surface transport	By trucks/ dumpers to the appropriately located hopper/CHP within the ML area.

14.2 BASELINE STATUS OF ENVIRONMENT

The base line status of environment was prepared by Min Mec R&D laboratory, New Delhi. The schedules adopted for sampling/monitoring the area are indicated in Table 14.1 below. The summary of Soil Sample Analysis is given in Table 14.4, ambient air quality monitoring results in Table 14.5, Noise sampling in Table 14.7 and Water Sample Analysis in Table 14.8.

The different elements of environment namely land, water, ecology, air, climate and socio-economic status of the area was studied for the post monsoon season of 2012. The schedules adopted for sampling/monitoring the area are indicated in Table 14.1 and the location of sampling/monitoring stations is enclosed (Plate II) along with 10 km buffer zone (study area).

TABLE 14.1
MONITORING SCHEDULE AND PARAMETERS

Sl. No.	Description of parameters	Schedule and duration of monitoring
1.	Air quality in the vicinity of the mine – PM 10, PM 2.5, SO_2, and NO_X	6 stations. Twice a week for three months
2.	Water quality (all parameters as per drinking water standards IS:10500)	4 samples once a year
3.	Ambient noise levels	5 stations once a season
4.	Study of Flora and Fauna	Within the study area
5.	Soil quality	One sample from core zone and one from study area

Secondary data sources were utilized for collection of information about hydro-geological conditions, socio-economics, seismicity and important places and industries in surrounding areas.

14.2.1 Existing/Pre-Mining land use pattern

a) Core zone

The total area of 2583.486 Ha, covering part of the 14 villages is mostly in the form of private, government and forest land. Summary of the existing land details as per revenue and forest department records are given in Table 14.2 and the details khasra wise are given in **Annexure 3-1**.

TABLE 14.2
EXISTING LAND USE DETAILS OF TOTAL AND APPLIED MINING LEASE AREA (HA)

Sl. No.	Village	Private Land			Govt. Land					Total Area (Private + Govt. Land)
		Agriculture	Non Agriculture	Total Area	Populated	Water body	Other	CBJ**	Total Area	
A.	As per Revenue Departments Records									
1	Tihlirampur	97.902	62.685	160.587	6.83	21.225	39.094	0	67.149	227.736
2	Dholnara	59.64		59.64	6.833	0.376	3.317	2.788	13.314	72.954
3	Murogaon	302.393		302.393	8.256	1.303	4.29	23.504	37.353	339.746
4	Libra	121.416	7.621	129.037	2.897	0.439	4.694	15.943	23.973	153.01
5	Kunjemura	199.715		199.715	14.221	13.596	8.308	30.17	66.295	266.01
6	Jhinkabahal	3.844		3.844	0	0	0	0	0	3.844
7	Radopali	351.676		351.676	8.336	5.895	19.955	0.125	34.311	385.987
8	Dolesara	20.748		20.748	0	0	1.242	0	1.242	21.99
9	Bhalumura	16.297		16.297	0	0	0.704	0.622	1.326	17.623
10	Sarasmal	56.869	9.158	66.027	0	1.332	3.563	15.236	20.131	86.158
11	Pata	316.064	13.166	329.23	13.314	5.529	14.47	15.326	48.639	377.869
12	Chitwahi	142.461		142.461	0.252	0.867	8.153	0	9.272	151.733
13	Gare	157.224		157.224	10.482	4.241	11.596	1.957	28.276	185.5
14	Saraitola	156.228	13.722	169.95	8.395	1.364	7.969	29.703	47.431	217.381
Total of A		2002.477	106.352	2108.829	79.816	56.167	127.355	135.374	398.712	2507.541
B.	As per Forest Departments Record									
Government Forest Land										*75.945
Grand Total										2583.486

Note: * *75.945 Ha of Protected Forest land and 135.374 Ha of Revenue Forest land is present within the mine lease area, which needs to be diverted for mining purpose after obtaining forestry clearance from the Ministry of Environment and Forest, Govt. of India under the Forest (Conservation) Act 1980.*

** *Small/ big trees forest*

b) Buffer zone

The land use pattern in the buffer zone as per Census 2011 is summarised in Table 14.3.

TABLE 14.3
LAND USE PATTERN OF BUFFER ZONE (AS PER CENSUS 2011)

Land use	Area (Ha)	Percent
Irrigated agricultural land	1052.93	1.66%
Unirrigated agricultural land	28577.71	45.16%
Culturable waste land	1368.24	2.16%

Land use	Area (Ha)	Percent
Area not available for cultivation	15654.31	24.74%
Forest land	16624.81	26.27%
Total	**63278**	**100%**

14.2.2 Soil quality

Top soil samples were collected from core zone and buffer zone. The results of analysis are given in Table 14.4.

TABLE 14.4
SOIL TEST RESULTS

Parameter	Units	Pata (core zone)	Tamnar (buffer zone)
pH	-	7.80	8.10
E.C	µmho/cm	203	202
$CaCO_3$	% by mass	17.8	17.2
Bulk Density	g/cm^3	1.7	1.5
Moisture	% by mass	13.97	20.86
Organic Carbon	% by mass	0.46	0.28
Organic Matter	% by mass	0.79	0.48
Chloride	% by mass	1.5	2.5
Sulphate	% by mass	1.06	0.24
Phosphorous	mg/kg	1.25	1.44
Nitrate	mg/kg	10.3	8.55
Iron	mg/kg	24.04	13.28
Sodium	% by mass	0.0162	0.0331
Potassium	% by mass	0.0032	0.0041

The soil is silty clay in texture and red to pale brown in colour. pH of 7.80 and 8.10 show that the soil is nearly neutral. The conductivity is normal. The soil has sufficient organic carbon. Available Nitrogen in soil was found very less. Available Phosphorous (P) is low and was found 1.25 mg/kg and 1.44 mg/kg in core and buffer zone respectively.

14.2.3 Water regime

a) Surface water regime

The block exhibits undulating topography. The ground elevation in the block ranges from 242 m to 303 m. General slope of the ground is towards South.

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The easterly flowing Kelo River constitutes the main drainage system of the block. Kelo River is flowing across the coal block towards East and its diversion is not proposed. It will be protected by leaving statutory barriers. A number of small streamlets drain the terrain in various directions giving a sub dendritic drainage pattern. Elevation in the study area varies from 240 m to 640 m. Other than nalas and rivers, there exist a number of surface water bodies like rainfall fed ponds/dug wells etc. within the buffer zone.

b) Ground water

The district is mainly underlain by crystalline rocks of Proterozoic age belonging to Chota Nagpur gneissic complex. Presence of sandstone of Lameta Formation (infratrappeans) and Deccan trap basalt though insignificant, have also been reported. Extensive Lateritisation with occasional bauxite deposits are also found.

Ground water occurs under water table condition in, laterite and weathered mantle. It occurs under semi-confined to confined conditions in the deeper fractured basalts. The depth of water level varies from 4.67 to 12.34 m bgl during pre-monsoon period and from 1.43 to 9.35 m bgl during post-monsoon period in the shallow aquifers. The long term (decadal) trend analysis of water level indicates that about 13% of the wells in pre monsoon and none of the wells in post monsoon period show a significant (20 cm/year) falling trend. The exploration by Central Ground Water Board had indicated presence of potential fractures upto 90 m bgl. The optimum depth of bore wells in the district is found to be between 50 to 90 m bgl. (http://cgwb.gov.in/nccr/Raigarh1.htm)

14.2.4 Ecology

The leasehold area can be demarcated under two major groups of vegetation structure i.e. Forest land and non forest land. The non forest land under Government ownership is barren land while under private ownership it is agriculture and non agricultural land. The area of protected forest is 75.945 Ha and that of revenue Forest is 135.374 Ha. The forest area will be diverted after obtaining Forest Clearance from MoEF, Govt. of India.

a) Flora

The forest of the study area as per revised classification of Indian Forest types belongs to sub group 5B/C1 (Northern Tropical dry deciduous Sal Bearing Forest) and sub group 5B/C2 (Northern Tropical dry Mixed deciduous Forest). Common plant species found in the forest are Sal (*Shorea robusta*), Mahua (*Madhuca latipolia*), Tendu (*Diospyros melanozylon*), Palas (*Butea monosperma*), Neem *(Azadiracta indica)* etc. and the crops grown in the area are gram, maize and paddy.

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b) Fauna

Due to biotic pressure, forest fire and overgrazing, the number of fauna seen in the study area is limited. During survey of the study area and interview from local old age persons at site, it is observed that most of the species which were common in the area in the past are seen rarely nowadays. Animals found in the core zone include rabbit, mongoose, house rat etc. The animals found in study area are rabbit, Jackal, Fox, Monkey, Langur, Jungle myna, Grey heron, Owl, House crow, Common quail etc.

14.2.5 Quality of air, ambient noise and water

i. Air quality

Ambient air quality monitoring results of 6 different stations including 1 station within the core area is given in Table 14.5. The monitoring results indicated that the air quality is good and conforms to the standards stipulated for rural areas.

TABLE 14.5
AIR QUALITY OF THE STUDY AREA

	PM 10	PM 2.5	SO_2	NO_x	PM 10	PM 2.5	SO_2	NO_x	PM 10	PM 2.5	SO_2	NO_x
	Kunjemura (CA1)				**Tamnar (BA1)**				**Khamharia (BA2)**			
Max.	47.3	27.8	11.9	17.2	64.2	37.8	17.6	22.9	52.0	30.3	12.5	17.5
Min.	39.0	22.0	7.5	8.9	50.7	28.3	11.3	12.9	36.0	20.3	8.2	10.2
Avg.	42.5	24.5	9.8	13.3	57.3	32.9	14.6	18.8	44.8	25.9	10.1	14.7
98%tile	47.1	27.6	11.9	17.1	63.7	37.1	17.5	22.7	51.9	30.2	12.4	17.4
	Kerakhol (BA3)				**Ukraipalli(BA4)**				**Dhaurabhata (BA5)**			
Max.	42.8	25.0	5.9	11.9	44.2	26.3	11.0	12.3	65.3	38.7	21.7	30.0
Min.	31.9	17.7	7.7	9.0	32.9	19.1	7.6	9.3	35.9	21.2	11.3	16.1
Avg.	37.5	21.6	8.8	10.5	37.4	21.5	9.2	11.2	52.0	30.0	16.6	24.3
98%tile	42.7	24.4	9.9	11.8	44.1	25.5	11.0	12.3	65.0	38.5	21.7	29.4

The Indian Ambient Air Quality Standards permitting the maximum concentration of contaminants for ambient air quality, set for different categories of areas are given in Table 14.6 for the sake of comparison.

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TABLE 14.6
AMBIENT AIR QUALITY STANDARDS

Area	Category	24 hours average concentrations, $\mu g/m^3$				
		PM10	PM2.5	SO_2	NO_X	CO (8 hourly)
A	Industrial, Residential, Rural and Other Area	100	60	80	80	02 mg/m^3
B	Ecologically Sensitive Area (notified by Central Government)	100	60	80	80	02 mg/m^3

Source: National Ambient Air Quality Standards vide CPCB Notification B-29016/20/90/PCI-L dated 18th November 2009

As is apparent from the analytical data, the ambient air quality in the region is well within the standards specified as per the Air (Prevention & Control of Pollution) Act, 1981.

ii. Ambient noise quality

Noise level survey has been conducted and results at 5 locations including 1 at core zone and 4 in the buffer zone is given in Table 14.7. The noise level monitoring data was recorded round the clock for 24 hours. The ambient noise levels were found within the permissible limits as per the statutory norms.

TABLE 14.7
AMBIENT NOISE LEVELS IN THE STUDY AREA, Leq dB(A)

Hours	Gare	Kerakhol	Kondkel	Tamnar	Ukraipali
	(N1)	(N2)	(N3)	(N4)	(N5)
Day time Leq.	61.20	49.50	46.70	54.20	47.20
Night time Leq.	47.90	41.60	41.30	45.00	42.30
Average Leq.	56.22	46.60	44.70	50.80	45.30
Permissible (Day)	55	55	55	55	55
Permissible (Night)	45	45	45	45	45

iii. Water quality

Water quality survey to assess the quality of both surface & ground water has been conducted during the post monsoon season (October – December 2012. The results of 2 surface water samples and 2 ground water samples are given for assessing the water quality in core and study area. The samples were tested as per the drinking water standards (IS : 10500) and the test results show that all the elements concentration is below permissible limits. The details of water test analysis are given in Table 14.8.

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TABLE 14.8
WATER QUALITY TEST RESULTS

Parameters	Specifications as per IS : 10500:2012		Pata Core zone (GW-1)	Mudagaon (GW-2)	Budia (Kelo River Downstream) (SW 1)	Jorekela Pajhar nadi down stream (SW-2)
	Acceptable limit	Permissible limit				
Colour, Hazen units	5	15	<5	<5	<5	<5
Taste	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable	Agreeable
Odour	Agreeable	Agreeable	Agreeable			
Turbidity, NTU	1	5	38.6	17.6	82.7	220.9
pH value	6.5-8.5	No relaxation	5.3	5.15	6.54	6.66
Total Dissolved solids, mg/l	500	2000	106	85	195	173
Total hardness (as $CaCO_3$) mg/l	200	600	52	48	120	104
Alkalinity, mg/l	200	600	56	48	56	48
Chlorides (as Cl) mg/l	250	1000	20	20	28	12
Iron (as Fe) mg/l	0.3	No relaxation	2.1	0.5	0.6	2.6
Fluoride (as F) mg/l	1.0	1.5	0.3	0.04	0.03	0.04
Sulphate (as SO_4) mg/l	200	400	7	2	62	4
Nitrate (as NO_3) mg/l	45	No relaxation	3.9	1.7	0.8	84.6
Calcium (as Ca), mg/l	75	200	13	11	45	13
Magnesium (as Mg)	30	100	5	5	2	17
Copper (as Cu) mg/l	0.05	1.5	BDL	BDL	BDL	BDL
Manganese (as Mn) mg/l	0.1	0.3	0.1158	0.75	BDL	0.0058
Mercury (as Hg) mg/l	0.001	No relaxation	BDL	BDL	BDL	BDL
Cadmium (as Cd) mg/l	0.003	No relaxation	BDL	BDL	BDL	BDL
Selenium (as Se), mg/l	0.01	No relaxation	BDL	BDL	BDL	BDL
Arsenic (as As), mg/l	0.1	0.05	BDL	BDL	BDL	BDL
Lead (as Pb), mg/l	0.01	No relaxation	BDL	BDL	BDL	BDL
Zinc (as Zn), mg/l	5	15	0.1011	0.6532	BDL	BDL
Total Chromium as Cr, mg/l	0.05	No relaxation	BDL	BDL	BDL	BDL
Aluminum (as Al)	0.03	0.2	BDL	BDL	0.27	1.08
Boron, mg/l	0.5	1.0	0.040	0.0076	0.0854	0.1736

Note: *BDL of Cu is 0.0032; Mn is 0.0026; Hg is 0.0008; Cd is 0.0027; Al is 0.0046; Se is 0.0031; As is 0.0029; Pb is 0.0037; Cr is 0.0009; Zn is 0.0048 mg/l*

14.2.6 Climatic conditions

The area experiences tropical climate. The meteorological data recorded at IMD station Raigarh from 1999 to 2008 are given in Table 14.9.

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TABLE 14.9
METEOROLOGICAL DATA OF RAIGARH (1999-2008)

Month	Relative humidity (%)		Temperature (°C)		Wind velocity* km/hr		Rainfall in mm
	8.30 hrs	**17.30 hrs**	**Min.**	**Max.**	**8.30 hrs**	**17.30 hrs**	
January	68	44	29.01	12.22	3.4	2.6	7.94
February	63	44	31.14	15.98	3.5	3.1	17.52
March	53	37	35.87	20.04	4.3	2.4	9.97
April	43	30	40.55	24.56	4.8	3.2	12.55
May	46	31	41.36	27.41	3.9	3.1	32.10
June	66	54	37.47	26.18	3.4	2.6	197.99
July	83	76	32.34	25.21	5.1	4.5	283.31
August	87	82	31.45	24.26	5.0	4.8	368.97
September	82	79	32.23	23.94	3.7	3.8	204.63
October	73	65	32.27	21.31	4.3	3.7	44.97
November	72	54	31.26	15.40	3.7	3.7	9.22
December	72	53	28.82	12.75	3.3	3.3	0.00
Average	**67**	**54**	**33.67**	**20.41**	**4.0**	**3.5**	**1189.17**

* *Data for wind velocity at 8.30 hrs and 17.30 hrs is from 2001 to 2005*

Micro-meteorological survey

On-site monitoring was undertaken for various meteorological variables in order to generate the site-specific data. The central micro-meteorological station was installed at a height of about 5 meters from ground level free from any obstruction. The data generated is then compared with the meteorological data generated by nearest India Meteorological Department (IMD) station located at Raigarh. Hourly micro-meteorological data has been recorded at the site. Minimum and maximum temperature recorded was 7.50°C and 34.90°C with mean of 21.66°C, minimum and maximum relative humidity recorded was 33.20% and 97.20% with mean of 70.12%. The wind speed varied between 1.50 km/hr to 25.50 km/hr with mean of 4.93 km/hr and the predominant wind direction was observed from NE with 28.32% of occurrences including calm.

14.2.7 Human settlements

A socio-economic study has been carried for the study area. The data are based on 2011 Census report. The break-up of population for male, female is summarized in Table 14.10.

TABLE 14.10
DISTRICT AND BLOCK WISE POPULATION IN THE STUDY AREA

District	Tehsil	No. of villages	Total population	Male	Female
Sundergarh	Hemgir	10	6591	3340	3251

District	Tehsil	No. of villages	Total population	Male	Female
Raigarh	Lailunga	3	1004	487	517
	Gharghoda	22	23898	4829	4626
	Tamnar	92	82690	41390	41300
	Total	**35**	**114183**	**50046**	**49694**

The employment pattern, break-up of main workers and SC/ST and amenities are summarised in Table 14.11.

TABLE 14.11
EMPLOYMENT PATTERN IN STUDY AREA

Occupation	Population	%
Main workers	36522	31.98
Marginal workers	16171	14.16
Non workers	61490	53.86
Total	**114183**	
Break-up of main workers		
Cultivators	**14246**	**39.01**
Agriculture labour	**10971**	**30.04**
Household industry	**600**	1.64
Others	10705	29.31
Total	**36522**	**100.00**
Other Details		
Literate	72301	63.32
SC	11535	10.10
ST	56651	26.58

From the above table, it can be observed that about 50% of the population is non workers. Out of the total main workers, about 50% are involved as cultivators, about 31% as agriculture labour and about 3% in household industries. The literacy in the study area is about 60% as compared to the national rate of 65.28 % as per Census 2011 records.

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14.2.8 Places of historical, tourist and religious importance

There is no such place within core or study area.

14.2.9 Mines and industries within study area

The block is free from any mining activity and there are 12 mines and industries present within the buffer zone.

14.2.10 Does area (Partly or fully) fall under notified area under water (Prevention & control of Pollution) Act 1974.

No.

14.3 ENVIRONMENTAL IMPACT ASSESSMENT

Baseline information on various relevant environmental aspects generated and compiled for the project area, covering both core and buffer zones has been incorporated in para 14.1 and paragraphs there under. This information provides an outline of the prevailing environmental scenario at the mining site and its surroundings. Mining, like any other development activity, is bound to have some impact on the existing environment; both adverse and beneficial. The impacts on the physical, ecological and socio-economic environment of the area due to the proposed project are given in the following paragraphs:

14.3.1 Land environment

a) Land degradation and aesthetic environment

The total mine lease area is 2583.486 Ha. At the end of 5th year 1621.40 Ha i.e. 62.76 % of land will remain undisturbed. The disturbed area within ML will comprise excavated land, external dumps, area occupied by infrastructure, diverted road, inclines, green belt etc. The anticipated land use at the end of 5th year and at the end of mining operations is tabulated in Table 14.12.

TABLE 14.12

PROPOSED LAND USE AT THE END OF FIFTH YEAR & END OF MINE LIFE

Sl. No.	Particulars	At the end of 5th Year of Mine Operation	At the end of Last Year of Mine Operation
1	Excavation	380.70	2440.55
2	Backfilling	0.00	2109.49
3	Void	380.70	331.06*

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Sl. No.	Particulars	At the end of 5th Year of Mine Operation	At the end of Last Year of Mine Operation
4	Surface Dump	380.00	0.00
5	Bund/ Embankment	5.20	5.2
6	Top Soil Dump	60.00	0.00
7	Settling pond*	10.00	5.00
8	Diverted Road	30.30	30.30
9	In West Part: CHP. Inclines and shaft pit, Head office, Lamp room, Attendance office, Driver rest room, parking & sub station	50.94	50.94
10	In East Part: Office, workshop, washery etc	68.54	0.00
11	7.5 m green belt around ML boundary	12.44	12.44
12	Green belt along Kelo river 45 m west side and 15 m east side	23.63	23.63
13	Under Kelo River	15.42	15.42
14	Undisturbed area / Indirectly affected area/ area for exploration	1566.31	0.00
	Total	**2583.48**	**2583.48**

* *331.06=195.15 ha in East Pit with 170m depth +135.91 ha in West Pit with 60m depth*

** *Settling pond 10 ha in 5th year (5 ha for mine water+5ha for dump runoff)*

Surface dump: There will be only one surface dump proposed which will be located over the coal bearing area in the southern portion of the West pit area. This dump will be spread over an area 380 ha and will accommodate 218.81 Mcum (B) OB waste. The dumping will start from 1st year and continue upto 6th year. However the exclusive dumping into this surface dump will be upto 5th year after which part of the OB will be backfilled in 6th year.

Top soil dump: The total topsoil generated will be 14.64 mcum (B) during the life of the mine. Unutilised part of the same will be stacked separately in a soil stack pile located beyond the surface dump over the coal bearing area within West Pit area of 60.00 Ha before 15th year after which it will be over the backfilled area.

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b) Land profile

Presently, the core zone is virgin and plain terrain sloping towards south-west. The mining operations are not anticipated to cause any adverse impact on topography outside the core zone. It is proposed to establish only some essential quarters within the ML for the Mine Personnel to cater to essential services manpower. Remaining persons will be accommodated at a suitable site outside the ML area. Within core zone, the void area of the excavated pit at the end of mine life 29th year will be 331.06 ha=195.15 ha in East Pit with 170m depth +135.91 ha in West Pit with 60m depth.

c) Visual intrusion

Due care has to be taken (from the conception stage of the project) for reducing the visual intrusion to a minimum. However, the movement of vehicles for transportation of coal to the coal receiving pit/crusher may cause some intrusion. Appropriate measures such as green belt cover will be needed to reduce visual intrusion from dumps, roads and facilities.

14.3.2 Impact on air quality

The opencast mining operations are prone to generation of higher levels of SPM and to a limited extent of SO_2, NO_x and CO due to blasting, fuel, oil combustion, burning of coal etc. However, there are no point source emissions. The OB will be transported by 150 T and 100 T R.D. trucks to surface dumps and later on, as soon as decoaled area is available suitable for backfilling, to the site of back-filling.

The coal will be transported by 85T/100 T R.D.(CB) trucks to the coal receiving pit/crusher and further transported to the plant by conveyors. This may cause increased air pollution along the roads, if adequate control measure like regular maintenance of road, tree plantation along road and maintenance of leak proof truck bodies are not taken.

14.3.3 Impact on water quality

The surface water quality is likely to be affected with higher load of suspended solids by the following:

- Wash off from dumps
- Soil erosion from mine and roads
- Pumping out mine water to surface water channels

The outside dump may contribute to the pollution of surface water in terms of suspended solids. Since dumping location proposed to be carried out is at a safe distance (2 km) from existing surface water channels i.e. Kelo River, it will have limited impact on water quality. The pumped out water during dewatering may carry higher levels of suspended solids. Other sources of pollution are by oil spillage at the pit head and at the mine site infrastructure viz. light vehicle workshop, lubricant and oil storage area resulting in oil and grease contamination of surface water if appropriate control measures are not adopted. Control measures like check dams will be adopted to counter any solids being carried away by precipitation.

Ground water pollution can take place only if dumps and stock piles contain harmful chemical substances, which may get leached by precipitation of water and percolate to the ground water table, thus causing water pollution. However, this is not the case with this mine, as neither the coal nor the OB, contains any harmful ingredients which may leach down to the water table and pollute it. Therefore, no adverse impact on ground water quality is anticipated considering this aspect. The leaching down of pollutants (oil, grease etc.) to the ground water may render the water un-potable and hence cannot be used by the local people. The percolation of sewage waste from the pit head as well as mine area can also pollute the ground water if control measures are not adopted as envisaged in the management plan.

Meager amount of sanitary waste, expected to be generated from various facilities will be treated properly through septic tanks and soak pits and is not anticipated to cause any water pollution.

14.3.4 Impact on noise level

Noise is unwanted and unpleasant sound which causes distraction, disturbance and annoyance. Continuous exposure to high level of noise can impair human hearing power.

The mining activities generate noise mainly on account of:

- Operating mining machinery
- Use of explosives
- Moving road vehicles

The impact of this airborne noise will be more on the operating personnel and on the persons working nearby and not so much on the surroundings. The noise of activities may also disturb animals/birds living in the surroundings forcing them to change their habitat. In the present case, the noise caused will be mainly restricted to the core zone. The noise level data recorded at various places in the study area is well within the desired limit. But, the future establishment of noise due the proposed project activity may pose some problem if project management does not adopt appropriate control measures.

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14.3.5 Effect on vibration level (due to blasting)

No ground vibration study has been conducted hence the impact of the proposed activity on ground vibration cannot be exactly anticipated. But, based on experience of similar mines appropriate control measures have been spelt out in management plan.

14.3.6 Impact on water regime

Water required during initial 3 years for construction and mine development is proposed to be sourced form Kelo river or Bore wells. From 3rd year onwards, Industrial water from mine sump and settling pond would be used till the end of the life of the mine. Kelo River is flowing across the coal block.

Thus impact on the surface water resources is envisaged during initial years only. However, in view of availability of ground water at shallow levels, most of water requirement is planned to be drawn from ground water (mine sump), which will have some impact on the ground water resources.

14.3.7 Impact on socio-economic environment

Human settlement

1679 project affected families of all fourteen villages within the mine lease area will have to be rehabilitated. The land owners will be deprived of their land and the non land owners will be deprived of their earnings. Care will be taken for rehabilitation and employment of the displaced people.

On the other hand, the mining and allied activities will provide job opportunities for eligible persons and many will find employment in service sector and marketing of day-to-day needs viz. poultry and other agricultural products. The facilities and amenities like first aid room, training centre etc. to be set up for the project will improve the basic infrastructure and these amenities can also be used by the people of the nearby villagers.

The proposed long term activity will open up market and opportunities growth for self employed and cultivators. To this extent, the impact will be significantly beneficial since un-employment and under employment is the main socio-economic problem faced by the people in this area.

14.3.8 Impact on historical monument/ religious place/ tourist places

There is no such place within and outside the ML boundary upto 10 km radius. Hence, impact on historical monument religious place/ tourist places will not take place.

14.4 ENVIRONMENTAL MANAGEMENT PLAN

The environmental impact assessment made in the preceding section has identified the areas where certain control measures are called for to minimise the negative impacts. Subsequent paragraphs deals with effective measures proposed to be taken up with regard to the following aspects so that the proposed mining and allied activities can be continued in an environment-friendly manner:

- Land use planning – Afforestation and landscape development
- Air pollution control
- Blasting and noise control
- Water pollution control
- Socio-economic aspects

14.4.1 Land use planning

i. Land degradation control measures

Land degradation is one of the major adverse outcomes of opencast mining activities and any effort to control adverse impacts is considered incomplete when appropriate land reclamation strategy is not adopted. Since the land degradation in this mine is partly in the form of excavated void and partly in the form of external and internal dumps, the reclamation strategy must include a programme for the reclamation of the disturbed land.

a) Mined area reclamation

The lessee will have to take necessary steps to keep the area under disturbance at any stage of mining operation to a minimum. This can be achieved by carrying out the reclamation programme simultaneously with excavation.

The gap can be reduced between degradation and the reclamation by this programme. The post mining land use of core zone shows that all the disturbed areas will be reclaimed before abandoning the mine.

b) Reclamation procedure

Reclamation procedure has been described stage wise in the following paragraphs. Year wise reclamation programme is as shown in Table 14.13.

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TABLE 14.13
PROGRAMME OF EXCAVATED AND BACKFILLED AREA, CUMULATIVE (HA)

Upto the end of year	Area mined	Backfilled area	Remark
1st year	26.16	0.00	No backfilling
3rd year	129.97	0.00	No backfilling
5th year	380.70	0.00	No backfilling
10th	1099.37	358.27	Part Direct Backfilling and Part from rehandled surface Dump
15th year	1747.06	673.05	Part Direct Backfilling and Part from rehandled surface Dump
20th	1949.85	1122.31	Part Direct Backfilling and Part from rehandled surface Dump
25th year	2272.42	1536.00	Part direct backfilling and part from rehandled surface dump
End of mine 29th	2440.55	2109.49	Part direct backfilling and part from rehandled crown dump
Post Mine Closure Stage 32nd	2440.55	2440.55	Backfilling from rehandled crown dump*

* *During the post mine closure period (30th to 32nd year), part of the crown dump will be fully rehandaled and backfilled into the residual void (below surface level) while part of the crown dump (with an extent of 138 ha with 72.37 mcum B) will be reduced in height from 100m to 80m and backfilled*

ii. Top soil management

The total topsoil generated will be 14.64 mcum (B) during the life of the mine. Unutilised part of the same will be stacked separately in a soil stack pile located beyond the surface dump over the coal bearing area within West Pit area of 60.00 Ha before 15th year after which it will be over backfilled area. It will be used for growing plants along the fringes of the site roads and reclamation of surface dump and backfilled area.

The top soil stockpile will be low height not exceeding 6 m and will be grassed to retain fertility. Besides this, there would be temporary stacks near the excavation area and area to be reclaimed which will be made use of for concurrent filling without bringing the topsoil to the soil stack near the OB dump. The generation and disposal of total waste quantities for the life of the mine are shown in Table 14.14.

TABLE 14.14
WASTE DISPOSAL (TOP SOIL & OB) IN MCUM (BANK) PROGRESSIVE

Year/ Stage	Bund	Backfilling upto surface level OB,		Crown OB dumping		Rehandaled crown OB		Resultant of crown dumping & rehandling OB dump	OB Dumping		Surface Dump Rehandling		Resultant of surface dumping & S. Dump rehandling	Top soil Utilised		Total OB & T soil		Resultant total backfilling including rehandling of crown and s. dump
	Prog	Prog	Cumul	Prog	Cumul	Prog	Cumul	Cumul	Prog	Cumul	Prog	Cumul	Cumul	Progr	Cumul	Prog	Cumul	Cumul
Const. (0)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0.00	0.00	0.00	0.00	0.00
1st year	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.77	4.77	0.00	0.00	0	0.00	0.00	4.84	4.84	0.00
2nd-3rd year	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	43.48	48.25	0.00	0.00	0	0.00	0.00	43.48	48.25	0.00
4th - 5th year	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	123.5	171.74	0.00	0.00	0	0.00	0.00	123.5	171.74	0.00
6th - 10th year	0.00	381.64	381.64	242.05	242.05	0.00	0.00	0.00	47.07	218.81	86.74	86.74	132.07	2.05	2.05	759.56	931.37	468.38
11th - 15th year	0.00	372.95	754.59	247.17	489.22	0.00	0.00	0.00	0.00	218.81	25.62	112.36	106.45	2.41	4.46	648.14	1579.52	866.95
16th - 20th year	0.00	493.78	1248.38	0.00	489.22	0.00	0.00	0.00	0.00	218.81	106.45	218.81	0	2.25	6.72	602.49	2182.00	1467.18
21st - 25th year	0.00	493.06	1741.44	0.00	489.22	0.00	0.00	0.00	0.00	218.81	0.00	218.81	0	2.19	8.90	495.25	2677.25	1960.25
26th - 29th End of mine	0.00	296.99	2038.43	0.00	489.22	284.30	284.30	204.92	0.00	218.81	0.00	218.81	0	3.83	12.74	585.12	3262.37	2541.54
Closure plan 30th - 32nd	0.00	0.00	2038.43	0.00	489.22	132.55	416.85	72.37	0.00	218.81	0.00	218.81	0	1.91	14.65	134.46	3396.84	2674.09
Total	0.07	2038.43		489.22		416.85			218.81		218.81			14.65		3396.84		

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iii. Post reclamation land use

The first step in a successful reclamation programme is to decide the post reclamation land use. The post mine closure land use at the end of Opencast and underground stage (78th to 80th year) is given in Table 14.15.

TABLE 14.15

MINE CLOSURE LAND USE (OC AND UG) IN HA (END OF 80TH YEAR)

Sl. No.	Description of ML Area	Land use (Ha.)						
		Bund	Void	Public use	Company use	Un-disturbed	Plantation (Forest)/ agriculture including GB	Total
1.	Backfill	0.00	0.00	0.00	0.00	0.00	2440.55	2440.55
2.	Void/water body	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3.	Surface dump	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4.	Bund	5.20	0.00	0.00	0.00	0.00	0.00	5.20
5.	Green belt #	0.00	0.00	0.00	0.00	0.00	36.07	36.07
6.	Top soil dump*	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7.	Settling pond**	0.00	0.00	0.00	0.00	0.00	5.00	5.00
8.	Road diversion	0.00	0.00	30.30	0.00	0.00	0.00	30.30
9. a	Facilities Retained part (West part: CHP Incline, Shaft, Pit, office, lamp room, attendance office, rest room, parking, first aid room, substation etc.)	0.00	0.00	5.0	0.00	0.00	0.00	5.00
9.b	Dismantled Part (West part: CHP Incline, Shaft, Pit, office, lamp room, attendance office, rest room, parking, first aid room, substation etc.)	0.00	0.00	0.00	0.00	0.00	45.94	45.94
10.	Under Kelo River	0.00	0.00	0.00	0.00	15.42	0.00	15.42
11.	Undisturbed	0.00		0.00	0.00	0.00	0.00	0.00
	Total	**5.20**	**0.00**	**35.30**	**0.00**	**15.42**	**2527.56**	**2583.48**

Notes : * *Top soil dump of 60 Ha. was over the coal bearing area before 10th year after which it reduced to zero by 15th year as area under it was excavated, the topsoil in subsequent years was stacked over the backfilled area*

** *Surface water reservoir in facilities area measuring 5.0 Ha will be backfilled in the post mine closure stage (OC+UG combined)*

*** *Surface dump will be rehandled from 7th year to 20th year and area below it excavated*

#. Green Belt of 36.07 ha = 23.63 ha along Kelo river 45 m westside and 15 m eastside + 12.44 ha over 7.5 m along ML boundary.

During post mine closure plan period, agriculture is proposed instead of plantation over the rehandled crown dump area as well as over the backfilled area obtained as a result of reducing the void except over 211.319 ha including the crown dump of 138 ha which will be left for forest use as in pre-mining scenario.

It would be appropriate to restore the lands to the original land use to the extent possible. The crown dump will be reduced from +100 m height to 0 m (general ground level) during 30th to 32nd year and the material will be backfilled into the void upto surface fully except the crown dump of 138 ha which will be left with a 80m height. The level area may be converted into agriculture land in the post mine closure scenario so that some of the people could go back to agriculture profession. The stage plan at the end

29th year & section showing the mine at the conceptual stage is given in Plate XXVI & XXXVI respectively.

iv. Soil conservation measures

The following control measures to prevent soil erosion and wash off of fines from freshly excavated benches and dumps will be adopted:

- Garland drains will be provided around the mine whenever required to arrest any soil from the mine area being carried away by the rain water.
- The bench levels will be provided with water gradient against the general pit slope to decrease the speed of storm water and prevent its uncontrolled descent.
- Special local stone paved chutes and channels will be provided wherever required, to allow controlled descent of water, especially from external dumps.
- Gullies formed, if any, on side of the benches shall be provided with check dams of local stone or sand filled bags.
- The inactive dump slopes will be planted with bushes, grass, shrubs and trees to prevent soil erosion after applying top soil.
- Retaining walls (with gabion, concrete or local stone) will be provided, wherever required, to support the benches or any loose material and also to arrest sliding of loose debris.

v. Afforestation

a) Compensatory afforestation

Compensatory plantation will be provided in line with the prevailing rules of forest department.

b) Plantation during mining

A plantation program over life of the mine has been planned in a phase wise manner. The plantation will be started from first year of mining along the boundary of ML area from south to north. A 7.5 m width of green belt development around the ML area will be carried out and more width of green belt will be taken up wherever space is available. Plantation over surface dump area will be not be done as it will be backfilled. A thick plantation is proposed to be provided and maintained around the mining area and along the roads. Plantation over the backfilled area will be begin from 16th year. The yearly requirement of plants during the various years and stages of the mining project is as shown in the Table 14.16.

TABLE 14.16
YEAR/STAGE WISE AND LOCATION WISE REQUIREMENT OF PLANTS ALONG WITH BIFURCATION INTO FOREST AND AGRICULTURE LANDUSE

Year	Backfilled reclm. area	Dump reclm. area	Green belt area	Total plantation area in ha	Total tree @ 2500 no per ha	Backfilled area for agriculture without plantation	Made Fit for Agriculture in Post Mine Closure after cutting trees	Dismantled area for agriculture without plantation	Settling pond area filled for agriculture without plantation	Total fit for agriculture	Fit for Forest in Post Mine Closure
1	2	3	4	5	6	7	8	9	10	11	12
1st year	0.00	-	7.21	7.21	18,025					0.00	
2nd-3rd year	0.00	-	14.43	14.43	36,075					0.00	
4th - 5th year	0.00	-	14.43	14.43	36,075					0.00	
6th - 10th year	198.97	194.76		393.73	984,325					0.00	
11th - 15th year	281.30			281.30	703,250					0.00	
16th - 20th year	514.51			514.51	1,286,275					0.00	
21st - 25th year	418.95			418.95	1,047,375					0.00	
End of OC mine 29th	612.04			612.04	1,530,100					0.00	
Closure plan 78th -80th year		-		0.00	-	414.78	1850.52	45.94	5.00	**2316.24**	211.32
Total*	**2025.77**	**194.76**	**36.07**	**2256.60**	**5641500**	**414.78**	**1850.52**	**45.94**	**5.00**	**2316.24**	**211.32**

* *Total backfilled area of 2440.55 comprises of 2025.77 ha planted (out of which 175. 249 ha will be returned as forest land and 1850.52 ha will be for agriculture use) +414.78 ha area made fit for agriculture. Thus, total agriculture land in backfilled area of 2265.30 ha comprises 1850.52 ha made fit for agriculture after cutting trees + 414.78 ha directly converted to agriculture after backfilling.*

Out of 2583.48 ha ML area, 2440.55ha will be backfilled. Out of backfilled area of 2440.55ha, 211.319 ha (during pre-mining *75.945 Ha of Protected Forest land and 135.374 Ha of Revenue Forest land)* will be converted into forest use while the rest 2265.30 ha will be useable as agriculture land where as in facilities area 45.94 ha and in backfilled settling pond 5 ha will also be useable as agriculture land. Hence the total land useable as agriculture land will be 2265.30 + 45.94 + 5.0 = 2316.24 ha. The plan showing mine closure at the abandoned stage is given Plate XXXVI.

The common species used for plantation in the region are Sal, Mahua, Gulmohar, Neem, Siris, Acacia, Casuarina, Pongamia, Mango, China-rose, Kaner, etc.

14.4.2 Air and dust pollution control measures

The SPM, CO, SO_2 and NO_x concentrations are within limits as already discussed earlier. The mining operations and related activities are anticipated to increase the levels of SPM and gaseous pollutants to a limited extent. The control measures to be adopted are mentioned in the following paragraphs:

i. Controlling fugitive dust

Dust particles, which are normally generated during mining operation and transportation, deteriorate the ambient air quality. Adequate control measures are, therefore, proposed to be taken during mining operations, transportation and loading operations. These control measures are discussed as follows:

a) Mines

a) Dust suppression systems (like water spraying) will be adopted at:
   - Faces before and after blasting
   - Faces while loading

b) Dust extraction systems will be used in drill machines and coal handling systems.

c) Dust generation will also be reduced by using sharp drill bits for drilling holes and drills with flushing system.

b) Haul roads and stock-piles

- Dust suppression system (like water spraying) would be adopted at roads, which are used for transportation. Fixed sprinklers (Whirling) have been proposed with timers to be installed along the haul roads and coal transportation roads to suppress the dust.

- Transport vehicles shall be maintained leak proof.

- Suitable dust suppression systems such as mist sprays with or without chemical will be provided at appropriate places for preventing dust pollution during handling and stockpiling of coal.

- Transfer points of coal will be provided with appropriate hoods/chutes to prevent fugitive dust emission.

ii. Preventing dispersal of air borne dust

In addition to the control measures proposed during mining and transportation operations, following steps will be taken to prevent air pollution due to airborne dust:

- Dense tree belts will be planted around the mine and sites housing handling/ loading facilities.
- Plantation over already mined out area will be done after backfilling as per schedule (with minimum gap between excavation and afforestation)
- Dust masks will be provided as safety measure to the workers, engaged at dust generation points like drills, loading/unloading points, etc.

iii. Measures to mitigate CO levels

It has already been discussed that the concentration of CO in the ambient air is negligible and is far below the prescribed limit of CPCB and is not anticipated to exceed it in future.

Still all heavy and light vehicles shall be tested for pollutants concentration in their exhausts regularly and well maintained. Strict vigil will be kept in and around the operational area for any fire which shall be immediately controlled.

iv. Measures to mitigate NO_x levels

The main reasons of production of NO_x gases are:

a. Poor quality of explosive having large oxygen imbalance which can be due to following reasons:

  - Manufacturing defect
  - The use of expired explosives in which disintegration of ingredients has taken place.

b. Incomplete detonation is caused mainly due to low primer: column ratio.

To ensure that NO_x levels do not increase during the proposed mining operations, the following control measures will be adopted:

a. Good quality explosives will be used for which the oxygen balance will be checked from time to time. The expired explosives will not be used for which a strict vigil will be kept on the date of manufacture. Even as a normal procedure, all explosives will be subjected to a visual inspection and if disintegrated ingredient are spotted, the explosives will not be used even if it is within expiry date.

b. Primer: Column ratio will be rationalised. The ratio thus established, for producing minimum NO_x, will be adhered to.

The mine ambient air quality will be regularly tested to detect the presence of any pollutants above prescribed limits and appropriate measures will be adopted.

14.4.3 Noise and blasting

a) Measures to control noise pollution

The following control measures will be adopted to keep the ambient noise levels below permissible limits of 75 dB (A).

i. Provision and maintenance of thick tree belts to screen noise.

ii. Avenue plantation within the project area to dampen the noise.

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

iv. Provision of the air silencer to modulate the noise generated by the machines will be made wherever required.

To protect the workers from exposures to higher noise levels, the following measures will be adopted:

i. Provision of protective devices like ear muffs/ear plugs to those workers who cannot be isolated from the source of noise.

ii. Confining the noise by isolating the source of noise.

iii. Reducing the exposure time of workers to the higher noise levels.

b) Measures to reduce ground vibrations due to blasting and prevent fly rocks

The vibrations due to blasting will be studied during stages of mining operations and the recommendations/ suggestions given as per the result of the said study will be strictly adhered to especially the charge per delay.

c) General recommendations and suggestion

i. The peak particle velocity (PPV) of ground vibration will be kept below permissible limits by controlled blasting techniques.

ii. Suitable powder factor will be adopted for overburden and coal.

iii. Drilling and charging pattern will be modified, if required, based on the vibration study to be carried out.

iv. Short delay detonators will preferably be used in blasting rounds rather than detonating fuse as trunk line.

v. To contain fly rocks, stemming column will not be less than burden of the hole and the blasting area will be muffed.

vi. Each blast will be carefully planned, checked, executed and observed. Blasting data will be recorded. During blasting, a responsible officer will be supervising the whole operation.

vii. Covering the detonating fuse, in case it is used, at least with 150 mm thick cover of sand or drill cuttings.

viii. Blasting will be carried out at mid-day and never at night.

ix. Blasting will not be carried out when strong winds are blowing towards the inhabited areas.

Apart from the above, in order to ensure slope stabilisation, controlled production blasting will be adopted to avoid tension cracks and back breaks. Such cracks filled with water reduce stability of excavated slopes and angle of slopes. Good drainage system will be provided in and around the mine.

14.4.4 Water pollution control measures

a) Effluent from mine

i. To prevent surface and ground water contamination by oil/grease and sewage waste, following control measures are proposed to be implemented:

- Leak proof containers will be used for storage and transportation of oil/grease. In the store also, the container containing oil/grease will be kept in empty, safe and open containers of higher volume than the containers to avoid oil/grease spillage. The area over which oil/grease is handled will be kept effectively impervious. Any wash off from the oil/grease handling area or workshop will be drained through impervious drains, collected in specially constructed pit and treated appropriately to remove any oil/grease and the water will be recycled. The oil grease will be sold to authorized vendors and sludge disposed off in specially constructed pit.

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- The sewage waste generated will be drained by underground impervious drains, lead to appropriately designed septic tanks and soak pits to prevent any pollution of surface or ground water.

ii. The surface and ground water in and around the mine, loading plant and infrastructure will be regularly tested and appropriate control measures adopted in case of any pollutant is detected above the prescribed limit.

iii. All stacking and loading areas will be provided with proper garland drains equipped with baffles to prevent wash offs from reaching the downstream natural channels.

iv. A domestic waste water treatment plant will be provided in mine office area so that the water after treatment can be reused.

b) Storm water

Control measures to be adopted are briefly discussed below:

- Check dams will be provided to prevent solids from wash off and screen if any from the mine related activities.
- Peripheral bunds will be erected on the outer edge of the abandoned benches before reclamation so that the soil is not carried away by storm water.
- A water gradient of about 1 in 100 will be kept at every bench towards inside of the bench to prevent formation of gullies in the bench slopes causing serious erosion.
- Chutes will be constructed by using local stone or masonry to guide the water in areas with loose soil to prevent erosion and uncontrolled descent of water wherever necessary.
- Construction of garland drains around freshly excavated and dumped areas so that flow of water with loose material is prevented. The mine water will be passed through specially constructed settling ponds to arrest any loose material being carried away with water.
- Any areas with loose debris within the lease hold will be planted.

c) Measures to minimise adverse effects on water regime

During the process of mine rehabilitation and with the completion of backfilling, a water body will be created in the mined out pit which will act as water reservoir improving the ground water recharge, source of attraction for fauna and will help in the maintenance of afforested areas. To enhance aesthetic appearance, parks and lawns will be made around the water body.

14.4.5 Socio-economic aspects including resettlement and benefits

As there will be displacement of 1679 families in all fourteen villages, a rehabilitation programme is required. However, the land and home or both oustees will be given rehabilitation and resettlement benefits according to the Govt. of Chhattisgarh Policies and prevailing practice in industries in the vicinity. The detailed R&R plan is under preparation. In addition to the provisions of the CG R&R Policy 2007, as the proportion of tribal families among the land losers is significant and in view of project area falling under scheduled V, a separate Tribal Development Plan (TDP) is essential for vulnerable group. The company is in the process of making a Tribal Development Plan containing the profile of community, livelihood pattern, a need assessment for community development and a specific communication program to engage with the community. The survey is being done by Asian Institute of Sustainable Development Ranchi (Jharkhand).

The employment will be provided as per the provisions of the Policy of Govt. of Chhattisgarh. Advisory Committee will be formed by Collector/ Revenue Divisional Commissioner. The development in the area which is predominantly backward, will largely benefit the local population. Preference will be given to the local people for gainful employment in the unskilled and semi-skilled categories as and when the need arises.

Due to development activity in the rural and backward area, traders and private enterprises will grow in the region, which will provide indirect employment to the local people. The company will arrange medical camps, sports competitions and awareness programmes for the benefit of the local people.

14.5 MONITORING SCHEDULE OF EMP

i. In order to keep a watch on the environmental control measures discussed about air quality, water quality and noise level monitoring shall be done regularly every year by taking measurements near the mine and residential areas preferably close to some of the earlier stations so as to keep a comparative check with respect to the base line data. For air quality monitoring, continuous monitoring on 24 hours sampling basis should be done for two days per week and analytical checks made for SPM, SO_2, NO_x and CO.

ii. For effective management of the environment, it is envisaged to have an organisational set-up under the administrative supervision of the Mines Management where responsibilities can be delegated to technical personnel like Mining Engineer, Geologist/Chemist and Horticulturist with regard to specific aspects of environment management plan. The organisation for the purpose is as indicated in the chart given in Plate XL.

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iii. The Master Surface Plan (Plate IV) on 1: 10,000 scale and the Key Map (Plate II) portray the general environmental picture of the area and the region surrounding it.

Conclusion

1. Project affected families will be 1679 of fourteen villages.
2. Compensatory plantation is to be planned in line with Forest Department Rules.
3. Agricultural land shall be converted to industrial or mining site during mining tenure.
4. After the change in land use, the mining will provide the opportunity to create a water storage reservoir and comparatively higher tree plantation and greenery will improve the general quality of the environment. In the process, sustained production of energy vital for the power industry and economy of the area will be ensured.
5. Meteorology and general air quality of the area will not suffer and the planned operations will not have any significant adverse impact on the hydrograph and water quality in the area.
6. Only minor nature of air pollution is visualized for which more than adequate preventive measures have been contemplated.

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CHAPTER 15

MINE CLOSURE PLAN

15.1 INTRODUCTION

The overall area which will ultimately come under mine planning is termed as Gare Palma Sector – II coal mine has been allotted to M/s Maharashtra State Power Generation Company Limited (MSPGCL) by Ministry of Coal vide allotment order no.103/30/2015/NA, dated 31-08-2015.

The Coal mine lies in Mand Raigarh Coalfield of Raigarh district in Chhattisgarh state. This coal block (Extent of area 2583.486 Ha) is proposed to produce coal at the rate of 23.60 MTPA (22.00 MT from OC +1.6 MT from UG) though the peak capacity of OC will be 23.6 MTPA before the UG becomes operational.

The coal produced from this block shall be utilized in the existing and proposed thermal power plants.

I). Name of applicant with complete address

The name of the applicant and address is given in Table 15.1.

TABLE 15.1
NAME AND ADDRESS OF THE COMPANY

Particulars	Information
Name of the Company	Maharashtra State Power Generation Company Limited
Address	"Prakashgad" Plot No. G-9, Anant Kanekar Marg, Bandra (East), Mumbai, Maharashtra-400051.
Phone	022 – 26476231; 022-26474211
Fax	022 – 26581400
E- mail	md@mahagenco.in
Official Website	http://www.mahagenco.in

II). Status of the applicant

MSPGCL is a State owned PSU of Govt. of Maharashtra. It was incorporated in India under Company's Act1956 with Corporate Identity no. **U400100MH2005SGC153648**

Maharashtra State Power Generation Company Limited (MSPGCL) is engaged in power generation with total Installed capacity of 12077 MW as on 31.01.2016, as below:

Thermal	:	8640 MW
Gas Turbine	:	672 MW
Hydro	:	2585 MW
Solar	:	180 MW
Total	**:**	**12077 MW**

The company has 2570 MW of ongoing projects and 7870 MW in planning stage, and is also planning to install 2500 MW of solar power projects in 5 years.

Ministry of Coal vide, letter no. 13016/ 26/2004-CA-I/CA-III(Pt.)(Vol.II) Dt. 24.02.2016 also allotted Mahajanwadi Coal Block to Mahagenco for captive use only under Rule 4 of the Auction by Competitive Bidding.

III). Minerals which are occurring in the area and which the applicant intends to mine

Coal

IV). Information about Enduse Plants

a. As Per Allotment order

TABLE 15.2
NAME WITH LOCATION AND REQUIREMENT OF COAL AS PER ALLOTMENT ORDER DT 31-08-2015

Sl. No.	Name of specified End Use Plant	Location/ Address	Configuration	Capacity
1.	Chandrapur Thermal Power Station Unit 8 & Unit 9	Chandrapur Thermal Power Station Unit 8 & 9(2x500MW), Expansion Project, Nirman Bhavan, Urja Nagar, Chandrapur-442404. Distance from mine 800 km	2x500 MW	1000 MW
2.	Koradi Thermal Power Station Unit 8, Unit 9 and Unit 10	Koradi Complex, Chindwara Road, Koradi-441111, Distt. Nagpur, Maharashtra. Distance from mine 595 km	3x660 MW	1980 MW

Sl. No.	Name of specified End Use Plant	Location/ Address	Configuration	Capacity
3.	Parli Thermal Power Station Unit 8	Taluka parli Vaijnath, Dist. Beed-431520, Maharashtra Distance from mine 1147 km	250 MW	250 MW
	Total			**3230 MW**

b. Additionally Proposed

MSPGCL have requested MOC/NA vide letter No. CMD Mahagenco/ED(Coal/Fuel)/34C (a copy of the letter enclosed at **Annexure-1-2**) proposing to extract coal from Gare Palma Coal Mine up to its full capacity, i.e. 23.6 Mty, and utilise extra coal for other thermal plants of Mahagenco and surrender an equal amount of linkage coal from CIL to the extent the demand for other EUPs will be met from the coal mine.

MOC/NA vide letter no.103/32015/ NA dt. 19.02.2016 (**Annexure 1-3**) clarified that the issue of diversion arises after the commencement of production and advised that Mahagenco may submit the Mining Plan to Ministry of coal for approval and tender intimation towards proposed diversion as per clause 8.4 of Allotment Agreement (**Annexure 15-1**) as and when required.

Taking the above into consideration, the Mining Plan has been prepared for the full capacity of the mine, i.e. 23.6 Mtpa.

V). Annual coal requirement

The coal requirement calculation with norms used for computing consumption is given in Table 15.3.

TABLE 15.3
NORMS USED FOR COMPUTING CONSUMPTION

Sl. No.	Particulars	Name of power plant			Total
		Chandrapur	Koradi	Parli	
1	Capacity, MW	2x500=1000	3x660=1980	1x250	**2330**
2	Station Heat Rate "KCal/KWhr"	2375	2250	2375	**2308**
3	Avg Calorific value "KCal/kg)"	4350	4350	4350	**4350**
4	Specific consumption "Kg/kWhr"	0.5460	0.5172	0.5747	**0.5306**
5.	Plant Load Factor	85%	85%	85%	**85%**

Sl. No.	Particulars	Name of power plant			Total
		Chandrapur	Koradi	Parli	
6	Total Coal Requirement "MTPA"	2x2.0327 = 4.065	3x2.5419 = 7.626	1X1.12 = 1.070	**12.761**
7	Coal availability from this project "MTPA"	4.061	7.626	1.070	**12.761**
8	Linkage/e-Auction from CIL"MTPA"	Nil	Nil	Nil	**Nil**
9	Other blocks of the company "MTPA"	Nil	Nil	Nil	**Nil**
10	Percentage of end use requirement to be met from this mine	100%	100%	100%	**100%**

The total coal requirement for already linked power plants as per allotment order and as per specific heat consumption norms comes to 12.761 MTPA. The balance coal out of the total production of 23.6 MTPA will be used for other thermal plants of Mahagenco as explained in the paragraph 1.8.2.

VI). Annual target coal production

Based on the above explanation this block is proposed to produce Opencast Normative- 22MTPA & Peak-23.6 MTPA and Underground- 1.6 MTPA.

VII). Name of RQP preparing mining plan

The particulars of RQP are given in Table 15.4.

TABLE 15.4
PARTICULARS OF RQP

Name	:	Mr.B.D.Sharma
Address (i) Office	:	A-121, Paryavaran Complex, IGNOU Road New Delhi – 110030
Phone	:	011-29534777, 29532236, 29535891
Fax	:	+91-11-29532568
E-mail	:	min_mec@vsnl.com; minmec@bol.net.in
Web site	:	http://www.minmec.co.in
Registration Number	:	13016/18/2004-CA
Date of grant / renewal	:	01.06.2004
(ii) Residence	:	A-121, Paryavaran Complex, IGNOU Road New Delhi – 110030
Phone	:	011-29534777, 29535891

Copy of RQP certificate are attached as **Certificate I**).

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VIII). Location

The "Gare Palma Sector – II Coal Block area lies in Mand Raigarh Coalfield in Raigarh district of Chhattisgarh state. The mine site is located in Tihli Rampur, Kunjemura, Gare, Saraitola, Mudagaon, Rodopali, Pata, Chitwahi, Dholnara, Jhinka Bahal, Dolesara, Bhalumura, Sarasmal and Libara of District Raigarh in Chhattisgarh. The area is covered in the Survey of India Toposheet No. 64 N/8 & 12 (R.F. 1:50,000) and is bounded by:

As per Allotment Letter:

Latitude : 22° 06' 23.55" N to 22° 10' 37.04" N
Longitude : 83° 26' 22.18" E to 83 ° 31' 19" E

As per Nominated Authority letter F.No.104/28/2015/NA dt. 13-10-2015 (Copy at **Annexure 3-2A**), the coordinates in WGS 84 system are given below. As mentioned in the letter, the earlier coordinates were using reference system based on modified Everest datum but presently CMPDI is following WGS 84 System which is the standard reference system followed globally. It is to be need that the respective position of any point does not change physically on the ground.

Latitude : 22° 06' 24.215" to 22° 30' 49.891" N
Longitude : 83° 26' 15.433" to 83° 31' 12.632" E

(Refer location plan and key plan - Plate I & II)

IX). Communication & accessibility

The Gare Palma area is situated around 35 km away from Raigarh Township, which is also the nearest railway station on Mumbai-Howrah main line of SE Railway. The block is connected by road from Raigarh via Punjipathara by State Highway. Punjipathara village is situated on Raigarh-Ghargoda main road. The distance from Raigarh to Ghargoda is around 40 km. The road distance between Raigarh to Punjipathara is about 20 Km. and Punjipathara to Ghargoda is 20 Km towards north. From Punjipathara the road leads to the Gare Palma area via Tamnar TPP Area situated at a distance of 10 Km. on Punjipathara- Milupara road, which passes through the block. Tamnar is situated in the south-western part of the Gare Palma Sector-I area in the sub block 'F'. A network of road is present within the block.

X). Summary details of the coal block area

Land Use and Ownership / Occupancy

I.P. NAGPAL
Under Secretary
Govt. of India
Ministry of Coal
New Delhi

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The present land use of the area required for the project is given below in Table 15.5.

TABLE 15.5
PRESENT LAND USE OF THE AREA REQUIRED FOR THE PROJECT

Sl. No.	Village	Private Land			Govt. Land				Total Area	Total Area (Private + Govt. Land)
		Agriculture	Non Agriculture	Total Area	Populated	Water body	Other	CBJ**		
A. As per Revenue Departments Records										
1	Tihlirampur	97.902	62.685	160.587	6.83	21.225	39.094	0	67.149	227.736
2	Dholnara	59.64		59.64	6.833	0.376	3.317	2.788	13.314	72.954
3	Murogaon	302.393		302.393	8.256	1.303	4.29	23.504	37.353	339.746
4	Libra	121.416	7.621	129.037	2.897	0.439	4.694	15.943	23.973	153.01
5	Kunjemura	199.715		199.715	14.221	13.596	8.308	30.17	66.295	266.01
6	Jhinkabahal	3.844		3.844	0	0	0	0	0	3.844
7	Radopali	351.676		351.676	8.336	5.895	19.955	0.125	34.311	385.987
8	Dolesara	20.748		20.748	0	0	1.242	0	1.242	21.99
9	Bhalumura	16.297		16.297	0	0	0.704	0.622	1.326	17.623
10	Sarasmal	56.869	9.158	66.027	0	1.332	3.563	15.236	20.131	86.158
11	Pata	316.064	13.166	329.23	13.314	5.529	14.47	15.326	48.639	377.869
12	Chitwahi	142.461		142.461	0.252	0.867	8.153	0	9.272	151.733
13	Gare	157.224		157.224	10.482	4.241	11.596	1.957	28.276	185.5
14	Saraitola	156.228	13.722	169.95	8.395	1.364	7.969	29.703	47.431	217.381
Total of A		**2002.477**	**106.352**	**2108.829**	**79.816**	**56.167**	**127.355**	**135.374**	**398.712**	**2507.541**
B. As per Forest Departments Record										
Government Forest Land										*75.945
Grand Total										**2583.486**

Note: * *75.945 Ha of Protected Forest land and 135.374 Ha of Revenue Forest land is present within the mine lease area, which needs to be diverted for mining purpose after obtaining forestry clearance from the Ministry of Environment and Forest, Govt. of India under the Forest (Conservation) Act 1980.*

** *Small/ big trees forest*

15.1.1 Reasons for closure

It is a new allotted block. Therefore Progressive Mine Closure Plan is described along with the coverage of activities to be taken care of at the closure stage. Reasons for Mine Closure can be exhaustion of mineral, lack of demand, uneconomic operations, natural calamity or directives from a statutory organization.

15.1.2 Statutory obligations

I. Statutory Obligations already received

The following letters/ permissions/approvals have been received:

1. Allotment Order vide Ministry of Coal letter No.103/30/2015/NA, dated 31-08-2015 (**Annexure 1-1**)

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2. The Agreement signed with the Nominated Authority on 30th March 2015 (**Annexure 15-1**)

15.1.2.1 Compliance to various conditions mentioned in the letters/ permissions issued so for is tabulated below:

1. **Allotment Order vide Ministry of Coal letter No.103/30/2015/NA, dated 31-08-2015 (Annexure 1-1)**

Sl. No.	Obligations	Compliance
1	To depute an Authorised Representative to execute the Allottee Agreement (the "Agreement") on its behalf as per the following schedule: Date : 30th March 2015	The Agreement Signed on 30th March 2015 The First Amendment Agreement signed on 30th March 2015

2. **The Agreement signed with the Nominated Authority on 30th March 2015 (Annexure 15-1)**

Sl. No.	Conditions and Obligations Related to Mining/ Safety Closure and Conservation	Compliance
1.	Within 30 days allotee shall submit detailed plan towards commencement of mining operation (Commencement Plan) including mining lease and required and revision of mining plan, if any.	Complied
2.	Make an application to state Govt. for grant of mining lease in the name of Allottee.	Shall be complied
3.	Coal extracted from the coal mine shall be utilized strictly in the specified end use plant.	Out of the 23.6 Mtpa planned production, 12.761 Mtpa coal will be utilized in existing 3 plants as per the allotment order. For the balance production, the procedures of tendering intimation towards proposed diversion as per clause 8.4 of Allotment Agreement will be followed as and when required, when such capacity of mine is reached (refer MOC letter **Annexure 1-4**).
4.	Reduce Generation of Middllings and washery rejects, which in any case shall not exceed	In the Mining Plan, provision for space for a washery has been

Sl. No.	Conditions and Obligations Related to Mining/ Safety Closure and Conservation	Compliance
	normative limit, and utilize them in any captive power plant of the allottee. Any Middllings and washery rejects, may be sold by the allottee.	made. The decision regarding capacity and layout of washery will be reached after thorough investigation. MSPGCL has approached CMPDIL for generation of data (washability tests, cleaning possibilities etc) and report preparation. Being thermal coal, no middlings are anticipated to be generated. The washery rejects shall be within the normative limits and will be disposed off strictly as per rules and regulation framed by Ministry of Environment & Forest and change from time to time
5.	In the event that the allottee is desirous of utilizing the coal in his other plant or subsidiary company then he shall provide written intimation (Diversion Notice) to Central Govt, at least thirty days prior to the such intended utilization., with mechanism for transportation of coal.	The procedures of tendering intimation towards proposed diversion as per clause 8.4 of Allotment Agreement will be followed as and when required, when such capacity of mine is reached.
6.	The allotee shall comply with all applicable laws and observe Good Industry Practice for the protection of the general health, safety, welfare, social security and minimum wages of employees engaged including contractor or sub contractor.	Shall be complied with
7.	The Allottee shall install and utilize such recognized modern safety devices and observe such recognized modern safety precautions as are provided and observed under Good Industry Practice. The allotee shall maintain in a safe and sound condition all infrastructure and equipment constructed or acquired in connection with mining operations and required for ongoing operations.	Shall be complied with

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Sl. No.	Conditions and Obligations Related to Mining/ Safety Closure and Conservation	Compliance
	The allottee shall train employees engaged at the Coal Mine including employees of any contractor or sub-contractor and of all other person having legal access to the area covered by this Agreement in accordance with the Good Industry Practice. The allottee shall construct maintain, and operate health programs and facilities to serve the employees engaged at the Coal Mine including employees of any contractor or sub-contractor and of all other person having legal access to the area covered by this Agreement which programs and facilities shall install, maintain and use modern health devices and equipment and shall practice modern health procedures and precautions in accordance with Good Industry Practice.	
8.	In the event allottee provides housing, the same shall be built to a standard that provides suitable living environments adequate for health and well being and which meets applicable sanitation standards in term of good industry practice.	Shall be complied with.
9.	The Mine Plan approved in relation to the prior allottee, if any shall also be applicable to the allottee. Upon allocation of coal mine, the allottee may revise the Mine Plan for extraction of more coal as compared to mine plan subject to revision. Allottee may increase the production to the maximum possible extent and utilize the coal as per clause 8 (i.e. in specified end use plants)	MOC vide letter no. 103/30/ 2015- NA, dt. 11.01.2016, intimated that the Mining Plan submitted by the earlier allottee did not receive MOC approval and MSPGCL need to apply afresh seeking approval of Mining Plan. Fresh Mining Plan has been prepared. The capacity of the mine has been optimised to the maximum.
10.	Upon exhaustion of the extractable reserves, coal mine shall be closed in the manner provided in the mine closure plan and the applicable laws.	Mine Closure Plan and the applicable Laws shall be adhered to

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II. Statutory obligations still to be received

Other obligations will be there as a result of the following approvals:

a. Mining Plan approval letter from MOC

b. Environmental clearance letter from MOEF

c. Forestry clearance letter from Forest Dept. MOEF

d. No objection certificate from State Pollution Control Board

e. Permission from CGWB for withdrawal of ground water

f. Permission for mine opening from coal controller

g. Permission letter from Controller of Explosives

h. Letter from DGMS for use of HEMM and drilling /blasting

All the obligations spelt out in the above letters/ clearances and also in other letters which may be issued in future will be complied by the Company.

15.1.3 Closure plan preparation

The Progressive Mine Closure Plan and Mine Closure Plan have the approval of the Board of Directors of the Company and the relevant document is attached as **Annexure 15-2**.

15.2 MINE DESCRIPTION

Mine description comprises Geology, Reserves, Mining Method and Coal Beneficiation. Geology and reserves are already covered under Chapter 4 and Mining method under Chapter 5.

15.3 MINE CLOSURE PLAN

15.3.1 Mined out land

i Land degradation and aesthetic environment

The year wise position of mining is given below in Table 15.6.

TABLE 15.6
YEAR WISE POSITION OF MINING AREA

Year	Excavation Area Ha.	
	Progressive	Cumulative
1st Year	26.16	26.16
2nd-3rd year	103.81	129.97
4th - 5th year	250.73	380.70

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Year	Excavation Area Ha.	
	Progressive	Cumulative
6th - 10th year	718.67	1099.37
11th - 15th year	647.69	1747.06
16th - 20th year	202.79	1949.85
21st - 25th year	322.57	2272.42
End of mine 26th - 29th	168.13	2440.55
OC Closure plan 30th -32nd	0.00	2440.55
Total	**2440.550**	

ii. Land degradation control measures

Land degradation is one of the major adverse outcomes of opencast mining activities and any effort to control adverse impacts is considered incomplete when appropriate land reclamation strategy is not adopted. Since the land degradation in this mine is partly in the form of excavated void and partly in the form of external and internal dumps, the reclamation strategy must include a programme for the reclamation of the disturbed land.

iii. Mined area reclamation

The lessee will take necessary steps to keep the area under disturbance at any stage of mining operation to a minimum. This can be achieved by carrying out the reclamation programme simultaneously with excavation. The gap can be reduced between degradation and the reclamation by this programme. The post mining land use of core zone shows that all the disturbed areas will be reclaimed before abandoning the mine excluding the small void.

iv. Reclamation procedure

Reclamation procedure has been described stage wise in the following paragraphs.

Transportation and unloading of top soil at reclamation dump site/spoil bank and levelling of top soil heaps

After the levelling of OB heaps is completed by the dozers, laying of topsoil will be undertaken. The topsoil will preferably be directly brought from the freshly excavated area for the purpose of maximum benefit. In case it is not adequate, the top soil deficiency will be made up from the top soil stack, for which provision has been made. The top soil brought to the reclamation dump site and unloaded will also be in the form of heaps.

Dozers will be deployed for levelling the top soil. It is proposed to lay about 0.5m-1m thick layer of top soil during levelling.

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Biological reclamation

After levelling of top soil, the technical reclamation is complete. The next step will be biological reclamation comprising plantation of grasses, legumes, herbs and trees. All these species will preferably be local. Before planting the trees, dug pits will be made and filled with top soil mixed with manure. Thus the area will be prepared for plantation before the onset of monsoon. The plantation will then be done during June/July after the 1st rain showers.

All the above steps have been explained by a section presented in Fig 15.1 below:

DEPICTION OF METHOD OF PHYSICAL AND BIOLOGICAL RESTORATION/ RECLAMATION/ REHABILITATION

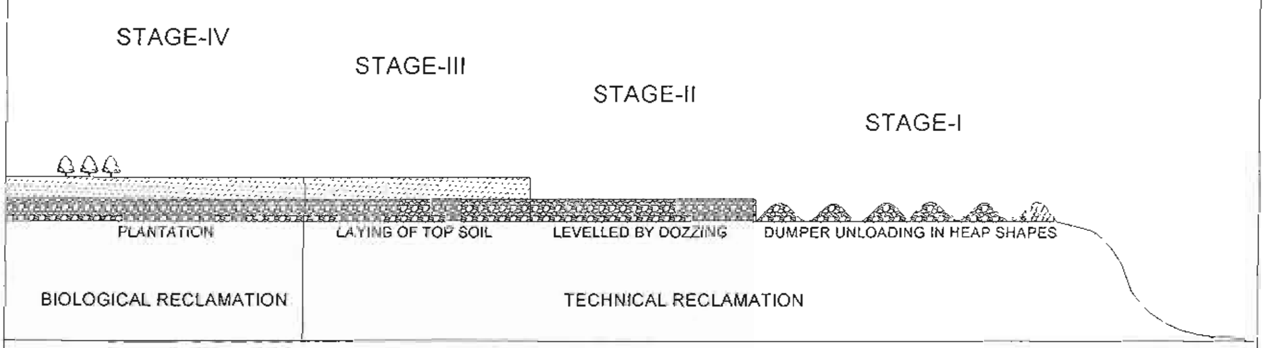

FIG 15.1: SECTION SHOWING VARIOUS STAGES OF RECLAMATION

Arrangement of Plants/ saplings

To fulfil the requirements of nursery plants, a nursery will be established at the site. During peak requirements, additional plants will be transported from Govt./Forest nurseries located around the area. Local species will be opted for plantation.

Protection of Reclaimed Area

The reclaimed and afforested area has to be protected from cattle menace, soil erosion, plant diseases, etc. Plants will be protected from diseases by the application of proper pesticides. Soil working, manuring, etc. will be done whenever necessary. Plants will be protected from cattle menace by proper watch and ward or fencing. Watering will be done periodically as per requirement to support the normal growth of the plants.

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