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REPORT ON

SUBSIDENCE PREDICTION

FOR

JAMUNIA U/G MINE

WESTERN COALFIELDS LIMITED

December 2009

CMPDI

(International Consultant)

Area Planning Officer
WCL, Peach Area

1.0 Introduction:

Jamunia block is located in the north-eastern part of Pench-Kanhan Valley Coalfield, Dist: Chhindwara, Madhya Pradesh. It forms the north-eastern contiguous part of Urdhan Block and northern part of Nehariya Block.

The area is covered in the survey of India toposheet No. 55 J/15 (RF 1:50,000) and is defined by:

Latitudes : N 22° 16' 49" and N 22° 18' 07"

Longitudes : E 78° 57' 00" and E 78° 59' 00"

Area of the project - 4 km^2

1.2 Boundaries of the Project

North : Arbitrary line 200m north of boreholes MPJ-32, MPJ-31, MPJ-27, MPJ-24 & MPJ-28.

East : Gunor River

South : Gunor River, Fault $F_{1(U)}$-$F_{1(U)}$, Gunor River and Fault F_2-F_2

West : Dolerite dyke

The approach to the block is through an all-weather road from Khirsadoh/Parasia upto Urdhan via Shivpuri and Thesgora mines.

The area can also be negotiated from Sarna, located 8 km north-east of Chhindwara on Narsingpur road. From Sarna, there is metaled road for about 8 km upto Palatwada. From Palatwada, the block is at a distance of about 22 km and is served by unmetalled road. The area can also be approached from Amarwara, a Tehsil town on Chhindwara-Narsingpur State Highway in dry weather. The distance between Amarwara and Jamunia is about 40 kms. The approach upto Ghogri is through a metaled road and from Ghogri via. Umaria and Banki through cart tracks. The Gunor River has to be negotiated while coming through this route.

This area has a pleasant climate. Summer is moderate but winter is cold. The average annual rainfall is around 1150 mm. The precipitation is concentrated during the period from 15th June to 15th September. In this area the average relative humidity varies from 22.5% to 76%.

Jamunia Block is approximately 40 km north-east of Parasia, the main mining town in Pench Valley. Chhindwara Town is located 27 kms south-east of Parasia. The state highway No. 19 connects Chhindwara with Parasia. Chhindwara is connected to Amla (120 km) through a broad gauge line of Central Railway. Parasia is the nearest rail head for Jamunia Block (Ref. Plate-I).

Project Report for Jamunia U/G Mine, Pench Area, WCL was prepared by CMPDI, RI-IV in January 2000 with a combination of one Continuous Miner Panel and one LHD panel. This report envisaged a target production of 0.56 Mty with a total capital investment of Rs. 91.3168 Crores.

Project Report for Jamunia U/G Mine is based on "Geological Report on exploration for coal, Jamunia Block, MECL, December 1998". The detailed exploration in Jamunia Block has been carried out by MECL in three phases, which is tabulated below :–

Sl. No.	Series	No. of Boreholes	Period	Agency
1	TG series	3	Jan. 1987 to March 1987	MECL
2	PU series	10	March 1988 to March 1994	"
3	MPJ series	83	Nov. 1996 to February 1998	"

The proposed Jamunia U/G Mine has been projected in major portion (4.0 km^2) of Jamunia Geological Block. The total area of Jamunia Geological Block is 5.30 km^2 involving 62 boreholes with a total meterage of 12050.15m.

The present geological assessment of the proposed mine area is based on the data of 46 boreholes involving a total meterage of 9430.40m in mine area of 4.0 km^2. The borehole density works out to 12 boreholes per km^2.

1.2.2 The exploration in Jamunia Block has proved the existence of five coal seams viz; Seam-I, Seam-II, Seam-III, Seam-IV and Seam-V numbered from top to bottom. These seams occur in the Middle Barakar column.

Seam-I is split into three seam sections namely IA, IB and IC. Seam IB has again split into top and bottom sections. The parting between Seam-III & Seam-IV is also reduced to less than 0.30m in central & south-western part and hence in this part, Seam-III and IV is considered as merged seam.

1.3 HISTORY OF MINING

Jamunia Geological Block is a virgin block located in the north-eastern part of Pench-Kanhan Valley Coalfield. It lies north-east of Urdhan Block and north of Naheriya Block. The perennial Gunor River forms the southern and eastern boundary of Jamunia Block and separates Naheriya and Dhankasa Blocks. Naheriya, Thesgora and Mathani are the nearest operating underground mines and Urdhan O/C is the nearest opencast mine, which has just started. Naheriya, Urdhan and Dhankasa are adjacent blocks to Jamunia Block.

This Project Report proposes to work Jamunia U/G Mine by Bord and Pillar method and extraction by caving. The target capacity of the mine has been envisaged as 0.72 Mty or 2400 tpd, which will be generated from 2 continuous cutting technology panels. The different options considered during formulation of this Project Report are Departmental Option and Partial Hiring Option. In Departmental Option, all the

activities to generate production of 0.72 Mty would be done departmentally. In Partial Hiring Option, the production of 0.72 Mty would be generated by outsourcing the production related activities by hiring of C.M. equipment.

In the Departmental Option, the total capital investment has been estimated as Rs. 305.6049 Crores and the project is yielding a Financial IRR of 7.45% at 100% capacity utilization and 2.40% at 85% capacity utilization. To achieve 12% IRR at 85% capacity utilization level, the premium required over and above the weighted average sale price (Rs. 1295.80/t) is about Rs. 370.41/t.

In the Partial Hiring Option, the total capital requirement has been estimated as Rs. 127.5223 Crores and the project is yielding an IRR of 12.00% at 85% capacity utilization if the outsourcing cost of the production districts is restricted to Rs. 368.42/t.

The report proposes a target capacity of 0.72 Mty that would be generated by operating 2 continuous cutting districts. The peak production capacity is to be considered as 1.25 to 1.35 times (0.90 Mty to 0.972 Mty) the normative production capacity for EMP clearance.

The financial analysis as given above, suggests that the project is yielding an IRR less than 12% at 85% level of capacity achievement in Departmental Option. For Partial Hiring Option with an outsourcing cost of Rs. 368.42/t, the project is yielding 12% IRR. The outsourcing cost appears to be very less where no contractor would be available to operate his machines. In view of the above, the project is recommended for approval, subject to a viable Fuel supply agreement with a customer on cost plus basis.

1.4 DIFFICULTIES & CONSTRAINTS IN MINING WITH ASSOCIATED RISKS

Continuous cutting technology for underground coal extraction has the reputation of being reliable and cost effective. Jamunia U/G Block is one of the geological blocks in Pench Area, where this technology can be introduced. Following difficulties and constraints in mining with associated risks are anticipated while implementing this Project:

a) The thick cover of Basalt overlying the Barakar, Motur and Jabalpur formations could cause difficulty in caving of roof in those areas where the thickness of formations between the Basalt formation and the roof of first workable seam is less than 10 times the total thickness of extraction. Induced caving methods may have to be adopted in such areas for safety consideration. However, Cavability studies are required for ascertaining the Cavability characteristics.

b) Some part of the surface area overlying Jamunia U/G Mine is covered by State Revenue forest and major part is Tenancy land. The approach road suggested in this P.R. would be from Urdhan O/C embankment road and a portion of tenancy land avoiding forest land. However, as there is an involvement of Forest land, Forestry clearance under Forest Conservation Act will be required from MOEF besides approval of EMP. Subsidence Prediction

studies are required to be carried out to ascertain the extent of tensile strain developed below the forest due to extraction below ground. Capital provision has been made to acquire total Tenancy land, Govt. land and for paying NPV of involved forest land in this report. Also capital provision for subsidence studies has been made in this report.

c) The productivity of Continuous Miner district is based on the competency of roof, likely support density and the capability of the roof bolting machine, which is an integral part of the Continuous Miner package. Based on the geo-engineering properties of the strata overlying the coal seams and orientation of faults, panels, etc., the support density has been worked out. Capital provision has been made for detailed scientific studies for design of suitable support system during development and extraction stage. In case the support density requirement exceeds the envisaged density, the output from the Continuous Miner districts will be reduced thus affecting the overall economics of the mine.

d) Availability of clean water for operating the Continuous Miner packages during the initial development years could pose a problem since the nearby mines of Pench Area are known to be dry.

e) Though Continuous Miners can extract coal in odd shaped areas created by faults etc., yet small patches where faults have reduced the clearance to less than 150m may be difficult to mine. In the mining block, there are patches where the thickness is less than 2.4m. In such patches shaly coal/shale may have to be cut by the Continuous Miner.

1.5 TOPOGRAPHY, DRAINAGE & HFL

The entire area of Jamunia block is occupied by Deccan Trap Basalt, which on differential erosion has given rise to rugged terrain. In general, the slope is towards east i.e., towards Gunor River. The area in the central part is comparatively flat with gentle slope and forms the valley. The northern and southern parts are occupied by hills/plateau. The northern part occupied by hills has steep slopes towards south as compared to its northern side. In the southern part the hill/plateau has the maximum altitude in the south-western corner. These plateaus have steep scarps towards south along the Gunor River.

The major drainage in this area is provided by southerly and westerly flowing perennial Gunor River located along the south & eastern boundary of the block. A southerly flowing nalla in the central part of the block is the main tributary to Gunor River. Some part of the block has Govt. Revenue forest. The area is covered with trees like Sal, Mahua, Tendu, Teak etc. Some part of the area especially valleys with rich soil and flat terrain are under cultivation. The crops grown are maize, Jowar, ground nut and wheat.

The Highest Flood Level (HFL) along the course of Gunor River in the block has not been recorded anywhere. In Nehariya Block, 720m RL was assumed as HFL and

accordingly the surface contour line of 720m along the Gunor River was marked for HFL. The northern and eastern bank of Gunor River is marked by steep slopes and hence the zones of highest flood levels are likely to be very minimum in this part of the block.

2.0 LAND USE

The land use pattern of this area is directly controlled by the topography. The plateau and valley portion are used as cultivated land round the year.

Out of the total area of 4.00 km^2 involved for mining purpose, the Government Revenue Forest covers an area of 0.747 km^2, while around 3.1624 km^2 is tenancy land and 0.0906 km^2 of land belongs to Government non-forest land. In addition to this, 0.07 km^2 (7 ha) land is proposed to be acquired at Bokai Combined Township, which is 5-6 km from the mine site.

The top soil is typical black cotton soil occurring mostly in the valleys. Thickness of soil varies from 0.00m to about 7.00m. Sub-soil is dull brown to grey in color with dominance of boulders of Basalt.

Major crops in this area are Maize, Jowar, Groundnut and wheat. Major flora in this area is Teak, Sal, Mahua, and Tendu together with thorny bushes. Monkeys, Peacocks, Fox, etc. represent major fauna of the area.

2.1 Limitations

a) It is noticed in certain parts of the block that the coal seams are devolatised, affected to varying degrees probably due to nearness of hidden igneous intrusive bodies.

b) The strike of the coal Seam is N65^{o}E-S30^{o}W in the central part to N30^{o}E-S30^{o}W in the eastern part and N55^{o}E-S55^{o}W to NE-SW in the western part. Again the dip is 3^o (1 in 18) in southern part while in western and northern part, it is 6^o-8^o (1 in 9 to 1 in 7). These changes in dip and strike may be due to normal depositional features or due to presence of faults.

c) The faults are assumed to have 60^o dip in the absence of any positive data in this regard.

d) The actual position of faults may shift between two nearby boreholes except where these have been intersected in boreholes.

e) The presence of some additional faults and minor slips cannot be ruled out. Similarly the throw of the faults as deciphered may be cumulative throw of more than one fault of lesser magnitude.

f) The floor contours, isochores etc. for the seam have been drawn based on the assumption of gradual change between the points of observation and hence have certain limitations.

g) The overall quality of heat affected coal containing less than 2% moisture in band by

band analysis has been determined by (weighted) averaging the band by band analysis data.

The heat effected coal develops porosity and moisture is absorbed in pore spaces when equilibrated on 60% RH & 40°C. Hence the proximate analysis at 60% RH & 40°C of low moisture (heat effected) coal does not give the correct picture of seam quality.

h) Vmu% has been considered from the overall analysis (at 60% RH & 40°C) for making the heat effected zones. The useful heat value (HU) and grade of the seam has been determined from the weighted average of air dried moisture and ash percentages of heat effected (low moisture) coal. A deduction of 159 kilo calories per kilogram for each 1% reduction (pro-rata) of Vmu below 19% has been made to arrive at the useful heat value of the heat effected coal containing less than 19% Vmu.

2.2 GEOLOGY AND STRUCTURE OF BLOCK AREA

The generalized sequence of Satpura-Gondwana Basin has been given in Table-2.2.

TABLE-2.2

Geological Succession of Pench-Kanhan Valley Coalfield

Age	Formation		Lithology
Sub-Recent to Recent	Soil		Sandy and clayey soil
---------- UNCONFORMITY ----------			
Upper Cretaceous	Deccan Traps Dolerite Dykes		Basalt, massive and vesicular with vugs of quartz and zeolites and intertrappean beds of variegated colours, Basic intrusive.
---------- UNCONFORMITY ----------			
Jurassic	Jabalpur Formation		Sandstone, Jasper bearing conglomerates with soft white clays.
---------- UNCONFORMITY ----------			
Triassic	Mahadeva Group/ Formation	Bagra Conglo-Merate	Coarse conglomerate with quartz pebbles in matrix of sandy clays.
	Denwa Clays		Thick beds of soft variegated clays inter-stratified with sub-ordinate bands of white sandstone.

	Pachmarhi Sandstone	Coarse white soft sandstone with layers of white sub-angular quartz pebbles
---------- UNCONFORMITY ----------		
Upper Permian	Bijori Formation	Sandstone, micaceous shales, carbonaceous shales with streaks of coal

Age	Formation	Lithology
	Motur Formation	Red, buff, pink and pale green clays with nodular concretions and sandstone.
Lower Permian	Barakar Formation	Feldspathic sandstone, shales, carbonaceous shales, fire clays and coal seams
	Talchir Formation	Basal boulder bed followed by alternation of graded sandstone and greenish arenaceous micaceous shales.
---------- UNCONFORMITY ----------		
Archaeans	Gneisses and Granites	Porphyritic, streaky biotite gneisses and granite.

2.3 Barakar is the coal bearing formation

2.3.3 Geology of the mining block

The geological succession of the mining block as deduced from the borehole data has been given in table-2.3.

TABLE-2.3

GEOLOGICAL SUCCESSION IN JAMUNIA BLOCK

Age	Formation	Lithology	Thickness Range (m) Min.	Max.
Sub- Recent to Recent	Soil (Residual & transported)	Sandy and clayey soil	0.00	7.00
Upper Cretaceous to Eocene	Deccan trap with inter-trappeans Dolorite Dyke.	Flows of Basalt with beds with clay / clayey-stone of variagated colours	28.36	95.97

---------- UNCONFORMITY ----------				
Jurassic	Jabalpur	Gritty sandstone & clays with red jasper pebbles	0.00	65.26
---------- UNCONFORMITY ----------				
Permian	Motur	Clay / clayey stone of brick red, purple & grey colour with sandstone lenses bands at places	14.00	108.96
	Barakar	Sandstone, with kaolinised feldspers interbanded with shale and coal seams	40.00 +	79.62
	Talchir	Fine grained argillaceous sandstones & green shale	6.05 +	
---------- UNCONFORMITY ----------				
Pre-Cambrian	Metamorphics	Not encountered in any of the borehole		

3.0 STRUCTURAL SETTING OF PROJECT

3.1 Geological Structure of the Coalfield:

The rectilinear outline of the Satpura-Gondwana basin can be ascribed to the effect of faults which trend roughly in east-west direction. The Gondwana formation preserved in this linear trough shows a broad synclinal structure cropping out on either limb. The lower Gondwana beds in the south dip northwards.

3.2 Geological Structure of the Mining Block:

The geological structure of Jamunia mining block has been deciphered mostly on the basis of subsurface data obtained from boreholes drilled in the block.

3.3 Strike and Dip:

The attitude of the beds has been deciphered from the floor contour plans. The strike of the coal seam is N65^{o}E- S30^{o}W to N30^{o}E- S30^{o}W swerving to NNE-SSW. However, local undulations and drag effects can be seen near the faults. The dip of the coal seam in general is towards north-west and varies from 3^{o} to 8^{o}. The corresponding gradient is 1 in 7 to 1 in 18.

4.0 GEOLOGICAL COAL RESERVES

4.1 Reserve Categorization

All the reserves in the mineable area have been categorized as `Proved' following the usual norms as applicable for underground proposition.

4.2 Quantity Estimate Criteria

The isochores, isogrades and the iso-Vmu lines have been drawn on the basis of principle of gradual change. It is assumed that variation between any two points of observations is gradual and uniform.

(a) Dolerite dyke is intersected in borehole MPJ-32 in place of Seam-III, IV & V. Similarly, all the seams have been assimilated by dyke in borehole PU-76. A 40m wide influence line has been marked around the dyke and it has been assumed that the coal within this zone is burnt. The reserves within this dyke zone have not been estimated.

(b) The Vmu lines (volatile matter on unit coal basis) are drawn for 18% & 30% Vmu, to indicate devolatilised heat effected and normal coal.

(c) The coal seams are heat effected to varying degrees in certain parts of the block. The degree of devolatisation (heat effect) is expressed in terms of Vmu% and accordingly 18% & 30% Vmu lines have been drawn to demarcate the heat affected coal less than 30% Vmu and normal coal (> 30% VMu).

The reserves for the block have been estimated based on these quality parameters of coal seams. The heat effected coals for the boreholes for which the Vmu% was not determined, has been demarcated on the basis of moisture content in band by band analysis (on air dried/as received basis). The seams/sections containing less than 2% moisture (weighted average) has been considered as heat effected coal and it has been assumed that the seam contains less than 30% VMu.

(d) Volatile Matter on unit coal basis (VMu) for the coal seams have been calculated based on the seam overall analysis (at 60% RH and 40^{o}C) using the usual method.

(e) The overall quality of heat effected coal containing less than 2% moisture in band by band analysis has been determined by (weighted) averaging the band by band analysis. The proximate analysis at 60% RH & 40^{o}C of low moisture (heat effected) coal does not give the correct picture of seam quality.

(f) Only VMu % has been considered from the overall analysis (at 60% RH & 40^{o}C) of heat effected coal. The useful heat value (HU) and grade of the seam has been determined from the weighted average of air dried moisture and ash percentages. A deduction of 159 k. Cal/kg for each 1% reduction (pro-rata) of VMu below 19% has been made to arrive at the useful heat value of the heat effected coal containing less than 19% moisture.

(g) The reserves mostly occur within 250m depth from the surface.

(h) Sectors

The Jamunia Mining Block has been divided into sectors based on the disposition of the faults. The sector boundaries for the individual sectors have been given in Table-4.1.

Table-4.1

Sectors for Reserve Estimation

Sector No.		North	East	South	West
1	III	Fault F_3-F_3	Gunor river	Gunor river, fault $F_{1(u)}$-$F_{1(u)}$ & F_2-F_2	Heat affected zone of dyke
2	V	Fault F_4-F_4	Extended line of fault F_6-F_6	Fault F_3-F_3	Heat affected zone of dyke
3	VI	Fault F_5-F_5	Junction of extended fault F_4-F_4 and fault F_5-F_5	Fault F_4-F_4	Heat affected zone of dyke
4	VII	Fault F_6-F_6 & block boundary	Junction of extension of fault F_4-F_4 & fault F_6-F_6	Fault F_5-F_5	Heat affected zone of dyke
5	VII I	Block boundary	Gunor river	Fault F_3-F_3 & Fault F_6-F_6	Junction of block boundary and Fault F_6-F_6

5.0 Details of the Project:

Company	:	Western Coalfields Limited
Area	:	Pench Area
Colliery	:	Jamunia UG mine, PA
Name of the Seam Proposed to work	:	Seam II, III, IV and V
Average Thickness of seam	:	Seam II (2.8 m) Seam III + IV (4.0 m) Seam IV (3.0 m)
Average Gradient of Seam	:	1 in 10
Depth range	:	Seam II (120 – 268 m) Seam III + IV (133 - 267 m) Seam IV (141 - 281m)
Area of Geological Block	:	5.3 km^2
Borehole density of Block	:	12 BHs/km^2
Total Geological reserves	:	96.921 Mt.
Mineable Reserves	:	33.27 Mt.
Extractable Reserves	:	22.76 Mt.
Total Capital investment	:	305.6049 Cr.
Earnings per manshift	:	Rs.1031.80
Manpower	:	UG – 440 Surface – 105 Total – 545 Nos.
Target output	:	0.720 Mty
Total Life of Mine	:	37 Yrs.
OMS	:	6.723 Te.
Land to be acquired	:	407 Ha. Govt. land – 9.06 Ha. Tenancy land – 316.24 Ha. Forest land (74.70 Ha.) State revenue forest
Cost of rehabilitation	:	No rehabilitation is envisaged in this project.

5.1 MINEABLE & EXTRACTABLE RESERVES

5.1.2 Mineable Reserves

The following table shows the workable seam wise Geological Reserves, Geological losses, Mining losses and Mineable reserves (> 1.5m thickness) considered in Jamunia U/G Mine:

Seam	Area considered (ha)	Thick-ness Range (m)	Geological Reserves (Mt)	Geological Losses (Mt)	Mining Loses (Mt)	Other Coal losses if any (Mt)	Mineable Reserves (Mt)
Seam-II	400	1.5 to 4.15	14.864	5.961	2.490	-	8.903
Seam-III + IV/IV	400	2.75 to 7.55	24.958	10.364	5.150	-	14.594
V	400	1.5 to 5.92	17.465	7.692	2.870	-	9.773
TOTAL			**57.287**	**24.017**	**10.510**	**-**	**33.270**

The above given losses are on account of barriers against faults, odd shaped areas, inaccessible places and 15m barrier against Gunor River. Out of the Geological Reserves of 57.287 Mt, the Geological losses are to the tune of 24.02 Mt and therefore the mineable reserves work out to 33.27 Mt.

5.2 Extractable Reserves

The following table shows the workable Seam-wise Geological Reserves, Geological Losses, Mineable Reserves, Mining Loses and Extractable Reserves (> 1.5m thickness) considered in Jamunia U/G Mine:

Seam	Geological Reserves (Mt)	Geological Losses (Mt)	Mineable Reserves (Mt)	Mining Losses (Mt)	Extractable Reserves (Mt)
Seam-II	14.864	5.961	8.903	2.490	6.413
Seam-III +IV/IV	24.958	10.364	14.594	5.150	9.444
Seam-V	17.465	7.692	9.773	2.870	6.903
Total	**57.287**	**24.017**	**33.270**	**10.510**	**22.76**

The above given mineable losses are on account of barriers, angle of draw against surface features, protective pillars against mine entries, sub-panelisation, ribs in pillars and the areas where thickness is more than 4.5m in Seam-III + IV/IV & Seam-V. Out of Mineable Reserves of 33.27 Mt, the mining losses are to the tune of 10.51 Mt. Therefore the extractable reserves works out to 22.76 Mt.

5.3 MINE DEVELOPMENT STRATEGY

For the development of the proposed Jamunia U/G Mine, following strategy is envisaged:

a) Acquire land for mine infrastructure, entries, caving and township, which includes Tenancy, Government and Forest lands.

b) Construct approach road with culverts for gaining unrestricted access to inclines site from existing Urdhan O/C embankment avoiding forest land.

c) Arrange for temporary and permanent power supply and water supply arrangement at the mine entries site and begin drivage/sinking.

d) Drive the inclines (2 nos.) from surface up to the floor of Seam-V crossing Seam-II and Seam-III + IV/IV at a gradient of 1 in 4.5.

e) Start development of five nos. of main trunk roadways in Seam-II and Seam-V simultaneously in Sector III. The Pillars in main dips will be rectangular in shape, 45m along the strike and 34.5m along the dip. It is proposed to drive the main dips using Continuous Miners. After the main dips in Seam-II and Seam-V have touched fault F_3-F_3, flanks development will be started in Seam-II. Meanwhile drifting is proposed to be done simultaneous to cross fault F_3-F_3 in both Seam-II & V. The main trunk roadways and pillars in all the seams are proposed to be superimposed.

f) By the time, the main trunk roadways reach upto the fault F_3-F_3, sinking of airshaft of 4.5m diameter with 196m depth upto the floor of Seam-V in Sector III along with installation of mechanical ventilation in the fan drift is to be completed.

g) Once the main trunk roadways are developed in Seam-II and Seam-V upto the block boundary in the northern side, full-fledged two flank Continuous Miner panels will be introduced to give the target production in 7^{th} year.

h) Construct coal handling arrangement and other service and welfare buildings for the smooth operation of the mine.

i) To transfer the coal from Seam-II to Seam-V, strata bunkers of 150 t capacity will be made in the parting between Seam-II and Seam-V in trunk roadways. Coal will be discharged from trunk belt conveyor installed in main dips of Seam-II to the main dips of Seam-V through these bunkers and finally coal will be brought upto incline by trunk belt conveyor installed in Seam-V. Another strata bunker is proposed to be made from Seam-II to Seam-V at the place where belt incline touches Seam-V. The coal coming from the panels of Sector III of Seam-II will be dropped in this bunker on the incline belt conveyor installed in Seam-V.

j) The main trunk roadways will be five in number in all the workable seams, out of

which, one will be used as belt roadway for coal transportation and the other as haulage roadway for material. The third roadway will be used for travelling of men where a man riding arrangement in the form of chair lift system is proposed. All the above said three roadways will be intake roadways. The extreme sides of the main trunk roadways (two trunk roadways on either side) will be served as return roadways. Also Incline no. 2 is proposed to be installed with direct haulage, which will be used for material supply as well as traveling of men using mine cars.

k) After the development and extraction of Seam-II is completed, development of main trunks and panel development will be started in Seam-III + IV/IV.

In the proposed liquidation plan, an attempt has been made to depillar the panels of Seam-III + IV/IV after a gap of more than 5 years as compared to the respective panels of Seam-II. Similarly after the development and extraction of Seam-III + IV/IV is completed, development of panels will be started in Seam-V. While preparing the liquidation plan for depillaring of panels of Seam-V, a gap of more than 5 years has been kept in comparison to the already depillared respective panels of Seam-III + IV/IV.

l) The average parting between Seam-II & Seam-III + IV/IV is about 7m and Seam-III+IV/IV & Seam-V is about 8m. It is proposed to develop along the floor of Seam-III+IV/IV. In the panels, wherever the parting is less than 3m between Seam-III+IV/IV and Seam-V, development along the roof in Seam-III+IV/IV has to be done to maintain a minimum parting of 3m.

m) The dimension of pillars in main trunk roadways and panels are as per CMR-99. In the main trunk roadways of all the three workable seams, upto a depth of 240m, the pillars will be rectangular in shape with a size of 34.5m x 45m and beyond 240m depth, the pillar sizes are proposed to be square shaped with a size of 45m x 45m. In the panels, it is proposed to keep 34.5m x 34.5m pillar sizes upto a depth of 240m and 45.0m x 45.0m pillar sizes beyond 240m depth for a gallery width of 4.8m. The pillars in the panels & main trunk roadways are superimposed in workable seams.

n) Sector-III is a big sector which has 8 panels namely Panels 1, 2, 3, 4, 5, 6, 16 & 17. Sector VIII, is another big sector having 6 panels namely Panels 7, 8, 9, 10, 11 & 12. Sector-V, VI & VII have one panel each for working. Therefore 17 panels are proposed for working in three workable seams.

o) Beyond the northern boundary, the area is unexplored. In this Project Report, it is proposed to explore the area beyond the proposed northern boundary for which 2000m drilling is proposed. After the exploration, if the continuity of same set of seams is established with similar structure and same geo-mining conditions, then some more area can be annexed upto the Gunor River on the northern side. Necessary capital provision has been made in Appendix-A.7 for the above said purpose.

6.0 PROPOSED METHOD OF MINING

There will be five nos. of main trunk roadways initially in Seam-II & Seam-V and later on in Seam-III+IV/IV. Strata Bunkers are proposed in these main trunk roadways from Seam-II to Seam-V cutting Seam-III+IV/IV. The coal of Seam-II

will be dropped into these strata bunkers upto Seam-V.

Similarly the coal of Seam-III+IV/IV will be dropped in these strata bunkers upto Seam-V. The dropped coal will be collected by the belt conveyor, which is installed in the trunk roadways of Seam-V and will be transported to the surface.

Panels in Seam-II will be developed and depillared initially. After completion of Seam-II, the workings will be shifted to Seam-III+IV/IV and will be developed and depillared. Lastly, Seam-V will be developed and depillared in all the panels. All the workable seams have same no. of panels. In the liquidation plan, sufficient care has been taken to provide a gap of at least 5 years between the depillaring of panel of a lower seam with the same panel of upper seam for settlement of goaf.

6.1 DESCRIPTION OF MINING METHOD

6.2 Mining Parameters

The mining Parameters are enlisted as under:

a) **No. of headings** - Generally 5 (In some panels, because of technical compulsion, more/less no. of headings are proposed).

b) **Gallery width** - 4.8m

c) **Development height** - The height of development galleries will be restricted to 4.5m or the seam thickness whichever is less. Since the maximum cutting height of Continuous Miner is 4.5m, the concept of C.M. application demands that the galleries are to be supported only one time using quality roof bolts so that no further heightening is involved and scope for secondary support is ruled out. It would be better to develop and support in one phase.

d) **Extraction height** - The height of extraction will be restricted to 4.5m or the seam thickness whichever is less. As the maximum cutting height of C.M. is 4.5m, therefore it is proposed to restrict upto the maximum cutting height of C.M.

e) **Depth of proposed workings** - The depth range of proposed workings in Seam-II, Seam-III+IV/IV and Seam-V is 120m – 268m, 133m-267m and 141-281m respectively.

f) **Pillar sizes** - There are two pillar sizes as per the depth of the mine workings in all the three workable seams. In a depth range of 150m to 240m, the proposed pillar size will be 34.5m x 34.5m. In a depth range of 240m to 360m, the proposed pillar size will be 45.0m x 45.0m. These both pillar sizes are proposed with a gallery width of 4.8m.

g) **Panel Details** - Main Trunk Roadways are proposed in all the workable seams almost in the center of mine property. From the main trunk roadways panels are drawn upto the mine boundary or faults on the eastern and western sides. Panel width is generally kept as five headings either with 34.5m x 34.5m pillar size or 45.0m x 45.0m pillar size. In certain panels because of technical compulsions (close proximity of the disposition of two faults etc.), more/less than 5 headings are proposed.

h) **Cut-out distance** - The cut-out distance has been assumed as 6.0m based on the likely strata behavior.

The panel layout, no. of panels, size of panel has been decided on the basis of geo-mining conditions of Jamunia U/G mining area.

6.3 Method of Development

Jamunia U/G Mine is proposed to be developed on Bord & Pillar method. The main dips and the panels will generally consist of 5 headings as this is the standard and most productive width for a Continuous Miner District. In the panels, which are near the faults or in odd shaped areas, the number of headings may be increased or decreased in view of conservation of coal as against creating another panel.

The pillar sizes in the panels will vary as per depth in each sector for a gallery width of 4.8m. The pillars in panels will be square shaped. In the Continuous Miner district, the height will be restricted to 4.5m or seam thickness whichever is less. Since the maximum cutting height of Continuous Miner is about 4.5m, it is proposed to develop and support in one phase where no further heightening will be involved. The galleries will be supported one time only using good quality roof bolts so that scope for secondary support is ruled out. Removal of support particularly resin grouted roof bolts is impossible without blasting. This then further weakens the roof and exposes the work force to unsupported roof.

The standard layout for development using Continuous Miner is shown in Plate No. XII, Figure-1. The reason for proposing a 5-heading layout is:

a) One drive for the Continuous Miner to be cutting i.e. Drive No.2 left (2L on the plan)

b) One drive being roof bolted (2R on the plan)

c) One drive being cleaned (1R on the plan)

d) One drive having the ventilation and direction lines extended (Main on the plan)

e) One drive ready for cutting (IL on the plan)

This layout ensures that the Continuous Miner always gets a supported face to cut and there is no idling of equipment due to shortage of working faces. No doubt, availability of supported face is subject to the support requirement and the capability of the bolting machine.

7.0 Cavability Characteristics

The strata between top most workable seam i.e. Seam-II (Barakar formation) and Deccan traps comprise mainly Motur and Jabalpur formations. The thickness of the intervening strata varies between 73m to 180 m. The thickness of Deccan Traps varies from 16m to 90m.

Report on cavability study of Deccan trap basalt formation in the adjacent Naheriya U/G Mine was received in December 2007 (Refer Annexure-III A) and this report has mentioned that the Deccan Trap Basalt Formation is difficult to cave. Therefore, caving of roof would be a difficult proposition over those panels where the thickness of strata between the basalt formation and first workable coal seam is less than 10 times the thickness of combined working thickness of all workable seams. Although the report on Cavability Study has restricted its conclusion to Naheriya U/G Mine area only, it can still serve as an indication for Jamunia U/G Mine also.

On the basis of above study, the ratio has been studied in the boreholes within Jamunia U/G Mine boundary (Refer Annexure-III B). The study indicates that in majority of the area, the ratio of thickness of strata between the basalt formation and first workable coal seam is more than 10. In few places, the ratio is more than 9. If the bulking factor is low, such as 1.1 or 1.2, the intervening strata may not be sufficient to fill the void after caving, resulting in unfilled gaps below the basalt and the roof of the first workable coal seam. This may give rise to large spans, it may be advisable to restrict panel size and height of extraction in certain areas of the property till the caving characteristics of the basalt trap are established by trial in a panel in favorable part of the mine area.

It is suggested to carry out physico-mechanical tests for the entire thickness of basalt formation in Jamunia Block. Piece length should also be obtained from the cores to ascertain the massive nature of the trap. If the basalt traps prove to be dense, difficulty in caving could be experienced in the panels where the thickness of strata between the basalt trap and Seam-II is less than 10 times the combined thickness of extraction.

However, it is suggested to entrust the strata control and cavability studies to a scientific research organization for which sufficient capital provision has been kept in the report.

8.0 SUBSIDENCE

Caving is proposed as method of extraction in this report. The depth of the mine varies from around 108m to 280m. The surface topography is hilly in nature and some portion is covered with forest. Subsidence cracks may appear on the surface even though workable seams are at a depth. It is proposed to fill these cracks by properly ramming incombustible material. If by mining the seams, certain area is lowered due to subsidence below HFL, suitable drainage channels may be made so as to guide the water away from such subsided area. Additionally, constant monitoring of such areas especially during monsoon is suggested so that chance of occurrence of mishap due to entry of water into underground workings is minimized.

The surface topography is hilly in nature and some portion is covered with forest. Depillaring is not proposed under the surface features taking angle of draw of 35^0 into consideration.

To study the impact of subsidence on surface it is proposed to carry out subsidence prediction studies in association with any scientific agency. Based on the results of this study, certain modifications may have to be made in this report. It is further suggested to generate subsidence related data while working. This data can be

utilized for calibrating the subsidence model for accurate prediction of subsidence and its related damages especially in areas near the river/nalla. Based on the recommendations of subsidence study, the coal sterilized within the barrier zone of the Gunor River can be partially or fully released for extraction.

While estimating the seam-wise extractable reserves, angle of draw of 35^{o} has been considered. It is proposed in this report to acquire the whole mining area whether or not affected due to subsidence and fence it to prevent unauthorized entry. The subsidence cracks, which reach the surface will be packed tightly with soil and mud and non-carbonaceous debris and regularly dozed so that topography does not change substantially and artificial water bodies are not created.

Based on the recommendations of subsidence study, the coal sterilized within the barrier zone of the Gunor River can be partially or fully released for extraction.

It is recommended that while carrying out extraction, close subsidence monitoring should be done, particularly in the area nearby the nallas /river, as a precautionary measure.

8.1 GENERAL PRECAUTIONS

- Shuttle cars are tyre-mounted equipment. It must be ensured that the sectional profile of the wheel-locking ring matches with the wheel rim groove and is of the correct size. Periodically the locking ring should be examined for each tyre-mounted vehicle for its suitability and record of such examination should be maintained. While fitting a new locking ring, it should be ensured that the same fits correctly in its rim groove.

- Trailing cables of mobile equipment like Continuous Miner, Shuttle Car, Roof Bolter, etc. get cut quite frequently due to various reasons. The cable joints have to be vulcanized. Continuity of insulation of the cable, after every vulcanization should be tested and the insulation resistance recorded.

- Operation of the Quad Bolter has been observed at Tandsi U/G Mine of WCL. It is felt that the machine lacks the flexibility to install roof bolts at spacing closer than 0.6 m in a row. The efficacy of the machine is dependent upon using all the four bolting rigs simultaneously. For the purposes of this PR, Dual Boom Twin Roof Bolters have been provided, as they are more flexible as compared to Quad Bolters. The support density envisaged in the PR is within the capability of the Dual Boom Twin Roof Bolters. In case the support density is increased, another bolting machine will be required to share the bolting load so that production of the Continuous Miner panel is not affected and a supported face is always available for cutting. The provision of these machines has been kept in Appendix A.3 in the Departmental Option.

- All equipment in the Continuous Miner package are electro-hydraulically operated. All provisions and guidelines stated in "DGMS Tech. Circular No.1 of 1996 regarding use of high pressure hydraulic hoses in underground coal mines" should be strictly followed.

- Quality of roof bolting consumables plays a critical role in the efficacy of roof bolting. Quality control must be exercised at the mine level by carrying out short encapsulation tests, etc.

- The Mine Management taking into account the risks involved in various operations should prepare a Safety Management Plan and the control measures to be adopted to obviate the risks. The risks should again be rated after applying the control measures to ascertain the activities that require close monitoring and preventive actions. The Safety Management Plan is a rolling plan to be prepared by a team of personnel related to the job. The approach should be non- judgmental and the control measures should be agreeable to all persons at the grass root level for proper compliance.

Cavability Study:

Cavability study of Deccan Trap Formation for Two Boreholes CMPNE -1 and CMPNE – 2.

Received vide letter No: CMPDI?HQ/UMD/1301 dt: 06/12/2007

Background :

Two boreholes namely, CMPNE - 1 and CMPNE – 2 were drilled in Naheriya Block to access cavability of Basalt Trap. The job was assigned to CMPDI (HQ) by RI- IV Nagpur.

The cores of the above mentioned boreholes were tested for Physico-mechanical properties by NIT, Nagpur.

The present report is based on the physico-mechanical properties determined from these two Boreholes.

Procedure:

CMRI, Dhanbad has developed an empirical formula to determine an index by which cavability of roof rocks can ge quantify3d. the cavability Index, I is gven by :

$$I = (S \times L^n \times t^{0.5}) / 5$$

Where S= Compressive strength of Roof strata

L= Average length of core pieces

t= Thickness of individual bed

n = a constant, depends on RQD of a rock bed (1.1 to 1.3)

This empirical formula for cavability assessment of roof strata is meant for longwall method of mining.

Based on the above cavability index, each bed within the roof strata of a coal seam may be classified into five categories:

Cavability index	Category	Cavability Type
• Less than 2000	I	Easily cavable Roof
• 2000 to 5000	II	moderately cavable roof
• 5000 to 10000	III	Roof cavability with difficulty
• 10000 to 14000	IV	Cavable with substantial difficulty
• More than 14000	V	Cavable with extreme difficulty

Results:

The cavability index of each bed as determined from the above empirical formula has been given in Table – 1 and 2. This can be seen from the tables that bed no. 16 (table – 1) within the basalt trap has a cavability index of 35742 which is "Cavable with extreme difficulty" i.e. of category V. similarly, bed No. 30 (Table -2) with the basalt trap has a cavability index of 80744 which too is " Cavable with extreme difficulty" i.e. of category V.

It can be observed from the cavability index table that strata in between coal seams and the basalt trap are easily cavable. No problem in caving is expected where the gap between the basalt trap and the upper coal seam is more than ten times of the combined working thickness. Several beds within the basalt trap are of extremely difficulty to cave category. Where such beds come within ten times of the combined working thickness from the upper working seam, difficulty in caving will be encountered.

9.0 Subsidence Prediction:

9.1 Methodology and Parameters:

Subsidence prediction model developed by Subsidence cell, CMPDIL (HQ) based on stochastic influence function has been used for subsidence prediction of Jamunia UG mine, based on the earlier study conducted for nearby Neharia UG mine.

All the relevant data in respect of mining parameters, geology, surfce features and sequence of operation have been collected from Project Report of Jamunia UG mine, prepared by RI-IV, CMPDIL, in January. Details of mine layout plan, surface features, surface contours and

other relevant data from plans were converted into digital form using Mines Package. Panel boundaries of working of seam were digitalized from seam folio plans of respective seams. Surface contours and surface features such as HT line, Gunor river, Dhankasa nala and its tributaries were digitalized from topographical plan DRG No. NS-0 Forest boundary, HFL and village were digitalized from seam folio plan of seam V.

The digital data have been used as input parameters for subsidence data of Jamunia UG Mine or its adjacent mines, the value of subsidence factor and likely subsidence influence area/ Angle of draw have been taken from the report on subsidence investigation carried by CMRI under S&T scheme at North Chandametta and Surki collieries in Pench and Kanhan Area of WCL and subsidence observations date of Shobhapur Colliery, WCL which was carried out by CMPDIL.

The input parameters taken for subsidence prediction are as follows:

i) Subsidence factor - 0.46

ii) Angle of Draw : a) for undisturbed overlying strata - 30^0

b) for disturbed overlying strata - 350

iii) Percentage of extraction - 800

iv) Average thickness of the seam for each panel or for the part of the panel where thickness vary significantly within the panel.

v) Average depth of the seam for each panel of for the part of the panel where depth vary significantly within the panel.

For subsidence prediction, underground extraction area has been divided into 20m X 20m grid blocks as an element of subsidence calculation. From the calculated subsidence at each grid point, subsidence contours, surface topography after subsidence at different stages of extraction and their 3D views have been drawn with the help of computer.

9.2 **Subsidence prediction result**:

The subsidence prediction result and its impact on surface topography are shown in Plats. The plots have been generated using computer and HP Draft Master II Plotter. The scale of plates is 1:10,000. The maximum value of prediction subsidence observed over the entire mining area is 2.089m after extraction of Seam II and III(after 13 Yrs. of mining) and 4.345m after extraction of all the seams (after 36 Yrs. of mining)

9.3 **Subsidence contours and surface topography along with 3D views**:

From the calculated subsidence at grid interval of 20m X 20m, subsidence contours have been generated at an interval of 20cm and 30cm at the end of 13Yrs and at the end of 36 Yrs. of mining respectively. Plate I shows the subsidence contours at the end of 13 Yrs. of mining i.e. after simultaneous extraction of Seam II and III. Plate shows panels or part of the panels extracted in seam II and seam III respectively. Plate shows the subsidence contours at the end of 36 Yrs. of mining i.e. after

simultaneous extraction of seam IV and V. This is final subsidence of the mine because in this period all the four workable seams should have been extracted. Plate shows the panel or part of the panels extracted in seam IV and seam V. To give a fairly good idea about the ground behavior after mining, 3D view of subsidence after 13 yrs. and after 36 Yrs. of mining are shown in plate. In 3D view of subsidence, view direction is South – West and Z-amplification in 1:40 so as to give better visual impact of the surface subsidence.

Surface topography before mining, after 13 Yrs. of mining and after 36 Yrs. of mining are shown in plate. Change in surface topography due to subsidence can be seen in the plates. To give general idea about the ground behavior after mining, 3D view of surface topography before mining, after 13 Yrs. of mining and after 36 Yrs. of mining are shown in plates. In 3D view of subsidence, view direction is South – West and Z-amplification is 1:1.5.

From the subsidence prediction it is found that Gunor river falls within subsidence influenced zone near panel. This shows that 60m barrier against Gunor river in the above mentioned panels extraction should be further restricted so that influence of subsidence get restricted at the banks of river.

10.0 Conclusion and effect of subsidence on surface features:

The above conclusion is based on the test results of the core from boreholes drilled in Nehariya Block. As the properties of rock change from place to place, the same may not hold good for Jamunia Block.

The surface over the proposed mining area comprises of forest land and agricultural land. The generated elevation of the surface ranges from 700m to 782m i.e. the difference of elevation is 82m. for such elevation the maximum predicted subsidence of 1.412m will not extensively affect the drainage pattern in the area. However, drainage will be affected at several places due to formation of pools and cracks which needs to be filled up to achieve original drainage pattern.

Even after leaving 60m barrier from panel of Gunor river and Dhankasa Nalla, it is found that extent of subsidence influence is reaching inside the river at some places and therefore, extraction in some of the panels has been suggested to be limited so that subsidence does not affect the river. In this circumstances preventive measures against inrush of surface water such as making embankment against river (towards Southern and Western side of the property), partial extraction, and extraction with stowing, restricting extraction in the panels or any other measures is to be taken.

Non-metaled roads situated in the mining area will also get affected by subsidence, therefore considering the importance of road; either road should be diverted or regarded if existing.

Note:

It is recommended that while carrying our extraction, close subsidence monitoring may be done and based on observations necessary corrections in prediction, if so required may be done.

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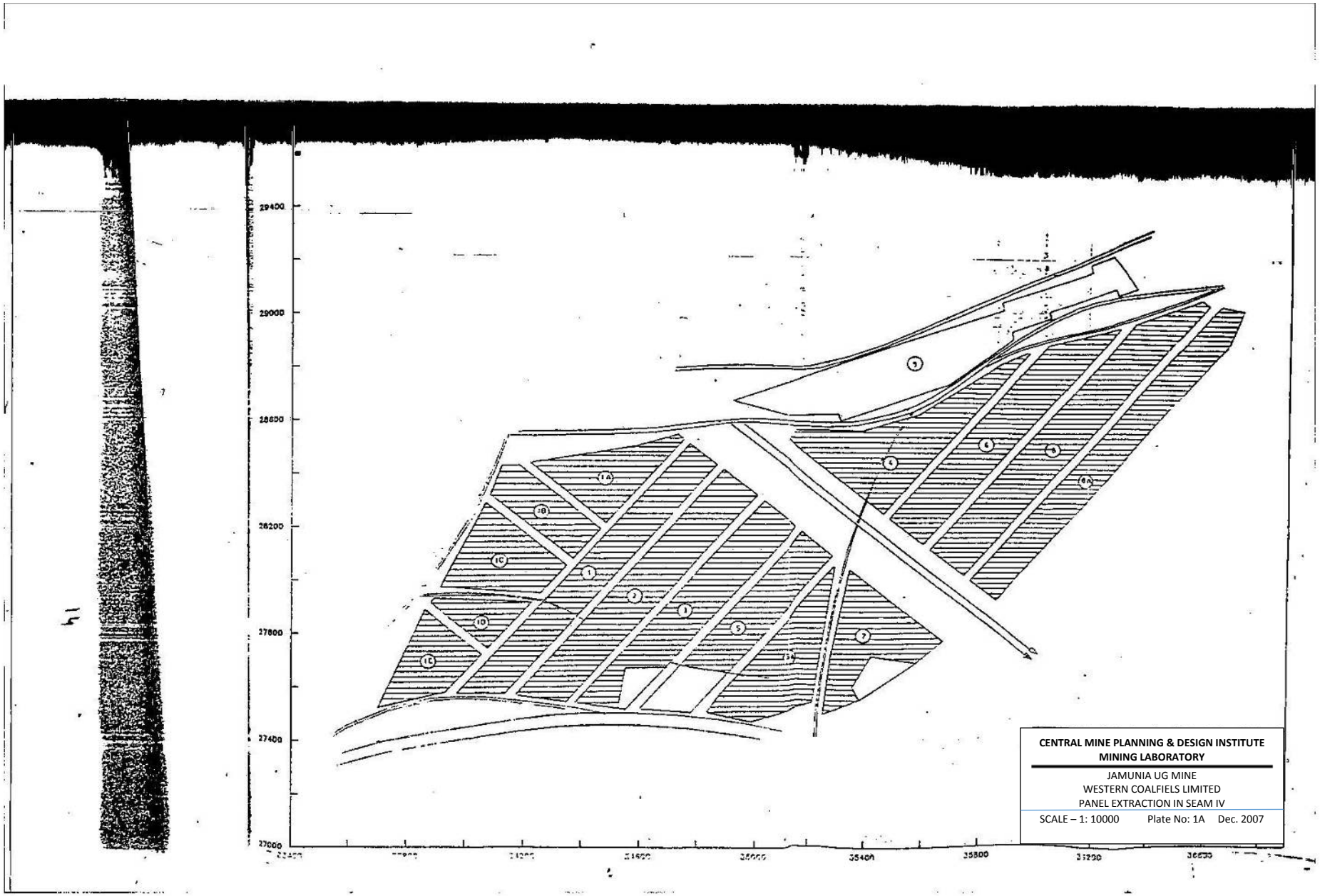
Study to ascertain the cavability nature of soil/rock formation in Jamunia block (within mine boundary)

Borehole	Sector No.	Basalt trap	Cavable OB thickness – between Basalt Trap & Top most workable coal seam i.e. Seam – II(m)				Coal Seams (Workable) Thickness – (m)						OB/Coal ration = (J+M+B)/Tot. coal
		Thickness (m)	Jabalpur (J)	Motor (M)	Barakar (B)	Total OB Thickness (J+M+B) m	II	III+IV/IV	Corrected III+IV/IV	V	Corrected V	Total Coal	
MPJ – 1	III	52.0	3.00	71.80	35.12	109.92	3.1	7.57	4.5	2.76	2.76	10.36	10.61
MPJ – 2	III	59.50	3.00	54.57	31.72	89.29	2.26	3.97	3.97	4.07	4.07	40.30	8.67
MPJ – 3	III	83.56	1.44	37.66	44.34	83.44	0	5.8	4.5	1.52	1.52	6.02	13.86
MPJ – 6	III	92.34	5.98	84.37	27.22	117.57	2.3	3.59	3.59	3.83	3.83	9.72	12.1
MPJ – 9	III	59.00	4.37	45.91	27.18	77.46	1.57	5.16	4.5	2.15	2.15	8.22	9.42
MPJ – 14	III	53.75	31.84	39.91	23.50	95.25	2.53	5.62	4.5	3.29	3.29	10.32	9.23
MPJ – 15	III	59.97	21.03	44.23	29.77	95.03	1.87	4.55	4.5	1.87	1.87	8.24	11.53
MPJ – 16	III	57.66	32.93	41.41	28.00	102.34	2.83	6.74	4.5	2.30	2.3	9.63	10.63
MPJ – 17	III	43.66	57.34	17.86	38.31	113.51	2.45	4.72	4.5	2.45	2.45	9.40	12.08
MPJ – 29	III	57.00	21.50	44.67	29.40	95.57	2.35	5.21	4.5	3.73	3.73	10.58	9.03
MPJ – 33	III	57.22	23.78	14.00	24.38	62.16	2.95	3.68	3.68	0.00	0.00	6.63	9.38

MPJ – 36	III	49.04	13.96	34.61	24.80	73.37	2.69	3.84	3.84	2.27	2.27	8.80	8.34
PU – 25	III	30.50	2.64	41.94	28.97	73.55	1.25	0.00	0.00	0.00	0.00	1.25	58.84
PU – 33	III	89.91	0.09	48.86	36.11	85.06	2.73	0.00	0.00	0.00	0.00	2.73	31.16
PU – 74	III	71.33	-	54.89	35.52	90.41	2.65	4.10	4.1	2.93	2.93	9.68	9.34
PU - 197	III	52.76	2.07	37.47	24.02	63.56	2.26	3.47	3.47	4.10	4.1	9.83	6.47
TG – 22	III	44.76	2.41	91.19	44.97	138.57	2.66	4.40	4.4	3.19	3.19	10.25	13.52
MPJ-5	V	42.88	6.06	45.80	40.28	92.14	2.39	6.77	4.5	5.05	4.5	11.39	8.09
MPJ-8	V	16.20	25.09	48.71	36.75	110.55	3.35	5.21	4.5	2.34	2.34	10.19	10.85

Borehole	Sector No.	Basalt trap	Cavability				Coal Sea (Workable) Thickness – (m)						OB/Coal ration = (J+M+B)/ Total coal
		Thickness (m)	Jabalpur (J)	Motor (M)	Barakar (B)	Total OB Thickness (J+M+B) m	II	III+IV/IV	Corrected III+IV/IV	V	Corrected V	Total Coal	
TG-17	V	33.60	2.54	64.66	32.48	99.68	3.20	0.00	0	4.34	4.34	7.54	13.22
TG-18	V	30.68	-	104.90	28.98	133.88	3.29	4.34	4.34	5.92	4.5	12.13	11.01
MPJ – 10	VI	38.15	11.85	89.09	13.28	114.22	2.87	5.38	4.5	5.16	4.5	11.87	9.62
MPJ – 21	VI	40.14	25.00	53.86	30.99	109.85	2.91	4.63	4.5	4.57	4.5	11.91	9.22
MPJ – 22	VI	50.66	36.34	65.00	28.25	129.59	0.00	2.85	2.85	3.59	3.59	6.44	20.12
MPJ – 32	VI	88.00	12.00	129.00	39.00	180.00	2.95	0.00	0	0.00	0	2.95	61.02
MPJ – 35	VI	57.86	14.64	80.82	25.52	120.98	3.46	4.85	4.5	3.12	3.12	11.08	10.92
PU – 26	VI	30.82	1.08	95.10	9.70	105.88	2.91	5.29	4.5	4.17	4.17	11.58	9.14
PU – 78	VI	42.21	3.72	57.41	40.87	102.00	4.15	6.03	4.5	2.23	2.23	10.88	9.38
MPJ – 20	VII	51.61	65.26	12.17	50.22	121.65	3.60	5.31	4.5	4.74	4.5	12.60	9.65
MPJ – 31	VII	84.00	44.02	94.48	33.52	172.02	3.05	4.73	4.5	3.30	3.3	10.85	15.85
PU – 28	VII	42.35	2.65	71.63	46.62	120.90	3.53	7.68	4.5	0.00	0	8.03	15.06
PU - 31	VII	48.12	2.42	108.96	21.28	132.66	2.20	3.86	3.86	0.00	0	6.06	21.89

MPJ-18	VIII	60.36	46.83	60.46	36.35	143.64	2.92	4.50	4.5	2.35	2.35	9.77	14.7
MPJ-23	VIII	85.77	31.65	86.08	35.17	152.90	3.25	3.65	3.65	4.88	4.5	11.40	13.41
MPJ-24	VIII	90.74	25.26	101.50	33.77	160.53	3.26	5.32	4.5	4.36	4.36	12.12	13.25
MPJ-25	VIII	88.92	14.48	98.98	42.07	155.53	2.48	4.38	4.38	5.13	4.5	11.36	13.69
MPJ-26	VIII	57.25	27.25	71.88	38.90	138.03	3.02	4.37	4.37	2.43	2.43	9.82	14.06
MPJ-27	VIII	87.26	41.74	77.00	29.96	148.70	2.83	3.21	3.21	0.00	0	6.04	24.62
MPJ-28	VIII	82.49	31.01	87.50	19.49	138.00	2.73	3.90	3.9	2.50	2.5	9.13	15.12
MPJ-30	VIII	89.86	45.14	66.50	43.21	154.85	3.54	3.66	3.66	0.00	0	7.20	21.51
MPJ-34	VIII	48.28	26.42	93.80	15.50	135.72	3.28	5.33	4.5	2.37	2.37	10.15	13.37
PU – 29	VIII	38.42	3.07	105.60	46.84	155.51	3.79	0.00	0	4.34	4.34	8.13	19.13
PU - 32	VIII	38.17	5.33	105.00	60.85	141.18	2.78	6.45	4.5	3.05	3.05	10.33	13.67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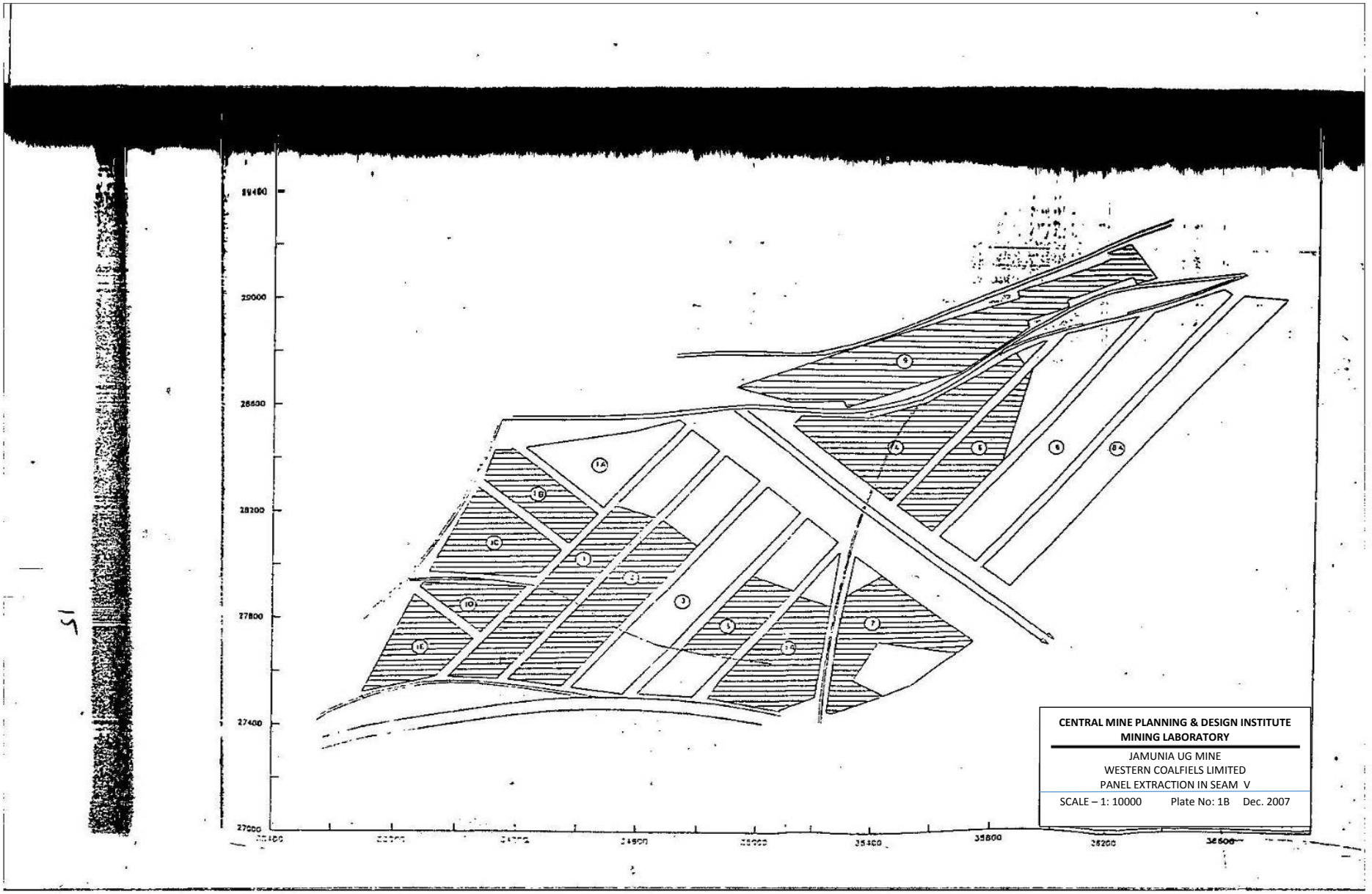
CENTRAL MINE PLANNING & DESIGN INSTITUTE
MINING LABORATORY
JAMUNIA UG MINE
WESTERN COALFIELS LIMITED
PANEL EXTRACTION IN SEAM IV
SCALE – 1: 10000 Plate No: 1A Dec. 2007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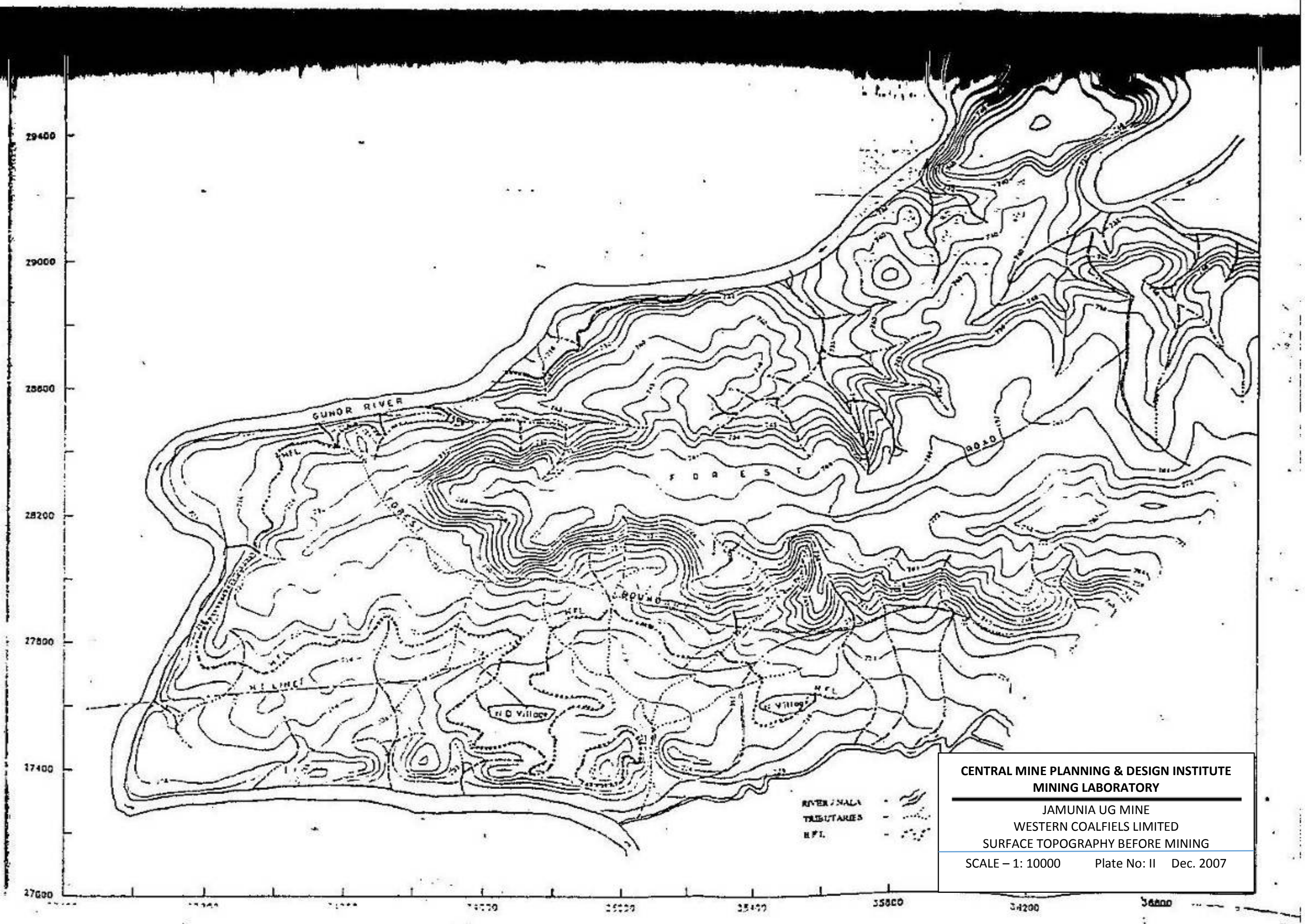
1A
1B
1C
1D
1E
1
2
3
5
7
9
8A
CENTRAL MINE PLANNING & DESIGN INSTITUTE
MINING LABORATORY
JAMUNIA UG MINE
WESTERN COALFIELS LIMITED
PANEL EXTRACTION IN SEAM V
SCALE – 1: 10000 Plate No: 1B Dec. 2007



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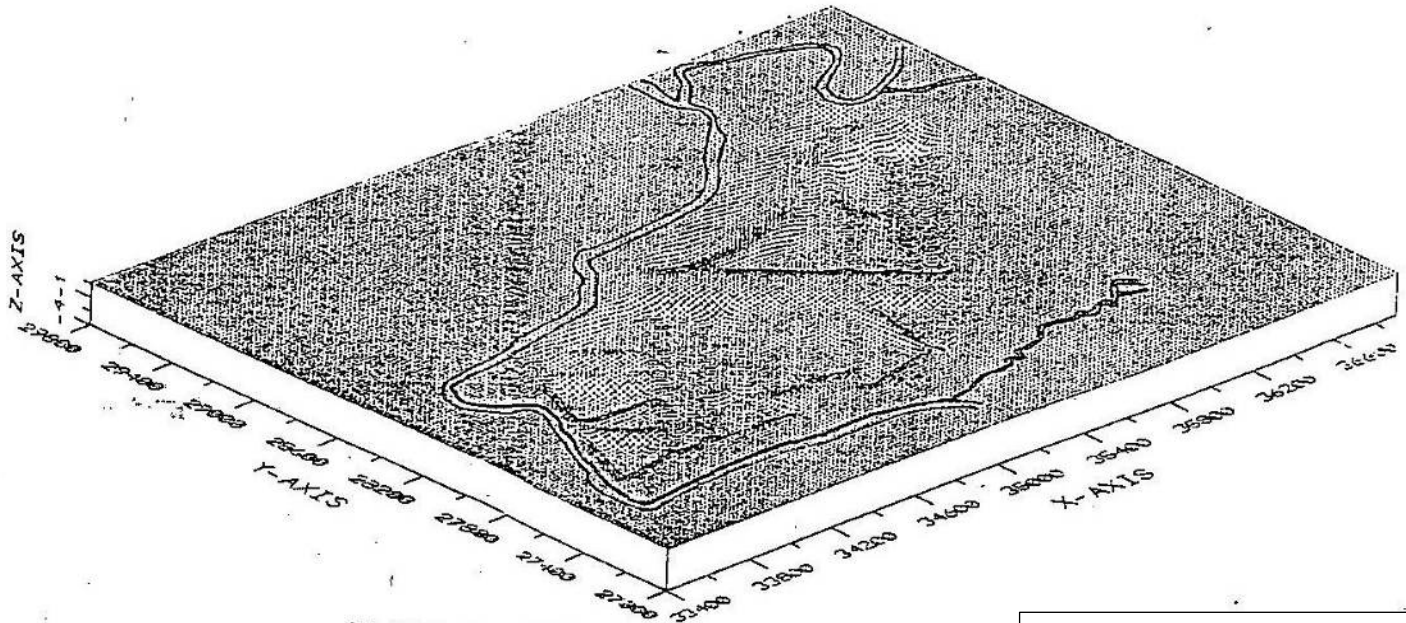
WESTERN COALFIELS LIMITED
SURFACE TOPOGRAPHY BEFORE MINING

SCALE – 1: 10000 Plate No: II Dec. 2007



3D VIEW OF SUBSIDENCE AFTER 13 YEARS OF MINING

VIEW DIRECTION - S W

Z - AMPLIFICATION - 40

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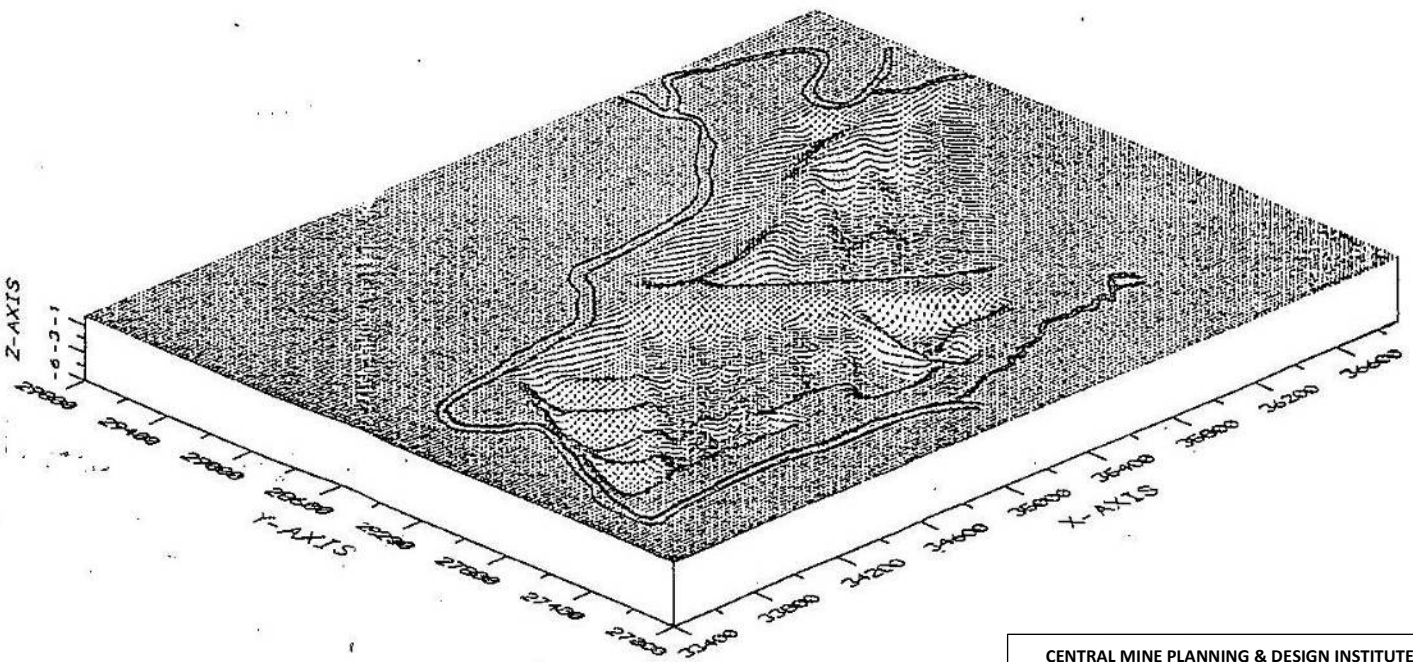
JAMUNIA UG MINE
WESTERN COALFIELS LIMITED
3d View of Subsidence after 13 yrs. of mining

SCALE – 1: 10000 Plate No: III Dec. 2007



3D VIEW OF SUBSIDENCE AFTER 36 YEARS OF MINING

VIEW DIRECTION - S W

Z - AMPLIFICATION - 40

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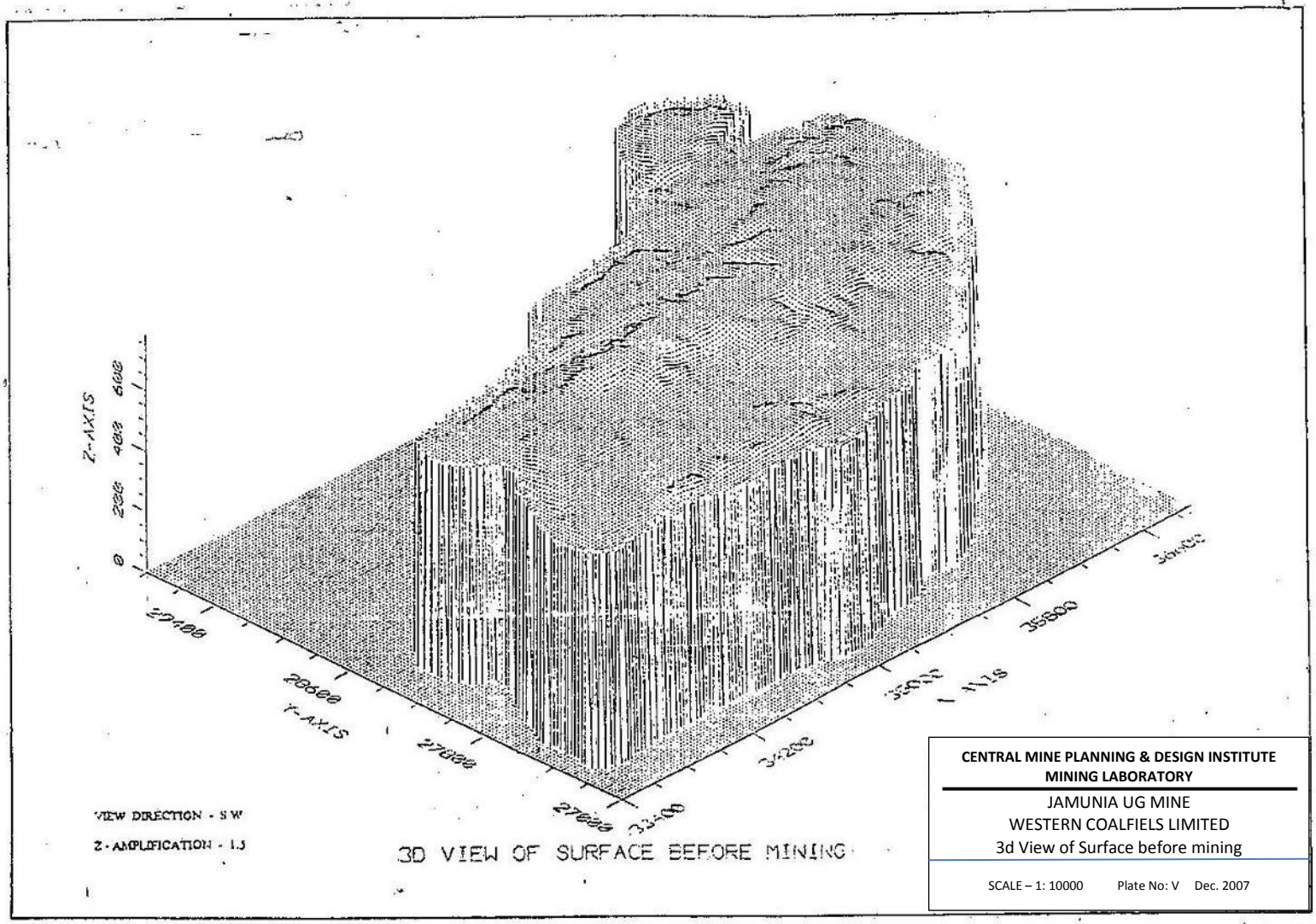
JAMUNIA UG MINE
WESTERN COALFIELS LIMITED
3d View of Subsidence after 36 yrs. of mining

SCALE – 1: 10000 Plate No: IV Dec. 2007



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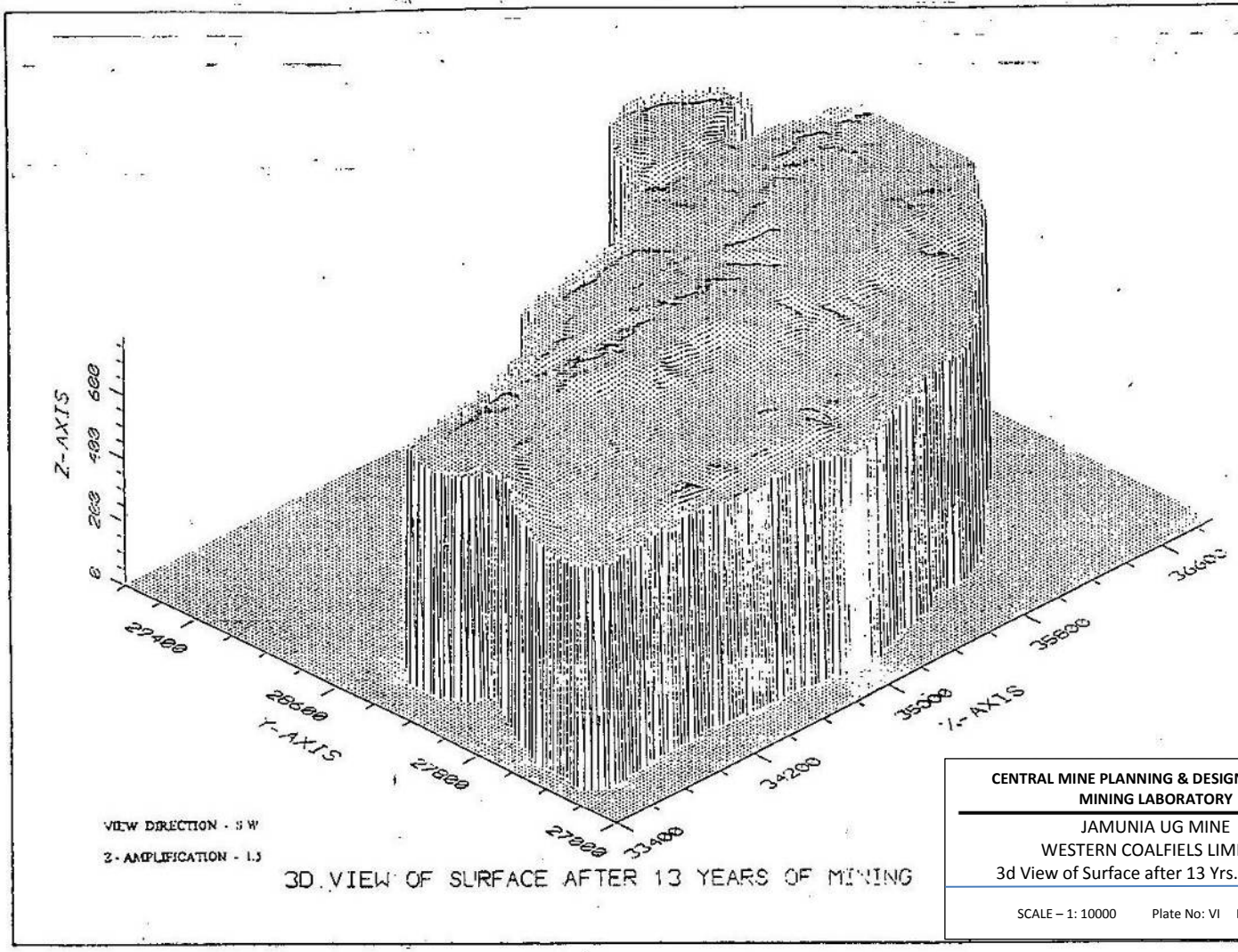
MINING LABORATORY

JAMUNIA UG MINE
WESTERN COALFIELS LIMITED
3d View of Surface before mining

SCALE – 1: 10000 Plate No: V Dec. 2007



3D VIEW OF SURFACE AFTER 13 YEARS OF MINING

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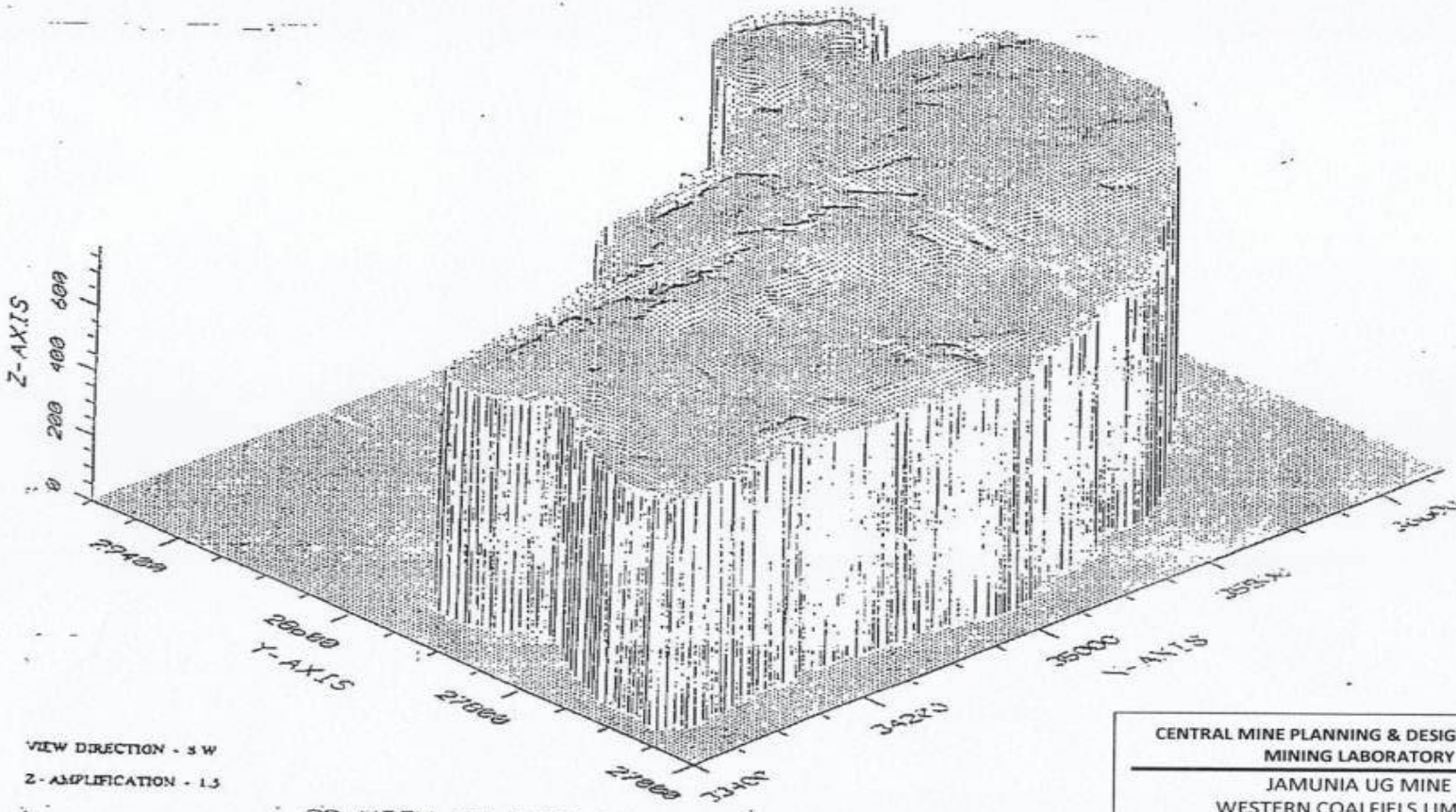
JAMUNIA UG MINE
WESTERN COALFIELS LIMITED
3d View of Surface after 13 Yrs. of mining

SCALE – 1: 10000 Plate No: VI Dec. 2007



3D VIEW OF SURFACE AFTER 36 YEARS OF MINING

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WESTERN COALFIELS LIMITED
3d View of Surface after 36 Yrs of mining

SCALE – 1: 10000 Plate No: VII Dec. 2007

Area Planning Officer
WCL, Pench Area