RAJRAPPA OCP

2011

Land Restoration / Reclamation Monitoring of more than 5 mc. m. (Coal + OB) Capacity Open Cast Coal Mines of Central Coalfields Limited Based on Satellite Data for the Year 2011

March-2012

Submitted to:

Central Coalfields Limited
Ranchi, Jharkhand

Land Restoration / Reclamation Monitoring of more than 5 mc. m. (Coal + OB) capacity Open Cast Coal Mines of Central Coalfields Limited Based on Satellite Data for the Year 2011

March-2012

Remote Sensing Cell
Geomatics Division
CMPDI, Ranchi

CONTENTS

	Executive Summary	**iii-vi**
1.0	Background	1
2.0	Objective	2
3.0	Methodology	2
4.0	Land Reclamation in Central Coalfields Limited	5

LIST OF TABLE

1.0	Project wise Land Reclamation Status in 5 OC projects of CCL	vi
2.0	Status of Land Reclamation in 5 OC projects of CCL	7

LIST OF FIG

1	Project wise Land Reclamation Status in Year 2011	vii
2	Methodology for Land Reclamation Monitoring	3
3-7	Status of Land Reclamation 5 OC projects of CCL	8-12

LIST OF PLATES

1.0	Plates of Land Reclamation 5 OC projects of CC	13-15

LIST OF PHOTOGRAPH

1	Plantation on Backfilled area (2010) - Ashok OCP	16
2	Avenue Plantation- Ashok OCP	17
3	Plantation- Ashok OCP	18
4	Plantation on Backfilled area (2011) - Piparwar OCP	19
5	Plantation on OB- KD Hesalong OCP	20
6	Plantation on OB- Rajrappa OCP	21

Executive Summary

1.0 Project

Land restoration / reclamation monitoring of 5 opencast coal mines of Central Coalfields Ltd. (CCL) producing 5 million cu. m. and more (Coal + OB) per year based on satellite data, regularly on annual basis.

2.0 Objective

Objective of the land restoration / reclamation monitoring is to assess the area of backfilled, plantation, social forestry, active mining area, water bodies, and distribution of wasteland, agricultural land and forest in the leasehold area of the project. This will help in assessing the progressive status of mined land reclamation and to take up remedial measures, if any, required for environmental protection.

3.0 Salient Findings

- Out of the total mine leasehold area of 47.14 Km^2 of the 5 OC projects Viz. Ashok, Piparwar, KD Hesalong, Parej East and Rajrappa considered for monitoring during year 2011; total excavated area is only 25.11Km^2 (53.27%) of which 15.95 Km^2 area (63.53%) has been planted, 4.56 Km^2 area (18.17%) has been backfilled and 4.60 Km^2 area (18.31%) is under active mining. It is evident from the analysis that 81.69% areas of the OC projects have already been reclaimed and balance 18.31% area is under active mining. Project wise details are given in Table-1 & Fig -1.

- On comparing the status of land reclamation carried out in year 2011 with respect to year 2010 in different projects, it is evident from the analysis that area of land reclamation has increased from 19.71 Km^2 (Yr.2010) to 20.51 Km^2 (Yr.2011) includes plantation and backfilled. This increase of 0.80 Km^2 area of land reclamation in one year is the result of the efforts made by CCL. Area of plantation has also increased from15.42 Km^2(Yr.2010) to 15.95 Km^2 (Yr.2011) in 5 OC projects of CCL. Details are given in Table-2.

- Area of biological reclamation (plantation) has increased marginally in all the projects except Rajrappa projects in span of one year. This increase in area of

plantation is the result of the efforts of the CCL taken up towards environmental protection.

TABLE-1 (Area in Km^2)

Project wise Land Reclamation Status in OC projects of Central Coalfields Ltd Based on Satellite data of the Year 2010 and 2011

% Calculated in respect of total Excavated area

Sl No.	Projects	Leasehold	Plantation ii		Backfilled/OB iii		Active Mining Area iv		Total Excavated Area I+ii+iii		Total Reclaimed Area Ii+iii	
			2010	2011	2010	2011	2010	2011	2010	2011	2010	2011
1	Ashoka	5.42	1.23	1.27	0.52	0.54	1.33	1.38	3.08	3.19	1.75	1.81
			39.94	*41.24*	*16.88*	*17.54*	*43.18*	*44.81*			*56.82*	*56.74*
2	Piparwar	11.2	5.10	5.51	0.74	0.70	1.47	2.03	7.31	8.24	5.84	6.21
			69.77	*75.38*	*10.12*	*9.58*	*20.11*	*27.78*			*79.89*	*75.36*
3	KDH	4.5	1.36	1.37	0.73	0.89	0.15	0.35	2.24	2.61	2.09	2.26
			60.71	*61.17*	*32.59*	*39.74*	*6.70*	*15.63*			*93.30*	*86.59*
4	Parej East	6.2	0.48	0.55	0.48	0.51	0.43	0.50	1.39	1.56	0.96	1.06
			34.53	*39.57*	*34.53*	*36.70*	*30.94*	*35.98*			*69.06*	*67.95*
5	Rajrappa*	19.82	7.25	7.25	1.82	1.92	0.23	0.34	9.30	9.51	9.07	9.17
			77.96	*77.96*	*19.57*	*20.65*	*2.47*	*3.66*			*97.53*	*96.42*
		47.14	15.42	15.95	4.29	4.56	3.61	4.60	23.32	25.11	19.71	20.51
			66.12	*63.53*	*18.40*	*18.17*	*15.48*	*18.31*	*49.47*	*53.27*	*84.52*	*81.69*

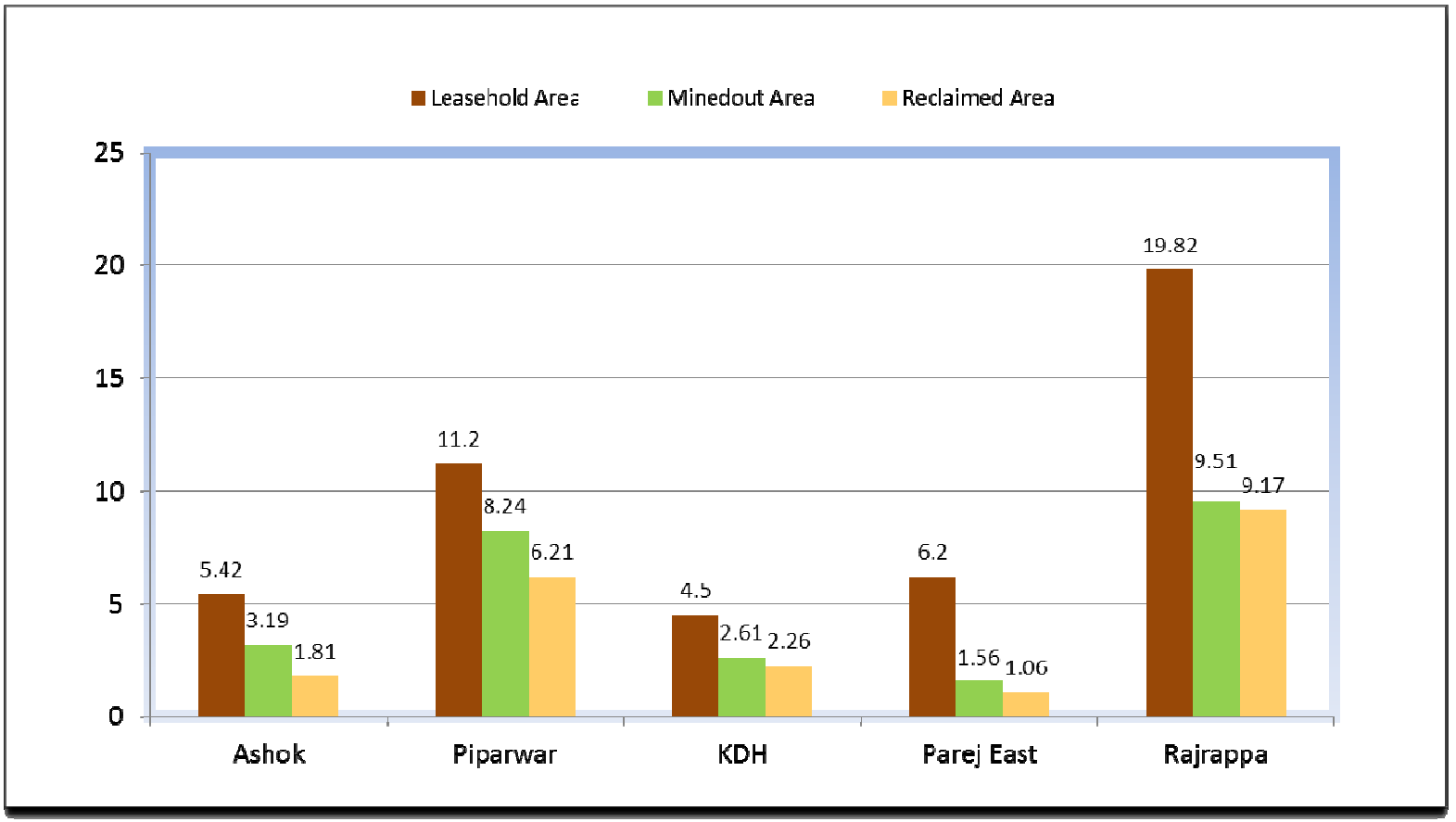

Fig. 1 : **Project wise Land Reclamation Status in Year 2011**

1.0 Background

1.1 Land is the most important natural resource which embodies soil, water, flora, fauna and total ecosystem. All human activities are based on the land which is the scarcest natural resource in our country. Mining is a site specific industry and it could not be shifted anywhere else from the location where mineral occurs. It is a fact that surface mining activities do effect the land environment due to ground breaking. Therefore, there is an urgent need to reclaim and restore the mined out land for its productive use for sustainable development of mining. This will not only mitigate environmental degradation, but would also help in creating a more congenial environment for land acquisition by coal companies in future.

1.2 Keeping above in view, Coal India Ltd. (CIL) issued a work order vide letter no. CIL/WBP/Env./2009/2428 dated 29.12.2009 to Central Mine Planning & Design Institute (CMPDI), Ranchi, for monitoring land reclamation. Status of all the opencast coal mines having production of more than 5 million m^3 per annum (coal + OB taken together per annum) based on remote sensing satellite data, regularly on annual basis for sustainable development of mining. Further, another work order vide letter no. CIL/WBP/ENV./2011dated23/08/11was issued by CIL for monitoring of less than 5 million m^3 per annum capacity (Coal +OB) projects from the year 2011 at interval of three years. The result of land reclamation status of all such mines to be put on the website of **CIL**, (www.coalindia.in), **CMPDI** (www.cmpdi.co.in) and the concerned coal companies in public domain. Detail report to be submitted to Coal India and respective subsidiaries.

1.3 Land reclamation monitoring of all open cast coal mining projects would also comply the statutory requirements of Ministry of Environment & Forest (MoEF).Such monitoring would not only facilitate in taking timely mitigation measures against

environmental degradation, but would also enable coal companies to utilize the reclaimed land for larger socio-economic benefits in a planned way.

1.4 Present report is embodying the finding of the study based on satellite data of the year 2011 carried out for 5 no of OC projects of capacity more than 5 mcm (coal +OB) for Central Coalfields Ltd.

2.0 Objective

Objective of the land reclamation/restoration monitoring is to assess the area of backfilled, plantation, OB dumps, social forestry, active mining area, settlements and water bodies, distribution of wasteland, agricultural land and forest land in the leasehold area of the project. This is an important step taken up for assessing the progressive status of mined land reclamation and for taking up remedial measures, if any, required for environmental protection.

3.0 Methodology

There are number of steps involved between raw satellite data procurement and preparation of final map. National Remote Sensing Centre (NRSC) Hyderabad, being the nodal agency for satellite data supply in India, provides only raw digital satellite data, which needs further digital image processing for extracting the information and map preparation before uploading the same in the website. Methodology for land reclamation monitoring is given in given in fig 2. Following steps are involved in land reclamation /restoration monitoring:

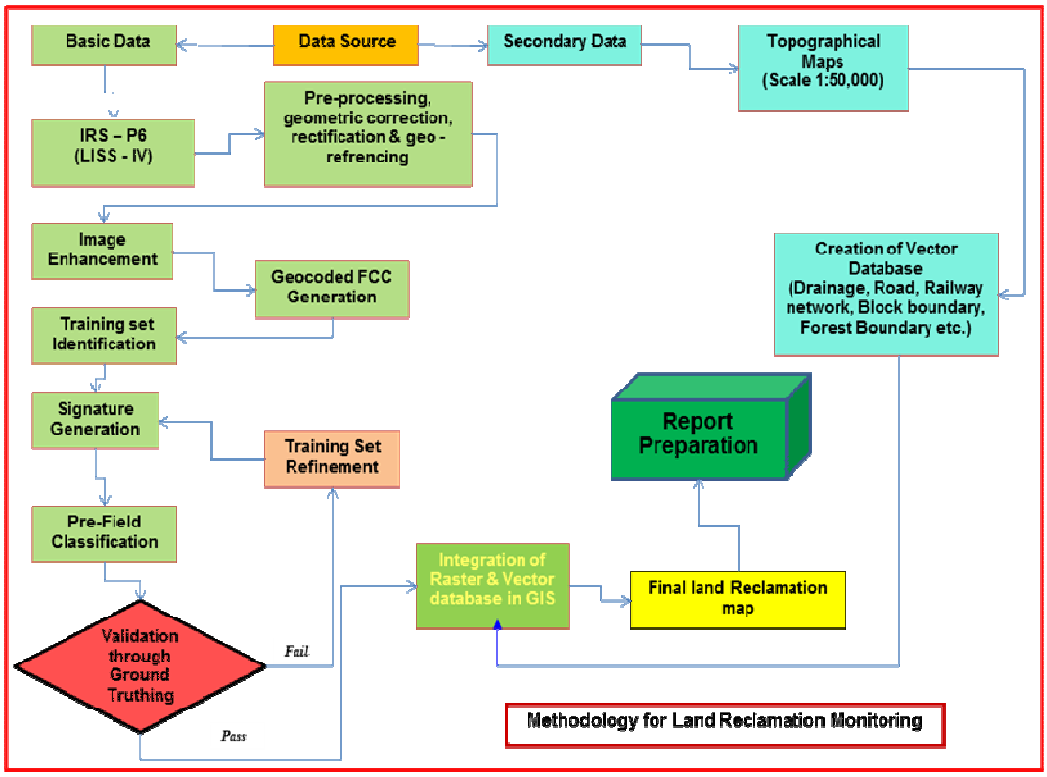

Figure: 2 Methodology for Land Reclamation Monitoring

3.1 Data Procurement: After browsing the data quality and date of pass on internet, supply order for data is placed to NRSC. Secondary data like leasehold boundary, topo sheets are procured for creation of vector database.

3.2 Satellite Data Processing: Satellite data are processed using ERDAS IMAGINE digital image processing s/w. Methodology involves the following major steps:

- **Rectification & Georeferencing:** Inaccuracies in digital imagery may occur due to 'systematic errors' attributed to earth curvature and rotation as well as 'non-systematic errors' attributed to satellite receiving station itself. Raw digital images contain geometric distortions, which make them unusable as maps. Therefore, georeferencing is required for correction of image data using ground control points (GCP) to make it compatible to SoI toposheet.

- **Image enhancement:**

  To improve the interpretability of the raw data, image enhancement is necessary. Local operations modify the value of each pixel based on brightness value of neighbouring pixels using ERDAS IMAGINE 9.3 s/w. and enhance the image quality for interpretation.

- **Training set selection**

  Training set requires to be selected, so that software can classify the image data accurately. The image data are analysed based on the interpretation keys. These keys are evolved from certain fundamental image-elements such as tone/colour, size, shape, texture, pattern, location, association and shadow. Based on the image-elements and other geo-technical elements like land form, drainage pattern and physiography; training sets were selected/identified for each land use/cover class. Field survey was carried out by taking selective traverses in order to collect the ground information (or reference data) so that training sets are selected accurately in the image. This was intended to serve as an aid for classification.

- **Classification and Accuracy assessment**

  Image classification is carried out using the maximum likelihood algorithm. The classification proceeds through the following steps: (a) calculation of statistics [i.e. signature generation] for the identified training areas, and (b) the decision boundary of maximum probability based on the mean vector, variance, covariance and correlation matrix of the pixels. After evaluating the statistical parameters of the training sets, reliability test of training sets is conducted by measuring the statistical separation between the classes that resulted from computing divergence matrix. The overall accuracy of the classification was finally assessed with reference to ground truth data.

- **Area calculation**

  The area of each land use class in the leasehold is determined using ERDAS IMAGINE v. 9.3software and given in table 2.

- **Overlay of Vector data base**

  Vector data base created based on secondary data. Vector layer like drainage, railway line, leasehold boundary, forest boundary etc. are superimposed on the image as vector layer in the Arc GIS database.

- **Pre-field map preparation**

  Pre-field map is prepared for validation of the classification result

3.3 Ground Truthing:

Selective ground verification of the land use classes are carried out in the field and necessary corrections if required, are incorporated before map finalization.

3.4 Land reclamation database on GIS:

Land reclamation database is created on GIS platform to identify the temporal changes identified from satellite data of different cut-off dates.

4.0 Land Reclamation Status in Central Coalfields Ltd.

4.1 Following 5 OC projects producing more than 5 million m^3. (Coal + OB together)of Central Coalfields Ltd. have been taken up during the year 2011 for land reclamation monitoring:

- Ashok
- Piparwar
- KD Hesalong
- Parej East
- Rajrappa

4.2 Area statistics of different land use classes present in OC projects in the year 2011 is given in Table 2. Land use maps derived from the satellite data is given in Plate no. 1 to 5. Changes in land use status are shown in Fig. 3 – 7 and field photographs showing plantation and backfilled area in mining projects in photo 1-6.

4.3 Study reveals that 81.69% of excavated mining area has already been reclaimed by CCL in above 5 OC projects, out of which 63.53% area has been revegitated and 18.17% area are backfilled.

4.4 After analyzing the satellite data of year 2010 vs. 2011, it is evident that plantation carried out on backfilled area, OB dumps as well as under social forestry in all the 5 mines of CCL has marginally increased to the extent of 0.53 Km^2 in span of last one year.

4.5 It may be seen from the table.1 that area of total reclamation has increased in the year 2011 in comparison to year 2010 but in terms of percentage it has been reduced due to increase of total excavated area in the year 2011.

Table-2 STATUS OF LAND RECLAMATION IN CENTRAL COALFIELDS LTD. BASED ON SATELLITE DATA OF THE YEAR 2011

		Ashoka		Piparwar		KD Hesalong		Rajrappag		Parej East	
		Area	%	Area	%	Area	%	Area	%	Area	%
FOREST	Dense Forest	0.00	0.00	0.01	0.09	0.01	0.22	0.05	0.25	0.01	0.16
	Open Forest	0.63	11.62	0.65	5.80	0.16	3.56	0.38	1.92	1.36	21.94
	Total Forest	**0.63**	**11.62**	**0.66**	5.89	**0.17**	**3.78**	**0.43**	**2.17**	**1.37**	**22.10**
SCRUB	Scrubs	0.54	9.96	0.44	3.93	0.60	13.33	6.10	30.78	1.70	27.42
PLANTATION	Social Forestry	0.32	5.90	2.74	24.46	0.15	3.33	1.80	9.08	0.10	1.61
	Plantation on OB Dump	0.95	17.53	2.77	24.73	1.22	27.11	5.45	27.50	0.45	7.26
	Total Plantation(Biological Reclamation)	**1.27**	**23.43**	**5.51**	**49.20**	**1.37**	**30.44**	**7.25**	**36.58**	**0.55**	**8.87**
	Total Vegetation	**2.44**	**45.02**	**6.61**	**59.02**	**2.14**	**47.56**	**13.78**	**69.53**	**3.62**	**58.39**
ACTIVE MINING	Coal Quarry	0.78	14.39	1.18	10.54	0.20	4.44	0.22	1.11	0.40	6.46
	Coal Face	0.1	1.85	0.07	0.63	0.01	0.00 0.22	0.01	0.05	0.01	0.00
	Advance quarry site	0.40	7.38	0.43	3.84	0.11	2.44	0.01	0.05	0.01	0.16
	Coal Dump	0.10	1.85	0.35	3.13	0.03	0.67	0.10	0.50	0.13	2.10
	Total Active Mining Area	**1.38**	**25.46**	**2.03**	**18.14**	**0.35**	**7.78**	**0.34**	**1.72**	**0.55**	**8.72**
RECLAIMED	Barren OB Dump	0.54	9.96	0.70	6.24	0.89	19.78	1.92	9.69	0.51	8.23
	Barren backfilled area										
	Waterfilled quarry										
	Total Area Under Technical Reclamation	**0.54**	**9.96**	**0.70**	**6.24**	**0.89**	**19.78**	**1.92**	**9.69**	**0.51**	**8.23**
	Total Area Under Mine Oparation	**1.92**	**35.42**	**2.73**	**24.38**	**1.24**	**27.56**	**2.26**	**11.40**	**1.06**	**17.09**
Agriculture	Crop lands	0.01	0.18	0.03	0.26	0.00	0.00	0.32	1.61	0.50	8.06
	Fallow Land	0.78	14.39	0.42	3.75	0.00	0.00	1.24	6.26	0.01	0.16
	Total Agricultural	**0.79**	**14.58**	**0.45**	**4.01**	**0.00**	**0.00**	**1.56**	**7.87**	**0.51**	**8.23**
Wastelands	Wastelands	0.15	2.77	0.22	1.96	0.63	14.00	0.78	3.94	0.07	1.13
	Fly Ash Pond										
	Sand Body	0.00	0.00	0.03	0.27	0.00	0.00	0.03	0.15	0.01	0.00
	Total Wastelands	**0.15**	**2.77**	**0.25**	**2.23**	**0.63**	**14.00**	**0.81**	**4.09**	**0.08**	**1.30**
Settlements	Urban Settlement	0.00	0.00	0.00	0.00	0.26	5.78	0.43	2.17	0.23	3.70
	Rural Settlement	0.08	1.48	0.55	4.91	0.00	0.00	0.18	0.91	0.42	6.77
	Industrial Settlement	0.01	0.00 0.18	0.41	3.66	0.01	0.22	0.21	1.06	0.10	1.61
	Total Settelements(E)	**0.09**	1.66	**0.96**	**8.57**	**0.27**	**6.00**	**0.82**	**4.14**	**0.75**	**12.09**
Waterbodies	Waterbodies(F)	**0.03**	**0.55**	**0.20**	**1.79**	**0.22**	**4.89**	**0.59**	**2.98**	**0.18**	**2.90**
	Grand Total	**5.42**	**100.00**	**11.20**	**100.00**	**4.50**	**100.00**	**19.82**	**100.00**	**6.20**	**100.00**

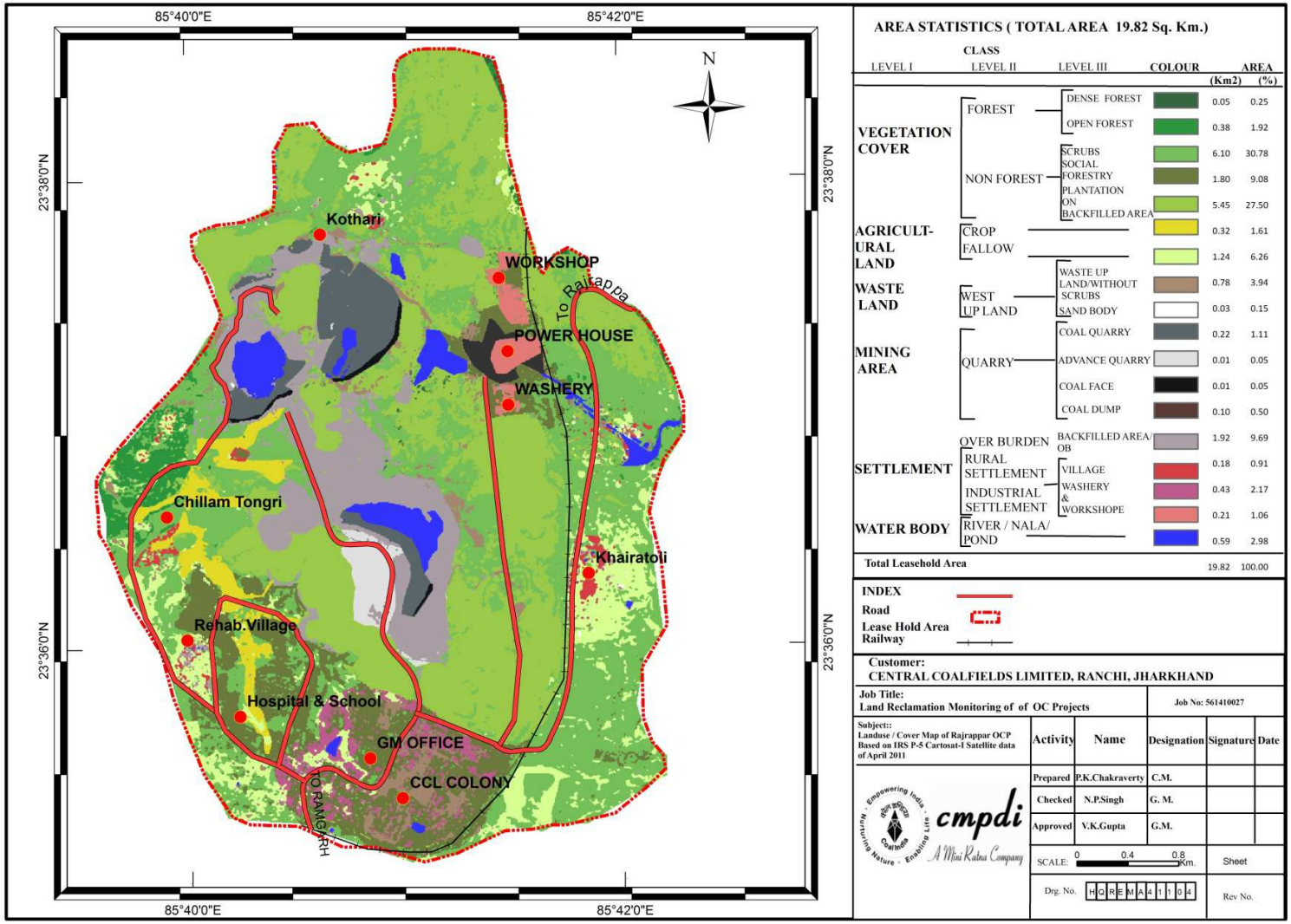
85°40'0"E
85°42'0"E
23°38'0"N
23°36'0"N
N
Kothari
WORKSHOP
To Rajrappa
POWER HOUSE
WASHERY
Chillam Tongri
Khairatoli
Rehab.Village
Hospital & School
GM OFFICE
CCL COLONY
TO RAMGARH
AREA STATISTICS (TOTAL AREA 19.82 Sq. Km.)
CLASS
LEVEL I
LEVEL II
LEVEL III
COLOUR
AREA (Km2) (%)
VEGETATION COVER
FOREST
DENSE FOREST 0.05 0.25
OPEN FOREST 0.38 1.92
NON FOREST
SCRUBS 6.10 30.78
SOCIAL FORESTRY 1.80 9.08
PLANTATION ON BACKFILLED AREA 5.45 27.50
AGRICULT-URAL LAND
CROP 0.32 1.61
FALLOW 1.24 6.26
WASTE LAND
WEST UP LAND
WASTE UP LAND/WITHOUT SCRUBS 0.78 3.94
SAND BODY 0.03 0.15
MINING AREA
QUARRY
COAL QUARRY 0.22 1.11
ADVANCE QUARRY 0.01 0.05
COAL FACE 0.01 0.05
COAL DUMP 0.10 0.50
OVER BURDEN
BACKFILLED AREA/ OB 1.92 9.69
SETTLEMENT
RURAL SETTLEMENT
VILLAGE 0.18 0.91
INDUSTRIAL SETTLEMENT
WASHERY & WORKSHOPE 0.43 2.17
0.21 1.06
WATER BODY
RIVER / NALA/ POND 0.59 2.98
Total Leasehold Area 19.82 100.00
INDEX
Road
Lease Hold Area
Railway
Customer:
CENTRAL COALFIELDS LIMITED, RANCHI, JHARKHAND
Job Title:
Land Reclamation Monitoring of of OC Projects
Job No: 561410027
Subject::
Landuse / Cover Map of Rajrappar OCP Based on IRS P-5 Cartosat-I Satellite data of April 2011
Activity
Name
Designation
Signature
Date
Prepared P.K.Chakraverty C.M.
Checked N.P.Singh G. M.
Approved V.K.Gupta G.M.
cmpdi
A Mini Ratna Company
SCALE: 0 0.4 0.8 Km.
Sheet
Drg. No. HQREMA4110 4
Rev No.

Plate – 4

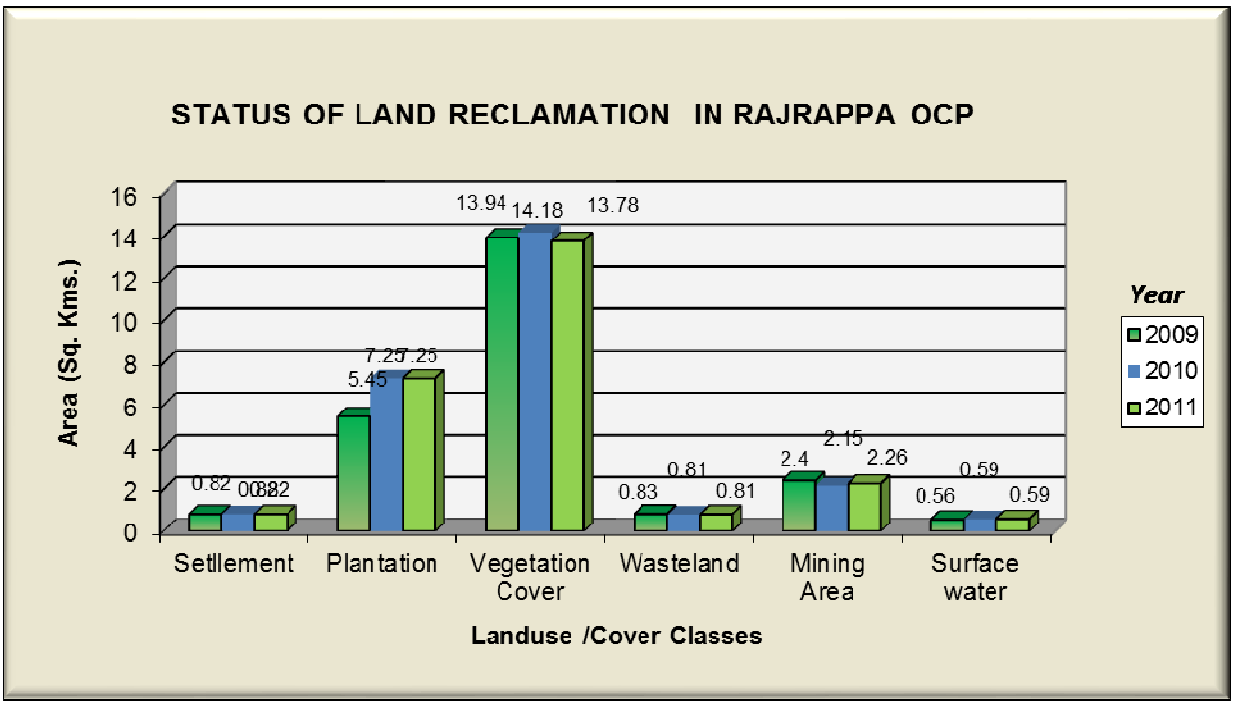
STATUS OF LAND RECLAMATION IN RAJRAPPA OCP
Area (Sq. Kms.)
16
14
12
10
8
6
4
2
0
13.94
14.18
13.78
7.25
7.25
5.45
0.82
0.82
0.83
0.81
0.81
2.4
2.15
2.26
0.56
0.59
0.59
Settlement
Plantation
Vegetation Cover
Wasteland
Mining Area
Surface water
Landuse /Cover Classes
Year
2009
2010
2011

Figure 6

Plantation on OB- Rajrappa OCP

Central Mine Planning & Design Institute Ltd.
(A Subsidiary of Coal India Ltd.)
Gondwana Place, Kanke Road, Ranchi 834031, Jharkhand
Phone : (+91) 651 2230001, 2230002, 2230483, FAX (+91) 651 2231447, 2231851
Wesite : www.cmpdi.co.in, Email : cmpdihq@cmpdi.co.in