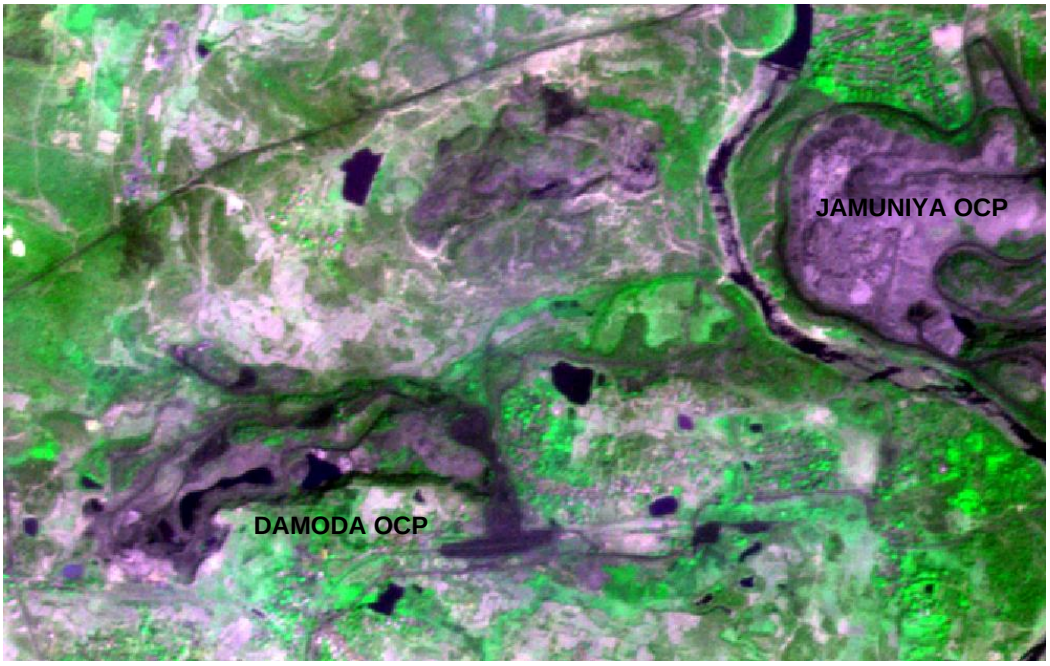
Land Restoration / Reclamation Monitoring of less than 5 m cu. m. (Coal + OB) Capacity Open Cast Coal Mines of Bharat Coking Coal Limited Based on Satellite Data for the Year 2012



Submitted to:

Bharat Coking Coal Limited

cmpdi
A Mini Ratna Company

Land Restoration / Reclamation Monitoring of less than 5 m. cu. m (Coal + OB) capacity Open Cast Coal Mines of Bharat Coking Coal Limited Based on Satellite Data for the Year 2012

March-2013

Remote Sensing Cell
Geomatics Division
CMPDI, Ranchi

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Executive Summary

1.0 Project

Land restoration / reclamation monitoring of 5 opencast coal mines of Bharat Coking Coal Ltd. (BCCL) producing less than 5 million cu. m. (Coal + OB) per year based on satellite data of the year 2012, on every three year 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 land in the leasehold area of the various projects. This will help in assessing the progressive status of mined out 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 1228 hectares of the 5 OC projects Viz. Damoda, Jamuniya, Shatabdi, Ghanoodih & Kuiya considered for monitoring during year 2012; total excavated area is only 506.07 ha out of which 63.30 ha area (12.51%) has been planted, 313.24 ha area (61.90%) has been backfilled and 129.53 ha area (25.59%) is under active mining. It is evident from the analysis that 74.41% area of the OC projects have already been reclaimed and balance 25.59% area is under active mining. Project wise details are given in Table-1 & Fig -1.

- Of the total area reclaimed by BCCL, 12.51% is under biological reclamation (plantation) and 61.90% is under technical reclamation. Out of 5 projects of BCCL, Kuiya OCP ranks on top for land reclamation (81.79%) followed by Damoda OCP (73.37%).

TABLE-1

Project wise Land Reclamation Status in OC projects of Bharat Coking Coal Ltd Based on Satellite data of the Year 2012

Area in Hectare *% Calculated in respect of total Excaveted area*

Sl No.	Projects	Leasehold Area	Plantation	Area under Backfilling	Active Mining Area	Total Excaveted Area	Total Reclaimed Area
			2012	2012	2012	2012	2012
1	**Damoda**	**575.00**	**42.19**	**57.43**	**36.15**	**135.77**	**99.62**
			31.08	*42.30*	*26.63*		*73.37*
2	**Jamuniya**	**73.80**	**0.00**	**41.89**	**18.52**	**60.41**	**41.89**
			0.00	*69.35*	*30.66*		*69.34*
3	**Shatabdi**	**181.29**	**5.20**	**56.25**	**28.66**	**90.11**	**61.45**
							68.19
4	**Ghanoodih**	**73.00**	**1.01**	**30.23**	**14.51**	**45.75**	**31.24**
			2.21	*66.08*	*31.72*		*68.28*
5	**Kuiya**	**325.00**	**14.90**	**127.44**	**31.69**	**174.03**	**142.34**
			8.57	*89.54*	*18.21*		*81.79*
	Total	**1228.09**	**63.30**	**313.24**	**129.53**	**506.07**	**376.54**
			12.51	*61.90*	*25.59*		*74.41*

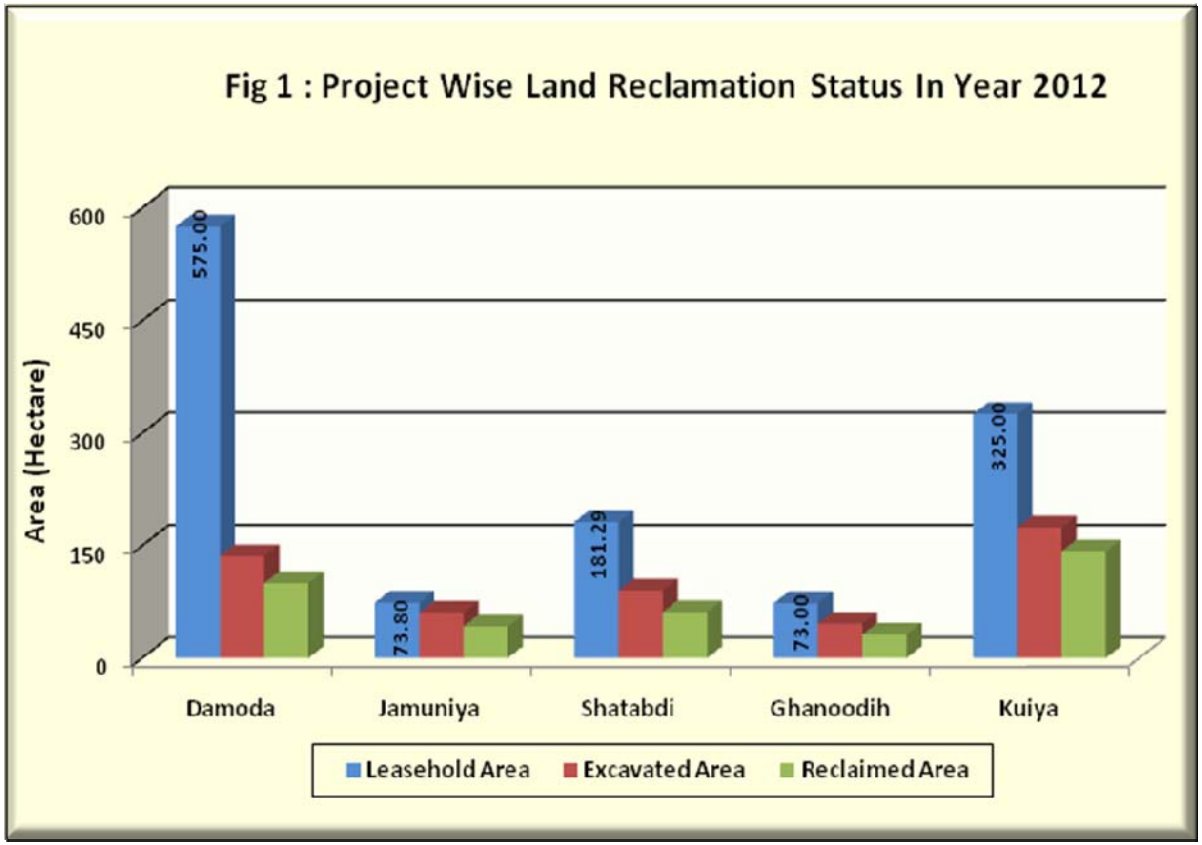


Fig 1 : Project Wise Land Reclamation Status In Year 2012
Area (Hectare)
600
450
300
150
0
575.00
73.80
181.29
73.00
325.00
Damoda
Jamuniya
Shatabdi
Ghanoodih
Kuiya
Leasehold Area
Excavated Area
Reclaimed Area

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 most scarce 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, M/s. Coal India Ltd. (CIL) issued a work order vide letter no. CIL/WBP/Env/2011/4706 dated 12.10.2012 for monitoring of opencast mines of less than 5 million m^3 per annum capacity (Coal +OB) from the year 2012 at intervals of three years. The result of land reclamation status of all such mines is to be published on the website of CIL, (www.coalindia.in), CMPDI (www.cmpdi.co.in) and the concerned coal companies in public domain. Detailed reports are to be submitted to Coal India and respective subsidiaries.

1.3 Land reclamation monitoring of all opencast 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 2012 carried out for 5 OC projects of Bharat Coking Coal Ltd. producing less than 5 mcm (Coal+OB) per annum.

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:

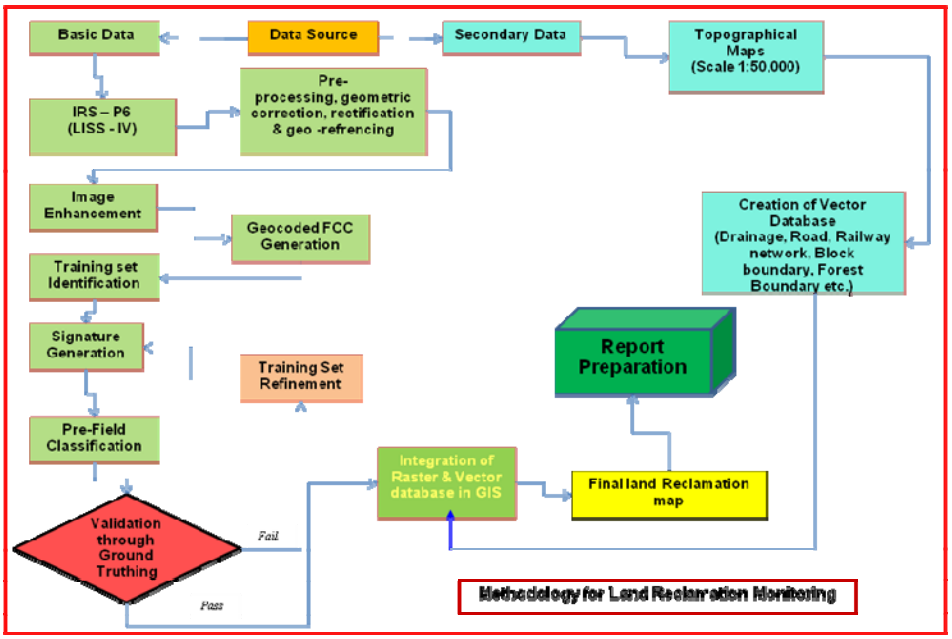


Figure: 2 Methodology for Land Reclamation Monitoring

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. 9.3 software 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 Bharat Coking CoalLtd.

4.1 Following 5 OC projects producing less than 5 million m^3. (Coal + OB together) of Bharat Coking Coal Ltd. Have been taken up during the year 2012 for land reclamation monitoring:

- Damoda
- Jamuniya
- Shatabdi
- Ghanoodih
- Kuiya

4.2 Area statistics of different land use classes present in OC projects in the year 2012 is given in Table 2. Land use maps derived from the satellite data is given in Plate no. 1 to 5. Land use statuses are shown in Fig. 3 – 7 and field photographs showing plantation and backfilled area in mining projects are shown in photos 1-2.

4.3 Study reveals that 74.41% of excavated area has already been reclaimed by BCCL in the OC projects, out of which 12.51% area has been planted and 61.90% area are backfilled.

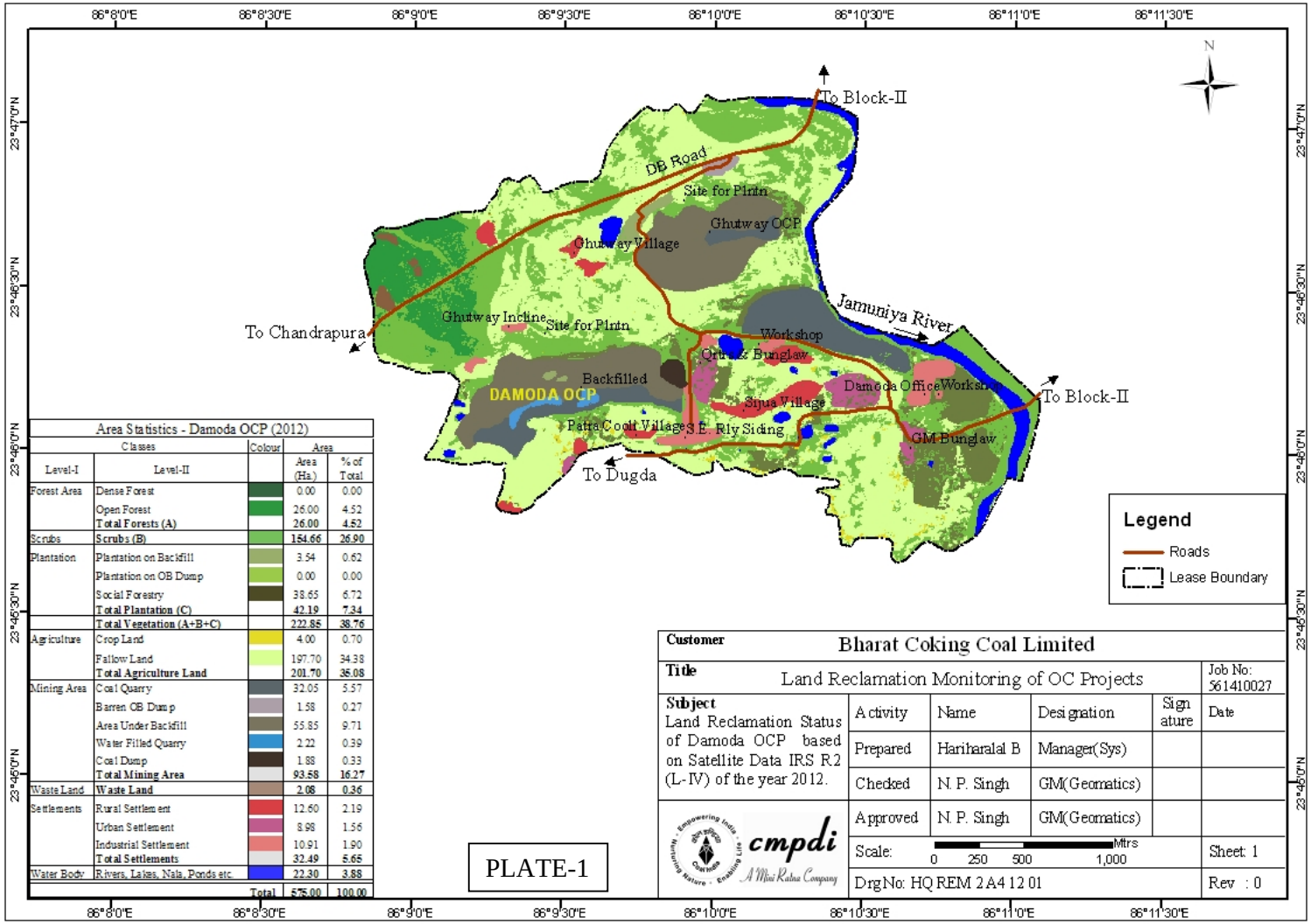
4.4 After analyzing the satellite data of year 2012, it is evident that plantation carried out on backfilled area, OB dumps as well as under social forestry in all the 5 mines of BCCL taken up for study, has reached only 12.51% till now. Damoda project under barora area has taken up some ecological restoration programmes and started further plantation in their area of around 4.7 hectares. This is a welcome measure from the company's side should be highly appreciated.

It can also be seen from the Table.1 that the total area of reclamation has reached 74.41% till the year 2012.

Table-2 STATUS OF LAND RECLAMATION IN BCCL BASED ON SATELLITE DATA OF THE YEAR 2012

(Area in Hectare)

		DAMODA		JAMUNIYA		SHATABDI		GHANOODIH		KUIYA		TOTAL	
		Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
FORESTS	Dense Forest	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Open Forest	26.00	4.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	26.00	2.12
	Total Forest	**26.00**	**4.52**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**26.00**	**2.12**
SCRUBS													
	Scrubs	**154.66**	**26.90**	**9.85**	**13.35**	**51.97**	**28.67**	**15.32**	**20.99**	**72.97**	**22.45**	**304.77**	**24.82**
PLANTATION	Social Forestry	38.65	6.72	0.00	0.00	5.20	2.87	0.03	0.04	5.40	1.66	49.28	4.01
	Plantation on OB Dump	0.00	0.00	0.00	0.00	0.00	0.00	0.96	1.32	4.20	1.29	5.16	0.42
	Plantation on Backfill	3.54	0.62	0.00	0.00	0.00	0.00	0.02	0.03	5.30	1.63	8.86	0.72
	Total Plantation *(Biological Reclamation)*	**42.19**	**7.34**	**0.00**	**0.00**	**5.20**	**2.87**	**1.01**	**1.38**	**14.90**	**4.58**	**63.30**	**5.15**
	Total Vegetation	**222.85**	**38.76**	**9.85**	**13.35**	**57.17**	**31.54**	**16.33**	**22.37**	**87.87**	**27.04**	**394.07**	**32.09**
ACTIVE MINING	Coal Quarry	32.05	5.57	14.10	19.11	21.12	11.65	11.58	15.86	23.50	7.23	102.35	8.33
	Coal Face	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.27	0.00	0.00	0.20	0.02
	Coal Dump	1.88	0.33	1.72	2.33	2.23	1.23	0.51	0.70	5.22	1.61	11.56	0.94
	Advance Quarry Site	0.00	0.00	0.00	0.00	4.64	2.56	1.77	2.42	1.44	0.44	7.85	0.64
	Quarry Filled With Water	2.22	0.39	2.70	3.66	0.67	0.37	0.45	0.62	1.53	0.47	7.57	0.62
	Total Area under *Active Mining*	**36.15**	**6.29**	**18.52**	**25.10**	**28.66**	**15.81**	**14.51**	**19.87**	**31.69**	**9.75**	**129.53**	**10.55**
RECLAIMED	Barren OB Dump	1.58	0.27	23.56	31.92	2.40	1.32	4.40	6.03	31.94	9.83	63.88	5.20
	Area under Backfilling	55.85	9.71	18.33	24.84	53.85	29.70	25.83	35.38	95.50	29.38	249.36	20.30
	Total Area under *Technical Reclamation*	**57.43**	**9.98**	**41.89**	**56.76**	**56.25**	**31.02**	**30.23**	**41.41**	**127.44**	**39.21**	**313.24**	**25.51**
	Total Area under *Mine Operation*	**93.58**	**16.27**	**60.41**	**81.86**	**84.91**	**46.83**	**44.74**	**61.28**	**159.13**	**48.96**	**442.77**	**36.05**
WASTELANDS	Waste Lands	2.08	0.36	0.94	1.27	4.77	2.63	3.70	5.07	15.20	4.68	26.69	2.17
	Fly Ash Pond / Sand Body	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total Wasteland	**2.08**	**0.36**	**0.94**	**1.27**	**4.77**	**2.63**	**3.70**	**5.07**	**15.20**	**4.68**	**26.69**	**2.17**
WATERBODIES	Reservoir, nallah, ponds	22.30	3.88	2.60	3.52	2.45	1.35	0.50	0.68	0.80	0.25	28.65	2.33
	Total Waterbodies	**22.30**	**3.88**	**2.60**	**3.52**	**2.45**	**1.35**	**0.50**	**0.68**	**0.80**	**0.25**	**28.65**	**2.33**
AGRICULTURE	Crop Lands	4.00	0.70	0.00	0.00	0.00	0.00	0.04	0.05	0.20	0.06	4.24	0.35
	Fallow Lands	197.70	34.38	0.00	0.00	10.43	5.75	0.09	0.12	22.70	6.98	230.92	18.80
	Total Agriculture	**201.70**	**35.08**	**0.00**	**0.00**	**10.43**	**5.75**	**0.13**	**0.17**	**22.90**	**7.05**	**235.16**	**19.15**
SETTLEMENTS	Urban Settlement	8.98	1.56	0.00	0.00	0.85	0.47	0.00	0.00	26.10	8.03	35.93	2.93
	Rural Settlement	12.60	2.19	0.00	0.00	13.58	7.49	7.60	10.41	2.20	0.68	35.98	2.93
	Industrial Settlement	10.91	1.90	0.00	0.00	7.13	3.93	0.00	0.00	10.80	3.32	28.84	2.35
	Total Settlement	**32.49**	**5.65**	**0.00**	**0.00**	**21.56**	**11.89**	**7.60**	**10.41**	**39.10**	**12.03**	**100.75**	**8.20**
	Grand Total	**575.00**	**100.00**	**73.80**	**100.00**	**181.29**	**100.00**	**73.00**	**100.00**	**325.00**	**100.00**	**1228.09**	**100.00**



Area Statistics - Damoda OCP (2012)

Classes		Colour	Area	
Level-I	Level-II		Area (Ha.)	% of Total
Forest Area	Dense Forest		0.00	0.00
	Open Forest		26.00	4.52
	Total Forests (A)		**26.00**	**4.52**
Scrubs	**Scrubs (B)**		**154.66**	**26.90**
Plantation	Plantation on Backfill		3.54	0.62
	Plantation on OB Dump		0.00	0.00
	Social Forestry		38.65	6.72
	Total Plantation (C)		**42.19**	**7.34**
	Total Vegetation (A+B+C)		**222.85**	**38.76**
Agriculture	Crop Land		4.00	0.70
	Fallow Land		197.70	34.38
	Total Agriculture Land		**201.70**	**35.08**
Mining Area	Coal Quarry		32.05	5.57
	Barren OB Dump		1.58	0.27
	Area Under Backfill		55.85	9.71
	Water Filled Quarry		2.22	0.39
	Coal Dump		1.88	0.33
	Total Mining Area		**93.58**	**16.27**
Waste Land	**Waste Land**		**2.08**	**0.36**
Settlements	Rural Settlement		12.60	2.19
	Urban Settlement		8.98	1.56
	Industrial Settlement		10.91	1.90
	Total Settlements		**32.49**	**5.65**
Water Body	Rivers, Lakes, Nala, Ponds etc.		22.30	3.88
		Total	575.00	100.00

PLATE-1

Customer	Bharat Coking Coal Limited				
Title	Land Reclamation Monitoring of OC Projects				Job No: 561410027
Subject Land Reclamation Status of Damoda OCP based on Satellite Data IRS R2 (L-IV) of the year 2012.	Activity	Name	Designation	Signature	Date
	Prepared	Hariharalal B	Manager(Sys)		
	Checked	N. P. Singh	GM(Geomatics)		
	Approved	N. P. Singh	GM(Geomatics)		
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	Drg No: HQ REM 2 A4 12 01				Rev : 0

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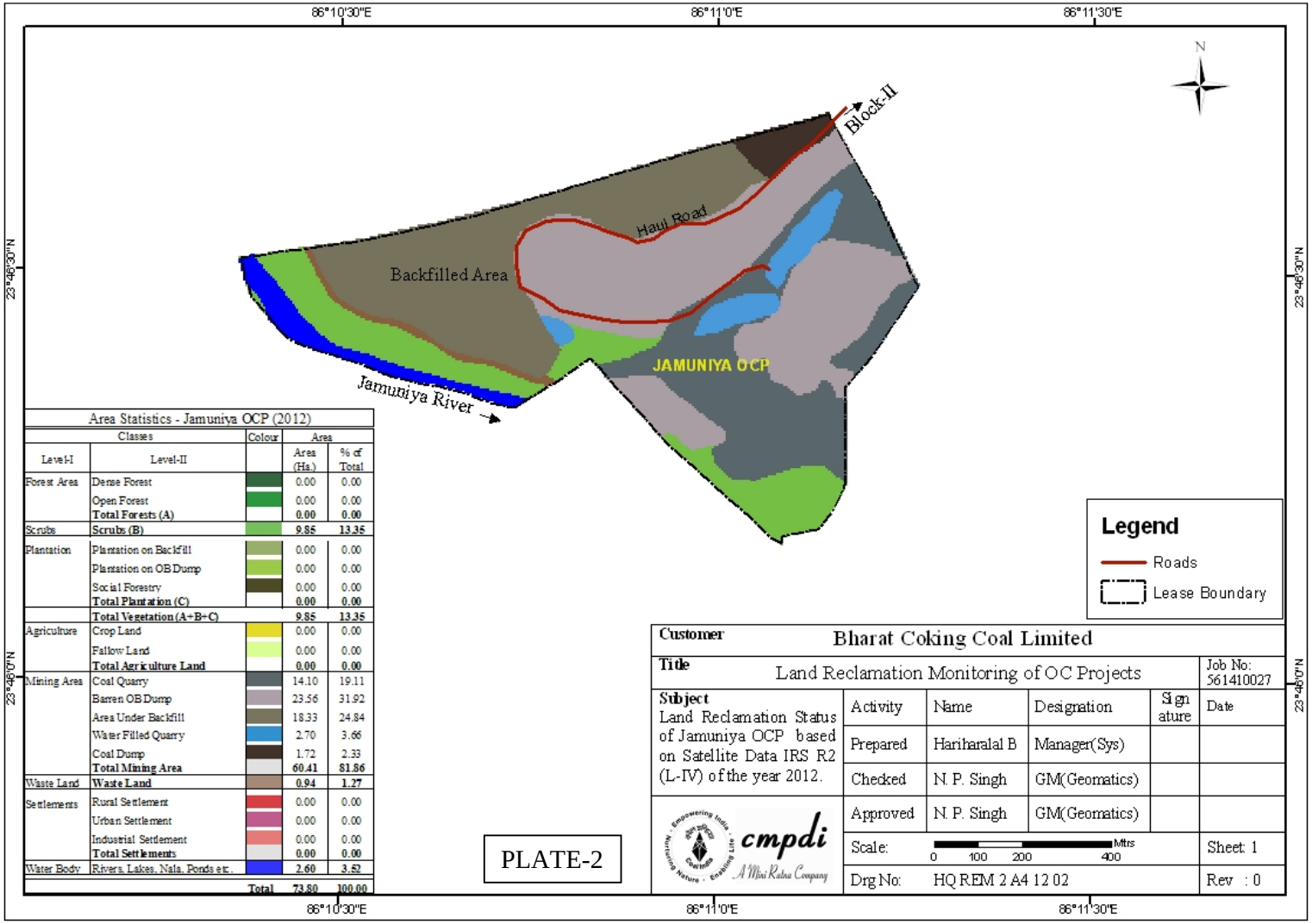
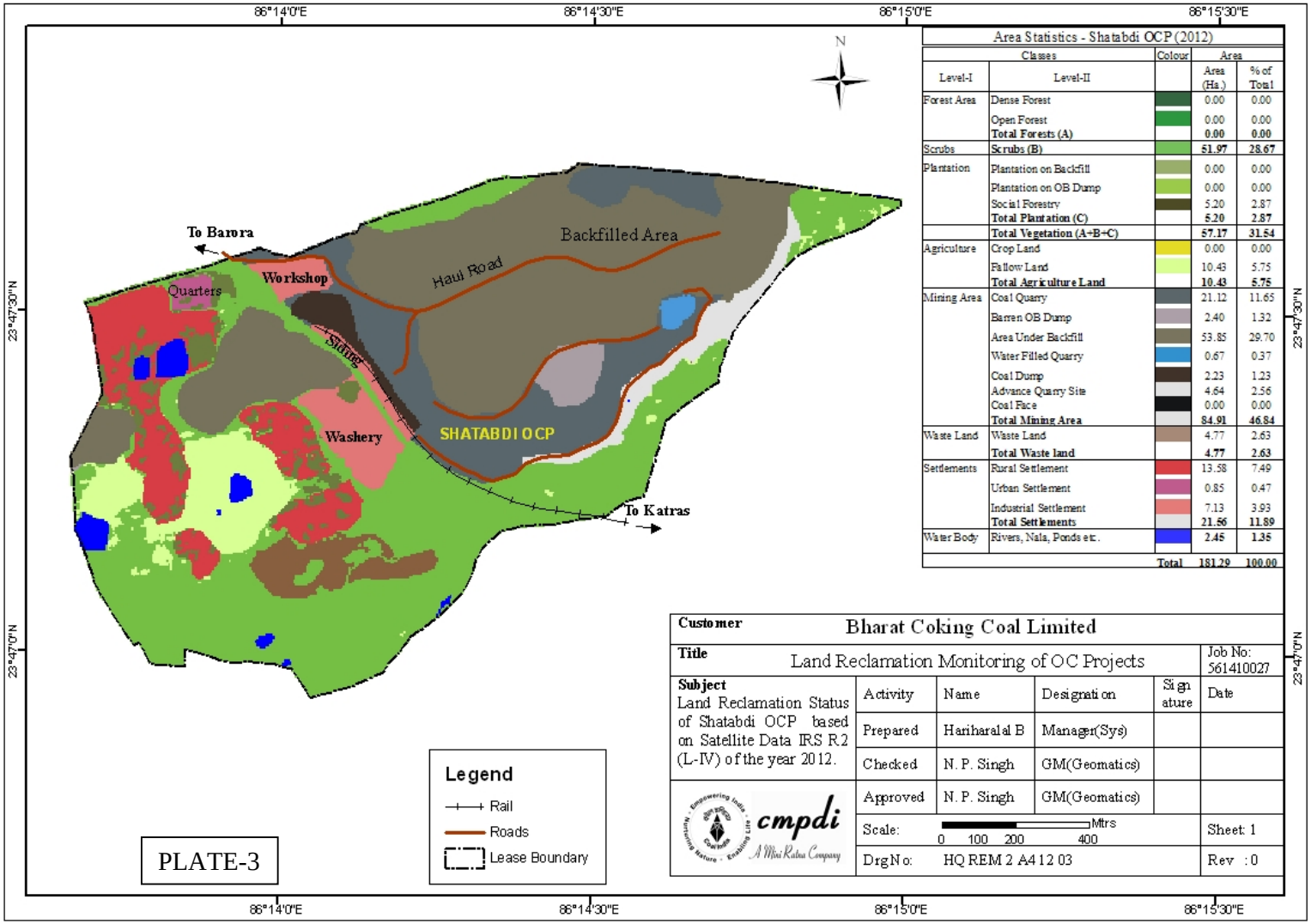


Area Statistics - Jamuniya OCP (2012)

Classes		Colour	Area	
Level-I	Level-II		Area (Ha.)	% of Total
Forest Area	Dense Forest		0.00	0.00
	Open Forest		0.00	0.00
	Total Forests (A)		**0.00**	**0.00**
Scrubs	**Scrubs (B)**		**9.85**	**13.35**
Plantation	Plantation on Backfill		0.00	0.00
	Plantation on OB Dump		0.00	0.00
	Social Forestry		0.00	0.00
	Total Plantation (C)		**0.00**	**0.00**
	Total Vegetation (A+B+C)		**9.85**	**13.35**
Agriculture	Crop Land		0.00	0.00
	Fallow Land		0.00	0.00
	Total Agriculture Land		**0.00**	**0.00**
Mining Area	Coal Quarry		14.10	19.11
	Barren OB Dump		23.56	31.92
	Area Under Backfill		18.33	24.84
	Water Filled Quarry		2.70	3.66
	Coal Dump		1.72	2.33
	Total Mining Area		**60.41**	**81.86**
Waste Land	**Waste Land**		**0.94**	**1.27**
Settlements	Rural Settlement		0.00	0.00
	Urban Settlement		0.00	0.00
	Industrial Settlement		0.00	0.00
	Total Settlements		**0.00**	**0.00**
Water Body	Rivers, Lakes, Nala, Ponds etc.		2.60	3.52
		Total	**73.80**	**100.00**

Customer	Bharat Coking Coal Limited				
Title	Land Reclamation Monitoring of OC Projects				Job No: 561410027
Subject Land Reclamation Status of Jamuniya OCP based on Satellite Data IRS R2 (L-IV) of the year 2012.	Activity	Name	Designation	Sign ature	Date
	Prepared	Hariharalal B	Manager(Sys)		
	Checked	N. P. Singh	GM(Geomatics)		
	Approved	N. P. Singh	GM(Geomatics)		
	Scale: 0 100 200 400 Mtrs				Sheet: 1
	Drg No: HQ REM 2 A4 12 02				Rev : 0



Area Statistics - Shatabdi OCP (2012)

Classes		Colour	Area	
Level-I	Level-II		Area (Ha.)	% of Total
Forest Area	Dense Forest		0.00	0.00
	Open Forest		0.00	0.00
	Total Forests (A)		**0.00**	**0.00**
Scrubs	**Scrubs (B)**		**51.97**	**28.67**
Plantation	Plantation on Backfill		0.00	0.00
	Plantation on OB Dump		0.00	0.00
	Social Forestry		5.20	2.87
	Total Plantation (C)		**5.20**	**2.87**
	Total Vegetation (A+B+C)		**57.17**	**31.54**
Agriculture	Crop Land		0.00	0.00
	Fallow Land		10.43	5.75
	Total Agriculture Land		**10.43**	**5.75**
Mining Area	Coal Quarry		21.12	11.65
	Barren OB Dump		2.40	1.32
	Area Under Backfill		53.85	29.70
	Water Filled Quarry		0.67	0.37
	Coal Dump		2.23	1.23
	Advance Quarry Site		4.64	2.56
	Coal Face		0.00	0.00
	Total Mining Area		**84.91**	**46.84**
Waste Land	Waste Land		4.77	2.63
	Total Waste land		**4.77**	**2.63**
Settlements	Rural Settlement		13.58	7.49
	Urban Settlement		0.85	0.47
	Industrial Settlement		7.13	3.93
	Total Settlements		**21.56**	**11.89**
Water Body	Rivers, Nala, Ponds etc.		**2.45**	**1.35**
		Total	**181.29**	**100.00**

Customer	Bharat Coking Coal Limited				
Title	Land Reclamation Monitoring of OC Projects				Job No: 561410027
Subject Land Reclamation Status of Shatabdi OCP based on Satellite Data IRS R2 (L-IV) of the year 2012.	Activity	Name	Designation	Signature	Date
	Prepared	Hariharalal B	Manager(Sys)		
	Checked	N. P. Singh	GM(Geomatics)		
cmpdi A Mini Ratna Company	Approved	N. P. Singh	GM(Geomatics)		
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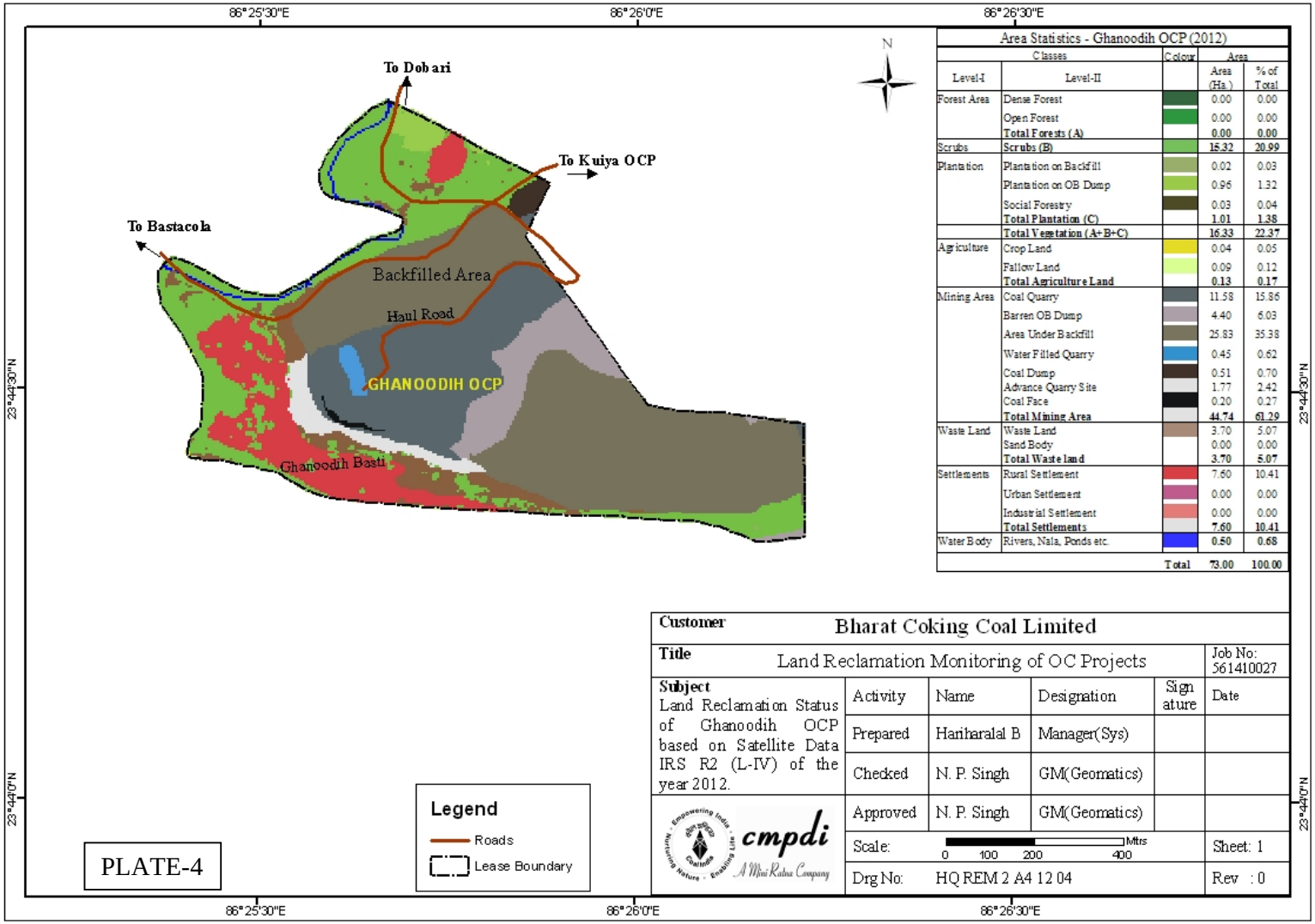
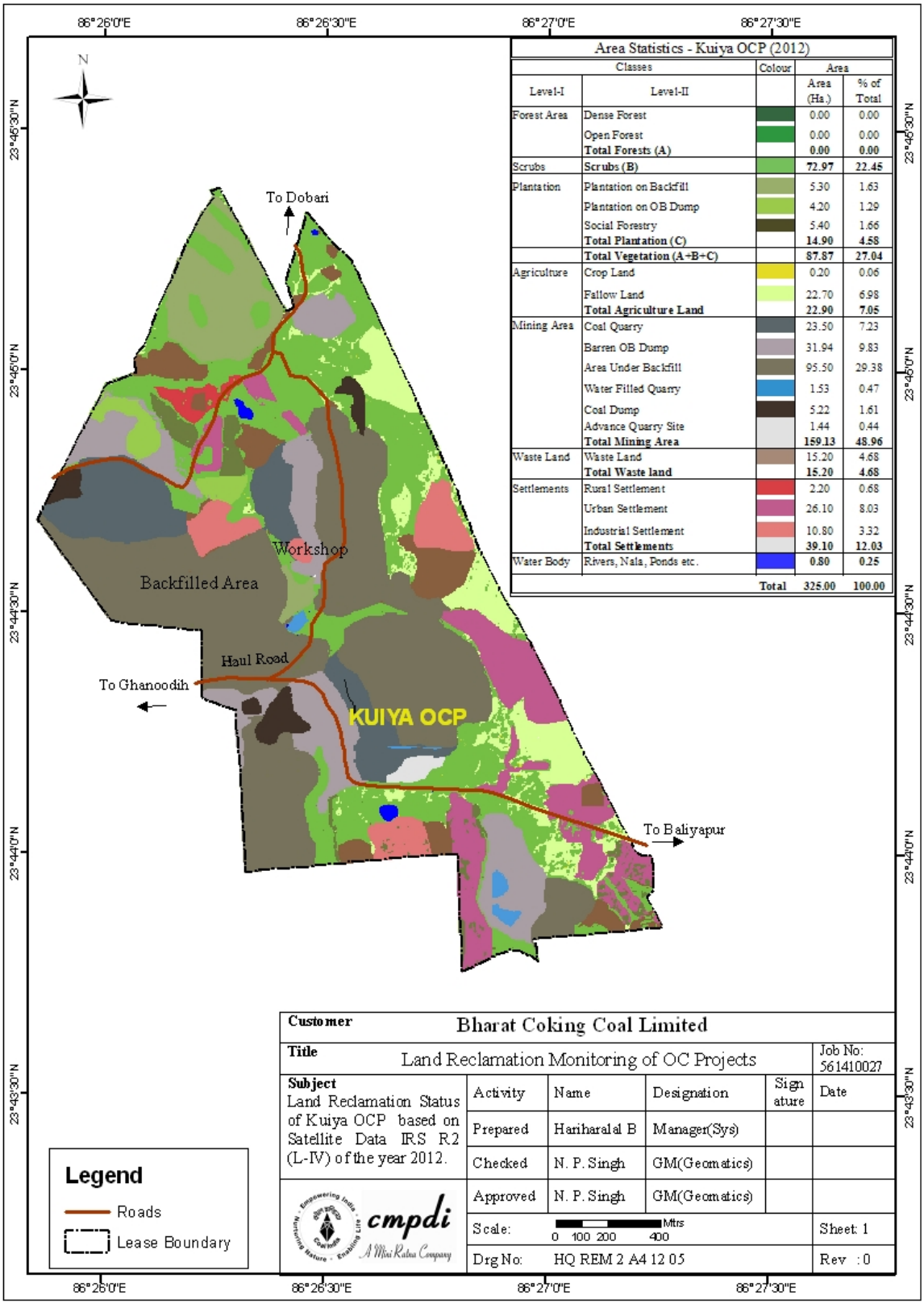
	Drg No: HQ REM 2 A4 12 03				Rev : 0



Area Statistics - Ghanoodih OCP (2012)

Classes		Colour	Area	
Level-I	Level-II		Area (Ha.)	% of Total
Forest Area	Dense Forest		0.00	0.00
	Open Forest		0.00	0.00
	Total Forests (A)		**0.00**	**0.00**
Scrubs	**Scrubs (B)**		**15.32**	**20.99**
Plantation	Plantation on Backfill		0.02	0.03
	Plantation on OB Dump		0.96	1.32
	Social Forestry		0.03	0.04
	Total Plantation (C)		**1.01**	**1.38**
	Total Vegetation (A+B+C)		**16.33**	**22.37**
Agriculture	Crop Land		0.04	0.05
	Fallow Land		0.09	0.12
	Total Agriculture Land		**0.13**	**0.17**
Mining Area	Coal Quarry		11.58	15.86
	Barren OB Dump		4.40	6.03
	Area Under Backfill		25.83	35.38
	Water Filled Quarry		0.45	0.62
	Coal Dump		0.51	0.70
	Advance Quarry Site		1.77	2.42
	Coal Face		0.20	0.27
	Total Mining Area		**44.74**	**61.29**
Waste Land	Waste Land		3.70	5.07
	Sand Body		0.00	0.00
	Total Waste land		**3.70**	**5.07**
Settlements	Rural Settlement		7.60	10.41
	Urban Settlement		0.00	0.00
	Industrial Settlement		0.00	0.00
	Total Settlements		**7.60**	**10.41**
Water Body	Rivers, Nala, Ponds etc.		**0.50**	**0.68**
		Total	**73.00**	**100.00**

Customer	Bharat Coking Coal Limited				
Title	Land Reclamation Monitoring of OC Projects				Job No: 561410027
Subject Land Reclamation Status of Ghanoodih OCP based on Satellite Data IRS R2 (L-IV) of the year 2012.	Activity	Name	Designation	Sign ature	Date
	Prepared	Hariharalal B	Manager(Sys)		
	Checked	N. P. Singh	GM(Geomatics)		
	Approved	N. P. Singh	GM(Geomatics)		
	Scale: 0 100 200 400 Mtrs				Sheet: 1
	Drg No: HQ REM 2 A4 12 04				Rev : 0



Classes		Colour	Area	
Level-I	Level-II		Area (Ha.)	% of Total
Forest Area	Dense Forest		0.00	0.00
	Open Forest		0.00	0.00
	Total Forests (A)		**0.00**	**0.00**
Scrubs	**Scrubs (B)**		**72.97**	**22.45**
Plantation	Plantation on Backfill		5.30	1.63
	Plantation on OB Dump		4.20	1.29
	Social Forestry		5.40	1.66
	Total Plantation (C)		**14.90**	**4.58**
	Total Vegetation (A+B+C)		**87.87**	**27.04**
Agriculture	Crop Land		0.20	0.06
	Fallow Land		22.70	6.98
	Total Agriculture Land		**22.90**	**7.05**
Mining Area	Coal Quarry		23.50	7.23
	Barren OB Dump		31.94	9.83
	Area Under Backfill		95.50	29.38
	Water Filled Quarry		1.53	0.47
	Coal Dump		5.22	1.61
	Advance Quarry Site		1.44	0.44
	Total Mining Area		**159.13**	**48.96**
Waste Land	Waste Land		15.20	4.68
	Total Waste land		**15.20**	**4.68**
Settlements	Rural Settlement		2.20	0.68
	Urban Settlement		26.10	8.03
	Industrial Settlement		10.80	3.32
	Total Settlements		**39.10**	**12.03**
Water Body	Rivers, Nala, Ponds etc.		**0.80**	**0.25**
		Total	**325.00**	**100.00**

PLATE-5

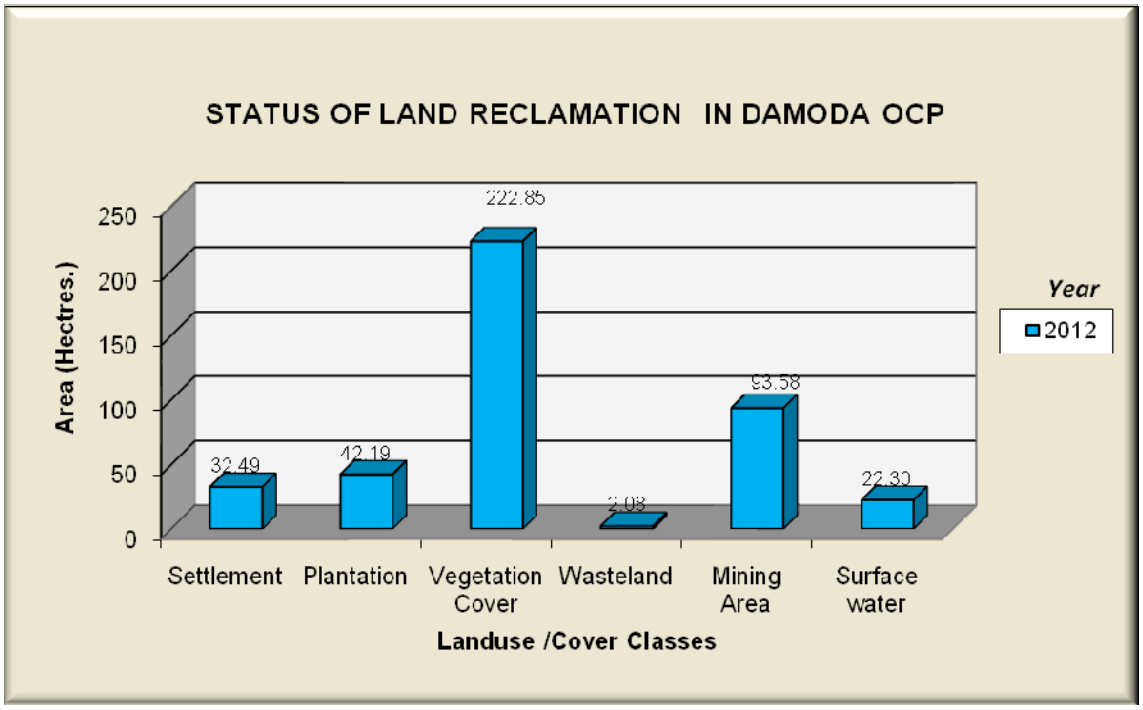


FIGURE - 3

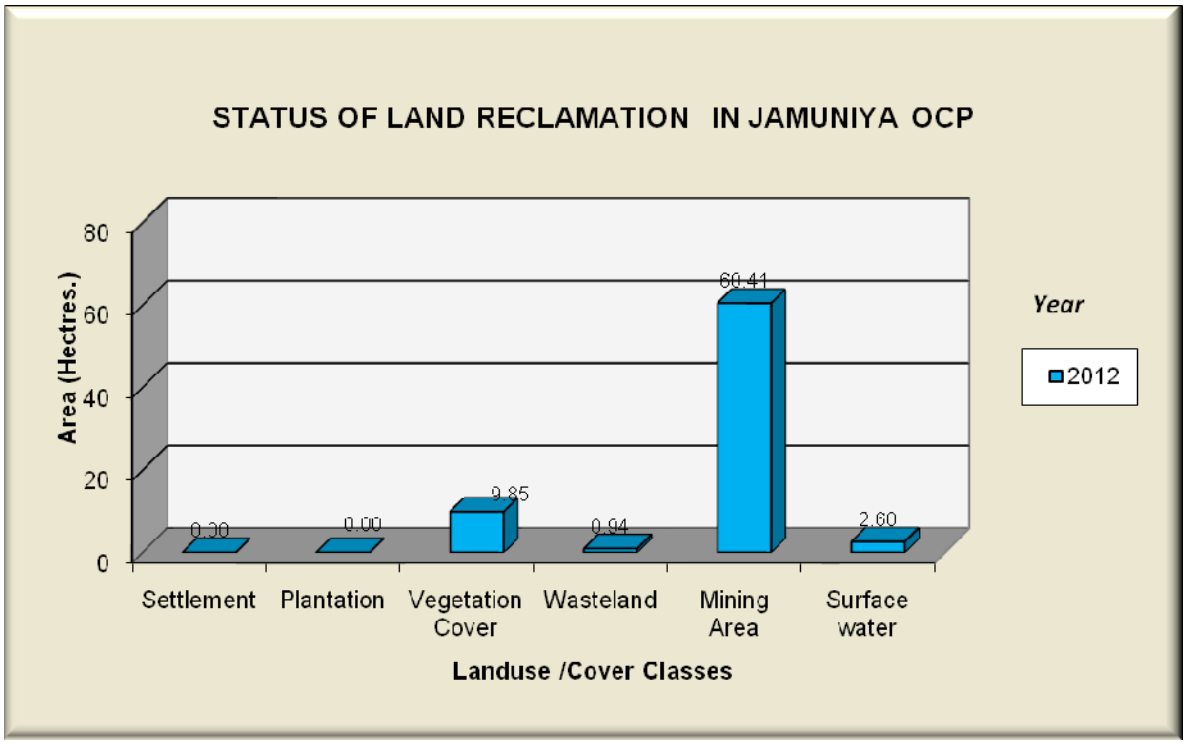


FIGURE - 4

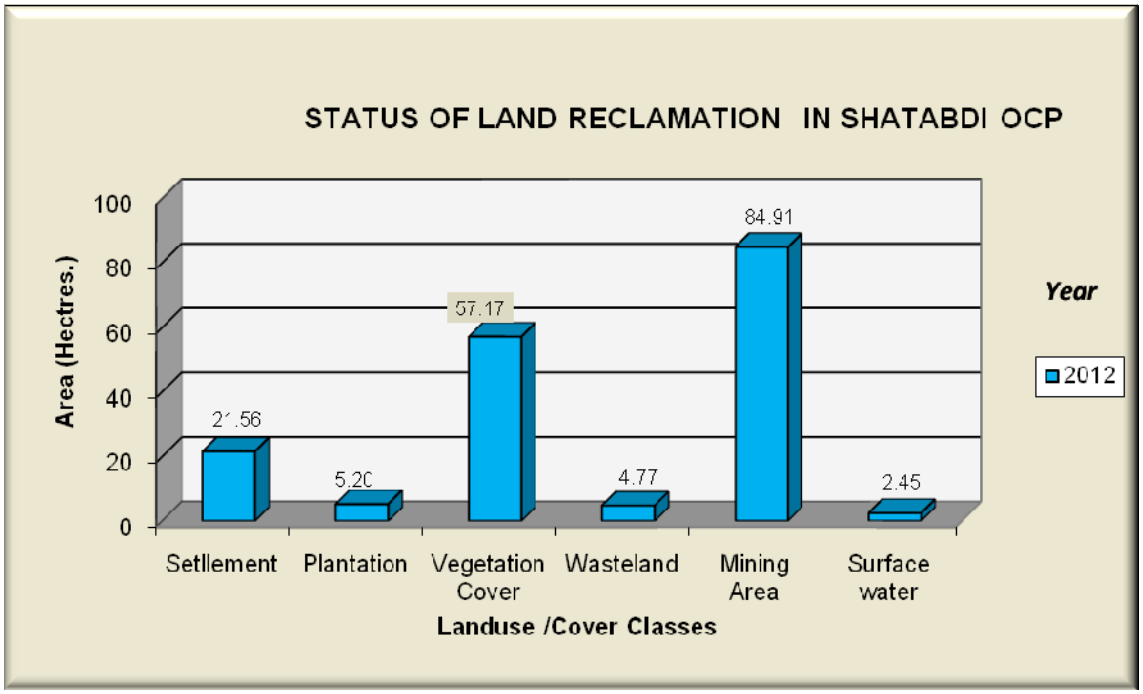


FIGURE – 5

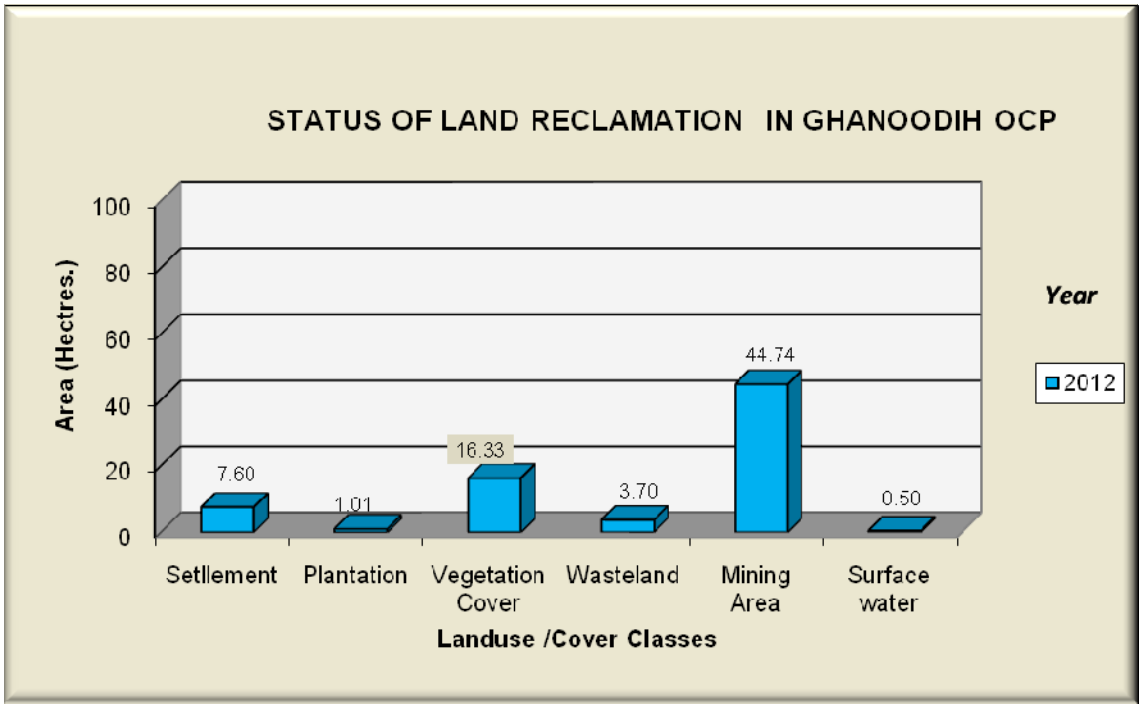


FIGURE - 6

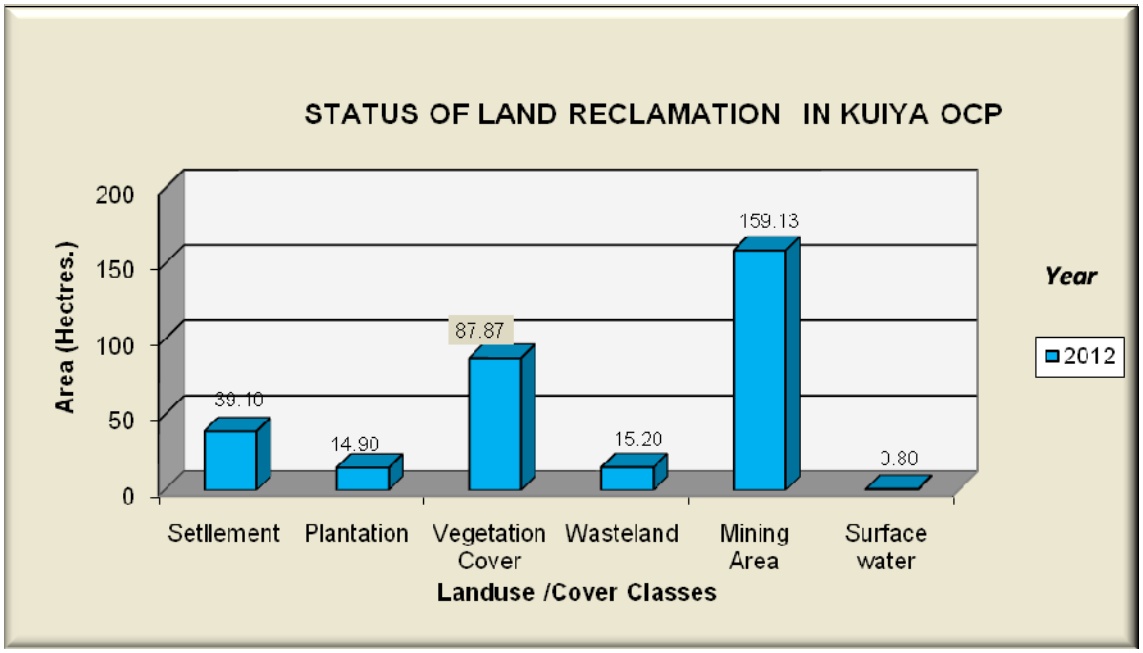


FIGURE - 7

Photo 1: Plantation on OB Dump (Ghanoodih OCP)

Photo 2: Plantation on Internal OB Dump/Backfill (Kuiya OCP)

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