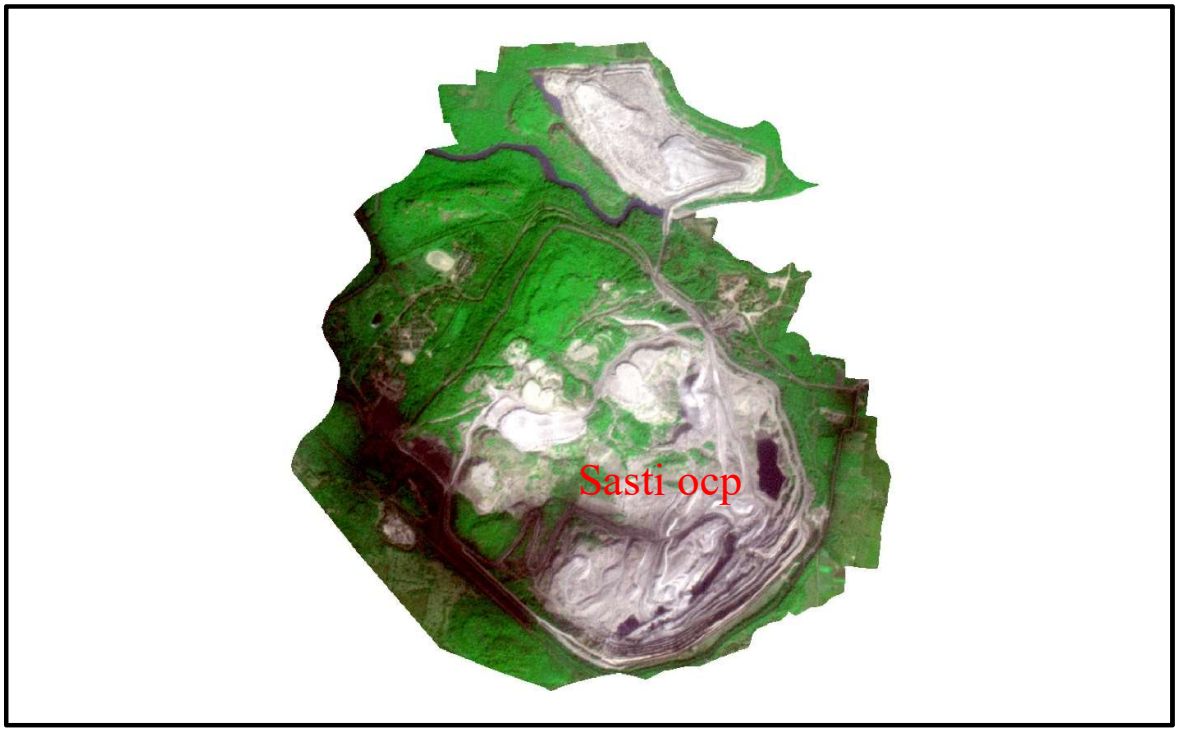
Land Restoration/Reclamation Monitoring of more than 5 million cu.m. (Coal+OB) Capacity Opencast Coal Mines of Western Coalfields Limited based on Satellite Data of the Year 2022



Submitted to

Western Coalfields Limited

Land Restoration/Reclamation Monitoring of more than 5 million cu.m. (Coal+OB) Capacity Opencast Coal Mines of Western Coalfields Limited based on Satellite Data of the Year 2022

March 2023

Remote Sensing Cell
Geomatics Division
CMPDI, Ranchi

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Executive Summary

1.0 Project

Land restoration / reclamation monitoring of 14 opencast coal mines of Western Coalfields Ltd. (WCL) producing 5 million cu.m. and more (Coal+OB) per year based on satellite data, regularly on annual basis. Among 14 opencast coal mines projects, 4 projects namely Yekona-I & II (Amal), New Majri UG to OC, Pauni-II (Expn) and MKD-I (Expn) have been included in 2021 for the first time as their capacity (Coal+OB) have been increased to category of more than 5 million cubic meter from category of less than 5 million cu.m. per year.

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 total leasehold area of 150.99 Km2 of 14 projects of WCL viz. Sasti, Padmapur, Durgapur, Mugoli, Umrer, Ukni, Niljai, New Majri. Makardhokra-III, Penganga, Yekona-I & II (Amal), New Majri UG to OC, Pauni-II (Expn.) and MKD-I (Expn.) considered for monitoring during 2022-23; the total excavated area is 37.17 Km^2 out of which 11.87 Km^2 area (31.93%) is backfilled, 4.23 Km^2 area (11.38%) has been planted and 21.07 Km^2 area (56.69%) is under active mining. It is evident from the analysis that 43.31% area of the OC projects has been reclaimed (biological and technical) and balance 56.69% area is under active mining. Project wise details are given in Table-1 & Fig-1. (For comparison purpose, refer Table-1).

- On comparing the status of land reclamation for the year 2021 with respect to the year 2020 in different projects, it is evident from the analysis that total area under land reclamation has increased from 14.37 Km^2 (Yr. 2021) to 16.10 Km^2 (Yr.2022). Out of 14 projects of WCL, Sasti OC ranks on top for land reclamation (90.79%) followed by Umrer OC (64.17%) and New Majri OC (47.24%).

- Area under biological reclamation (plantation) has increased from 3.84 Km^2 (Yr. 2021) to 4.23 Km^2 (Yr. 2022) whereas area of technical reclamation (area under backfilling) has increased from 10.53 Km^2 (Yr. 2021) to 11.87 Km^2 (Yr. 2022) in WCL. The total increase of 1.73 Km^2 under reclamation is the result of the efforts of the Western Coalfields Ltd. taken up towards environmental protection.

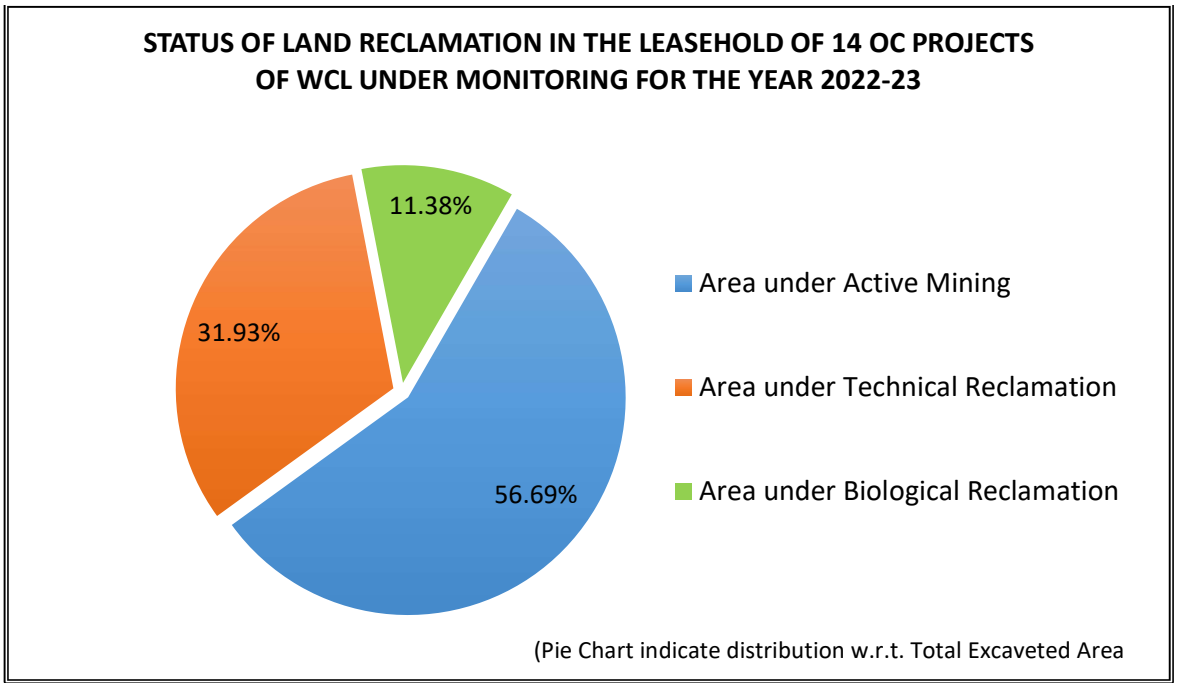


Fig.1: Pie Chart indicating distribution (%) of reclamation activities in 14 OC Mines of WCL

Table-1

Projectwise Land Reclamation Status in Opencast Projects of WCL

(>5 Million Cubic Metre Coal+OB) based on Satellite Data of the year 2022

(Area in Sq. Kms.)

Sl. No.	Project	Total Leasehold Area		Technical Reclamation		Plantation						Area under Active Mining		Total Excavated Area		Total Area under Plantation (% Green Cover Generated in Leasehold)		Total Area under Reclamation	
				Area under Backfilling		Biological Reclamation		Other Plantations											
						Plantation on Excavated / Backfilled Area		Plantation on External Over Burden Dumps		Social Forestry, Avanue Plantation Etc.									
1	*2*	*3*		*4*		*5*		*6*		*7*		*8*		*9 (=4+5+8)*		*10 (=5+6+7)*		*11(=4+5)*	
		2021	*2022*	*2021*	*2022*	*2021*	*2022*	*2021*	*2022*	*2021*	*2022*	*2021*	*2022*	*2021*	*2022*	*2021*	*2022*	*2021*	*2022*
1	Sasti	9.20	9.20	2.46	2.62	0.79	0.83	1.70	1.70	0.65	0.67	0.55	0.35	3.80	3.80	3.14	3.20	3.25	3.45
				64.74%	68.95%	20.79%	21.84%					14.47%	9.21%			34.13%	34.78%	85.53%	90.79%
2	Padmapur	8.29	8.29	0.61	0.59	0.20	0.28	1.95	2.14	0.81	0.83	1.22	1.18	2.03	2.05	2.96	3.25	0.81	0.87
				30.05%	28.78%	9.85%	13.66%					60.10%	57.56%			35.71%	39.20%	39.90%	42.44%
3	Durgapur	15.50	15.50	0.85	1.17	0.84	0.93	2.59	2.72	1.19	1.19	2.93	2.53	4.62	4.63	4.62	4.84	1.69	2.10
				18.40%	25.27%	18.18%	20.09%					63.42%	54.64%			29.81%	31.23%	36.58%	45.36%
4	Mugoli	12.55	12.55	1.34	1.46	0.14	0.14	1.71	1.81	0.47	0.56	1.88	1.85	3.36	3.45	2.32	2.51	1.48	1.60
				39.88%	42.32%	4.17%	4.06%					55.95%	53.62%			18.49%	20.00%	44.05%	46.38%
5	Umrer	9.45	9.45	1.68	1.50	1.40	1.58	1.58	1.45	2.31	2.31	1.71	1.72	4.79	4.80	5.29	5.34	3.08	3.08
				35.07%	31.25%	29.23%	32.92%					35.70%	35.83%			55.98%	56.51%	64.30%	64.17%
6	Ukni	12.85	12.85	0.48	0.52	0.00	0.00	1.64	1.66	0.72	0.86	1.97	1.94	2.45	2.46	2.36	2.52	0.48	0.52
				19.59%	21.14%	0.00%	0.00%					80.41%	78.86%			18.37%	19.61%	19.59%	21.14%
7	Niljai	17.61	17.61	1.34	1.44	0.11	0.11	1.65	2.04	1.23	1.23	2.94	2.84	4.39	4.39	2.99	3.38	1.45	1.55
				30.52%	32.80%	2.51%	2.51%					66.97%	64.69%			16.98%	19.19%	33.03%	35.31%
8	New Majri	7.74	7.74	1.13	1.52	0.36	0.36	1.32	1.24	1.47	1.47	2.28	2.10	3.77	3.98	3.15	3.07	1.49	1.88
				29.97%	38.19%	9.55%	9.05%					60.48%	52.76%			40.70%	39.66%	39.52%	47.24%
9	MKD-III	9.23	9.23	0.31	0.37	0.00	0.00	0.00	0.00	0.07	0.07	1.02	1.01	1.33	1.38	0.07	0.07	0.31	0.37
				23.31%	26.81%	0.00%	0.00%					76.69%	73.19%			0.76%	0.76%	23.31%	26.81%
10	Penganga	7.63	7.63	0.33	0.67	0.00	0.00	0.00	0.00	0.39	0.49	1.00	0.90	1.33	1.57	0.39	0.49	0.33	0.67
				24.81%	42.68%	0.00%	0.00%					75.19%	57.32%			5.11%	6.42%	24.81%	42.68%
11	Yekona-I&II(Amal)	16.79	16.79	0.00	0.01	0.00	0.00	0.00	0.00	0.03	0.03	0.54	1.11	0.54	1.12	0.03	0.03	0.00	0.01
				-	0.89%	-	0.00%					-	99.11%			0.18%	0.18%	0.00%	0.89%
12	New Majri UG to OC	7.06	7.06	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.37	0.75	1.03	0.75	1.03	0.33	0.37	0.00	0.00
				-	0.00%	-	0.00%					-	100.00%			4.67%	5.24%	0.00%	0.00%
13	Pauni -II (Expn)	10.95	10.95	0.00	0.00	0.00	0.00	0.19	0.13	0.08	0.18	0.87	1.17	0.87	1.17	0.27	0.31	0.00	0.00
				-	0.00%	-	0.00%					-	100.00%			2.47%	2.83%	0.00%	0.00%
14	MKD -1 (Expn) OC	6.14	6.14	0.00	0.00	0.00	0.00	0.04	0.10	0.00	0.00	0.97	1.34	0.97	1.34	0.04	0.10	0.00	0.00
				-	0.00%	-	0.00%					-	100.00%			0.65%	1.63%	0.00%	0.00%
	Total	**150.99**	**150.99**	**10.53**	**11.87**	**3.84**	**4.23**	**14.37**	**14.99**	**9.75**	**10.26**	**20.63**	**21.07**	**35.00**	**37.17**	**27.96**	**29.48**	**14.37**	**16.10**
				30.09%	31.93%	10.97%	11.38%					58.94%	56.69%			18.52%	19.52%	41.06%	43.31%

Note : In reference of the above Table-1, different parameters are classified as follows

1 Area under Biological Reclamation includes area under plantation done on backfilled area only.

2 Area under Technical Reclamation includes areas under barren backfill only.

3 Area under Active Mining includes coal quarry, advance quarry & quarry filled with water etc.

4 Social forestry and plantation on external OB dump are not included in biological reclamation and are put under other plantation.

5 % claculated in respect to total excaveted area except for "Total area under plantation" where % is in terms of leasehold area.

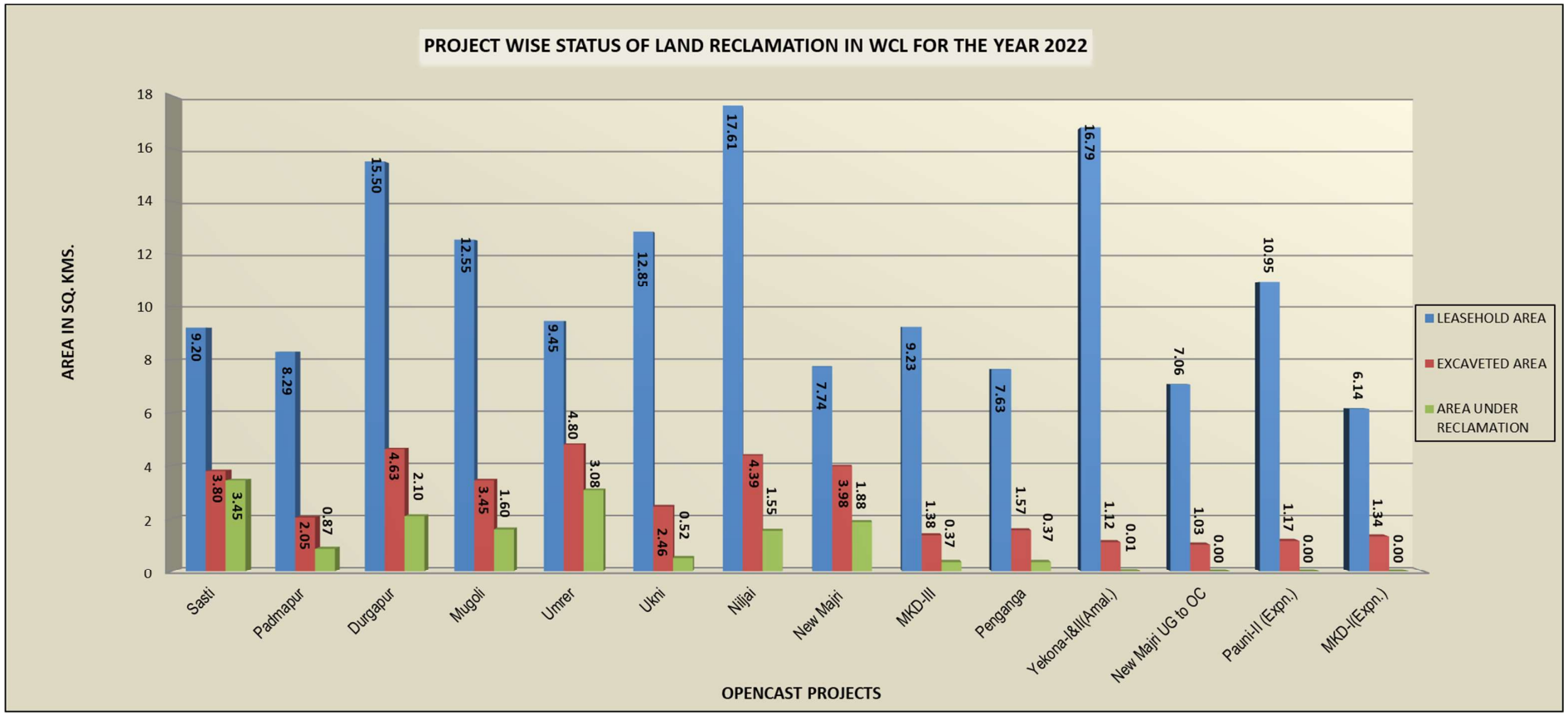


Fig.2: Land reclamation status in 14 OC projects of WCL for the year 2022

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./2011 dated23/08/11 was 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. This order has been renewed in CIL letter no. CIL/WBP/Env/2011/4706 dated 12.10.2012 for the next five years. Again this work order has been renewed vide letter no. CIL/WBP/Env/2017/DP/8391 dated 22.06.2017 for a period next five years starting from 2017-18 to 2021-22. The work order was renewed vide letter no. CIL/ ENVT/2022-23/W.O/10899 dated 06.07.2022 for a period of 2 more years from 2022-23 to 2023-24. The result of land reclamation status of all such mines is put on the websites of **CIL**, (www.coalindia.in), **CMPDI** (www.cmpdi.co.in) and the concerned coal companies in public domain. Detailed report is 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 2022 carried out for all the OC projects producing more than 5 mcm (Coal+OB) for Western 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 Fig 2. Following steps are involved in land reclamation /restoration monitoring:

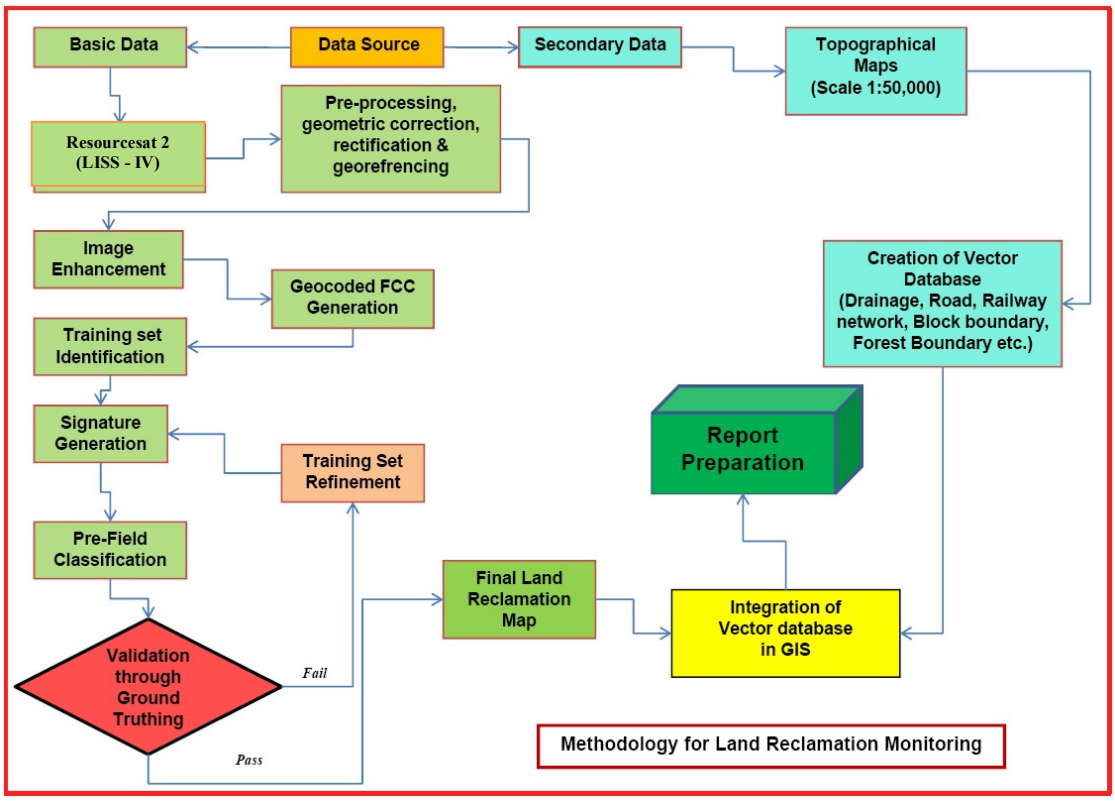


Figure: 3 - ***Methodology for Land Reclamation Monitoring***

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 2014 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 2014 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.2014 software.

- **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 10.2 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 is 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-of dates.

4.0 Work Plan

Fourteen opencast projects of WCL producing more than 5 million cubic m. (Coal + OB together) have been taken up for land reclamation/ restoration monitoring in 2022-23, based on the Resoursesat-2/2A(L-IV) Satellite data, using ERDAS Imaging digital image processing s/w and ArcGIS 10.2 platform. Land reclamation monitoring will be carried out regularly on annual basis to assess the progressive status of land reclamation/ restoration in the above OC mines. The report of this study has been uploaded on the websites of CMPDI, CIL & WCL in public domain.

5.0 Land Reclamation Status in Western Coalfields Limited

5.1 Following 14 OC projects producing more than 5 million cubic m. (Coal + OB together) of Western Coalfields Ltd. have been taken up for land reclamation monitoring based on Satellite Data of the year 2022:

- Sasti
- Padmapur
- Durgapur
- Mugoli
- Umrer
- Ukni
- Niljai
- New Majri
- MKD-III
- Penganga
- Yekona-I & II (Amal.)
- New Majri UG to OC
- Pauni-II (Expn.)
- MKD-I(Expn.)

5.2 Project wise Land Reclamation status in WCL for the year 2022 is given in Table 1 and also shown graphically in Fig 1. Area statistics of different land use class present in the mine leasehold of the above projects for the year 2022 are shown in the Table 2. It is important to mention here that leasehold boundaries of Yekona-I & II (Amal), New Majri UG to OC and MKD-I (Expn.) projects have been modified as per latest EC. Land use maps derived from satellite data are shown in Plate 1-14. Year wise changes in the different land use classes based on satellite data are depicted in Bar Charts in Fig. 4–17 for the last three years only.

5.3 Study reveals that 16.10 Km^2 (43.31%) of excavated area has been under reclamation in the above mentioned mines of WCL out of which 4.23 Km^2 (11.38%) area has been revegetated and 11.87 Km^2 (31.93%) area is under backfilling. There is an overall increase of 1.73 Km^2 in area under reclamation in WCL in the year 2022 with respect to the year 2021, out of which there is an increase of 1.34 Km^2 in area under technical reclamation (Barren Backfilling) and an increase of 0.39 Km^2 in area under biological reclamation (Plantation on Backfilled Areas) (Refer Table-1). In New Majri OC project plantation on OB has been reduced by 0.08 Km^2 on account of tree felling for the purpose of coal mining. In Umrer OC plantation on OB dump has been reduced 0.13 Km^2 on account of OB dumping on vegetated OB dump area due to constraint of dumping space.

5.4 Analysis of satellite data also indicates that total area under active mining has increased from 20.63 Km^2 (Yr.2021) to 21.07 Km^2 (Yr.2022). In some OC project area under active mining has reduced due to increase in area under backfilling.

5.5 After comparing the satellite data of year 2022 vs. 2021, study also reveals that area under backfilling has increased from 10.53 Km^2 (Yr. 2021) to 11.87 Km^2 (Yr. 2022).

5.6 Total area under biological reclamation has increased from 3.84 Km^2 (Yr. 2021) to 4.23 Km^2 (Yr. 2022). There is no biological reclamation in Yekona-I & II (Amal.), New Majri UG to OC, Pauni-II (Expn.), MKD-I and MKD-III OC & Penganga OC.

5.7 Analysis of satellite data also indicates that total area under plantation (Green Cover) has increased from 27.96 Km^2 (Yr. 2021) to 29.48 Km^2 (Yr. 2022). The increase of 1.52 Km^2 area under Green Cover areas may be attributed to continuous effort of WCL towards environmental protection.

5.8 After comparing the satellite data of year 2022 vs. 2021, it is evident that total area under plantation (Green Cover) in Sasti, Padmapur, Durgapur, Mugoli, Niljai, Umrer, Ukni, Niljai, Makardhokra-III and Penganga Opencast Projects has increased. It has been also observed in some of the projects natural vegetation has also started growing on stabilized old backfilled areas and overburden dumps due to high soil fertility.

5.9 On comparing the status of land reclamation for the year 2022 with respect to the year 2021 in different projects, it is evident that the total area under reclamation has increased from 14.37 Km^2 (Yr. 2021) to 16.10 Km^2 (Yr. 2022).

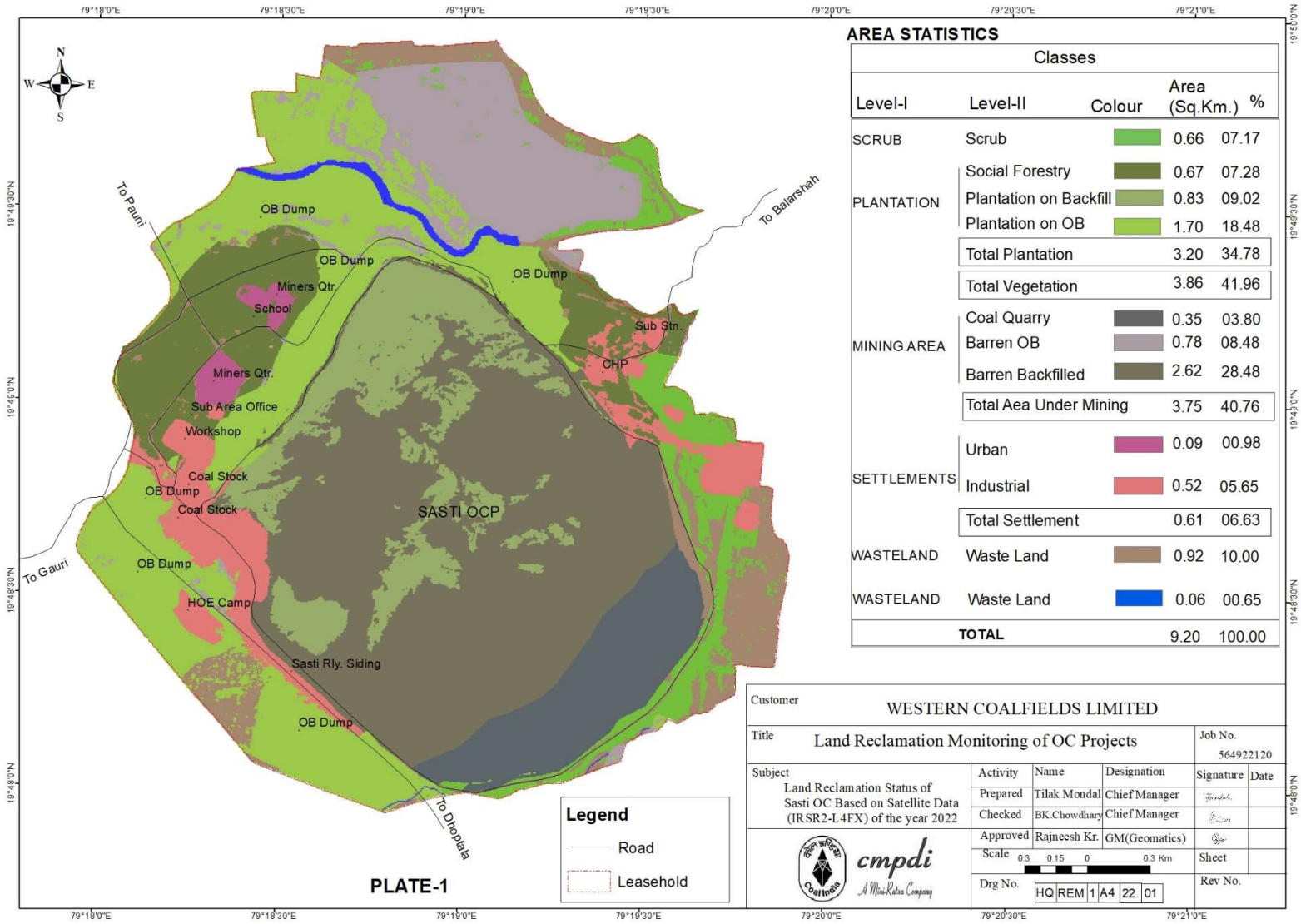
5.10 Out of 14 projects of WCL, maximum area under reclamation is in Sasti Opencast Project (90.79%) followed by Umrer OC (64.17%) and New Majri OC (47.24%).

TABLE - 2

Status of Land Use / Reclamation in OC Mines(>5mcu.m) of Western Coalfields Ltd based on Satellite data of the Year 2022

(Area in Sq.Km)

		Sasti		Padmapur		Durgapur		Mugoli		Umrer		Ukni		Niljai		New Majri		MKD-III		Penganga		Yekona-I&II (Amal)		MKD-I (Expn.)		New Majri Ug to OC		Pauni -II (Expn)		Total	
		Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
FORESTS	Dense Forest	0.00	0.00	0.00	0.00	1.27	8.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.27	0.84
	Open 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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Total Forest	0.00	0.00	0.00	0.00	**1.27**	**8.19**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	0.00	**0.00**	**0.00**	**0.00**	0.00	**0.00**	**0.00**	**0.00**	**1.27**	**0.84**
SCRUBS	Scrubs	**0.66**	**7.17**	**0.69**	**8.32**	**0.57**	**3.68**	**1.94**	**15.46**	**0.00**	**0.00**	**1.94**	**15.10**	**1.56**	**8.86**	**0.05**	**0.65**	**0.56**	**6.07**	**1.22**	**15.99**	**2.58**	**15.37**	**0.82**	**13.36**	**0.85**	**12.04**	**1.07**	**9.77**	**14.51**	**9.61**
PLANTATION	Social Forestry	0.67	7.28	0.83	10.01	1.19	7.68	0.56	4.46	2.31	24.44	0.86	6.69	1.23	6.98	1.47	18.99	0.07	0.76	0.49	6.42	0.03	0.18	0.00	0.00	0.37	5.24	0.18	1.64	10.26	6.80
	Plantation on OB Dump	1.70	18.48	2.14	25.81	2.72	17.55	1.81	14.42	1.45	15.34	1.66	12.92	2.04	11.58	1.24	16.02	0.00	0.00	0.00	0.00	0.00	0.00	0.10	1.63	0.00	0.00	0.13	1.19	14.99	9.93
	Plantation on Backfill	0.83	9.02	0.28	3.38	0.93	6.00	0.14	1.12	1.58	16.72	0.00	0.00	0.11	0.62	0.36	4.65	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.23	2.80
	Total Plantation *(Biological Reclamation)*	**3.20**	**34.78**	**3.25**	**39.20**	**4.84**	**31.23**	**2.51**	**20.00**	**5.34**	**56.51**	**2.52**	**19.61**	**3.38**	**19.19**	**3.07**	**39.66**	**0.07**	**0.76**	**0.49**	**6.42**	**0.03**	**0.18**	**0.10**	**1.63**	**0.37**	**5.24**	**0.31**	**2.83**	**29.48**	**19.53**
	Total Vegetation	**3.86**	**41.96**	**3.94**	**47.53**	**6.68**	**43.10**	**4.45**	**35.46**	**5.34**	**56.51**	**4.46**	**34.71**	**4.94**	**28.05**	**3.12**	**40.31**	**0.63**	**6.83**	**1.71**	**22.41**	**2.61**	**15.54**	**0.92**	**14.98**	**1.22**	**17.28**	**1.38**	**12.60**	**45.26**	**29.98**
ACTIVE MINING	Coal Quarry	0.35	3.80	0.97	11.70	2.03	13.10	1.85	14.74	1.60	16.93	1.73	13.46	2.52	14.31	1.98	25.58	1.01	10.94	0.90	11.80	0.94	5.60	1.30	21.17	1.03	14.59	0.84	7.67	19.05	12.62
	Coal Dump	0.00	0.00	0.00	0.00	0.05	0.32	0.00	0.00	0.12	1.27	0.10	0.78	0.11	0.62	0.00	0.00	0.00	0.00	0.23	3.01	0.17	1.01	0.00	0.00	0.03	0.42	0.16	1.46	0.97	0.64
	Advance Quarry Site	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	1.46	0.16	0.11
	Quarry Filled With Water	0.00	0.00	0.21	2.53	0.45	2.90	0.00	0.00	0.01	0.11	0.11	0.86	0.21	1.19	0.12	1.55	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.65	0.00	0.00	0.01	0.09	1.16	0.77
	Total Area under *Active Mining*	**0.35**	**3.80**	**1.18**	**14.23**	**2.53**	**16.32**	**1.85**	**14.74**	**1.73**	**18.31**	**1.94**	**15.10**	**2.84**	**16.13**	**2.10**	**27.13**	**1.01**	**10.94**	**1.13**	**14.81**	**1.11**	**6.61**	**1.34**	**21.82**	**1.06**	**15.01**	**1.17**	**10.68**	**21.34**	**14.13**
RECLAIMED	Barren OB Dump	0.78	8.48	1.75	21.11	1.50	9.68	2.24	17.85	0.15	1.59	3.21	24.98	3.80	21.58	0.47	6.07	2.58	27.95	1.66	21.76	0.84	5.00	0.24	3.91	1.02	14.45	2.64	24.11	22.88	15.15
	Barren Backfilled Area (Technical Reclamation)	2.62	28.48	0.59	7.12	1.17	7.55	1.46	11.63	1.50	15.87	0.52	4.05	1.44	8.18	1.52	19.64	0.37	4.01	0.67	8.78	0.01	0.06	0.00	0.00	0.00	0.00	0.00	0.00	11.87	7.86
	Total Area	**3.40**	**36.96**	**2.34**	**28.23**	**2.67**	**17.23**	**3.70**	**29.48**	**1.65**	**17.46**	**3.73**	**29.03**	**5.24**	**29.76**	**1.99**	**25.71**	**2.95**	**31.96**	2.33	30.54	0.85	5.06	0.24	3.91	1.02	14.45	2.64	24.11	34.75	23.02
	Total Area Under Mine Operation	**3.75**	**40.76**	**3.52**	**42.46**	**5.20**	**33.55**	**5.55**	**44.22**	**3.38**	**35.77**	**5.67**	**44.12**	**8.08**	**45.88**	**4.09**	**52.84**	**3.96**	**42.90**	**3.46**	**45.35**	**1.96**	**11.67**	**1.58**	**25.73**	**2.08**	**29.46**	**3.81**	**34.79**	**56.09**	**37.15**
WASTELANDS	Waste Lands	0.92	10.00	0.42	5.07	1.39	8.97	0.30	2.39	0.27	2.86	1.02	7.94	1.55	8.80	0.14	1.81	0.70	7.58	1.54	20.18	1.21	7.21	0.33	5.37	0.41	5.81	0.46	4.20	10.66	7.06
	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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.98	0.05	0.71	0.15	1.37	0.26	0.17
	Total Wasteland	**0.91**	**10.00**	**0.42**	**5.07**	**1.39**	**8.97**	**0.30**	**2.39**	**0.27**	**2.86**	**1.02**	**7.94**	**1.55**	**8.80**	**0.14**	**1.81**	**0.70**	**7.58**	**1.54**	**20.18**	**1.21**	**7.21**	**0.39**	**6.35**	**0.46**	**6.52**	**0.61**	**5.57**	**10.91**	**7.23**
WATERBODIES	Reservoir, nallah, ponds	0.06	0.65	0.12	1.45	0.05	0.32	0.00	0.00	0.20	2.12	0.00	0.00	0.03	0.17	0.01	0.13	0.03	0.33	0.11	1.44	0.12	0.71	0.04	0.65	0.03	0.42	0.33	3.01	1.13	0.75
	Total Waterbodies	**0.06**	**0.65**	**0.12**	**1.45**	**0.05**	**0.32**	**0.00**	**0.00**	**0.20**	**2.12**	**0.00**	**0.00**	**0.03**	**0.17**	**0.01**	**0.13**	**0.03**	**0.33**	**0.11**	**1.44**	**0.12**	**0.71**	**0.04**	**0.65**	**0.03**	**0.42**	0.33	3.01	1.13	0.75
AGRICULTURE	Crop Lands	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.85	9.21	0.00	0.00	4.76	28.35	0.68	11.07	0.94	13.31	0.51	4.66	7.74	5.13
	Fallow Lands	0.00	0.00	0.00	0.00	1.59	10.26	1.92	15.30	0.00	0.00	1.50	11.67	1.98	11.24	0.00	0.00	2.85	30.88	0.66	8.65	6.08	36.21	2.52	41.04	2.25	31.87	4.22	38.54	25.57	16.94
	Total Agriculture	**0.00**	**0.00**	**0.00**	**0.00**	**1.59**	**10.26**	**1.92**	**15.30**	**0.00**	**0.00**	**1.50**	**11.67**	**1.98**	**11.24**	**0.00**	**0.00**	**3.70**	**40.09**	**0.66**	**8.65**	**10.84**	**64.56**	**3.20**	**52.12**	**3.19**	**45.18**	**4.73**	**43.20**	**33.31**	**22.06**
SETTLEMENTS	Urban Settlement	0.09	0.98	0.00	0.00	0.39	2.52	0.12	0.96	0.15	1.59	0.00	0.00	0.34	1.93	0.34	4.39	0.00	0.00	0.00	0.00	0.01	0.06	0.01	0.16	0.07	0.99	0.02	0.18	1.54	1.02
	Rural Settlement	0.00	0.00	0.00	0.00	0.05	0.32	0.03	0.24	0.00	0.00	0.02	0.16	0.20	1.14	0.00	0.00	0.00	0.00	0.03	0.39	0.03	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.24
	Industrial Settlement	0.52	5.65	0.29	3.50	0.15	0.97	0.18	1.43	0.11	1.16	0.18	1.40	0.49	2.78	0.04	0.52	0.21	2.28	0.12	1.57	0.01	0.06	0.00	0.00	0.01	0.14	0.07	0.64	2.38	1.58
	Total Settlement	**0.61**	**6.63**	**0.29**	**3.50**	**0.59**	**3.81**	**0.33**	**2.63**	**0.26**	**2.75**	**0.20**	**1.56**	**1.03**	**5.85**	**0.38**	**4.91**	**0.21**	**2.28**	**0.15**	**1.97**	**0.05**	**0.30**	**0.01**	**0.16**	0.08	**1.13**	0.09	0.82	4.28	2.83
	Grand Total	**9.20**	**100.00**	**8.29**	**100.00**	**15.50**	**100.00**	**12.55**	**100.00**	**9.45**	**100.00**	**12.85**	**100.00**	**17.61**	**100.00**	**7.74**	**100.00**	**9.23**	**100.00**	**7.63**	**100.00**	**16.79**	**100.00**	**6.14**	**100.00**	**7.06**	**100.00**	**10.95**	**100.00**	**150.98**	**100.00**



AREA STATISTICS

Classes				
Level-I	Level-II	Colour	Area (Sq.Km.)	%
SCRUB	Scrub		0.66	07.17
PLANTATION	Social Forestry		0.67	07.28
	Plantation on Backfill		0.83	09.02
	Plantation on OB		1.70	18.48
	Total Plantation		3.20	34.78
	Total Vegetation		3.86	41.96
MINING AREA	Coal Quarry		0.35	03.80
	Barren OB		0.78	08.48
	Barren Backfilled		2.62	28.48
	Total Aea Under Mining		3.75	40.76
SETTLEMENTS	Urban		0.09	00.98
	Industrial		0.52	05.65
	Total Settlement		0.61	06.63
WASTELAND	Waste Land		0.92	10.00
WASTELAND	Waste Land		0.06	00.65
	TOTAL		9.20	100.00

Customer	WESTERN COALFIELDS LIMITED				
Title	Land Reclamation Monitoring of OC Projects			Job No.	564922120
Subject	Land Reclamation Status of Sasti OC Based on Satellite Data (IRSR2-L4FX) of the year 2022	Activity	Name	Designation	Signature / Date
		Prepared	Tilak Mondal	Chief Manager	
		Checked	BK.Chowdhary	Chief Manager	
		Approved	Rajneesh Kr.	GM(Geomatics)	
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		Drg No.	HQ REM 1 A4 22 01		Rev No.

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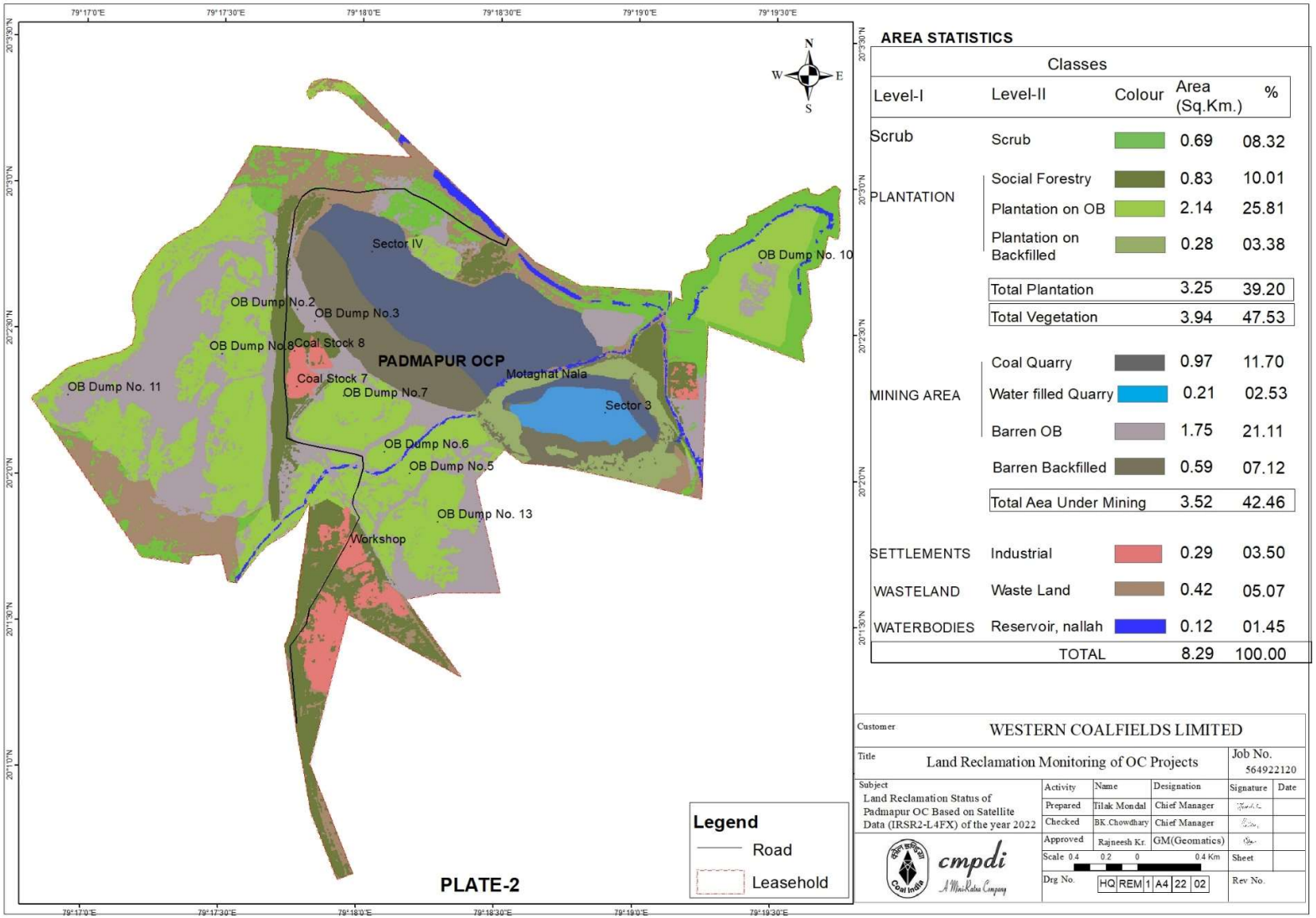

AREA STATISTICS

Classes

Level-I	Level-II	Area (Sq.Km.)	%
Scrub	Scrub	0.69	08.32
PLANTATION	Social Forestry	0.83	10.01
	Plantation on OB	2.14	25.81
	Plantation on Backfilled	0.28	03.38
	Total Plantation	3.25	39.20
	Total Vegetation	3.94	47.53
MINING AREA	Coal Quarry	0.97	11.70
	Water filled Quarry	0.21	02.53
	Barren OB	1.75	21.11
	Barren Backfilled	0.59	07.12
	Total Aea Under Mining	3.52	42.46
SETTLEMENTS	Industrial	0.29	03.50
WASTELAND	Waste Land	0.42	05.07
WATERBODIES	Reservoir, nallah	0.12	01.45
	TOTAL	8.29	100.00

Customer: WESTERN COALFIELDS LIMITED

Title: Land Reclamation Monitoring of OC Projects

Job No. 564922120

Subject: Land Reclamation Status of Padmapur OC Based on Satellite Data (IRSR2-L4FX) of the year 2022

Activity	Name	Designation	Signature	Date
Prepared	Tilak Mondal	Chief Manager		
Checked	BK.Chowdhary	Chief Manager		
Approved	Rajneesh Kr.	GM(Geomatics)		

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Drg No. HQ REM 1 A4 22 02

Rev No.

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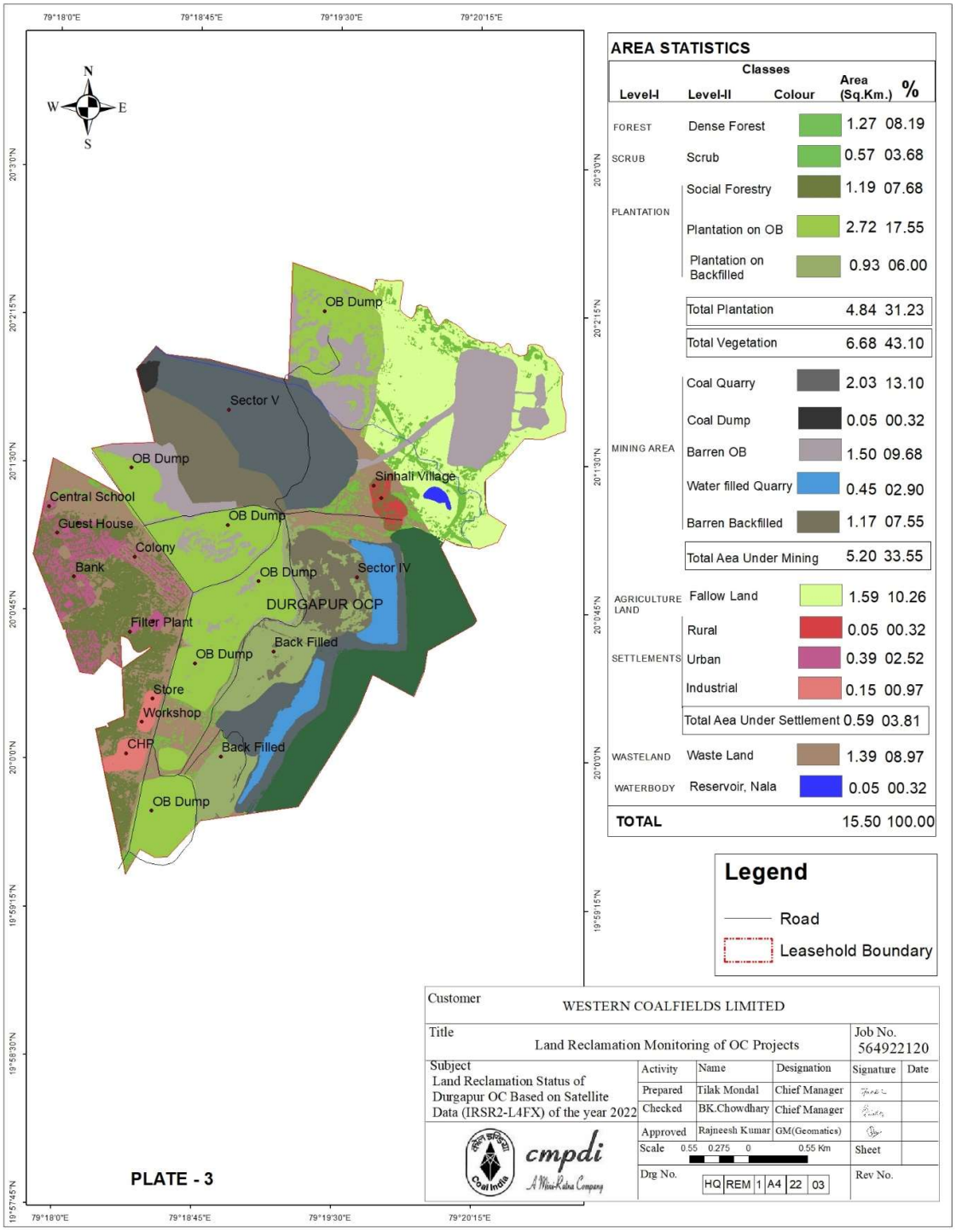
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19°57'45"N
N
W
E
S
OB Dump
Sector V
OB Dump
Sinhali Village
Central School
Guest House
OB Dump
Colony
Bank
OB Dump
Sector IV
DURGAPUR OCP
Filter Plant
Back Filled
OB Dump
Store
Workshop
CHP
Back Filled
OB Dump
PLATE - 3
AREA STATISTICS
Classes
Level-I
Level-II
Colour
Area (Sq.Km.)
%
FOREST
Dense Forest
1.27 08.19
SCRUB
Scrub
0.57 03.68
PLANTATION
Social Forestry
1.19 07.68
Plantation on OB
2.72 17.55
Plantation on Backfilled
0.93 06.00
Total Plantation
4.84 31.23
Total Vegetation
6.68 43.10
MINING AREA
Coal Quarry
2.03 13.10
Coal Dump
0.05 00.32
Barren OB
1.50 09.68
Water filled Quarry
0.45 02.90
Barren Backfilled
1.17 07.55
Total Aea Under Mining
5.20 33.55
AGRICULTURE LAND
Fallow Land
1.59 10.26
SETTLEMENTS
Rural
0.05 00.32
Urban
0.39 02.52
Industrial
0.15 00.97
Total Aea Under Settlement
0.59 03.81
WASTELAND
Waste Land
1.39 08.97
WATERBODY
Reservoir, Nala
0.05 00.32
TOTAL
15.50 100.00
Legend
Road
Leasehold Boundary
Customer
WESTERN COALFIELDS LIMITED
Title
Land Reclamation Monitoring of OC Projects
Job No.
564922120
Subject
Land Reclamation Status of Durgapur OC Based on Satellite Data (IRSR2-L4FX) of the year 2022
Activity
Name
Designation
Signature
Date
Prepared
Tilak Mondal
Chief Manager
Checked
BK.Chowdhary
Chief Manager
Approved
Rajneesh Kumar
GM(Geomatics)
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Drg No.
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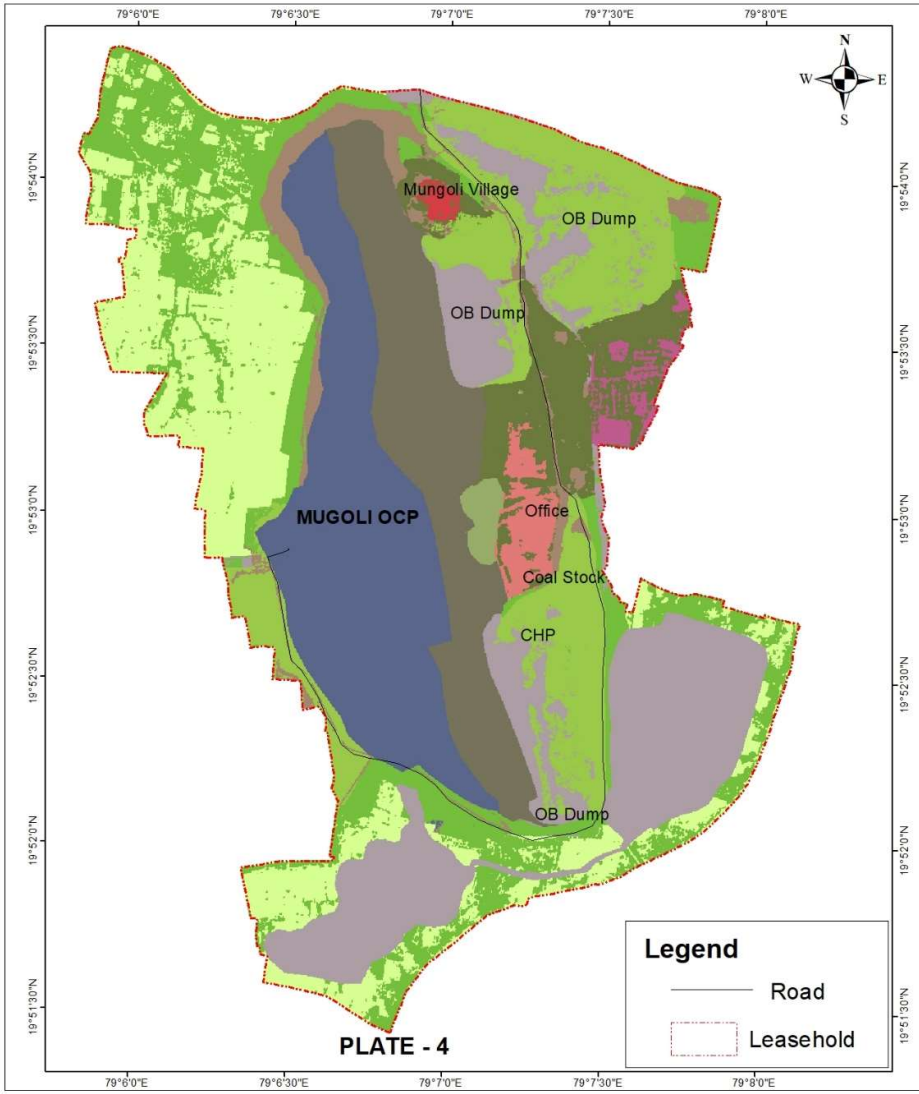

AREA STATISTICS

Classes				
Level-I	Level-II	Colour	Area (Sq.Km.)	%
SCRUB	Scrub		1.94	15.46
PLANTATION	Social Forestry		0.56	04.46
	Plantation on OB		1.81	14.42
	Plantation on Backfill		0.14	01.12
	Total Plantation		2.51	20.00
	Total Vegetation		4.45	35.46
MINING AREA	Coal Quarry		1.85	14.74
	Barren Backfilled		1.46	11.63
	Barren OB		2.24	17.85
	Total Aea Under Mining		5.55	44.22
AGRICULTURE	Fallow Land		1.92	15.30
WASTELAND	Waste Land		0.30	02.39
SETTLEMENTS	Rural		0.03	00.24
	Urban		0.12	00.96
	Industrial		0.18	01.43
	Total Settlement		0.33	02.63
	TOTAL		12.55	100.00

Customer	WESTERN COALFIELDS LIMITED				
Title	Land Reclamation Monitoring of OC Projects			Job No. 564922120	
Subject	Activity	Name	Designation	Signature	Date
Land Reclamation Status of Mugolii OC based on Satellite Data (IRSR2-L4FX) of the year 2022	Prepared	Tilak Mondal	Chief Manager		
	Checked	BK.Chowdhary	Chief Manager		
	Approved	Rajneesh Kr.	GM(Geomatics)		
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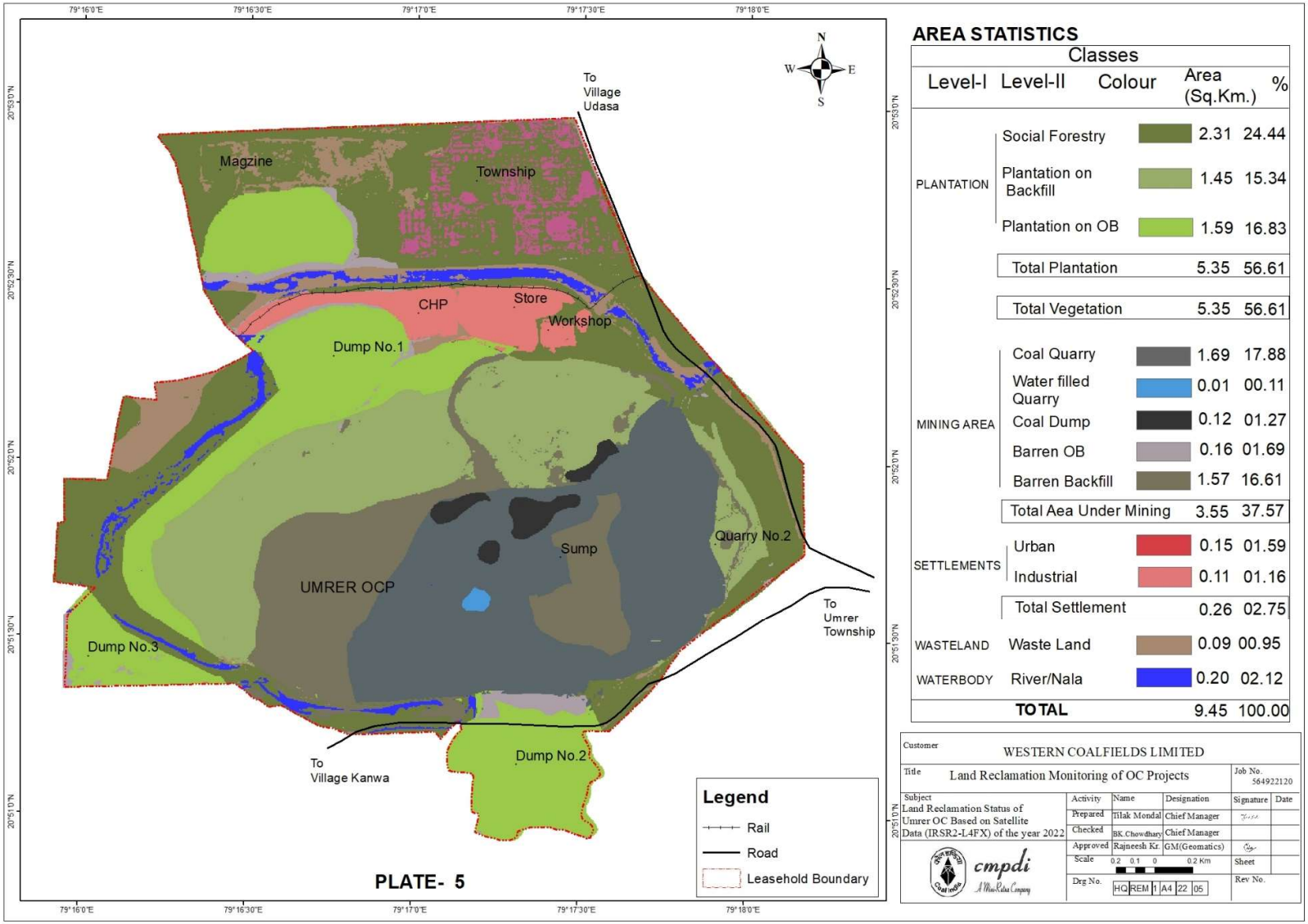

AREA STATISTICS

Classes				
Level-I	Level-II	Colour	Area (Sq.Km.)	%
PLANTATION	Social Forestry		2.31	24.44
	Plantation on Backfill		1.45	15.34
	Plantation on OB		1.59	16.83
	Total Plantation		5.35	56.61
	Total Vegetation		5.35	56.61
MINING AREA	Coal Quarry		1.69	17.88
	Water filled Quarry		0.01	00.11
	Coal Dump		0.12	01.27
	Barren OB		0.16	01.69
	Barren Backfill		1.57	16.61
	Total Aea Under Mining		3.55	37.57
SETTLEMENTS	Urban		0.15	01.59
	Industrial		0.11	01.16
	Total Settlement		0.26	02.75
WASTELAND	Waste Land		0.09	00.95
WATERBODY	River/Nala		0.20	02.12
	TOTAL		9.45	100.00

Customer	WESTERN COALFIELDS LIMITED				
Title	Land Reclamation Monitoring of OC Projects				Job No. 564922120
Subject	Activity	Name	Designation	Signature	Date
Land Reclamation Status of Umrer OC Based on Satellite Data (IRSR2-L4FX) of the year 2022	Prepared	Tilak Mondal	Chief Manager		
	Checked	BK Chowdhary	Chief Manager		
	Approved	Rajneesh Kr.	GM(Geomatics)		
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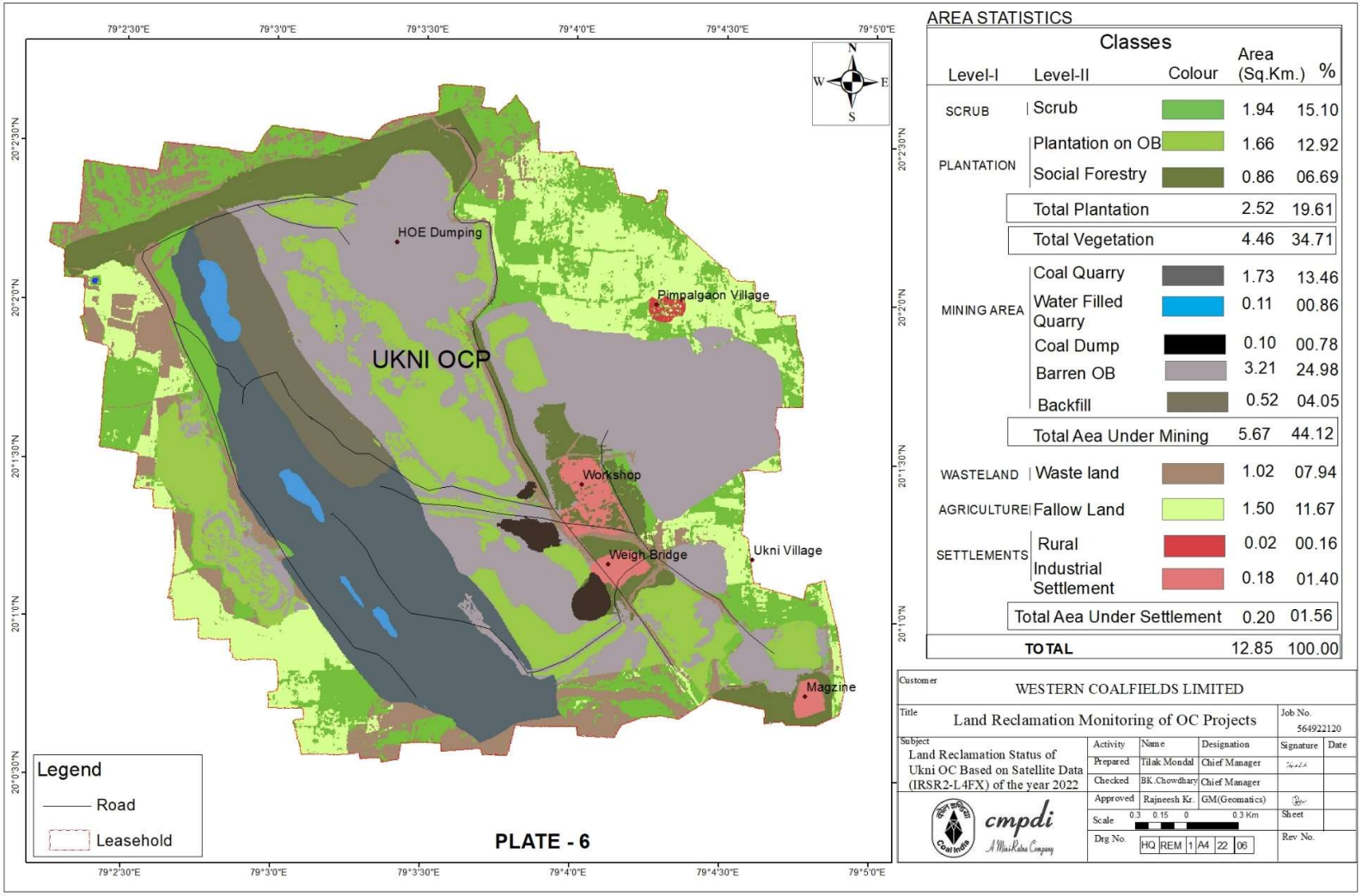

AREA STATISTICS

Level-I	Level-II	Colour	Area (Sq.Km.)	%
SCRUB	Scrub		1.94	15.10
PLANTATION	Plantation on OB		1.66	12.92
	Social Forestry		0.86	06.69
	Total Plantation		2.52	19.61
	Total Vegetation		4.46	34.71
MINING AREA	Coal Quarry		1.73	13.46
	Water Filled Quarry		0.11	00.86
	Coal Dump		0.10	00.78
	Barren OB		3.21	24.98
	Backfill		0.52	04.05
	Total Aea Under Mining		5.67	44.12
WASTELAND	Waste land		1.02	07.94
AGRICULTURE	Fallow Land		1.50	11.67
SETTLEMENTS	Rural		0.02	00.16
	Industrial Settlement		0.18	01.40
	Total Aea Under Settlement		0.20	01.56
	TOTAL		12.85	100.00

Customer	WESTERN COALFIELDS LIMITED				
Title	Land Reclamation Monitoring of OC Projects			Job No.	564922120
Subject	Land Reclamation Status of Ukni OC Based on Satellite Data (IRSR2-L4FX) of the year 2022	Activity	Name	Designation	Signature / Date
		Prepared	Tilak Mondal	Chief Manager	
		Checked	BK.Chowdhary	Chief Manager	
		Approved	Rajneesh Kr.	GM(Geomatics)	
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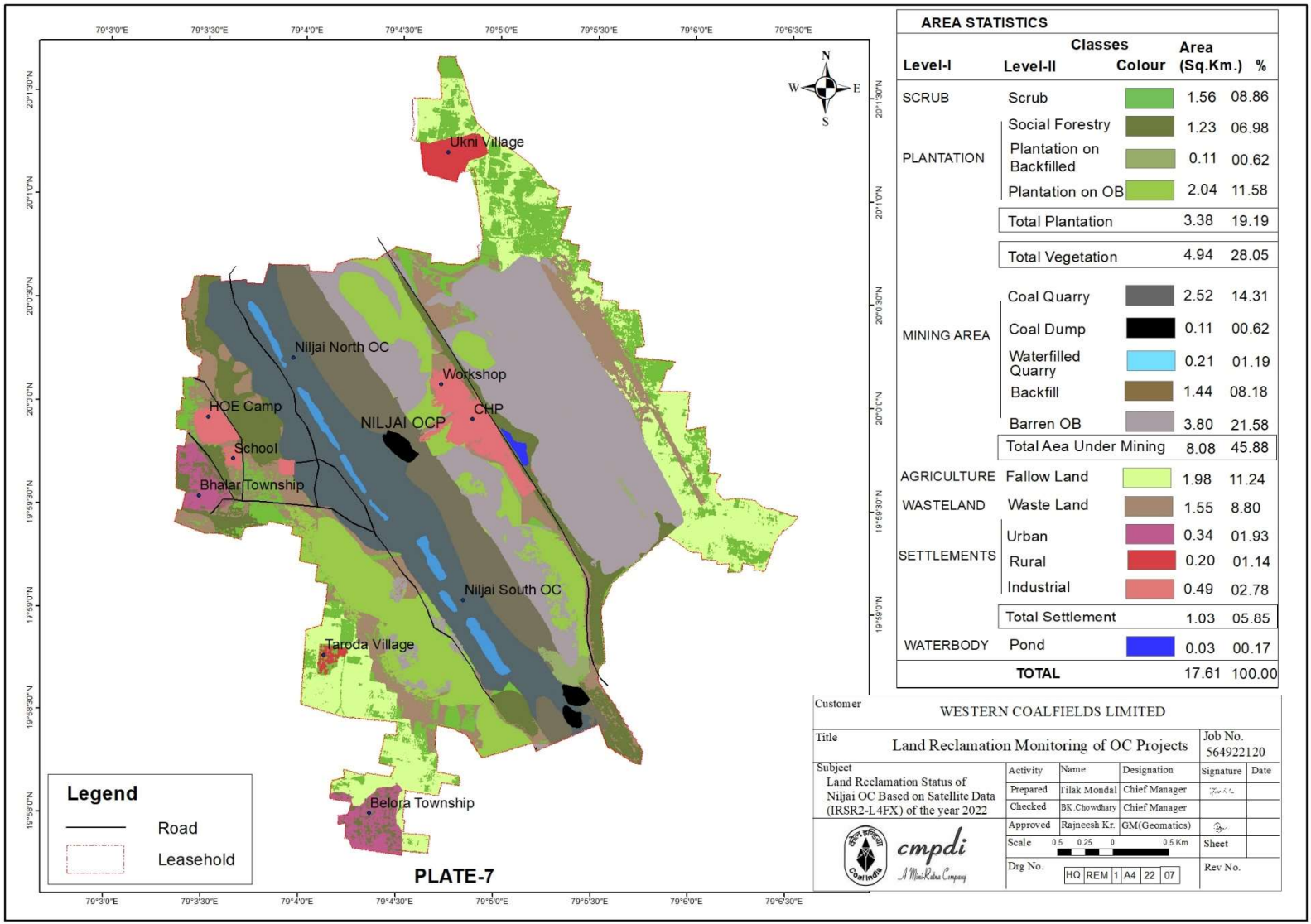

AREA STATISTICS

Level-I	Level-II	Classes Colour	Area (Sq.Km.)	%
SCRUB	Scrub		1.56	08.86
PLANTATION	Social Forestry		1.23	06.98
	Plantation on Backfilled		0.11	00.62
	Plantation on OB		2.04	11.58
	Total Plantation		3.38	19.19
	Total Vegetation		4.94	28.05
MINING AREA	Coal Quarry		2.52	14.31
	Coal Dump		0.11	00.62
	Waterfilled Quarry		0.21	01.19
	Backfill		1.44	08.18
	Barren OB		3.80	21.58
	Total Aea Under Mining		8.08	45.88
AGRICULTURE	Fallow Land		1.98	11.24
WASTELAND	Waste Land		1.55	8.80
SETTLEMENTS	Urban		0.34	01.93
	Rural		0.20	01.14
	Industrial		0.49	02.78
	Total Settlement		1.03	05.85
WATERBODY	Pond		0.03	00.17
	TOTAL		17.61	100.00

Customer	WESTERN COALFIELDS LIMITED				
Title	Land Reclamation Monitoring of OC Projects			Job No. 564922120	
Subject	Land Reclamation Status of Niljai OC Based on Satellite Data (IRSR2-L4FX) of the year 2022	Activity	Name	Designation	Signature / Date
		Prepared	Tilak Mondal	Chief Manager	
		Checked	BK.Chowdhary	Chief Manager	
		Approved	Rajneesh Kr.	GM(Geomatics)	
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		Drg No.	HQ REM 1 A4 22 07		Rev No.

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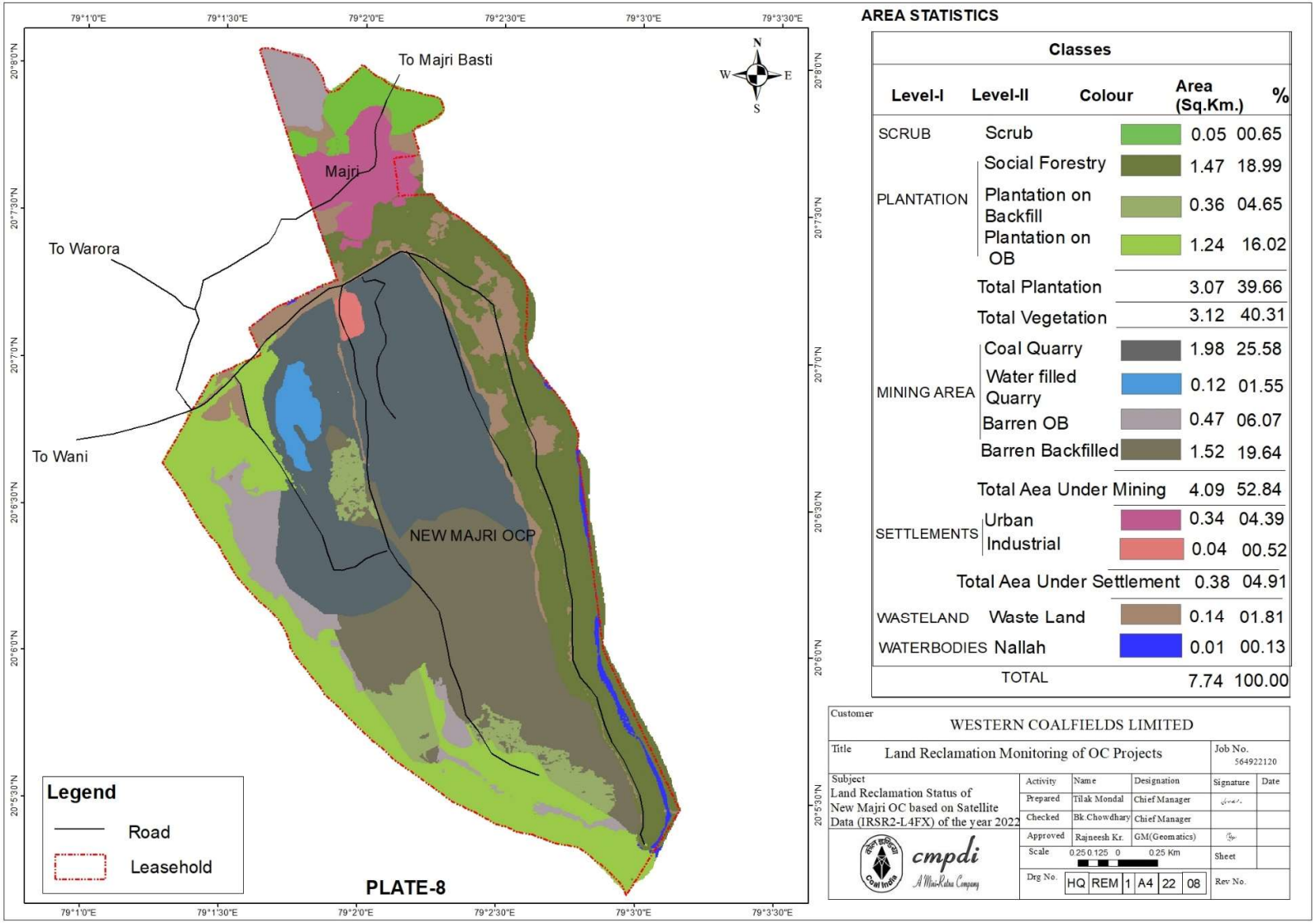
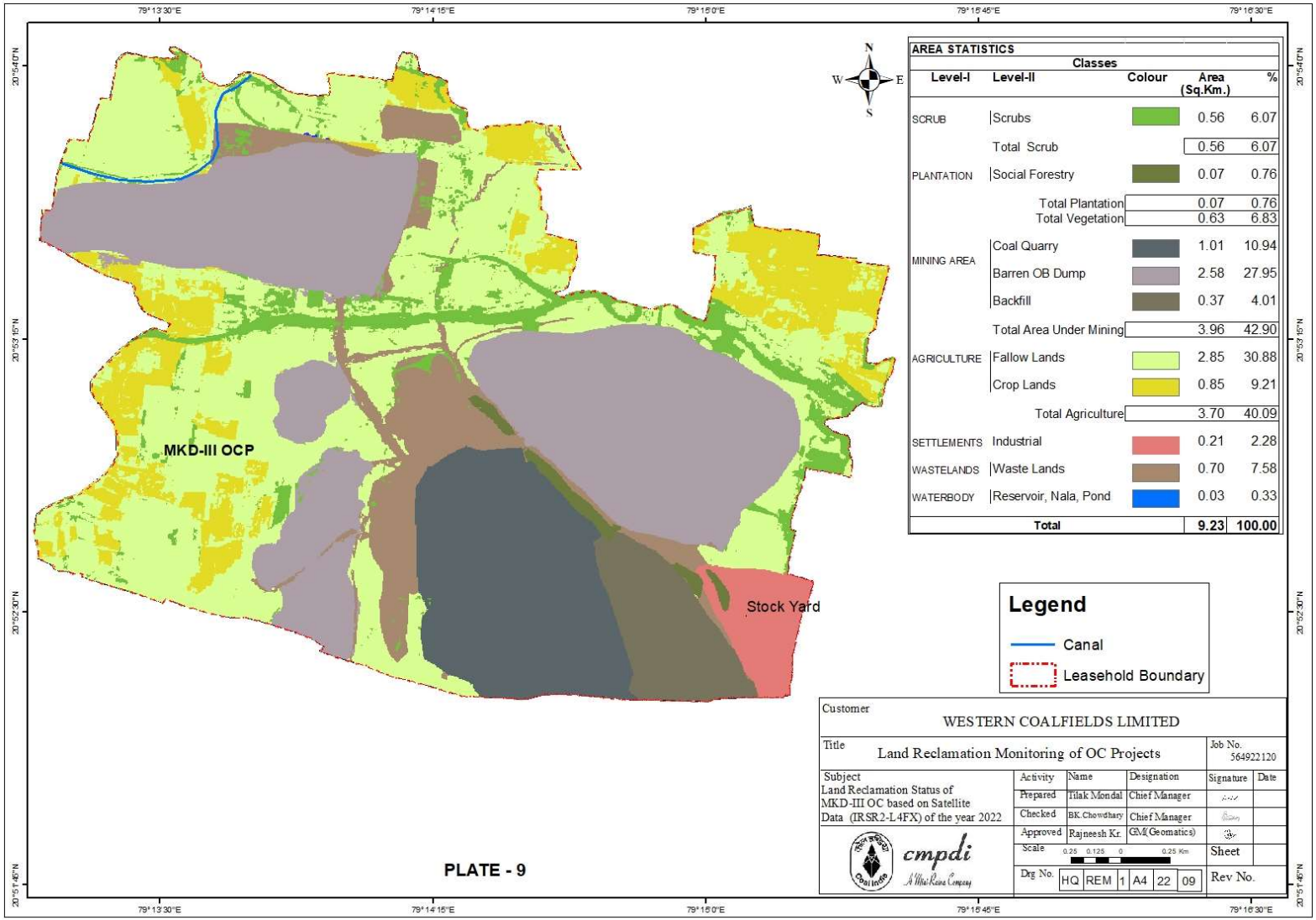


AREA STATISTICS

Classes				
Level-I	Level-II	Colour	Area (Sq.Km.)	%
SCRUB	Scrub		0.05	00.65
PLANTATION	Social Forestry		1.47	18.99
	Plantation on Backfill		0.36	04.65
	Plantation on OB		1.24	16.02
	Total Plantation		3.07	39.66
	Total Vegetation		3.12	40.31
MINING AREA	Coal Quarry		1.98	25.58
	Water filled Quarry		0.12	01.55
	Barren OB		0.47	06.07
	Barren Backfilled		1.52	19.64
	Total Aea Under Mining		4.09	52.84
SETTLEMENTS	Urban		0.34	04.39
	Industrial		0.04	00.52
	Total Aea Under Settlement		0.38	04.91
WASTELAND	Waste Land		0.14	01.81
WATERBODIES	Nallah		0.01	00.13
	TOTAL		7.74	100.00

Customer	WESTERN COALFIELDS LIMITED				
Title	Land Reclamation Monitoring of OC Projects			Job No. 564922120	
Subject	Activity	Name	Designation	Signature	Date
Land Reclamation Status of New Majri OC based on Satellite Data (IRSR2-L4FX) of the year 2022	Prepared	Tilak Mondal	Chief Manager		
	Checked	Bk Chowdhary	Chief Manager		
	Approved	Rajneesh Kr.	GM(Geomatics)		
cmpdi A Miniratna Company	Scale 0.25 0.125 0 0.25 Km			Sheet	
	Drg No. HQ REM 1 A4 22 08			Rev No.	


79°13'30"E
79°14'15"E
79°15'0"E
79°15'45"E
79°16'30"E
20°54'0"N
20°53'15"N
20°52'30"N
20°51'45"N
N
W
E
S
MKD-III OCP
Stock Yard
PLATE - 9
AREA STATISTICS
Classes
Level-I | Level-II | Colour | Area (Sq.Km.) | %
SCRUB | Scrubs | 0.56 | 6.07
Total Scrub | 0.56 | 6.07
PLANTATION | Social Forestry | 0.07 | 0.76
Total Plantation | 0.07 | 0.76
Total Vegetation | 0.63 | 6.83
MINING AREA | Coal Quarry | 1.01 | 10.94
Barren OB Dump | 2.58 | 27.95
Backfill | 0.37 | 4.01
Total Area Under Mining | 3.96 | 42.90
AGRICULTURE | Fallow Lands | 2.85 | 30.88
Crop Lands | 0.85 | 9.21
Total Agriculture | 3.70 | 40.09
SETTLEMENTS | Industrial | 0.21 | 2.28
WASTELANDS | Waste Lands | 0.70 | 7.58
WATERBODY | Reservoir, Nala, Pond | 0.03 | 0.33
Total | 9.23 | 100.00
Legend
Canal
Leasehold Boundary
Customer
WESTERN COALFIELDS LIMITED
Title
Land Reclamation Monitoring of OC Projects
Job No. 564922120
Subject
Land Reclamation Status of MKD-III OC based on Satellite Data (IRSR2-L4FX) of the year 2022
Activity | Name | Designation | Signature | Date
Prepared | Tilak Mondal | Chief Manager
Checked | BK.Chowdhary | Chief Manager
Approved | Rajneesh Kr. | GM(Geomatics)
cmpdi
A Mini Ratna Company
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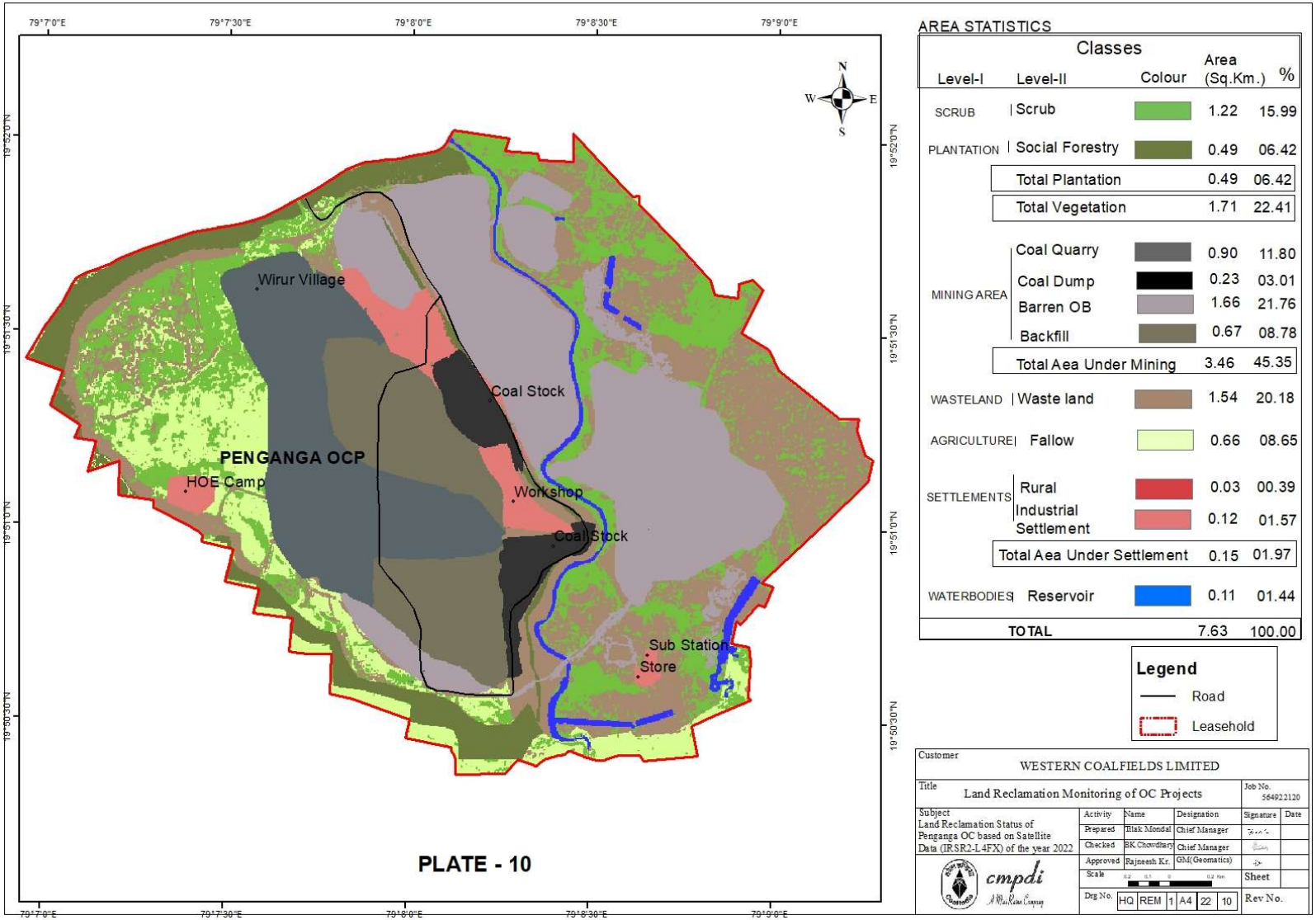
Drg No. HQ REM 1 A4 22 09
Rev No.



AREA STATISTICS

Classes			Area (Sq.Km.)	%
Level-I	Level-II	Colour		
SCRUB	Scrub		1.22	15.99
PLANTATION	Social Forestry		0.49	06.42
	Total Plantation		0.49	06.42
	Total Vegetation		1.71	22.41
MINING AREA	Coal Quarry		0.90	11.80
	Coal Dump		0.23	03.01
	Barren OB		1.66	21.76
	Backfill		0.67	08.78
	Total Aea Under Mining		3.46	45.35
WASTELAND	Waste land		1.54	20.18
AGRICULTURE	Fallow		0.66	08.65
SETTLEMENTS	Rural		0.03	00.39
	Industrial Settlement		0.12	01.57
	Total Aea Under Settlement		0.15	01.97
WATERBODIES	Reservoir		0.11	01.44
TOTAL			7.63	100.00

Legend
Road
Leasehold

Customer: WESTERN COALFIELDS LIMITED

Title: Land Reclamation Monitoring of OC Projects

Job No. 564922120

Subject: Land Reclamation Status of Penganga OC based on Satellite Data (IRSR2-L4FX) of the year 2022

Activity	Name	Designation	Signature	Date
Prepared	Tilak Mondal	Chief Manager		
Checked	BK Chowdhary	Chief Manager		
Approved	Rajneesh Kr.	GM(Geomatics)		

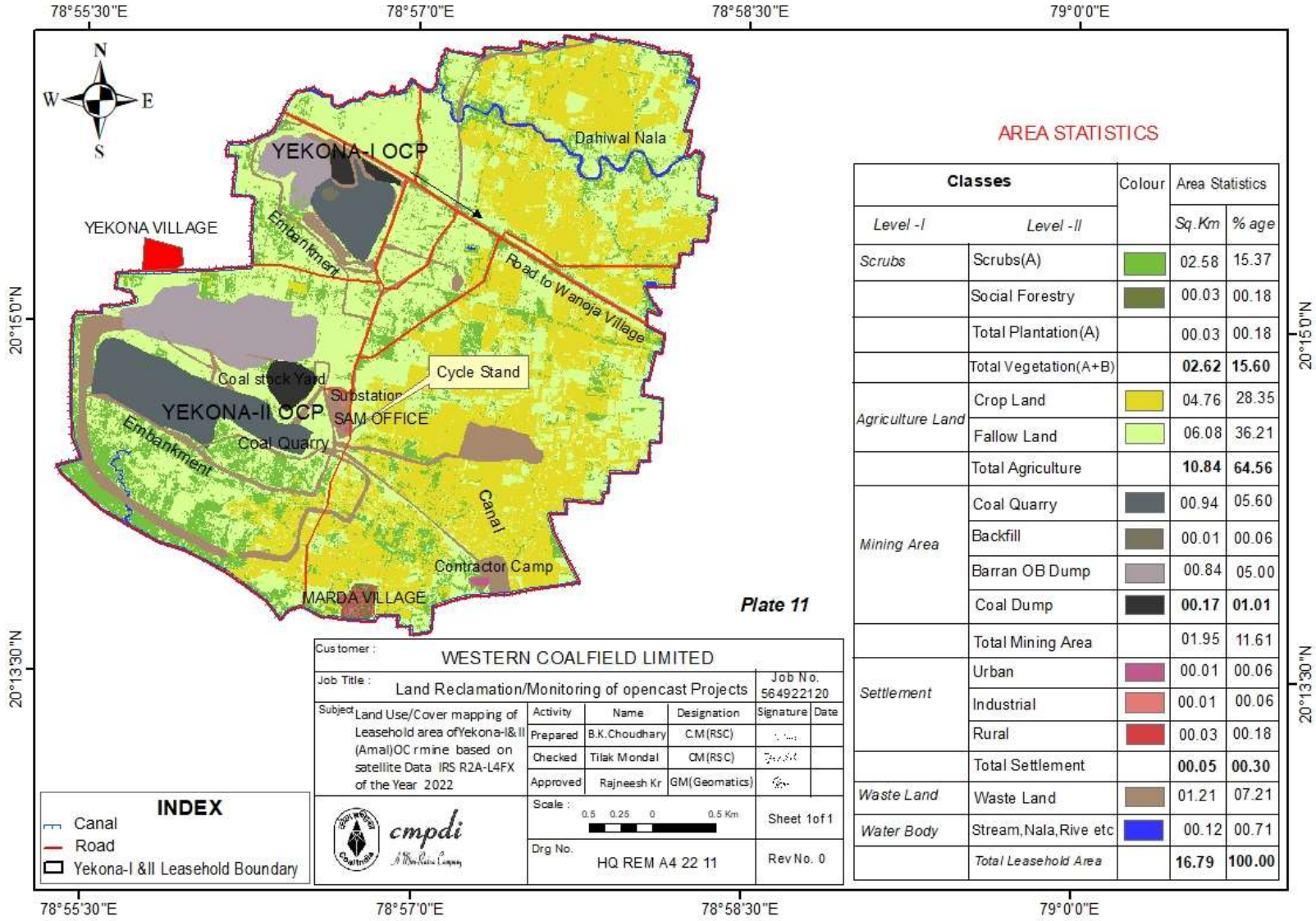
Scale

Sheet

Drg No. HQ REM 1 A4 22 10

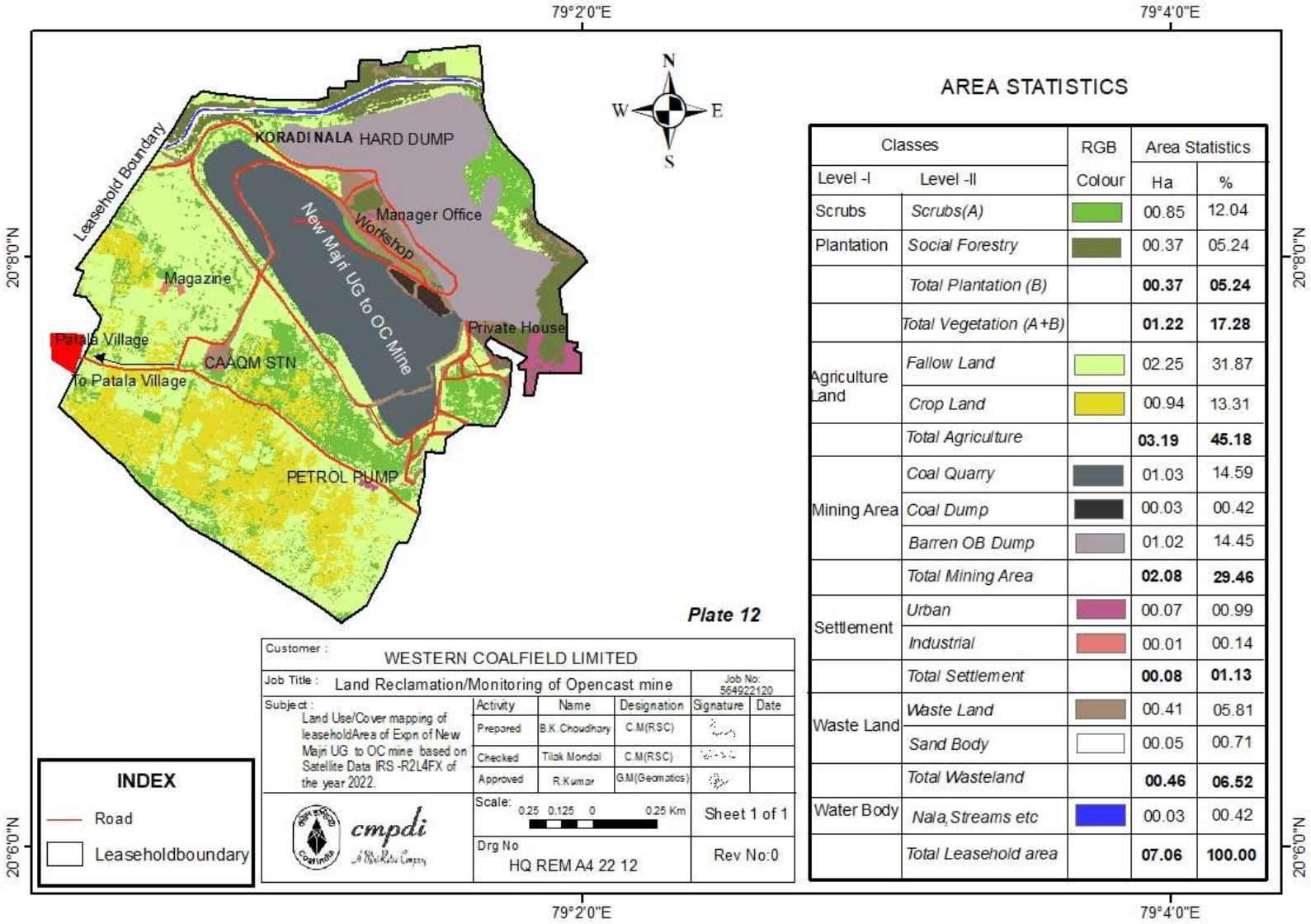
Rev No.

cmpdi



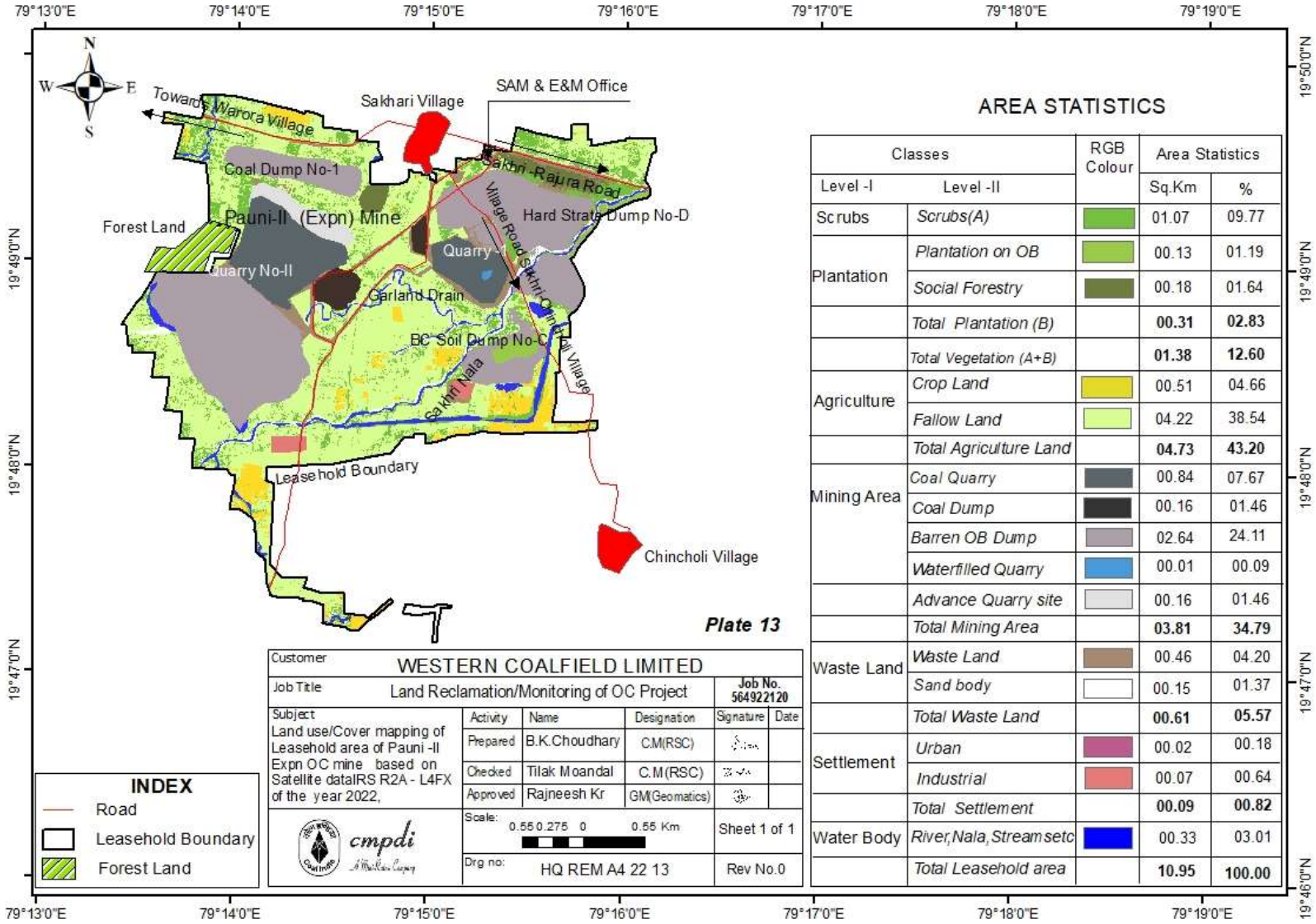
AREA STATISTICS

Classes		Colour	Area Statistics	
Level -I	*Level -II*		*Sq.Km*	*% age*
Scrubs	Scrubs(A)		02.58	15.37
	Social Forestry		00.03	00.18
	Total Plantation(A)		00.03	00.18
	Total Vegetation(A+B)		**02.62**	**15.60**
Agriculture Land	Crop Land		04.76	28.35
	Fallow Land		06.08	36.21
	Total Agriculture		**10.84**	**64.56**
Mining Area	Coal Quarry		00.94	05.60
	Backfill		00.01	00.06
	Barran OB Dump		00.84	05.00
	Coal Dump		**00.17**	**01.01**
	Total Mining Area		01.95	11.61
Settlement	Urban		00.01	00.06
	Industrial		00.01	00.06
	Rural		00.03	00.18
	Total Settlement		**00.05**	**00.30**
Waste Land	Waste Land		01.21	07.21
Water Body	Stream,Nala,Rive etc		00.12	00.71
	Total Leasehold Area		**16.79**	**100.00**



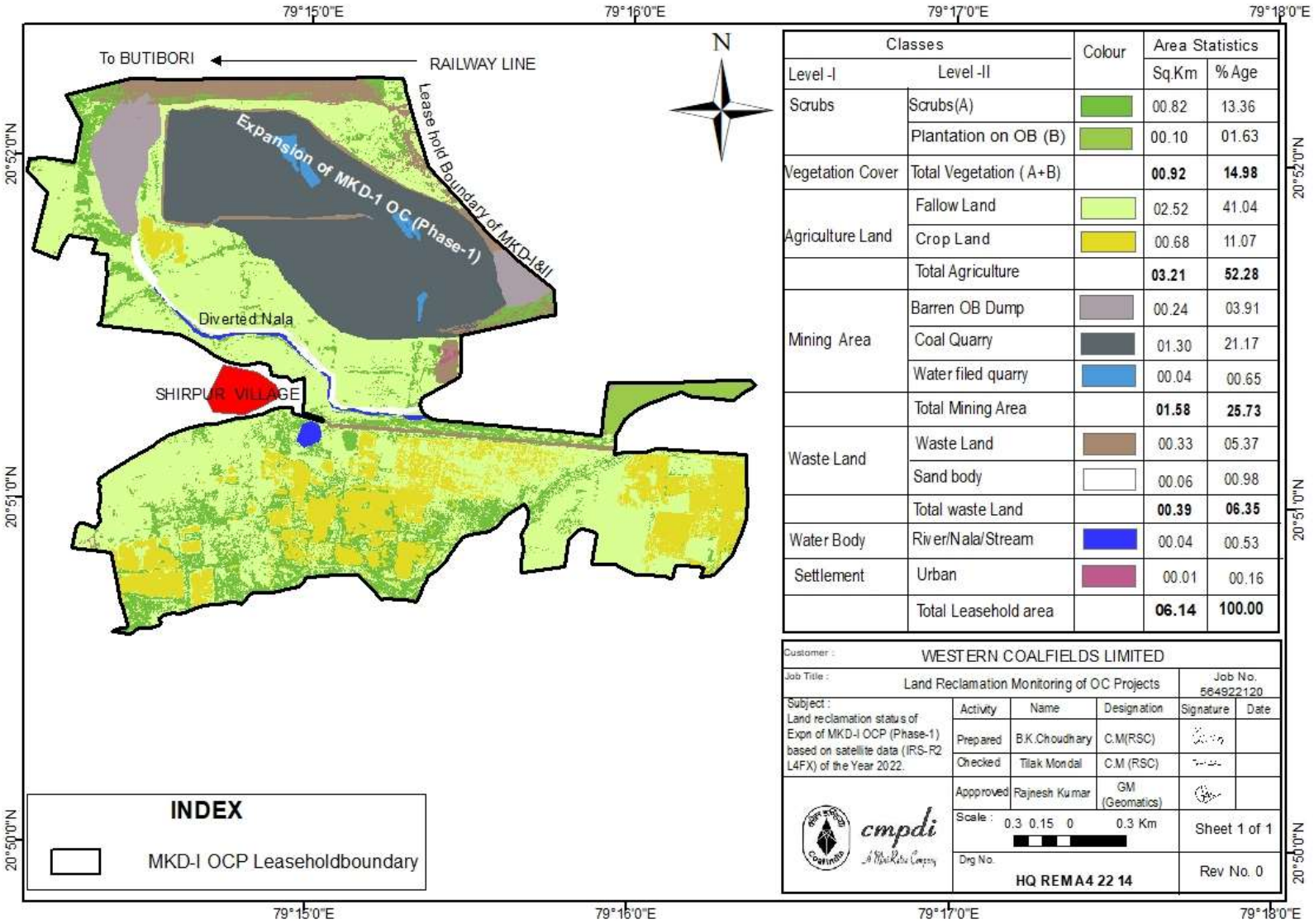
AREA STATISTICS

Classes		RGB	Area Statistics	
Level -I	Level -II	Colour	Ha	%
Scrubs	*Scrubs(A)*		00.85	12.04
Plantation	*Social Forestry*		00.37	05.24
	Total Plantation (B)		**00.37**	**05.24**
	Total Vegetation (A+B)		**01.22**	**17.28**
Agriculture Land	*Fallow Land*		02.25	31.87
	Crop Land		00.94	13.31
	Total Agriculture		**03.19**	**45.18**
Mining Area	*Coal Quarry*		01.03	14.59
	Coal Dump		00.03	00.42
	Barren OB Dump		01.02	14.45
	Total Mining Area		**02.08**	**29.46**
Settlement	*Urban*		00.07	00.99
	Industrial		00.01	00.14
	Total Settlement		**00.08**	**01.13**
Waste Land	*Waste Land*		00.41	05.81
	Sand Body		00.05	00.71
	Total Wasteland		**00.46**	**06.52**
Water Body	*Nala,Streams etc*		00.03	00.42
	Total Leasehold area		**07.06**	**100.00**



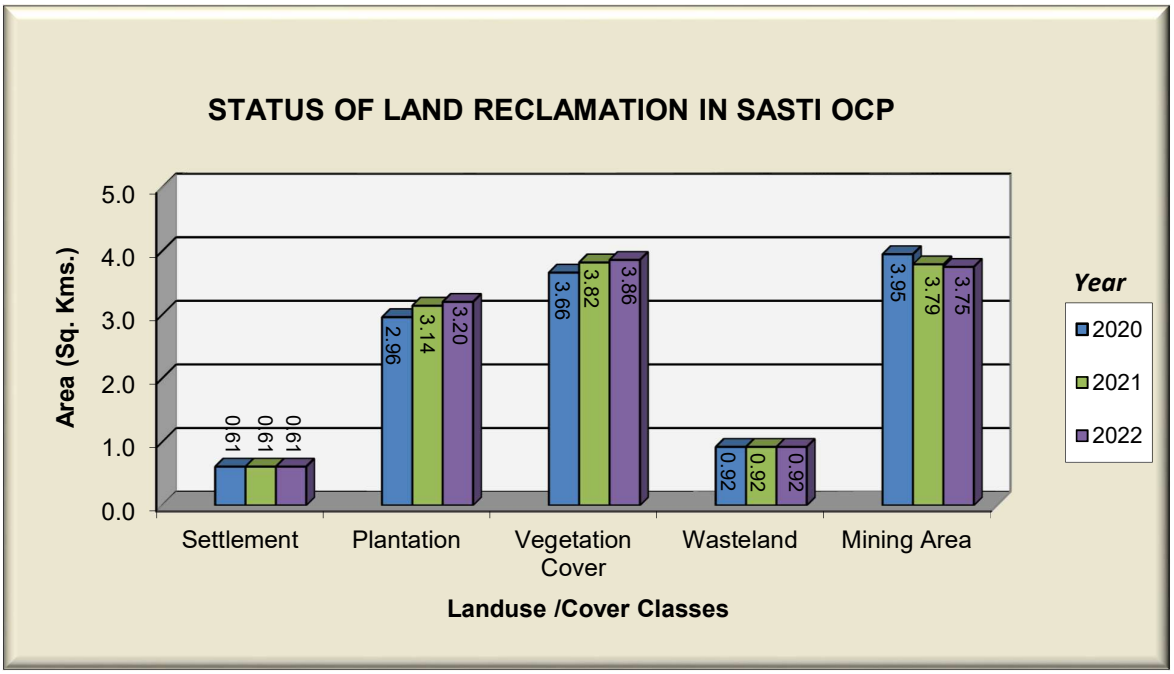
AREA STATISTICS

Classes		RGB Colour	Area Statistics	
Level -I	Level -II		Sq.Km	%
Scrubs	*Scrubs(A)*		01.07	09.77
Plantation	*Plantation on OB*		00.13	01.19
	Social Forestry		00.18	01.64
	Total Plantation (B)		**00.31**	**02.83**
	Total Vegetation (A+B)		**01.38**	**12.60**
Agriculture	*Crop Land*		00.51	04.66
	Fallow Land		04.22	38.54
	Total Agriculture Land		**04.73**	**43.20**
Mining Area	*Coal Quarry*		00.84	07.67
	Coal Dump		00.16	01.46
	Barren OB Dump		02.64	24.11
	Waterfilled Quarry		00.01	00.09
	Advance Quarry site		00.16	01.46
	Total Mining Area		**03.81**	**34.79**
Waste Land	*Waste Land*		00.46	04.20
	Sand body		00.15	01.37
	Total Waste Land		**00.61**	**05.57**
Settlement	*Urban*		00.02	00.18
	Industrial		00.07	00.64
	Total Settlement		**00.09**	**00.82**
Water Body	*River,Nala,Streamsetc*		00.33	03.01
	Total Leasehold area		**10.95**	**100.00**



Classes		Colour	Area Statistics	
Level -I	Level -II		Sq.Km	%Age
Scrubs	Scrubs(A)		00.82	13.36
	Plantation on OB (B)		00.10	01.63
Vegetation Cover	Total Vegetation (A+B)		**00.92**	**14.98**
Agriculture Land	Fallow Land		02.52	41.04
	Crop Land		00.68	11.07
	Total Agriculture		**03.21**	**52.28**
Mining Area	Barren OB Dump		00.24	03.91
	Coal Quarry		01.30	21.17
	Water filed quarry		00.04	00.65
	Total Mining Area		**01.58**	**25.73**
Waste Land	Waste Land		00.33	05.37
	Sand body		00.06	00.98
	Total waste Land		**00.39**	**06.35**
Water Body	River/Nala/Stream		00.04	00.53
Settlement	Urban		00.01	00.16
	Total Leasehold area		**06.14**	**100.00**

Customer :	WESTERN COALFIELDS LIMITED			
Job Title :	Land Reclamation Monitoring of OC Projects			Job No. 564922120
Subject : Land reclamation status of Expn of MKD-I OCP (Phase-1) based on satellite data (IRS-R2 L4FX) of the Year 2022.	Activity	Name	Designation	Signature / Date
	Prepared	B.K.Choudhary	C.M(RSC)	
	Checked	Tilak Mondal	C.M (RSC)	
	Appproved	Rajnesh Kumar	GM (Geomatics)	
cmpdi	Scale : 0.3 0.15 0 0.3 Km			Sheet 1 of 1
	Drg No. HQ REMA4 22 14			Rev No. 0



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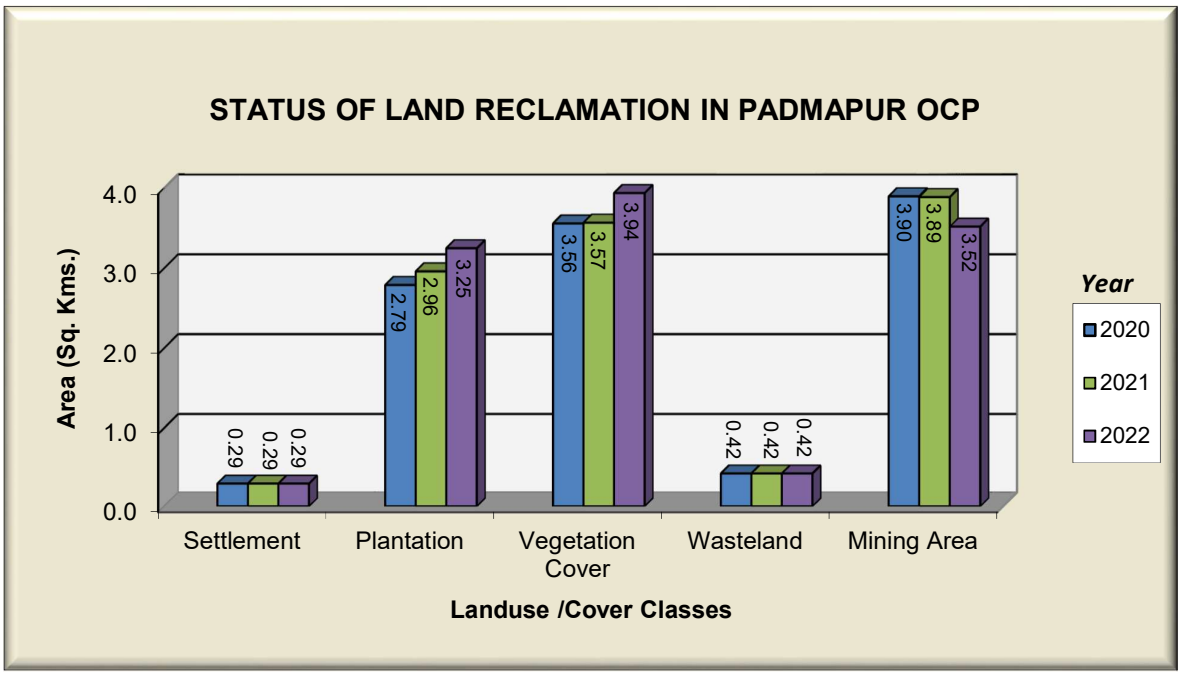

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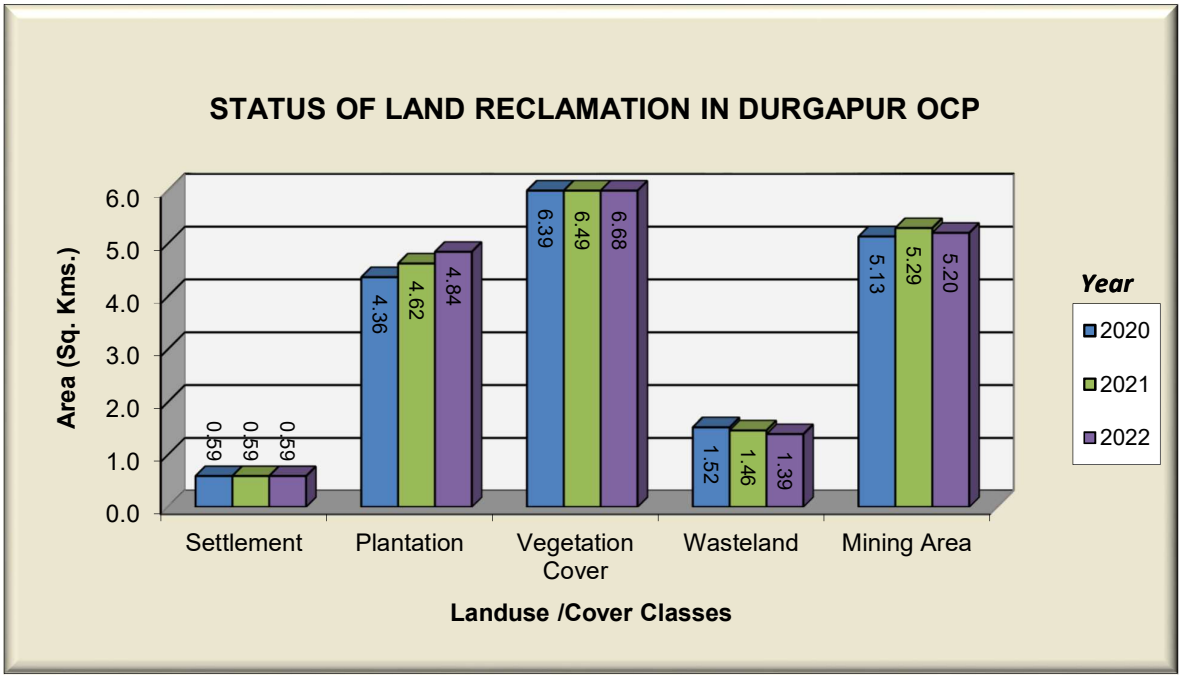

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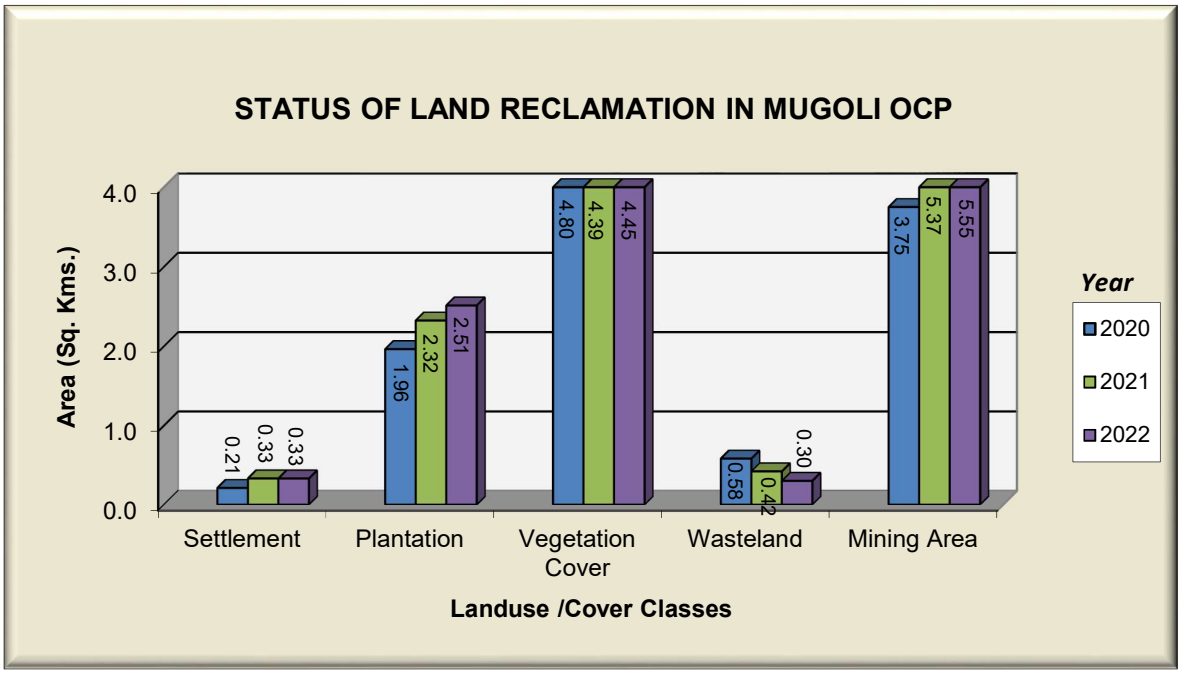

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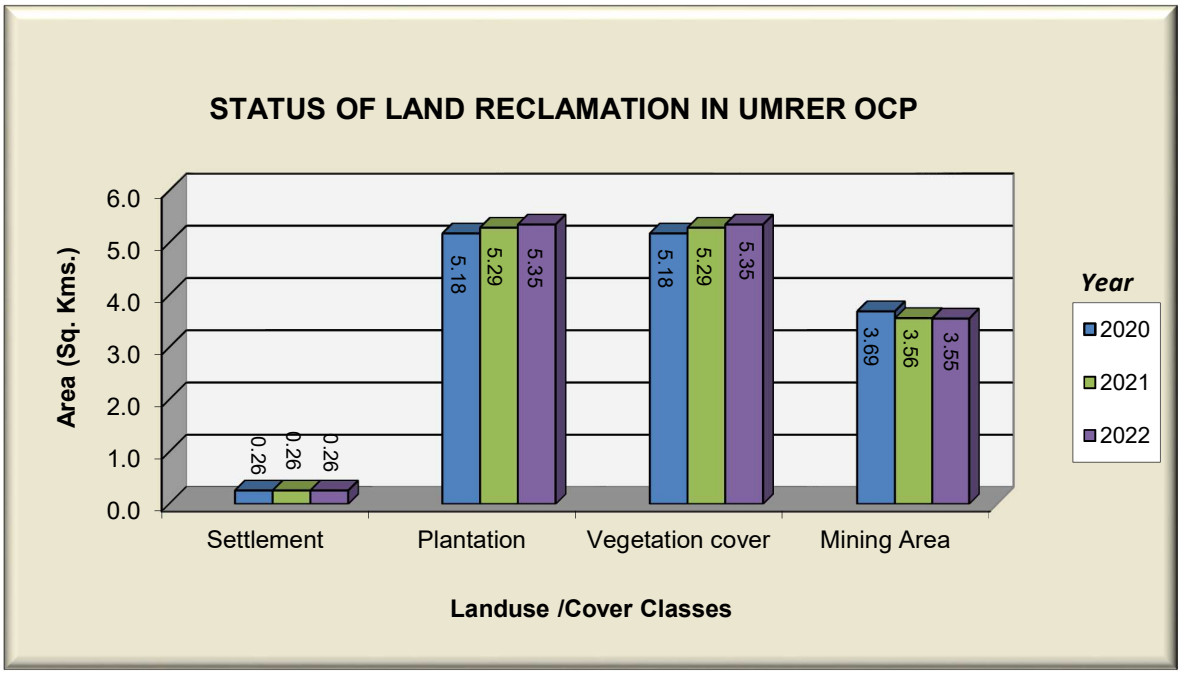

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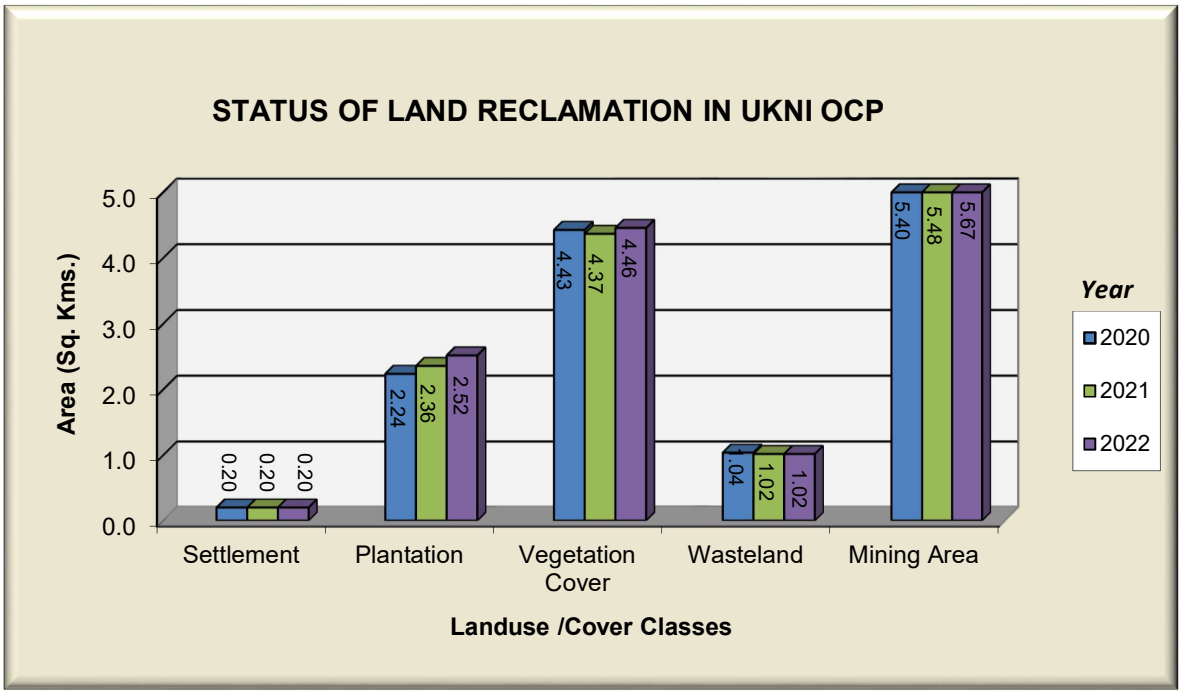

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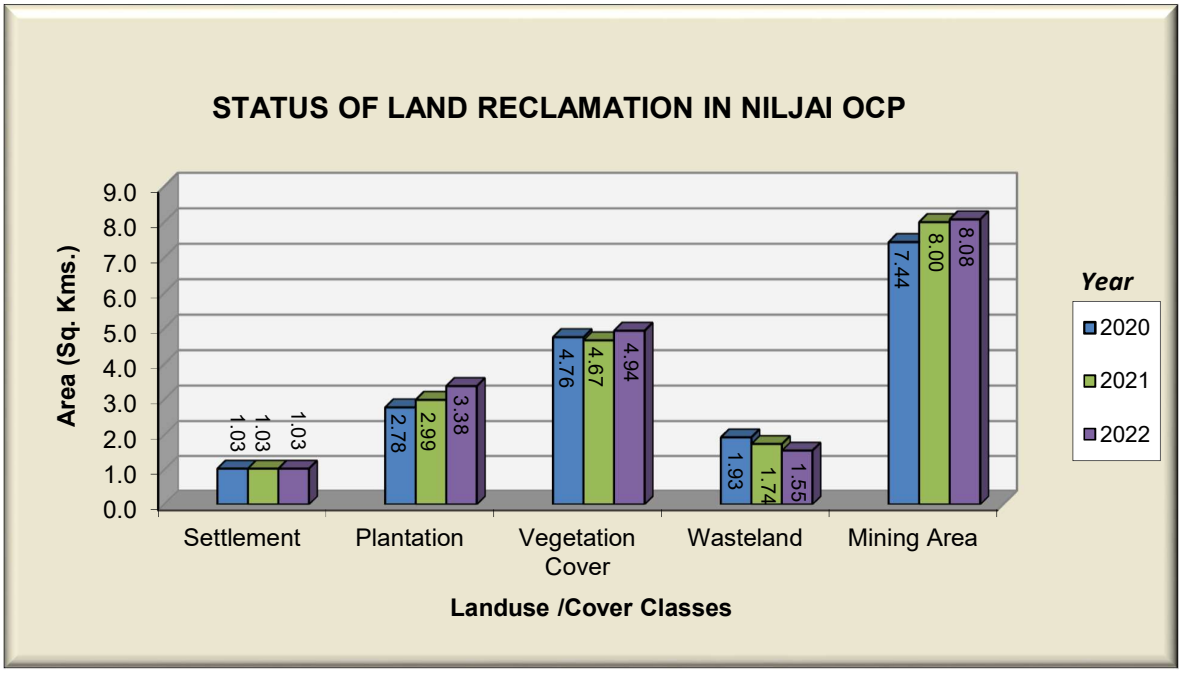

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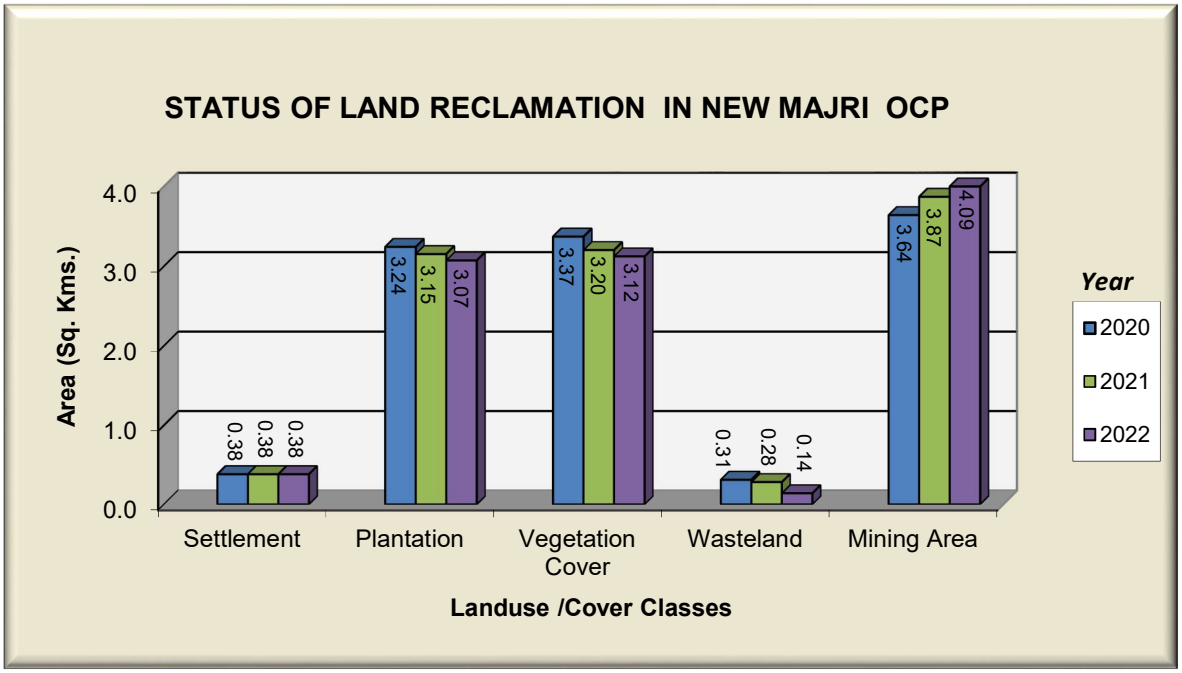

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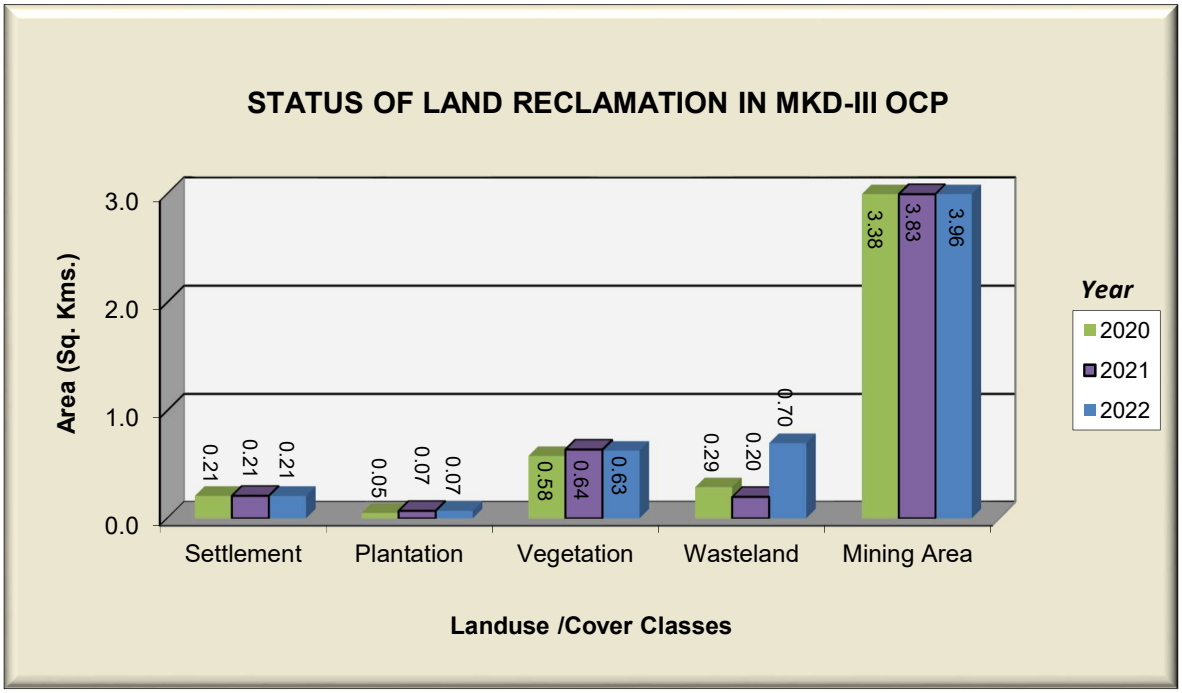

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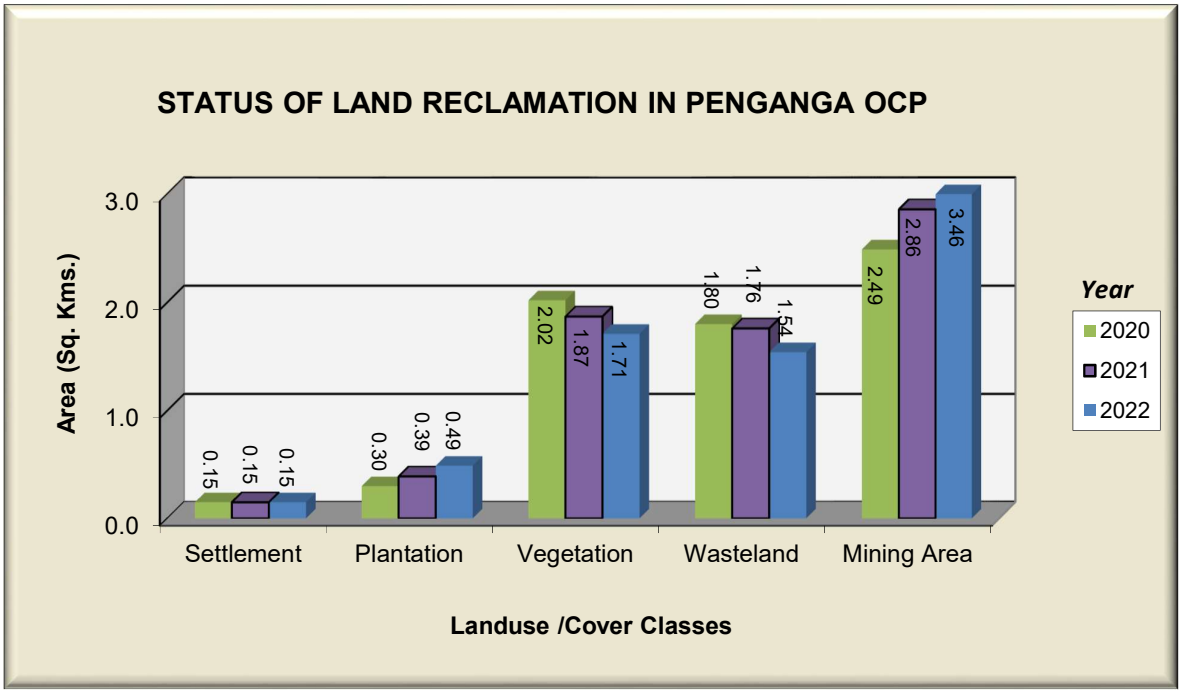

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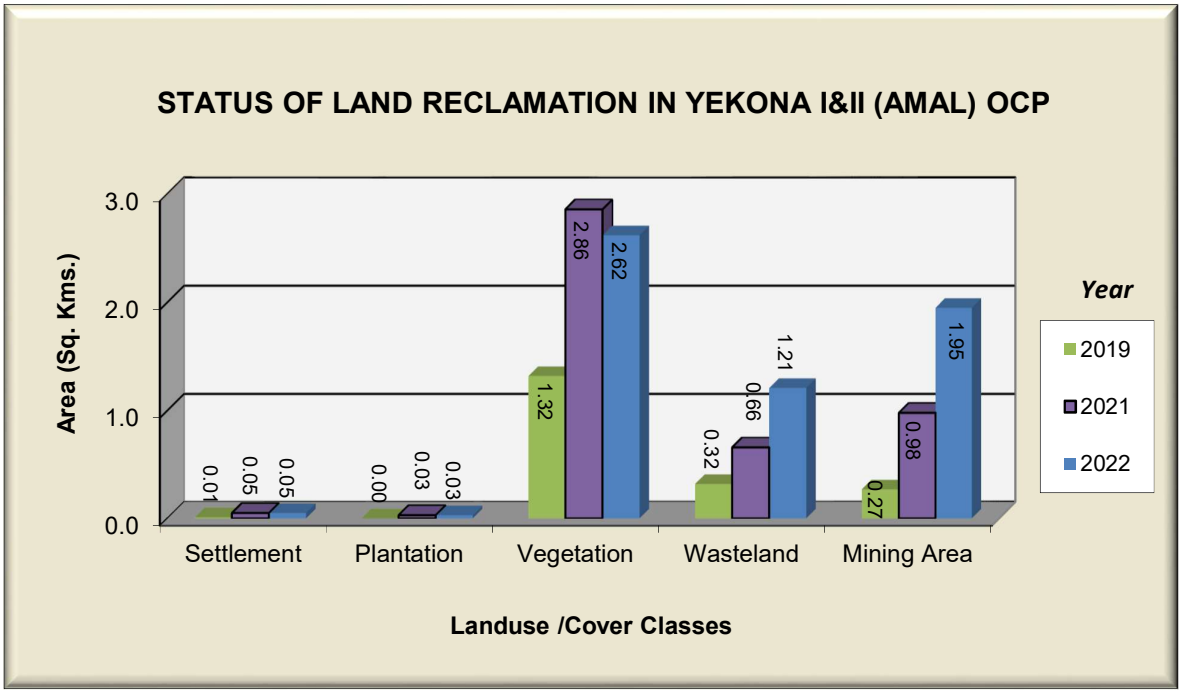

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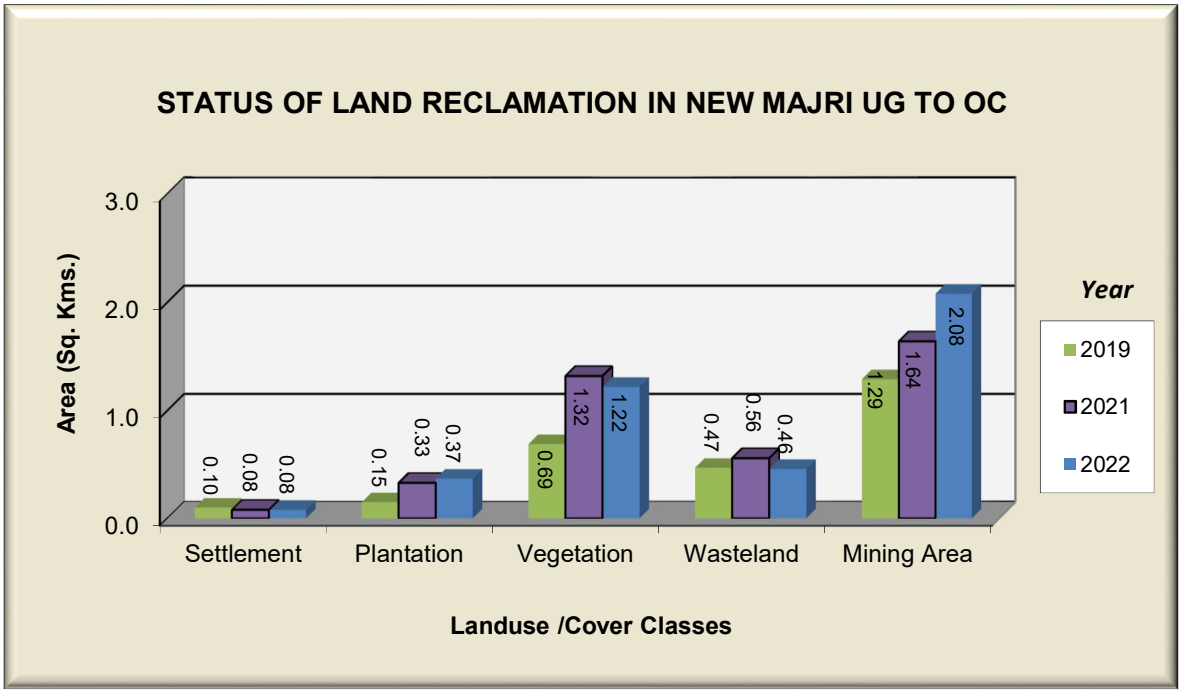

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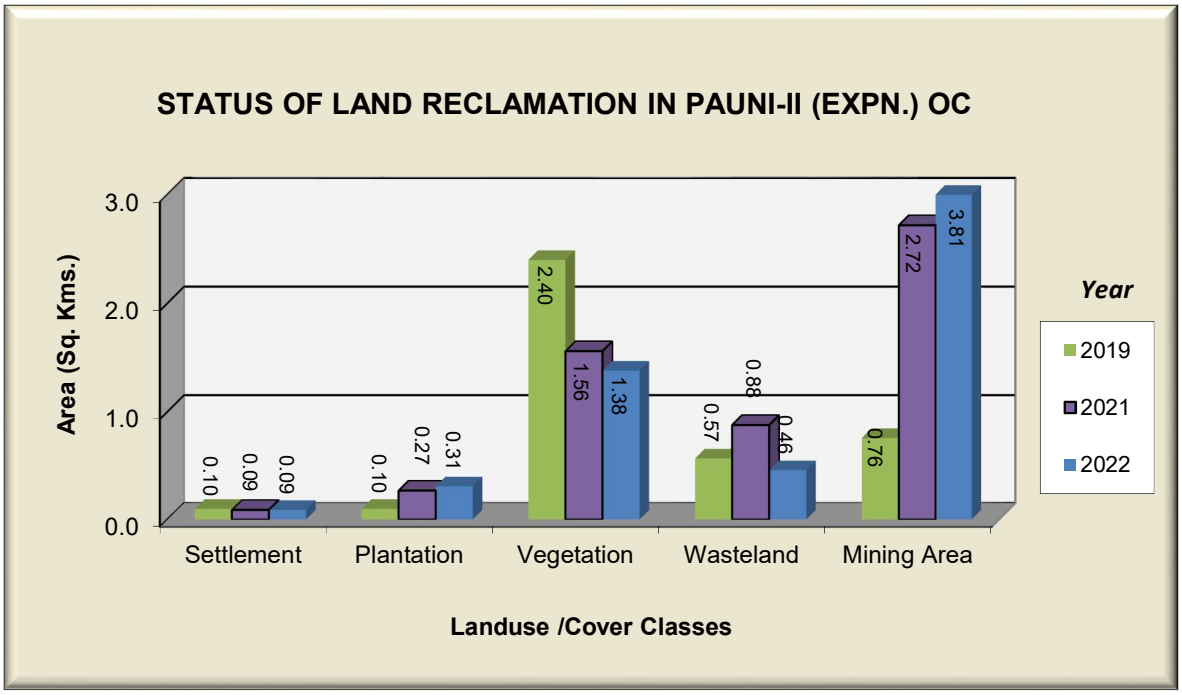

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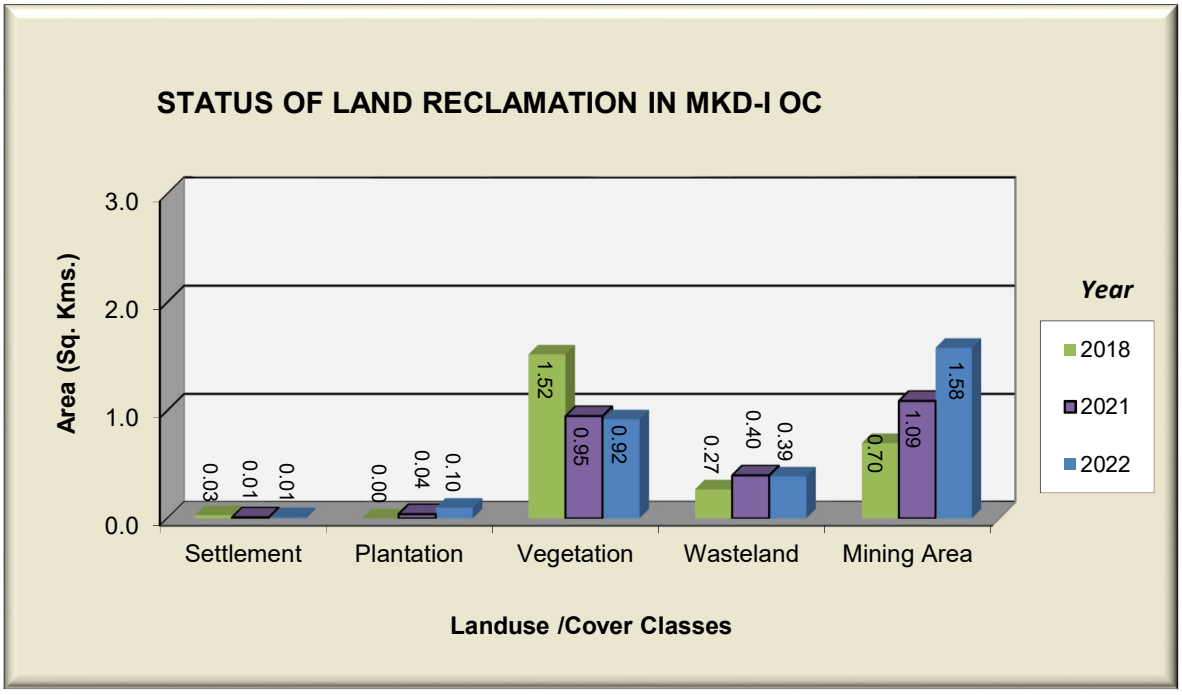

Figure 17

Photograph-1: Plantation on Internal OB/Backfill (Sasti OCP)

Photograph-2: Plantation on External OB dump (Padmapur OCP)

Photograph-3: Plantation on External OB dump of (Durgapur OCP)

Photograph-4: Plantation on Embankment (Mugoli OCP)

Photograph-5: Plantation on Internal OB dump (Umrer OCP)

Photograph-6: Plantation on External OB dump (Ukni OCP)

Photograph-7: Social Forestry (Niljai OCP)

Photograph-8: Plantation on OB Dump (New Majri OCP)

Photograph-9: Social Forestry (Penganga OCP)

Photograph-10: Avenue Plantation (MKD-III OCP)

Photograph-11: Social Forestry (Yekona-I&II (Amal.) OCP)

Photograph-12: Social Forestry (New Majri UG to OC)

Photograph-13: Social Forestry (Pauni-II (Expn.) OCP)

Photograph-14: Social Forestry (MKD-I OCP)

ABBREVIATIONS

SoI	Survey of India
MoEF & CC	Ministry of Environment, Forest & Climate Change
CIL	Coal India Limited
ECL	Eastern Coalfields Limited
BCCL	Bharat Coking Coal Limited
CCL	Central Coalfields Limited
WCL	Western Coalfields Limited
SECL	South Eastern Coalfields Limited
NCL	Northern Coalfields Limited
MCL	Mahanadi Coalfields Limited
NEC	North Eastern Coalfields
CMPDIL	Central Mine Planning & Design Institute Ltd
NRSC	National Remote Sensing Centre
R2/ R2A	ResourceSat Satellites
LISS - 4	Linear Imaging and Self Scanning Sensor
FCC	False Colour Composite
OCP	Opencast Project
UGP	Underground Project
OB	Over Burden
GCP	Ground Control points
GIS	Geographic Information System
WGS-84	World Geodetic System
UTM	Universal Transverse Mercator

GLOSSARY

Sl.	Term	Definition
1.	Land Reclamation	To manage, reclaim and restore mined out/ degraded land as close as possible to its original stage.
2.	Over Burden	The material that lies above the coal seam/ deposit
3.	Monitoring	A process of evaluation to check or keep record for a period of time.
4.	Opencast Coal Mine	Open-pit mining, also known as opencast mining, is a surface mining technique that extracts minerals from an open pit in the ground.
5.	Social Forestry	Social forestry is the management and protection of forests and afforestation of barren and deforested lands with the purpose of helping environmental, social and rural development. Plantation (Social/ Avenue or other) carried out outside mining area.
6.	Biological Reclamation	Plantation on Backfilled areas (Stablised Internal Dumps)
7.	Technical Reclamation	Area under backfilling (Over burden dumped inside the mine voids) in mining area.
8.	Green Cover Generated	Total Plantation carried out in the lease area of Project. This includes Plantation on Backfill, Plantation on OB and Social Forestry.
9.	Leasehold Area	The area, for which lease is granted for the purpose of undertaking mining and allied operations.
10.	Excavated area	Mined out area which includes active mining, area under backfilling and plantation on backfilled areas
11.	Active Mining	Mining areas which include Coal Quarry, Advance Quarry, Quarry Filled with Water etc.
12.	Environmental Protection	It is the practice of protecting the natural environment by individuals, organizations and governments. Its objectives are to conserve natural resources and the existing natural environment and, where possible, to mitigate damage and reverse trends.
13.	Remedial Measure	Any measure or action required or undertaken to investigate, monitor, clean up, remove, treat, prevent, contain or otherwise remediate the presence or release of any hazardous substance or activity.
14.	Systematic Error	Every measurement differing from the true measurement in the same direction, and even by the same amount in some cases.

15.	Geometric Distortion	It refers to the improper positioning of any image with respect to their true geographic position when viewed in a properly scaled common image display plane.
16.	Land Use/ Cover Class	Land cover is what covers the surface of the earth and land use describes how the land is used.
17.	Accuracy	The closeness of agreement between a measured quantity value and a true quantity value.
18.	Environmental Clearance	Environmental Clearance (EC) for any developmental projects like coal mining projects etc. has been made mandatory by the Ministry of Environment, Forests and Climate Change (MoEF & CC) through its Notification issued on 27.01.1994 under the provisions of Environment (Protection) Act, 1986.
19.	Rectification and Geo-referencing	Geo-referencing is the assigning of absolute location of a data point or data points. Geo-rectification refers to the removal of geometric distortions between sets of data points, most often the removal of terrain, platform, and sensor induced distortions from remote sensing imagery.
20.	Image Enhancement	It is the process of modifying digital images so that the results are more suitable for processing or further image analysis.
21.	Training set selection	It is a portion of a data set used to fit or train a model for prediction or classification of values that are known in the training set, but unknown in other (future) data.
22.	Image Classification	It refers to the task of extracting information classes from a multiband raster image. The resulting raster from image classification can be used to create thematic maps.
23.	Temporal Changes	The 'temporal change' means the change in any entity with a period of time.
24.	Ground Truthing	Collection of primary/ basic information from ground realities for satellite image interpretation and thematic mapping.
25.	Cluster	Group of opencast and/ or underground mines clubbed together for administrative purposes.
26.	Arc GIS	GIS Software used for Map preparation
27.	ERDAS IMAGINE	Satellite Image Data Classification Software

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
Website : www.cmpdi.co.in, Email : cmpdihq@cmpdi.co.in