AQUIFER SYSTEMS
of
CHHATTISGARH

Prepared Under Supervision of:
Dr. S.C. Dhiman
Chairman

CENTRAL GROUND WATER BOARD
NORTH CENTRAL CHHATTISGARH REGION
MINISTRY OF WATER RESOURCES
GOVERNMENT OF INDIA
2012

Contributors

Overall Guidance and Supervision:

Dr. S.C. Dhiman, Chairman, Central Ground Water Board

Prepared by:

Shri J.R. Verma, Scientist "B", Central Ground Water Board, NCCR, Raipur

Shri B.K. Sahoo, Scientist "C", Central Ground Water Board, RGI, Raipur

Principal Contributors:

Shri K.C. Naik, Regional Director, Central Ground Water Board, NCCR, Raipur

Shri Sunil Kumar, Regional Director (I/C), Central Ground Water Board, NHR, Dharamshala

Shri S.K. Sinha, Scientist "D", Central Ground Water Board, CHQ, Faridabad

Shri D. Chakraborty, Scientist "C", Central Ground Water Board, NCCR, Raipur

Shri S.K. Swaroop, Scientist "B", Central Ground Water Board, CHQ, Faridabad

ध्रुव विजय सिंह
DHRUV VIJAI SINGH

सचिव
भारत सरकार
जल संसाधन मंत्रालय
श्रम शक्ति भवन
रफी मार्ग, नई दिल्ली-110 001

SECRETARY
GOVERNMENT OF INDIA
MINISTRY OF WATER RESOURCES
SHRAM SHAKTI BHAWAN
RAFI MARG, NEW DELHI-110 001

सत्यमेव जयते

13TH September 2012

MESSAGE

Ground water utilization has increased significantly during the last two decades. The unplanned and indiscriminate use of this vital resource has resulted in declining water levels and water quality deterioration in certain areas. The apparent stress on ground water resources is more often a management issue, and this needs to be addressed in a holistic manner, for its long term sustainability, through an integrated approach. Aquifer mapping is an essential step towards the effective management of ground water resources.

The atlas entitled **"Aquifer Systems of Chhatisgarh"** is a step towards achieving the ultimate goal of aquifer wise management of ground water resources in Chhatisgarh State.

I congratulate Central Ground Water Board, Ministry of Water Resources for its efforts to bring out this document containing data and information pertaining to various aspects of ground water including aquifer disposition in the State. I am sure this atlas will be of immense use to planners, policy makers, researchers and users involved in ground water sector.

(Dhruv Vijai Singh)

डॉ. एस. सी. धीमान
Dr. S. C. Dhiman

सत्यमेव जयते

अध्यक्ष
भारत सरकार
केन्द्रीय भूमि जल बोर्ड
जल संसाधन मंत्रालय
भूजल भवन एन.एच. 4 फरीदाबाद

Chairman
Government of India
Central Ground Water Board
Ministry of Water Resources
Bhujal Bhawan, NH-IV, Faridabad

Foreword

Availability of fresh water has always been a prime consideration in fostering the socio economic growth of the people. Rapid urbanization coupled with industrialization has resulted in increased demand of ground water at an alarming rate. Dependence on ground water is increasing continuously in order to supplement the domestic, agricultural and industrial requirements. In the last two decades there is a paradigm from development to management of Ground Water. The management of ground water is to be focussed on aquifers, which act as the repository of ground water.

To meet these challenges, it has become imperative to formulate aquifer management plan to establish the priorities for ground water use with community involvement at various levels of implementation. Central Ground Water Board over the years has generated enormous data on various aspects of ground water and has been utilised to prepare aquifer maps depicting their extent and characteristics and are compiled in the form of Atlas on "Aquifer Systems of Chhattisgarh".

This will provide a framework for prioritizing the aquifer level management strategies and build inventory of the aquifers for better understanding of the groundwater resources. An attempt has been made to present various aquifer systems in the form of maps by integrating all thematic information to formulate the aquifer wise ground water management plans.

The sincere efforts of the dedicated team of officers of Central Ground Water Board, North Central Chhattisgarh Region, Raipur is highly appreciated. I am sure this atlas would be of immense use in formulating scientifically viable implementable strategies for efficient management of ground water resources ensuring sustainability.

(Dr. S.C. Dhiman)

Ph. 0129-2419075 Fax 0129-2412524 E-mail chmn-cgwb@nic.in

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INTRODUCTION

Ever increasing demand for ground water resources in hard rock regions of the State with limited renewal potential poses a serious threat to ensure sustainable development of ground water for its judicious use in various sectors. This precious resource needs to be managed judiciously to ensure adequate supplies of dependable quantity and quality. It is a natural resource with economic, strategic and environmental value, which is under stress both due to changing climatic and anthropogenic factors. Shortage of ground water in hard rock areas is well known due to its limited areal extent in secondary porosity generally developed due to weathering, fracturing, jointing, faulting, etc. within the hard rock formations which are sparsely distributed.

Chhattisgarh after carved out from the State of Madhya Pradesh on 1st November, 2000 has taken quantum leap in various developmental activities which fulfilled the long cherished aspirations of the local populace. The State richly endowed with natural resources is also true in respect of its water availability as almost 80% of the population is dependent on agriculture and allied activities for livelihood. It is pertinent to mention that water being a catalyst for development of the State is never understated as Chhattisgarh is known as rice bowl of India. The State experiences sub-tropical climate, characterized by extreme summer and moderate winter having average rainfall of about 1300 mm.

As per the 2009 assessment, jointly done by the Water Resources Department, Govt. of Chhattisgarh and Central Ground Water Board, Raipur, the annual replenishable ground water resource has been estimated as 12.22 billion cubic meter (bcm), out of which 11.58 bcm is considered to be available for development for various uses after keeping 0.64 bcm for natural discharge during non-monsoon period for maintaining flows in springs, rivers and streams. Out of 146 blocks, 38 blocks have stage of development within 30 to 50%, 25 blocks within 50 and 70%. Only 15 blocks have attained stages of development more than 70%. Rests 68 blocks have stage of development within 30%. The State as a whole has a stage of development of only 31.04%, 14 have been categorized as semi-critical from ground water development point of view. Out of these 14 blocks, 7 fall in Durg, 3 in Dhamtari and one each in Bilaspur, Kawardha, Raigarh and Rajnandgaon districts. Caution should be exercised while planning ground water development in these blocks. Rest 132 blocks has been categorized as safe from ground water development point of view.

It is not out of context to emphasize that Planning Commission has impressed upon for the need of National Ground Water Management Programme which encompasses aquifer mapping & delineation; recharge to ground water & well use efficiencies associated to aquifers; demand management of aquifers through participatory approach; legislation of ground water; etc. for ensuring improved governance of ground water. In view of this a comprehensive mapping of aquifers of Chhattisgarh State has been felt essential and in this regard a baseline collation of existing data has been attempted for the preparation of

Aquifer Atlas of Chhattisgarh on 1:2,50,000 scale. The Aquifer maps would ultimately help to develop an Aquifer Information and Management System (AIMS) for sustainable management of ground water resources in the State. In the State of Chhattisgarh, twelve (12) principal aquifers have been identified and reflected in the map which have subsequently further down-scaled and mapped to twenty three (23) major aquifers and the standard national coding of aquifers have been adopted.

In order to initiate the preparation of the aquifer atlas of Chhattisgarh, the geological map of 1:2,50,000 scale (GSI) was used as base map for identification of lithounits which in turn helped in delineating the principal aquifer systems in the State. Subsequently, these principal aquifers were further sub-divided into major aquifers based on the surface and sub-surface data generated by the CGWB through its ground water exploration programme. The base map of major aquifers in turn was utilized for generating various thematic maps by superimposing the diverse aspects that are essential for preparation of aquifer management plan. Thereafter, several maps were generated viz. basin, drainage, soil, geomorphology, land use, exploratory wells, ground water monitoring observation wells, depth to water level (pre & post monsoon), water level trend, area suitable for recharge & augmentation, area suitable for ground water development, ground water development scenario, ground water quality. Collation of all these generated maps were utilized for arriving at the aquifer management plan of the State and the same has been depicted as management plan map.

In order to support all the maps prepared in the Aquifer Atlas of Chhattisgarh, necessary tables indicating the data were prepared and is part of this atlas for better understating of the aquifers in different districts of Chhattisgarh. Major aquifers in Chhattisgarh with principal aquifer code and major aquifer code along with area covered has been synthesize in the table for preparation of aquifer atlas and unified codification. Locations of areas affected by salinity, fluoride, nitrate and arsenic in different district of Chhattisgarh and aquifer wise ground water management plan for the principal aquifers have also been tabulated.

Table 1: Administrative Divisions of Chhattisgarh

Sl No	District name	Area (sq km)	Number of Tehsils	Number of Development Blocks	Number of towns
1	**Bastar**	10577.7	3	12	2
2	**Bijapur**	8809.6	1	4	
3	**Bilaspur**	8342.9	8	10	14
4	**Dantewara**	8390.3	3	7	4
5	**Dhamtari**	4068	3	4	2
6	**Durg**	8627.2	11	12	18
7	**Janjgir-Champa**	3877.6	8	9	8
8	**Jashpur**	5826.7	4	8	2
9	**Kanker**	6773.4	6	7	1
10	**Kawardha**	4228.3	2	4	2
11	**Korba**	6621.8	4	5	4
12	**Koriya**	6643.8	4	5	7
13	**Mahasamund**	4758.1	3	5	5
14	**Narayanpur**	4640.8	1	2	
15	**Raigarh**	7088.9	6	9	5
16	**Raipur**	12461.9	13	15	14
17	**Rajnandgaon**	8080.9	8	9	7
18	**Surguja**	15777.9	9	19	7
Total		**135595.8**	**97**	**146**	**102**

Source: censusindia.gov.in (Census-2011)

ADMINISTRATIVE DIVISIONS

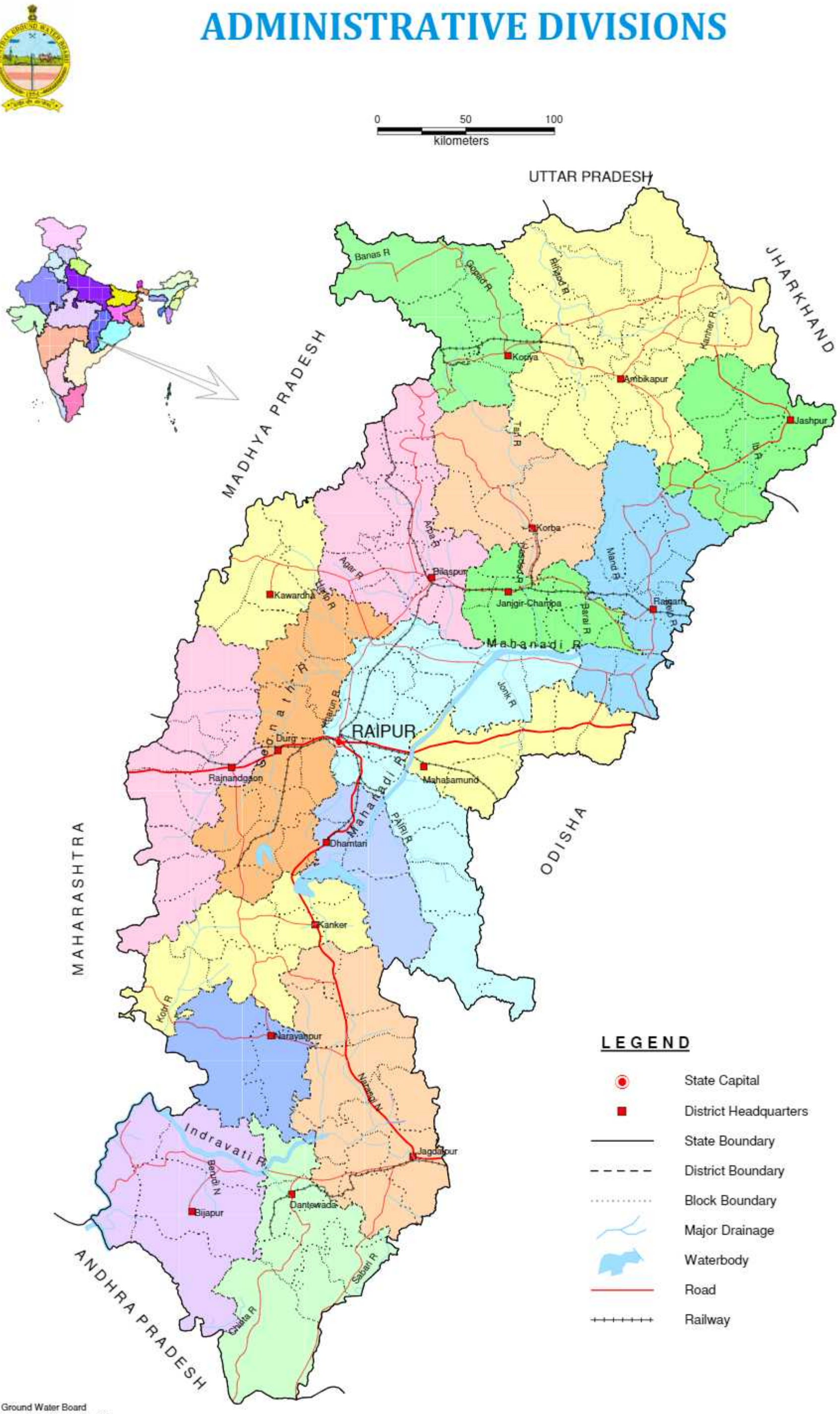

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Table 2a: River Basins of Chhattisgarh					
Sl No	Basin/Sub-basin	Place of origin of main river	Catchment area		Major tributaries
			Total	In Chhattisgarh	
1	**Brahmani**	Chhotanagpur Plateau (Jharkhand)	37020	1441.5	Sankh
2	**Godavari**	Nashik District (Maharashtra)	312812	38785.6	Sabri & Indravati
3	**Ganga**	Gangotri Uttar Kashi District (Uttaranchal)	1086000	18470.5	Rihand & Banas
4	**Mahanadi**	Sihawa Hills, Dhamtari District (C.G)	141589	76150	Seonath, Hasdeo, Tel, Mand & Kelo
5	**Narmada**	Amarkantak Hill Ranges, Shahdol (MP)	98796	748.3	Banjar
Total				**135595.9**	

Table 2b: Major River Basins				
Sl No	Basin/Sub-basin	Sub-basin	Number of watershed	Area
1	**Brahmani**	Brahmani	6	1441.5
2	**Godavari**	Indravati	30	28043.6
3		Kolab and others (Godavari)	18	9803.6
4		Wainganga	6	938.4
5	**Ganga**	Sone	32	18470.5
6	**Mahanadi**	Mahanadi Lower	11	2662.5
7		Mahanadi Middle	41	42943.6
8		Mahanadi Upper	25	30543.9
9	**Narmada**	Narmada Upper	8	748.4
Total			**177**	**135595.9**
Area in Sq km				

RIVER BASINS

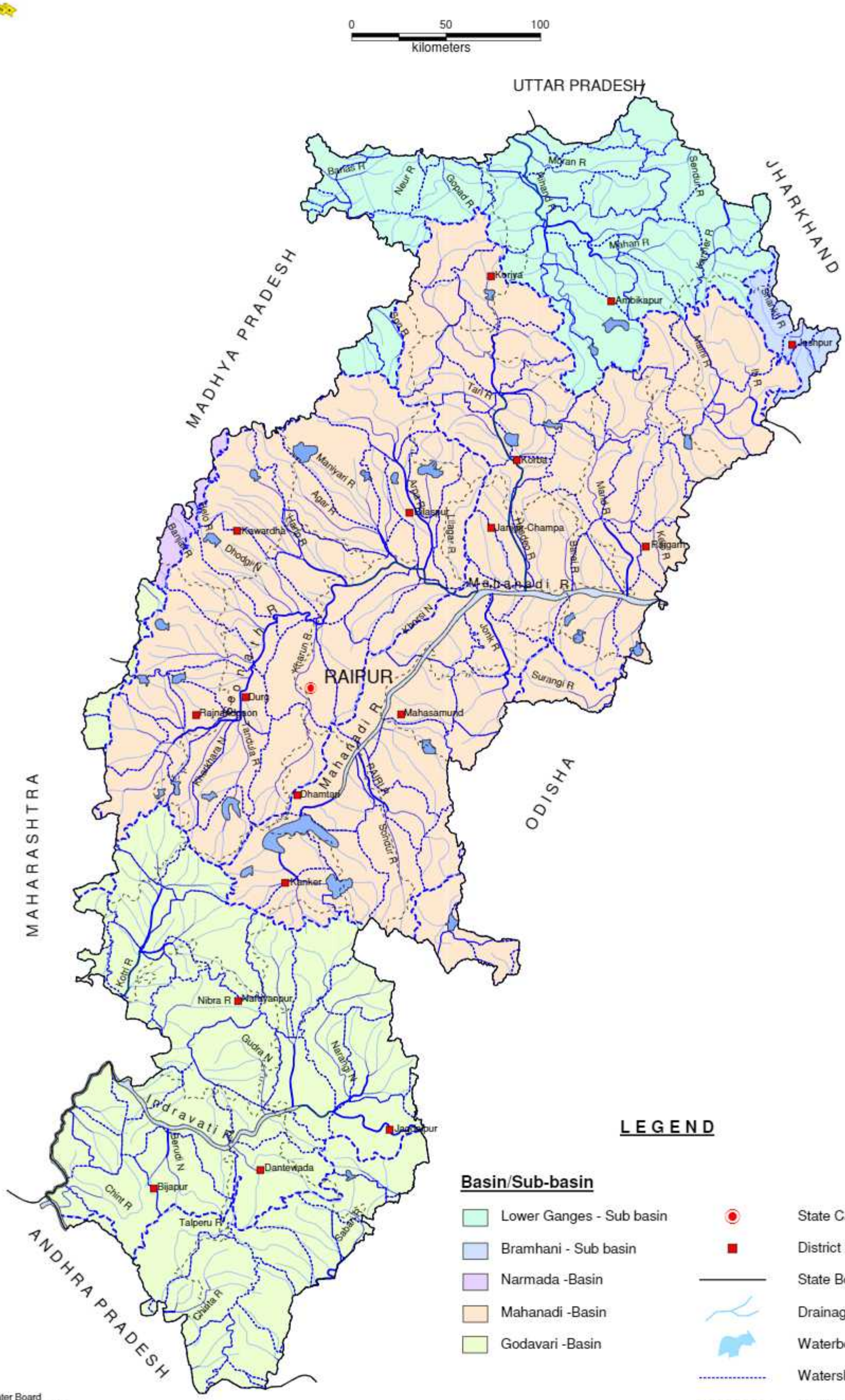

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Table 3: District wise Distribution of Principal Aquifer Systems

District Name	Alluvium		Laterite		Basalt		Sandstone		Shale		Limestone		Granite		Schist		Quartzite		Charnockite		BGC		Gneiss		Total area
	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	
Bastar			55.36	0.52	217.25	2.05	789.60	7.46	2896.85	27.39	421.70	3.99	22.31	0.21			15.60	0.15	61.14	0.05	5060.03	47.84	1041.34	9.81	10577.69
Bijapur			61.78	0.70	586.46	6.66			165.66	1.88	687.92	7.81	427.59	4.85	2.44	0.03			928.88	0.69			5948.84	67.53	8809.56
Bilaspur			26.60	0.32	62.68	0.75	409.10	4.90	1467.48	17.59	2345.00	28.11					35.79	0.43			3021.62	36.22	974.65	11.68	8342.91
Dantewada			94.38	1.12	281.27	3.35	92.39	1.10	520.84	6.21	27.78	0.33	33.76	0.40							270.68	3.23	7069.25	84.25	8390.35
Dhamtari			8.22	0.20			968.26	23.80	396.15	9.74	782.65	19.24							6.08	0.00	1906.68	46.87			4068.04
Durg			10.44	0.12	1.30	0.02	892.35	10.34	2899.83	33.61	3613.79	41.89	69.75	0.81	13.15	0.15					614.50	7.12	512.11	5.94	8627.21
Janjgir-Champa							180.66	4.66	2213.72	57.09	1126.43	29.05									75.27	1.94	281.56	7.26	3877.63
Jashpur			211.69	3.63	276.06	4.74	97.23	1.67													5241.71	89.96			5826.69
Kanker			159.58	2.36	533.57	7.88	71.28	1.05					901.70	13.31	42.26	0.62	7.71	0.11			4396.86	64.91	660.41	9.75	6773.37
Kawardha			213.73	5.05	451.73	10.68	9.72	0.23	324.67	7.68	1506.62	35.63	221.48	5.24	1028.64	24.33					454.26	10.74	17.42	0.41	4228.26
Korba							4115.70	62.15	81.47	1.23					23.48	0.35					2270.85	34.29	130.25	1.97	6621.75
Koriya					11.35	0.17	6460.17	97.24													29.95	0.45	142.37	2.14	6643.85
Mahasamund							1268.55	26.66			207.40	4.36	18.26	0.38							2924.84	61.47	339.08	7.13	4758.12
Narayanpur			140.85	3.04	2110.70	45.48	166.75	3.59	607.48	13.09											1473.84	31.76	141.20	3.04	4640.82
Raigarh			31.48	0.44	7.02	0.10	3807.07	53.70	1517.79	21.41	163.06	2.30									1562.51	22.04			7088.93
Raipur			1.02	0.01			1616.94	12.98	2436.13	19.55	4051.93	32.51	6.30	1.77					213.90	0.16	3629.99	29.13	505.67	4.06	12461.87
Rajnandgaon	40.41	0.01	351.43	4.35	630.87	7.81	171.19	2.12	499.45	6.18	1627.26	20.14	2751.43	34.05	472.16	5.84	509.97	6.31					1022.78	12.66	8080.89
Surguja			622.91	3.95	219.74	1.39	6859.87	43.48							8.47	0.05					6782.96	42.99	1283.98	8.14	15777.93
Total Area	**40.41**	**0.02**	**1989.47**	**1.47**	**5390.0**	**3.98**	**27976.8**	**20.63**	**16027.52**	**11.82**	**16561.55**	**12.21**	**4452.58**	**3.28**	**1590.6**	**1.17**	**569.07**	**0.42**	**1210.00**	**0.89**	**39716.55**	**29.29**	**20070.91**	**14.80**	**135595.90**

Area in Sq Km and % in respect to the total area of the District

PRINCIPAL AQUIFER SYSTEMS

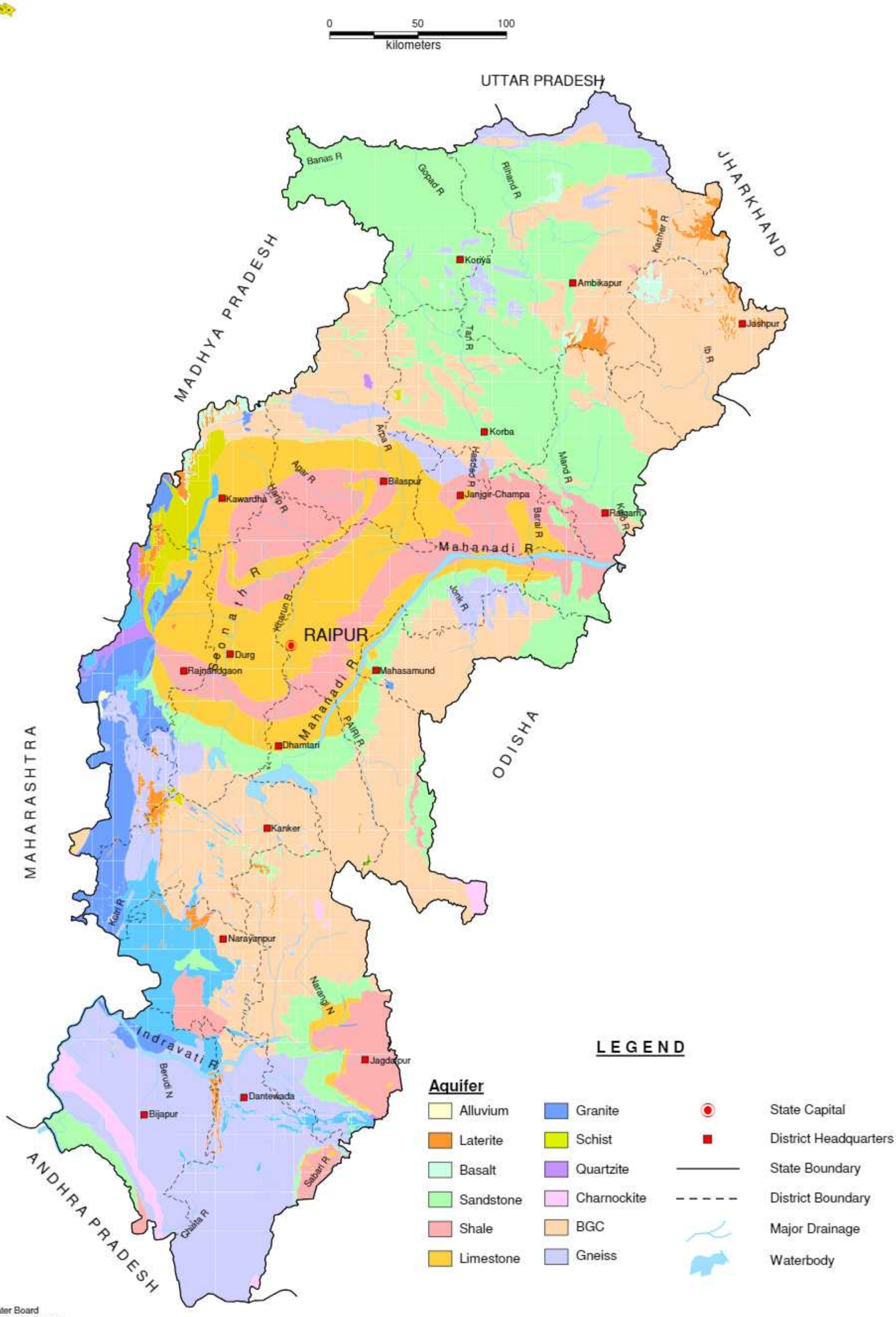

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Table 4: Aquifer Systems of Chhattisgarh						
Sl No	Principal Aquifer Code	Principal Aquifer Name	Major aquifer Code	Major Aquifer Name	Area Covered	%
1	AL	Alluvium	AL01	Fluvial Alluvium (Clay/Silt/Sand/ Calcareous concretions)	40.41	0.03
2	LT	Laterite	LT01	Laterite / Ferruginous concretions	1989.47	1.47
3	BS	Basalt	BS01	Basic Rocks (Basalt)	875.47	0.65
4			BS02	Ultra Basic	4514.5	3.33
5	ST	Sandstone	ST02	Sandstone with Shale	10727.37	7.91
6			ST03	Sandstone with Shale/ Coal beds	9137.84	6.74
7			ST05	Sandstone/Conglomerate	7257.58	5.35
8			ST06	Sandstone with Shale	854.03	0.63
9	SH	Shale	SH03	Shale, Limestone and Sandstone	860.69	0.63
10			SH05	Shale/Shale with Sandstone	5374.75	3.96
11			SH06	Shale with Limestone	9792.08	7.22
12	LS	Limestone	LS03	Limestone/Dolomite	13651.08	10.07
13			LS04	Limestone with Shale	2910.47	2.15
14	GR	Granite	GR02	Acidic Rocks (Pegmatite, Granite, Syenite, Rhyolite, etc.)	4453	3.28
15	SC	Schist	SC02	Phyllite	1551.04	1.14
16			SC03	Slate	39.55	0.03
17	QZ	Quartzite	QZ01	Quartzite	569.07	0.42
18	CK	Charnokite	CK01	Charnockite	1198	0.88
19	KH	Khondalite	KH01	Khondalite	12	0.01
20	BG	Banded Gneissic Complex (BGC)	BG01	Banded Gneissic Complex (BGC)	39716.6	29.29
21	GN	Gneiss	GN01	Undifferentiated metasedimentaries/ Undifferentiated metamorphic	6570.55	4.85
22			GN02	Gneiss	13500.35	9.96
Area in Sq km						

MAJOR AQUIFERS

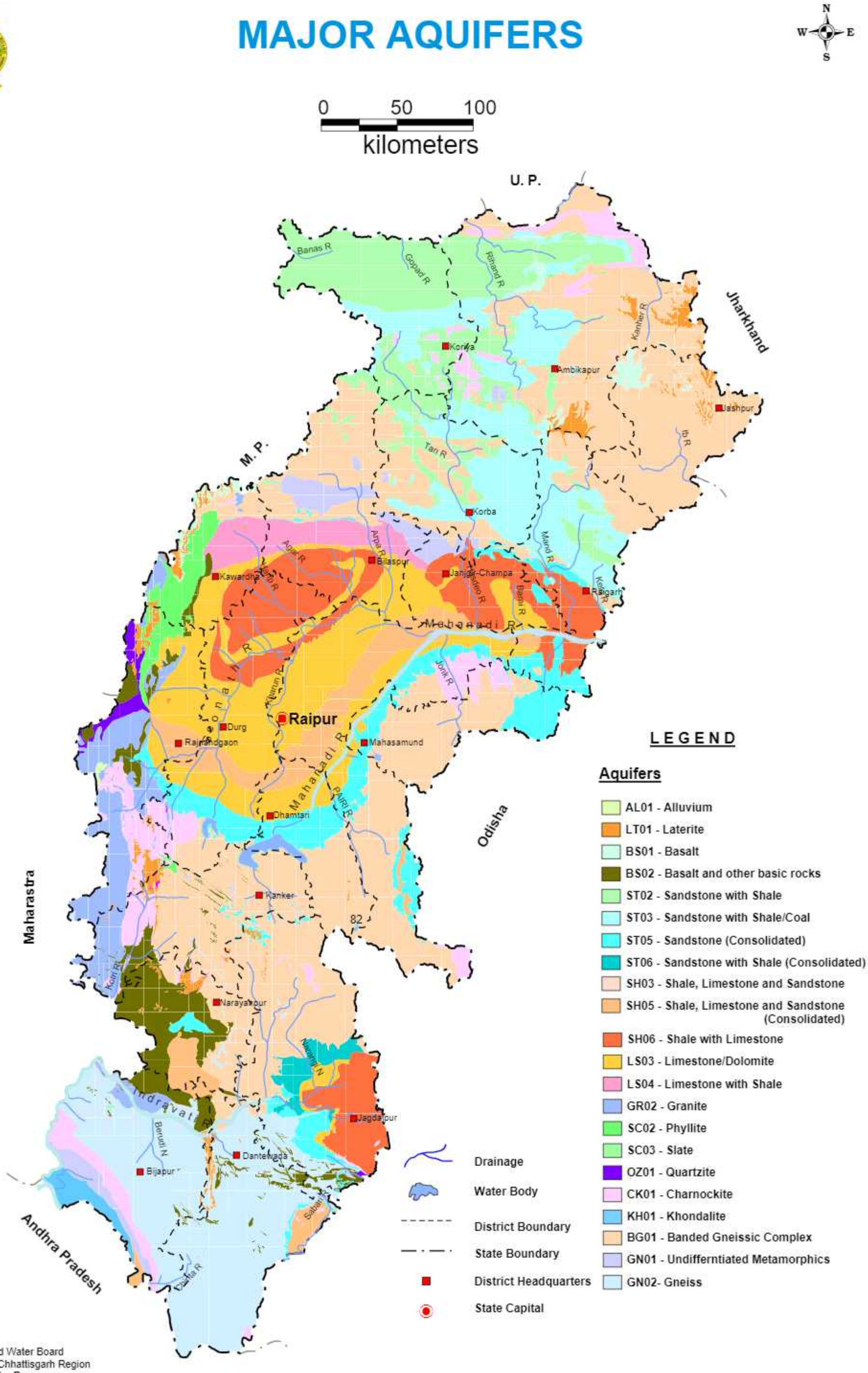

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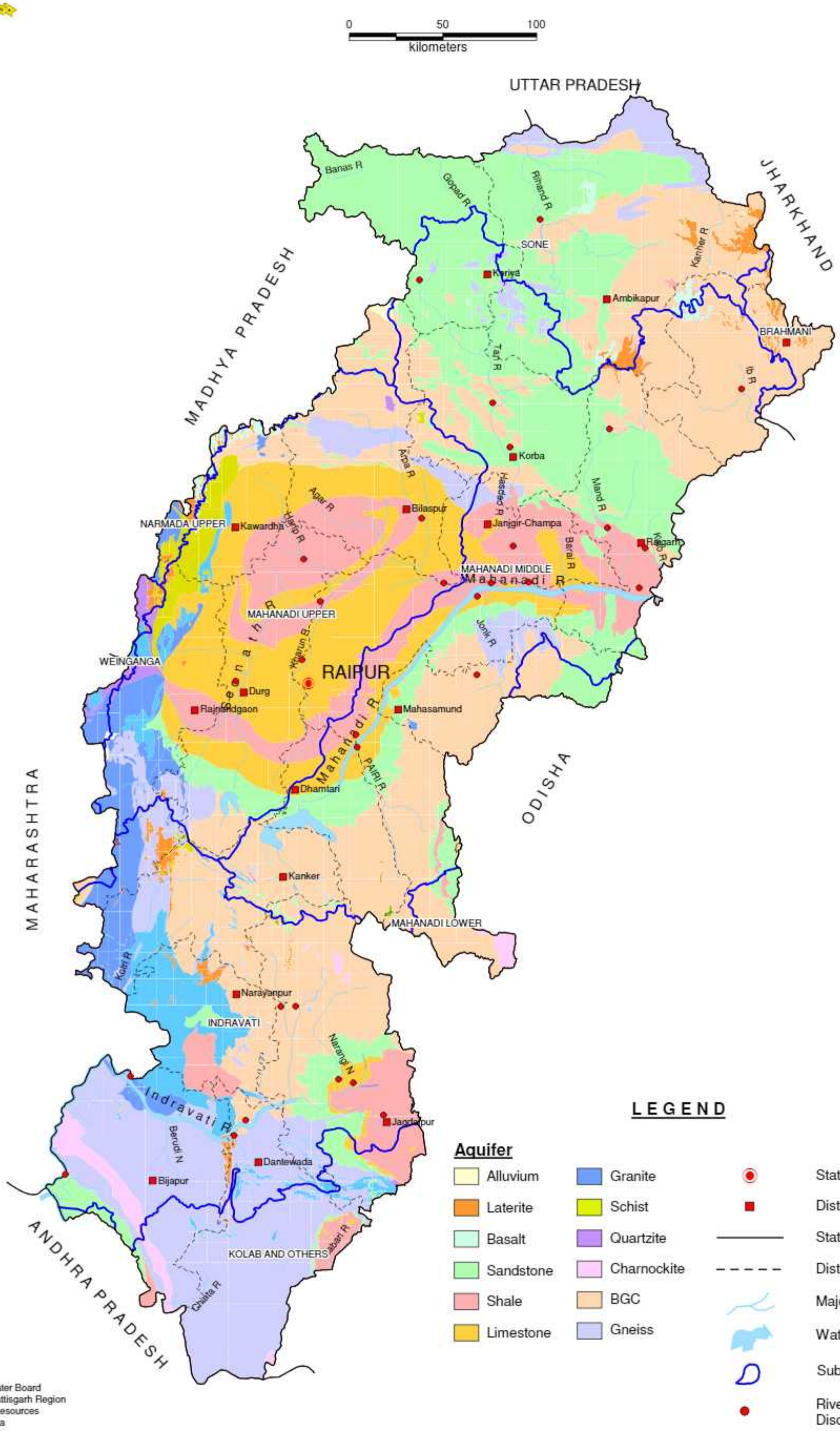
Table 5: Aquifer distribution - River Basin wise

Name of Basin/ Sub-basin	Total Area	Alluvium	Laterite	Basalt	Sandstone	Shale	Limestone	Granite	Schist	Quartzite	Charnokite	BGC	Gneiss
Brahmani	1441.5		183.5	8.7	8.9				1.2			1239.2	
Indravati	28043.6		635.1	3382.4	532.5	3089.1	822.4	2106.9	62.0		745.8	8680.8	7986.5
Kolab and others (Godavari)	9803.6		31.3	287.2	453.9	1101.8	315.1			15.6	244.2		7354.2
Wainganga	938.4	12.7	97.9	117.4				404.0	30.4	276.0			
Mahanadi Lower	2662.5				775.7	44.3		214.2				1582.4	45.9
Mahanadi Middle	42943.6		165.2	187.9	14996.4	5169.3	3007.8	30.3		7.7		17958.7	1431.9
Mahanadi Upper	30543.9	27.7	151.5	873.7	1374.6	6623.1	12416.3	1492.4	1283.9	269.8	220.0	3597.1	2213.5
Narmada Upper	748.4		186.1	138.8	0.2			205.2	205.9			0.5	
Sone	18470.5		538.8	393.9	9834.7				7.3			6658.1	1038.9
Total	**135595.9**	**40.4**	**1989.5**	**5390**	**27976.8**	**16027.5**	**16561.6**	**4453**	**1590.6**	**569.1**	**1210**	**39716.7**	**20070.9**

Area in Sq Km

AQUIFERS - RIVER BASINWISE



LEGEND

Aquifer

- Alluvium
- Laterite
- Basalt
- Sandstone
- Shale
- Limestone
- Granite
- Schist
- Quartzite
- Charnockite
- BGC
- Gneiss

- State Capital
- District Headquarters
- State Boundary
- District Boundary
- Major Drainage
- Waterbody
- Sub - Basin Boundary
- River Gauging and Discharge Sites

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Table 6: Aquifer wise area of Parliamentary Constituencies

Parliamentary Constituency	Area	Alluvium	Laterite	Basalt	Sandstone	Shale	Limestone	Granite	Schist	Quartzite	Charnokite	BGC	Gneiss
Bastar	25812.8		156.2	1254.9	773.4	3702.6	1088.5	1247	2.4	12.8	61.1	3554.4	13959.6
Bilaspur	8850.2		31.9	127.5	415.0	1356.6	1985.7	38.6		35.8	928.9	3203.3	726.9
Durg	5365.2				40.7	2632.1	2692.4						
Janjgir	10064.0				4166.0	1264.4	1420.5		23.5			2513.4	676.1
Kanker	18048.8		341.5	2403.5	1670.0	643.1	797.8	929.734	45.7	7.7		10024.9	1184.9
Mahasamund	10972.6		1.0		2688.7	541.5	1360.1	222.405				6054.2	104.7
Raigarh	11009.8		224.4	284.4	3223.0	543.6						6734.33	
Raipur	4892.9				298.4	1382.2	2992.4				220		
Rajnandgaon	10467.4	40.3	544.9	910.4	169.5	801.3	2605.3	2015	1507.2	463.2		343	1067.38
Sarangarh	6061.4				1415.6	3116.1	48.9					546.8	934.0
Surguja	24050.7		691.7	409.3	13116.6	44.1	1570.0		11.5	49.6		6741.4	1416.7
Total area	**135593.8**	**40.3**	**1991.5**	**5390.0**	**27976.9**	**16027.5**	**16561.6**	**4452.7**	**1590.3**	**569.1**	**1210.02**	**39715.7**	**20070.2**

Area in Sq Km

PARLIAMENTARY CONSTITUENCIES

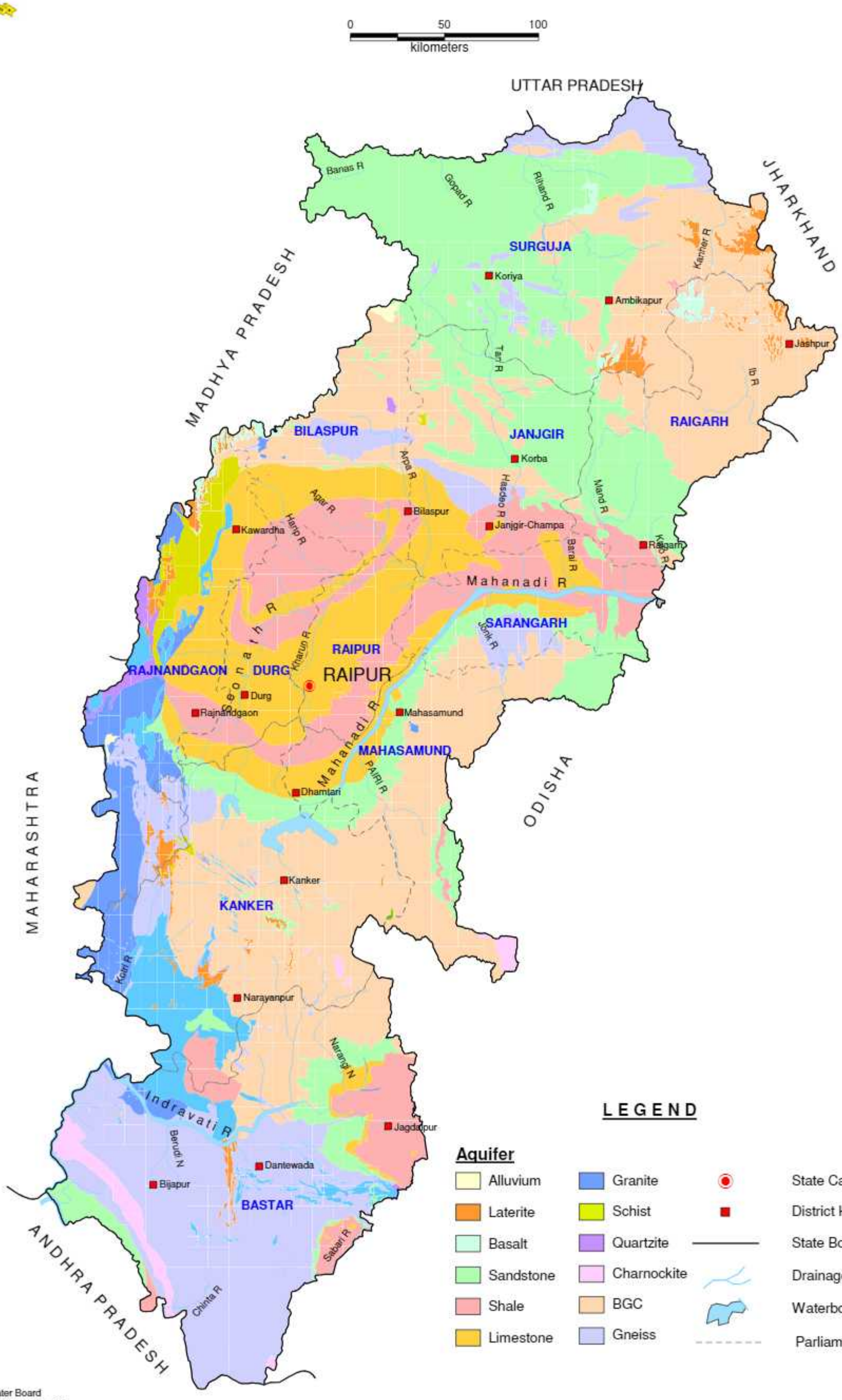

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Table 7: Population Census of Chhattisgarh

Sl No	District Name	Males	Females	Total	Density/sq. Km	Decennial growth rate	Sex ratio
1	**Bastar**	697359	714285	1411644	140	17.83	1024
2	**Bilaspur**	1349928	1312149	2662077	322	33.21	972
3	**Bijapur**	128761	126419	255180	39	8.76	982
4	**Dantewara**	263562	269229	532791	59	11.9	1022
5	**Dhamtari**	397250	401949	799199	236	13.11	1012
6	**Durg**	1681251	1661558	3342809	391	18.95	988
7	**Janjgir-Champa**	816057	804575	1620632	398	23.01	986
8	**Jashpur**	425085	426958	852043	146	14.65	1004
9	**Kanker**	372987	375606	748593	115	15	1007
10	**Kawardha**	411637	410602	822239	195	40.66	997
11	**Korba**	612158	594405	1206563	183	19.25	971
12	**Koriya**	334336	324703	659039	100	12.4	971
13	**Mahasamund**	511475	520800	1032275	216	20	1018
14	**Narayanpur**	70189	70017	140206	20	19.49	998
15	**Raigarh**	749439	744188	1493627	211	18.02	993
16	**Raipur**	2048856	2013304	4062160	310	34.65	983
17	**Rajnandgaon**	762170	775350	1537520	191	19.82	1017
18	**Surguja**	1195145	1166184	2361329	150	19.74	976
Total		**12827645**	**12712281**	**25539926**	**189**	**22.59**	**991**

Source: Census 2011

POPULATION DENSITY

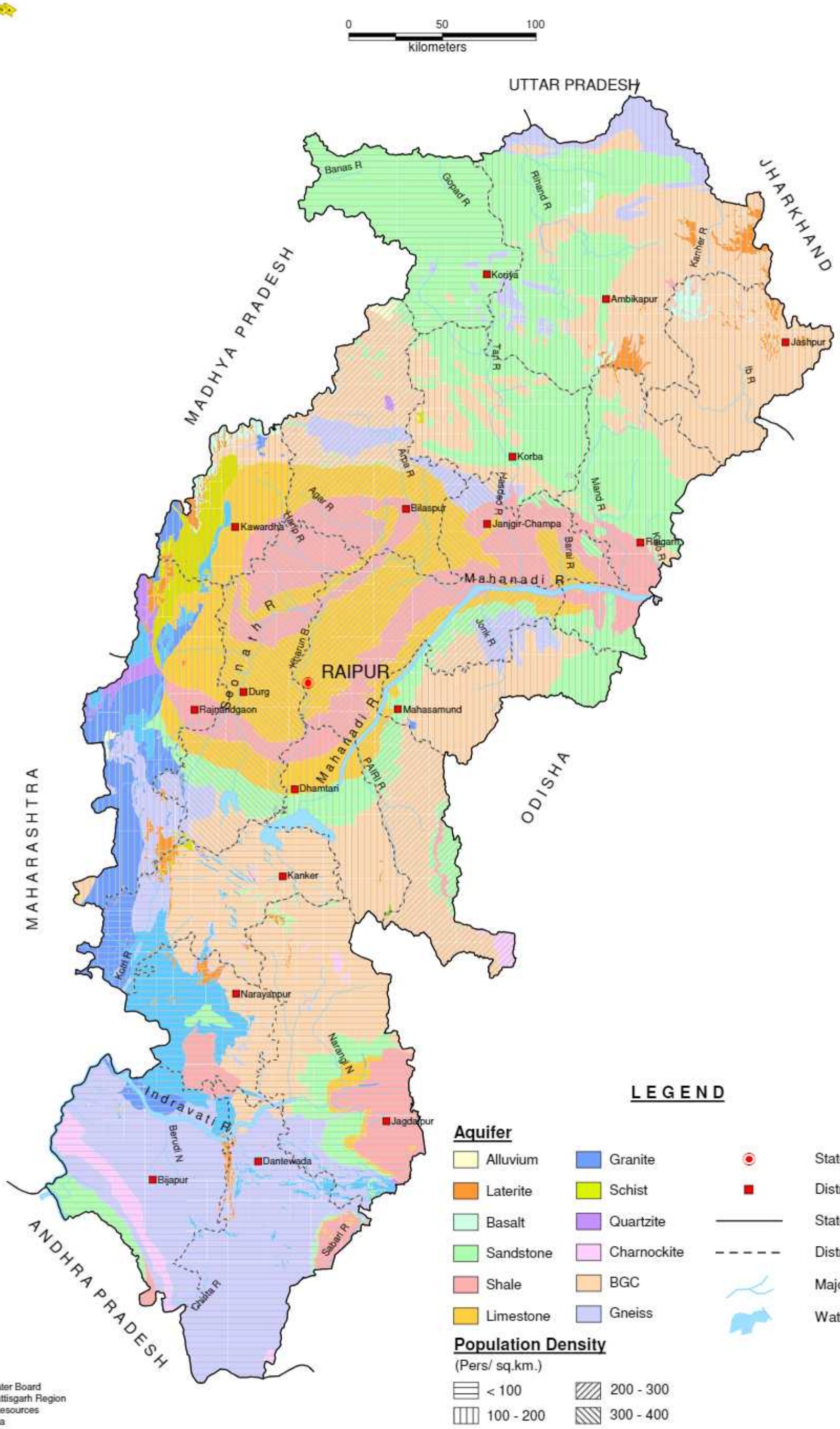

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Table 8: District wise Land Use

S.N.	District Name	Reserve Forest	Protected Forest	Other Forest	Scrub & Grass Land	Arable Land	Total Area
1	**Bastar**	2621.83	775.19	979.65	4227.58	1973.44	10577.69
2	**Bilaspur**	2645.51	3671.87	150.70	367.28	1974.21	8809.57
3	**Bijapur**	1579.85	1833.55			4929.50	8342.90
4	**Dantewara**	2806.83	376.45	3302.53		1904.86	8390.67
5	**Dhamtari**	1905.45	141.72		322.65	1700.94	4070.76
6	**Durg**	517.50	205.43		657.11	7244.48	8624.51
7	**Janjgir-Champa**	168.09	5.75		89.43	3614.36	3877.63
8	**Jashpur**	1138.63	85.83	820.75		3781.49	5826.70
9	**Kanker**	1889.62	2673.37	244.67	314.29	1651.44	6773.39
10	**Kawardha**	804.35	750.83			2673.08	4228.27
11	**Korba**	199.01	4282.06			2140.72	6621.79
12	**Koriya**	2271.11	2269.07	68.72		2035.00	6643.90
13	**Mahasamund**	424.60	580.00			3753.54	4758.14
14	**Narayanpur**	545.00	655.91	2455.80	629.29	354.83	4640.82
15	**Raigarh**	1482.64	376.52	52.76		5177.11	7089.03
16	**Raipur**	1467.20	2072.89		908.10	8014.56	12462.75
17	**Rajnandgaon**	947.61	1026.66		54.15	6048.53	8076.94
18	**Surguja**	5989.46	2796.51			6991.96	15777.93
Total		**29404.29**	**24579.61**	**8075.58**	**7569.87**	**65964.05**	**135593.39**

Area in Sq km

LAND USE

0 50 100
kilometers

UTTAR PRADESH
JHARKHAND
MADHYA PRADESH
MAHARASHTRA
ODISHA
ANDHRA PRADESH

Banas R
Gopad R
Pitmand R
Kanher R
Korba
Korea
Ambikapur
Jashpur
Ib R
Tawa R
Arpa R
Agar R
Hasdeo R
Mand R
Kharun R
Bilaspur
Janjgir-Champa
Kawardha
Seonath R
Barai R
Kelo R
Raigarh
Mahanadi R
Jonk R
RAIPUR
Durg
Rajnandgaon
Mahasamund
Dhamtari
Pairi R
Kanker
Kotri R
Narayanpur
Narangi N
Indravati R
Berudi N
Jagdalpur
Dantewada
Bijapur
Sabari R
Chitta R

LEGEND

Aquifer

- Alluvium
- Laterite
- Basalt
- Sandstone
- Shale
- Limestone
- Granite
- Schist
- Quartzite
- Charnockite
- BGC
- Gneiss

- State Capital
- District Headquarters
- State Boundary
- District Boundary
- Major Drainage
- Waterbody

Landuse

- Reserved Forest
- Protected Forest
- Aerable Land
- Other Forest
- Scrub and Grass Land

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Table 9: District wise and Aquifer wise distribution of Exploratory Wells

District Name	Basalt	Sandstone	Shale	Limestone	Granite	Schist	Charnockite	BGC	Gneiss	Total
Bastar	1	4	10	20	4	NA	2	6	2	**49**
Bijapur	0	NA	0	0	0	0	0	NA	0	**0**
Bilaspur	0	0	33	24	NA	NA	NA	11	0	**68**
Dantewada	0	0	0	1	0	NA	NA	0	0	**1**
Dhamtari	NA	4	10	30	0	NA	0	16	NA	**60**
Durg	3	7	14	58	0	0	NA	6	3	**91**
Janjgi Champa	NA	0	12	36	NA	NA	NA	0	3	**51**
Jashpur	0	0	NA	NA	NA	NA	NA	54	NA	**54**
Kanker	0	0	NA	NA	24	0	NA	39	0	**63**
Kawardha	0	0	5	13	0	0	NA	0	0	**18**
Korba	NA	24	0	NA	NA	9	NA	0	5	**38**
Koriya	0	9	NA	NA	NA	NA	NA	0	0	**9**
Mahasamund	NA	16	NA	8	0	NA	NA	16	4	**44**
Narayanpur	0	0	0	NA	NA	NA	NA	3	0	**3**
Raigarh	0	34	35	0	NA	NA	NA	17	NA	**88**
Raipur	NA	3	22	41	0	NA	3	19	0	**88**
Rajnandgaon	14	14	7	11	35	2	NA	NA	0	**83**
Surguja	0	34	NA	NA	NA	0	NA	32	1	**67**
Total	**18**	**149**	**148**	**242**	**63**	**11**	**5**	**219**	**18**	**873**

NA: Aquifer not available
No Exploration has been done in Alluvium, Laterite and Quartzite

GROUND WATER EXPLORATORY WELLS

0 50 100
kilometers

UTTAR PRADESH

JHARKHAND

MADHYA PRADESH

MAHARASHTRA

ODISHA

ANDHRA PRADESH

Banas R
Gopad R
Pitrand R
Kanher R
Tan R
Arpa R
Agar R
Hasdeo R
Mand R
Kharo R
Seonath R
Kharun R
Jonk R
Mahanadi R
Pairi R
Kotri R
Narangi N
Indravati R
Berudi N
Sabari R
Chinta R

Koriya
Ambikapur
Jashpur
Korba
Bilaspur
Kawardha
Janjgir-Champa
Raigarh
RAIPUR
Durg
Rajnandgaon
Mahasamund
Dhamtari
Kanker
Narayanpur
Dantewada
Bijapur

LEGEND

Aquifer

- Alluvium
- Laterite
- Basalt
- Sandstone
- Shale
- Limestone
- Granite
- Schist
- Quartzite
- Charnockite
- BGC
- Gneiss

- State Capital
- District Headquarters
- State Boundary
- District Boundary
- Major Drainage
- Waterbody
- Exploratory Well

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Table 10: Aquifer wise Distribution of Ground Water Observation Wells

District Name	Sandstone		Shale		Limestone		Granite		Schist		Quartzite		BGC		Gneiss		Total Number of observation wells
	DW	*Pz*	*DW*	*Pz*	*DW*	*Pz*	*DW*	*Pz*	*DW*	*Pz*	*DW*	*Pz*	*DW*	*Pz*	*DW*	*Pz*	
Bastar	2	0	6	2	3	3	0	0	NA	NA	0	0	8	0	5	2	31
Bijapur	NA	NA	0	0	0	0	0	0	0	0	NA	NA	NA	NA	5	1	6
Bilaspur	3	0	10	8	17	8	NA	NA	NA	NA	0	0	8	3	5	0	62
Dantewada	0	0	0	0	0	0	0	0	NA	NA	NA	NA	0	0	13	3	16
Dhamtari	4	3	3	1	3	4	0	0	NA	NA	NA	NA	9	4	NA	NA	31
Durg	6	0	14	13	17	8	0	0	0	0	NA	NA	1	4	1	0	64
Janjgir-Champa	1	1	16	5	9	8	NA	NA	NA	NA	NA	NA	0	0	1	1	42
Jashpur	0	0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	34	11	NA	NA	45
Kanker	1	0	NA	NA	NA	NA	5	0	0	0	NA	NA	13	3	2	0	24
Kawardha	0	0	0	2	6	8	0	0	2	2	NA	NA	2	0	0	0	22
Korba	15	25	0	0	NA.	NA.	NA	NA	0	0	NA	NA	4	0	0	4	48
Koriya	20	6	NA	NA	NA.	NA.	NA	NA	NA	NA	NA	NA	0	0	0	0	26
Mahasamund	5	4	NA	NA	2	2	0	0	NA	NA	NA	NA	10	14	0	0	37
Narayanpur	0	0	0	0	NA	NA	NA	NA	NA	NA	NA	NA	0	0	7	2	9
Raigarh	16	16	9	0	3	4	NA	NA	NA	NA	NA	NA	5	3	NA	NA	56
Raipur	2	6	11	0	18	20	2	0	NA	NA	NA	NA	14	5	0	0	78
Rajnandgaon	0	0	3	2	8	2	14	4	2	0	1	0	NA	NA	4	1	41
Surguja	20	9	NA	NA	NA	NA	NA	NA	0	0	NA	NA	27	9	3	2	70
Total	**95**	**70**	**72**	**33**	**89**	**69**	**13**	**0**	**4**	**2**	**1**	**0**	**151**	**57**	**36**	**17**	708

PLATE - X

GROUND WATER OBSERVATION WELLS

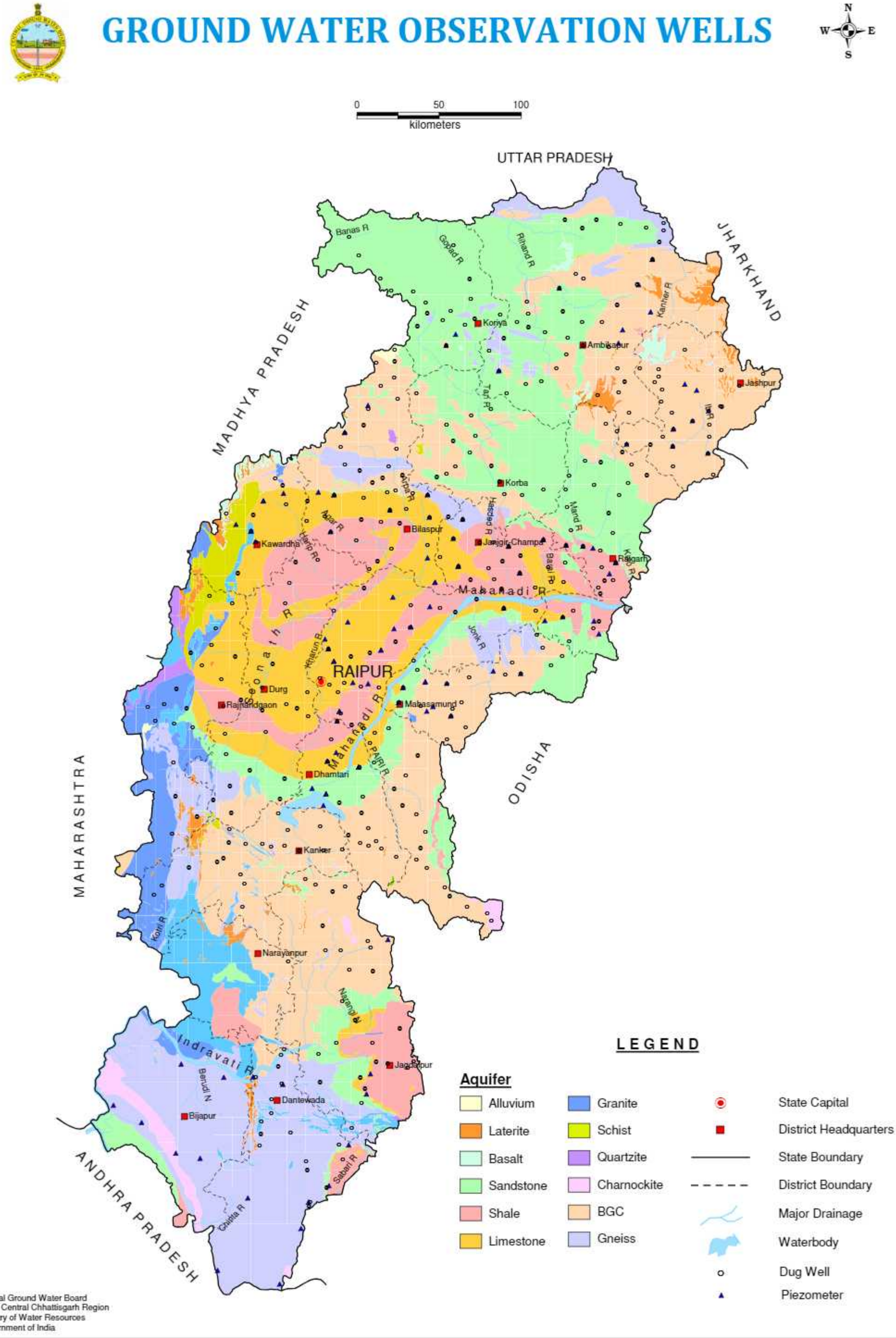

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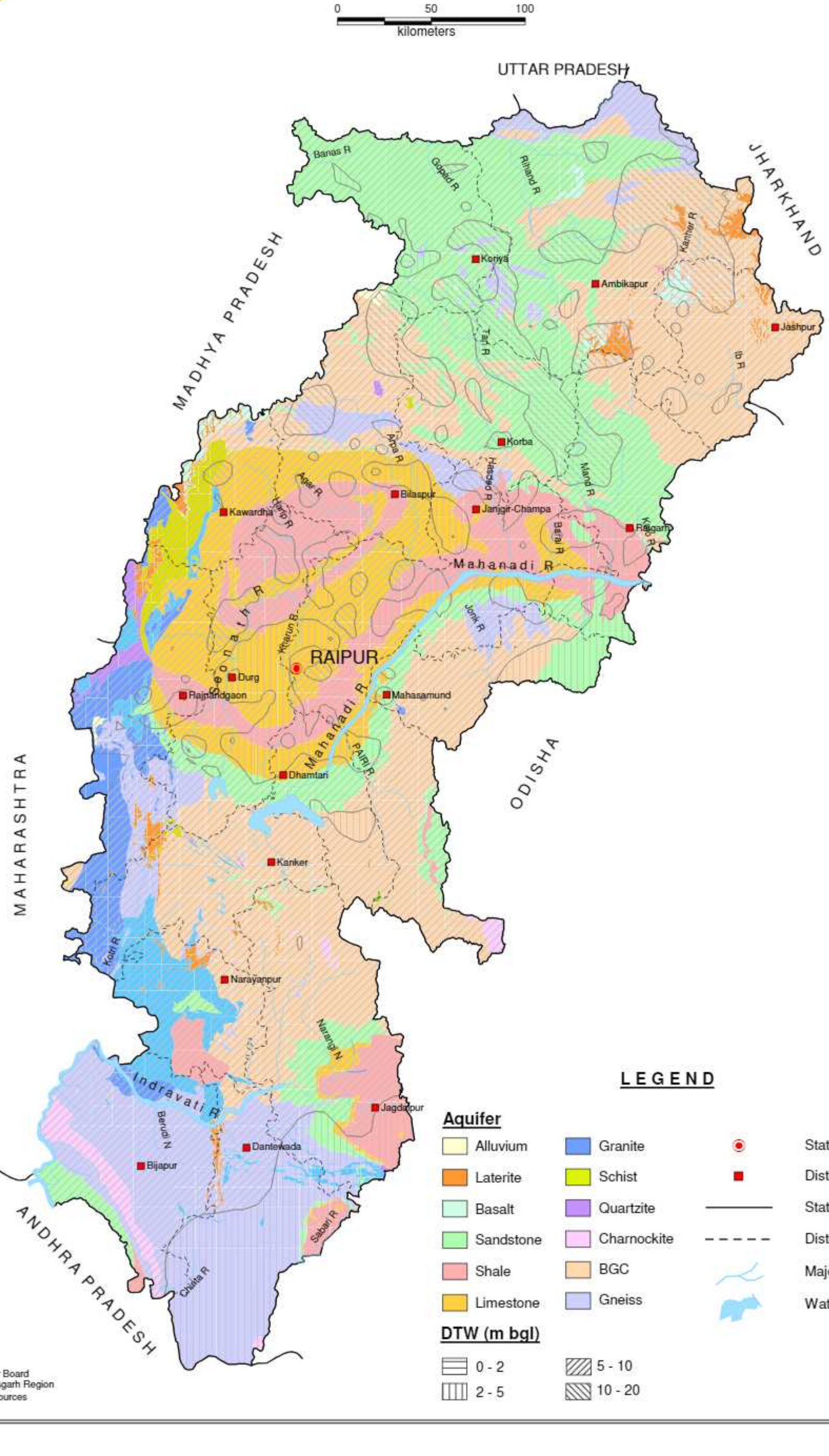
Table 11: Depth to Water Level, Pre Monsoon, 2011

District Name	Alluvium		Laterite		Basalt		Sandstone		Shale		Limestone		Granite		Schist		Quartzite		Charnokite		BGC		Gneiss	
	Min	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*
Bastar			5.2	8.9	2.6	7.5	2.4	9.8	2.3	9.8	2.4	8.5	5.6	9.6			2.3	4.7	2.8	13.6	1.9	9.5	1.9	8.8
Bijapur			5.7	9.9	3.3	8.4			5.8	6.7			5	10	5	9.2	5	8.9	5	8.9			2	8.1
Bilaspur			10.6	15.8	5.4	14.6	2.5	7.9	2.5	12.1	5.5	8.2									1.7	11.9	1.9	7.9
Dantewada			5.6	9.2	2.5	8.5	3.1	4.9	2.8	8.2	1.8	5	2	5							4.5	9.1	2	11.6
Dhamtari			5.8	8.3			2.8	7.9	2.9	4.8	1.7	7.3									1.9	7.8		
Durg			5.8	9.4	5.7	7.8	2.9	13.2	2.3	11.5	1.9	11.2	5	9.1	5	7.8					5	8.2	4.6	7.8
Janjgir - champa							2.8	9.2	5.4	8.3	1.4	11.6									2	13.1	5	11
Jashpur			11.2	15.3	2.9	14.6	5.9	13.2													2	11.3		
Kanker			5.3	7.8	5	7.8	6.4	6.8					5	8.9	5.4	6.8					5	7.8	5	8.3
Kawardha			5.3	8.4	2.8	13.8	5.3	7.8	2.5	11.3	2	11.9	5	8.3	6.8	12.5					5	8.4	5.2	8.7
Korba							5.6	13.6	5.6	11.9					5	7.8					2	11.8	5	9.1
Koriya					2.4	13.7	5.4	12.6													5	12.3	5	11.2
Mahasamund							5.8	16.1			2	12.1	5	7.4							2	12.6	1.9	9.1
Narayanpur			5.2	7.9	5.3	8.4	5.8	7.5	5.6	8.4											5	9.1		
Raigarh			11.6	13.9			2.9	12.3	2.6	8.5	2	8.9									2	11.8		
Raipur							5.5	7.9	2.8	9.4	2	9.6	5	7.3					5	9.2	2	8.4	2.2	8.9
Rajnandgaon	5.7	8.6	5.2	7.3	2.6	13.7	2.6	13.1	2.4	12.1	2	13.8	2	12.3	5	7.9	5	9.2					4.2	8.2
Surguja			5.6	8.3	5.8	14.7	2.7	11.6							10	12.2					2	12.1	5	11.4

All figures in m bgl

DEPTH TO WATER LEVEL

(PRE-MONSOON 2011)



LEGEND

Aquifer

Alluvium	Granite
Laterite	Schist
Basalt	Quartzite
Sandstone	Charnockite
Shale	BGC
Limestone	Gneiss

State Capital	
District Headquarters	
State Boundary	
District Boundary	
Major Drainage	
Waterbody	

DTW (m bgl)

0 - 2	5 - 10
2 - 5	10 - 20

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Government of India

Table 12: Depth to Water Level, Post Monsoon, 2011

District name	Alluvium		Laterite		Basalt		Sandstone		Shale		Limestone		Granite		Schist		Quartzite		Charnokite		BGC		Gneiss	
	Min	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*
Bastar			1.8	8.4	2	4.5	2	4.6	1.2	4.6	1.8	4.6	2	4.8			1.1	4.3	1.8	3.8	8.6	1.3	7.8	10
Bijapur			1.2	4.6	1.6	4.3			1.6	9.3	1.9	4.2	1.8	4.1	1.9	3.9	1.8	11.3	1.9	4.6				
Bilaspur			1.6	9.3	1.8	7.3	1.2	7.6	1.8	8.7	1.3	8.4									8.4	1.5	8.2	10
Dantewada			1.8	4.7	1.9	4.1	1.6	4.1	1.9	4.6	1.1	8.9	1.1	4.2							5			5
Dhamtari			1.9	4.5			1.8	7.5	1.3	4.6	1.5	7.7									8.1			
Durg			1.3	4.3	1.8	4.8	1.9	9.5	1.1	8.4	1.1	8.1	1.5	8.2	1.6	4,2					4.3	1.9	8.6	10
Janjgir - Champa							1.3	4.1	1.5	7.3	1.8	8.4									4.3	1.1	4.3	5
Jashpur			1.2	4.3	1.7	7.6	1.4	7.8													7.6			
Kanker			1.6	4.3	1.6	4.1	1.8	4.2					1.8	4.7	1.5	4.6					4.6	2	4.9	5
Kawardha			1.8	10	1.8	3.7	1.8	8.3	1.9	8.2	1.4	7.8	1.1	8.1	1.8	4.6					8.4	2	3.8	5
Korba							1.9	9.3	1.6	3.9					1.5	4.1					8.9	2	7.9	10
Koriya					1.8	4.1	1.3	7.3													7.7		7.8	10
Mahasamund							1.8	6.8			1.5	4.6	1.3	4.2							8.1	2	4.7	5
Narayanpur			1.1	4.7	1.5	4.7			1.8	4.1												2	8.5	10
Raigarh			1.2	10	4.6	10	1.8	9.1	1.4	10	1.9	9.3									6.7			
Raipur			1.6	4.7							1.2	7.3	4.2	7.3					4.2	7.9	7.9	2	4.8	5
Rajnandgaon	1.4	3,8	1.8	9.2	4.1	10	1.8	4.2			1.3	6.8	1.8	7.9	2	8.2	4.6	6.8				2	4.6	5
Surguja			1.7	8.8	1.7	4.1	1.1	7.8							5	7.9					8.5	2	7.9	10

All figures in m bgl

DEPTH TO WATER LEVEL

(POST-MONSOON 2011)

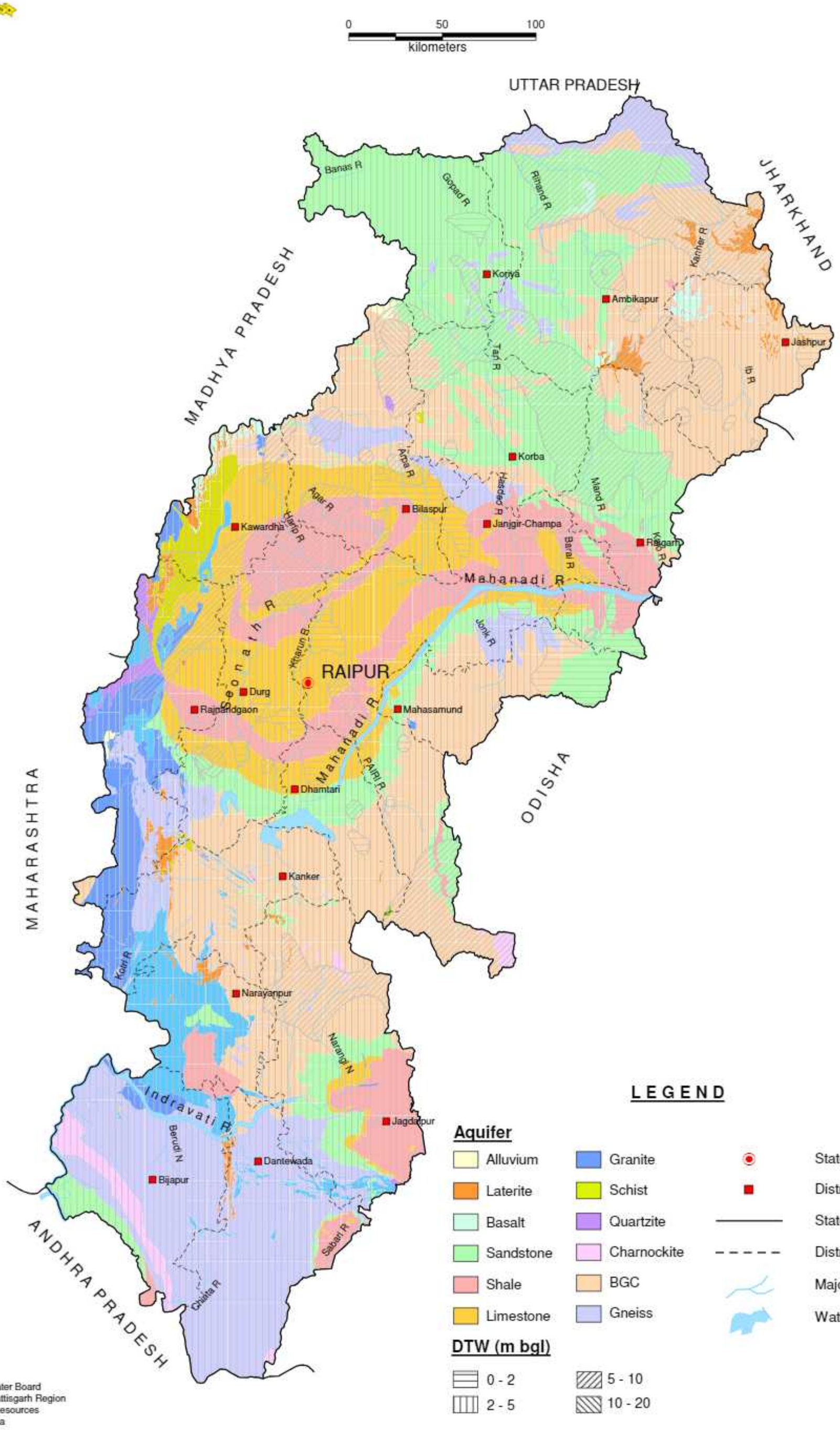

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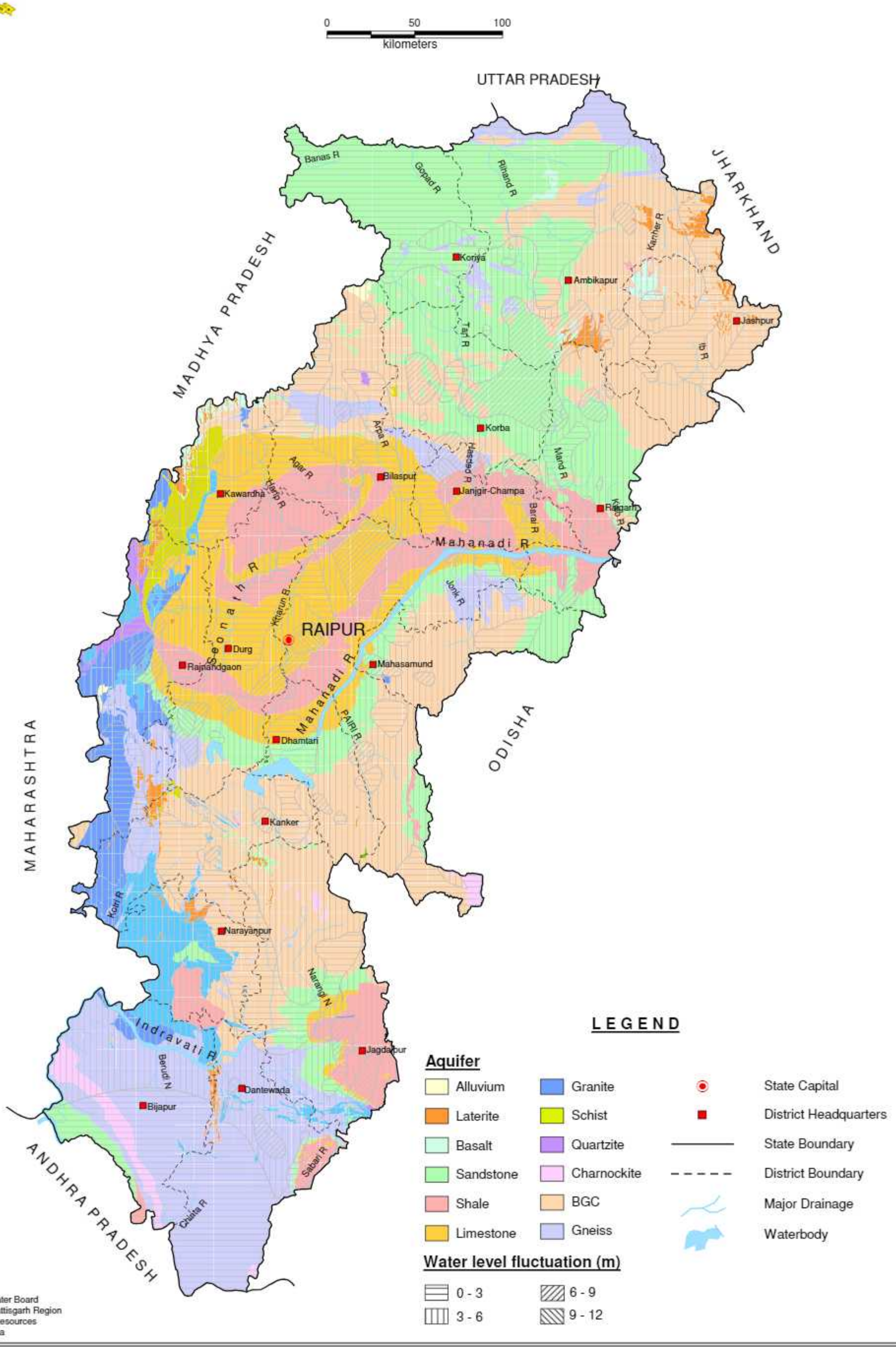
Table 13: Seasonal Ground Water Level Fluctuation, May 2011 vs Nov 2011

District Name	Alluvium		Laterite		Basalt		Sandstone		Shale		Limestone		Granite		Schist		Quartzite		Charnokite		BGC		Gneiss	
	Min	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*
Bastar			0.1	6	0.1	6	0.1	6	0.1	9	0.5	9	3	6			3	6	3	6	0.1	6	3	9
Bijapur			0.1	3	0.1	6			0.1	6	0.1	6	0.1	3	3	6	3	6	3	6			0.1	6
Bilaspur			0.1	6	0.1	6	0.1	6	0.1	9	3	9	3	6			3	6			3	9	3	12
Dantewada			0.1	6	0.1	6	0.1	6	0.1	6	3	6	0.1	3							0.1	6	3	6
Dhamtari			3	6			0.1	9	3	9	3	6									3	6		
Durg			3	6	3	6	0.1	12	0.1	9	0.1	9	3	9	3	6					3	6	3	9
Janjgir - Champa							0.1	12	3	12	3	12									3	9	0.1	12
Jashpur			0.1	6	0.1	6															0.1	6		
Kanker			0.1	6	0.1	6	0.1	9					0.1	6	3	6	3	6			0.1	9	0.1	6
Kawardha			6	9	0.1	6	0.1	6	0.1	6	3	9	0.1	6	0.1	6					0.1	6	3	6
Korba							0.1	12	3	12					3	6					3	12	3	9
Koriya					0.1	8	0.1	6													3	12	0.1	6
Mahasamund							0.1	9			0.1	9	3	9							3	9	0.1	6
Narayanpur			0.1	6	0.1	6	0.1	6	3	6											0.1	6	0.1	6
Raigarh			3	9	6	9	0.1	12	0.1	9	0.1	9									0.1	9		
Raipur							0.1	9	3	9	0.1	12	3	9					3	6	0.1	9	2	6
Rajnandgaon	3	6	0.1	6	0.1	9	3	12	3	6			0.1	12	3	6	3	6					3	6
Surguja			3	9	0.1	6	0.1	9							3	6					0.1	9	3	9

All figures in m

GROUND WATER LEVEL FLUCTUATION

(POST-MONSOON Vs PRE-MONSOON 2011)



LEGEND

Aquifer

Alluvium	Granite	State Capital	
Laterite	Schist	District Headquarters	
Basalt	Quartzite	State Boundary	
Sandstone	Charnockite	District Boundary	
Shale	BGC	Major Drainage	
Limestone	Gneiss	Waterbody	

Water level fluctuation (m)

0 - 3	6 - 9
3 - 6	9 - 12

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Government of India

Table 14: Ground Water Condition

Sl No	District Name	Area (sq km)	Condition
1	**Bastar**	10577.7	Major parts of the district covered with gneiss and other crystalline aquifer, low yield potential and represented by high ground water gradient. Eastern part of the district is covered with limestone aquifer which is more potential in the district.
2	**Bijapur**	8809.6	Major parts of the district covered with gneiss and other crystalline rocks with low yield potential and represented by high ground water gradient.
3	**Bilaspur**	8342.9	District is covered partly by crystalline aquifer and sedimentary aquifer. Sedimentary aquifer mainly consists of limestone and shale. Discharge potential of this aquifer is very high (upto 20 lps). Ground water gradient is very low.
4	**Dantewara**	8390.3	Major parts of the district covered with gneiss and other crystalline rocks having low yield potential and represented by high ground water gradient.
5	**Dhamtari**	4068	Major part covered with granitic aquifer, yield potential ranges from 3 to 5 lps. Sedimentary formation is having high yield potential in the district.
6	**Durg**	8627.2	Northern part of the district is covered with sedimentary aquifer mainly consist of shale and limestone. Due to karstification, these aquifers are highly productive.
7	**Janjgir-Champa**	3877.6	About 50 % area of the district is covered with sedimentary formation and remaining part by crystalline aquifer. Yield potential of sedimentary formation is moderate.
8	**Jashpur**	5826.7	Entire district is covered with gneiss and basaltic aquifer. Yield potential of this formation is very low.
9	**Kanker**	6773.4	Entire district is covered with granitic aquifer. Due to fracturing potential zones are developed in localized patches.
10	**Kawardha**	4228.3	A small portion of the district is covered with limestone and shale aquifer. Due to cavernous nature these formations are highly productive. Remaining part is covered with schist and phyllite, which behaves as aquiclude.
11	**Korba**	6621.8	Major part of the area is covered with semi- consolidated sandstone and shale aquifer of Gondwana formation. Due to argillaceous nature, these formation are low productive.
12	**Koriya**	6643.8	Major part of the district is covered with semi- consolidated shale and sandstone aquifer of the Gondwana formation. Due to argillaceous nature, these formations are less productive.
13	**Mahasamund**	4758.1	Major part of the district is covered with granitic aquifer which is less productive. Eastern part of the district is covered with limestone, shale and sandstone aquifer of Chhattisgarh group which acts as potential aquifer in the district.
14	**Narayanpur**	4640.8	Major parts of the district covered with gneiss and other crystalline rocks of low yield potential and represented by high ground water gradient.
15	**Raigarh**	7088.9	Major part of the district is covered with semi-consolidated shale and sandstone aquifer of Gondwana formation. Due to argillaceous nature, these formations are less productive. Southern part of the district is covered with shale aquifer of Chhattisgarh formation.
16	**Raipur**	12461.9	Major part of the district is covered with granitic aquifer which is less productive. Northern part of the district is covered with limestone, shale and sandstone aquifer of the Chhattisgarh group which forms potential aquifer in the district.
17	**Rajnandgaon**	8080.9	Major part of the District is covered with granitic aquifer which is less productive. Northern part of the district is covered with limestone and shale aquifer of the Chhattisgarh group which forms potential aquifer in the district
18	**Surguja**	15777.9	Major part of the district is covered with semi consolidated shale and sandstone aquifer of Gondwana formation. Due to argillaceous nature, these formation are low productive.
Total		**135595.8**	

WATER TABLE ELEVATION

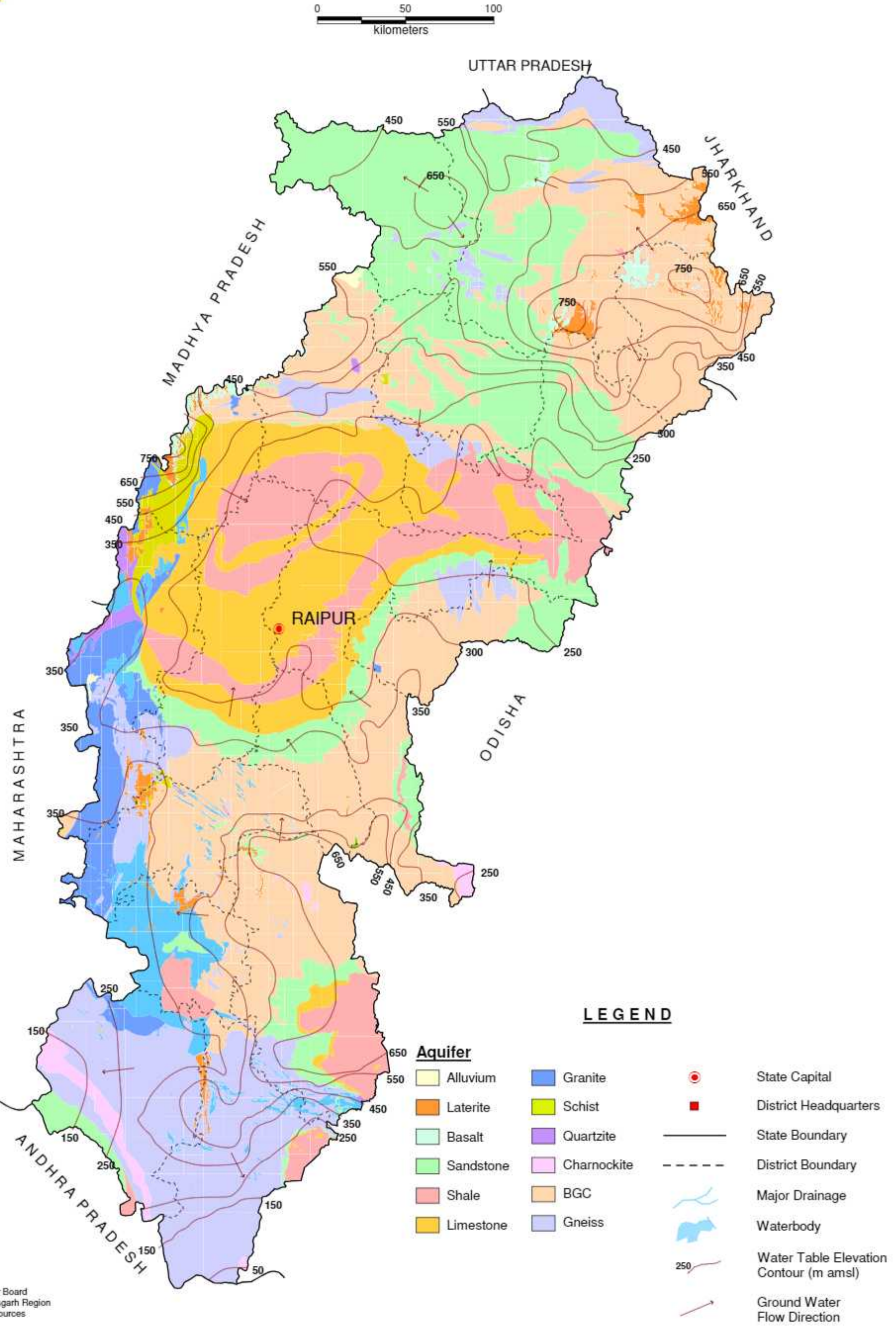

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Table 15: Area affected by Salinity, Fluoride, Nitrate and Arsenic in Ground Water in different Districts of Chhattisgarh

Sl No	Parameters	Name of districts (in parts)
1	**EC > 3000 µS/cm**	Nil
2	**Fluoride (>1.5mg/litre)**	Surguja,Raipur,Raigarh,Bastar,Bijapur and Koriya
3	**Nitrate (>45 mg/litre)**	Korba, Rajnandgaon, Durg, Janjgir-Champa, Jashpur, Surguja, Raigarh, Raipur and Koriya
4	**Arsenic (>0.05 mg/litre)**	Rajnandgaon

GROUND WATER QUALITY

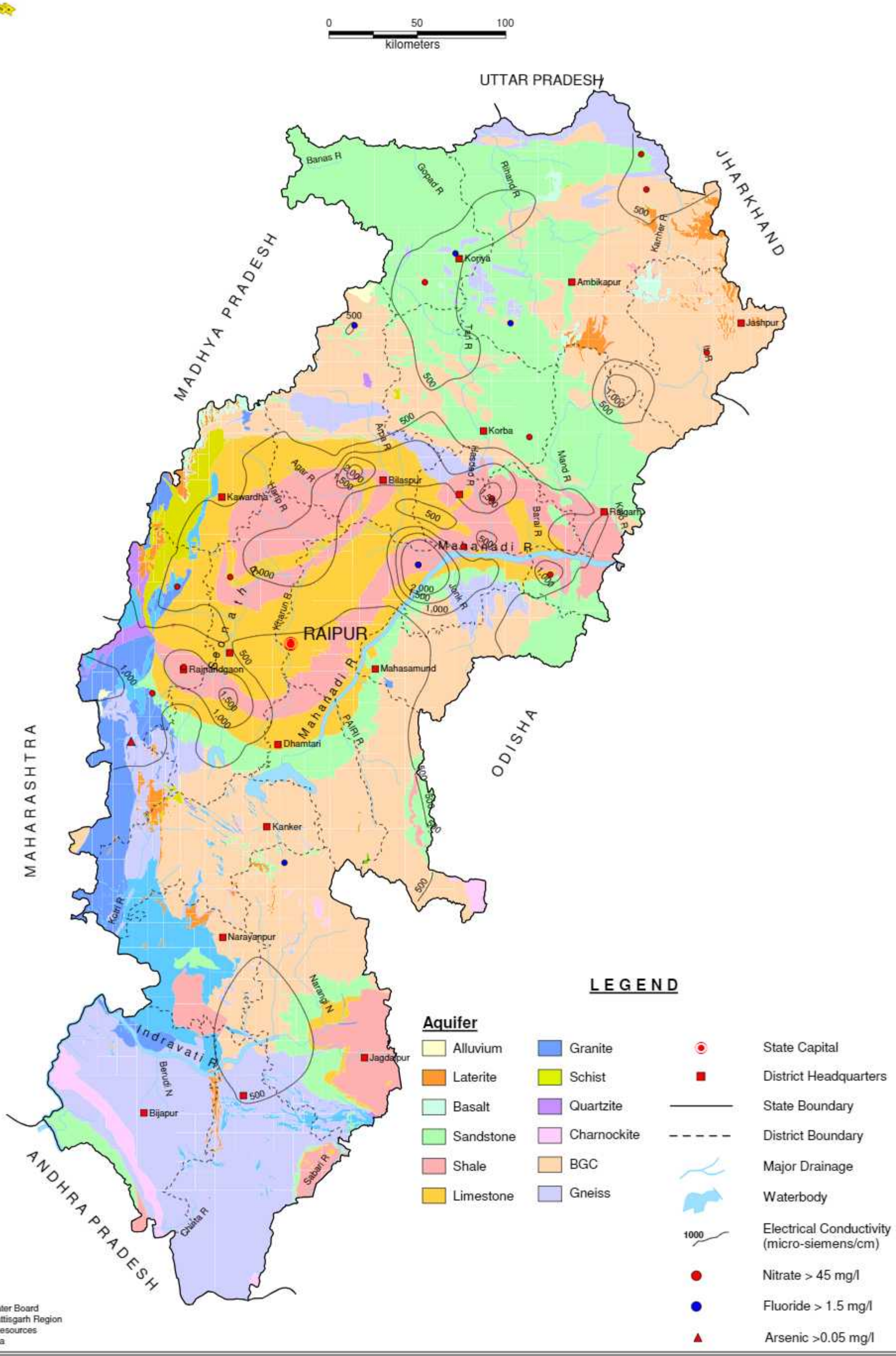

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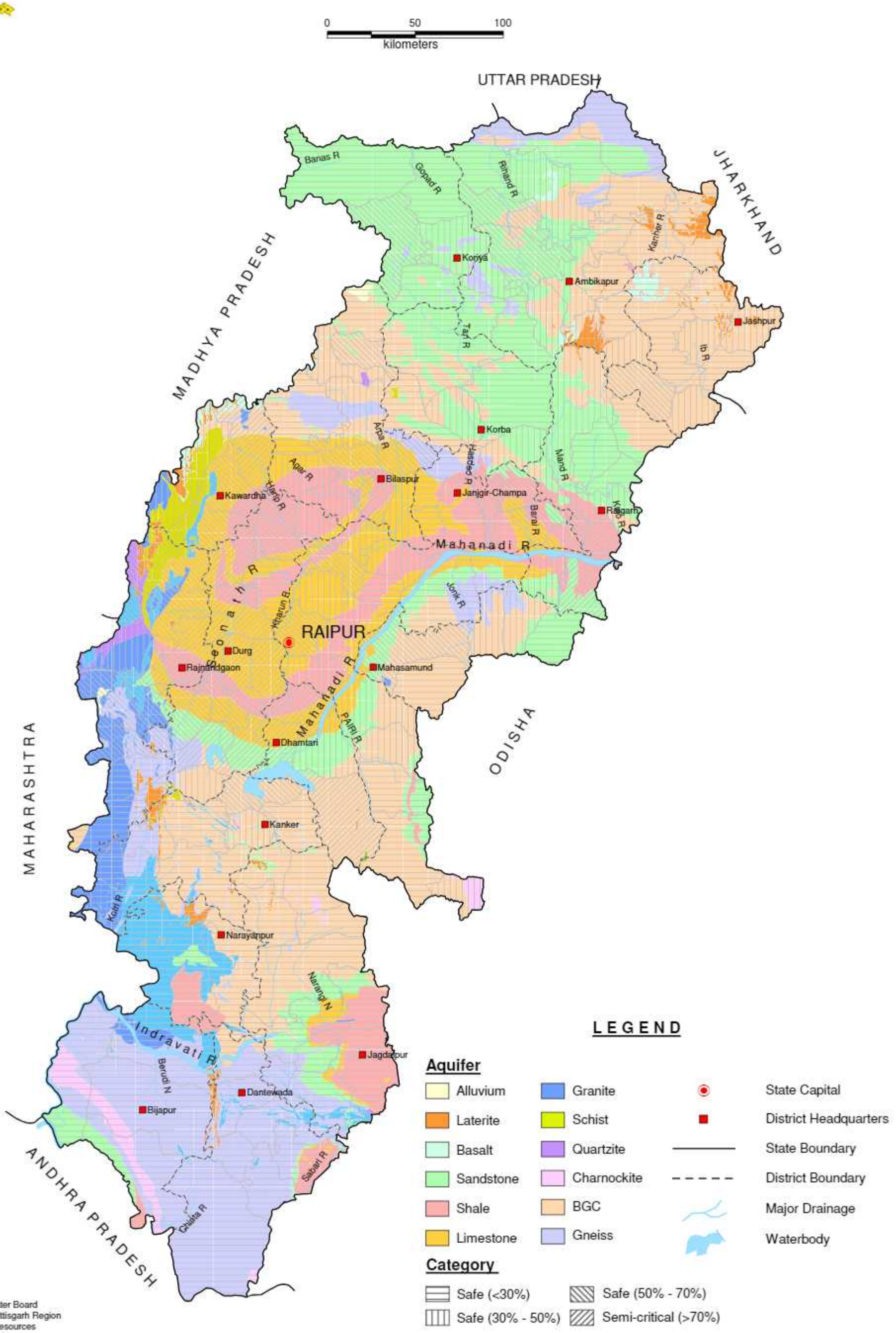
Table 16: Aquifer wise Stage of Ground Water Development

S. N	District	1		2		3		4		5		6		7		8		9		10		12		13		Total area
		Alluvial	SGWD	Laterite	SGWD	Basalt	SGWD	Sand-stone	SGWD	Shale	SGWD	Lime-stone	SGWD	Granite	SGWD	Schist	SGWD	Quart-zite	SGWD	Charnockite	SGWD	BGC	SGWD	Gneiss	SGWD	
1	Bastar			55.36	21	217.3	12	789.6	10	2897	22	421.7	13	22.31	23			15.6	0	61.14	25	5060	23	1041	15	10578
2	Bijapur			61.78	20	586.5	8			165.7	22	687.9	14	427.6	15	2.44	12			928.9	24			5949	15	8810
3	Bilaspur			26.6	24	62.68	23	409.1	26	1467	45-70	2345	30-65					35.79	12			3022	30	974.7	30	8343
4	Dantewada			94.38	12	281.3	12	92.39	23	520.8	23	27.78	13	33.76	13							270.7	23	7069	15	8390
5	Dhamtari			8.22	28			968.3	45-70	396.2	73	782.7	30-75							6.08	20	1907	50-70			4068
6	Durg			10.44	24	1.3	50	892.4	45-70	2900	35-70	3614	30-76	69.75	65	13.15	23					614.5	50-70	512.1	50-60	8627
7	Janjgir - champa							180.7	45	2214	35-71	1126	50-65									75.27	50-60	281.6	50-60	3878
8	Jashpur			211.69	20.63	276.1	23	97.23	23													5242	50			5827
9	Kawardha			159.58		533.6	50	71.28	23					901.7	50-70	42.26	32	7.71	10			4397	50	660.4	30	6773
10	Korba			213.73	30	451.7	61	9.72	43	324.7	40-70	1507	50-70	221.5	40-55	1029	50-65					454.3	50	17.42	60	4228
11	Narayanpur							4116	23	81.47	45					23.48	25					2271	30	130.3	30	6622
12	Raigarh					11.35	23	6460	23													29.95	30	142.4	30	6644
13	Raipur							1269	45			207.4	62	18.26	60							2925	30	339.1	50	4758
14	Rajnandgaon			140.85	15	2111	20	166.8	12	607.5	23											1474	15	141.2	15	4641
15	Surguja			31.48	28	7.02	32	3807	30-70	1518	50-70	163.1	50									1563	50			7089
16	Bastar			1.02	23			1617	25-50	2436	30-50	4052	50-60	6.3	50					213.9	45	3630	50	505.7	50	12462
17	Bijapur	40.41	12	351.43	23	630.9	61	171.2	45-70	499.5	50-70	1627	50-61	2751	60	472.2	50	510	12					1023	30-50	8081
18	Bilaspur			622.91	24	219.7	16	6860	50-65							8.47	30					6783	30	1284	30-50	15778

Area in Sq km and SGWD-Stage of Ground Water Development in percentage

CATEGORIZATION OF GROUND WATER ASSESSMENT

(SHALLOW AQUIFER)



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Source: - Dynamic Ground Water Resource of India, 2009

Table 17: District wise Distribution and Characteristics of Basalt Aquifer System

District Name	Major Aquifers (Area in Sq km)		Aquifer Properties								
	Basic - Basalt	Ultra Basics	Aquifer System	Type of Aquifer	Thickness of Weathered Zone	DTW (Decadal Avg)	Fractures encountered	Transmissivity	Yield	Specific Yield	Quality (EC in µS/cm)
	BS01	BS02			*m*	*m bgl*	*m bgl*	*m^2/day*	*m^3/day*	*%*	
Bastar		217.2	Single	Unconfined to Semi-confined	5 -15	8	20-50	6 - 70	90 - 180	1-1.5	500-750
Bijapur		586.5	Single	-	5 -15	9	20-50	6 - 70	90 - 180	1-1.5	500-750
Bilaspur	62.7		Single	Unconfined	5 - 10	8.8	15-30	10-30	90-120	1-1.5	500-1000
Dantewada		281.3	Single	Unconfined	10 - 20	7.3	50-80	5 - 50	90 - 180	1-2	500-750
Durg		1.3	Single	Unconfined, Semi-confined	10 - 20	8	20-50	20-50	90-400	1-2	500-750
Jashpur	276.1		Single	Unconfined, Semi-confined	5 - 10	9	15-30	10-30	90-120	2-3	500-750
Kanker		533.6	Single	Unconfined	10-45	8	50-80	20-80	90-400	1-2	500-750
Kawardha	296.9	154.8	Single	Unconfined	5 - 10	14	50-80	10 - 90	70 - 350	1.5-2	500-750
Koriya	11.4		Single	Unconfined	5 - 10	12	60-120	10-15	50-150	1-2	500-750
Narayanpur		2110.7	Single	Unconfined, Semi-confined	5 -15	12	50-80	20-80	90-400	1 -2	500-750
Raigarh	7.0		Single	Unconfined	5 - 10	8	15-30	10-15	90-120	1-1.5	500-750
Rajnandgaon		630.9	Single	Unconfined, Semi-confined	5 -15	7.5	50-80	20-80	90-400	1-2	500-750
Surguja	221.4		Single	Unconfined	5 - 10	7.9	15-30	10-15	90-120	1-1.5	500-750
Total Area	**875.5**	**4516.2**									

DTW: Depth to Water Level, m bgl: meters below ground level

BASALT - AQUIFER SYSTEM

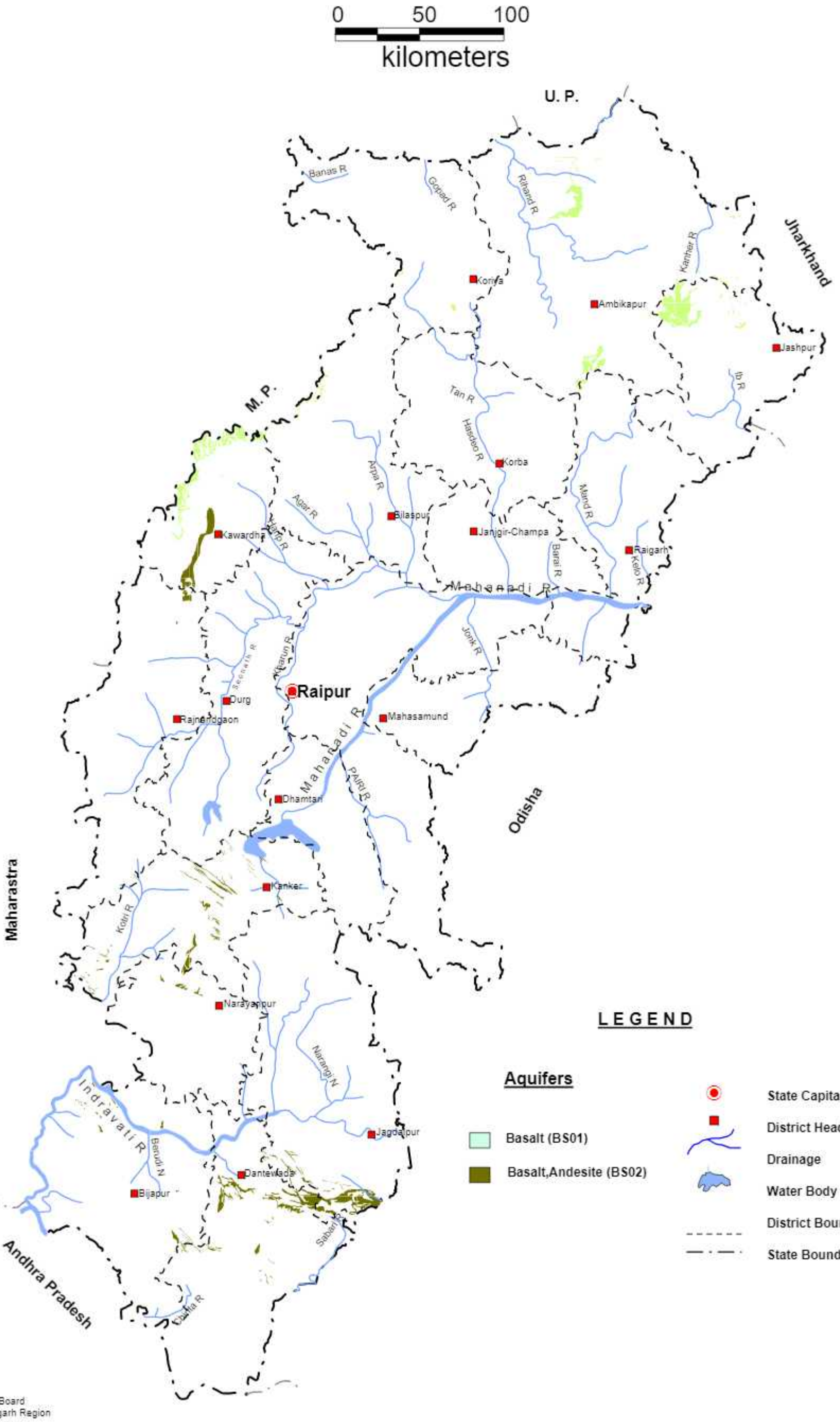

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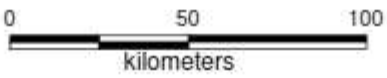
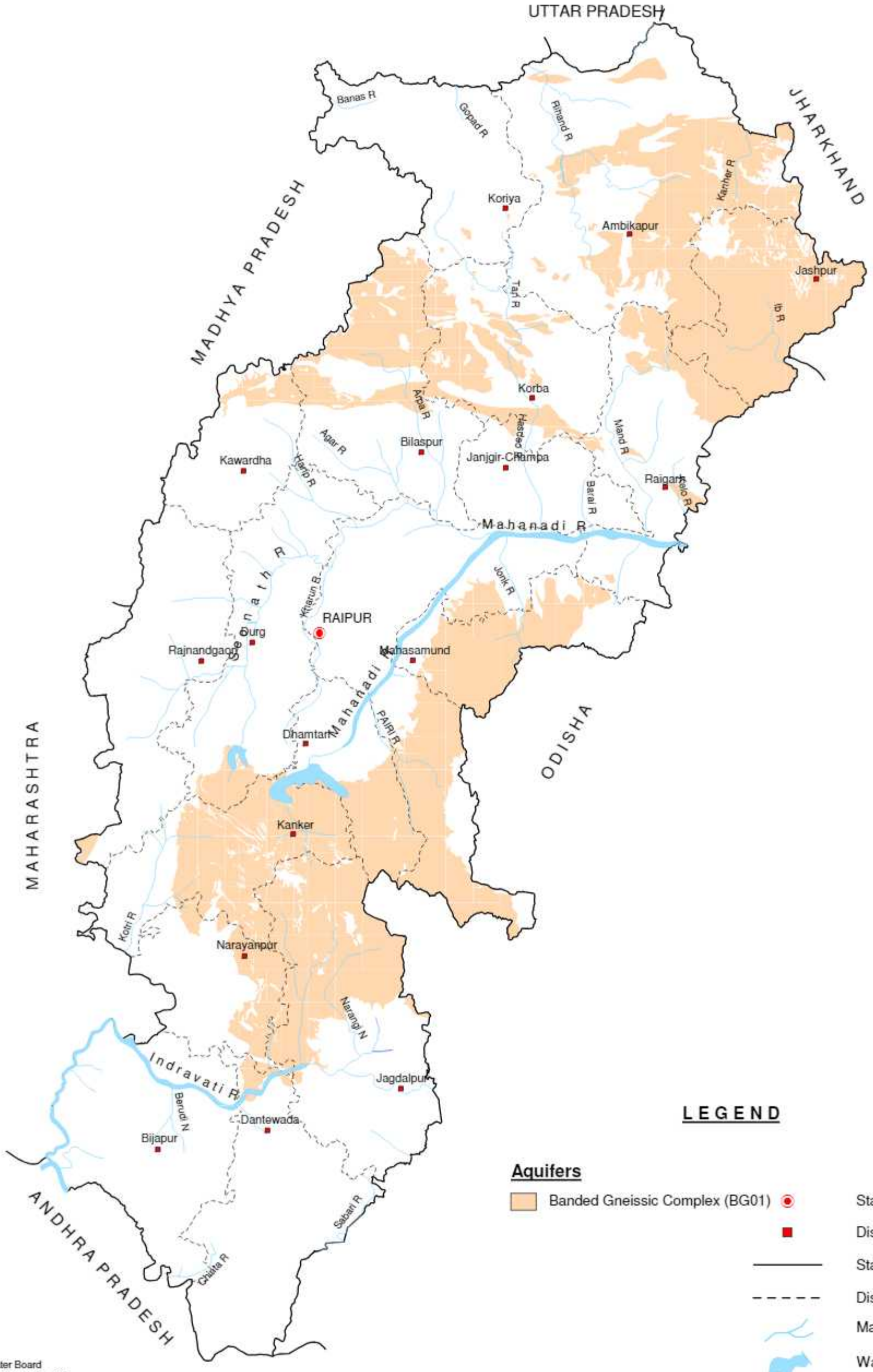
Table 18: District wise Distribution and Characteristics of Banded Gneissic Complex Aquifer System

District Name	*Major Aquifer (Area in Sq km)*	*Aquifer Properties*								
	BGC	Aquifer System	Type of Aquifer	Thickness of Weathered Zone	Fractures encountered	DTW (Decadal Avg)	Transmissivity	Yield	Specific Yield	Quality (EC in µS/cm)
	BG01			*m*	*m bgl*	*m bgl*	*m^2/day*	*m^3/day*	*%*	
Bastar	5060.0	Single	Unconfined to Semi-confined	8-15	12 - 60	8	6 - 40	30 - 260	1-3	500-1200
Bilaspur	3021.6	Single	Unconfined to Semi-confined	10 - 20	15 - 60	7.8	5 - 50	360 - 480	1-3	500-1000
Dantewada	270.7	Single	Unconfined to Semi-confined	10 - 20	20 - 60	6	2 - 40	30 - 260	1-3	500-1000
Dhamtari	1906.7	Single	Unconfined to Semi-confined	10 - 20	20 - 60	8	20-50	90 - 250	1-3	500-750
Durg	614.5	Single	Unconfined to Semi-confined	10 - 20	20 - 70	9.3	20-50	90 - 250	1-3	500-750
Janjgir - Champa	75.3	Single	Unconfined to Semi-confined	10 - 20	20-30	7	20-50	90 - 250	1-3	500 -1000
Jashpur	5241.7	Single	Unconfined to Semi-confined	10 - 20	10-50	8.4	2 - 30	90 - 250	1-3	500-1000
Kanker	4396.9	Single	Unconfined to Semi-confined	10 - 20	10-50	11	2-176	100 - 400	1-3	500-1500
Kawardha	454.3	Single	Unconfined to Semi-confined	10 - 20	10-50	14	6-145	90 - 250	1-3	500-1500
Korba	2270.9	Single	Unconfined to Semi-confined	5 - 15	10-50	12	5-50	43 - 210	1-3	500-1500
Koriya	30.0	Single	Unconfined to Semi-confined	5-10	30-80	13	11-77	10 - 80	1-3	500-1000
Mahasamund	2924.9	Single	Unconfined to Semi-confined	12 - 15	100 - 200	8	5 - 15	90 - 250	1-3	500-1500
Narayanpur	1473.8	Single	Unconfined to Semi-confined	10-20	60-170	9	3-45	90 - 250	1-3	500-2000
Raigarh	1562.5	Single	Unconfined to Semi-confined	5 - 20	40 - 100	8	12 - 22	150 - 200	1-3	500-2500
Raipur	3630.0	Single	Unconfined to Semi-confined	10-15	40 - 100	8	20-60	90 - 250	1-3	500-750
Surguja	6783.0	Single	Unconfined to Semi-confined	10-15	40 - 100	7.7	30-80	90 - 250	1-3	500-750
Total Area	**39716.6**									

DTW: Depth to Water Level, m bgl: meters below ground level

BANDED GNEISSIC COMPLEX





LEGEND

Aquifers

- Banded Gneissic Complex (BG01)

- State Capital
- District Headquarters
- State Boundary
- District Boundary
- Major Drainage
- Waterbody

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GNEISS - AQUIFER SYSTEM

0 50 100
kilometers

UTTAR PRADESH
JHARKHAND
MADHYA PRADESH
MAHARASHTRA
ODISHA
ANDHRA PRADESH
Banas R
Gopad R
Rihand R
Kanher R
KORIYA
AMBIKAPUR
JASHPUR
Tarr R
Ib R
KORBA
Arpa R
Hasdeo R
Mand R
BILASPUR
JANJGIR-CHAMPA
RAIGARH
Kelo R
KAWARDHA
Hiarp R
Agar R
Barar R
Mahanadi R
Jonk R
Sonath R
Kharun R
RAIPUR
DURG
RAJNANDGAON
MAHASAMUND
DHAMTARI
Mahanadi R
PAIRI R
KANKER
Kotri R
NARAYANPUR
Narangi N
Indravati R
JAGDALPUR
Berudi N
DANTEWADA
BIJAPUR
Sabari R
Chitra R

LEGEND

Aquifers

- Undifferentiated Metamorphics (GN01)
- Gneiss (GN02)

- State Capital
- District Headquarters
- State Boundary
- District Boundary
- Major Drainage
- Waterbody

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Table 19: District wise Distribution and Characteristics of Gneiss Aquifer System

District Name	*Major Aquifers (Area in sq km)*		*Aquifer Properties*								
	Gneiss	Gneiss	Aquifer System	Type of Aquifer	Thickness of Weathered Zone	Fractures Encountered	DTW (Decadal Avg)	Transmissivity	Yield	Specific yield	Quality (EC in µS/cm)
	GN01	GN02			*m*	*m bgl*	*m bgl*	m^2/day	m^3/day	%	
Bastar	23.7	1014.2	Single	Unconfined Semi-confined	8 - 15	20 - 50	6	12-40	80 - 240	1- 1.5	500-750
Bijapur	619.5	5285.0	Single	Unconfined Semi-confined	5-20	20-60	7	20-60	80-180	1- 1.5	250-500
Bilaspur	1010.4		Single	Unconfined Semi-confined	10-25	30-90	7.8	15-52	40-170	1- -2	500-750
Dantewada		7066.2	Single	Unconfined Semi-confined	10 - 15	20-70	7	13-57	25-250	1- 1.5	500-750
Janjgir - Champa	281.6		Single	Unconfined Semi-confined	5-10	20-50	7	13-57	25-250	1- 1.5	500-750
Kanker	58.6	18.5	Single	Unconfined Semi-confined	5-25	10-60	6.9	14-20	25-250	1- 2.0	500-1500
Korba	153.7		Single	Unconfined Semi-confined	10-25	10-60	8	6-27	25-250	1- 1.5	500-1500
Narayanpur		98.0	Single	Unconfined Semi-confined	8-20	10-60	7	17-15	40-120	1- 1.5	500-750
Rajnandgaon		14.9	Single	Unconfined Semi-confined	10 - 15	10-12	7.5	17-15	40-120	1- 1.5	500-750
Surguja	88.9		Single	Unconfined Semi-confined	10 - 15	10-15	11	17-15	40-120	1- 1.5	500-750
Total Area	**2236.4**	**13496.8**									

DTW: Depth to Water Level, m bgl: meters below ground level

Table 20: District wise Distribution and Characteristics of Sandstone Aquifer System

District Name	Major Aquifers (Area in sq km)				Aquifer Properties								
	Sandstone with Shale	Sandstone with coal beds	Sandstone/ Conglomerate	Sandstone with Shale	Aquifer System	Type of Aquifer	Aquifer Thickness	DTW (Decadal Avg)	Fractures encountered	Transmissivity	Yield	Specific Yield	Quality (EC in µS/cm)
	ST02	ST03	ST05	ST06			*m*	*m bgl*	*m bgl*	*m^2/day*	*m^3/day*	*%*	
Bastar			789.6	854.0	Single	Unconfined	20-150	7	38 - 60	20-50	50 - 250	1- 2	500-1000
Bijapur			61.3		Single	Unconfined	50-80	6	38 - 60	20-50	50 -100	1- 2	500-1000
Bilaspur	315.4	14.2			Single/ Multiple	Unconfined Semi-confined	60-200	8	20-120	20-120	70-300	1- 3	500-1000
Dantewada			92.4		Single	Unconfined	50-80	8	20 - 70	20-50	50 -100	1- 2	500-700
Dhamtari			970.9		Single	Unconfined	50-150	8.9	20 - 70	20-90	40-180	1- 2	500-700
Durg			889.7		Single	Unconfined	50-150	12	20 - 70	20-90	40-180	1- 2	500-700
Janjgir - Champa			180.7		Single	Unconfined	50-150	7.7	20-120	20-90	40-180	1- 2	500-700
Kanker			71.3		Single	Unconfined	50-100	7.3	50-80	20-90	40-180	1- 2	500-700
Kawardha			6.9		Single	Unconfined	60-80	7.3	30-50	20-30	40-180	1- 2	500-700
Korba	1370.6	2702.4	42.7		Single/ Multiple	Unconfined Semi-confined	60-400	12	60-300	10-80	40 - 350	1 - 3	500-1500
Koriya	5331.2	1129.1			Single/ Multiple	Unconfined Semi-confined	60-400	8	60-300	20-70	40 - 300	1 - 3	1000-1500
Mahasamund			1268.6		Single	Unconfined	50-100	8	30-90	20-30	40-180	1- 1.5	500-1500
Narayanpur			166.8		Single	Unconfined	50-100	8	30-70	20-30	40-180	1- 1.5	500-750
Raigarh	616.7	2264.4	926.2		Single	Unconfined Semi-confined	60-400	7.8	60-300	20-180	40 - 350	1 -3	500-1500
Raipur			1616.9		Single	Unconfined	50-100	7.5	30-70	25-100	40-180	1 -1.5	500-750
Rajnandgaon			171.2		Single	Unconfined	50-100	7.3	30-70	20-30	40-180	1 -1.5	500-750
Surguja	3740.0	3027.8	2.5		Single/ Multiple	Unconfined Semi-confined	60-500	7.4	60-300	20-70	40 - 350	1 -3	500-1500
Total Area	**11373.9**	**9137.8**	**7257.6**	**854.0**									

DTW: Depth to Water Level, m bgl: meters below ground level

SANDSTONE - AQUIFER SYSTEM

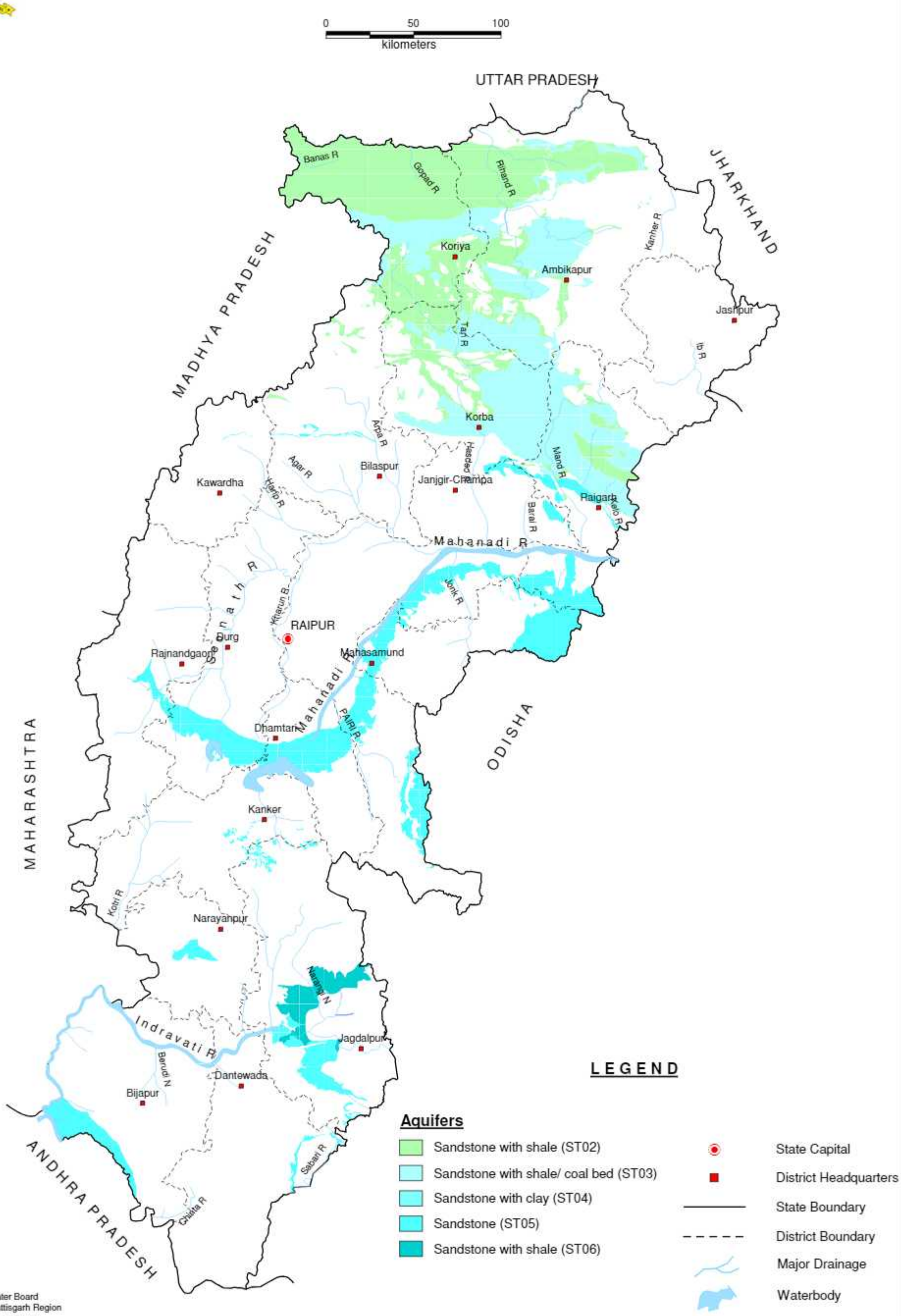

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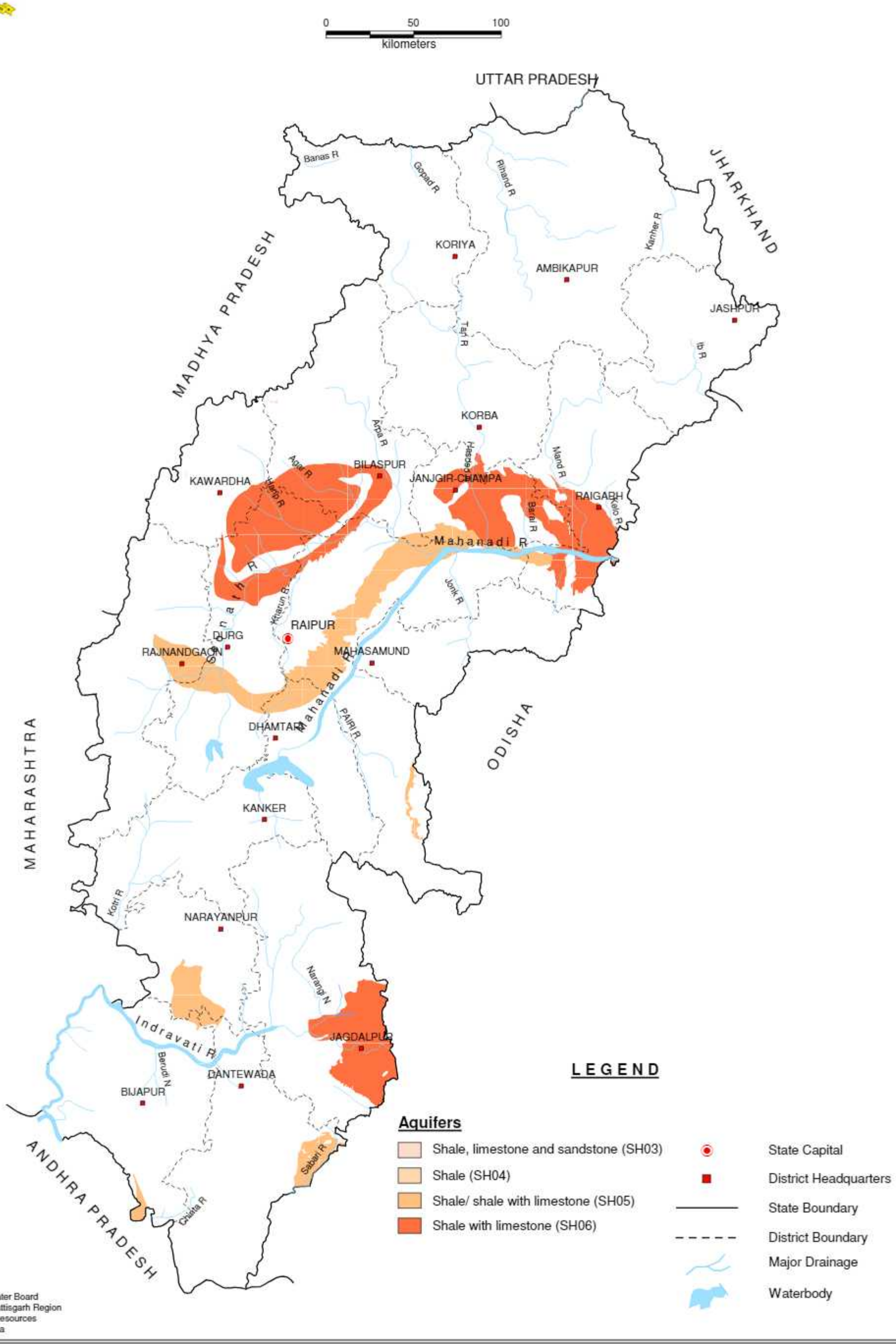
Table 21: State wise Distribution and Characteristics of Shale Aquifer System

District Nmae	*Major Aquifers (Area in Sq km)*			*Aquifer Properties*								
	Shale, Limestone and Sandstone	Shale/ Shale with Sandstone	Shale with Limestone	Aquifer System	Type of Aquifer	Aquifer Thickness	DTW (Decadal Avg)	Fractures encountered	Transmissivity	Yield	Specific Yield	Quality (EC in µS/cm)
	SH03	SH05	SH06			*m*	*m bgl*	*m bgl*	*m^2/day*	*m^3/day*	*%*	
Bastar			2042.8	Single	Unconfined to Semi confined	50-200	6	24-160	36-395	60-160	1 - 1.5	500-1000
Bijapur		165.7		Single	Unconfined to Semi confined	50-150	6.4	50-70	20-40	80 -600	1 - 1.5	500-1000
Bilaspur	18.2	89.3	1371.5	Single	Unconfined to Semi confined	50-300	7.5	23-90	100-600	80 -600	1 - 3	500-1500
Dantewada		520.8		Single	Unconfined to Semi confined	50-150	7.5	23-90	20-50	40 -120	1 - 1.5	500-1000
Dhamtari		396.2		Single	Unconfined to Semi confined	50-150	7.9	20-70	4-350	70-250	1 -2	500-1000
Durg		578.0	2321.8	Single	Unconfined to Semi confined	50-300	12	20-280	20-550	80-600	1 - 3	500-2000
Janjgir - champa		277.2	1936.5	Single	Unconfined to Semi confined	40-250	7.9	50-150	6-240	80-240	1 -2	500-1000
Jashpur	97.2			Single	Unconfined to Semi confined	30-50	7.0	20-50	5-30	40-120	1 -2	500-750
Kawardha	2.8		324.7	Single	Unconfined to Semi confined	50-300	6	15-40	20-300	10-240	1 -2	500-1000
Korba			81.5	Single	Unconfined to Semi confined	50-100	8	20-70	10 -30	40-120	1 - 2.5	500-750
Narayanpur		607.5		Single	Unconfined to Semi confined	50-100	8.3	20-80	10 -30	40-120	1 - 1.5	500-750
Raigarh		100.7	1417.1	Single	Unconfined to Semi confined	50-200	7.7	25-100	20-120	80-240	1 - 2	500- 2000
Raipur		2140.1	296.1	Single	Unconfined to Semi confined	50-200	7.2	25-100	10 -200	80-240	1 -1.5	500- 2000
Rajnandgaon		499.4		Single	Unconfined to Semi confined	50-150	7.2	50-100	20-120	40-160	1 - 2	500-1000
Surguja	87.9			Single	Unconfined to Semi confined	50-100	6.9	20-50	20 -60	40-160	1 - 2	500-1000
Total Area	206.2	5374.7	9792.1									

DTW: Depth to Water Level, m bgl: meters below ground level

SHALE - AQUIFER SYSTEM



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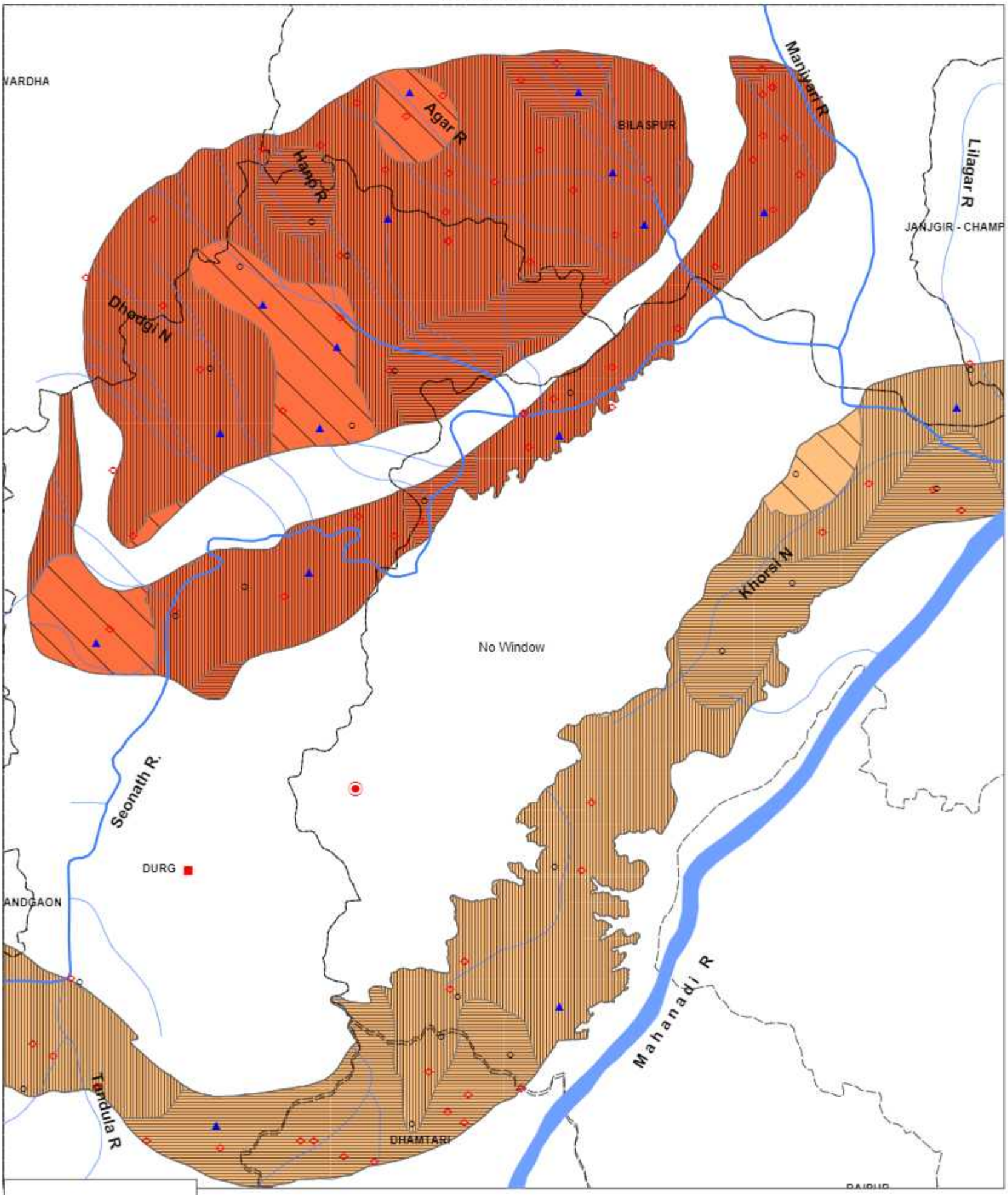
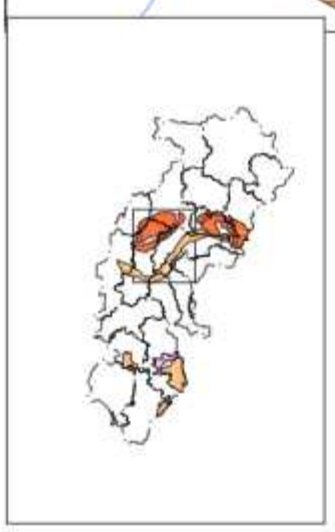
SHALE AQUIFER

CHHATTISGARH BASIN

N
W E
S

0 50 100
kilometers





LEGEND

State Capital
District HQ
District Boundary
Drainage

Observation Well
Piezometer
Exploratory Well

Depth to Water Level (m bgl)
3 - 6
6 - 9
9 - 12

AQUIFERS
Shale (SH05)
Shale with Limestone (SH06)

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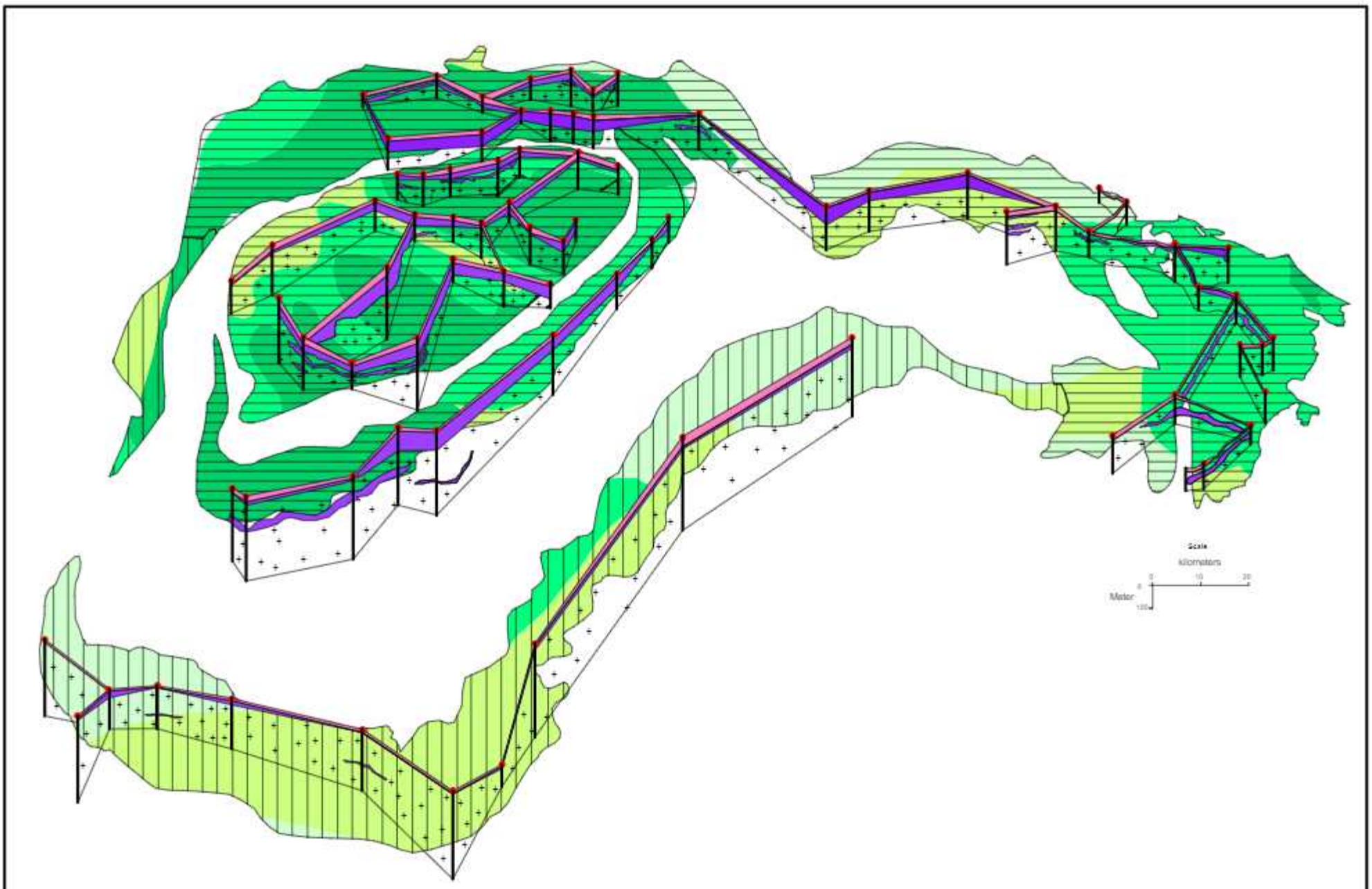
Government of India

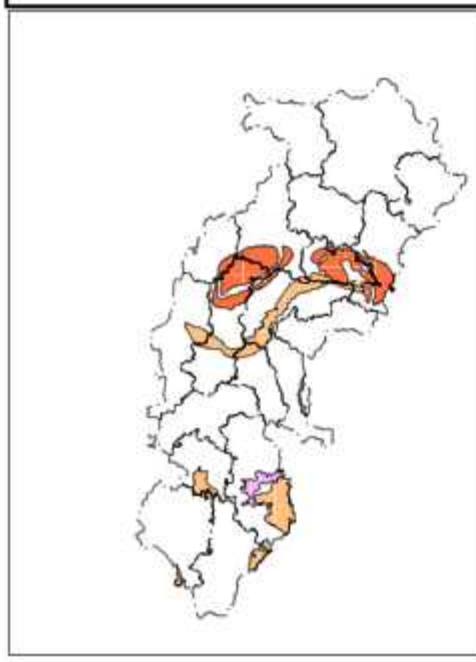
SUBSURFACE DISPOSITION OF SHALE AQUIFER

CHHATTISGARH BASIN

N
W E
S

0 50 100
kilometers





LEGEND

AQUIFERS

Shale (SH05)

Shale with limestone (SH06)

Weathered mantle

Fractured & Cavernous

Basement

Yield Potential (lps)

< 1 | 1 - 3 | 3 - 5 | 5 - 10

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Table 22: District wise Distribution and Characteristics of Limestone Aquifer System

District Name	*Major Aquifer (Area in sq km)*		*Aquifer Properties*								
	Limestone/ Dolomite	Limestone with Shale	Aquifer System	Type of Aquifer	Thickness	Zones encountered	DTW (Decadal Avg)	Transmissivity	Yield	Specific Yield	Quality (EC in µS/cm)
	LS03	LS04			*m*	*m bgl*	*m bgl*	m^2/day	m^3/day	*%*	
Bastar	385.00		Single	Unconfined, Semi confined	40- 200	20-140	12	10-240	40-1200	1 -3	500-1000
Bijapur		687.93	Single	Unconfined, Semi confined	40- 80	20-50	7	10 -30	40 -180	1 -2	500-750
Bilaspur	1059.85	1291.82	Single	Unconfined, Semi confined	30-250	25-150	11	20-450	40-1200	1 -3	500-1000
Dhamtari	782.72		Single	Unconfined, Semi confined	40-450	30-140	13	10-450	40-1200	1 - 3	500-1000
Durg	3613.79		Single	Unconfined, Semi confined	40-450	30-140	13	10-450	40-1200	1 - 3	500-1000
Janjgir - Champa	1043.36	83.07	Single	Unconfined, Semi confined	50-200	30-75	8	20-150	40 -240	1 - 2	500-1000
Kawardha	658.97	847.65	Single	Unconfined, Semi confined	50-200	25-120	12	20-150	40 -240	1 -2.5	500-1500
Mahasamund	207.40		Single	Unconfined, Semi confined	50-200	20-70	9	20-60	40 -400	1 -2.5	500-1000
Raigarh	163.06		Single	Unconfined, Semi confined	50-200	20-90	13	20- 250	40 -400	1 -2.5	500-1500
Raipur	4051.93		Single	Unconfined, Semi confined	50-300	30-120	8	5 - 250	40 -180	1 -1.5	500-1000
Rajnandgaon	1627.26		Single	Unconfined, Semi confined	50-200	30-90	8	10 - 100	40 -180	1 -1.5	500-1000
Total Area	**13593.33**	**2910.47**									

DT : Depth to Water Level , m bg : meters below ground level

LIMESTONE - AQUIFER SYSTEM

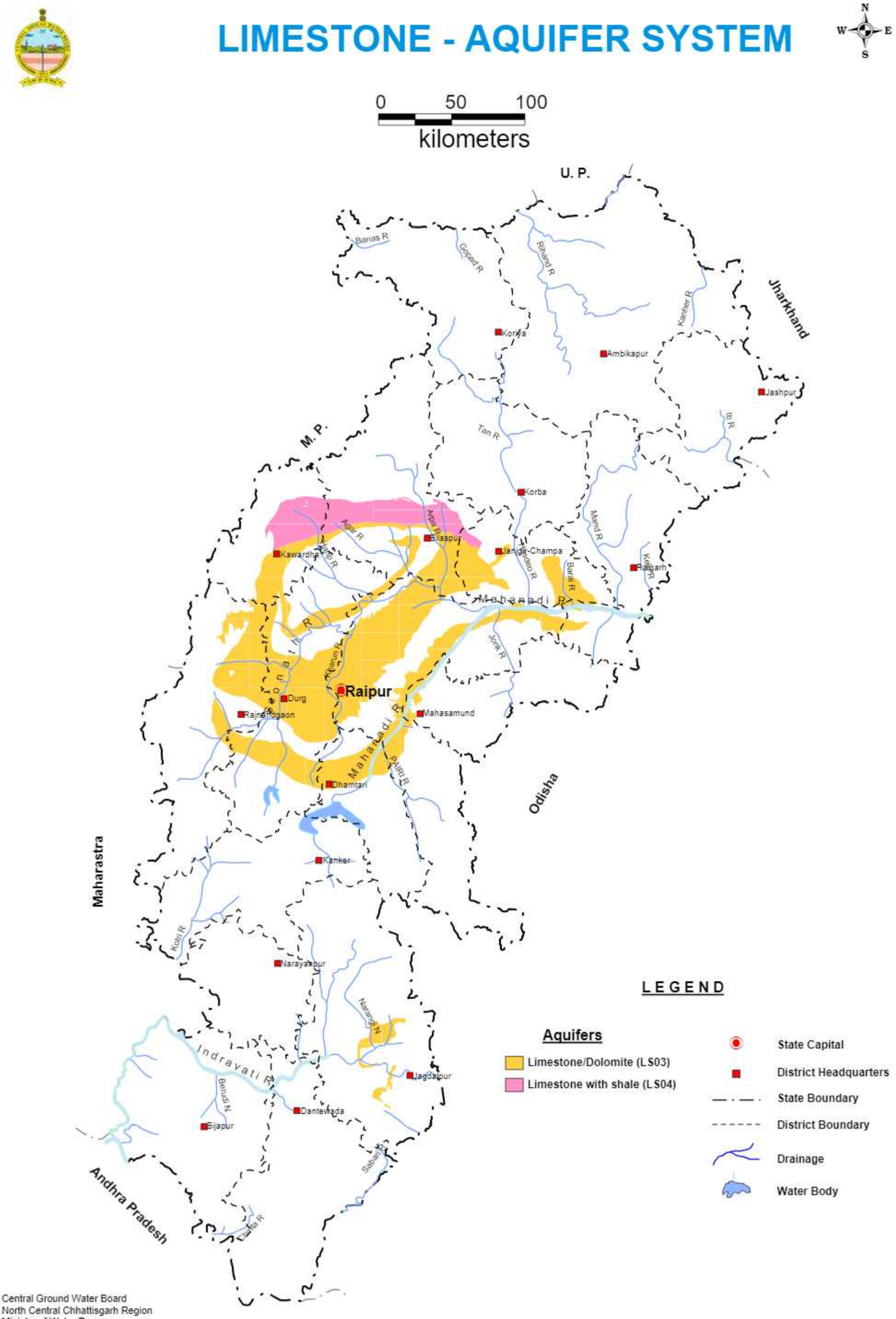

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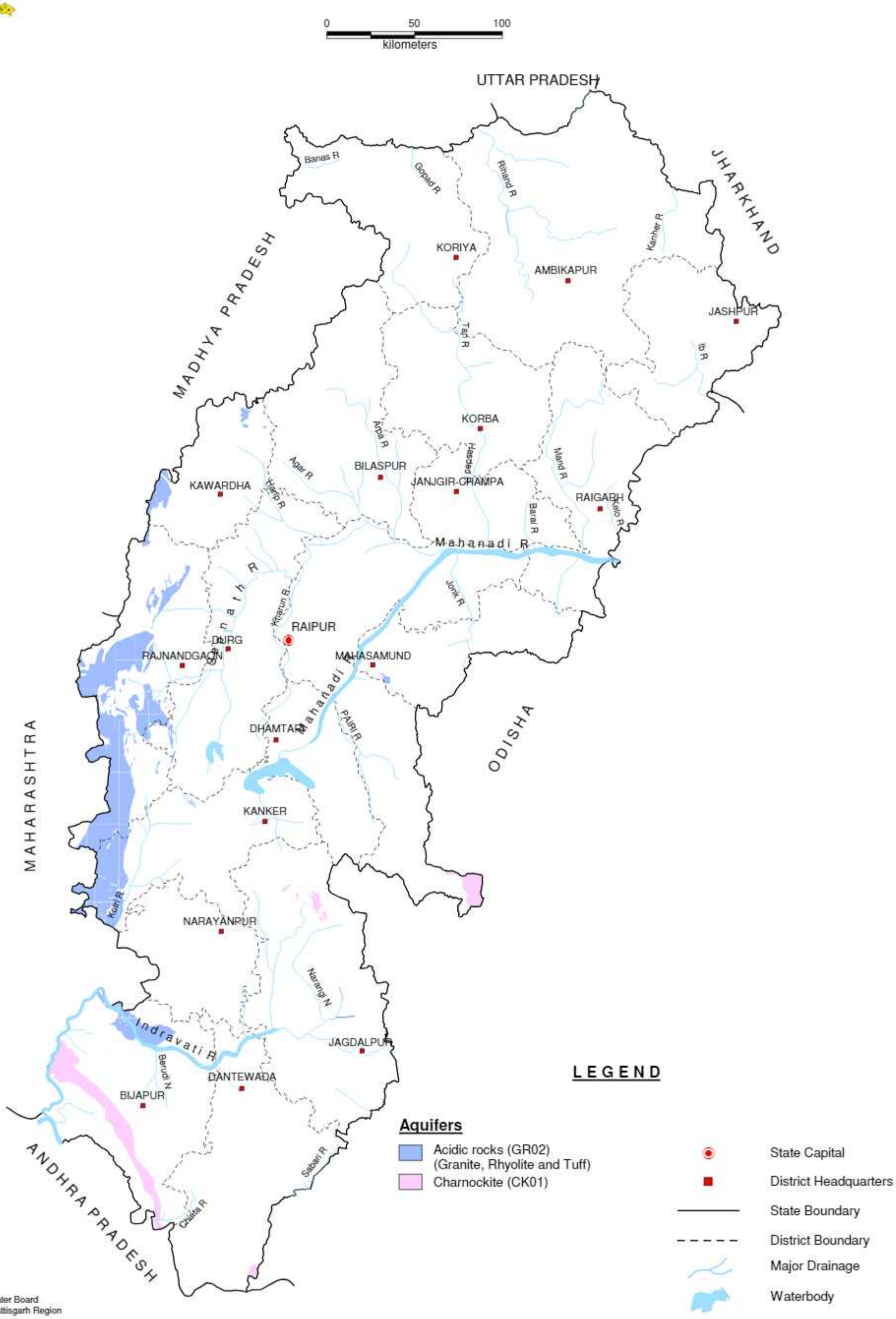
Table 23: District wise Distribution and Characteristics of Granite Aquifer System

District Name	*Major Aquifers (Area in sq km)*	*Aquifer Properties*								
	Intrusive Acidic Rocks	Aquifer System	Type of Aquifer	Thickness of Weathered Zone	Fractured Zones Encountered	DTW (Decadal Avg)	Transmissivity	Yield	Specific Yield	Quality (EC in µS/cm)
	GR02			*m*	*m bgl*	*m bgl*	*m^2/day*	*m^3/day*	*%*	
Bijapur	426.7	Single	Unconfined Semi-Confined	10-15	20- 70	6	17-120	40 -120	1- 2	500-750
Jashpur	69.7	Single	Unconfined Semi-Confined	10-20	20-60	8	14-80	40-120	1- 2	500-750
Kanker	901.7	Single	Unconfined Semi-Confined	10 - 20	15 -80	9	14 -140	40 -400	1- 2	500-750
Kawardha	221.5	Single	Unconfined Semi-Confined	10-20	20-60	10	4-50	10-240	1- 2	500-1000
Mahasamund	18.3	Single	Unconfined Semi-Confined	12 - 15	20 - 90	9	20 -82	40- 180	1- 2	500-1000
Rajnandgaon	2751.4	Single	Unconfined Semi-Confined	12 - 15	20 -80	8.5	20 - 76	40- 180	1- 2	500-1000
Total Area	**4389.3**									

DTW: Depth to Water Level, m bgl: meters below ground level

GRANITE - AQUIFER SYSTEM



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ALLUVIUM AND LATERITE - AQUIFER SYSTEMS

0 50 100
kilometers

UTTAR PRADESH
JHARKHAND
MADHYA PRADESH
MAHARASHTRA
ODISHA
ANDHRA PRADESH
CHHATTISGARH

Banas R
Gopad R
Rihand R
Kanher R
Arpa R
Hasdeo R
Mand R
Agar R
Hasdeo R
Maniyari R
Kelo R
Barai R
Mahanadi R
Jonk R
Kharun R
Seonath R
Indravati R
Pairi R
Kotri R
Narangi N
Berudi N
Sabari R
Chitda R

KORIYA
AMBIKAPUR
JASHPUR
KORBA
BILASPUR
JANJGIR-CHAMPA
RAIGARH
KAWARDHA
RAIPUR
DURG
RAJNANDGAON
MAHASAMUND
DHAMTARI
KANKER
NARAYANPUR
JAGDALPUR
DANTEWADA
BIJAPUR

LEGEND

Aquifers

- Alluvium (AL01)
- Laterite (LT01)

- State Capital
- District Headquarters
- State Boundary
- District Boundary
- Major Drainage
- Waterbody

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INTRUSIVES

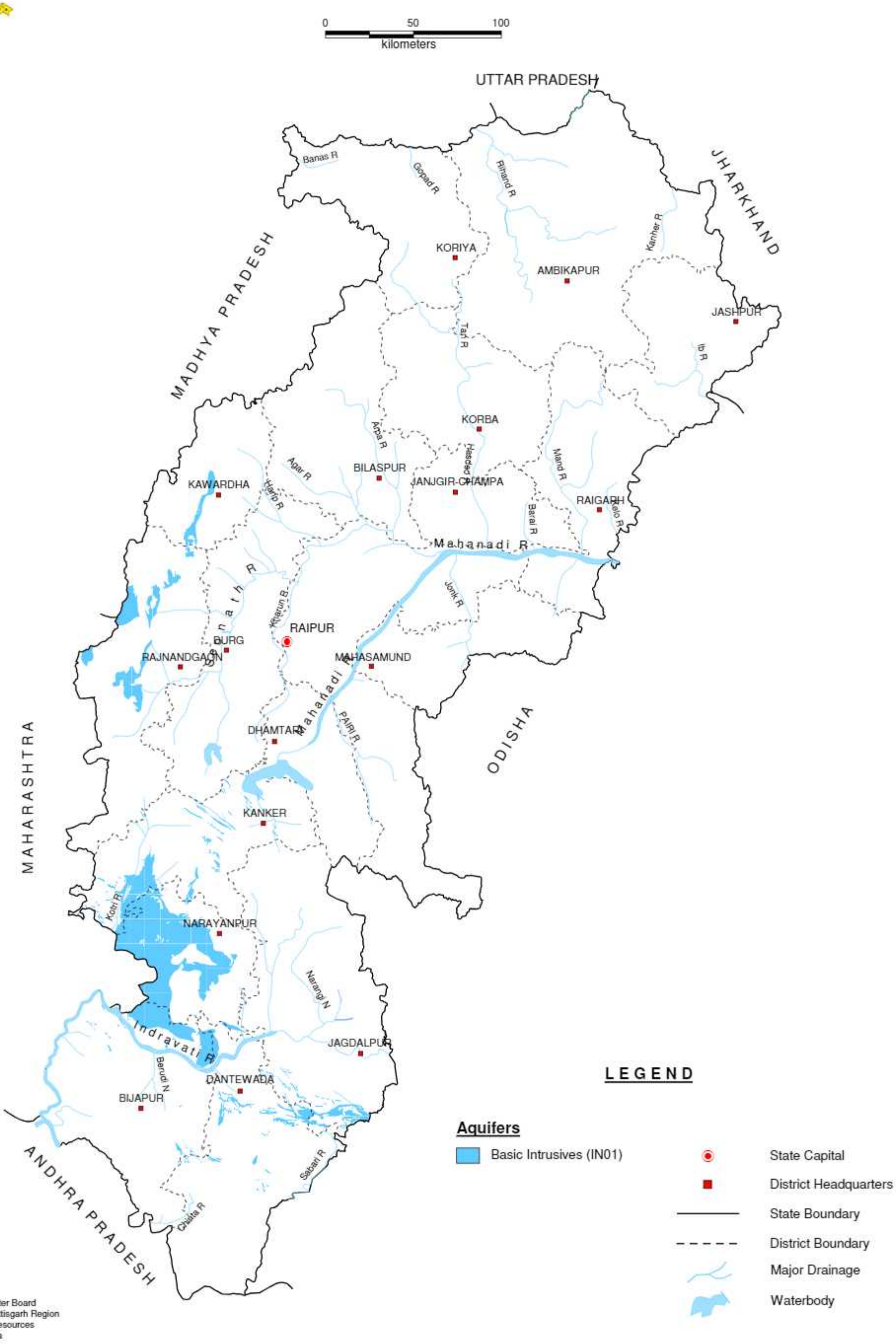

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Table 24: District wise Distribution and Characteristics of Schist Aquifer System

District Name	*Major Aquifers (Area in sq km)*		*Aquifer Properties*								
	Phyllite	Slate	Aquifer System	Type of Aquifer	Thickness of Weathered Zone	Fractures Encountered	DTW (Decadal Avg)	Transmissivity	Yield	Specific Yield	Quality (EC in µS/cm)
	SC02	SC03			*m*	*m bgl*	*m bgl*	*m^2/day*	*m^3/day*	*%*	
Bastar	2.4		Single	Unconfined Semi-Confined	5-10	20-40	7.8	2-20	40 - 100	1-1.5	500-1000
Dhamtari	10.9	2.3	Single	Unconfined Semi-Confined	5-10	20-30	7	3-30	40 - 100	1-1.5	500-1000
Jashpur	31.0	11.3	Single	Unconfined Semi-Confined	6 - 15	20 -40	12	2-35	12 - 160	1-1.5	500-1000
Kanker	1028.6		Single	Unconfined Semi-Confined	10-25	10-100	8	4-80	40- 240	1-1.5	500-1000
Raipur	470.8	1.3	Single	Unconfined Semi-Confined	10-25	10-60	8	4-40	40- 240	1-1.5	500-1000
Rajnandgaon	7.3		Single	Unconfined Semi-Confined	5-10	20-30	7	4-15	40-120	1-1.5	500-1000
Total Area	**1551.0**	**14.9**									

DTW: Depth to Water Level, m bgl: meters below ground level

CRYSTALLINE - AQUIFER SYSTEM

(QUARTZITE, SCHIST AND KHONDALITE)

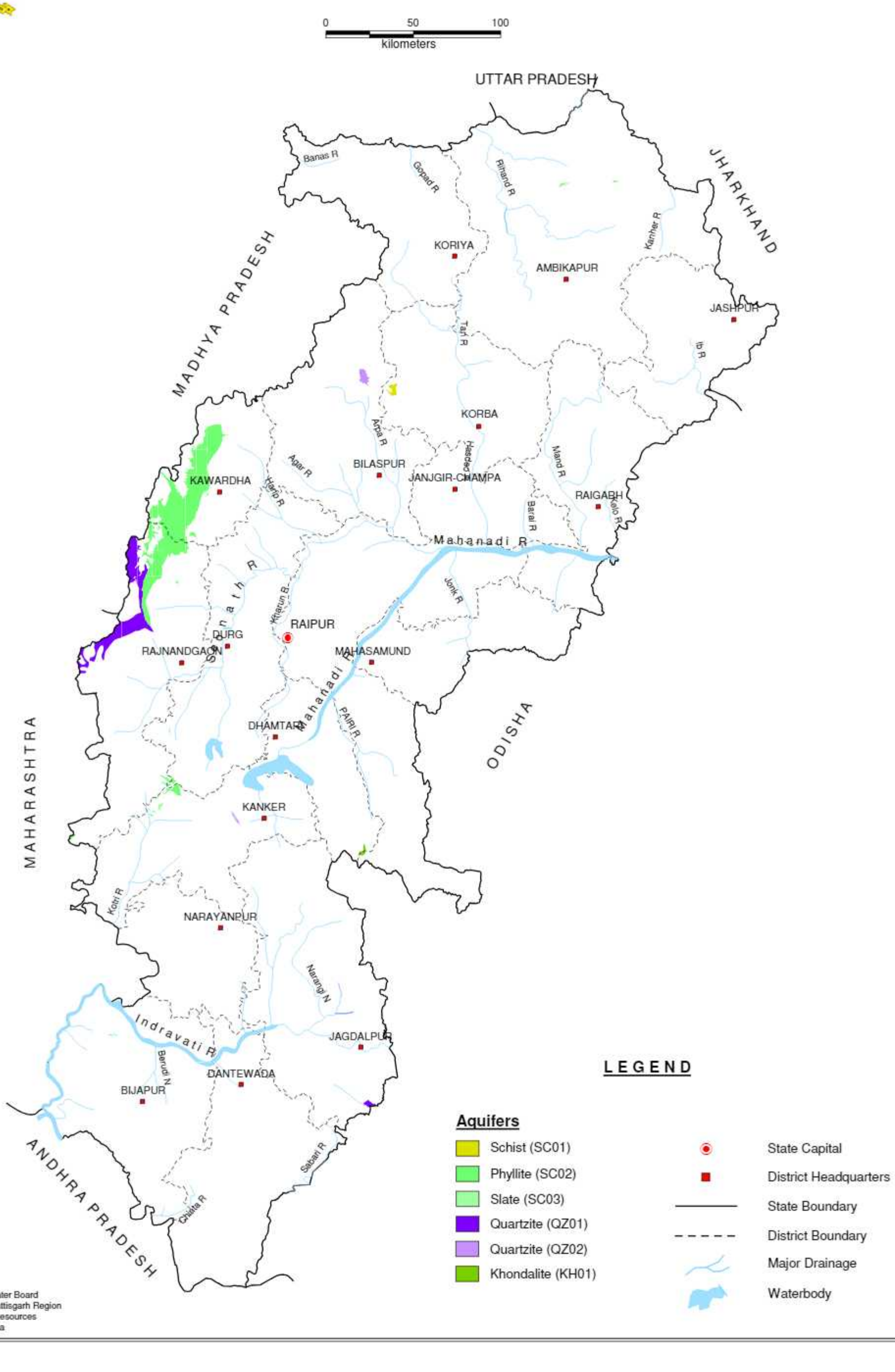

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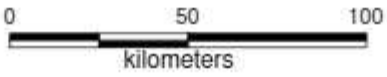
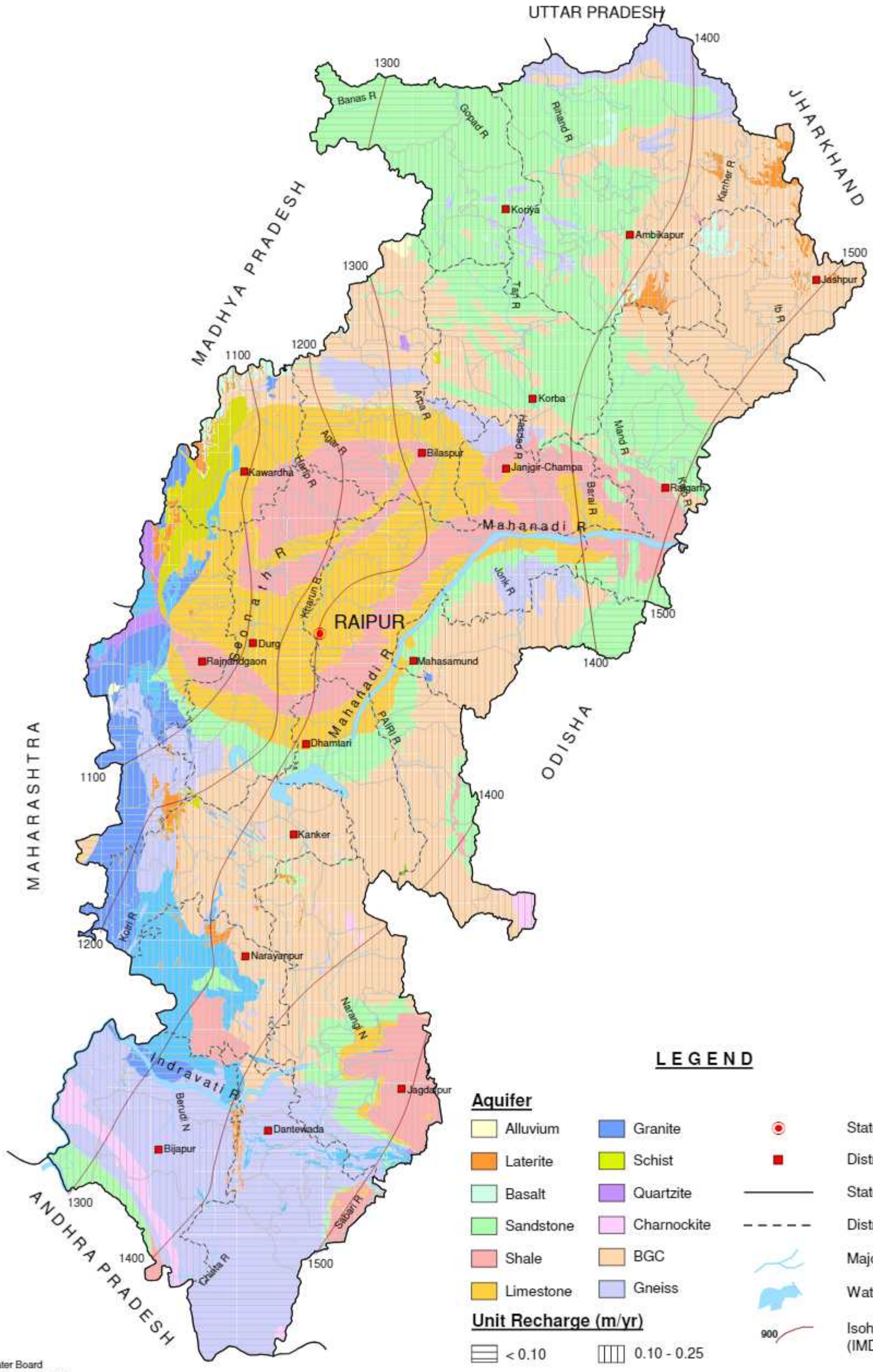
Table 25 : District wise and Aquifer wise Annual Replenishable Recharge (m/yr)

Sl No	District Name	Alluvium		Laterite		Basalt		Sandstone		Shale		Limestone		Granite		Schist		Quartzite		Charnokite		BGC		Gneiss	
		Min	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*	*Min*	*Max*
1	Bastar			0.11	0.13	0.09	0.13	0.09	0.13	0.08	0.13	0.08	0.13	0.11	0.13			0.13	0.14	0.09	0.13	0.08	0.13	0.09	0.13
2	Bijapur			0.06	0.10	0.06	0.10			0.06	0.10	0.09	0.10	0.06	0.10	0.09	0.10	0.09	0.10	0.09	0.10				
3	Bilaspur			0.08	0.14	0.08	0.14	0.07	0.14	0.06	0.11	0.06	0.11									0.07	0.14	0.07	0.11
4	Dantewada			0.06	0.10	0.06	0.10	0.08	0.09	0.06	0.10	0.09	0.10	0.06	0.10	0.09	0.10					0.06	0.10	0.06	0.10
5	Dhamtari			0.10	0.17			0.12	0.17	0.11	0.15	0.11	0.14									0.12	0.17		
6	Durg			0.10	0.10	0.11	0.10	0.10	0.15	0.09	0.17	0.09	0.17	0.10	0.15	0.10	0.11					0.11	0.17	0.10	0.15
7	Janjgir - Champa							0.09	0.01	0.09	0.13	0.09	0.13									0.10	0.11	0.09	0.10
8	Jashpur			0.09	0.13	0.11	0.12	0.11	0.12			0.11	0.22									0.09	0.15		
9	Kanker			0.11	0.13	0.11	0.15	0.11	0.15					0.12	0.13	0.12	0.13					0.11	0.15	0.11	0.15
10	Kawardha			0.11	0.22	0.12	0.22	0.11	0.13	0.09	0.13			0.11	0.22	0.11	0.17					0.11	0.22	0.11	0.13
11	Korba							0.09	0.14	0.10	0.13					0.14						0.09	0.14	0.13	0.14
12	Koriya					0.10	0.13	0.10	0.15													0.10	0.15	0.10	0.15
13	Mahasamund							0.10	0.14			0.10	0.14	0.10	0.14							0.12	0.15	0.12	0.14
14	Narayanpur			0.11	0.13	0.09	0.13			0.08	0.13													0.09	0.13
15	Raigarh			0.09	0.14	0.09		0.08	0.14	0.09	0.14	0.09	0.15									0.08	0.12		
16	Raipur			0.09	0.15	0.14		0.08	0.15	0.07	0.15	0.07	0.13	0.10	0.16					0.09	0.13	0.08	0.16	0.08	0.13
17	Rajnandgaon	0.14	0.14	0.07	0.09	0.08	0.08	0.08	0.11	0.09	0.11	0.08	0.11	0.76	0.14	0.08	0.11	0.77	0.11					0.76	0.91
18	Surguja			0.11	0.14	0.97	0.14	0.09	0.14							0.11	0.14					0.10	0.14	0.10	0.14

ANNUAL REPLENISHABLE RECHARGE





LEGEND

Aquifer

- Alluvium
- Laterite
- Basalt
- Sandstone
- Shale
- Limestone
- Granite
- Schist
- Quartzite
- Charnockite
- BGC
- Gneiss

- State Capital
- District Headquarters
- State Boundary
- District Boundary
- Major Drainage
- Waterbody
- 900 Isohyet in mm (IMD Normal)

Unit Recharge (m/yr)

- < 0.10
- 0.10 - 0.25

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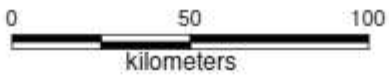
Isohyets are adopted from IMD, Data (Recharge - GW Estimation - 2009; Rainfall from IMD)

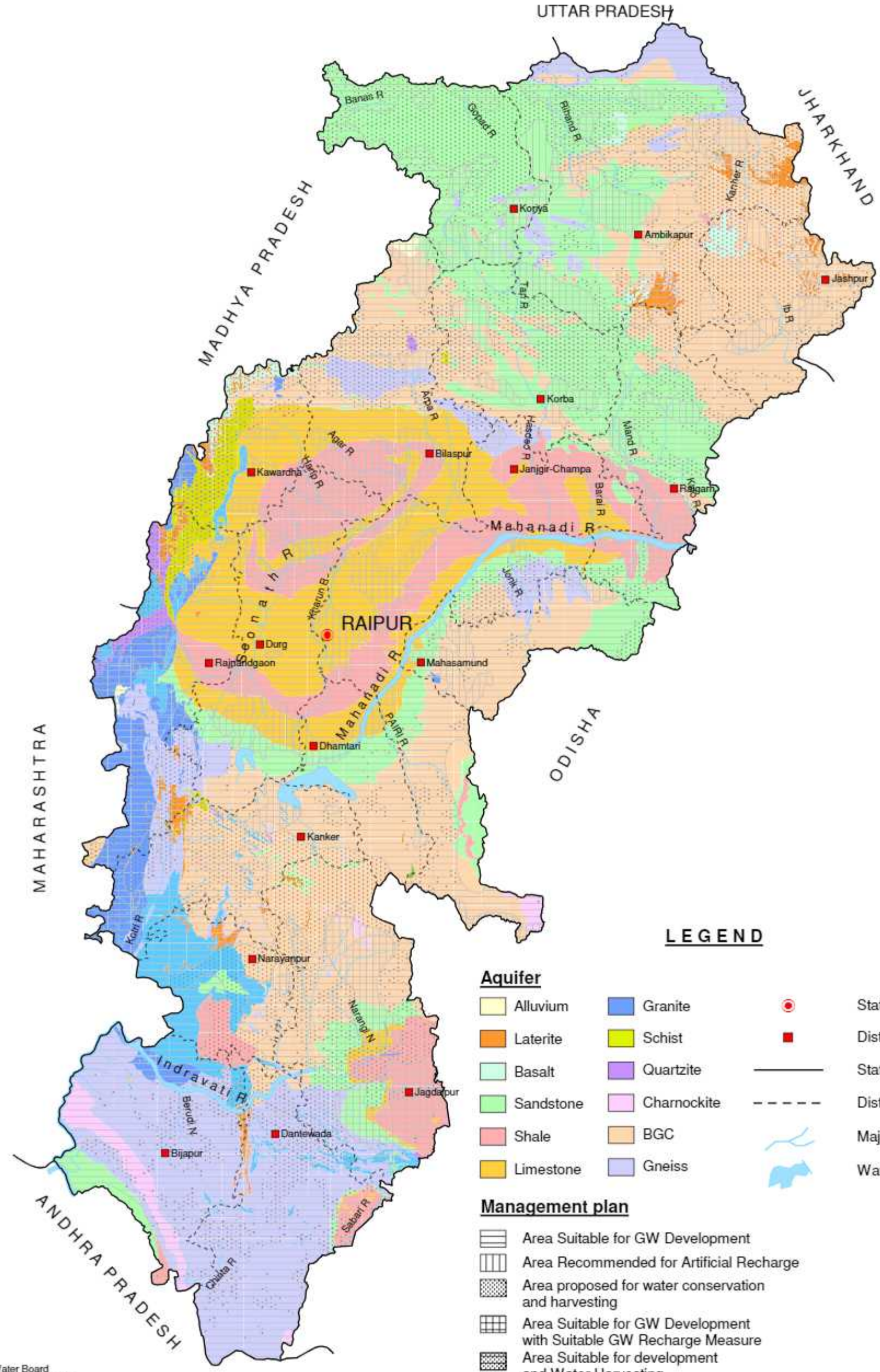
Table 26: Aquifer wise Ground Water Management Plan

Sl No	Name of Aquifer	Area covered	Area Suitable for Artificial Recharge		Area Suitable for Development		Area Suitable for Conservation	
			Area	*%*	*Area*	*%*	*Area*	*%*
1	**Alluvium**	40.41			40.41	0.03		
2	**Laterite**	1989.47	137.59	0.1	1466.01	1.08	1130.53	0.83
3	**Basalt**	5390	209.07	0.15	4452.06	3.28	1728.56	1.27
4	**Sandstone**	27976.82	5631.92	4.15	23200.75	17.11	10988.36	8.1
5	**Shale**	16027.52	5790.96	4.27	15397.56	11.36	1809.03	1.33
6	**Limestone**	16561.55	4400.63	3.25	16366.99	12.07	318.62	0.23
7	**Granite**	4453	463.25	0.34	2500	1.84	1154.7	0.85
8	**Schist**	1590.59	17.54	0.01	1571.78	1.16	1130.86	0.83
9	**Quartzite**	569.1	1.49	0	561.36	0.41	441.99	0.33
10	**Charnockite**	1210	20	0.01	76.73	0.06	24.1	0.02
12	**BGC**	39719.94	4780.08	3.53	31375.65	23.14	15953.54	11.77
13	**Gneiss**	20067.51	519.67	0.38	19334.17	14.26	5846.74	4.31
Total		**135595.91**	**21972.21**	**16.2**	**116343.47**	**85.8**	**40527**	**29.9**

Area in Sq km

GROUND WATER MANAGEMENT PLAN





LEGEND

Aquifer

- Alluvium
- Laterite
- Basalt
- Sandstone
- Shale
- Limestone
- Granite
- Schist
- Quartzite
- Charnockite
- BGC
- Gneiss

- State Capital
- District Headquarters
- State Boundary
- District Boundary
- Major Drainage
- Waterbody

Management plan

- Area Suitable for GW Development
- Area Recommended for Artificial Recharge
- Area proposed for water conservation and harvesting
- Area Suitable for GW Development with Suitable GW Recharge Measure
- Area Suitable for development and Water Harvesting

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Table 27: District wise Area Prioritized for Artificial Recharge

Sl No	District Name	Laterite	Basalt	Sandstone	Shale	Limestone	Granite	Schist	Quartzite	Charnockite	BGC	Gneiss	Total Area
1	**Bastar**		47.0	392.6	1246.4	231.2	59.2				1039.2	200.5	3216.1
2	**Bijapur**												
3	**Bilaspur**	4.0	5.2	177.3	1103.3	574.1					476.8	60.9	2401.6
4	**Dantewada**												
5	**Dhamtari**			188.2		376.8					53.9		618.9
6	**Durg**			284.0	2094.0	966.4							3344.5
7	**Janjgir - Champa**				19.5	18.9						87.8	126.2
8	**Jashpur**	66.4	1.9	1.8							909.0		979.1
9	**Kanker**		24.2	2.6			30.9		1.5		482.8	8.2	550.1
10	**Kawardha**	36.9	36.4	591.1	32.3	286.9	51.5	13.2					1048.4
11	**Korba**										292.3		292.3
12	**Koriya**		7.5	1093.5							21.0	42.7	1164.7
13	**Mahasamund**			234.0		22.6	1.8				725.7	56.8	1040.8
14	**Narayanpur**										122.2	5.5	127.6
15	**Raigarh**			616.9	811.2	80.8	37.7						1546.7
16	**Raipur**			27.9	461.9	1693.4	282.2			20.0	164.9		2650.3
17	**Rajnandgaon**		85.6	1.5	22.3	149.5		2.0				6.1	267.0
18	**Surguja**	30.3	1.3	2020.6				2.3			492.2	51.2	2597.9
Total Area		**137.6**	**209.1**	**5631.9**	**5791.0**	**4400.6**	**463.3**	**17.5**	**1.5**	**20.0**	**4780.1**	**519.7**	**21972.2**

Area in Sq km

Table 28: Area Delineated for Water Conservation and Harvesting

Sl No	District Name	Laterite	Basalt	Sandstone	Shale	Limestone	Granite	Schist	Quartzite	Charnockite	BGC	Gneiss	Total Area
1	Bastar	55.4	26.3	352.1	1163.3	165.2				24.1	2860.6	472.3	5119.2
2	Bijapur	39.1	93.5		46.7		73.8		28.8			1212.3	1494.2
3	Bilaspur	22.6	54.8	75.1		8.2					1333.2	693.8	2187.7
4	Dantewada	16.0	84.6	72.3	163.1	5.8					161.1	2001.0	2503.8
5	Dhamtari			97.0			1.0				299.9		397.9
6	Durg	10.4		15.2		2.5	33.2				20.0	135.4	216.7
7	Janjgir - Champa			31.8		5.6					35.3	23.5	96.2
8	Jashpur	121.0	270.6	88.4							2208.0		2688.0
9	Kanker	59.4	50.1	59.3			329.7	24.1	6.2		2123.6	206.2	2858.7
10	Kawardha	127.7	244.1	7.1		80.6	107.5	754.2			183.9	4.7	1509.9
11	Korba			1621.4	10.0			23.5			1113.2	10.8	2779.0
12	Koriya		1.2	4326.6							2.7	41.6	4372.1
13	Mahasamund			261.2		2.4	1.9				134.1	61.6	461.2
14	Narayanpur	8.1	585.3	84.0	421.4						715.0	14.7	1828.5
15	Raigarh	25.3	7.0	1434.7	4.5						626.2		2097.7
16	Raipur			315.6		7.7	11.9	327.2	406.9		736.7	287.5	2093.6
17	Rajnandgaon	231.4	182.0	4.6		40.4	595.5	1.9				463.4	1519.3
18	Surguja	414.2	128.9	2142.0							3400.1	218.1	6303.3
Grand Total		**1130.5**	**1728.6**	**10988.4**	**1809.0**	**318.6**	**1154.7**	**1130.9**	**442.0**	**24.1**	**15953.5**	**5846.7**	**40527.0**

Area in Sq km

Table 29: Area Suitable for Ground Water Development

Sl No	District Name	Alluvium	Laterite	Basalt	Sandstone	Shale	Limestone	Granite	Schist	Quartzite	Charnockite	BGC	Gneiss	Total Area
1	**Bastar**			217.2	685.8	2896.4	421.7			15.6	26.7	3198.9	1028.5	8490.9
2	**Bijapur**		61.8	567.2		116.6	493.4		2.4				5947.5	7188.9
3	**Bilaspur**		26.6	62.7	409.1	1467.5	2345.0			35.8		3021.6	974.6	8342.9
4	**Dantewada**		94.4	279.8	92.4	490.9	27.8	33.8				270.2	7056.7	8345.9
5	**Dhamtari**		8.2		968.3	396.2	782.7					1795.9		3951.2
6	**Durg**				889.7	2899.8	3613.8	39.1	13.1			613.4	410.1	8479.0
7	**Janjgir - Champa**				180.7	2213.7	1126.4					75.3	281.6	3877.6
8	**Jashpur**		165.3	6.2	9.7							3238.7		3419.9
9	**Kanker**		128.1	491.8	19.1			704.6	23.5			3230.9	478.1	5076.1
10	**Kawardha**		213.7	451.7	9.7	324.7	1506.6	221.5	1028.6			454.3	17.4	4228.3
11	**Korba**				4115.7	81.5			23.5			2270.9	130.3	6621.8
12	**Koriya**			11.4	3615.1							30.0	115.3	3771.7
13	**Mahasamund**				1109.5		207.4	18.3				2924.8	339.1	4599.1
14	**Narayanpur**		132.7	1528.8	82.7	186.1						980.8	127.9	3039.0
15	**Raigarh**		31.4	7.0	3743.9	1517.8	163.1					1317.5		6780.7
16	**Raipur**		1.0		1128.2	2307.1	4051.9	164.2			50.0	3229.4	505.7	11437.5
17	**Rajnandgaon**	40.4	292.9	629.7	171.2	499.4	1627.3	1319.0	472.2	510.0			637.5	6199.6
18	**Surguja**		309.8	198.5	5969.9				8.5			4723.1	1284.0	12493.8
Total		**40.4**	**1466.0**	**4452.1**	**23200.8**	**15397.6**	**16367.0**	**2500.5**	**1571.8**	**561.4**	**76.7**	**31375.7**	**19334.2**	**116343.9**

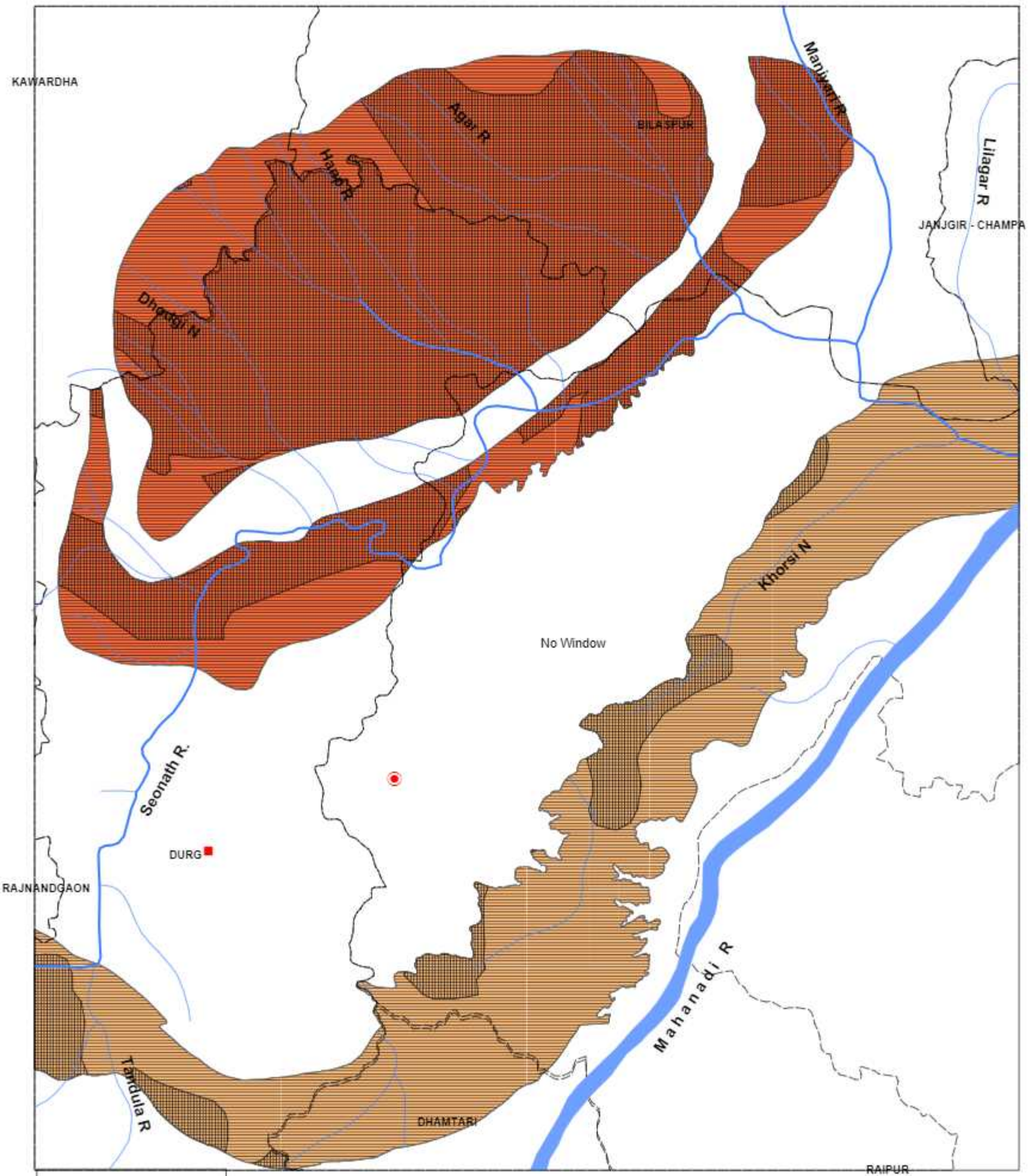
Area in Sq km

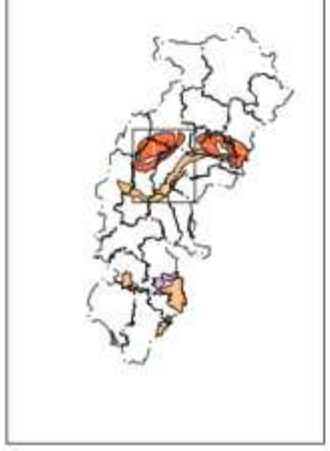
AQUIFER MANAGEMENT PLAN

SHALE AQUIFER ,CHHATTISGARH BASIN

0 50 100

kilometers





LEGEND

MANAGEMENT PLAN

- State Capital
- District HQ
- District Boundary
- Drainage
- Area Suitable for Development
- Area Suitable for Development backed by Artificial Recharge

AQUIFERS

- Shale (SH05)
- Shale with Limestone (SH06)

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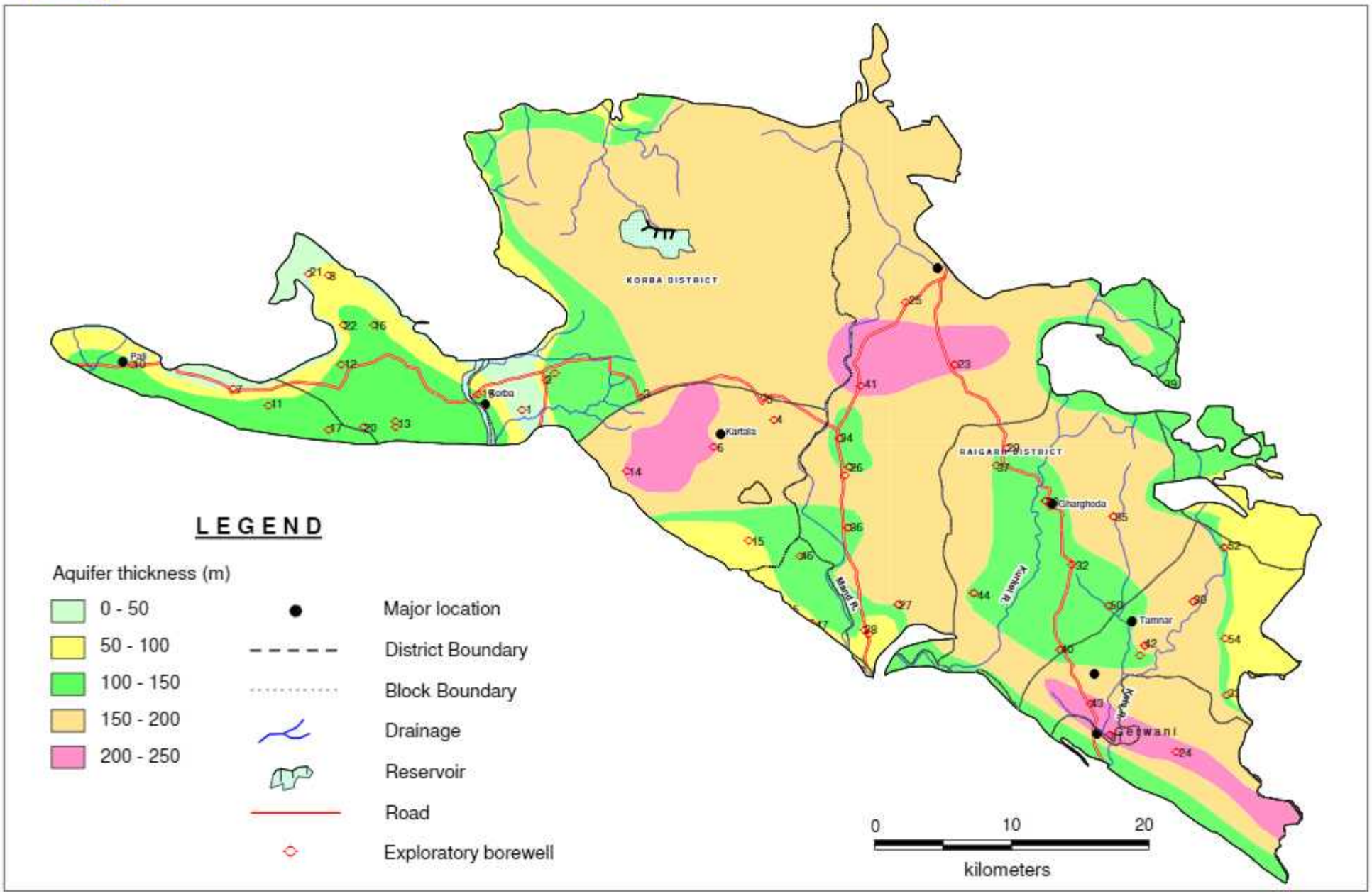
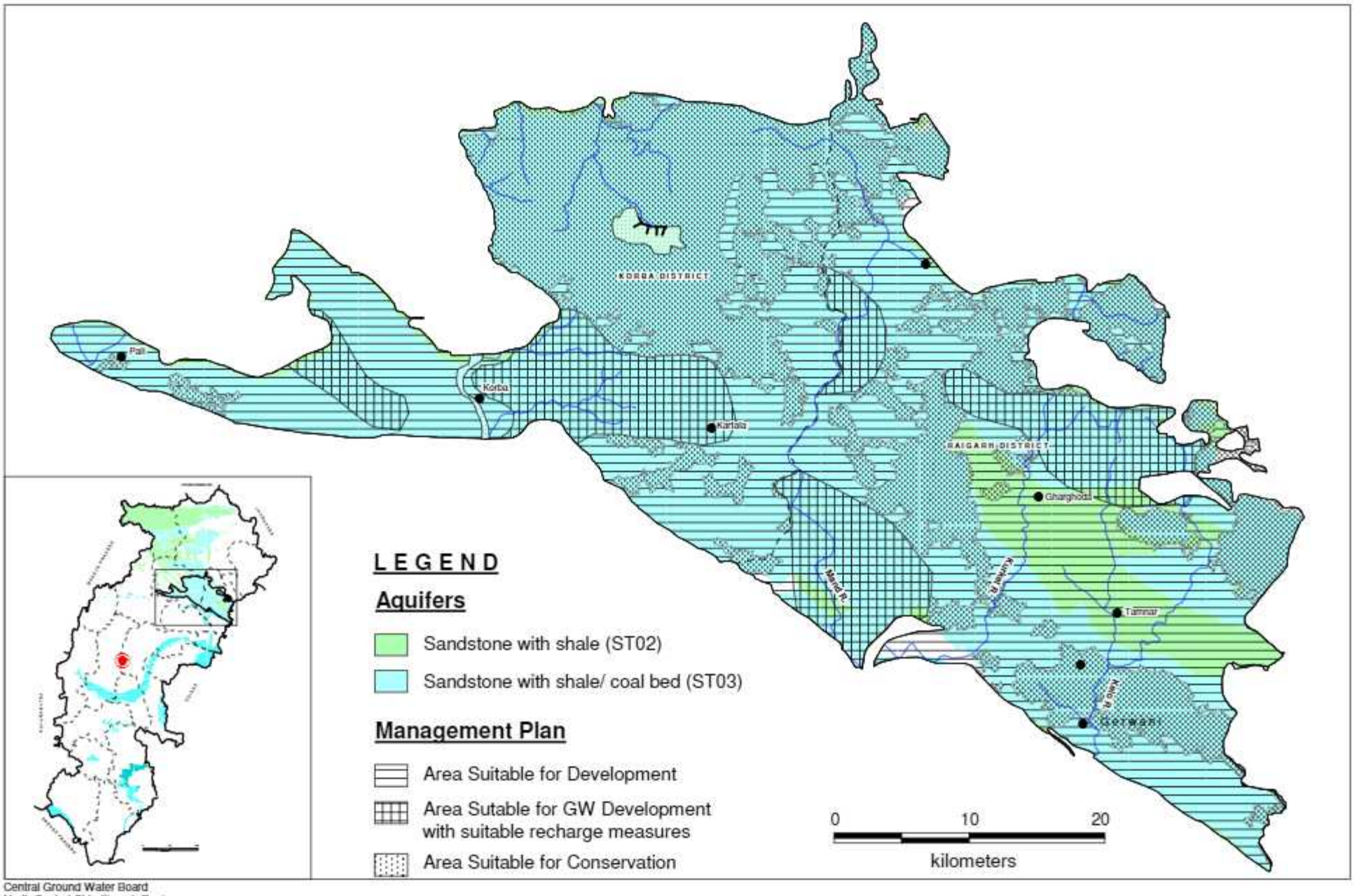
AQUIFER MANAGEMENT PLAN

GONDAWANA AQUIFER, MAND BASIN





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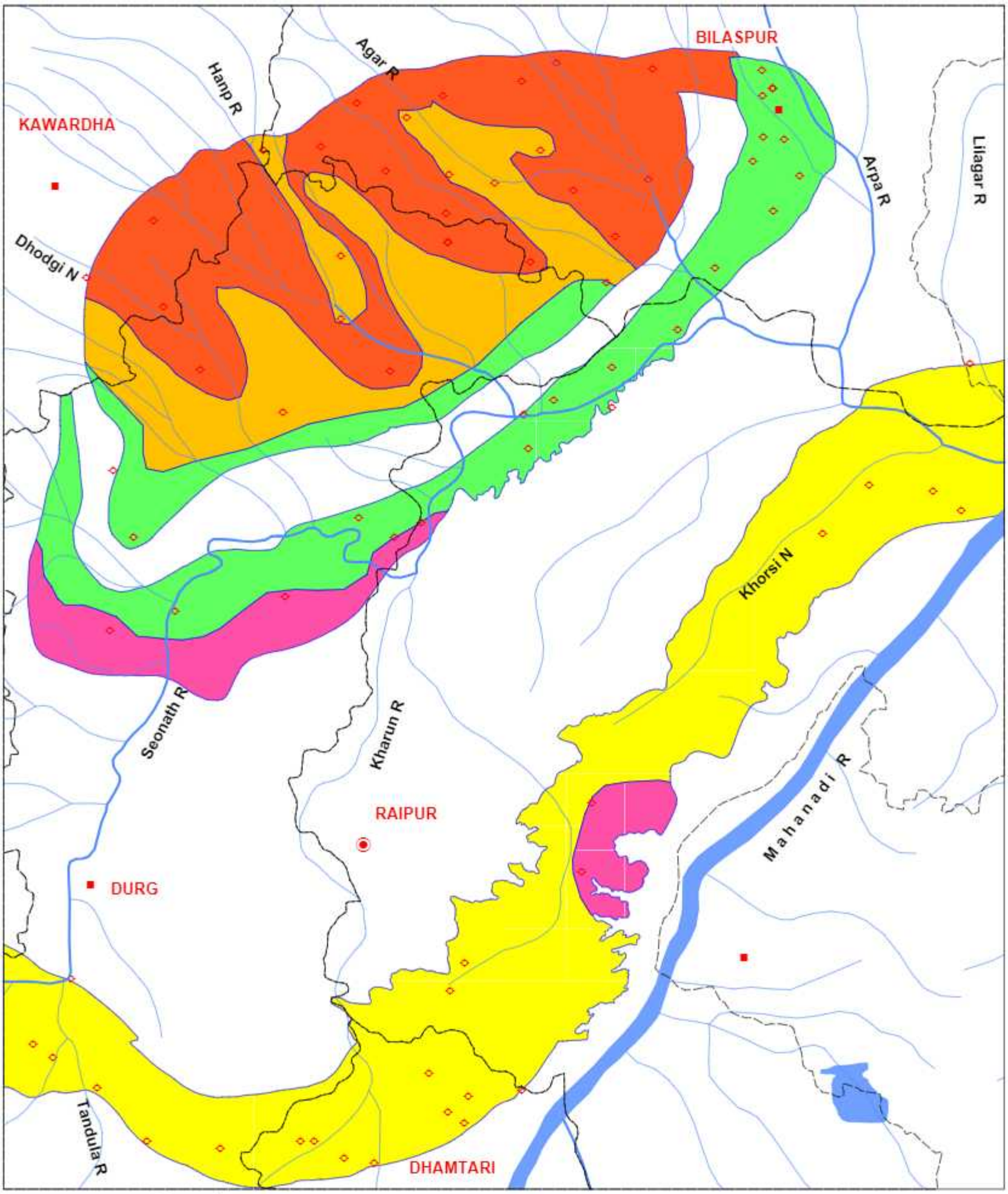
Government of India

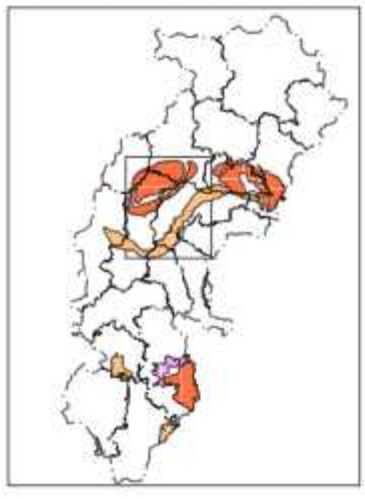
ISOPACH MAP

SHALE AQUIFER

N
W E
S

0 50 100
kilometers





LEGEND

- State Capital
- District Headquarters
- State Boundary
- Exploratory Well
- Water Body
- Drainage

Thickness of aquifer (m)

- < 40
- 40 -60
- 60 -80
- 80 - 100
- > 100

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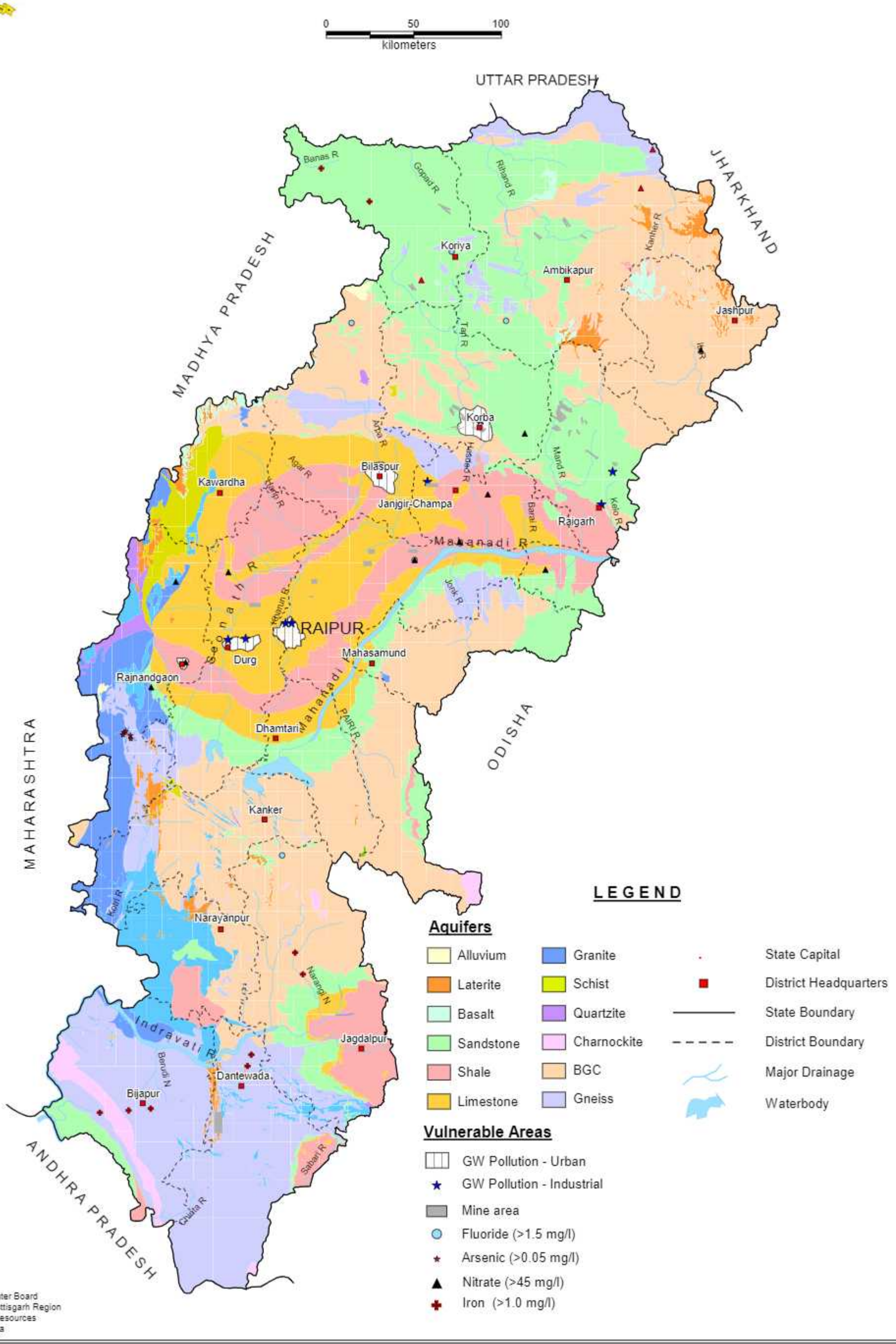
GROUND WATER VULNERABLE AREAS *



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WAY FORWARD

Looking into the increasing thrust on ground water resources and the present scenario of availability with its expected demand to raise in future, calls for attention in for re-orientation of approach in ground water management. While addressing the issues of management of ground water it is imperative that proper planning keeping in mind various social obligations and its requirement for various purposes is ensured. There is a need to synergize the fragmented efforts of various agencies/ institution/ stakeholders those are involved in the domain of ground water. It is only the comprehensive management plan that can provide a frame-work for the sustenance of ground water resources and focus on various issues related to sustainable ground water development with appropriate management interventions would be the right path. In order to achieve the same multi-disciplinary and multi-jurisdictional approach is required to ensure proactive participation of the stakeholders at appropriate levels.

The aquifer atlas of Chhattisgarh prepared at 1:2,50,000 scale is the initial base line approach to guide towards the route of ground water management. This atlas provides a synoptic view of characterization of regional and local aquifer systems of the State. Further refinement of this is essential to understand the local aspects of geology, hydrology and geochemistry of major aquifer/ sub-aquifer systems of the State. Furtherance to this would be attained by simultaneous mapping of stakeholders and governance institutions including Central and State Governments, Panchayats, Water User Associations (WUA), other community organizations and non-profit organizations.

This requires filling of data gaps through exploratory drilling /other investigations; synthesis of data collected during specific studies carried out by various Government organizations and other agencies into a new data set that broadly describe an aquifer system covering the entire area of State on a regional/ local scale; placing of long-term data generation into a system of regional data base in GIS platform; compilation of data and use of computer based models to simulate ground water flow system using estimated hydrologic characteristics as model inputs and lastly the results of simulations that would be used to define changes in recharge and discharge conditions brought about by development. Also the understanding of regional ground water flow system functions under natural i.e. pre-developed and current i.e. developed conditions has to be ascertained. The ultimate goal is to establish, with the availability of data in micro-level and development of models on local / micro-scale societal management interventions can be planned.

This atlas prepared would be refined for mapping the geometry and extent of aquifers the State at 1:50,000 scale to develop hydrogeological conceptual model; develop an understanding of the inter-connections in the aquifers; understanding flow from recharge to discharge and to assess the sustainability of aquifers which would lead to developing of protection/ management strategies. Once the conceptual hydrogeological model is established the input of the same would be put to numerical model which in turn shall help to predict how much ground water can be safely developed from an aquifer; assess potential for contamination migration from surface sources; complete capture zone analysis and to develop well head protection strategies.