केंद्रीय भूमि जल बोर्ड

जल संसाधन, नदी विकास और गंगा संरक्षण

विभाग, जल शक्ति मंत्रालय

भारत सरकार

Central Ground Water Board

Department of Water Resources, River Development and Ganga Rejuvenation,

Ministry of Jal Shakti

Government of India

AQUIFER MAPPING AND MANAGEMENT OF GROUND WATER RESOURCES

BILASPUR DISTRICT, CHHATTISGARH

उत्तर मध्य छत्तीसगढ़ क्षेत्र, रायपुर

North Central Chhattisgarh Region, Raipur

2020-21

भारत सरकार

Government of India

जल शक्ति मंत्रालय, जल संसाधन, नदी विकास एवं गंगा संरक्षण बिभाग

Ministry of Jal Shakti, Department of Water Resources, River Development & Ganga Rejuvenation

केन्द्रीय भूमि जल बोर्ड

Central Ground Water Board

बिलासपुर जिला, छत्तीसगढ़ के जलभृत नक्शे एवं भूजल प्रबंधन योजना

Aquifer Maps and Ground Water Management Plan of Bilaspur District, Chhattisgarh

केन्द्रीय भूमि जल बोर्ड

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रायपुर

FOREWORD

Groundwater resources are being developed over years in order to meet domestic, irrigation and industrial requirements. The spatial distribution of availability of ground water resources however, is uneven and is being indiscriminately exploited by various users thereby creating relentless pressure. On the other hand, rapid urbanization, industrialization and land use changes has resulted decline of water levels in many parts of the country.

There is an urgent need for scientific approach for proper management of the available ground water resources for sustainability of this precious natural resource for present and future generation.

Central Ground Water Board has been in the forefront of activities for occurrence, development, and management of this resource through various scientific studies and techniques. Over the last four decades CGWB, NCCR, Raipur has gathered a huge amount of data regarding ground water resources of Chhattisgarh. Based on this experience aquifer mapping of Bilaspur district was prepared with the vast amount of data generated and available with North Central Chhattisgarh Region. The report embodies all the features of ground water and related aspects of the study area including physiography, meteorological conditions, hydrology, drainage, geomorphology, geology, hydrogeology, ground water resources, hydrochemistry, geophysics, ground water problems etc.

The report titled "A REPORT ON AQUIFER MAPS AND GROUNDWATER MANAGEMENT PLAN OF BILASPUR DISTRICT, CHHATTISGARH" is prepared by Sh. Sidhant Kumar Sahu, Scientist-B under supervision of Sh. A.K. Biswal, Scientist-E. I appreciate the concerted efforts put by the author to make it possible to bring the report in its present shape. I hope this report will no doubt be useful and worthy for the benefit of Bilaspur district and would be a useful document for academicians, administrators, planners and all the stakeholders in ground water.

Though utmost care has been taken to minimize the errors, some errors may have inadvertently crept in. It is expected that these mistakes will be taken in the proper spirit.

Dr. P. K. Naik
(REGIONAL DIRECTOR)

Executive summary

Aquifer mapping is a multidisciplinary scientific process wherein a combination of geological, hydrogeological, geophysical, hydrological and quality data is integrated to characterize the quantity, quality and movement of ground water in aquifers. However, due to paradigm shift in focus from development to management of ground water in last one decade, the need for more reliable and comprehensive aquifer maps on larger scale has been felt for equitable and sustainable management of the ground water resources at local scale. Volumetric assessment of ground water and strategies for future development and management are the primary objectives of aquifer mapping.

Under the aquifer mapping Programme, all the development blocks of Bilaspur District namely Bilha, Kota, Marwahi, Masturi, Pendra, Gaurela and Takhatpur were taken up for study covering an area of 5816 sq. km. It falls in the Survey of India's Degree Sheet No. 64 E 16, F (10, 11, 13, 14, 15 & 16), G 13, I 14, J (1, 2, 3, 4, 7 & 8) and K (1, 5 & 6) between the Latitude 21° 70'- 23° 14'N and Longitude 81° 71' to 82° 48'. Bilaspur district is situated in the NNW corner of Chhattisgarh. The northern part is bordered by Koria Districts (Chhattisgarh) and Madhyapradesh. On the eastern and south-eastern part has common boundaries with Korba district and Janjhgirchampa district respectively. The southeren part is bordered by Bolodabazar district and the western boundary is shared by Mungeli district. The nearest airport to the District is at Bilaspur. All-important places within the district are well connected by a network of the state highways and all-other roads.

The total population of the study area as per 2011 Census is 19,61,922 out of which rural population is 13,47,491 & the urban population is only 6,14,431.

The study area experiences sub-tropical climate. The average annual rainfall for the study area is around 1078 mm (Average of the last five years i.e. 2013 to 2018)

Geomorphologically the study area displays Structural Plains, Pediment/Pediplain, Denudational Hills and Flood plains with an elevation ranging from 250 to 1120 msl.

The net sown area is 225397 Ha, while double-cropped area is 28424 Ha. The gross cropped area of the district is 253825 Ha. The net Irrigated cropped area is 112700 Ha, while the area under groundwater irrigation is 51375 Ha which is about 45.58% of net cropped area.

Based on the exploratory drilling data generated for the blocks, the existing aquifer systems in the area may be divided into phreatic and fractured aquifer. The major aquifers present in the study area are 1. Shale (Maniari and Terenga), 2. Limestone (Pandaria and Chandi) and Granite (Kanker granite), Discharge varies from negligible to 26 lps in fractured aquifer and 10 to 130 m3/day in weathered aquifer. Higher yields are obtained where thick weathered zones are associated with bedrock fracturing.

As per 2020 ground water resource calculation stage of ground water development in the study area is only 47.52 %. So, there is scope of utilizing more ground water for future irrigation purpose and other purposes. Additional number of Ground water abstraction structure may be developed for the effective utilization of ground water resources.

The existing demand for irrigation in the area is 16945.32 Ham while the same for domestic use is 6132.76 Ham and for industrial field is 558.36 Ham. To meet the future demand for ground water, a total quantity of 24379.34 Ham of ground water is available for future use.

The major ground water issues identified during the survey in the study area are as follows: (i) Drying of Dugwells and handpumps during summer. (ii) Inherent hydrogeological character of aquifer. (iii) Drilling difficulties in limestone terrain (iv) Fluoride concentration. (v) Nitrate contamination and (vi) Uranium contamination.

In study area because of complex hydrogeological conditions ground availability is scattered. In area where ground water availability is limited, surface water may be conserved and utilized. High value of Fluoride and Nitrate has been reported from several locations. In granitic aquifer system at many places ground water is contaminated with Fluoride because of geogenic reasons. The problem of fluoride contamination in drinking water may be tackled by setting up of small defluorination units in affected villages or alternate source may be identified. Similarly, Iron filter may be used for the villages having high Iron concentration. Regular ground water quality monitoring is also required.

So far as Management strategies are concerned for ground water availability, for effective utilization of Ground water existing draft for irrigation may be coupled with micro irrigation system. Change in irrigation pattern, optimum use of available resource, use of ground water potential created after artificial recharge can lead to groundwater savings and increase in gross cropped area of the district.

Acknowledgment

The author is grateful to Shri Sunil Kumar, Chairman, Central Ground Water Board for giving opportunity for preparation of Aquifer Map and Management Plan of, Bilaspur district of Chhattisgarh state. I express my sincere gratitude to Shri Sateesh Kumar Member (East), CGWB for giving valuable guidance, encouragement and suggestions during the preparation of this report. The author is thankful to Dr. P. K Naik, Regional Director, Central Ground Water Board, NCCR, Raipur for extending valuable guidance and constant encouragement during the preparation of this report. I am extremely grateful to Sh. A.K. Biswal, Scientist-E for his continuous guidance and support during preparation of this report. The author is also thankful to Dr. P. K Naik, Regional Director (Retd.) and Sh A.K. Patre, Sc-D for the guidance and suggestions. I would like to acknowledge the help rendered by Smt Prachi Gupta, Sc-B while preparing aquifer map and 3-d disposition of aquifers. The author is also thankful to Sh Uddeshya kumar, Sc-B for rendering help and valuable inputs while preparing the report. The author is also thankful to Sh Rakesh Dewangan, Sc-B for the chemical analysis and valuable inputs on quality issues. The author is also thankful to Sh A. K. Sinha, Sc-B for sharing the geophysical studies. The efforts made by Sh. T.S. Chouhan, Draftsman, for digitization of maps are thankfully acknowledged. The author is also thankful to the state agencies for providing the various needful data. The author is thankful to Technical Section, Data Centre, Chemical Section, Report Processing Section and Library of CGWB, NCCR, Raipur for providing the various needful data.

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AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN, BILASPUR DISTRICT, CHHATTISGARH

(08 BLOCKS- BILASPUR, PATHALGAON, KANSABEL, KUNKURI, DULDULA, PHARSABAHAR, BAGICHA & MANORA)

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ABBREVIATIONS

a msl	above mean sea level
BDR	Basic Data Report
BW	Borewell
CGWB	Central Ground Water Board
Dia	Diameter
DTW	Depth to Waterlevel
DW	Dugwell
EC	Electrical Conductivity
EW	Exploratory Wells
GS	Gabion structures
GW/ gw	Ground Water
ham	Hectare meter
HP	Handpump (Shallow)
lpcd	litres per capita per day
lpm	litres per minute
lps	liters per second
m	meter
m bgl	meter below ground level
m2/day	Square meter/ day
m3/day	cubic meter/day
MCM/mcm	Million Cubic Meter
NCCR	North Central Chhattisgarh Region
NHNS/ NHS	National Hydrograph Network Stations
OW	Observation Well
PZ	Piezometre
STP	Sewage Treatment Plan
T	Transmissivity
TW	Tubewell

1. INTRODUCTION

1.1 Objective

The groundwater is the most valuable resource for the country. However, due to rapid and uneven development, this resource has come under stress in several parts of the country. Central Ground Water Board (CGWB) is, therefore, involved in hydrogeological investigations for the re-appraisal of groundwater regime. CGWB has also carried out ground water exploration in different phases with prime objective of demarcating and identifying the potential aquifers in different terrains for evaluating the aquifer parameters and also for developing them in future. The reports and maps generated from the studies are mostly based on administrative units such as districts and blocks and depict the subsurface disposition of aquifer on regional scale. However, due to paradigm shift in focus from development to management of ground water in last one decade, the need for more reliable and comprehensive aquifer maps on larger scale has been felt for equitable and sustainable management of the ground water resources at local scale.

1.2 Scope of study

The groundwater management plan includes Ground Water recharge, conservation, harvesting, development options and other protocols of managing groundwater. These protocols will be the real derivatives of the aquifer mapping exercise and will find a place in the output i.e, the aquifer map and management plan. The main activities under NAQUIM are as follows:

a) Identifying the aquifer geometry

b) Aquifer characteristics and their yield potential

c) Quality of water occurring at various depths

d) Assessment of ground water resources

e) Preparation of aquifer maps and

f) Formulate ground water management plan

The demarcation of aquifers and their potential will help the agencies involved in water supply in ascertaining, how much volume of water is under their control. The robust and implementable ground water management plan will provide a “Road Map” to systematically manage the ground water resources for equitable distribution across the spectrum.

1.3 Approach and Methodology

The activities under the aquifer project can be summarized as follows:

i) Data Compilation & Data Gap Analysis: One of the important aspects of the aquifer mapping Programme was the synthesis of the large volume of data already collected during specific studies carried out by the Central Ground Water Board and various other government organizations with a new set of data generated that broadly describe an aquifer system. The data were compiled, analyzed, synthesized and interpreted from available sources. These sources were predominantly non-computerized data that were converted into computer-based GIS data sets. On the basis of these available data, Data Gaps were identified.

ii) Data Generation: It was evident from the data gap that additional data should be generated to fill the data gaps in order to achieve the objective of the aquifer mapping Programme. This was done by multiple activities like exploratory drilling, hydro chemical analysis, use of geophysical techniques as well as detail hydrogeological surveys.

ii) Aquifer map Preparation: On the basis of integration of data generated through various hydrogeological and geophysical studies, aquifers have been delineated and characterized in terms of quality and potential. Various maps have been prepared bringing out the Characterization of Aquifers. These maps may be termed as Aquifer Maps depicting spatial (lateral and vertical) variation of the aquifers existing within the study area, quality, water level and vulnerability (quality and quantity).

iv) Aquifer Management Plan: Based on the integration of these generated, compiled, analysed and interpreted data, the management plan has been prepared for sustainable development of the aquifer existing in the area.

1.4 Area Details

Under the aquifer mapping Programme, an area comprising of 7 no of blocks of Bilaspur district was taken up covering an area of 5816 sq. km. Bilaspur district is situated in the NNW corner of Chhattisgarh (Fig.1). The northern part is bordered by Koria Districts (Chhattisgarh) and Madhyapradesh. On the western and south-western part has common boundaries with Korba district and Janjhgirchampa district respectively. The southeren part is bordered by Bolodabazar district and the western boundary is shared by Mungeli district. It falls in the Survey of India's Degree Sheet No. 64 E 16, F (10, 11, 13, 14, 15 & 16), G 13, I 14, J (1, 2, 3, 4, 7 & 8) and K (1, 5 & 6) between the Latitude 21° 70'- 23° 14'N and Longitude 81° 71' to 82° 48'. The nearest airport to the District is at Bilaspur. All-important places within the district are well connected by a network of the state highways and all-other roads.

1.4.1 Administrative Division

District includes 07 blocks and It is further divided in 645 gram panchayats and 905 villages. The name of the 7 blocks are given below.

1. Bilha Block
2. Kota Block
3. Marwahi Block
4. Masturi Block
5. Pendra Block
6. Gaurela Block
7. Takhatpur Block

The administrative map for the study area is given in Figure 1.

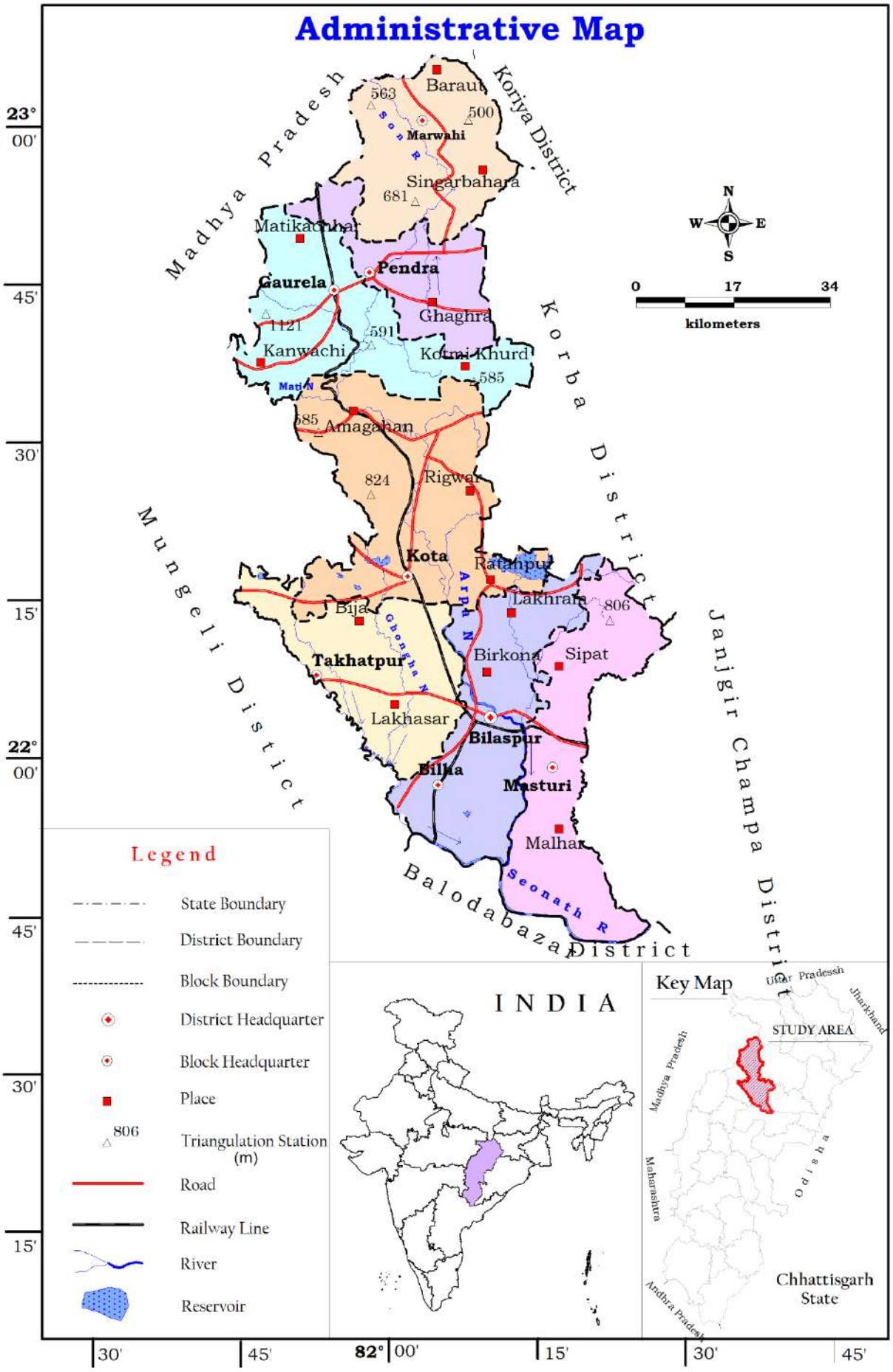

Figure 1 Administrative Map of Bilaspur District

1.5 Data Availability, Data Adequacy and Data gap Analysis

Table 1 Data Integration

Districts	Blocks	Existing			Data Generation		
		EW	Chem	WL	EW	Chem	WL
Bilaspur	Bilha	14	09	09	03	19	19
	Kota	08	20	20	05	23	23
	Marwahi	03	13	13	0	10	10
	Masturi	05	09	09	01	20	20
	Pendra	0	03	03	0	09	09
	Gaurela	03	04	04	03	11	11
	Takhatpur	17	08	08	0	13	13
TOTAL		**50**	**66**	**66**	**12**	**105**	**105**

1.6 Rainfall

The study area receives rainfall mainly from south-west monsoon. It sets in third/fourth week of June and continues till mid-August/September with heaviest showers in the months of July and August and nearly 95% of the annual rainfall is received during this period. The average annual rainfall for the study area is around 1078 mm (Average of the last five years i.e. 2013 to 2018) which is presented below in Figure 2. Source: Statistical handbook Bilaspur district.

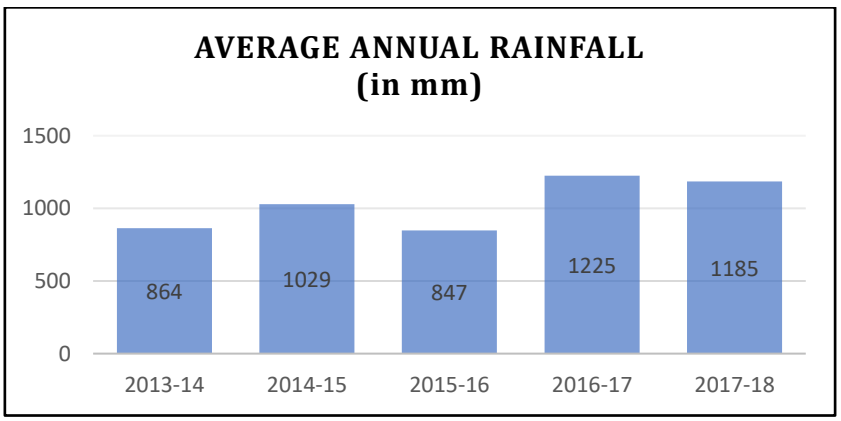

Figure 2 Avg. Rainfall in Bilaspur District

1.7 Physiography/Geomorphology

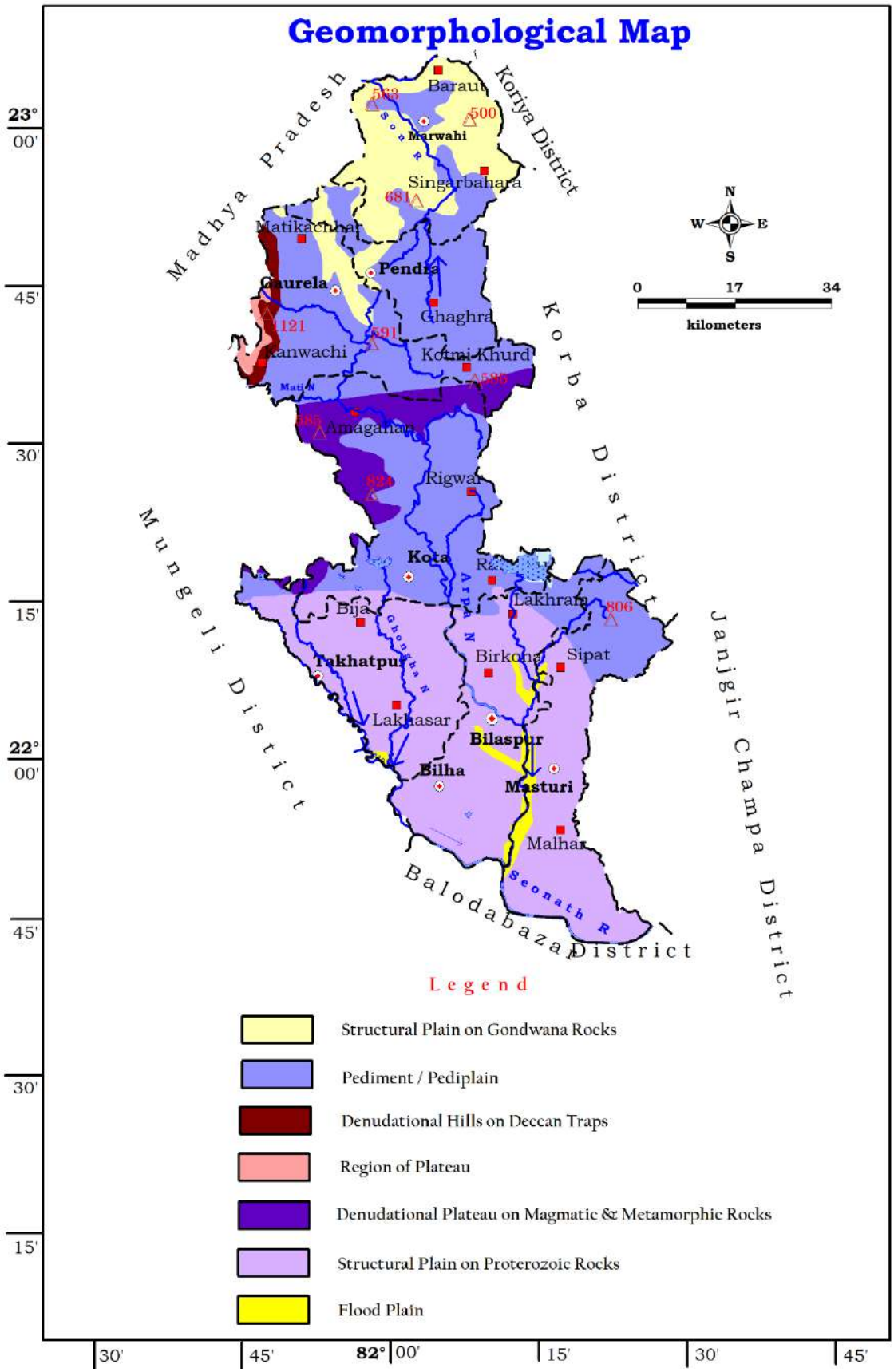

Figure 3 Geomorphology Map of the Study area

The southern part of the district is a plain land with gentle slopes. It is also called the Chhattisgarh plains. The land is very fertile and is mostly used for the agriculture purposes. The northern part of the district is mostly hilly with highly undulating topography where the agriculture is restricted to few patches only. Physiographically the Bilaspur district can be divided into two parts. The first part consists high plateau area covering north and central part of the district (covering Kota, Gaurela, Pendra and Marwahi blocks) separated by the intermittent narrow valleys and steeply slopping plains. The second part is the gently slopping plain land covering southern parts of the district (Takhatpur, Belha and Masturi blocks). The high topographic area on the northern part of the district forms water divide between the rivers Ganges and Mahanadi. The hill ranges on the northwestern part is the water divide between Mahanadi and Narmada Rivers. Major part of the Chhattisgarh basin is drained by Mahanadi River. The topography varies between 250 m amsl in the southern plains and 1120 m amsl in the northern hills. Basically the hill ranges on northern part are due to structural activities and the area on southern part (Chhattisgarh plain) can be categorised as pediplain.

1.8 Land use

There is 111489 ha revenue forest, protected forest and other forest in the district. Area not available for cultivation is 38845 ha. Details are presented in Table no.2. Figure 4 shows the Landuse pattern in the study area.

Table 2 Land use pattern (in ha)

Blocks	Total Geographical Area (In ha)	Revenue forest area (In ha)	Area not available for cultivation (In ha)	Non-agricultural & Fallow land (In ha)	Agricultural Fallow land (In ha)	Net sown area (In ha)	Double cropped area (In ha)	Gross cropped area (In ha)
Gourela	59830	31738	2204	2811	639	19032	2129	21161
Marwahi	70772	26912	6658	9101	1550	23584	1164	24748
Pendra	34921	14360	1302	2511	715	14179	3045	17224
Takhatpur	71940	1231	5104	3806	3302	45449	10719	56168
Masturi	73920	3036	6318	4335	4034	46848	2589	49437
Bilha	79877	1674	8738	6508	5824	45034	6226	51260
Kota	83345	32538	8521	2740	1869	31271	2552	33827
Bilaspur (Total)	**474605**	**111489**	**38845**	**31812**	**17933**	**225397**	**28424**	**253825**

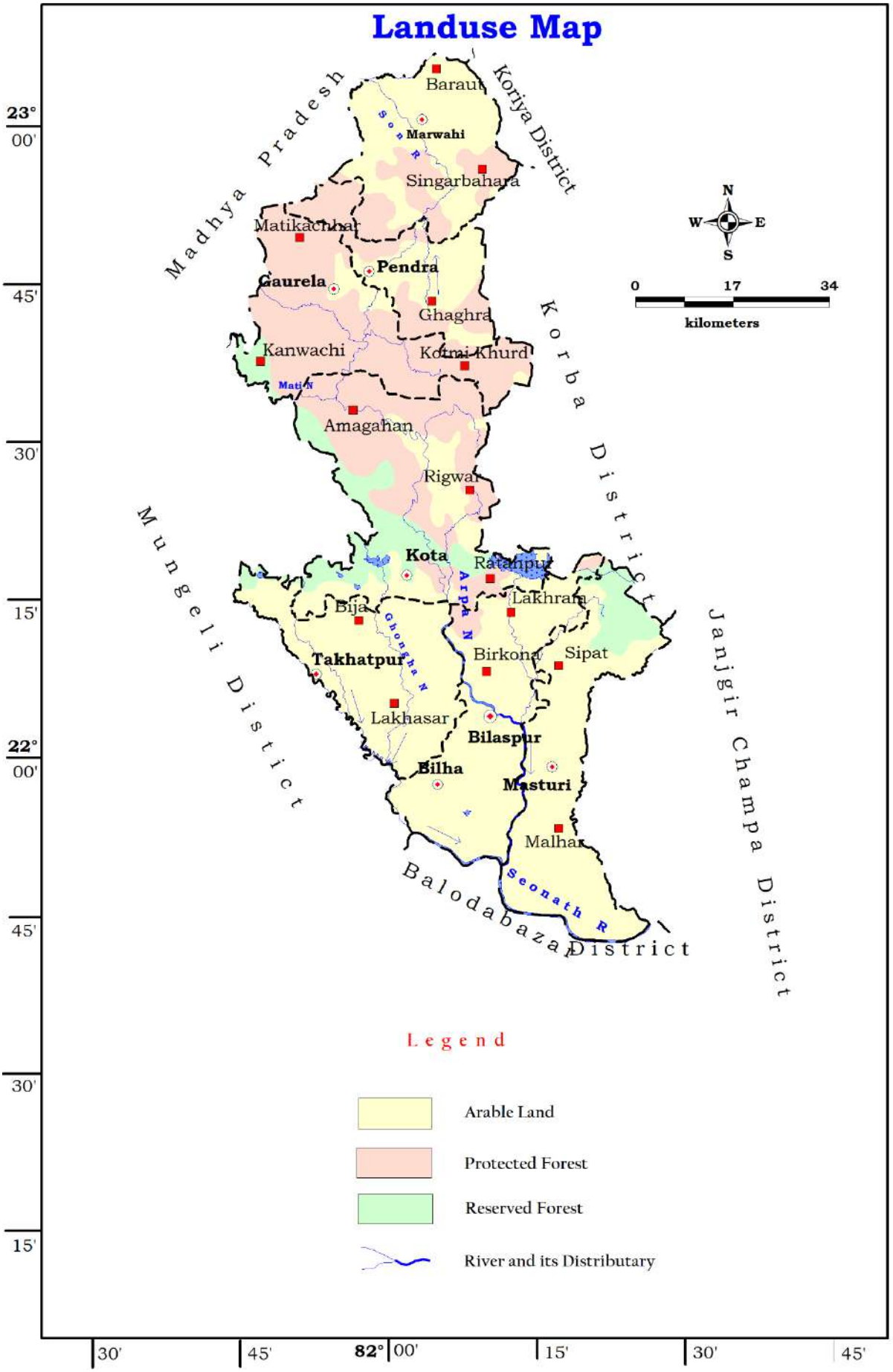

Figure 4 Landuse map of the study area

1.9 Soil

The soils in the district are having wide variations. In all four types of soils are abundant in the study area and are mostly insitu in nature.

1. **Vertisol:** The vertisol are mostly found in south and southeastern parts of the district. They range from grey/red to deep black colour and are almost impermeable when saturated. They are sticky in wet season and are very hard in dry season.
2. **Ultisol:** The ultisol types of soil are found in east and northern parts of the district and is red to yellow in colour. This colour is attained mainly due to the accumulation of iron oxide, which is highly insoluble in water.
3. **Inceptisol:** Inceptisol soils occupy mostly hill slopes and are found along the western boundary of the district.
4. **Alfisol:** Alfisol soils are fertile leached soils found in humid areas where annually dropping leaves form a thick humus layer. These soils cover maximum area in the northern and central parts of the district.

   In general it can be said that the district is covered by red gravely soils, red sandy soils, lateritic soils, red and yellow soils and black soils.Figure 5 represents the different kind of soil that present in the study area.

Table 3 Details of different kind of soil

Si No	US Soil taxonomy	Indian equivalent
1	Vertisol	Deep black soil
		Medium black soil
2	Ultisol	Lateritic soil
		Red and yellow soil
3	Inceptisol	Shallow black soil
4	Alfisol	Red gravelly soil
		Red sandy soil

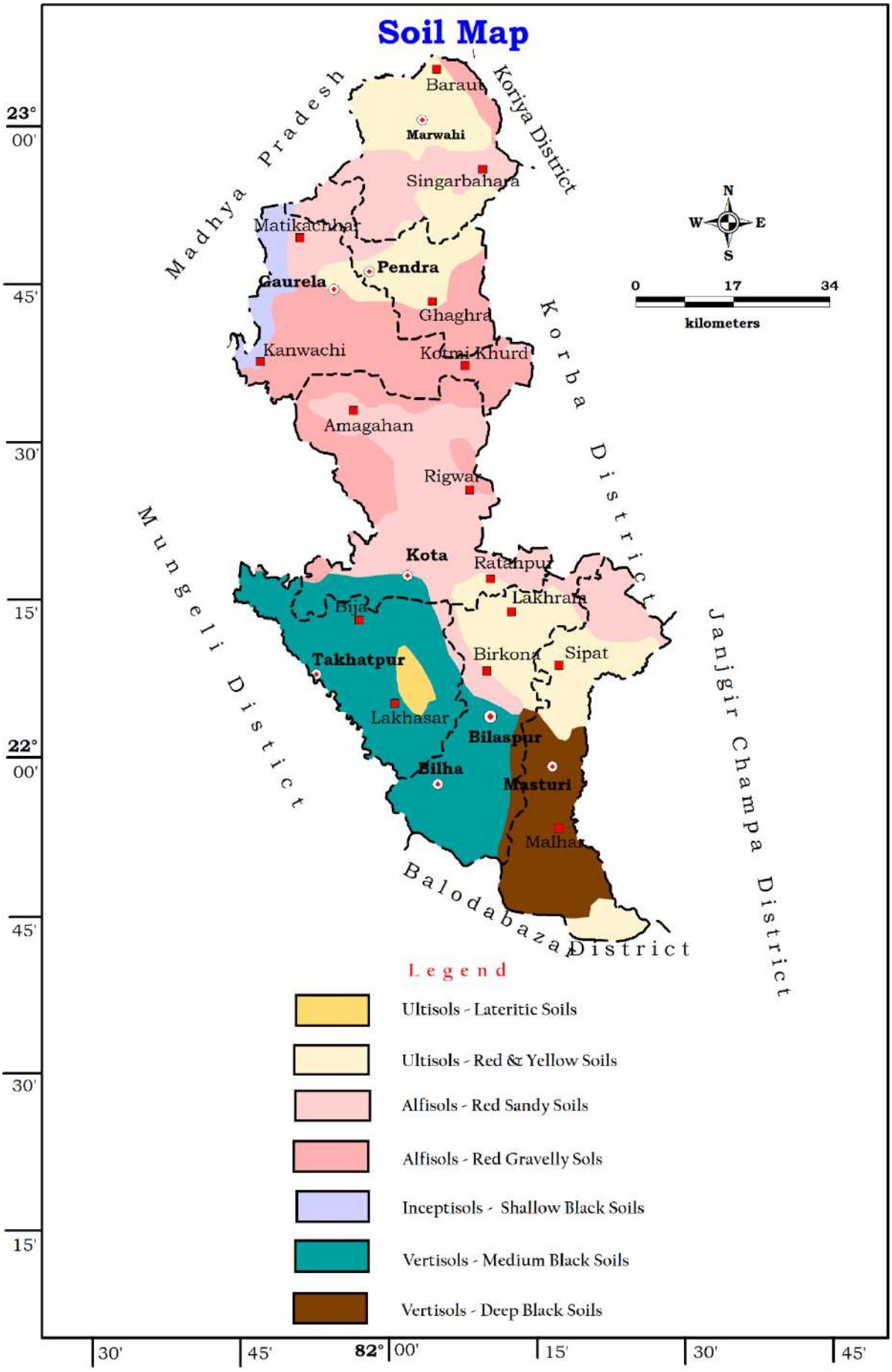

Figure 5 Soil map of the study area

1.10 Hydrology and Drainage

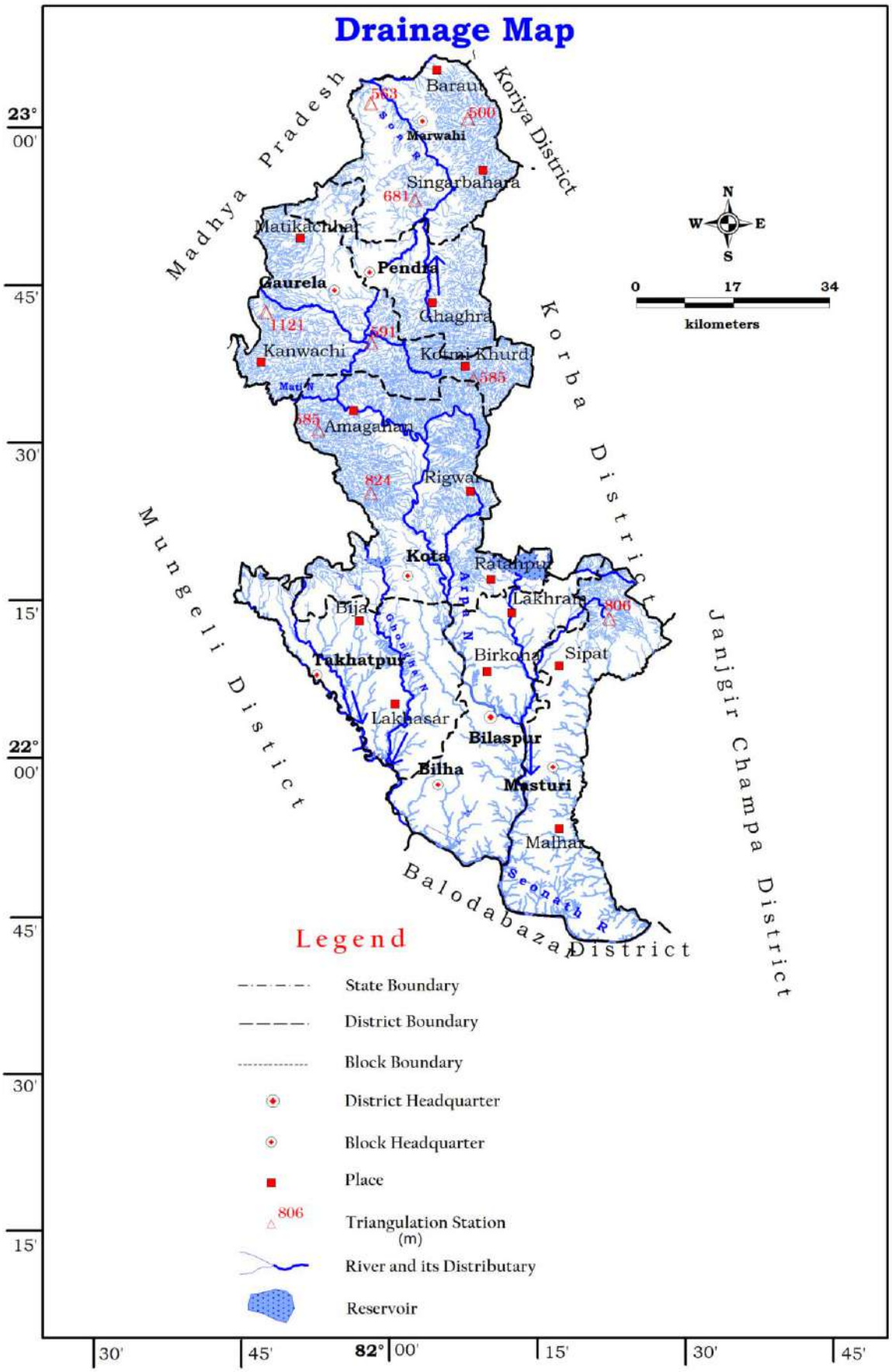

Figure 6 Drainage map of the study area

The Mahanadi River drains about 90% of the area in the district. The Major tributaries of Mahanadi are Seonath, Maghdhara, Sukhad, Jaswa, Sagar, Teswa, Agar, Maniari, Chhotinarmada, Gongha, Arpa, Khurung and Lilagar. Son is the major tributary to the Ganges. The Tipan and Alan nalas are the tributaries to the Son River.

The northern part of the district is characterised by dendritic pattern and the southern part by trellis (sub-parallel drainage pattern). The drainage density drastically reduces in the plains suggesting the pervious nature of the underlying formations (shale, limestone and dolomite) than the formations on the northern part of the district (granites, gneisses, schists and quartzites).

1.11 Geology

Geologically the district can be categorised into three groups.

i. **The Archaean Crystallines**: It consists of granites, gneisses, schists, phyllites and quartzites. Generally occurs in Pendra, Gourela and Kota block of Bilaspur district.
ii. **Precambrian Sedimentaries:** It belongs to Chhattisgarh Supergroup mainly consisting of limestone, shales and dolomites. Generally occurs in Takhatpur, Bilha and Masturi block of Bilaspur district.
iii. **Gondwana Supergroup**: it consists Barakar sandstones and Talchir shales. Generally occurs in Marwahi block of Bilaspur district

i. **Archaean Crystallines:**

- **Bastar gneisses:** The Bastar gneisses occur in Dantewara, Sukma and Bijapur, Bastar, Narayanpur, Kondagaon, Kanker, Rajnandgaon, Durg, Kawardha, Bilaspur, Janjgir-Champa, Mahasamund, Korba and parts of Raigarh district. Bastar gneiss is also known as gneiss-migmatite complex having the major rock type as granite and gneiss.
- **Unclassified metamorphics:** Isolated patches and linear metamorphic belt running parallel to the Central Indian Suture occurs in Bilaspur, Janjgir-Champa, Raigarh, Surguja and Koriya districts. These rocks in Bilaspur –Katghora area having schist occurs as isoclinal anticlines and these folds were occupied by the intrusive grey granite, converting them into gneisses of varying composition. These unclassified rocks occupy small area only.

ii. **Precambrian Sedimentaries**

- **Pandaria formation:** This formation represent the calc-argillite facies developed all along the northern part of the Hirri sub-basin. This lithounit overlies the Chandrapur

arenite along the northern margin and is characterized by predominance of pink to purple-colored calcareous shale with lenses and pockets of bedded flaggy limestone, stromatolitic limestone and dolomite (Thorat et al., 1990) and bedded limestone associated with the chert bands. These lenses and pockets vary widely in dimension from a few meters to several hundred meters in length.

- **Chandi formation:** This comprises a major stromatolitic limestone sequence developed around southern side of depocentre of Hirri sub-basin as arcuate outcrop pattern. Throughout the eastern part, the carbonate facies disappears and is only present as intercalated discrete pockets or lenses in calcareous argillite.
- **Maniari formation:** It is named after the river along which the rock is best developed and shows an oval-shaped outcrop in the central part of the sub-basin. It represents the closing phase of deposition in Chhattisgarh basin and consists of lower gypsiferous grey siltstone and shale followed by reddish brown calcareous and non-calcareous shale with limestone and dolomite.

iii. Gondwana supergroup

- **Barakar sandstone:** The Barakars have fine to course-grained, sub rounded to rounded, subarkosic semi consolidated sandstones. They are white, grey or pink to brown in color, intercalated with shales and coal. Shales are many times bituminous in nature. The intercalation of sandstone & shale in various ratios produces sandstone, shale sandy shale, shaley sand etc. The total thickness of Barakar Formation varies from 100 to 800 m in the

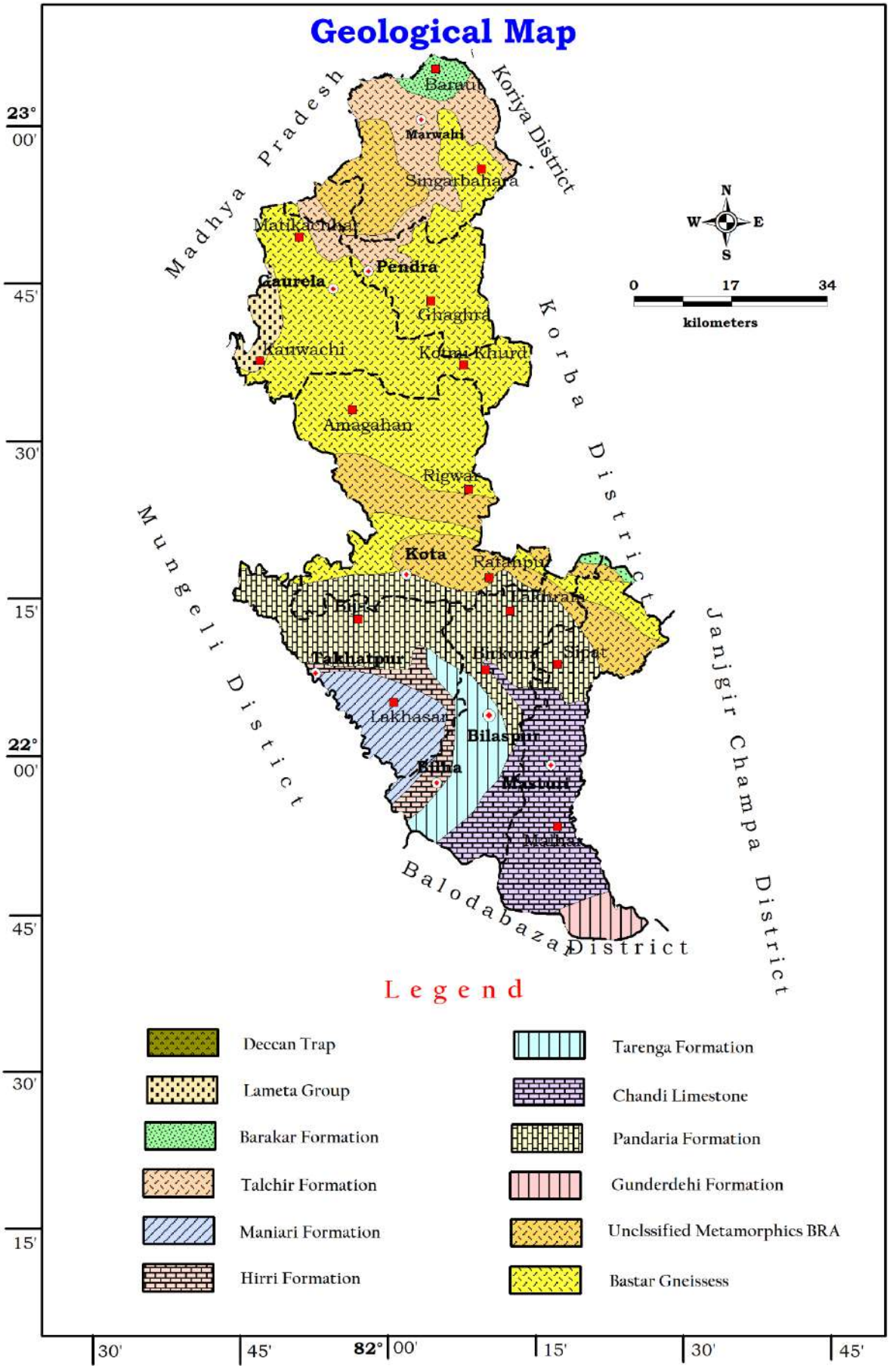

Figure 7 Geological map of the study area

1.12 Agriculture, Irrigation, Cropping Pattern

Agriculture is practiced in the area during Kharif and Rabi season every year. During the Kharif, cultivation is done through rainfall while during the Rabi season, it is done through ground water as well as partly through surface water like canals and other sources. The groundwater abstraction structures are generally Dugwells, Borewells /tubewells. The principal crops are paddy, wheat, vegetables and pulses. In some areas, double cropping is also practiced. The agricultural pattern, cropping pattern and area irrigated data of Bilaspur district is given in Table No. 3 (A, B, C).

Table 4(A) Cropping pattern (in ha)

			Cereal									
Kharif	**Rabi**	**Paddy**	**Wheat**	**Jowar & Maize**	**Kodo Kutki**	**Others**	**Pulses**	**Tilhan**	**Fruits Vegetables**	**Reshe**	**Mirch Masala**	**Sugarcane**
225247	28716	225344	5510	2316	641	13	11671	2618	5021	168	716	118

Table 4(B) Area irrigated by various sources (in ha)

No. of canal s (private and Govt.)	**Irrigated area**	**No.of bore wells/ Tube wells**	**Irrigated area**	**No. Of dug wells**	**Irrigated area**	**No. of Ponds**	**Irrigated area**	**Irrigated area by other sources**	**Net Irrigated area**	**% of irrigated area wrt. Net sown area**
98	59520	13525	49855	3012	1520	3802	1805	10	112700	50

Table 4(C) Contribution of Groundwater in Irrigation Pattern (in ha)

Area Irrigated through Borewells/Tube wells	**Area Irrigated through Dug wells**	**Area Irrigated through Groundwater**	**Net Area Irrigated through all sources**	**% Groundwater contribution in Irrigation wrt Net Irrigated Area**
49855	1520	51375	112700	45.6

2. DATA COLLECTION, DATA GENERATION, DATA INTEGRATION AND DATA INTERPRETATION

2.1 Hydrogeological Data

The semi-consolidated rocks of study area mainly represented by Kanker granite and Chhattisgarh Super Group of rocks (Predominantly by Maniyari Formation followed by Hirri, Tarenga and Chandi formations), which consists mainly of shale and limestone. In general two aquifers exist in the area. The depth range of the first shallow unconfined/ phreatic aquifer between 4.5 to 37 mbgl and the second fractured aquifer below 15 mbgl. It has been found that within the fractured aquifer, there are 1-6 nos. of water bearing zones are found with different thickness as well as of varying horizontal extent. In the study area, key wells were established during the pre-monsoon period and have been subsequently monitored in the post-monsoon period. The key wells are distributed throughout the study area covering all the geological formations, the details of which are presented in the Figure 8 and Annexure 1.

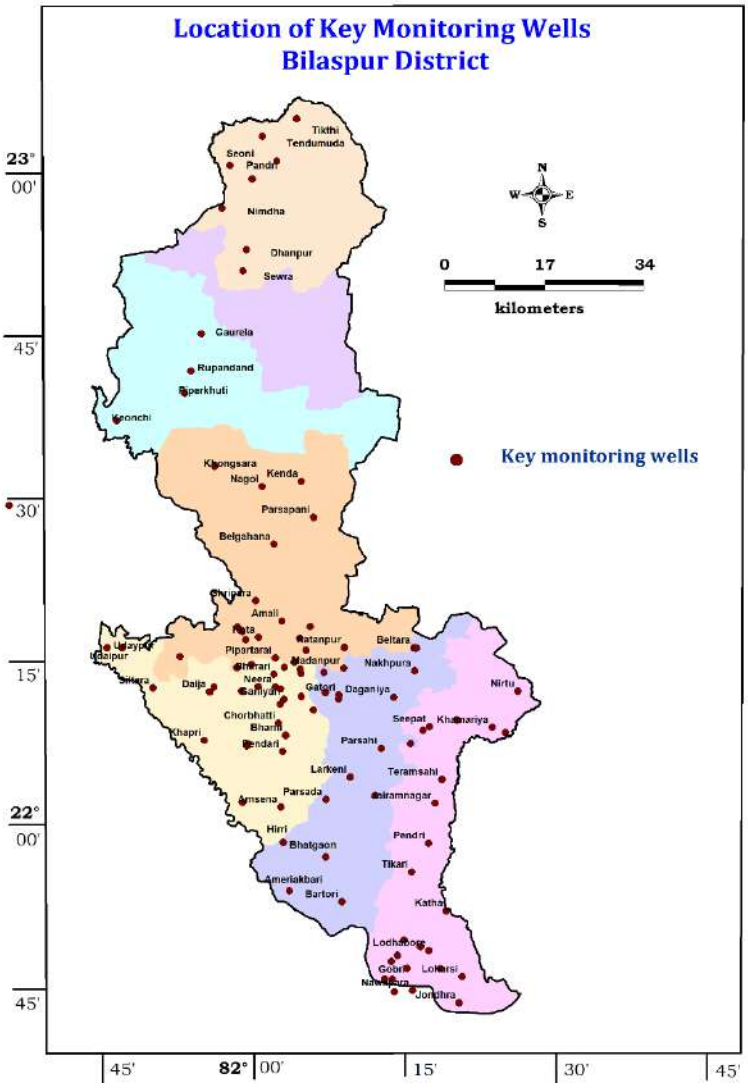

Figure 8 Key Montoring Wells of the study area

2.1.1 Water level behavior

Pre-monsoon and Post-monsoon depth to water level maps as well as seasonal fluctuation maps have been prepared on the basis of the depth to waterlevel periodically monitored data of the key wells established in the study area.

i. Pre- monsoon waterlevel

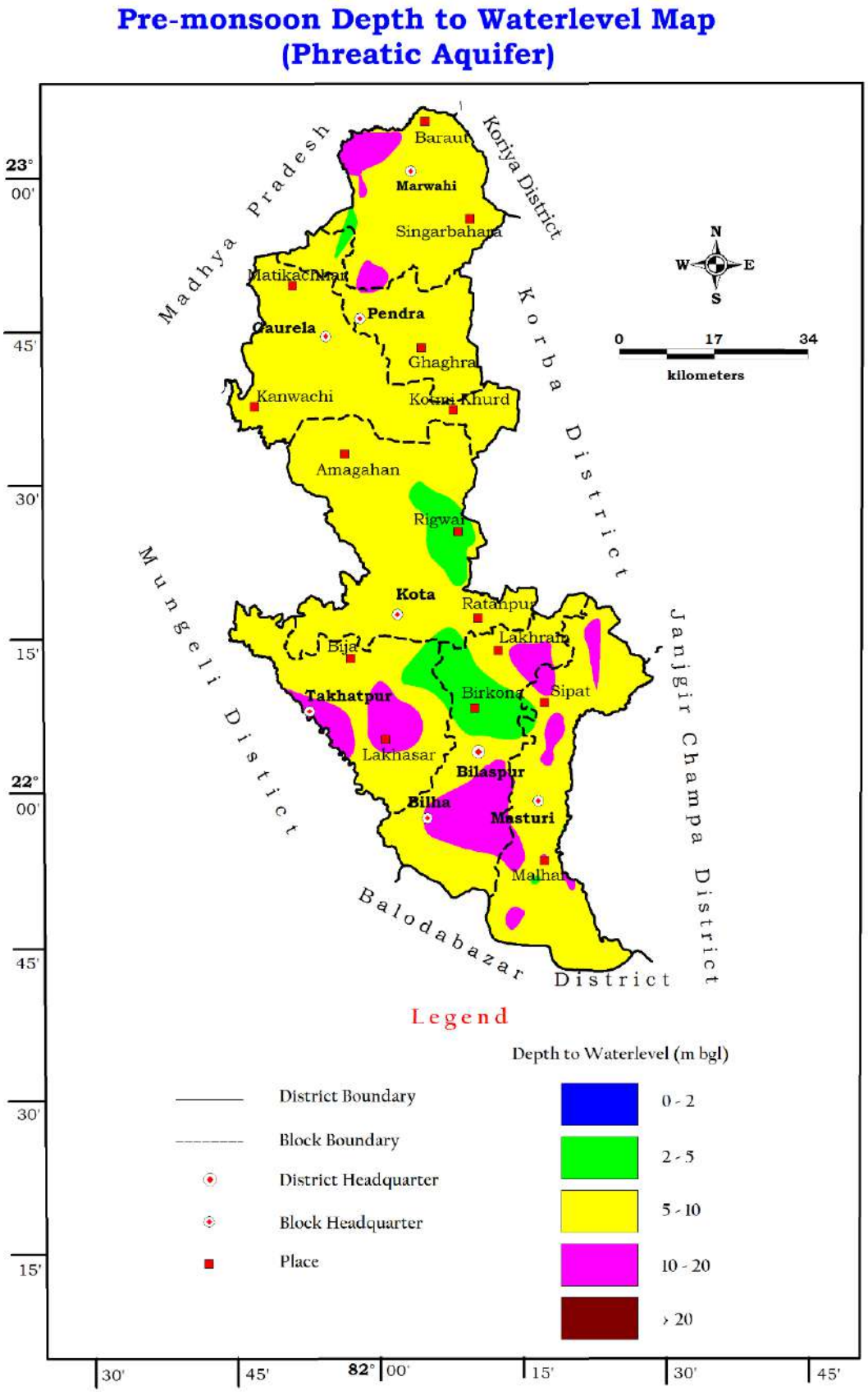

Figure 9 Pre-monsoon Waterlevel Map of Phreatic Aquifer

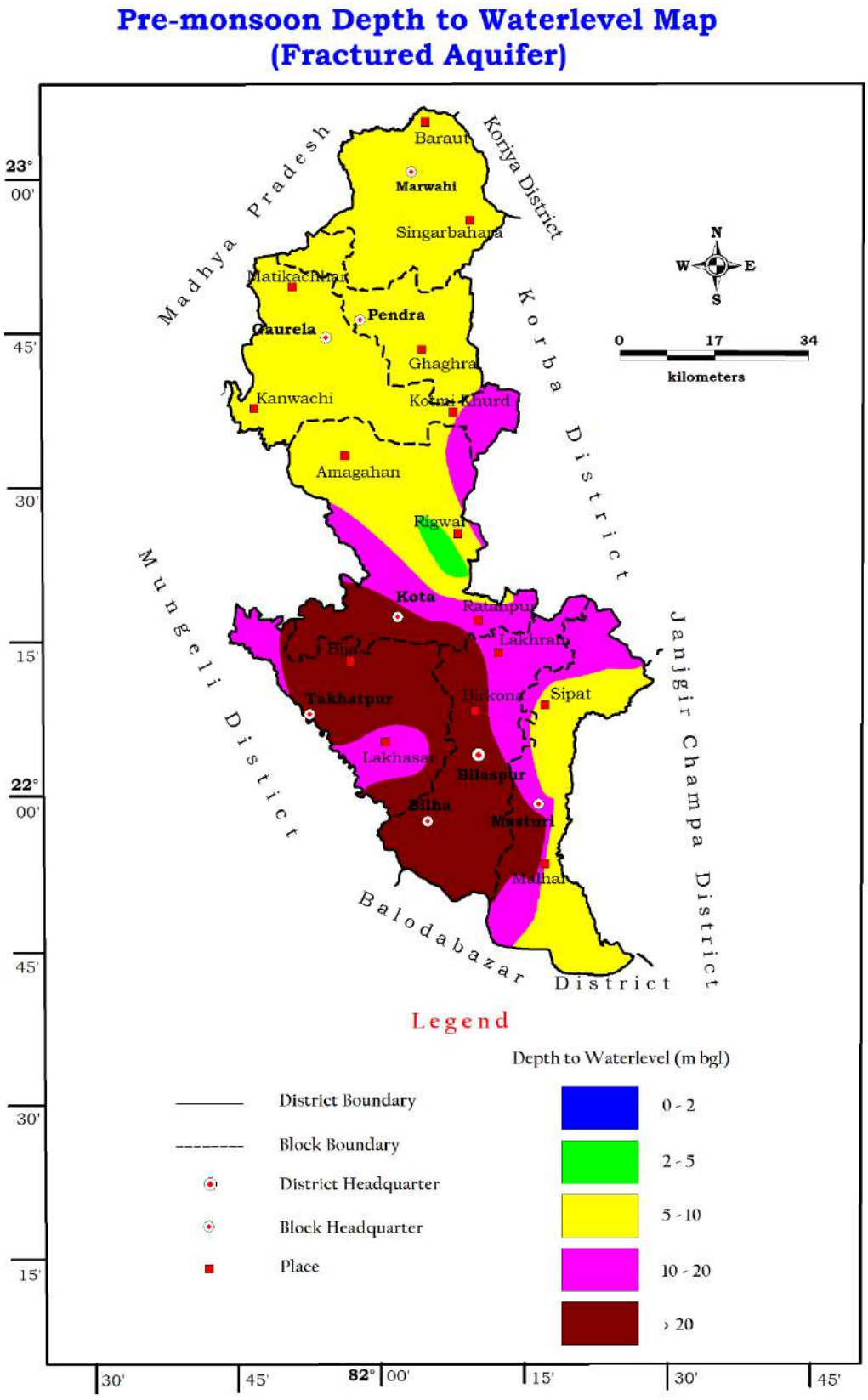

Figure 10 Pre monsoon Water Level Maps of Fractured Aquifer

In the pre-monsoon period, it has been observed that in the study area water level in phreatic aquifer vary between 3.37 to 15.10 m bgl with average water level of 7.87 m bgl. In deeper fractured aquifer, water level varies between 4.05 to 45.4 m bgl with average water level of 18.52 m bgl shown in Table 5(A).

Table 5(A) Aquifer wise Depth to Waterlevel (Pre-monsoon)

District	Aquifer Type	Min (m. bgl)	Max (m. bgl)	Avg (m. bgl)
Bilaspur	Phreatic aquifer	3.37	15.10	7.87
	Fractured Aquifer	4.05	45.4	18.52

ii. Post- monsoon waterlevel

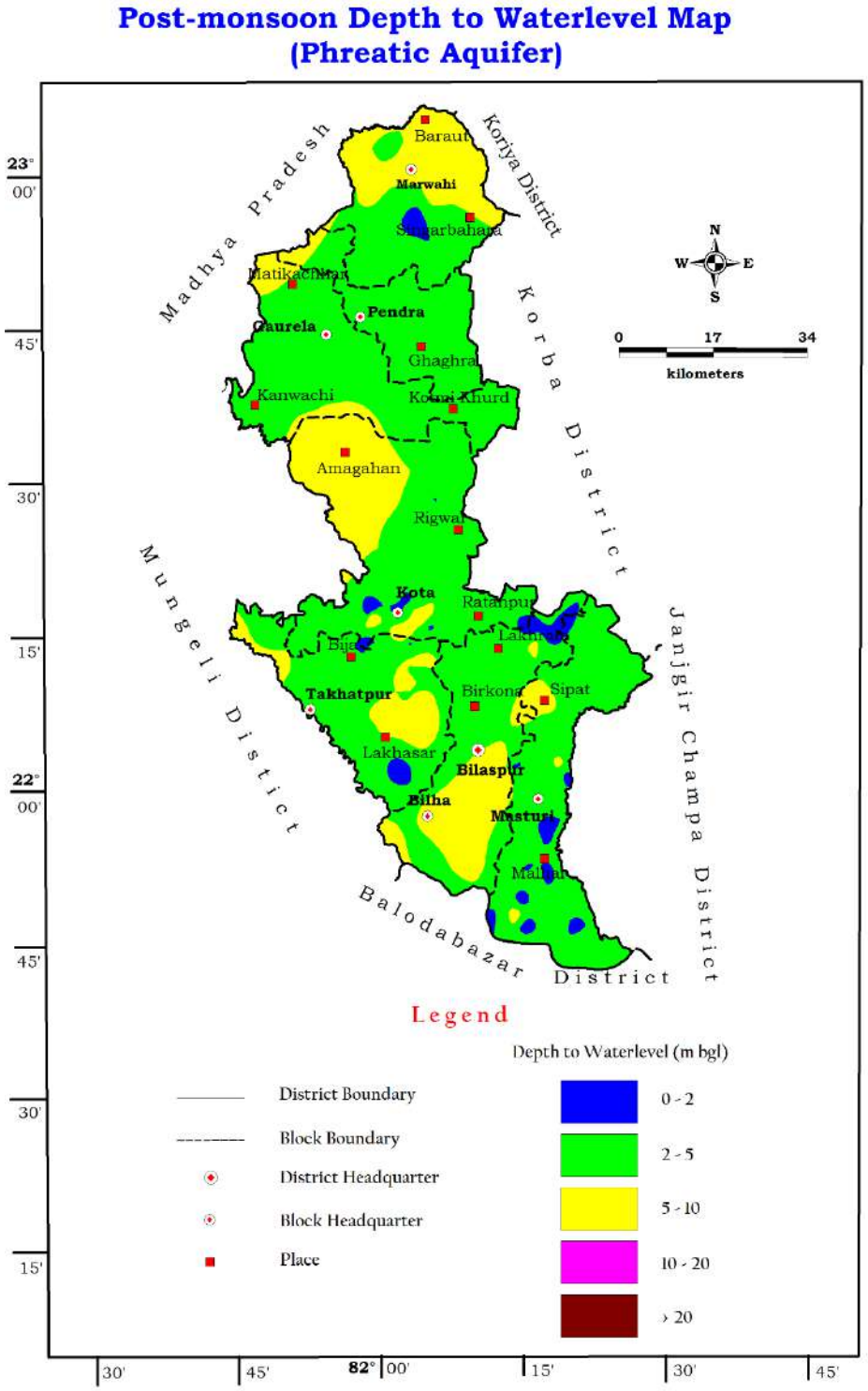

Figure 11 Post monsoon Water Level Map of Phreatic Aquifer

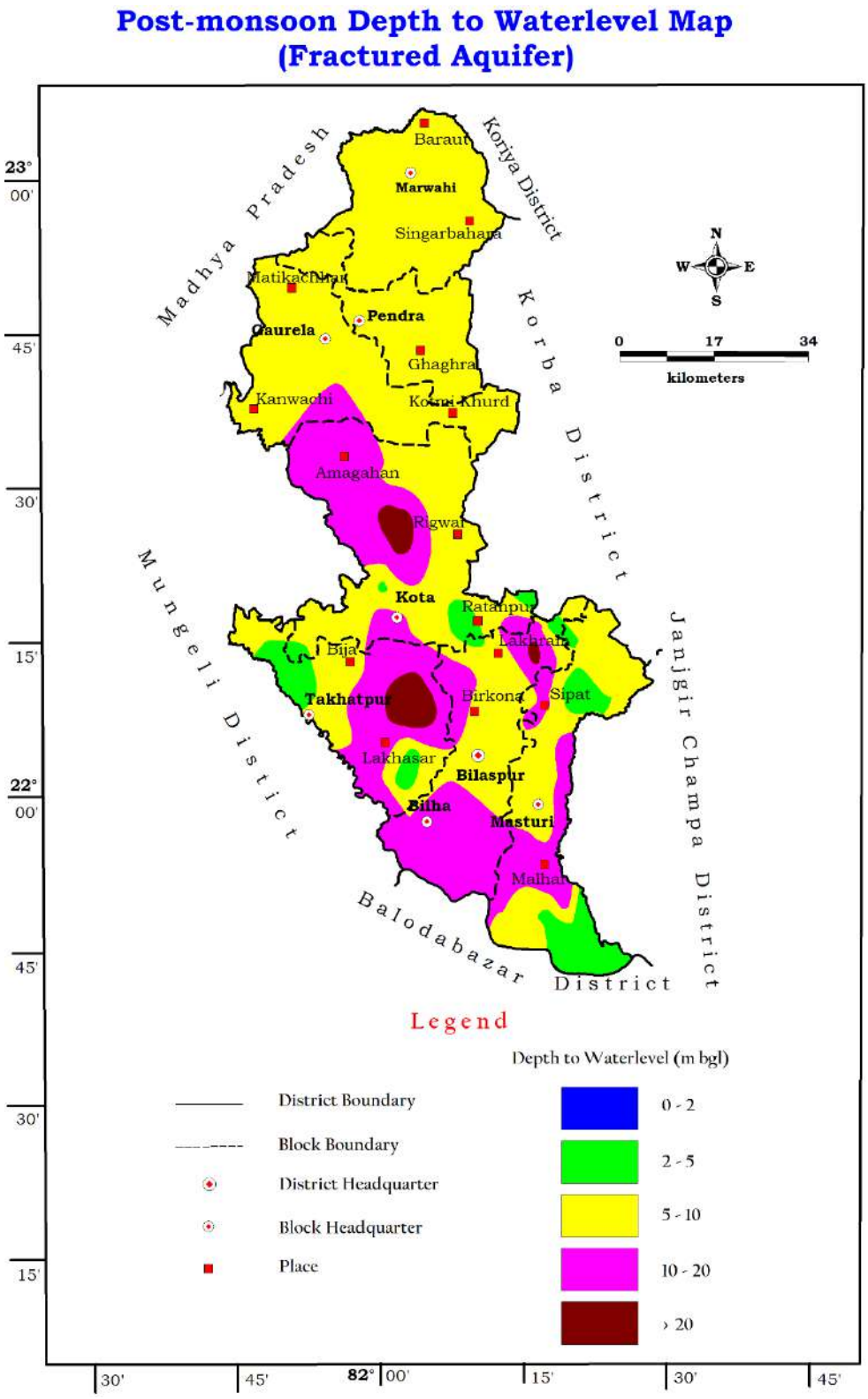

Figure 12 Post monsoon Water Level Maps of Fractured Aquifer

In the post-monsoon period, it has been observed that in the study area, water level in phreatic aquifer varies between 0.61 to 9.33 m bgl with average water level of 3.68 m. In deeper fractured aquifer, water level varies between 2.1 to 29.57 m bgl with average water level of 9.98 m bgl shown in Table 5(B).

Table 5(B) Aquifer wise Depth to Water Level (Post-monsoon)

District	Aquifer Type	Min (m. bgl)	Max (m. bgl)	Avg (m. bgl)
Bilaspur	Phreatic aquifer	0.61	9.33	3.68
	Fractured Aquifer	2.10	29.57	9.98

iii. Seasonal water level fluctuation:

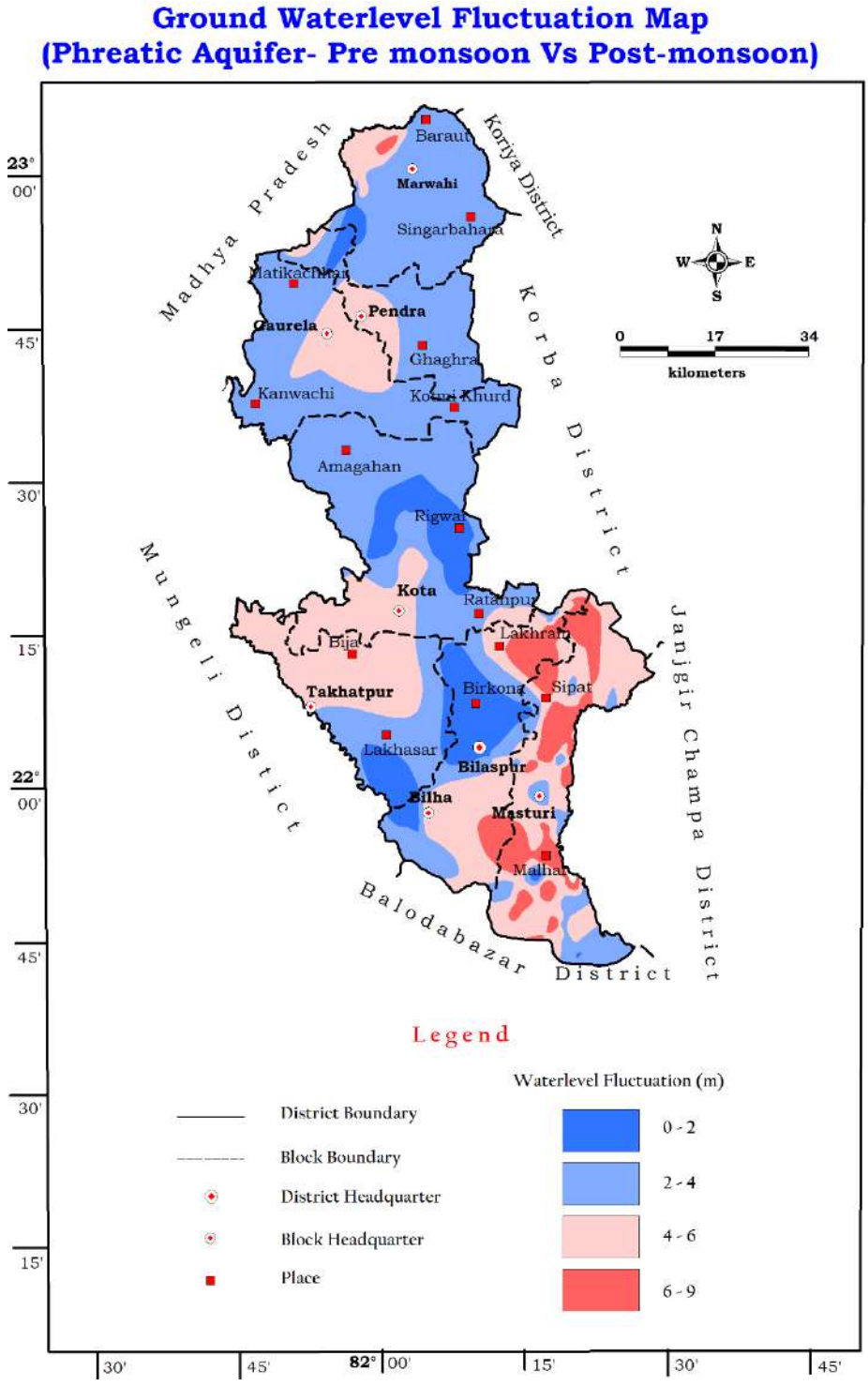

Figure 13 Water level fluctuation of phreatic aquifer

The water level fluctuation data indicates that in the study area, water level fluctuation in phreatic aquifer varies from 0.15m to 9m with an average fluctuation of 4.51m shown in Table 5(C).

Table 5(C) Aquifer wise Depth to Water Level Fluctuation

District	Aquifer Type	Min	Max	Avg
Bilaspur	**Phreatic aquifer**	0.15	9	4.51

2.2 Hydrochemical Data

To know the hydro chemical behaviour of the ground water in the study area, 134 nos. of ground water samples were collected from the key wells and (NHNS) during pre-monsoon period of measurement. Also water samples were collected from borewells during exploration carried out in the area and analysed in the chemical laboratory of Central Ground Water Board, NCCR, Raipur for determination of various chemical parameters. The results and findings are presented in Annexure 2

2.3 Exploratory Data

A total of 62 Exploratory well exist in the study area out of which 50 nos. are Existing exploratory well and and 12 nos. are newly generated exploratory wells in the study area. Location of the exploratory wells shown in Figure 15. The results and findings are presented in Annexure 3

2.4 Geophysical Data

Geophysical surveys (Vertical Electrical Sounding or VES) have been conducted in the study area in Bilaspur district to delineate the disposition of the existing aquifer system and 42 nos. of soundings were carried out covering mostly the Bilaspur urban area. The results and findings are presented in Annexure 4.

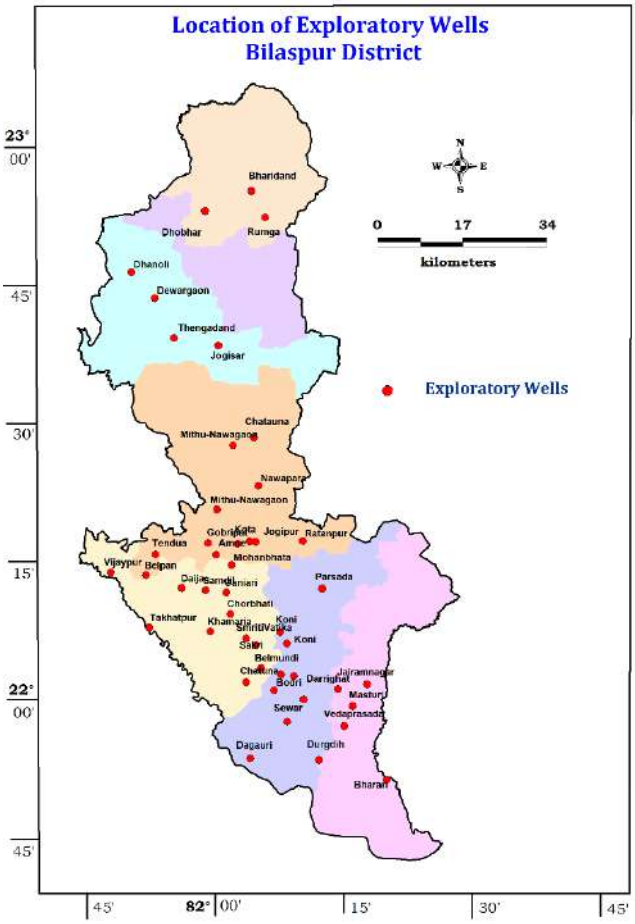

Figure 14 Location of Exploratory wells in the study area

3. AQUIFER DISPOSITION AND GROUND WATER RESOURCES

3.1 Aquifer Geometry and Characterization

Based on the exploratory drilling data generated for the blocks (Annexure 3), the existing aquifer systems in the area may be divided into two namely phreatic and deeper fractured aquifer. The major aquifers present in the study area is 1. Shale (Maniari and Terenga), 2. Limestone (Pandaria and Chandi) and Granite (Kanker granite). Details are represented in Table 6.

Table 6 Aquifer Characteristics of Bilaspur District

CHARACTERISTICS	**AQUIFER SYSTEM**	
	Weathered	**Fractured**
Major Rock type	Shale, Limestone, Granite	Shale, Limestone, Granite
Weathered thickness (mbgl)	4.5 to 37	-
Depth range of the aquifer (mbgl)	4.5 to 37	12 to 66
Fracture encountered (mbgl)	-	12 to 188
No. of waterbearing zones	-	1 to 6
Transmissivity (m^2/day)	-	0.2 to 412 (Avg- 71.52 m^2/day)
Yield	10 to 130 m3/day	Up to 26 lps
Sustainability	1 to 4 hours	0.5 to 7 hours

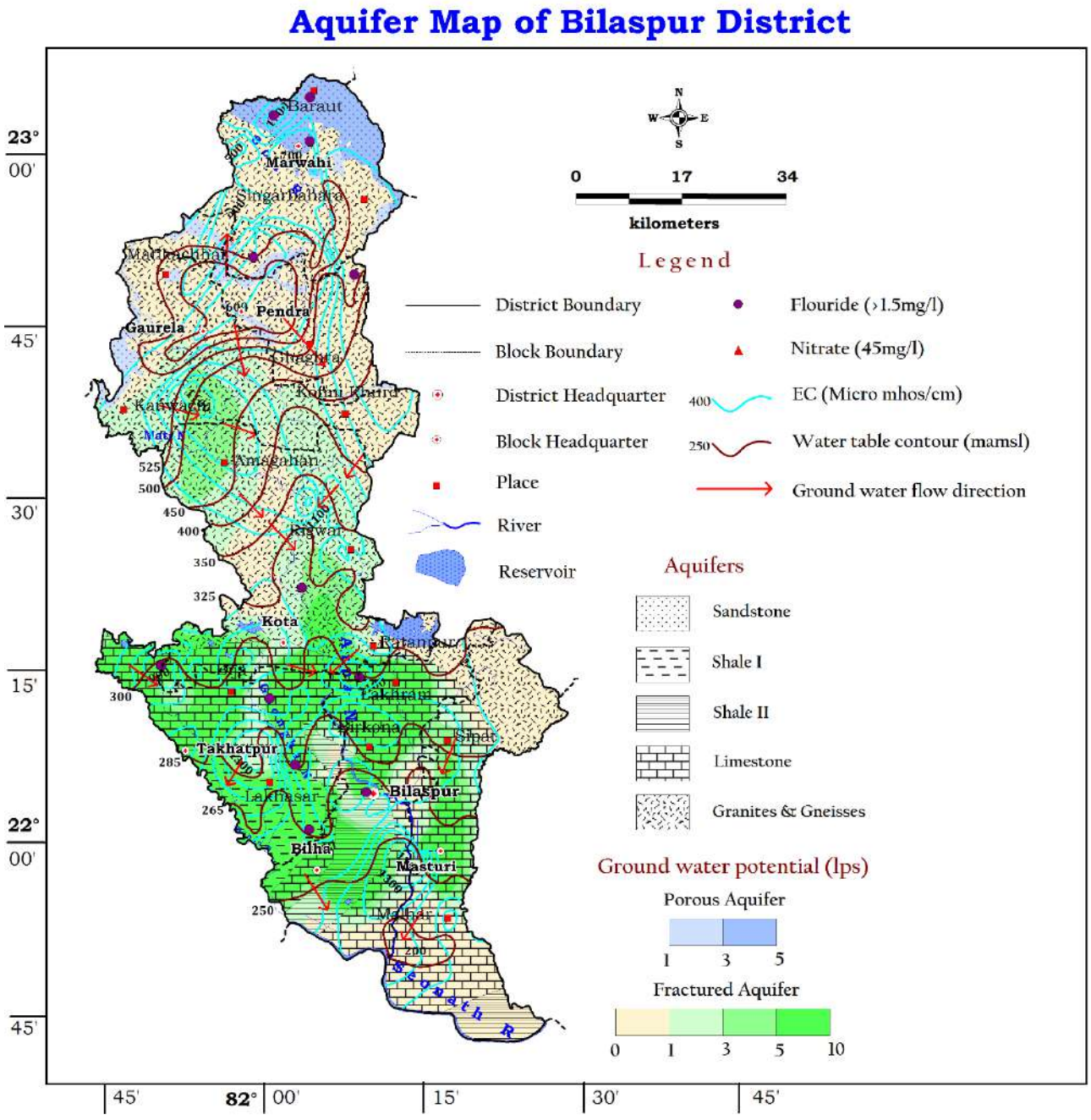

Figure 15 Aquifer Map of Study Area

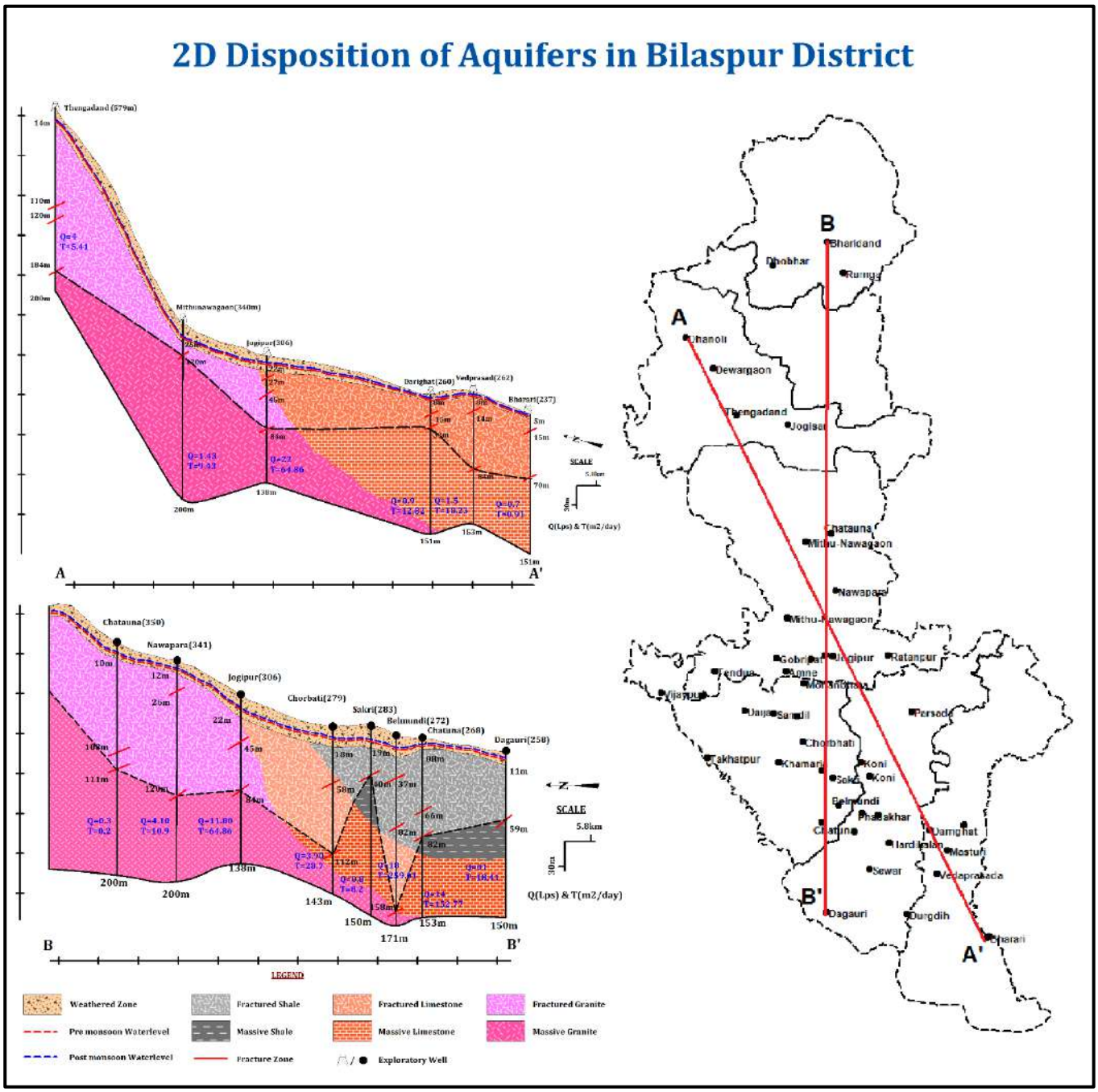

Figure 16 Cross-section of Study area

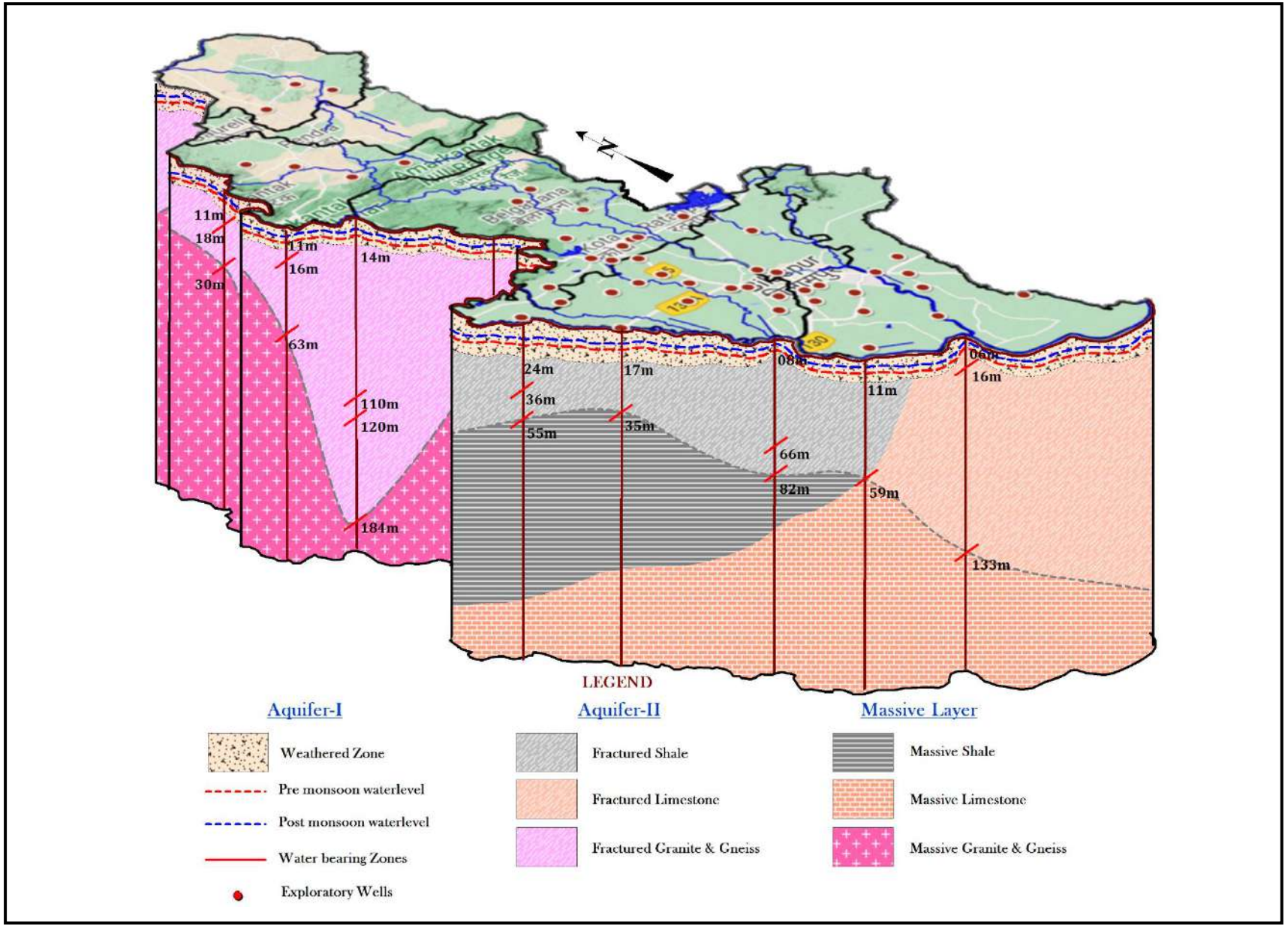

Figure 17 3D disposition of aquifer in study area

3.2 Groundwater Resources Availability and Extraction

In the ground water resource estimation, the unit of assessment to ground water resources has been taken as the smallest administrative unit i.e. Block. The hilly areas (slope greater than 20%) have been excluded from the computations. The assessment unit has been divided into command and non-command areas and ground water resources have been estimated separately for command and non-command areas. The ground water recharge in the monsoon season and non- monsoon season has also been estimated separately.

The water level data collected by CGWB through NHS monitoring and from state ground water survey, has been utilized for resource estimation. The rainfall data from Indian Meteorological Department has been incorporated in the assessment. The irrigation data for tube wells and dug wells were provided by Water Resources Department. The state could not get success to obtain the stream data from the concern department. The domestic dug wells & bore wells data are not available, therefore per capita consumption of 60 liters per day per person for rural areas and 100 liters per day per person for urban areas have been taken into consideration. The data of ground water withdrawal for industries incorporated from the NOC issued by CGWA and from State Industries Department.

Stage of ground water extraction of the Bilaspur district is 47.52%. The category and stage of ground water extraction of all the blocks in the district are given in the Table 7. Based on the resource assessment made, the resource availability in Block wise in Bilaspur district upto 200m depth is given in Table 8.

Table 7 Blockwise stage of extraction and Category

District	Block Name	Stage of Ground Water Extraction (%)	Category
Bilaspur	**Belha**	80.19	Semi-critical
	Kota	29.99	Safe
	Marwahi	26.11	Safe
	Masturi	39.13	Safe
	Pendra	46.18	Safe
	Gaurela	26.13	Safe
	Takhatpur	61.12	Safe

Table 8 Groundwater Resource up to 200m bgl (MCM)

District	Block	Dynamic Resources (MCM)		Insitu Resources (MCM)		Total Resources (MCM)
		Aquifer I	Aquifer II	Aquifer I	Aquifer II	
Bilaspur	Bilha	103.66	3.87	20.04	37.05	164.62
	Kota	84.71	1.74	27.05	37.21	150.72
	Marwahi	61.70	0.79	16.38	36.40	115.26
	Masturi	80.49	1.44	17.35	33.58	132.85
	Pendra	34.53	0.43	11.55	15.89	62.40
	Gaurela	47.32	1.62	20.91	22.61	92.47
	Takhatpur	84.96	1.08	15.86	32.20	134.10

3.3 Existing and Future Water Demand (2025)

Table 9 Ground Water Resources of the Study area in Ham

Block	Total Annual Ground Water (Ham) Recharge	Total Natural Discharge (Ham)	Annual Extractable Ground Water Resourse (Ham) (3=1-2)	Current Annual Ground Water Extraction (Ham)				Annual GW Allocation for Domestic Use as on 2025	Net Ground Water Availability for future use (9=3-4-5-8)	Stage of ground water Extraction in % (7/3 *100)
				Irrigation Use	Industrial Use	Domestic Use	Total Extraction (7=4+5+6)			
	1	2	3	4	5	6	7	8	9	
Belha	11046.50	680.01	10366.48	5498.33	176.08	2637.98	8312.38	3389.32	1302.76	80.19
Kota	9032.12	560.83	8471.29	1885.50	22.53	632.24	2540.27	732.96	5830.30	29.99
Marwahi	6855.09	685.51	6169.58	1241.03	0.22	369.35	1610.58	504.23	4424.12	26.11
Masturi	8752.33	703.72	8048.61	2028.13	175.39	945.98	3149.49	1291.43	4553.67	39.13
Pendra	3836.70	383.67	3453.04	1338.75	0.00	255.96	1594.72	320.23	1794.05	46.18
Gaurela	5257.73	525.78	4731.95	836.25	0.36	399.71	1236.31	500.07	3395.28	26.13
Takhatpur	9027.84	532.16	8495.68	4117.34	183.78	891.56	5192.67	1115.41	3079.16	61.12
TOTAL	**53808.31**	**4071.68**	**49736.63**	**16945.32**	**558.3573**	**6132.766**	**23636.42**	**7853.65**	**24379.34**	**47.52**

Total annual ground water recharge and annual extractable ground water resource of the district have been estimated to be 53808.31 Ham and 49736.63 Ham respectively. Gross ground water Extraction for all uses in the district is 23636.42 Ham. The existing demand for irrigation in the area is 16945.32 Ham while the same for domestic use is 6132.76 Ham and for

industrial field is 558.36 Ham. To meet the future demand for ground water, a total quantity of **24379.34** Ham of ground water is available for future use.

4. GROUND WATER RELATED ISSUES

- **Drying of Dugwells and handpumps during summer-** At several places of Kota and northern part of Masturi, Bilha and Takhatpur blocks phreatic aquifer i.e. zone of dugwells dried up in summer due to large number of shallow borewells in the area.
- **Inherent hydrogeological character of aquifer-** The fractures are also very localised which results very low yield and less transmissivity in aquifers.
- **Drilling difficulty:** Due to clay inclusion in cavernous limestone drilling can not be progressed beyond the clayey zone so well construction in Limestone aquifer system is problemetic in Bilashpur district.
- **Fluoride concentration-** Fluoride observed in granitic terrain at places of Bilaspur, district. More than permissible limit found at Kota, Gaurela, Pendra, Marwahi ranges-1.9-3.1 mg/l.
- **Nitrate contamination-** More than permissible limit found in villages like Ganiyari-84 mg/l (Takhatpur block) and Marwahi-50 mg/l (Marwahi block).
- **Uranium contamination-** U observed more than permissible limit in places like Adbhar-0.0986 mg/l, Damdam-0.10396 mg/l (Pendra) in Bilaspur district.

5. GROUND WATER MANAGEMENT STRATEGY

- It has been observed during fieldwork, there is colossal wastage of groundwater through private well and public water supply system. So, Information, Education and Communication (IEC) activities need to be organized to sensitize people on the issues of depleting groundwater resource. Massive awareness campaigns are essential to aware people about the importance of community participation in saving water.
- Desiltation of existing Tanks and Talabs to be carried out for efficient storage of rainwater. Also Rain water harvesting structures may be constructed in villages to reduce stress on groundwater.
- It has been observed that the demand of ground water is increasing for irrigation, industrial and domestic uses. At locations where water level is declining, we have to go for artificial recharge on a long-term sustainability basis. Artificial Recharge structures may be constructed at suitable locations especially in the areas where the water level remains more than 3m in the post-monsoon period in the district to arrest the huge non-

committed run-off and augment the ground water storage in the area. The different types of artificial recharge structures feasible in the block are described in Table 10.

Table 10 Types and number of Artificial Recharge structures feasible

Block/District	Area Identified for Artificial recharge (sq.km)	Vol. of Sub Surface Potential for Artificial recharge (MCM)	Types of Structures Feasible and their Numbers			
			Percolation tank	Nalas bunding cement plug/ check dam	Gravity head /Dug well/ tube well/Recharge shaft	Gully plugs Gabion structures
Recharge Capacity - (MCM)/structure			**0.2192**	**0.0326**	**0.00816**	**0.0073**
Belha	449.48	17.115	52	175	422	312
Gaurela	0.00	0.000	0	0	0	0
Kota	192.94	7.814	24	80	192	142
Marwahi	493.35	49.992	152	510	1231	911
Masturi	101.54	3.046	9	31	75	56
Pendraroad	15.58	1.052	3	11	26	19
Takhatpur	369.26	31.572	96	322	778	575
Total (Bilaspur)	**1622.15**	**110.59**	**336.00**	**1129.00**	**2724.00**	**2015.00**

- Abandoned tube well and dug well may be used for the recharge through shaft especially in urban and water stressed areas.
- Fluoride and Iron filter plant may be installed in the villages having higher value of contaminants.
- In urban areas STP may be installed for the treatment of sewage water in proper numbers to avoid contamination of ground water. Treatment of sewage water in village through soak pit for the individual houses and Seechewal model or similar model for community level may be adopted to avoid contamination of ground water. Treated water may also be reused for irrigation and other industrial purposes.
- Since the stage of development in the district is 45.52 %. There is scope of utilizing more ground water for future irrigation purpose. Additional number of Ground water abstraction structure may be developed for the effective utilization of ground water resources in the district (Figure 18). The ground water is presently developed through dug wells and tube wells. Yield potential for the block has been shown in Aquifer map (Figure 15). Sites for wells need to be selected only after proper scientific investigation. The ground water quality also needs to be ascertained and the wells used for water supply should be first checked for Iron, Fluoride and other pollutants.

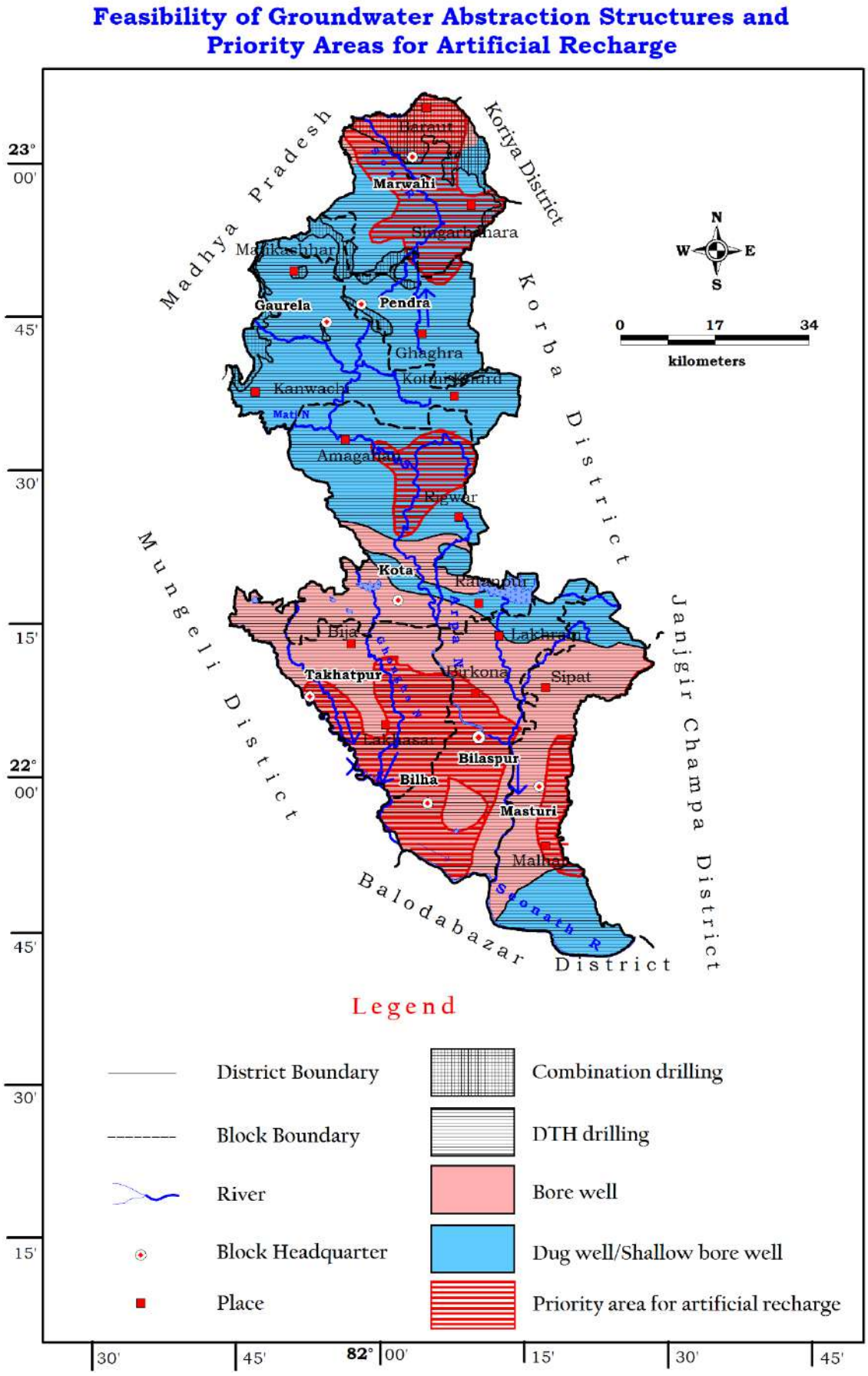

Figure 18 Feasibility of GW Abstraction and Area Identified for Artificial Recharge Map

Table 11 Additional groundwater abstraction structure proposed

Block	Annual Extractable Ground Water Resource (ham)	Stage of ground water Development (%)	Present ground water draft (ham)	Ground water draft at 60% stage of development (ham)	Surplus ground water at present Stage of Development (ham)	Number of TW Recommended in each block (Assuming unit draft as 1.6 ham/structure/ year)	Number of DW Recommended in each block (Assuming unit draft as 0.72 ham/structure/ year)	Additional Irrigation potential creation for Maize/ wheat in winter season in Ha (Assuming 500 mm water requirement)	Additional Irrigation potential creation for Paddy in Ha (Assuming 900 mm water requirement)
Kota	8471.29	29.99	2540.27	5082.77	2542.50	953	1413	5085.01	2288.25
Marwahi	6169.58	26.11	1610.58	3701.75	2091.17	784	1162	4182.34	1882.05
Masturi	8048.61	39.13	3149.49	4829.17	1679.68	630	933	3359.35	1511.71
Pendra	3453.04	46.18	1594.72	2071.82	477.10	179	265	954.21	429.39
Gaurela	4731.95	26.13	1236.31	2839.17	1602.86	601	890	3205.72	1442.57
TOTAL (Bilaspur)	**30874.47**	**167.54**	**10131.37**	**18524.68**	**8393.31**	**3147**	**4663**	**16786.63**	**7553.97**

6. CONCLUSION:

For effective utilization of Ground water existing draft for irrigation may be coupled with micro irrigation system. Change in irrigation pattern, optimum use of available resource, use of ground water potential created after artificial recharge can lead to groundwater savings and increase in gross cropped area of the district (Table 12).

Table 12 Detail of groundwater saved through change in cropping pattern and other interventions

Block	Existing Gross Ground Water Draft for Irrigation in Ham	Additional Saving of GW after using Micro Irrigation methods in Ham(Assuming 30 % saving)	GW recharge through Artificial recharge structure in Ham	Total GW Resource Enhancement	Stage of Ground Water Extraction (%) As per 2020 GWRE	Expected Stage of Ground Water Extraction (%) after intervention
Belha	5498.33	1649.5	1711.45	3360.95	80.19	60.55
Kota	1885.5	565.65	781.4	1347.05	29.99	25.87
Marwahi	1241.03	372.31	0	372.31	26.11	24.62
Masturi	2028.13	608.44	304.63	913.07	39.13	35.14
Pendra	1338.75	401.63	105.19	506.81	46.18	40.27
Gaurela	836.25	250.88	0	250.88	26.13	24.81
Takhatpur	4117.34	1235.2	3157.17	4392.38	61.12	40.29
TOTAL (Bilaspur)	**16945.33**	**5083.61**	**6059.84**	**11143.45**	**308.85**	**251.55**

Annexure 1 Details of key wells established

SN	District	Block	Location	Longitude	Lattitude	DTW Post monsoon
1	Bilaspur	Pendra	Adbhar	81.5915	22.4908	4.73
2	Bilaspur	Masturi	Bakarkuda	82.26948	21.91898	4.18
3	Bilaspur	Kota	Banabel	82.1078	22.4681	2.52
4	Bilaspur	Kota	Bansajhal	82.1167	22.3833	2.78
5	Bilaspur	Bilha	Bartoli	82.1475	21.8797	5.6
6	Bilaspur	Kota	Belgahana	82.0333	22.4333	4.03
7	Bilaspur	Bilaspur	Bhadrapara	82.33575	22.1615	2.64
8	Bilaspur	Bilha	Bilaspur (Hemunagar)	82.1864	22.0533	6.04
9	Bilaspur	Bilha	Bilha	82.086	21.9585	5.8
10	Bilaspur	Masturi	Binauri	82.26655	21.86013	4.25
11	Bilaspur	Bilha	Bitkuli	82.0499	21.9464	4.72
12	Bilaspur	Bilha	Bohardi	82.0801	21.564	2.32
13	Bilaspur	Masturi	Bothidih	82.2427	21.9908	4.8
14	Bilaspur	Masturi	Chilhati	82.3136	21.7794	3.83
15	Bilaspur	Bilha	Dagauri	82.0706	21.8939	4
16	Bilaspur	Marwahi	Danikundi	82.0667	22.9292	1.42
17	Bilaspur	Marwahi	Dhanpur	81.9861	22.8833	4.31
18	Bilaspur	Takhatpur	Ganiyari	82.04839	22.19384	4.27
19	Bilaspur	Takhatpur	Gatori	82.1389	22.1944	2.22
20	Bilaspur	Gaurela (pendrarod) - 2	Gaurela	81.9111	22.7542	2.26
21	Bilaspur	kota	Ghansipur (sainik camp)	82.1379	22.3585	2.96
22	Bilaspur	Bilha	Hirri	82.05	21.9708	4.53
23	Bilaspur	Takhatpur	Jaroundha	81.5644	22.1535	5.34
24	Bilaspur	Kota	Jhingatpur	81.9972	22.3667	3.37
25	Bilaspur	Kota	Jogipur	82.075	22.2958	7.48
26	Bilaspur	Mungeli	Kanteli.1	81.65	22.1528	5.97
27	Bilaspur	Kota	Kargi khurd	81.95861	22.2675	4.29
28	Bilaspur	Kota	Kenda	82.0806	22.5319	3.51
29	Bilaspur	Gaurela (pendrarod) - 1	Keonchi	81.7708	22.6208	4.1
30	Bilaspur	Mungeli	Khamaria	81.84346	22.06952	7.42
31	Bilaspur	Takhatpur	Khamharia1	81.9875	22.1222	5.51
32	Bilaspur	Masturi	Koni	82.2383	21.9819	4.86
33	Bilaspur	Kota	Kota(kargi)	82.025	22.2889	1.72
34	Bilaspur	Marwahi	Kotmi.1	82.0875	22.8111	4.98
35	Bilaspur	Belgahana	Konchua	81.5846	22.2839	5.42
36	Bilaspur	Marwahi	Kudwahi	81.98	22.8648	3.61
37	Bilaspur	Takhatpur	Kuli	82.41607	22.14239	3.87
38	Bilaspur	Marwahi	Lekhani	81.97796	22.90898	4.25
39	Bilaspur	Masturi	Malhar	82.2858	21.8914	1.39
40	Bilaspur	Marwahi	Marwahi	82.0694	23.02	6.38
41	Bilaspur	Bilaspur	Matiyari	82.25868	22.12598	5.24

42	Bilaspur	Masturi	Masturi	82.2677	21.9913	0.92
43	Bilaspur	Kota	Nawapara	82.12183	22.42917	3.29
44	Bilaspur	Kota	Nawadih	81.9979	22.3939	4.99
45	Bilaspur	Marwahi	Nimdha	81.945	22.94694	3.55
46	Bilaspur	Lormi	Pali(Lormi)	81.8353	22.2578	4.84
47	Bilaspur	Masturi	Panchpedi	82.27	21.82806	2.28
48	Bilaspur	Kota	Pandra Patha	82.04292	22.42815	3.62
49	Bilaspur	Masturi	Kohronda	82.3549	21.9276	0.61
50	Bilaspur	Marwahi	Pandri (Dhanwari Posa)	81.99552	22.99228	5.44
51	Bilaspur	Takhatpur	Pendari	82.04603	22.11384	6.52
52	Bilaspur	Gaurela (pendrarod) - 1	Piperkhuti	81.8833	22.6639	4.1
53	Bilaspur	Kota	Ratanpur	82.1778	22.2806	3.98
54	Bilaspur	Gaurela (pendrarod) - 1	Rupandand	81.89333	22.6975	3.5
55	Bilaspur	Kota	Saraipalli	81.9361	22.3417	5.24
56	Bilaspur	Marwahi	Seoni	81.9583	23.0125	5.6
57	Bilaspur	Marwahi	Shekhwa	82.08889	22.84167	4.28
58	Bilaspur	Kota	Shivtarai	81.93417	22.34889	4.87
59	Bilaspur	Kota	Shripara	82.0058	22.21	3.89
60	Bilaspur	Takhatpur	Sipat	82.2792	22.1458	7.1
61	Bilaspur	Mungeli	Surada	81.67024	22.08683	7.78
62	Bilaspur	Kota	Saudhakhurd	82.0669	22.4972	3.44
63	Bilaspur	Takhatpur	Takhatpur	81.5139	22.081	4.21
64	Bilaspur	Takhatpur	Takhatpur.1	81.8694	22.1333	3.84
65	Bilaspur	Marwahi	Tendumuda	82.01222	23.05806	4.57
66	Bilaspur	Kota	Tenduwa	81.8833	22.2542	3.19
67	Bilaspur	Masturi	Tikari (Sadak Para)	82.2677	21.9913	4.92
68	Bilaspur	Marwahi	Tikthi	82.0694	23.0844	5.79
69	Bilaspur	Takhatpur	Udaypur	81.75444	22.2725	5.21
70	Bilaspur	Pendra road	Dharhar	81.9642	22.9761	6.03
71	Bilaspur	Kota	Chhatauna	82.06778	22.01972	3.72
72	Bilaspur	Pendra Road	DamDam	82.13917	22.82667	4.32
73	Bilaspur	Marwahi	Marwahi	82.069	23.02	6.38
74	Bilaspur	Marwahi	Larkeni	82.1581	22.0744	4.25
75	Bilaspur	Kota	Kanchanpur	82.057	22.3711	3.88
76	Bilaspur	Bilaspur	Bilaspur (Lalkhadan)	82.1999	22.045	9.33
77	Bilaspur	Belha	Nakhpura	82.26755	22.23633	6.2
78	Bilaspur	Masturi	Jondhra	82.33771	21.73036	4.35
79	Bilaspur	Masturi	Teramsahi	82.31087	22.07026	2.4
80	Bilaspur	Takhatpur	Udaipur	81.77949	22.27241	3.9
81	Bilaspur	Takhatpur	Siltara	81.83132	22.21006	5.1
82	Bilaspur	Takhatpur	Amsena	82.04316	22.02846	1.1
83	Bilaspur	Kota	Shripara	82.00352	22.3455	4.2
84	Bilaspur	Kota	Khongsara	81.93847	22.55021	7.4
85	Bilaspur	Kota	Tenganmada	82.00289	22.52115	7.6
86	Bilaspur	Kota	Parsapani	82.09671	22.47553	1.9
87	Bilaspur	Bilha	Andhiyari para	82.298	22.284	3.6

88	Bilaspur	Bilha	Belpara	82.293	22.276	2.2
89	Bilaspur	Bilha	Beltara	82.274	22.271	1.2
90	Bilaspur	Bilha	Limha	82.311	22.278	1
91	Bilaspur	Bilha	Salkha	82.3	22.259	1
92	Bilaspur	Bilha	Bamhu	82.24	22.23	3.5
93	Bilaspur	Bilha	Banka	82.349	22.31	2
94	Bilaspur	Bilha	Basha(Bichpara)	82.289	22.234	2.3
95	Bilaspur	Bilha	Dhauramuda	82.311	22.241	2
96	Bilaspur	Bilha	Khondra	82.381	22.263	3.8
97	Bilaspur	Bilha	Lakhram	82.203	22.235	3
98	Bilaspur	Bilha	Muchkhanda	82.278	22.193	4.8
99	Bilaspur	Bilha	Nirdhi	82.213	22.337	3.8
100	Bilaspur	Bilha	Puta	82.388	22.324	3.8
101	Bilaspur	Takhatpur	Kathakoni	82.01619	22.1235	8
102	Bilaspur	Takhatpur	Dauna	81.98561	22.00296	3.65
103	Bilaspur	Takhatpur	Khairi	81.96365	22.098	3
104	Bilaspur	Takhatpur	Kukusda	81.95824	22.04466	4.35
105	Bilaspur	Takhatpur	Lata	81.935	22.05723	4.1
106	Bilaspur	Takhatpur	Motimpur	81.94652	22.05189	3.7
107	Bilaspur	Kota	Bharari	82.032	22.232	2.4
108	Bilaspur	Kota	Gauband	82.076	22.233	5.1
109	Bilaspur	Kota	Khargahani	82.066	22.251	3.4
110	Bilaspur	Kota	Khargahna	82.075	22.24	2.1
111	Bilaspur	Kota	Patharra	82.049	22.243	1.8
112	Bilaspur	Kota	Pipartarai	82.034	22.257	7.75
113	Bilaspur	Kota	Ajaypur	82.005	22.213	2.45
114	Bilaspur	Kota	Amali	82.045	22.314	1.8
115	Bilaspur	Kota	Amtara	82.117	22.204	3.45
116	Bilaspur	Kota	Bainsajhar	82.092	22.305	5
117	Bilaspur	Kota	Bardwar	81.97	22.242	0.85
118	Bilaspur	Kota	Bhadam	82.077	22.198	3.6
119	Bilaspur	Kota	Chherkaban	82.085	22.269	1.8
120	Bilaspur	Kota	Chorbhatti	82.039	22.157	4.8
121	Bilaspur	Kota	Chuihapara	82.115	22.235	3.2
122	Bilaspur	Kota	Ganiyari	82.042	22.186	7
123	Bilaspur	Kota	Ghutku	82.097	22.177	4.9
124	Bilaspur	Kota	Gobripat	81.985	22.285	6.5
125	Bilaspur	Kota	jogipur	82.077	22.286	6.2
126	Bilaspur	Kota	Kalhamar	82.106	22.28	2.5
127	Bilaspur	Kota	Kalmitar	82.114	22.261	3.8
128	Bilaspur	Kota	Kapasiya	81.979	22.22	5
129	Bilaspur	Kota	Kargi khurd	81.959	22.266	4.92
130	Bilaspur	Kota	Kota	82.025	22.296	1.9
131	Bilaspur	Kota	Lamer	82.077	22.212	7
132	Bilaspur	Kota	Laphandi	82.099	22.196	4.3
133	Bilaspur	Kota	Madanpur	82.147	22.241	4.2

134	Bilaspur	Kota	Nawapara	81.978	22.206	2.7
135	Bilaspur	Kota	Newara	82.043	22.209	5.2
136	Bilaspur	Kota	Pataita	81.979	22.297	0.9
137	Bilaspur	Kota	Tada	81.994	22.247	2.2
138	Bilaspur	Masturi	Arjuni	82.35333	21.99833	2.5
139	Bilaspur	Masturi	Beltukari	82.31111	22.05306	6.2
140	Bilaspur	Masturi	Bhatapara	82.35472	22.03556	5.1
141	Bilaspur	Masturi	Bhilain	82.28778	22.05278	2.7
142	Bilaspur	Masturi	Jairamnagar	82.30278	22.03333	4.6
143	Bilaspur	Masturi	Kachhar	82.31722	22.06194	2.8
144	Bilaspur	Masturi	Kotmisar	82.34667	22.02861	1.95
145	Bilaspur	Masturi	Paraghat	82.32611	22.02278	1.4
146	Bilaspur	Masturi	Parsda	82.28056	22.04333	2.8
147	Bilaspur	Masturi	Piparsati	82.34667	22.05639	3
148	Bilaspur	Masturi	Amora	82.3725	21.96972	2.9
149	Bilaspur	Masturi	Chauha	82.28556	21.93444	1
150	Bilaspur	Masturi	Daridond	82.38139	22.01806	3.1
151	Bilaspur	Masturi	Darrabhata	82.32806	22.12111	2.5
152	Bilaspur	Masturi	Darrighat	82.23278	22.02389	4.5
153	Bilaspur	Masturi	Devgaon	82.26028	22.06583	2.4
154	Bilaspur	Masturi	Hirri	82.31944	21.97972	3.5
155	Bilaspur	Masturi	Jheriya	82.36889	22.08472	2.6
156	Bilaspur	Masturi	Karra	82.22944	22.03861	1.6
157	Bilaspur	Masturi	Kaudia	82.30306	22.11278	3.4
158	Bilaspur	Masturi	Khutighat	82.32556	21.94028	3.1
159	Bilaspur	Masturi	Limtara	82.25972	22.03861	2.5
160	Bilaspur	Masturi	Murlidih	82.3925	21.98778	1.3
161	Bilaspur	Masturi	Pakariya	82.39306	22.00944	2
162	Bilaspur	Masturi	Parsada	82.2525	21.96472	4.05
163	Bilaspur	Masturi	Pondi	82.38611	22.06806	5.1
164	Bilaspur	Masturi	Risda	82.31361	21.95444	1.9
165	Bilaspur	Masturi	Sankar	82.35972	22.09972	1.8
166	Bilaspur	Masturi	Sonadula	82.35583	22.1125	1.8
167	Bilaspur	Masturi	Chilhati	82.3081	21.7803	2.9
168	Bilaspur	Masturi	Gobri	82.2155	21.7641	3.1
169	Bilaspur	Masturi	Khapri	82.2533	21.781	1
170	Bilaspur	Masturi	Khapri (Menth)	82.2318	21.7443	4.3
171	Bilaspur	Masturi	Kokri	82.2285	21.764	3.7
172	Bilaspur	Masturi	Manikchauri	82.2372	21.8004	5.78
173	Bilaspur	Masturi	Nawapara	82.2623	21.7465	4.3
174	Bilaspur	Masturi	Pataidih	82.2748	21.8137	3.7
175	Bilaspur	Masturi	Ratiha	82.2479	21.824	1.1
176	Bilaspur	Masturi	Amarkunda	82.2798	21.7076	2.4
177	Bilaspur	Masturi	Amgaon	82.1903	21.7958	1.6
178	Bilaspur	Masturi	Bemetara	82.2153	21.6965	3.7
179	Bilaspur	Masturi	Bharari	82.3331	21.8539	3.35

180	Bilaspur	Masturi	Binaika	82.2396	21.8835	2.35
181	Bilaspur	Masturi	Bohardih	82.3659	21.8028	2.3
182	Bilaspur	Masturi	Chicharda	82.3113	21.7007	4.1
183	Bilaspur	Masturi	Chisda	82.325	21.7505	4.1
184	Bilaspur	Masturi	Damru	82.2586	21.7235	3.23
185	Bilaspur	Masturi	Dhabadih	82.1712	21.7416	2.3
186	Bilaspur	Masturi	Gidhpuri	82.2142	21.8357	3.3
187	Bilaspur	Masturi	Goradih	82.3306	21.8089	2.45
188	Bilaspur	Masturi	Jalso	82.3099	21.8537	2.4
189	Bilaspur	Masturi	Jondhara	82.3442	21.7277	3.3
190	Bilaspur	Masturi	Junvani	82.2921	21.8646	1.2
191	Bilaspur	Masturi	Kesla	82.1869	21.7699	1.4
192	Bilaspur	Masturi	Loharsi	82.3357	21.7747	1.35
193	Bilaspur	Masturi	Malhar	82.2807	21.8951	2.89
194	Bilaspur	Masturi	Mohtara	82.1909	21.7015	1.8
195	Bilaspur	Masturi	Pachperi	82.2637	21.8353	3.4
196	Bilaspur	Masturi	Pakariya	82.2562	21.8741	1.8
197	Bilaspur	Masturi	Phodipali	82.3403	21.7542	4.2
198	Bilaspur	Masturi	Rajpur	82.1468	21.7888	2.3
199	Bilaspur	Masturi	Rasera	82.2087	21.716	3.25
200	Bilaspur	Masturi	Sakulkari	82.2892	21.8369	2.3
201	Bilaspur	Masturi	Sasaha	82.3783	21.7769	2.4
202	Bilaspur	Masturi	Tangar	82.3565	21.8221	2.23
203	Bilaspur	Masturi	Tarashiv	82.2904	21.7283	2.89

Annexure 2 Details of Exploration in Bilaspur District

Si. No	District	Block	location	LAT	LONG	Depth	Casing	Formation	Zone_encountered	Discharge
1	BILASPUR	Masturi	Darrighat	22.0209	82.2378	151.74	8.71	Gypsiferous shale	14-15,35	0.9
2	BILASPUR	Takhatpur	Daija	22.2039	81.9319	124.08	15.11	Shale	27-30.5, 68.75, 82.6, 110.3	10
3	BILASPUR	Kota	Ratanpur	22.2889	82.1692	151.5	17.5	Phyllites	21-27, 32	0.8
4	BILASPUR	Kota	Gobripat	22.2851	81.9837	151.74	11.74	Shale and Dolomite	18, 20, 24.5, 41.42, 59.5, 82.5	4
5	BILASPUR	Masturi	Bakarkuda	21.9083	82.2528	151.74	8.2	Limestone	14-16, 49, 83	Negligible
6	BILASPUR	Belha	Sewar	21.9617	82.1386	115.3	11.7	Dolomite & limestone	14-16, 113, 115.3	11.5
7	BILASPUR	Masturi	Vedaprasada	21.9536	82.25	119.47	8.86	Shale	14, 85	1.5
8	BILASPUR	Belha	Durgdih	21.8922	82.2008	150	5.6	Dolomite & limestone	14-16,133.5	0.47
9	BILASPUR	Belha	Bodri	22.0192	82.1133	125.5	23.9	Dolomite & limestone	20-25,49, 125.5	7
10	BILASPUR	Kota	Mithu-Nawagaon	22.3458	82.0014	144	24.1	Gneiss & Schist	27-29,30	0.5
11	BILASPUR	Takhatpur	Mohanbhata	22.2455	82.0301	91.66	32.66	Limestone	14-16,49.25	14.28
12	BILASPUR	Takhatpur	Vijaypur	22.2319	81.7936	64.4	33.99	Dolomite and Shale	30, 36, 55	6.5
13	BILASPUR	Takhatpur	Samdil	22.1994	81.9789	124.08	15.2	Shale	17- 22.9,35	1.32
14	BILASPUR	Takhatpur	Chorbhati	22.1567	82.0278	142.52	18	Gypsiferous shale	14-19,58, 112	3.9
15	BILASPUR	Takhatpur	Sakri	22.1	82.0771	120.85	19.25	Shale	21-29,40	0.8
16	BILASPUR	Belha	Beltara	22.2725	82.2733	123	17.8	Schist	18-24,30	Negligible
17	BILASPUR	Marwahi	Rumga	22.8747	82.095	115	11.7	Granite Gneiss	12--15,25	0.47
18	BILASPUR	Belha	Dagauri	21.8953	82.0661	150	11.7	Dolomite & limestone	14-16, 59	1
19	BILASPUR	Takhatpur	Ganiari	22.1958	82.0192	134	25.85	Gypsiferous shale	14-19,59.4,66.3,73.3,90,112,121.8	10.2
20	BILASPUR	Belha	Hardikalan	22.0019	82.1711	103.32	11.7	Dolomite and Shale	25-30, 48, 75	5.75
21	BILASPUR	Takhatpur	Takhatpur	22.1322	81.8686	119.9	17.5	Shale	14-16,34.7	8
22	BILASPUR	Kota	Amne	22.2643	81.9998	35	19	Dolomite & limestone	14-16	1.5
23	BILASPUR	Kota	Jogipur	22.2874	82.077	138	22	Alluvium & Phyllites	27, 45, 84	11.8
24	BILASPUR	Takhatpur	Khamaria	22.1253	81.9881	151.7	43.2	Shale	14-16,44	1.5
25	BILASPUR	Belha	Khapri	21.8408	82.1311	150	11.7	Dolomite & limestone	16.5-20,30	Negligible
26	BILASPUR	Kota	Tendua	22.2647	81.8813	87.2	14.3	Shale	18, 23, 35.5, 58, 62	13
27	BILASPUR	Masturi	Bharari	21.8567	82.3333	151.74	8.15	Limestone & Dolomite	15-18, 69-70	0.71

28	BILASPUR	Takhatpur	Belpan	22.2274	81.8622	29.5	6.5	Dolomite & limestone	14-18,37	2.125
29	BILASPUR	Marwahi	Bharidand	22.9222	82.0686	70	14.3	Granite	12--20,35	0.2
30	BILASPUR	Gourela	Dewargaon	22.7286	81.8794	87.4	11.7	Granite Gneiss	14-16.1, 63.5	0.9
31	BILASPUR	Belha	Sirgiti	22.0444	82.1519	150	8.5	Shale	17-21.5, 78	1
32	BILASPUR	Gourela	Dhanoli	22.7756	81.8339	101.2	11.7	Granite Gneiss	12--18,30	0.35
33	BILASPUR	Marwahi	Dhobhar	22.8861	81.9778	101.2	6.4	Granite	12--17,30	0.35
34	BILASPUR	Gourela	Jogisar	22.6425	82.0036	142.6	11.7	Granite Gneiss	28-31.2, 42	1
35	BILASPUR	Takhatpur	Belpan OW	22.2271	81.8622	50.5	8.5	Dolomite & limestone	25, 32, 48	2.27
36	BILASPUR	Takhatpur	Belmundi	22.0583	82.0875	171.4	44	Dolomite & limestone	14-18, 37,82,158	18
37	BILASPUR	Belha	Koni	22.1033	82.1378	81.7	22.7	Limestone	20-24,65,79	26
38	BILASPUR	Belha	Koni OW-I	22.1033	82.1378	79.8	24.5	Limestone	17-19,62,78	12.39
39	BILASPUR	Belha	Koni OW-II	22.1033	82.1378	98.2	23.5	Limestone	16-18.5,78	8
40	BILASPUR	Kota	Kota	22.2833	82.0417	129.8	19.5	Gneiss	15-19, 68	2.5
41	BILASPUR	Takhatpur	Chatuna	22.0333	82.0583	88.2	8.2	Dolomite & limestone	14-16, 30,66,75	14
42	BILASPUR	Takhatpur	Chatuna OW	22.0333	82.0583	88	6	Dolomite & limestone	14-16, 56,82	14
43	BILASPUR	Kota	Shivtarai	22.3497	81.941	204	40.7	Gneiss	20-24,32	dry
44	BILASPUR	Belha	Phadakhar	22.0472	82.1261	204	7.5	Shale	20-22,102	>1.5
45	BILASPUR	Takhatpur	SmritiVatika	22.1125	82.0583	134.4	44.8	Sh/Lst/Dolomite	18-20,81,92	7.14
46	BILASPUR	Takhatpur	SmritiVatikaOW-I	22.1125	82.0583	79.8	31.5	Sh/Lst/Dolomite	14-16,78	7.14
47	BILASPUR	Takhatpur	SmritiVatikaOW-II	22.1125	82.0583	134.9	37.7	Sh/Lst/Dolomite	14-20, 83-123	12.39
48	BILASPUR	Masturi	Masturi	21.9903	82.2667	77.5	4.5	Limestone, sh.	14-16,77	25
49	BILASPUR	Belha	Koni	22.1244	82.1244	31.3	31	Alluvum	3-31.3,42	0.41
50	BILASPUR	Belha	Kududand	22.0944	82.125	90	40	ABONDOND	14-17	
51	BILASPUR	Masturi	Jairamnagar	22.02938	82.29489	86	7.4	Limestone	15.9-19,67.8-70.8	8
52	BILASPUR	Belha	Parsada	22.20287	82.20735	200	11.6	Limestone	25.8-28.8,41-44,135.6-138.6	26
53	BILASPUR	Kota	Nawapara	22.38856	82.08219	200	12	Metamorphics	22.7-25.8,117.4-120.4	4.1
54	BILASPUR	Kota	Mithu-Nawagaon	22.46209	82.03287	200	25.5	Granite gneiss	19.7,21,27	1.4
55	BILASPUR	Kota	Bhaisajhar	22.28848	82.06501	200	20.7	Granite gneiss	41-44,62-65,108-111	4.8
56	BILASPUR	Kota	Chatauna	22.4763	82.07372	200	10	Metamorphics	108-111	0.316
57	BILASPUR	Gourella	Thengadand	22.65618	81.91714	200	14	Granite gneiss	108-111,117-120,181-184	4

Annexure 3 Details of Chemical Analysis

District	Block	Location	Long	Lat	PH	EC	CO3	HCO3	Cl	No3	SO4	F	TH	Ca	Mg	Na	K	Si	Po4
(In ppm)																			
Bilaspur	Pendra	Adbhar	81.5915	22.4908	7.67	731	0	232	106	10	44	1.9	200	48	19	92	1.05	20	0
Bilaspur	Masturi	Bakarkuda	82.26948	21.91898	7.2	542	0	207	50	4.9	53	0.43	237	56	23	29	2.16	10	0
Bilaspur	Kota	Banabel	82.1078	22.4681	7.58	248	0	122	7	0.97	16	0.57	90	24	7.2	17	0.93	15	0
Bilaspur	Kota	Bansajhal	82.1167	22.3833	7.57	238	0	153	14	0.9	9.7	0.53	120	28	12	17	0.91	14	0
Bilaspur	Bilha	Bartoli	82.1475	21.8797	7.15	883	0	366	78	9.6	64	0.42	330	72	36	70	3.4	9.2	0
Bilaspur	Kota	Belgahana	82.0333	22.4333	7.43	313	0	256	21	0.85	14	0.48	135	40	8.4	17	1	17	0
Bilaspur	Takhatpur	Beltara	82.2681	22.2722	7.27	630	0	256	35	12	72	0	300	100	12	22	1	9.2	0
Bilaspur	Bilha	Hemunagar	82.1864	22.0533	7.52	122	0	49	3.5	21	5.2	0	50	12	4.8	3.2	6.4	16	0
Bilaspur	Bilha	Bilha	82.086	21.9585	7.68	470	0	226	35	5.5	20	0.3	245	72	16	3.2	6.4	13	0
Bilaspur	Masturi	Binauri	82.26655	21.86013	7.33	520	0	171	35	0	91	0.48	235	72	13	21	3.3	9	0
Bilaspur	Bilha	Bohardi	82.0801	21.564	7.6	435	0	348	28	0	37	0.42	210	44	24	69	3	9.2	0
Bilaspur	Masturi	Bothidih	82.2427	21.9908	7.4	329	0	134	50	27	20	0.41	160	44	12	28	1.3	31	0
Bilaspur	Bilha	Chakarbhata	82.12472	22.00111	7.4	307	0	159	43	7.6	17	0.34	170	48	12	18	1	26	0
Bilaspur	Marwahi	Chchgohana	82.0365	23.01962	7.2	517	0	195	21	0.73	35	0.35	230	68	14	21	3.2	8.4	0
Bilaspur	Bilha	Dagauri	82.0706	21.8939	7.4	431	0	195	28	0	34	0.45	85	20	8.4	71	3	9.8	0
Bilaspur	Marwahi	Danikundi	82.0667	22.9292	7.1	893	0	342	71	10	102	0.37	345	100	23	67	3.4	9	0
Bilaspur	Marwahi	Dhanpur	81.9861	22.8833	7.3	220	0	85	7	21	22	0.34	65	16	6	24	1.6	29	0
Bilaspur	Takhatpur	Ganiyari	82.04839	22.19384	7.5	727	0	195	106	11	75	1.16	170	44	14	105	1.1	21	0
Bilaspur	Takhatpur	Ganiyari.2	82.0417	22.1861	7.2	709	0	195	71	84	60	0.34	305	88	20	39	3.2	18	0
Bilaspur	Takhatpur	Gatori	82.1389	22.1944	7.4	190	0	61	14	22	5	0	80	20	7.2	2.9	6	16	0
Bilaspur	Gaurela (pendrarod) - 2	Gaurela	81.9111	22.7542	7.3	247	0	98	14	8.6	15	0	100	24	9.6	9.8	2.7	8	0
Bilaspur		Ghansipur	82.1379	22.3585	7.4	587	0	256	35	31	31	0.44	260	56	29	27	2.8	21	0
Bilaspur	Bilha	Hirri	82.05	21.9708	7.5	370	0	207	14	2.1	11	0.45	165	32	20	16	0.86	17	0
Bilaspur	Takhatpur	Jaroundha	81.5644	22.1535	7.4	883	0	421	43	0.96	87	0.38	440	84	55	26	3.1	12	0
Bilaspur	Kota	Jhingatpur	81.9972	22.3667	7.4	602	0	256	35	15	46	0.33	270	56	31	18	6.3	9	0
Bilaspur	Kota	Jogipur	82.075	22.2958	7.4	475	0	256	35	1.06	13	0.46	225	48	25	15	0.93	16	0

Bilaspur	Mungeli	Kanteli.1	81.65	22.1528	7.5	445	0	244	21	0.8	12	0.56	210	52	19	16	0.88	17	0
Bilaspur	Kota	Kargi khurd	81.95861	22.2675	7.34	932	0	384	43	44	62	0.4	330	36	58	68	1.6	14	0
Bilaspur	Kota	Kenda	82.0806	22.5319	7.3	600	0	274	43	14	29	0.22	280	72	40	16	0.7	11	0
Bilaspur	Gaurela (pendrarod) - 1	Keonchi	81.7708	22.6208	7.5	357	0	183	14	0.74	10	0.41	145	32	16	16	0.74	13	0
Bilaspur	Kota	Khaira	82.1407	22.3624	7.53	349	0	183	14	0	14	0.99	120	40	4.8	31	1.4	18	0
Bilaspur	Mungeli	Khamaria	81.84346	22.06952	7.72	448	0	268	14	0	5	0.6	200	44	22	17	4.6	19	0
Bilaspur	Takhatpur	Khamharia1	81.9875	22.1222	7.3	1334	0	537	78	17	132	0.25	470	88	60	106	3.3	16	0
Bilaspur	Masturi	Koni	82.2383	21.9819	7.2	1917	0	195	28	2.2	200	0.65	780	220	55	42	4.1	11	0
Bilaspur	Kota	Kota(kargi)	82.025	22.2889	7.5	744	0	342	43	4.4	48	0.14	300	68	31	40	2.9	10	0
Bilaspur	Marwahi	Kotmi.1	82.0875	22.8111	7.5	472	0	244	28	0.77	15	0.47	220	44	26	16	1.3	12	0
Bilaspur	Belgahana	Konchua	81.5846	22.2839	7.6	315	0	146	14	21	12	0.23	120	40	4.8	23	1.4	16	0
Bilaspur	Marwahi	Kudwahi	81.98	22.8648	7.8	447	0	274	7	0.8	5	0.58	200	40	24	18	4.7	28	0
Bilaspur	Takhatpur	Kuli	82.41607	22.14239	7.5	313	0	122	21	1	19	0.26	110	32	7.2	22	1.5	20	0
Bilaspur	Marwahi	Lekhani	81.97796	22.90898	7.4	978	0	329	92	2.6	68	0.69	395	108	30	35	2.73	24	0
Bilaspur	Takhatpur	Madanpur	82.14722	22.24111	7.7	1109	0	232	23	7	81	3.15	410	84	48	95	0.87	32	0
Bilaspur	Masturi	Malhar	82.2858	21.8914	7.6	242	0	110	18	0	13	0.44	110	36	4.8	0.8	2.7	8.4	0
Bilaspur	Marwahi	Marwahi	82.0694	23.02	7.6	627	0	329	28	0	31	0.91	185	60	8.4	72	3	9	0
Bilaspur	Bilaspur	Matiyari	82.25868	22.12598	7.4	356	0	171	18	9.8	20	0.71	160	44	12	14	1.12	6	0
Bilaspur	Masturi	Masturi	82.2677	21.9913	7.4	843	0	354	64	22	51	0.54	310	60	38	3	2.19	7.4	0
Bilaspur	Kota	Minrapara	82.1174	22.3857	7.8	717	0	305	78	15	19	0.68	295	64	32	42	3.18	12	0
Bilaspur	Bilha	Narmada khapri	82.1431	22.0814	7.4	680	0	232	71	15	36	0.77	290	64	31	24	2.55	21	0
Bilaspur	Kota	Nawapara	82.12183	22.42917	7.7	720	0	366	43	0	19	0.97	290	40	46	42	3.2	13	0
Bilaspur	Kota	Nawadih	81.9979	22.3939	7.8	453	0	262	14	11	4	1	200	60	12	21	5	17	0
Bilaspur	Takhatpur	Neora	81.93167	22.2125	7.5	658	0	305	50	0	29	0.61	280	80	19	32	0.71	10	0
Bilaspur	Marwahi	Nimdha	81.945	22.94694	7.3	1061	0	335	142	2	52	0.69	440	96	48	41	3.2	18	0
Bilaspur	Lormi	Pali	81.8353	22.2578	7.6	1110	0	378	99	10	77	2.75	340	60	46	94	0.91	21	0
Bilaspur	Masturi	Panchpedi	82.27	21.82806	7.5	663	0	220	99	13	28	0.52	290	44	43	33	0.7	11	0
Bilaspur	Masturi	Kohronda	82.3549	21.9276	7.6	669	0	317	35	31	29	0.97	210	72	7.2	72	3	9.5	0
Bilaspur	Masturi	Lalkhadan	82.1999	22.045	7.6	626	0	293	28	11	17	0.84	170	20	29	62	0.77	12	0
Bilaspur	Marwahi	Pandri	81.99552	22.99228	7.7	716	0	329	71	11	19	0.82	300	28	55	43	2.9	13	0

Bilaspur	Takhatpur	Pendari	82.04603	22.11384	7.8	260	0	122	21	0	5.2	1.94	95	24	8.4	22	0.4	28	0
Bilaspur	Gaurela (pendrarod) - 1	Piperkhuti	81.8833	22.6639	7.4	1174	0	537	50	0	107	0.38	470	56	79	69	2.7	14	0
Bilaspur	Kota	Ratanpur	82.1778	22.2806	7.6	466	0	171	50	0	18	0.77	190	60	9.6	19	0.88	27	0
Bilaspur	Gaurela (pendrarod) - 1	Rupandand	81.89333	22.6975	7.6	691	0	268	64	2.7	35	0.54	300	76	26	23	0.61	20	0
Bilaspur	Kota	Saraipalli	81.9361	22.3417	7.8	466	0	207	35	6.9	14	0.76	200	56	14	19	0.98	28	0
Bilaspur	Marwahi	Seoni	81.9583	23.0125	7.6	458	0	244	28	0	10	0.96	215	48	23	16	0.98	18	0
Bilaspur	Marwahi	Sewra	81.98056	22.85167	7.8	264	0	146	7	0	4.7	2.3	90	24	7.2	23	0.42	28	0
Bilaspur	Marwahi	Shekhwa	82.08889	22.84167	7.4	308	0	207	71	9.7	93	1.12	550	140	48	70	3.4	17	0
Bilaspur	Kota	Shivtarai	81.93417	22.34889	7.7	313	0	110	21	22	5.7	0.7	90	28	4.8	25	1.5	9	0
Bilaspur	Kota	Shripara	82.0058	22.21	7.5	585	0	256	28	15	38	2.3	260	56	29	19	7	7	0
Bilaspur	Takhatpur	Sipat	82.2792	22.1458	7.7	352	0	183	21	0	14	0.52	120	28	12	32	1.4	19	0
Bilaspur	Mungeli	Surada	81.67024	22.08683	7.4	860	0	342	57	28	50	0.81	350	52	53	37	2.3	8	0
Bilaspur	Kota	Saudhakhurd	82.0669	22.4972	7.5	1130	0	476	64	12	126	0.95	470	80	65	70	2.3	14	0
Bilaspur	Takhatpur	Takhatpur.1	81.8694	22.1333	7.9	455	0	268	14	0	6.7	0.52	200	44	22	19	5.8	17	0
Bilaspur	Marwahi	Tendumuda	82.01222	23.05806	7.4	1936	0	842	43	2	146	2.92	800	272	29	44	4.7	11	0
Bilaspur	Kota	Tenduwa	81.8833	22.2542	7.5	480	0	220	21	10	18	0.53	150	40	12	34	0.5	26	0
Bilaspur	Masturi	Tikari	82.2677	21.9913	7.6	523	0	256	28	13	26	0.77	200	48	19	17	0.72	11	0
Bilaspur	Marwahi	Tikthi	82.0694	23.0844	7.6	1055	0	348	113	31	56	2.93	450	100	48	38	3.1	19	0
Bilaspur	Takhatpur	Udaypur	81.75444	22.2725	7.5	457	0	201	28	11	18	0.51	160	48	9.6	33	0.5	26	0
Bilaspur	Mungeli	Chandrakuri	81.90436	21.83883	7.4	647	0	299	43	11	27	2.5	280	52	36	32	0.72	11	0
Bilaspur	Pendra road	Dharhar	81.9642	22.9761	7.5	760	0	366	14	0	88	0	370	80	41	24	2	9	0
Bilaspur	Kota	Chhatauna	82.06778	22.01972	7.7	276	0	134	14	0	5.6	2.2	90	24	7.2	22	0.44	27	0
Bilaspur	Pendra Road	DamDam	82.13917	22.82667	8.1	1257	0	561	57	0	76	2.41	160	32	19	215	2.25	17	0
Bilaspur	Marwahi	Marwahi	82.069	23.02	7.8	595	0	207	14	50	62	2.75	250	44	34	23	1.36	24	0
Bilaspur	Marwahi	Larkeni	82.1581	22.0744	7.2	459	0	232	21	12	18	3.1	175	56	8.4	35	0.45	23	0
Bilaspur	Kota	Kanchanpur	82.057	22.3711	7.01	351	0	183	14	0	12	2.41	190	32	26	33	1.4	19	0
Bilaspur	Bilaspur	Bhadrapara	82.33575	22.1615	7.9	595	0	195	71	22	19	0	160	40	14	62	0.8	10	0