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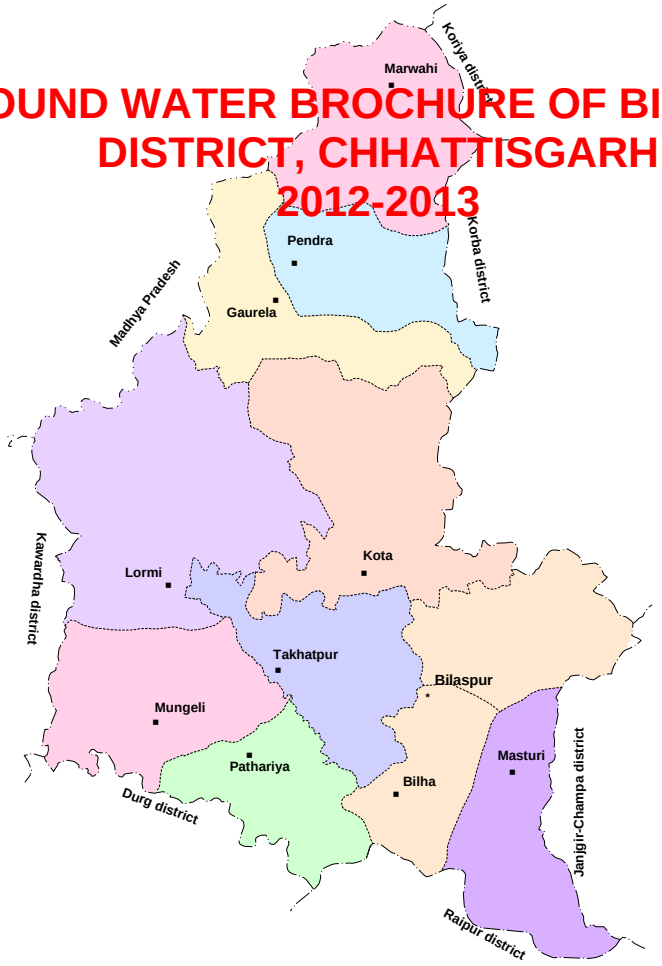
GOVERNMENT OF INDIA
MINISTY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD

GROUND WATER BROCHURE OF BILASPUR DISTRICT, CHHATTISGARH 2012-2013



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DISTRICT AT A GLANCE

By
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1. GENERAL INFORMATION

i) Geographical area (Sq. km)	8569
ii) Administrative Divisions (As on 2011)	
a) Number of Tehsil/ Block	8/ 10
b) Number of Panchayat/ Villages	864/ 1616
iii) Population as on 2011Census	2662077
iv) Annual Normal Rainfall	1351 mm
iv) Average Annual Rainfall (1992-11)	1082 mm

2. GEOMORPHOLOGY

i) Major Physiographic Units	Northern Hills & Chhattisgarh Plain
ii) Major Drainages	Seonath, Arpa & Son

3. LAND USE (Sq. km) As on 2010

i) Forest Area	3307
ii) Net Area Sown	3602
iii) Cultivable Area	4060.39

4. MAJOR SOIL TYPES

Medium black soil, sandy soil

5. AREA UNDER PRINCIPAL CROPS, in Sq. km (As on 2010)

Rice: 3216.26
Pulses: 1107.65
Wheat: 129.03

6. IRRIGATION BY DIFFERENT SOURCES (2010)

(Areas in Sq. km. and Numbers of Structures)

i) Dugwells	24.30/ 6305
ii) Tubewells/Borewells	223/ 11031
iii) Canals	1137/ (length: 456 km)
iv) Ponds	40.53/ 6388
v) Other sources	25.96/ --
vi) Net Irrigated Area	1451
vii) Gross Irrigated Area	1573

7. NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB (As on 31.3.2011)

i) No of Dugwells	43

ii) No of Piezometers	17

8. PREDOMINANT GEOLOGICAL FORMATIONS

Archaeans : Unclassified Metamorphics, Granites and Gneiss
Proterozoics : Chhattisgarh Supergroup (Sedimentaries)

9. HYDROGEOLOGY

i) Major Water Bearing Formation	Proterozoic Sedimentaries (Limestone, Shale and Dolomites of Chhattisgarh Supergroup)
ii) Pre-monsoon Depth to Water Level During 2012 (mbgl)	2.26 to 16.52, Avg.: 8.30
iii) Post-monsoon Depth to Water Level During 2012 (mbgl)	0.11 to 10.33, Avg.: 4.34
iv) Long Term Water Level Trend in 10 yrs (2002-2011) in m/yr	Fall: 0.06 to 0.47 Rise: 0.03 to 0.47

10. GROUND WATER EXPLORATION BY CGWB (As on 31.3.2012)

i) No of Wells Drilled	EW: 68, OW: 07, PZ: 06, Total: 81
ii) Depth Range (m)	29 to 157
iii) Discharge (litres per second)	0.35 to 19
iv) Transmissivity (m^2/day)	Chhattisgarh Supergroup: 2 to 405, Archaeans: 1 to 44

11. GROUND WATER QUALITY

i) Presence of Chemical Constituents More Than Permissible Limit (e.g. EC, F, As, Fe)	Some patches underlain by Maniari and Tarenga shale have high EC values upto 2300.
ii) Type of Water	Water is potable and fit for irrigation purpose

12. DYNAMIC GROUND WATER RESOURCES (As on March 2009)- in Ham

i) Annual Replenishible Ground Water Resources	52353.99
ii) Net Annual Ground Water Draft	23229.37
iii) Projected Demands for Domestic and Industrial Uses upto 2025	6392.43
iv) Stage of Ground Water Development	46.71%

13. AWARENESS AND TRAINING ACTIVITY

1. I) Mass Awareness Programmes Organised
   Date: 16.03.2007,Place: Bilapsur
   ii) Mass Awareness & Training Programme under Hydrology Project, year 2012, Place Bilaspur Town

2. Water Management Training Programmes Organised
   i) Date: 2002-03, Place: South East Central Railway
   ii) Date: 21st and & 22nd Feb. 2005, Place: South Eastern Coalfields Ltd., Bilaspur town.

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14. EFFORTS OF ARTIFICIAL RECHARGE & RAIN WATER HARVESTING

i) Projects Completed by CGWB (No & Amount spent)	Nil
iii) Project under Progess	1/101.53 lakh

15. GROUND WATER CONTROL AND REGULATION

i) Number of Over Exploited Blocks (Stage of Development > 100%)	Nil
ii) Number of Critical Blocks (Stage of Development > 90%)	Nil
iii) Semi Critical Blocks	
iii) Number of Blocks Notified	Nil

16. MAJOR GROUND WATER PROBLEMS AND ISSUES

The areas underlain by Maniari and Tarenga shale & dolomite have high value of EC. Drilling and construction of wells in the areas underlain by Pandaria Formation is a bit difficult due to the presence of clay in the cavernous and crushed rocks.

1. INTRODUCTION

In May 1998 the original Bilaspur District was divided into 3 districts namely Bilaspur, Janjgir Champa & Korba. Bilaspur district is located on the northwestern part of the Chhattisgarh state and is bounded by East longitudes 81°29'02" & 82°27'44" and by North latitudes 21°42'40" & 23°06'58" falling in the Survey of India toposheets nos 64E/16, F/6,7,10 to 16, G/9,13, I/4, J/1 to 4,7,8, K/1,5,6. It covers an area of 8569 sq.km. It is surrounded by Durg and Raipur districts on the south, Kawardha and Mandla districts (Madhya Pradesh) in the west, Koriya district in the north, Korba and Janjgir-Champa districts in the east (**Plate-I**). Bilaspur is the district headquarters and is 120 km away form the State capital Raipur. It is well connected with State capital by road and railways. National Highway No. 200 passes through the town. It is on the Mumbai- Howrah main railway line. The district is well connected by all weathered roads.For the convenience of administration, the district is divided into 8 no. of tehsils, 10 no. of Community Development blocks & 858 no. of gram panchayats

In the district there are 16 urban centers. The Bilaspur town is managed by Municipal Corporation, Mungeli town is managed by Municipality and rest 14 towns (Baitalpur, Belha, Bodri, Deori, Ghutku, Gaurela, Kota, Lingiyadih, Lormi, Mahmand, Ratanpur, Sirgiti, Pendra and Takhatpur,) are covered by Nagar Panchayats. The urban population constitutes 25.50% of the total population in the district and the Bilaspur town is having a population of 4, 54,000. There are no major industries except one in Belha block. Dolomite is the major mineral mined around Hirri area. Laterites and limestones are used as building materials and are mined at isolated patches.

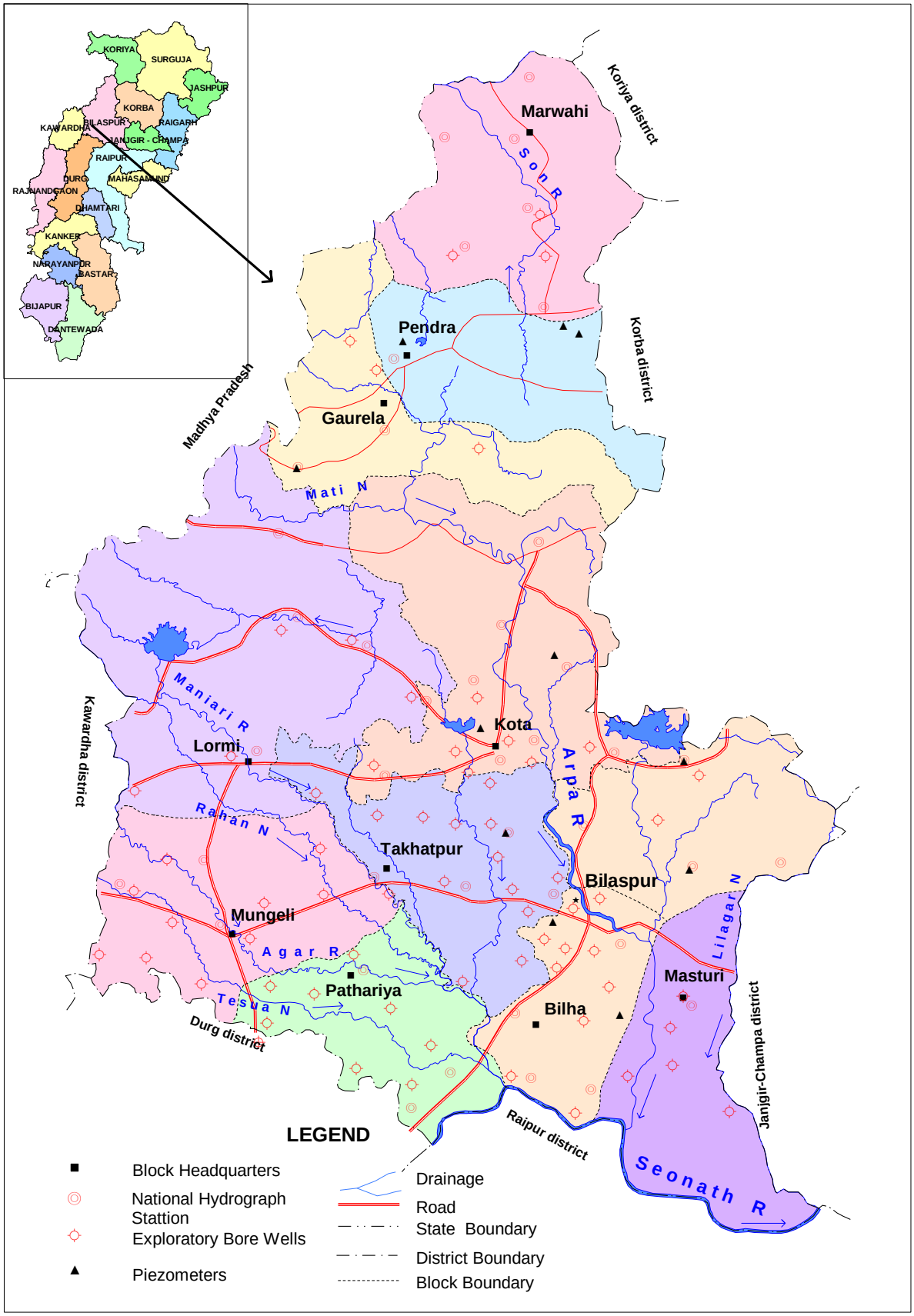
As per 2011 census the total population in the district is 26,62,077. The decadal growth rate is 33% nearly 76% of the population resides in the rural areas. The female population is less than males. The population density is 332 persons/ sq.km and the literacy rate is around 72%.

The Mahanadi River drains about 90% of the area in the district and the rest is by the Ganges River (**Plate-I**). 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).

Around 38.78% of the total area is covered by forest. The southern part of the district is a plain land with gentle slopes covering an area of 48% of the total geographical area in the district. It is also called the Chhattisgarh plains. The land is very fertile and is mostly used for the agriculture purposes with few surface irrigation facilities. The northern part of the district is mostly hilly with highly undulating topography where the agriculture is restricted to few patches only. The net area sown during the year 2011 is around 360195 ha. Paddy is the main crop (88%) followed by pulses. There are three medium and 125 no of small irrigation projects exist in the district. There is no major irrigation project in the area. The three medium irrigation projects are

Khunj, Ghongha and Maniyari. Lormi, Mungeli, Masturi and Bilaspur blocks are the major beneficiaries of these projects. The small projects consist of small reservoirs

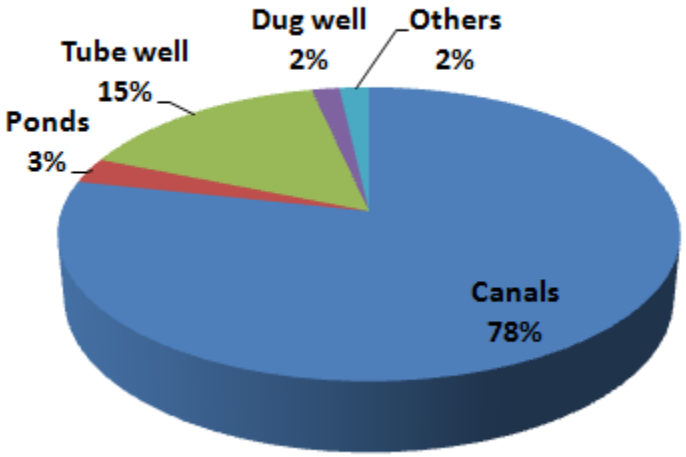
Plate - 1 Index map of the Bilaspur District



constructed across the nalas, diversion canals, ponds and lift irrigation systems. Kota block is having more no. of small irrigation projects.

Nearly 40% of the net sown area is irrigated by all sources. Irrigation by Canals almost 72% of the net irrigated area and parts of Bilaspur, Masturi, Mungeli and Lormi blocks are covered by canal irrigation system. The irrigation by surface water mainly supports Kharif crop (98.6%). Nearly 246.95 sq. km area spread over the entire district (17% of the net irrigated area) is irrigated by ground water. **Fig. 1** shows the details of area irrigated by different sources used for irrigation in the district.

Fig 1 Details of Area Irrigated

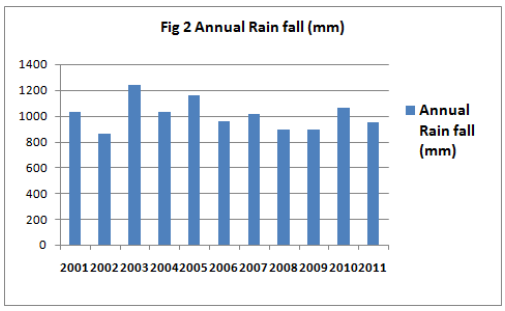


Central Ground Water Board carries out different hydrogeological studies related to assessing the prevailing hydrogeological conditions, ground water potential, level of development and management of ground water resources through different surveys and studies like exploratory drilling, geophysical studies, geochemical studies, ground water level monitoring, systematic hydrogeological studies, reappraisal hydrogeological studies in the district. The Systematic hydrogeological study and the Reappraisal Hydrogeological Studies of the district were carried out during 1976-77 and 1995-96 respectively. The reports on Ground Water Resources and Development Potential of the district were released in 2000 and 2006.

The Urban Hydrogeological Studies in and around Bilaspur Municipal Corporation was carried out during 2002-03. The Block-wise groundwater resources estimation of the district was carried out jointly by CGWB and Water Resource Department, Govt. of Chhattisgarh in 2004, 2009 & 2011. In the district a total of 68 nos of borewells were drilled under exploration programme using DTH rigs. Ninety two (92) nos. of vertical electrical resistivity soundings (VES) were carried out in the area in order to select best sties for drilling as well as to delineate the Arpa river alluvium near Bilaspur town. A total of 43 nos. of dug wells (DW) and 17 no. of piezometers (Pz) are being monitored four times a year for water levels and one time for water quality in the area on long term basis.

2.0 RAINFALL AND CLIMATE

The Bilaspur district receives rainfall mainly from the southwest monsoon. It sets in 3rd / 4th week of June and continues till mid August/ September with heaviest showers in the months of July and August. The average annual rainfall for the district is around 1082 mm (1992-2011). The months of July and August are the heaviest rainfall months and nearly



95% of the annual rainfall is received during June to September months. The rainfall is unevenly distributed in different tehsils and also the amount of rainfall varies from year to year.The district experiences a hot and semi-humid climate. The annual temperature varies from 10° C to 45° C. The hottest months are May and June and the minimum temperature is observed in the months of December and January.

3.0 GEOMORPHOLOGY & SOIL TYPES

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 Lormi, 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, Mungeli, Pathariya, 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. The hill ranges on the northwestern boundary of the district forms part of the Amarkantak ranges. The Deccan traps along the western boundary forms high peaks. 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. In the district four types of soil are observed as per US soil taxonomy and is shown in **Table-1**.

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.

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 accumulation of iron oxide, which is highly insoluble in water. Inceptisol soils occupy mostly hill slopes and are found along the western boundary of the district.

Table 1: Soil Classification

Sl. No.	US soil taxonomy	Indian equivalents
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

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.

4.0 GROUND WATER SCENARIO

4.1 Hydrogeology

Hydrogeologically the district can be categorised into three groups.

i) The Archaean rocks consisting of granites, gneisses, schists, phyllites and quartzites.

ii) Proterozoic sediments belonging to Chhattisgarh Supergroup mainly consisting of limestone, shales and dolomites and

iii) a) Semiconsolidated sediments belonging to Gondwana Supergroup consisting of Barakars sandstones and Talchir shales.

b) The unconsolidated alluvium along the major river courses of Arpa, Maniari, Khurung, Lilagar and Agar.

4.1.1 Archaean Crystallines

The Archaean crystallines and the Proterozoic sediments cover 93% of the area of the district. The ground water in crystallines occurs under water table conditions in the weathered formation and within fractures and fissures below weathered zones. On an average the thickness of the weathered formation in the area is around 15 m with the maximum thickness goes up to 32 m. The occurrence of fractures at depth in the area is not common. Therefore the ground water potential depend on the thickness of the weathered formation in a well. The ground water development in these formations is mostly by way of large diameter dug wells located at favourable places.

4.1.2 Precambrian Sedimentaries

The Precambrain sediments of Chhattisgarh Supergroup are marine in origin and mainly consist of sandstone, limestone, shale and dolomites. The primary porosity and permeability of these formations is very poor. The ground water in these formations occurs under water table, semi confined and confined conditions. The weathered and the cavernous part of the formation and also the fractured zones constitute the aquifers in the area. These formations are most potential in the district and are well developed. The maximum thickness of the weathered formation in the area is around 30 m. The cavernous zones are occurring mostly in the depth range of 10 to 70 m. The fractures are productive even at depths of 150 to 200 m. Chandrapur sandstone is basically hard and compact in nature and is less potential. The conglomerate occurring between Chandrapur and Pandaria Formation forms the potential zone in the area. The Pandaria Formation consists of alternate beds of shale, shaly limestone and limestone. The cavernous zones are well developed and these make this formation potential. The Maniari shales are fine grained, soft and compact in nature and are intercalated with gypsum lamina. The gypsum lamina can easily be dissolved thereby resulting large no of cavities along the bedding plain. For this reason, the Maniari shales are high potential ones. The ground water development in Maniari shales is mostly by dug wells to a depth of 15 m and by bore wells to a depth of 180 m. In limestones and dolomites the solution cavities and karstic zones makes the formation highly potential. The discharge from these formations was reported as high as 35 lps. Several artesian flowing and non-flowing wells are reported in karstic terrain of Mungeli and Patharia blocks by various workers in the area. To site few places, Satganga, Goadkhani and Bhainsamunda are noteworthy.

4.1.3 Semi-Consolidated and Unconsolidated Sediments

The Barakar sandstone formation of Gondwana Supergroup and river alluvium in the area are having very limited aerial extents. The Barakar sandstones are found in parts of Murwahi and Gaurela blocks of the district and the ground water in this formation occurs under phreatic and semi-confined to confined condition. The alluvium is formed along the

river courses of Arpa, Maniari, Khurung, Lilagar and Agar. The alluvium consists of clay, sand, gravel and cobbles and form good aquifer under water table condition. This formation is developed by dug wells with depth ranging from 5 to 20 m. The specific capacity of this formation varies from 110 to 450 lpm/m. The alluvial deposit around Arpa river covers an area of 175 sq.km, which is highly potential.

4.2 Water Level Scenario

As a part of National Hydrograph Network Observation Stations (NHS), 43 no of dug wells and 17 no of piezometers are established to monitor water levels four times in a year i.e. in January, May (Pre-monsoon), August and in November (post-monsoon). The dug well depths are varying form 3.76 to 19.82 mbgl. These monitoring wells are distributed throughout the district covering all the lithological formations.

4.2.1 Depth to Water Level- Pre-monsoon (May 2012)

The depth to water (DTW) level observed during pre-monsoon period in the month of May 2007 is presented in **Plate- 2**. The average depth to water level in the district during pre-monsoon period is 8.30 m bgl. The water level varies between 5 to 16.5 m in the area. The shallow water levels are observed in the central parts of Takhatpur block and also in Setganga area. The water levels in the range of 10 to 20 m is observed in 28.9 % of cases and covers mostly in the parts of Patharia and Mungeli blocks which are mostly underlain by formations of the Chhattisgarh Supergroup. In Murwahi block the water levels are more than 15 m in a a small part in the district.

4.2.2 Depth to Water Level- Post-monsoon (November 2012)

The depth to water level measured during the post-monsoon period in the month of November 2011 is presented in **Plate- 3** The average depth to water level in the district during post-monsoon period is 4.34m bgl. From the figure it is clear that the water levels during the post-monsoon period are mostly varying from 0 to 5 m. The water levels in the range of 5 to 10 m are observed in Belha, Patharia, Mungeli and Gaurela blocks. The deepest water level is observed at Dhanikundi and is in Barakar sandstone. it is interoperated that nearly in 64% of the cases the water levels are below 5 m.

4.2.2 Water Level Fluctuation (May-Nov. 2012)

In the entire district the water levels in the month of November have shown a rise when compared with that of in the month of May. Most of the wells have a rise in water level in the range of more than 4 m and are in Masturi, Bilha, Pathriya, takhatpur, Lormi and Kota blocks. In Mungeli block the fluctuation is in the range of 0 to 4 m. The Marwahi, Pendra and Gaurela blocks have a fluctuation of 2 to 4 m.

4.2.4 Water Level Trend (2002 to 2012)

The long term water level trend analysis shows that during the pre-monsoon period around 29% of the wells have a rising trend of water levels and the rest 71% have a falling trend. Around 62% of the wells show either rise or fall in the range of 0 to 0.2 m/yr, which is practically insignificant. Most of the falling trends (49%) are in the range of 0 to 0.2 m/yr.

Plate -2 Premonsoon (May 2012) depth to water level

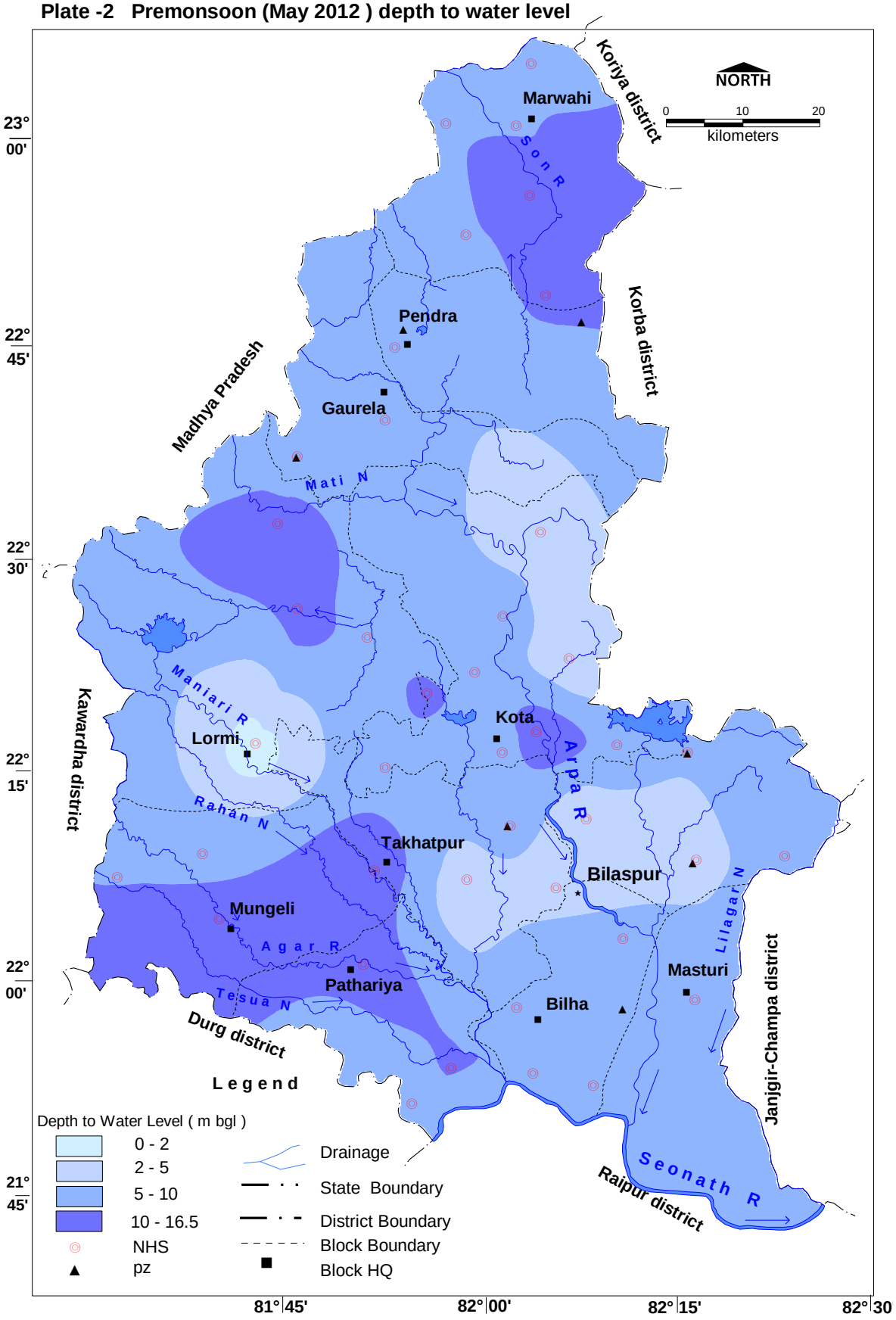
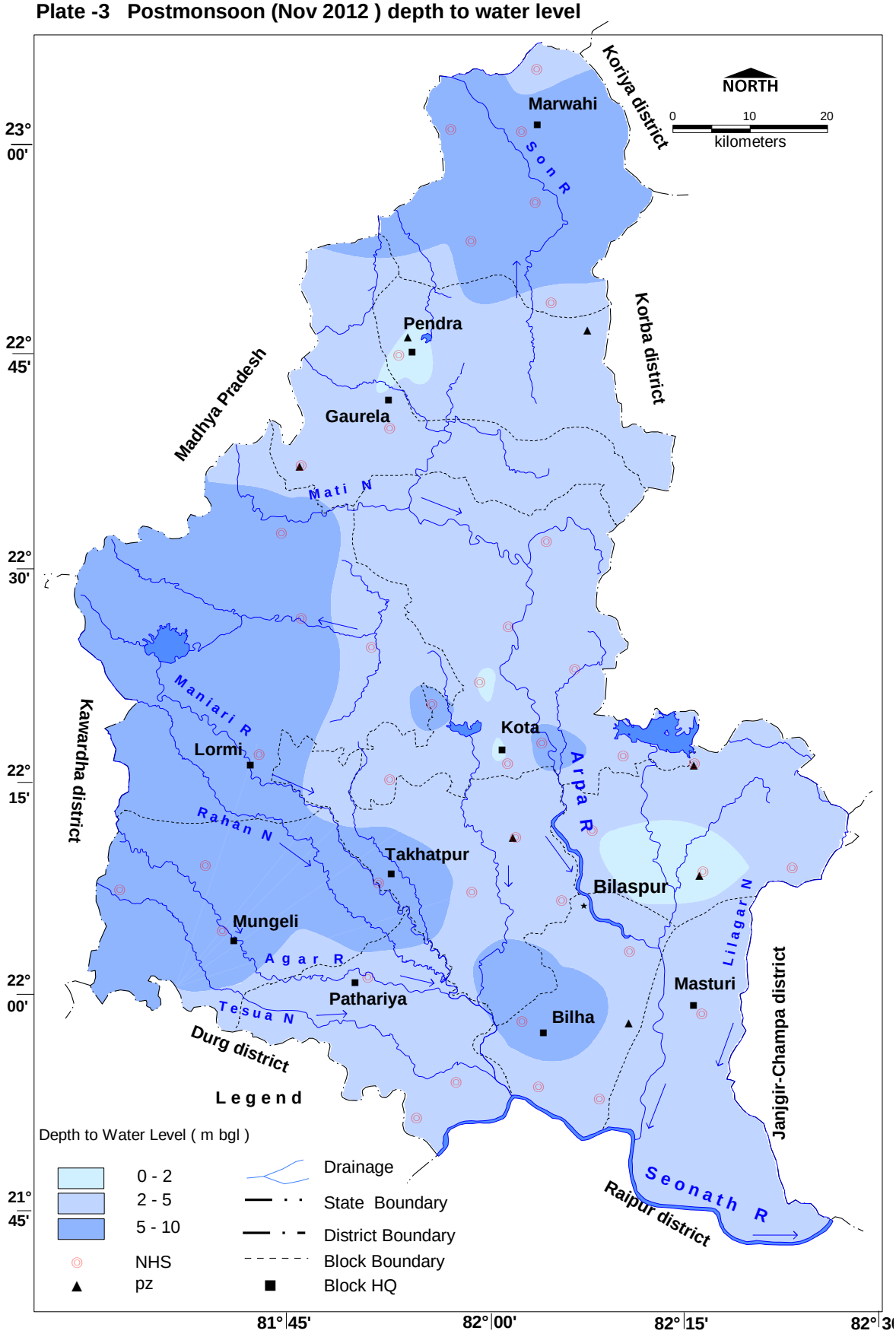


Plate -3 Postmonsoon (Nov 2012) depth to water level



The maximum falling trend is observed in the monitoring well at Bilaspur followed by Pathriya and Sipat. The rising trend has been observed in Lormi, Kota, Saragaon and Belgahana wells. The rising trend is observed in the canal command area and the hilly tracts and the falling trend is more significant in the Chhattisgarh plain area in the southern half of the district. The pre-monsoon long-term water level fall suggests an increase in ground water abstraction over the years.

Similarly during the post-monsoon period around 33% of the wells show a rising trend and 67% show falling trend of water level. Around 69% of the wells show either a rise or fall of water level trend in the range of 0 to 0.2 m/yr. Most of the falling trends (42%) are observed in the range of 0 to 0.2 m/yr. The maximum falling trend in water level is observed in Chaparawa observation well and is followed by Dhanpur and Dhanikundi observation wells. The maximum rising trend is observed in the Kota and followed by Sipat observation wells during this period.The falling trend of water level is observed in Marwahi, Lormi, Takhatpur and Patharia blocks. The falling trend during post-monsoon period may be due to inadequate recharge because of declining rainfall over the years.

4.2.5 Ground Water Flow

The northern part of the district is covered by hill ranges with steep slopes where as the southern part is a plain land. The regional ground water flow is in the direction of southeast. In the north central part of the district the contours are closer indicating steepness of the terrain thereby the gradient of ground water flow is high in comparison to the southern part of the district. In southern part, the contours are widely separated indicating flatness of the terrain where the gradient of ground water flow is less. It may also be seen that the flow of ground water is mostly towards the major drainage suggesting that the base flow is towards the drainage system, which finally joins Seonath River.

4.2.6 Aquifer Parameters

The Precambrian sedimentaries are potential aquifers in the district. The transmissivity and specific yield of different formations varies in wide limits. In Archaean crystallines 13 no of wells are drilled and their discharge is very low i.e. less than 1 lps. The transmissivity (T) value in general is less than 1 m^2/day and the specific capacity is less than 3 lpm/m of drawdown. The Hirri, Pandaria and Maniari Formations are good aquifers. The transmissivity and specific capacity values recorded for the exploratory wells at Belpan is exceptionally high and is the order of 4003.34 m^2/day and 835.57 lpm/m of drawdown respectively. **Table- 2** is presented here to show the transmissivity and specific capacity obtained for different formations in the area.

The systematic hydrogeological investigations carried out in the area shows that the specific capacity of the dug wells located in alluvium ranges between 110 and 450 lpm/m of drawdown and if the wells are tapping alluvium and calcareous shales the specific capacity varies from 25 to 425 lpm/m of drawdown. The specific capacity of wells located in calcareous shales and limestone varies from 30 to 61 lpm/m of drawdown. The calculated specific capacity depends on the dimension of the well and larger the diameter the higher is the specific capacity of the well.

Table 2: Range of transmissivity (T) and Sp. Capacity value obtained in Bilaspur district					
Sl. No.	Formation	Transmissivity (m^2/day)		Sp Capacity (lpm/m)	
		Min	Max	Min	Max
1	Maniari	8.2	186.14	2.88	128.64
2	Hirri	51.35	4003.3	16.44	284.21
3	Tarenga	0.98	357.05	2.5	108.49
4	Chandi	0.25	2198	1.05	14.09
5	Pandaria	2.69	345.68	7.41	227.87
6	Archaean basement crystalline	0.79	35.97	2.21	16.67

4.3 Ground Water Resources

The total ground water recharge from all the sources is 52353.99 ham. The net available resources after the natural discharge of 2617.17 ham is 49736.28 ham. Existing gross ground water draft for all purposes is 23229.37ham out of which 18419.52ham is for irrigation and 6392.43ham is for domestic and industrial water supply. The stage of the ground water development in the district is 46.71 %. The Belha block (89.19 %) has the highest stage of ground water development followed by the Takhatpur (64.18 %) and the Pendra Road (51.66 %) blocks. Belha has been categorised as semi-critical and all other blocks are safe for future groundwater development. The block wise resource is presented in Plate-4. The comparisition of Stage of Ground Water Development of 2004 & 2009 is presented in Fig 3

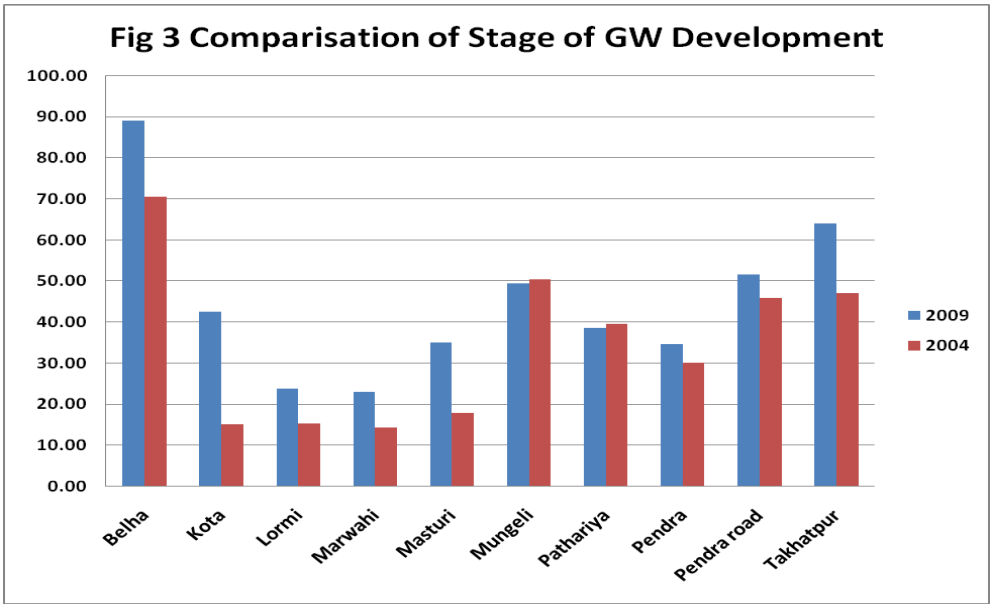


Table 3: Ground water resource of Bilaspur district as on March 2009

Assessment Unit / Block	Total Annual Recharge in Ham	Net Ground Water Availability in Ham	Existing Gross Ground Water Draft for Irrigation in Ham	Existing Gross Ground Water Draft for Domestic & Industrial Water Supply in Ham	Existing Gross Ground Water Draft for All Uses in Ham	Allocation For Domestic & Industrial Water Supply in Ham	Net Ground Water Availability for Future Irrigation Development in Ham	Stage of Ground Water Development in %
Belha	6673.51	6339.84	4110.18	1544.26	5654.44	2140.44	89.22	89.19
Kota	3850.33	3657.81	1110.57	450.2	1560.77	587.96	1959.28	42.67
Lormi	6620.51	6289.48	1011.9	487.43	1499.33	636.58	4641	23.84
Marwahi	6006.29	5705.98	1041.66	277.35	1319.01	362.24	4302.08	23.12
Masturi	4778.78	4539.84	1103.23	491.65	1594.88	642.1	2794.51	35.13
Mungeli	7318.04	6952.13	3046.1	389.75	3435.85	509.01	3397.02	49.42
Pathariya	5079.62	4825.64	1589.29	276.62	1865.91	361.26	2875.09	38.67
Pendra	2752.28	2614.67	695.26	210.89	906.15	275.42	1643.99	34.66
Pendra road	2198.24	2088.32	929.26	149.47	1078.73	194.99	964.07	51.66
Takhatpur	7076.39	6722.57	3782.07	532.23	4314.3	682.43	2258.07	64.18
District	52353.99	49736.28	18419.52	4809.85	23229.37	6392.43	24924.33	46.71

4.4 Ground Water Quality

The quality of the ground water in the phreatic zone is suitable for domestic, agriculture and industrial purposes. However higher value of nitrate is found at few places. Ground water in the district is mostly calcium bicarbonate type. The value of electrical conductivity (EC) in the phreatic zone ranges from as low as 101 micro-siemens/ cm to 1133 micro-siemens/cm. Parts of the Takhatpur, Patharia and Mungeli blocks have high values of SO_4 in the ground water in the deeper zones due to the presence of gypsum veins in the underlying Maniari sahle. The Ec value in the deeper zones is found to be as high as 2300 micro-siemens/cm. The range of EC shows that the water has a very less residence time.

5 GROUND WATER MANAGEMENT STRATEGY

Only one block (Belha) has been categorized as “semi-critical” from ground water development point of view and rest of the blocks are “safe”. Nearly 73.91% of the area in the district is showing declining water level trend during the post monsoon period. Out of the decling trend rate of more than 0.4 m/yr with maximum of .53 m/yr is shown by 1.40% area of total geographical area, while 10.80% area is fall in the range of 0.2 to .4 m/yr. Based on the decline trend of water levels, stage of ground water level and depth to water levels more than 3m. bgl a map showing areas for ground water management has been

Plate - 4 Ground water resource as on March 2009

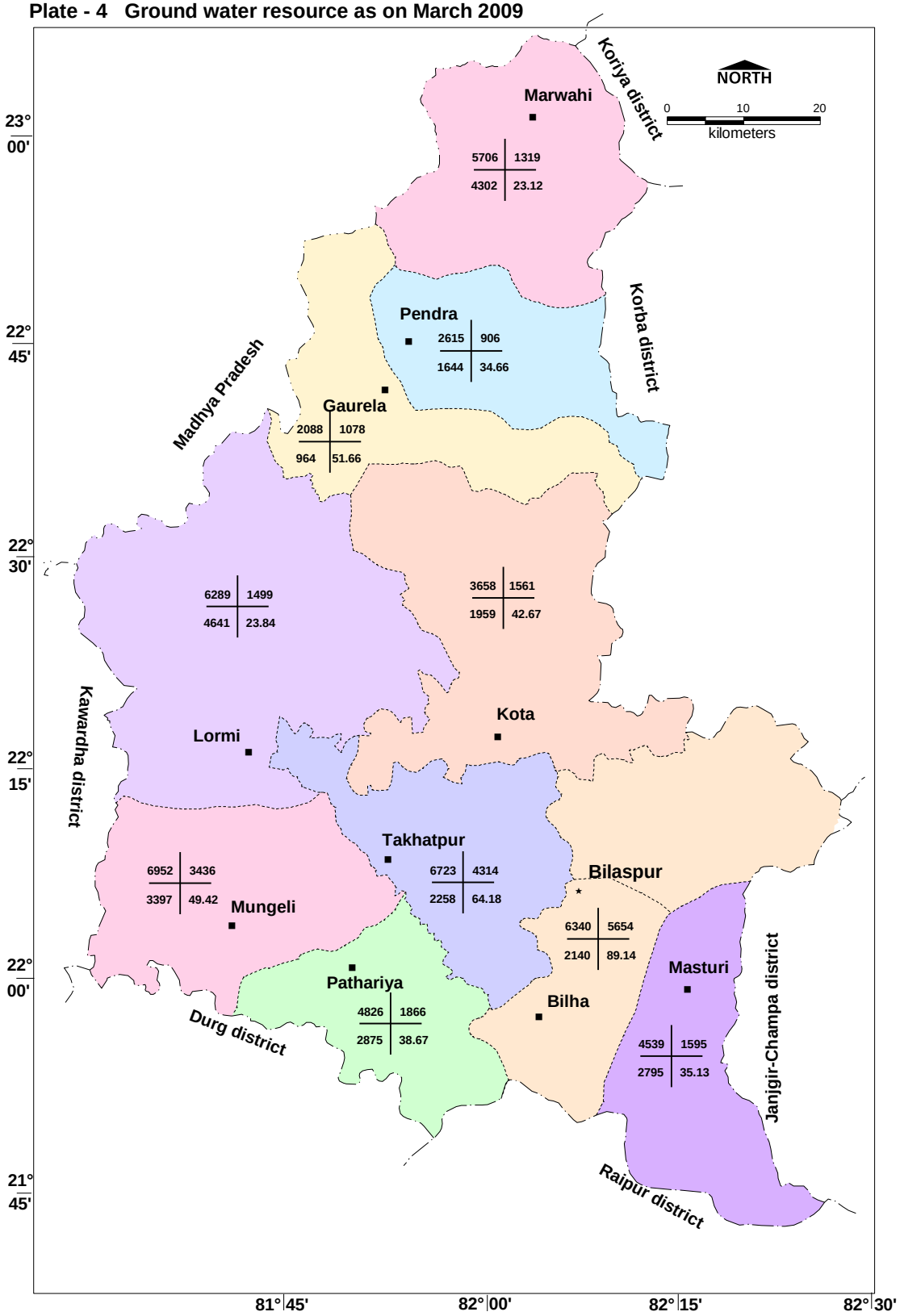
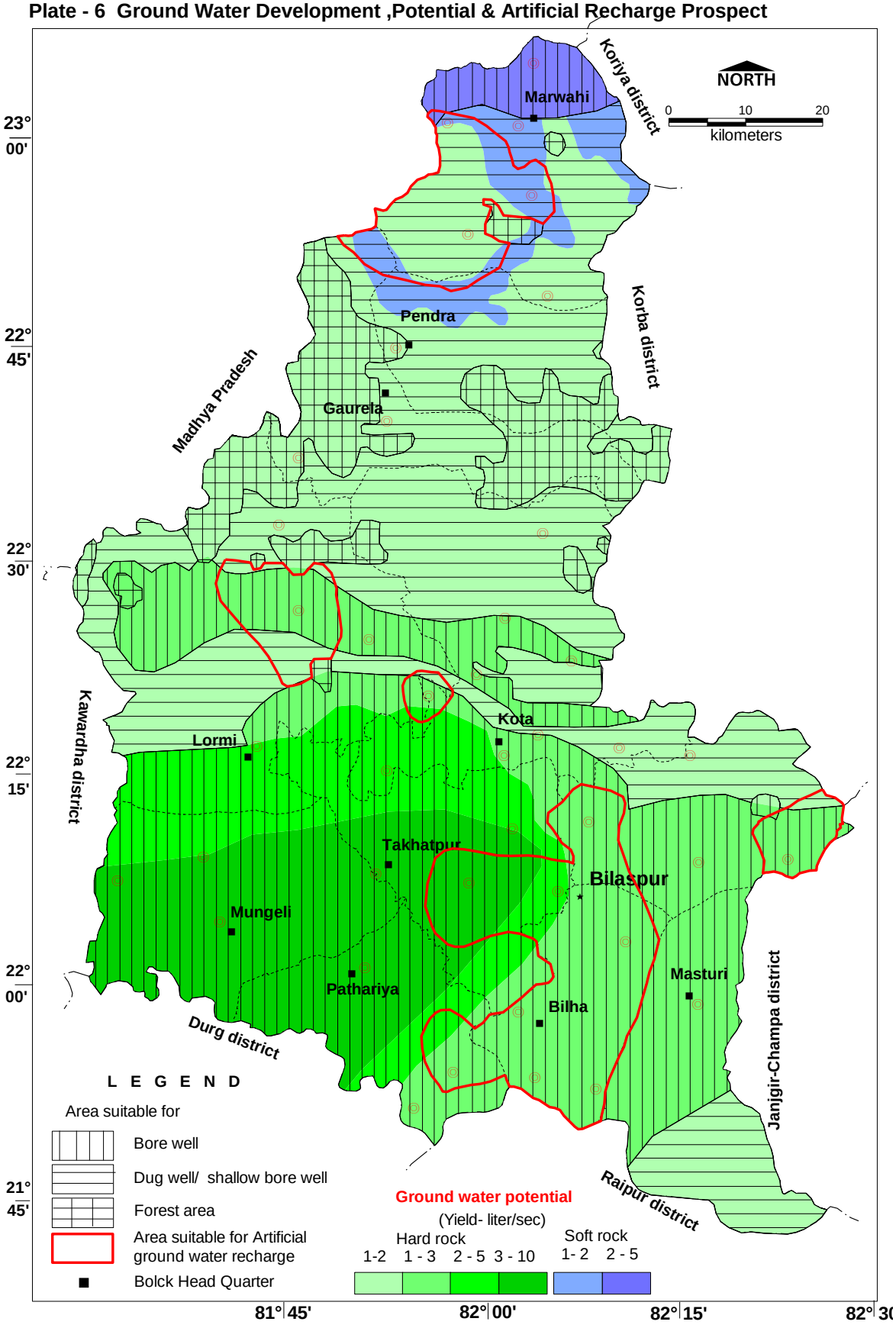


Plate - 6 Ground Water Development ,Potential & Artificial Recharge Prospect



presented in Plate 5. These parts of the area require immediate attention to regain the water levels or to maintain the water levels irrespective of development activities in the area in future. To achieve this target artificial recharge to the ground water is one of the solutions, which may be taken up in these areas. Plate VI Area Recommended For Ground Water Management & Development

6 GROUND WATER RELATED ISSUES & PROBLEMS

Though the southern half of the district which is underlain by the Chhattisgarh Supergroup of rocks serve as the potential ground water reservoir, drilling in some part of these areas are to be carried out very carefully. In hard rock areas DTH drilling is recommended. In these terrains the weathered portion is usually cased to prevent formation collapse and drilling would continue to the desired depth. The part of the borehole drilled in the hard rocks is usually kept naked. The time taken for drilling varies and depends on the nature of the formation and capacity of the drilling rig. Collapsing of cavernous limestone is common problem in Pandaria Formation therefore proper casing of the collapsible strata before further drilling is always required.

In soft and loose formations followed by hard rock, combination type of rig is best suited. Here the loose over burden is drilled by mud rotary method and is cased either by slotted pipe or by blank pipe depending on the productiveness of the aquifers. In hard rock DTH method is used to drill up to targeted depth. Wells drilled at Mungeli, Rohra, Lormi, Chilfi are the citing examples of wells drilled using combination rig, and the wells are tapping only the deep fracture zones. The exception is the bore hole drilled at Mungeli where both shallow granular zones and deeper fracture zones are tapped.

In semi-consolidated Gondwana rocks rotary types of rigs are best suitable. In these areas pilot bore hole drilling is done to the desired depth and geophysical logging is carried out to delineate the potential granular zones. Based on the results, well assembly is recommended and is lowered after reaming the pilot borehole. The annular space between the assembly pipe and the bore hole is filled with suitable gravel. The well development is done with air compressor till the water from the borehole is free from suspended material and mud cake is cleared.

Large diameter dug wells are very popular in the area and are constructed in the weathered formation. In these wells the water table is very shallow. In alluvial areas, filter points are very popular. These are dug cum bore wells constructed in loose sand and clay formation to a depth of 5 to 9 mbgl. Due to the shallow nature of ground water level and as they are constructed in the river alluvium near town area (Bilaspur urban area) the water is not suitable for drinking purposes because of their proximity to the local pollutants.

Parts of the Takhatpur, Patharia and Mungeli blocks have high values of SO_4 in the ground water due to the presence of gypsum veins in the underlying Maniari sahle

.

The northern half of the district which is underlain by the older metamorphics and the granites are not promising from ground water point of view and hence can be exploited through the large diameter dug wells.

7 AWARENESS & TRAINING ACTIVITY

One mass awareness programme, three water management training programmes and one Awareness Raising Training programme have been conducted in the district. The details of the programmes are as follows.

Sl. No.	Year	Programme	Venue
1	2002-03	WMTP	South East Central Railway
2	2002-03	WMTP	South Eastern Coal Fields Ltd
3	2004-05	WMTP	Bilaspur
4	2006-07	MAP	Bilaspur
5.	2011-12	Awareness Raising Training Under (HP)	Bilaspur Town

8 AREAS NOTIFIED BY CGWA/SGWA

None of the blocks in the district is categorized as over exploited from ground water abstraction point of view. Only one block i.e. Bilha is categorized as semi-critical. Hence none of the blocks of the district has been notified by the CGWA/SGWA for regulation of ground water.

RECOMMENDATIONS

- Due to the high cavernous nature of the Pandaria Formation drilling by DTH method is difficult. Combination type of rigs can successfully drill wells in this formation, which is having very high ground water potential.
- The alluvium along Arpa and Maniari are good reservoirs of the ground water. Bore wells in these areas can be constructed by deploying combination type of rig, which can tap both the phreatic and deeper zones thereby increasing the yield of the wells.
- The water in the deeper zones (125 m) in and around Bodri have very high EC values, which is not suitable for drinking and agriculture purposes and hence should be avoided.
- It is observed that the south central part in the district, mainly parts of Belha, Takhatpur, Patharia and Mungeli blocks are suitable for artificial recharge. The rainwater can be harvested by percolation tank and the ground water can be recharged by recharge shaft method. The shale covered areas can be recharged by injection well method.
- The flow of ground water is mostly towards the major drainage system in the district suggesting that the base flow is along them and finally along the Seonath river. Arresting and/or reducing the velocity the base flows by construction of suitable sub-surface structures on the upstream side of the rivers and nalas can improve the ground water scenario during the non-monsoon period on the down stream side.
- In the northern hilly regions, the exploration carried out has shown no deeper productive fractures. In these areas, the ground water can be harnessed through large diameter dug wells.
- As the stage of ground water development in the district is 46.71 % there is a lot of scope for further development. The southern half of the district is more potential from ground water development point of view and can be harnessed through construction of bore wells.

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Plate - 5

Hydrogeological Map of Bilaspur District