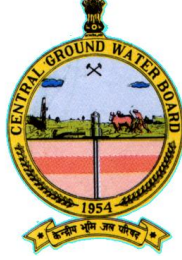


DISTRICT GROUND WATER INFORMATION BOOKLET



ANUPPUR DISTRICT MADHYA PRADESH



**Ministry of Water Resources
Central Ground Water Board
North Central Region
Government of India**

ANUPPUR DISTRICT PROFILE

S.No	ITEMS	STATISTICS
1	General Information	
	i) Geographical Area (Sq.Km)	3724
	ii) Administrative Divisions (as on year 2013) Number of Tehsil / Block Number of Panchayats/ Villages	4/4 282/585
	iii) Population (Census 2011)	7,49,521
	iv) Normal Rainfall (mm)	1423.6
2	GEOMORPHOLOGY	
	Major Physiographic Units	1Pushprajgarh Plateau 2Son River Plateau area 3Narmada Valley area
	Major Drainage	Johila sub-basin Son sub-basin Narmada basin
3	Land Use (Sq. Km.) i) Forest area : ii) Net sown area : iii) Cultivable area :	782 1052 1052
4	Major Soil Types	Black Cotton, Sandy-Loamy and Clayey-Loamy
5	Area under principle crops (2006)	Paddy, Wheat, Maize and Gram
6	IRRIGATION BY DIFFERENT SOURCES	
	Structures	No Area (Sq. Km.)
	Dug wells	1992 15.14
	Tube wells/ Bore wells	104 2.86
	Tanks/ ponds	185 2.0
	Canals	80 8.00
	Other Sources	15
	Net Irrigated Area.	43
	Gross Irrigated Area	43
7	Number of Ground Water Monitoring Wells of CGWB (As on 31-03-2013)	
	No. of Dug Wells	16
	No. of piezometers	05
8	PREDOMINANT GEOLOGICAL	Archaeans,

	FORMATIONS	Gondwanas, Lameta Beds and Basalts.
9	HYDROGEOLOGY	
	Major water bearing formation (Pre-monsoon DWL during 2012) (post-monsoon DWL during 2012) Long term water level trend in 10 yrs (2003-2012)	Archaeans, Gondwana , Lameta & Bagh Beds 3.03- 13.75 1.66-17.86 +0.01 to -0.14(Rise) +0.12 to -0.14(fall)
10	GROUND WATER EXPLORATION BY CGWB (as on 31.03.2013)	
	No of wells drilled (EW, OW, PZ, SH, Total)	12 EW+ 05 PZ Total =17
	Depth Range (m)	30.99-232.00
	Discharge (litres per second)	0.20-25
	Storativity (S)	5.0 X 10 ⁻⁴
	Transmissivity (m ² / day)	175
11	GROUND WATER QUALITY	
	Presence of Chemical constituents more than permissible limit (EC, F,AS, Fe etc.)	EC-105-755, Nitrate-0.2-56, Fluoride – 0.01-1.3 in phreatic aquifer
12	DYNAMIC GROUND WATER RESOURCES (2009) in MCM	
	Net Ground Water Availability	377.3
	Gross Annual Ground Water Draft	22.5
	Projected demand for Domestic and Industrial Uses up to next 25 Years (2035)	15.4
	Stage of Ground Water Development	6%
13	EFFORTS OF ARTIFICIAL RECHARGE & RAIN WATER HARVESTING	
	Projects completed by CGWB	Nil
	Projects under technical guidance of CGWB	Nil
14	GROUND WATER CONTROL AND REGULATION	
	Number of OE Blocks	All blocks are under Safe category
	Number of Critical Blocks	
	Number of Notified Blocks	
15	MAJOR GROUND WATER PROBLEMS AND ISSUES	Depletion of water levels near Coal mines is reported.

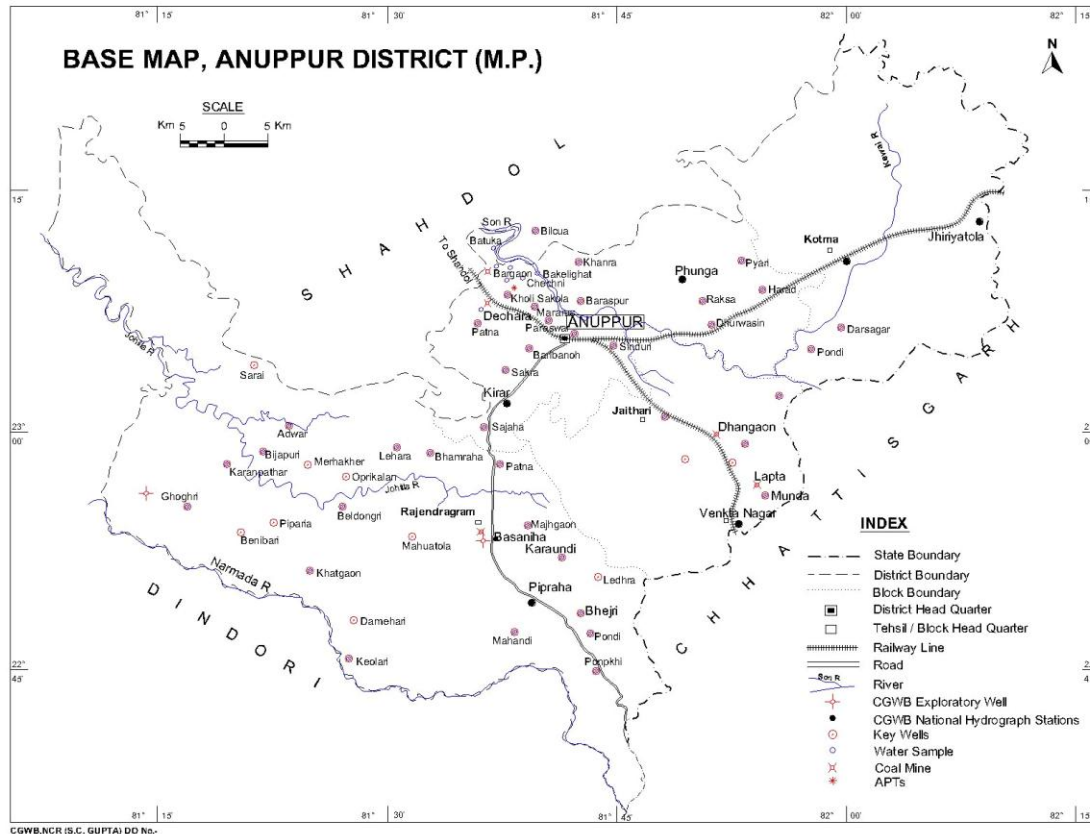
1.0 INTRODUCTION

Anuppur is situated in eastern corner of Madhya Pradesh. It came into existence on 15th August 2003, by reorganization of Shahdol district. The Anuppur is one of the tribal district of Madhya Pradesh. Anuppur is also famous for **Amarkantak** hill and pilgrim station, where from two important rivers namely, Narmada and the son originates. District Anuppur is surrounded by Shahdol district in north, Umariya and Dindori districts in west and south-west, Bilaspur and Korea districts of Chhattishgarh State in south and east sides. The district lies between North latitude 22° 7' and 23°25' and East longitude 81°10' and 82° 10', falling in Survey of India toposheet nos. 64E, 64F and 64 I. It extends for about 86 Km from north to south and 117 Km from east to west.

The area of district is 3724 Sq. Km, and it has been divided into four tehsils and blocks (Fig- 1). There are 585 villages in the district. Details of administrative divisions of the district is given in Table-1.

Table-1 : Administrative divisions (Blocks), Anuppur district, M.P.

1	Pushprajgarh
2	Anuppur
3	Jaithari
4	Kotma



Drainage: Anuppur district falls under two river basins i.e. the Ganga and the Narmada. Excepting small and narrow belt along the south-west boundary, in Pushprajgarh tehsil, which is drained by the river Narmada, entire Anuppur district forms the part of the Ganga river system. The river Son is an important tributary of the Ganga river. Both the Narmada and the Son originates from Amarkantak hill of Maikal Range (1057 mamsl) at 22°40' N 81°46'E from Anuppur district. The river Narmada flows in west word direction in the district, while the river Son flows from south-east to north-west direction. The important tributaries of Son river in the district are Johila, Gujar Kewai and Tipan rivers. The Samrar nadi is only important tributary of river the Narmada in the district.

CGWB Activities: Systematic hydrogeological surveys of the district was carried out by Shri R.N.Sharma and Shri A.K.Budhaliya, then Junior Hydrogeologists, during year 1987-88. Shri A.K.Jain, Junior Hydrogeologist carried out Reappraisal hydrogeological surveys of the district during year 1998-99. Exploratory drilling in the district started in year 1979-80, to study inflow of water in Jamuna coal field area of Kotma block. Subsequently CGWB had taken up regular ground water exploration during period 1988-93. Total 12 exploratory wells and 5 Pz are drilled at various places in different geological formations of the district. Under the World Bank assisted Hydrology Project, 3 shallow and 2 deep Piezometers were constructed by CGWB at Anuppur, Kotma and Rajendragram.

2.0 RAINFALL AND CLIMATE

For description of meterological parameters , data of nearest I.M.D. Observatory located at Umariya has been used.

The normal annual rainfall of the district is 1235.0 mm. The district receives maximum rainfall during south-west monsoon period from June to September. About 89.3 % of annual rainfall is receieved during monsoon season. Only 10.7 % of the annual rainfall occurs during non-monsoon period, from October to May. Thus maximum water available for ground water recharge is during south-west monsoon season.

The normal maximum temperature recorded during the month of May is 41.3° C, and minimum during the month of December is 8.4° C. The normal annual means maximum and minimum temperatures of Anuppur district are 31.6° C and 18.2° C respectively.

During the south-west monsoon, the relative humidity generally exceeds 88 % during month of August. Relative humidity decreases during non-monsoon season. In summer season, relative humidity's are less than 38 %. May is the driest month of the year.

The wind velocity in the area is higher, during pre-monsoon period as compared to post-monsoon season. The maximum wind velocity 6.8 Km/hr is observed during the month of June and minimum 2.3 Km/hr is recorded during month of November. The average normal annual wind velocity of Anuppur district is 4.3 Km/hr

The climate of Anuppur district, is characterized by a hot summer and general dryness during the south-west monsoon season. The year may be divided into four seasons. The cold season is December to February and followed by the hot season from March to about the middle of June. The period from middle of June to September is the south-west monsoon season. October and November form the post-monsoon or transition period.

3.0 GEOMORPHOLOGY AND SOIL TYPES

3.1 Geomorphology :

Anuppur is predominantly hilly and forested district. It is picturesque with certain pockets and belt of Sal and mixed forest. From Geomorphological point of view, the district consists of series of mountain ranges and rivers. It can be divided into three geographical divisions :

1. High land of mountain ranges
2. The central plateau and
3. Low land of valley areas.

In general, Anuppur district is characterized by hilly to undulating terrain with altitude ranging between 470 m and 1170 m, above mean sea level. The main high relief features of the area are the Maikal Range and Maikal Plateau (Amarkantak Plateau) in south-east part of the district covered with deccan Trap Basalts. Some denudational hills/ hillocks are at foot hills of Rajendragram plateau. Linear ridges of intrusives (Dolerites) at northern and north-eastern part, and Plateaus in remaining part of the district. The river Son is forming valley in the district.

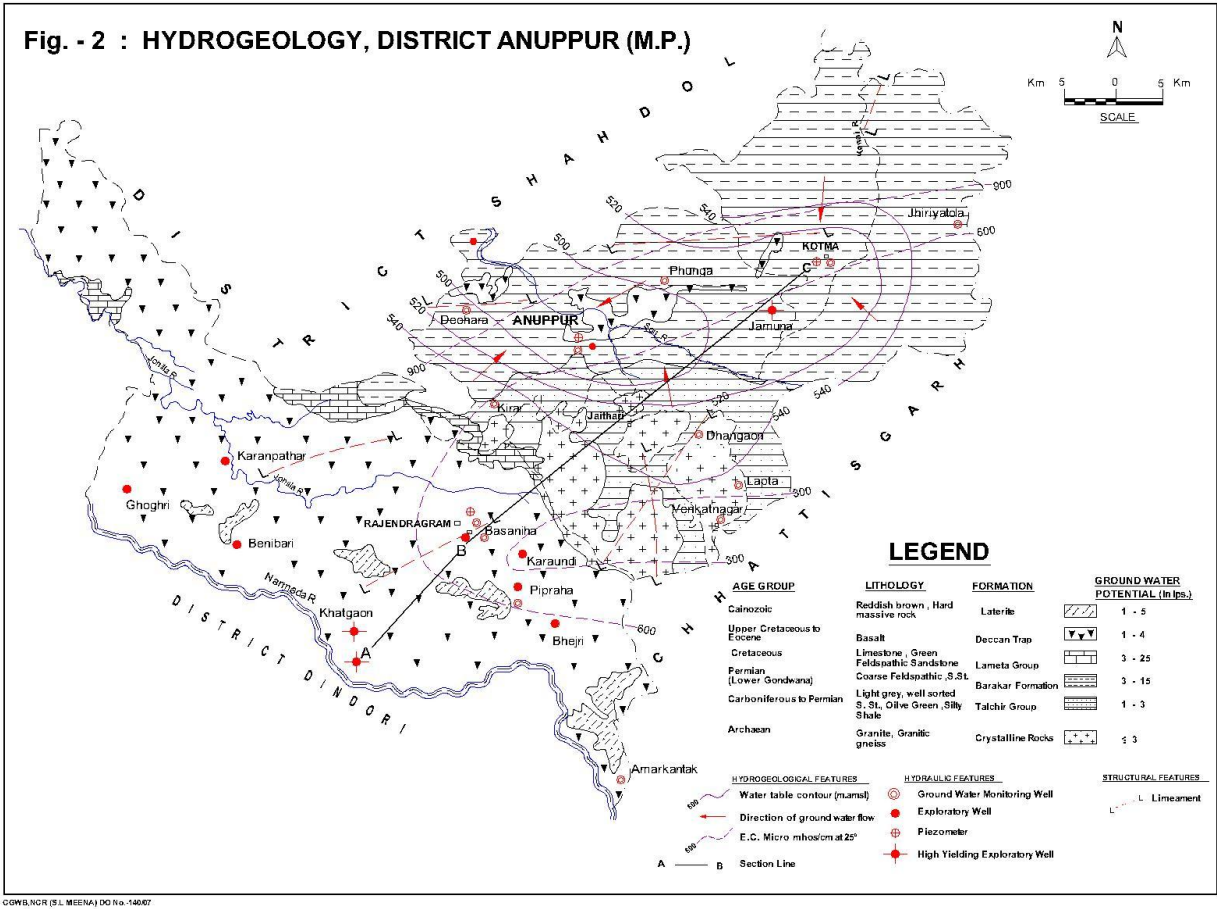
3.2 Soils :

The anuppur district is mainly occupied by four types of rocks, namely Basalts, Lametas, Gondwanas and Archaeans. Soils are also depending upon lithology of the area. Hence soils of the area are mainly:Black Cotton, Sandy-Loamy and Clayey-Loamy.

4.0 GROUND WATER SCENARIO

4.1 Hydrogeology:

Anuppur district is underlain by various geological formations, forming different types of aquifers in the area (Fig 2). Main lithological units of the area are, Archaeans, Gondwanas, Lametas and Basalts. Occurrence and movement of ground water in hard rocks is essentially by development and nature of secondary porosity through joints and fractures. Primary porosity in Gondwana rocks and vesicularity in basalts play and important role. Lametas are also potential aquifers made up of relatively loose and friable material. Ground water in general occurs under unconfined to semi-confined conditions. The occurrence and movement of ground water in different lithological units is described below:



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Archeans :

Granites and Granitic-Gneisses are main rock types, occurring in south-east part of the district. They are crystalline hard rocks, forming basement in the district. They yield water through fractures, joints and secondary porosity developed in weathered portions. In Jaithari block area, quite many dug wells exists in these formations and wells yield moderate quantity of ground water. The yield depends upon the saturated thickness of the weathered mantle overlying the massive rock. The open wells that exists in these formations, range in depth from 8m to 20mbgl. The general yield potential of Archeans is less than 180 L.P.M..

Gondwanas :

The semi-consolidated Gondwana group of rocks, that bears coal deposits are forming main ground water reservoir in this district. The felspathic, medium to coarse grained sand stone, bears ground water in the interconnected primary pores in the formation, as well as the contact planes between shales and sand stones. Coal seams in Gondwana formations are acting as confining layers giving rise to artesian conditions at several places. Ground water is also mined out along with the coal in almost all coal fields of the district. Ground water occurs in unconfined, semi-confined and confined conditions in the Gondwana formations of the district. It is reported that due to excessive pumpage of ground water from the underneath coal mines, there has been

appreciable lowering of water levels in the phreatic ground water regime overlying the coal field area, particularly in Kotma block area. Gondwana formation particularly the upper part of Barakar Sandstone support development of phreatic aquifers, which extends from few metres below ground level to 25 m below land surface. The Talchir formation of lower Gondwana group, comprising of well sorted sandstone, olive green shales and basal conglomerates are forming poor aquifer in the area. These formations are occurring southwards of Anuppur town. Exploratory well drilled by CGWB in Anuppur town has yielded only 15 L.P.M. discharge in Talchir formation. The Barakar formations which are upper part of lower Gondwanas are forming potential aquifers in the area. These formations are covering north and eastern part of Anuppur district. The yield of Barakar formations in the district is recorded between 150 and 960 L.P.M.

Lametas :

These are sedimentary deposits resting over Archeans /Gondwana formations and are overlain by Basalts. siliceous Lime stones of Lametas are compact and impervious in nature. Nodular lime stone and poorly consolidated sand stone of Lametas are forming good aquifers in the area. Lametas occurring below Basalts, are under semi-confined to confined conditions. Lametas are occupying hilly and forested area, where population and habitation is rather poor. Dug wells in this formation is generally used for drinking/domestic purposes by tribal population. It is observed that 80 % of dugwells are within the depth range of 8 m to 16 m, below ground level; with diameter of 3-4 m. CGWB had taken up exploratory drilling in Rajendragram plateau of Pushprajgarh Block, where Lameta beds are occurring below Basalts at deeper level. Since lametas are relatively loose and friable rocks found below Basalts at depth (more than 100 m), there is difficulty in drilling in this formation deploying DTH or DTH-Rotary Combination rigs. After penetrating basalts, drilling in loose and friable Lameta beds at depth more than 100 m becomes unserviceable using these rigs, because available rigs can not function to operate using rotary system at depth. Because of this reason CGWB had abandoned many exploratory wells in Rajendragram plateau area , where Lametas are occurring below Basalts. Thickness of Lameta Beds is recorded as 80 m at Keolari exploratory well site. Yield of Lameta beds recorded during exploratory drilling vary from 180 to 1500 L.P.M.

Deccan Traps :

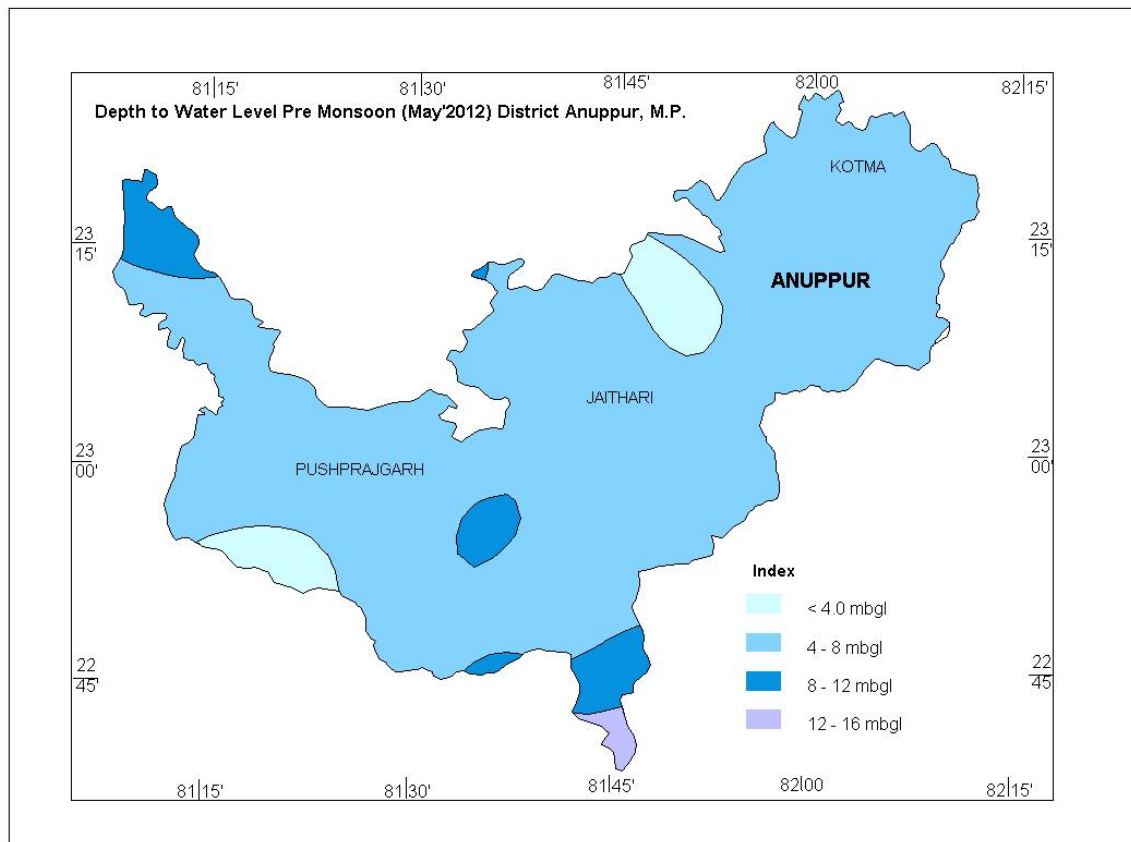
These are Basaltic flows, forming hill ranges in south-western part of the district. Rajendragram plateau of Pushprajgarh Block is fully occupied by basaltic rocks. In basaltic terrain , ground water generally occurs under phreatic conditions in shallow weathered, jointed and fractured horizons. Basalt does not exhibit uniform nature, both vertically and laterally. Physiographic locations, thickness of weathered mantle, degree of joints, fractured or sheared zones, characteristics of vesicular horizons and their inter-connections are important factors, that play a decisive role in the yield capacity of open wells, tapping shallow aquifers. The deeper aquifer system appears to be under semi-confined conditions. Jointed/fractured form of massive unit is creating possibility of their acting as leaky confining bed, consequently resulting into semi-confined conditions for water bearing vesicular unit occurring beneath it. On the other hand if massive unit is compact and have not developed fractured porosity, then under favourable conditions they may act as a confining bed for the water bearing vesicular horizon, occurring below it and thus leading to confined conditions. Dugwells in basaltic flows of Deccan Traps vary in depth from 6 to 15 m, below ground level and diameter ranges between 2 m to 3 m.

CGWB had drilled number of tube wells in Rajendragram plateau of Anuppur district, and thickness of Basalt vary from 1 m (at Keolari) to 127 m (at Karanpathar). Yield of exploratory wells ranges between 60 to 240 L.P.M.

Depth to water Level : Central Ground Water Board has been carrying out water level monitoring of Ground Water Monitoring Wells (GWMW), since year 1990 in the district. There are 21 monitoring wells in the district including 5 piezometers. Water levels of these monitoring wells are being monitored four times in a year; Viz during the month of January, May, August and November. To study ground water regime of the area, pre-monsoon and post-monsoon depth to water level maps of the district has been prepared. South-west part of Anuppur district is highly undulating and forest covered. In that area there are no Ground water Monitoring Well for observation and preparation of maps. In general depth to water level is less than 18 mbgl during all seasons.

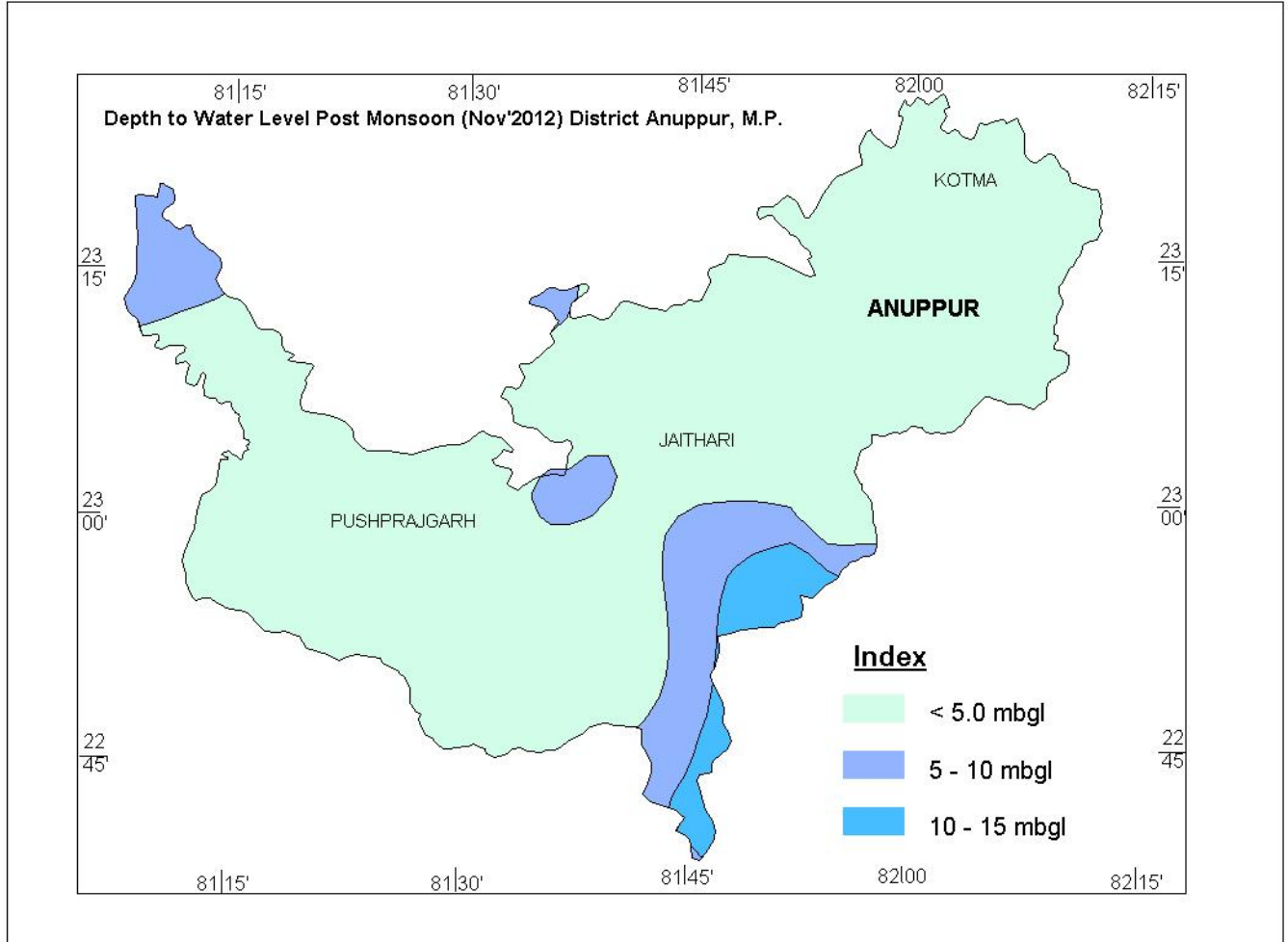
Pre-monsoon (May 2012) :

The depth to water level map for premonsoon period (May 2012) is prepared and is presented as figure 3. A perusal of the map reveals that the depth to water level ranges from less than 4 mbgl to 16 mbgl. However, in major part the depth to water level ranges from 4 to 8 mbgl. The minimum depth to water level recorded is 3.03 whereas maximum water level recorded is 13.75 mbgl.



Post-monsoon (November 2012) :

The depth to water for post monsoon period is prepared and is presented as figure 4. A perusal of the map reveals that the depth to water level ranges from less than 5 mbgl to 15 mbgl. However in major part the depth to water level is less than 5 mbgl. The minimum water level recorded is 1.66 mbgl whereas maximum water level recorded is 17.86 mbgl.



Aquifer Parameters :

CGWB had drilled 12 Exploratory Wells in the district. Hydrogeological data of exploratory wells in the district is given below in Table 2.

Table 2: Hydrogeological details of CGWB exploratory wells drilled in Anuppur district

S.No	Name of site	Depth Drilled (m)	Aquifer zones	SWL (m) b.g.l.	Yield (L.P.M .)	Draw-down (m)	E.C. (Micromhos /cm)	Aquifer
1	Bakho	232.00	35.00-38.00 59.00-66.00 69.00-74.00 105.00-113.00 139.00-150.00	12.36	151	10.00	-----	Barakar Sandstone
2	Anuppur	166.81	36.00-46.00 85.00-95.00 99.00-108.00	4.66 (S) 70.43(D)	10 / 15	39.54/ 22.31	950	Talchir Sandstone
3	Karanpat-har	153.13	10.50-14.50 32.00-35.00 48.00-53.00 61.00-70.00 103.00-108.00 131.83-151.00	7.44	180	-----	-----	Basalt/ Lameta
4	Ghoghari	158.16	18.00-20.00	8.00	204	11.0	193	Basalt
5	Benibari	104.10	73.70-104.10	39.60	240	0.98		Basalt
6	Khetgaon	111.32	60.00-72.00	21.10	954			Basalt/Lameta
7	Keolari	83.00	48.00-75.00	17.43	1500	6.00		Lameta
8	Basaniha	171.50	134.00-170.00	39.38	Negli.	----		Basalt/Lameta
9	Karaundi	106.50	43.44-52.63 61.73-70.93 88.00-93.00	14.10	60	20.0	-----	Basalt
10	Pipraha	122.16	60.00-70.00	>30.00	240	20.00	453	Basalt/ Lameta
11	Bhejri	122.10	62.65-68.00	31.68	282	-dry	-----	Basalt/ Lameta
12	Jamuna Colliery	90.40	38.00-41.00 45.50-50.50 53.50-56.50 59.00-63.50 65.50-69.50 71.50-74.00 76.00-82.00 83.50-87.00	13.65	840	13.40	122	Barakar Sandstone

Perusal of above table reveals that, yield of Gondwana formations vary from 10 LPM to 840 LPM, and draw down ranges between 13.4 m and 39.54 m. Yield of Lameta formations of the district vary from 240 to 1500 LPM and draw down was recorded between 6.00 to 20.00 m. Yield of Deccan Trap basalts was recorded between 60 to 240 LPM, and draw down was observed between 11.00 to 20.00 m .Long duration pumping tests (APT) were conducted only at Jamuna Colliery, for determination of aquifer parameters of coal bearing Barakar formation.

At this site **well field** , consisting of one pumping well, 5 observation wells and 2 piezometers was constructed , in which Step Drawdown and long duration Aquifer Performance Tests were conducted. Analysis of A.P.T. results reveals that regional transmissivity of barakar sediments is estimated to be 175 m²/ day, while the hydraulic conductivity is 5 m/day. The specific yield of the dewatered material has been computed as 0.038. Co-efficient of storage was computed as 5.0 x 10⁻⁴.

4.2 Ground Water Resources (2009) :

Ground water resource estimation of Anuppur district has been computed for Base Year-2009, on block wise basis. Entire Blocks of this district are falling under non-command category, as there are no major irrigation projects in the district, and medium irrigation project is not irrigating the area to its designed capacity.

All blocks of the district are categorized as safe blocks, and highest stage of ground water development is computed as 10 % for Jaitahri Block. The net ground water availability in the district is 37,730 ham and ground water draft for all uses is 2,250 ham, making stage of ground water development 6 % (8 % in 2003/04) as a whole for district . After making allocation for future domestic and industrial supply for next 25 years, balance available ground water for future irrigation would be 35,352 ham at 50 % stage of ground water development's safe limits in the district. Block wise ground water resource estimation data of Anuppur district is given below in Table 3.

Table 3 : Block Wise Ground Water Resource Estimation Data of Anuppur District (Base Year-2009)

S. No.	District/ Assessment Unit	Sub-unit Command/ Non- Command/	Net Annual Ground water Availability (ham)	Existing Gross Ground water Draft for Irrigation (ham)	Existing Gross Ground water Draft for Domestic & Industrial water Supply (ham)	Existing Gross Ground water Draft for All uses (11+12) (ham)	Provision for domestic, and industrial requirement supply to next 25 year (2033) (ham)	Net Ground water Availability for future irrigation d development (ham)	Stage of Ground water developme nt 13/10)*10 0) (%)	
	Anuppur						179			
1	Anuppur	Command	-	-	-	-	-	-	-	
		Non-Command	9877	38	285	323	384	9456	3	safe
		Block Total	9877	38	285	323	384	9456	3	safe
2	Jaitahri	Command	-	-	-	-	-	-	-	
		Non-Command	10471	699	358	1057	381	9391	10	safe
		Block Total	10471	699	358	1057	381	9391	10	safe
3	Kotma	Command	-	-	-	-	-	-	-	
		Non-Command	5284	147	124	271	195	4942	5	safe
		Block Total	5284	147	124	271	195	4942	5	safe
4	Pusprajgarh	Command	-	-	-	-	-	-	-	
		Non-Command	12098	156	444	599	580	11363	5	safe
		Block Total	12098	156	444	599	580	11363	5	safe
		District Total	37730	1039	1211	2250	1540	35152	6	safe

4.3 Ground Water Quality (2011):

Ground water quality of the district, is accessed annually by CGWB on the basis of water samples collected from Ground Water Monitoring Wells. Electric conductivity vary between 105 to 755 $\mu\text{s}/\text{cm}$ at 25° C. The concentration of fluoride is within permissible limits, fluoride ranges between 0.01 mg/l to 1.3 mg/l. The concentration of Nitrate ranges between 0.2 mg/l to 56 mg/l. However water samples collected from CGWB piezometers located at Anuppur and Kotma are having nitrate concentration 125 and 52 mg/l respectively, which is in excess to permissible limits of 45 mg/l. Excessive nitrate content in ground water system, may be because of seepage from sewage waste or due to high uses of nitrate fertilizers.