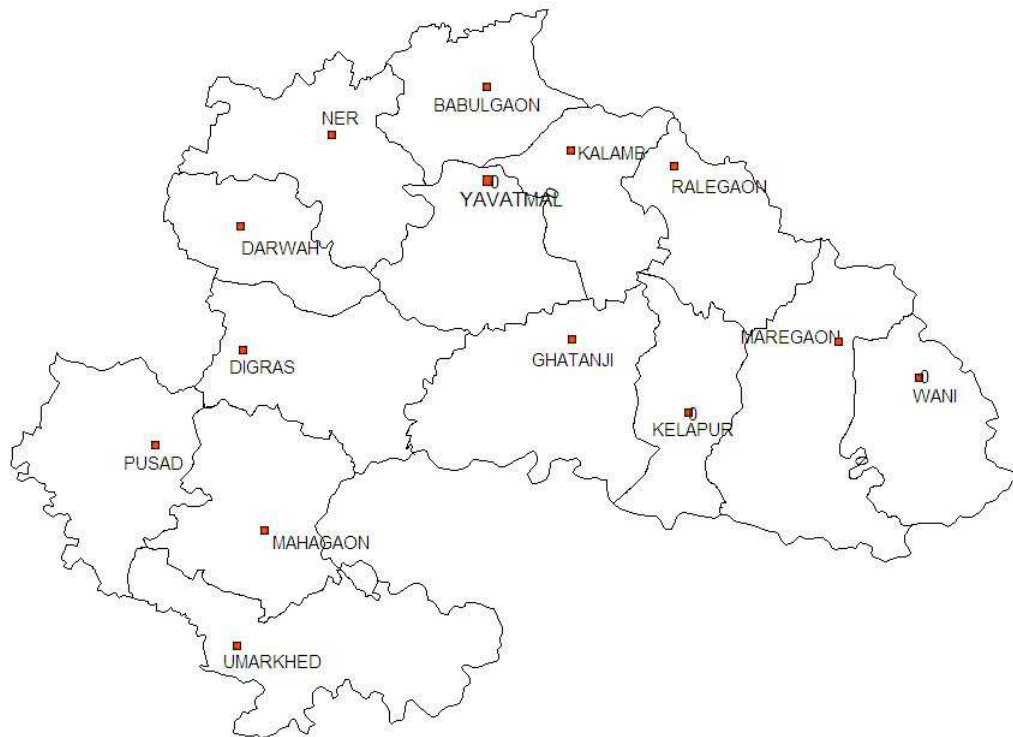




**GOVT OF INDIA
MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD**

**GROUND WATER INFORMATION
YAVATMAL DISTRICT
MAHARASHTRA**



**CENTRAL REGION
NAGPUR
2007**

YAVATMAL DISTRICT AT A GLANCE

1. GENERAL INFORMATION

Geographical Area	13582 sq. km
Administrative Divisions (As on 31/03/2007)	: Taluka-16; Yavatmal, Ner, Babhulgaon, Kalamb, Darwha, Digras, Pusad, Umardhed, Mahagaon, Arni, Ghatanji, Kelapur, Ralegaon, Maragaon, Zhari- Zhamni and Wani
Villages	: 2108
Population	: 24,58,271
Average Annual Rainfall	: 850 mm to 1150 mm

2. GEOMORPHOLOGY

Major Physiographic unit	: Three; Satpuda hill range, Plateau and Penganga and Wardha plain
Major Drainage	: Two; Wardha and Penganga,

3. LAND USE (2001-02)

Forest Area	: 2031 sq. km.
Net Area Sown	: 8947 sq. km.
Cultivable Area	: 9298 sq. km.

4. SOIL TYPE

Three types of soils, Shallow coarse, Medium black and Deep black

5. PRINCIPAL CROPS (2002-03)

Wheat	: 200.00 sq. km.
Cotton	: 4612.8 sq. km.
Jowar	: 1929.34 sq. km.
Pulses	: 843.37 sq. km.

6. IRRIGATION BY DIFFERENT SOURCES (2000-01)-

Nos./Potential Created (ha)

Dugwells	: 34797 / 89360
Tubewells/Borewells	: 1074 / 3441
Tanks/Ponds	: 71 / 10095
Other Minor Surface Sources	: 5692 / 16357
Net Irrigated Area	: 52193

7. GROUND WATER MONITORING WELLS (As on 31/05/2007)

Dugwells	: 51
Piezometers	: 5

8. GEOLOGY

Recent	: Alluvium
Upper Cretaceous-Lower Eocene	: Deccan Trap Basalt
Cretaceous	: Lameta Beds
Upper Carboniferous - Permian	: Gondwana
Pre-Cambrian	: Vindhyan /Pakhals/Penganga Beds
Achaean	: Granites/ Gneisses

9. HYDROGEOLOGY

Water Bearing Formation	: Aquifers belonging to Archean, Penganga Beds, Gondwana, Lameta and Deccan Traps
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Premonsoon Depth to Water Level (May 2006)	:	2.48 to 13.00 m bgl (May-2006)
Postmonsoon Depth to Water Level (Nov. 2006)	:	0.58 to 11.30 m bgl (Nov-2006)
Premonsoon Water Level Trend (1997-2006)	:	Rise: Negligible to 0.33 m/year Fall: Negligible to 0.89 m/year
Postmonsoon Water Level Trend (1997-2006)	:	Rise: Negligible to 0.24 m/year Fall: Negligible to 0.67 m/year

10. GROUND WATER EXPLORATION (As on 31/03/07)

Wells Drilled	:	EW-78, OW-23, Pz-12
Depth Range	:	19.45 to 470.00 m bgl
Discharge	:	0.13 to 49.40 lps
Transmissivity	:	2.26 to 202.00 m ² /day

11. GROUND WATER QUALITY

Good and suitable for drinking and irrigation purpose, except high fluoride (>1.5 mg/l) contamination in parts of Kelapur, Maregaon and Wani talukas.

Type of Water	:	Ca-HCO ₃ & Ca-Cl
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12. DYNAMIC GROUND WATER RESOURCES- (As on 31/03/2004)

Annual Replenishable GW Resources	:	1278.33 MCM
Total draft (Irrigation + Domestic)	:	314.34 MCM
Projected Demand (Domestic + Industrial)	:	111.43 MCM
Stage of Ground Water Development	:	24.48 %

13. AWARENESS AND TRAINING ACTIVITY

Mass Awareness Programme	:	One
a. Date	:	27/12/04
b. Place	:	Pahapal
c. Participants	:	500
Water Management Training Programme	:	Two
a. Date	:	12 to 13/03/04 & 28 to 29/10/04
b. Place	:	Yavatmal.
c. Participants	:	50 & 140

14. ARTIFICIAL RECHARGE & RAINWATER HARVESTING

Projects Completed	:	Nil
Projects under Technical Guidance	:	Nil

15. GROUND WATER CONTROL & REGULATION

Over Exploited Taluka	:	None
Critical Taluka	:	None
Notified Taluka	:	None

16. MAJOR GROUND WATER PROBLEMS AND ISSUES

Parts of the district i.e., Kelapur, Maregaon and Wani talukas are affected by the high fluoride concentration in ground water.

Ground Water Information Yavatmal District

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Ground Water Information

Yavatmal District

1.0 Introduction

Yavatmal district is one of the eleven districts of Vidarbha region of Maharashtra. It is bounded on east by Chandrapur district, on south by Andhra Pradesh State and Nanded district on west by Washim and Hingoli districts and on north by Amravati and Wardha districts. Wardha River forms the northeastern boundary of the district. The district lies between 19°26' and 20°42' north latitudes and 77°18' and 79°9' east longitudes. It falls in parts of the Survey of India Toposheets No. 55L, 55I, 56E, 56I, 56M, covering 13582 sq.km, area.

The district headquarters is located at Yavatmal Town. For administrative convenience, the district is divided in 16 talukas viz. Yavatmal, Wani, Maregaon, Pandharkawda, Ghatanji, Ralegaon, Babulgaon, Kalamb, Darwha, Ner, Digras, Pusad, Mahagaon, Umarkhed, Zhari Zhamni and Arni. It has a total population of 24,58,271 as per 2001 census. The district has 13 towns and 2108 villages. The district is well drained by Wardha and Penganga rivers and their tributaries.

Central Ground Water Board has taken up several studies in the district. A list of studies conducted in the district is presented in **Table-1**.

Table 1: Studies undertaken by CGWB.

S. No.	Officer	AAP	Type of Survey/Study
1.	S/Shri V.V. Sable K.R. Shrinivasan	1967-68	Systematic Hydrogeological Survey
2.	Shri V.A. Totre	1970-71	-do-
3.	Shri V.V. Sable	1971-72	-do-
4.	Shri V.V.S. Mani	1972-73	-do-
5.	S/Shri A.B. Deshmukh, J.N. Rai and Miss P. Tripathi	1975-76	-do-
6.	Shri N. Somasundaram	1981-82	-do-
7.	Dr. J. N. Rai	1981-82	-do-
8.	Shri S Sudarshana	1986-87	Reappraisal Hydrogeological Studies
9.	Shri S.K. Jain	1992-93	-do-
10.	Shri G Sudarshan	1992-93	-do-
11.	Shri D. Venkateshwaran	1993-94	-do-
12.	Shri S.Sudarshana	1993-94	-do-
13.	Shri D.Y. Sirsikar	1994-95	-do-
14.	Sh. B. R. Lamsoge	2005-06	-do-
15.	Sh D. N. Mandal	2005-06	-do-
16.	Sh P. Madhnure	2005-06	-do-
17.	Sh B. N. Warke	2005-06	-do-

To explore the ground water potential and aquifer properties, exploratory drilling was undertaken by the department during the year 1984 and the drilling programme was completed in the year 1995. Under this programme 78 Exploratory Wells (EW), 23 Observation Wells (OW), and 12 Piezometers (PZ) were constructed. The details of ground water exploration are presented in **Table 2**

Table 2: Salient Features of Ground Water Exploration.

S. No.	Taluka	Formation /Aquifer	Wells			Depth (mbgl)	SWL (mbgl)	Discharge (lps)	Zones (mbgl)
			E W	O W	PZ				
1.	Arni	Basalt	1	—	2	30.00–200.00	46.50–68.00	0.38	6.0-158.0
2.	Babul-gaon	Basalt	3	1	1	30.00–128.10	5.45–7.65	0.14–3.17	—
		Sandstone	1	—	—	85.40	—	—	—
3.	Darwah	Basalt	2	—	1	30.00–201.30	3.45	0.14	—
4.	Digras	Basalt	4	—	—	189.10–201.30	2.70–30.07	0.60	—
5.	Ghatanji	Basalt	3	—	—	173.70–201.30	30.07	0.60–3.77	46.0-87.0
		Sandstone	1	1	—	201.30	4.00–4.75	1.37–7.37	—
6.	Jhari-Jhamni	Basalt	1	2	—	77.00–190.55	6.43–6.50	12.18–14.88	12.0-77.0
7.	Kalamb	Basalt	1	—	1	30.00–103.70	—	—	—
8.	Kelapur	Basalt	3	3	2	30.00–152.50	5.70–50.00	3.77–19.66	27.0-130.0
		Limestone	1	—	—	201.30	—	1.37	9.0-80.0
9.	Maha-gaon	Basalt	3	1	—	123.25–200.00	1.90–9.80	1.05–7.76	10.0-138.5
10.	Maregaon	Basalt	1	1	—	46.95–48.00	13.36–14.00	5.94–14.50	40.8-87.0
		Sandstone	1	—	—	86.25	2.54	1.37	8.0-19.6
11.	Ner	Basalt	5	2	1	19.45–201.30	2.20–3.38	0.14–17.90	—
12.	Pusad	Basalt	4	—	—	201.30	3.00–23.80	0.14–1.73	6.0-119.0
13.	Ralegaon	Basalt	1	1	—	130.0–158.0	—	3.17–7.76	15.0-75.0
		Limestone	1	—	—	201.30	—	1.05	136.0-140.0
14.	Umarched	Basalt	4	3	—	79.00–201.30	1.55–10.46	1.73–49.40	4.0-138.0
15.	Wani	Sandstone	31	7	4	31.80–470.00	0.50–19.00	0.13–11.60	10.0-470.0

S. No.	Taluka	Formation /Aquifer	Wells			Depth (mbgl)	SWL (mbgl)	Discharge (lps)	Zones (mbgl)
			E W	O W	PZ				
16.	Yavatmal	Basalt	4	1	—	103.70– 201.30	3.20– 64.00	0.38– 10.98	—
		Sandstone	2	—	—	34.30– 43.95	6.85– 7.39	1.37	24.0
	Total		78	23	12	19.45– 470.00	0.50– 68.00	0.13–49.40	10.00- 470.00

Ground Water exploration was aimed at delineating the productive aquifers and ground water worthy areas down to the target depth of 470 metres below ground level (m bgl) in unconsolidated formations and up to 201 m bgl in consolidated formations. The yield ranges from 0.4 litres per second (lps) to 8 lps for a maximum drawdown of 30 m in unconsolidated formations and 0.14 lps to 49.48 lps for a maximum draw down of 49 m in consolidated formation. Productive zones in Basalt are observed down to 138 m bgl, whereas in Sandstone they are observed even down to 470 m bgl.

A map of the district showing the taluka Boundaries, Taluka headquarters, physical features and location of exploratory and monitoring wells is presented as **Figure-1**.

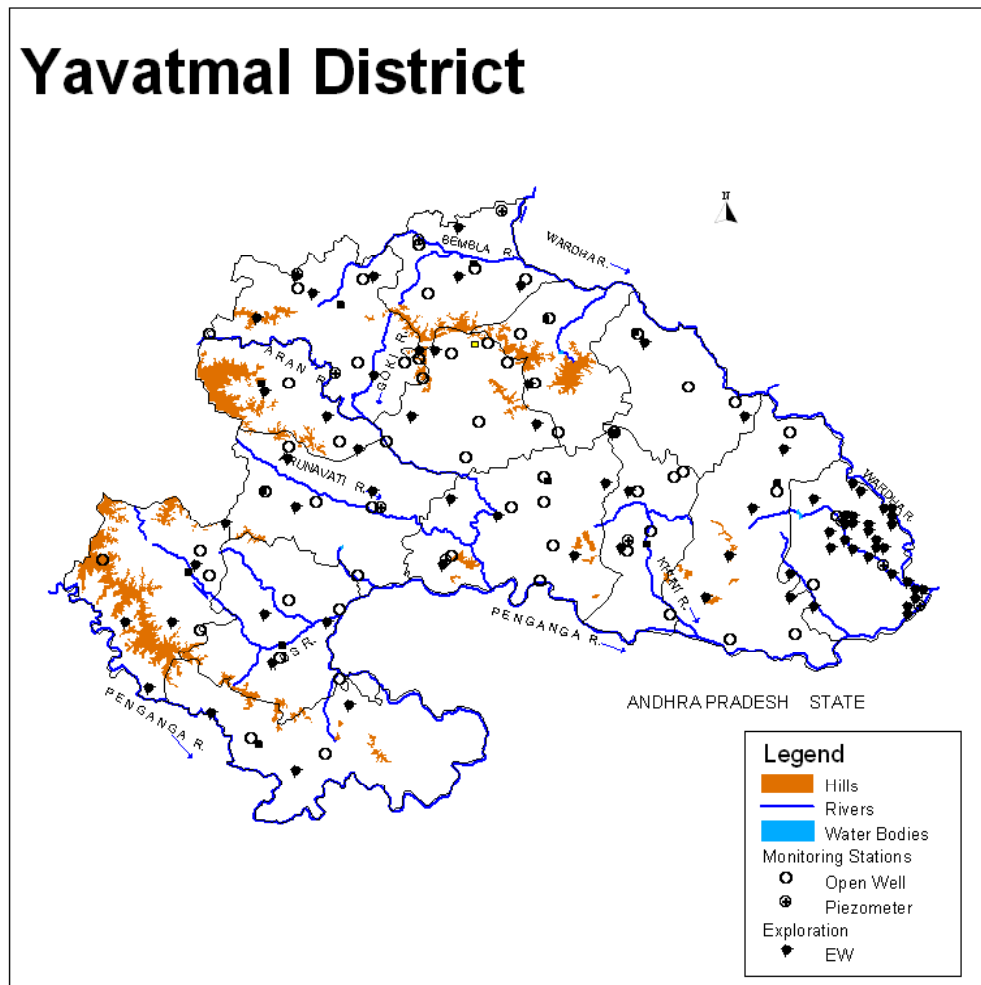


Figure 1: Location

2.0 Climate and Rainfall

The Climate of the district is characterised by a hot summer and general dryness throughout the year except during the south-west monsoon season, i.e., June to September. The temperature rises rapidly after February till May, which is the hottest month of the year. The mean daily maximum temperature during May is 41.8°C and the mean daily minimum temperature during December is 15.1°C

The normal annual rainfall (1901) varies from about 850 to 1150 mm and it increases from NW to SE direction in the district and reaches maximum around Pandharkawada. The average annual rainfall for the last ten years 1996-2005 ranges from 479.94 mm (Ner) to 932.54 mm (Yavatmal) and the same is presented in **Table-3**. Thus the rainfall has decreased during the last 10 years period.

Table 3: Annual Rainfall Data (1996-2005). (mm)

Taluka	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Avg.
Arni	929.20	758.00	640.70	563.00	438.00	568.00	939.00	408.00	282.05	402.00	592.80
Babulgaon	1020.70	631.50	770.60	930.00	753.00	927.00	761.00	762.00	462.00	612.00	762.98
Darwah	637.70	609.20	758.80	916.50	1000.00	930.00	1063.00	594.00	423.66	522.00	745.49
Digras	730.80	671.60	815.30	1027.40	836.50	822.00	986.30	472.00	462.00	656.00	747.99
Ghatanji	958.00	767.00	979.60	1049.00	1025.00	931.00	1114.00	1130.00	438.00	712.00	910.36
Jhari-Jhamni	775.00	986.80	1055.60	577.00	414.40	525.00	573.00	336.00	323.51	387.00	595.33
Kalamb	910.00	643.70	1057.40	936.40	957.00	1117.00	1212.00	1218.00	388.12	844.00	928.36
Kelapur	800.00	741.20	1101.30	1181.00	991.00	1061.00	1053.00	742.00	830.00	624.00	912.45
Maregaon	1211.70	1129.40	1191.50	772.40	671.00	681.50	570.00	496.00	327.04	412.30	746.28
Ner	807.60	674.00	463.50	503.30	395.80	496.20	424.00	345.00	329.00	361.00	479.94
Pusad	1003.00	893.70	1179.90	1205.90	628.20	1032.80	1325.10	734.80	477.74	687.00	916.81
Ralegaon	875.00	822.00	915.80	952.00	1195.00	1099.00	1044.00	1130.00	438.00	712.00	918.28
Umardhed	1075.50	1108.60	689.30	541.80	477.00	939.60	647.40	816.30	357.22	512.00	716.47
Wani	677.20	931.00	914.00	1055.00	919.00	627.30	658.00	632.90	592.25	697.40	770.41
Yavatmal	876.40	832.60	876.40	1220.90	1075.80	1278.80	1110.40	563.80	661.85	828.40	932.54
Average	885.85	813.35	893.98	895.44	785.11	869.08	898.68	692.05	452.83	597.94	778.43

3.0 Geomorphology and Soil Types

The northern fringe of the district is hilly and forms part of Satpura range. South of these hill ranges, covering almost entire north-central part constitutes the Alluvial plain. Southern part of the district is characterized by hilly rugged terrain as a part of Deccan Plateau. Purna is the main river flowing through the district. Other important rivers are Man, Murna and Kate.

Three types of soils are observed in the district i.e., (a) The shallow coarse soil which is reddish brown and brownish in colour, occurring in general at higher elevations along the ridges and also at the foothills zone of the major hills (b) The medium black soil is developed along the tributary drainage's and also along the intermediate gradient area. (c) The deep black soil, which is developed along the lower reaches of Wardha and Penganga riverbeds. They differ from medium black soil in depth and fertility.

The soils in the district are slightly alkaline, clayey loamy in texture and contains calcium carbonate.

4.0 Ground Water Scenario

4.1 Hydrogeology

Deccan Trap Basalt is the predominant water bearing formation, followed by Gondwana formation having Sandstone and Shale sequence. Penganga and Quaternary Alluvium aquifers are spread in limited areas. Archean aquifers are limited and have less significance in the area. . A map depicting the hydrogeological features is shown in **Figure-2**.

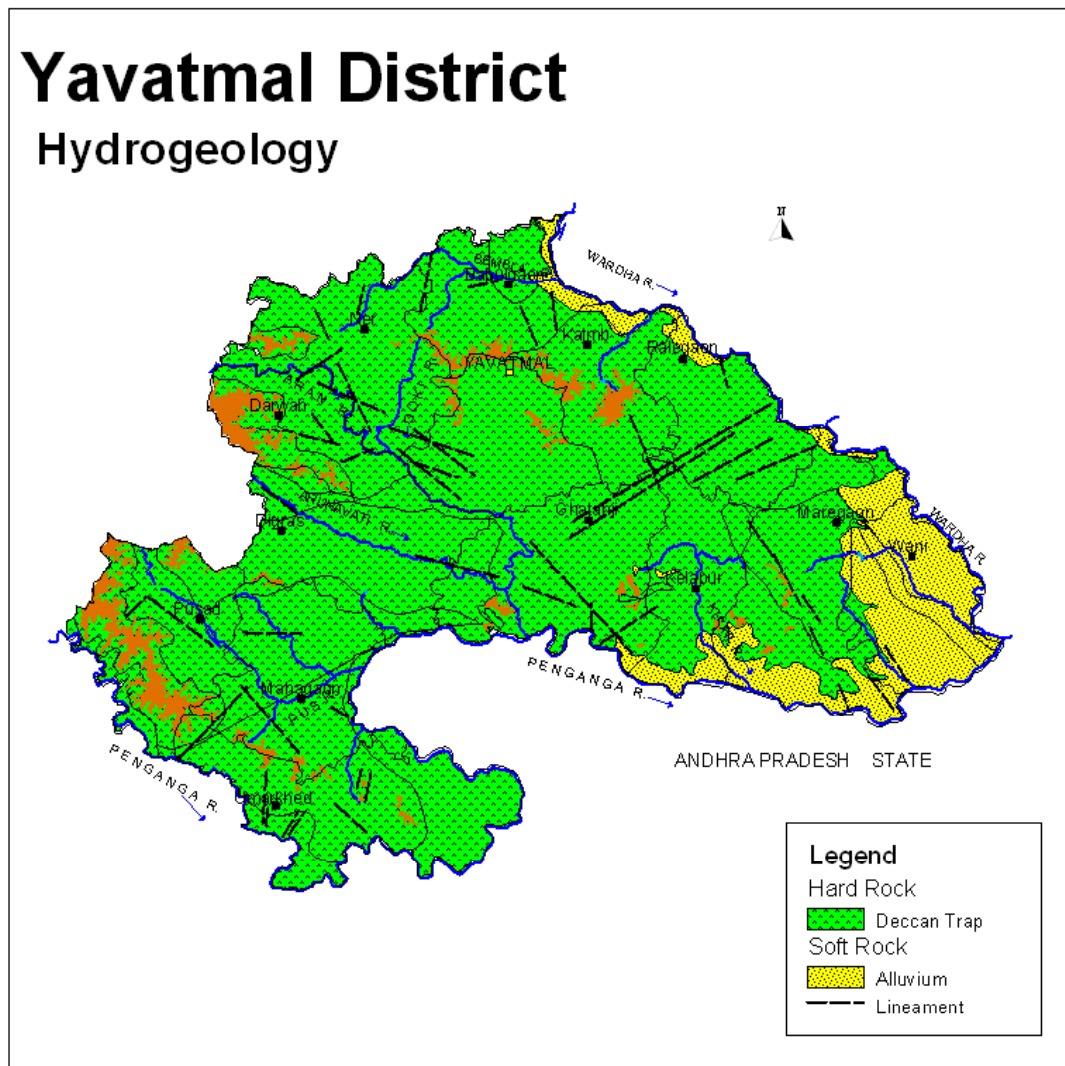


Figure 2: Hydrogeology

4.1.1 Archean

Achaeans, which comprise granite, granitic gneiss and schist occur in Umarnhed taluka. These rocks as such have limited ground water potential. In these rocks only weathered portions and jointed zones possess water-bearing capacity and ground water occurs under unconfined condition in the area.

4.1.2 Vindhyan

In Vindhyan, Limestones are water bearing while Sandstone due to

their hard and compact nature has poor ground water potential and occur in southeastern peripheral parts of Wani taluka. The limestones as such are massive but wherever they are cavernous they are capable of holding water. The ground water occurs under unconfined condition in the area.

4.1.3 Gondwana

The Gondwana consists of Kamthi and Barakar Sandstone and Shale and occupy north-south extending elongated stretch in parts of Maregaon and Wani talukas. Sandstone is usually friable and possesses primary porosity due to its granular nature. They are most productive water bearing formations in the district. The ground water occurs under semi confined to confined conditions in the area and water bearing zones have been encountered down to depth of 470 m.

4.1.4 Deccan Trap Basalt

Deccan Trap Basalt is widely spread and important water bearing formation, which occupies almost entire district except south eastern part of the district. On the whole Deccan Trap Basalt exhibit a multi aquifer system. Based on the lithologs of 51 exploratory wells and piezometers it is observed that weathered Vesicular Basalt mainly forms the predominant shallow aquifer down to the depth of 20 m bgl. Massive Basalt is also encountered at the top thereby forming poor yielding aquifer and also restricting the ground water recharge to the underlying porous Vesicular Basalt. Fractured Basalt is also observed in certain places with limited to significant thickness. In Deccan Trap Basalt phreatic aquifer generally occurs down to 25 m, however, fracture zones have occurred within 80 m range excluding at few place where it occurs down to 158 m also.

4.1.5 Alluvium

Alluvium occurs in patches along the banks of Wardha and Penganga rivers and their major tributaries and consists of clay and silt with lenticular bodies of sand and gravel. In Ralegaon area, it is observed that sand zones are found in the depth range of 20-25 m bgl, while the top 15-16 m is full of clay and silt. Ground water in Alluvium occurs both under unconfined and semi-confined conditions.

4.1.6 Water Level Scenario

Central Ground Water Board periodically monitors 60 National Hydrograph Network Stations (NHNS) stations in the Yavatmal district, four times a year i.e. in January, May (Premonsoon), August and November (Postmonsoon). The data on premonsoon and postmonsoon water levels along with fluctuation during 2006 and long term water level trends (1997-06) is given in **Table- 4**.

Table 4: Water Level Data (2006) with Long Term Trend (1997-06).

S. No.	Location	Pre monsoon Water Level (m bgl)	Post monsoon Water Level (m bgl)	Fluctuation (m)	Premonsoon Trend		Postmonsoon Trend	
					Rise (m/yr)	Fall (m/yr)	Rise (m/yr)	Fall (m/yr)
1	Akolabazar	9.35	7.40	1.95		0.29		0.32
2	Arni	3.20	1.00	2.20		0.10		0.06
3	Arni2	-	-	-		0.29	0.00	
4	Babhulgaon	7.63	4.90	2.73	-	-	-	-
5	Bori (Arab)	-	-	-		0.16		0.02
6	Bori (Patan)	12.70			0.01			0.01
7	Chaparda	4.79	3.45	1.34		0.001	0.08	
8	Dhanaj	5.55	2.62	2.93		0.002	0.24	
9	Dhanki	4.58	4.75	-0.17		0.31		0.12
10	Dhanoda	10.20	8.28	1.92	0.14		0.14	
11	Digras	6.95	2.95	4.00		0.19		0.09
12	Ghatanji	8.00	4.65	3.35		0.20		0.14
13	Ghatwadi	8.70	3.89	4.81		0.10		0.04
14	Harsi	7.70	0.58	7.12		0.16		0.00
15	Injhala	12.41	10.20	2.21		0.10		0.08
16	Jamwadi	2.70	2.30	0.40	0.11			0.31
17	Jodmoha	7.68	5.35	2.33		0.15	0.00	
18	Kalamb	11.00	7.50	3.50	0.06			0.56
19	Karanji1	7.72	5.50	2.22		0.16		0.05
20	Kayar	7.00			0.18		0.00	
21	Kolambi	5.45	3.07	2.38		0.05		0.00
22	Kotha	7.50	1.62	5.88	0.01		0.09	
23	Ladkhed	9.80	3.65	6.15		0.08	0.07	
24	Lonbhel	7.54	3.78	3.76		0.10		0.00
25	Madkona	13.00	7.68	5.32		0.35	0.05	
26	Mahagaon	4.05	3.75	0.30		0.89		0.37
27	Mandeo	10.72	1.37	9.35		0.15		0.16
28	Mangrule	4.45	4.35	0.10		0.11		0.06
29	Mardi	6.05	3.32	2.73		0.05		0.30
30	Maregaon	10.95	6.70	4.25		0.22		0.00
31	Marwadi Khurd	6.80	1.70	5.10		0.08	0.05	
32	Mohada	6.10	4.87	1.23		0.09		0.19
33	Mohgaon Kasba	9.10	4.25	4.85		0.008		0.10
34	Mojhar	2.50	1.08	1.42	-	-	-	-
35	Mojhar2	-	-	-		0.07		0.18
36	Mudana	10.15	5.02	5.13	0.12			0.10
37	Mukutban	9.05			-	-	-	-
38	New Waghdara	-	-	-		0.05		0.01
39	Pahapal	6.55	2.70	3.85	0.05		0.20	
40	Pahur	8.40	1.72	6.68		0.13		0.00
41	Pandharkawada	2.48	0.80	1.68		0.03		0.20
42	Parwa	9.38	2.22	7.16		0.07		0.17

S. No.	Location	Pre monsoon Water Level (m bgl)	Post monsoon Water Level (m bgl)	Fluctuation (m)	Premonsoon Trend		Postmonsoon Trend	
					Rise (m/yr)	Fall (m/yr)	Rise (m/yr)	Fall (m/yr)
43	Phul Sawangi	9.60	8.75	0.85				
44	Punwat	3.80	1.95	1.85		0.21		0.17
45	Pusad	6.60	2.47	4.13		0.18	0.07	
46	Ralegaon	10.35	4.42	5.93	-	-	-	-
47	Sakhra (P1)	10.15	8.40	1.75	-	-	-	-
48	Sakhra (WT)	9.10	6.10	3.00	0.15		0.12	
49	Savar	6.55	2.62	3.93	0.04			0.19
50	Sawali	9.40	7.20	2.20		0.14		0.08
51	Saykheda	6.70	2.65	4.05	0.02		0.02	
52	Selodi	5.40	2.05	3.35	-	-	-	-
53	Sindhi	-	-	-		0.03		0.09
54	Talegaon	4.25	0.90	3.35	0.33			0.04
55	Umarda	5.45	3.20	2.25	0.20			0.12
56	Umarched	8.05	6.60	1.45		0.03	0.21	
57	Vai (Lingi)	6.94	3.20	3.74		0.23	0.01	
58	Wadgaon	10.10	2.22	7.88	0.00		0.006	
59	Wadhona	4.61	2.61	2.00		0.17		0.67
60	Wani	8.63	11.30	-2.67	-	-	-	-

4.1.6.1 Depth to Water Level – Premonsoon (May-2006)

The depth to water levels in the district during premonsoon ranges between 2.48 (Pandharkawada) and 13.00 (Madkona) m bgl. Depth to water level during premonsoon has been depicted in **Figure-3**. Shallow water levels within 10 m bgl are seen in almost entire district except few isolated patches in parts of Kelapur, Zhari-Zhamni, Maregaon, northern parts of Kalamb, Ralegaon and Yavatmal talukas where water level ranges between 10-20 m bgl.

4.1.6.2 Depth to Water Level – Postmonsoon (Nov-2006)

The depth to water levels during postmonsoon ranges between 0.58 m bgl (Harsi) and 11.30 m bgl (Wani). Spatial variation in postmonsoon depth to water levels is shown in **Figure-4**. Shallow water levels within 10 m bgl are observed in entire district with dominant range being 2-5 m bgl. Very shallow water level of less than 2 m bgl is observed in south western part of Pusad taluka and north western parts of Darwha and Ner talukas. Water levels of 10-20 m bgl are observed in small eastern part of Wani taluka.

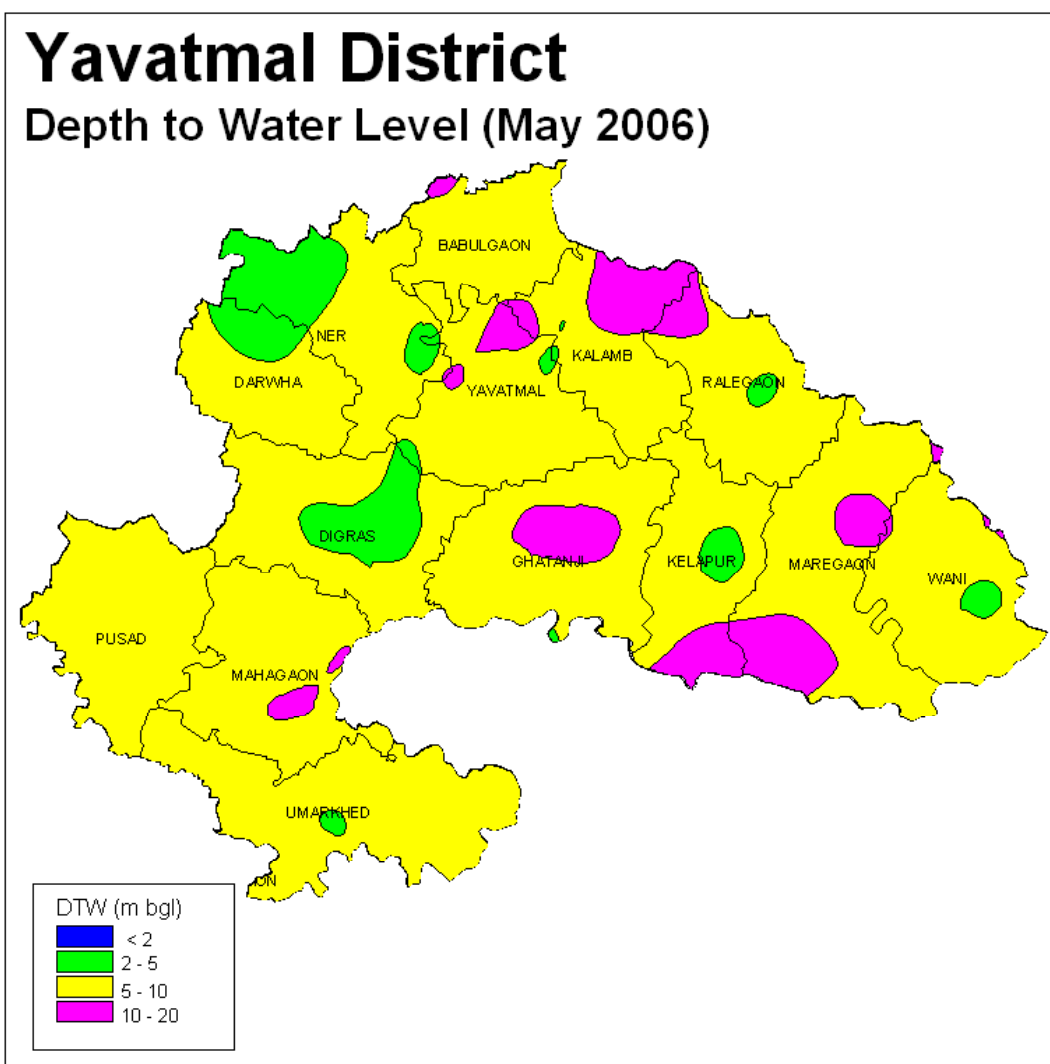


Figure 3: Depth to Water Level (Premonsoon- May 2006)

4.1.6.3 Seasonal Water Level Fluctuation– (May-Nov. 2006)

In major part of the district rise in water levels in the range of 0.10 m (Mangrule) to 9.35 m (Mandeo) is observed. Fall in water levels is observed only at Wani (-2.67 m) and Dhanki (-0.17). In major parts of the district rise in water levels has been observed in entire south, central, north and eastern parts whereas fall in water levels is observed in restricted east central part of the district. Rise in water levels in the range of 2 to 4 m is observed in major parts of the district. Rise of more than 4 m is observed in Pusad and parts of Mahagaon talukas in western parts, Darwha and Ner in Central Parts, Yavatmal, Ralegaon and Babulgaon talukas in northern parts and Ghatanji and Kelapur talukas. Rise of 0 to 2 m is observed in isolated areas in Umarchhed, Yavatmal, Digras, Kalamb and Ralegaon talukas. Decline in water levels is observed in a small area in Wani taluka.

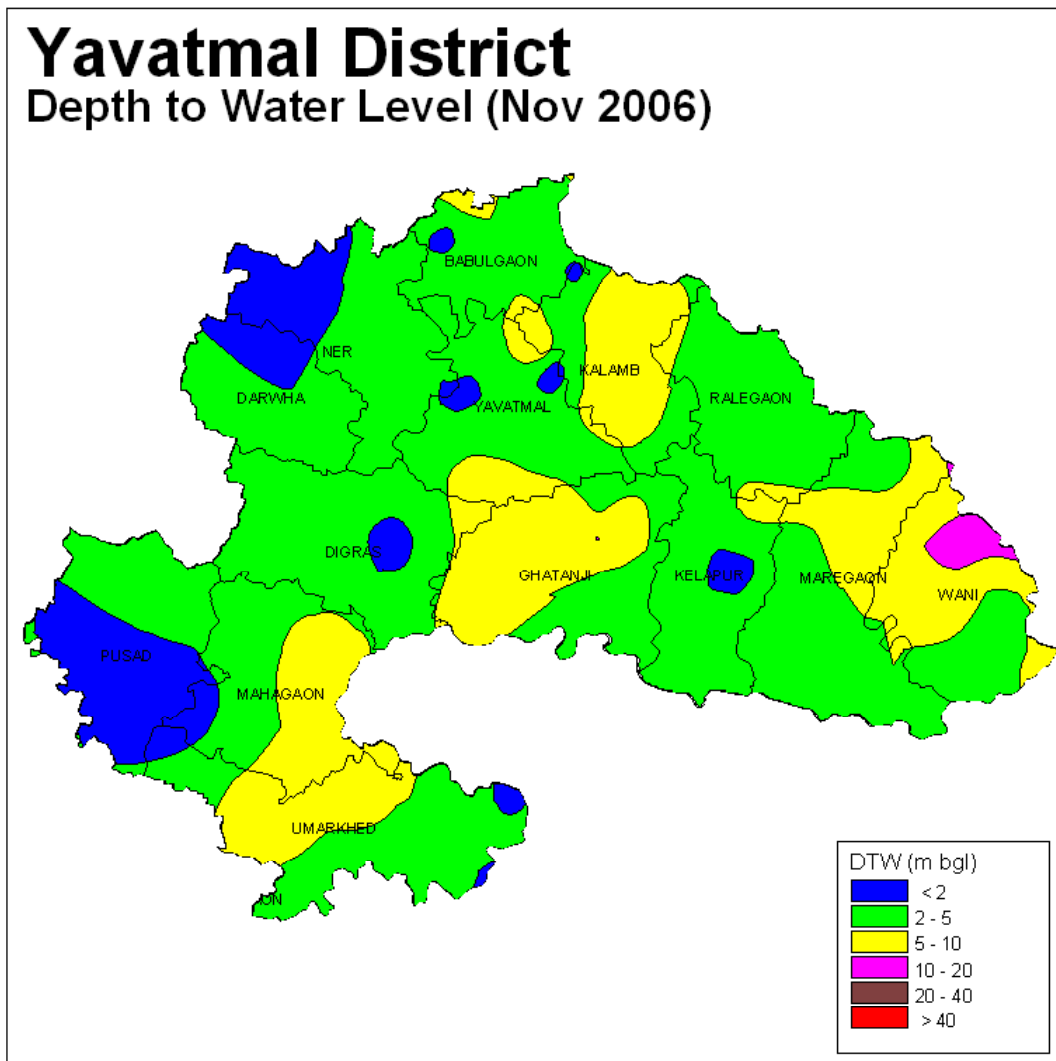


Figure 4: Depth to Water Level (Postmonsoon- Nov. 2006)

4.1.6.4 Water Level Trend (1997-2006)

Trend of water levels for premonsoon and postmonsoon periods for last ten years (1997-2006) have been computed for 52 NHNS and are given in **Table-4**. Analysis of trend indicates that during premonsoon period, rise in water levels has been recorded at 14 stations and it ranges between negligible and 0.33 m/year (Talegaon). Fall in water levels has been observed at 38 stations and ranges between negligible at few stations and 0.89 m/year (Mahagaon). During post monsoon period, rise in water levels has been recorded at 17 stations and it ranges from negligible at few stations to 0.24 m/year (Dhanaj), whereas at 35 stations, fall in water levels ranging between negligible at few stations and 0.67 m/year (Wadhona) is observed. Thus in major part of the district, both during pre and postmonsoon periods declining trend of water levels has been observed.

4.1.7 Aquifer Parameters

Pumping tests from shallow aquifers (down to 20 m depth), reveals that the dugwells tapping weathered vesicular and weathered Massive Basalt

have higher specific capacity in the range of 13.95 to and 513 lpm/m. The wells located in the Massive Basalt have the specific capacity in the range of 5 and 67 lpm/m. Jointed Basalt have specific capacity ranging from 14.53 to 83.85 lpm/m. Highly fractured and Jointed Basalt have specific capacity of 663.86 lpm/m. The wells tapping Limestone, Sandstone and Alluvial aquifers shows moderate to high specific capacity ranging between 20 and 511 lpm/m.

During the course of ground water exploration, pumping tests were conducted at 11 exploratory wells. It was observed that in Deccan Traps the transmissivity varies from 18.74 to 202 m²/day and storativity varies from 3.4x10⁻⁴ to 5.2x10⁻⁴. In Trap-covered Gondwanas/Vindhyan/Archeans, transmissivity varies from 3.61 to 19.24 m²/day whereas storativity varies from 8.7x10⁻⁵ to 1.35 x10⁻⁴.

4.2 Ground Water Resources

Central Ground Water Board and Ground Water Survey and Development Agency (GSDA) have jointly estimated the ground water resources of Yavatmal district based on GEC-97 methodology. The same is presented in **Table-5**. The net annual available ground water resources are 1278.34 MCM and the ground water draft is 314.35 MCM. The ground water resources are shown in **Figure-5**.

Ground water development scenario varies in the district, while eastern part consisting of Wani, Maregaon, Kelapur, Ghatanji and Jhari-Jhamni talukas are the least developed talukas with less than 15% of development. Ralegaon, Yavatmal, Babulgaon, Kalamb and Arni are the next developed talukas with the stage of development between 15 to 25%. Ground water development in Darwah, Ner, Digras, Pusad and Umardhed talukas is 25 to 40%. Maximum ground water development is 45% in Mahagaon taluka. As per the GEC norms all the talukas and 64 watersheds falls in "Safe" category. The western part of the district covered by Deccan Trap Basalt have better ground water development as compared to the eastern part where the Gondwana or Trap covered Gondwana/Vindhyan/Penganga aquifers are observed. The overall stage of ground water development in the district is 24.48%. No taluka or watershed is categorised as "Over-Exploited"/"Critical"/"Semi-Critical" and the area has not been notified by CGWA or SGWA.

Yavatmal District Ground Water Resources

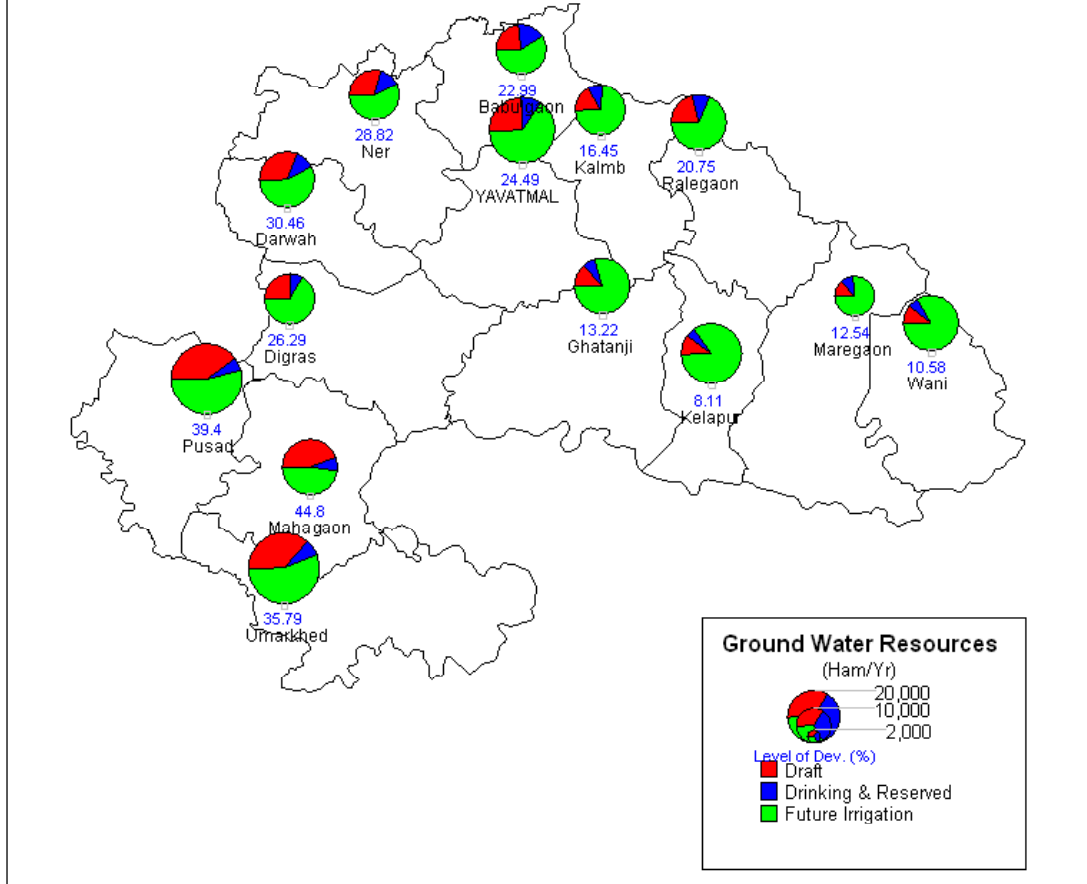


Figure 5: Ground Water Resources

Table-5: Taluka wise Ground Water Resources (March 2004).

Taluka	Area Type	Net Annual Ground water Availability (ham/yr)	Existing Gross Groundwater Draft for Irrigation (ham/yr)	Existing Gross Groundwater Draft for Domestic & Industrial water Supply (ham/yr)	Existing Gross Groundwater Draft for All uses (ham/yr)	Allocation for domestic & industrial requirement supply up to next 25 years (ham/yr)	Net Groundwater Availability for future irrigation development (ham/yr)	Stage of Groundwater Development (%)
1	2	3	4	5	6	7	8	9
WANI	COMMAND	641.57	23.20	19.68	42.88	44.46	353.56	6.68
	NON COMMAND	7102.45	518.05	258.68	776.73	513.03	6078.31	10.94
	TOTAL	7744.02	541.25	278.36	819.61	557.50	6431.87	10.58
MAREGAON	COMMAND	459.61	11.05	8.11	19.16	16.90	191.28	4.17
	NON COMMAND	4207.21	337.05	228.81	565.86	455.67	3345.10	13.45
	TOTAL	4666.82	348.10	236.92	585.01	472.58	3536.37	12.54
PANDHARKAVADA	COMMAND	1807.98	189.88	36.39	226.27	83.54	1358.17	12.51
	NON COMMAND	6573.63	458.64	162.36	621.00	318.37	5728.80	9.45
	TOTAL	8381.61	648.52	198.75	847.27	401.91	7086.97	10.11
GHATANJI	COMMAND	1521.64	289.57	55.24	344.81	92.93	1070.26	22.66
	NON COMMAND	6720.06	501.29	243.22	744.50	502.74	5512.21	11.08
	TOTAL	8241.70	790.85	298.46	1089.31	595.66	6582.48	13.22
RALEGAON	COMMAND	1095.51	129.58	33.03	162.61	77.75	532.58	14.84
	NON COMMAND	6519.72	1064.68	353.23	1417.91	693.49	4682.18	21.75
	TOTAL	7615.23	1194.26	386.26	1580.52	771.24	5214.76	20.75
YAVATMAL	COMMAND	3306.67	693.96	90.57	784.53	230.30	1777.96	23.73
	NON COMMAND	6937.30	1320.77	403.07	1723.83	778.08	5042.73	24.85
	TOTAL	10243.97	2014.73	493.64	2508.36	1008.38	6820.69	24.49
BABULGAON	COMMAND	587.91	22.36	27.88	50.24	53.14	332.02	8.55
	NON COMMAND	5473.98	830.35	512.79	1343.14	1014.75	3297.19	24.54
	TOTAL	6061.89	852.71	540.67	1393.38	1067.89	3629.21	22.99
KALAMB	COMMAND	941.26	48.25	37.37	85.62	69.49	502.81	9.10
	NON COMMAND	6034.49	768.15	293.94	1062.09	590.74	4603.18	17.60
	TOTAL	6975.75	816.40	331.31	1147.71	660.23	5105.98	16.45

1	2	3	4	5	6	7	8	9
DARWHA	COMMAND	1230.73	323.05	50.10	373.14	104.33	497.87	30.32
	NON COMMAND	7041.62	1734.63	411.65	2146.28	826.38	4294.81	30.48
	TOTAL	8272.35	2057.68	461.74	2519.42	930.70	4792.68	30.46
NER	COMMAND	315.17	57.20	41.58	98.79	30.78	118.28	31.34
	NON COMMAND	5873.48	1284.88	399.53	1684.40	833.53	3478.84	28.68
	NON COMMAND	5873.48	1284.88	399.53	1684.40	833.53	3478.84	28.68
	TOTAL	6188.64	1342.08	441.11	1783.19	864.31	3597.12	28.81
DIGRAS	COMMAND	1953.83	241.31	35.57	276.88	87.96	826.37	14.17
	NON COMMAND	4162.36	1118.20	213.09	1331.30	412.95	3469.05	31.98
	TOTAL	6116.19	1359.52	248.66	1608.18	500.91	4295.42	26.29
PUSAD	COMMAND	4389.99	2115.69	125.74	2241.43	205.44	1342.47	51.06
	NON COMMAND	8005.90	2387.44	254.65	2642.09	548.15	5391.30	33.00
	TOTAL	12395.89	4503.13	380.39	4883.52	753.60	6733.77	39.40
MAHAGAON	COMMAND	1162.18	463.73	54.81	518.54	80.48	415.64	44.62
	NON COMMAND	6933.20	2825.50	283.01	3108.51	588.99	3561.72	44.84
	TOTAL	8095.37	3289.23	337.82	3627.05	669.47	3977.35	44.80
UMARKHED	COMMAND	4014.39	595.33	118.37	713.69	254.04	2068.86	17.78
	NON COMMAND	8457.94	3417.34	332.63	3749.97	658.30	4884.55	44.34
	TOTAL	12472.33	4012.67	451.00	4463.66	912.34	6953.41	35.79
ZHARI ZHAMANI	COMMAND	131.01	9.17	6.50	15.68	3.80	58.44	11.96
	NON COMMAND	6119.28	519.28	182.50	701.78	373.80	5140.69	11.47
	TOTAL	6250.29	528.45	189.00	717.45	377.60	5199.14	11.48
ARNI	COMMAND	3224.71	641.41	99.19	740.61	190.49	1542.29	22.97
	NON COMMAND	4886.83	921.96	198.31	1120.27	408.37	3756.36	22.92
	TOTAL	8111.54	1563.37	297.51	1860.88	598.86	5298.66	22.94
TOTAL	COMMAND	26784.16	5854.74	840.14	6694.88	1625.84	12988.87	25.00
	NON COMMAND	101049.44	20008.20	4731.45	24739.65	9517.34	72267.02	25.00
	TOTAL	127833.60	25862.94	5571.59	31434.53	11143.18	85255.89	24.48

4.3 Ground Water Quality

The geochemical classification of ground water in the area was carried out to see the dominance of ions in ground water. In the district, 45 samples were collected, out of which 44 were representing Basaltic aquifer and 1 sample was from Alluvium. The epm percentage of alkaline earths (Ca+Mg), alkali metals (Na+K), weak acids (CO₃+HCO₃) and strong acids (Cl+SO₄+NO₃) ions in the ground water samples were calculated and samples were broadly classified into four classes as given in **Table-6**.

Table-6 Geochemical Classification of Ground Water Samples.

Sr. No.	Classification	Type	No. of Sample	% of Sample
1	Alkaline earths (Ca+Mg > 50%) exceeds alkali metals and weak acids (CO ₃ +HCO ₃ > 50%) exceeds strong acids	Ca-HCO ₃	27	60
2	Alkali metal (Na+K > 50%) exceeds alkaline earths and weak acids (CO ₃ +HCO ₃ > 50%) exceeds strong acids.	Na-HCO ₃	1	2
3	Alkaline earths (Ca+Mg > 50%) exceeds alkali metals and strong acids (Cl+SO ₄ +NO ₃ > 50%) exceeds weak acids	Ca-Cl	17	38
4	Alkali metal (Na+K > 50%) exceeds alkaline earths and strong acids (Cl+SO ₄ +NO ₃ > 50%) exceeds weak acids	Na-Cl	-	-
	Total		45	100

It is clear from **Table-6** that the ground water in the district is dominated by Ca-HCO₃ type of water. But all the samples from the Deccan Trap Basalt aquifer do not have Ca-HCO₃ type of water but some of these samples belongs to Ca-Cl type of water indicating that the ground water have changed due to the presence of high concentrations of strong acid ions in ground water coming from anthropogenic sources.

4.3.1 Suitability of Ground Water for Drinking Purpose

The suitability of ground water for drinking purpose is determined keeping in view the effects of various chemical constituents in water on the biological system of human being. Though many ions are very essential for the growth of human, but when present in excess, have an adverse effect on human body. The standards proposed by the Bureau of Indian Standards (BIS) for drinking water (IS-10500-91, Revised 2003) were used to decide the suitability of ground water. The classification of ground water samples was carried out based on the desirable and maximum permissible limits for the parameters viz., TDS, TH, Ca, Mg, Cl, SO₄ and NO₃ prescribed in the standards and is given in **Table-7**.

Table-7 Classification of Ground Water Samples based on BIS Drinking Water Standards (IS-10500-91, Revised 2003)

Parameters	DL	MPL	Samples with conc. < DL	Samples with conc. in DL-MPL	Samples with conc. >MPL
TDS (mg/L)	500	2000	18	27	0
TH (mg/L)	300	600	8	25	12
Ca (mg/L)	75	200	9	30	6
Mg (mg/L)	30	100	11	33	1
Cl (mg/L)	250	1000	42	3	0
SO ₄ (mg/L)	200	400	45	0	0
NO ₃ (mg/L)	45	No relaxation	16	No relaxation	29
F (mg/L)	1.0	1.5	45	0	0

(Here, DL- Desirable Limit, MPL- Maximum Permissible Limit)

The **Table-7** shows that the concentrations of TDS, Cl, SO₄ and F in all the samples are below the maximum permissible limit of the standards. Only few samples are having the concentration of Ca and Mg more than the maximum permissible limits while 27% of samples were found to have TH more than MPL. It is also seen from the **Table-7** that the potability of ground water in the wells is mainly affected due to the NO₃ as its concentration exceeds more than MPL in 64% of samples. Overall, it can be concluded that the ground water quality in the wells monitored in the district is affected because of high NO₃ concentrations.

4.3.2 Suitability of Ground Water for Irrigation Purpose

The water used for irrigation is an important factor in productivity of crop, its yield and quality of irrigated crops. The quality of irrigation water depends primarily on the presence of dissolved salts and their concentrations. Sodium Absorption Ratio (SAR) and Residual Sodium Carbonate (RSC) are the most important quality criteria, which influence the water quality and its suitability for irrigation.

4.3.2.1 Sodium Absorption Ratio (SAR)

Sodium Absorption Ratio (SAR) is an expression pertaining to cation make up of water and soil solution and is used for characterizing the sodium hazard of irrigation water.

SAR value is used to calculate the degree to which irrigation water tends to enter into cation exchange section in the soil. The main problem with high sodium concentration is its effect on soil permeability. Sodium also contributes directly to the total salinity of the water and may be toxic to sensitive crops such as fruit trees. The higher value of SAR indicates soil structure damage.

4.3.2.2 Residual Sodium Carbonate (RSC)

Residual Sodium Carbonate (RSC) is considered to be superior to SAR as a measure of sodicity particularly at low salinity levels. The classification of ground water samples based on SAR and RSC values for its suitability for irrigation purpose is shown below in **Table-8**.

Table-8 Classification of Ground Water for Irrigation based on SAR and RSC.

SAR	<10		10-18		18-26		>26	
Category	Good		Good to		Doubtful		Unsuitable	
Total Samples	No. of Samples	%	No. of Samples	%	No. of Samples	%	No. of Samples	%
45	45	100	0	0	0	0	0	0
RSC	<1.25		1.25-2.50		>2.50			
Category	Good		Doubtful		Unsuitable			
Total Samples	No. of Samples	%	No. of Samples	%	No. of Samples		%	
45	42	94	2	4	1		2	

The **Table-8** shows that the SAR value of ground water samples collected is below 10 indicating that such type of water can be used for irrigation on almost all soils with little danger of development of sodium exchangeable problem. The RSC values of ground water samples collected from the wells is less than 1.25 except in three well, which reflects that the overall quality of ground water in the monitoring wells is good for irrigation purpose. The high value of RSC (>2.50) was found in the ground water of monitoring well from Dhanoda village of the district and is unsuitable for irrigation purpose.

4.4 Status of Ground Water Development

The yields of wells are functions of the permeability and transmissivity of aquifer encountered and varies with location, diameter and depth etc. There are three type of ground water structures i.e. dugwells, borewells and tubes wells in the area. Their yield characteristics are described below.

Dugwells tapping Alluvium along Penganga River in Kelapur, Maregaon and Wani talukas have tremendous ground water yield. Yield of dugwells tapping Limestone is rather poor except few dugwells in Wani taluka. The average yield varies between 40 –150 m³/day in winter and 5-50 m³/day in summer. Dugwells tapping Gondwana formation have poor yield except around Kayar in Wani taluka. Dugwells tapping Basalt have shown drastic variation in yield in time and space. They provide seasonal irrigation except isolated patches in Ralegaon and Kelapur talukas where perennial irrigation practices are noticed. Most of the dugwells are located in geomorphic depressions and canal command area. The winter yield varies from 50 to 250 m³/day and 15 to 100 m³/day in summer season.

Ground water is predominantly used for irrigation, as it is the major ground water utilising sector. As per the data available for year 2000-01, area irrigated by ground water is 451.80 sq. km., whereas the surface water accounts for 70.13 sq.km. area, and the net irrigated area is about 522 sq.km., thus ground water account for 86%, of net irrigated area. There are about 35871 irrigation dugwells in the district which, create an irrigation potential of 928.01 sq.km., out of which 700.83 sq.km., potential is utilised. In addition to this an irrigation potential of 27.28 sq.km. is utilised through 1074 borewells/tubewells.

State Government has drilled large number of borewells fitted with hand

pumps and electric motors for rural drinking water purposes in Deccan Trap area of the district. In all G.S.D.A, Government of Maharashtra, in the year 2003-04 were successfully operating 5082 borewells fitted with hand pumps and 269 borewells fitted with electric pumps under use for water supply in the district. Ground water development in the district is mostly through dugwells.

5.0 Ground Water Management Strategy

Ground water has special significance for agricultural development in the State of Maharashtra. Ground water development in some parts of the State has reached a critical stage resulting in declining of ground water levels. Thus there is a need to adopt an integrated approach of development of ground water resources dovetailed with ground water augmentation to provide sustainability to ground water development.

5.1 Ground Water Development

Ground water development scenario of the district is favourable for further ground water development in years to come. However, as the development of ground water resources proceeds with increasing ground water withdrawal, the depletion of water table will accelerate resulting into drying or deepening of existing wells. There are many pockets in the district where water levels have deepened and also certain areas lack adequate natural replenishment. Therefore, artificial recharge measures would be required simultaneously so as to augment the ground water resources of the area. There is a need for assessing the scope and extent of artificial recharge potential available at present in the area so as to make a comprehensive management plans for the district. The artificial recharge potential has been assessed accordingly on the scientific pattern and methodology in this study.

The district is underlain by unconsolidated formations and consolidated formation, therefore, Direct Rotary (DR) and down the Hole Hammer (DTH) rigs respectively are suggested for deployment. As the net ground water availability in the district is 1278.34 MCM, therefore 1,96,667 ha of additional land can be brought under assured irrigation by considering the crop water requirement of 0.65 m

The nature and yield potential of the aquifers occurring in different areas is given below in **Table-9**, whereas the map is presented as **Figure-6**.

Table 9: Nature and Yield Potential of Aquifers

Sr. No.	Taluka	Main Aquifers	Yield Potential	Type of wells Suitable
1	Arni	Basalt	Medium	Dugwell, DCB
2	Babulgaon	Alluvium/Basalt	Medium to High	Dugwell, DCB
3	Darwha	Basalt	Low to Medium	Dugwell, DCB
4	Digras	Basalt	Low	Dugwell, DCB
5	Ghatanji	Basalt	Medium	Dugwell, DCB
6	Jhara Jhamani	Basalt	Medium	Dugwell, DCB
7	Kalamb	Basalt	Medium	Dugwell, DCB
8	Kelapur	Basalt	Medium	Dugwell, DCB
9	Mahagaon	Basalt	Medium	Dugwell, DCB
10	Maregaon	Basalt	Medium to High	Dugwell, DCB

Sr. No.	Taluka	Main Aquifers	Yield Potential	Type of wells Suitable
11	Ner	Basalt	Medium	Dugwell, DCB
12	Pusad	Basalt	Low to Medium	Dugwell, DCB
13	Ralegaon	Basalt	Medium	Dugwell, DCB
14	Umarkhed	Basalt	Medium to High	Dugwell, DCB
15	Wani	Alluvium/Basalt	Medium to High	Dugwell, DCB, Tubewell
16	Yavatmal	Basalt	Medium	Dugwell, DCB

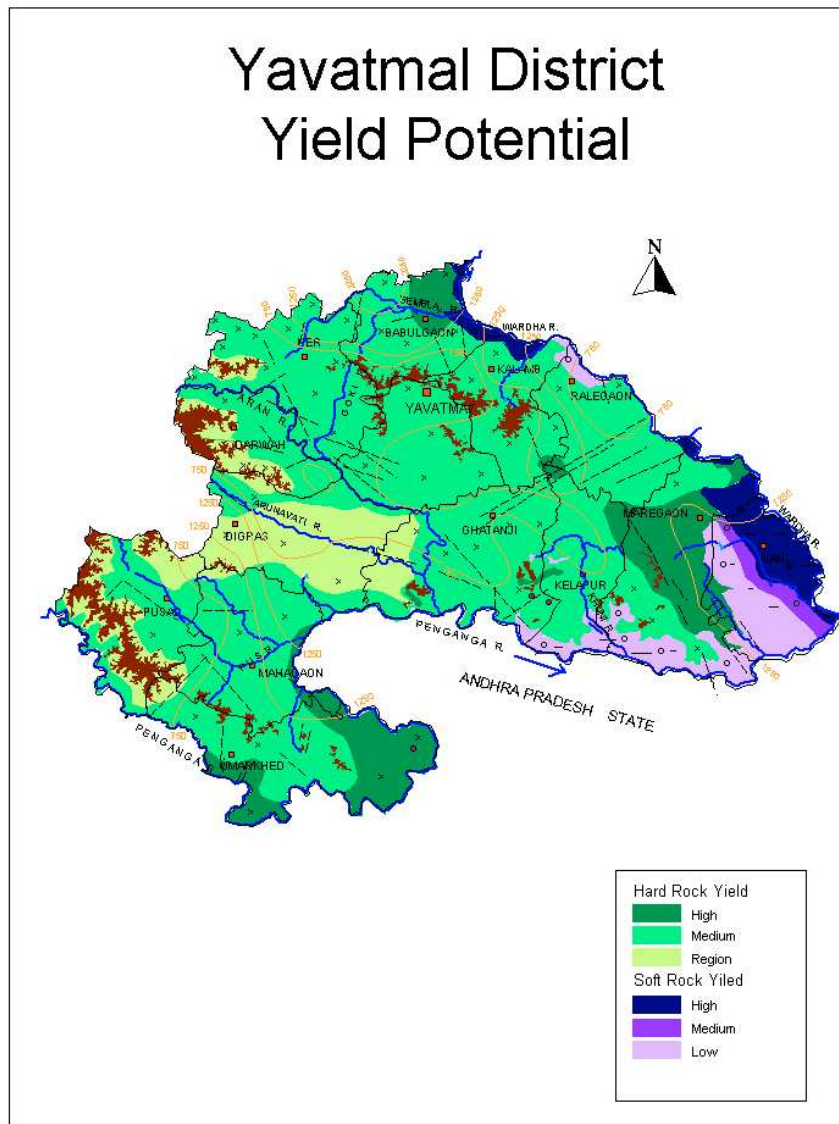


Figure 6: Yield Potential

5.2 Water Conservation and Artificial Recharge

As the district receives moderate rainfall therefore availability of surface water is limited to monsoon period only. Small schemes of water conservation have been completed in the district to augment the water supply directly or indirectly. Total 221 percolation tanks have been constructed in the district, which are helping in augmenting the ground water supply by artificial recharge. 249 Kolhapur Type (KT) weirs provide additional storage for

domestic use beyond monsoon months with a potential to irrigate 6386 ha in the district. Number of Under Ground Bandharas (UGB), Village Tanks and Gabion structures have been constructed to check the ground and surface water flow in the district. In addition to these number of Fracture Cement Sealing (FCS), bore hole blasting and hydro fracturing have been undertaken in the district by GSDA, Government of Maharashtra, for sustainable water supply.

The area having maximum potential for ground water recharge through artificial measures lies in Wani, Kelapur, Umarched, Ghatanji, Ner, Yavatmal and Darwha talukas. The suitable artificial structures recommended are recharge shaft, cement plugs, percolation tanks in soft rock formations and percolation tanks, cement plug, KT-weir, gabion structures in hard rock formations.

The volume of water for recharging the unsaturated zone (dry) of phreatic aquifers is estimated by multiplying the taluka wise area with the available unsaturated thickness and the average specific yield of the particular strata. Thus, the total storage potential of phreatic unsaturated aquifer varies from 9.04 MCM in Digras and Arni talukas to 142.56 MCM in Wani taluka. The total storage potential of phreatic aquifer, which can be augmented through artificial recharge in the district is estimated as 951.61 MCM.

6.0 Ground Water Related Issues and Problems

A detailed study of 26 villages of Kelapur (Pandharkawda) taluka carried out by CGWB has revealed that the high concentration of fluoride in ground water is occurring in deeper zones. The concentration of fluoride varies from place to place in different rock types vertically and laterally. High contents of fluoride ranging from 0.91 (Pimpri) to 13.41 mg/L (Dharna) have been found only in deeper zones whereas the shallow zone has not shown fluoride content beyond 0.88 mg/L (Khatara). The villages like Dharna, Sakhra, Sonurli, Susuri, Wadhona (Bk.), Wadhona(Kh.), Runjha and Govarai have been found affected by Fluorosis. Mottled teeth, stiff joints and muscular pains are reported in these villages. The fluoride problems may be tackled by providing safe drinking water, educating and creating awareness in public and construction of hand pumps in phreatic zones and in the vicinities of surface water bodies preferably. Artificial recharge techniques can be used to dilute the fluoride concentration.

7.0 Mass Awareness and Training Activities

7.1 M.A.P. and W.M.T.P.

Till March 2007, one MAP and two WMTP had been organised in the district. The details are given in **Table-10**.

Table-10: Status of MAP and WMTP.

S. No.	Item	AAP	Venue	Date	No of Persons Attended
1	WMTP	2003-04	Yavatmal	12 to 13/03/04	50
2	WMTP	2004-05	Yavatmal.	28 to 29/10/04	140
3	MAP	2004-05	Pahaphal	27/12/04	500

7.2 Participation in Exhibition, Mela, Fair etc.

During the MAP and WMTP at Pahapal and Yavatmal, an exhibition depicting rainwater harvesting model, various ground water related posters, leaflets, literature and technical reports were displayed along with maps of Yavatmal district. The models, maps, posters were explained to the visitors in details.

8.0 Areas Notified by CGWA/SGWA

As per ground water resource estimation all the talukas fall under "Safe" category, hence till March 2007 the area has not been notified either by CGWA or SGWA.

9.0 Recommendations

1. Ground Water development has to take place very judiciously in Deccan Traps. Further ground water development should be promoted in difficult and scarcity areas. Ground water augmentation efforts may also be made by constructing percolation tanks, cement plugs and KT weirs at appropriate and need based location on scientific lines.
2. The additional storage potential of the phreatic aquifers may be harnessed appropriately considering the drinking water scarcity and irrigation needs of the area. It will generate many fold benefits to ameliorate the suffering of underprivileged regions and economic up-liftment of the local populations.
3. The additional volume of ground water i.e., 951.61 MCM augmented by artificial recharge would be sufficient to cater the drinking needs of 1,44,180 rural population for 4 months summer period at the rate of 55 lpd/person.
4. Alternately, the additional irrigation potential can be generated from 951.61 MCM to the extent of 1,29,500 ha considering the crop water requirement of 0.65 m/ha prevailing in the area. Both these requirements may also be managed by suitable appropriation of the augmented resources. Stress on ground water withdrawals from deeper aquifers will be reduced which shall be used in exigency and emergency for the future water needs.
5. Parts of the district is affected by the high fluoride concentration in ground water and therefore the utilization of water from phreatic aquifers will minimize the incidence of fluorosis in the endemic areas as deeper aquifers are discharging fluoride contaminated ground water.
6. Appropriate recharge schemes best suited in the area may be identified on the basis of local and site-specific surveys and terrain conditions.
7. A multi-sectoral approach is needed to study the ground water development augmentation and management perspective. Therefore, all the aspects related to conjunctive use, ground water legislation, involvement of NGO, woman and community participation, mass awareness campaign, selection of appropriate pump sets, adoption of new irrigation methods, tissue culture technology will play an important role in conserving and developing the precious water resources.