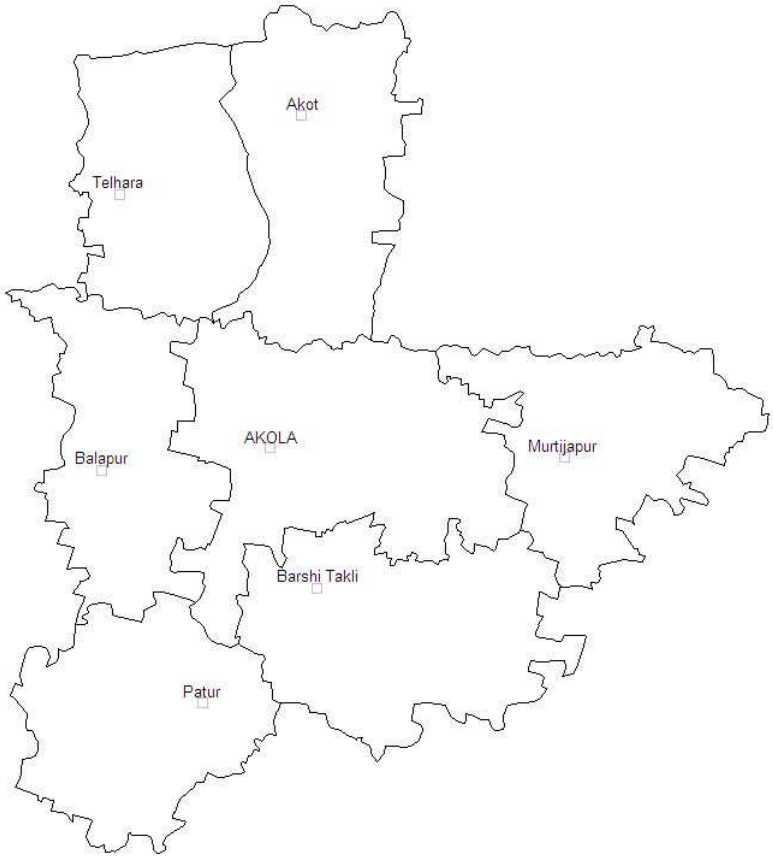
जल वर्ष 2007 Water Year 2007

स्वच्छ सुरक्षित जल – सुन्दर खुशहाल कल

CONSERVE WATER - SAVE LIFE

GOVT OF INDIA
MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD

GROUND WATER INFORMATION
AKOLA DISTRICT
MAHARASHTRA



CENTRAL REGION
NAGPUR
2007

AKOLA DISTRICT AT A GLANCE

1. GENERAL INFORMATION

Geographical Area	:	5417 sq. km.
Administrative Divisions (As on 31/03/2007)	:	Taluka-7; Akola, Barshi Takli, Murtijapur, Akot, Telhara, Balapur and Patur.
Villages	:	1009
Population	:	16,30,239
Average Annual Rainfall	:	750 to 950 mm

2. GEOMORPHOLOGY

Major Physiographic unit	:	Two; Satpuda hill range and Purna plain
Major Drainage	:	One; Purna

3. LAND USE (2000-01)

Forest Area	:	467 sq. km.
Net Area Sown	:	3878 sq. km.
Cultivable Area	:	4437 sq. km.

4. SOIL TYPE

: Medium black and Deep black soil.

5. PRINCIPAL CROPS (2005-06)

Cotton	:	1975.01 sq. km.
Pulses	:	1225.31 sq. km.
Jowar	:	868.65 sq. km.
Oil Seeds	:	695.22 sq. km.

6. IRRIGATION BY DIFFERENT SOURCES (2000-01) **- Nos. / Potential Created (ha)**

Dugwells	:	18729 / 44563
Tubewells/Borewells	:	400 / 717
Tanks/Ponds	:	7939 / 10726
Other Minor Surface Sources	:	2094 / 3407
Net Irrigated Area	:	28874 ha

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

Dugwells	:	22
Piezometers	:	04

8. GEOLOGY

Pliestocene-Recent	:	Alluvium
Upper Cretaceous-Lower Eocene	:	Basalt (Deccan Traps)

9. HYDROGEOLOGY

Water Bearing Formation	:	Basalt (Deccan Traps) fractured, jointed. Under phreatic conditions. Alluvium- Sand and Gravel, Under semi-confined to confined conditions.
Premonsoon Depth to Water Level (May-2006)	:	4.44 to 30.70 m bgl
Postmonsoon Depth to Water Level (Nov.-2006)	:	1.43 to 38.00 m bgl
Premonsoon Water Level Trend (1997-2006)	:	Rise: 0.02 to 0.29 m/year Fall: 0.08 to 1.42 m/year
Postmonsoon Water Level Trend (1997-2006)	:	Rise: Negligible to 0.06 m/year Fall: 0.02 to 1.96 m/year

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

Wells Drilled	:	EW-92, OW-29, Pz-11
Depth Range	:	11.30 to 428.50 m bgl
Discharge	:	0.14 – 30.00 lps
Storativity	:	3×10^{-6} to 1.7×10^{-3}
Transmissivity	:	31.3 to 247 m^2/day (Basalt) 18.55 to 6725 m^2/day (Alluvium)

11. GROUND WATER QUALITY

Good and suitable for drinking and irrigation purpose, except the saline areas of the Purna Alluvium.

Type of Water	:	Basalt- Ca-HCO_3 Alluvium- Na-HCO_3 & Na-Cl

12. DYNAMIC GROUND WATER RESOURCES- (As on 31/03/2004)

Annual Replenishable GW Resources	:	323.15 MCM
Total Draft (Irrigation + Domestic)	:	124.73 MCM
Projected Demand (Domestic + Industrial)	:	51.31MCM
Stage of Ground Water Development	:	38.57%

13. AWARENESS AND TRAINING ACTIVITY

A	Mass Awareness Programme	:	Two
	Date	:	12/02/02 & 26/03/07
	Place	:	Chohatta Bazaar & Akola
	Participants	:	300 & 250
B	Water Management Training Programme	:	Nil

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

The areas of Purna River Alluvium covering Akot and Telhara talukas and northern parts of Akola and Balapur talukas are affected by inland salinity problem coupled with the problems like drought and water level decline. Wide range of problems were faced during exploratory drilling operations in hard rock areas of Akola district i.e., mainly encountering of caving formation (red bole) and loss of drilling medium.

Ground Water Information
Akola District

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Akola District

1.0 Introduction

Akola district is one of the eleven districts of Vidarbha region of Maharashtra. It is situated in the northern part of the State abutting Madhya Pradesh and lies between north latitudes 20°16' and 21°17' and east longitudes 76°38' and 77°38'. The total area of th e district is 5417 sq.km. and falls in parts of Survey of India degree sheets 55 C, 55 D, 55 G and 55 H. The district is bounded on the north by Madhya Pradesh State, on the east by Amravati, on the west by Buldhana district and on the south and south east by Washim district.

The district headquarters is located at Akola Town. For administrative convenience, the district is divided in 7 talukas viz., Akola, Barshi Takli, Murtijapur, Akot, Telhara, Balapur and Patur. It has a total population of 16,30,239 as per 2001 census. The district has 7 towns and 1009 villages. The major part of the district comes under Purna-Tapi basin. Purna is the main river flowing through the district.

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.	Sharma, CSS	1982-83	Systematic Hydrogeological Survey
2.	Rai, J.N.	1982-83	-do-
3.	Vedapuri, K.M.	1983-85	-do-
4.	Sharma, I.K.	1984-85	-do-
5.	Jain, S.K.	1988-89	-do-
6.	Joshi, D.	1990-91	-do-
7.	Elangavon, D.	1980-81	Reappraisal Hydrogeological Studies
8.	Toppo, Sunil	2002-03	-do-
9.	Devithiraju, J	2002-03	-do-

Shri G.S. Deshpande (1981) and then Shri P.R. Subramanian (1998) compiled the report on Hydrogeology of the district.

Ground water exploration in the district has been taken up in different phases since 1957. The ground water exploration has been done in Alluvial and hard rock areas occupied by Deccan Trap Basalt. A total of 92 EW, 29 OW and 11 Piezometers have been constructed till March 2007.

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

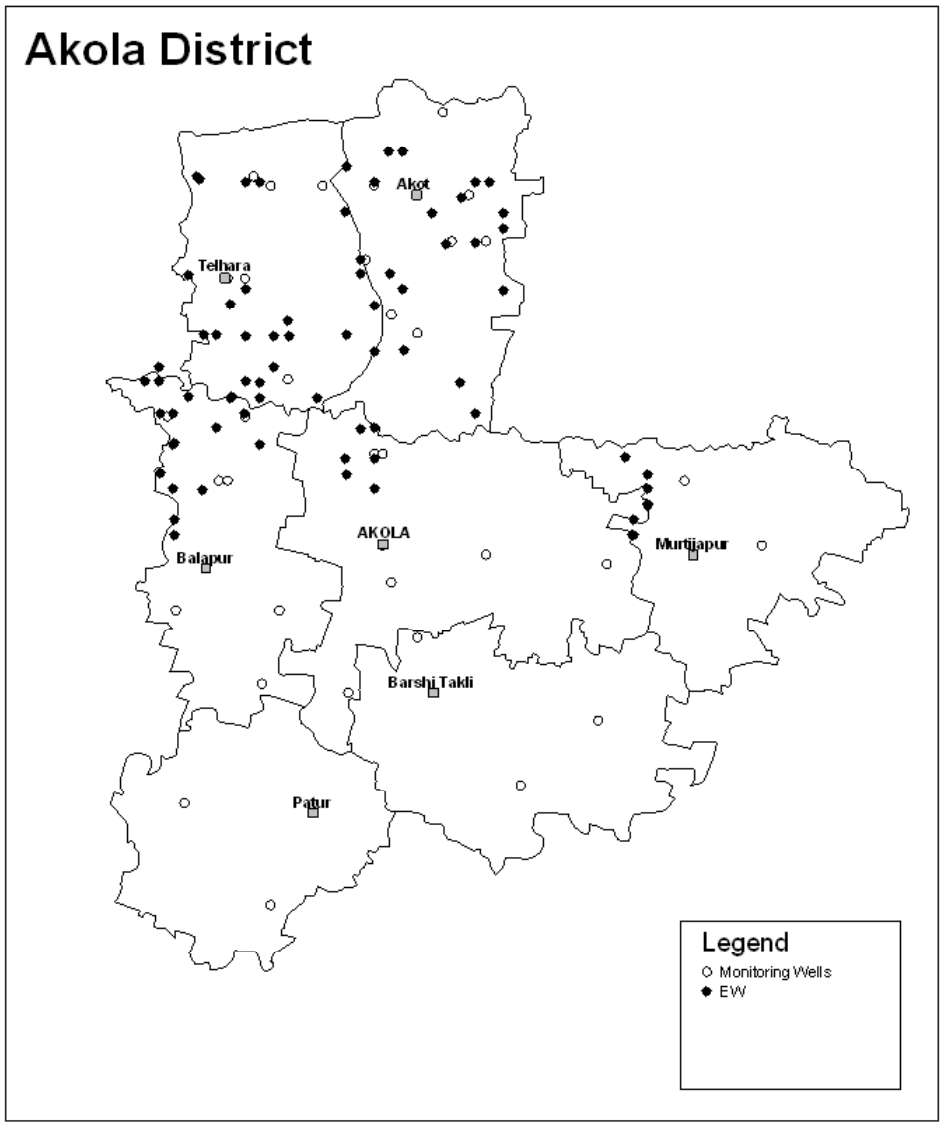

Figure 1: Location

Table 2: Salient Features of Ground Water Exploration.

S. No.	Taluka	Forma-tion	Wells			Depth (mbgl)	SWL (mbgl)	Discharge (lps)	Draw-Down (m)	Zones (mbgl)
			EW	OW	Pz					
1.	Akola	Alluvium	9	1	0	11.30 – 231.00	13.82 - >100	0.14 – 10.00	5.69 – 44.90	28.00 – 231.00
		Basalt	6	3	0	20.00 – 200.00	3.38 – 14.70	0.78 – 15.00	2.78-11.37	-
2.	Akot	Alluvium	19	8	7	34.74 – 428.50	4.00 – 19.87	0.80 – 16.15	0.85 – 12.14	7.00 – 421.00
3.	Balapur	Alluvium	10	3	1	38.66 – 37.99	7.70 – 25.50	0.50 – 20.09	1.00 – 6.97	9.75 – 48.75
		Basalt	4	0	0	200.00 - 300.25	5.50 – 13.75	0.38 – 1.37	6.50 – 22.80	-
4.	Barshi-Takli	Basalt	3	0	0	177.50 – 200.00	3.65 – 8.35	0.38 – 0.78	11.85– 17.68	-
5.	Murtija-pur	Alluvium	8	1	0	16.69 – 56.73	10.50– 19.20	1.00 – 3.76	1.5	11.50 – 13.00

		Basalt	4	2	0	24.70 – 200.00	2.42 – 16.85	0.78 – 12.18	10.52– 25.00	-
6.	Patur	Basalt	4	0	0	104.95 – 200.00	3.50 – 5.00	1.37 – 1.73	11.90- 31.70	-
7.	Telhara	Alluvium	25	11	3	27.00- 326.69	4.21 – 26.49	1.36 – 30.00	0.67 – 34.83	7.00 – 317.00
	Total		**92**	**29**	**11**	**11.30 – 428.50**	**2.42 - >100**	**0.14 – 30.00**	**0.85 – 44.90**	**7.00 – 317.00**

In Basalt 21 exploratory wells and 05 observation wells were drilled and their depth ranged from 20.00 to 200.00 metres below ground level (m bgl). The discharge from these wells varied from traces to 15.00 litres per second (lps), for a drawdown of 2.78 to 31.7 m. Static water levels ranged from 2.42 to 16.85 m bgl. The potential aquifer zones have been encountered up to 70 - 80 m depth, whereas deeper zones do not form potential aquifer in the district.

In Purna Alluvium, 71 exploratory wells, 24 observation wells and 11 Piezometers were constructed. The alluvial area has been divided into fresh ground water belt in the north and saline area in the south, based on the ground water exploration findings. The depth of the wells ranged from 27.00 to 428.50 m bgl. Static water levels vary from 4.21 to 26.49 m bgl. Discharge from exploratory wells ranged from 1.31 to 30.00 lps for drawdowns ranging from 0.67 to 44.90 m. Granular zones have been encountered and screened at various depths. However, it is found that zones down to the depth of 80 m falling in younger alluvium have better yields and the water is less saline. This zone can be used for agricultural purposes by means of shallow tubewells constructed down to the depth of 70 m and yielding up to 10 lps for 30 m lift.

2.0 Climate and Rainfall

The climate of the district is characterized by a hot summer and general dryness throughout the year except during the south-west monsoon season, i.e., June to September. The mean minimum temperature is 12.6℃ and mean maximum temperature is 42.4℃.

The normal annual rainfall over the district varies from about 740 mm to 860 mm. The average annual rainfall for the last ten years 1996-2005 ranges from 637.8 mm (Murtizapur) to 871.3 mm (Patur) and the same is presented in **Table-3**.

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

S. No	**Taluka**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**Avg.**
1.	Akola	696.3	851.3	970.00	1081.7	667.80	934.00	726.20	422.12	460.40	734.88	659.05
2.	Akot	498	810	653.00	653.00	636.00	758.00	698.00	721.30	426.09	726.97	691.02
3.	Balapur	848	718	873.00	921.00	588.00	892.00	794.00	463.30	448.60	535.11	689.38
4.	Barshitakli	450	342	743.00	833.00	453.00	918.20	1047.00	661.50	501.60	766.67	871.34
5.	Murtijapur	580	819	675.00	700.00	621.00	598.00	644.00	515.50	483.10	865.81	749.64
6.	Patur	789	463	787.00	877.00	585.00	1008.00	749.00	1211.0	883.30	870.40	740.50
7.	Telhara	856	882	882.00	746.00	672.80	592.00	757.00	789.38	329.10	759.90	637.80
	Average	**673.90**	**697.90**	**797.57**	**830.24**	**603.37**	**814.31**	**773.60**	**683.44**	**504.60**	**751.39**	**719.82**

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.

Two type of soils have been observed in the district namely medium black soil occurring in plain central part of trap origin and deep black soil occurring in valley in northern part.

4.0 Ground Water Scenario

4.1 Hydrogeology

Deccan Trap Basalt of upper Cretaceous to lower Eocene age is the major rock formation in the district covering the southern part, whereas almost entire northern part is underlain by Recent Alluvium. A map depicting hydrogeological features is presented as **Figure-2**.

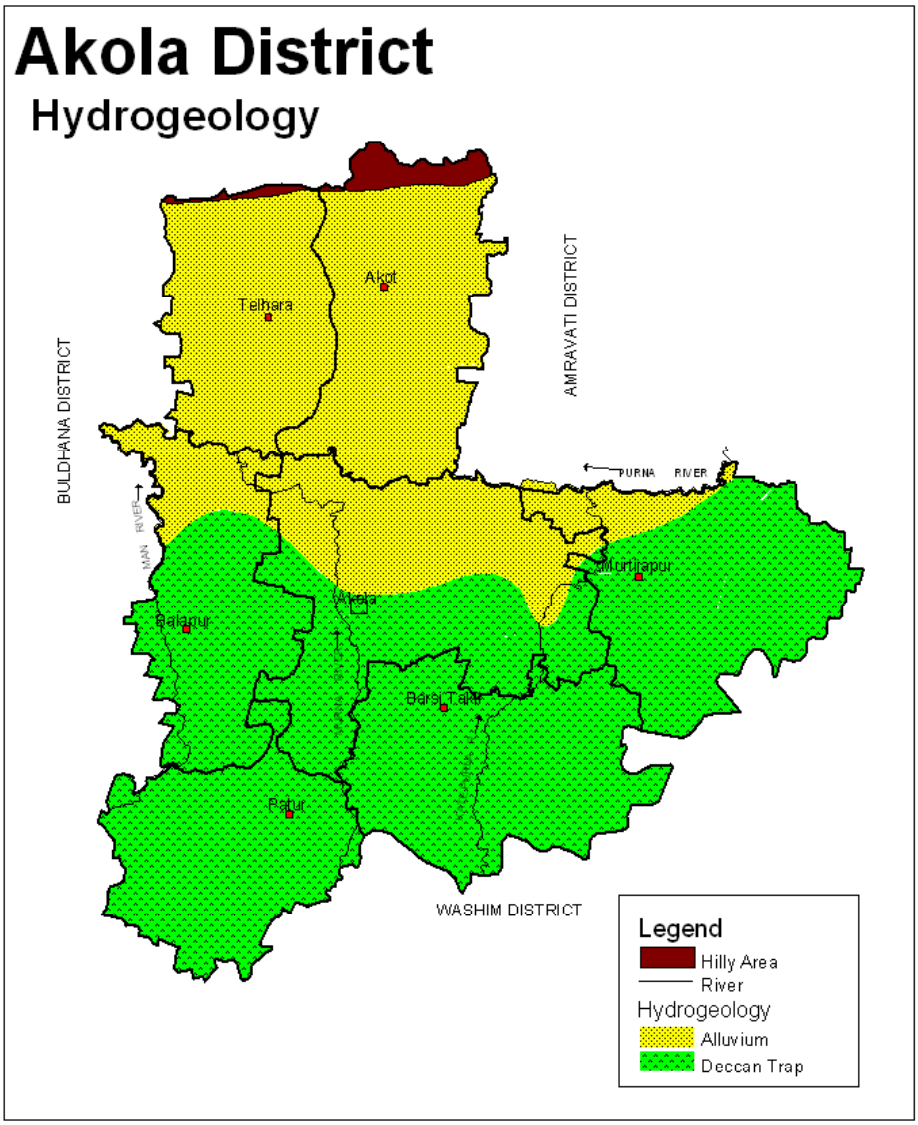

Figure 2- Hydrogeology

4.1.1 Deccan Trap Basalt

Ground water in Deccan Trap Basalt occurs mostly in the upper weathered and fractured parts down to 20-25 m depth. At places potential zones are encountered at deeper levels in the form of fractures and inter-flow zones. The upper weathered and fractured parts form phreatic aquifer and ground water occurs under water table (unconfined) conditions. At deeper levels, the ground water occurs under semi-confined conditions.

The yield of dugwells tapping upper phreatic aquifer ranges between 20 and 90 m^3/day. Borewells drilled down to 70 m depth, tapping weathered and vesicular basalt are found to yield 2 to 10 m^3/day.

4.1.2 Alluvium

Northern part of the district, covering about 2650 sq. km. in parts of Akot, Akola and Telhara talukas is underlain by Purna Alluvium. Purna Alluvium can be subdivided into two sub units, i.e., younger Alluvium extending down to 70-80 m depth and older Alluvium attaining a maximum depth of 450 m. However, only upper 70-80 m of Alluvium, comprising sand and gravel, forms the potential aquifer. At deeper levels the Alluvium is mostly clayey and does not form potential aquifer.

Ground water in Alluvium occurs both under water table and semi-confined conditions. The yield of wells constructed in Alluvium varied between 5 and 100 m^3/hr.

4.1.3 Water Level Scenario

Central Ground Water Board periodically monitors 26 National Hydrograph Network Stations (NHNS) stations in the Akola 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	Premonsoon WL	Postmonsoon WL	Fluct-uation	Premonsoon Trend		Postmonsoon Trend	
		(m bgl)	(m bgl)	(m)	Rise (m/yr)	Fall (m/yr)	Rise (m/yr)	Fall (m/yr)
1	2	3	4	5	6	7	8	9
1	Akola	16.75	14.95	1.80		0.17		0.25
2	Akot	23.40	13.82	9.58		1.42		1.96
3	Andura	20.90	19.78	1.12		0.16		0.16
4	Babulkhed	21.77	8.38	13.39		0.08	0.04	
5	Barshi Takli	20.25	7.53	12.72	0.02			0.13
6	Borgaon Manju	4.95	2.65	2.30		0.12		0.08
7	Chani	9.35	4.98	4.37	0.17		0.01	
8	Hiwarkhed	14.35	14.35	0.00	0.26			0.10

1	2	3	4	5	6	7	8	9
9	Kapsi	10.10	9.50	0.60	0.09			0.09
10	Kurankhed	12.06	20.50	-8.44		0.20		0.39
11	Malkapur	17.30	8.60	8.70		0.28		0.30
12	Murtizapur	10.55	2.68	7.87		0.44		0.19
13	Nimba	-	38.00	-		0.95		0.66
14	Patsul	12.12	7.47	4.65		0.54		0.39
15	Patur	4.44	1.43	3.01		0.09	0.003	
16	Pinjar	7.80	3.22	4.58		0.22		0.02
17	Popetkheda	12.10	2.45	9.65	-	-	-	-
18	Rasulpur	15.05	13.10	1.95		0.21		0.17
19	Shivani	-	-	-	0.29			
20	Telhara	23.23	22.55	0.68		0.58		0.66
21	Telhara2	25.68	25.31	0.37		1.07		1.26
22	Ural 1	30.45	29.84	0.61	-	-	-	-
23	Ural	13.53	7.38	6.15		0.25		0.18
24	Vallabhnagar Akot	30.70	26.75	3.95		0.52		0.42
25	Wadegaon	16.35	12.60	3.75		0.38		0.20
26	Wyala	11.45	11.26	0.19	0.13		0.06	

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

The depth to water levels in the district during May 2006 ranges between 4.44 (Patur) and 30.70 (Vallabhnagar-Akot) m bgl. Depth to water levels during premonsoon (May 2006) has been depicted in **Figure-3**. Shallow water levels, within 10 m bgl are seen in the southern part of the district, i.e., southern part of Patur taluka and eastern part of Barshi Takli taluka. Deeper water levels of more than 20 m bgl are observed in the northwestern part of the district in parts of Telhara, Akot and small western part of Balapur taluka. The water levels in major part of the district covering entire western, central, north eastern and eastern parts is between 10 and 20 m bgl.

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

The depth to water levels during postmonsoon (Nov. 2006) ranges between 1.43 m bgl (Patur) and 38.00 m bgl (Nimba). Spatial variation in postmonsoon depth to water levels is shown in **Figure-4**. Shallow water levels within 5 m bgl are observed in southern part of the district in parts of Patur, Barshi Takli and Murtizapur talukas and as a small patch in central part of Akola taluka. Water levels are between 5 and 10 m bgl in south central parts of the district covering parts of Patur, Barshi Takli, Akola, Murtijapur and north eastern parts of Akot taluka. North central and north eastern parts of the district covering parts of Balapur, Akola, Akot, Telhara and Murtijapur talukas have water levels between 10 and 20 m bgl. Deeper water levels of more than 20 m bgl are observed in northwestern part of the district covering most of the Telhara taluka and small areas in adjoining Akot, Akola and Balapur talukas.

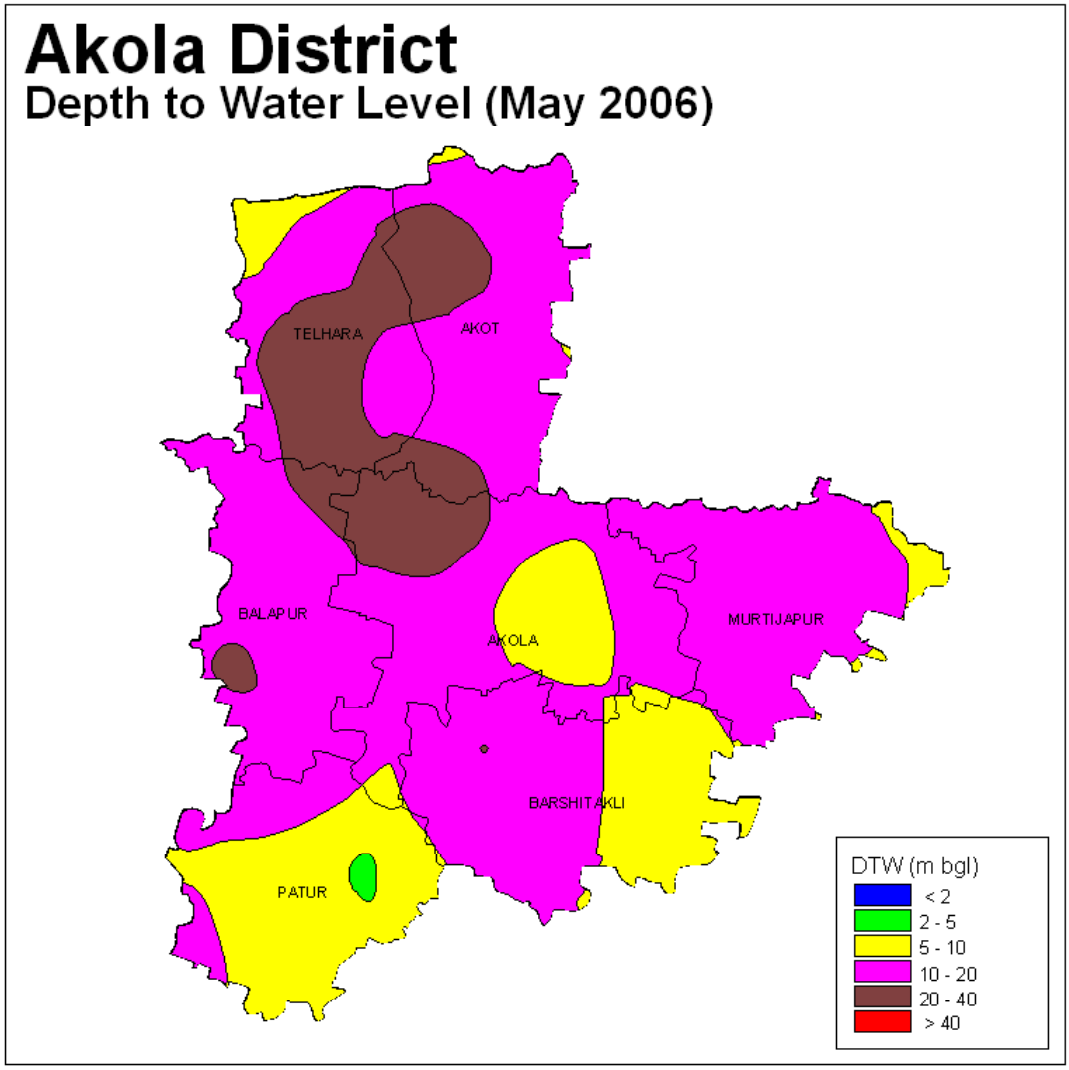

Figure 3- Depth to Water Level (Premonsoon- May 2006)

4.1.5 Seasonal Water Level Fluctuation (May-Nov. 2006)

In major part of the district rise in water level in the range of 0.37 (Telhara) to 13.39 m (Babulkhed) is observed. In major part of the district rise in water level has been observed in entire south, central, north and eastern parts whereas fall in water level is observed in restricted east central part of the district. Rise in water level in the range of 0 to 2 m is observed in the north western part of the district covering major part of Telhara taluka and in small central part of the district in parts of Akola and Balapur talukas. Rise of 2 to 4 m is observed in elongated area in the south and central parts of the district covering parts of Patur, Akola and Balapur talukas and in parts of Akot and Telhara talukas in northern part of the district. Rise of more than 4 m is observed in south western part of the district in parts of Patur and Balapur talukas and in north eastern part of Akot taluka in northern part of the district. Fall in water level is observed only in small areas in east central part of the district in eastern part of Akola taluka and western part of Murtizapur taluka.

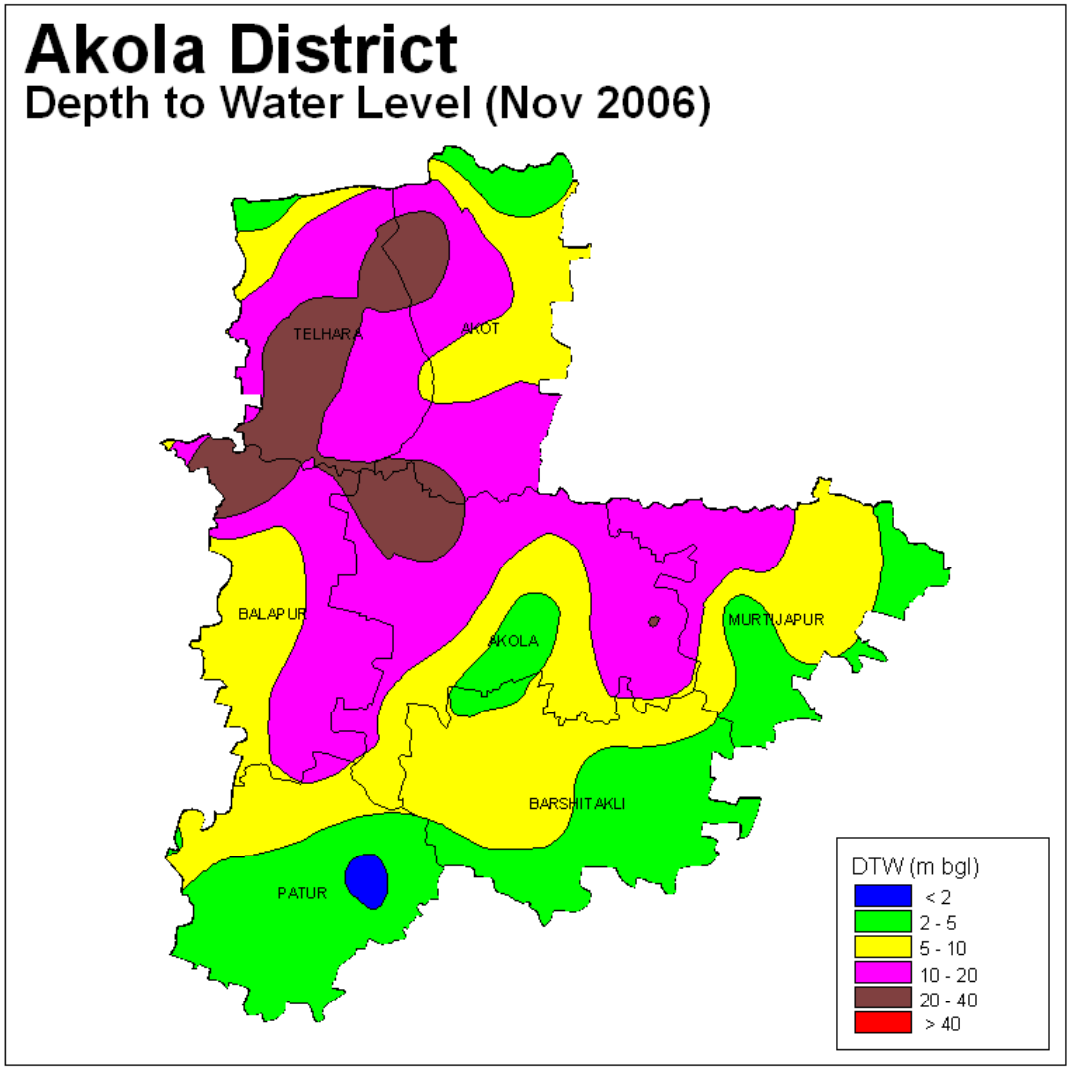

Figure 4- Depth to Water Level (Post Monsoon- Nov. 2006)

4.1.6 Water Level Trend (1997-2006)

Trend of water levels for pre-monsoon and post-monsoon periods for last ten years (1997-2006) have been computed for 24 NHNS and are given in **Table-4**.

Analysis of trend indicates that during premonsoon period, rise in water levels has been recorded at 6 stations and it ranges between 0.02 (Barshi Takli) and 0.29 m/year (Shivani). Fall in water levels has been observed at 18 stations and ranges between 0.08 (Babulkhed) and 1.42 m/year (Akot). During postmonsoon period, rise in water levels has been recorded at 4 stations and it ranges from negligible (Patur) to 0.06 m/year (Wyala), whereas at 20 stations, fall in water levels ranging between 0.02 (Pinjar) and 1.96 m/year (Akot) is observed. Thus in major part of the district, both during pre and postmonsoon periods declining trends have been observed.

4.1.7 Aquifer Parameters

Aquifer parameters are available from ground water exploration carried out in the Alluvial area of the district as well as from the pumping tests carried

out on dugwells in Basaltic and Alluvial terrain. The specific capacity of the wells tapping Deccan Trap Basalt ranges between 0.02.and 6.03 lps/m of draw down and the transmissivity ranges from 31.29 to 247 m^2/day. The specific capacity of dugwells tested in Alluvial aquifer ranges between 1.1 and 10 lps/m of drawdown. During the pumping tests conducted on the exploratory wells in Alluvium, the transmissivity was found to vary from 18.55 to as high as 6725 m^2/day. The storage coefficient varied between $3x10^{-6}$ and $1.7x10^{-3}$.

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 Akola district based on GEC-97 methodology. The same are presented in **Table-5**, whereas the graphical representations of the resources on the map are shown in **Figure-5**. Ground Water Resources estimation was carried out for 5119.45 sq. km. area out of which 47.29 sq. km. is under command and 4313.08 sq. km. is non-command. About 760 sq. km. area has poor quality of ground water.

As per the estimation the total annual ground water recharge is 340.54 MCM with the natural discharge of 17.12 MCM, thus the net annual ground water availability comes to be 323.42 MCM. The gross draft for all uses is estimated at 124.73 MCM with irrigation sector being the major consumer having a draft of 112.15 MCM. The domestic and industrial water requirements are worked at 24.75 MCM. The net ground water availability for future irrigation is estimated at 174.15 MCM.

Stage of ground water development varies from 19.27% (Akola) to 72.78% (Akot). The overall stage of ground water development for the district is 38.57%. Taluka wise assessments indicate that all the talukas in the district fall under “Safe” category. However, One watershed, i.e., PTSB-1 is “Over-Exploited” and two watersheds, i.e., PT-8 and PTSP-1 are “Semi-Critical”.

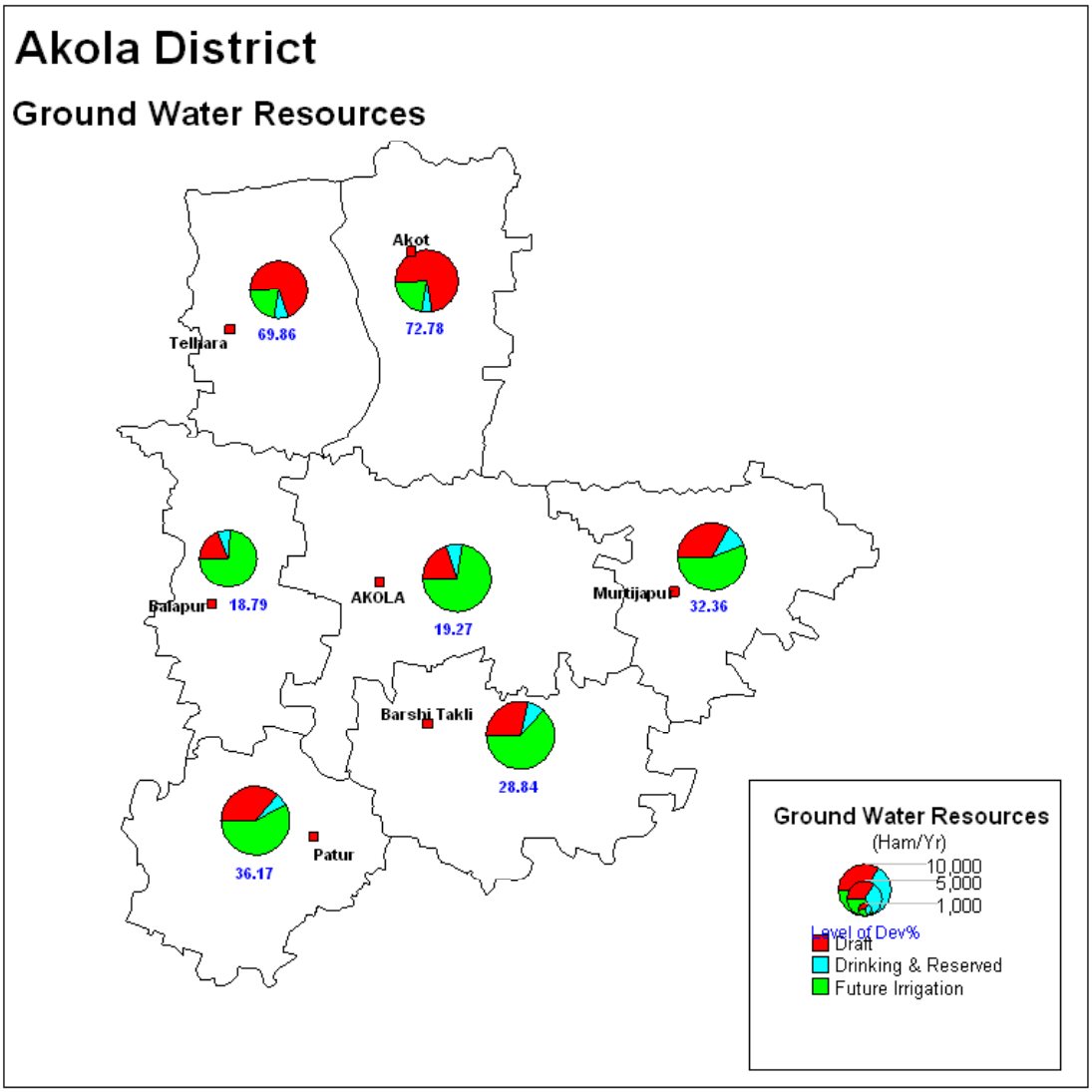

Figure 5 – Ground Water Resources

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 upto next 25 years (ham/yr)	Net Groundwater Availability for future irrigation development (ham/yr)	Stage of Groundwater Development (%)
AKOLA	COMMAND	653.57	28.09	31.93	60.01	14.91	163.42	9.18
	NON COMMAND	4743.20	804.36	175.75	980.10	391.52	3712.29	20.66
	TOTAL	5396.77	832.44	207.68	1040.12	406.43	3875.71	19.27
AKOT	NON COMMAND	4541.82	3163.40	142.35	3305.75	249.29	1000.99	72.78
BALAPUR	COMMAND	12.82	6.88	1.10	7.98	0.30	2.67	62.23
	NON COMMAND	3779.10	572.70	131.89	704.59	272.24	2809.51	18.64
	TOTAL	3791.91	579.58	132.99	712.57	272.53	2812.18	18.79
BARSI TAKLI	COMMAND	161.61	14.67	8.15	22.82	3.03	23.68	14.12
	NON COMMAND	4566.38	1159.87	180.69	1340.56	389.46	3063.00	29.36
	TOTAL	4727.99	1174.54	188.84	1363.38	392.48	3086.68	28.84
MURTIZAPUR	COMMAND	314.03	47.17	25.08	72.25	7.02	36.24	23.01
	NON COMMAND	4643.94	1284.30	247.89	1532.19	523.01	2707.96	32.99
	TOTAL	4957.97	1331.47	272.97	1604.44	530.03	2744.21	32.36
PATUR	COMMAND	162.13	95.47	16.52	111.98	3.73	34.50	69.07
	NON COMMAND	5146.07	1661.58	146.48	1808.06	321.89	3069.17	35.13
	TOTAL	5308.20	1757.05	163.00	1920.04	325.61	3103.67	36.17
TELHARA	NON COMMAND	3617.35	2376.60	150.43	2527.03	298.77	791.79	69.86
TOTAL	**COMMAND**	**1304.15**	**192.28**	**82.77**	**275.05**	**28.98**	**260.52**	**21.09**
	NON COMMAND	**31037.85**	**11022.80**	**1175.48**	**12198.28**	**2446.16**	**17154.71**	**39.30**
	TOTAL	**32342.01**	**11215.09**	**1258.24**	**12473.33**	**2475.14**	**17415.23**	**38.57**

4.3 Ground Water Quality

In the district, 13 water samples were collected during May 2006, out of which 8 samples were representing Deccan Trap Basalt and 5 were representing Alluvium. The 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	6	46
2	Alkali metal (Na+K > 50%) exceeds alkaline earths and weak acids (CO_3+HCO_3 > 50%) exceeds strong acids.	Na-HCO_3	3	23
3	Alkaline earths (Ca+Mg > 50%) exceeds alkali metals and strong acids (Cl+SO_4+NO_3 > 50%) exceeds weak acids	Ca-Cl	1	8
4	Alkali metal (Na+K > 50%) exceeds alkaline earths and strong acids (Cl+SO_4+NO_3 > 50%) exceeds weak acids	Na-Cl	3	23
	Total		**13**	**100**

In majority of samples representing Basaltic aquifer, it was found that the water is of Ca-HCO_3 type while the water in the samples from Alluvium were of Na-HCO_3 and Na-Cl type. The type of water in Alluvium gives an idea about inland salinity problem existing in the Purna Alluvium basin of the district.

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, SO_4 and NO_3 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	5	6	2
TH (mg/L)	300	600	7	4	2
Ca(mg/L)	75	200	13	0	0
Mg(mg/L)	30	100	1	9	3
Cl (mg/L)	250	1000	10	3	0
SO_4 (mg/L)	200	400	11	1	1
NO_3 (mg/L)	45	No relaxation	9	--	4
F (mg/L)	1.0	1.5	11	2	0

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

The perusal of **Table-7** shows that out of 13 samples, 4 samples are having the concentration of NO_3 above MPL while TDS and TH of ground water in 2 samples is beyond MPL. The Mg concentration in 3 samples and SO_4 in one sample were also found beyond the MPL. Overall, 5 ground water samples were found non-potable. These samples were collected from the dugwell located at Patsul, Kurankhed, Pinjar, Akola and Andura. It is also seen that the concentration of parameters such as Ca, Cl and F in all the samples are within the MPL. Therefore, it can be concluded that the ground water quality in majority of the area is good for drinking purpose.

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 Permissible**		**Doubtful**		**Unsuitable**	
Total Samples	No. of Samples	%	No. of Samples	%	No. of Samples	%	No. of Samples	%
13	12	92	1	8	Nil	Nil	Nil	Nil
RSC	**<1.25**		**1.25-2.50**		**>2.50**			
Category	**Good**		**Doubtful**		**Unsuitable**			
Total Samples	No. of Samples	%	No. of Samples	%	No. of Samples	%		
13	9	69	1	8	3	23		

The **Table-8** shows that out of 13 samples, 12 samples are having SAR values below 10 indicating that the possibility of sodium hazard is low if the water is used for irrigation purpose. The ground water sample collected from well located at Andura is having SAR value in the range of 10 to 18 and is under the permissible category. The RSC values of 3 samples collected from the well located at Telhara, Babulkhed and Andura were above 2.5 and the water in these wells is unsuitable for irrigation purpose. All the remaining samples were having RSC values less than 1.25 except the sample at Popatkheda where the RSC value was found to be 1.68.

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 tubewells in the area. Their yield characteristics are described below.

Dugwells are generally used for both domestic water requirements and for minor irrigation purposes in this area. The depth of dugwells in Basaltic areas of the district ranges from 5 to 20 m. The reported yield of dugwells in Basalt for irrigation purposes varies from 20 to 90 m^3/day. However, dugwells in Alluvium and wells located in favourable area in Basalt can yield 100 to 250 m^3/day. In Alluvial area, the dugwells are generally 5 to 25 m deep and yield between 1 and 600 m^3/day.

Ground water is predominantly used for irrigation, as it is the major ground water utilising sector. As per the data available for year 1998-99, area irrigated by ground water is 88.38 sq. km., whereas the surface water accounts for only 17.32 sq.km. The recent data (2000-01) indicates more than 100% increase in all figures with area irrigated by ground water increasing to 224.10 sq.km., whereas surface water accounts for 64.64 sq.km. of area and net irrigated area stands at 288.74 sq.km. Thus it is clear that ground water is the major source for irrigation purposes as it accounts for about 78% of net irrigated area. There are about 18729 dugwells in the district which create an irrigation potential of 445.63 sq.km., out of which 247.95 sq.km. of irrigation potential is utilised. In addition to this 7.27 sq.km of irrigation potential is utilised through 400 borewells/tubewells during 2000-01.

State government has drilled large number of borewells and tubewells

fitted with hand pumps and electric motors for rural drinking water purposes in the district. In all GSDA, Government of Maharashtra has drilled 2466 borewells under various schemes for rural water supply in the district of which 2177 are reported to be successful. Yields of borewells range from 500 to 3000 lph. The ground water development in the district is mostly through dugwells. The success rate of borewells/tubewells drilled by GSDA is about 82%**.**

5.0 Ground Water Management Strategy

Ground water has special significance for agricultural development in the State of Maharashtra. The ground water development in some parts of the State has reached a critical stage resulting in decline in ground water levels. There is thus 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

Major part of the district in the southern part comprising of Balapur, Patur, Barshi Takli talukas and part of Murtijapur taluka is underlain by Deccan Trap Basalt. The ground water in these areas is generally developed through dugwells and borewells. The northern part of the district, covering parts of Telhara, Akot, Akola and Murtijapur taluka, comprises of Purna Alluvium. In Alluvium the ground water can be exploited through dugwells and shallow tubewells. The ground water in some parts of Alluvium, particularly in southern parts of Akot and Telhara talukas is brackish. Therefore, caution and knowledge of local conditions is essential for constructing a well.

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

Table-9: Nature and Yield Potential of Aquifers

S. No	Taluka	Main Aquifer	Yield Potential	Type of Wells Suitable	Remarks
1.	Akola Northern Part	Alluvium	High	Dugwells Tubewells	Partly Brackish
2.	Akola Southern Part	Basalt	High	Dugwells Borewells	
2.	Akot	Alluvium	Medium to High	Dugwells Tubewells	Partly Brackish
3.	Balapur	Basalt	Low to Medium	Dugwells	
4.	Barsi Takli	Basalt	Low	Dugwells	
5.	Murtizapur	Basalt	Medium to High	Dugwells Borewells	
6.	Telhara	Alluvium	Medium to High	Dugwells Tubewells	

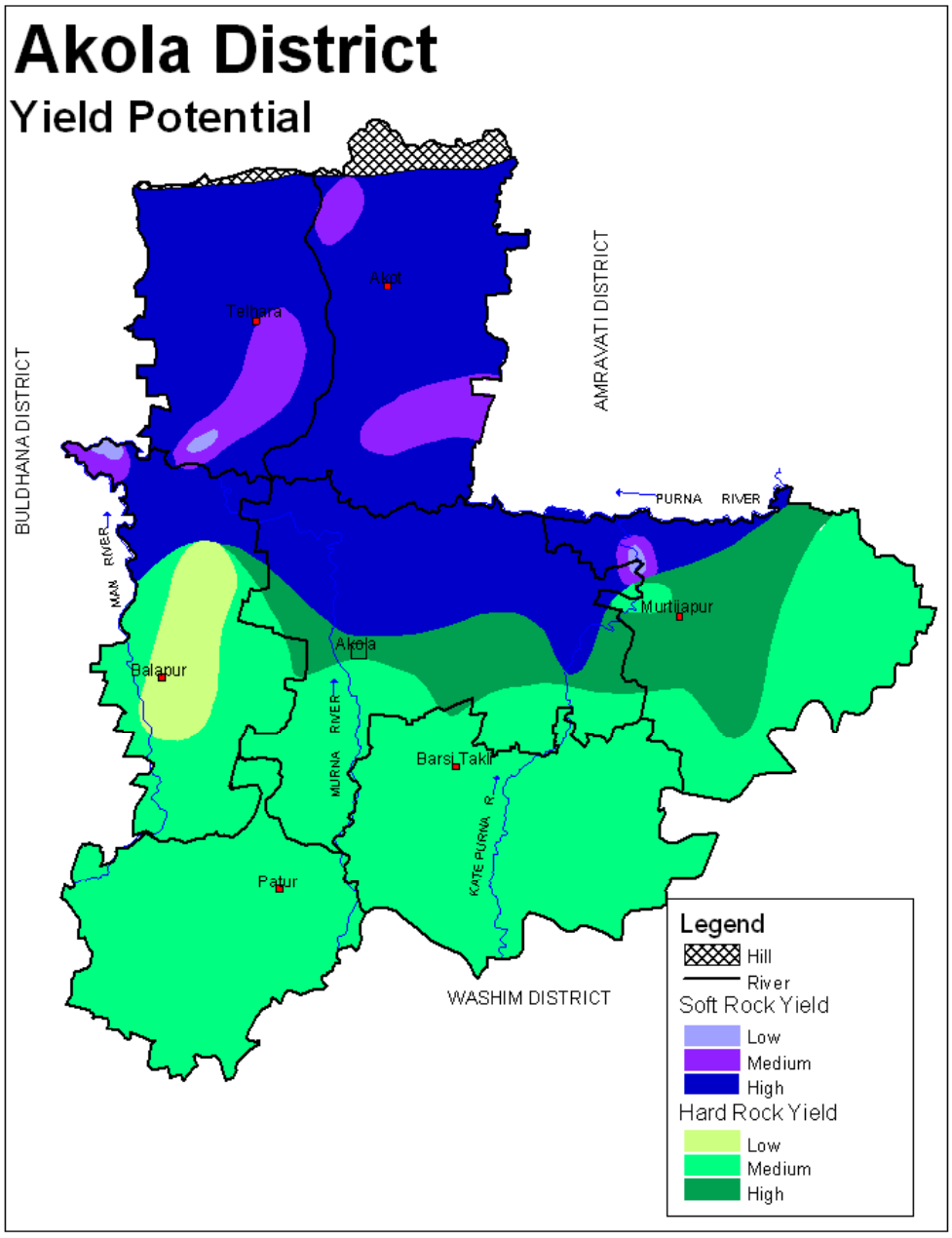

Figure 6 – Yield Potential

5.2 Water Conservation and Artificial Recharge

In the Basaltic area, the artificial recharge structures feasible are check Dams, gully plugs, percolation Tanks, nalla bunds, etc. Existing dugwells can also be used for artificial recharge, however, the source water should be properly filtered before being put in the wells. The artificial recharge structures suitable for Alluvial areas are percolation tanks and recharge wells/shafts. The most feasible artificial recharge structure suitable for Alluvial areas, are shallow recharge wells/shafts on the river bed of the tributaries. The ground water in a southern part of the Alluvial area is brackish. In such areas, quality of ground water needs to be considered before selecting the site. In the areas with poor ground water quality, the water conservation structures are more feasible.

These sites need to be located where the hydrogeological conditions

are favourable, i.e., where sufficient thickness of de-saturated/unsaturated aquifer exists and water levels are more than 5 m deep.

6.0 Ground Water Related Issues and Problems

Drought area has been observed in northern part of the area i.e., in northern part of Akot and Telhara talukas. Deeper water levels of more than 20 m bgl are also observed in parts of Telhara, Akot and Akola talukas. These areas being occupied by Purna Alluvium, where restricted thickness of potential granular zones in the shallow phreatic aquifer is observed. The special study carried out by CGWB in Purna River Alluvial basin indicates that in southern parts of Akot and Telhara talukas and northern parts of Akola and Balapur talukas brackish to saline ground water has been observed with EC ranging from 2000 to more than10000 μ mhos/cm at 25℃. Thus it is inferred that these areas of Purna River Alluvium are affected by inland salinity problem due to diagenetically altered meteoric water having longer residence time, high rate of evapotranspiration and it is restricted to the sandy aquifers inter-layered with clayey beds due to which less recharge of ground water is taking place.

A wide range of problems were faced during exploratory drilling operations in hard rock areas of Akola district i.e., mainly encountering of caving formation and loss of drilling medium.

Caving Formation: Red boles and inter-trappean beds have collapsible nature when they are saturated. The weathered/highly fractured saturated formation at the contact zones also collapse resulting in to the stucking of drill rods. This sometimes leads to loss of circulation fluid there by compounding the problems further. The red bole is encountered in Mahisang, Ramgaon, and Pardi. The red bole is usually encountered at the depth of more the 170 m and thickness is ranging about 8 to 10 m. It starts collapsing after water zone is encountered this results in stucking of drill rods. The casing or cement sealing of the red bole is not possible below 100 m bgl, as the present rig is equipped to lower casing down to 100 m bgl depth.

Loss of Drilling Formation: Loss of air in jointed and fractured Basalt was observed during drilling. The problem can be solved by sealing the zones by lowering casing or by cement sealing. This process may often damage the potential aquifer zones if not carried out meticulously with proper equipment. Such problem was noticed during drilling of exploratory well at Shivni at 256 m bgl.

7.0 Mass Awareness and Training Activities

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

Till March 2007, 2 Mass Awareness Programmes (MAP) have been organised in the district one at Chohatta Bazar and another at Akola, whereas WMTP (Water Management Training Programme) is yet to be organised and will be taken up during current AAP. The details are given in **Table-10**.

Table-10: Status of MAP & WMTP

S. No.	Year	Programme	Venue	Date	No. of Persons Attended
1	2001-02	MAP	Chohatta Bazar	12/02/2002	300
2	2006-07	MAP	Akola.	26/03/2007	250

7.2 Participation in Exhibition, Mela, Fair etc.

During the MAP at Akola, an exhibition depicting rainwater harvesting model, various ground water related posters, leaflets, literature and technical reports were displayed along with maps of Akola 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 no area has been notified either by CGWA or SGWA.

9.0 Recommendations

1 Southern part of the district is underlain by Deccan Trap Basalt, where only dugwells are most feasible structures for ground water development. The sites for borewells need to be selected only after proper scientific investigation.

2 Borewells generally tap deeper fractures, which may not be sustainable. Besides, the borewells should only be used for drinking water supply and not for irrigation.

3 Northern part of the district is underlain by Purna Alluvium, which is about 450 m thick. However, upper 70-80 m of Alluvium, i.e., younger Alluvium comprises sand and gravel forming potential aquifer. The ground water in the Alluvium can be developed through dugwells and shallow tubewells.

4 The ground water is brackish to saline in southern part of Alluvial areas. In such areas, the wells should be constructed after careful study of local hydrogeological conditions.

5 The overall stage of ground water development for the district is only about 38%. Therefore, there is scope for further development of ground water resources.

6 All the talukas in the district fall in “Safe” Category. However, One watershed, i.e., PTSB-1 is “Over-Exploited” and two watersheds, i.e., PT-8 and PTSP-1 are “Semi-Critical”. Therefore, further ground water development is not recommended in these watersheds.

7 Drought and deeper water level areas has been observed in parts of Akot an Telhara talukas. Thus future water conservation and artificial recharge structures needs to be prioritised in these parts as well as in the “Over-Exploited” and “Semi-Critical” watersheds of the district.

8 The scope exists for construction of suitable artificial recharge

structures in the district. The structures recommended for Basaltic areas are nala bunds, check dams and KT weirs. The existing dugwells may also be used for artificial recharge of ground water provided source water is free of silt and dissolved impurities.

9 In the Alluvial area of the district, wherever the ground water is not saline percolation tanks and recharge wells/shafts are suggested. The most feasible artificial recharge structure suitable in such areas, are recharge wells/shafts on the river bed of the tributaries.

10 In saline areas of Purna River Alluvium, water conservation structures may be constructed along with recharge structures on the periphery of the saline tract to augment the fresh water recharge.

11 The existing village ponds need to be rejuvenated to act both as water conservation and artificial recharge structures.