1793/DBR/2013

भारत सरकार
जल संसाधन मंत्रालय
केंद्रीय भूमिजल बोर्ड

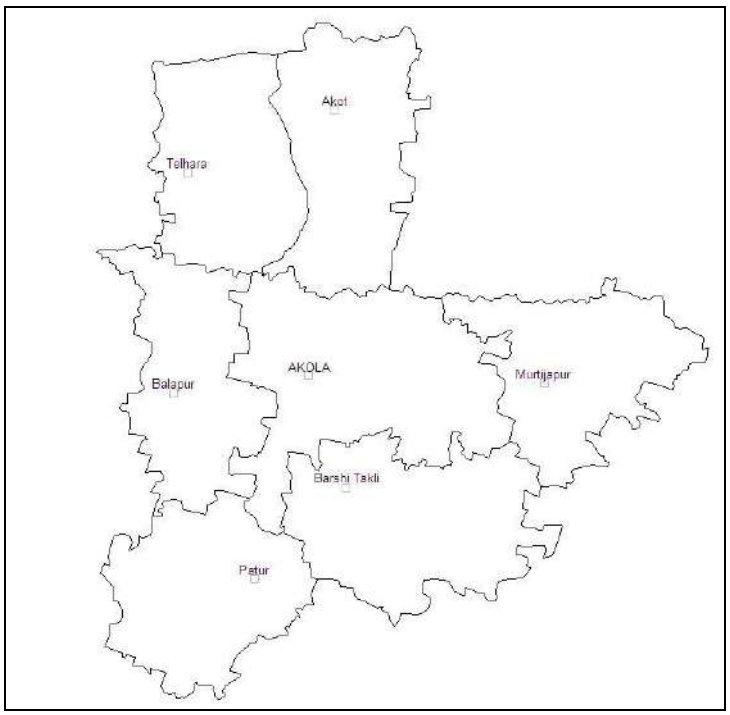
GOVT OF INDIA

MINISTRY OF WATER RESOURCES

CENTRAL GROUND WATER BOARD

महाराष्ट्र राज्य के अंतर्गत अकोला जिले की भूजल विज्ञान जानकारी

GROUND WATER INFORMATION AKOLA DISTRICT MAHARASHTRA



By

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Scientist-B

द्वारा

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वैज्ञानिक - ख

मध्य क्षेत्र, नागपुर

CENTRAL REGION
NAGPUR

2013

AKOLA DISTRICT AT A GLANCE

1. GENERAL INFORMATION

Geographical Area	:	5428 sq. km.
Administrative Divisions (2011)	:	Taluka-7; Akola, Barshi Takli, Murtijapur, Akot, Telhara, Balapur and Patur.
Villages	:	1009
Population	:	1818617
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

Forest Area(2010-11)	:	447.96 sq. km.
Net Area Sown(2007-08)	:	4844.17 sq. km.
Cultivable Area(2007-08)	:	4664.62 sq. km.

4. SOIL TYPE

	:	Medium black and Deep black soil.

5. PRINCIPAL CROPS (2007-08)

Cotton	:	1929.94 sq. km.
Pulses	:	1075.90 sq. km.
Jowar	:	872.27 sq. km.
Oil Seeds	:	617.63 sq. km.

6. IRRIGATION BY DIFFERENT SOURCES (2006-07) **- Nos. / Potential Created (ha)**

Dugwells	:	21456/ 46713
Tubewells/Borewells	:	324 / 1092
Other Minor Surface Sources	:	609 / 1764
Net Irrigated Area	:	45856

7. GROUND WATER MONITORING WELLS (2011)

Dugwells	:	19
Piezometers	:	04

8. GEOLOGY

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-2011)	:	4.47 to 30.65 m bgl
Postmonsoon Depth to Water Level (Nov.-2011)	:	2.15 to 21.15 m bgl
Premonsoon Water Level Trend (2001-2010)	:	Rise: 0.11 to 1.06 m/year Fall: Negligible to 1.09 m/year
Postmonsoon Water Level Trend (2001-2010)	:	Rise: 0.028 to 1.23 m/year Fall: 0.02 to 1.12 m/year

10. GROUND WATER EXPLORATION (As on March, 2011)

Wells Drilled	:	EW-98, OW-33, Pz-27
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- (2009)

Net Annual Ground water Availability	:	44820.40(ham/yr)
Total Draft (Irrigation + Domestic)	:	14464.61(ham/yr)
Projected Demand (Domestic + Industrial)	:	2456.81(ham/yr)
Stage of Ground Water Development	:	32.27%

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 State. 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 the 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 18,18,617 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**.

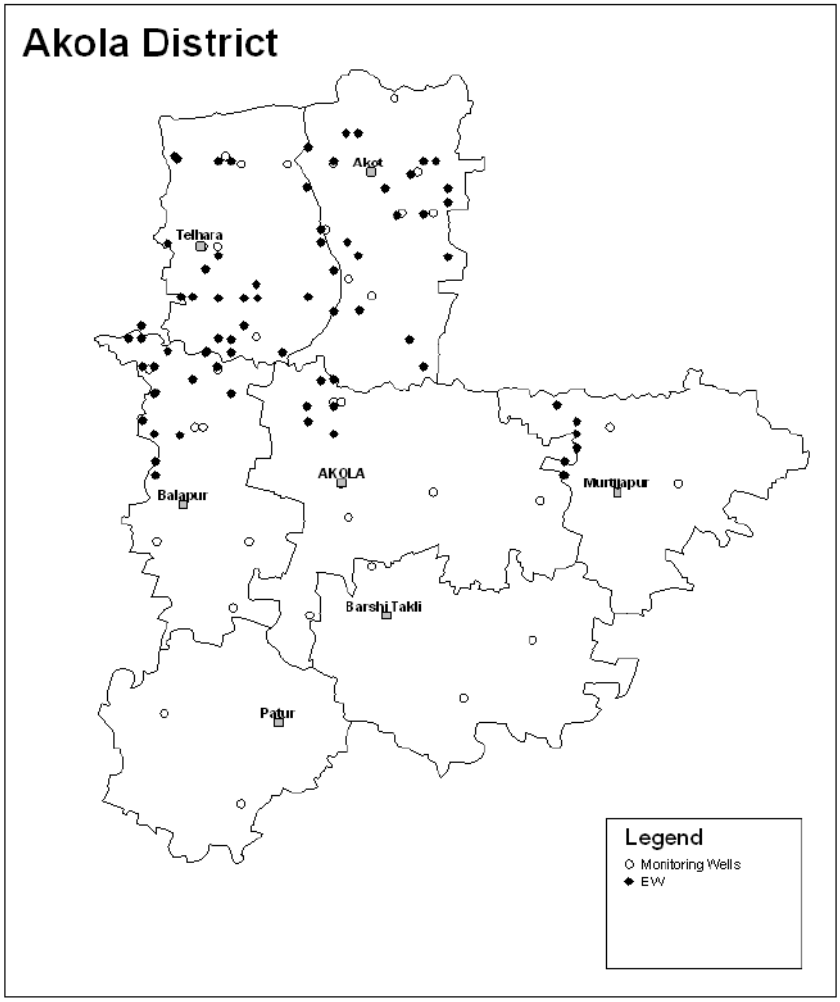

Figure 1: Location

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	9	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	2	38.66 – 37.99	7.70 – 25.50	0.50 – 20.09	1.00 – 6.97	9.75 – 48.75
		Basalt	6	0	0	190.80 - 300.25	5.50 – 13.75	0.38 – 1.37	6.50 – 22.80	-
4.	Barshi-Takli	Basalt	3	0	1	177.50 – 200.00	3.65 – 8.35	0.38 – 0.78	11.85– 17.68	-
5.	Murtija-pur	Alluvium	8	1	1	16.69 – 56.73	10.50– 19.20	1.00 – 3.76	1.5	11.50 – 13.00
		Basalt	6	2	0	24.70 – 303.5	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		**100**	**29**	**14**	**11.30 – 428.50**	**2.42 - >100**	**0.14 – 30.00**	**0.85 – 44.90**	**7.00 – 317.00**

In Basalt 28 exploratory wells and 05 observation wells were drilled and their depth ranged from 20.00 to 303.50 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 13 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 11.30 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°C and mean maximum temperature is 42.4°C.

The Normal annual rainfall over the district varies from about 740 mm to 860 mm. The average annual rainfall for the last ten years 2002-2011 ranges from 602.41 mm (Balapur) to 856.70 mm (Patur) and the same is presented in **Table-3**.

Table 3: Annual Rainfall Data (2002-2011). (mm)

S. No	Taluka	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Average
1.	Akola	726.20	422.12	460.40	734.88	1092.25	753.6	659.7	692.7	1068.8	661	727.17
2.	Akot	698.00	721.30	426.09	726.97	929.2	934.2	589.02	811.6	1013.3	728.8	757.85
3.	Balapur	794.00	463.30	448.60	535.11	884.3	610.6	535.4	567	702.8	483	602.41
4.	Barshitakli	1047.00	661.50	501.60	766.67	1314.52	928	626.8	746.9	981.1	614.2	818.83
5.	Murtijapur	644.00	515.50	483.10	865.81	1062.9	1012.9	501.31	535	1038.2	881.2	753.99
6.	Patur	749.00	1211.0	883.30	870.40	1298.2	932.1	550	873	746	454	856.70
7.	Telhara	757.00	789.38	329.10	759.90	953.2	963.6	510.3	751.8	797.2	521.1	713.26
	Average	**773.60**	**683.44**	**504.60**	**751.39**	**1076.37**	**876.43**	**567.50**	**711.14**	**879.77**	**620.47**	**747.17**

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 types 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

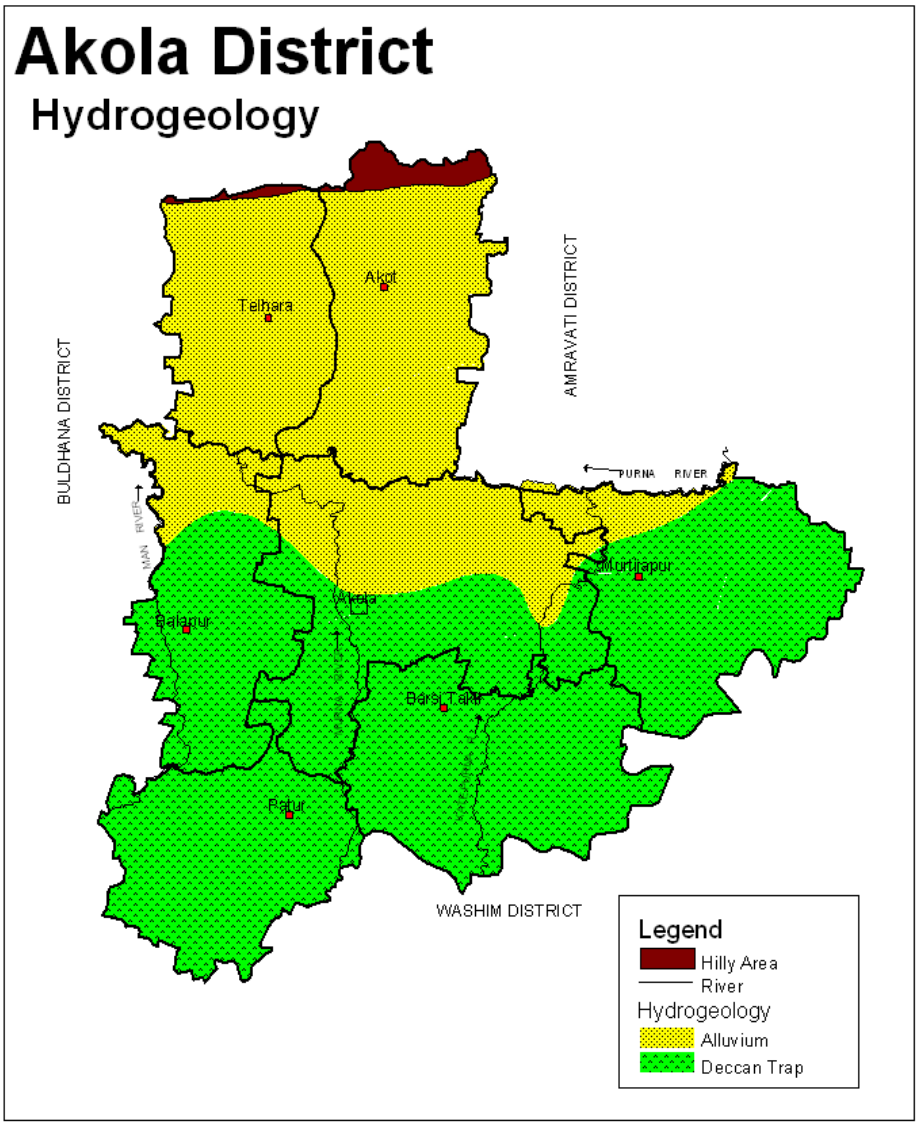

Figure 2- Hydrogeology

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 19 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 2011 and long term water level trends (2010-2011) is given in **Table- 4**.

Table 4: Water Level Data (2011) with Long Term Trend (2001-10).

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	12.95	-	-	0.1728	-	0.0286	-
2	Andura	21.50	21.15	0.35	-	0.4202	--	0.0673
3	Babulkhed	20.45	20.05	0.40	-	-	-	-
4	Barshi Takli	30.65	10.25	20.40	-	0.6675	0.0348	-
5	Borgaon Manju	5.7	3.4	2.3	0.1076	-	-	0.0204
6	Chani	6.8	6.4	0.4	0.3642	-	0.4575	-
7	Kapsi	9.3	-	-	-	0.0916	0.1846	-

8	Kurankhed	10.7	10.4	0.3	-	0.3253	-	0.1537
9	Malkapur	16.8	15.6	1.2	-	0.3335	0.4450	-
10	Murtizapur	8.25	2.45	5.80	-	0.0048	0.3313	-
11	Patsul	8.0	6.7	1.3	0.1542	-	0.2291	-
12	Patur	4.47	3.4	1.07	-	0.1917	0.0727	-
13	Pinjar	7.9	-	-	-	0.0062	-	0.0218
14	Popetkheda	9.3	2.15	7.15	1.0641	-	1.2363	-
15	Telhara2	30.0	-	-	-	1.0954	-	1.1276
16	Ural 1	10.0	10.50	-0.50	0.3314	-	0.4604	-
17	Ural	5.7	4.65	1.05	-	-	-	-
18	Wadegaon	16.0	16.2	-0.2	-	0.0228	-	0.0579
19	Wyala	10.0	11.95	-1.95	0.1096	-	0.1067	

4.1.3.1 Depth to Water Level – Premonsoon (May-2011)

The depth to water levels in the district during May 2011 ranges between 4.47(Patur) and 30.65 (Barshi Takli) m bgl. Depth to water levels during premonsoon (May 2011) 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, 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-2011)

The depth to water levels during postmonsoon (Nov. 2011) ranges between 2.15 m bgl (Popet kheda) and 21.15 m bgl (Andura). 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, 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 Akola and Balapur talukas.

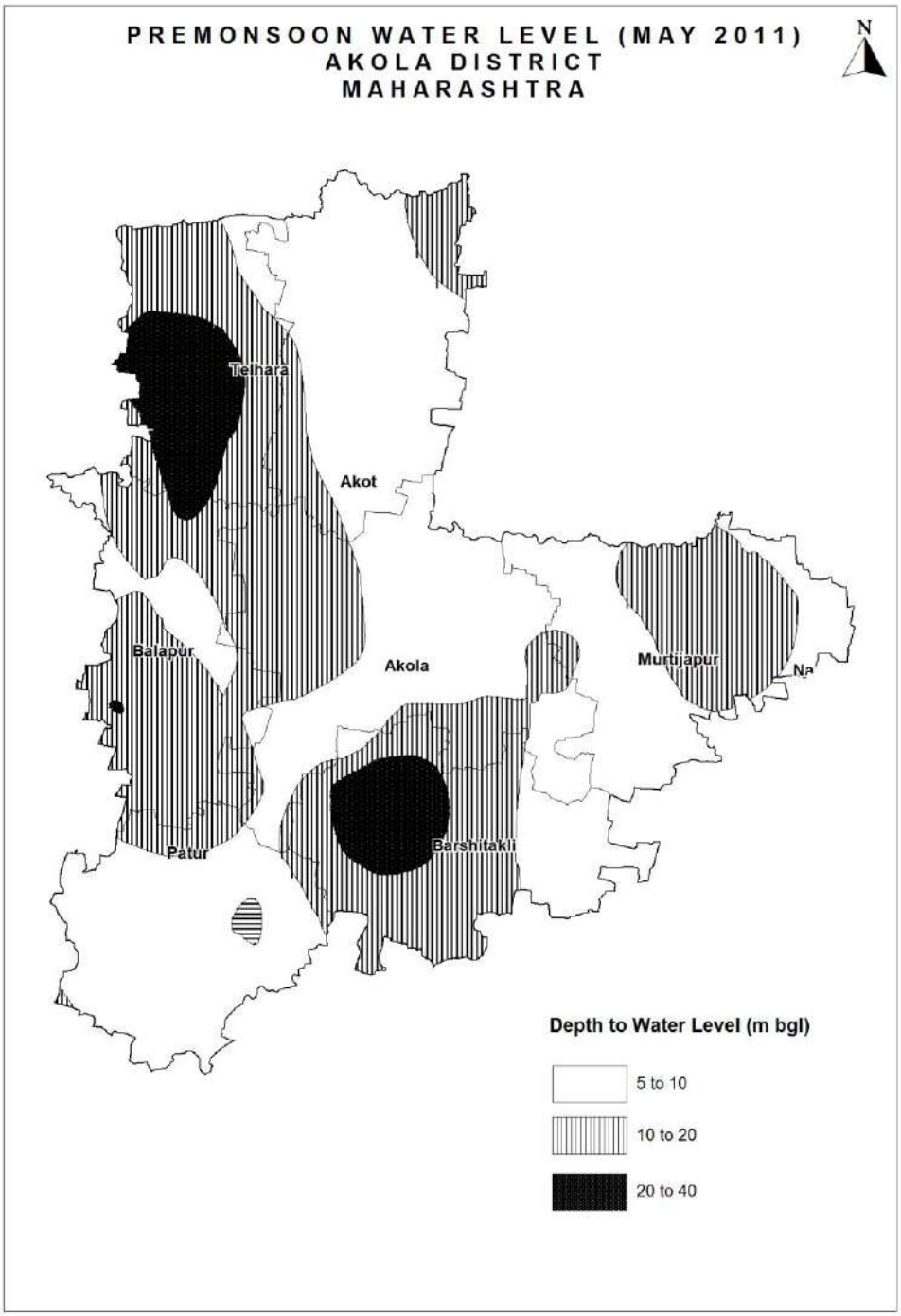

Figure 3- Depth to Water Level (Premonsoon- May 2011)

4.1.5 Seasonal Water Level Fluctuation (May-Nov. 2011)

Rise as well as fall has been recorded in seasonal water level fluctuation. 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.

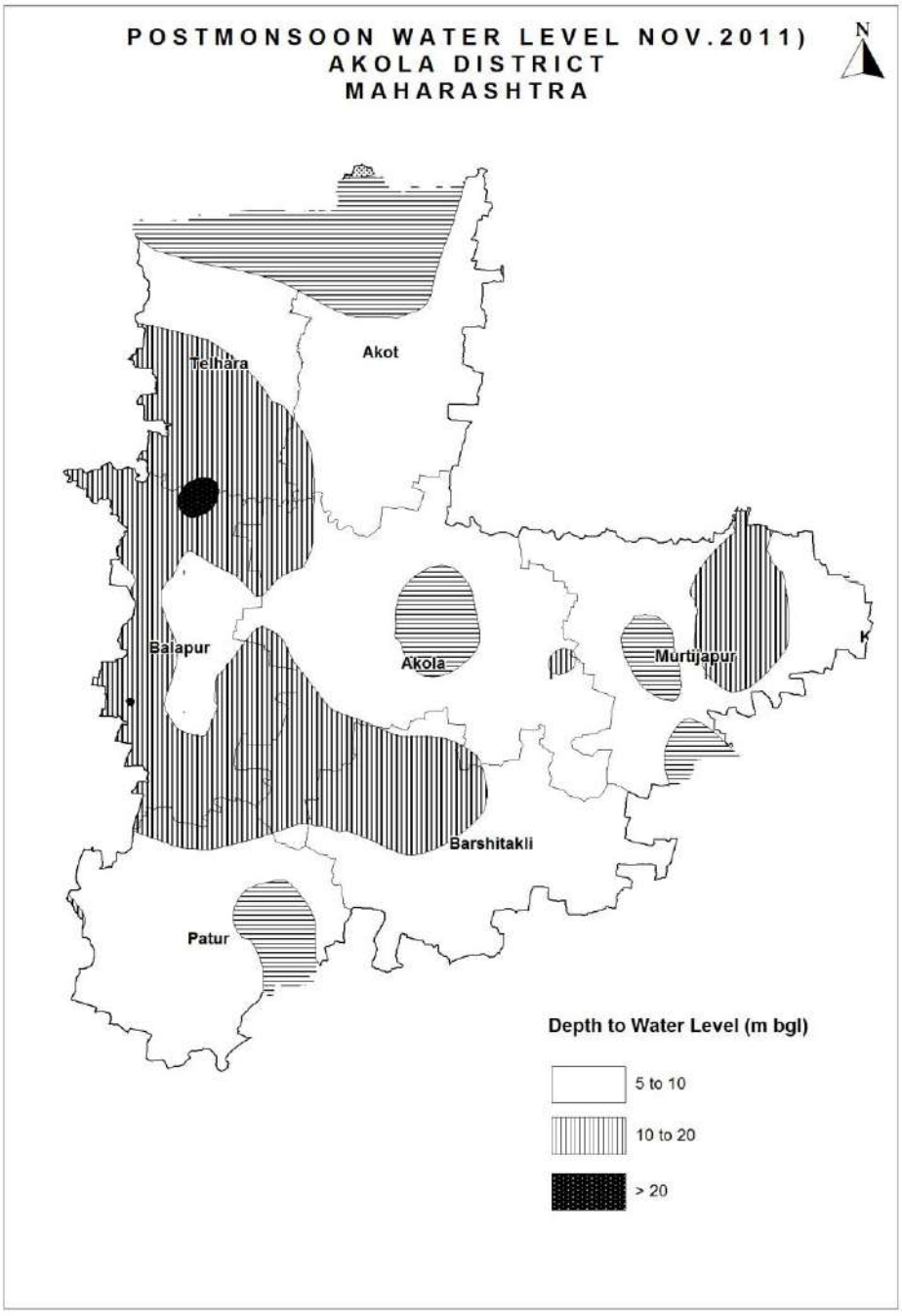

Figure 4- Depth to Water Level (Post Monsoon- Nov. 2011)

4.1.6 Water Level Trend (2010-2011)

Trend of water levels for pre-monsoon and post-monsoon periods for last ten years (2010-2011) have been computed for 19 NHNS and are given in **Table-4**.

Analysis of trend indicates that during premonsoon period, rise in water levels has been recorded at 7 stations and it ranges between 0.1076 (Borgaon Manju) and 1.064 m/year (Popetkheda). Fall in water levels has been observed at 10 stations and ranges

between 0.0048 (Murtizapur) and 1.094 m/year (Telhera-2).

During postmonsoon period, rise in water levels has been recorded at 11 stations and it ranges from 0.0286 (Akola) to 1.236 m/year (Popetkheda), whereas at 6 stations, fall in water levels ranging between 0.0204 (Borgan Manju) and 1.1276 m/year (Telhara-2) 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 net annual ground water availability comes to be 448.20 MCM. The gross draft for all uses is estimated at 144.64 MCM with irrigation sector being the major consumer having a draft of 132.36 MCM. The domestic and industrial water requirements are worked at 24.57 MCM. The net ground water availability for future irrigation is estimated at 291.27 MCM.

Stage of ground water development varies from 19.74% (Balapur) to 58.06% (Akot). The overall stage of ground water development for the district is 32.98%. Taluka wise assessments indicate that all the talukas in the district fall under “Safe” category.

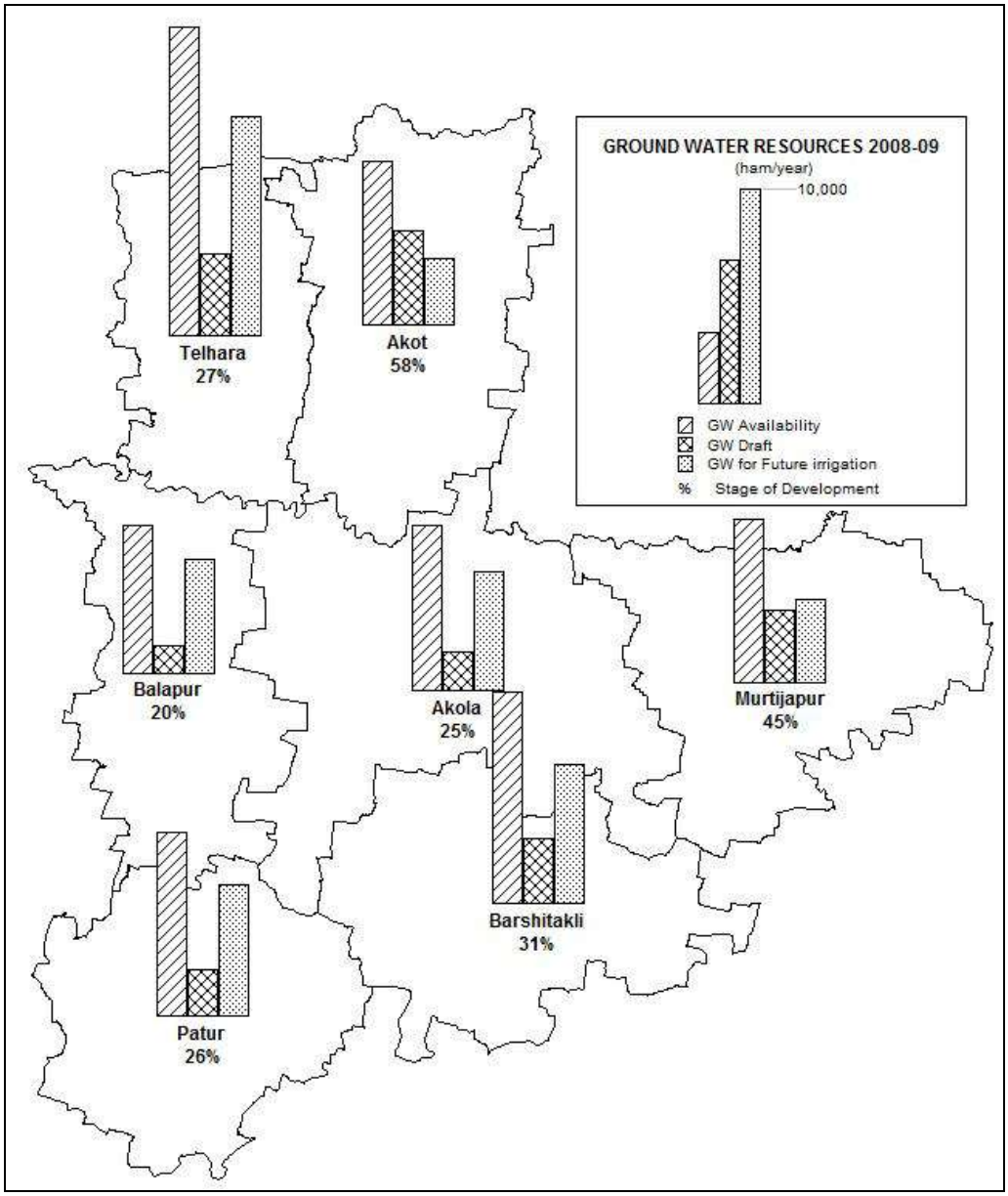

Figure 5 – Ground Water Resources

Table-5: Taluka wise Ground Water Resources (March 2009). **Figures in HAM**

Administrative Unit	Command / Non-Command / Total	Net Annual Ground Water Availability	Existing Gross Ground Water Draft for Irrigation	Existing Gross Ground Water Draft for Domestic and Industrial water Supply	Existing Gross Ground Water Draft for All uses	Provision for Domestic and Industrial Requirement for 2025	Net Ground Water Availability for Future Irrigation Development	Stage of Ground Water Development (%}
Akola	Command	1208.156	218.8504	43.51776	262.3682			
Akola	Non Command	4327.597	956.5258	152.8499	1109.376			
Akola	Total	5535.753	1175.376	196.3676	1371.744	389.0159	3947.175	24.77972
Akot	Command	1406.588	643.4222	15.05648	658.4787			
Akot	Non Command	4033.61	2426.621	73.72366	2500.345			
Akot	Total	5440.198	3070.043	88.78014	3158.823	178.7117	2261.624	58.06449
Balapur	Command	499.7618	170.4026	21.11989	191.5225			
Balapur	Non Command	4452.538	651.9867	134.4514	786.4381			
Balapur	Total	4952.3	822.3892	155.5713	977.9606	311.1427	3818.769	19.7476
Barsi Takli	Command	725.6923	165.9801	44.28281	210.2629			
Barsi Takli	Non Command	6333.374	1742.198	207.495	1949.693			
Barsi Takli	Total	7059.066	1908.178	251.7778	2159.956	507.3293	4641.741	30.59832
Murtizapur	Command	830.4952	475.6145	74.51366	550.1281			
Murtizapur	Non Command	4645.117	1716.959	171.7627	1888.722			
Murtizapur	Total	5475.612	2192.574	246.2764	2438.85	492.7832	2794.828	44.54023
Patur	Command	1350.295	535.4454	57.88178	593.3272			
Patur	Non Command	4750.108	936.3508	74.84328	1011.194			
Patur	Total	6100.403	1471.796	132.7251	1604.521	265.4501	4363.156	26.30189
Telhara	Command	5799.826	1037.956	81.79826	1119.754			
Telhara	Non Command	4457.243	1557.898	75.10683	1633.005			
Telhara	Total	10257.07	2595.854	156.9051	2752.759	312.374	7300.091	26.83768
Total	**Command Area**	**11820.81**	**3247.67**	**338.17**	**3585.84**			
	Non Command Area	**32999.59**	**9988.59**	**890.23**	**10878.77**			
	Total	**44820.4**	**13236.21**	**1228.40**	**14464.61**	**2456.81**	**29127.36**	**32.98**

4.3 Ground Water Quality

CGWB is monitoring the ground water quality of the Akola district since the last four decades through its established monitoring wells. The objectives behind the monitoring are to develop an overall picture of the ground water quality of the district. During the year 2011, the Board has carried out the ground water quality monitoring of 14 monitoring wells. These wells mainly consist of the dug wells representing the shallow aquifer. The sampling of ground water from these wells was carried out in the month of May 2011 (pre-monsoon period). The water samples after collection were immediately subjected to the analysis of various parameters in the Regional Chemical Laboratory of the Board at Nagpur. The parameters analyzed, include pH, Electrical Conductivity (EC), Total Alkalinity (TA), Total Hardness (TH), Nitrate (NO_3) and Fluoride (F). The sample collection, preservation, storage, transportation and analysis were carried out as per the standard methods given in the manual of American Public Health Association for the Examination of Water and Wastewater (APHA, 1998). The ground water quality data thus generated was first checked for completeness and then the validation of data was carried out using standard checks. Subsequently, the interpretation of data was carried out to develop the overall picture of ground water quality in the district in the year 2011.

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., TA, TH, NO_3 and F prescribed in the standards and is given in **Table-6**.

Table-6: Classification of Ground Water Samples for Drinking 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
TA (mg/L)	200	600	-	13	1
TH (mg/L)	300	600	-	7	7
NO_3 (mg/L)	45	No relaxation	8	-	6
F (mg/L)	1.0	1.5	13	1	-

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

The perusal of **Table-6** shows that the concentrations of all the parameters except nitrate in most of the samples are the within maximum permissible limit of the within BIS standards. It is also seen from the **Table-6** that the potability of ground water in the wells is mainly affected due to the Nitrate (NO_3) as its concentration exceeds MPL in 42% of samples. Overall, it can be concluded that the ground water quality in the wells monitored in the district is affected because of high NO_3 concentrations. The high concentration of Nitrate may be due to domestic waste, waste water and sewage in the urban and rural part of district.. .

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. Electrical Conductivity (EC) and Residual Sodium Carbonate (RSC) are the most important quality criteria, which influence the water quality and its suitability for irrigation.

Electrical Conductivity (EC)

The amount of dissolved ions in the water is best represented by the parameter electrical conductivity. The classification of water for irrigation based on the EC values is as follows.

Low Salinity Water (EC: 100-250 µS/cm): This water can be used for irrigation with most crops on most soils with little likelihood that salinity will develop.

Medium Salinity Water (EC: 250 – 750 µS/cm): This water can be used if moderate amount of leaching occurs. Plants with moderate salt tolerance can be grown in most cases without special practices for salinity control.

High Salinity Water (EC: 750 – 2250 µS/cm): This water cannot be used on soils with restricted drainage. Even with adequate drainage, special management for salinity control may be required and plants with good salt tolerance should be selected.

Very High Salinity Water (EC: >2250 µS/cm): This water is not suitable for irrigation under ordinary condition. The soils must be permeable, drainage must be adequate, irrigation water must be applied in excess to provide considerable leaching and very salt tolerant crops should be selected.

The classification of ground water samples collected from monitoring wells for was carried out irrigation purpose and given below in **Table-7**.

It is clear from the **Table-7** that maximum number of samples (67%) falls under the category of high salinity water while nearly 36% of samples fall in very high salinity water category. This shows that the ground water in the pre-monsoon season from shallow aquifer in the district should be used for irrigation with proper soil and crop management practices..

Table-7: Classification of Ground Water for Irrigation based on EC.

Type	EC (µS/cm)	No. of Samples	% of Samples
Low Salinity Water	<250	Nil	Nil
Medium Salinity Water	250-750	Nil	Nil
High Salinity Water	750-2250	9	64
Very High Salinity Water	>2250	5	36
Total		**14**	**100.0**

Residual Sodium Carbonate (RSC)

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

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

Type	RSC	No. of Samples	% of Samples
Good	<1.25	12	86
Doubtful	1.25-2.50	2	14
Unsuitable	>2.50	-	-
Total		**14**	**100**

The perusal of **Table-8** shows that the RSC values of ground water samples collected from the wells is less than 1.25 in about 86% of wells, which reflects that the overall quality of ground water in the monitoring wells is good for irrigation purpose.

4.4 Status of Ground Water Development

Ground water development depends on many factors viz. availability, crop water requirement, socioeconomic fabric and the yield of aquifers existing in the area.

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 4^{th} Minor Irrigation Census, data available for year 2006-07, no of Dug wells and bore wells, surface schemes are 21456, 324 and 609 respectively. Potential created by dug wells, bore wells and surface water schemes are 46713, 1092 and 1764 ha respectively. Net irrigated area is 45856 ha.

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	

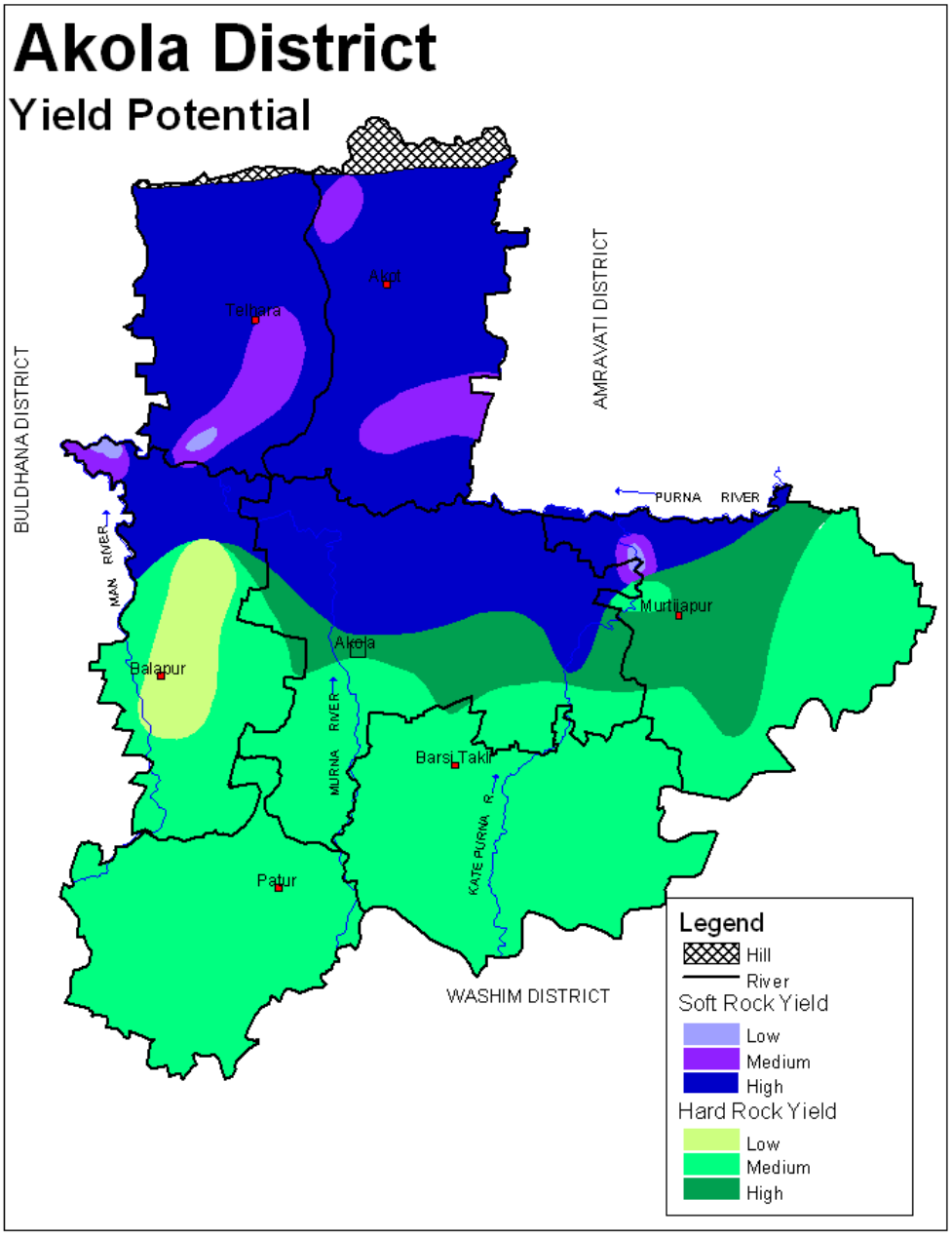

Figure 6 – Yield Potential

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 district 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 and Barshi Takli talukas. These areas being occupied by Purna Alluvium and Deccan Traps. 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°C. 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 2012, 2 Mass Awareness Programmes (MAP) have been organised in the district, one at Chohatta Bazar and another at Akola, Status of mass awareness programmes organised is given in table **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 2012 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 Ground water quality is adversely affected by nitrate concentration in 42% of samples. Thus all the wells used for water supply should be analysed for nitrate contents and if it is found beyond permissible limit, the ground water may be used for other purposes than drinking. Adequake sanitary protection to the wells may be provided to control the nitrate contamination.

4 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.

5 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.

6 The overall stage of ground water development for the district is only about 32.98%. Therefore, there is scope for further development of ground water resources.

7 Drought and deeper water level areas has been observed in parts of Barshi Takli an Telhara talukas. Thus future water conservation and artificial recharge structures needs to be prioritised in these.

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.