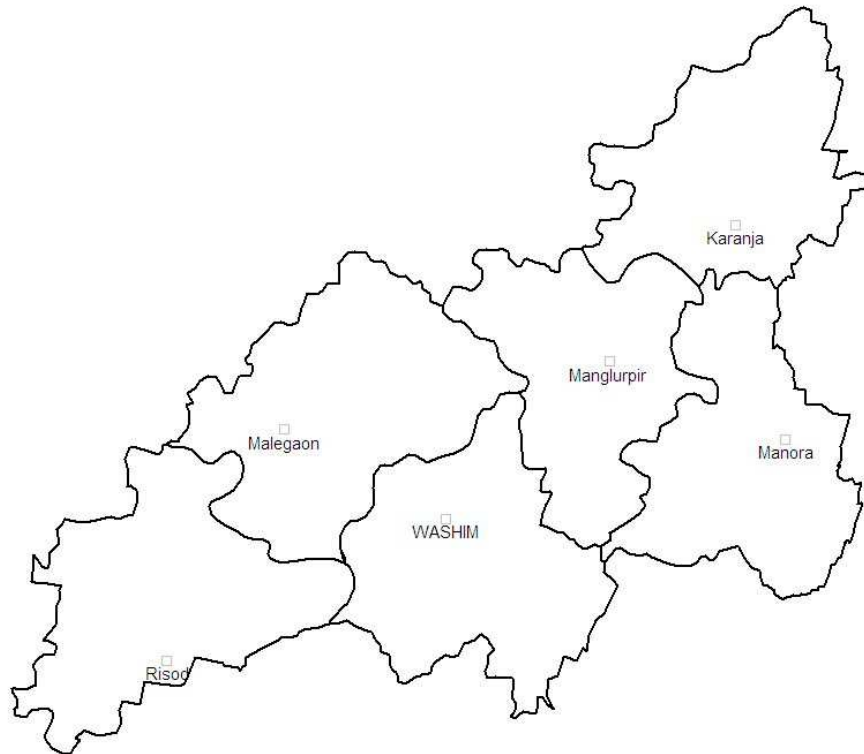




**GOVT OF INDIA
MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD**

**GROUND WATER INFORMATION
WASHIM DISTRICT
MAHARASHTRA**



**CENTRAL REGION
NAGPUR
2007**

WASHIM DISTRICT AT A GLANCE

1. GENERAL INFORMATION

Geographical Area	: 5196 sq. km.
Administrative Divisions (As on 31/03/2007)	: Taluka-6; Washim, Karanja, Manora, Mangrulpir, Malegaon, Risod.
Villages	: 789
Population	: 10,19,000
Normal Annual Rainfall	: 872 mm to 966 mm

2. GEOMORPHOLOGY

Major Physiographic unit	: One; Balaghat Plateau
Major Drainage	: One; Penganga

3. LAND USE (2000-01)

Forest Area	: 370 sq. km.
Net Area Sown	: 3538 sq. km.
Cultivable Area	: 3885 sq. km.

4. SOIL TYPE

Medium black and Deep black soil.

5. PRINCIPAL CROPS (1993-94)

Wheat	: 106 sq. km.
Cotton	: 1450 sq. km.
Jowar	: 158 sq. km.
Total Pulses	: 210 sq. km.

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

Nos./Potential Created (ha)

Dugwells	: 18538/49469
Borewells	: 152/823
Tanks/Ponds	: 2846/4997
Other Minor Surface Sources	: 1899/5424
Net Irrigated Area	: 26141 ha

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

Dugwells	: 22
Piezometers	: 1

8. GEOLOGY

Recent	: Alluvium
Upper Cretaceous-Lower Eocene	: Deccan Trap Basalt

9. HYDROGEOLOGY

Water Bearing Formation	: Basalt- weathered/fractured/ jointed vesicular/massive, under. phreatic and semi-confined to confined conditions
Premonsoon Depth to Water Level (May-2006)	: 5.60 to 11.70 m bgl
Postmonsoon Depth to Water Level (Nov.-2006)	: 1.00 to 7.83 m bgl
Premonsoon Water Level Trend (1997-2006)	: Rise: 0.05 to 0.15 m/year Fall: 0.02 to 0.45 m/year
Postmonsoon Water Level Trend (1997-2006)	: Rise: 0.02 to 0.46 m/year Fall: 0.03 to 0.32 m/year

- 10. GROUND WATER EXPLORATION** (As on 31/03/07)
- | | |
|----------------|--|
| Wells Drilled | : EW-19, OW-10 |
| Depth Range | : 30.00 to 208.65 m bgl |
| Discharge | : 0.14 – 9.84 lps |
| Storativity | : 3.1×10^{-3} to 6.6×10^{-6} |
| Transmissivity | : 8.10 to 1638.73 m ² /day (Basalt) |
- 11. GROUND WATER QUALITY**
Good and suitable for drinking and irrigation purpose, however localized nitrate contamination is observed.
- | | |
|---------------|---------------------------------|
| Type of Water | : Ca-Cl and Ca-HCO ₃ |
|---------------|---------------------------------|
- 12. DYNAMIC GROUND WATER RESOURCES-** (As on 31/03/2004)
- | | |
|--|--------------|
| Annual Replenishable GW Resources | : 407.93 MCM |
| Total draft (Irrigation+Domestic) | : 154.22 MCM |
| Projected Demand (Domestic + Industrial) | : 26.20 MCM |
| Stage of Ground Water Development | : 37.81% |
- 13. AWARENESS AND TRAINING ACTIVITY**
- | | |
|--------------------------------------|------------------|
| Mass Awareness Programme | : One |
| a. Date | : 25/01/07 |
| b. Place | : Washim |
| c. Participants | : 300 |
| Water Management Training Programme: | : One |
| a. Date | : 23 to 24/01/07 |
| b. Place | : Washim |
| c. Participants | : 45 |
- 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**
Ground water quality is adversely affected by nitrate contamination.

Ground Water Information Washim District

Contents

1.0	Introduction	1
2.0	Climate and Rainfall	3
3.0	Geomorphology and Soil Types	3
4.0	Ground Water Scenario.....	4
4.1	Hydrogeology.....	4
4.2	Ground Water Resources.....	8
4.3	Ground Water Quality	11
4.4	Status of Ground Water Development.....	13
5.0	Ground Water Management Strategy	14
5.1	Ground Water Development.....	14
5.2	Water Conservation and Artificial Recharge.....	15
6.0	Ground Water Related Issues and Problems	15
7.0	Mass Awareness and Training Activities.....	16
7.1	M.A.P. and W.M.T.P.	16
7.2	Participation in Exhibition, Mela, Fair etc.....	16
8.0	Areas Notified by CGWA/SGWA	16
9.0	Recommendations	16

List of Figures

1. Location
2. Hydrogeology
3. Depth to Water Level (Premonsoon- May 2006)
4. Depth to Water Level (Postmonsoon- Nov. 2006)
5. Ground Water Resources
6. Yield Potential

List of Tables

1. Studies undertaken by CGWB.
2. Salient Features of Ground Water Exploration.
3. Annual Rainfall Data (1996-2005).
4. Water Level Data (2006) with Long Term Trend (1997-06).
5. Taluka wise Ground Water Resources (March 2004).
6. Geochemical Classification of Ground Water Samples.
7. Classification of Ground Water Samples based on BIS Drinking Water Standards (IS-10500-91, Revised 2003).
8. Classification of Ground Water for Irrigation based on SAR and RSC.
9. Nature and Yield Potential of Aquifers.
10. Status of MAP and WMTP.

Ground Water Information

Washim District

1.0 Introduction

Washim is one of the 11 districts of Vidarbha and was carved out of Akola district recently. It is situated in the north eastern part of the State abutting Madhya Pradesh and lies between north latitudes 19°11' and 21°16' and east longitude 76°07' and 77°14' and falls in parts of Survey of India degree sheets 55 D, 55 H, 56 A and 56 E. The district has a geographical area of 5196 sq. km.

The district headquarters is located at Washim Town. For Administrative convenience, the district is divided in 6 talukas viz, Washim, Karanja, Malegaon, Mangrulpir, Manora and Risod. It has a total population of 10,19,000 as per 2001 census. The district has 4 Nagar Parishads, 6 Panchayat Samitis and 493 Gram Panchayats. The district forms part of Godavari and Tapi basin. Penganga River 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.	S/Shri Sirsikar, D.Y. and Rai, J.N.	1982-83	Systematic Hydrogeological Surveys
2.	S/Shri Jain, S.K. and Joshi, Devendra	1988-89	Systematic Hydrogeological Surveys
3.	S/Shri Suresha, A; and Arumugam	1990-91	Systematic Hydrogeological Surveys
4.	Shri Toppo, Sunil.	2002-03	Reappraisal Hydrogeological Studies
5.	Shri Davithuraj, J.	2002-03	Reappraisal Hydrogeological Studies
6.	Shri Warke, B.N.	2002-03	Reappraisal Hydrogeological Studies

Dr. P.K. Jain, Scientist-D in 2005 compiled the report entitled "Ground Water Resources and Development Potential of Washim District, M.S."

Ground water exploration in the district was undertaken during 1997 to 2001. A total number of 19 Exploratory Wells (EW) and 10 Observation Wells (OW) were drilled at 19 sites. Pumping tests to determine aquifer parameters were also conducted at 4 sites. The taluka wise salient features of ground water exploration are given in **Table-2**.

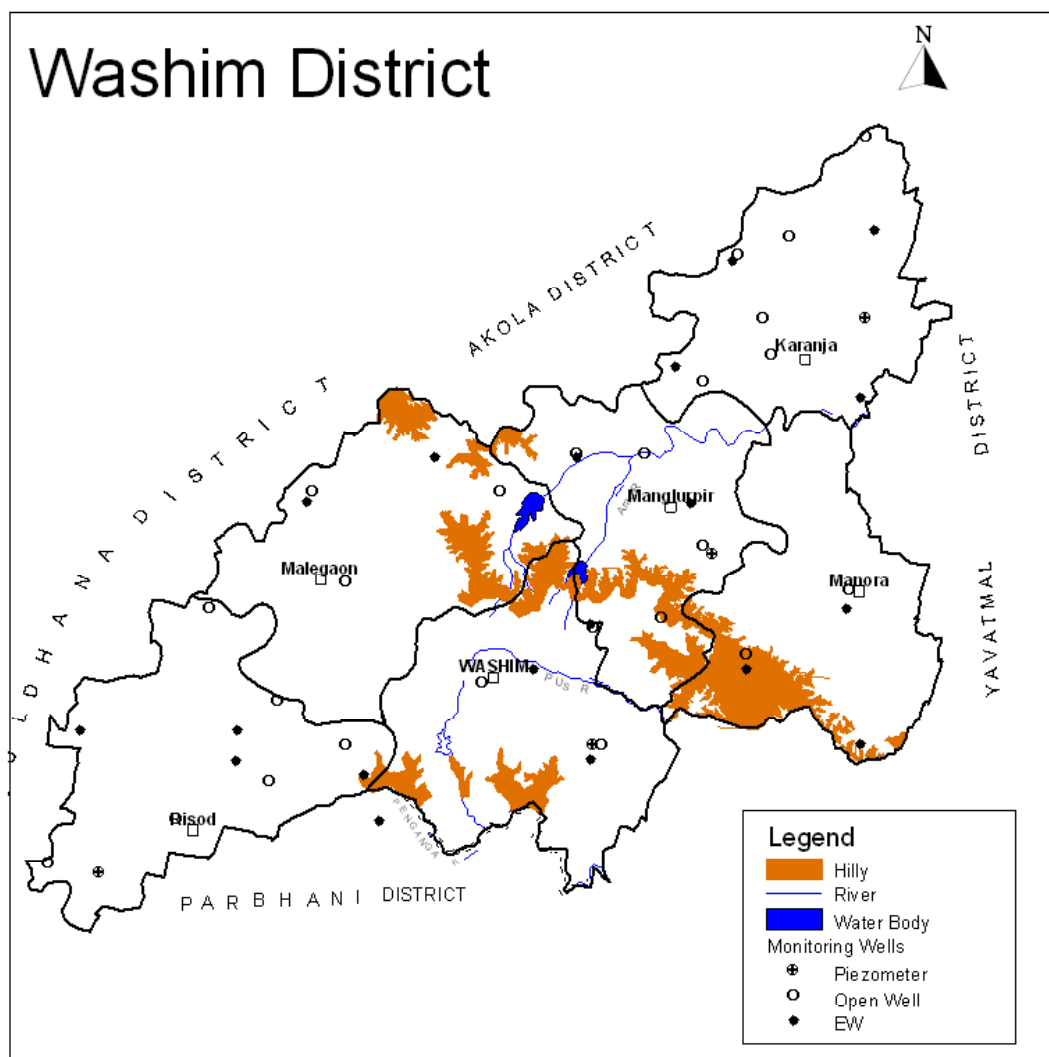


Figure-1: Location

Table 2: Salient Features of Ground Water Exploration.

S. No.	Taluka	Wells			Depth (mbgl)	SWL (mbgl)	Dis-charge (lps)	Draw-Down (m)	Zones (mbgl)
		EW	OW	PZ					
1.	Karanja	4	3	-	40 - 172	3.05-26.65	1.37-4.43	0.89 – 12.38	8 – 44
2.	Malegaon	2	-	-	200.00	17.57-45.00	0.56-0.78	-	4 - 65
3.	Mangrulpir	3	3	-	30 - 184	2.66-57.00	0.38-9.84	11.4 – 27.25	5 – 58
4.	Manora	3	-	-	117 – 200	5.75-12.75	0.14-1.37	13.93	5 – 86
5.	Risod	3	3	-	60 – 200	6.42-26.55	2.16-5.94	0.55 – 15.35	7 – 192
6.	Washim	4	1	-	111 – 208.65	4.60-5.15	0.14-1.37	15.0 – 15.10	6 – 193
	Total	19	10	-	30.00-208.65	2.66-57.00	0.14 - 9.84	0.89 – 27.25	4.00 – 193.00

The depth of the wells varies from 30 to 208 metres below ground level (m bgl), while discharge varies between 0.14 and 9.84 litres per second (lps). Out of 19 exploratory wells drilled in the district, 5 exploratory wells have shown discharges more than 3 lps. Except for the exploratory wells at Lohara, Medsi, Mutha, Dhanora (Bk.), Masela Pen and Belkheda water levels were shallow in other wells, with the deepest water level being recorded at Dhanora (Bk) i.e., 57.00 m bgl. Deeper aquifer zones have been encountered in many wells beyond 50 m depth, the deepest being at 193 m at Devthana (Bk) exploratory well in Washim taluka.

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**.

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°C and mean maximum temperature is 42°C.

The normal annual rainfall over the district varies from 872 mm (Risod) to about 966 mm (Washim). The average annual rainfall for the period 1996-2005 ranges from 792.6 mm (Karanja) to 1344.4 mm (Malegaon) and the same is presented in **Table-3**.

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

Taluka	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	Average
Washim	734.0	876.0	1098.0	1254.0	809.0	1524.0	2160.0	1235.7	1059.2	1167.2	1207.9
Karanja	668.0	602.0	917.0	918.0	772.0	756.0	915.0	743.5	546.2	1062.3	792.6
Mangrurpir	1037.0	560.0	935.0	1014.0	848.0	934.0	1108.0	543.0	482.5	1001.3	919.4
Risod	852.0	914.0	1269.0	1375.0	637.0	851.0	1377.4	683.9	547.9	773.6	1039.3
Malegaon	1138.0	1107.0	1299.0	1514.0	1129.0	1533.0	1691.0	1017.0	684.2	906.8	1344.4
Average	885.8	811.8	1103.6	1215.0	839.0	1119.6	1450.3	844.6	664.0	982.2	1060.7

3.0 Geomorphology and Soil Types

The district forms part of Deccan Plateau with slope towards southeast from Sahayadri hills and has a varied topography consisting of hills, plains and undulating topography near riverbanks. The district forms a part of Godavari and Tapi basins. Balaghat Plateau comprises of low-lying hills forming water divide. Many of the tributaries to Godavari and Tapi rivers originate from the Balaghat Plateau. Penganga River is the main river flowing through the district. Other rivers are Adol, Aran, Kapsi, Nirguna and Mun. Based on geomorphological setting and drainage pattern, the district is divided into 36 watersheds.

The soil of the district is basically derived from Deccan Trap Basalt and major part of the district is occupied by medium black soil of 25-50 cm depth

occurring in the plains in entire south western, north eastern and northern parts of the district, whereas the shallow black soil of 7.5 to 25 cm depth occur in restricted hilly parts of the district in central elongated part and the northern peripheral part.

4.0 Ground Water Scenario

4.1 Hydrogeology

The entire district is underlain by the Basaltic lava flows of upper Cretaceous to lower Eocene age. The shallow Alluvial formation of Recent age also occur as narrow stretch along the major rivers flowing in the area but it does not play much important role from ground water point of view. A map depicting the hydrogeological features is shown in **Figure-2**.

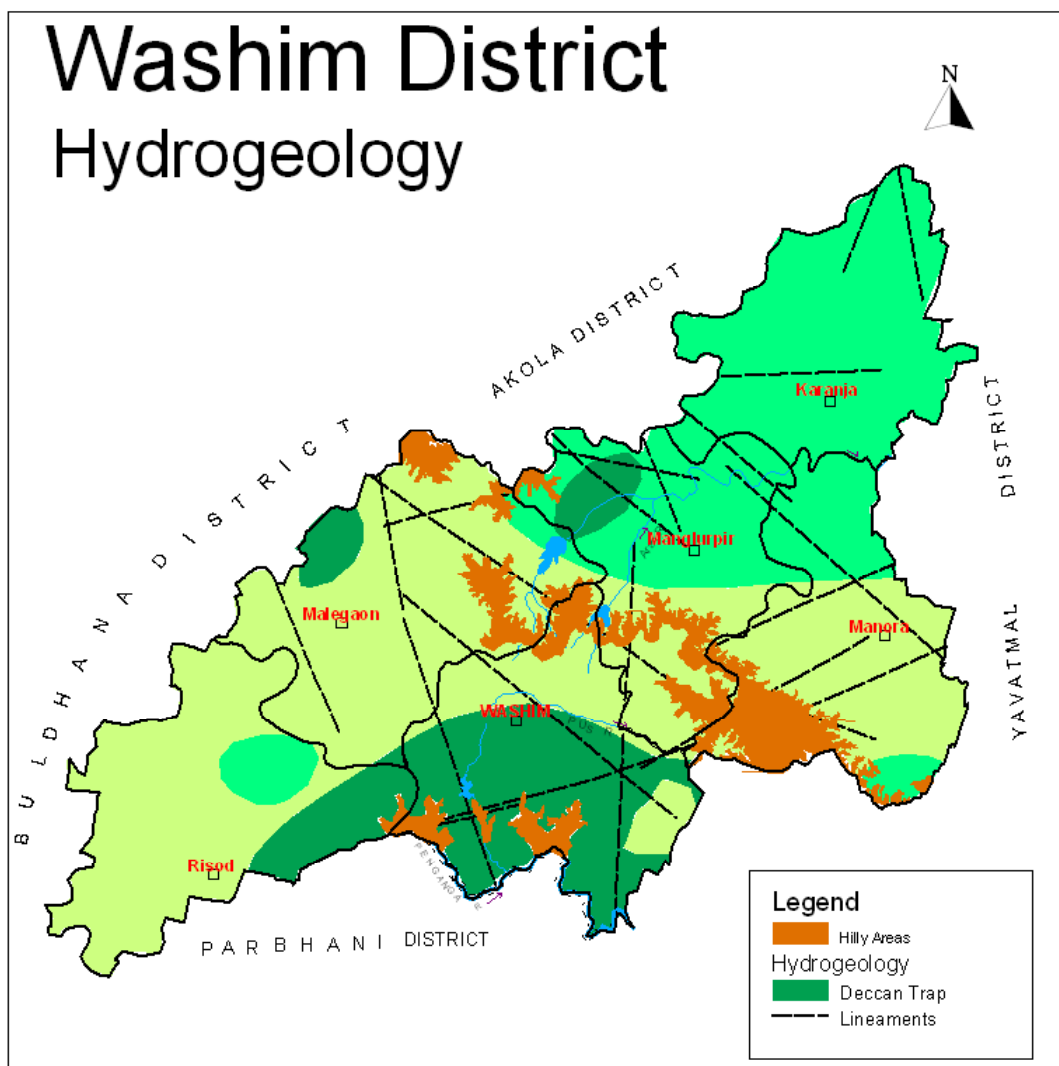


Figure-2: Hydrogeology

4.1.1 Deccan Trap Basalt

Deccan Traps occurs as Basaltic lava flows, which are normally horizontally disposed over a wide stretch and give rise to tableland type of topography, on weathering also known as plateau. These flows occur in

layered sequence ranging in thickness from few metres to 50 m. Flows are represented by massive portion at bottom and vesicular portion at top and are separated from each other by marker bed known as bole bed

Ground water in Deccan Trap Basalt occurs under phreatic and semi-confined conditions. The weathered and fractured trap occurring in topographic lows form the main aquifer in the district The vesicular portion of different lava flow varies in thickness from 8 to 10 m and forms the potential zones.

4.1.2 Water Level Scenario

Central Ground Water Board periodically monitors 23 National Hydrograph Network Stations (NHNS) stations in Washim 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 Trends (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	Bitoda (Bhoyar)	7.40	4.75	2.65	0.15			0.16
2	Chikli	8.80	2.42	6.38		0.10		0.05
3	Dapuri	9.46	4.03	5.43		0.34		0.11
4	Dhanaj Khurd	9.17	2.68	6.49		0.17		0.05
5	Kamargaon	5.60	1.69	3.91	0.05		0.06	
6	Karanja	7.08	2.11	4.97		0.45		0.25
7	Kenwad	8.80	1.95	6.85		0.11		0.02
8	Kinhi Raja	9.47	2.90	6.57		0.15		0.13
9	Loni	8.73	1.30	7.43		0.32		0.22
10	Malegaon	8.18	2.60	5.58		0.11		0.08
11	Medshi	6.08	2.96	3.12		0.35		0.05
12	Pimpalgaon2	-	-	-		0.19		0.32
13	Risod	11.70	3.05	8.65		0.24		0.17
14	Rithad	6.71	2.77	3.94		0.43		0.24
15	Sakhar Doha	7.70	5.70	2.00		0.10		0.06
16	Sangaon	10.45	1.73	8.72		0.07	0.04	
17	Sendurjan Adhao	8.57	4.99	3.58		0.02	0.05	
18	Shaha	11.20	7.83	3.37		0.06		0.10
19	Shelu Bazar	7.80	6.20	1.60		0.17		0.29
20	Sheluwada	5.65	1.63	4.02		0.07		0.28
21	Vilegaon(Kherda)	11.20	2.78	8.42		0.17		0.07
22	Wada	8.83	3.03	5.80		0.12	0.46	
23	Washim	8.75	1.00	7.75		0.08	0.02	

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

The depth to water levels in the district during May 2006 ranges between 5.60 (Kamargaon) and 11.70 (Risod) 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 almost entire district, i.e., northern part of Risod taluka and almost entire Malegaon, Washim, Mangrulpir, Manora and Karanja talukas. Water levels in the range of 10-20 m bgl are observed in isolated patches in southern part of Risod taluka, northern part of Malegaon taluka and north western part of Karanja taluka.

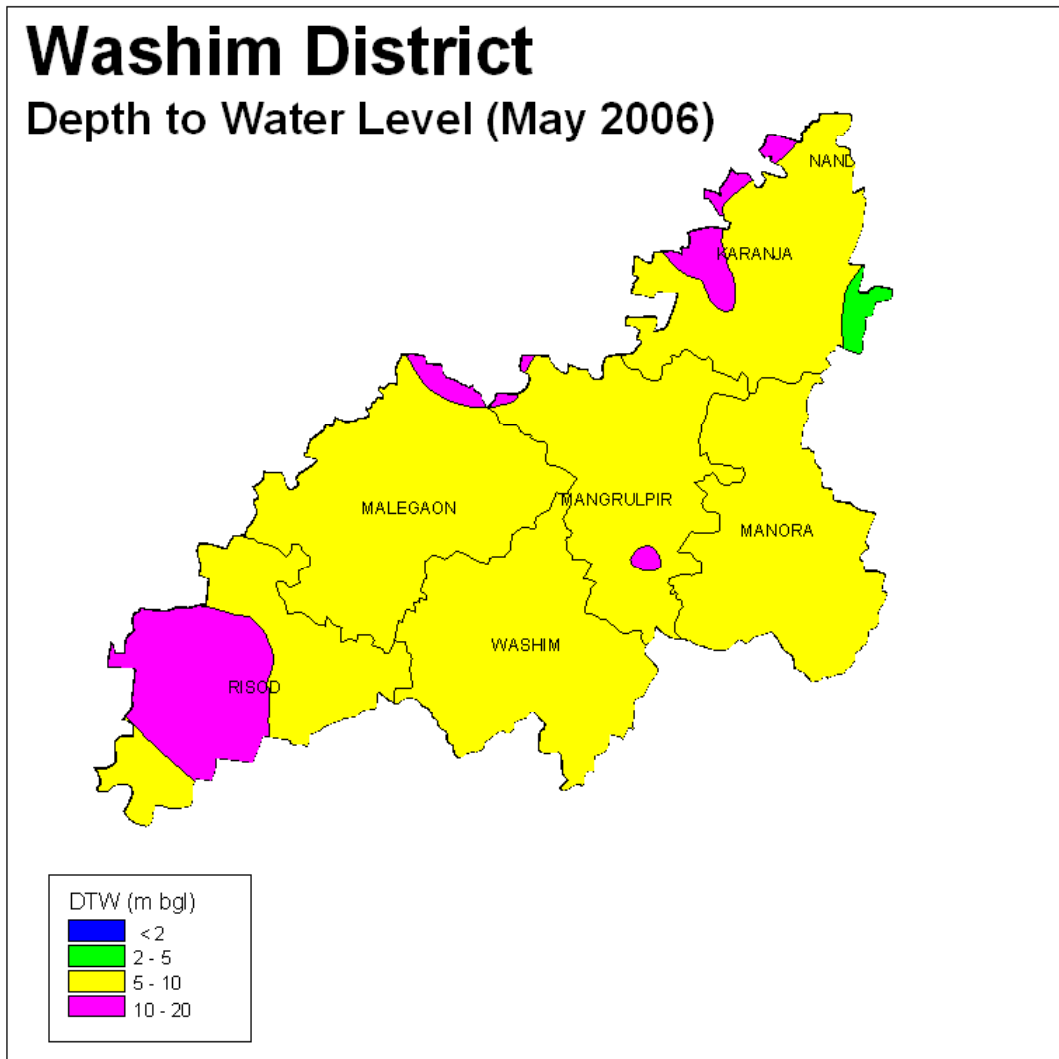


Figure-3: Depth to Water Level (Premonsoon- May 2006)

4.1.3 Depth to Water Level – Postmonsoon (Nov.-2006)

The depth to water levels during Nov. 2006 ranges between 1.00 m bgl (Washim) and 11.20 m bgl (Shaha). Spatial variation in postmonsoon depth to water levels is shown in **Figure-4**. In the entire district the water levels are shallow within 10 m bgl. Water levels of 2-5 m bgl is the most dominant range occupying almost entire Risod, Malegaon and Manora talukas and major parts of Washim, Mangrulpir and Karanja talukas. Water levels of less than 2 m bgl are observed in isolated patches i.e., in southern part of Risod taluka, central

elongated part in Washim taluka and northeastern part of Karanja taluka. Water levels of 5-10 m bgl are also observed in isolated patches i.e., in parts of Mangrulpir and Karanja talukas.

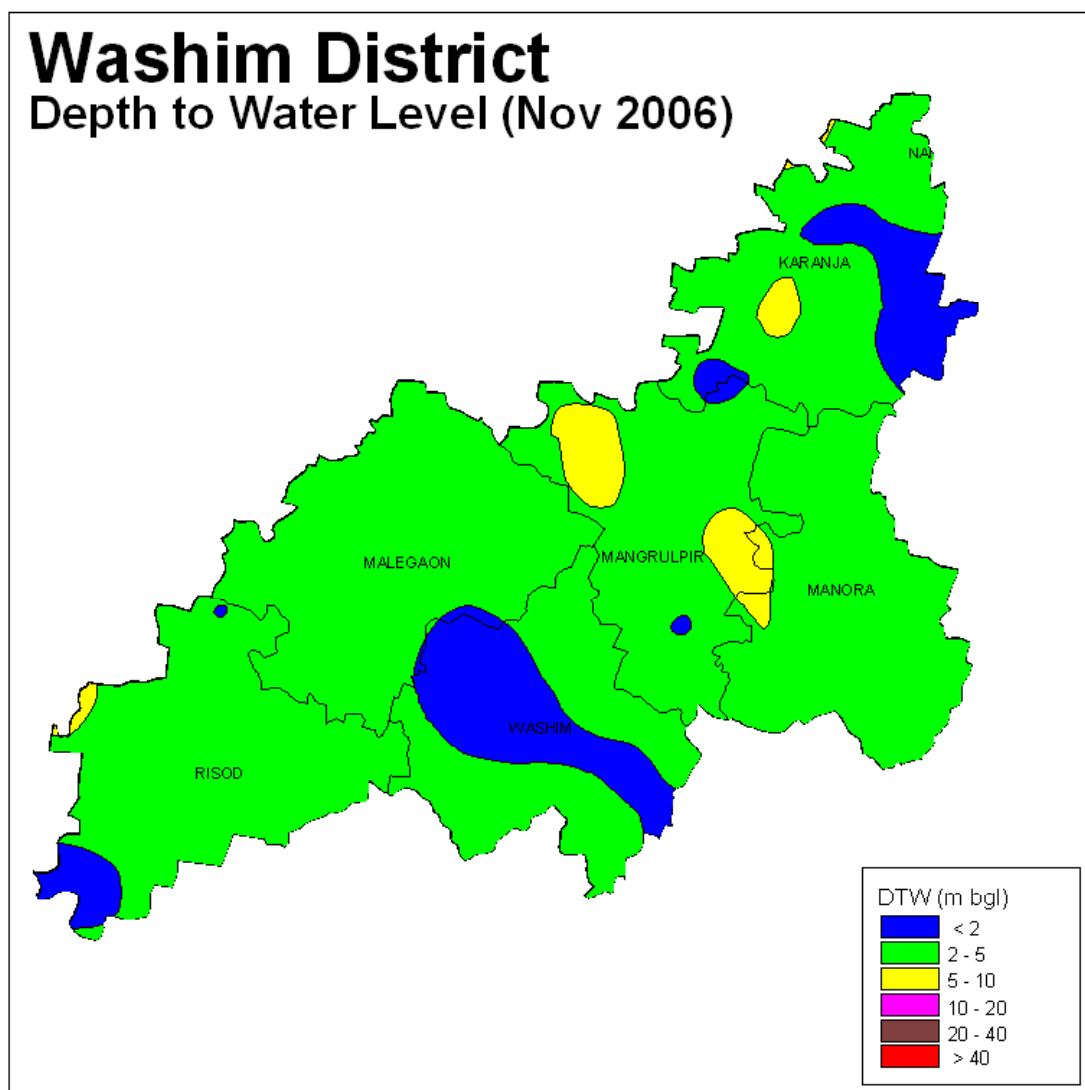


Figure-4: Depth to Water Level (Postmonsoon- Nov.2006)

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

In major part of the district rise in water levels in the range of 1.60 (Shelu Bazar) to 8.72 m (Sangaon) is observed. In entire district rise in water levels has been observed. Major part of the district covering entire Risod, Washim and Malegaon talukas and parts of Mangrulpir, Manora and Karanja talukas show rise of more than 4m. Rise in the range of 2 to 4 m is the next major range occupying major parts of Mangrulpir and Manora talukas and south eastern parts of Karanja taluka.

4.1.5 Water Level Trend (1997-2006)

Trend of water levels for premonsoon and postmonsoon period for last ten years (1997-2006) have been computed for 23 NHNS and are given in **Table-4**.

Analysis of trend indicates that during premonsoon period, rise in water

levels has been recorded at only 2 stations and it ranges between 0.05 m/year (Kamargaon) and 0.15 m/year (Bitoda Bhoyar). Fall in water levels has been observed at 18 stations in the range of 0.02 m/year (Shendurjana Adhao) to 0.43 m/year (Rithad). During postmonsoon period, rise in water levels has been recorded at 5 stations and it ranges from 0.02 m/year (Washim) to 0.46 m/year (Wada), whereas at 18 stations, fall in water levels ranging between 0.03 m/year (Kenwad) and 0.32 m/year (Pimpalgaon-2) is observed. Thus in major part of the district, both during pre and postmonsoon periods declining trend of water levels has been observed.

4.1.6 Aquifer Parameters

The aquifer parameters are available from pumping tests conducted at 4 exploration sites. The transmissivity of Deccan Traps varies between 8.10 (Lohara) and 1638.73 m²/day (Shelu Bazar) while the storage coefficient of the formation varies from 3.1x10⁻³ to 6.6x10⁻⁶.

4.2 Ground Water Resources

Central Ground Water Board and Groundwater Survey and Development Agency (GSDA) have jointly estimated the ground water resources of Washim district based on GEC-97 methodology. The same is presented in **Table-5**. Ground water resources estimation was carried out for 4907.31 sq. km. area out of which 46.48 sq. km. area is under command and 4860.83 sq. km. is non-command. Taluka wise ground water resources are shown in **Figure-5**.

As per the estimation the total annual ground water recharge is 429.44 MCM with the natural discharge is 21.51 MCM, thus the net annual ground water availability comes to be 407.93 MCM. The total gross draft for all uses is estimated at 154.23 MCM with irrigation sector being the major consumer having a draft of 141.15 MCM. The domestic and industrial water requirements are worked at 26.20 MCM. The net ground water availability for future irrigation is estimated at 227.43 MCM. Stage of ground water development varies from 29.70% (Manglurpir) to 46.71% (Karanja). The overall stage of ground water development for the district is 37.81%. All the talukas and watersheds have been categorised as "Safe"

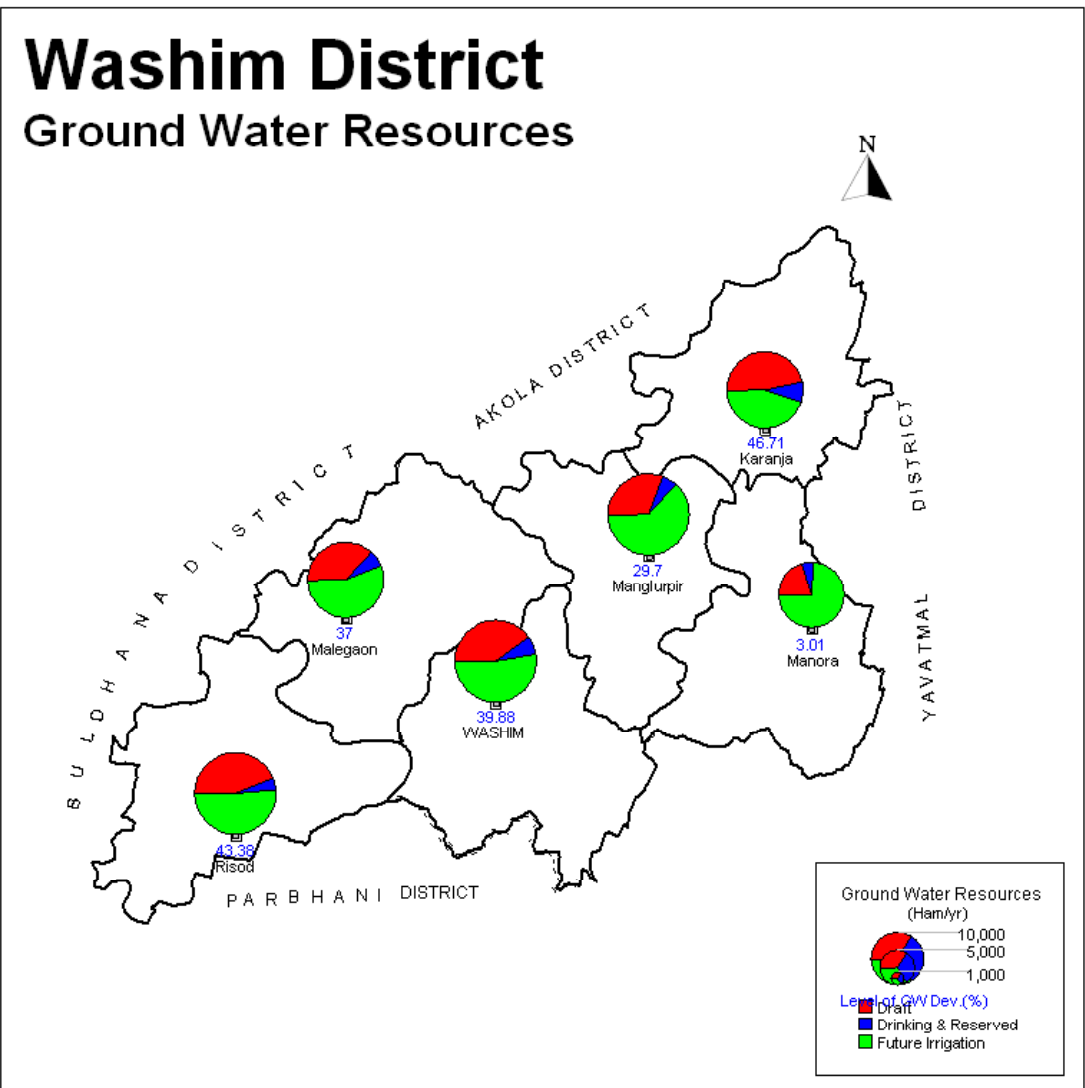


Figure-5: Ground Water Resources

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 (%)
WASHIM	COMMAND	305.72	64.14	27.25	91.39	5.59	41.63	29.89
	NON-COMMAND	6692.11	2473.55	225.55	2699.10	505.86	3685.83	40.33
	TOTAL	6997.83	2537.69	252.80	2790.50	511.45	3727.45	39.88
RISOD	COMMAND	67.53	3.37	0.71	4.08	0.75	2.63	6.05
	NON-COMMAND	7371.63	3047.81	175.42	3223.23	352.87	3832.43	43.72
	TOTAL	7439.16	3051.18	176.13	3227.31	353.62	3835.06	43.38
MALEGAON	COMMAND	255.55	24.70	7.67	32.37	4.28	32.34	12.67
	NON-COMMAND	6143.11	2124.66	210.16	2334.82	453.00	3641.80	38.01
	TOTAL	6398.66	2149.36	217.83	2367.18	457.28	3674.14	37.00
KARANJA	COMMAND	15.14	3.99	1.18	5.17	0.22	1.75	34.14
	NON-COMMAND	6403.26	2718.07	274.74	2992.81	561.30	2912.53	46.74
	TOTAL	6418.39	2722.06	275.92	2997.98	561.52	2914.28	46.71
MANGRULPIR	COMMAND	741.57	136.78	55.53	192.32	10.76	113.61	25.93
	NON-COMMAND	6529.79	1795.64	171.35	1966.99	411.27	4418.05	30.12
	TOTAL	7271.36	1932.43	226.88	2159.31	422.03	4531.66	29.70
MANORA	COMMAND	303.06	42.77	15.25	58.02	3.51	53.64	19.14
	NON-COMMAND	5964.30	1679.83	142.76	1822.59	309.57	4007.40	30.56
	TOTAL	6267.35	1722.60	158.01	1880.61	313.08	4061.04	30.01
TOTAL	COMMAND	1688.56	275.76	107.59	383.35	25.11	245.60	22.70
	NON-COMMAND	39104.19	13839.56	1199.98	15039.54	2593.87	22498.03	38.46
	TOTAL	40792.75	14115.32	1307.57	15422.89	2618.98	22743.63	37.81

4.3 Ground Water Quality

In the district, 17 water samples were collected during May 2006. The geochemical classification of ground water samples is 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	7	41
2	Alkali metal (Na+K > 50%) exceeds alkaline earths and weak acids (CO ₃ +HCO ₃ > 50%) exceeds strong acids.	Na-HCO ₃	-	-
3	Alkaline earths (Ca+Mg > 50%) exceeds alkali metals and strong acids (Cl+SO ₄ +NO ₃ > 50%) exceeds weak acids	Ca-Cl	9	53
4	Alkali metal (Na+K > 50%) exceeds alkaline earths and strong acids (Cl+SO ₄ +NO ₃ > 50%) exceeds weak acids	Na-Cl	1	6
	Total		17	100

As all the samples are from Basaltic aquifer, the type of water present in these samples should be of Ca-HCO₃ type. But the classification shows that 9 samples are having Ca-Cl type of water and 7 samples are of Ca- HCO₃ type indicating that the type of water in 9 samples have been changed from Ca-HCO₃ type to Ca-Cl type. This may be because of percolation of waste and wastewater containing high concentration of strong acid ions (Cl+NO₃+SO₄) to ground water. It also shows that the one sample was of Na-Cl type of water. This sample was collected from the well located at Shelu Bazar.

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	8	9	0
TH (mg/L)	300	600	8	9	0
Ca (mg/L)	75	200	9	8	0
Mg (mg/L)	30	100	7	10	0
Cl (mg/L)	250	1000	16	1	0
SO ₄ (mg/L)	200	400	16	1	0
NO ₃ (mg/L)	45	No relaxation	4	--	13
F (mg/L)	1.0	1.5	16	1	0

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

The **Table-7** shows that out of the 17 ground water samples, 13 samples (76%) have NO₃ concentration more than MPL (>45 mg/L) while the concentration of all the other parameters is less than MPL. This indicates that the potability of ground water is mainly affected due to NO₃.

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	%
17	17	100	Nil	Nil	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		%	
17	16	94	Nil	Nil	1		6	

The **Table-8** shows that the ground water samples from all the wells have SAR values less than 10. Similarly, RSC values of almost all the samples are also below 1.25 except in one sample at Shelu Bazar, where RSC value is found to be 3.35. Overall, the ground water quality in the wells monitored is good for irrigation purpose and there is a less possibility of developing sodium hazard.

4.4 Status of Ground Water Development

Ground water development depends on many factors viz., availability, crop water requirement, socio-economic fabric and on the yield of the aquifers existing in that area. The yields of wells are functions of the permeability and transmissivity of aquifer encountered and varies with location, diameter and depth etc. Ground water in the area is being developed by two type of abstraction structures i.e., borewells and dugwells. However dugwells are the main ground water abstraction structures in the district. The yield of such structures varies from 120 to 350 m³/day. High yielding dugwells are generally located in weathered and fractured Basalt occurring in physiographic depressions.

Ground water is predominantly used for irrigation, as it is the major ground water utilising sector. As per the data available for year 1996-97, area irrigated by ground water is 99.47 sq.km., whereas surface water accounts for only 26.75 sq.km. and the net irrigated area is 126.22 sq.km. However recent data (2000-01) indicates almost 100% increase in all figures with area irrigated by ground water being 201.13 sq.km., whereas surface water accounting 60.28 sq.km., of area and net irrigated area stands at 261.41 sq.km., Thus it is clear that ground water is the major source of irrigation as it accounts for about 77% of net irrigated area. The district had 18538 irrigation dugwells, which create an irrigation potential of 494.69 sq.km., out of which 442.15 sq.km., of irrigation potential is utilised. In addition to this 7.60 sq.km. of irrigation potential is utilised through 152 borewells/tubewells during 2000-01.

State government has drilled large number of borewells fitted with hand pumps and electric motors for rural drinking water purposes in the district. In all till March 2002, GSDA, Government of Maharashtra was successfully operating 2393 borewells for rural water supply under various schemes in the district, out of which 81 are fitted with electric pumps and the rest with hand pumps. In addition to this, 3994 dugwells are also the main source of water

supply, out of which 1762 are public and 2237 are private dugwells.

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 of 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

The entire district is underlain by Deccan Trap Basalt. The central and western parts of the district comprising parts of Risod, Malegaon, Washim, Mangrulpir and Manora talukas have low ground water development potential. The areas with medium ground water development potential are observed in northern part of the district comprising entire Karanja and northern parts of Mangrulpir and Manora talukas. The southern parts of the district comprising parts of Risod and Washim talukas have high ground water development potential. In these areas the ground water can be developed through dugwells, dug-cum-bored wells (DCB) and borewells. The yield of dugwells in the district may be expected from 20 to 120 m³/day depending on the local hydrogeological conditions.

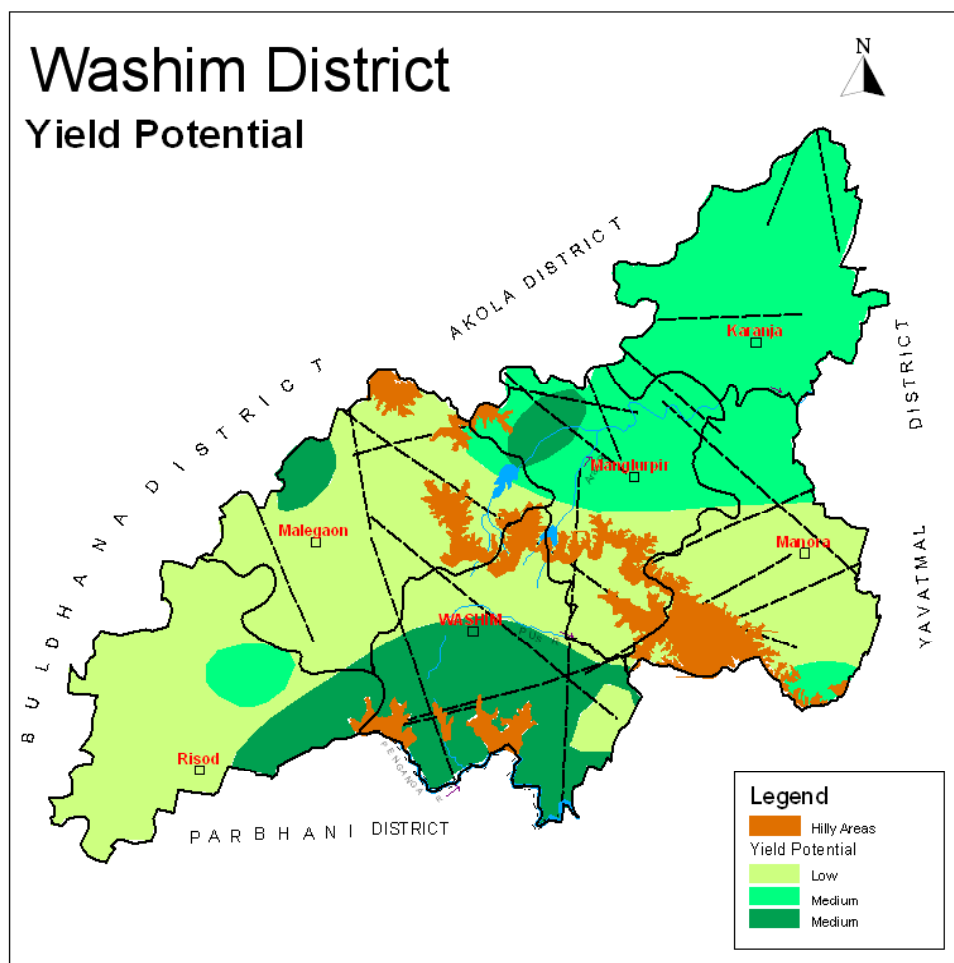


Figure-6: Yield Potential of Aquifers

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 Aquifer	Yield Potential	Type of Wells Suitable
1.	Karanja	Basalt	Medium	Dugwell DCB
2.	Malegaon	Basalt	Low	Dugwell DCB
3.	Mangrulpir	Basalt	Low to Medium	Dugwell DCB
4.	Manora	Basalt	Low to Medium	Dugwell DCB
5.	Risod	Basalt	Low	Dugwell DCB
6.	Washim	Basalt	Low to High	Dugwell DCB

5.2 Water Conservation and Artificial Recharge

A large number of water conservation structures in the form of check dams, percolation tanks and KT weirs have been constructed in the district. As per the data available for year 2001, 117 percolation tanks had been constructed with total storage capacity of 21 MCM. KT weirs at 110 locations and 21 diversion dams have also been constructed. As a part of soil and land conservation measure, 2806 bushwood dams, 3125 line check dams, 14550 loose boulder dams 4201 gully plugs/earthen dams, 884 earthen nala bunds, 693 cement nala bunds and 318 underground bandharas have also been constructed.

In Basaltic area, the artificial recharge structures feasible are check dams, gully plugs, percolation tanks, nalla bunds, etc. The structures like gully plugs, contour bunds are most favourable in the hilly area located in the central parts, in parts of Malegaon, Mangrulpir, Washim and Malegaon. Existing dugwells can also be used for artificial recharge, however, the source water should be properly filtered before being put in the wells.

These sites need to be located where the hydrogeological conditions are favourable, i.e., where sufficient thickness of unsaturated/de-saturated aquifer exists and water levels are more than 5 m deep.

6.0 Ground Water Related Issues and Problems

The rainfall data analyses for the period 1901-2001 indicates drought area in the western part of the district i.e., in major part of Risod taluka with moderate drought occurring for 20% of years during the period. The normal annual rainfall during the period is also minimum in this part. Thus future water conservation and artificial recharge structures in the district may be prioritised in this part of the district. Ground water quality is adversely affected by nitrate contamination in 94% of the samples collected in May 2006. Continues intake of high nitrate concentration water causes infant methaemoglobinemia, popularly known as Blue Babies disease. Thus all the

wells used for water supply should be first analysed for nitrate contents and if the nitrate content is found beyond permissible limit the ground water may be used for other purposes than drinking. Adequate sanitary protection to the wells may be provided to control the nitrate contamination.

7.0 Mass Awareness and Training Activities

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

Till March 2007, 1 MAP and 1 WMTP had been organised in the district at Washim. 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	MAP	2006-07	Washim	25/01/07	300
2	WMTP	2006-07	Washim.	23 & 24/01/07	45

7.2 Participation in Exhibition, Mela, Fair etc.

During the MAP and WMTP at Washim, an exhibition depicting rainwater harvesting model, various ground water related posters, leaflets, literature and technical reports were displayed along with maps of Washim 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 The entire district is underlain by the Deccan Trap Basalt where only dugwells are most feasible structures for ground water development. The sites for borewell 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 contamination in 94% of the samples collected in May 2006. Thus all the wells used for water supply should be first analysed for nitrate contents and if the nitrate content is found beyond permissible limit the ground water may be used for other purposes than drinking. Adequate sanitary protection to the wells may be provided to control the nitrate contamination.
- 4 The overall stage of ground water development for the district is only 38%, therefore, scope for further development of ground water resources exists.
- 5 The southern parts of the district comprising parts of Risod and Washim talukas have high ground water development potential. In these areas the ground water can be developed through dugwells, dug-cum-bored wells and borewells. The yield of dugwells in the district may be

expected from 20 to 120 m³/day depending on the local hydrogeological conditions.

- 6 Drought and deeper water levels area has been observed in south-western parts of Risod taluka. Thus future water conservation and artificial recharge structures needs to be prioritised in these parts of the district.
- 7 The scope exists for constructing of suitable artificial recharge structures in the district. The structures recommended for the hilly-Basaltic area in the central parts in parts of Malegaon, Mangrulpir, Washim and Malegaon are: contour bunds, gully plugs, nala bunds and check dams. For other Basaltic areas, the nala bunds, check dams and KT weirs are suggested. The existing dugwells may also be used for artificial recharge of ground water provided source water is free of silt and dissolved impurities.
- 8 The existing village ponds need to be rejuvenated to act both as water conservation and artificial recharge structures.