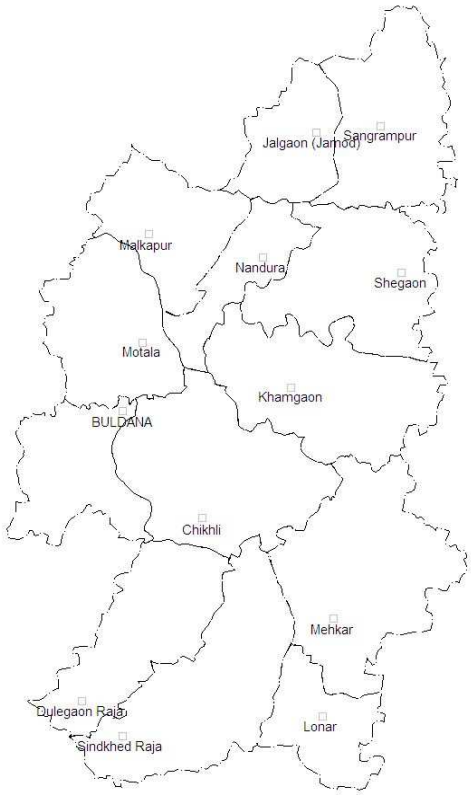
जल वर्ष 2007 Water Year 2007

स्वच्छ सुरक्षित जल – सुन्दर खुशहाल कल

CONSERVE WATER - SAVE LIFE

GOVT OF INDIA
MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD

GROUND WATER INFORMATION
BULDHANA DISTRICT
MAHARASHTRA



CENTRAL REGION
NAGPUR
2007

BULDHANA DISTRICT AT A GLANCE

1. GENERAL INFORMATION

Geographical Area	:	9670 sq. km.
Administrative Divisions (As on 31/03/2007)	:	Taluka- 13, Buldhana, Mohala, Malkapur, Nandura, Jalgaon (Jamod), Sangrampur, Shegaon, Khamgaon, Chikhli, Mehkar, Lonar, Sindkhed Raja and Deulgaon Raja.
Villages	:	1427
Population	:	22,32,480
Normal Annual Rainfall	:	500 to 900 mm

2. GEOMORPHOLOGY

Major Physiographic unit	:	Three; Satpudas, Purna plains and Ajanta ranges.
Major Drainage	:	Two: Purna and Penganga

3. LAND USE

Forest Area (2001-02)	:	561 sq. km.
Net Area Sown (2000-01)	:	6582 sq. km.
Cultivable Area (2000-01)	:	7264 sq. km.

4. SOIL TYPE

3 Types- a) Shallow and gravelly reddish soil of Satpudas; b) Deep and clayey black soil of Purna Alluvium and c) Shallow and black, brown or reddish soils of Ajanta ranges.

5. PRINCIPAL CROPS (2001-02)

Wheat	:	214 sq. km.
Jowar	:	1513 sq. km.
Total Pulses	:	2025 sq. km.
Cotton	:	2647 sq. km.

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

Dugwells	:	62354/136354
Borewells	:	621/1396
Tanks/Ponds	:	591/1853
Other Minor Surface Sources	:	1170/3036
Net Irrigated Area	:	66533 ha

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

Dugwells	:	34
Piezometers	:	1

8. GEOLOGY

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

9. HYDROGEOLOGY

Water Bearing formation	:	Basalt-Weathered/fractured/ jointed vesicular/massive, under phreatic and semi-confined to confined conditions. Alluvium- Sand and Gravel under semi-confined to confined conditions.

Premonsoon Depth to Water Level	:	3.25 to 27.70 m bgl (May-2006)
Postmonsoon Depth to Water Level	:	0.10 to 7.83 m bgl (Nov-2006)
Premonsoon Water Level Trend (1997-2006)	:	Rise:0.01 to 0.60 m/year Fall: Negligible to 0.67 m/year
Postmonsoon Water Level Trend (1997-2006)	:	Rise: 0.02 to 0.49 m/year Fall: 0.01 to 1.97 m/year

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

Wells Drilled	:	EW-44, OW-16, Pz-4
Depth Range	:	19.55 to 311.20 m bgl
Discharge	:	Traces to 14.89 lps
Storativity	:	1.09×10^{-3} to 3×10^{-6} (Alluvium) 8×10^{-8} to 4.2×10^{-2} (Basalt)
Transmissivity (m^2/day)	:	0.89 to 1575m^2/day (Alluvium) 8.35 to 396 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	:	695.95 MCM
Total Draft (Irrigation + Domestic)	:	416.44 MCM
Projected Demand (Domestic + Industrial)	:	49.69 MCM
Stage of GW Development	:	59.84 %

13. AWARENESS AND TRAINING ACTIVITY

A	Mass Awareness Programme	:	One
	a. Date		26/03/06
	b. Place	:	Jalgaon (Jamod)
	c. Participants	:	200
B	WMTP	:	One
	a. Date	:	24 & 25/03/07
	b. Place	:	Shegaon
	c. Participants	:	75

14. ARTIFICIAL RECHARGE & RAINWATER HARVESTING

Projects Completed	:	Nil
Projects under Technical Guidance	:	Nil

15. GROUND WATER CONTROL & REGULATION

Over-Exploited Taluka	:	1, Jalgaon (Jamod)
Critical Taluka	:	None
Notified Taluka	:	None

16. MAJOR GROUND WATER PROBLEMS AND ISSUES

Northern part of the district comprising of Jalgaon (Jamod) and the southern part comprising of Chikhli, Mehkar, Donegaon and Deolgaon Raja talukas comes under “Drought Area”. Deeper water levels of more than 20 m bgl are observed in parts of Malkapur, Nandura and Jalgaon (Jamod) talukas. Ground water quality is adversely affected by nitrate contamination. In small north eastern part of Shegaon taluka brackish to saline ground water is observed.

Ground Water Information
Buldhana District

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Buldhana District

1.0 Introduction

Buldhana is the western most district of Vidarbha. It lies between 19°51' and 21°17' north latitudes and 75°57' to 76° 59' east longitudes and falls in Survey of India Toposheets 55-A, 55-C, 55-D and 55-P. The district covers an total geographical area of 9661.00 sq.km. It is surrounded by Madhya Pradesh State in the north, on the east by Akola district, on the south by Parbhani district, in the west by Aurangabad and Jalgaon district and in the north east by Amravati district.

The district headquarters is located at Buldhana Town. For administrative convenience, the district is divided in 13 talukas viz, Buldhana, Motala, Malkapur, Nandura, Jalgaon (Jamod), Sangrampur, Shegaon, Khamgaon, Chikhli, Mehkar, Lonar, Sindkhed Raja, Deulgaon Raja. The population of Buldhana district is 22,32,480 persons and the population density is 230 persons/sq.km. as per the 2001 census. Agriculture is the main occupation of the people. The district forms part of Godavari and Tapi basin. Purna and Penganga Rivers are the main rivers flowing through the district.

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

Table 1: Studies undertaken by CGWB.

S. No.	Year	Surveyed area	Work done
1.	1982-83	Northern part around Jalgaon (Jamod), Sangrampur, Nandura and Shegaon.	Systematic Hydrogeological Survey
2.	1984-85	Middle part around Chikhli and Mehkar	-do-
3.	1987-88	Northern part around Madhya Pradesh boundary	-do-
4.	1988-89	Central part around Khamgaon	-do-
5.	1990-91	Western part around Motala and Malkapur	-do-
6.	1990-91	South-Western part around Deolgaon Raja and Sindkhed Raja	-do-
7.	1990-91	South-Eastern part around Lonar	-do-
8.	1995-96	Middle-Eastern part around Khamgaon	Reappraisal Hydrogeological Survey
9.	2006-07	Entire District	-do-

A report on hydrogeology of the district was first compiled in 1991 and in 2005 Shri S.K. Bansal, Sc-D, compiled the report entitled "Ground Water Resources and Development Potential of Buldhana District, M.S."

Apart from above studies, Ground water exploration in the district has also been taken up in different phases. The exploratory drilling programme in Buldhana district started in the year 1984 and continued from time to time and

a total of 60 wells have been drilled in the district. Pumping test to determine aquifer parameters were also conducted at 13 sites. The taluka wise salient features of ground water exploration are given in **Table-2**.

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.	Buldhana	Basalt	2	0	0	200.00	1.75-42.80	<0.14-0.38	-	8.00-62.00
2.	Chikhli	Basalt	5	0	0	160.00-200.00	8.10-12.40	0.38	13.70	Traces-2.16
3.	Deulgaon Raja	Basalt	3	0	0	200.00	>50.00	Traces	-	13.00-183.00
4.	Jalgaon Jamod	Alluvium	2	2	1	34.40-300.41	5.05-9.66	0.50-8.30	10.89-33.34	7.70-103.00
		Basalt	1	2	0	19.55-135.45	10.50-35.64	0.38-6.81	-	9.00-70.00
5.	Khamgaon	Basalt	4	0	0	153.75-200.00	0.78-5.23	Traces-0.14	20.00-20.31	10.00-93.00
6.	Lonar	Basalt	3	0	0	200.00	8.20	Traces-0.14	-	15.00-46.00
7.	Malkapur	Basalt	2	0	0	200.00	5.66-9.45	Traces-0.14	-	12.00-17.00
8.	Mehkar	Basalt	3	1	0	200.00	2.08-6.23	0.50-3.77	0.60-32.88	5.00-163.00
9.	Motala	Basalt	5	1	0	60.20-200..00	1.14-29.07	0.14-14.89	4.26	12.00-125.00
10.	Nandura	Basalt	2	2	0	26.65-200.00	19.03->50.00	Tarces-12.18	-	13.00-168.00
11.	Shegaon	Basalt	2	3	0	56.15-200.00	6.42-7.85	0.38-12.18	13.90-15.84	15.00-158.00
12.	Sindkhed Raja	Basalt	2	3	0	26.25-200.00	3.33-4.83	0.38-10.98	3.73-6.75	7.00-143.00
13.	Sangram-pur	Alluvium	6	2	3	61.50-311.20	3.57-18.00	0.08-10.00	0.55-38.00	8.00-302.00
		Basalt	1	1	0	123.25-160.00	-	5.94	-	33.00-117.00
	Total		44	16	4	19.55-311.20	1.75->50.00	Traces-14.89	0.37-38.00	8.00-302.00

In hard rock areas of the district occupied by Basalt, 35 exploratory wells (EW) and 12 observation wells (OW) were drilled during the period 2000-2003. The depth of the wells ranged from 19.55 to 200.00 m bgl. The discharge from these wells varied from traces to 14.89 lps, and 16 wells, i.e., 34% wells were found to be high yielding with discharge > 3 lps. Static water levels ranged from 1.75 to > 50.00 m bgl. Deeper aquifer zones have been encountered in most of the wells beyond 100 m depth, the deepest being at 168.0 m at Wadi exploratory well.

In Alluvial area 9 EW, 4 OW and 4 Peizometers (Pz) were constructed. The thickness of Alluvium is more than 300 m and the depth of the wells ranged from 61.50 to 311.20 m bgl. The discharge from these wells varied from traces to 10 lps. Static water levels ranged from 3.57 to 16.65 m bgl. Aquifer zones have been encountered in the wells down to the depth of 302 m, thus establishing that ground water occurs under confined conditions even down to the depth of 300 m, however the yields of the deeper zones below 80

m are restricted as they occur in the older Alluvium, which is more clayey. The younger Alluvium, which occurs down to the depth of 70 – 80 m bgl, is more productive than the older Alluvium. This zone can be used for agricultural purposes by means of shallow tubewells constructed down to the depth of 65-70 m and yielding up to 10 lps for 30 m lift.

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

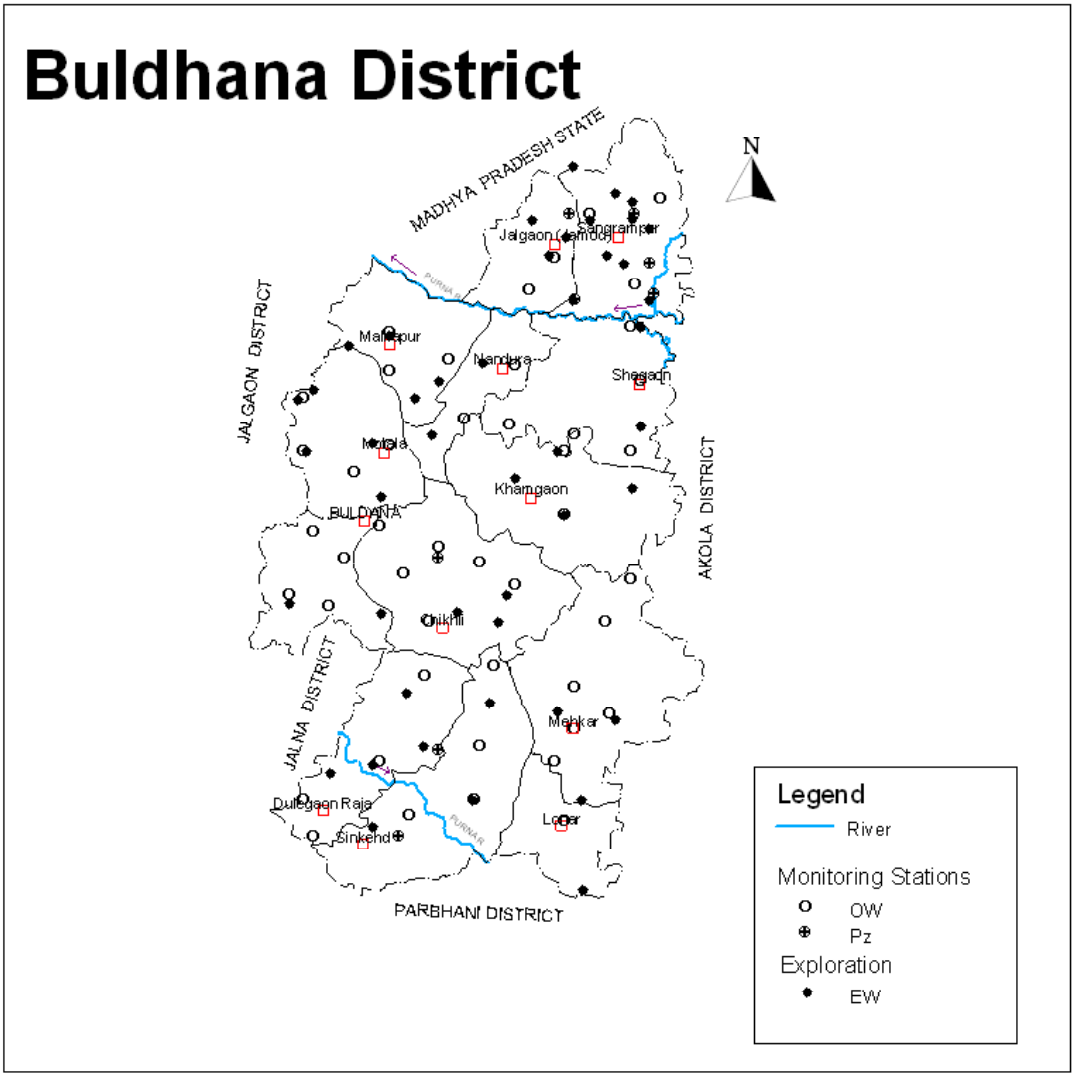

Figure-1: Location

2.0 Climate and Rainfall

The Climate of the district is 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 13℃ and mean maximum temperature is 42.3℃.

The normal annual rainfall over the district ranges from 711 mm to 911 mm. It is the minimum in the northern parts of the district around Malkapur (711 mm) and Jalgaon (Jamod) (719 mm). The average annual rainfall of last ten years (1996-2005) in the district varied from 539 mm (Nandura) to 845 mm (Sindkhed Raja) 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
Buldana	839.00	778.80	778.80	684.60	563.00	734.80	1324.00	831.70	655.20	629.00	**781.89**
Chikhli	704.00	675.00	675.00	687.30	615.40	752.20	879.80	635.90	662.20	832.00	**711.88**
D.Raja	632.40	471.00	471.00	650.20	748.80	746.60	690.40	719.00	643.00	697.50	**646.99**
Mehkar	775.00	573.00	573.00	1126.00	771.00	1065.00	876.00	579.00	599.80	647.00	**758.48**
Lonar	815.00	543.00	543.00	950.00	653.00	1185.00	1033.00	491.00	553.00	761.00	**752.70**
S.Raja	653.80	486.00	486.00	909.00	795.80	1287.00	1286.00	932.00	815.00	799.00	**844.96**
Malkapur	694.40	796.00	796.00	489.00	571.00	524.00	1029.00	702.00	678.00	446.00	**672.54**
Motala	718.60	656.20	656.20	644.80	626.00	689.00	970.00	891.00	541.00	345.00	**673.78**
Nandura	547.00	384.00	384.00	439.00	572.00	649.00	1075.40	496.00	465.00	376.00	**538.74**
Khamgaon	674.20	407.60	407.60	739.80	621.00	691.50	775.50	477.40	459.20	595.80	**584.96**
Shegaon	695.80	663.40	663.40	580.00	660.10	790.10	1007.00	556.70	378.60	591.90	**658.70**
Jalgaon	784.40	812.00	812.00	511.00	558.00	553.60	1109.00	702.00	521.00	409.00	**677.20**
Sangrampur	781.00	750.00	750.00	487.00	520.00	549.50	905.00	922.00	380.00	543.00	**658.75**
Average	**716.51**	**615.08**	**615.08**	**684.44**	**636.55**	**785.95**	**996.93**	**687.36**	**565.46**	**590.17**	**689.35**

The average annual rainfall for the last ten years when compared with the normal annual rainfall, it is observed that the average rainfall is much less than the normal annual rainfall, except during 2002 when it has exceeded the normal annual rainfall. Thus the rainfall has definitely decreased in the district over the period of time.

3.0 Geomorphology and Soil Types

Physiographyically the district falls under three structural cum physical units. In the north is a hilly strip of the Satpudas, Purna plains in the middle and the Ajanta range comprising Buldhana plateau in the south. The northern region forms a part of Satpudas or Gawilgarh hills, which rise to general elevations of 600 to 700 m above mean sea level (amsl) with occasional peaks rising up to 1000 m amsl or more. Purna plain is the main lowland region of the district, with average elevation ranging between 250 and 270 m amsl. The Ajanta range carrying on its flat top high level mesa of Buldhana plateau covers the southern part of the district. The edge of this plateau, over looking the Purna plains to its north, is a hilly ghat with average elevations of 500 to 600 m amsl. The northern part of the district falls under Tapi basin and consists of 34 watersheds, whereas the southern part falls in Godavari basin and consists of 23 watersheds.

The Satpudas have shallow, gravely and stony reddish soils. The soil over the piedmont deposits is coarse, highly friable and is locally known as Malli soil and is well suited for horticulture. To the south of the Satpuda piedmont, the Alluvial plains are covered by deep Alluvial soil, locally known as Bharkali soil, which are deep black, very fine in texture and highly retentive of moisture. Southwards away from the river, the soils are replaced by Kali regular soils, which are moderately deep. The soils of the plateau are Bhorandi or Khelk, a thin yellowish coarse soil, often less than half meter deep. The upper plateau is generally covered by shallow, black, brown or reddish soil. These are locally known as Barad soils.

4.0 Ground Water Scenario

4.1 Hydrogeology

Deccan Trap lava flows and Purna Alluvium are the major water bearing

formations of Buldhana district. A map depicting the hydrogeological features is shown in **Figure-2**.

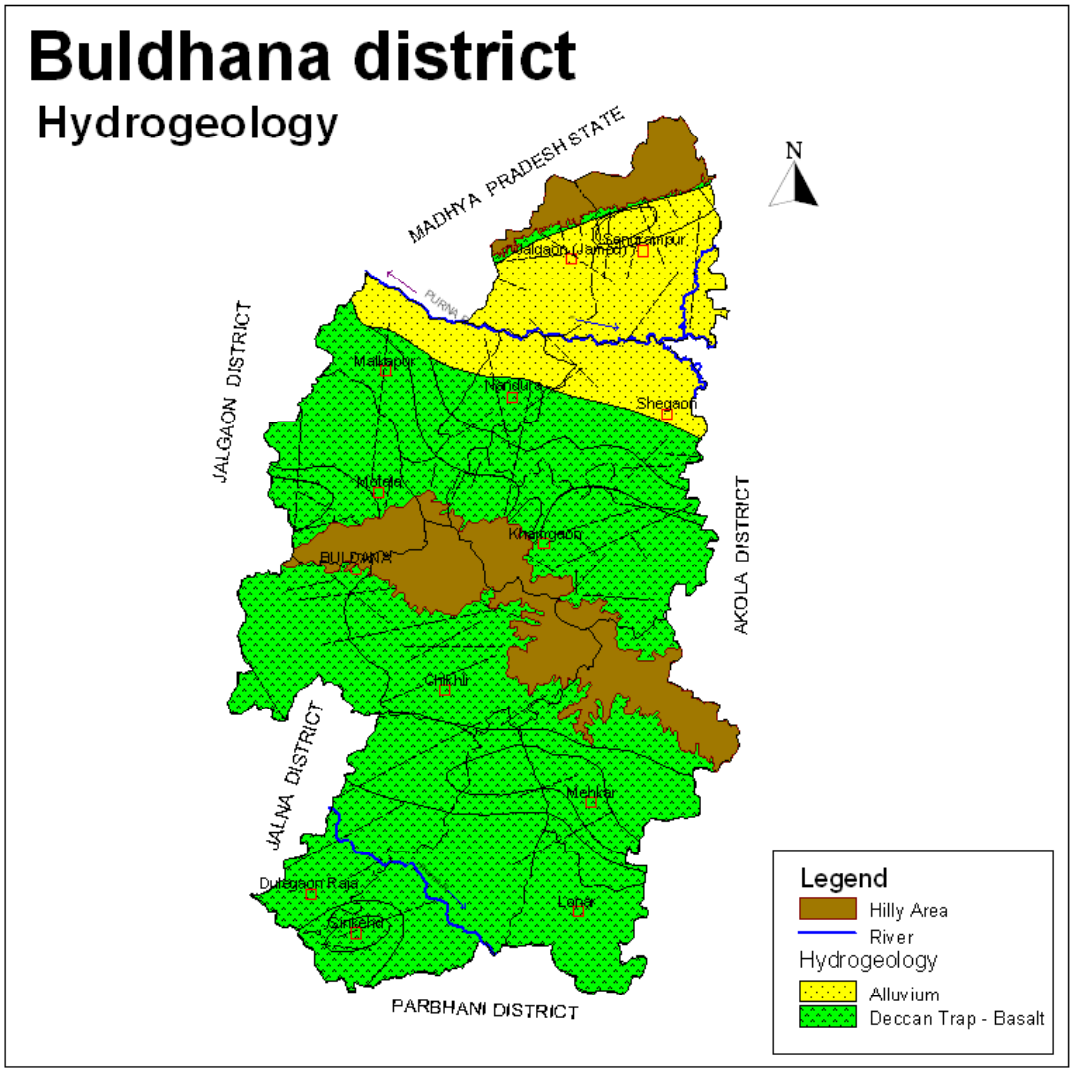

Figure-2: Hydrogeology

4.1.1 Deccan Trap Basalt

Major part of the district is covered by basaltic lava flows of upper Cretaceous to lower Eocene age. The Deccan lava sequence is grouped under Satpura group in the northern part whereas in southern part it is grouped under Sahyadri group.

Deccan Trap Basalt forms an important water bearing formation of the district. The disposition of vesicular unit and massive unit of different lava flows has given rise to multi layered aquifer system. The water bearing capacity of Vesicular Basalt largely depends upon size and shape of vesicles, density of vesicles and the degree of inter connection of vesicles. Massive Basalt generally does not possess primary porosity. However, Massive Basalt, which is fractured, jointed and weathered posses' water bearing capacity. Degree of weathering and topographic setting also plays a major role in respect of productivity. In Basalt, ground water occurs both in Vesicular and Massive Basalt as well as inter flow zones in weathered mantle, fractured

zones. In general ground water occurs under water table conditions in shallow aquifer and semi-confined to confined conditions in deeper aquifer. The unconfined aquifer is developed due to the weathering and jointing of upper flow in Basalt down to depth of 15-20 mbgl.

4.1.2 Alluvium

The northern part of the district on either side of Purna River is underlain by thick Alluvial deposits of Pleistocene to Recent age and is termed as Purna Alluvium. The Alluvium is also observed in a small patch southwest of Malkapur and east of Khamgaon along the boundaries of district. The Alluvial valley lies in narrow belt and covers roughly about 1800 sq. km. The valley extends about 51 sq.km. in Buldhana district and it tapers towards the western end.

In Alluvial deposits, inter pore spaces in sand and gravel renders them a high degree of porosity and permeability to make them a good ground water reservoir. However lithological variation results in variable water yielding capacity depending upon the sand-clay ratio. Purna Alluvium has a proven thickness of more than 300 meters. Based on studies the entire thickness of Alluvium has been divided into younger Alluvium and older Alluvium. The younger Alluvium contains comparatively more sand layers and thus forms good aquifer. The older Alluvium, which is more clayey with thin horizons of sand and silt forms a comparatively lesser potential aquifer. In younger Alluvium ground water generally occurs in confined to semi-confined conditions in the depth range of 11-40 m bgl, while in older Alluvium it occurs under confined conditions below the depth of 40 m.

4.1.3 Water Level Scenario

Central Ground Water Board periodically monitors 40 National Hydrograph Network Stations (NHNS) stations in the Buldhana 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 trend (1997-06) is given in **Table- 4**.

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

S. No.	Location	Pre-monsoon WL (m bgl)	Post-monsoon WL (m bgl)	Fluctuation (m)	Premonsoon Trend		Postmonsoon Trend	
					Rise (m/yr)	Fall (m/yr)	Rise (m/yr)	Fall (m/yr)
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
1	Amdapur	10.39	6.33	4.06		0.37		0.16
2	Bibi	7.10	0.70	6.40	-	-	-	-
3	Buldhana	10.16	1.26	8.90		0.59		0.06
4	Datala	13.34	13.20	0.14	0.01			0.52
5	Deolgaon (Sakarsha)	10.00	5.21	4.79		0.10		0.03
6	Deolgaon Mahi	7.35	4.02	3.33		0.02		0.06
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
7	Deolgaon Raja	6.60	1.50	5.10	0.58		0.49	
8	Dhad	12.05	3.48	8.57		0.27	0.11	
9	Dhamangaon	10.40	2.85	7.55		0.67		0.20

S. No.	Location	Pre-monsoon WL (m bgl)	Post-monsoon WL (m bgl)	Fluctuation (m)	Premonsoon Trend		Postmonsoon Trend	
					Rise (m/yr)	Fall (m/yr)	Rise (m/yr)	Fall (m/yr)
1	2	3	4	5	6	7	8	9
10	Dighi	27.70	14.26	13.44	-	-	-	-
11	Dongar Khandala	5.30	-	-		0.36		0.11
12	Garadgaon	6.28	1.06	5.22	0.40			0.14
13	Hatedi	8.40	2.23	6.17		0.20		0.16
14	Jalgaon Jamod	-	-	-		0.54		0.82
15	Karwand	3.25	1.41	1.84	0.06		0.08	
16	Kelwad	7.05	1.65	5.40		0.09		0.04
17	Khamgaon	8.15	2.27	5.88		0.17	0.06	
18	Kingaon Raja	6.45	1.56	4.89	0.04		0.16	
19	Kolori	11.40	3.93	7.47	0.05			0.30
20	Laohala	10.00	3.18	6.82	0.24			0.26
21	Lokhanda	7.45	3.02	4.43		0.09		0.09
22	Lonar1	9.50	3.53	5.97	0.60			1.97
23	Mehkar	11.70	8.24	3.46	0.02			0.12
24	Mera Khurd	11.43	7.05	4.38	0.10		0.02	
25	Motala	7.22	1.67	5.55		0.09	0.03	
26	Nandura	15.10	15.10	0.00	0.14		0.03	
27	Naygaon	6.05	3.30	2.75		0.10		0.38
28	Padali	8.85	4.47	4.38		0.002		0.32
29	Paturda	9.70	8.10	1.60	0.06			0.39
30	Pimpalgaon Devi	10.30	4.55	5.75		0.38		0.15
31	Pimpalgaon Raja	17.35	12.57	4.78	0.02		0.13	
32	Rohinkhed	13.32	9.55	3.77	0.13			0.17
33	Sailani	12.20	2.25	9.95		0.03	0.18	
34	Sendurjana		1.90			0.26		0.01
35	Shegaon	9.75	2.05	7.70		0.38		0.04
36	Sindkhed Raja	15.70	0.10	15.60		0.54	0.34	
37	Sonala	-	-	-		0.03		0.53
38	Sultanpur	8.33	2.12	6.21		0.53		0.20
39	Tarvadi	11.10	5.40	5.70	0.12			0.28
40	Wanawand	14.75	-	-		0.17		0.38

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

The depth to water level in the district during May 2006 ranges between 3.25 (Karand) and 27.70 m bgl (Dighi). Depth to water level during premonsoon (May 2006) has been depicted in **Figure-3**. Shallow water levels, within 10 m bgl are seen in major part of the central and southern areas of the district, i.e., in major parts of Deulgaon Raja, Sindkhed Raja, Lonar Mehkar, Buldhana, Chikhali, Khamgaon and Motala talukas. Water levels of 10-20

mbgl are observed in major northern Alluvial part of the district i.e., in major parts of Sangrampur, Jalgaon (Jamod), Malkapur, Nandura and Shegaon talukas. Water levels in the range of 10 to 20 m bgl are also observed in southeastern part of the district in parts of Lonar, Mehkar and Khamgaon talukas and in northwestern part of the district in parts of Buldhana and Deolgaon Raja talukas. Deeper water levels of more than 20 m bgl are observed in restricted northwestern part of the district in parts of Malkapur, Nandura and Jalgaon (Jamod) talukas. Thus water levels through out the district are within 20 m bgl, except in small areas in northwestern part where they are more than 20 m bgl.

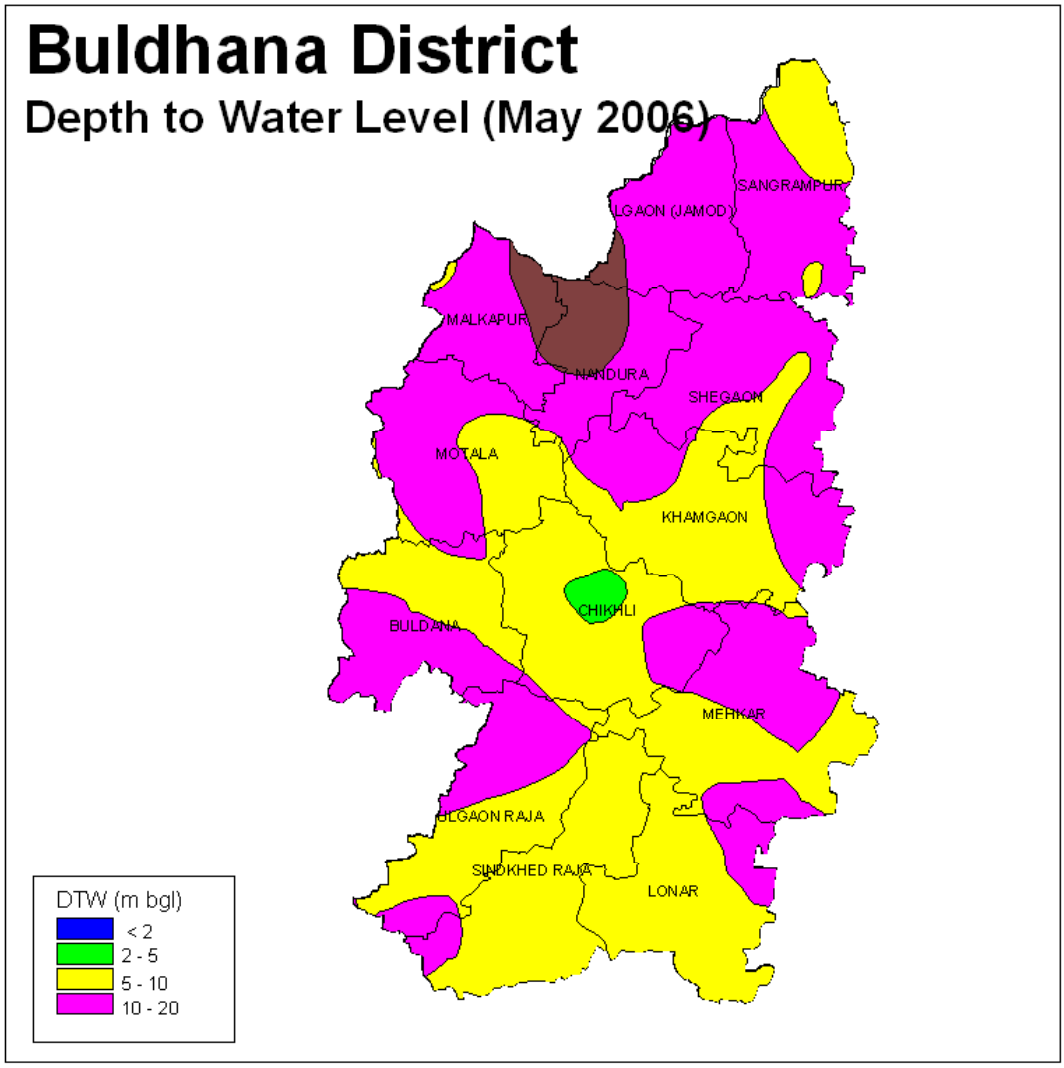

Figure-3: Depth to Water Level (Premonsoon- May 2006)

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

The depth to water level during postmonsoon (Nov. 2006) ranges between 0.10 m bgl (Sindkhed Raja) and 15.10 m bgl (Nandura). Spatial variation in post monsoon depth to water level is shown in **Figure-4**. Shallow water levels within 10 m bgl occupy almost entire district in south, central and northeastern parts. Water levels between 10 and 20 m bgl are observed in north western Alluvial areas of the district, occupying major parts of Malkapur, Nandura and Jalgaon (Jamod) talukas and small areas in eastern parts of

Sangrampur and Shegaon talukas.

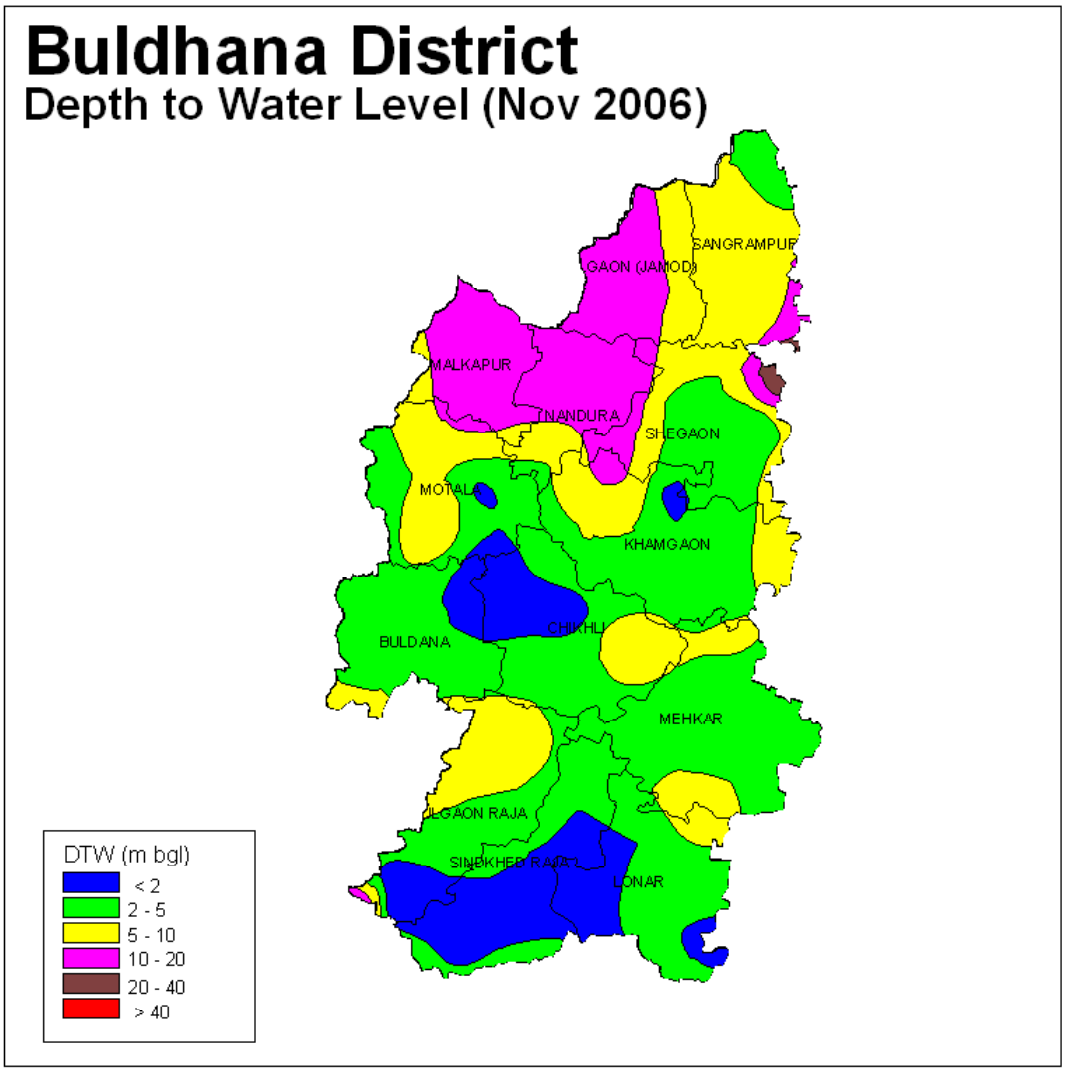

Figure-4: Depth to Water Level (Postmonsoon- Nov. 2006)

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

In entire district rise in water levels in the range of 0.14 (Datala) to 15.60 m (Sindkhed Raja) is observed with rise of more than 4 m being the most dominant range observed in entire southern, central and northwestern areas occupying major parts of Deolgaon Raja, Sindkhed Raja, Lonar, Mehkar, Chikhli, Buldhana, Khamgaon, Motala, Shegaon, Nandura and Malkapur talukas. Rise of 2 to 4 m is observed in patches in small parts of Deolgaon Raja, Mehkar, Chikhli, Khamgaon, Malkapur and Motala and in major parts of Sangrampur and Jalgaon (Jamod) talukas. Rise in water levels in the range of 0 to 2 m is occupies very small isolated patches in parts of Malkapur, Nandura and Shegaon talukas.

4.1.3.4 Water Level Trend (1997-2006)

Trend of water levels for premonsoon and postmonsoon period for last ten years (1997-2006) have been computed for 38 NHNS and are given in **Table-4**.

Analysis of trend indicates that during pre monsoon period, rise in water

level has been recorded at 15 stations and it ranges between 0.01 m/year (Datala) and 0.60 m/year (Lonar-1). Fall in water level has been observed at 23 stations and it ranges between negligible at Padali and 0.67 m/year at Dhamangaon. During postmonsoon period, rise in water levels has been recorded at 11 stations and it ranges from 0.02 m/year (Mera Khurd) to 0.49 m/year (Deolgaon Raja), whereas at 27 stations, fall in water level ranging between 0.01 m/year (Sendurjana) and 1.97 m/year (Lonar-1) is observed. Thus in major part of the district, both during pre and postmonsoon periods declining trends of water levels have been observed.

4.1.4 Aquifer Parameters

To determine the aquifer parameters, 5 pumping tests in Alluvial area and 8 pumping tests in hard rock area (Basalt) have been conducted in the past on exploratory wells. Based on these tests, it was observed that in Alluvium the transmissivity ranges from 0.89 to 1575.96 m^2/day and the storativity ranges from 1.09×10^{-3} to 3.00×10^{-6}. The transmissivity in Basalt ranges from 8.35 to 395.85 m^2/day and the storativity varies between 8×10^{-8} and 4.2×10^{-2}.

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 Buldhana district based on GEC-97 methodology. The same is presented in **Table-5**. Ground Water Resources assessment was done for 7709.11 sq. km. area of which 481.09 sq. km. is under command and 6671.01 sq. km. is non-command. About 557 sq. km. area comes under poor ground water quality. Taluka wise ground water resources are shown in **Figure-5.**

As per the estimation, the total annual ground water recharge is 732.57 MCM with the natural discharge of 36.62 MCM, thus the net annual ground water availability comes to be 695.95 MCM. The gross draft for all uses is estimated at 416.44 MCM with irrigation sector being the major consumer having a draft of 387.58 MCM. The domestic and industrial water requirements for the next 25 years are worked out at 49.69 MCM. The net ground water availability for future irrigation is estimated at 248.54 MCM.

The stage of ground water development varies from 38.45% (Mehkar) to 121.65% (Jalgaon-Jamod). The overall stage of ground water development for the district is 59.84%. As per estimation, Jalgaon (Jamod) taluka falls in “Over-Exploited” category, Buldhana in “Semi-Critical” category whereas remaining 11 talukas fall in “Safe” category. Out of the total 57 watersheds, 2 watersheds (PT-10 and PT-11) fall under “Over-Exploited” category; 1 watershed (GP-1) falls under “Critical” category; 11 watersheds (PT-8, PT-12, PT-16, PTB-1, PTV-2, GP-1, GPD-1, GPD-2, PG-1, PG-2, PG-4) fall under “Semi-Critical” category while remaining 43 watersheds fall under “Safe” Category.

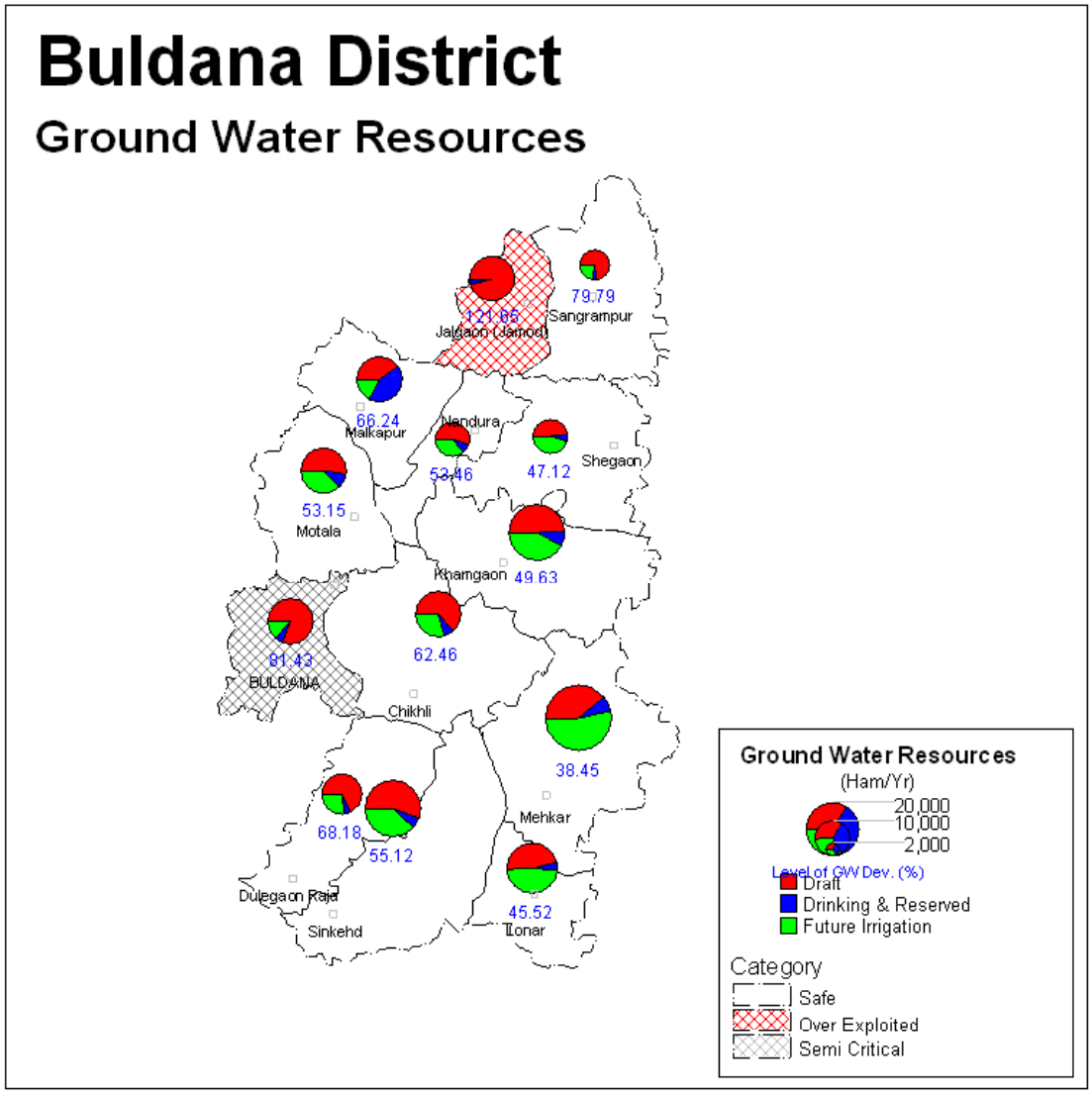

Figure-5: Ground Water Resources

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 Ground water Draft for All uses (ham/yr)	Allocation for domestic & industrial requirement supply up to next 25 years (ham/yr)	Net Ground water Availability for future irrigation development (ham/yr)	Stage of Groundwater Development (%)
1	2	3	4	5	6	7	8	9
BULDHANA	C	503.21	719.48	39.14	758.61	12.33	36.45	150.76
	NC	4935.66	3416.86	253.47	3670.33	307.59	650.61	74.36
	TOTAL	5438.87	4136.34	292.61	4428.95	319.92	687.06	81.43
CHIKHALI	C	87.70	92.46	11.22	103.68	4.16	17.04	118.22
	NC	5824.66	3295.07	294.19	3589.26	442.71	1668.51	61.62
	TOTAL	5912.36	3387.53	305.41	3692.94	446.86	1685.55	62.46
DEULGAON RAJA	C	311.18	259.56	15.16	274.72	9.05	106.55	88.28
	NC	3811.31	2410.07	125.76	2535.83	211.81	991.58	66.53
	TOTAL	4122.49	2669.63	140.93	2810.56	220.86	1098.13	68.18
MALAKAPUR	C	681.86	785.30	69.15	854.45	63.01	131.34	125.31
	NC	2740.65	1305.99	106.52	1412.51	262.31	750.03	51.54
	TOTAL	3422.51	2091.29	175.67	2266.96	325.32	881.37	66.24
NANDURA	C	314.45	369.77	25.26	395.03	20.73	67.68	125.63
	NC	3345.46	1436.32	125.12	1561.43	310.34	1190.06	46.67
	TOTAL	3659.91	1806.09	150.38	1956.46	331.07	1257.74	53.46
MOTALA	C	719.65	633.80	69.87	703.67	55.40	190.22	97.78
	NC	4373.23	1793.42	209.72	2003.14	491.98	1761.09	45.80
	TOTAL	5092.88	2427.22	279.59	2706.81	547.38	1951.31	53.15

1	2	3	4	5	6	7	8	9
KHAMGAON	C	1270.31	907.93	84.17	992.10	88.03	344.81	78.10
	NC	5920.74	2337.45	239.51	2576.96	537.86	2737.76	43.52
	TOTAL	7191.05	3245.38	323.68	3569.06	625.89	3082.58	49.63
SHEGAON	C	573.24	444.60	35.17	479.77	31.40	131.13	83.69
	NC	3237.11	1210.39	105.42	1315.81	245.15	1581.83	40.65
	TOTAL	3810.36	1654.99	140.59	1795.58	276.55	1712.96	47.12
JALGAON	C	165.05	141.54	12.14	153.68	6.26	12.08	93.11
	NC	4336.53	5123.08	199.46	5322.54	204.40	481.66	122.74
	TOTAL	4501.58	5264.62	211.60	5476.22	210.67	493.74	121.65
SANGRAMPUR	NC	2560.70	1966.24	77.05	2043.29	119.78	592.20	79.79
MEHKAR	C	384.67	362.48	26.49	388.97	14.43	130.81	101.12
	NC	9577.52	3097.55	344.14	3441.69	732.53	5243.34	35.94
	TOTAL	9962.20	3460.02	370.63	3830.66	746.95	5374.15	38.45
LONAR	C	986.20	948.77	59.57	1008.34	35.85	337.19	102.24
	NC	5325.52	1762.91	101.87	1864.78	279.47	2807.38	35.02
	TOTAL	6311.72	2711.67	161.45	2873.12	315.32	3144.57	45.52
S'INDKHED RAJA	C	655.88	745.58	48.05	793.64	29.92	156.44	121.00
	NC	6952.12	3191.33	208.48	3399.82	453.02	2736.86	48.90
	TOTAL	7608.00	3936.92	256.54	4193.45	482.93	2893.30	55.12
TOTAL	**C**	**6653.40**	**6411.28**	**495.39**	**6906.67**	**370.56**	**1661.74**	**103.81**
	NC	**62941.22**	**32346.66**	**2390.72**	**34737.39**	**4598.95**	**23192.90**	**55.19**
	TOTAL	**69594.61**	**38757.94**	**2886.12**	**41644.06**	**4969.51**	**24854.64**	**59.84**

4.3 Ground Water Quality

In the district, 16 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	6	38
2	Alkali metal (Na+K > 50%) exceeds alkaline earths and weak acids (CO_3+HCO_3 > 50%) exceeds strong acids.	Na-HCO_3	1	6
3	Alkaline earths (Ca+Mg > 50%) exceeds alkali metals and strong acids (Cl+SO_4+NO_3 > 50%) exceeds weak acids	Ca-Cl	9	56
4	Alkali metal (Na+K > 50%) exceeds alkaline earths and strong acids (Cl+SO_4+NO_3 > 50%) exceeds weak acids	Na-Cl	-	-
	Total		**16**	**100**

It is clear from the Table-6 that the ground water in the district is mainly dominated by Ca-Cl type of water followed by Ca-HCO_3. However the groundwater in the Basalt is generally of Ca-HCO_3 type, the change in the type of water may be due to the excess amount of strong acids ions getting percolated to ground water from anthropogenic sources. In one sample of Basaltic aquifer, the ground water was found to be of Na-HCO_3 type. This may be due to the cation exchange or precipitation leading the dominance of Na over Ca.

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	6	10	0
TH (mg/L)	300	600	3	9	4
Ca (mg/L)	75	200	7	9	0
Mg (mg/L)	30	100	2	12	2
Cl (mg/L)	250	1000	11	5	0
SO_4 (mg/L)	200	400	16	0	0
NO_3 (mg/L)	45	No relaxation	1	--	15
F (mg/L)	1.0	1.5	16	0	0

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

The **Table-7** shows that the potability of groundwater in 94% of wells monitored has been affected by the high concentration of NO_3 present in ground water. The TH and concentration of Mg in some of the ground water samples have also crossed the maximum permissible limits. Overall, the ground water quality scenario of the wells monitored in the district is not bright.

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	%
16	16	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		%	
16	16	100	Nil	Nil	Nil		Nil	

The **Table-8** clearly indicates that the SAR and RSC values of all ground water samples collected from the district is less than 10 and 1.25 respectively suggesting that the 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, 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 three type of abstraction structures i.e., dugwells, borewells and tubewells. However dugwells are the main ground water abstraction structures in the district. The yield of dugwells in Alluvium and in Basalt varies from 5 to 100 m^3/day. High yielding dugwells are generally located in weathered and fractured Vesicular Basalt occurring in physiographic depressions. The yield of borewells varies from 100 – 43850 lph, whereas that of tubewells varies from 100 – 64530 lph.

Ground water is predominantly used for irrigation, as it is the major ground water utilising sector. As per the data available for year 2000-01, area irrigated by ground water is 574.28 sq.km., whereas surface water accounts for only 91.05 sq.km. and the net irrigated area is 665.33 sq.km. Thus it is clear that ground water is the major source of irrigation as it accounts for about 86% of net irrigated area. The district had total of 62354 irrigation dugwells, which create an irrigation potential of 1363.54 sq.km., out of which 1210.39 sq.km. of irrigation potential is utilised. In addition to this 12.22 sq.km of irrigation potential is utilised through 621 borewells/tubewells during 2000-01.

GSDA, Government of Maharashtra has drilled number of borewells/tubewells for rural water supply. Most of the high yielding borewells/tubewells (discharge more than 5000 lph) are generally located in the close vicinity of lineament and are fitted with power pumps while the other high as well as poor yielding bore wells are fitted with hand pumps. In all till March 2005, GSDA, was successfully operating 4590 borewells/tubewells for water supply under various schemes in the district, out of which 240 are fitted with electric pumps and the rest with hand pumps. 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, particularly the southern part, is underlain by Deccan Trap Basalt. The development potential of ground water in Deccan Trap Basalt is low in parts of Deulgaon Raja, Sindkhed Raja and Lonar talukas in southern part and Motala, Buldhana, Chikhali and Khamgaon talukas in the central part and Malkapur taluka in north western part of the district. Ground water in these areas can be developed through dugwells and dug-cum-bored wells (DCB).

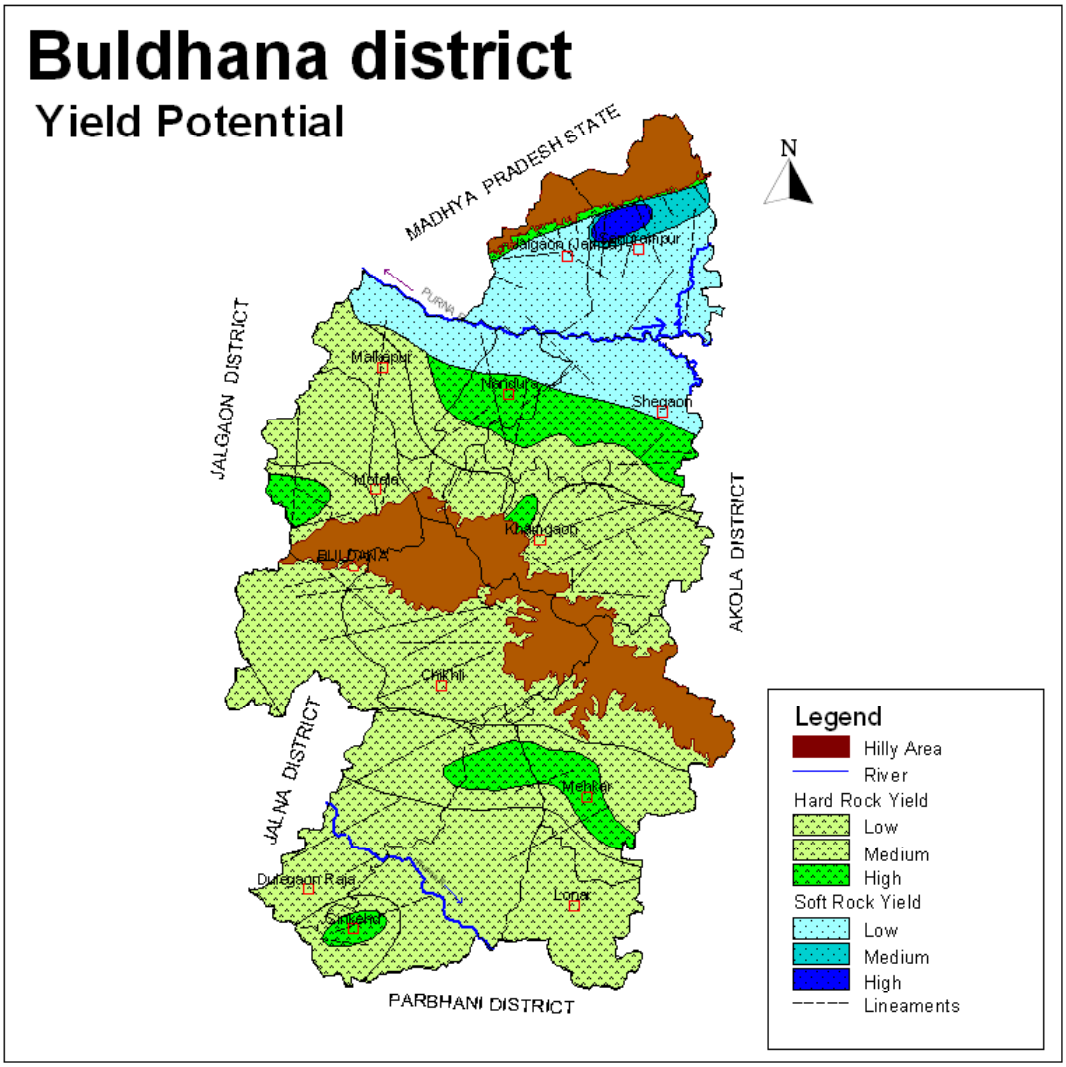

Figure-6: Yield Potential

In parts of Nandura and Shegaon talukas in north central part and in parts of Khamgaon and Motala talukas in the central part of the district, the

ground water development potential is medium to high. In these areas the ground water can be developed through dugwells, DCB and borewells. The yield of dugwells in the weathered and jointed Massive Basalt may be expected from 10 to 50 m^3/day whereas in case of Vesicular Basalt, yields up to 100 m^3/day may be expected. Northern part of the district covering parts of Malkapur, Nandura, Shegaon, Jalgaon (Jamod) and Sangrampur are underlain by Purna Alluvium. In these areas, the ground water may be developed through dugwells and shallow tubewells. The yields of wells in Alluvium are expected to be 15 to 100 m^3/day, however, in summer they may drop down to 5 to 25 m^3/day.

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.	Buldhana	Basalt	Low	Dug Well, DCB
2.	Chikhali	Basalt	Low	Dug Well, DCB
3.	Deulgaon Raja	Basalt	Low to Medium	Dug Well, DCB, Borewell
4.	Jalgaon (Jamod)	Alluvium	Low	Dug Well, DCB
5.	Khamgaon	Basalt	Low to Medium	Dug Well, DCB, Borewell
6.	Lonar	Basalt	Low	Dug Well, DCB
7.	Malkapur (Northern Part)	Alluvium	Low	Dug Well, DCB
8.	Malkapur (Southern Part)	Basalt	Low to Medium	Dug Well, DCB
9.	Mehkar	Basalt	Low to High	Dug Well, DCB, Borewell
10.	Motala	Basalt	Low to High	Dug Well, DCB, Borewell
11.	Nandura (Northern Part)	Alluvium	Low	Dug Well, DCB
12.	Nandura (Southern Part)	Basalt	Medium to High	Dug Well, DCB, Borewell
13.	Sangrampur	Alluvium	Low to Medium	Dug Well, DCB
14.	Shegaon (Northern Part)	Alluvium	Low	Dug Well, DCB
15.	Shegaon (Southern Part)	Basalt	Medium to High	Dug Well, DCB, Borewell
16.	Sindkhed Raja	Basalt	Low to Medium	Dug Well, 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. In all 75 minor irrigation tanks, 309 percolation tanks, 6 lift irrigation schemes, 3 large KT weirs, 198 small K.T. Weirs have been constructed in the district.

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 areas, occurring in the central part of the district. 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. Ground water in small north eastern part of the district in Alluvium area is brackish to saline. 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

The rainfall data analyses for the period 1901-2003 indicates that the northern part of the district comprising of Jalgaon (Jamod) and the southern part of the district comprising of Chikhli, Mehkar Donegaon and Deolgaon Raja where the occurrence of droughts was more than 20% of the years, comes under the category of “Drought Area”. Deeper water levels of more than 20 m bgl are observed in restricted northwestern part of the district in parts of Malkapur, Nandura and Jalgaon (Jamod) talukas. Thus future water conservation and artificial recharge structures in the district may be prioritised in these parts 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 methaemoglobinamea, popularly known as Blue Babies. 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.

The special study carried out by CGWB in Purna River Alluvial basin indicates that in small north eastern part of Shegaon taluka brackish to saline ground water has been observed with EC ranging from 2000 to 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.

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 Buldhana. 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	2005-06	Jalgaon (Jamod)	26/03/06	200
2	WMTP	2006-07	Shegaon	24 & 25/03/07	75

7.2 Participation in Exhibition, Mela, Fair etc.

During the MAP at Jalgaon (Jamod) and WMTP at Shegaon, an exhibition depicting rainwater harvesting model, various ground water related posters, leaflets, literature and technical reports were displayed along with maps of Buldhana 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 Jalgaon (Jamod) taluka falls in "Over Exploited" category, Buldhana in "Semi Critical" category and remaining all talukas fall under "Safe" category. However, till March 2007 the area has not been notified either by CGWA or SGWA.

9.0 Recommendations

1 Major part of the district is underlain by Deccan Trap Basalt, where only dug wells 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 ground water is brackish to saline in some parts underlain by Purna Alluvium, particularly in deeper zones. 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 relatively low, i.e., 59.84% thus there is a scope for further development of ground water resources.

6 Jalgaon (Jamod) taluka falls under "Over-Exploited" and Buldhana under "Semi-Critical" category, therefore, further development of ground water resources is not recommended in these talukas. Also further ground water development is not recommended in 2 "Over-Exploited" watersheds (PT-10 and PT-11); 1 "Critical" watershed (GP-1). Whereas dual approach of development coupled with artificial recharge measures needs to be adopted in 11 "Semi Critical" watersheds (PT-8, PT-12, PT-16, PTB-1, PTV-2, GP-1, GPD-1, GPD-2, PG-1, PG-2, PG-4). Thus future water conservation and artificial recharge structures needs to be prioritised in

these parts of the district.

7 The scope exists for construction of suitable artificial recharge structures in the district. The structures recommended for the hilly- Deccan Trap Basalt area in the central part 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 In Alluvial area of the district, percolation tanks and recharge wells/shafts are suggested wherever the ground water is not saline. The most feasible artificial recharge structure suitable for Alluvial areas, are recharge wells/shafts on the river bed of the tributaries.

9 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.

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