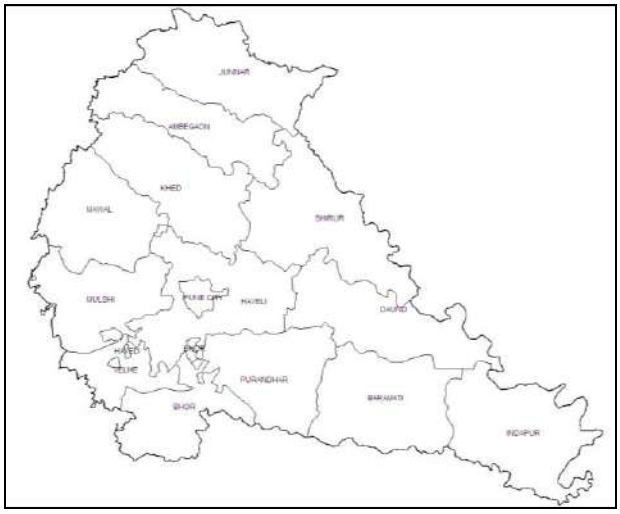
1810/DBR/2009

भारत सरकार
जल संसाधन मंत्रालय
केंद्रीय भूजल बोर्ड

GOVT OF INDIA
MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD

महाराष्ट्र राज्य के अंतर्गत पुणे जिले की भूजल विज्ञान जानकारी

GROUND WATER INFORMATION
PUNE DISTRICT
MAHARASHTRA



By
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द्वारा
एस. एस. पी. मिश्रा
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मध्य क्षेत्र, नागपुर
CENTRAL REGION
NAGPUR
2013

PUNE DISTRICT AT A GLANCE

1. GENERAL INFORMATION

Geographical Area	: 15642 sq km
Administrative Divisions	: 14 Taluks
Villages	: 1866
Population (Census-2011)	: 72,33,000
Normal Annual Rainfall	: 468 to 4659 mm

2. GEOMORPHOLOGY

Major Physiographic Units	: 4 Nos (Western Ghat, Foot Hills, Central Plateau and Eastern Plains)
Major Drainage	: 3 Nos (Bhima-Ghod, Mula-Mutha & Nira)

3. LAND USE (Year 2010-11)

Forest Area	: 1720 sq km
Net Area Sown	: 9920 sq km
Cultivable Area	: 10150 sq km

4. SOIL TYPE : 2 types (medium black & deep Black)

PRINCIPAL CROPS (year-2011)

Pulses	: 930 sq km
Cereals	: 7430 sq km
Oil Seeds	: 710 sq km
Sugarcane	: 660 sq km
Cotton	: Nil

5. IRRIGATION BY DIFFERENT SOURCES (2010-11)

Dug Wells/Tube Wells	: 1,45,500 Ha
Canal Irrigation	: 12,440 Ha
Net Irrigated Area	: 3,20,000 Ha

6. GROUND WATER MONITORING WELLS(as on 31.05.2012)

Dug Wells	: 43 Nos
Piezometers	: 06 Nos

7. GEOLOGY **:** Alluvium (Recent age)
: Deccan Trap Basalt (Upper cretaceous to Eocene)

8. **HYDROGEOLGY**

Water Bearing Formations: Weathered, fractured, jointed and vesicular Basalts

Pre-Monsoon Depth to Water Level (May-2011)	: 0.40 to 20.10 mbgl
Post-Monsoon Depth to Water Level (Nov.2011)	: 0.09 to 14.65 mbgl
Pre-Monsoon Water Level Trend (2002-11)	: Rise- Negligible to 0.75 m/yr
	: Fall- Negligible to 0.56 m/yr
Post-Monsoon Water Level Trend (2002-11)	: Rise- Negligible to 0.63 m/yr
	: Fall- Negligible to 0.27 m/yr

9. **GRPOND WATER EXPLORATION (as on 31.03.2011)**

Wells Drilled	: EW-72, OW-34 Nos
Depth Range	: 25.50 to 201.30 mbgl.
Discharge	: Negligible to 30.62 lps.

10. GROUND WATER QUALITY

Good and suitable for drinking and irrigation purposes. However localized Nitrate Contamination is observed.

11. DYNAMIC GROUND WATER RESOURCES (Base Year 2008-09)

Net Annual Ground Water Availability (HAM)	: 1,66,284.05
Existing Annual Ground Water Draft for all uses (HAM)	: 1,18,908.84
Allocation for domestic & Industrial Water Supply (up to next 25 years) (HAM)	: 12,762.63
Stage of Ground Water Development	: 71.51%

12. Awareness and Training Programmes

Mass awareness Programmes	: Nil
Water Management Training Programmes	: 1 No
Date	: 19-21 Nov 2003
Place	: Dept. of Geology, Pune University

13. GROUND WATER CONTROL AND REGULATION

Over-Exploited Taluka	: None
Critical Taluka	: None
Semi-Critical Taluka	: 2 No.'s (Baramati & Purandhar)
Notified Area	: None

14. MAJOR GROUND WATER PROBLEM AND ISSUES

About 50 % area of Pune district is falling under Rain Shadow zone of Maharashtra state. Long term rain fall data analysis reveals that eastern, southern, south-eastern, central and north-central part area of district around Indapur, Baramati, Jujuri, Daund, Talegaon, Dhamdhare, Alandi, Shirur and Bhor are classified as drought areas. Decadal pre-monsoon water level trend (2002-11) shows fall in water levels up to 0.56 m/year in 30% of the GWMW of the district, whereas in postmonsoon season fall is observed upto 0.27 m/year in 37% of GWMW. The stage of ground water development has reached up to 96.13% in two talukas of the district namely Baramati and Purandhar and are categorized under "Semi-Critical" category. In 17% water samples collected from CGWB Ground Water Monitoring Wells, excessive nitrate content (> 45 mg/L) was recorded during year 2011.

Ground Water Information
Pune District

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Pune District

1.0 Introduction

Pune is the second largest district of Maharashtra State in respect of area. The district has a geographical area of 15642 sq.km., which is 5.08% of the total area of State. It is situated in the western part of the State and lies between north latitude 17°54' and 19°24' and east longitudes 73°29' and 75°10' and falls in parts of Survey of India degree sheets 47-E, 47-F, 47-I, 47-J, 47-K, 47-N and 47-O. It is bounded by Ahmadnagar district in the north and east. Satara and Solapur districts in south and south east respectively and Thane and Raigarh districts in north west and west respectively. For administrative convenience it is divided in 14 talukas namely Pune City, Haveli, Khed, Ambegaon, Junnar, Shirur, Daund, Indapur, Baramati, Purandhar, Bhor, Velhe, Mulsi and Maval. The population of the district is 72,33,000 as per 2001 census with density of 462 persons/sq.km. There are 25 towns and 1866 villages in the district, out of which 18 villages are not habited. The district has 13 Panchayat Samitis, 11 Nagar Parishads, 2 Municipal Corporation and 1407 Gram Panchayats.

As per land use details (2010-11) the district has an area of 1720 sq.km occupied by forest. The gross cultivable area of district is 10150 sq.km whereas net sown area is 9920 sq.km.

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

Table 1: Studies undertaken by CGWB (March 2012).

S. No.	Officer	AAP	Type of Survey / Study
1.	V. V. Sable	1964 – 65	Systematic Hydrogeological Surveys in parts of Pune district.
2.	V. V. S. Mani	1966 – 67	Systematic Hydrogeological Surveys in parts of Pune and Ahmadnagar districts.
3.	J. P. Dias	1969 – 70 1970 – 71 1971 – 72 1973 – 74 1974 – 75 1975 – 76	Systematic Hydrogeological Surveys in parts of Pune district.
4.	S. S. Rao	1977 – 78	Systematic Hydrogeological Surveys in

			parts of Pune district.
5.	S. V. Chougala	1982 – 83	Systematic Hydrogeological Surveys in parts of Pune district.
6.	D. K. Rai	1982 – 83	Systematic Hydrogeological Surveys in parts of Pune district.
7.	P. K. Jain	1989 – 90	Systematic Hydrogeological Surveys in parts of Pune district.
8.	S. N. Ramaih	1989 – 90	Systematic Hydrogeological Surveys in parts of Pune district.
9.	S.K. Bhatnagar	1991-92	Reappraisal Hydrogeological Studies in parts of Pune district.
10.	S.K. Verma	1991-92	Reappraisal Hydrogeological Studies in parts of Pune district.
11.	V.M. Halyal	1994-95	Reappraisal Hydrogeological Studies in parts of Pune district.
12.	D. Saha	1994-95	Reappraisal Hydrogeological Studies in parts of Pune district.
13.	A.B. Kawade	2004-05	Reappraisal Hydrogeological Studies in parts of Pune district.

In addition to the above a report on “Ground Water Resources and Development Potential of Pune District, Maharashtra” was compiled during year 1993 by Shri D. B. Shetye, Scientist- C. Ground water exploration in the district has been taken up since 1994 and total of 72 Exploratory Wells, 34 Observation Wells and 6 piezometers have been drilled. The taluka wise salient features of ground water exploration are given in **Table-2**.

Table–2: Salient Features of Ground Water Exploration (March 2012).

S. No.	**Taluka**	**Wells Drilled**	**Drilled Depth (m bgl)**	**Zones (m bgl)**	**Discharge (lps)**	**SWL (m bgl)**
1	Shirur	5 EW 1 OW	171.10 to 200.50	6.40 to 13.00 161.00 to 171.00	Traces to 3.40	1.80 to 2.87
2	Daund	4 EW 3 OW	103.80 to 180.00	5.00 to 178.00	Traces to 12.18	3.41 to 19.00
3	Indapur	4 EW	200.00	5.00 to 10.00	Traces to 0.56	1.87 to 2.05
4	Ambegaon	5 EW	195.30 to 200.00	9.00 to 15.00 184.50	Traces to 1.05	7.95 to 14.15
5	Junnar	5 EW 2 OW	43.00 to 200.00	6.00 to 10.00 180.00 to 189.00	Traces to 10.45	2.50 to 6.00
6	Khed	4 EW 2 OW	115.90 to 200.00	15 to 24.00 161 to 167.00	Traces to 4.07	5.00 to 103.00

7	Purandhar	8 EW	73.20 to 200.00	18.00 137 to 152.00	Traces to 2.34	1.50 to 50.00
8	Baramati	3 EW 3 OW	24.50 to 200.00	9.20 to 15.30 167 to 174.00	Traces to 8.24	2.19 to 30.00
9	Haveli	20 EW 12 OW	31.50 to 201.30	4.50 to 158.00	Traces to 12.88	2.54 to 22.52
10	Mulshi	3 EW 4 OW	75.00 to 200.00	6.50 to 66.00	Traces to 30.68	2.95 to 8.90
11	Bhor	6 EW 4 OW	60.00 to 200.00	2.50 to 83.00	Traces to 8.25	5.85 to 30.00
12	Velhe	2 EW 2 OW	30.00 to 200.00	8.00 to 84.00	Traces to 1.50	3.80 to 50.00
13	Maval	4 EW	180.00 to 200.00	14.00 to 103.00	Traces to 3.00	4.30 to 50.00
14	**Total**	**EW-72 OW-34**	**24.50 to 201.30**	**2.50 to 184.50**	**Traces to 30.62**	**1.50 to 103.00**

It is observed from Table–2 that 72 EW and 33 OW were drilled in Deccan Trap basaltic area of the district. These wells are ranging in depth from 24.50 to 201.30 m bgl and the zones have been encountered in the depth range of 2.50 to 184.5 m bgl. The discharge of these wells varies from < 0.14 lps to 30.62 liters per second and static water level varies from 1.50 to 103.00 m bgl. The deeper zones below 50 m bgl have also been encountered in the district with the deepest zone being encountered at 184.50 m bgl. The discharge of the wells show wide variation and it varies from traces to 30.62 lps (Lavle.

A map of the district showing the taluka boundaries, taluka headquarters, physical features and location of monitoring wells is presented as **Figure-1,** whereas locations of exploratory wells are shown as **Figure-2**.

2.0 Climate and Rainfall

The climate of the district is on the whole is agreeable. The winter season is from December to about the middle of February followed by summer season which last up to May. June to September is the south-west monsoon season, whereas October and November constitute the post-monsoon season. The mean minimum temperature is about 12°C and mean maximum temperature is about 39°C.

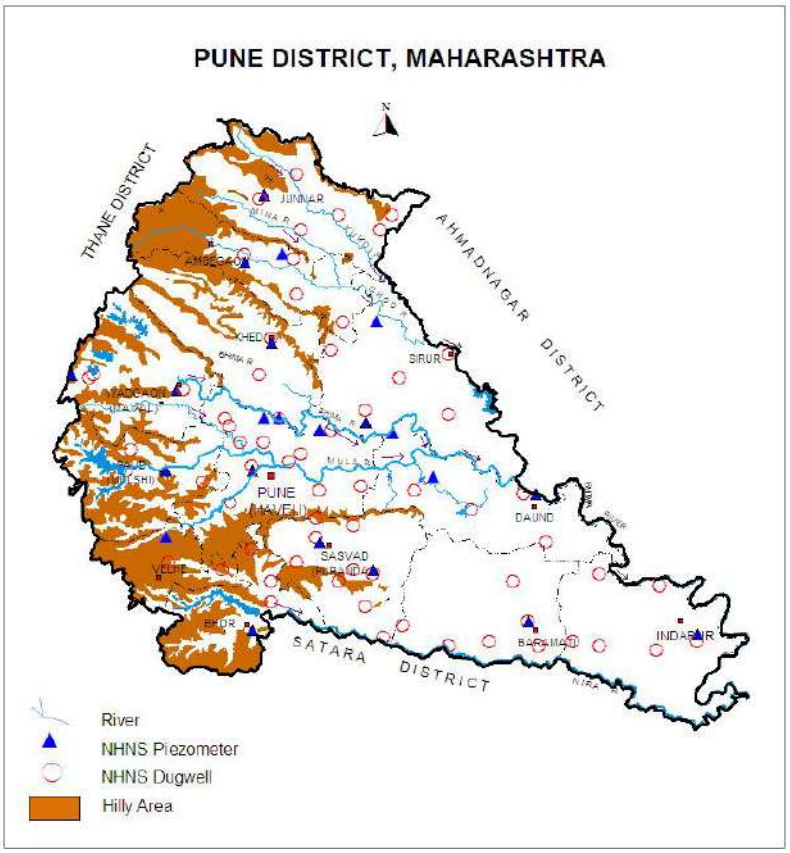

Figure-1: Location

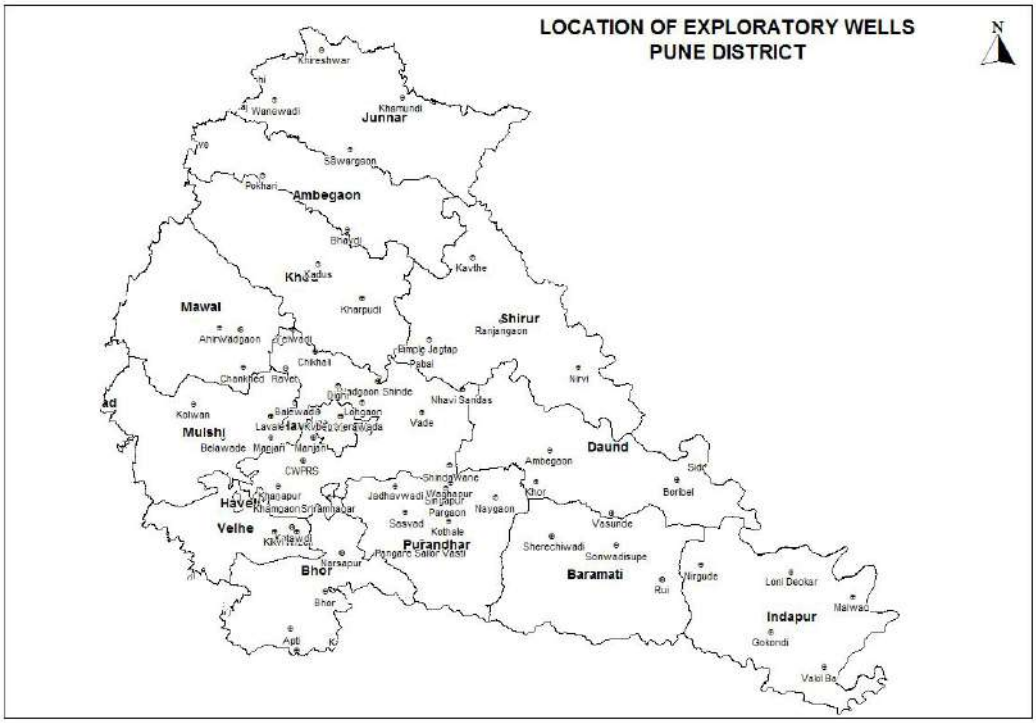

Figure-2: Location OF Exploratory Wells, Pune District

The normal annual rainfall over the district varies from about 468 mm to 4659 mm. It is minimum in the eastern part of the district around Daund (468 mm), Baramati (486 mm) and Jujuri (494 mm). This increases towards west and reaches a maximum around Khandala (4659 mm) in the western ghat.

The Chances of receiving normal rainfall are maximum (50 to 55%) in eastern part around Indapur and Daund, in the central part around Pune city and small area around Junnar in northern part of the district. Rainfall analysis also indicates occurrence of drought prone area in eastern, southern, south-eastern, central and north western part around Indapur, Baramati, Jujuri, Daund, Talegaon, Damdhare ,Alandi, Shirur and Bhore covering about 50% area of the district. Taluka wise average annual rainfall for the period 2003 to 2012 ranges from about 474 mm (Daund) to 2668 mm (velhe) and same is presented in Table-3

Table-3 Annual Rainfall Data for Year 2003-2012 (Rainfall in mm)

Taluka	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**Decadal Average**
Pune City	335.3	652.4	1239.5	1246	779.44	689.29	909.7	1169	979.9	492.7	**849.32**
Haveli	452.2	890.6	1250.36	1247.5	859.04	706.09	938.3	1147.8	979.6	505.4	**897.67**
Mulshi	1251	1878	2875.8	2804	1834	1602	1836.7	1592	1792	1438	**1890.35**
Bhor	712	1380.1	1714	1762	1429.4	998	1213	1121	1129.3	833	**1229.18**
Maval	1026	1466	2561	2252	1442.6	1399.5	1364.8	1168	1482	1013	**1571.14**
Velhe	1420	2054.4	6320.6	3997	3263	2409	1405	2043	2695.1	2070.4	**2667.7**
Junnar	648.2	771.8	1344.4	1237	880	747.4	706	862.3	769	557.1	**852.32**
Khed	386.2	775	973.1	1461.1	756.5	692.66	639.6	1018.4	637.7	436.2	**777.65**
Ambegaon	421.8	735.1	1025	1338.3	830.9	735	732.3	823.4	836	616.6	**809.44**
Shirur	266	374	460	760	674	492	859.6	849.5	441.8	321	**549.69**
Baramati	113.2	521	711	567	622	454	738.8	804.6	291	235	**505.76**
Indapur	163.3	651.9	696.1	668	640.3	345.4	932.4	805.8	399	250.6	**555.28**
Daund	156.3	522	742.2	594	604.85	326.7	474.3	639.3	347.6	337.4	**474.46**
Purandhar	215	710	1158	1476	519	497	806	602	609.4	371	**696.34**
District Average	**540.46**	**995.87**	**1647.9**	**1529.2**	**1081**	**814.62**	**968.3**	**1046.1**	**956.38**	**676.9**	

3.0 Geomorphology and Soil Types

The district forms part of Western Ghat and Deccan Plateau. Physiographically the district can be divided in to three distinct belts i.e. (1) The western belt stretching

from 16 to 31 km east of Sahayadri- an extremely rugged country cut by deep valleys, divided and crossed by hill ranges. (2) The central belt extending for about 30 km east of western belt across the tract whose eastern belt is roughly marked by a line drawn from Pabal in the north to south up to Purandhar through Pune. In this belt a series of small hills stretch in to valleys and large spurs from Plateaux and (3) The eastern belt with a rolling topography and low hills sinking slowly in to the plains with relatively broader valleys. Therefore, the physiography of the district has given rise to four major characteristic land forms namely; (1) The hills and Ghats (2) The foot hills (3) the plateau and (4) the plains.

The district has three major drainage systems namely (i) The Bhima-Ghod River System in northern, north-eastern and eastern part of which Bhima River has a total length of about 355 km and Ghod river has a drainage of about 196 km. (ii) Mula-Mutha River System covering the central part and having total length of 242 km in the district. (iii) Nira River system covering south, south-east and eastern part and has total length of about 231 km in the district. The other Important rivers that are flowing through the district are Bhima, Andhra, Karna, Shivganga, Pushpavati, Pauna and Indrayani. All the rivers have most semi-dendritic drainage pattern and the drainage density is quite high. Based on geomorphological setting and drainage pattern the district is divided into 71 watersheds.

4.0 Ground Water Scenario

4.1 Hydrogeology

The entire area of the district is underlain by the basaltic lava flows of upper Cretaceous to lower Eocene age. The shallow alluvial formation of Recent age also occurs as narrow stretch along the major rivers flowing in the area. A map depicting the hydrogeological features is shown in **Figure–3**.

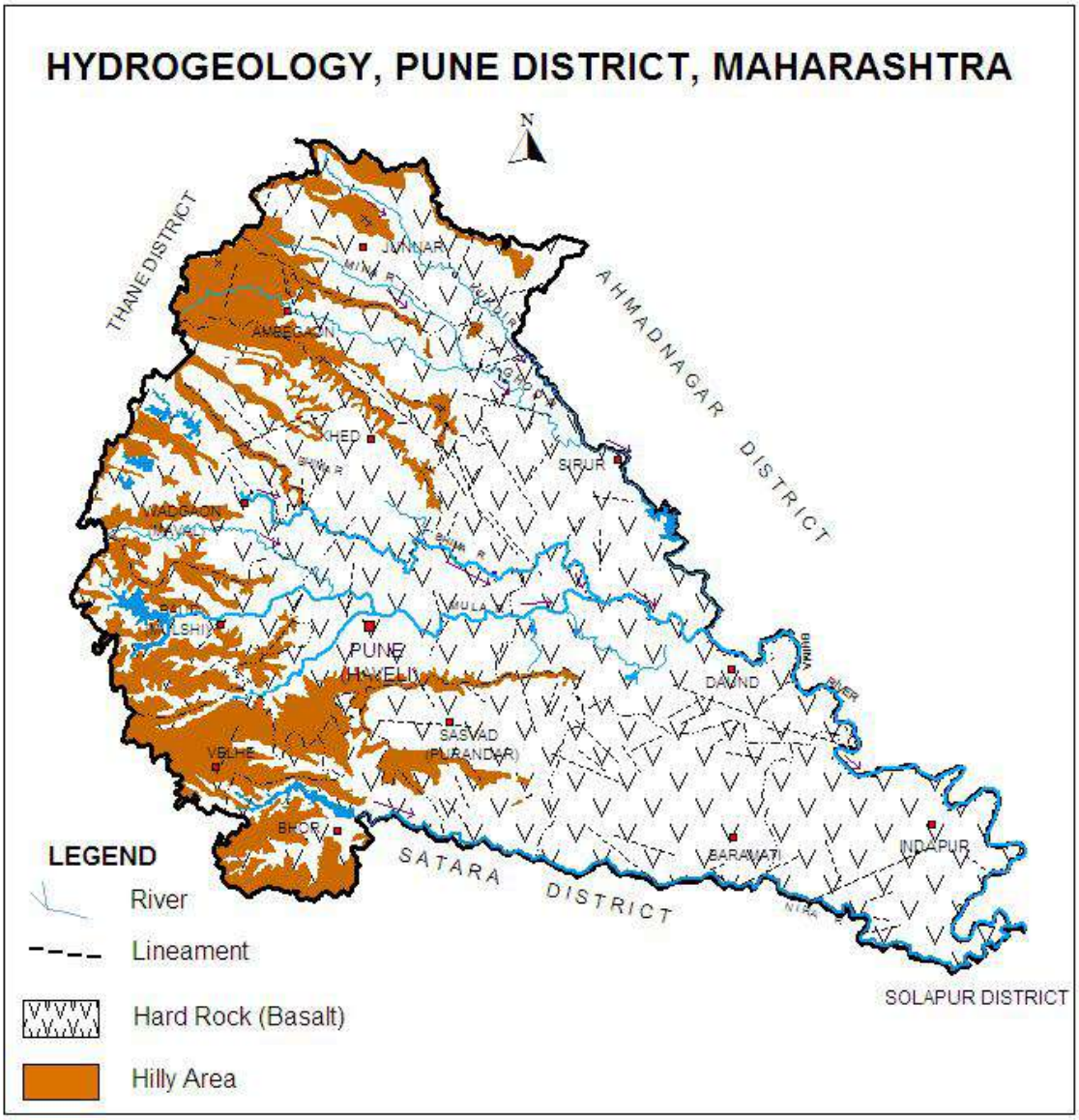

Figure-3: Hydrogeology

4.1.1 Hard Rock (Deccan Trap Basalt)

Basaltic lava flows occupies more than 95% of the area of the district. These flows are normally horizontally disposed over a wide stretch and give rise to table land type of topography also known a plateau. These flows occur in layered sequences ranging in thickness from 7 to 45 m and represented by massive unit at the bottom and vesicular unit at the top of the flow. These flows are separated from each other by marker bed known as ‘bole bed’.

The water bearing properties of these flows depend upon the intensity of weathering, fracturing and jointing which provides availability of open space within the

rock for storage and movement of ground water. The thickness of weathering in the district various widely up to 20 m bgl. However, the weathered and fractured trap occurring in topographic lows forms the potential aquifer in the district.

The ground water in the district occurs under phreatic, semi – confined and confined conditions. Generally the shallower zones down to the depth of 20 to 22 m bgl form the phreatic aquifer. The water bearing zones occurring between the depth 20 and 40 m bgl when weathered or having shear zones yield water under semi-confined condition. The deep confined aquifers generally occur below the depth of 40 m bgl.

The vesicular unit of lava flow when exposed or lying just few meter below the surface forms a potential aquifer in the district. However, the vesicular portion of different lava flows varies in thickness from few m to 10 m and nature and density of vesicles, their distribution, interconnection, weathering are the decisive factors for occurrence and movement of water in these units. The massive portions of basaltic flows are normally devoid of water, but when it is weathered, fractured and jointed forms potential aquifer. In Deccan Trap Basalt, the yield of the dugwells in different formations ranges from 30 to 150 lpm/day depending upon the local hydrogeological conditions. The yields of borewells also show wide variations and it ranges from traces to 30.62 lps (Lavle) a seen from CGWB exploration data.

4.1.2 Soft Rock (Alluvium)

Alluvium occurs in small areas along banks and flood plains of major rivers like Bhima, Ghod, Mula, Mutha and their tributaries. In alluvium the granular detrital material like sand and gravel usually occurring as thin layer in the district yields water. But due to its limited extent the ground water potential in this formation is negligible.

4.2 Water Level Scenario

Central Ground Water Board monitors water levels in 43 Ground Water Monitoring wells (GWMW) in the district. These GWMW are measured four times in a year Viz. January (Rabi Season), May (Pre-monsoon), August (Monsoon) and November (Post-Monsoon).

4.2.1 Depth to Water Level-Pre Monsoon (May-2011)

The premonsoon depth to water level monitored during May-2011 ranges between 0.40 m.bgl (at Chinchwad) in west-central part and 20.10 mbgl (at Otur) in northern part of the district. It is observed that in western half of the district where more rainfall occurs, depth to water level during pre-monsoon season is less than 5 mbgl. Depth to water level in eastern and south-eastern part of district is reported between 5 to 10 m bgl excepting in part of Daund, Baramati and Indapur talukas where canal irrigation system is applied. In isolated pockets depth to water level is occurring more than 10 mbgl in central parts (parts of Pune and Daund talukas) and northern parts (parts of Junnar taluka). Pre Monsoon depth to Water level Map is given in **Figure-4**.

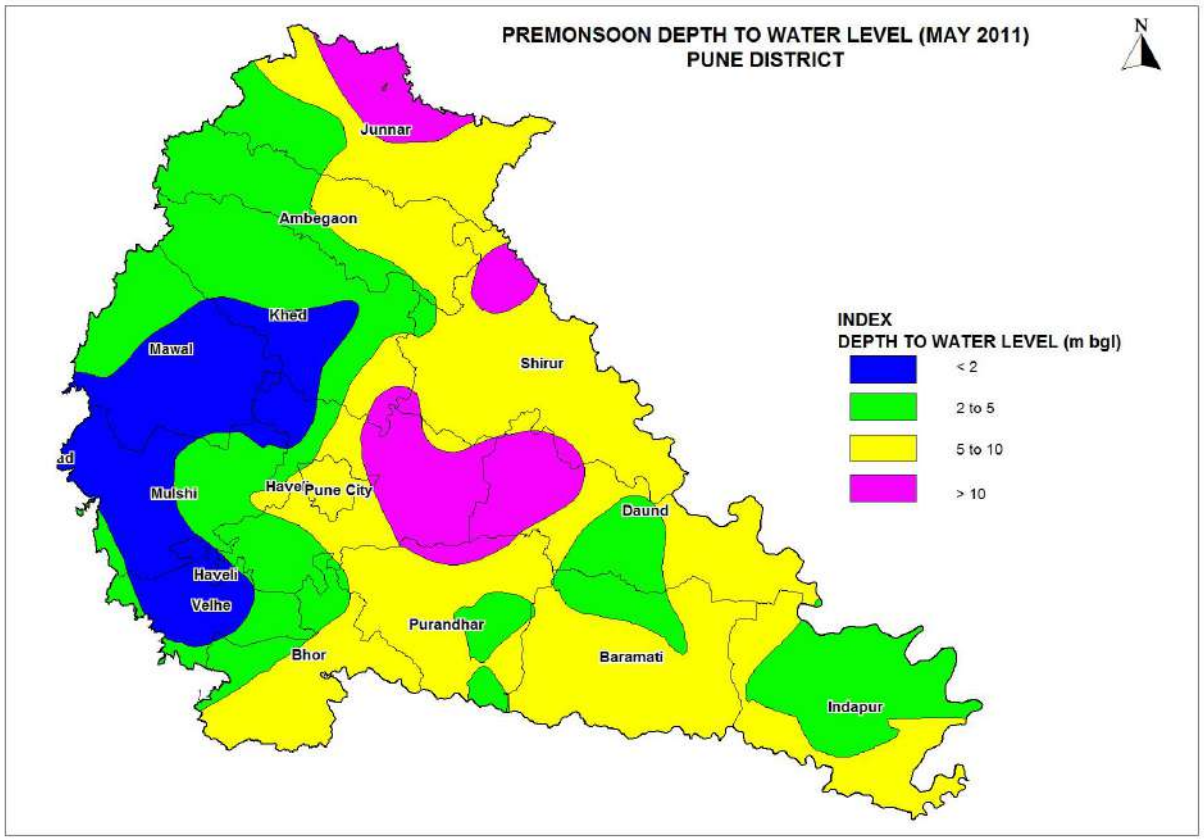

Figure-4: Premonsoon Depth to Water Level (May 2011)

4.2.2 Depth to Water Level –Post Monsoon (November-2011)

The depth to water level in district during post-monsoon (Nov.2011) varies from 0.65 at Dorlewadi to 15.65 m bgl at Otur. Shallow water level of less than 2 m bgl is reported in almost entire western part, in central part (parts of Shirur and Khed talukas) and in southeastern part (parts Daund and Baramati talukas) of the district. In major part of the district in central, northern and southern parts the water level is occurring between 2 to 5 m bgl. Deeper water levels of more than 10 m bgl are restricted in extreme norhtern parts of the district (part of Junnar taluka). The post monsoon depth to water level map is depicted in **Figure-5**.

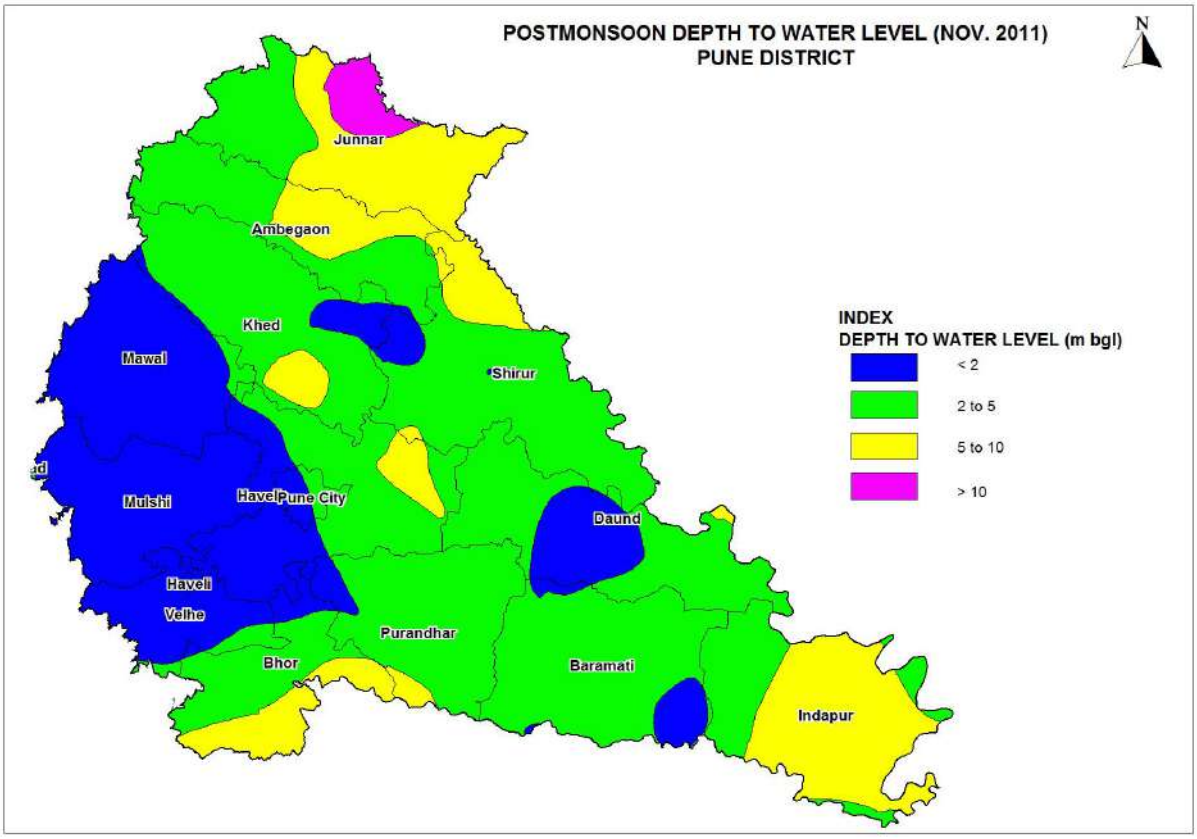

Figure-5: Postmonsoon Depth to Water Level (Nov. 2011)

4.2.3 Seasonal Water Level Fluctuation (May to November-2011)

Seasonal Water Level fluctuation analysis between pre monsoon and post monsoon season for year 2011 reveals that rise in water levels is found between 0.20m (Lonawala & Kalamb) to 12.35 m (Lonikand). In major part of the district in north-western and south-eastern part, water level fluctuation is varying from 0 to 2m.

In central and eastern part of the district fluctuation is recorded between 2 to 6m. Water level fluctuation of more than 6 m is observed in isolated pockets at Karanje,Urli-Kanchan and Lonikand. Fall in water level between pre and post monsoon season of year-2011 is also observed at six places and it vary from 0.05m at Belhe to 2.00 m at Mahalunge Padval.

4.2.4 Water Level Trend (year 2002-2011)

Decadal Trend of water levels for pre monsoon and post monsoon periods for last ten years (2002-2011) have been computed for Ground Water Monitoring Wells (GWMW) of the district. Analysis of Long term water level trend data indicates that rise in water levels in pre monsoon period has been recorded at 31 GWMW and its ranges from negligible (0.006 m/year at Parne) to 0.75 m/year (Dhumalwadi). Fall in water levels has been also observed in 13 GWMW during pre monsoon season and fall is ranging from negligible (0.007 m/year at Belhe) to 0.56 m/year (Zendewadi). During post monsoon period rise in water level has been recorded in 30 GWMW ranging from negligible (Talegaon) to 0.63 m/year (Jejuri), while fall in water levels is recorded in 11 GWMW and it varies from Negligible (0.0018 at Ale) to 0.27 m/year (Shirur). Thus decadal water level trend analysis reveals that by and large 70% wells during pre monsoon period and 73% wells during post monsoon period are showing rising water levels. The falling trend in water levels is observed in 30% and 37% of wells during the premonsoon and postmonsoon season.

The premonsoon water level trend map was also prepared for the period May 2002-2011 and the same is presented in Figure- 6. A perusal of the map indicates that in major part of the district the rising trend of water level in the range 0 to 0.20 m/year is observed. The falling trend of water level is observed in central-southern parts of the district (in parts of Pune, Purandhar and Bhor talukas) and in small western part of Mulshi taluka and in parts of Daund and Shirur talukas in eastern parts of the district.

4.3 Aquifer Parameters

The aquifer parameters of phreatic aquifer are available from Systematic Hydrogeological Surveys conducted by CGWB earlier. In Deccan Trap Basalt, the unit area specific capacity of dugwells ranges from 0.77 to 18.9 lpm/dd/sq.m., while

permeability ranges from 12 to 65 m/day. The transmissivity of phreatic aquifer ranges between 18 and 89m^2/day. The Specific Yield vary 1.7 to 9.7% in the district. In Alluvium, the unit area specific capacity ranges from from 5.95 to 32.00 lpm/dd/sq.m, transmissivity vary from 97 to 248m^2/day and specific yield ranges between 5 to 9%.

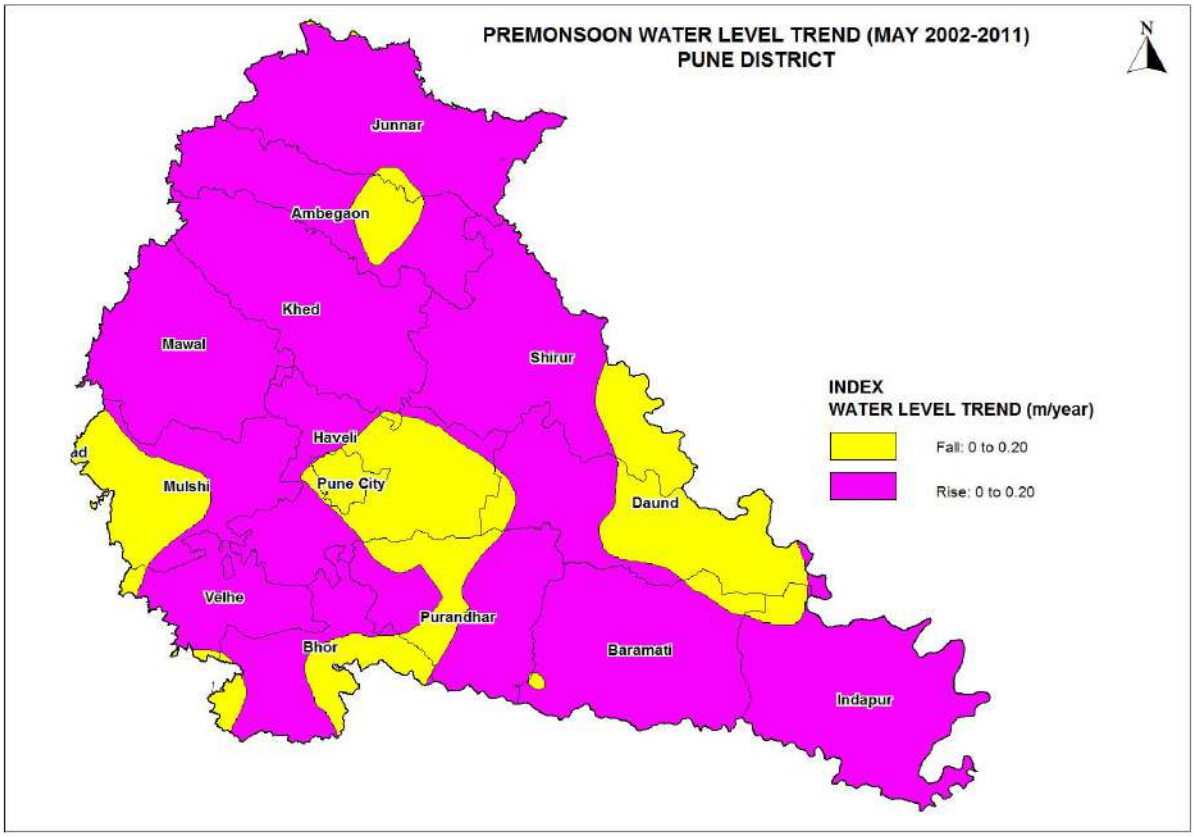

Figure-6: Premonsoon Water Level Trend (May 2002-2011)

4.4 Yields of Dugwells and Borewells

The yields of the wells are functions of permeability and transmissivity of aquifer tapped. This varies with location, diameter and depth of wells. There are mainly two types of ground water structures in the district i.e. dugwells and borewells. Yield of dugwells varies according to the nature of formations tapped. For Deccan Trap Basalt range of reported yield of dugwells in different horizons is given in Table-4. As observed from CGWB exploratory data, the yield of borewells also show vide variation from place to place and it ranges from meager to 30.62 lps (Lavle). This variation of yields in a single type of aquifer is due to lateral/spatial variation in permeability of the formation/aquifer material.

Table-4: Yields of Dugwells

Formation	Yield Range (l.p.m./day)	Elevation Range (m, a.m.s.l.)
Massive basalt poorly weathered/jointed with thin vesicular zone.	30-60	787-838
Weathered and highly jointed massive basalt with thick vesicular zones.	90-150	721-787
Weathered, fractured and jointed massive basalt with thick vesicular zone.	60-120	651-721
Highly weathered and moderate to poorly jointed basalt	40-80	560-651

It is seen from above table that at higher elevations, yields of the wells are low ranging from 30 to 60 l.p.m./day. Maximum yield in the range of 90 to 150 l.p.m./day is reported in weathered and highly jointed massive basalt with thick vesicular zones, followed by 60 to 120 l.p.m./day in weathered, fractured and jointed massive basalt with thick vesicular zone. In highly weathered and moderate to poorly jointed basalt yield of wells vary from 40 to 80 l.p.m./day.

4.5 Ground Water Resources

Central Ground Water Board and Ground Water Survey and Development Agency (GSDA) of Maharashtra State have jointly carried out Taluka and Watershed wise estimation of ground water resources of Pune district for base year 2008-09 according to GEC methodology 1997.Ground Water Resource Estimation figures as a whole for Pune district indicates that Net Ground Water Availability is 1662.84 MCM and Existing Ground Water Draft for all uses is 1189.08 MCM. After making provision for Domestic and Industrial Supply for next 25 Years kept as 127.62 MCM, Ground Water Availability for future Irrigation is 466.21 MCM. Over all Stage of Ground Water development of the district is 71.51%. **Two Talukas namely Baramati and Purandhar are categorized as Semi-Critical where stage of ground water development is computed as 96.13% and 83.95 % respectively**. In these Talukas further development of ground water is not recommended without adhering to the precautionary measures i.e. artificial recharge to augment ground water resources and adoption of ground water management practices in these areas. Taluka wise ground water resources figures of Pune district are given below.

Table-5: Taluka wise Ground Water Resources of Pune District (2008-09)

Taluka	Net G.W. Availability (ha-m)	Existing G.W. Draft for all uses (ha-m)	Provision for domestic & Industrial requirement for next 25 years (ha-m)	G.W. availability for future Irrigation (ha-m)	Stage of G.W. Develop-ment (%)	Category
Ambegaon	11289.25	8678.77	877.08	2141.02	76.88	Safe
Baramati	19049.27	18312.73	830.22	1451.31	96.13	Semi-Critical
Bhor	3771.51	1521.67	520.43	1991.58	40.35	Safe
Daund	13870.15	11289.09	762.69	2191.37	81.39	Safe
Haveli	11847.18	1521.67	1119.20	4814.85	54.90	Safe
Indapur	24819.00	11289.09	1879.84	5113.22	88.72	Safe
Junnar	15740.31	6503.96	883.57	2321.51	87.58	Safe
Khed	14139.97	22020.65	1944.64	3751.07	66.30	Safe
Maval	8687.74	13785.22	762.70	7120.06	13.51	Safe
Mulshi	7962.64	1038.23	799.17	6524.84	13.04	Safe
Purandhar	13575.11	11396.87	579.31	2024.59	83.95	Semi-Critical
Shirur	16679.89	13517.91	1560.36	2745.31	81.04	Safe
Velhe	4852.04	295.69	233.43	4430.52	06.09	Safe
District Total	**166284.05**	**118908.84**	**12762.63**	**46621.27**	**71.51**	

4.6 Ground water Quality

CGWB is monitoring the ground water quality of the Pune 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 24 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.

4.6.1 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., 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**
TH (mg/L)	300	600	16	7	1
NO_3 (mg/L)	45	No relaxation	16	-	8
F (mg/L)	1.0	1.5	24	Nil	Nil

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

The perusal of **Table-6** shows that the concentrations of most of the parameters are within desirable limit of the BIS standards except NO_3 which has recorded concentration of more than maximum permissible limits in 17% of samples . Overall, it can be concluded that the ground water quality in the wells monitored in the district is not much affected except nitrate concentration in some wells.

4.6.2 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. 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 observed from the **Table-7** that maximum number of samples (54%) falls under the category of High salinity water while nearly 17% 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 can 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	7	29
High Salinity Water	750-2250	13	54
Very High Salinity Water	>2250	4	17
Total		**24**	**100**

4.7 Status of Ground Water Development

Ground water development depends on many factors viz. availability, crops water requirement, socio-economic fabric and on yield potential of aquifer system existing in the area. Ground water in the district is predominantly used for irrigation as it is major ground water utilizing sector. The minor irrigation data of year 2010-11 indicates that the area irrigated by ground water sources in Pune district is 1,45,500 hectares whereas canal irrigation accounts for 1,22,400 hectares and net irrigated area by all sources stand as 3,20,000 hectares. Thus it is analyzed that ground water is major source of irrigation and it accounts for 46 % of net irrigated area. It is reported that there were 91,669 dugwells/tubewells in the district for irrigation in year 2010-11. In addition to this ground water is also important source of rural water supply.

5.0 Ground Water Management Strategy

Ground water has special significance for agricultural development in state of Maharashtra. The ground water development in some part of the state has reached to critical stage resulting in decline of ground water levels. Thus there is 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

Excepting along rivers, almost entire district is underlain by Deccan Trap Basalt and major parts of the district adjoining the hilly areas as well as the entire northern, south western and south eastern parts have low ground water development potential. Such areas occur in almost entire Junnar, Ambegaon, Maval, Mulshi, Velhe, Bhor and parts of Khed and Shirur talukas. The central part of the district is occupied by the areas with medium to high ground water potential. Such areas are observed in parts of Khed, Shirur, Haveli and Purandar talukas and almost entire Baramati and Daund talukas. In the hard rock areas of the district the ground water can be developed through dugwells, which are the most feasible structure for ground water development. The borewells generally tap deeper fractures thus selection of site for pinpointing of borewells need proper scientific investigation. The yield of

dugwells in the district may be expected from 30 to 150 m^3/day depending on the local hydrogeological conditions.

The nature and yield potential of the aquifers occurring in different areas is given below in **Table-8**. A perusal of Table-8 shows that the 5 talukas i.e., Haveli, Shirur, Daund, Baramati and Purandar have medium to high yield potential and the suitable abstraction structures are dugwell, DCB and borewells. However in Baramati and Purandar talukas, which have been categorised as “Semi-Critical”, future ground water development is not recommended without adhering to the precautionary measures, i.e., artificial recharge to augment the ground water resources and adoption of ground water management practices, so that the sustainable development is achieved.

Table-8: Nature and Yield Potential of Aquifers.

S. No.	Taluka	Aquifer	Yield Potential	Type of wells suitable
1	Pune City	Basalt	Medium	Dugwells and borewells
2	Haveli	- do -	Medium to high	Dugwells and borewells
3	Khed	- do -	Low and high	Dugwells, DCB and borewells
4	Ambegaon	- do -	Low	Dugwells
5	Junnar	- do -	Low	Dugwells
6	Shirur	- do -	Medium to high	Dugwells, DCB and borewells
7	Daund	- do -	Medium to high	Dugwells, DCB and borewells
8	Indapur	- do -	Low to Medium	Dugwells, DCB and borewells
9	Baramati	- do -	Medium to high	Dugwells, DCB and borewells
10	Purandhar	- do -	Medium to high	Dugwells, DCB and borewells
11	Bhor	- do -	Low to medium	Dugwells and borewells
12	Velhe	- do -	Low to medium	Dugwells and borewells
13	Mulshi	- do -	Low to medium	Dugwells and borewells
14	Maval	- do -	Low to medium	Dugwells and borewells

5.2 Water Conservation and Artificial Recharge

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 favorable in hilly areas, particularly in almost entire Mulsi, Velhe, Bhor and parts of Khed and Junnar talukas. Existing dugwells can also be used for artificial recharge, however, the source water should be properly filtered before being put in the wells. The most feasible artificial recharge structure suitable for Alluvial areas restricted along the banks of major rivers and their tributaries, are shallow recharge wells on the river bed of the tributaries. Percolation tanks are also suitable, wherever source water availability is there.

The sites for artificial recharge structures need to be located where the hydrogeological conditions are favorable, 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 Problems

Parts of Pune district falls under rain shadow zone of Maharashtra State. From long term rainfall data, it is observed that eastern, southern, south eastern, central and nort western part of district around Indapur, Baramati, Jujuri, Daund, Talegaon, Dhamdhare, Alandi,Shirur and Bhor covering about 50 % geographical area experiences drought conditions. Therefore these areas are classified as Drought Prone Areas. Decadal pre-monsoon water level trend (2002-11) shows fall in water levels up to 0.56 m/year in 30% of the GWMW of the district, whereas in postmonsoon season fall is observed upto 0.27 m/year in 37% of GWMW. The falling trend of water level is observed in central-southern parts of the district (in parts of Pune, Purandhar and Bhor talukas) and in small western part of Mulshi taluka and in parts of Daund and Shirur talukas in eastern parts of the district..

Ground Water Resource Estimation for Year 2008-09 also reveals that the stage of ground water development has reached up to 96.13% and two talukas of the district namely Baramati and Purandhar are categorized under “Semi-Critical” categories. This is an indication for critical situation of ground water conditions in

district for which implementation of rain water harvesting and artificial recharge structures are to be given in depleting water levels areas.

Quality of ground water is also affected by excessive nitrate content of more than 45mg/liter in some pockets which makes water unsuitable for drinking in those pockets. In 17% water samples collected from CGWB Ground Water Monitoring Wells excessive nitrate content was recorded during year 2011. Continuous intake of high nitrate content water causes infant “Methaemoglobinamea” popularly known as Blue Baby Syndrome. Thus all wells used for water supply should be first analyzed for nitrate content and if nitrate concentration found beyond permissible limit of 45mg/liter then it should not be used for drinking. Adequate sanitary protection including leakage from sewerage system in populated area should be taken to control nitrate pollution in ground water system.

7.0 Mass Awareness and Training Activities

7.1 M.A.P. and Water Management Training Programme (WMTP)

One Water Management Training Programme was organized in Geology Department of Pune University between period 19.11.03 to 21.11.03 in which 30 participants took part. In addition to this, CGWB has also conducted 2 State Level Workshops under IEC activities. The details are given below in Table-9.

Table-9: Details of WMTP and Workshops Conducted (March 2012).

S. No.	AAP	Venue	Date	No of Persons Attended
WMTP				
1.	2003-04	Dept. of Geology Pune University.	19 to 21/11/03	30
WORKSHOPS				
2.	2009-10	Workshop on ‘Dugwell Recharge- Efficiency and Efficacy’, YASHADA, Pune	04/02/2010	65
3.	2010-11	Workshop on ‘Role Role of Traditional Methods and Recent Technologies in Ground Water Augmentation and Management’ ‘YASHADA, Pune	12/02/2011	40

7.2 Organization of Exhibition, Mela, Fair etc.

During Water Management Training Programme (WMTP) in Pune University exhibition was also organized. In said exhibition Models/ Posters of Rain Water Harvesting were depicted and literature /technical reports were also displayed along with various maps of Pune district. The Models, Maps, Posters were explained to visitors in details by CGWB Officers.

8.0 Area Notified by CGWB/SGWA

As per Ground Water Resources Estimation for base Year 2008-09, two Taluka of Pune district namely Baramati and Purandhar are falling under “Semi-Critical” category. However, so far none of talukas have been notified either by CGWA or SGWA for regulation in the district.

9.0 Recommendations

(1) Almost entire Pune district is underlain by Deccan Trap Basalt, where dugwells are most feasible ground water abstraction structures for ground water development.

(2) Borewells are another alternative structures but their construction requires special technical and scientific attention. Borewells generally tap deeper fracture in hard area for which selection of sites is suggested at favorable hydrogeological locations.

(3) The Overall Stage of Ground Water Development in the district has reached about 71.51%. Therefore future development of ground water resources should be taken up with proper care and planning.

(4) In Semi-Critical Baramati and Purandhar Talukas there is limited scope for further ground water development unless scheme for augmentation of ground water resources by means of artificial recharge is not made. Therefore future ground water development is not recommended without adhering to precautionary measures i.e. artificial recharge to augment ground water resources and adoption of ground water management practices in these areas.

(5) Haveli, Shirur and Daund talukas have medium to high yield potential and suitable abstraction structures recommended for ground water development in theses areas are dugwells, DCB and borewells.

(6) Quality of ground water is also affected by excessive nitrate content of more than 45mg/liter which makes water unsuitable for drinking. In 17% water samples collected from CGWB Ground Water Monitoring Wells, excessive nitrate content was recorded during year 2011. Hence all wells used for water supply should be first analyzed for nitrate content and if nitrate concentration found beyond permissible limit of 45mg/liter then it should not be used for drinking. Adequate sanitary protection including leakage from sewerage system in populated area should be taken to control nitrate pollution in ground water system.

(7) There is scope for construction of suitable artificial recharge structures in the district especially in Semi-Critical areas. The structures recommended for hilly areas in west and north west parts are Contour Bunds, Gully Plugs, Nala Bunds and Check Dams etc. In other part of district structures like Nala Bunds, Check dams. KT Weirs and Percolation Tanks are suggested at suitable hydrogeological locations. Existing Dug Wells may also be used for artificial recharge of ground water, but due care is to be taken for pure and silt free water is used for recharge.

(8) Existing Percolation Tanks and village Ponds needs to be rejuvenated to act as water conservation and artificial recharge structures.

(9) For creating awareness among people towards water conservation and Augmentation of Ground Water Resources, Mass Awareness Programmes should be organized in large scale involving local public. Similarly Farmers should also be encouraged to adoption of appropriate crops planning and also to adopt modern irrigation practices including drip and sprinkler irrigation system.