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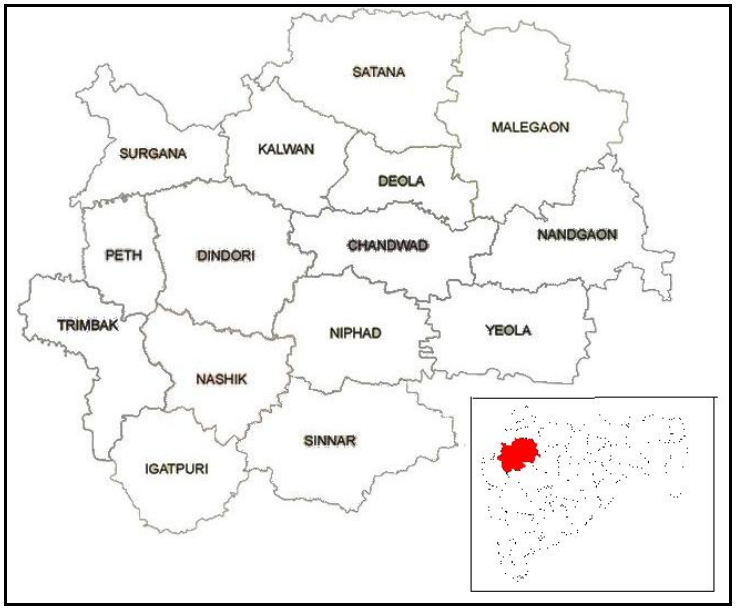
भारत सरकार
जल संसाधन मंत्रालय
केंद्रीय भूजल बोर्ड
GOVT OF INDIA
MINISTRY OF WATER RESOURCES
CENTRAL GROUND WATER BOARD

महाराष्ट्र राज्य के अंतर्गत नाशिक जिले की भूजल विज्ञान जानकारी
GROUND WATER INFORMATION
NASHIK DISTRICT
MAHARASHTRA



By

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द्वारा

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सहायक भूजल वैज्ञानिक

मध्य क्षेत्र, नागपुर

CENTRAL REGION, NAGPUR

2014

NASHIK DISTRICT AT A GLANCE

1. GENERAL INFORMATION

Geographical Area	:	15548 sq. km
Administrative Divisions		Taluka – 15; Nashik, Igatpuri, Dindori, Peint, Surgana, Deola, Satana, Kalwan, Chandwad, Niphad, Sinnar, Yeola, Malegaon, Nandgaon, Trimbakeshwar.
Villages	:	1931
Population (2011 Census)	:	61,09,052
Normal Annual Rainfall	:	575 to 2500 mm

2. GEOMORPHOLOGY

Major Physiographic unit	:	3; Satmala, Selbari and Dolbari, hill ranges, eastern and southern plains and Godavari valley.
Major Drainage	:	2 ; Godavari and Girna

3. LAND USE (2008-09)

Forest Area	:	3442.37 sq. km.
Net Area Sown	:	8010 sq. km.
Cultivable Area	:	8803 sq. km.

4. SOIL TYPE : 4; Lateritic black soil (Kali), Reddish brown soil (Mal), Coarse shallow reddish black soil (Koral) and Medium light brownish black soil (Barad).

5. PRINCIPAL CROPS (2008-09)

Food Grains	:	4640 sq. km.
Pulses	:	780 sq. km.
Oil Seeds	:	260 sq. km.
Sugar Cane	:	250 sq. km.

6. IRRIGATION BY DIFFERENT SOURCES (4th MI Census, 2006-07)**- Nos./Potential Created/Potential Utilized (ha)**

Dugwells	:	178793/ 311094/ 308784
Tubewells/Borewells	:	10928/ 15599/ 15588
Surface Flow Schemes	:	7569/ 15838/ 15680
Surface Lift Sources	:	1682/ 2775/ 2710
Net Irrigated Area	:	342762

7. GROUND WATER MONITORING WELLS (As on 30/11/2011)

Dugwells	:	43
Piezometers	:	14

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-confine to confined conditions.

Premonsoon Depth to Water Level (May-2011)	:	GL to 18.36 m bgl
Postmonsoon Depth to Water Level (Nov.-2011)	:	0.20 to 18.42 m bgl
Premonsoon Water Level Trend (2002-2011)	:	Rise : 0.01 to 3.12 m/year Fall : Negligible to 1.19 m/year
Postmonsoon Water Level Trend (2002-2011)	:	Rise : Negligible to 1.27 m/year Fall: Negligible to 1.00 m/year

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

Wells Drilled	:	Piezometers- 14
Depth Range	:	30.60 to 70.00 m bgl
Discharge	:	0.14 to 1.73 lps

11. GROUND WATER QUALITY

Good and suitable for drinking and irrigation purpose, however localized nitrate contamination is observed.

12. DYNAMIC GROUND WATER RESOURCES (As on 31/03/2009)

Net Annual Ground Water Availability	:	2084.23 MCM
Annual Ground Water Draft (Irrigation + Domestic)	:	992.97 MCM
Allocation for Domestic and Industrial requirement up to next 25 years	:	66.69 MCM
Stage of Ground Water Development	:	49.33 %

13. AWARENESS AND TRAINING ACTIVITY

Mass Awareness Programme	:	Nil
Water Management Training Programme	:	1
a. Date	:	09/03/2003
b. Place	:	Nashik

14. GROUND WATER CONTROL AND REGULATION

Over-Exploited Taluka	:	None
Critical Taluka	:	None
Semi – Critical Taluka	:	4; Chandwad, Deola, Niphad, Sinnar
Notified Taluka	:	None

15. MAJOR GROUND WATER PROBLEMS AND ISSUES

Major part of the district (about 75%) falling east of Western Ghats comprising almost entire Sinnar, Niphad, Surgana, Kalvan, Satana, Chandwad, Yeola talukas and parts of Dindori, Peint and Malegaon talukas is classified as drought areas. The premonsoon water level trend shows fall in water level in the range of 0 to 0.20 m in northern and north eastern parts of the district occupying parts Baglan, Kalwan, Dindori, Nasik and Trambakeshwar talukas. Similarly as per current assessment of ground water resources it is also seen that the ground water development in Chandwad, Deola, Niphad and Sinnar talukas have already reached up to 89%, 95%, 84% and 99% respectively and these talukas fall under “Semi-Critical” category. The ground water quality is mainly affected by nitrate as 60% of samples are having high nitrate concentration.

Ground Water Information
Nashik District

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Nashik District

1.0 Introduction

Nasik District is situated in north western part of Maharashtra. It lies between 19°35' and 20°50' north latitude and between 73°16' and 74°56' east longitude and falls in parts of Survey of India degree sheets 46-H, 46-L and 47-E and 47-I. The district has a geographical area of 15530 sq. km. It is surrounded by Dhule district in the north, Dangs and Surat district of Gujarat State in the northwest, Jalgaon in the east and northeast, Ahmednagar in the south, Aurangabad in the southeast and Thane in the west and southwest.

The district headquarters is located at Nasik Town. For administrative purpose four divisions have been formed namely Nasik, Niphad, Malegaon and Peth. The district is further subdivided in to 15 talukas viz., Nashik, Igatpuri, Dindori, Peint, Surgana, Deola, Satana, Kalwan, Chandwad, Niphad, Sinnar, Yeola, Malegaon, Nandgaon and Trimbakeshwar.

As per 2001 census, the population of the district is 61,09,052. The district has 18 towns and 1931 villages. Nashik is one of the largest district in Maharashtra in terms of area and population. The district forms part of Godavari basin (southern part) and Tapi basin (northern part). Godavari and Girna 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 the district is presented is Table–1.

Table 1: Studies undertaken by CGWB.

S. No.	Officer	AAP	Type of Survey / Study
1.	Shri N.G. Gajbhiye	1971 – 72	Systematic Hydrogeological Surveys in parts of Nashik district.
2.	Dr. S.S. Rao	1977-78	Systematic Hydrogeological Surveys in parts of Nashik district.
3.	Shri V.V. Rane	1978-79	Systematic Hydrogeological Surveys in parts of Nashik district.
4.	S/Shri S. Das and D.B. Shetye	1980-81	Systematic Hydrogeological Surveys in parts of Nashik district.
5.	S.S. Sudarshana	1982-83	Systematic Hydrogeological Surveys in parts of Nashik district.
6.	S/Shri Binoy Ranjan and S.K. Bhatnagar	1989-90	Systematic Hydrogeological Surveys in parts of Nashik district.
9.	S/Shri B.K. Kallapur and S. Kudesia	1991-92	Reappraisal Hydrogeological Studies in parts of Nashik district.
11.	Shri D. Saha	1995-96	Reappraisal Hydrogeological Studies in parts of Nashik district.
12.	S/Shri A.B. Kawade, S.C. Paranjape and Sunil Toppo	2004-05	Reappraisal Hydrogeological Studies in parts of Nashik district.

In addition to the above a report on "Ground Water Resources and Development Potential of Nashik District, Maharashtra" was issued during year 1991 by Shri P.K. Agrawal, Scientist- C. Ground water exploration is yet to be

taken up in the district, however during 1995, 14 Peizometers (Pz) have been drilled in the district to monitor the water levels. In addition to this 8 Pz have also been drilled under HP-I during 1997-98 and 1998-99. The salient features of Peizometers are given in **Table-2**.

Table–2: Salient Features of Peizometers.

S. No.	Location	Depth (m bgl)	SWL (m bgl)	Discharge (lps)	Zones (m bgl)
	Departmental				
1	Sinner	50.00	3.90	0.14	15.00
2	Pimpalnara	50.00	12.80	1.05	24.00
3	Pimplus	30.60	7.85	1.05	11.00
4	Vavi	30.60	9.78	1.73	18.00
5	Palkhed	50.00	-	1.16	4.20
6	Vinchur	50.00	34.60	1.16	38.00
7	Pandurli	30.60	7.00	0.56	22.50
8	Jakhori	50.00	20.90	0.14	40.80
9	Adgaon	42.80	5.32	0.14	7.50
10	Pachorewani	50.00	30.10	0.14	15.80 43.50
11	Umbrane	50.00	13.80	1.73	18.40
12	Gilane	50.00	6.65	1.16	7.00
13	Khamkheda	30.60	12.60	1.05	15.40
14	Shirpuruwadi	70.00	-	-	-
	Outsourcing				
15	Dahigaon	45	-	-	-
16	Dahlewadi (Vijay Nagar)	30.6	-	-	-
17	Igatpuri	30.0	-	-	-
18	Kotambi	30.0	-	-	-
19	LAKHMAPUR	30.60	-	-	-
20	Ravalgaon	90.00	-	-	-
21	Thengode	50	-	-	-
22	Tinghri	30	-	-	-

It is observed from Table–2 that the depth of the 14 Piezometers drilled ranged from 30.60 to 70.00 meters below ground level (m bgl). The discharge from these wells varied from 0.14 to 1.73 litres per second (lps), for a high drawdown of >100 m. Static water levels ranged from 3.90 to 34.60 m bgl. The potential aquifer zones have been encountered in the depth range of 4.20-40.80 mbgl.

A map of the district showing the taluka boundaries, taluka headquarters, physical features and location of Piezometers and Ground Water Monitoring Wells is presented as **Figure-1**.

2.0 Climate and Rainfall

The climate of the district is on the whole is agreeable. The climate of Nashik district is characterized, by general dryness throughout the year except during the south-west monsoon season. 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 maximum temperature in summer is 42.5°C and minimum temperature in winter is less than 5.0°C. Relative humidity ranges from 43% to 62%.

The normal annual rainfall in the district varies from about 500 mm to 3400 mm. It is minimum in the north eastern part of the district and increases towards west and reaches a maximum around Igatpuri in the western ghat. The chances of receiving normal rainfall are maximum (50 to 55%) in the north eastern part around Malegaon and Nandgaon and minimum in the central part of the district. The study of negative departures of the annual rainfall over normal reveals that major part of the district (about 75%) falling east of Western Ghats comprising almost entire Sinnar, Niphad, Surgana, Kalvan, Satana, Chandwad, Yeola talukas and parts of Dindori, Peint and Malegaon talukas can be categorized as drought area.

The average annual rainfall for the period 2002 to 2011 ranges from about 476.7 mm (Devali) to 3508.1 mm (Igatpuri) and same is presented in Table–3.

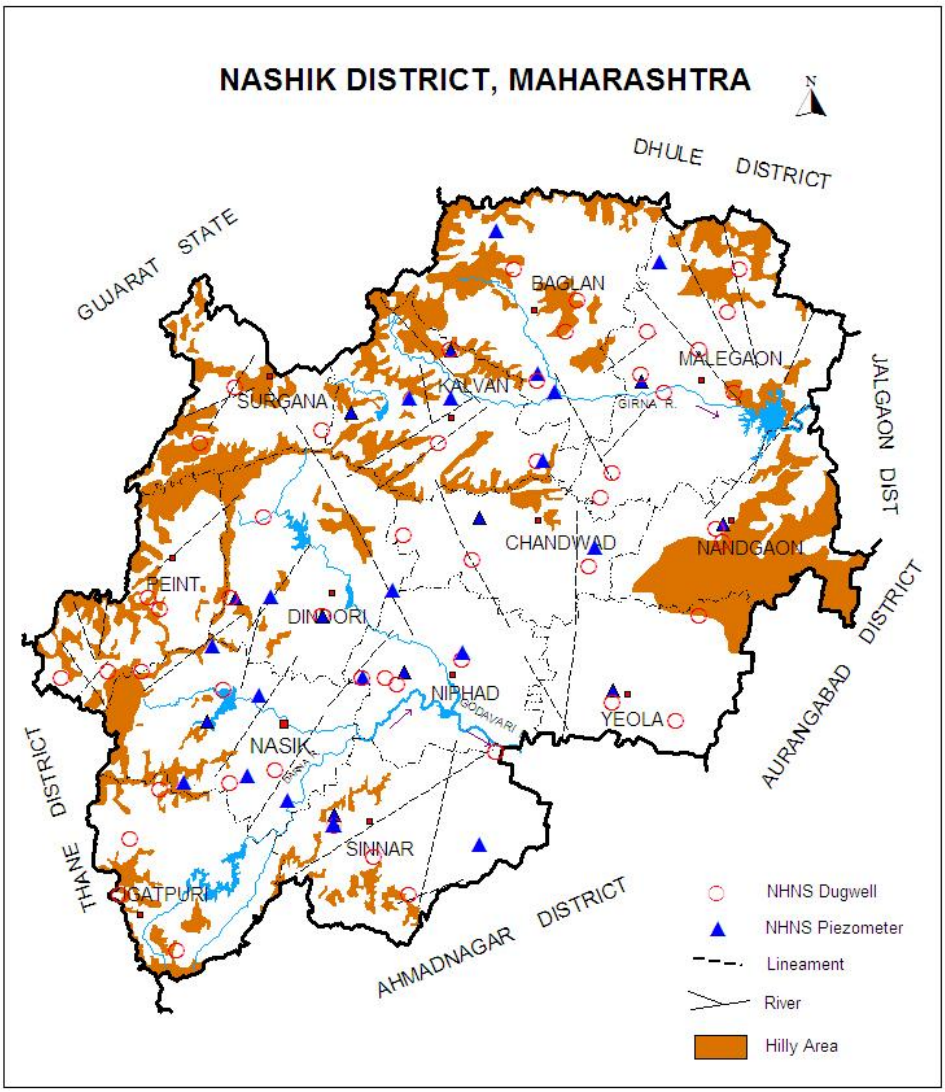

Figure-1: Location

Table–3: Annual Rainfall Data (2002-11) (mm)

S. N.	Taluka	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Average
1	Baglan	583	577	745	603	960	810	517	594	458	526	637.3
2	Chandwad	716	438	828	640	1161	791	722	479	776	559	711.0
3	Devali	377	391	465	491	864	675	436	369	416	283	476.7
4	Dindori	867	860	1093	799	1082	772	959	473	684	576	816.5
5	Igatpuri	2847	3569	3902	4463	4778	3664	3853	2080	2895	3030	3508.1
6	Kalwan	868	772	1031	874	1414	826	759	544	529	479	809.6
7	Malegaon	553	395	672	422	851	739	475	525	777	396	580.5
8	Nandgaon	584	400	517	413	878	629	672	526	682	583	588.4
9	Nasik	813	912	1058	1202	1323	833	1127	429	642	564	890.3
10	Niphad	694	619	1044	885	879	781	678	392	522	277	677.1
11	Peth	1772	2160	2603	2847	3345	1957	2231	1416	1814	1832	2197.7
12	Sinnar	465	811	702	676	951	689	664	546	613	469	568.6
13	Surgana	2048	1927	2474	3067	2992	1947	1931	1269	1387	1772	2081.4
14	Trimbakeshwar	2120	2312	2459	3749	3794	2515	2278	1284	1475	1646	2363.2
15	Yevla	444	392	863	507	932	679	648	275	766	599	610.5

3.0 Geomorphology and Soil Types

The district forms part of Western Ghat and Deccan Plateau. Physiographically Nasik district comprises varied topography. The main system of hills is Sahayadri and its offshoots viz., Satmala, Selbari and Dolbari hill ranges. These hill ranges along with eastern and southern plains and Godavari valley are the distinct physiographic units. The northern part of the district falls under Tapi basin and is drained by easterly flowing Girna River along with its tributaries, whereas the southern part of the district falls under Godavari basin an is drained by Godavari River and its tributaries. Other important rivers in the district are Damanganga, Vaitarna, Darna, Kadva, Aram, Mosam, Panjan and Manegad.

The soils of the district are the weathering products of Basalt and have various shades from gray to black, red and pink color. The soils occurring in the district are classified in the four categories namely lateritic black soil (Kali), reddish brown soil (Mal), coarse shallow reddish black soil (Koral), medium light brownish black soil (Barad). In general the soils are very fertile and suitable for growing cereal and pulses. The black soil contains high alumina and carbonates of calcium and magnesium with variable amounts of potash, low nitrogen and phosphorus. The red soil is less common and is suitable for cultivation under a heavy and consistent rainfall.

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 banks of Godavari and Girna Rivers flowing in the area. A map depicting the hydrogeological features is shown as **Figure–2**.

4.1.1 Hard Rock (Deccan Trap Basalt)

Basaltic lava flows occupies about 90% 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 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'.

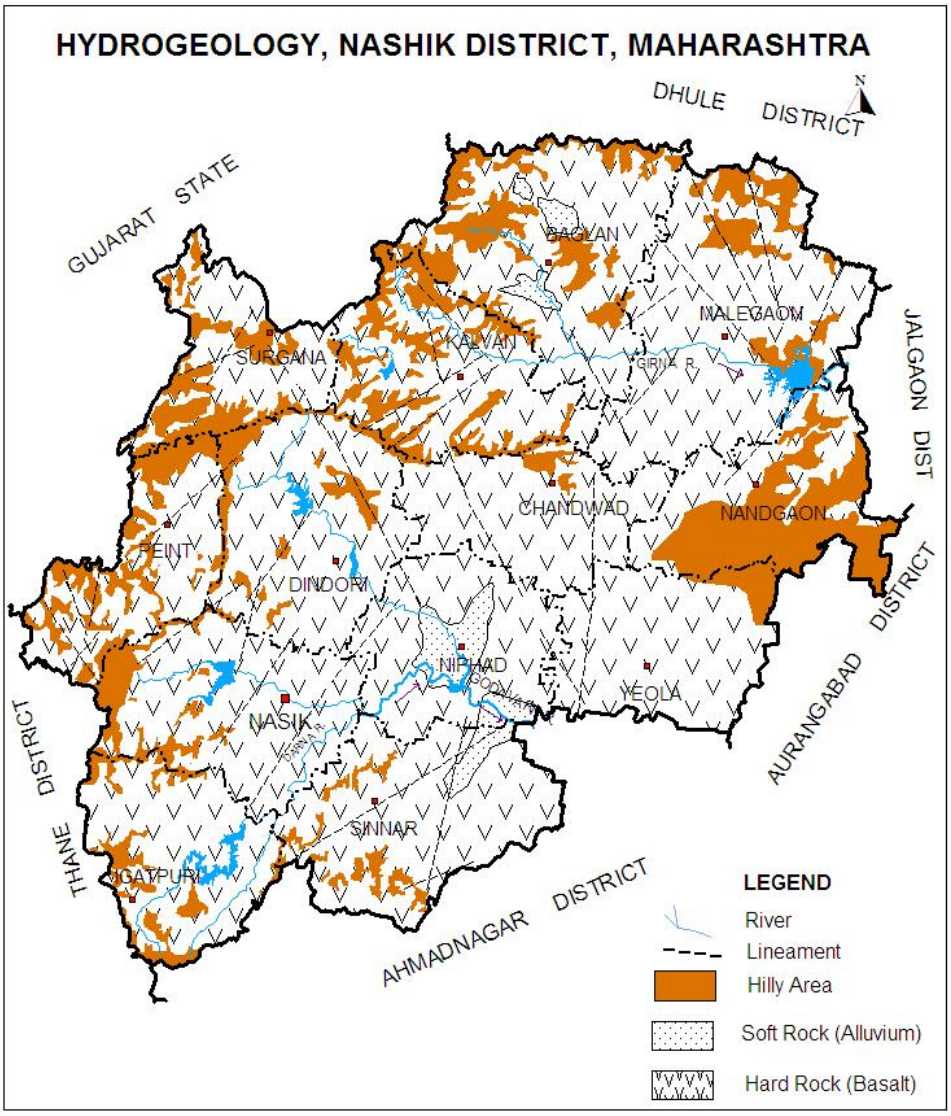

Figure-2: Hydrogeology

The ground water in Deccan Trap Basalt occurs mostly in the upper weathered and fractured parts down to 20-25 m depth. At places potential zones are encountered at deeper levels in the form of fractures and inter-flow zones. The upper weathered and fractured parts form phreatic aquifer and ground water occurs under water table (unconfined) conditions. At deeper levels, the ground water occurs under semi-confined to confined conditions. The yield of dugwells tapping upper phreatic aquifer down to the depth of 12 to 15 m bgl ranges between 45 to 90 m^3/day depending upon the local hydrogeological conditions. Borewells drilled down to 70 m depth, tapping weathered and vesicular basalt are

found to yield 18 to 68 m^3/day. The discharge of Peizometers ranges from 0.14 to 1.73 as seen from CGWB data.

4.1.2 Soft Rock (Alluvium)

Alluvium occurs in small areas in the form of discontinuous patches along the banks and flood plains of major rivers like Godavari, Girna and their tributaries. In alluvium the granular detrital material like sand and gravel usually occurring as thin layer in the district yields water. In the district Alluvium occupies an area of 1500 sq.km and it ranges in thickness from 7- 21 meters. It consists of reddish and brownish clays with intercalations of sand, gravel and kanker. The loosely cemented coarse sands and gravels form 3-4 meters thick lower most horizons at the bottom of these alluvial pockets. Ground water in Alluvium occurs both under semi confined and confined conditions. The dugwells constructed in Alluvium has been ranging in depth from 8-12 m, whereas the borewells range in depth form 15 to 20 m and the yield of both the dugwells and borewells ranges from 13 to 22 m^3/day.

4.2 Water Level Scenario

Central Ground Water Board monitors water levels in 57 GWMW stations in the district. These GWMW are measured four time in a year viz., January, May (Premonsoon), August and November (Postmonsoon).

4.2.1 Depth to Water Level – Premonsoon (May 2011)

The premonsoon depth to water levels monitored during May 2011 ranges between GL (Harsul) and 19.24 m bgl (Ravalgaon). The depth to water levels during premonsoon has been depicted in **Figure-3.** The water levels in major part of the district covering entire western, central, north eastern and eastern parts are between 5 and 10 m bgl. Shallow water levels within 5 m bgl occur in southwestern and north eastern parts of the district in parts of Malegaon, Penth, Trimbakeshwar and Igatpuri talukas. Deeper water levels of 10 to 20 m bgl are observed in parts of Yeola, Chandwad, Kalwan, Niphad, Dindori and Baglan (Satana) talukas.

4.2.2 Depth to Water Level – Postmonsoon (Nov. 2011)

The depth to water level during postmonsoon (Nov. 2011) ranges between 0.20 m bgl (Khambale) and 18.42 m bgl (Satana). Spatial variation in postmonsoon depth to water level is shown in **Figure-4.** The water levels between 5 and 10 m bgl have been observed in major parts of the district in the southern, and northern and central parts of the district. The shallow water levels within 5 m bgl are observed in southwestern,southeastern and Northeastern, Northwestern parts of the district covering parts of Nasik and Igatpuri Dindori, Kalwan,Surgana, Malegaon, Nandgaon and Yeola talukas . Deeper water levels of 10 to 20 m bgl are observed in northern and northcentral parts of the district in Baglan (Satana) and Deolali talukas.Very shallow water levels within 2 m bglare observed in Western and southwestern aprts in Penth,Trimbak and Igatpuri talukas as well as in small patches in Malegaon, Nandgaon and Yeola talukas.

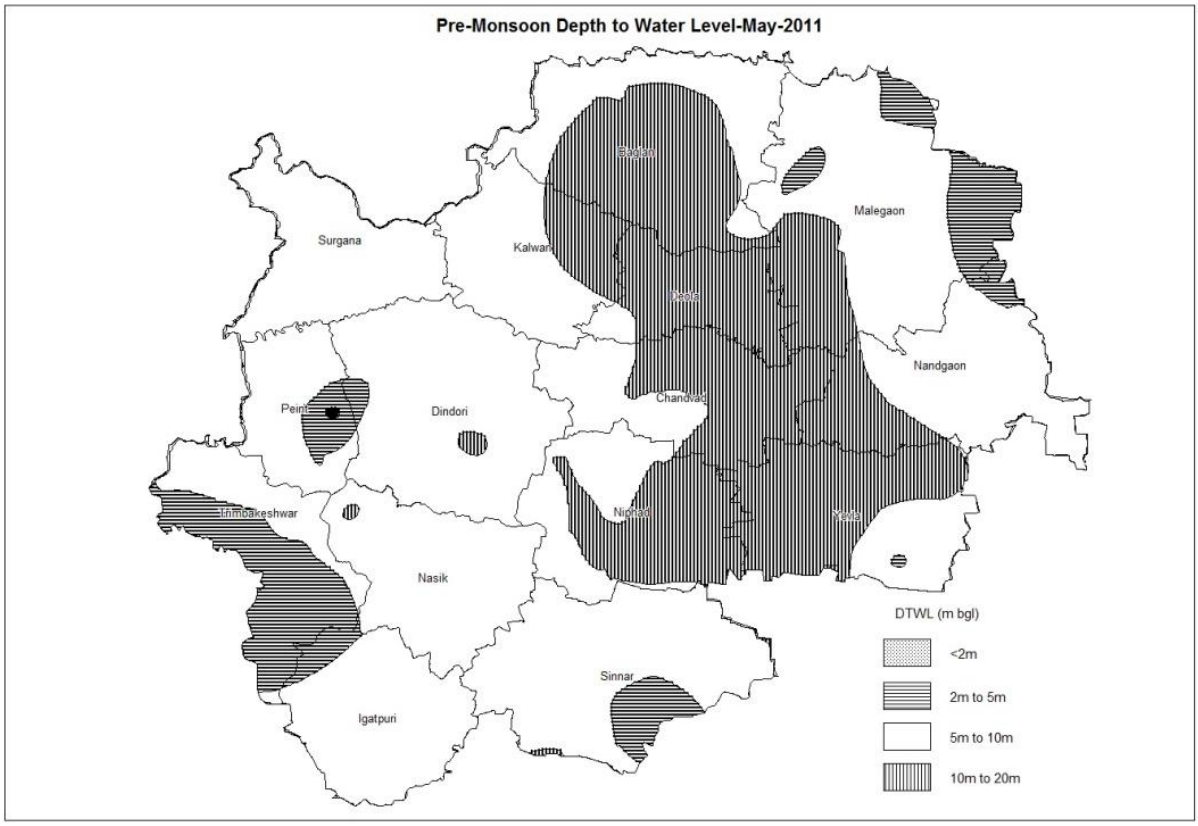

Figure-3: Depth to Water Level (Premonsoon- May 2011)

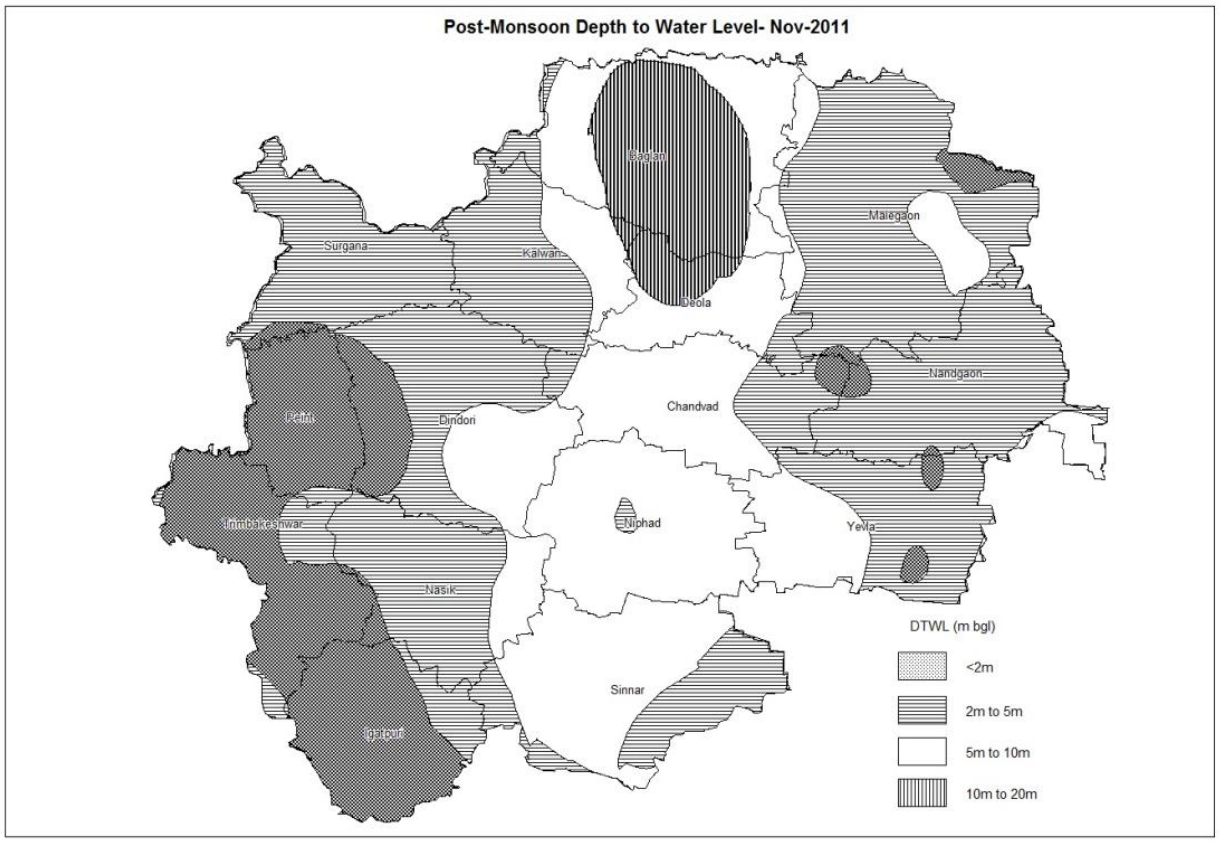

Figure-4: Depth to Water Level (Postmonsoon- Nov. 2011)

4.2.3 Seasonal Water Level Fluctuation (May to Nov. 2011)

Seasonal water level fluctuation between premonsoon and postmonsoon of 2011 have been computed. Water level fluctuation in the range of 0.19 (Kona) to1.14 m (Thengode) is observed in the district. Rise in water levels in the range of 2 to 4 m is observed in major parts of the district in northeast to southwest patch. Rise of more than 4 m is mainly observed in north eastern and south eastern parts occupying almost entire Surguna and Yevla talukas. Rise of 0 to 2 m is observed in isolated patches in northern part of the district in Baglan taluka and southern part of the district in Sinnar taluka.

4.2.4 Water Level Trend (2002-2011)

Trend of water levels for premonsoon and postmonsoon periods for last ten years (2002-2011) have been computed. Analysis of long term water level trend data indicates that rise in water levels in premonsoon period has been recorded at 37 NHNS and its ranges from 0.01 (Vasali) to 3.12 m/year (Thengode) and fall in water levels has been observed in 16 NHNS and it ranges between negligible (Tinghri) to 1.19 m/year (Shirpurwade-Baglan). During postmonsoon period rise in water levels has been recorded at 32 GWMW ranging from negligible (Karajgaon) to 1.27 m/year (Sakara) while at 22 GWMW fall in water level have been recorded and it ranges between negligible (Chachadgaon) and 1.00 m/year (Tinghri). Thus in major parts of the district, both during premonsoon and postmonsoon seasons declining water level trends have been recorded.

The premonsoon water level trend map was also prepared for the period May 2002-2011 and the same is presented in **Figure- 5**.

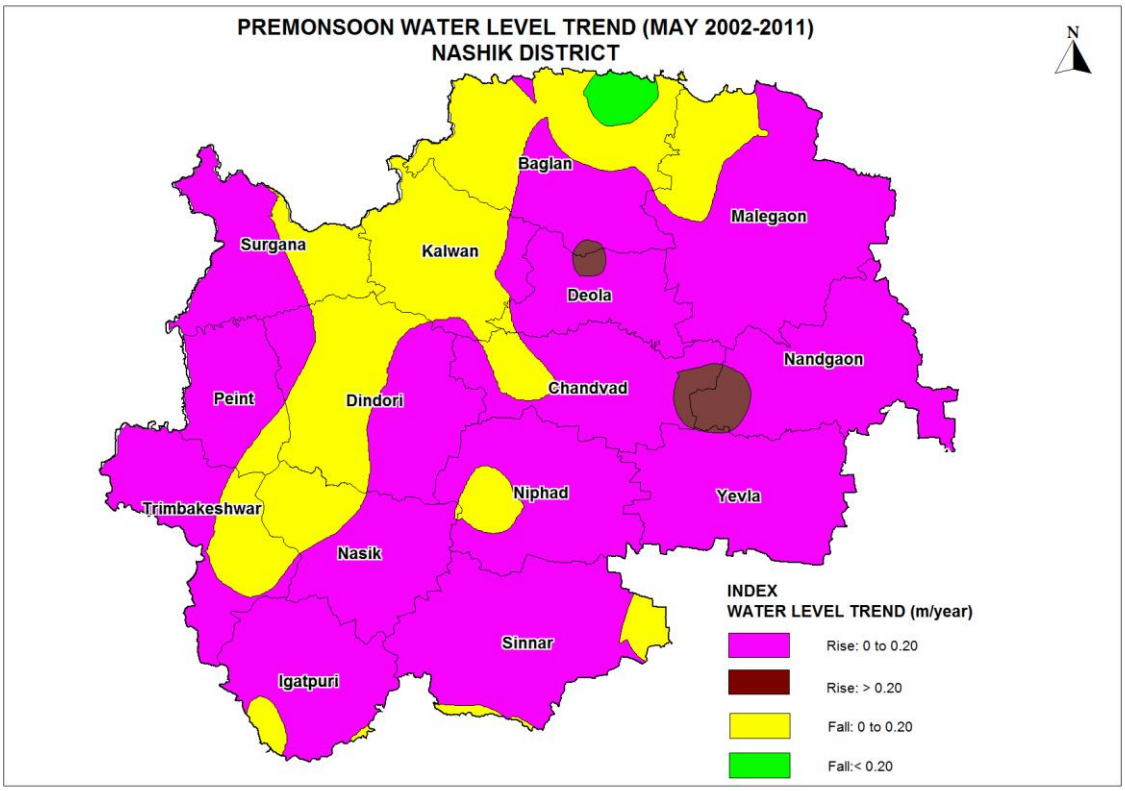

Figure-5: Premonsoon Water Level Trend May 2002-2011)

The perusal of map indicates that major parts of the district are showing rising water level trends in the range of 0 to 0.20m mainly in eastern, central, southern parts of the district comprising almost entire Malegaon, Deola,

Chandvad, Nandgaon, Yevla, Niphad, Sinnar, Igatpuri, Peint talukas and parts of Dindori, Nasik. The falling trend in the range of 0 to 0.20 m is observed in northern and north eastern parts of the district occupying parts Baglan, Kalwan, Dindori, Nasik and Trambakeshwar talukas. Thus in major part of the district rising water level trend is observed.

4.3 Yields of Dugwells and Borewells

The yields of the wells are the functions of the permeability and transmissivity of aquifer encountered. This varies with location, diameter and depth of wells. There are mainly three types of ground water structures i.e. dugwells, borewells and tubewells in the area. Their yield characteristics are presented in Table–4. Dugwells are generally used for both domestic water requirements and for minor irrigation purposes in the district. The depth of dugwells in Basaltic area of the district ranges from 12 to 15 m and the yield varies from 45 to 90 m^3/day depending upon the local hydrogeological conditions. Borewells drilled down to 70 m depth, tapping weathered and vesicular basalt are found to yield 18 to 68 m^3/day. The discharge of Peizometers ranges from 0.14 to 1.73 as seen from CGWB data. This variation of yields in the single type of aquifer is due to lateral/spatial variation in permeability of the formation/aquifer material. The dugwells constructed in Alluvium has been ranging in depth from 8-12 m with diameters of 2-3 m, whereas the borewells range in depth form 15 to 20 m and the yield of both the dugwells and borewells ranges from 13 to 22 m^3/day.

Table-4: Yields of Wells.

S. No.	Formation	GW Abstraction Structure	Depth Range (m bgl)	Yield Range (m^3/day)
1	Alluvium	Dugwell	8 to 12	13 to 22
		Shallow Tubewell	15 to 20	
2	Basalt	Dugwell	12 to 15	45 to 90
		Borewell	50 to 70	18 to 68

4.4 Ground Water Resources

Central Ground Water Board and Ground Water Survey and Development Agency (GSDA) have jointly estimated the ground water resources of Satara district based on GEC–97 methodology for the year 2009 and the same are presented in Table–5.

Ground water resources estimation was carried out for 13488.56 sq. km. area out of which 1650.24 sq. km. is under command and 11838.32 sq. km. is non-command. As per the estimation the total annual ground water recharge is 2201.12 MCM with the natural discharge of 116.89 MCM, thus the net annual ground water availability comes to be 2084.23 MCM. The gross draft for all uses is estimated at 1028.16 MCM with irrigation sector being the major consumer having a draft of 992.97 MCM. The net annual ground water availability for future irrigation is 1050.79 MCM, whereas the allocation for domestic and industrial requirements is 66.69 MCM. Stage of ground water development varies from 3.60% (Penth) to 98.72 % (Sinnar), whereas the overall stage of ground water development for the district is about 49.33%. Taluka wise assessments indicate that most of the talukas in the district fall under “Safe” category except Chandwad, Deola, Niphad and Sinnar talukas which fall under “Semi-Critical” category and their stage of ground water development is about 89%, 95%, 84% and 99% respectively.

Table 5: Ground Water Resources of Nashik District as on March 2009

Taluka	Area type	Net Annual Ground Water Availability (ham/yr.)	Annual Ground Water Draft (ham/yr.)			Allocation for Dom. & Ind. Requirement up to next 25 years (ham/yr.)	Ground Water Availability for Future Irrigation (ham/yr.)	Stage of GW Develop-ment (%)	Category
			Irrigation	Dom. & Ind. Uses	Total				
Bagalan Satana	Command	4122.7	1151.4	65.17	1216.58				Safe
	Non-command	11143.56	8629.32	197.17	8826.48				
	Total	15266.30	9780.72	262.34	10043.06	529.67	5220.16	65.79	
Chandwad	Command	1792.77	1366.43	37.21	1403.64				Semi-Critical
	Non-command	7987.66	7172.66	145.38	7318.04				
	Total	9780.43	8539.09	182.59	8721.68	421.64	1739.26	89.17	
Deola	Command	1012.32	551.86	25.68	577.54				Semi-Critical
	Non-command	4513.23	4607.10	92.58	4699.68				
	Total	5525.55	5158.96	118.26	5277.22	195.08	631.56	95.51	
Dindori	Command	4954.73	1196.56	57.90	1254.46				Safe
	Non-command	9309.83	47000.6	196.86	4897.46				
	Total	14264.56	5897.16	254.76	6151.92	537.39	8414.74	43.13	
Igatpuri	Command	1934.09	13.90	9.74	23.63				Safe
	Non-command	20091.07	1931.20	187.22	2118.42				
	Total	22025.16	1945.10	196.96	2142.06	406.72	19796.60	9.73	
Kalwan	Command	386.63	54.14	23.48	77.61				Safe
	Non-command	6832.20	4301.56	151.03	4452.60				
	Total	7218.84	4355.70	174.51	4530.21	338.50	2498.48	62.76	
Malegaon	Command	5734.77	2097.78	121.39	2219.16				Safe
	Non-command	12452.46	8417.38	239.35	8656.73				
	Total	18187.24	10515.16	360.74	10875.90	684.21	6458.88	59.80	
Nandgaon	Command	309.19	66.20	13.02	79.22				Safe
	Non-command	10839.77	4792.38	218.97	5011.35				
	Total	11148.96	4858.58	231.99	5090.57	460.30	5809.10	45.66	

Taluka	Area type	Net Annual Ground Water Availability (ham/yr.)	Annual Ground Water Draft (ham/yr.)			Allocation for Dom. & Ind. Requirement up to next 25 years (ham/yr.)	Ground Water Availability for Future Irrigation (ham/yr.)	Stage of GW Develop-ment (%)	Category
			Irrigation	Dom. & Ind. Uses	Total				
Nasik	Command	15056.16	2688.30	110.00	2798.30				Safe
	Non-command	4787.84	4814.63	86.59	4901.22				
	Total	19844.00	7502.93	196.59	7699.52	333.32	8904.16	38.80	
Niphad	Command	10987.08	7026.96	165.67	7192.63				Semi-Critical
	Non-command	8124.29	8643.81	209.54	8853.35				
	Total	19111.37	15670.77	375.21	16045.98	590.61	1737.62	83.96	
Peth	Command	897.21	13.26	11.73	25.00				Safe
	Non-command	10106.57	207.81	163.73	371.55				
	Total	11003.77	221.08	175.47	396.55	348.06	10321.01	3.60	
Sinnar	Command	2725.88	384.56	40.24	424.80				Semi-Critical
	Non-command	13091.93	14936.35	254.96	15191.31				
	Total	15817.81	15320.91	295.21	15616.11	453.12	2130.07	98.72	
Surgana	Command	131.97	6.85	5.82	12.66				Safe
	Non-command	13270.95	737.52	203.76	941.28				
	Total	13402.92	744.37	209.57	953.94	430.74	12261.62	7.12	
Trimbak	Command	98.17	7.21	0.91	8.12				Safe
	Non-command	13391.85	851.50	223.77	1075.27				
	Total	13490.02	858.70	224.68	1083.39	451.07	15627.33	8.03	
Yeola	Command	3648.25	1560.56	101.64	1662.20				Safe
	Non-command	8688.07	6368.07	158.01	6526.08				
	Total	12336.32	7928.63	259.66	8188.29	489.44	3528.94	66.38	
Total	**Command**	**53791.96**	**18185.97**	**789.60**	**18975.57**				
	Non-command	**154631.28**	**81111.90**	**2728.94**	**83840.83**				
	Total	**208423.24**	**99297.87**	**3518.53**	**102816.40**	**6669.87**	**105079.53**	**49.33**	

4.5 Ground Water Quality

CGWB is monitoring the ground water quality of the Nashik 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 16 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 Hardness (TH), Carbonate (CO_3), Bi-Carbonate (HCO_3), 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.

4.5.1 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), May 2011

Parameters	DL	MPL	Samples with conc. < DL	Samples with conc. In DL-MPL	Samples with conc. >MPL
pH	6.5 to 8.5	No relaxation	15	-	-
TH (mg/L)	300	600	5	9	1
NO_3 (mg/L)	45	No relaxation	6	-	9
F (mg/L)	1.0	1.5	15	-	-

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

The perusal of **Table-6** shows that the concentrations of all the parameters except nitrate in most of the samples is within the maximum permissible limit of BIS standards. It is also seen from the **Table-6** that the potability of ground water in the wells is mainly affected due to the Nitrate (NO_3) as its concentration exceeds more than MPL in 60% of samples. Overall, it can be concluded that the ground water quality in the wells monitored in the district is affected because of high NO_3 concentrations.

4.5.2 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.

4.5.2.1 Electrical Conductivity (EC)

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

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

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

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

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

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

It is clear from the **Table-7** that maximum number of samples (53%) falls under the category of high salinity water while nearly 20% of samples fall in very high salinity water category. This shows that the ground water in the pre-monsoon season from shallow aquifer in the district should be used for irrigation with proper soil and crop management practices.

Table-7: Classification of Ground Water for Irrigation based on EC (May 2011).

Type	EC (µS/cm)	No. of Samples	% of Samples
Low Salinity Water	<250	Nil	Nil
Medium Salinity Water	250-750	4	27
High Salinity Water	750-2250	8	53
Very High Salinity Water	>2250	3	20
Total		**15**	**100.0**

4.5.2.2 Residual Sodium Carbonate (RSC)

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

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

Type	RSC	No. of Samples	% of Samples
Good	<1.25	15	100
Doubtful	1.25-2.50	Nil	Nil
Unsuitable	>2.50	Nil	Nil
Total		**15**	**100**

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

4.6 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. Ground water in the district is predominantly used for irrigation as it is the major ground water utilizing sector. The ground water development in the district is mostly through dugwells.

As per 4th MI census 2006-07, there are about 1,78,793 dugwells in use in the district which create an irrigation potential of 3110 sq. km. out of which 3087 sq. km. of irrigation potential is utilized, whereas 10928 borewells create an irrigation potential of 155.99 sq. km. out of which 155.88 sq. km. of irrigation potential is utilized. There are 9251 surface water schemes which create of 186.13 sq km of which 183.90 sq km is utilized. The area irrigated by ground water is 3243 sq. km., whereas the surface water accounts for about 183.90 sq.km. and the net irrigated area is about 3427 sq.km., thus ground water account for 99%, of net irrigated area as per 4th MI census.

State Government agencies have drilled number of borewells/tubewells fitted with hand pumps and electric motors for rural drinking water purposes in the district. In all till March 2012, GSDA, Government of Maharashtra is operating 7293 successful borewells/tubewells for rural water supply under various schemes in the district out of which 6724 have been fitted with hand pumps and 569 with power pumps.

5.0 Ground Water Management Strategy

Ground water has special significance for agricultural development in the district. Ground water development in some part of the district has reached to a critical stage resulting in decline of ground water levels. Thus, there is need to adopt and 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 is underlain by Deccan Trap Basalt, hence the most feasible abstraction structure for ground water development are dugwells followed by borewells. However, the borewells generally tap deeper fractures thus sites for borewell need to be selected only after proper scientific investigation so as to minimize the failure rate. The yield of dugwells in Basalt may be expected from 20 to 100 m^3/day depending on the local hydrogeological conditions. In Alluvium, the shallow tubewells tapping the granular zones till the

basement is encountered are the most feasible ground water abstraction structure, that are expected to yield up to 25 m^3/day followed by dugwells, where the thickness and areal extent of Alluvium is less.

The hilly areas of the district where rocks are hard and compact, resistant to weathering with steep gradient causing rapid runoff and low infiltration are not feasible for ground water development. Such areas occur in southern part of the district covering parts of Sinnar taluka and southern part of Igatpuri taluka; western part of the district covering almost entire Peint taluka and eastern part of district covering southern part of Nandgaon taluka. Similarly, in central-southern part of the district covering Chandwad, Deola, Niphad and Sinnar 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.

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 parts of Sinnar and Peint talukas and parts of Igatpuri and Nandgaon 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

It is seen from long term rainfall data that major part of the district (about 75%) falling east of Western Ghats comprising almost entire Sinnar, Niphad, Surgana, Kalvan, Satana, Chandwad, Yeola talukas and parts of Dindori, Peint and Malegaon talukas experiences drought conditions for more than 20% of the years. Therefore, these areas are classified as drought areas. The premonsoon water level trend shows fall in water level up to 20 cm/year in northern and north eastern parts of the district occupying parts Baglan, Kalwan, Dindori, Nasik and Trambakeshwar talukas. Similarly as per current assessment of ground water resources it is also seen that the ground water development in Chandwad, Niphad, Deola and Sinnar talukas have already categorized as Semi-Critical. Thus the situation is quite critical in not favorable for ground water development in these parts and the future ground water conservation and recharge structures needs to be prioritized in these areas.

At some places like Satana, Sinnar, Nandgaon and Rasalapur the EC of ground water is above 2000 μ mhos/cm at 25°C. In all these places except Rasalapur the high EC is accompanied by high nitrate ion concentration indicating contamination due to anthropogenic sources. At such places ground water at deeper levels may be explored. The ground water quality is mainly affected by nitrate as 60% of samples are having high nitrate concentration. Continuous intake of high nitrate concentration water causes infant

methaemoglobinamea, 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 2011, one Water Management Training Programme (WMTP) had been organised in the district. The details are given in Table-8.

Table-8: Status of WMTP.

S. No.	Item	AAP	Venue	Date	Participants
1.	WMTP	2003-04	Rotary Hall, Ganjmal, Nashik.	09/03/03	125

7.2 Participation in Exhibition, Mela, Fair etc.

During the Indian Agricultural Trade Fair (IATF), held at Nashik during 30/11/05 to 05/12/05, an exhibition stall depicting rainwater harvesting model, various ground water related posters, leaflets, literature and technical reports were displayed along with maps of Nashik district. The models, maps, posters were explained to the visitors in details and leaflets on water conservation in day-to-day life and artificial recharge were provided to the visitors.

8.0 Areas Notified by CGWA / SGWA

As per ground water resources estimation, 4 talukas viz., Chandwad, Niphad, Deola and Sinnar fall under “Semi-Critical” category. However, so far none of the talukas have been notified either by CGWA or SGWA for ground water regulation in the district.

9.0 Recommendations

1. The major part of the district is underlain by Deccan Trap Basalt, where only dugwells are most feasible ground water abstraction structures for development. However the borewells are another alternative but sites for borewell need to be selected only after proper scientific investigation.
2. Borewells generally tap deeper fracture which may not be sustainable throughout the year. Hence the borewell should only be used for drinking purpose and not for irrigation purposes.
3. Alluvium occurs in small areas alongside the river courses which is about 20 m thick. The ground water in the Alluvium can be developed through dugwells and shallow tubewells expected to yield upto 25 m^3/day.
4. The overall stage of ground water development for the district is about 49.33%, however, this low development is restricted to western and eastern parts of the district and is not equitably distributed. Therefore, there is scope for future development of ground water resources in these parts of the district.
5. There are 4 “Semi-Critical” talukas viz., Chandwad, Deola, Niphad and Sinnar where there is very limited scope for further ground water development. Therefore 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 in these areas.

6. The hilly areas of the district are not feasible for ground water development. Such areas occur in southern part of the district covering parts of Sinnar taluka and southern part of Igatpuri taluka; western part of the district covering almost entire Peint taluka and eastern part of district covering southern part of Nandgaon taluka.
7. The ground water quality is mainly affected by nitrate as 60% of samples are having high nitrate concentration. 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 purposes other than drinking. Adequate sanitary protection to the wells may be provided to control the nitrate contamination.
8. The scope exists for construction of suitable artificial recharge structure in the district. The structure recommended particularly for the hilly area occupying parts of Sinnar taluka and almost entire Peint taluka and parts of Igatpuri and Nandgaon talukas are contour bunds, gully plugs, nala bunds and check dams etc. For other hard rock areas of the district, nala bunds, check dam, KT weirs and percolation tanks at suitable sites are suggested. The existing dugwells may also be used for artificial recharge of ground water by insuring that the water used for recharge should be free from silt and other impurities.
9. The existing percolation tanks and village ponds need to be rejuvenated to act both as water conservation and artificial recharge structure.
10. To enhance the ground water resources and for sustainable development, mass awareness programmes should be organized in large scale by district administration. Such programmes are necessary so as to educate the user regarding yielding capacity of aquifer and declining trend of water levels in the district. Similarly farmer should also be encouraged to adopt appropriate crop planning and irrigation practices.