केंद्रीय भूमि जल बोर्ड

जल संसाधन, नदी विकास और गंगा संरक्षण मंत्रालय

भारत सरकार

Central Ground Water Board

Ministry of Water Resources, River Development and Ganga Rejuvenation

Government of India

AQUIFER MAPPING REPORT

Chandvad, Deola, Niphad and Sinnar Talukas, Nashik District, Maharashtra (Part-I)

मध्य क्षेत्र, नागपुर

Central Region, Nagpur

भारत सरकार
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CENTRAL GROUND WATER BOARD

जल बचत जल संचय

Aquifer Maps and Ground Water Management Plan

जलभृत नक्शे तथा भूजल प्रबंधन योजना

चांदवड, देवला, निफाड़ व सिन्नर तालुका, नासिक जिला, महाराष्ट्र

CHANDVAD, DEOLA, NIPHAD &, SINNAR TALUKAS, NASHIK DISTRICT, MAHARASHTRA

मध्य क्षेत्र, नागपुर / Central Region, Nagpur
नवम्बर 2016 /November 2016

PART-I

AQUIFER MAPS AND GROUND WATER MANAGEMENT PLANS, OF CHANDVAD, DEOLA, NIPHAD AND SINNAR TALUKAS, NASHIK DISTRICT, MAHARASHTRA

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AQUIFER MAPS AND GROUND WATER MANAGEMENT PLANS, OF CHANDVAD, DEOLA, NIPHAD AND SINNAR TALUKAS, NASHIK DISTRICT, MAHARASHTRA

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AQUIFER MAPS AND GROUND WATER MANAGEMENT PLANS, OF CHANDVAD, DEOLA, NIPHAD AND SINNAR TALUKAS, NASHIK DISTRICT, MAHARASHTRA

1 INTRODUCTION

1.1 Objective

National Aquifer Mapping (NAQUIM) has been introduced in XII five year plan to carry out detailed hydrogeological investigation on a scale of 1:50,000. The activities under study includes toposheet wise micro level hydrogeological data acquisition supported by geophysical and hydro-chemical investigations supplemented with ground water exploration down to the depths of 200 meters. The study also include quality monitoring (intensive inventory of wells), Hydrological and Hydrometeorological studies, Infiltration Tests, Geophysical Surveys, Water Quality Analysis, Isotope Study, Specific Yield determination, Slug Test, GIS data integration & analysis, Preparation of Aquifer map, compilation and Printing of reports etc. The activities under NAQUIM are aimed at identifying the aquifer geometry, aquifer characteristics their yield potential along with the quality of water occurring at various depths, aquifer wise assessment of ground water resources and development of an aquifer wise GIS based water supply management plan. The clear demarcation of aquifers and accurate assessment of their potential will help institutions/agencies and stakeholders to effectively understand and manage groundwater resources at regional and local level.

Under the NAQUIM study Chandvad,Deola,Niphad and Sinnar Talukas of Nashik district has been taken up and toposheet wise micro level hydrogeological data acquisition supported by geophysical and hydro-chemical investigations supplemented with ground water exploration down to the depths of 200 meters have been carried out.

Aquifer mapping itself is an improved form of groundwater management – recharge, conservation, harvesting and protocols of managing groundwater. These protocols are the real derivatives of the aquifer mapping exercise and have find a place in the output (the map) and the outcome (changes within social behaviour that reflects these protocols). In fact, some important socio-economic information at the scale of well has form the basic sample of groundwater information and has been collected as part of the aquifer mapping effort to define the aquifer geometry, type of aquifers, ground water regime behaviours, hydraulic characteristics and geochemistry of Multi-layered aquifer systems on 1:50,000 scale.

1.2 Scope of the study

National Aquifer Mapping Programme (NAQUIM) is the thrust area of CGWB activities in the 12^{th} and 13^{th} plan period, there has been lot of deliberations and Concept note / implementation strategies are being finalized by CGWB. In view of the challenging work ahead, involvement of State Ground Water Department being the implementing agency in the area of ground water development and management is of prime importance to achieve the objectives envisaged under NAQUIM. In the 12^{th} five-year plan, it is proposed to cover thrust areas and requires scientific interventions through participatory approach of end users.

In Chandvad, Deola, Niphad and Sinnar Talukas of Nashik district, following are the main issues and challenges:

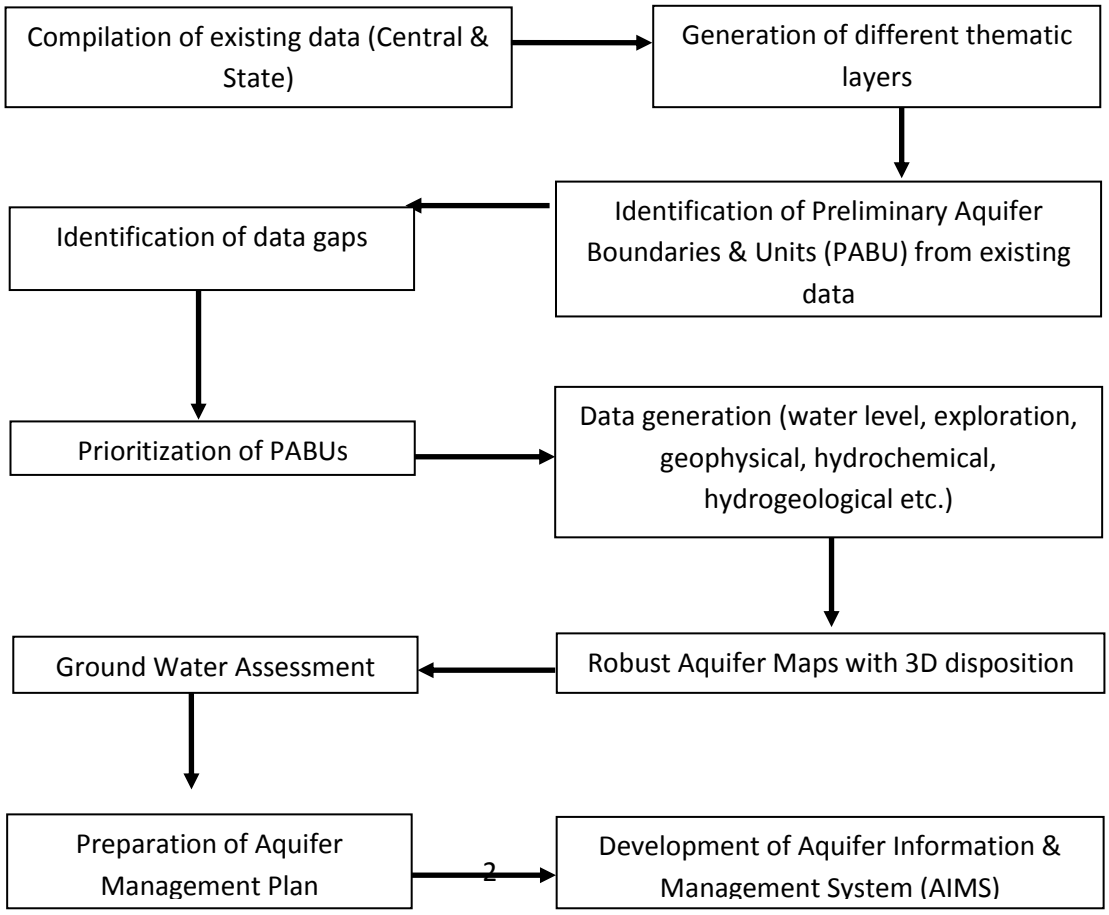
- Paucity of rains with long dry spells
- Limited aquifer thickness and heterogeneous nature of formation
- Drying up of aquifer
- Failure of borewells due to unscientific site selection
- Decline of water level

To resolve such issues, aquifer mapping has been taken up in Chandvad, Deola, Niphad and Sinnar Talukas of Nashik district with following broad objectives:

- To define the aquifer geometry with precise lateral and vertical demarcation.
- To define ground water regime behaviour in time and space.
- To study the hydraulic characteristics of both shallow and deeper aquifer.
- To study the Geochemistry of aquifer systems down to the depth of 200 m.
- To prepare Aquifer Maps indicating dispositions of aquifers along with their characterization.
- To formulate the Aquifer Management Plans for sustainable development and management of ground water resources.

1.3 Approach and methodology

The experiences gain during the Pilot Project on Aquifer Mapping carried under the World Bank funded Hydrology Project (HP-II) has been used to study the area under study. The action plan for Aquifer mapping is as given below:



Five major steps have been identified for Aquifer mapping, namely:

1. Compilation of existing ground water data and data gap analysis
2. Generation of additional ground water data
3. Preparation of Aquifer Maps
4. Preparation of Aquifer Management Plans
5. Participatory ground water management

Systematically NAQUIM study is planned considering each of the above-mentioned steps to address the following issues:

1. The existing data from all state and central agencies have been collected and processed to make a validated ground water database. The specific parameters missing in the secondary data like co-ordinates and reduced ground elevation etc. Have been collected and standard database in GIS platform has been made.
2. The data generation to bring out validated ground information on aquifer geometry, its characteristics, status of development and stress acting in localized aquifer system like quality and scarcity, need for augmentation with suitable site and design and other factors controlling the ground water occurrence and movement in surface and sub-surface have been optimized. Specific scientific data required have been generated and used for better understanding of the total ground water system including the interaction with surface water.
3. Preparation of Aquifer Maps
4. Preparation of Aquifer Management Plans
5. Implementation of Aquifer management plan by Participatory ground water management.

a. Demystify the science of ground water hydrology through capacity building and community level participation in real time data collection planning and development.

b. Establishment of protocols for participatory ground water management through

i). Suggesting mechanism for collection of required data / parameters for seasonal assessment of ground water resources and their regular updating at local level involving the end users.

ii). Formulating appropriate strategies and methodology for strengthening local institutions and end users for ground water management and capacity building of stakeholders (staff / officials/PRIs/NGOs/CSOs etc.).

c. Strengthen local institutions to address emerging ground water issues in respect of quantity and quality of ground water resources.

d. Transform the perception of groundwater from private property to that of a “common good”, where individual farmers take decisions for collective good.

1.4 Study area

The Central Ground Water Board in view of the current and futuristic requirement of water and its availability has initiated the National Aquifer Mapping Programme (NAQUIM) in India during XII five year plan, with a priority to study over-exploited, critical and semi-critical talukas. The Central Ground Water Board in consultation of Groundwater Surveys and Development agency, Govt. of Maharashtra, Pune has selected Chandvad, Deola, Niphad and Sinnar Talukas of Nashik district on priority for the detailed hydrogeological investigation under NAQUIM. The Deola, Chandvad, Niphad & Sinnar talukas are situated in the central part of Nashik district, cover an area of 577.46, 890.07, 1151.75 and 1326.48 sq. km respectively. Thus, the total the area of study is 3946.76 sq. km. These talukas have been categorized as semi critical, as per Ground Water Resources Estimation carried out by

CGWB and GSDA as on 2013.The index map and administrative map of the study area is presented in **Fig. 1.1.**

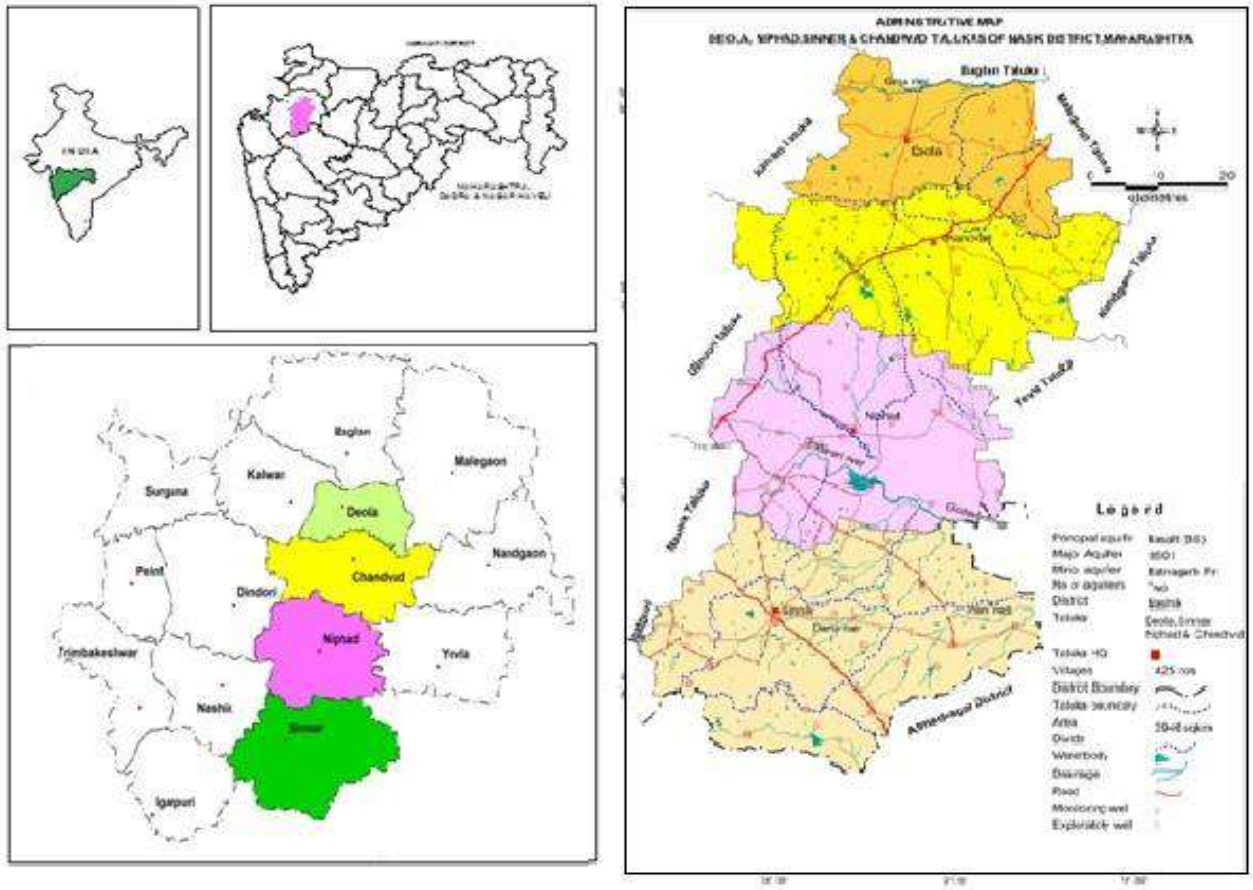


Fig. 1.1: Index & Administrative map

1.5 Data Adequacy and Data Gap Analysis

The available data of the exploratory wells, Ground water level monitoring stations, Geophysical surveys and ground water quality monitoring stations of Central Ground Water Board were compiled and analysed for adequacy**.** In addition to these the data on ground water monitoring stations and ground water quality stations of the State Govt. (GSDA) were also utilised for same. After taking into consideration the available data of Ground Water Exploration, Geophysical Survey data, Ground Water Monitoring and Ground Water Quality, the data adequacy has been worked out. The norms of data adequacy were designed considering the heteogentity of aquifers in the area**.** The area consist of basaltic lava flows where ground water occurs in phreatic condition in weathered portion generally up to 30 meters depth and in semi confined to confined condition between 30 and 200 meter depth. Only two aquifer systems exists i.e. Aquifer-I which extends up to weathered Zone upto 30m followed by Aquifer-II which normally exists in the fractured portion of hard rock between 30 to 200 meters depth.

The locations of existing exploratory wells, ground water monitoring station and ground water quality station were plotted in toposheet and data gaps have been identified

with respect to the norms for each quardent of 5" X 5" grid in toposheet.For data gap identification in respect of aquifer geometry and aquifer parameter for Aquifer-II, one data point in each alternate quadrant and central quadrant have been considered.Thus, 5 EW and 5 OW have been considered in each toposheet.While, for Ground Water level Monitoring data for Aquifer-I (un-confined/ Phreatic) one open/dug well has been considered for each quadrant of a toposheet and for monitoring of Aquifer-II (fractured zone) the OW constructed during ground water exploration is used as piezometers for GW monitoring and monitored four times annually for three years as per the national net work hydrograph monitoring schedule. Ground Water Quality Data for Aquifer-I (un-confined / Phreatic) one sample from open/dug wells is taken for each quadrant of a toposheet and for Aquifer-II (fractured zone) the water sample collected from EW constructed during exploration.

After taking in to consideration, the available data of Ground Water exploration, Geophysical survey,Ground water monitoring and Ground water quality, summerised details of data required, data existing and data gap in respect of exploratory wells, ground Water monitoring and ground water quality stations is give below in Table 1.1 Based on Data Gap Analysis following additional data was generated**.**

Table 1.1. Summarized details of Data Gap and Data Adequacy in Chandvad, Deola, Niphad and Sinnar Talukas

Exploratory data			**Geophysical data**			**GW monitoring data**			**GW quality data**		
Req.	Exist.	Gap	Req	Exist.	Gap	Req.	Exist.	Gap	Req.	Exist.	Gap
39	14	25	75	26	49	49	14	35	49	14	35

The data adequacy analysis indicates that data gap exists in Geophysical Survey (VES), Exploratory Wells, Ground Water Level Monitoring and Ground Water Quality for shallow as well as deeper aquifer. Location of existing exploratory wells **(Fig. 1.2),** location of existing GW level monitoring stations & Quality sampling stations **(Fig 1.3).**

1.6 Data Gap Identification

The data adequacy as discussed above indicates that the existing data is not sufficient for preparation of aquifer maps; hence data gap has been identified for Exploratory Wells, Geophysical Survey (VES), Ground Water Monitoring Wells and Ground Water Quality. Based on the data gap identification, the data generation activity was planned and completed in 2015-16.

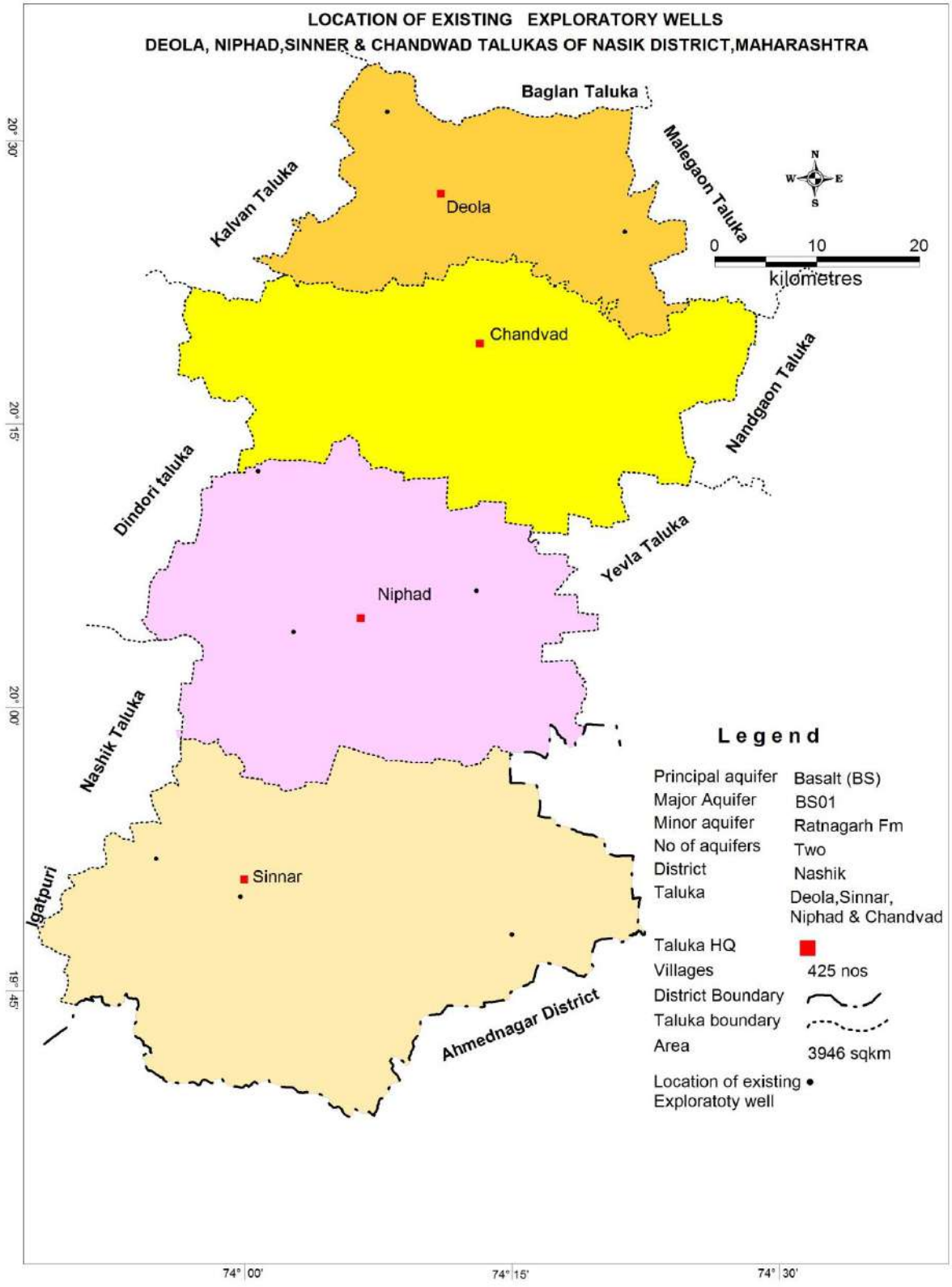


Fig. 1.2: Location of existing exploratory wells

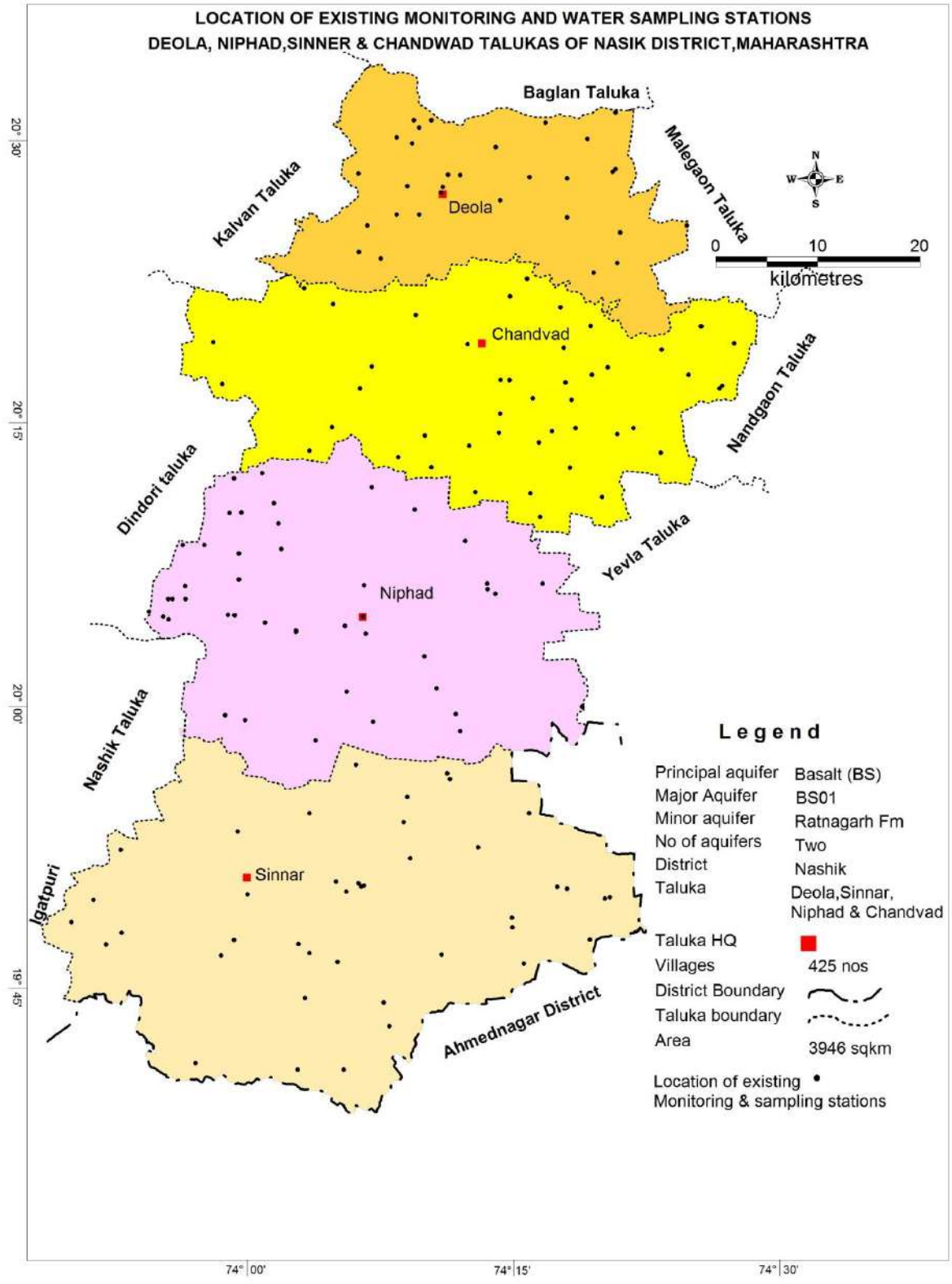


Fig. 1.3: Location of existing GW monitoring and Quality sampling stations

1.7 Rainfall and Climate

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. From June to September is the south-west monsoon season, whereas October and November are 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 the 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, Chandvad, Deola talukas .The annual rainfall data has been given in for 2004-2015has been given in Table 1.2 and Variation in average annual rain fall across the area is shown in **Fig.1.4**.

Table 1.2. Annual Rainfall Data of Devla, Niphad, Sinnar and Chandvad talukas, Nashik district for the period 2004-2015 (in mm)

Taluka	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average
Chandvad	828	640	1161	791	722	479	776	559	649	583.5	486.4	484.2	815.9
Deola	465	491	864	675	436	369	416	283	384	500.4	398.8	414.2	569.6
Niphad	1044	885	879	781	678	392	522	277	507	541.5	368.7	345.6	722.0
Sinnar	702	676	951	689	664	546	613	469	447	569	390.2	284.8	700.1

Rainfall data of rain gauge stations located at taluka headquarters of Deola, Niphad, Sinnar and Chandvad talukas are subjected to various types of statistical analysis to understand the characteristic of the rainfall. The long term rainfall analysis for the period 1901 to 2015 for Niphad and Sinnar talukas and for the period of 1998 to 2015 for Chandvad and Deola talukas indicate that there is significant fall (-9.693mm/year) in the rainfall trend at Deola taluka while significant rise (+1.067 mm/year) in rainfall at Sinnar taluka. The probability of normal rainfall is about 72 % in Deola and 50% in Chanvad taluka while the chances of droughts are about 32% in these talukas. The long term rainfall analysis has been given in Table 1.3.

Table 1.3: Long term rainfall analysis of Devla, Niphad, Sinnar and Chandvad talukas, Nashik district

CATEGORY	Chandwad Taluka	Niphad Taluka	Sinner Taluka	Deola Taluka
PERIOD	1998 TO 2015	1901-2015	1901-2015	1998 to 2015
NO OF YEARS	18	113	115	18
NORMAL RAINFALL	650.3 mm	540mm	583.6	487.9 mm
STANDARD DEVIATION	205 mm	173mm	184mm	153 mm
COEFF OF VARIATION	32 %	32%	32 %	31 %
RAINFALL TREND / SLOPE	-8.2 mm/year	0.591mm/year	1.067mm/year	-9.693mm/year

CATEGORY	Chandwad Taluka		Niphad Taluka		Sinner Taluka		Deola Taluka	
	Number of years	% of total years	Number of years	% of total years	Number of years	% of total years	Number of years	% of total years
DEPARTURES								
POSITIVE	10	56	48	42	56	49	7	39
NEGATIVE	8	44	65	58	59	51	11	61
DROUGHTS								
MODERATE	5	28	18	16	22	19	2	11
SEVERE	0	0	4	4	6	5	0	0
ACUTE	0	0	0	0	0	0	0	0
NORMAL & EXCESS R/F								
NORMAL	9	50	66	58	61	53	13	72
EXCESS	4	22	25	22	26	23	3	17

NOTE: Rainfall departure: EXCESS: > +25; NORMAL: +25 TO -25; MODERATE: -25 TO -50; SEVERE: -50 TO -75; ACUTE: < -74

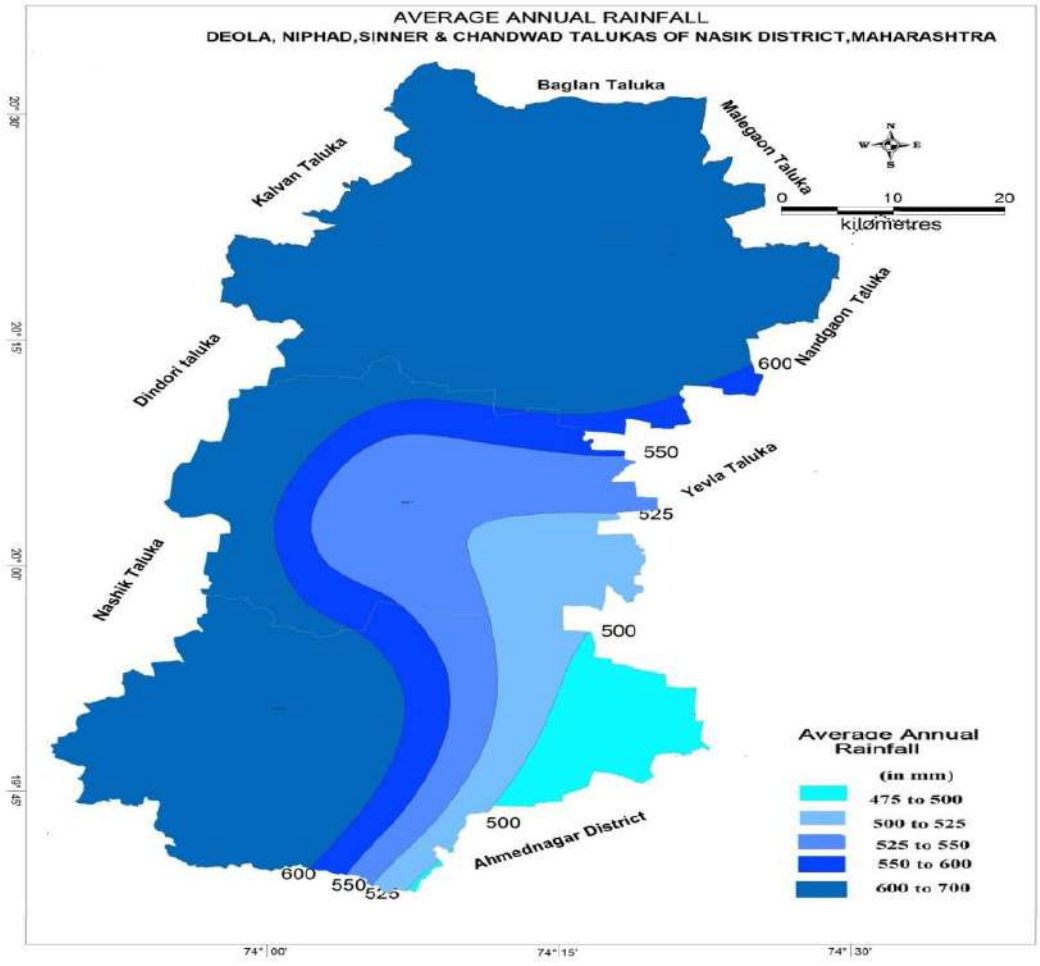


Fig.1.4 Average Annual Rainfall

1.8 Physiography

Physiographically, the Nasik district is a part of Western Ghat and Deccan Plateau. The main physiographic features are hills and valley. The Sahayadri and its offshoots i.e Satmala or Ajanta range (1127-1432m.amsl) are main system of hills, run right across the area. The Low-lying hill ranges with flat topped basaltic ridges form typical pleatue type of physiography. The plains of Godavari valley form the distinct wide valley type physiographic units; having general elevation of 500m to 550m amsl. The river valley is marked by bad land topography. The physiography of the area is shown in **Fig. 1.5**.

1.9 Geomorphology

The analysis of geomorphological data and thematic map collected from MRSAC, Nashik indicate that in the northern and southern part of the area forms the weathered pleatue of weathering upto 0-1m and 2-5m depth (PLW). The northern and southern part of area is also marked by undissected to slightly dissected pleatue of weathering upto 0-1m (PLU). The highly dissected pleatue is found at the highly elevated regions at southern fringe of the area and at the boundary of the Deola and Chandvad talukas boundary**,** as linear stretch (PLH)**.**The central part is marked by weathered plateau with canal command (PLC) and alluvial plain under canal command (APC). The Messa and Butte are also observed as scattered patches. The geomorphology of the area is shown in **Fig. 1.6** and presented in Table 1.4.

Table 1.4. Geomorphology of the area

SN	Geomorphic unit	Area (Sqkm)	Ground water condition
1	Alluvial Plain - Older - Moderate (AYM)	90.18	Form productive aquifer.Yiels may vary with thicness of alluvium.
2	Alluvial Plain Under Canal Command (APC)	1.62	Form productive aquifer.Yiels may vary with thicness of alluvium.
3	Butte (B)	47.49	Form runoff zone.Not suitable for groundwater development.
4	Escarment Slope (ES)	79.98	Form runoff zone.Not suitable for groundwater development.
5	Mesa (M)	8.86	Form runoff zone.Not suitable for groundwater development.
6	Outer Fringes of Plateau (OFP)	8.35	Form runoff zone.Not suitable for groundwater development.
7	Plateau Highly Dissected (PLH)	198.43	Form runoff zone.Prospect limited to Lineament/fracture zone.
8	Plateau Moderately Dissected (PLM)	330.16	Suitable for seasonal source only.Groundwater prospect are good along Lineaments.
9	Plateau Slightly Dissected (PLS), 0-1m weathering	892.61	Suitable for seasonal source only.Groundwater prospect are good along Lineaments.
10	Plateau Undissected (PLU), 0-1m weathering	44.35	Suitable for seasonal source only.Groundwater prospect are good along Lineaments.
11	Plateau Weathered (PLW), 2-5m weathering	335.01	Form productive aquifer.Good Recharge zone.
12	Plateau Weathered (PLWS), 1-2m weathering	940.18	Form productive deeper aquifer.Good Recharge zone.
13	Plateau Weathered-Canal Command (PLC)	934.87	Form productive aquifer.Good Recharge zone.
14	Valley Fill Shallow (VFS), 0-1m weathering	3.77	Good recharge zone.

1.10 Land Use, Agriculture, Irrigation and Cropping Pattern

The landuse details and the thematic map available with the MRSAC, Nashik has been collected and analysed with reference to the present agricultural practices, various land use etc. The major part of the areas is covered by agricultural land. The agriculture pattern in most of the area is under double crop and more than double crop. The northern part of the area, at the boundary between Deola and Chandvad taluka and southern part of the area in Sinnar taluka is under forest covers. The area under various principal crops is given in Table1.5 and thematic map on land use is shown in **Fig. 1.7**.

Table 1.5: Area under principal crops in Devla, Niphad, Sinnar and Chandvad talukas, Nashik district

Talukas	Onion	Cereals	Food Grains	Fruits and Vegetable	Bazara	Sugarcane
Deola	5784	24734	26831	12071	13516	1218
Chandvad	7430	38853	43114	20931	34169	548
Niphad	5068	43970	48927	17599	1145	4440
Sinnar	8051	21863	24033	40358	31517	7292

The main crops of area are Bajara, Rice, Jawar .The Bajara, Rice and Jowar are the main Kharif crops. Paddy is mainly grown in Tribal belt of the area The Wheat and Gram are grown during the rabbi season. Vegetables and Onion are main cash crops. After establishment of sugar factories, Sugarcane is also a cash crop grown in the area.

1.11 Soil

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.The soil map is shown in **Fig 1.8.**

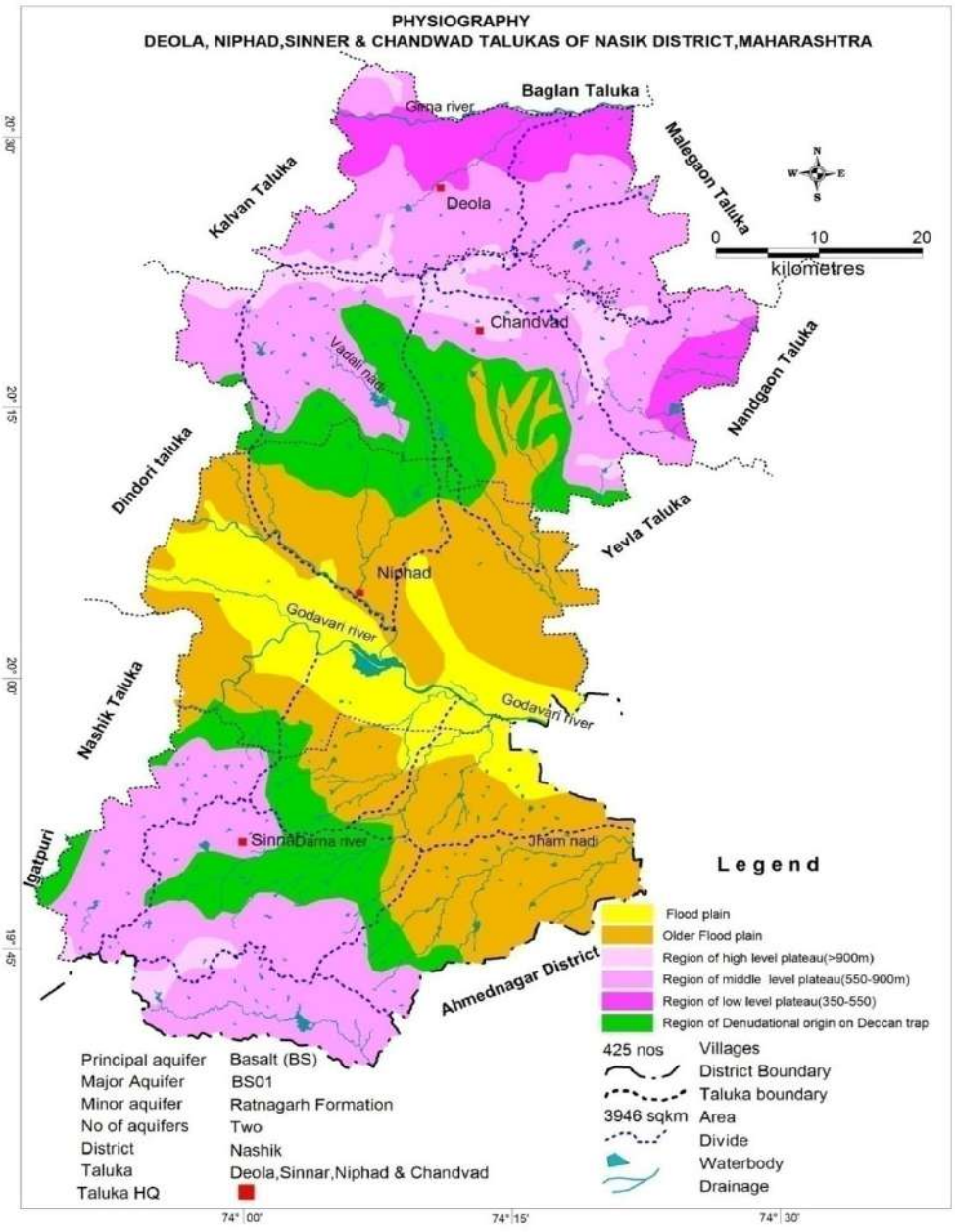


Fig. 1.5: Physiography

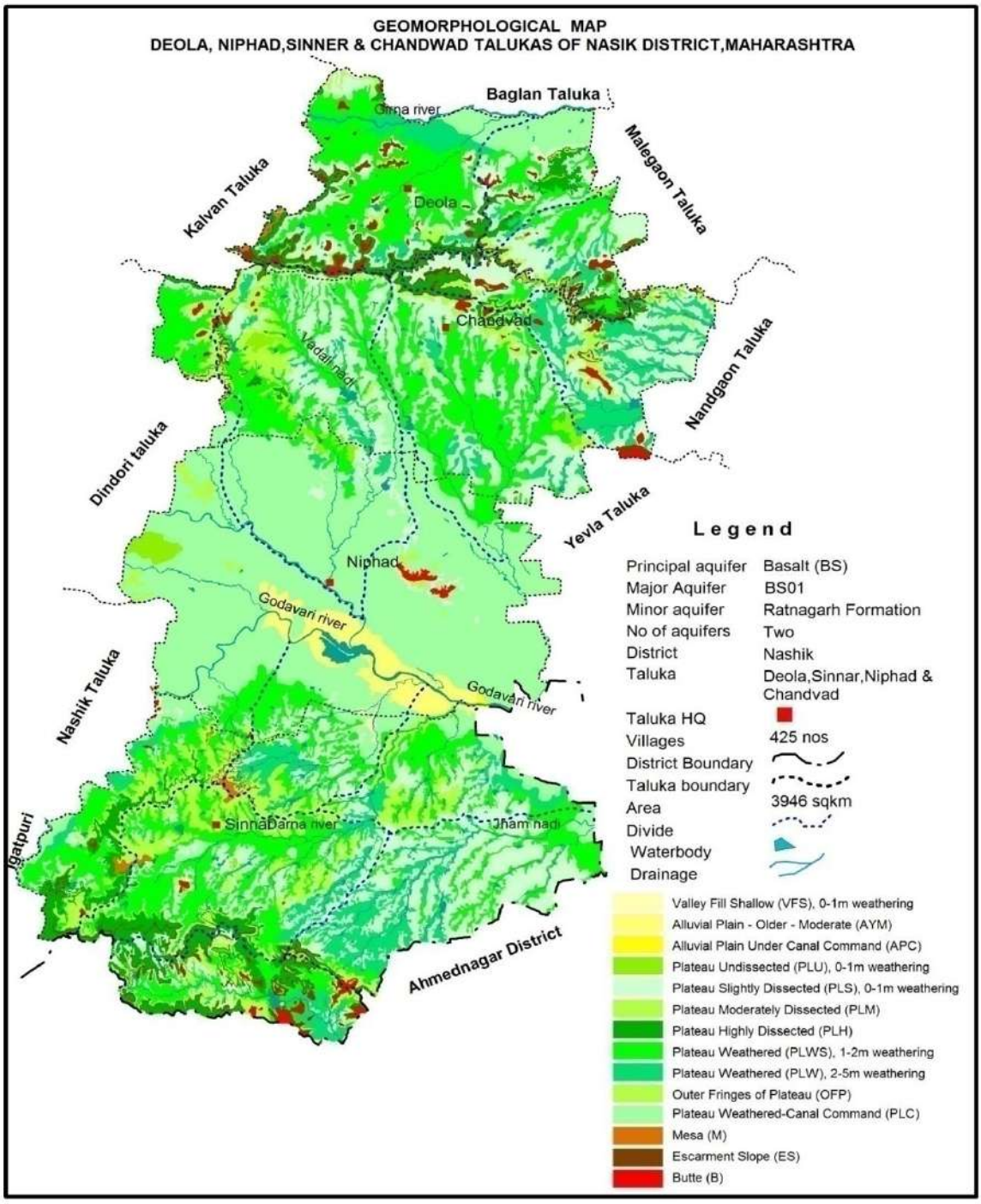


Fig. 1.6: Geomorphology

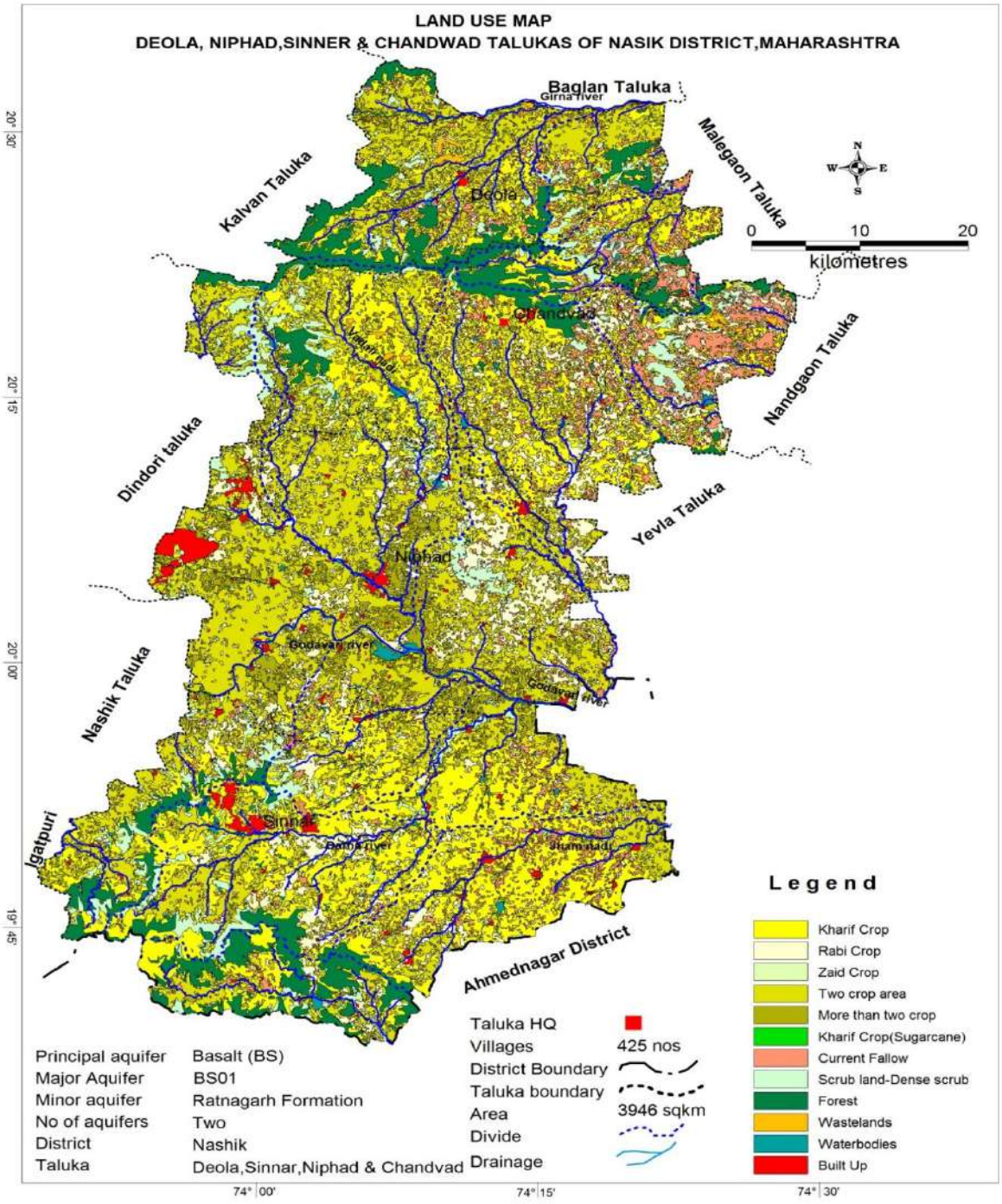


Fig. 1.7: Landuse

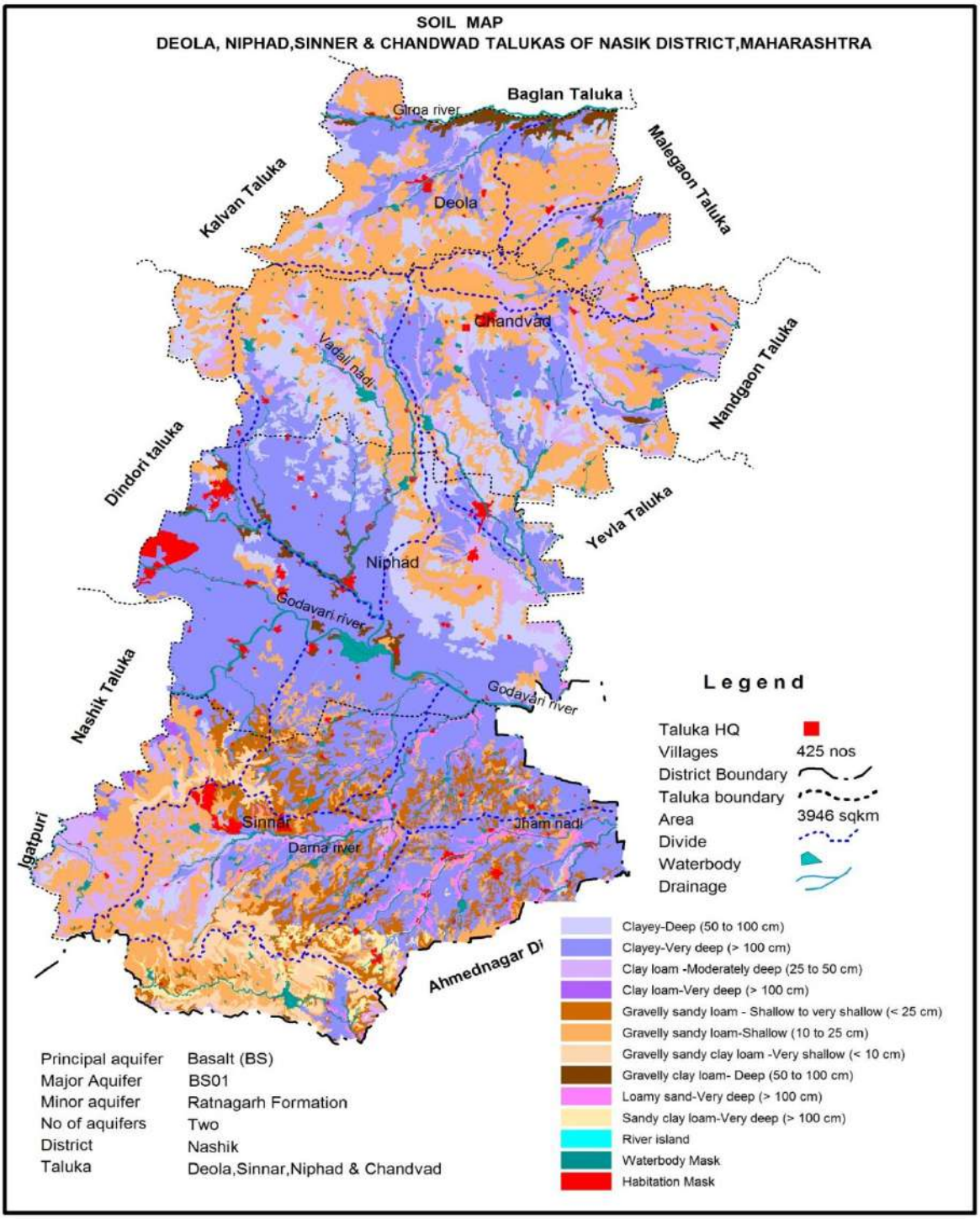

SOIL MAP
DEOLA, NIPHAD,SINNER & CHANDWAD TALUKAS OF NASIK DISTRICT,MAHARASHTRA
Baglan Taluka
Girna river
Kalvan Taluka
Malegaon Taluka
Deola
Chandvad
Vadali nadi
Nandgaon Taluka
Dindori taluka
Yevla Taluka
Niphad
Godavari river
Nashik Taluka
Godavari river
Igatpuri
Sinnar
Jham nadi
Darna river
Ahmednagar Di
Legend
Taluka HQ
Villages 425 nos
District Boundary
Taluka boundary
Area 3946 sqkm
Divide
Waterbody
Drainage
Clayey-Deep (50 to 100 cm)
Clayey-Very deep (> 100 cm)
Clay loam -Moderately deep (25 to 50 cm)
Clay loam-Very deep (> 100 cm)
Gravelly sandy loam - Shallow to very shallow (< 25 cm)
Gravelly sandy loam-Shallow (10 to 25 cm)
Gravelly sandy clay loam -Very shallow (< 10 cm)
Gravelly clay loam- Deep (50 to 100 cm)
Loamy sand-Very deep (> 100 cm)
Sandy clay loam-Very deep (> 100 cm)
River island
Waterbody Mask
Habitation Mask
Principal aquifer Basalt (BS)
Major Aquifer BS01
Minor aquifer Ratnagarh Formation
No of aquifers Two
District Nashik
Taluka Deola,Sinnar,Niphad & Chandvad

Fig. 1.8: Soil

1.12 Hydrology and Drainage:

1.12.1 Hydrology

There are three major, one medium and 837 minor irrigation projects in the study area. The command areas of major, medium and minor irrigation scheme are 39322 ha, 5400 ha, 19257ha. The area irrigated by surface water irrigation in Deola, Chandvad, Sinnar and Niphad talukas is 681ha, 9748 ha, 19169 ha and 51617 ha out of total cultivable area of 15316 ha,12698ha,56452ha and 21223ha respectively. There are total 837minor irrigation schems, out of these, 4 schemes are of (101 to 250 ha) irrigation capacity category, having Storage capacity of 2.94 mcm and area irrigated 591ha. Remaining 833 schemes are of category of irrigation capacity (0-100ha) comprises 612 perolation tanks and 221 Kolhapur type structure. The storage capacity of these tanks is 98.06 mcm and area irrigated is 18666 ha. The taluka wise details of minor irrigation schemes are presented in Table 1.6 and area irrigated by surface water scheme is shown in **Fig 1.9.**

Table 1.6: Taluka wise minor Irrigation Schemes

Sr No	Irrigation capacity (101 – 250ha)					Irrigation capacity (0 – 100ha)							
	Taluka	No	Irrigation Potential	Storage Capacity	Type of Structure	No	Irrigation Potential	Storage Capacity	Type of Structure	No.	Irrigation Potential	Storage Capacity	Type of Structure
1	**Sinnar**	-	-	1.54	Minor Tank	257	6888	19.14	Percolation Tank	73	1287	19.29	KT Weir
2	**Niphad**	1	131	1.40	KT Bhandara	47	832	14.14	do	29	442	15.16	do
3	**Chandvad**	2	257	-	Minor Tank	221	4633	18.45	do	90	1198	11.88	do
4	**Devla**	1	203	-	- do	87	2908	-		29	478.4		do
	Total	4	591	2.94		612	15261	51.73		221	3405.4	46.33	

(Source: Water Resources Department, Govt. of Maharashtra, June 2014)

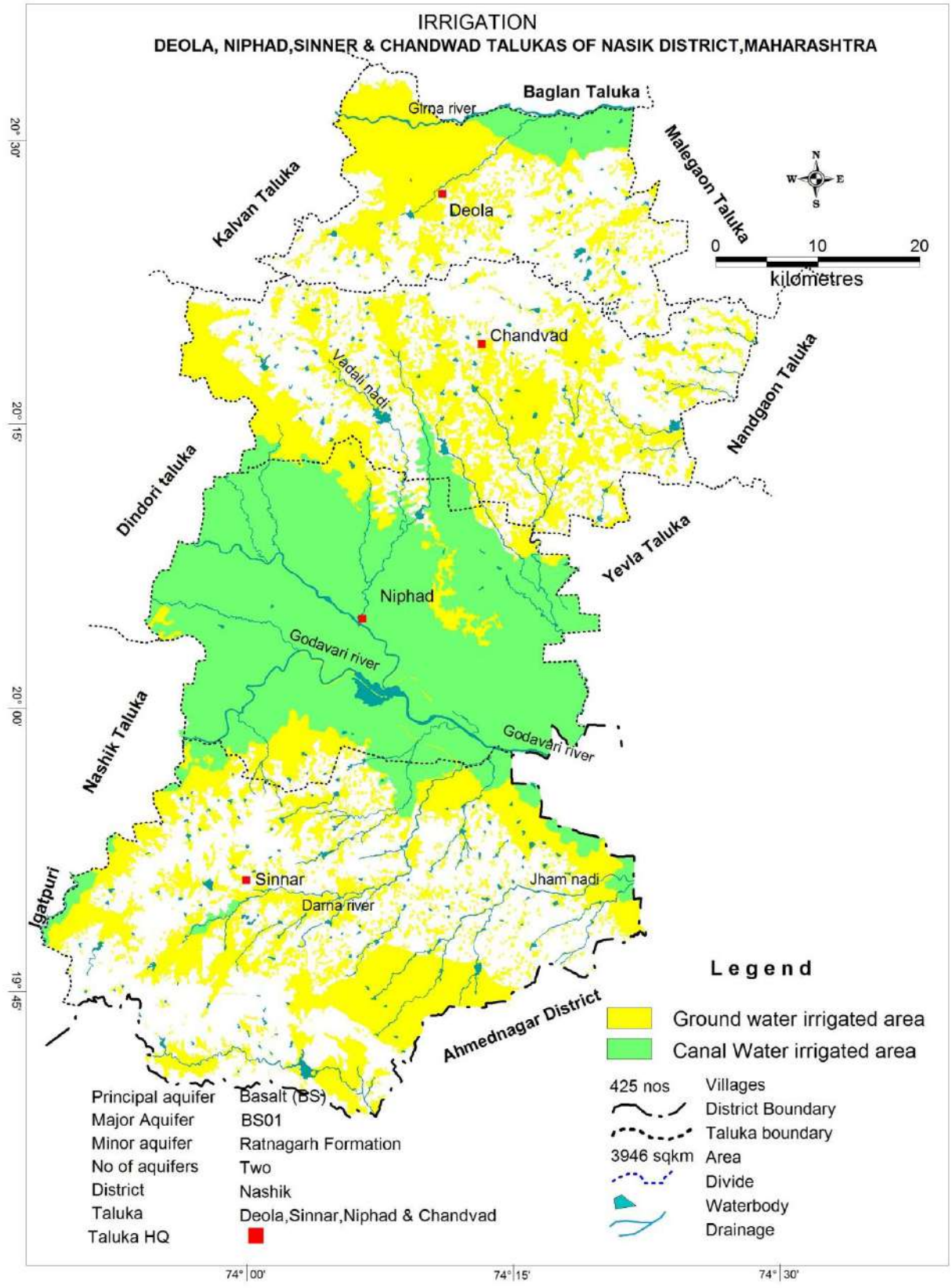


Fig. 1.9 Irrigation

1.12.2 Drainage

The Godavari and Girna are the two major rivers in the area. The watershed between these two rivers is satmala hill range, run right across the district; seperates the northern flowing Girna River & its tributaries flowing towards the Tapi River and the Godavari River & its tributaries flowing towards the south (Table 1.7). The Girna River rises in the Sahyaderi to the west of the district near Hatgad flows through Kalwan, Belgam, & Malegaon & enters into Jalgaon district where it turns north to meet the Tapti River. The Godavari River rises in the Triambak range & drains with its tributaries through the Nashik, igatpuri Dindori Chandwad, yeola & Niphad, sub divisions and passes into Ahmednagar district. Other important rivers draining the area are the Dhamanganga, vaitarna, Darna, kadva, Arna, Mosan, Panjan and Manegad. The drainage pattern is mainly dendritic, sub dendritic to sub parallel. The ordering of the stream is upto 7^{th} order. The drainage map is shown in **Fig. 1.10.**

Table 1.7. Drainage

Region	Basin	Sub-catchment	Watershed	WS Code	Watershed	Area (Sq. km)
Arabian Sea	Tapti	Girna	Aram, Punand	5C3C9	TE-108	37.3828
Arabian Sea	Tapti	Girna	Aram, Punand	5C3C9	TE-127	50.7433
Arabian Sea	Tapti	Girna	Aram, Punand	5C3C9	TE-128	251.288
Arabian Sea	Tapti	Girna	Panjari, Sukhi	5C3C7	TE-96	198.734
Arabian Sea	Tapti	Girna	Panjari, Sukhi	5C3C7	TE-117	3.55915
Arabian Sea	Tapti	Girna	Panjari, Sukhi	5C3C7	TE-129	118.225
Arabian Sea	Tapti	Girna	Panjari, Sukhi	5C3C7	TE-130	172.395
Bay of Bengal	Godavari	LBG	Godavari, Banganga	4E8C5	GV-7	167.733
Bay of Bengal	Godavari	LBG	Godavari, Banganga	4E8C5	GV-15	59.7489
Bay of Bengal	Godavari	LBG	Gui, Pimpalad	4E8C4	GV-26A	356.826
Bay of Bengal	Godavari	LBG	Gui, Pimpalad	4E8C4	GV-26A'	187.299
Bay of Bengal	Godavari	LBG	Kol, Haranoi	4E8C3	GV-30	37.1282
Bay of Bengal	Godavari	LBG	Kovda, Unada	4E8C6	GV-19	139.17
Bay of Bengal	Godavari	LBG	Kovda, Unada	4E8C6	GV-14	106.836
Bay of Bengal	Godavari	LBG	Kovda, Unada	4E8C6	GV-27	102.886
Bay of Bengal	Godavari	LBG	Kovda, Unada	4E8C6	GV-25	388.362
Bay of Bengal	Godavari	RBG	Darna-Kadva	4E8D4	GV-17	104.131
Bay of Bengal	Godavari	RBG	Darna-Kadva	4E8D4	GV-8'	1.20811
Bay of Bengal	Godavari	RBG	Darna-Kadva	4E8D4	GV-16	164.158
Bay of Bengal	Godavari	RBG	Darna-Kadva	4E8D5	GV-18	9.42068
Bay of Bengal	Godavari	RBG	Deo	4E8D3	GV-20	229.3
Bay of Bengal	Godavari	RBG	Deo	4E8D3	GV-21	356.413
Bay of Bengal	Godavari	RBG	Deo	4E8D3	GV-24	54.9907
Bay of Bengal	Godavari	RBG	U. Godavari, Alandi	4E8D6	GV-8	7.91384
Bay of Bengal	Godavari	RBG	Unari, Dedani	4E8D2	GV-29A	72.8295
Bay of Bengal	Godavari	RBG	Unari, Dedani	4E8D2	GV-23	228.445
Bay of Bengal	Godavari	RBG	Unari, Dedani	4E8D2	GV-28A	132.769
Bay of Bengal	Godavari	RBG	Unari, Dedani	4E8D2	GV-26B	0.000285655
Bay of Bengal	Godavari	RBG	Unari, Dedani	4E8D2	GV-28B	0.000263276
Bay of Bengal	Godavari	RBG	Unari, Dedani	4E8D2	GV-29B	0.000543375
Bay of Bengal	Godavari	RB tributary of Mula Pravara	Adul	4E8A8	GV-22A	175.633
Bay of Bengal	Godavari		Adul	4E8A8	GV-22A	0.000241152
Bay of Bengal	Godavari		Adul	4E8A8	GV-25B	0.000456293
Bay of Bengal	Godavari		Adul	4E8A8	GV-101	0.000546974

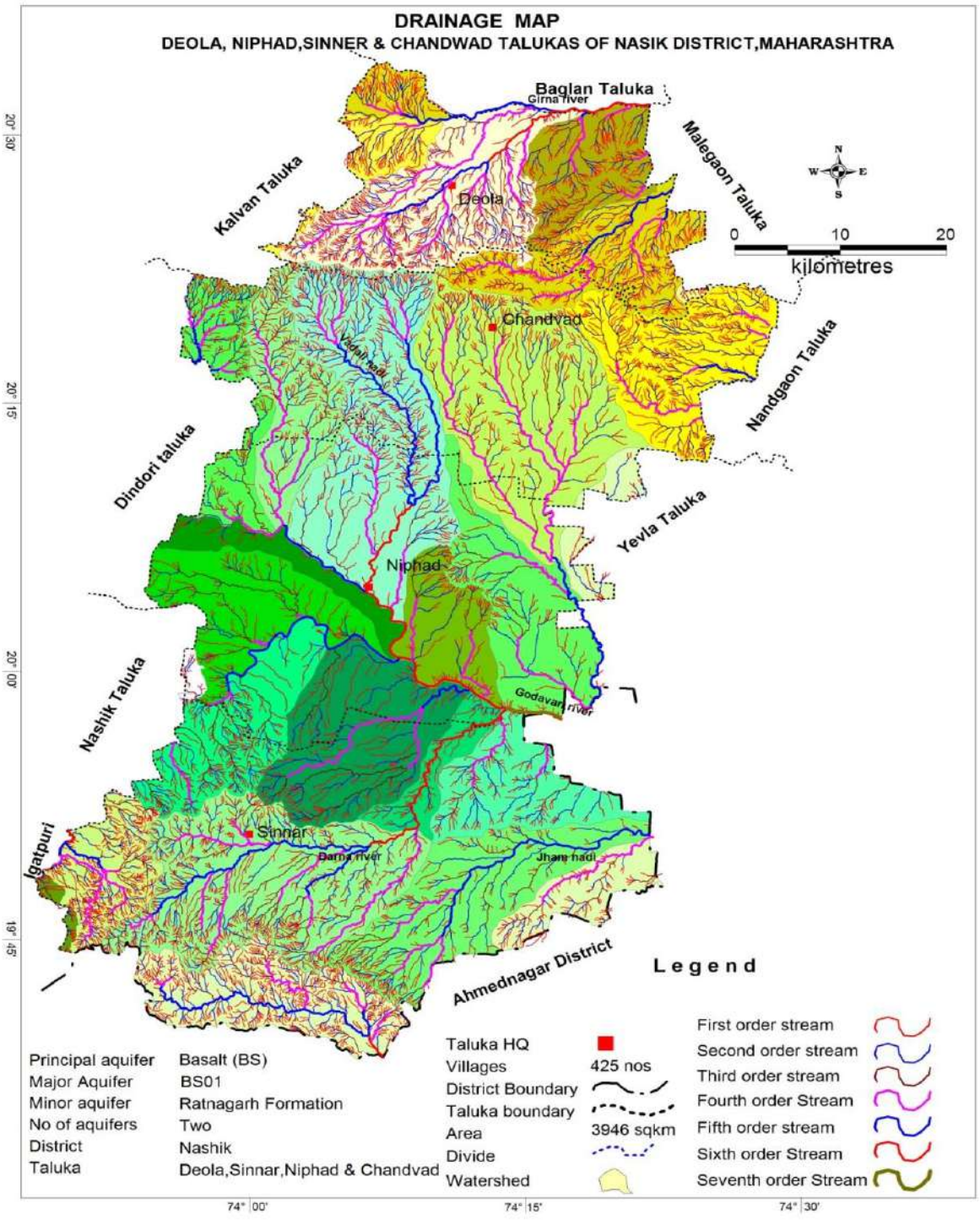


Fig. 1.10: Drainage

2 DATA COLLECTION AND GENERATION

The available data of the exploratory wells, Geophysical survey, Ground water level monitoring stations and ground water quality monitoring stations of Central Ground Water Board were compiled. In addition to these the data on ground water monitoring stations and ground water quality stations of the State Govt. (GSDA) was also utilised for same. The ancillary data such as numbers of ground water abstraction structures, irrigation facilities, rainfall etc., were collected from the Nasik distrct offices and compiled.

2.1 Data Collection and Compilation

The data collection and compilation for various components was carried out as given below:

- Hydrogeological Data – water level data of 49 key observation wells of CGWB for pre-monsoon and post-monsoon water level for the year 2015-16.Total 148 microlevel well inventory data of CGWB for detailed investigation
- Geophysical Data – The weathered zone resistivity and weathered zone thickness
- Hydrology Data – Data on various irrigation projects, their utilisation status from Irrigation department, Govt of Maharashtra.The number of ground water abstraction structures and area irrigated from Minor Irrigation, Govt of Maharashtra.
- Hydrometeorological Data - Long term rainfall data for each of the taluka from Dept. of Agriculture, Govt of Maharashtra
- Water Conservation Structures – Numbers, type and storage potential of water conservation structures prevailing in the area from Dept. of Planning
- Cropping Pattern Data – Data on prevailing cropping pattern from Agriculture Dept, Govt of Maharashtra

2.2 Data Generation

After taking into consideration, the data available with CGWB on Ground Water Exploration, Geophysical survey, Ground Water Monitoring Wells (GWMW) and Ground Water Quality, the data adequacy was compiled and it indicated that exploratory drilling is required at 25 locations, ground water monitoring wells are required at 35 locations for water level and forwater quality sampling. The geophysical survey (VES) was required at 49 locations. These 49 VES have been proposed to be conducted through outsourcing and the same will be conducted after approval of proposal by CHQ. The requirement, availability and gap of major data inputs i.e., exploratory wells, geophysical data, GWMW and ground water quality data are detailed in the Table 2.1. Based on Data Gap Analysis, all the necessary data was generated except VES as discussed below.

Table 2.1: Data Adequacy and Data Gap Analysis

EXPLORATORY DATA			GEOPHYSICAL DATA			GWMONITORING DATA			GW QUALITY DATA		
Req.	Exist.	Gap	Req	Exist.	Gap	Req.	Exist.	Gap	Req.	Exist.	Gap
39	14	25	75	26	49	49	14	35	49	14	35

2.1.1 Ground Water Exploration

Ground water exploration down to the depth of 200 m bgl in Deola, Niphad, Sinnar and Chandvad talukas has been taken and 21exploratory wells and 4 observation wells have been constructed up as per the data gap. The main aquifer zones identified are at the depth of 18-21, 32-41, 53-74, 70-90, 101-115, 152-165m.bgl and the discharge of exploratory wells varies from traces to 8.17 lps. The static water level SWL 4.8m.bgl to lower than 100m.bgl.The location of Exploratory wells and key observation wells in Deola, Niphad, Sinnar and Chandwad talukas are shown in **Fig 2.1** and the salient features of ground water exploration is presented as **Annexure II.**

2.1.2 Ground Water Monitoring Wells

As observed from Table 2.1, GWMW's were required at 35 locations as per the data gap and accordingly 35 key observation wells (KOW) were established apart from the existing 14 GWMW.Thus total 49 monitoring wells were utilised for Aquifer-1 study along with 148 micro-water level wells. For deeper Aquifer-II, 25 exploratory wells drilled by CGWB have been studied. The water level data from Nov. 2015 was collected and analysed.

2.1.3 Ground Water Quality

As observed from Table 2.1, ground water quality stations were required at 35 locations and correspondingly 35 key observation wells (KOW) were established in addition to the existing 14 GWMW to assess the ground water quality of shallow aquifer (Aquifer-I) of area.

2.1.4 Micro Level Hydrogeological Data Acquisition

In addition to the KOW's, micro level hydrogeological data was also required at 148 locations as per data gap analysis for deciphering the sub-surface lithological disposition, water level scenario and other hydrogeological inputs such as weathered thickness etc., of shallow aquifer (Aquifer-I). Thus 148 dug wells were inventoried for micro level data acquisition. The details of dugwells inventoried for micro level data acquisition are given in **Annexure-III**. The locations of micro level hydrogeological data acquisition wells are shown in **Fig. 2.2**.

2.1.5 Thematic Layers

The following 5 thematic layers were also generated on GIS platform which supported the primary database and provided precise information to assess the present ground water scenario and also to propose the future management plan.

- Drainage
- Geomorphology
- Soil
- Land Use – Land Cover
- Geology and Structure

The thematic layers such as drainage, geomorphology, soil, land use-land cover have been described in Chapter – I.

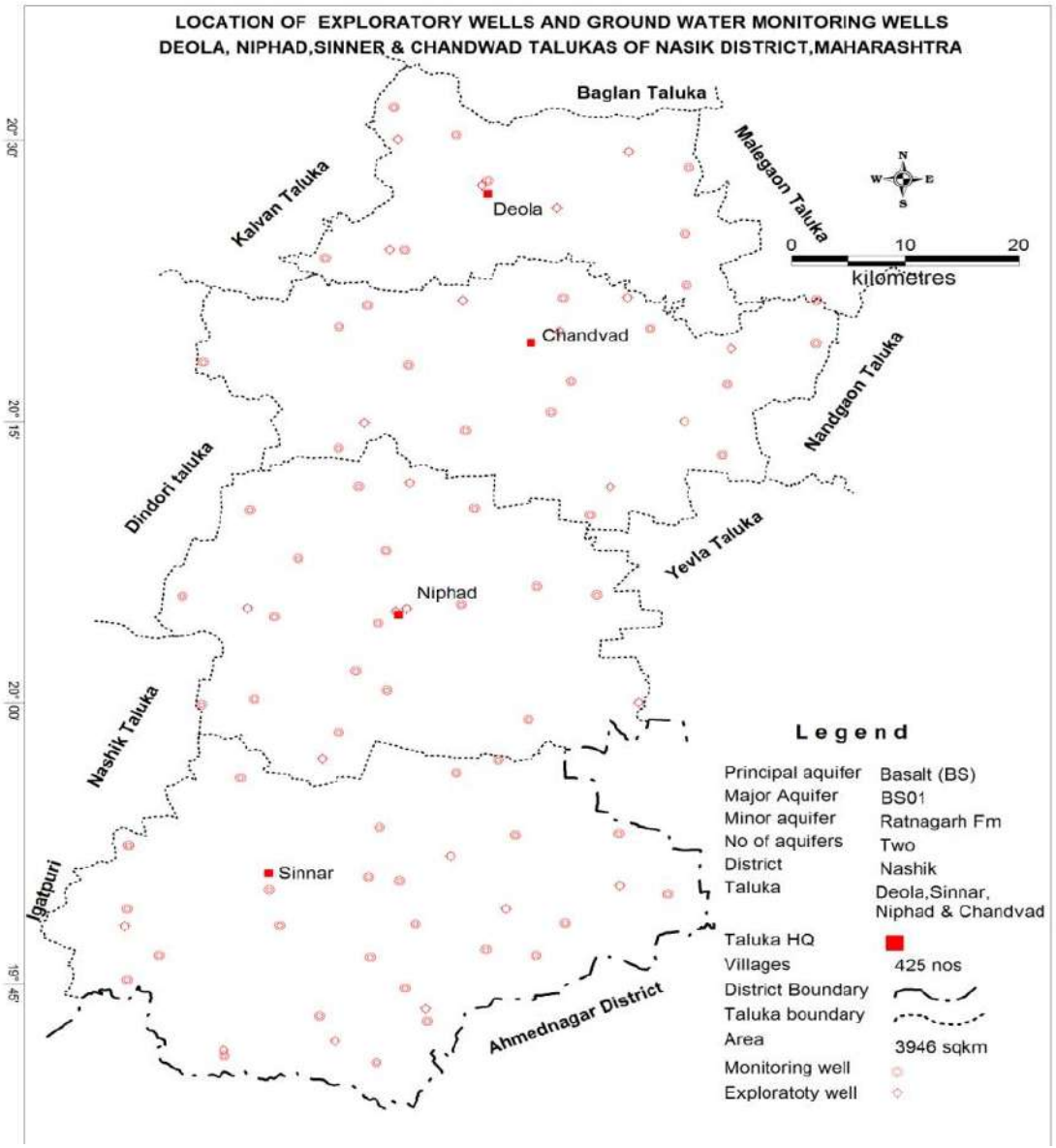


Fig.2.1: Locations of Exploration wells and Ground water monitoring Wells

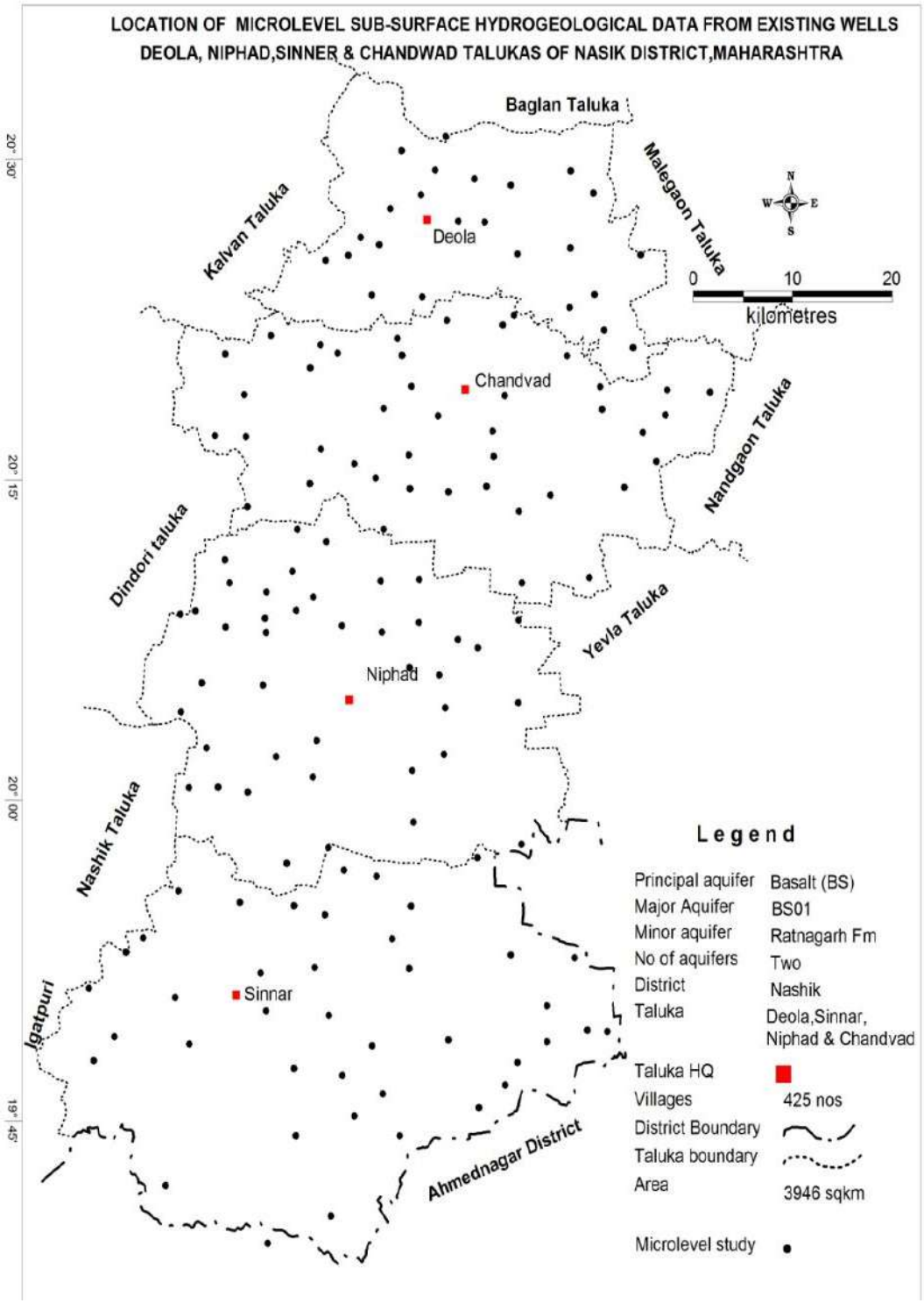


Fig. 2.2 Location of Micro level monitoring wells

2.1.6 Geology

2.1.6.1 Deccan traps

Deccan traps are a thick pile of basaltic lava flows, horizontally disposed and apparently more or less uniform in composition. Deccan Trap comprising of pahoehoe and Aa type of basaltic lava flows. Thin beds of volcanic tuffts are found between the flows along the contact at few places.Each individual flow is a typical section, which varies from porous weathered base to a massive middle unit, becoming increasingly vesicular towards the top. The entire lava pile is classified into lower Ratangarh and upper Ratangarh formations. Lower Ratangara has an overall thickness varying from 300 to 450 m and comprises eight compound pahoehoe flows.This formation is predominantly exposed in Deola and Niphad talukas. The rocks are fine to medium grained, hard compact and phyric. The Upper Ratangarh formation containing Phenocryst of plagiodase ranging in size form 3-7mm marks the upper contact of this Ratangarh formation. The formation is exposed north east and southern part of the district and comprises ten compound pahoehoe /Aa flow containing olivine phenocrysts. This formation show a maximum exposed thickness of 530 m in the areas south west of Nandgaon. The thickness of thin beds of tuft varying from 0.2 to 1m found at places at the flow contacts. The tuft is reddish brown to dark brown, fine grained and contains angular fragment of basalts and laths of plagioclase feldspar.

The flows have a general easterly gradient of 1:2000 towards ESE near Niphad. The gradient appears to have a general easterly gradient varying from 1 in 130 to 260. The lava pile in the district is profusely intruded by basaltic and dolerite dykes trending E-W, NNE-SSW, W and N-S. They vary in width from 0.5 to 35m and some of the dykes extended for over 30 km. The flows are traversed by three sets of vertical joints. The major joints are N10^{o} to 20^{o}, W-S 10^{o} to 20^{o}, WE-SW, N 30^{o}E, W60^{o} E- S60^{o}’ W.

2.1.6.2 Alluvium

The alluium is found along the river course and is composed of sand, Silt and clay. It ranges in thickness form 10 to 20m. The alluvium is calcarious in nature. The geology of the area is shown in **Fig. 2.3.**

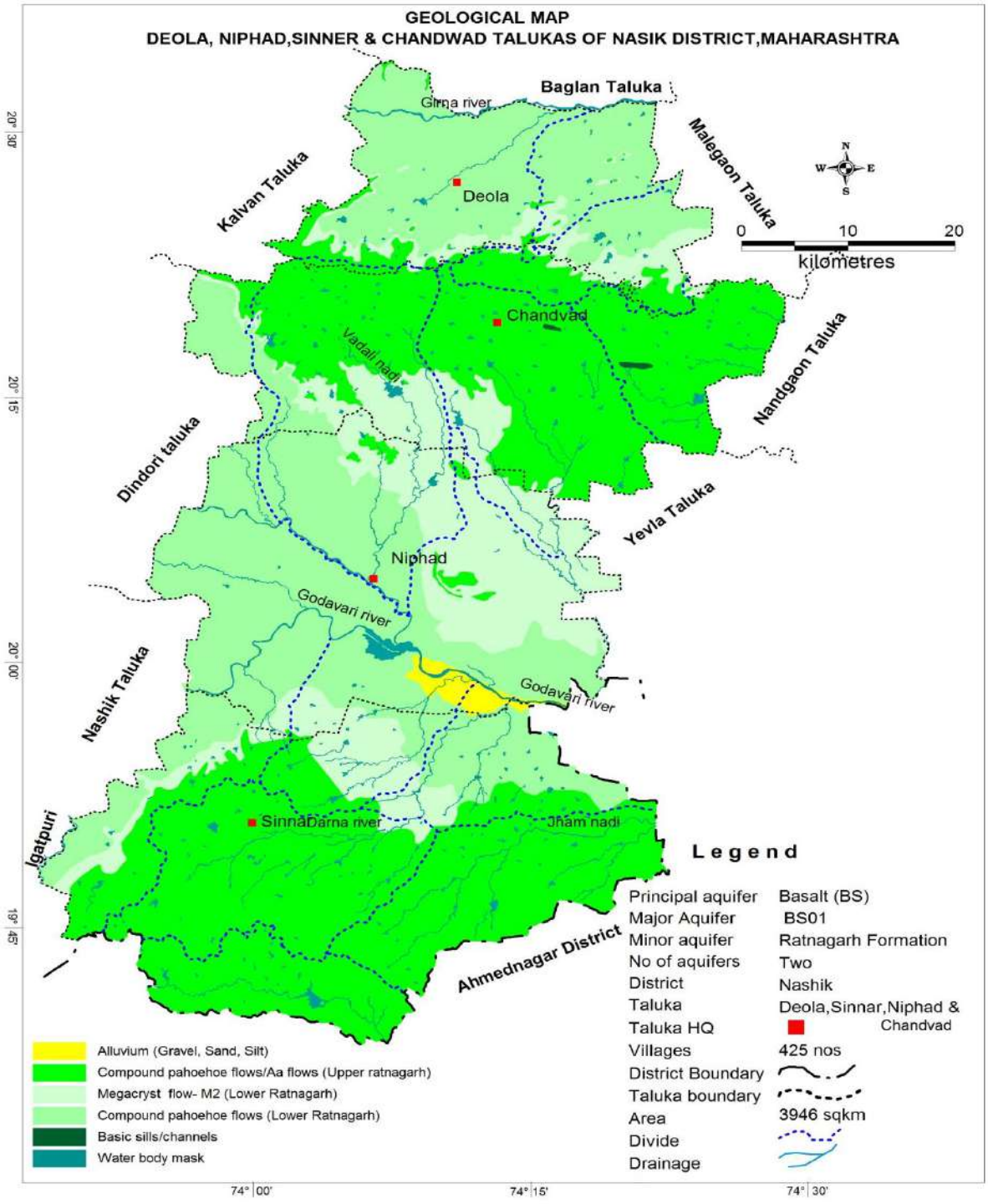


Fig. 2.3. Geology

3 DATA INTERPRETATION, INTEGRATION AND AQUIFER MAPPING

The data collected and generated on various parameters viz., water levels, water quality, exploration, aquifer parameters, geophysical, hydrology, hydrometeorology, irrigation, thematic layers was interpreted and integrated. Based on this the various aquifer characteristic maps on hydrogeology, aquifer wise water level scenario both current and long term scenarios, aquifer wise ground water quality, 2-D and 3-D sub surface disposition of aquifers by drawing fence and lithological sections, aquifer wise yield potential, aquifer wise resources, aquifer maps were generated and as discussed in details.

3.1 Hydrogeology

Deccan traps comprise a thick pile of basaltic lava flows horizontally disposed and more or less uniform in composition. Each individual flow is a typical section which varies from porous weathered base to a massive middle units becoming increasingly vesicular towards the top. Each distinct part of the flow forms a unit and differs in respect of their ability to receive stores and transmit ground water as a result of inherent physical characters like porosity and permeability. The ground water occurs in the area under water table and confined conditions in weathered, jointed and fractured portions of different basaltic flows as well as at inter-flow junctions. In basalts, ground water occurs in joints, fractures, faults and such other similar zones of weakness. The weathering and topographic setting plays a dominant role in respect of productivity.

The Vesicular basalts are of much significance for the occurrence of ground water if the vesicles are interconnected either due to interconnections of vesicles at the time of their formation or due to secondary reasons i.e. crushing or fracturing. The massive units are almost devoid of any openings and have low porosity and hence are less productive. But when they are traversed by closely spaced interconnecting joints, Contribute toward fracture porosity and thus form a productive zone of considerable potential. In the plains and valley regions the weathered and jointed basalt are commonly the main aquifers at the depth of 15m-22m bgl.

In general, the yield potential of these aquifers in these areas is about 1-2 lps; while the yield potential is upto 3 lps in areas occupied by highly weathered basalt and characterised by ground water convergence along the Godavari river. In hilly areas, fratured and jointed basalt encounter at a depth of about 20 to 30m.bgl, having a yield potential of 0.5 to 1lps. The daily discharge of wells varies from10 to 100 cum/day of 1 to 5 hour sustainability.The transmissivity varies from 9.75to 89.04$m^{2/}$day ansd storativity varies from 0.019 to 0.025. However, at places a local water table develops in the top most weathered portion at the elevated plateau top of good areal extent, represent the perched water table. The depth of perched water table is 5 to 6m.bgl. The wells in the hilly areas show rapid decline of water levels during the period following post monsoon and practically go dry in peak

summer. In foothill area water table is relatively shallower and sustains perennial yield in dug wells.

The Isolated pockets of alluvium along the course of Girna Godavari river valleys & along the course of their tributaries. The thickness of these alluvial patches varies from few meters to about 50 meters. It is more along the Girna & Godavari Rivers and less along their tributaries. The alluvium consists of clays sands silt & Gravels. These unconsolidated to consolidated materials, having permeability porosity & permeable contain fairly good potential of 2-3lps. The aquifers are found at the depth of 15 to 20 m.bgl.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 area is mostly through dugwells.

As per 4th MI census 2006-07, there are about 81423 dugwells in use in the area which have created an irrigation potential of 2917 sq. km. There are 901 surface water schemes which create an irrigation area of 639.79 sq km. The net irrigated area is about 3095 sq.km. The ground water accounts for 94 % of net irrigated area. The ground water is predominantly used for irrigation, as it is the major ground water utilising sector. The yield of potential aquifers in Chandvad, Deola, Niphad and Sinnar talukas is medium to high in basaltic aquifer with suggested structures are dugwell, DCB, and borewell. The hydrogeological map of area is prepared and presented in **Fig.3.1.**

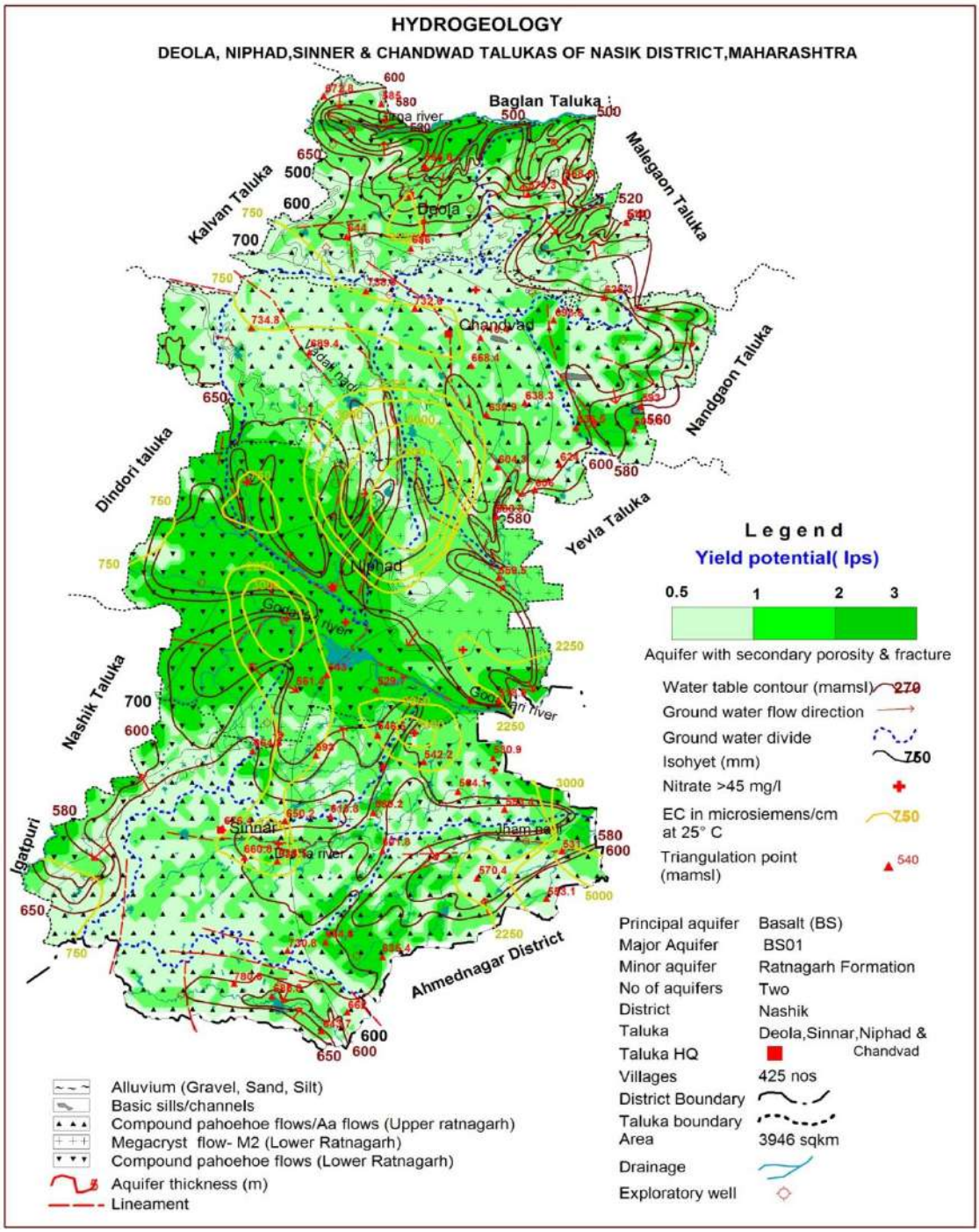


Fig. 3.1: Hydrogeology

3.2 Water level Scenario

To understand the depth to water level scenario in Deola, Niphad, Sinnar and Chandwad talukas, water level measurement of the key observation wells (KOW) were carried out in the month of May and November, 2016. The pre and post monsoon data collected from the KOWs along with data collected by GSDA, GoM from their network monitoring stations have been used to ascertain the water level scenario and preparation of depth to water level maps of the area.

Depth to Water Level (Aquifer-I) (Pre-monsoon May 2016)

The depth to water levels in May 2016 ranges between 5.20 (karajgaon) and 20.80 m bgl (Mouze Sukene). Premonsoon depth to water levels in major part of area varies from 10 to 15 m bgl, followed by water level of 5to10m.bgl. However, shallow water levels <5 mbgl is mostly observed as isolated patches along the river/ local nala in valley areas corressponde with ground water discharge areas. The deeper water level i.e 15 to 20 m bgl is observed at the higher elevation areas corressponde with the topographic divides.These areas are normally ground water recharge areas. The pre-monsoon depth to water level map is given in **Fig. 3.2** and the water level data is presented as **Annexure-IV**.

Depth to Water Level (Aquifer-I) (Post-monsoon Nov.2016)

The depth to water level in major part of the area during post-monsoon (Nov2016) varies rom 5-10m.bgl.While shallow water level of less than 5.0m.bgl observed along the valley portion of Godavari River and Girna River and low lying areas of its tributaries.These shollow water level zones correspond thedischarge areas.The deeper waterlevel of 10 to15 m.bgl observed along the areas of higher elevations, mainly confine to topographic divide.These areas indicate the recharge areas. The post-monsoon depth to water levelis given in **Fig 3.3.**

Depth to water level (Aquifer-II)

In Aquifer-II, the pre monsoon depth to water levels in Deola, Niphad, Sinnar and Chandvad talukas during May 2016 observed between 4.3 m bgl (wakad) and 61.0m bgl (Khadakjam). The deeper water level (>50 m bgl) occurs in major part of the area notably in nothern and southern part of the area, corresponde to the higher elevation areas. The Shallow water level (upto 10 m bgl) has been observed in eastern part of the areas representing valley portions, occupied by the weathered basaltic plateau and alluvium under canal command. In remaining parts of area water level ranges between 10 to50 m bgl. The pre-monsoon depth to water level for Aquifer –II is given in **Fig. 3.4** and the details are presented in **Annexure V**.

The post-monsoon depth to water level ranges from 2 m bgl (Wakad) to 37 m bgl (Khadakjam) in Aquifer-II and presented in **Fig. 3.5**. The deeper water level of depth 30 to 50m range occur in higher elevation areas in the southern and northern part of the area.The moderate water level of 20 to 30m.bgl is more or less observed in highly weathered pleatue of denudational origin.The shallow water level of 10-20m.bgl and 20-30m.bgl is observed in flood plain deposits.

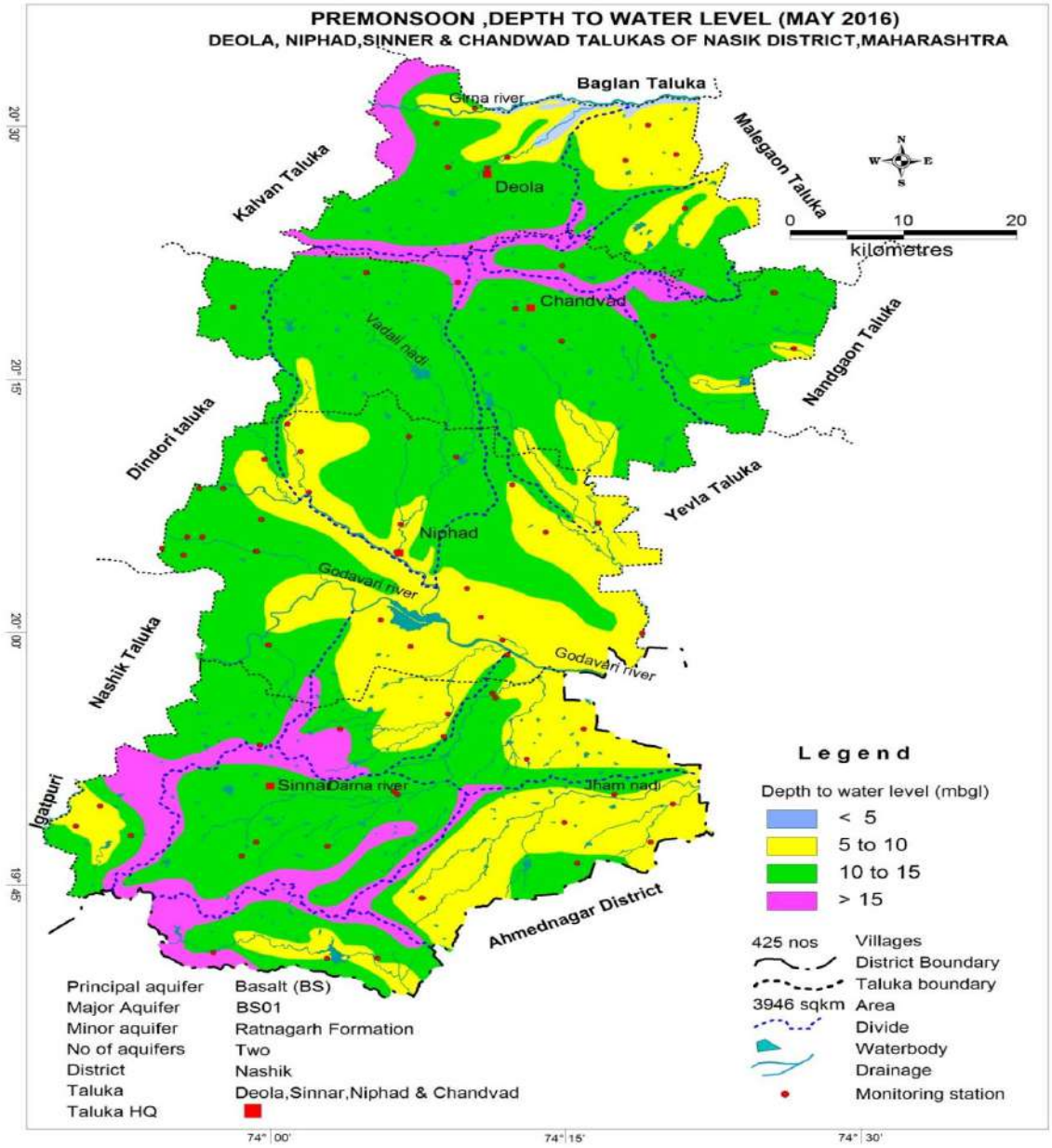


Fig 3.2 Aquifer-I Depth to water level (Pre-monsoon: May-2016)

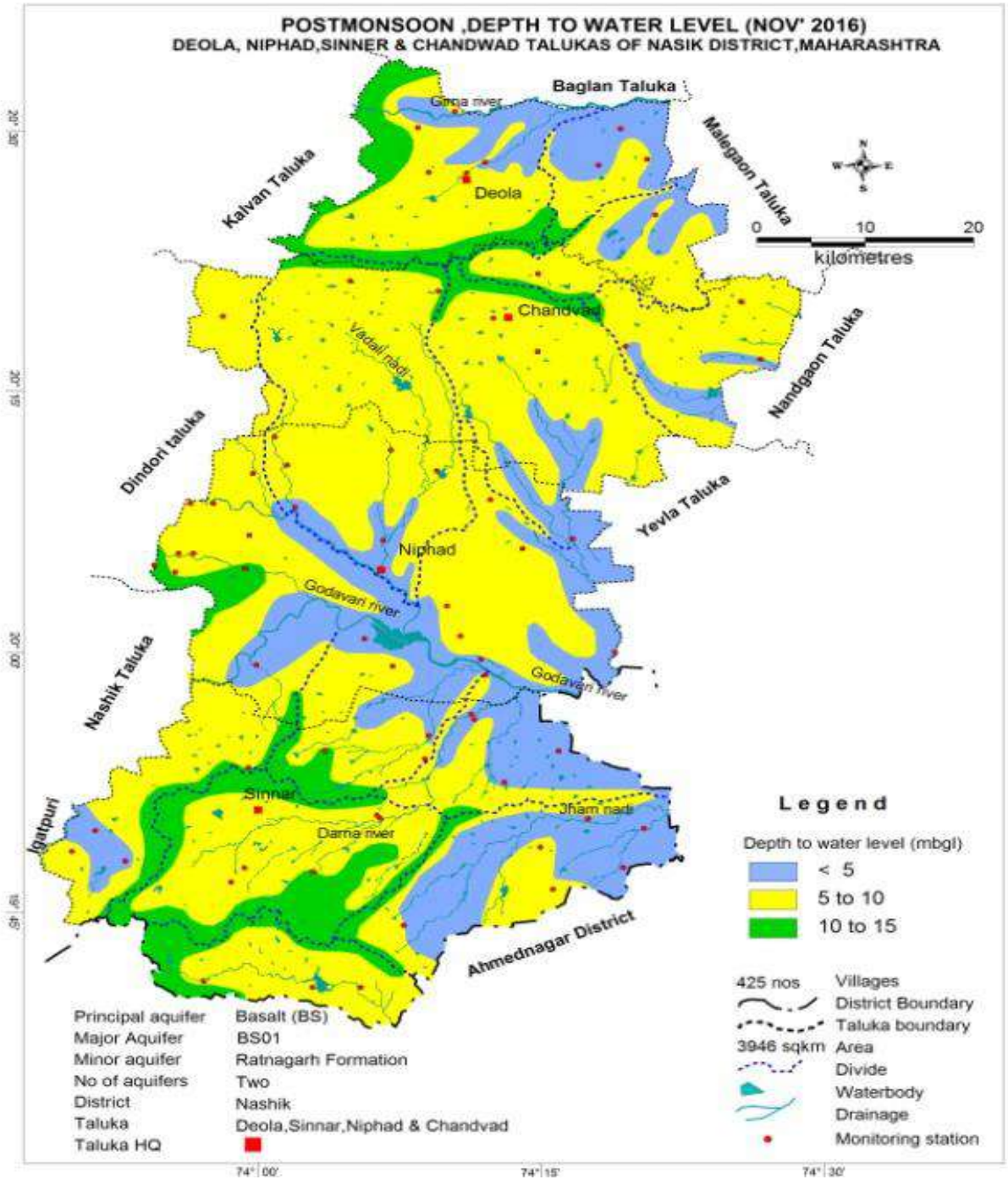


Fig 3.3 Aquifer-1 Depth to Water Level (Post-monsoon: Nov 2016)

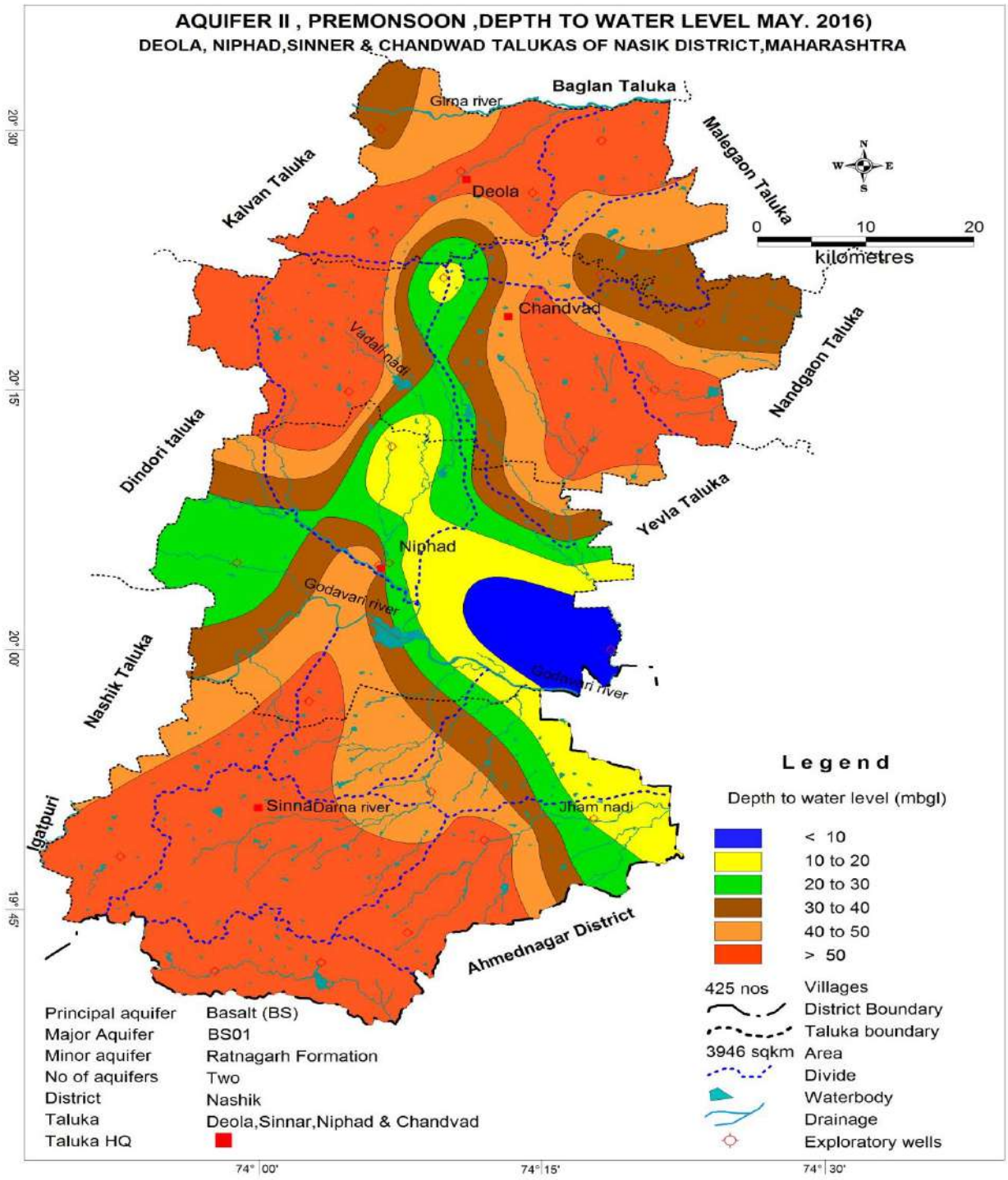


Fig.3.4: Aquifer-II, Depth to Water Level (Pre-monsoon: May-2016)

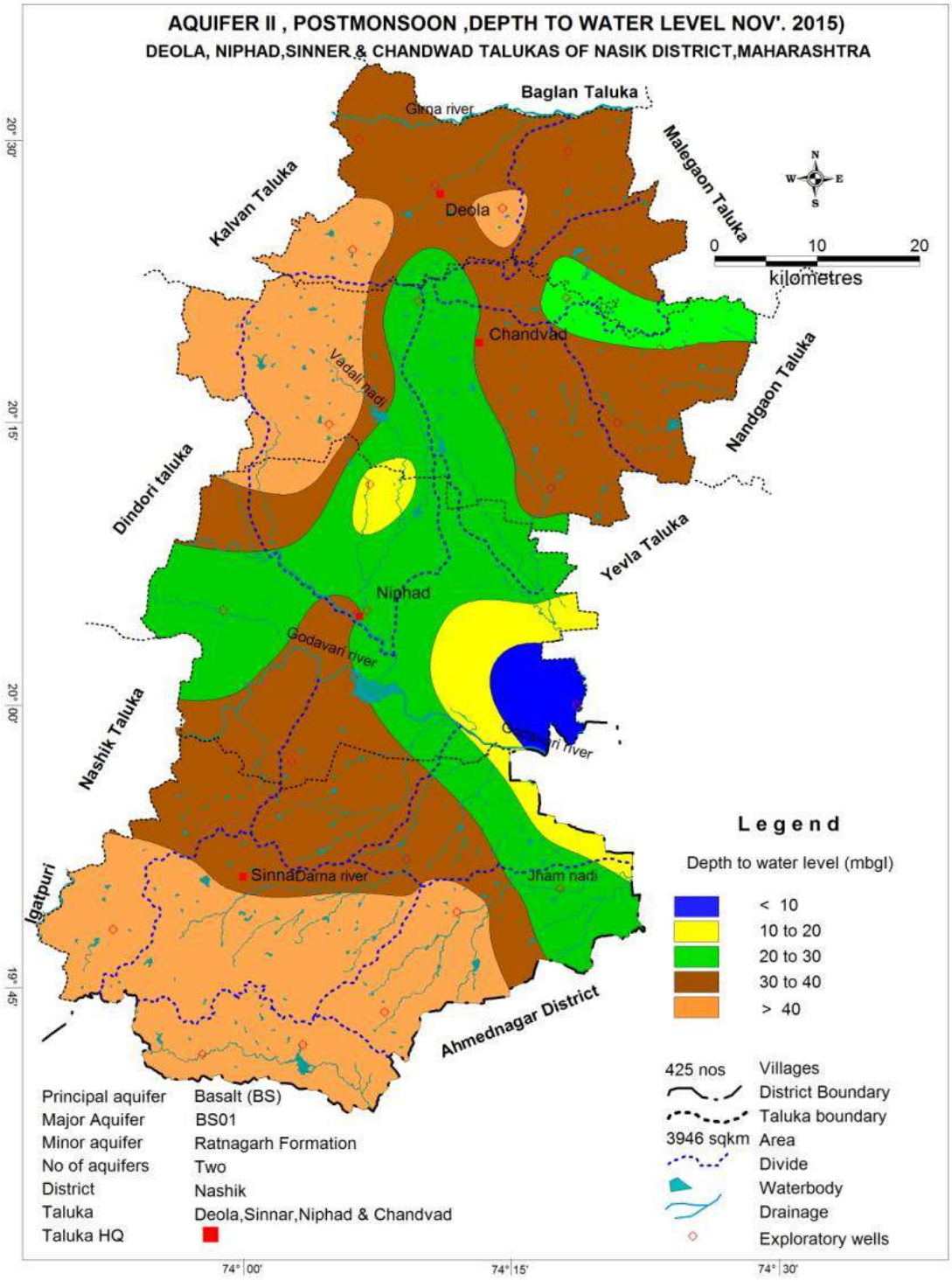


Fig. 3.5: Aquifer-II, Depth to Water Level (Post-monsoon: Nov-2015)

3.3 Water Level Fluctuation (Aquifer-I)

The water level measured during pre and post-monsoon period was used to calculate the fluctuation. The seasonal fluctuation (May 16-Nov 16) in water level was obtained from difference in water level during pre and post-monsoon water level (**Fig.3.6**). In the area, number of wells and their percentage falling in each fluctuation range is presented in Table 3.1.

Table 3.1: Seasonal fluctuation (May-16 vs Nov-16) in water level with percentage

No. of key wells	0 to 2 and 2-4m	4 to 6m	6 to 8m &>8m
49	31 (63.53%)	11 (22.49%)	7 (14.23%)

The water level fluctuations are grouped under three categories and are discussed under.

0-2 m and 2-4 m	-	Less water level fluctuation
4-6 m and	-	Moderate water level fluctuation
6-8 m and >8m	-	High water level fluctuation

The water level fluctuation indicate that in major part of the area fluction range from 0-2 to 2-4m.The higher fluctuation of more than 6.0 m corresponde to area of highly elevated area ,corressponde to recharge areas.

3.4 Water Table Contour

In a groundwater regime, Water table contours have been drawn by joining points of equal water level elevation with respect of mean sea level. Based on the elevation, ground water flow directions were demarcated (**Fig. 3.7**). It has been observed that,

1) The water table elevation varies from 580 m amsl to 650m.amsl in parts of Godavari basin and 500 m. amsl to650 m.amsl inparts of the Girna river basin.
2) The overall ground water movement in Chandvad, Sinnar and Niphad taluks is towards the central part of area indicate the ground water convergence area, drained by Godavari River. While ground water movement in Deola taluka is from south to north towards Girna River. The ground water flow into the river as base flow ,sustains the river flow during non rainy season.The topographic divides are areas of divergence of ground water flow and form the ground water recharge areas.
3) Water table contour is sub surface replica of topography.The ground water flow and surface water flow movements are similar in direction.The Godavari River is a perennial river due to effluent characterstics of ground water flow.
4) The water table gradient is steeper in Girna basin due to steep topographic gradient as compared to water table gradient in Godavari basin.

It has been observed that the ground water flow directions follow the major drainage of Godavari and Girna rivers and topography of the area. This indicates the topographic control for the ground water movement

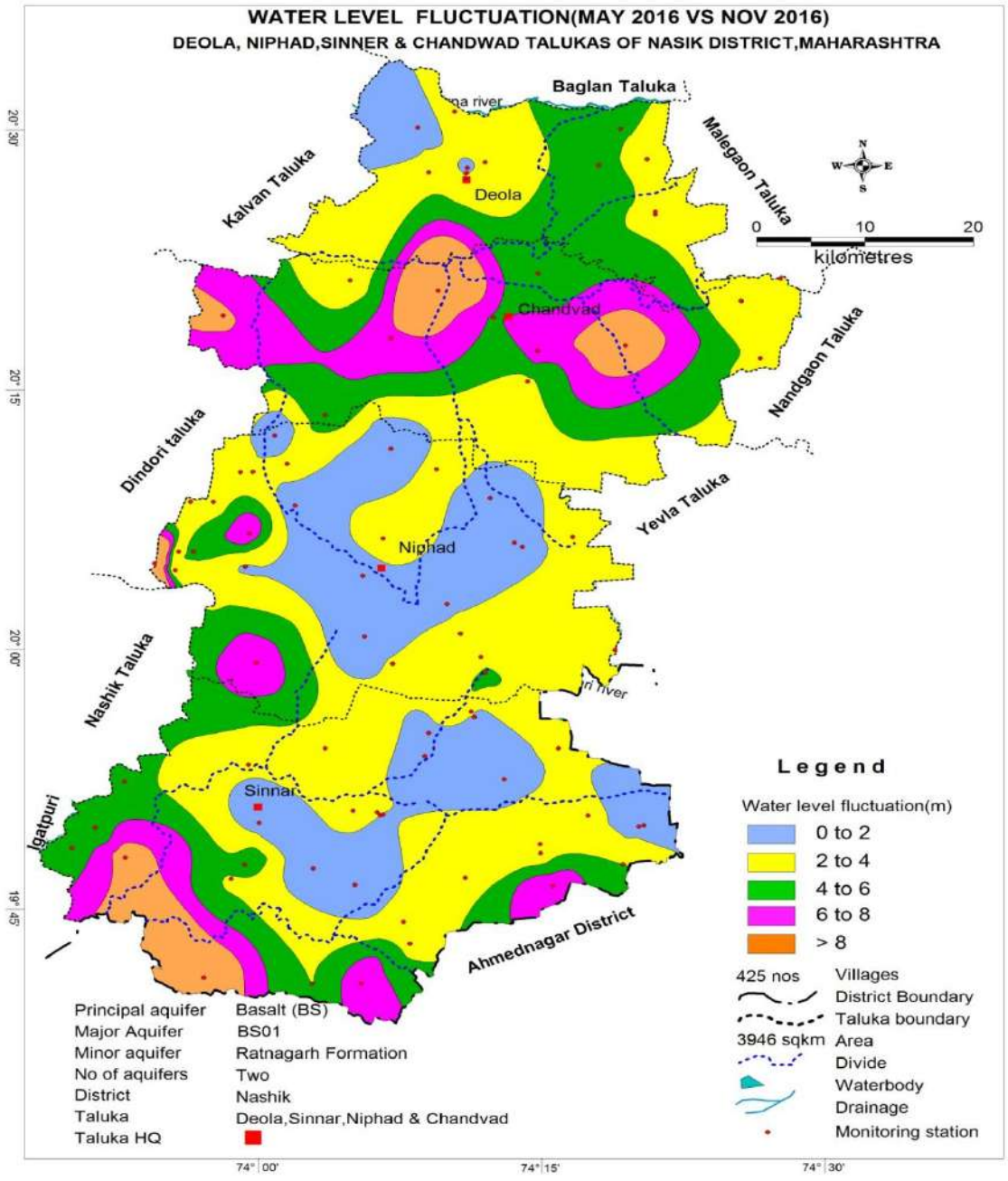


Fig. 3.6 Water Level Flutuation between pre and post-monsoon (May-Nov2016)

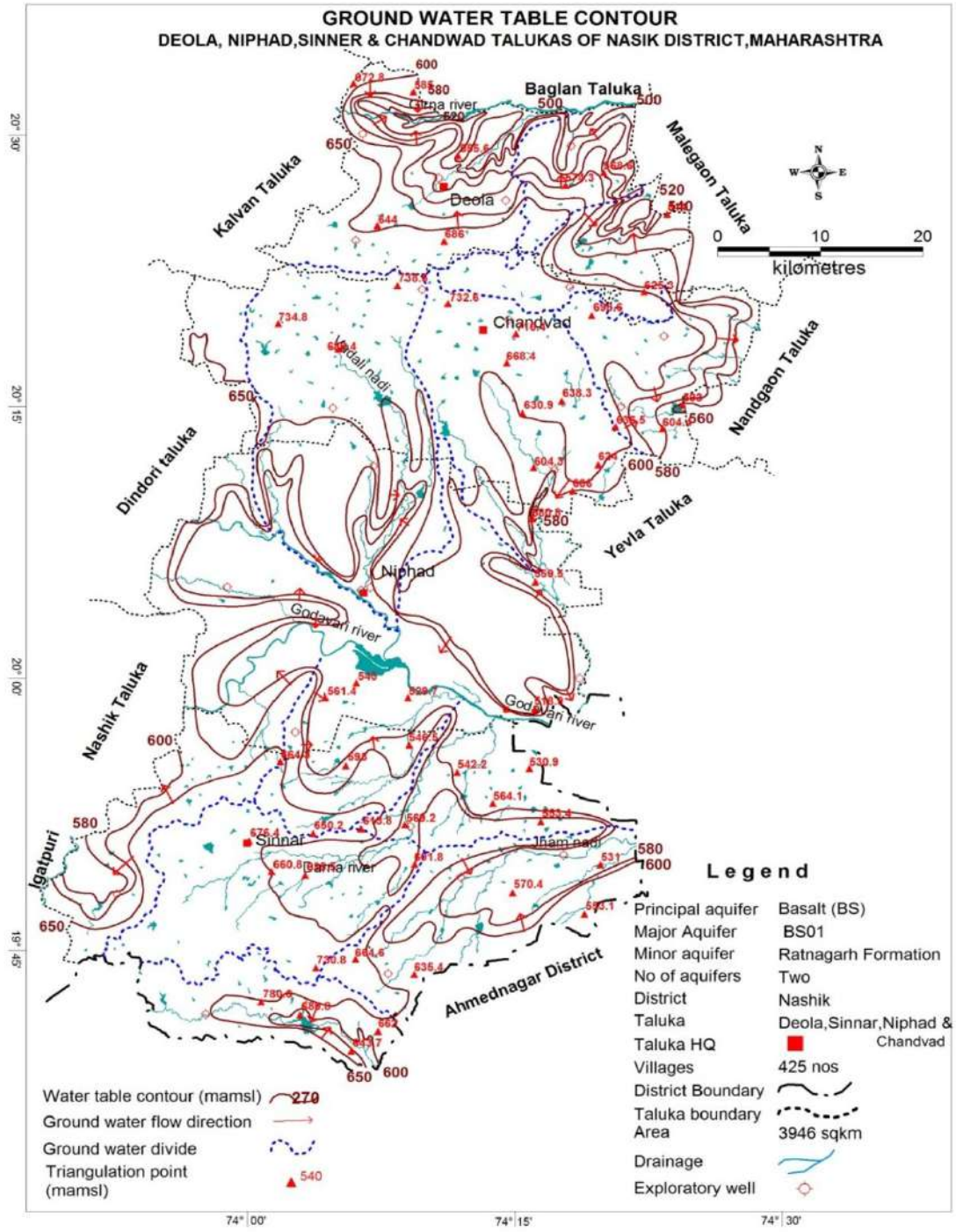


Fig. 3.7 Ground Water Table contour

3.5 Depth to Water Level Trend (2006-15)

Based on the CGWB's GWMW and Observation wells of GSDA, Nashik, the long-term trend of water levels for pre-monsoon and post-monsoon periods for the last ten years (2006-15) have been computed. For long term pre-monsoon water level trend 21 GWMW of CGWB and 54 OB Wells of GSDA were utilised for analysis while for post-monsoon trend analysis 21 wells of GWMW of CGWB were utilised, as per the availability of data. The maps depicting the spatial variation in long-term water level trend for pre-monsoon and post-monsoon period has been presented as **Fig 3.8 & 3.9** repectively and the data is presented in

Annexure VI.

In the study area, pre-monsoon rise in water levels trend has been recorded at 12 stations and it ranges between 0.0008 m/year (savaki lohner) to 0.74 m/year (sinnar) while falling trend was observed in 63 stations ranging from 0.002 (Eklahare) to 0.808 m/year (Shirur). In pre monsoon, the falling water level trend has been observed in almost entire area of Deola, Niphad, and Sinnarand Chandvad talukas except for small patches of rising trend along the Girna, Godavari, Darni River course and near Chandvad town.In the study area, post-monsoon fall in water levels trend has been recorded in entire area and it ranges between 0.10 m/year (sonewadi ozhar) to 0.95 m/year (Umarane). In major part of area the fall in water level trend is in the range of 0.4 -0.6m/year and more than 0-6m/year.

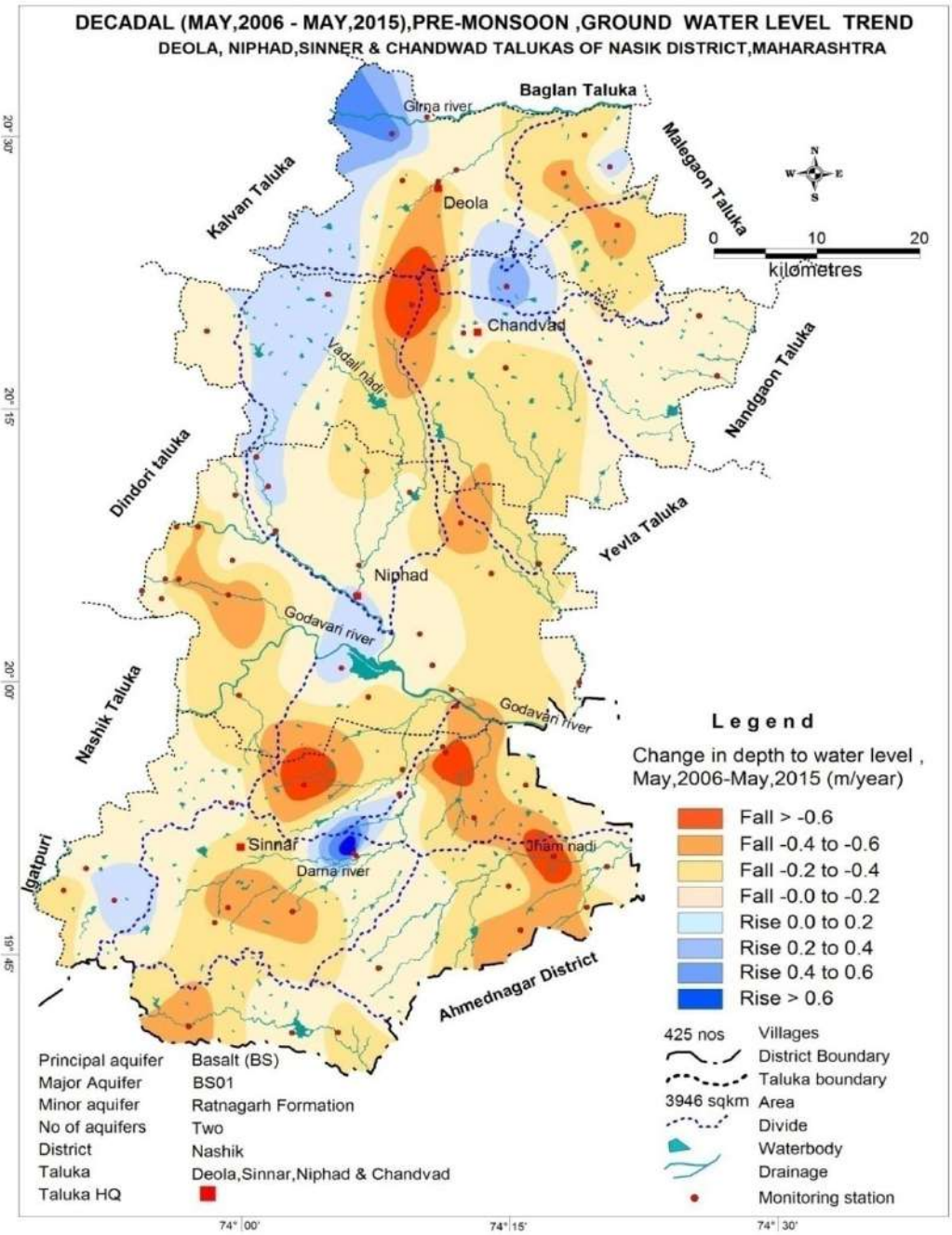


Fig. 3.8: Pre -monsoon decadal water level trend (2006-15)

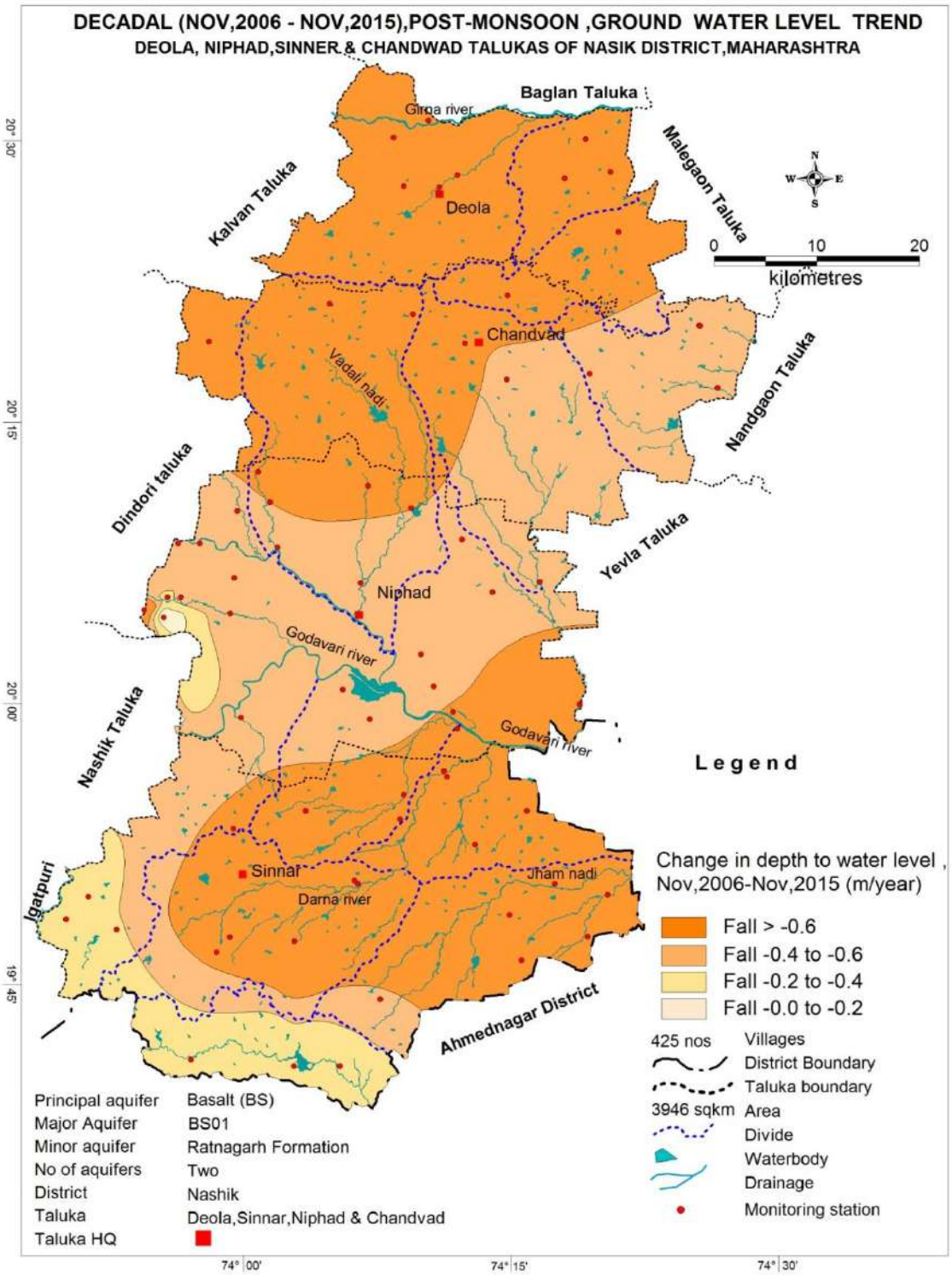


Fig. 3.9: Post-monsoon decadal water level trend (2006-15)

3.6 3-D and 2-D Aquifer Disposition

The data generated from ground water monitoring wells, micro level hydrogeological inventories, exploratory and observation wells, various thematic layers was utilized to decipher the aquifer disposition of the area. This particularly includes the information on geometry of aquifers and hydrogeological information of these aquifers. In the area, Deccan

Trap Basalt is the only formation and within it two aquifer systems has been deciphered as listed below:

Deccan Trap Basalt –
Aquifer – I (Shallow Aquifer): 10 to 30m
Aquifer – II (Deeper Aquifer): 30 to 90 m

The fence diagram indicating the disposition of various aquifers is presented in **Fig.3.10** and 3-D representation is presented in **Fig. 3.11**. The disposition of Aquifer-I and Aquifer-II followed by massive basalt can be observed in the Fence. To decipher the aquifer thickness section have been drawn along line A-A', B-B', C-C' and D-D':Section A-A' indicate that thickness of aquifer II is increasing at Niphad in the central part of the section and the hydrostatic pressure surface rises upto the water table and coincide with it: Section B-B' indicate that the thickness of aquifer II is increasing at Nandur Singote in the eastern part of area: Section C-C' thickness of II is increasing at village Sawargaon upto180m.In section D-D'thickness of aquifer does not show much variation in thickness.As a result of higher thickness of aqifer-II the yield at Niphad(4.4 lps) and sawargaon(7.69 lps) are higher yielding. .

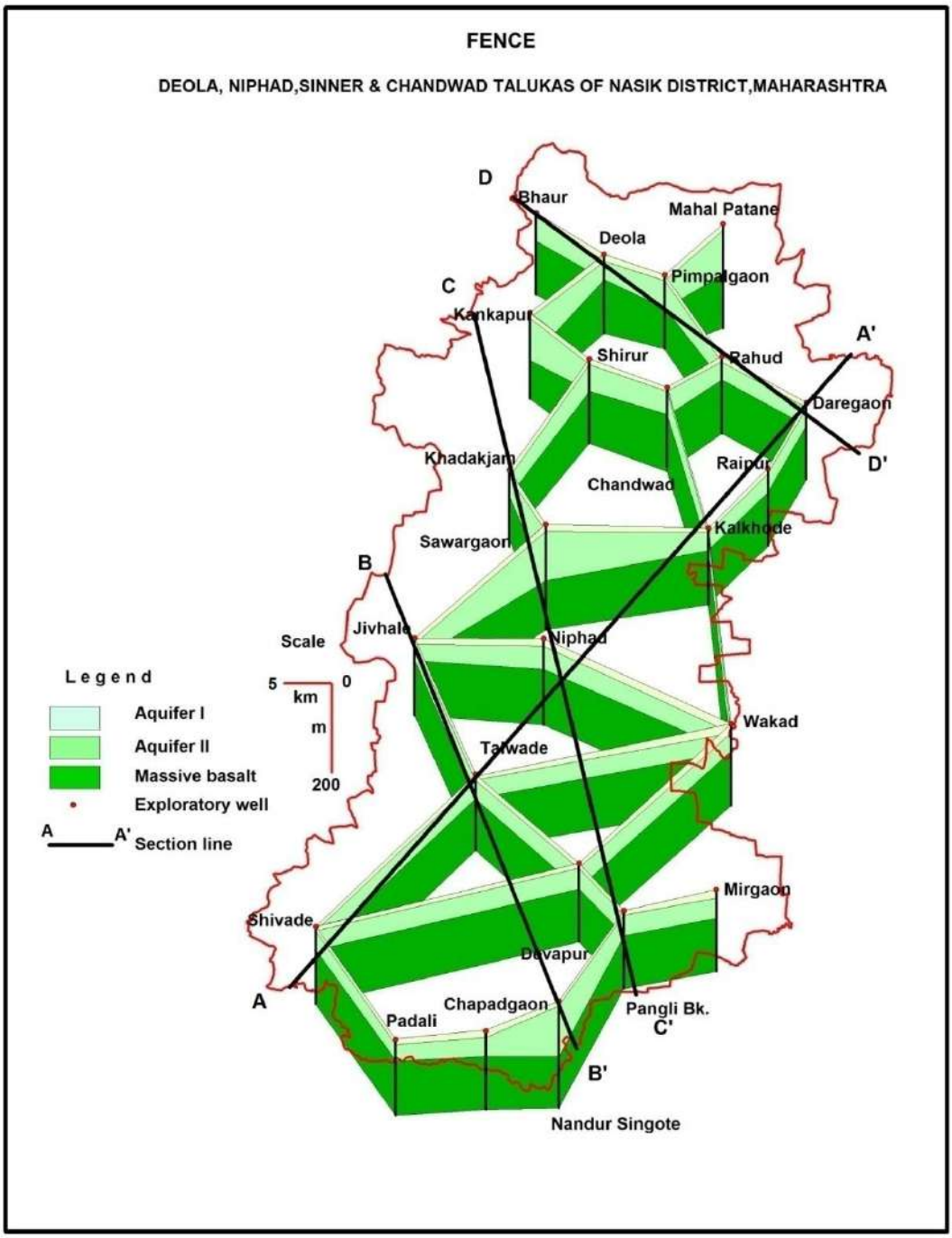


Fig.3.10 Fence Diagram

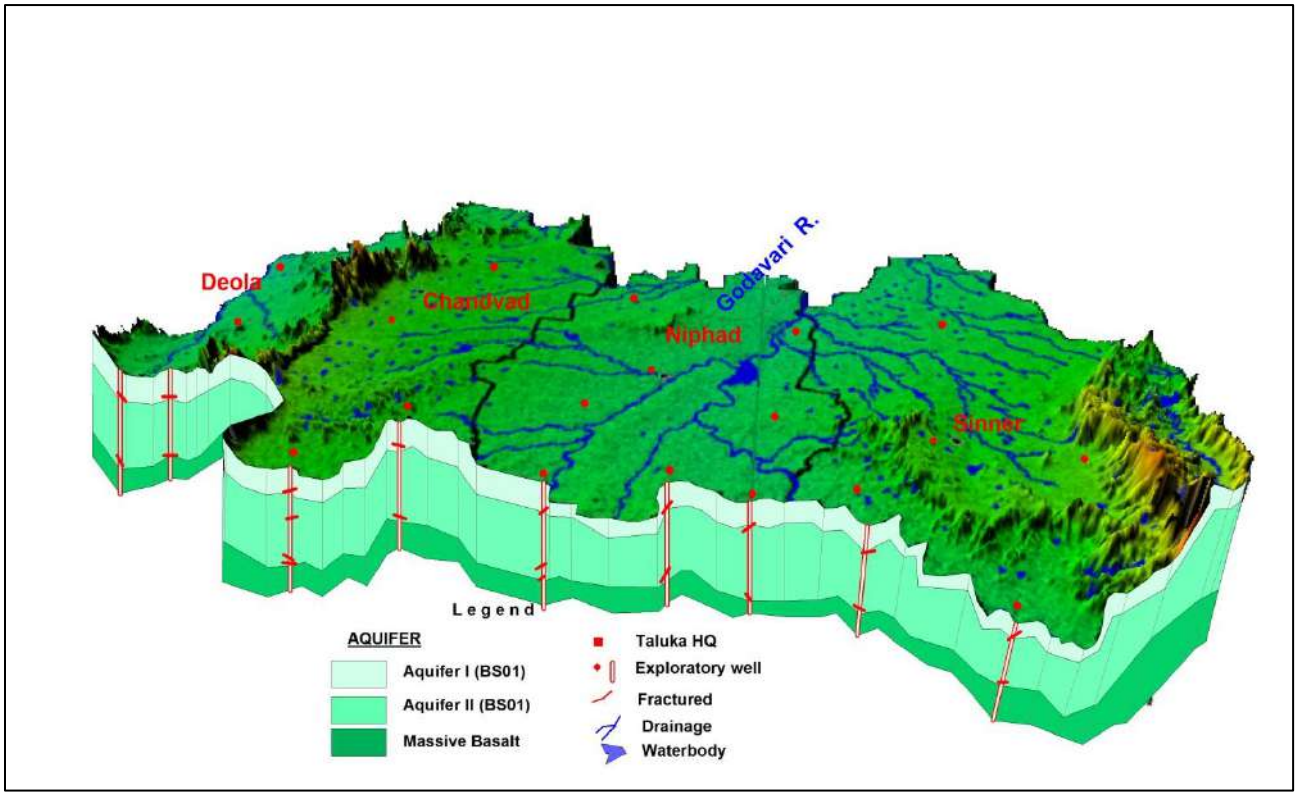
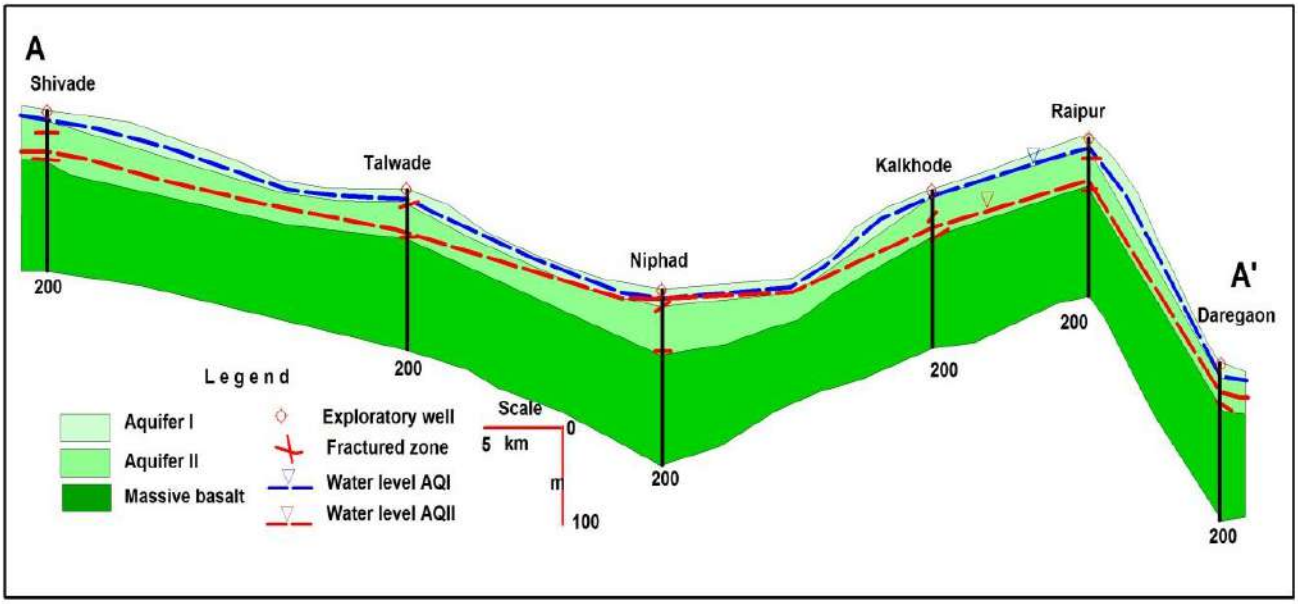
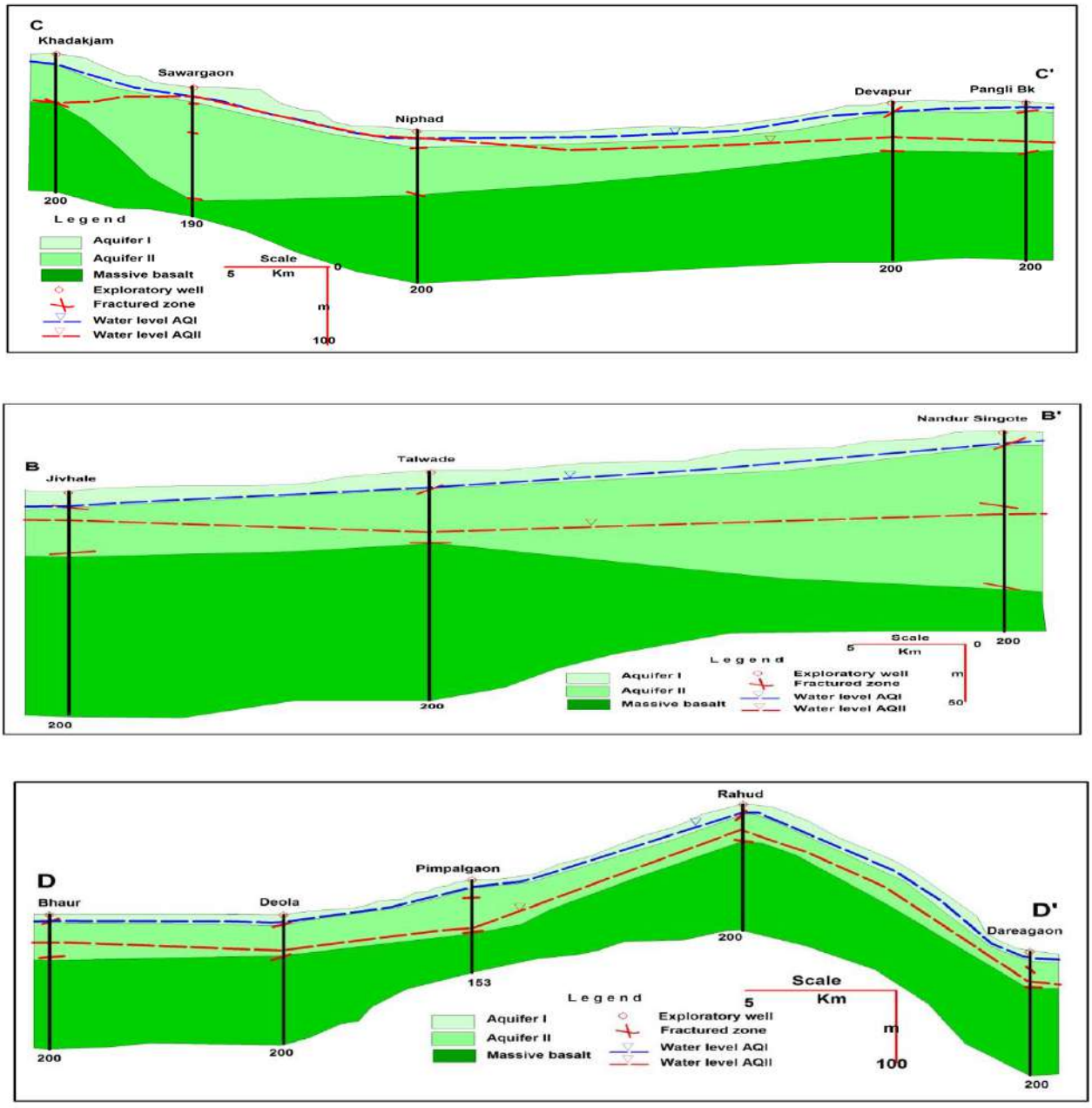


Fig.3.11 3D Aquifer Disposition





Sections along A-A', B-B', C-C', D-D'

4 GROUND WATER RESOURCES

4.1 Dynamic Ground Water Resources

Central Ground Water Board and Ground Water Survey and Development Agency (GSDA) have jointly estimated the ground water resources of Nashik district based on GEC-97 methodology as on 2013. Stage of ground water development of Chandwad, Deola, Niphad and Sinnar Talukas are 98.80, 91.09, 98.98 and 98.75% respectively and categorised as Semi-Critical. The details of resources for the year 2013 are given in Table 4.1 and shown in **Fig. 4.1**. The comparision of assessment values for previous years have been shown in **Fig 4.2.**

Table 4.1 Groundwater Resources Estimation of Deola, Chandwad, Niphad and Sinnar Talukas (2013)

S. No.	Administrative Unit	Command / Non-Command / Total	Net Annual Ground Water Availability	Existing Gross Ground Water Draft for irrigation	Existing Gross Ground Water Draft for domestic and industrial water supply	Existing Gross Ground Water Draft for All uses	Provision for domestic and industrial requirement supply to 2025	Net Ground Water Availability for future irrigation development	Stage of Ground Water Development
1	Chandvad	Command	1675.93	1353.52	37.21	1390.73			
		Non Command	8245.80	7501.60	145.38	7646.98			
		Total	9921.73	8855.12	182.59	9037.71	421.64	1319.27	91.09
2	Deola	Command	1032.30	592.55	25.68	618.23			
		Non Command	4656.86	4910.00	92.58	5002.57			
		Total	5689.16	5502.54	118.26	5620.80	195.08	825.60	98.80
3	Sinnar	Command	1803.49	386.36	40.24	426.60			
		Non Command	14147.75	15070.38	254.96	15325.34			
		Total	15951.24	15456.74	295.21	15751.94	453.12	1375.76	98.75
4	Niphad	Command	8018.22	6876.72	165.67	7042.39			
		Non Command	7683.33	8446.00	209.54	8655.55			
		Total	15701.55	15322.73	375.21	15697.94	483.78	594.92	99.98

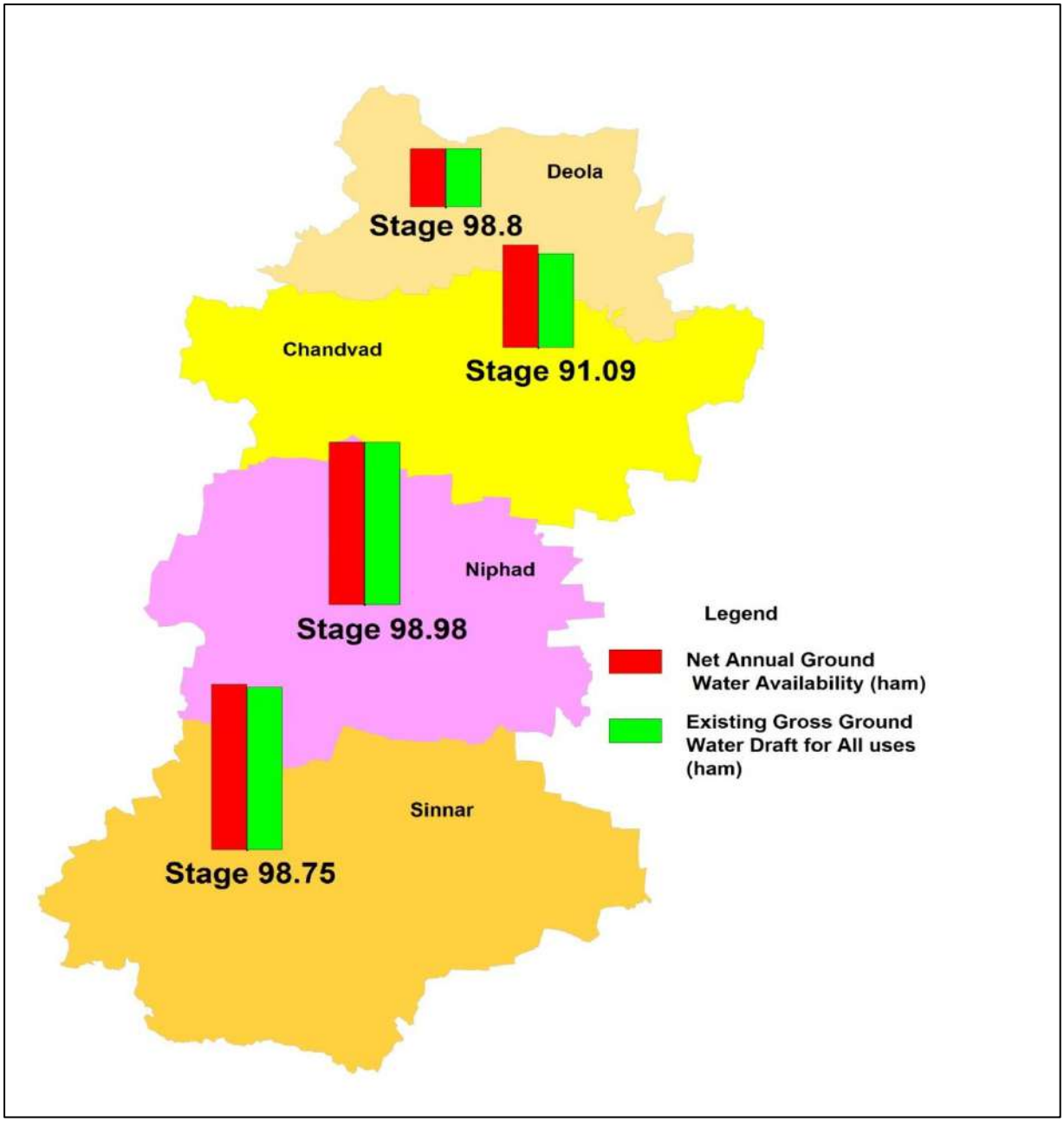


Fig. 4.1: Dynamic Ground Water resources (2013)

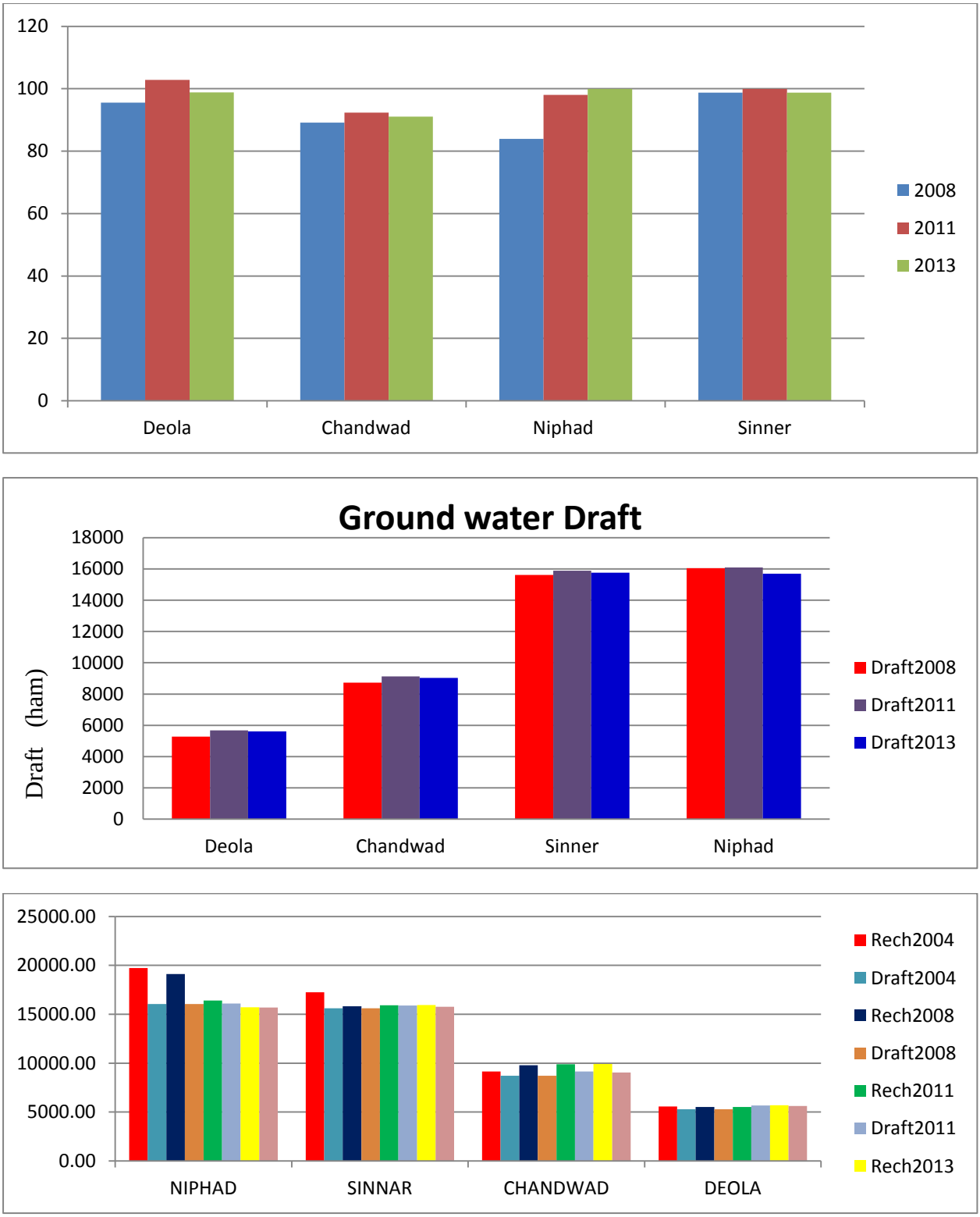


Fig. 4.2: Comparison of stage of ground water development

4.2 Static Ground Water Resources

The computation of static ground water resources has been carried out as per the aquifer thickness and specific yield of the aquifer material. The computations are as follows:

Static ground water Resource = Thickness of the aquifer below zone of water level fluctuation upto exploitable limit x areal extent of the aquifer x Specific yield of the aquifer

The computation of static resources of ground water is given in Table 4.2. The total static resource computed is 1.445 mcm.

Table 4.2. Computation of static ground water resources in Deola, Niphad, Sinnar and Chandvad Taluka, Nashik district

SN	Taluka	Lower	Upper	Mean	Longitude	Latitude	Area (Sqkm)	S	Resource (mcm)
1	Chandvad	0.5	1.5	1	74.3435	20.2925	283.733	0.0009	0.25536
2	Chandvad	0.5	1.5	1	74.0433	20.2435	58.4947	0.0009	0.052645
3	Chandvad	1.5	3	3	74.2232	20.2803	228.805	0.0009	0.617774
4	Chandvad	3	6	6	74.1584	20.2851	222.304	0.0009	1.200442
5	Chandvad	6	9	7.5	74.093	20.3576	39.7212	0.0004	0.119164
6	Chandvad	6	9	9	74.1814	20.2233	43.9488	0.0004	0.158216
7	Chandvad	9	11	10	74.1401	20.2167	13.0679	0.0004	0.052272
8	Total						890.0746		2.455871
9	Deola	0.5	1.5	1	74.401	20.427	182.285	0.0009	0.164057
10	Deola	1.5	3	2.25	74.2198	20.447	248.175	0.00025	0.139598
11	Deola	3	6	4.5	74.1695	20.427	63.0326	0.0009	0.255282
12	Deola	6	9	9	74.0858	20.3915	84.0137	0.0009	0.680511
13	Total						577.5063		1.239448
14	Niphad	0.5	1.5	1	74.2954	20.1083	29.4403	0.0009	0.026496
15	Niphad	0.5	1.5	1	74.2888	19.9984	33.5088	0.0009	0.030158
16	Niphad	0.5	1.5	1	74.0229	19.9598	462.855	0.0009	0.41657
17	Niphad	1.5	3	2.25	74.246	20.1548	174.564	0.00045	0.176746
18	Niphad	3	6	4.5	74.0998	20.2247	245.704	0.00045	0.497551
19	Niphad	6	9	7.5	74.077	20.1588	159.319	0.00045	0.537702
20	Niphad	9	11	10	74.0946	20.1722	46.3675	0.00045	0.208654
21	Total						1151.7586		1.893876
22	Sinnar	0.5	1.5	1	74.2445	19.925	2.44816	0.00025	0.000612
23	Sinnar	0.5	1.5	1	74.0229	19.8061	1098.61	0.0009	0.988749
24	Sinnar	1.5	3	2.25	74.2353	19.854	225.427	0.0009	0.45649
25	**TOTAL**						**1326.48516**		**1.445851**

5 AQUIFER MAP AND AQUIFER CHARACTERISTICS

5.1 Aquifer Characteristics

Basalt is the main rock type of the area and comprises two distinct units viz, upper vesicular unit and lower massive unit. The massive basalt is hard, compact and does not have

primary porosity and hence impermeable. Weathering, jointing and fracturing induces secondary porosity in massive unit of basalt. In vesicular basalt, when vesicles are interconnected constitutes good primary porosity and when the vesicles are filled/ partly filled the porosity is limited. Ground water occurs under phreatic/ unconfined to semi-confined conditions in basalts. A total of 18 lava flows were demarcated based on GSI maps and ground water exploration. The Basaltic flow map is shown in **Fig 5.1.**

Based on extensive analysis of historical data, micro level hydrogeological survey data generated and ground water exploration carried out in area, the following two types of aquifers can be demarcated and the details are given below:

Aquifer I - Unconfined aquifer, occurs in Deccan trap basalt which is exposed in entire area. Whereas, alluvium occurs in along the Godavari and Girna River, however, it does not form as potential aquifer. This aquifer generally occurs in the depth of 8 to 32 m bgl in basalts. Based on field observations, map of Aquifer–I is generated and shown in **Fig. 5.2**.

Aquifer II – Semi-confined to confined aquifer generally occurs in Deccan trap basalt which is exposed in major parts. This aquifer generally occurs to the depth 70 to 160 mbgl. Based on Ground Water Exploration, map of Aquifer –II depicting Depth of occurrence and fractured rock thickness is generated and shown in **Fig 5.3.** A perusal of Fig. 5.3 shows that the depth of occurrence of fractures is limited upto 160 mbgl with a thickness of fractures range between < 1.5 to 9 m.

Based on field survey and ground water exploration, the aquifer characteristic of Deola, Niphad, Sinnar and Chandvad taluka, Nashik district is given in Table 5.1 and the details of ground water exploration is given in **Annexure-II.**

Table 5.1 Aquifer Characteristic of Deola, Niphad, Sinnar and Chandvad taluka, Nashik District

Type of Aquifer	Formation	Depth range (mbgl)	SWL (mbgl)	Fractures / weathered Zones encountered (m bgl)	Fractures / weathered rocks Thickness (m)	Yield	Sustaina-bility	Aquifer parameter (Transmissivity – m^2/day)	Sy/S	Suitability for drinking/ irrigation
Aquifer-I	Deccan Trap-Weathered/ Fractured Basalt	8 - 32	1.20 – 15.00	Up to 32	6 to 20	10 to 100 m^3/day	1 to 5 Hours	9.25-89.04	0.019-0.028	Yes , suitable for both
Aquifer-I	Alluvium	10-20	5 - 10	Granular zone up to 20	1 to 3	200-300 m^3/day	2 to 5 Hours			
Aquifer-II	Jointed/ Fractured Basalt	25 -160	8-55	Up to 160	0.5 to 10	Upto 2.5 lps	0.5 to 3 hours	10.85-131.11	1.30×10^{-4} - 5.31×10^{-4}	Yes, suitable for both, except High EC

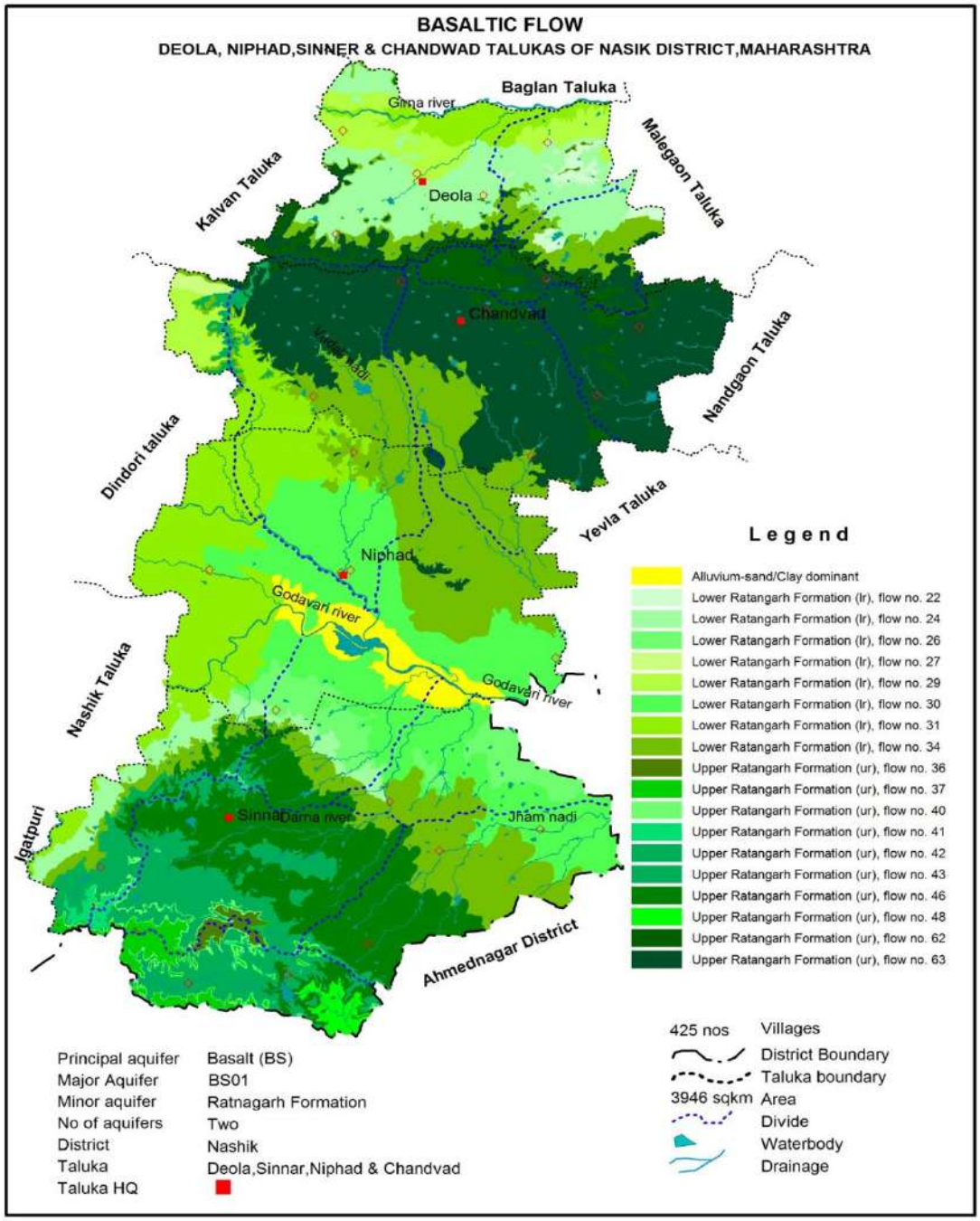


Fig. 5.1: Flow map

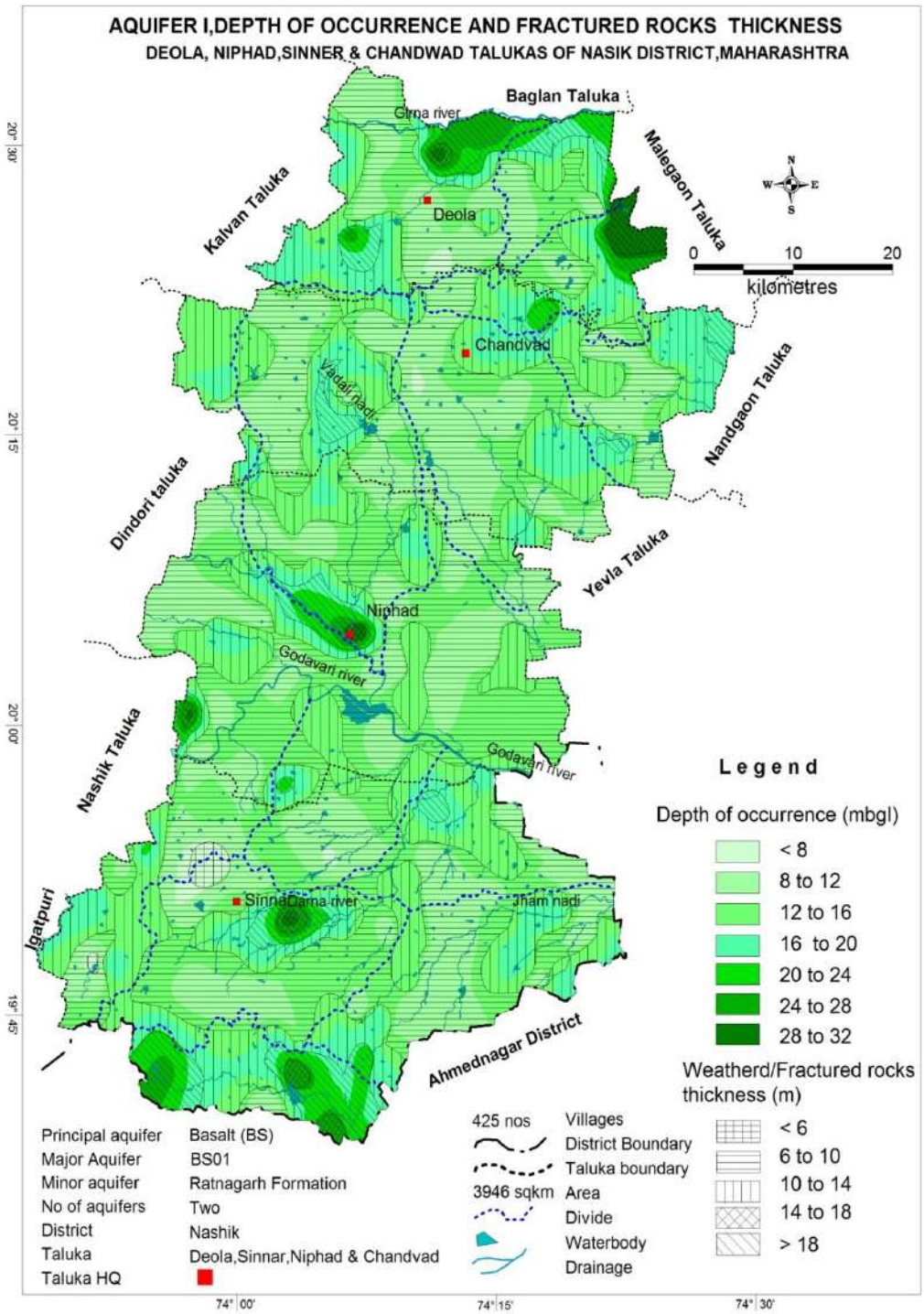


Fig. 5.2: Depth of occurrence & fractured rock thickness of Aquifer- I

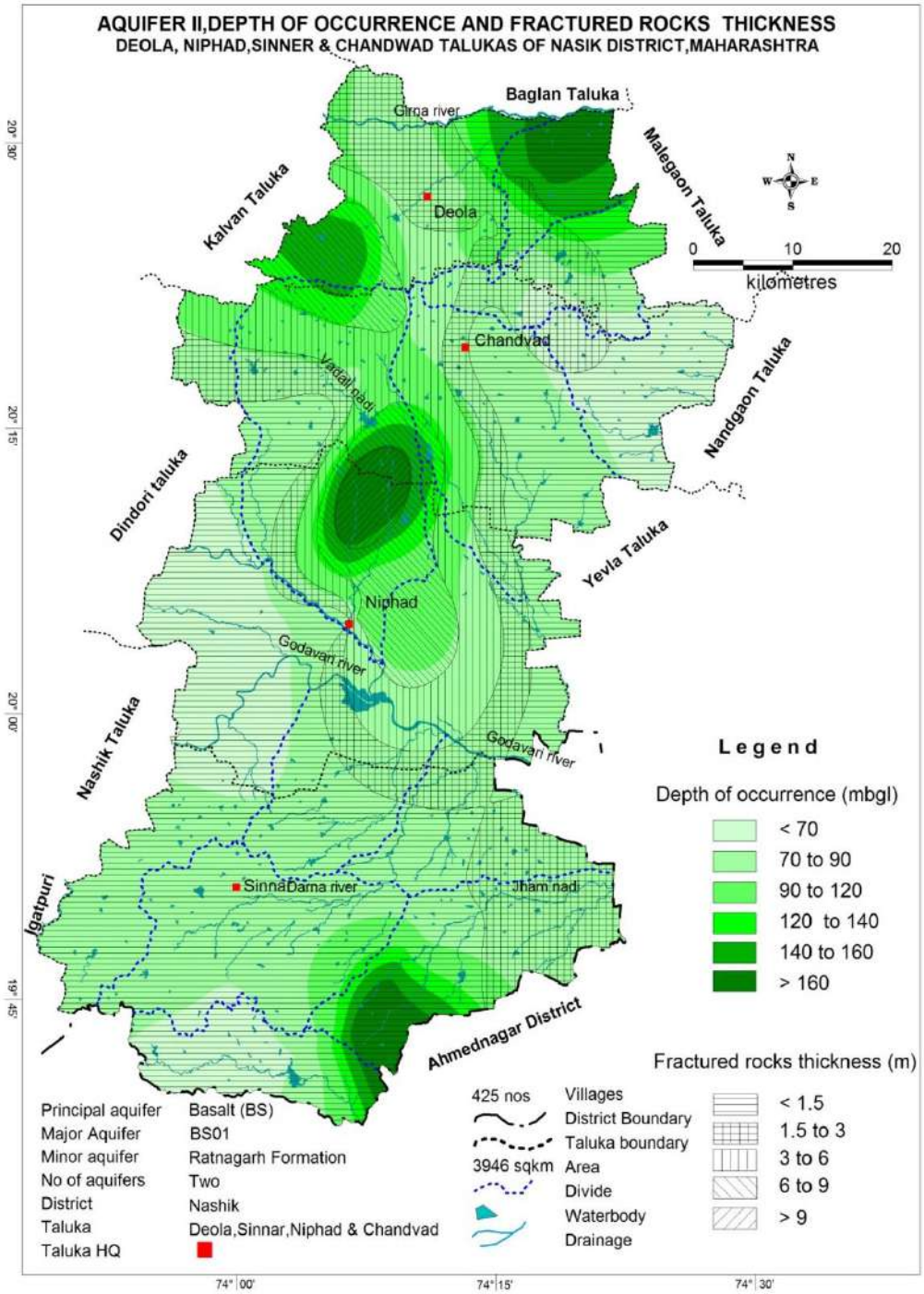


Fig. 5.3: Depth of occurrence and fractured rock thickness of Aquifer-II

5.1.1 Aquifer Group Thickness & Demarcation

Aquifer-I in the area predominantly consists of weathered fractured and jointed basalt and exposed almost covering entire area. The data collected during detailed well inventory have been used to understand the thickness of Aquifer-I i.e., unconfined shallow basaltic aquifer ranges from 6 to 20 m.The thickness in major part of the area is 6to 10m and occurs at the depth of 12 to 18m.bgl..The southern and northern border part of the area show maximum thickness of aquifer of 14 to 18m and occur at the depth of 20to24m.bgl. Joint and shear zones constitute ground water potential aquifers in the area.

Aquifer-II has been observed between the depth ranges of 70 m to 160 m bgl. Except the central part of Nipad taluka where the thickness of aquifer is in range between 6 to 11 m, the rest of area is having aquifer thickness range between 0.5 to 6 m.

The cumulative thickness of aquifer-I and aquifer-II is in major part of the area rage from 10 to 20m, shown in **Fig 5.4**

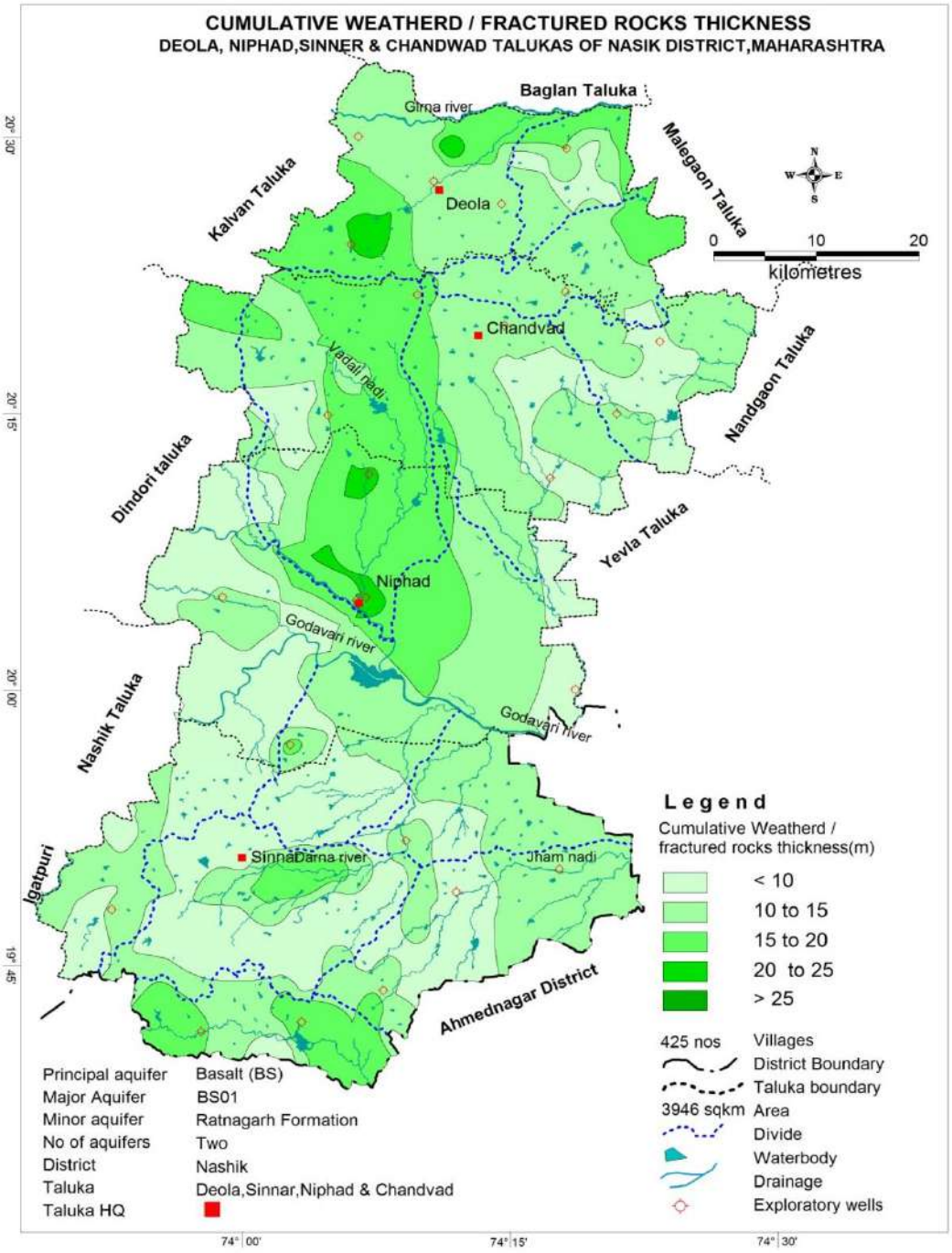


Fig. 5.4: Aquifer group thickness (fractured rock thickness)

5.1.2 Aquifer Parameters and Yield Potentials

The principle of pumping test is that if we pump water from an Exploratory well and measure the discharge and drawdown in both EW and OW, which is at known distance, we can substitute these measurements to calculate different aquifer parameters such as Transmissivity (T) Storativity (S) and yield potentials.

Transmissivity (T): It is defined as rate of flow under a unit hydraulic gradient through a cross-section of unit width over the saturated thickness of aquifer. It is expressed as m^2/day. The T value in Deola, Niphad, sinnar and Chandvad taluka, Nashik district range between 9.25 (Shirur, Chanvad) to 89.03 m^2/day (Rahud, Chandvad).

Storativity (S): The value of storativity for Aquifer –I is 0.019 tp 0.028 and for aquifer II is 1.30×10^{-4} - 5.31×10^{-4}

Yield potential (Q):

The yields of wells are functions of the permeability and transmissivity of aquifer encountered and vary with location, diameter and depth etc. There are three type of ground water structures i.e. dugwells, borewells and tubes wells in the area. Their yield characteristics are described below.

Aquifer-I: The Dugwells tapping Basalt in Deola, Niphad, Sinnar and Chandvad talukas are having low yield potential of about 10 to 15m^3/day in almost entire area. However, the moderate yield of 15 to25 m^3/day and 25 to50 m^3/day of wells is found as scattered patches. The high yield potential of basaltic formation underlain by thick weathered overburden and alluvium is 50 to 100 m^3/day, near the down reaches of Godavari River. The yield potential map of Aquifer-I for Deola, Niphad, Sinnar and Chandvad taluka, Nashik district is own in **Fig. 5.5.**

Aquifer-II: The data of exploratory wells reveals that, high yielding areas of 2-2.8 lps is restricted to drainage course of Godavari river and its tributaries in parts of Sinnar Taluka and also along the areas confined to Girna river. The moderate yield of basalt of 1to 2 lps is also confined to drainage course of tributaries of major rivers. The remaining area is having area is having moderate to low yield in upto 1 lps. The yield potential of basalt is governed by the weathering and recharge condition associated to the drainage course. The yield potential map of Aquifer-II for Deola, Niphad, Sinnar and Chandvad taluka, Nashik district is shown in **Fig. 5.6.**

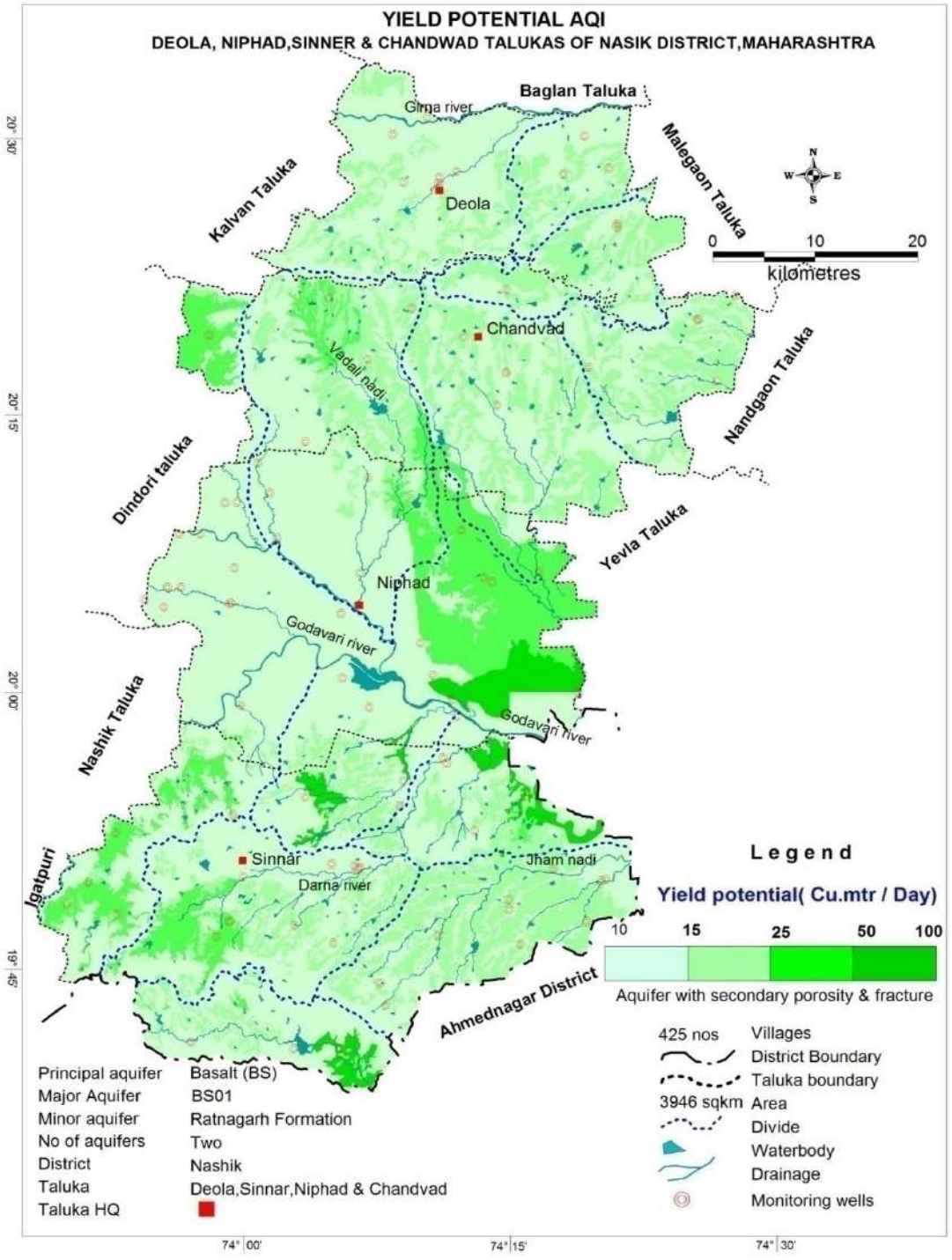


Fig. 5.5: Aquifer-I, Yield potential

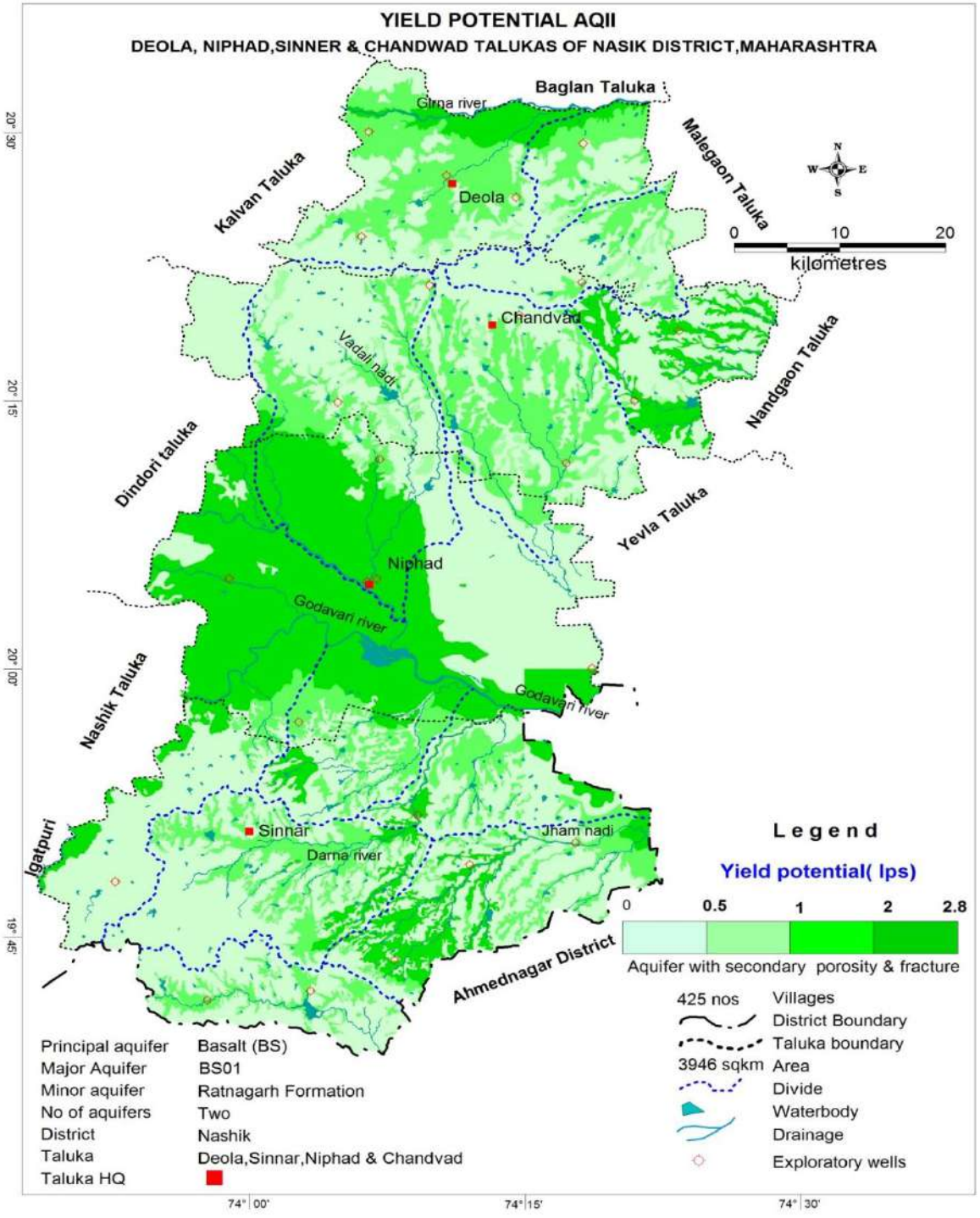


Fig. 5.6: Aquifer-II, Yield potential

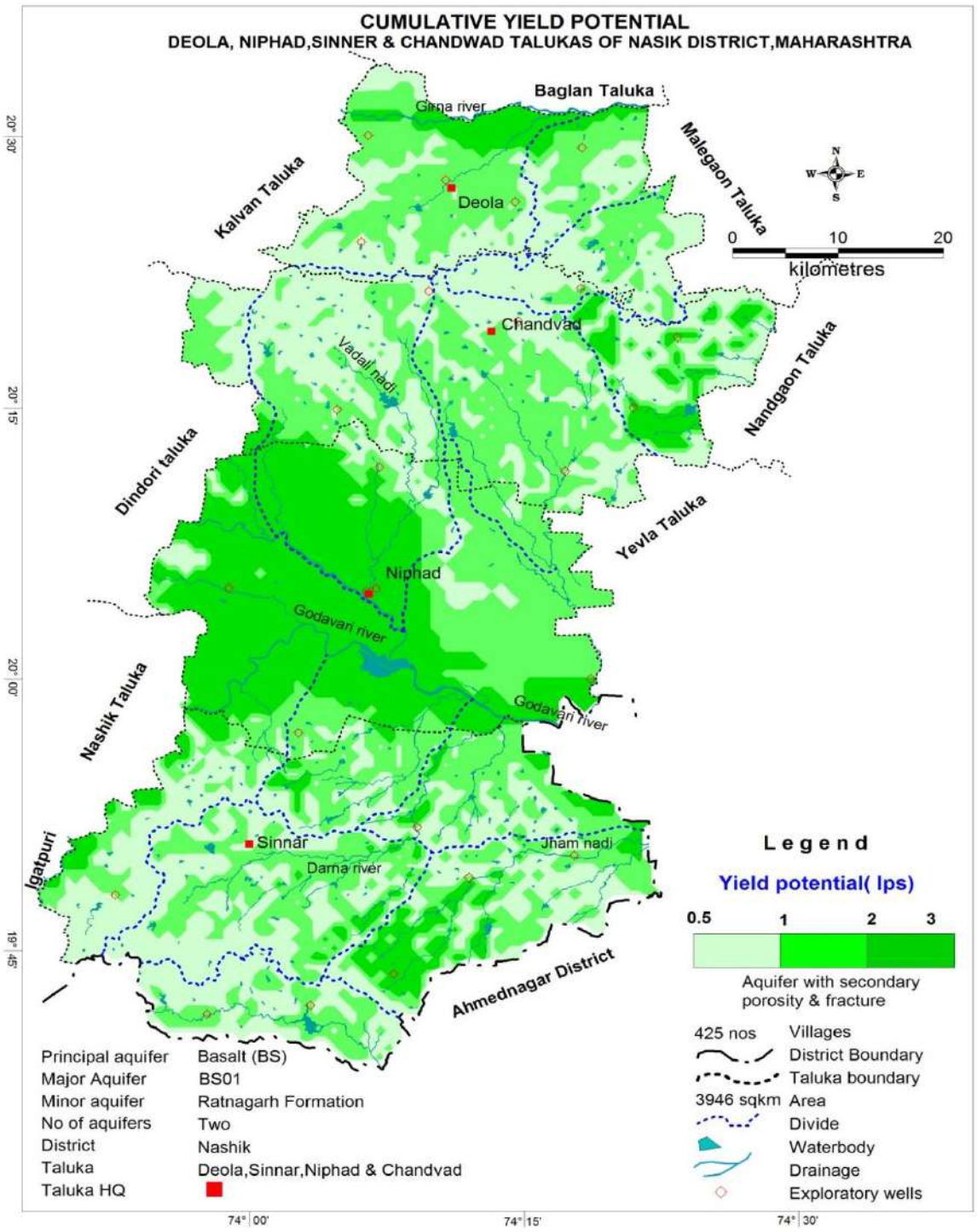


Fig. 5.7: Cummulative Yield potential

5.1.3 Recharge Parameters

During monsoon season, the rainfall recharge is the main recharge parameter, which is estimated as the sum total of the change in storage and gross draft. The change in storage is computed by multiplying groundwater level fluctuation between pre and post-monsoon periods with the area of assessment and specific yield. Monsoon recharge can be expressed as:-

$$R = h \times Sy \times A + DG$$

Where,

h = rise in water level in the monsoon season, S_y = specific yield

A = area for computation of recharge, D_G = gross ground water draft

The specific yield value as estimated from dry season balance method or field studies was taken, wherever available. In absence of field values of specific yield values through above methods recommended values as per GEC-1997 norms has been taken. The specific yield values for Deccan Traps - 0.002 to 0.03. Here, the value for Specific yield is taken as 0.02.

Table 5.2: Recharge parameters estimated based on Ground Water Resources Estimation (2013)

Taluka	Command / Non-Command / Total	Recharge from rainfall during monsoon season	Recharge from other sources during monsoon season	Recharge from rainfall during non-monsoon season	Recharge from other sources during non-monsoon season	Total Annual Ground Water Recharge	Provision for Natural Discharges	Net Annual Ground Water Availability
Chandvad	Command	839.23	156.93	0.00	767.97	1764.14	88.21	1675.93
	Non Command	6418.79	520.08	0.00	1792.99	8731.85	486.05	8245.80
	Total	7258.02	677.01	0.00	2560.96	10495.98	574.26	9921.73
Deola	Command	314.34	89.88	0.00	682.41	1086.64	54.33	1032.30
	Non Command	3393.02	411.57	0.00	1097.37	4901.96	245.10	4656.86
	Total	3707.36	501.46	0.00	1779.78	5988.59	299.43	5689.16
Niphad	Command	3390.74	620.60	77.74	4394.77	8483.84	465.62	8018.22
	Non Command	5770.92	553.31	31.64	1906.83	8262.71	579.38	7683.33
	Total	9161.66	1173.91	109.38	6301.59	16746.55	1045.00	15701.55
Sinnar	Command	573.25	189.37	1.28	1137.26	1901.16	97.67	1803.49
	Non Command	10320.06	1138.97	22.91	3618.28	15100.21	952.46	14147.75
	Total	10893.30	1328.34	24.19	4755.54	17001.37	1050.12	15951.24
TOTAL		31019	3680.72	133.57	15397.87	50232.49	2698.81	47263.68

The monsoon ground water recharge has two components- rainfall recharge and recharge from other sources. The other sources of groundwater recharge during monsoon season include recharge from rainfall, seepage from canals, surface water irrigation, tanks and ponds, ground water irrigation, and water conservation structures.

During the non-monsoon season, rainfall recharge is computed by using Rainfall Infiltration Factor (RIF) method. Recharge from other sources is then added to get total non-monsoon recharge. As the area is occupied by Deccan traps, the factor is taken as 0.07 to 0.14 depending on the formation, which is weathered basalt and vesicular jointed basalt. The details of recharge parameters are given in Table 5.2.

The discharge parameters include natural discharge in the form of springs and base flow and discharge for ground water irrigation, domestic and industrial draft.

6 AQUIFER MANAGEMENT PLAN

A through study was carried out based on data gap analysis, data generated in-house, data acquired from State Govt. departments and maps procured from MRSAC and GSI, an integrated approach was adopted while preparing aquifer management plan of Deola, Niphad, Sinnar and Chandvad talukas, Nashik district. Based on this, geomorphology, soil, land use, field data and lithological following management plan is carried out and the detailed aquifer management plan for Deola, Chandvad Niphad, and Sinnar talukas, Nashik district is presented in **Table 6.1**. The present ground water resources and draft scenario of Deola, Niphad, Sinnar and Chandvad talukas is shown in **Fig. 6.1.**

6.1 Aquifer Management Plan for Deola Taluka

The geographical area of Deola Taluka is 577.40 sq. km., as per ground water resources estimation 2013, the stage of ground water development is **98.80 %** and categorised as semi-critical. The annual ground water resource available is 56.89 MCM and the gross ground water draft for all uses is 56.21 MCM including 55.04 MCM for irrigation and 1.18 MCM for domestic sector. The major issues identified in Deola Taluka are high stage of ground water development, exploitation of ground water, limited aquifer potential and water scarcity during lean period.

To manage the resources, demand for agricultural and domestic requirement has been brought out with respect to Supply.

The Agricultural **demand** in rainfed area is worked out as 57.70 MCM. The agricultural demand from ground water and surface water is 55.03 and 3.77 MCM respectively. Whereas, the domestic demand for ground water and surface water is 1.18 and 0.30 MCM.

The Agricultural **supply** in rainfed area is 57.70 MCM due to monsoon. The agricultural supply from ground water and surface water is 55.03 and 3.77 MCM respectively. Whereas, the domestic supply for ground water and surface water is 1.18 and 0.30 MCM. Hence, there is no Demand-Supply gap. The management plan is to bring the stage of ground water development upto 70 % by maintain the gap between demand and supply of 23.41 MCM**.**

Supply side interventions proposed to tackle above said major issues through rainwater harvesting and artificial recharge. The volume of unsaturated granular zone available in Deola taluka is worked out as 988.17 MCM. The recharge potential available in the area is 19.76 MCM. The surface surplus runoff availability is 26.35 MCM. Therefore, the surface runoff of 20.72 MCM is considered for planning. For this, a total of 73 percolation tank and 207 Check dams are required as recharge measures. The volume of water expected to be conserved/recharged @75% efficiency is 10.97 MCM through Percolation tank and 4.66 MCM through Check dams. The cost estimate for 73 percolation tank and 207 check dams are Rs. 109.50and Rs. 62.10 crore respectively. The location of artificial recharge structures proposed is given in **Annexure VI** shown in **Fig 6.1.**

The rainwater harvesting in urban areas can be adopted in 25% of the household with 50 Sq. m roof area. A total of 0.15 MCM potential can be generated by taking 80% runoff coefficient. The estimated cost for rainwater harvesting through roof top is calculated as Rs.10.82 crore. Hence, this technique is not economically viable and therefore it is not recommended. Overall total volume of water expected to be recharged or conserved by artificial recharge is 27.57 MCM with a cost estimate of Rs. 171.60 crore, excluding roof top rain water harvesting which is not economically viable.

Demand side interventions are proposed as the micro-irrigation techniques like drip irrigation is proposed for crops irrigated on ground water like onion. The micro irrigation will save 11.96 mcm of water at the expenditure of 0.28crore. The aquifer management plan for Deola taluka is given in Table 6.1.

Thus, additional ground water resources available after implementing above measures is 27.57 MCM which would bring the stage of ground water development from 98.80 % to 66.87 % i.e. about 32.25 % reduction in the stage of ground water development with estimated expenditure of Rs. 171.60 crore.

6.2 Aquifer Management Plan for Chandvad Taluka

The geographical area of Chandvad Taluka is 890 sq. km., as per ground water resources estimation 2013, the stage of ground water development is **91.02 %** and categorised as semi-critical. The annual ground water resource available is 99.22 MCM and the gross ground water draft for all uses is 90.38 MCM including 88.55 MCM for irrigation and 1.83 MCM for domestic sector. The major issues identified in Chandvad Taluka are high stage of ground water development, exploitation of ground water, limited aquifer potential and water scarcity during lean period.

To manage the resources, demand for agricultural and domestic requirement has been brought out with respect to Supply.

The Agricultural **demand** in rainfed area is worked out as 75.32 MCM. The agricultural demand from ground water and surface water is 88.55 and 7.70 MCM respectively. Whereas, the domestic demand for ground water and surface water is 1.83 and 0.46 MCM.

The Agricultural **supply** in rainfed area is 75,32 MCM due to monsoon. The agricultural supply from ground water and surface water is 88.55 and 7.70 MCM respectively. Whereas, the domestic supply for ground water and surface water is 1.83 and 0.46 MCM. Hence, there is no Demand-Supply gap. The management plan is to bring the stage of ground water development upto 70 % by maintaining the gap between demand and supply of 29.89 MCM**.**

Supply side interventions proposed to tackle above said major issues through rainwater harvesting and artificial recharge. The volume of unsaturated granular zone available in Chandvad taluka is worked out as 1046.71 MCM. The recharge potential available in the area is 20.93 MCM. The surface surplus runoff availability is 27.91 MCM. Therefore, the surface runoff of 21.95 MCM is considered for planning. For this, a total of 77 percolation tank and 220 Check dams are required as recharge measures. The volume of water expected to be conserved/recharged @75% efficiency is 11.55 MCM through Percolation tank and 4.95 MCM through Check dams. The cost estimate for 32 percolation tank and 91 check dams are Rs. 115.50and Rs. 66.00 crore respectively. The location of artificial recharge structures proposed are given in **Annexure VI** and shown in **Fig. 6.1.**

The rainwater harvesting in urban areas can be adopted in 25% of the household with 50 Sq. m roof area. A total of 0.26 MCM potential can be generated by taking 80% runoff coefficient. The estimated cost for rainwater harvesting through roof top is calculated as Rs.16.93 crore. Hence, this technique is not economically viable and therefore it is not recommended. Overall total volume of water expected to be recharged or conserved by artificial recharge is 32.10 MCM with a cost estimate of Rs. 181.55 crore, excluding roof top rain water harvesting which is not economically viable.

Demand side interventions are proposed as the micro-irrigation techniques like drip irrigation is proposed for crops irrigated on ground water like onion. The micro irrigation will save 15.60 mcm of water at the expenditure of 0.36crore. The aquifer management plan for Chandvad taluka is given in Table 6.1.

Thus, additional ground water resources available after implementing above measures is 32.10 MCM which would bring the stage of ground water development from 91.02 % to 68.82 % i.e. about 22.20 % reduction in the stage of ground water development with estimated expenditure of Rs. 181.91 crore.

6.3 Aquifer Management Plan for NiphadTaluka

The geographical area of Niphad Taluka is 1151.75 sq. km., as per ground water resources estimation 2013, the stage of ground water development is **99.98 %** and categorised as semi-critical. The annual ground water resource available is 157.02 MCM and the gross ground water draft for all uses is156.98 MCM including 153.23 MCM for irrigation and 3.75 MCM for domestic sector. The major issues identified in Niphad Taluka are high stage of ground water development, exploitation of ground water, limited aquifer potential and water scarcity during lean period.

To manage the resources, demand for agricultural and domestic requirement has been brought out with respect to Supply.

The Agricultural **demand** in rainfed area is worked out as 11.84 MCM. The agricultural demand from ground water and surface water is 153.23 and 3.75 MCM respectively. Whereas, the domestic demand for ground water and surface water is 3.75 and 0.95 MCM.

The Agricultural **supply** in rainfed area is 11.84 MCM due to monsoon. The agricultural supply from ground water and surface water is 153.23 MCMand 3.75 MCM respectively. Whereas, the domestic supply for ground water and surface water is 3.75 and 0.95 MCM. Hence, there is no Demand-Supply gap. The management plan is to bring the stage of ground water development upto 70 % by maintain the gap between demand and supply of 67.24 MCM**.**

Supply side interventions proposed to tackle above said major issues through rainwater harvesting and artificial recharge. The volume of unsaturated granular zone available in Deola taluka is worked out as 1072.80 MCM. The recharge potential available in the area is 21.46 MCM. The surface surplus runoff availability is 28.61 MCM. Therefore, the surface runoff of 22.49 MCM is considered for planning. For this, a total of 79percolation tank and 225 Check dams are required as recharge measures. The volume of water expected to be conserved/recharged @75% efficiency is11.85 MCM through Percolation tank and 5.06 MCM through Check dams. The cost estimate for 79 percolation tank and 225 check dams are Rs. 118.50 and Rs. 67.50 crore respectively. The location of artificial recharge structures proposed are given in **Annexure VI** and shown in **Fig. 6.1.**

The rainwater harvesting in urban areas can be adopted in 25% of the household with 50 Sq. m roof area. A total of 0. 50 MCM potential can be generated by taking 80% runoff coefficient. The estimated cost for rainwater harvesting through roof top is calculated as Rs.36.53 crore. Hence, this technique is not economically viable and therefore it is not recommended. Overall total volume of water expected to be recharged or conserved by artificial recharge is 16.91 MCM with a cost estimate of Rs. 186.00 crore, excluding roof top rain water harvesting which is not economically viable.

Demand side interventions are proposed as the micro-irrigation techniques like drip irrigation is proposed for crops irrigated on ground water like onion and Sugarcane. The micro irrigation will save 51.90 mcm of water at the expenditure of 0.54crore. The aquifer management plan for Niphad taluka is given in Table 6.1. Thus, additional ground water resources available after implementing above measures is 68.81 MCM which would bring the stage of ground water development from 99.98 % to 69.51 % i.e. about 30.47 % reduction in the stage of ground water development with estimated expenditure of Rs. 186.00 crore.

6.4 Aquifer Management Plan for Sinnar Taluka

The geographical area of Niphad Taluka is 1326.48 sq. km., as per ground water resources estimation 2013, the stage of ground water development is **98.75 %** and categorised as semi-critical. The annual ground water resource available is 159.51 MCM and the gross ground water draft for all uses is 157.52 MCM including 154.57 MCM for irrigation and 2.95 MCM for domestic sector. The major issues identified in SINNAR Taluka are high stage of ground water development, exploitation of ground water, limited aquifer potential and water scarcity during lean period.

To manage the resources, demand for agricultural and domestic requirement has been brought out with respect to Supply.

The Agricultural **demand** in rainfed area is worked out as 169.19 MCM. The agricultural demand from ground water and surface water is 154.57 and 35.17 MCM respectively. Whereas, the domestic demand for ground water and surface water is 2.95 and 0.74 MCM.

The Agricultural **supply** in rainfed area is 169.19 MCM due to monsoon. The agricultural supply from ground water and surface water is 154.57 and 35.17 MCM respectively. Whereas, the domestic supply for ground water and surface water is 2.95 and 0.74 MCM. Hence, there is no Demand-Supply gap. The management plan is to bring the stage of ground water development upto 70 % by maintain the gap between demand and supply of 65.52 MCM**.**

Supply side interventions proposed to tackle above said major issues through rainwater harvesting and artificial recharge. The volume of unsaturated granular zone available in SINNAR taluka is worked out as 1978.81 MCM. The recharge potential available in the area is 39. 58 MCM. The surface surplus runoff availability is 52.77MCM. Therefore, the surface runoff of 41.49 MCM is considered for planning. For this, a total of 145 percolation tank and 415 Check dams are required as recharge measures. The volume of water expected to be conserved/recharged @75% efficiency is 21.75 MCM through Percolation tank and 9.34 MCM through Check dams. The cost estimate for 145 percolation tank and 415 check dams are Rs. 217,50 and Rs. 124.50 crore respectively. The location of artificial recharge structures proposed are given in **Annexure VI** and shown in **Fig. 6.1.**

The rainwater harvesting in urban areas can be adopted in 25% of the household with 50 Sq. m roof area. A total of 0.35 MCM potential can be generated by taking 80% runoff coefficient. The estimated cost for rainwater harvesting through roof top is calculated as Rs.25.29 crore. Hence, this technique is not economically viable and therefore it is not recommended.

Overall total volume of water expected to be recharged or conserved by artificial recharge is 31.09 MCM with a cost estimate of Rs. 342.80 crore, excluding roof top rain water harvesting which is not economically viable.

Demand side interventions are proposed as the micro-irrigation techniques like drip irrigation is proposed for crops irrigated on ground water like onion, sugarcane and fruits. The micro irrigation will save 36.64 mcm of water at the expenditure of 0.64crore.The aquifer management plan for Sinnar taluka is given in Table 6.1 Thus, additional ground water resources available after implementing above measures is 27.567.727 MCM which would bring the stage of ground water development from 98.80 % to 69.32 % i.e. about 29.43 % reduction in the stage of ground water development with estimated expenditure of Rs. 342.80 crore.

Table 6.1: Aquifer Management Plan of Deola Taluka, Nashik District

Block	**Chandwad**	**Proposed area**	**Deola**	**Proposed area**	**Niphad**	**Proposed area**	**Sinnar**	**Proposed area**	**Total**
District	Nashik		Nashik		Nashik		Nashik		
State	Maharashtra		Maharashtra		Maharashtra		Maharashtra		
Area	890.07		577.46		1151.75		1326.48		3945.76
Major Issues Identified	Over - Exploitation ,Declining WL, Water Scarcity - lean period								
Stage of GW Development	91.09%		98.80%		99.98%		98.75%		
Annual Available Resource (MCM)	99.22		56.89		157.02		159.51		472.64
Gross Annual Draft (MCM)	90.38		56.21		156.98		157.52		461.09
Domestic Demand	1.83		1.18		3.75		2.95		9.71
SUPPLY (MCM)									
Agricultural Supply -Rainfed	75.32		57.70		11.84		169.19		314.05
Agricultural Supply -GW	88.55		55.03		153.23		154.57		451.38
Agricultural Supply -SW	7.70		3.77		289.34		35.17		335.98
Domestic Supply - GW	1.83		1.18		3.75		2.95		9.71
Domestic Supply - SW	0.46		0.30		0.94		0.74		2.43
Total supply(mcm)	**173.86**		**117.98**		**459.10**		**362.62**		1113.55
GAP TO BRING STAGE OF GWD UPTO 70%	**29.89**		**23.41**		**67.24**		**65.52**		186.06
Interventions proposed to deal with overexploitation									
SUPPLY SIDE INTERVENTIONS									
Rainwater Harvesting and Artificial Recharge									
Volume of unsaturated granular zone (MCM)	1046.71		988.17		1072.80		1978.81		5086.49
Recharge Potential (MCM)	20.93		19.76		21.46		39.58		101.73
Surface water requirement @ 75% efficiency (MCM)	27.91		26.35		28.61		52.77		135.64
Availability of Surplus surface	21.95		20.72		22.49		41.49		106.65

Block	**Chandwad**	**Proposed area**	**Deola**	**Proposed area**	**Niphad**	**Proposed area**	**Sinnar**	**Proposed area**	**Total**
runoff (MCM)									
Surplus runoff considered for planning (MCM) @ 70%	21.95		20.72		22.49		41.49		106.65
Proposed Structures- Percolation Tank (@ Rs.150 lakh, Av. Gross Capacity-100 TCM*2 fillings = 200 TCM) and Check Dam (@ Rs.30 lakh, Av. Gross Capacity-10 TCM * 3 fillings = 30 TCM)	Percolation	CD	Percolation	CD	Percolation	CD	Percolation	CD	
Number of Strcutures	77	220	73	207	79	225	145	415	**1441.00**
Volume of Water expected to be conserved / recharged @ 75% effeciency (MCM)	11.55	4.95	10.95	4.66	11.85	5.06	21.75	9.34	**80.11**
Estimated Expenditure (Rs. in Cr.)	115.50	66.0	109.50	62.1	118.50	67.50	217.50	124.5	**881.10**
RTRWH - Urban Areas									
Households to be covered (25% with 50 m2 area)	11285		7216		24355		16860		59716.00
Total RWH potential (MCM)	0.32		0.19		0.63		0.43		1.57
Rainwater harvested / recharged @ 80% runoff co-efficient	0.26		0.15		0.50		0.35		1.25
Estimated Expenditure (Rs. in Cr.) @ Rs. 15000/- per HH , Economically not viable & Not Recommended	16.93		10.82		36.53		25.29		89.57
Total volume of water expected to be recharged/conserved by AR	16.50		15.61		16.91		31.09		80.11
Total Estimated Expn. For AR	181.50		171.60		186.00		342.00		881.10

Block	Chandwad	Proposed area	Deola	Proposed area	Niphad	Proposed area	Sinnar	Proposed area	Total
DEMAND SIDE INTERVENTIONS									
Proposed Cropping Pattern change	None		None		None		None		
Micro irrigation techniques	Crop area	Proposed area	Crop area	Proposed area	Crop area	Proposed area	Crop area	Proposed area	
Micro Irrigation Techniques in Onion cropped area ,saving water @ 0.26 m ,sqkm	75.3	60	57.84	46	80.51	40	50.68	50.68	
Volume of Water expected to be saved(MCM)	15.6		11.56		10.40		13.18		50.74
Estimated Expenditure (Rs. in Cr.) @ Rs. 60,000/- per acre	0.36		0.28		0.24		0.30		1.18
Micro Irrigation Techniques in Sugarcane cropped area (sqkm) ,saving water @ 0.83 m					82.70	50	13.19	11	
Volume of Water expected to be saved(MCM)					41.50		9.96		51.46
Estimated Expenditure (Rs. in Cr.) @ Rs. 60,000/- per acre					0.3		0.07		0.372
Micro Irrigation Techniques in fruit and vegetable cropped area ,saving water @ 0.3 m (Sqkm)							94.48	45	
Volume of Water expected to be saved(MCM)							13.50		13.50
Estimated Expenditure (Rs. in Cr.) @ Rs. 60,000/- per acre							0.27		0.27
Alternate Sources									
Alternative ground water sources	Nil		Nil	Nil	Nil	Nil	Nil	Nil	

Block	**Chandwad**	**Proposed area**	**Deola**	**Proposed area**	**Niphad**	**Proposed area**	**Sinnar**	**Proposed area**	**Total**
Location and other details of the sources	Nil		Nil	Nil	Nil	Nil	Nil	Nil	
Volume of Water expected to be served from these sources	32.10	0.00	27.17	0.00	68.81	0.00	67.73	0.00	195.81
Alternative surface water sources	Nil		Nil		Nil		Nil		Nil
Balance GWR available for GW Development after STAGE OF GWD is brought to 70%	2.21	0.00	3.76	0.00	1.58	0.00	2.21	0.00	9.75
Additional Area (sq.km.) proposed to be brought under assured GW irrigation with av. CWR of 0.65 m OR	3.39	0.00	5.78	0.00	2.42	0.00	3.40	0.00	15.00
Regulation of wells below 60 m	**Regulation of wells below 60 m**		**Regulation of wells below 60 m**		**Regulation of wells below 60 m**		**Regulation of wells below 60 m**		
stage can be brought to	68.8242		66.8708919		69.511696		69.319545		

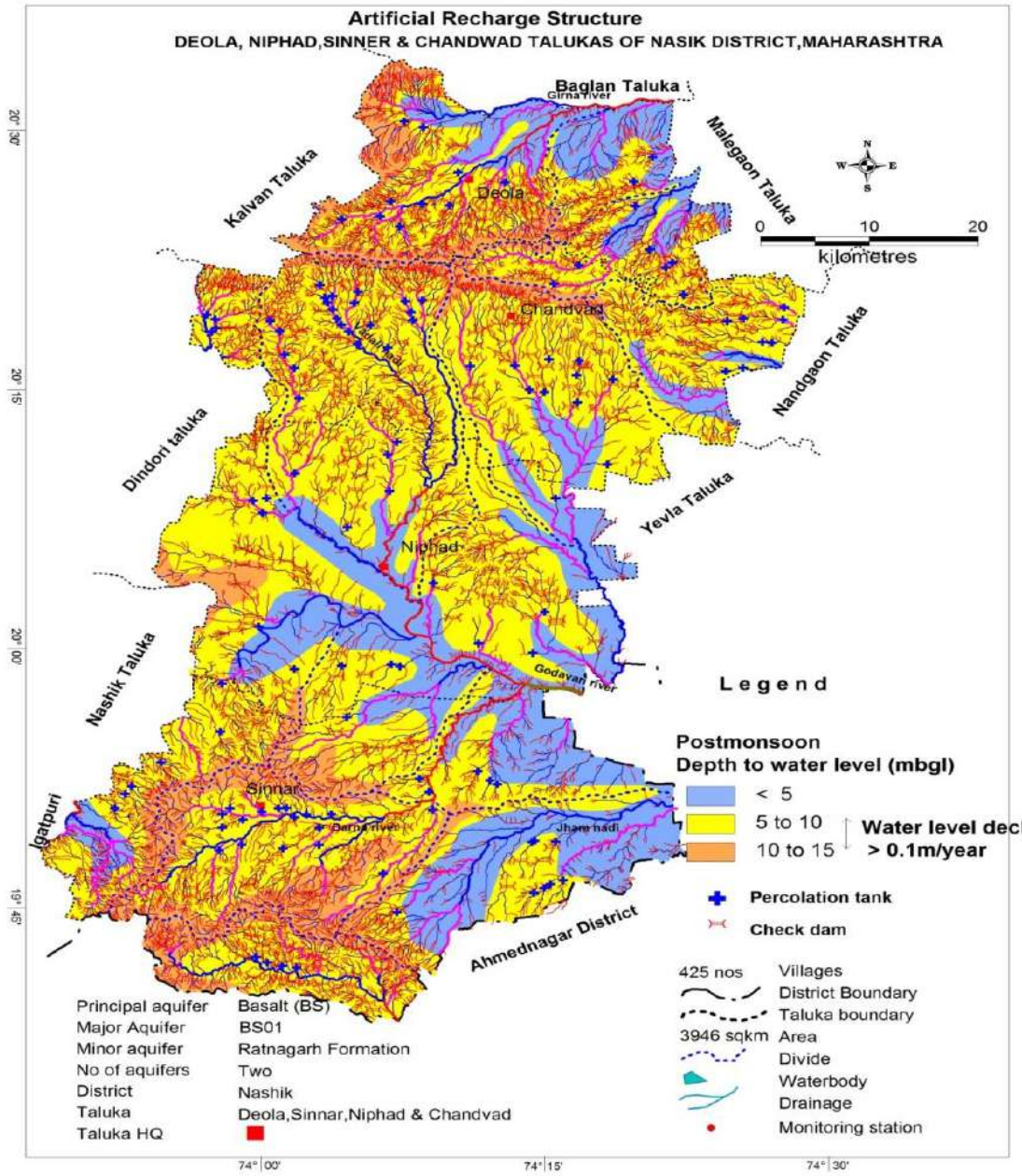


Fig. 6.1: Supply side intervention

7 SUMMARY AND RECOMMENDATIONS

7.1 Summary

Based on the aquifer mapping carried out in Deola, Chanvad, Sinnar and Niphad talukas, the following conclusions were drawn.

1. Data gap analysis was carried out in an area of 3946 Sq. Km in Deola, Chandad, Sinnar and Niphad talukas Nashik district which is part of Godavari River Basin.
2. Flows of the Deccan traps belonging to Cretaceous to Eocene age serve as potential aquifers in the area.
3. Ground water occurs in unconfined condition in weathered portions in the depth range between 5 to 30 m bgl. The thickness of aquifer-I in ranges from 6 to 18 m where the fractured rock encountered upto 32 m.
4. Ground water occurs under semi-confined to confined condition in fractured formation within the depth range between 30 to 200 mbgl. The thickness of aquifer-II in ranges from 1.5 to 9 m where the fractured rock encountered upto 160 m.
5. The overall quality of ground water is found suitable for drinking, domestic and irrigation purposes, except at few places. Rest of the parameters is within permissible limit.

7.2 Recommendation

The highly diversified occurrence and considerable variations in the availability and utilization of groundwater makes its management a challenging task. Scientific development and management strategy for groundwater has become imperative to avert the looming water crisis. In this context, various issues such as, prioritization of areas for development of groundwater resources vis-a-vis its availability, augmentation of groundwater through rainwater harvesting and artificial recharge, pricing and sectoral allocation of resources and participation of the stakeholders must be considered. In view of the above, the present study area a systematic, economically sound and politically feasible framework for groundwater management is required. Considering the local physiographical and hydrogeological set up and source water availability to augment the ground water the following artificial recharge methods are suggested

1. Percolation tank and check dams are feasible where source water is available in cultivable land of command area. The Percolation tank and the check dams should be constructed on 2nd and 3rd order drainages.
2. Percolation tank and check dams are feasible where source water is available in cultivable land of non-command area. Apart from this underground bandhara, KT weir and farm ponds and minor conservation structures are also to be constructed through participatory approach.
3. There is no gap between demand and supply in Deola, Chandvad, Sinnar and Niphad talukas.
4. A surface runoff of 20.72 MCM, 21.95MCM, 22.49MCM and41.49MCM and 11.68 MCM is available in Deola, Chandvad, Niphad and Sinnar talukas respectively.
5. As a part of supply side interventions, feasible artificial recharge and water conservation measures depending on the source water availability in the taluka are recommended as detailed below

a. A total of 73 percolation tanks, 207 check dam, are proposed in Deola taluka, which will augment ground water resources to the tune of 15.61 MCM. The estimated expenditure is 171.60 crores. However, the type, size and number of structures may be changed depending on the site specific conditions and site availability so as to utilize the entire surface water available.
b. A total of 77 percolation tanks, 220 check dam, are proposed in Chandvad taluka, which will augment ground water resources to the tune of 16.50 MCM. The estimated expenditure is 181.50 crores. However, the type, size and number of structures may be changed depending on the site specific conditions and site availability so as to utilize the entire surface water available.
c. A total of 79 percolation tanks, 225 check dam, are proposed in Niphad taluka, which will augment ground water resources to the tune of 22.49 MCM. The estimated expenditure is 186.00 crores. However, the type, size and number of structures may be changed depending on the site specific conditions and site availability so as to utilize the entire surface water available
d. A total of 145 percolation tanks, 415 check dam, are proposed in SINNAR taluka, which will augment ground water resources to the tune of 41.49 MCM. The estimated expenditure is 342.00 crores. However, the type, size and number of structures may be changed depending on the site specific conditions and site availability so as to utilize the entire surface water available

6. The demand side interventions are suggested by adopting micro irrigation schemes in Deola, Chandvad, Sinnar and Niphad talukas. The implementation of micro irrigation schemes will save 11.96MCM, 15.6MCM, 36.58 MCMand 51.90 MCM of ground water.The cost of micro irrigation scheme is about 0.28cr, 0.36cr, 0.54cr and 0.64cr.
7. In Deola taluka, additional ground water resources available after implementing above measures is 27.57 MCM which would bring the stage of ground water development from 98.80 % to 66.55 % i.e. about 32.25 % reduction in the stage of ground water development with estimated expenditure of Rs. 171.69 crore.
8. In Chandvad taluka, additional ground water resources available after implementing above measures is 32.10 MCM which would bring the stage of ground water development from 98.80 % to 66.56 % i.e. about 22.24 % reduction in the stage of ground water development with estimated expenditure of Rs. 181.50 crore.
9. In Niphad taluka, additional ground water resources available after implementing above measures is 68.81 MCM which would bring the stage of ground water development from 99.98 % to 69.51 % i.e. about 20.47 % reduction in the stage of ground water development with estimated expenditure of Rs. 186 crore.
10. In Sinnar taluka, additional ground water resources available after implementing above measures is 67.72 MCM which would bring the stage of ground water development from 98.75 % to 69.32 % i.e. about 29.43 % reduction in the stage of ground water development with estimated expenditure of Rs. 342 crore.

Annexure-I

Departure of annual rainfall from normal

Year	Niphad		Sinnar		Chandvad		Deola	
	ANNUAL	DEP%	ANNUAL	DEP%	ANNUAL	DEP%	ANNUAL	DEP%
1901	355.4	-34	604.4	4				
1902	439.2	-19	491.1	-16				
1903	484.7	-10	477.4	-18				
1904	301.9	-44	303.8	-48				
1905	290	-46	288.4	-51				
1906	357.8	-34	312.2	-47				
1907	422	-22	461.2	-21				
1908	249.7	-54	268.2	-54				
1909	505	-6	392.5	-33				
1910	832.9	54	764.1	31				
1911	275.3	-49	365	-37				
1912	483.4	-10	482.8	-17				
1913	408.2	-24	528.3	-9				
1914	765.7	42	524.9	-10				
1915	720.9	34	633.8	9				
1916	788.1	46	580.7	0				
1917	447.3	-17	349.8	-40				
1918	286.4	-47	241.1	-59				
1919	901.4	67	794.8	36				
1920	277.6	-49	272.1	-53				
1921	383.8	-29	331.2	-43				
1922	355	-34	343.4	-41				
1923	455.1	-16	430.4	-26				
1924	707.7	31	628.5	8				
1925	387.6	-28	558.4	-4				
1926	450	-17	616.5	6				
1927	697.3	29	802.1	37				
1928	650.8	21	565.6	-3				
1929	609.1	13	434.6	-26				
1930	750.8	39	736.2	26				
1931	798.8	48	820.4	41				
1932	812.2	50	874.4	50				
1933	941.2	74	1025.2	76				
1934	536	-1	448.3	-23				
1935	693.2	28	530.8	-9				
1936	529.1	-2	611.9	5				
1937	519.7	-4	842.2	44				
1938	884	64	1026.2	76				
1939	457	-15	488.7	-16				

Year	Niphad		Sinnar		Chandvad		Deola	
	ANNUAL	DEP%	ANNUAL	DEP%	ANNUAL	DEP%	ANNUAL	DEP%
1940	466.9	-14	601.3	3				
1941	571.2	6	541	-7				
1942	412.5	-24	333.5	-43				
1943	592.3	10	520	-11				
1944	749.4	39	783.4	34				
1945	391.6	-27	396	-32				
1946	652.1	21	814.3	40				
1947	492.1	-9	597.9	2				
1948	654.4	21	691.5	18				
1949	639.3	18	648.4	11				
1950	595.7	10	431.9	-26				
1951	545.2	1	623.4	7				
1952	250.5	-54	401.3	-31				
1953	432	-20	446.6	-23				
1954	530.9	-2	545.7	-6				
1955	444	-18	577.1	-1				
1956	1022.5	89	895.7	53				
1957	389.3	-28	412.2	-29				
1958	760.9	41	510.4	-13				
1959	579.5	7	579.9	-1				
1960	516.9	-4	628.1	8				
1961	422.7	-22	879.2	51				
1962	423.9	-22	636.1	9				
1963	483.9	-10	572.4	-2				
1964	415.7	-23	663.3	14				
1965	NA	NA	455.7	-22				
1966	296	-45	554.9	-5				
1967	535.6	-1	781.6	34				
1968	514	-5	746.3	28				
1969	641.6	19	954.9	64				
1970	561.2	4	649.4	11				
1971	412	-24	498.3	-15				
1972	256.4	-53	259.5	-56				
1973	359.2	-33	823.1	41				
1974	306.7	-43	928.4	59				
1975	469	-13	545.2	-7				
1976	734.3	36	856.8	47				
1977	450	-17	692.1	19				
1978	544	1	544	-7				
1979	621.1	15	758	30				
1980	478.8	-11	479	-18				
1981	437.9	-19	762.6	31				
1982	593.4	10	474	-19				

Year	Niphad		Sinnar		Chandvad		Deola	
	ANNUAL	DEP%	ANNUAL	DEP%	ANNUAL	DEP%	ANNUAL	DEP%
1983	582.6	8	598	2				
1984	359	-34	359	-38				
1985	226	-58	226	-61				
1986	327	-39	643	10				
1987	534	-1	495	-15				
1988	477	-12	723	24				
1989	NA	NA	638.6	9				
1990	494	-9	667.3	14				
1991	458.4	-15	681.9	17				
1992	545.5	1	334.2	-43				
1993	630	17	701.8	20				
1994	559	4	881.5	51				
1995	448	-17	377.9	-35				
1996	567	5	640.2	10				
1997	494	-9	510.3	-13				
1998	704	30	821.5	41	658	1	751	54
1999	785	45	709.2	22	690.1	6	541	11
2000	650	20	508	-13	463	-29	409	-16
2001	460	-15	390	-33	559	-14	447.5	-8
2002	414	-23	408	-30	715.7	10	377	-23
2003	512	-5	660.4	13	438	-33	391	-20
2004	941	74	649.8	11	828	27	464.8	-5
2005	884.5	64	676.3	16	639.8	-2	491	1
2006	879.2	63	951	63	1160.5	78	864.3	77
2007	780.7	45	688.8	18	791.4	22	675	38
2008	733.4	36	684.6	17	709	9	455	-7
2009	568	5	772.5	32	818	26	597	22
2010	725	34	804	38	879	35	443.4	-9
2011	383.5	-29	429	-26	552	-15	286	-41
2012	507	-6	447	-23	649	0	384	-21
2013	558.6	3	479.7	-18	440.3	-32	530.7	9
2014	486.4	-10	398.8	-32	368.7	-43	390.2	-20
2015	484.2	-10	414.2	-29	345.6	-47	284.8	-42

Annexure-II

Details of Ground Water Exploration

Village / Type of Well	Longitude Degree in decimals	Latitude Degree in decimals	Elev-ation	Topo sheet	Depth drilled (mbgl)	Depth of casing (mbgl)	Aquifer zones encountered (mbgl)	Aquifer	SWL (mbgl)	Discha-rge (lps)	DD (m)	Trans-Missivity (m2/day)	Stora-tivity	EC µS/cm	F mg/l	NO_3 mg/l	Date of completion	Rig Unit No.
Chandwad Taluka																		
Chandwad EW	20.3291	74.24444	700	46L/3	200	18		Massive basalt	>100	-	-	-	-	-	-	-	25.11.2015	DTH/LMP-87-74
Daregaon EW	20.3142	74.38947	436	47 L/7	200	12		Massive basalt	Dry	-	-	-	-	-	-	-	21.07.2015	DTH/LMP-87-74
Kalkhode EW	20.1910	74.28712	600	47 L/8	200	10		Fractured massive basalt	>100	-	-	-	-	-	-	-	05.02.2016	DTH/LMP-87-77
Khadakjam EW	20.2478	74.07986	658	46L/4	200	18	107.20-110.30	Massive basalt	>100	-	-	-	-	-	-	-	25.09.2015	DTH/LMP-87-74
Rahud EW	20.3592	74.30158	704	47 L/7	200	24	61.50-64.50	Vesicular Basalt	35	2.16	11	12		502	0.8	50	30.07.2015	DTH/LMP-87-74
Rahud OW	20.3592	74.30158	704	47 L/7	200	24	18.80-21.80, 55.40-58.40	Vesicular Basalt	38	0.14	-	-	-	654	0.1	52	13.08.2015	DTH/LMP-87-74
Raipur EW	20.2493	74.34933	620	46L/8	200	18		Massive basalt	>100	-	-	-	-	-	-	-	05.11.2015	DTH/LMP-87-74
Shirur EW	20.35689	74.16331	576	47 L/3	200	18	34.00-37.10, 70.60-73.70, 82.80-85.90	Fractured massive basalt	18	2.16	11	5.4		754	0.1	54	31.08.2015	DTH/LMP-87-74
Deola Taluka																		
Bhaur EW	20.5001	74.10803	564	46L/2	200	18	52.30-55.40	Amygdaloidal Basalt	39	0.14	-	-	-	1693	0.3	48	11.01.2016	DTH/LMP-87-74
Deola EW	20.4594	74.17868	566	46L/3	200	9.5	21.80-24.90	Massive basalt	>100	0.78	-	-	-	-	-	-	29.01.2016	DTH/LMP-87-74
Kankapur EW	20.4020	74.10150	655	46L/3	153.5	18	92-95, 113.30-116.40, 153.00-153.50	Amygdaloidal Basalt	58	8.77	-	-	-	-	-	-	12.02.2016	DTH/LMP-87-74
Kankapur OW	20.4020	74.10150	655	46L/3	156	18	88.90-92.00, 113.30-116.40, 153.00-156.00	Amygdaloidal Basalt	50	8.77	-	-	-	-	-	-	27.02.2016	DTH/LMP-87-74
Mahal Patane EW	20.4892	74.30268	515	46L/7	200	17	162.10-165.20	Massive basalt	>100	-	-	-	-	-	-	-	20.12.2015	DTH/LMP-87-74
Pimpalgaon EW	20.4389	74.24178	605	47L/3	153	18	101.10-104.20	Vesicular Basalt	>100	0.07	-	-	-	528	0.2	19	18.10.2015	DTH/LMP-87-74
Niphad Taluka																		

Village / Type of Well	Longitude Degree in decimals	Latitude Degree in decimals	Elev-ation	Topo sheet	Depth drilled (mbgl)	Depth of casing (mbgl)	Aquifer zones encountered (mbgl)	Aquifer	SWL (mbgl)	Discha-rge (lps)	DD (m)	Trans-Missivity (m2/day)	Stora-tivity	EC µS/cm	F mg/l	NO_3 mg/l	Date of completion	Rig Unit No.
Chapadgaon EW	20.0802	74.10640	556	46 L/4	190	24	15.70-18.80	Massive basalt	Dry	-	-	-	-	-	-	-	26.05.2015	DTH/LMP-87-74
Jivhale EW	20.0832	73.98115	564	46H/16	200	19			Dry	-	-	-	-	-	-	-	26.04.2016	DTH/LMP-87-74
Niphad EW	20.0828	74.11536	551	46 L/4	200	30	62.50-65.50,	Fractured massive basalt	22	3.17	26	-	-	1794	0.3	47	04.01.2016	DTH/LMP-87-77
Niphad OW	20.0828	74.11536	551	46 L/4	180	32	53.30-56.40, 62.50-65.50,	Fractured massive basalt	29	4.43	-	-	-	-	-	-	16.01.2016	DTH/LMP-87-77
Sawargaon EW	20.1946	74.11786	601	46 L/4	190	15	38.10-41.10, 71.60-74.70,99.10-102.10, 135.70-138.70, 181.40-184.50	Fractured massive basalt	14	7.76	23	-	-	999	0.3	51	20.11.2015	DTH/LMP-87-77
Sawargaon OW	20.1946	74.11786	601	46 L/4	200	15	35.00-38.10, 71.60-74.70,150.90-154.00	Fractured massive basalt	21	4.43	-	-	-	-	-	-	06.12.2015	DTH/LMP-87-77
Sawargaon OW	20.1946	74.11786	601	46 L/4	151	13	59.40-59.40, 148-150	Fractured massive basalt	22	2.16	-	-	-	-	-	-	18.12.2015	DTH/LMP-87-77
Talwade EW	19.9496	74.04453	605	46 I/1	200	21		Fractured massive basalt	>100	Traces	-	-	-	1114	0.4	49	11.10.2015	DTH/LMP-87-77
Wakad EW	19.9993	74.31081	527	47 I/5	200	13	7.60-10.60, 32.00-35.00	Fractured massive basalt	4.3	0.14	-	-	-	653	0.5	32	30.10.2015	DTH/LMP-87-77
Sinner Taluka																		
Chapadgaon EW	19.6987	74.05531	711	47 I/2	200	19		Fractured massive basalt	>100	-	-	-	-	584	0.1	33	06.08.2015	DTH/LMP-87-77
Devapur EW	19.8627	74.15235	576	47 I/1	200	13	47.20-50.30	Fr. massive basalt	>100	0.02	-	-	-	951	0.1	52	18.05.2015	DTH/LMP-87-77
Mirgaon EW	19.8367	74.29567	543	47I/5	200	19	7.60-10.60, 32.00-35.00, 71.60-74.70,	Fr. massive basalt	20	1.37	25	6.6	-	3252	0.12	9	14.04.2015	DTH/LMP-87-77
Nandur Singote EW	19.7274	74.13156	650	47 I/2	200	13	181.40-184.50	Fr. massive basalt	>100	-	-	-	-	-	-	-	05.07.2015	DTH/LMP-87-77
Padali EW	19.6902	73.96128	812	47 E/14	200	13		Fractured massive	>100	-	-	-	-	-	-	-	18.09.2015	DTH/LMP-87-77

Village / Type of Well	Longitude Degree in decimals	Latitude Degree in decimals	Elev-ation	Topo sheet	Depth drilled (mbgl)	Depth of casing (mbgl)	Aquifer zones encountered (mbgl)	Aquifer	SWL (mbgl)	Discha-rge (lps)	DD (m)	Trans-Missivity (m2/day)	Stora-tivity	EC µS/cm	F mg/l	NO_3 mg/l	Date of completion	Rig Unit No.
								basalt										
Pangli Bk. EW	19.8162	74.19945	578	46I/1	200	6.5	74.70-77.70	Fr. massive basalt	>100	-	-	-	-	-	-	-	2.5.15	DTH/LMP-87-77
Shivade EW	19.8006	73.87789	632	47E/13	200	12		Fractured massive basalt	>100	Traces	-	-	-	866	0.1	47	23.08.2015	DTH/LMP-87-77

Annexure III

Micro level data

S. No.	Village	Taluka	Longitude	Latitude	Yield	Well Type	Depth of Occurrence	Thickness	Pre_dtw	Altitude (M)	Rl_of_Pre-monsoon_Water_Level
1	Deshwandi	Sinnar	74.0026	19.9207	318	DW	12	8	10	631.3	621.3
2	Kasabe Sukene	Niphad	74.0251	20.0899	20	DW	11	8	10	552.1	542.1
3	Shirur	Chandvad	74.1547	20.3604	9	DW	11	8	10	748.3	738.3
4	Pimpalgaon Baswant	Niphad	73.9929	20.1697	4	DW	12	8	10	582.3	572.3
5	Komalwadi	Sinnar	74.1343	19.9411	47	DW	13	8	10	552.2	542.2
6	Sarole Kh.	Niphad	74.1387	20.1712	75	DW	13	8	10	599.4	589.4
7	Pimpalgaon Baswant	Niphad	73.96	20.1479	27	DW	14	10	10	570.4	560.4
8	Kundalgaon	Chandvad	74.456	20.3183	28	DW	18	14	10	566.4	556.4
9	Shingave	Niphad	74.0375	20.0345	35	DW	11	8	11	534.6	523.6
10	Ugaon	Niphad	74.1399	20.1314	75	DW	12	8	11	573.6	562.6
11	Bhokani	Sinnar	74.1302	19.809	41	DW	13	8	11	616.4	605.4
12	Khuntewadi	Deola	74.2134	20.4519	19	DW	13	8	11	556.4	545.4
13	Vaki Bk	Chandvad	74.2745	20.1698	18	DW	19	14	11	587.1	576.1
14	Suregaon	Sinnar	74.1405	19.7715	25	DW	13	8	12	619.4	607.4
15	Wadgaon Sinnar	Sinnar	73.9542	19.8102	11	DW	14	10	12	705.7	693.7
16	Giranare	Deola	74.3815	20.3531	3	DW	14	10	12	616.4	604.4
17	Khede	Niphad	74.101	20.1363	20	DW	13	8	13	571.4	558.4
18	Ghorwad	Sinnar	73.882	19.816	31	DW	14	10	13	617.8	604.8
19	Hiwargaon	Sinnar	74.103	19.9458	21	DW	15	12	13	566.4	553.4
20	Nimon	Chandvad	74.4146	20.32	102	DW	18	14	13	608	595
21	Songaon	Niphad	74.0105	20.0066	20	DW	14	10	14	540.2	526.2
22	Deola	Deola	74.148	20.4615	4	DW	14	10	14	587.8	573.8
23	Nandur	Niphad	74.169	20.0235	75	DW	15	12	14	539.4	525.4

S. No.	Village	Taluka	Longitude	Latitude	Yield	Well Type	Depth of Occurrence	Thickness	Pre_dtw	Altitude (M)	Rl_of_Pre-monsoon_Water_Level
	Madhyameshwar										
24	Khadak Malegaon	Niphad	74.1758	20.1725	75	DW	15	12	14	611	597
25	Vinchur Dalvi	Sinnar	73.8574	19.854	105	DW	19	14	14	571.3	557.3
26	Kokankhede	Chandvad	74.3517	20.3051	6	DW	16	13	15	685.1	670.1
27	Chandvad	Chandvad	74.2581	20.3157	4	DW	16	13	15	718.7	703.7
28	Karsul	Niphad	74.0281	20.1312	35	DW	18	14	16	557.2	541.2
29	Wajgaon	Deola	74.1372	20.4335	16	DW	19	14	17	613.4	596.4
30	Mohu	Sinnar	73.9097	19.893	4	DW	21	15	19	589.6	570.6
31	Lohoner	Deola	74.2014	20.5128	35	DW	25	16	24	521	497
32	Kundane	Chandvad	74.0326	20.3625	12	DW	10	7	10	774.7	764.7
33	Songiri	Sinnar	73.9436	19.9296	66	DW	12	8	10	573.7	563.7
34	Palkhed	Niphad	74.0532	20.1789	75	DW	15	12	10	588.6	578.6
35	Soni Sangvi	Chandvad	74.2719	20.2256	44	DW	14	10	11	617.4	606.4
36	Eklahare	Sinnar	74.1492	19.8925	4	DW	12	8	12	564	552
37	Manmad	Chandvad	74.4044	20.2643	4	DW	14	10	12	607.2	595.2
38	Bopane	Chandvad	74.2406	20.2449	20	DW	13	8	13	632.6	619.6
39	Uswad	Chandvad	74.318	20.3469	6	DW	14	10	14	709.6	695.6
40	Urdhul	Chandvad	74.2038	20.2407	35	DW	10	7	10	639	629
41	Manori	Sinnar	74.1566	19.7387	19	DW	11	8	10	621	611
42	Bhatgaon	Chandvad	74.1653	20.2694	18	DW	11	8	10	653.7	643.7
43	Kharde (wakhari)	Deola	74.1191	20.4393	2	DW	11	8	10	630.3	620.3
44	Panchkeshwar	Niphad	74.057	20.1483	75	DW	12	8	10	568.4	558.4
45	Vithewadi (lohoner)	Deola	74.1587	20.5069	35	DW	12	8	10	532.4	522.4
46	Khadakjamb	Chandvad	74.07	20.2472	35	DW	13	8	10	644.3	634.3
47	Khadangali	Sinnar	74.1678	19.9177	138	DW	15	12	10	547.4	537.4
48	Nagapur(n.v.)	Niphad	73.9539	20.0104	10	DW	29	20	27	558	531

S. No.	Village	Taluka	Longitude	Latitude	Yield	Well Type	Depth of Occurrence	Thickness	Pre_dtw	Altitude (M)	Rl_of_Pre-monsoon_Water_Level
49	Pangari Kh	Sinnar	74.2036	19.8137	45	DW	10	7	6	576.7	570.7
50	Chinchave (nimbait)	Deola	74.3203	20.3844	4	DW	10	7	6	576.2	570.2
51	Adgaon	Chandvad	74.1682	20.3229	15	DW	8	7	6	704.1	698.1
52	Kapashi	Deola	74.1783	20.3926	19	DW	8	7	7	667.5	660.5
53	Indraiwadi	Chandvad	74.2021	20.3745	3	DW	9	7	7	856.5	849.5
54	Ganur	Chandvad	74.1938	20.2999	17	DW	12	8	8	678.1	670.1
55	Vijay Nagar N.v.	Niphad	73.9462	20.0693	16	DW	15	12	8	582	574
56	Mahajanpur	Niphad	74.0478	19.9514	23	DW	10	7	9	589.9	580.9
57	Bokaddare	Niphad	74.2007	20.0726	150	DW	11	8	9	576.8	567.8
58	Sangavi	Sinnar	74.2316	19.9557	145	DW	18	14	10	520.1	510.1
59	Khuntewadi	Deola	74.229	20.4848	28	DW	22	15	10	525.4	515.4
60	Vinchur	Niphad	74.2128	20.1255	20	DW	11	8	11	587.4	576.4
61	Kothare	Niphad	74.0768	20.0468	35	DW	12	8	11	539.9	528.9
62	Adgaon	Chandvad	74.1591	20.3471	8	DW	12	8	11	738.3	727.3
63	Dongargaon	Deola	74.3217	20.491	7	DW	12	8	11	509.6	498.6
64	Tisgaon	Deola	74.3889	20.4254	20	DW	13	8	11	516.4	505.4
65	Kanlad	Niphad	74.274	19.9661	210	DW	14	10	11	514.9	503.9
66	Goharan	Chandvad	74.0071	20.3165	44	DW	16	13	11	689	678
67	Ghotewadi	Sinnar	74.2333	19.7607	8	DW	12	8	12	588.2	576.2
68	Kanmandale	Chandvad	74.0704	20.3373	10	DW	12	8	12	730.4	718.4
69	Mirgaon	Sinnar	74.2985	19.8122	4	DW	13	8	12	545.7	533.7
70	Narayangaon	Niphad	73.9705	20.0413	15	DW	13	8	12	550.2	538.2
71	Satwaichiwadi	Deola	74.1773	20.4721	18	DW	13	8	12	561.8	549.8
72	Tamaswadi	Niphad	74.1701	19.9834	50	DW	14	10	12	524.9	512.9
73	Sangavi	Deola	74.3447	20.3947	5	DW	14	10	12	555.8	543.8
74	Pathare Kh.	Sinnar	74.3568	19.82	30	DW	16	13	12	534.8	522.8

S. No.	Village	Taluka	Longitude	Latitude	Yield	Well Type	Depth of Occurrence	Thickness	Pre_dtw	Altitude (M)	Rl_of_Pre-monsoon_Water_Level
75	Khambale	Sinnar	74.1016	19.7859	13	DW	13	8	13	643.2	630.2
76	Vinchur	Niphad	74.1948	20.098	20	DW	13	8	13	596.7	583.7
77	Nimgavhan	Chandvad	74.246	20.2881	11	DW	13	8	13	669.7	656.7
78	Vinchur	Niphad	74.232	20.1191	35	DW	14	10	13	577.6	564.6
79	Kharde (wakhari)	Deola	74.0856	20.4211	16	DW	14	10	13	680.9	667.9
80	Jaitapur	Chandvad	73.9885	20.3481	59	DW	15	12	13	725.8	712.8
81	Umarane	Deola	74.3211	20.4309	48	DW	16	13	13	550.5	537.5
82	Datli	Sinnar	74.0886	19.8326	130	DW	20	15	13	612.4	599.4
83	Bhoyegaon	Chandvad	74.1664	20.2432	150	DW	14	10	14	640.6	626.6
84	Puri	Chandvad	74.0971	20.3489	54	DW	14	10	14	747.7	733.7
85	Karanjgaon	Niphad	74.0731	20.0184	35	DW	15	12	14	538.5	524.5
86	Karsul	Niphad	74.0267	20.1421	20	DW	15	12	14	562.6	548.6
87	Kahandalwadi	Sinnar	74.2584	19.7785	25	DW	16	13	14	564.8	550.8
88	Dongargaon	Deola	74.3433	20.4738	13	DW	16	13	14	522.2	508.2
89	Vitave	Chandvad	74.3019	20.238	22	DW	19	14	14	629.5	615.5
90	Thetale	Niphad	74.1754	20.1388	20	DW	15	12	15	592.6	577.6
91	Sogras	Chandvad	74.1412	20.3056	15	DW	16	13	15	682.4	667.4
92	Vadbare	Chandvad	74.2562	20.371	14	DW	17	14	15	780.5	765.5
93	Kundewadi	Sinnar	74.0282	19.8363	34	DW	20	15	15	646.5	631.5
94	Sawargaon	Niphad	74.0862	20.202	20	DW	17	14	16	621.8	605.8
95	Vadner Bhairao	Chandvad	74.01	20.2293	75	DW	19	14	16	614.2	598.2
96	Kumbharde	Deola	74.3537	20.3669	5	DW	18	14	17	591.1	574.1
97	Malwadi	Deola	74.1912	20.4916	18	DW	29	20	17	539.6	522.6
98	Wadali Wakhari	Deola	74.1299	20.3942	4	DW	18	14	18	682	664
99	Vadalibhoi	Chandvad	74.113	20.2626	22	DW	20	15	18	658.3	640.3
100	Vadalibhoi	Chandvad	74.081	20.2743	10	DW	20	15	19	687.1	668.1

S. No.	Village	Taluka	Longitude	Latitude	Yield	Well Type	Depth of Occurrence	Thickness	Pre_dtw	Altitude (M)	Rl_of_Pre-monsoon_Water_Level
101	Shivade	Sinnar	73.8619	19.7975	103	DW	6	5	2	615.4	613.4
102	Nimgaon Deopur	Sinnar	74.0846	19.9109	137	DW	9	7	2	595	593
103	Chas	Sinnar	74.0905	19.6762	50	DW	23	15	20	655.5	635.5
104	Ashapur	Sinnar	73.9312	19.7001	9	DW	25	17	23	858.3	835.3
105	Kharde (wakhari)	Deola	74.1074	20.4253	26	DW	26	18	24	642.8	618.8
106	Dodi Bk.	Sinnar	74.113	19.7543	96	DW	10	7	3	649.2	646.2
107	Sinnar (rural)	Sinnar	74.0225	19.8657	125	DW	11	8	4	683.8	679.8
108	Panchkeshwar	Niphad	74.0737	20.1588	75	DW	8	7	4	578.9	574.9
109	Jopul	Chandvad	74.1338	20.2516	50	DW	11	8	5	633.5	628.5
110	Wavi	Niphad	74.0584	20.2117	150	DW	13	8	5	613	608
111	Bharatpur	Sinnar	74.3255	19.8777	123	DW	9	7	5	527.6	522.6
112	Patpimpri	Sinnar	74.055	19.9182	84	DW	10	7	6	613.2	607.2
113	Sakore	Niphad	73.9455	20.1454	29	DW	10	7	6	574.9	568.9
114	Gulvanch	Sinnar	74.0748	19.8702	170	DW	12	8	6	617.7	611.7
115	Vadner Bhairao	Chandvad	74.0084	20.2839	41	DW	12	8	6	669.1	663.1
116	Behed	Niphad	73.9888	20.1355	29	DW	14	10	6	572.7	566.7
117	Dharangaon Veer	Niphad	74.1996	20.036	35	DW	8	7	6	545.6	539.6
118	Pimpalgaon	Deola	74.2385	20.4509	8	DW	8	7	6	563.5	557.5
119	Ahergaon	Niphad	73.9882	20.188	4	DW	10	7	7	594.1	587.1
120	Kanmandale	Chandvad	74.0803	20.3555	4	DW	10	7	7	756	749
121	Deopur	Sinnar	74.1657	19.8694	100	DW	15	12	7	574.4	567.4
122	Saradwadi	Sinnar	73.9403	19.8467	6	DW	8	7	7	698.6	691.6
123	Devergaon	Chandvad	74.1412	20.2116	20	DW	8	7	7	616.1	609.1
124	Dahiwad	Deola	74.2703	20.4263	6	DW	8	7	7	612.5	605.5
125	Kokankhede	Chandvad	74.35	20.3226	17	DW	9	7	7	707	700
126	Bhojapur	Sinner	74.0346	19.6733	35	DW	10	7	8	716.2	708.2

S. No.	Village	Taluka	Longitude	Latitude	Yield	Well Type	Depth of Occurrence	Thickness	Pre_dtw	Altitude (M)	Rl_of_Pre-monsoon_Water_Level
127	Talegaon Rohi	Chandvad	74.3394	20.1739	5	DW	11	8	8	611.2	603.2
128	Mirgaon	Sinnar	74.2986	19.8402	78	DW	12	8	8	539.5	531.5
129	Gonde	Sinnar	74.0547	19.7913	125	DW	13	8	8	657.2	649.2
130	Hiwargaon	Sinnar	74.088	19.9636	32	DW	14	10	8	571.4	563.4
131	Dahegaon	Niphad	74.2711	20.0765	36	DW	15	12	8	561.1	553.1
132	Bahaduri	Chandvad	73.9786	20.2844	14	DW	18	14	8	664.2	656.2
133	Hivarkhede	Chandvad	74.2472	20.2685	5	DW	8	7	8	647.5	639.5
134	Nagapur(n.v.)	Niphad	73.9818	20.0106	9	DW	9	7	8	547.7	539.7
135	Waregaon	Sinnar	74.3375	19.8212	9	DW	10	7	9	533	524
136	Lonwadi	Niphad	74.0285	20.1626	20	DW	10	7	9	575.3	566.3
137	Chincholi	Sinnar	73.8929	19.882	40	DW	11	8	9	596.7	587.7
138	Jivhale	Niphad	73.9662	20.092	11	DW	11	8	9	571.2	562.2
139	Meshi	Deola	74.2637	20.4796	4	DW	11	8	9	524.3	515.3
140	Sonewadi Bk.	Niphad	74.1662	20.1037	35	DW	12	8	9	572.7	563.7
141	Welapur	Niphad	74.2713	20.1409	44	DW	14	10	9	577.4	568.4
142	Rampur	Sinnar	74.2639	19.8796	59	DW	15	12	9	539.1	530.1
143	Mesankhede Kh	Chandvad	74.3913	20.2872	4	DW	10	7	10	622.3	612.3
144	Dodi Kh.	Sinnar	74.0566	19.7388	4	DW	12	8	12	711	699
145	Nandurtek	Chandvad	74.2668	20.3783	4	DW	14	10	14	774.1	760.1
146	Dusangwadi	Sinnar	74.2703	19.7959	4	DW	18	14	18	556	538
147	Dongaon	Chandvad	74.413	20.3008	4	DW	11	8	11	600.6	589.6
148	Bhadane	Chandvad	74.3732	20.2443	4	DW	20	15	20	617.1	597.1

Annexure IV

Water level data of Aquifer-1

No	Location	Block	Longitude	Latitude	Redu-ced level	Depth (mbgl)	MP (magl)	Diam-eter (m)	Shape	Lineing material	Lining (m)	Horizo-ntal bore	Aquifer	May 16 WL (mbgl)
1	Ghorwad	Sinner	73.88	19.8163889	570	13.00	0.50	5.45	Round	Concrete	9.30	Nil	WB	12
2	Vadgaon Pingla	Sinner	73.8811111	19.8730556	548	16.50	0.80	5.90	Round	Stone	10.30	Nil	FMB	15.6
3	Dhondbar	Sinner	73.88	19.7533333		13.80	0.50	8.30	Round	Stone	4.50	Nil	FMB	12.4
4	Konambe	Sinner	73.9069444	19.775	765	14.50	0.60	6.70	Round	Stone	6.70	Nil	FMB	13.2
5	Padli	Sinner	73.9616667	19.6861111	816	19.70	0.70	5.30	Round	Ring well (Concrete)	8.00	Nil	FMB	18.12
6	Chass	Sinner	74.09	19.6797222	675	55.00	0.90	3.60	Round	Stone	22.00	Nil	FMB	41.4
7	Jaygaon	Sinner	73.9755556	19.9330556	586	9.70	0.90	5.15	Round	Stone	3.30	Nil	FMB	8.9
8	Ghoatwadi	Sinner	74.2247222	19.775	593	16.10	0.60	4.65	Round	Concrete	2.60	Nil	FMB	14.4
9	Dodi (BK)	Sinner	74.1141667	19.7458333	660	9.40	0.50	10.00	Round	Stone	3.50	Nil	FMB	8.6
10	Chapadgaon	Sinner	74.0422222	19.7211111	736	22.00	0.70	6.50	Round	Concrete	18.00	Nil	FMB	20.3
11	KhambhalE	Sinner	74.1227778	19.8030556	623	16.50	0.00	3.00	Round	Nil	0.00	Nil	FMB	15.6
12	Manegaon	Sinner	74.0086111	19.8016667	676	10.10	0.40	3.10	Round	Stone	4.10	Nil	FMB	9.5
13	Gunvanch	Sinner	74.0927778	19.8886111		10.20	1.20	3.30	Round	Stone	9.40	Nil	FMB	9.6
14	Panchale	Sinner	74.2069444	19.8819444	544	11.60	0.00	6 x 6	Rectangular	Stone	5.30	Nil	FMB	6.9
15	Karwadi	Sinner	74.2947222	19.8833333	521	10.20	0.60	6.10	Round	Stone	4.00	Nil	FMB	9.6
16	Medhi	Sinner	74.1930556	19.9491667	538	18.20	0.55	3.50	Round	Concrete	6.60	Nil	FMB	15.45
17	Hivergaon	Sinner	74.1575	19.9372222	562	8.00	0.00	3.30	Round	Stone	2.50	Nil	FMB	7
18	Nandur Madhyamesh war	Niphad	74.2183333	19.9847222	541	16.30	0.00	3.30	Round	Stone	9.00	Nil	FMB	11.25
19	Khedlejhunge	Niphad	74.0991667	20.0111111	535	10.40	1.40	10.00	Round	Stone	3.00	Nil	FMB	7.2
20	Naitale	Niphad	74.1619444	20.0872222	562	21.20	0.80	6 x 10	Rectangular	Nil	0.00	Nil	FMB	10.2
21	Ojhar	Niphad	73.9266667	20.0944444	549	10.30	0.50	3.60	Round	Stone	4.60	Nil	FMB	8.1
22	Mouje Sukene	Niphad	74.0044444	20.0761111	558	23.20	0.50	5.50	Round	Stone	12.60	Nil	FMB	20.8
23	Karajgaon	Niphad	74.0727778	20.0277778	534	10.00	0.20	3.50	Round	Concrete	9.00	Nil	FMB	5.2
24	Bhendi	Niphad	74.0583333	19.9733333	568	14.20	0.85	3.50	Round	Stone	7.70	Nil	FMB	8.55
25	Nandurdi	Niphad	74.0986111	20.135	582	18.00	0.65	5.75	Round	Concrete	3.50	Nil	FMB	16.65

No	Location	Block	Longitude	Latitude	Redu-ced level	Depth (mbgl)	MP (magl)	Diam-eter (m)	Shape	Lineing material	Lining (m)	Horizo-ntal bore	Aquifer	May 16 WL (mbgl)
26	Vadali Nijak	Niphad	74.0241667	20.1283333	578	14.60	1.20	4.10	Round	Stone	5.60	4	FMB	8.55
27	Vavi	Niphad	74.075	20.1916667	609	10.40	0.85	6.10	Round	Stone	2.70	3	FMB	7.85
28	Chehadi Khurd	Niphad	73.9425	19.9980556	554	15.50	0.60	4.50	Round	Brick and Stone	11.00	Nil	FMB	12.00
29	Nagapur	Niphad	73.9869444	20.0030556	534	15.00	1.00	6.30	Round	Stone	2.80	2	FMB	12.00
30	Dhanegaon (Marargoi BK)	Niphad	74.2755556	20.0955556	565	18.50	0.40	5.50	Round	Stone	8.30	2	FMB	17.60
31	Vaki (BK)	Chandwad	74.2702778	20.1666667	625	11.00	0.50	3.30	Round	Concrete	3.60	Nil	FMB	9.80
32	Khadak Malegaon	Niphad	74.1725	20.1725	663	12.50	0.50	3.40	Round	Concrete	3.40	4	FMB	11.60
33	Jopul	Chandwad	74.1655556	20.2416667	642	8.80	0.00	3.60	Round	Concrete	4.60	Nil	FMB	8.50
34	Pathershambe	Chandwad	74.2541667	20.2855556	603	12.40	0.40	4.30	Round	Concrete	4.50	2	FMB	10.00
35	Mesankhede Khurd	Chandwad	74.3858333	20.2827778	659	14.00	1.00	5.50	Round	Stone	3.40	Nil	FMB	12.80
36	Vadbare	Chandwad	74.2475	20.3594444	797	20.00	0.50	4.20	Round	Stone	2.00	Nil	FMB	17.60
37	Uswad	Chandwad	74.3208333	20.3325	708	17.50	0.00	4.70	Round	Concrete	4.50	Nil	FMB	17.00
38	Khumhdade	Deola	74.3513889	20.3708333	608	21.50	0.50	4.50	Round	Concrete	12.50	Nil	FMB	19.00
39	Umrane	Deola	74.3502778	20.4169444	537	16.90	1.00	4.40	Round	Concrete	10.00	Nil	FMB	14.10
40	Dongargaon	Deola	74.3533333	20.4752778	517	16.00	0.70	4.10	Round	Concrete	4.00	3	FMB	14.80
41	Kundalgaon	Chandwad	74.4608333	20.3194444	575	21.00	1.00	5.10	Round	Concrete	3.50	2	FMB	18.60
42	Vadgaon Pangu	Chandwad	74.3811111	20.22	619	22.20	0.70	8.00	Round	Concrete	1.70	2	FMB	19.10
43	Vithewadi	Deola	74.1575	20.5044444	550	14.50	0.85	4.30	Round	Concrete	5.50	Nil	VB	10,5
44	Pilkos	Deola	74.105	20.5288889	556	21.20	1.25	5.20	Round	Concrete	4.50	3	FMB	18.50
45	Borale	Chandwad	73.9441667	20.3025	665	13.50	0.70	6.10	Round	Stone	6.00	Nil	FMB	10.90
46	Dhodambe (Doodh Kendra)	Chandwad	74.0586111	20.3341667	721	19.50	0.90	6.20	Round	Concrete	4.50	Nil	FMB	16.30
47	Kanmandle	Chandwad	74.0822222	20.3533333	754	12.50	0.90	4.50	Round	Stone	4.20	Nil	FMB	9.10
48	Wadala	Deola	74.1138889	20.4025	684	13.50	0.00	3.75	Round	Concrete	5.00	1	FMB	11.75
49	Hanumant pada	Deola	74.0469444	20.395	781	15,2	0.00	3.60	Round	Stone	2.50	Nil	FMB	12.90

AnnexureV

Water level data of Aquifer II

S. No	Village/ Type of well	Long_ Dec	Lat_ Dec	Elevation	Topo sheet	Depth drilled (mbgl)	Depth of casing (mbgl)	Aquifer zones encountered (mbgl)	Aquifer	SWL (mbgl)	Pre SWL (mbgl)	Post SWL	AQ I	AQ II	Massive	Discharge (lps)	DD(m)	Transmissivity (m2/day)	Stora-tivity	EC	F	No_3
1	Bhaur EW	20.50014	74.10803	564	46L/2	200	17.50	52.30-55.40	Amygdaloidal Basalt	38.50	38.5	24.00	18.0	90.0	200.0	0.14	-	-		1693	0.3	48
2	Kankapur EW	20.402	74.1015	655	46L/3	153.5	17.50	92-95, 113.30-116.40, 153.00-153.50	Amygdaloidal Basalt	57.60	57.6	35.00	18.0	153.0	153.5	8.77	-	-		-	-	-
3	Pimpalgaon EW	20.43897	74.2418	605	47L/3	153	17.50	101.10-104.20	Vesicular Basalt	>100	53.0	32.00	20.0	104.0	153.0	0.07				528	0.2	19
4	Mahal Patane EW	20.48925	74.3027	515	46L/7	200	17.30	162.10-165.20	Massive basalt	>100	54.0	25.00	25.0	165.0	200.0	-				-	-	-
5	Deola EW	20.4594	74.179	566	46L/3	200	9.50	21.80-24.90	Massive basalt	>100	52.0	27.00	25.0	70.0	200.0	0.78				-	-	-
6	Mirgaon EW	19.83678	74.2957	543	47I/5	200	18.50	7.60-10.60, 32.00-35.00, 71.60-74.70,	Fractured massive basalt	19.50	19.5	13.00	32.0	75.0	200.0	1.37	24.5	6.62		3252	0.12	9
7	Pangli Bk. EW	19.8162	74.1995	578	46I/1	200	6.50	74.70-77.70	Fractured massive basalt	>100	56.0	35.00	15.0	77.0	200.0	-	-			-	-	-
8	Devapur EW	19.86279	74.15235	576	47 I/1	200	13.00	47.20-50.30	Fractured massive basalt	>100	45.0	28.00	18.0	75.0	200.0	0.024	-			951	0.1	52
9	Nandur Singote EW	19.7274	74.13156	650	47 I/2	200	12.50	181.40-184.50	Fractured massive basalt	>100	61.0	41.00	18.0	185.0	200.0	-	-			-	-	-

S. No	Village/ Type of well	Long_ Dec	Lat_ Dec	Elevation	Topo sheet	Depth drilled (mbgl)	Depth of casing (mbgl)	Aquifer zones encountered (mbgl)	Aquifer	SWL (mbgl)	Pre SWL (mbgl)	Post SWL	AQ I	AQ II	Massive	Discharge (lps)	DD(m)	Transmissivity (m2/day)	Storativity	EC	F	No_3
10	Chapadgaon EW	19.69878	74.0554	711	47 I/2	200	18.50		Fractured massive basalt	>100	57.0	35.00	25.0	70.0	200.0	-	-			584	0.1	33
11	Shivade EW	19.80064	73.8779	632	47E/13	200	12.00		Fractured massive basalt	>100	52.0	32.00	15.0	75.0	200.0	0.02	-			866	0.1	47
12	Padali EW	19.69025	73.96128	812	47 E/14	200	12.50		Fractured massive basalt	>100	54.0	37.00	18.0	67.0	200.0	-	-			-	-	-
13	Talwade EW	19.94964	74.04453	605	46 I/1	200	21.00		Fractured massive basalt	>100	52.0	27.00	22.0	70.0	200.0	0.02	-			1114	0.4	49
14	Wakad EW	19.9994	74.31081	527	47 I/5	200	13.00	7.60-10.60, 32.00-35.00	Fractured massive basalt	4.30	4.3	2.00	35.0	70.0	200.0	0.14	-			653	0.5	32
15	Sawargaon EW	20.19468	74.11786	601	46 L/4	190	15.00	38.10-41.10, 71.60-74.70,99.10-102.10, 135.70-138.70, 181.40-184.50	Fractured massive basalt	13.56	13.6	8.00	25.0	185.0	190.0	7.76	23.24			999	0.3	51
16	Niphad EW	20.0829	74.11536	551	46 L/4	200	30.00	53.30-56.40, 62.50-65.50,	Fractured massive basalt	21.64	21.6	15.00	30.0	90.0	200.0	4.43	25.7			1794	0.3	47
	Chapadgaon EW	20.0802	74.1064	556	46 L/4	190	23.50	15.70-18.80	Massive basalt	Dry	45.0	21.00	25.0	75.0	190.0	-				-	-	-
17	Kalkhode EW	20.19104	74.28718	600	47 L/8	200	10.00		Fractured massive basalt	>100	53.0	21.00	15.0	70.0	200.0	-				-	-	-
18	Daregaon EW	20.3142	74.38948	436	47 L/7	200	11.50		Massive basalt	35.00	35.0	20.00	20.0	65.0	200.0	-				-	-	-
19	Khadakjam EW	20.24786	74.07986	658	46L/4	200	17.50	107.20-110.30	Massive basalt	>100	61.0	37.00	20.0	75.0	200.0	-				-	-	-
20	Raipur	20.24936	74.3493	620	46L/8	200	18.00		Massive basalt	>100	57.0	27.00	20.0	70.0	200.0	-				-	-	-

S. No	Village/ Type of well	Long_ Dec	Lat_ Dec	Elevation	Topo sheet	Depth drilled (mbgl)	Depth of casing (mbgl)	Aquifer zones encountered (mbgl)	Aquifer	SWL (mbgl)	Pre SWL (mbgl)	Post SWL	AQ I	AQ II	Massive	Discharge (lps)	DD(m)	Transmissivity (m2/day)	Stora-tivity	EC	F	No_3
21	Chandwad EW	20.32917	74.2444	700	46L/3	200	17.50		Massive basalt	>100	52.0	23.00	20.0	75.0	200.0	-				-	-	-
22	Shirur EW	20.35689	74.16331	576	47 L/3	200	17.50	34.00-37.10, 70.60-73.70, 82.80-85.90	Fractured massive basalt	17.50	17.5	12.00	23.0	90.0	200.0	2.16	11.2	5.44		754	0.1	54
23	Rahud EW	20.35928	74.3016	704	47 L/7	200	23.50	61.50-64.50	Vesicular Basalt	35.20	35.2	18.00	24.0	65.0	200.0	2.16	11.2	926.77		502	0.8	50

Annexure VI

Pre-monsoon water level trend

S. no.	District	Taluka	Village Name	Siteid	Latiitude	Longitude	Depth Of Well	Wls_Date	Dtw	Trend
1	Nashik	Chandvad	Chandvad	W201912074122501	20.32	74.20694	11.15	19-May-15	11.15	0.114242424
2	Nashik	Chandvad	Chikhalambe	W201918073580501	20.32167	73.96806	13.65	19-May-15	13.3	0.108484848
3	Nashik	Chandvad	Dahegaon Manmad	W201650074263501	20.28056	74.44306	10.11	19-May-15	10.06	0.024787879
4	Nashik	Chandvad	Dugaon	W201735074192501	20.29306	74.32361	13.33	19-May-15	13.15	0.188787879
5	Nashik	Chandvad	Kanmandale	W202120074045001	20.35556	74.08056	10.31	19-May-15	7.8	-0.170727273
6	Nashik	Chandvad	Nimgavhan	W201716074144601	20.28778	74.24611	80	19-May-15	35	0.326969697
7	Nashik	Chandvad	Nimgavhan	W201717074144601	20.28806	74.24611	30	19-May-15	28.2	0.396969697
8	Nashik	Chandvad	Shirur	W202045074093001	20.34583	74.15833	31.15	19-May-15	17.5	0.808484848
9	Nashik	Chandvad	Vadbare	W202145074144801	20.3625	74.24667	14.7	21-May-15	10.4	-0.248484848
10	Nashik	Chandvad	Varadi	W202009074253201	20.33583	74.42556	75	19-Apr-15	9.6	-0.076666667
11	Nashik	Chandvad	Varadi	W202008074253501	20.33556	74.42639	30	19-May-15	13.8	0.194242424
12	Nashik	Deola	Deola	W202732074110001	20.45889	74.18333	13.75	29-May-15	10.85	0.110848485
13	Nashik	Deola	Deopurpada	W203005074191001	20.50139	74.31944	10.61	29-May-15	9.3	0.284527027
14	Nashik	Deola	Gunjalnagar	W202714074105501	20.45389	74.18194	91	20-May-15	22.4	0.432424242
15	Nashik	Deola	Mahalpatane	W202820074203501	20.47222	74.34306	17	29-May-15	7.8	-0.046969697
16	Nashik	Deola	Matane	W202735074090001	20.45972	74.15	13.75	20-May-15	12.4	0.308484848
17	Nashik	Deola	Meshi	W202800074180001	20.46667	74.3	9.95	29-May-15	9.95	0.442121212
18	Nashik	Deola	Pilakos	W203010074082501	20.50278	74.14028	18.5	29-May-15	10.6	-0.442727273
19	Nashik	Deola	Savaki Lohner	W203105074102201	20.51806	74.17278	10.9	23-May-14	10.9	-0.000833333
20	Nashik	Deola	Umarane	W202508074210101	20.41889	74.35028	30	28-May-15	13.9	0.431818182
21	Nashik	Deola	Vasolpada	W202810074120001	20.46944	74.2	8.4	5-Apr-15	7.1	0.055151515
22	Nashik	Niphad	Ahergaon	W201045074013001	20.17917	74.025	10.5	25-May-15	8.8	-0.033636364
23	Nashik	Niphad	Brahmangaon Vinchur	W201025074092501	20.17361	74.15694	12.1	25-May-15	9	0.165945946
24	Nashik	Niphad	Chapadgaon	W200045074053501	20.0125	74.09306	10.11	25-May-15	4.1	-0.048716216
25	Nashik	Niphad	Chaurewasti Ozar	W200500073542701	20.08333	73.9075	90	25-May-15	30	0.024324324
26	Nashik	Niphad	Gajarwadi	W200238074095801	20.04389	74.16611	13.4	25-May-15	5.8	0.020909091
27	Nashik	Niphad	Karanji kh	W195840074120001	19.97778	74.2	14.36	25-May-15	10.7	0.495454545

S. no.	District	Taluka	Village Name	Siteid	Latiitude	Longitude	Depth Of Well	Wls_Date	Dtw	Trend
28	Nashik	Niphad	Karsul	W200819074015501	20.13861	74.03194	12.11	25-May-15	3.2	0.044242424
29	Nashik	Niphad	Kotamgaon	W200845074121601	20.14583	74.20444	10	25-May-15	8	0.45969697
30	Nashik	Niphad	Mhalsakore	W195910074070501	19.98611	74.11806	15	25-May-15	9.4	0.22969697
31	Nashik	Niphad	Mharalgoi Kh	W200630074163801	20.10833	74.27722	8.15	25-May-15	8.15	0.227272727
32	Nashik	Niphad	Mhasrulroad Ozar	W200540073554502	20.09444	73.92917	36	25-May-15	8.4	0.289090909
33	Nashik	Niphad	Ozar	W200540073554508	20.09444	73.92917	11.31	25-May-15	5.9	0.039864865
34	Nashik	Niphad	Ozar	W200540073563101	20.09444	73.94194	40	25-May-15	10.4	0.494827586
35	Nashik	Niphad	Pachorewani	W201222074005001	20.20611	74.01389	11	25-May-15	6.1	-0.02368932
36	Nashik	Niphad	Pimpalgaon Basvant	W201016073594001	20.17111	73.99444	11.86	25-May-15	9.7	0.073636364
37	Nashik	Niphad	Sakore	W200832073562201	20.14222	73.93944	12	25-May-15	6.8	0.23969697
38	Nashik	Niphad	Sarole Thadi	W200055074104001	20.01528	74.17778	11.61	25-May-15	11	0.062969697
39	Nashik	Niphad	Sarole Thadi	W195934074114501	19.99278	74.19583	30	19-May-15	14.4	0.253846154
40	Nashik	Niphad	Sawargaon	W201136074070001	20.19333	74.11667	14.5	25-May-15	7.1	0.283030303
41	Nashik	Niphad	Shirasgaon	W200642073593001	20.11167	73.99167	13	25-May-15	10.1	0.125757576
42	Nashik	Niphad	Sonewadi Bk	W200625074063501	20.10694	74.10972	11.75	25-May-15	5.5	0.017272727
43	Nashik	Niphad	Sonewadi Ozar	W200435073553301	20.07639	73.92583	35	31-May-12	5.1	0.183928571
44	Nashik	Niphad	Songaon	W195915073595201	19.9875	73.99778	17.8	25-May-15	10.7	0.311515152
45	Nashik	Niphad	Thergaon	W200448073591601	20.08	73.98778	30	25-May-15	12.7	0.334848485
46	Nashik	Niphad	Thergaon	W200448073591701	20.08	73.98806	61	25-May-15	13.9	0.613939394
47	Nashik	Niphad	Umberkhed	W200832073573501	20.14222	73.95972	15.7	25-May-15	11.1	0.416666667
48	Nashik	Niphad	Vinchur	W200557074135801	20.09917	74.23278	35	25-May-15	11.5	0.343636364
49	Nashik	Niphad	Wakad	W195958074185201	19.99944	74.31444	7.91	25-May-15	6.8	0.18769697
50	Nashik	Sinnar	Agaskhind	W194831073500501	19.80861	73.83472	74	22-May-15	9.8	0.401554054
51	Nashik	Sinnar	Atkawade	W194734073591501	19.79278	73.9875	91	22-May-15	14	0.484242424
52	Nashik	Sinnar	Atkawade	W194734073591502	19.79278	73.9875	30	22-May-15	15.1	0.632424242
53	Nashik	Sinnar	Baragaon Pimpri	W195418074033001	19.905	74.05833	15.56	23-May-15	15.56	0.684484848
54	Nashik	Sinnar	Chapadgaon	W194041074025001	19.67806	74.04722	11.36	31-May-12	11	0.030357143
55	Nashik	Sinnar	Chapadgaon	W194721074025201	19.78917	74.04778	61	22-May-15	12.8	0.450606061
56	Nashik	Sinnar	Chondhi	W195625074111501	19.94028	74.1875	13.5	23-May-15	10.2	0.256969697
57	Nashik	Sinnar	Dahiwadi	W195510074090001	19.91944	74.15	8	23-May-15	6.3	0.370606061
58	Nashik	Sinnar	Dodi kh	W194415074074001	19.7375	74.12778	7.85	22-May-15	7.85	0.093878788

S. no.	District	Taluka	Village Name	Siteid	Latiitude	Longitude	Depth Of Well	Wls_Date	Dtw	Trend
59	Nashik	Sinnar	Dubere	W194645073583101	19.77917	73.97528	12.15	15-May-12	11.95	0.351785714
60	Nashik	Sinnar	Eklahare	W195350074084801	19.89722	74.14667	12.11	22-May-15	9.8	0.002909091
61	Nashik	Sinnar	Khopadi kh	W195025074062501	19.84028	74.10694	6.81	23-May-15	6.8	0.06369697
62	Nashik	Sinnar	Mendhi	W195607074112501	19.93528	74.19028	91	22-May-15	12	0.72030303
63	Nashik	Sinnar	Mirgaon	W195024074172701	19.84	74.29083	91	22-May-15	11.8	0.762424242
64	Nashik	Sinnar	Mohdari	W195320073592701	19.88889	73.99083	8.31	22-May-15	5.8	0.140606061
65	Nashik	Sinnar	Nirhale	W194620074153501	19.77222	74.25972	13.9	22-May-15	13.9	0.581212121
66	Nashik	Sinnar	Padali	W194102073570402	19.68389	73.95111	18.65	22-May-15	18.65	0.461875
67	Nashik	Sinnar	Panchale	W195230074130001	19.875	74.21667	11.61	22-May-15	6.5	0.505272727
68	Nashik	Sinnar	Pandhurly	W194943073511901	19.82861	73.85528	8.61	27-May-15	8.23	0.011818182
69	Nashik	Sinnar	Pathare Bk	W194950074202501	19.83056	74.34028	7.16	23-May-15	3.3	-0.000909091
70	Nashik	Sinnar	Sayale	W194735074191801	19.79306	74.32167	9.2	22-May-15	7.7	0.385454545
71	Nashik	Sinnar	Shivade	W194758073525401	19.79944	73.88167	18	27-May-15	11.4	-0.116060606
72	Nashik	Sinnar	Sinnar	W195035074061501	19.84306	74.10417	12.9	22-May-15	6.4	-0.744242424
73	Nashik	Sinnar	Sonewadi	W194042074052501	19.67833	74.09028	16.86	22-May-15	13.5	0.251212121
74	Nashik	Sinnar	Ujjani	W195418074155301	19.905	74.26472	8.5	23-May-15	4.6	0.288484848
75	Nashik	Sinnar	Wavi	W194845074145501	19.8125	74.24861	10.86	22-May-15	9.3	0.216060606

Annexure VII

Post-monsoon water level trend

S.No.	District	Taluka	Village_Name	Site_ID	Latiitude	Longitude	WLS_Date	WLS_WTR_ Level	Trend
1	Nashik	Chandvad	Nimgavhan	W201716074144601	20.2878	74.2461	28-Nov-15	25	0.515151515
2	Nashik	Chandvad	Nimgavhan	W201717074144601	20.2881	74.2461	28-Nov-15	23.6	0.605757576
3	Nashik	Chandvad	Shirur	W202045074093001	20.3458	74.1583	28-Nov-15	5.7	0.76969697
4	Nashik	Chandvad	Varadi	W202009074253201	20.3358	74.4256	28-Nov-15	6.5	0.303636364
5	Nashik	Chandvad	Varadi	W202008074253501	20.3356	74.4264	28-Nov-15	13.9	0.496666667
6	Nashik	Deola	Gunjalnagar	W202714074105501	20.4539	74.1819	28-Nov-15	19.5	0.893636364
7	Nashik	Deola	Umarane	W202508074210101	20.4189	74.3503	28-Nov-15	15.7	0.952727273
8	Nashik	Niphad	Chaurewasti Ozar	W200500073542701	20.0833	73.9075	27-Oct-15	17.1	0.843355856
9	Nashik	Niphad	Mhasrulroad Ozar	W200540073554502	20.0944	73.9292	27-Oct-15	5.2	0.348181818
10	Nashik	Niphad	Ozar	W200540073563101	20.0944	73.9419	27-Oct-15	5.1	0.466328829
11	Nashik	Niphad	Sonewadi Ozar	W200435073553301	20.0764	73.9258	30-Nov-15	2.75	0.101428571
12	Nashik	Niphad	Thergaon	W200448073591701	20.0800	73.9881	27-Oct-15	10.9	0.421818182
13	Nashik	Niphad	Thergaon	W200448073591601	20.0800	73.9878	27-Oct-15	11.3	0.577878788
14	Nashik	Niphad	Vinchur	W200557074135801	20.0992	74.2328	28-Oct-15	9.8	0.582727273
15	Nashik	Sinnar	Agaskhind	W194831073500501	19.8086	73.8347	27-Oct-15	5.4	0.325409836
16	Nashik	Sinnar	Atkawade	W194734073591501	19.7928	73.9875	27-Oct-15	9.2	0.735151515
17	Nashik	Sinnar	Atkawade	W194734073591502	19.7928	73.9875	27-Oct-15	7.9	0.792121212
18	Nashik	Sinnar	Chapadgaon	W194041074025001	19.6781	74.0472	31-Oct-12	7	0.267857143
19	Nashik	Sinnar	Chapadgaon	W194721074025201	19.7892	74.0478	30-Oct-15	11.7	0.934848485
20	Nashik	Sinnar	Mendhi	W195607074112501	19.9353	74.1903	30-Oct-14	10.5	0.646666667
21	Nashik	Sinnar	Mirgaon	W195024074172701	19.8400	74.2908	27-Oct-15	9.4	0.914242424