



## केन्द्रीय भूमि जल बोर्ड

जल संसाधन, नदी विकास और गंगा संरक्षण  
विभाग, जल शक्ति मंत्रालय

भारत सरकार

### **Central Ground Water Board**

Department of Water Resources, River  
Development and Ganga Rejuvenation,  
Ministry of Jal Shakti  
Government of India

## **AQUIFER MAPPING AND MANAGEMENT OF GROUND WATER RESOURCES**

**BHANDARA DISTRICT  
MAHARASHTRA**

मध्यक्षेत्र, नागपुर  
**Central Region, Nagpur**

**AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN,  
BHANDARA DISTRICT, MAHARASHTRA  
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## BHANDARA DISTRICT AT A GLANCE

<b>1. GENERAL INFORMATION</b>			
	Geographical Area	:	4087 sq. km.
	Administrative Divisions (2011)	:	Block- 7; Bhandara, Pauni, Lakhandur, Lakhni, Sakoli, Mohadi, Tumsar
	Villages (Census 2011)	:	876 Nos.
	Population (Census 2011)	:	11,98,810
	Rainfall 2021	:	1247.9 mm
	Normal rainfall	:	1298.5 mm
	Long term rainfall Trend (1998-2021)	:	Falling trend 2.9 mm/year
<b>2. GEOMORPHOLOGY AND DRAINAGE</b>			
	Major Physiographic unit	:	Two; Structural units like hills and ridges, denudational units like pediments and fluvial units
	Major Drainage	:	Wainganga River and its tributaries namely Kanhan, Bagh, Chulbandh, Bawanthari, Sur and Garhvi.
<b>3. LAND USE</b> (sources: DSA 2020)			
	Forest Area	:	457 sq. km. (11.18%)
	Cultivable Area	:	3034 sq. km. (74 %)
	Net Area Sown	:	2081 sq. km. (51 %)
	Area Sown more than once	:	631.26 Sq. km. (15.44%)
<b>4.</b>	<b>SOIL TYPE</b>	:	61 % area of the district is covered by Clayey and Clay loam soil; 20% area is covered by sandy loam and 10 % area is covered by Gravelly clay and loamy soils.
<b>5. PRINCIPAL CROPS</b> (sources: DSA 2020)			
	Rice	:	1887.71 sq. km.
	Pulses	:	284.74 sq. km.
	Wheat	:	127.54 sq. km.
	Oil Seeds	:	92.99 sq. km.
	Sugarcane	:	47.83 sq. km.
<b>6. HORTICULTURAL CROPS</b>			
	Mango	:	1.48 sq. km.
	Citrus fruit	:	0.31 sq. km.
	Banana	:	0.44 sq. km.
	Others	:	1.59 sq. km.
<b>7. IRRIGATION BY DIFFERENT SOURCES</b> (2006-07) and DSA 2020			
	<b>Type</b>	<b>Nos</b>	<b>Potential Created (ha)</b>
	Dug wells	:	<b>9480</b> 13480
	Borewells	:	308 485
	Tanks or Ponds	:	2505 67146
	Other Minor Surface Sources	:	491 2835
	Area under Surface water irrigation (ha)	:	70550
	Area under Ground water irrigation (ha)	:	32126
<b>8. GROUND WATER MONITORING WELLS</b> (As on 31 <sup>st</sup> March 2022)			
	Dug wells	:	39

	Piezometers	:	04
<b>9. GEOLOGY</b>			
	Age		Formation
	Recent	:	Alluvium and Laterite
	Proterozoic (Vindhyan, Dongargarh, Sausar and Sakoli Super Group)		Quartzite and Shale; Sandstone, Granite, Rhyolite; Muscovite-Biotite-Schist, Granite, Tirodi Gneiss; Schist, Phyllites, Quartzite
	Archean's (Amgaon Super Group)	:	Granite & Gneisses.
<b>10. HYDROGEOLOGY</b>			
	Major Water Bearing Formation	:	1. Weathered/Fractured Granite and Granite Gneisses 2. Weathered and <b>Fractured Schist</b> 3. Alluvium- Sand and Gravel. <b>Under Unconfined to Semiconfined conditions.</b>
<b>Depth to water level in Shallow Aquifer</b>			
	Pre-monsoon Depth to Water Level (May-2021)	:	0.7 to 23.8 mbgl
	Post-monsoon Depth to Water Level (Nov.-2021)	:	0.1 to 19.8 mbgl
<b>Depth to water level in Deeper Aquifer</b>			
	Post- monsoon Water Level (May 2021)	:	2.1 to 45.3 mbgl
	Post- monsoon Water Level (Nov. 2021)	:	1.92 to 10.25 mbgl
<b>Water level Trend (2012-21)</b>			
	Pre- monsoon Water Level Trend (2012-2021)	:	Rise: 0.0036 to 0.4735 m/year Fall: 0.0094 to 0.69 m/year
	Post-monsoon Water Level Trend (2012-2021)	:	Rise: 0.0050 to 0.6697 m/year Fall: 0.0006 to 1.16 m/year
<b>11. GROUND WATER EXPLORATION (As on March 2022)</b>			
	Wells Drilled (CGWB)	:	EW-26, OW-6 & Pz-03, <b>Total -35</b>
	Depth Range	:	9.2 to 500.10 m bgl
	SWL		1.92 to 50.08 mbgl
	Discharge	:	traces to 8.77 lps
	Transmissivity	:	0.23 to 61
	Storativity		$1.49 \times 10^{-4}$ to $2.4 \times 10^{-5}$
<b>12. GROUND WATER QUALITY</b>			
	Type of Water	:	Predominantly Ca-Cl
<b>13. DYNAMIC GROUND WATER RESOURCES- (2020)</b>			
	Annual Extractable Ground Water Recharge	:	858.03 MCM
	Total Extraction	:	261.00 MCM
	Annual GW Allocation for Domestic Use as on 2025		36.48 MCM
	Net Ground Water Availability for future use	:	597.03 MCM
	Stage of Ground Water Development	:	30.42 %
	Category		<b>Safe</b>

14.	<b>MAJOR GROUND WATER PROBLEMS AND ISSUES</b> <ul style="list-style-type: none"> <li>• Declining water level trend of more than 0.2 m/year has been observed in parts of Lakhni, Lakhandur, Bhandara, Mohadi and Pauni blocks.</li> <li>• Shallow and Deeper aquifers are affected by Nitrate and Fluoride contamination in parts of all the blocks.</li> <li>• About 60% area of the district is having low yield potential (&lt;1 lps)</li> <li>• The area has experienced declining rainfall trend 2.9 m/year and eight times moderate droughts.</li> <li>• Low Development of Ground Water Resources</li> </ul>	
15.	<b>Aquifer Management Plan</b>	
	Supply side Management	: Proposed AR structures: 89 Percolation tanks, 175 Check Dams and 43 Recharge shafts
	Demand side Management	: 47.83 sq. km. sugarcane area proposed for Drip irrigation
	Expected Benefits	: <ul style="list-style-type: none"> <li>• Additional GW Resources enhanced by Supply side intervention (AR) = 19.22 MCM</li> <li>• Water saving through adopting Micro Irrigation in sugarcane crop area = 27.26 MCM</li> <li>• Balance GWR available for Development after SOD 70% – 380.36 MCM</li> <li>• Additional 585.11 sq km kharif crop area converted in double crop area.</li> <li>• Even after above, SOD will be 70% (safe category)</li> <li>• Increase in GW Availability &amp; Sustainability</li> </ul>

# AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN, BHANDARA DISTRICT, MAHARASHTRA

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# AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN, BHANDARA DISTRICT

## 1. INTRODUCTION

National Aquifer Mapping (NAQUIM) has been taken up in XII five-year plan by CGWB to carry out detailed hydrogeological investigation on 1:50,000 scale. The NAQUIM has been prioritized to study Over-exploited, Critical and Semi-Critical blocks as well as the other stress areas recommended by the State Govt. Aquifer mapping is a process wherein a combination of geologic, geophysical, hydrologic and chemical analyses is applied to characterize the quantity, quality and sustainability of ground water in aquifers.

The vagaries of rainfall, inherent heterogeneity & poor sustainability of hard rock aquifers, over exploitation of once copious alluvial aquifers, lack of regulatory mechanism has a detrimental effect on ground water scenario of the Country in last decade or so. Thus, prompting the paradigm shift from “**traditional groundwater development concept**” to “**modern groundwater management concept**”.

Varied and diverse hydrogeological settings demand precise and comprehensive mapping of aquifers down to the optimum possible depth at appropriate scale to arrive at the robust and implementable ground water management plans. The proposed management plans will provide the “**Road Map**” for ensuring sustainable management and equitable distribution of ground water resources, thereby primarily improving drinking water security and irrigation coverage. Thus, the crux of NAQUIM is not merely mapping, but reaching the goal-that of ground water management through community participation. The aquifer maps and management plans will be shared with the administration of Bhandara district, Maharashtra for its effective implementation.

The activities under NAQUIM are aimed at:

- ✚ Identifying the aquifer geometry,
- ✚ Aquifer characteristics and their yield potential
- ✚ Quality of water occurring at various depths,
- ✚ Aquifer wise assessment of ground water resources
- ✚ Preparation of aquifer maps and
- ✚ Formulate ground water management plan

### 1.1 ABOUT THE AREA

Bhandara district is a one of the districts of the Vidarbha Region in Maharashtra State. It is newly formed district and carved out by the division of Bhandara district into Bhandara and Gondia districts in May 1999. It is situated in the north eastern part of Maharashtra between 20°38' and 21°36' North latitudes and 79°27' to 80°06' East longitudes. The total area of the district is 4087 sq. km. and falls in parts of survey of India degree sheets 55O, 55P, 64C and 64D. It is bounded on south by Chandrapur district, east by Gondia district, on north by Balaghat district of Madhya Pradesh State and on west by Nagpur district.

The district headquarters is located at Bhandara Town. For administrative convenience, the district is divided into 7 blocks viz., Bhandara, Pauni, Lakhandur, Lakhni, Sakoli, Mohadi and Tumsar. It has a total population of 1198810 as per 2011 Census. The district has 12 towns and 771 villages. The district falls under the Wainganga basin with Wainganga River being the main River with tributaries namely Bagh, Bavanthadi, Chulbandh, Garhvi and Sur Rivers.

The district is categorized as safe as per Ground Water Resources Estimation 2020. The Index and Administrative map of the Bhandara district is presented in **Fig. 1.1** and **Fig. 1.2**. Bhandara district has been taken up under NAQUIM study in the year 2021-22 (AAP 2020-21)

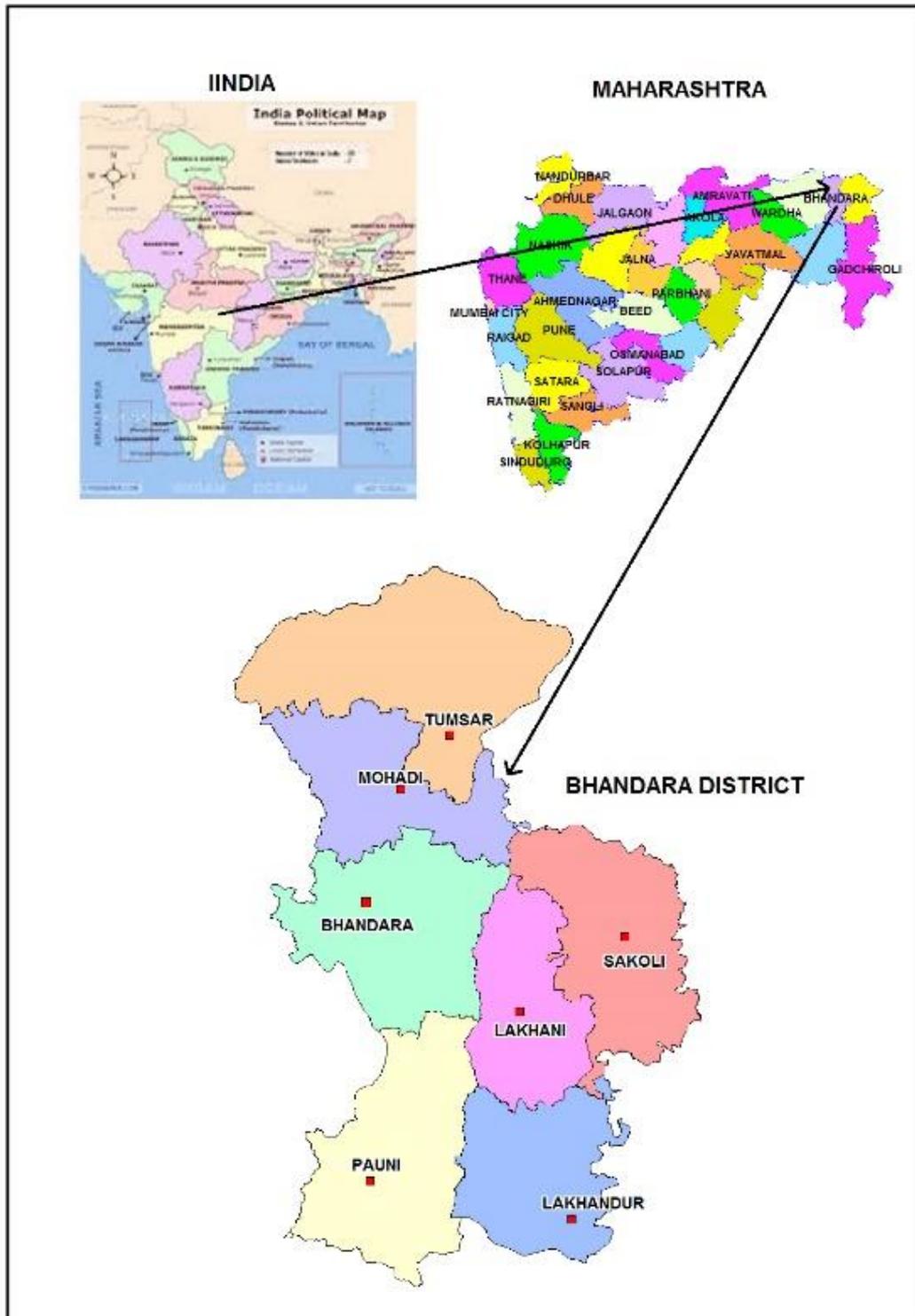
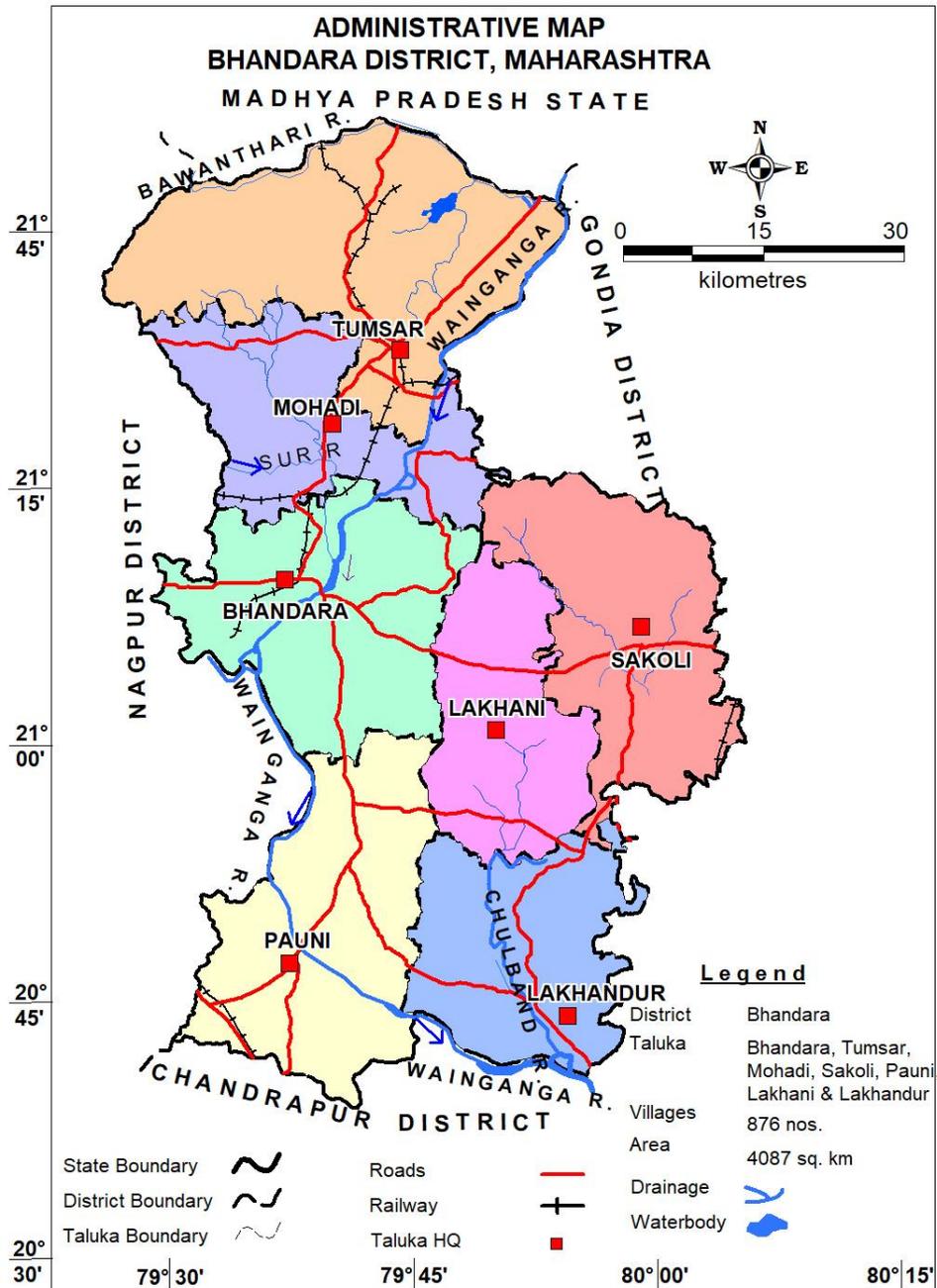


Figure 1. 1 : Index map, Bhandara District

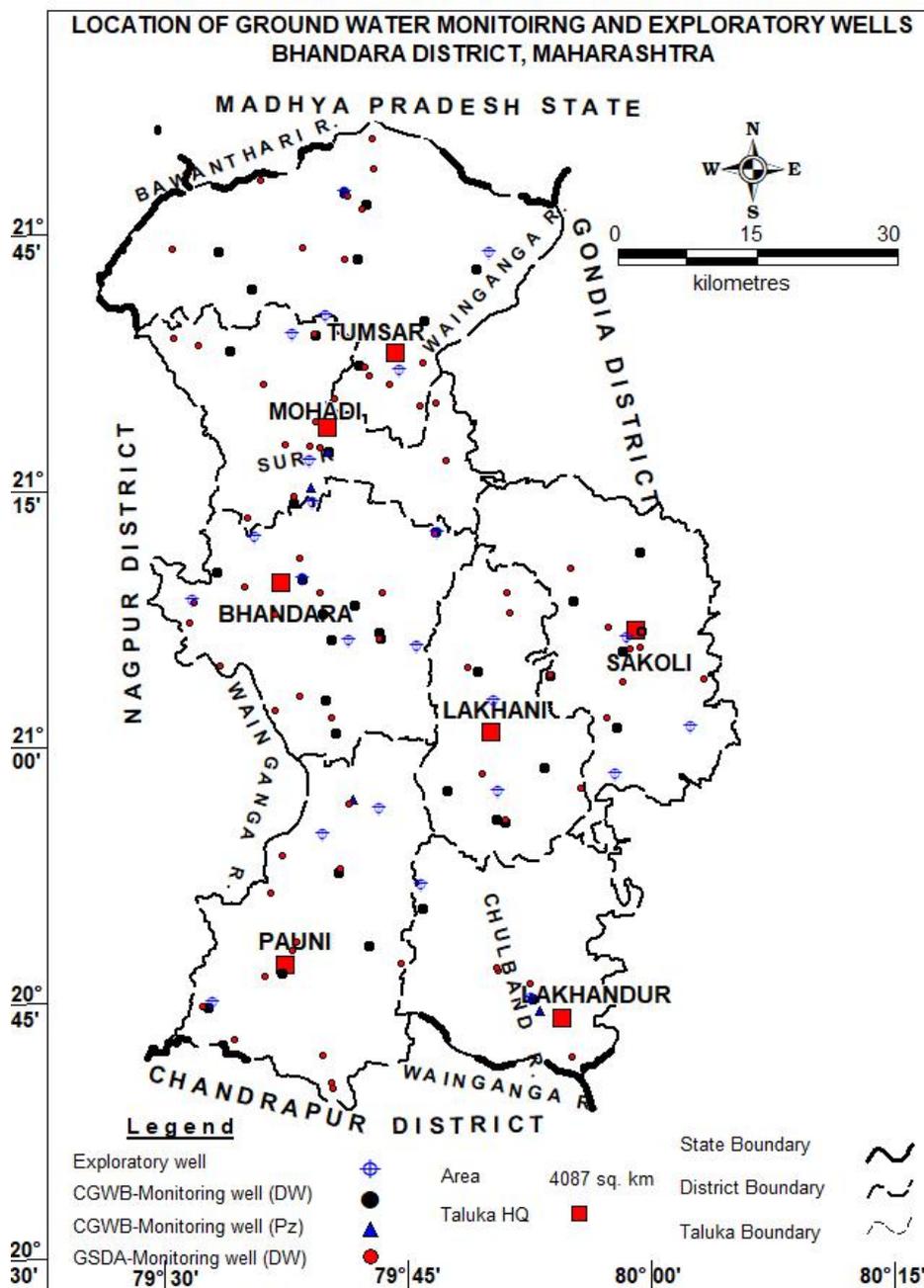


**Figure 1. 2 : Administrative map, Bhandara District**

Ground water exploration in the district has been taken up in different phases since 1991. During 1991-92 total 19 Exploratory Wells (EW), 06 Observation Wells (OW) have been drilled in the district. In addition to these 03 Piezometers (Pz) were also constructed for monitoring of ground water levels in 1999 and 2011.

The ground water exploration has been carried out in hard rock areas occupied by granites, gneisses and schist. To establish the geometry, disposition and potential of aquifers, ground water exploration down to the depth of 200 mbgl has been taken up where the data gap exists and accordingly 07 exploratory wells have been constructed during the years 2021-22. A total of 26 EWs, 06 OWs, and 03 Piezometers have been constructed till March 2022. Salient Features of Ground Water Exploration are given in **Annexure-I** and details of exploration are given in **Annexure-II**.

To assess the ground water regime, 43 existing ground water monitoring stations of CGWB and 81 monitoring stations of GSDA being monitored 4 times in a year are used to acquire micro level hydrogeological data to decipher the water level scenario, sub-surface lithological disposition and hydrogeological setup of shallow aquifer (Aquifer-I). The details of monitoring wells are given in **Annexure-III**. Locations of existing ground water monitoring stations and exploratory wells are shown in **Fig.1.3**.

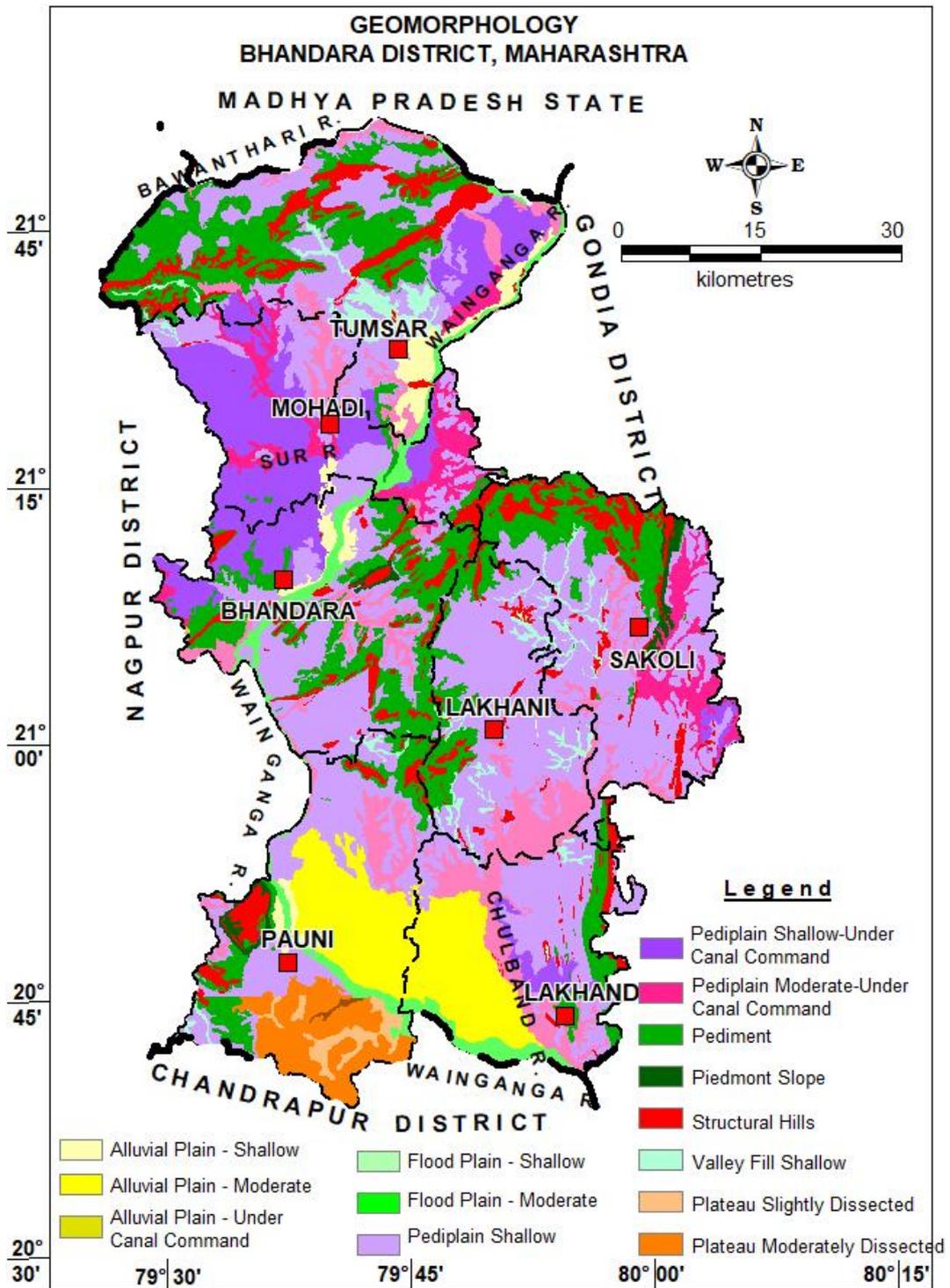


**Figure 1. 3: Locations of Existing Exploratory and Ground Water Monitoring Wells**

## 1.2 GEOMORPHOLOGY, DRAINAGE AND SOIL TYPES

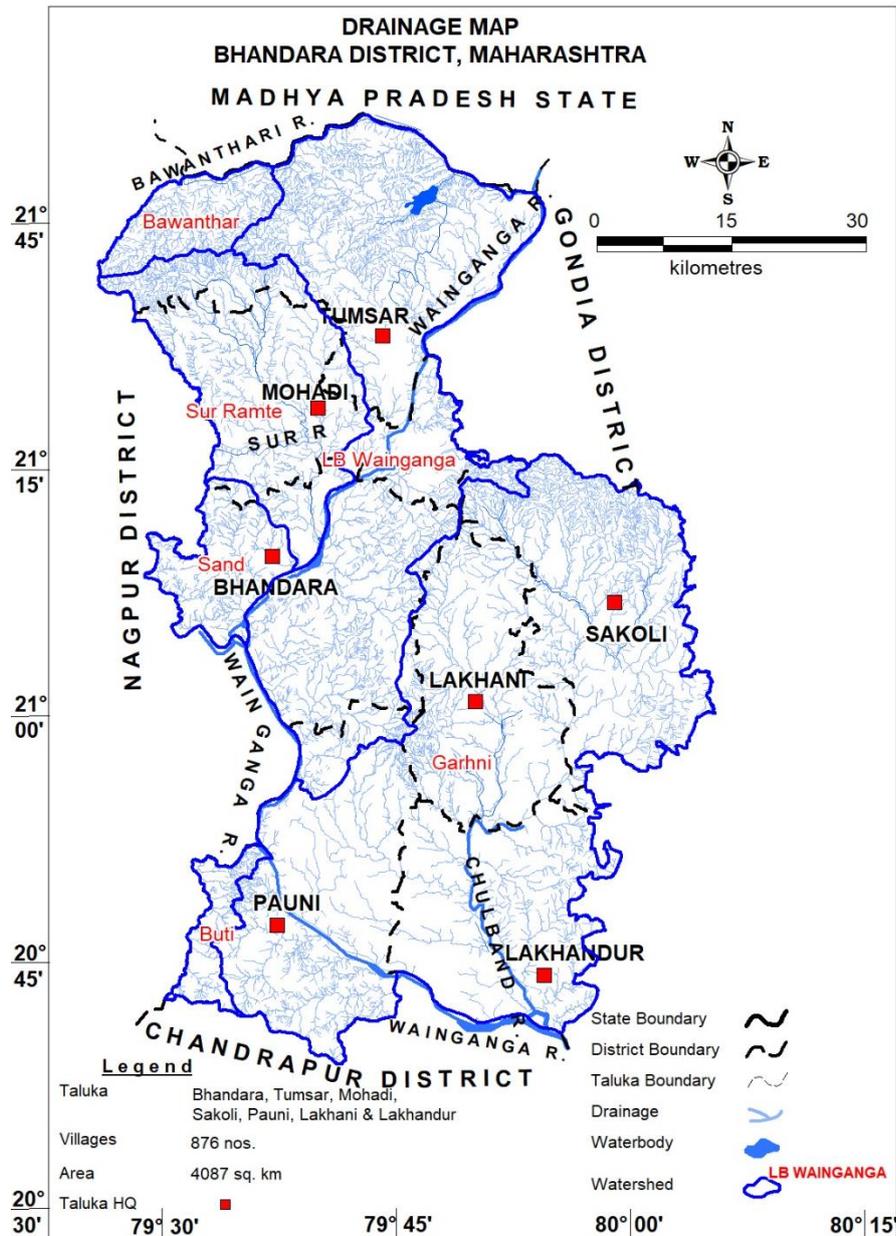
The district forms part of Wainganga sub-basin and has an undulating terrain with elevations ranging from 263 to 315 m amsl. Physiographically, the district can be broadly divided into two units viz; the one controlled by structural features i.e., the structural origin and the other controlled by differential weathering i.e., the denudation origin. The structural

hills and ridges are more common in the eastern and southern parts of the district, while the denudational features like pediments/pediains are seen in north-central, west central and south-west portions. The geomorphology of the area is shown in Fig. 1.4



**Figure 1. 4: Geomorphology, Bhandara District**

The entire area of the district falls in Godavari basin. Wainganga is the main river flowing in the district. The district is drained by the Wainganga River and its tributaries namely Bagh, Bavanthadi, Chulbandh, Garhvi and Sur Rivers.



**Figure 1. 5: Drainage, Bhandara District**

Soil plays a very important role in the agricultural activities and forest growth of the area. The fertility of the soil from agricultural point of view depends upon the texture and structure which controls the retaining and transmitting capacity of the soil to hold the moisture content and various nutrients such as nitrogen, phosphorous and potassium present in the parent rock. The process of formation of the soil in the area is influenced by the climate, geology, vegetation, drainage and topography. The soils of the district are varied, arising out of the tropical sub-humid weathering of crystalline metamorphic and igneous rocks. They are essentially residual, though along the southern extremes of the Wainganga valley, downstream of Pauni, alluvial soils predominate.

Based on the thematic map, it has been observed that about 61 % of the area of the district is occupied by Clayey and Clay loam soil types. Nearly 20 % of the area is covered by sandy loam and sandy clay loam soils; followed by Gravelly clay and loamy soil covering 10 % area of the district. Remaining part of the district is covered by Silty clay, Silty clay loam, Gravelly clay and silty loam soils. Depth of soil is more in the vicinity of main drainages and

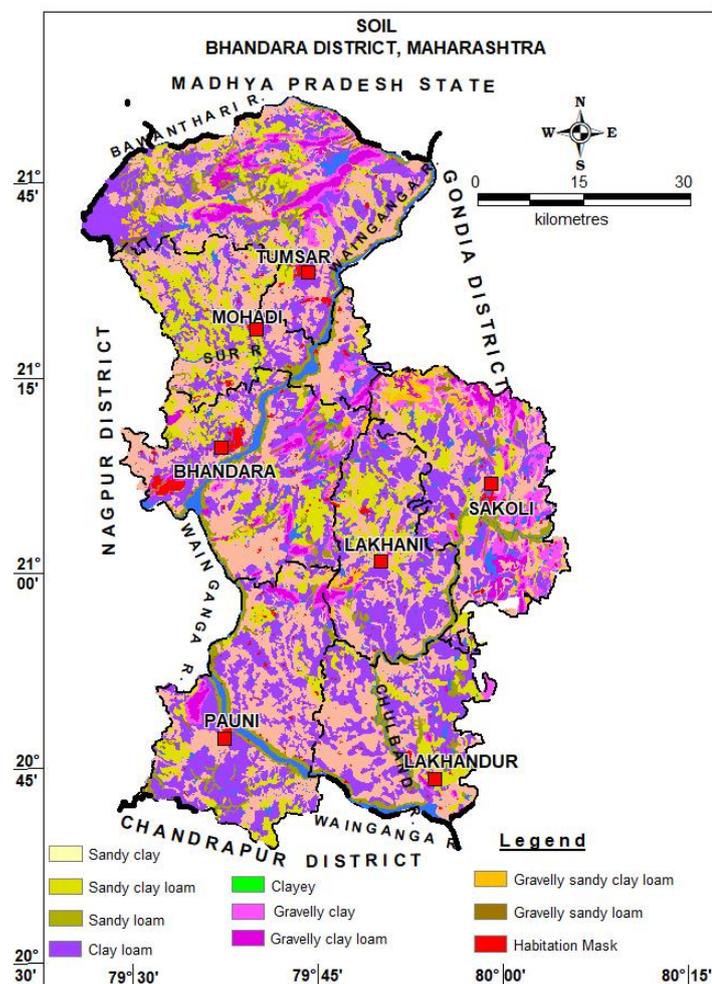
shallow away from river channels and least in hilly terrains. The thematic map of soil distribution in the district is shown in **Fig. 1.6**.

**Soil Infiltration test:** To estimate the actual rate of infiltration in various soil types and their impact on recharge to ground water in Bhandara district, 2 soil infiltration tests were conducted at Madgi and Salebardi villages. The data has been analyzed and the salient features of the soil infiltration tests are presented in **Table 1.1**. The duration of the test ranged from 80 to 120 minutes and the infiltration rate in the area ranged from 0.3 to 1.2 cm/hr. Based on soil infiltration test it is observed that:

- Soils with low Infiltration rate shall be responsible for high runoff and become saturated during rain events. There will be less recharge to ground water. This, in turn, decreases soil strength and increases erosion potential.
- Soils that have less Infiltration rates lead to an increase in the overall volume of runoff. The excess run off caused by low Infiltration rate of soils may also contribute to local and regional flooding of streams and rivers or may result in accelerated soil erosion of fields or stream banks.

**Table 1. 1: Salient Features of Infiltration Tests**

S.No.	District	Block	Location	Latitude	Longitude	Rate of infiltration (cm/hr)
1	Bhandara	Bhandara	Madgi	21°01'59"	79°45'44"	1.2
2	Bhandara	Bhandara	Salebardi	21°09'34"	79°34'49"	0.3



**Figure 1. 6 : Soil, Bhandara District**

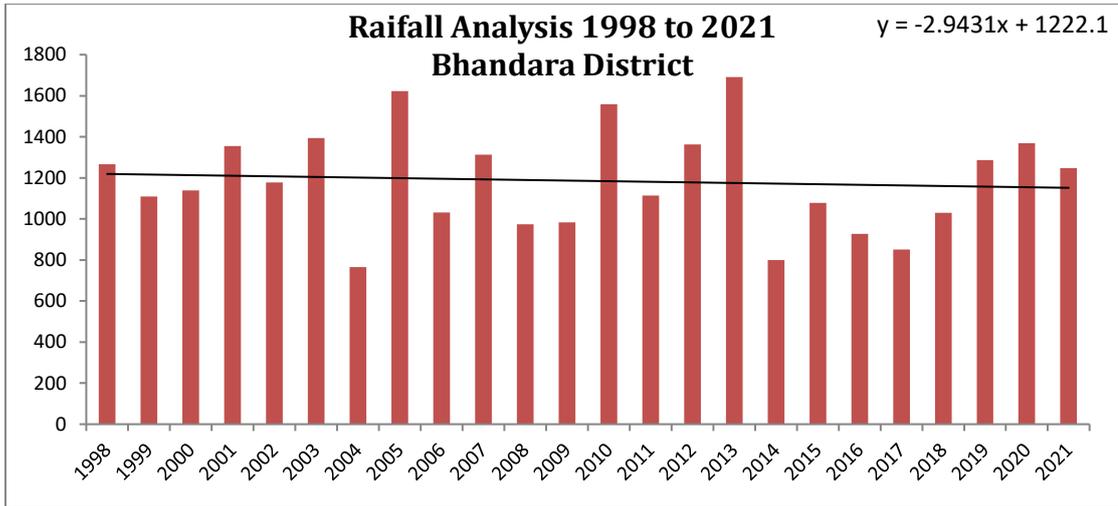
### 1.3 CLIMATE AND RAINFALL

The Climate of the district is characterized by the hot summer and general dryness throughout the year except during the south-west monsoon season, i.e., June to September. The temperature rises rapidly after February till May, which is the hottest month of the year. The mean daily maximum temperature during May is 45°C and the mean daily minimum temperature during December is 6°C

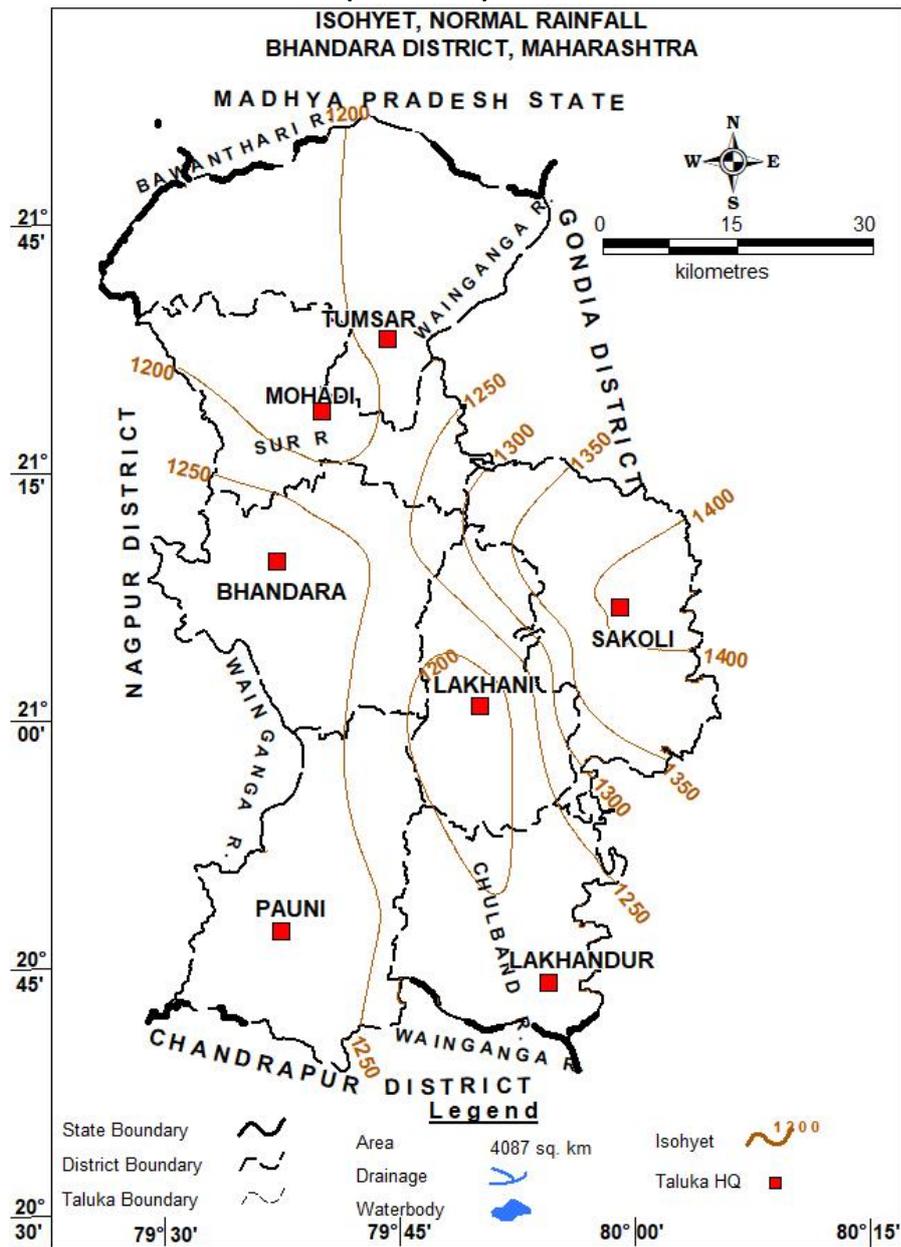
The normal rainfall of the district is 1298.5 mm spread over the 24 year varying from 48 to 93 rainy days. Annual rainfall data of 1998-2021 is analysed and presented in **Fig. 1.7**. This indicates that maximum rainfall occurred in 2013 (1691.2 mm) and minimum rainfall in 2004 (765.3 mm). The rainfall trend analysis shows a falling trend @ 2.9 mm/year. The rainfall analysis shows that the departure of annual rainfall from the normal rainfall, expressed in terms of percentage, varied from -47 to +17 percent. The departure percent analysed denotes the rainfall variation pattern with respect to normal rainfall during the period. The area experienced 16 times (67%) normal rainfall and 8 times (33%) moderate drought conditions as given in **Table 1.2**. The coefficient of variation of the annual rainfall from the mean rainfall has been observed to be 21% indicating that a range of  $\pm 21\%$  of the mean rainfall varying from 936.4 to 1434.2 mm was received in the area during the period. Significantly, the analysis indicate that the 936.4 was minimum assured rainfall to have been received during the period, however exceptional years 2004,2008,2014,2016 and 2017 falling out of this range were there in which the less rainfall was received during the period in the area. The isohyet map of the district is depicted in **Figure 1.8**.

**Table 1. 2: Long Term Rainfall Analysis (1998 to 2021) of Bhandara District**

PERIOD = 1998 to 2021						No. of years = 24		
YEAR	ANNUAL	NORMAL	% DEPARTURE	No of Rainy days	CATEGORY	NORMAL RAINFALL = 1298.5 mm		
1998	1266	1439.8	-12	93	NORMAL	STANDARD DEVIATION = 248.63 mm		
1999	1108.7	1439.8	-23	93	NORMAL	COEFFICIENT OF VARIATION = 21%		
2000	1139.5	1439.8	-21	60	NORMAL	MEAN=1134.7		
2001	1355.1	1439.8	-6	70	NORMAL	MEDIAN=1136.7		
2002	1177.7	1439.8	-18	56	NORMAL	SLOPE= -2.9 mm/Year		
2003	1393.3	1439.8	-3	80	NORMAL	INTERCEPT= 122.2 mm		
2004	765.3	1439.8	-47	56	MODERATE	EQUATION OF TREND LINE= -2.9431x + 1222.1		
2005	1622.8	1439.8	13	68	NORMAL	CATEGORY	NUMBER OF YEARS	% OF TOTAL YEARS
2006	1031.9	1439.8	-28	62	MODERATE	DEPARTURES		
2007	1313	1439.8	-9	73	NORMAL	POSITIVE	4	17
2008	974.4	1439.8	-32	70	MODERATE	NEGATIVE	20	83
2009	983.6	1439.8	-32	65	MODERATE	DROUGHTS		
2010	1558.7	1439.8	8	79	NORMAL	MODERATE	8	33
2011	1113.1	1439.8	-23	79	NORMAL	SEVERE	0	0
2012	1363.2	1439.8	-5	72	NORMAL	ACUTE	0	0
2013	1691.2	1439.8	17	80	NORMAL	NORMAL & EXCESS R/F		
2014	799.9	1439.8	-44	48	MODERATE	NORMAL	16	67
2015	1078.3	1439.8	-25	57	NORMAL	EXCESS	0	0
2016	927.9	1439.8	-36	64	MODERATE	NOTE: Departure: EXCESS RAINFALL: > +25; NORMAL RAINFALL: +25 TO -25; MODERATE DROUGHT: -25 TO -50; SEVERE DROUGHT: -50 TO -75; ACUTE DROUGHT: < -75		
2017	850.5	1439.8	-41	62	MODERATE			
2018	1029.6	1439.8	-28	51	MODERATE			
2019	1286.5	1439.8	-11	79	NORMAL			
2020	1368.3	1298.5	5	86	NORMAL			
2021	1247.9	1298.5	-4	88	NORMAL			



**Figure 1. 7 : Annual Rainfall Pattern (1998-2021)**



**Figure 1. 8: Isohyet map of Bhandara District**

## 1.4 GEOLOGY

Bhandara district is unique in Maharashtra in the sense that the entire area of the district is occupied by metamorphic and igneous rocks. The district is underlain by various types of rock formations from the oldest Granites and Gneisses of the Precambrian to the Recent Alluvium. The generalized geological sequence of the area is given in **Table 1.3** and the Geological Map of the district is depicted in **Figure 1.9**.

**Table 1. 3: Generalized Geological sequence Bhandara district**

AGE	GROUP	FORMATION	Lithology
Recent to sub recent		Alluvium	Sand, silt, clay & laterites (yellow to reddish brown, ferruginous with pisolitic texture)
Permian	Lower Gondwanas	Kamthi	Sandstone and ferruginous sandstone, dark brownish grey, pale red in colour, medium to coarse grained
Neoproterozoic	Vindhyan		Sandstone and Shale, Sandstone: light grey to light yellowish, medium to Coarse grained, gritty soft and friable. Shale: light grey to light reddish, thinly bedded.
Meso Proterozoic	Khairagarh Group		Granite, medium to coarse grained, composed of Quartz, feldspar, biotite and muscovite.
	Dharwar (Sausar/ Sakoli Groups)		Dolomitic Limestone/shale, Calc-Gneiss, Quartzite, Phyllites, Schists, Meta basalt/Rhyolites, Granite and Quartz reef.
	Nandgaon group		Granite, Basic intrusive, Arkose, grit, Sandstone and shale, Rhyolite, conglomerate, Quartzite.
Paleo-Meso Proterozoic	Bailadila		Quartzite/ banded Hematite Quartzite
Archaean's to Paleo Proterozoic	Amgaon Gneissic group	Crystalline & Older Metamorphics	Granite, Granite Gneisses with migmatite and Quartzites.

(GSI: DRM FIRST EDITION 2001)

### ARCHEANS

The granites and gneisses are found along a wide NE-SW tract in the north central part of the district, just north of Bhandara town. The gneiss comprises biotite-hornblende gneiss, amphibolites, granulites and migmatite. The biotite gneiss is often referred to as Tirodi gneiss. It is composite in character and forms the basement for younger metamorphosed sedimentary rocks.

### DHARWARS

The calc-granulites, mica and hornblende schists with associated quartzites form the Sausar Group. This is predominant in the north-eastern side of the district, occupying northern part of Tumsar block. The other dominant group of Meta sediments is termed as Sakoli Group and forms an important suite of rocks consisting mainly of low grade metamorphics such as phyllites, chlorite schist and quartzites. The outcrop of these rocks has a triangular shape,

known as 'Bhandara triangle', with its apex near Gondia and its base stretching in the SE-SW direction occupying major points of Bhandara, Lakhani, Sakoli and Lakhandur blocks.

#### **VINDHYANS**

A small occurrence of Vindhyan formation is seen in the extreme southern part of the district in parts of Pauni block. Which is generally hard and compact. They are almost horizontally and moderately jointed.

#### **LOWER GONDWANAS**

Lower Gondwana sediments belonging to Kamthi Group are exposed in a narrow outcrop in the southern part of the district in parts of Lakhandur block at its border with Chandrapur district. These are composed of conglomerate, sandstone, shale and clay.

#### **LATERITES**

Laterites are commonly seen as capping over Deccan traps, Kamthi sandstones and gneisses. It is generally reddish brown in colour. It is hard and thickness of which varies from a 0.5 m to 2 m. Laterite are exposed in very small areas of south and south eastern parts of the district.

#### **ALLUVIUM**

Adjoining the course of Wainganga River and Chulband River, a number of patches of Alluvium are found with an aerial extent ranging from 20 to 50 sq.km, the largest of which has an extent of 300 sq.km occupying major parts of Pauni block. The thickness of alluvium varies from 6 to 30 m.

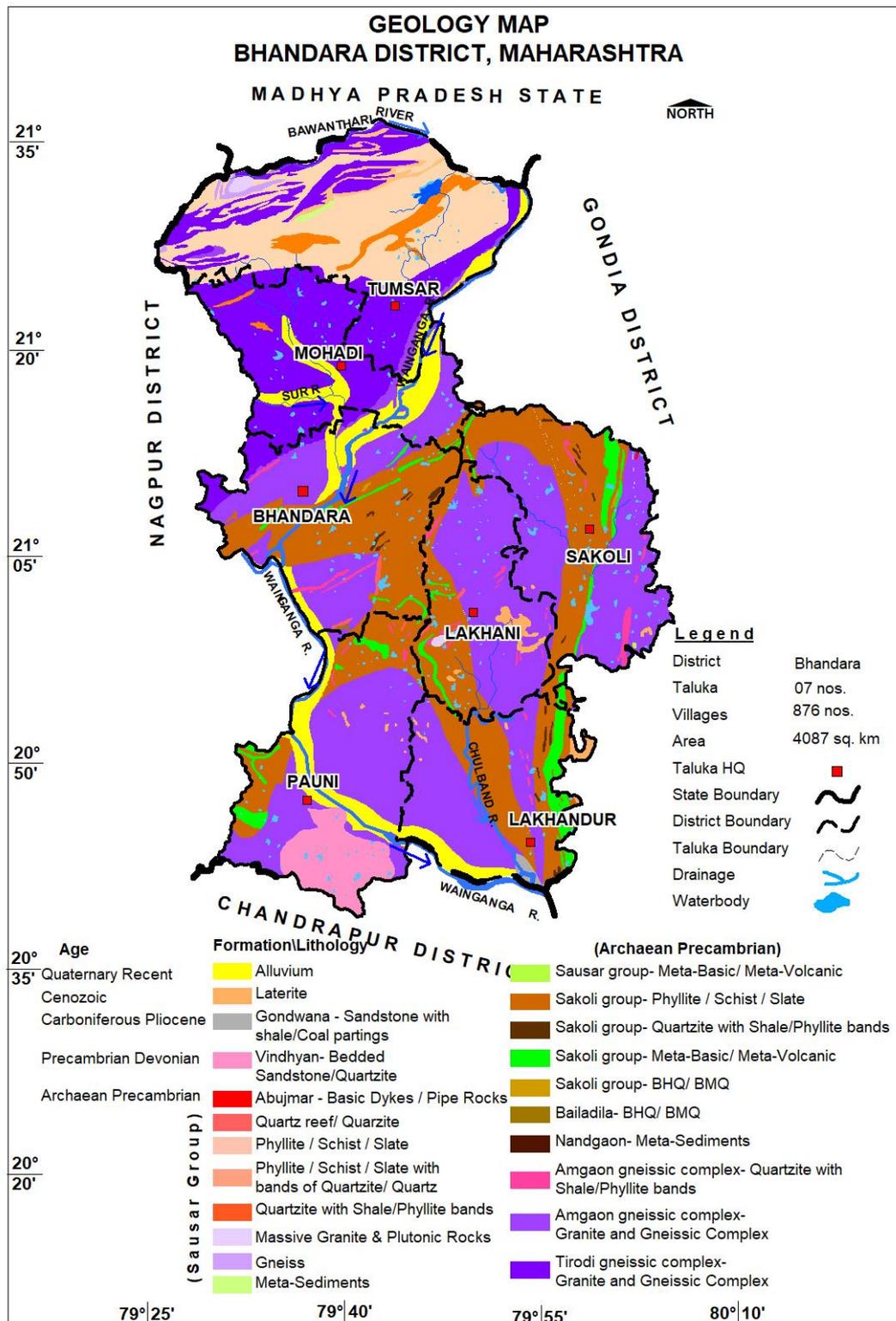


Figure 1. 9: Geological Map, Bhandara district

## 2. HYDROGEOLOGY

The major water-bearing geological formations in the district are Alluvium, Gondwana Kamthi Sandstone, Vindhyan Sandstone/shales and Archaean metamorphics and crystalline rocks. Amongst these, Kamthi sandstone and alluvium are very rich in ground water potential. The alluvium consisting of clay, Silt, Sand and Gravel occurs along the course of major rivers.

A map depicting hydrogeology of Bhandara district is presented in Fig. 2.1.

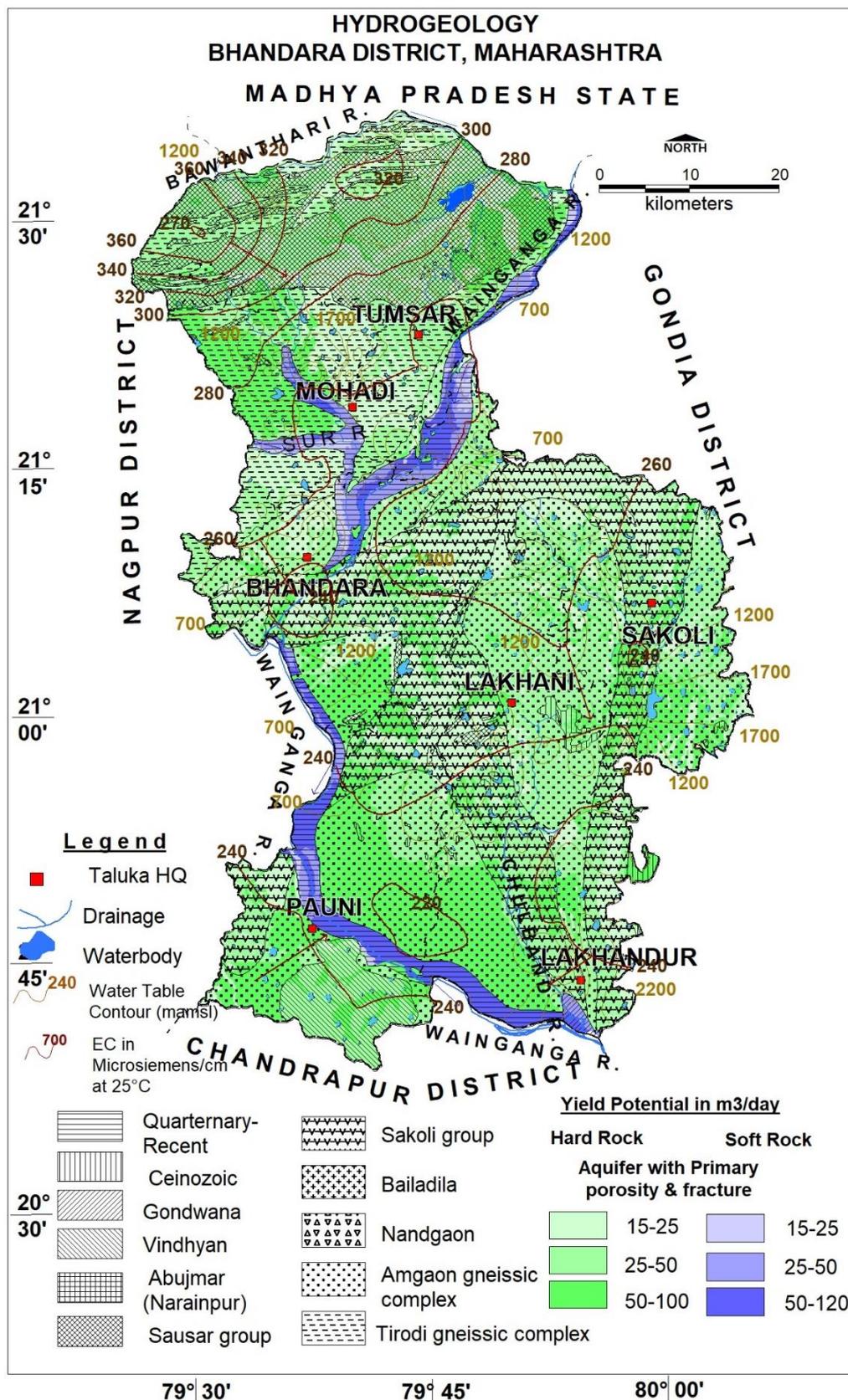


Figure 2. 1: Hydrogeology, Bhandara District

#### **ARCHAEOAN METAMORPHICS:**

The Pre-Cambrian crystalline rocks are the major water bearing formations in the district comprising granites, granitic gneisses, gneisses, schists, phyllites, amphibolites, quartzites, dolomite marble and limestone. In general, these rocks are devoid of effective intergranular porosity. But weathering, jointing, fracturing, shearing develops secondary porosity and permeability. The water-bearing capacity largely depends upon the degree of weathering, thickness of weathered zone, intensity of fracturing and jointing and thickness of sheared zones. Dugwells, dug cum borewells and bore wells are the common ground water abstraction structures. Ground water occurs under water table conditions and semi-confined to confined conditions in these formations. Water table conditions prevail in the weathered mantle and the fractures, jointed and sheared zones. At places where the argillaceous litho-units like phyllites and mica schist's act as a confining medium, the ground water is found to occur under semi-confined conditions. It is observed that depth of weathering generally ranges between 5 and 15 mbgl and dug wells are generally tapping this zone with yields up to 30 m<sup>3</sup>/day. Contrary to the general perception, the possibility of deep-seated joints and fracture zones exists in the area because of tectonic disturbance manifested in the form of dykes observed in the area. Therefore, borewells in the depth range of 40-60 m bgl are also successful in this formation at suitable places with yield varying up to 5000 lph. High yielding dug wells are generally located in fractured granites.

#### **VINDHYANS:**

Pre-Cambrian sedimentary rocks in the area possess poor primary porosity except limestone which are exhibiting fracture porosity and permeability with solution cavities. As a result of karstification, the fractures get widened and the permeability is increased. The ground water occurs under phreatic condition in fractures and cavities. It is observed that fractured zones have better water-bearing capacity as compared to hard and massive limestones.

#### **GONDWANA SANDSTONES:**

The rocks of this system are restricted to a small patch in the south –west part of the district. In Gondwana, ground water occurs in the weathered mantle and the fairly well-jointed portions of these rocks which comprise pink colored argillaceous quartzitic sandstones and carbonaceous shales. The weathered mantle constitutes a better aquifer in view of its high degree of porosity. Ground water occurs under water table conditions or phreatic condition in the weathered mantle and the joints and fractures of the country rock. It occurs under semi-confined state in the area where carbonaceous shale form aquicludes. It also occurs in the porous material of the sandstones.

#### **ALLUVIUM:**

In the alluvium bordering major rivers especially the Wainganga, ground water occurs in the sand and gravel, present in the lower horizons. The upper horizon mainly consists of clay and fine silt. Ground water occurs in the alluvium under phreatic semi-confined conditions in the inter-granular pore spaces of sand and gravel.

#### **WATER TABLE CONTOUR**

Based on the Premonsoon water level data, a Premonsoon water table contour map has been prepared and presented in **figure 2.2**. The map depicts occurrence and movement of ground water in the district. The ground water flow lines are marked to show the direction of ground water flow. The elevation of water table ranges from 215 to 370 m amsl and generally follows the topography. In general, the ground water movement is towards the south and south east. The ground water movement is generally sluggish in the alluvial areas with high permeable zones and in the areas of convergent ground water flow. Such areas have

been demarcated as ground water potential zones. In area of low permeability, the water table contours are closely spaced indicating steep gradient.

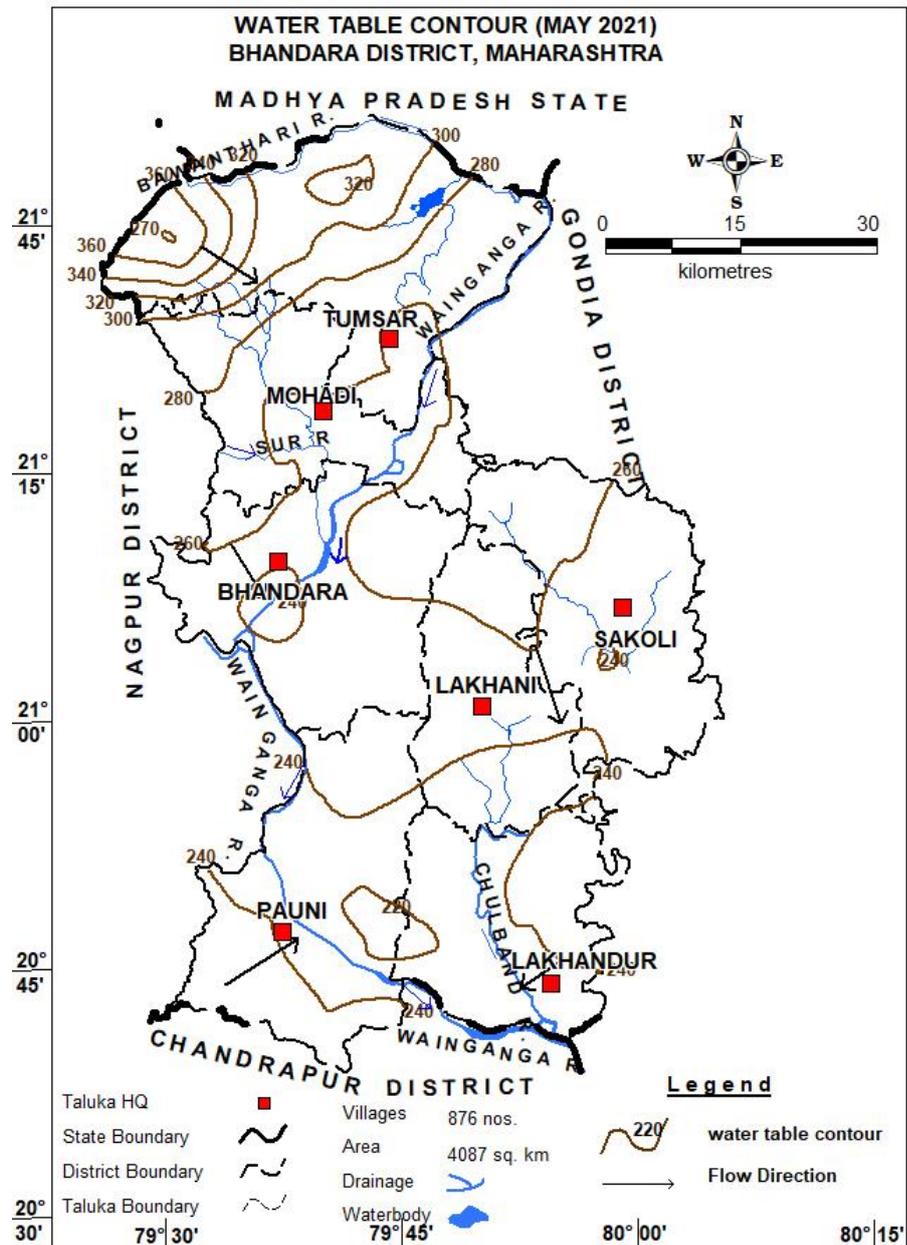


Figure 2. 2: Water Table Contour, Bhandara district

## 2.1 PRINCIPAL AND MAJOR AQUIFER SYSTEMS

Archean Crystalline and metamorphics (Granite, Granite Gneissic complex, Schist Quartzite-87% of the area), Alluvium (along the major rivers-9%), Gondwana Sandstone (3% of the area) and Vindhyan/Penganga Shale and Limestone (1%) are the major rock formations in the district.

In hydrogeological context, above formations have been categorized into principal and major aquifer systems. The maps depicting principal aquifers and major aquifers are presented in **Fig. 2.3 and 2.4**. Based on the ground water exploration carried out in the district so far, aquifer wise characteristics have been delineated and are shown in **Table 2.1**. The aquifer units found in each of the formation are given below:

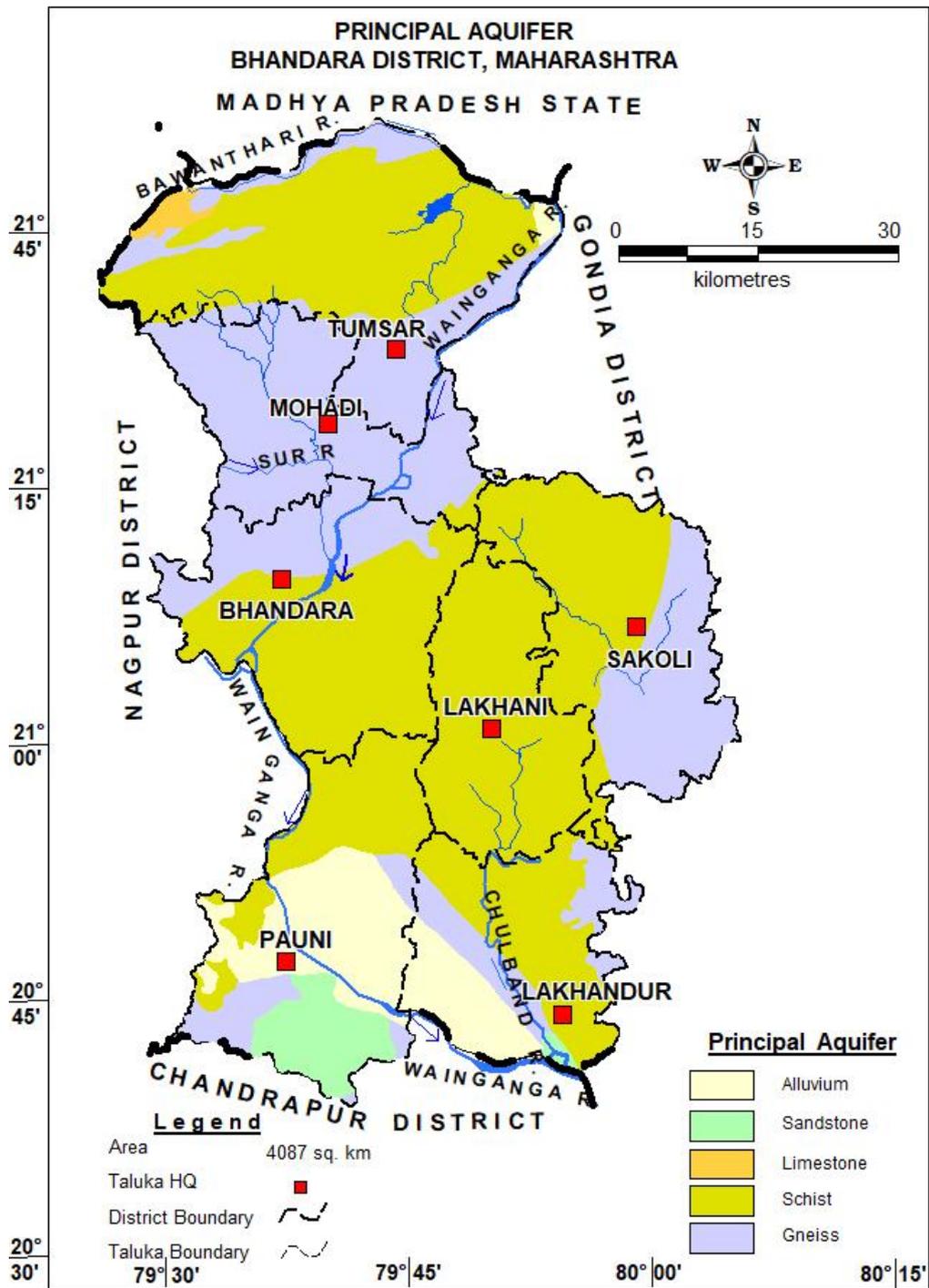
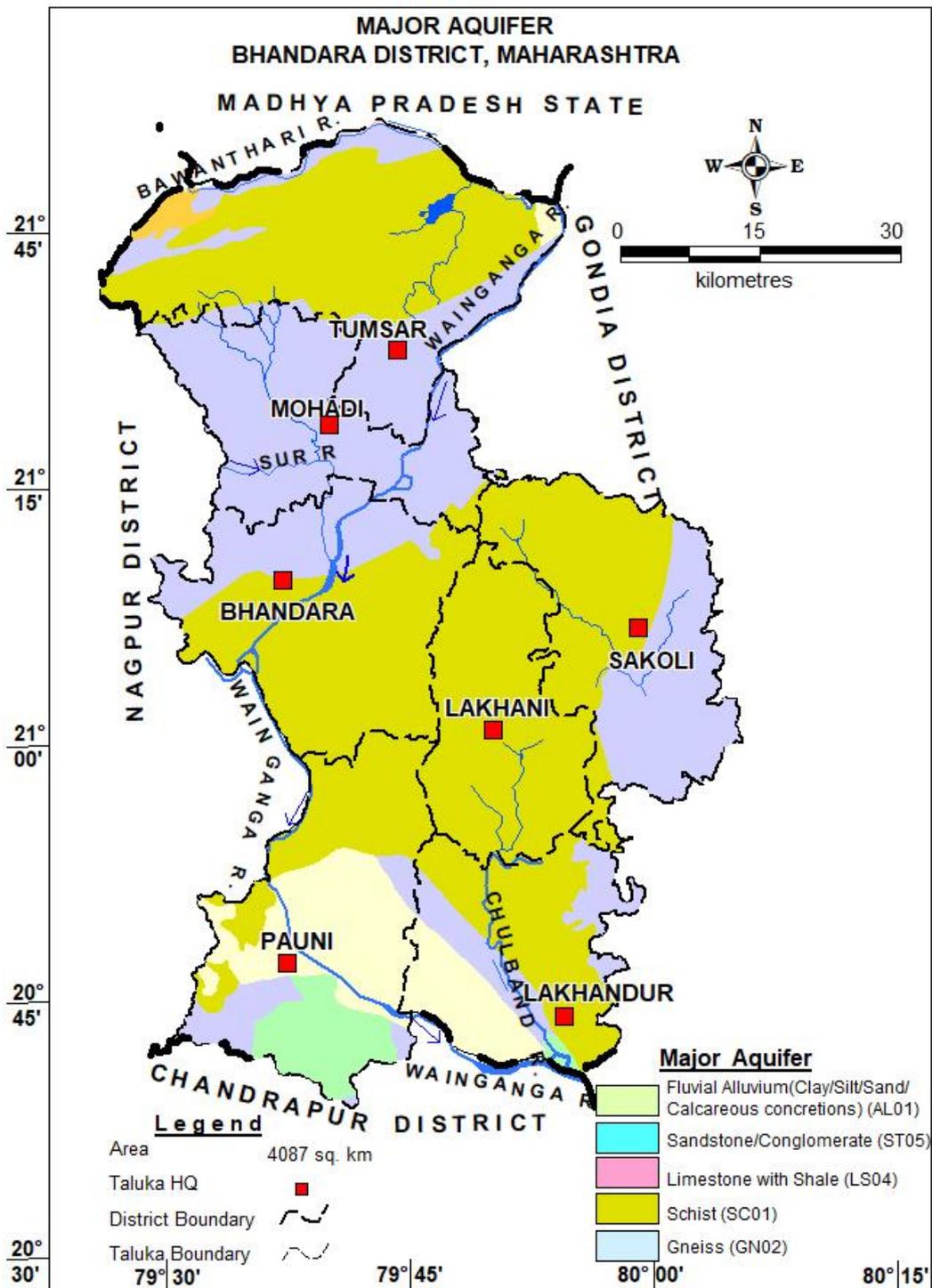


Figure 2. 3: Principal Aquifers, Bhandara district



**Figure 2. 4: Major Aquifers, Bhandara district**

### 2.2 Aquifer Geometry and Characterisation

Based on the ground water exploration data the existing aquifer systems in the area may be divided into two namely phreatic and deeper aquifer. Depth of occurrence of Aquifer -I and II is depicted in Fig. 2.6 and yield in the Fig. 2.7

#### **Gneiss Aquifer System:**

Groundwater occurrence is largely limited to secondary permeability, such as weathered zones, joints, fractures or faults. The potential of weathered zones depends on the degree and depth of weathering and associated fracturing, and the saturated thickness. The aquifers

are generally discontinuous, and often confined. Higher yields are obtained where thick weathered zones are associated with bedrock fracturing.

The depth of dug wells range from 9 to 18 mbgl and thickness of weathered/fractured zone varies from 5 to 15 m. The yield of dugwells in gneiss up to 50 m<sup>3</sup>/ day. The depth of borewell ranges from 40 to 500.10 m. Fractured zones are encountered up to 264 m and discharge was meagre to 8.77 lps. In majority of the wells productive fracture zones are encountered up to 100 m and in few places potential deep-seated fracture zones are encountered beyond 100m. Maximum discharge was found (8.77 lps) at Sindpuri, Tumsar block.

#### Schist Aquifer system:

Schist aquifer is dominant in sakoli group of rocks. Groundwater occurrence is largely limited to secondary permeability, such as weathered zones, joints and fractures. The potential of weathered zones depends on the degree and depth of weathering and associated fracturing, and the saturated thickness. The aquifers are generally discontinuous, and often confined. Higher yields are obtained where thick weathered zones are associated with bedrock fracturing.

The depth of dug wells range from 9 to 18 mbgl and thickness of weathered/fractured zone varies from 5 to 15 m. The yield of dugwells varies up to 50 m<sup>3</sup>/ day. The depth of borewell ranges from 40 to 201.6 m. fractured zones are encountered up to 159 m and discharge was meagre to 6.43 lps. In majority of the wells productive fracture zones are encountered up to 100 m and in few places potential deep-seated fracture zone encountered beyond 100m. Maximum discharge was found (6.43 lps) at Lakhandur, Lakhandur block.

#### Alluvium Aquifer system:

Alluvium aquifer is mainly confined to the banks of Wainganga Rivers and its tributaries occurring in narrow patch, they comprise mostly gravel, sand, silt and clays. Ground water occur under both water table and semi-confined conditions. The depth of dug wells varies from 30 to 45 m and average yield of the dug wells up to 120 m<sup>3</sup>/day.

**Table 2. 1: Aquifer Characteristic of Major aquifers of Bhandara district**

Major Aquifers	SR	HR			
	Alluvium (AI01)	Schist (SC02)		Gneiss (GN 02)	
Type of Aquifer (Phreatic/Semiconfined/Confined)	Aquifer-I (Phreatic)	Aquifer-I (Phreatic)	Aquifer-II (Semiconfined/ confined)	Aquifer-I (Phreatic)	Aquifer-II (Semiconfined/ confined)
Depth to Bottom of Aquifer (mbgl)	18-45	9-18	33-159	9-18	30-264
Granular/Weathered/Fractured rocks thickness (m)	12-30	5-15	0.5-3	5-15	0.5-3
Yield Potential	10-120 m <sup>3</sup> /day	<10 to 55 m <sup>3</sup> /day	up to 1.5 lps	<10-61 m <sup>3</sup> /day	upto 2.5 lps
Specific Yield (Sy)/ Storativity (S)	0.07	0.015	1.49x10 <sup>-4</sup> to 8.7x10 <sup>-4</sup>	0.015	1.1x10 <sup>-4</sup> to 2.4x10 <sup>-5</sup>
Transmissivity (T) (m <sup>2</sup> /day)	-	-	2 to 61	-	0.23 to 35.25

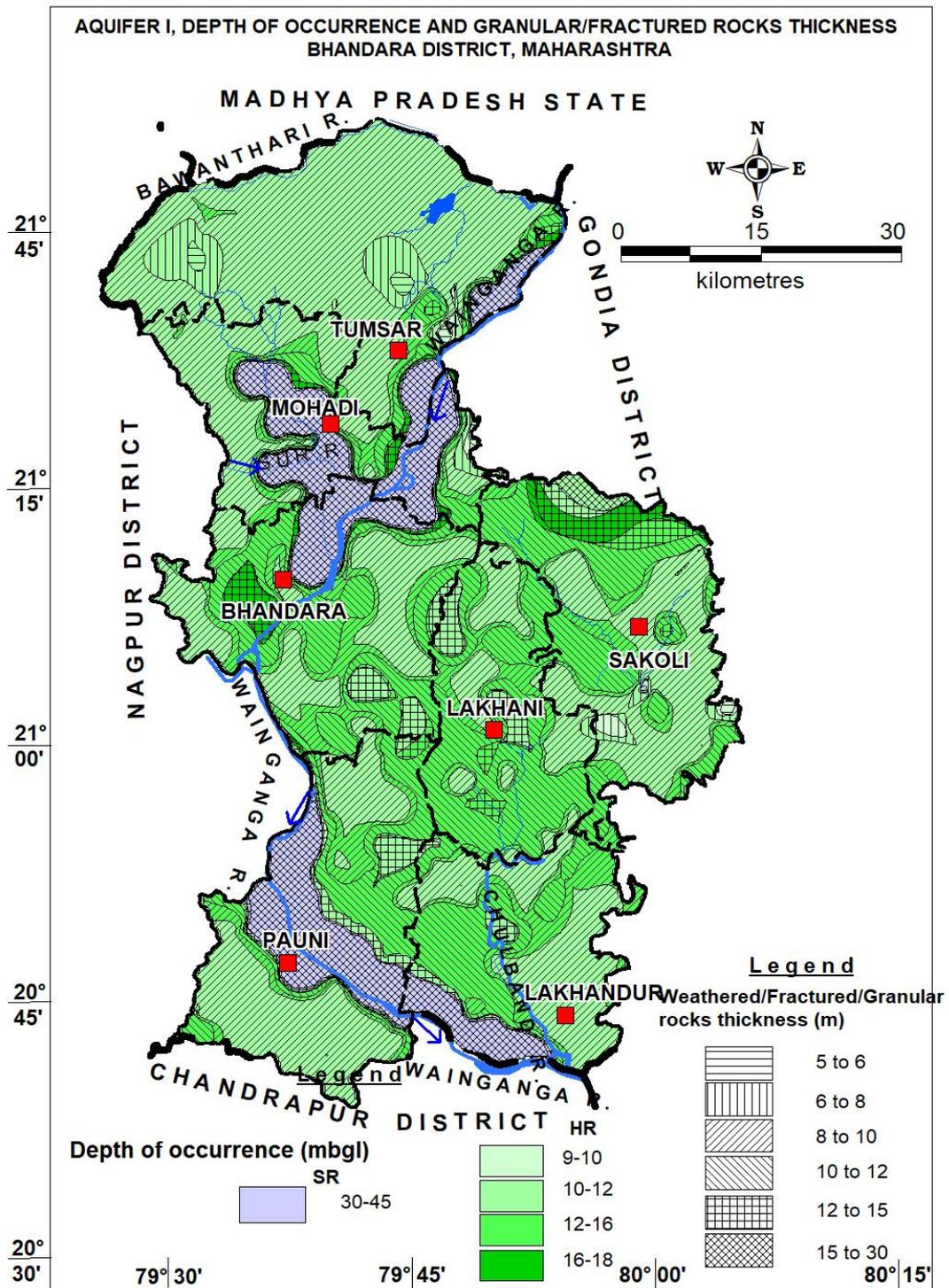


Figure 2. 5: Depth of Occurrence and Granular Zone/ Fractured rock thickness-Aquifer-I

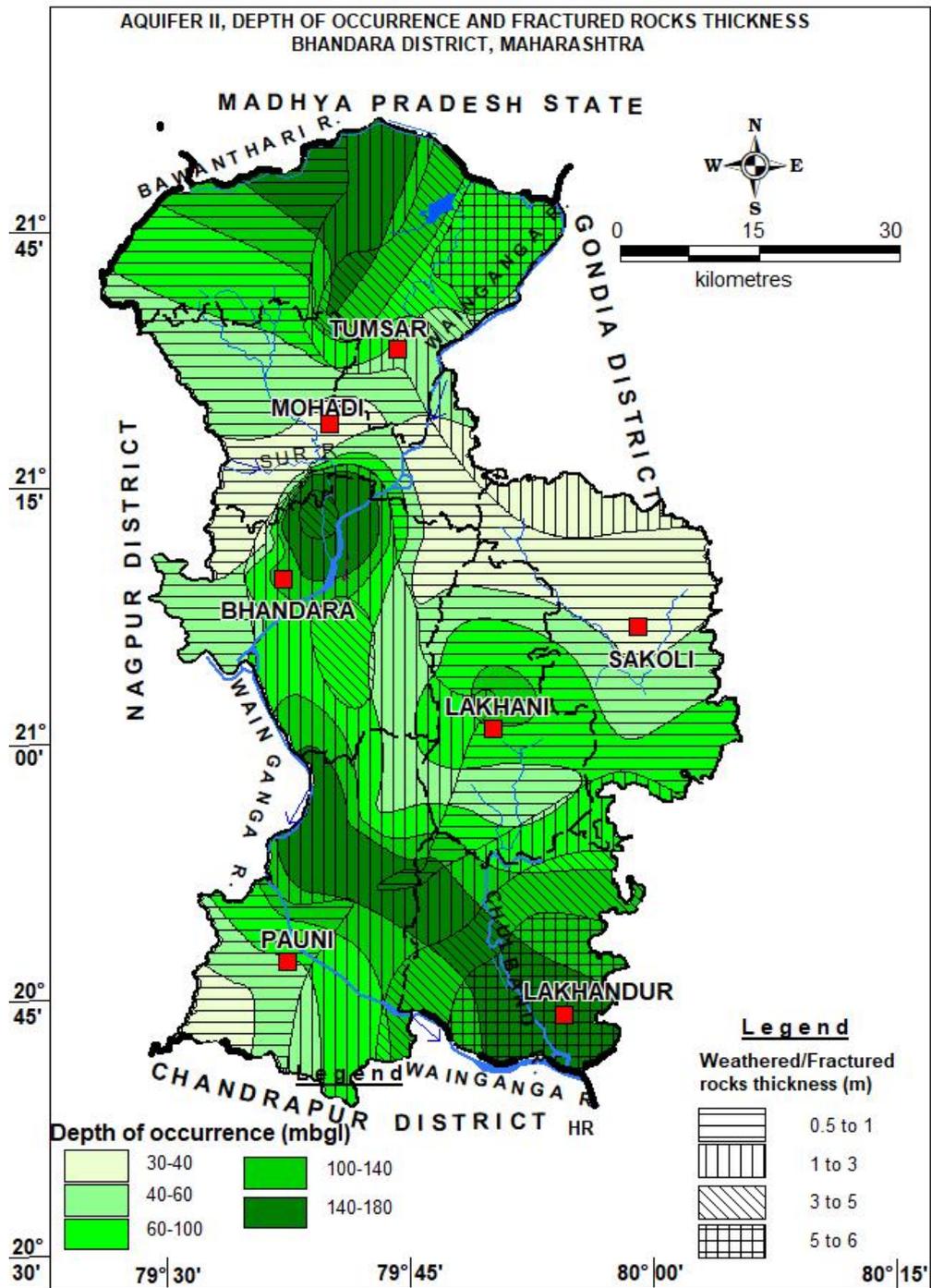


Figure 2. 6: Depth of Occurrence and Fractured rock thickness -Aquifer-II

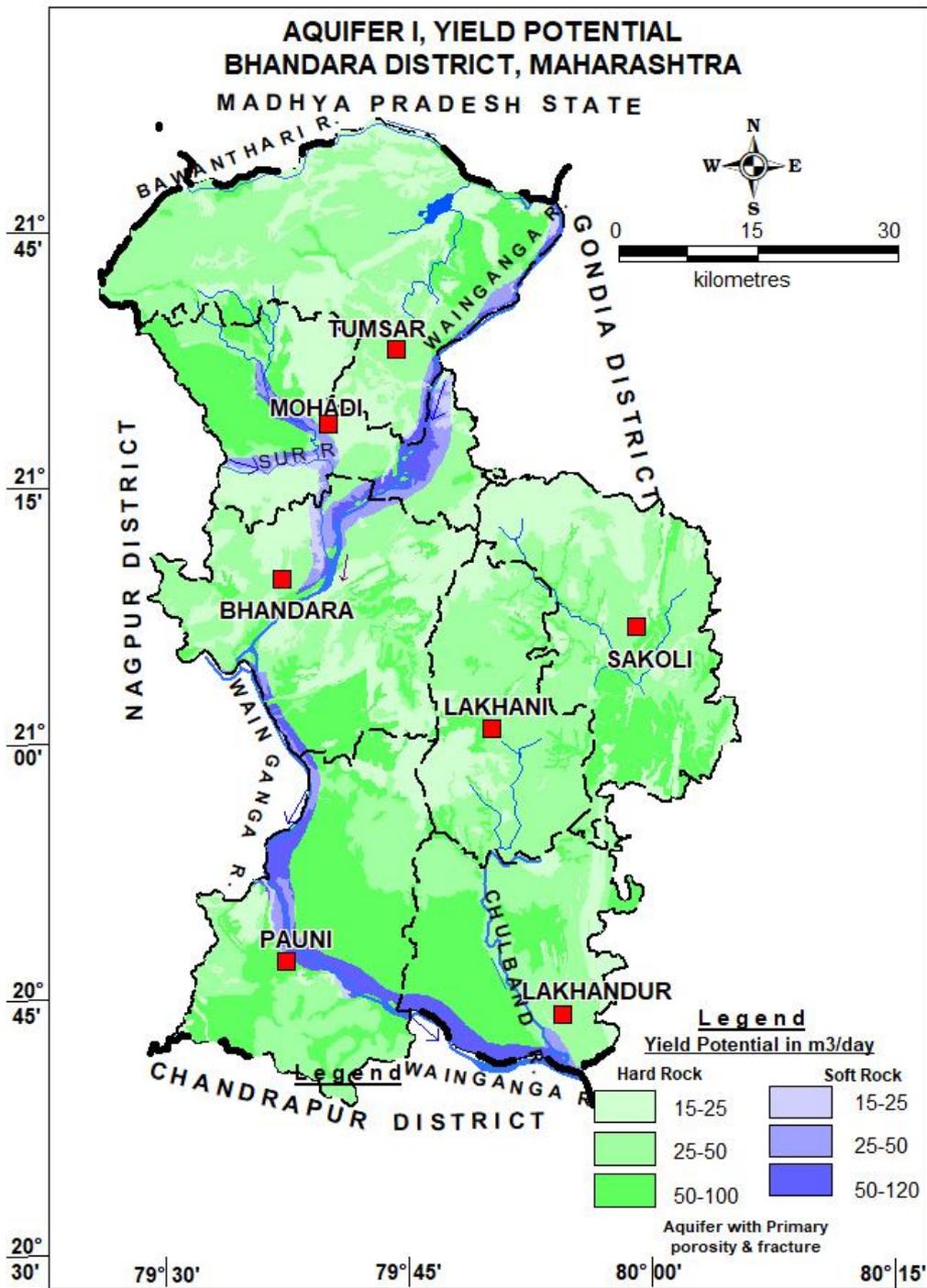


Figure 2. 7: Yield Potential Aquifer-I

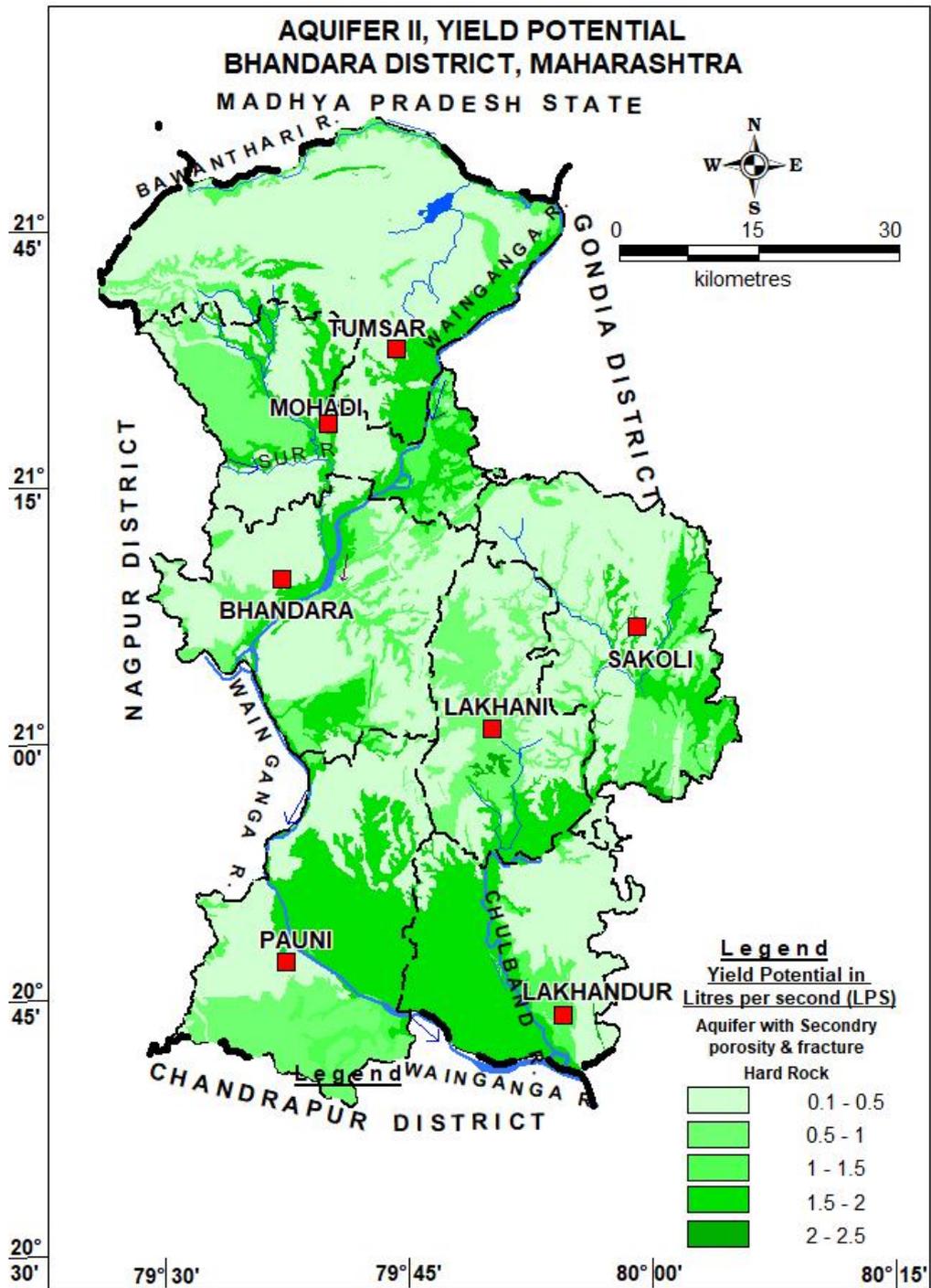


Figure 2. 8: Yield Potential, Aquifer-II

## 2.2 AQUIFER PARAMETERS

Based on pumping tests conducted on exploratory wells, it is observed that in crystalline rocks the transmissivity ranges from 0.23 to 61 m<sup>2</sup>/day and the Storativity from 1.5 x 10<sup>-4</sup> to 2.4 x 10<sup>-5</sup>.

The yields of wells are functions of the permeability and transmissivity of aquifer encountered and vary with location, diameter and depth etc. There are mainly two type of ground water structures i.e., dugwells and borewells in the district. Yields of dugwells vary according to the nature of formations tapped. The dugwells in Crystalline/Achaeans yield between 46 and 180 m<sup>3</sup>/day for drawdown of 0.20 to 5.63 m. In Alluvium, the yield of dugwells is observed between 65 and 600 m<sup>3</sup>/day for drawdown of 0.20 to 1.15 m. In exploratory wells drilled by CGWB the yield ranges from 0.14 to 8.77 lps. The borewells drilled by GSDA yield between 2000 and 5000 lph. It has been observed that the borewells drilled in granitic gneisses are more productive than drilled in Schist's/ Quartzite's.

## 2.3 3-D AND 2-D AQUIFER DISPOSITION

Based on the existing data, aquifer disposition in 3D, Fence diagram, bar diagram, various hydrogeological sections have been prepared along section lines to understand the subsurface disposition of aquifer systems and are shown in Fig. 2.9 to 2.16.

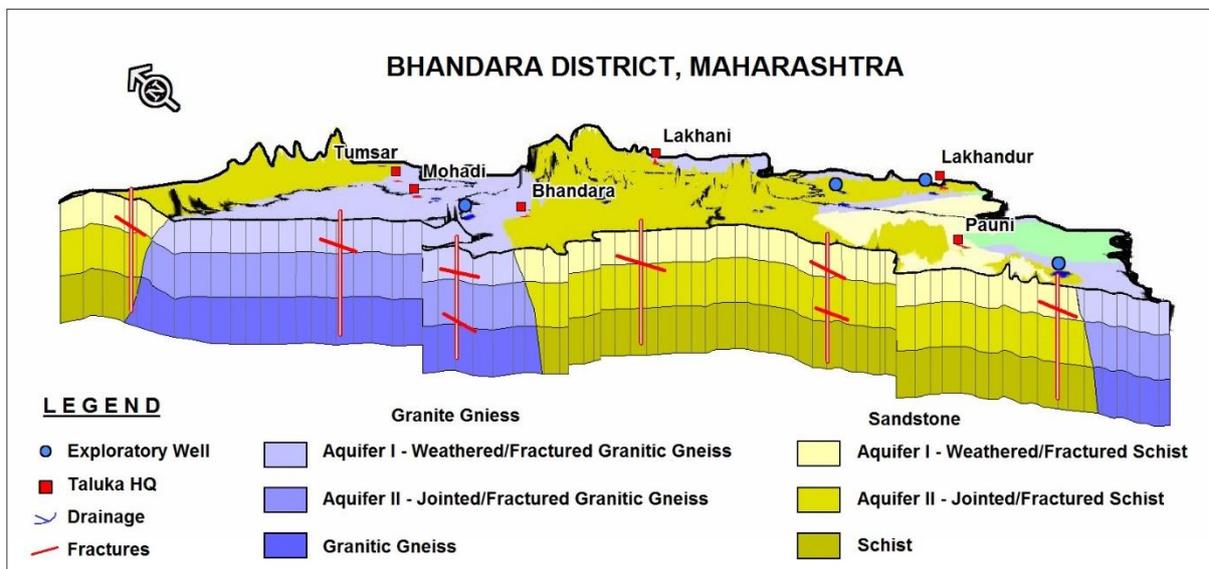


Figure 2. 9: 3D Aquifer Disposition

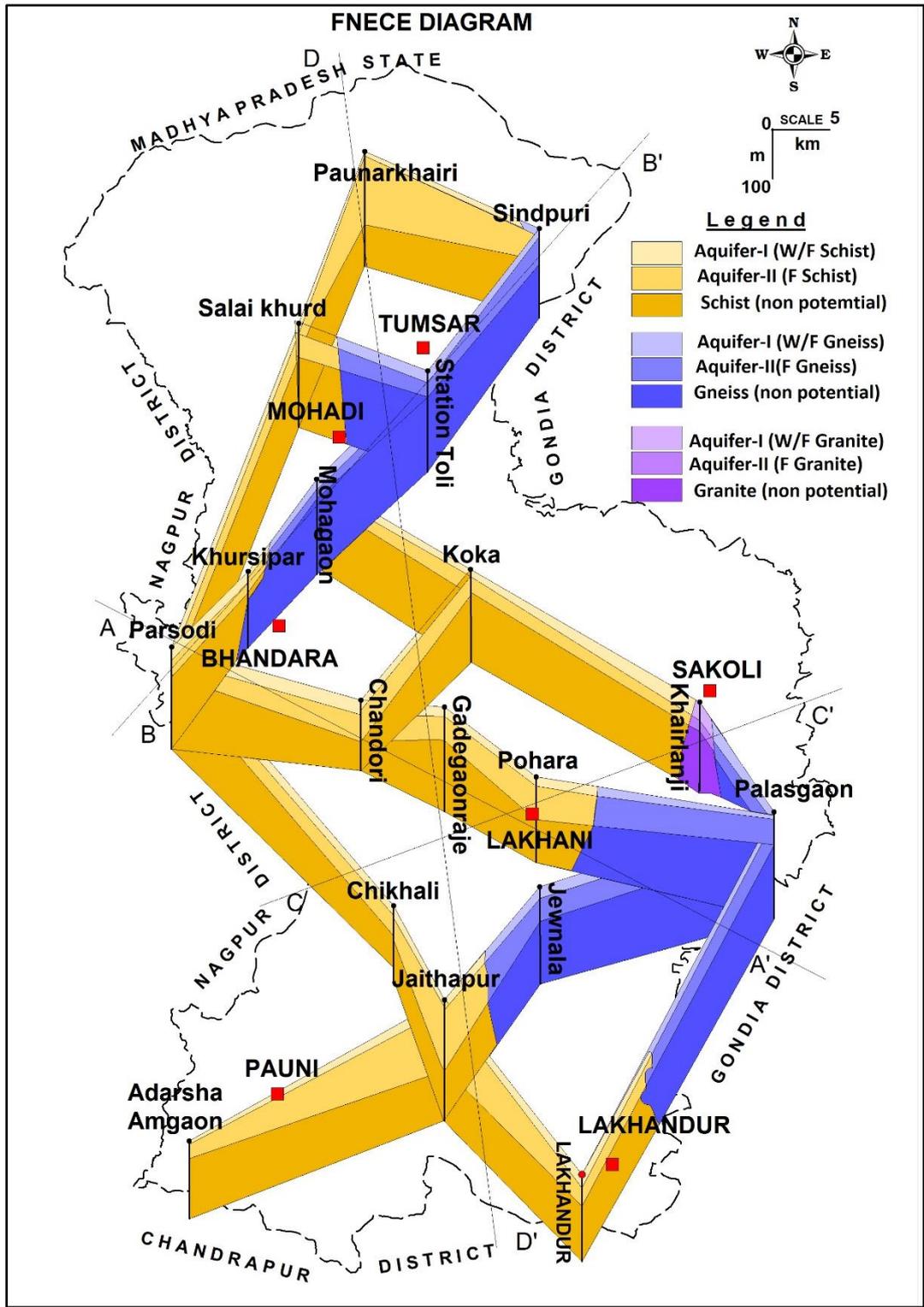


Figure 2. 10: 3D Fence Diagram

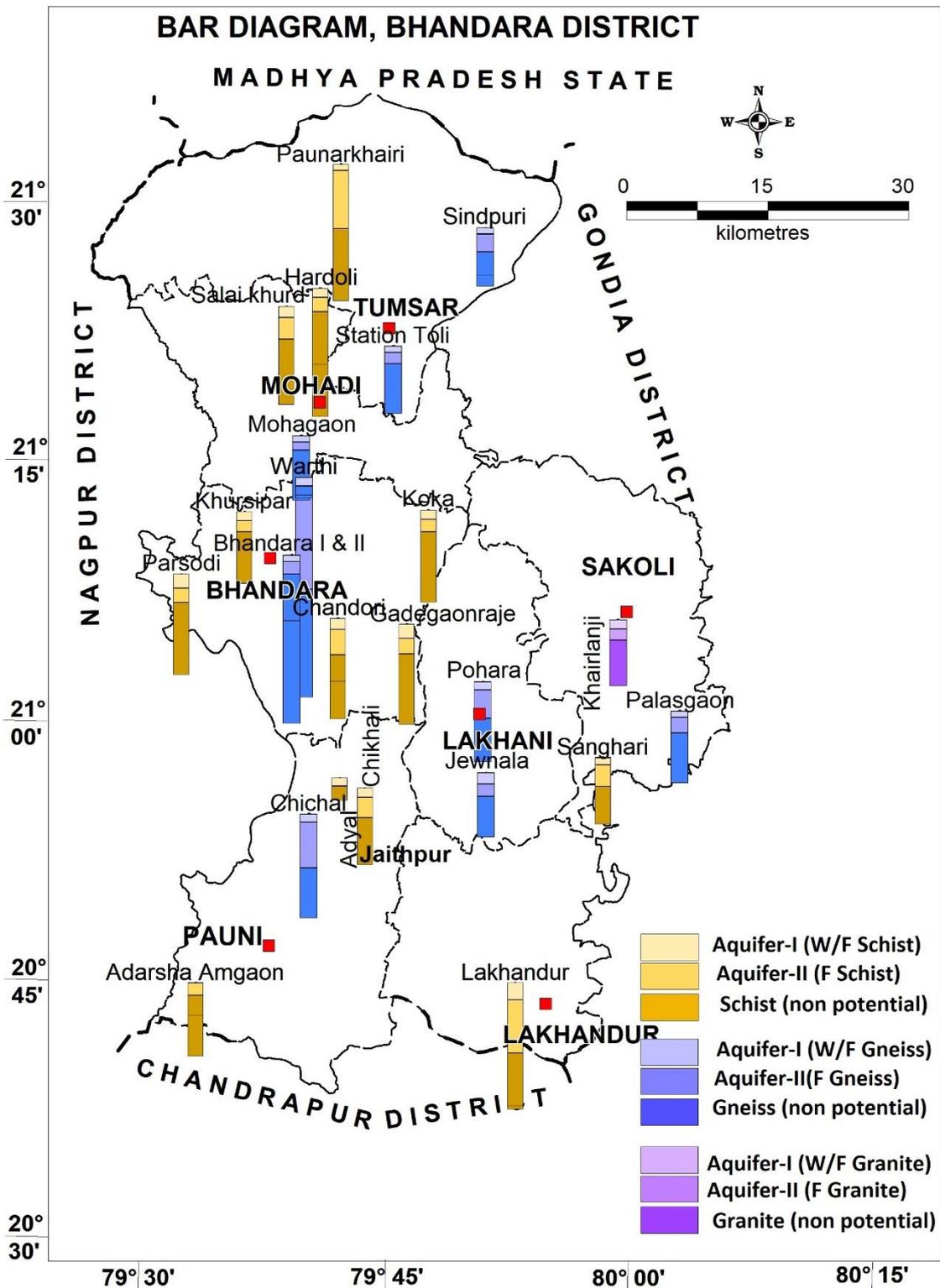


Figure 2. 11: 3D-Bar Diagram

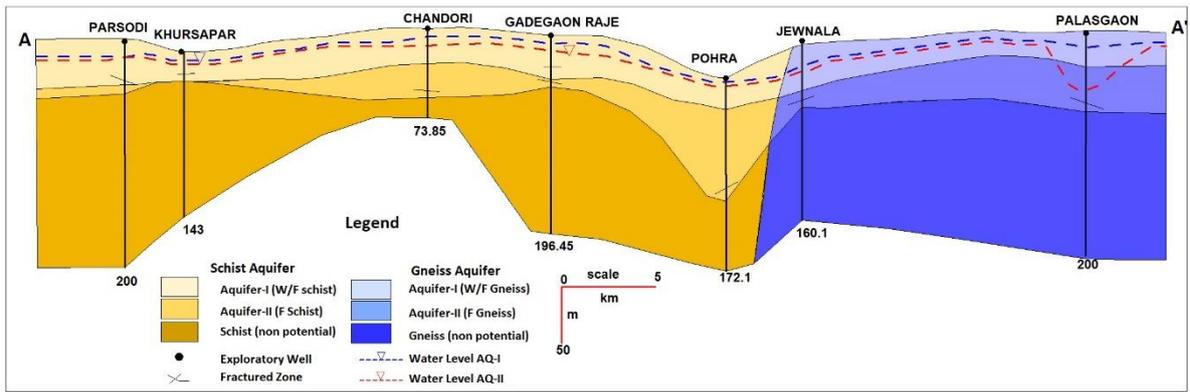


Figure 2. 12: Lithological section (A-A')

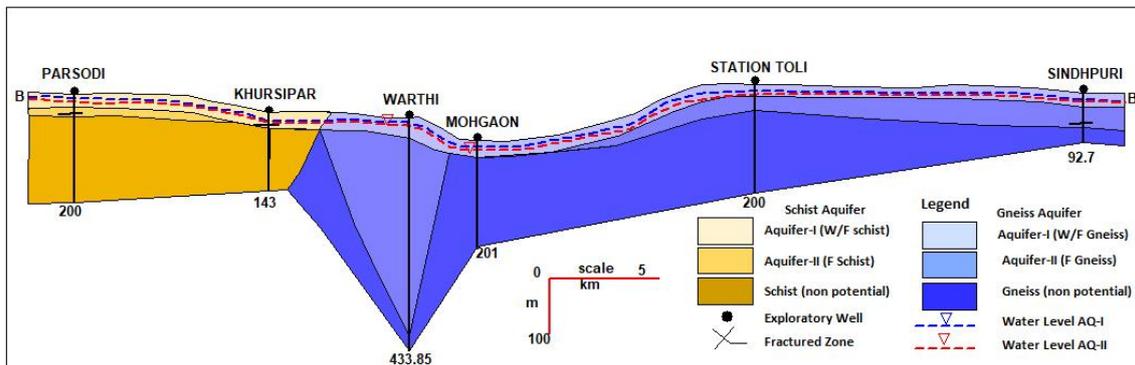


Figure 2. 13: Lithological section (B-B')

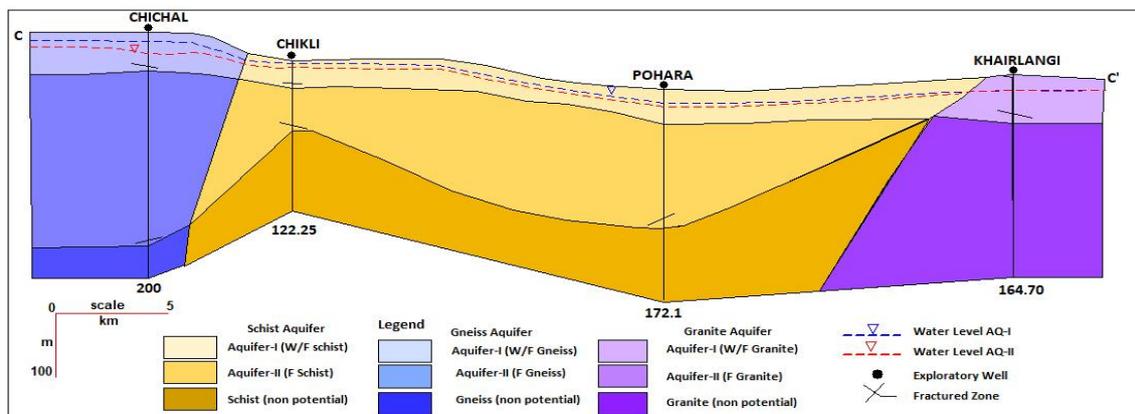


Figure 2. 14 : Lithological section (C-C')

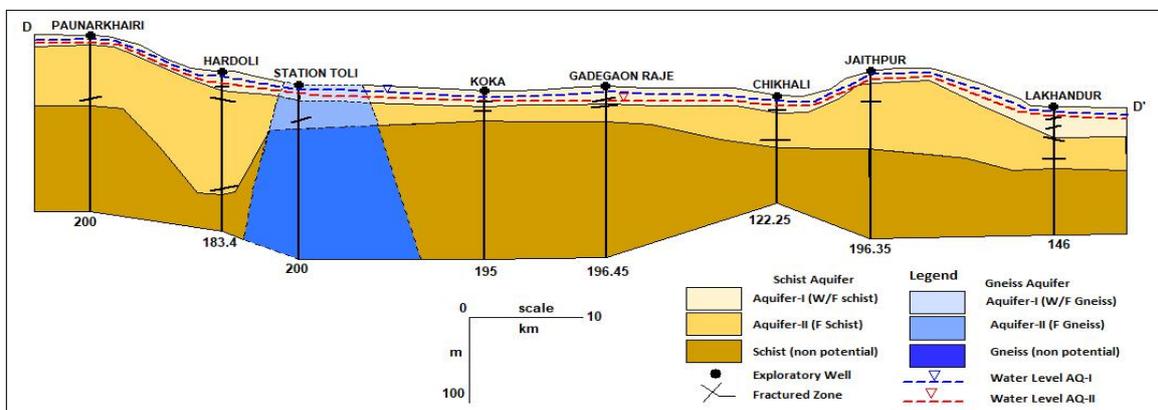


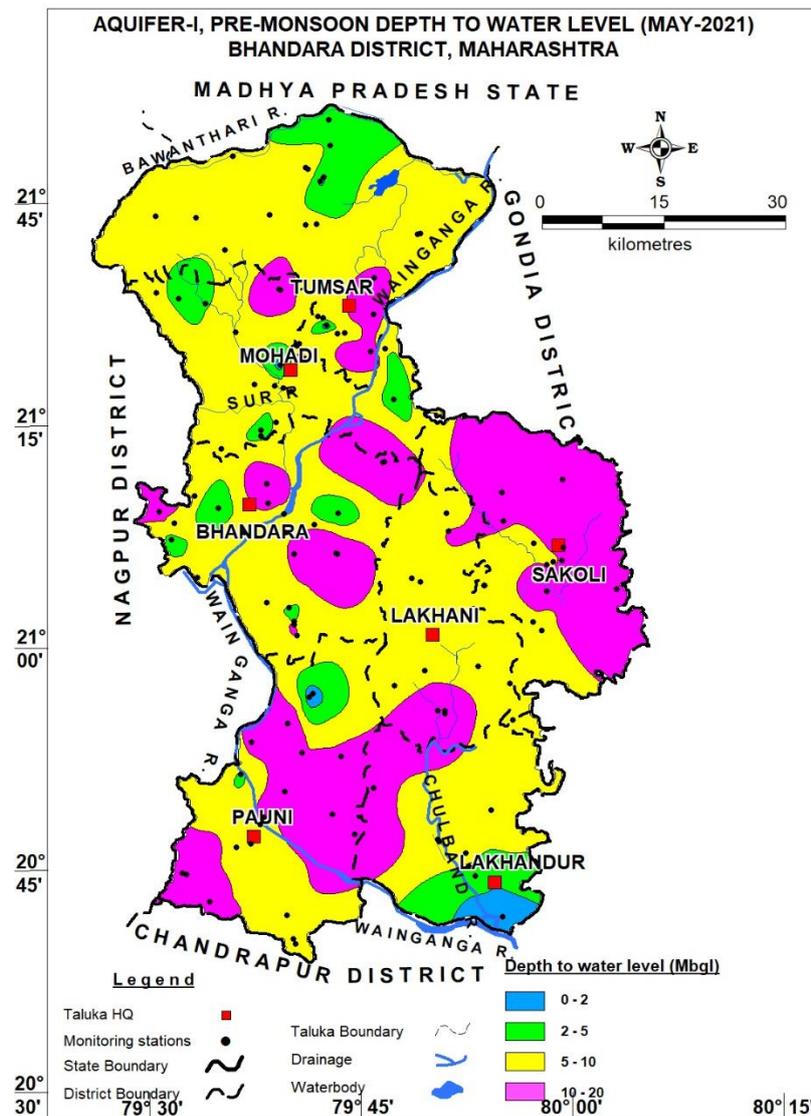
Figure 2. 15: Lithological section (D-D')

### 3. WATER LEVEL SCENARIO

#### 3.1 DEPTH TO WATER LEVEL (AQUIER-I/SHALLOW AQUIFER)

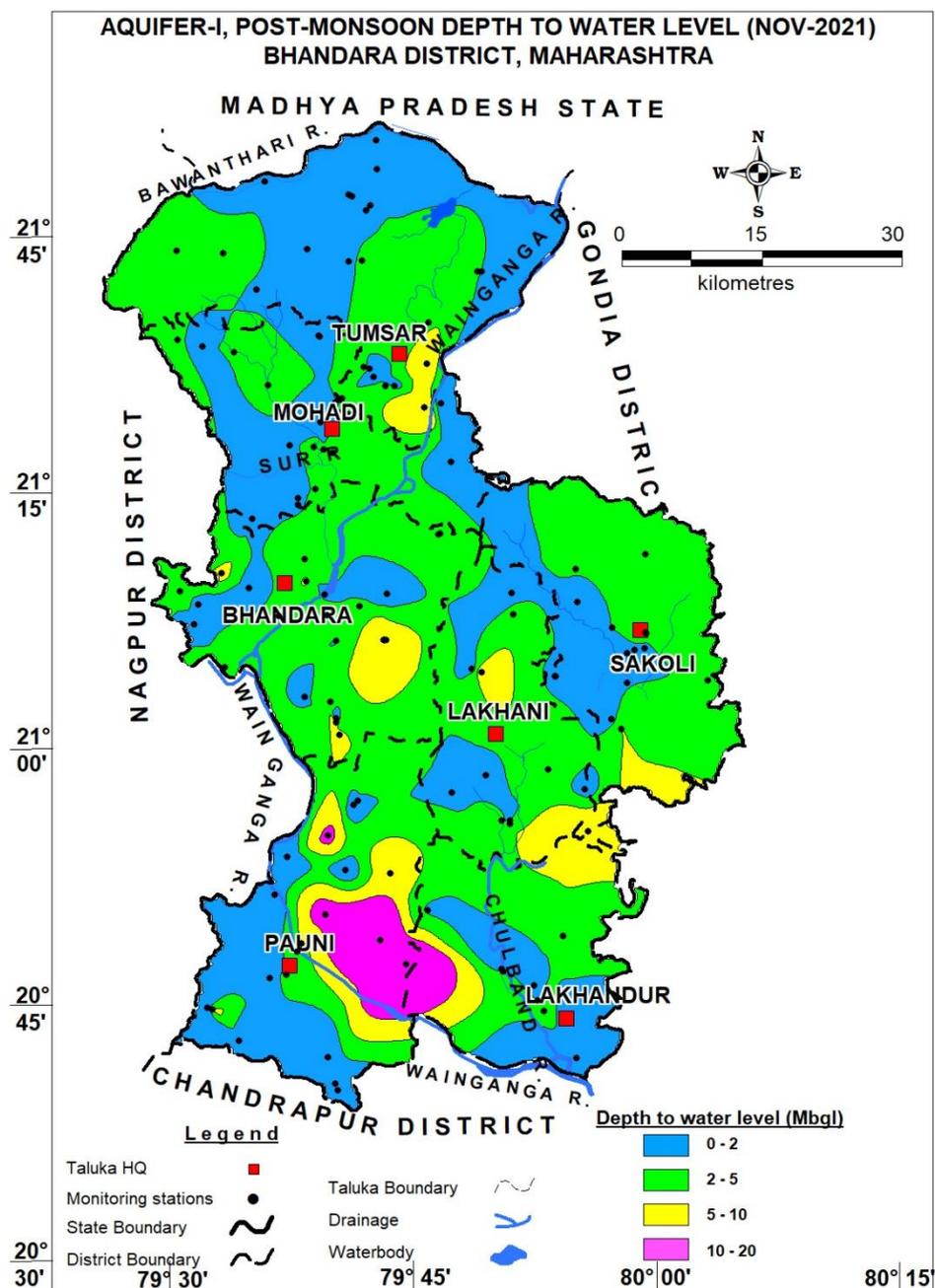
Central Ground Water Board periodically monitors 43 Ground Water monitoring wells four times a year i.e., in May (Pre monsoon), August, November (Post monsoon) and January in the district. Apart from this data, the data obtained from 82 wells from GSDA has also been used for preparation of depth to water level maps of the district. However, during May 2021, CGWB could not carry out the monitoring of these wells (GWMWs) in the state because of restrictions (lockdown) on the movement of men and material across the state due to COVID 19 pandemic; so, Pre-monsoon DTWL map is prepared based on GSDA data only and for post monsoon water level map both CGWB and GSDA data were used. Premonsoon and post monsoon data are given in **Annexure-III and IV**.

The depth to water levels during May 2021 were found ranging from 0.7 (Mangali Tudka, Tumsar block) to 23.8 mbgl (Dhargaon, Bhandara block). Shallow water level within 5 mbgl are observed in small isolated patches in all the blocks except Sakoli and Lakhni blocks covering 386 sq km area of the district. Water levels between 5 and 10 mbgl have been observed in major part of the district covering about 2506 sq. km. The depth to water level between 10 to 20 mbgl has been observed in major parts of Pauni and Sakoli blocks and isolated patches are also observed in rest of the blocks covering 1182 sq. km. area. The pre monsoon depth to water level map is depicted in **Fig. 3.1**.



**Figure 3. 1 : DTWL, Shallow Aquifer (May 2021)**

The depth to water levels in the district during Nov. 2021 were found ranging from 0.1 (Gobarwahi and Bageda, Tumsar block) to 19.8 mbgl (Dhargaon, Bhandara block). Shallow water levels less than 2 mbgl have been observed in 1434 sq. km area as patches in parts of all the blocks of the district. Water levels between 2-5 mbgl have been observed in major part of district covering 2144 sq. km. area. Water levels between 5 and 10 mbgl are observed as isolated patches in southern part of the district covering about 364 sq. km. area. The depth to water level more than 10 mbgl has been observed in isolated patches in Pauni and Lakhandur blocks covering only 131 sq. km. area of the district. Spatial variation in post monsoon depth to water levels is shown in **Fig. 3.2**.

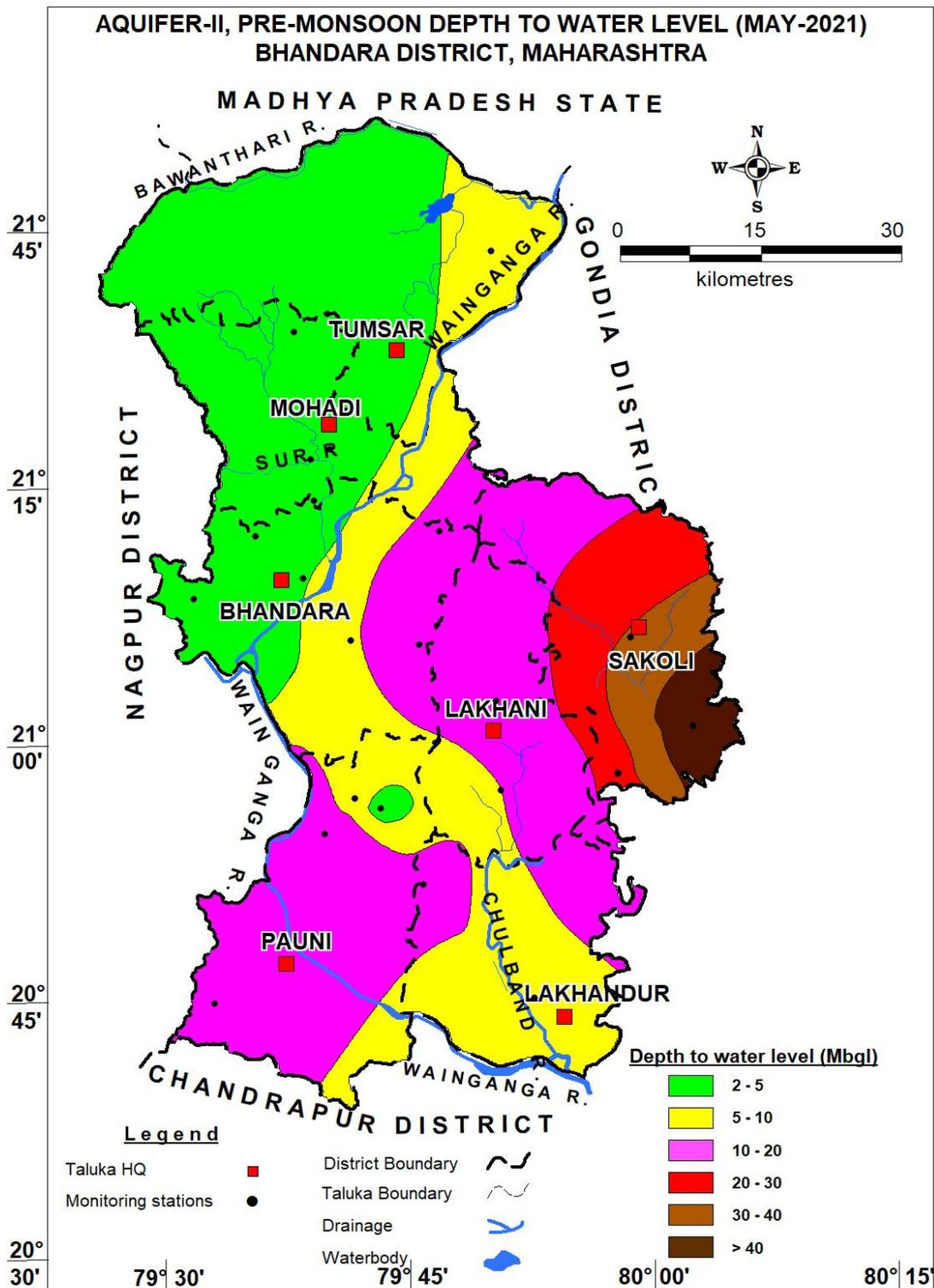


**Figure 3. 2: DTWL, Shallow Aquifer (Nov. 2021)**

### 3.2 DEPTH TO WATER LEVEL (AQUIFER-II/ DEEPER AQUIFER)

Total 35 exploratory wells' data has been used for preparation of depth to water level maps of the district. The pre-monsoon (May 2021) depth to water level in Bhandara District ranges from 2.1 (Parsodi, Bhandara block) to 45.3 mbgl (Palasgaon, Lakhandur block). The depth to water level less

than 10 mbgl has been observed in major part of Mohadi, Bhandara and Tumsar blocks. Water level between 10 and 20 mbgl has been observed in major part of Pauni and Lakhni blocks and parts of Sakoli and lakhandur blocks. Water level more than 20 mbgl has been observed in parts of Sakoli block. The Premonsoon depth to water level for Aquifer -II is given in Fig. 3.3.



**Figure 3. 3: DTWL, Deeper Aquifer (May 2021)**

The post-monsoon (November 2021) depth to water level in Bhandara District ranges from 1.92 (Bhandara, Bhandara block) to 10.25 mbgl (Adarsa Amgaon, Pauni block). The depth to water level less than 5 mbgl has been observed as continuous patch from north to south of the district. Water level between 5 and 10 mbgl has been observed in major part covering eastern and western

parts of the district. Water level between 10 to 20 mbgl has been observed as isolated small patch in Pauni block. The post monsoon depth to water level for Aquifer -II is given in Fig. 3.4.

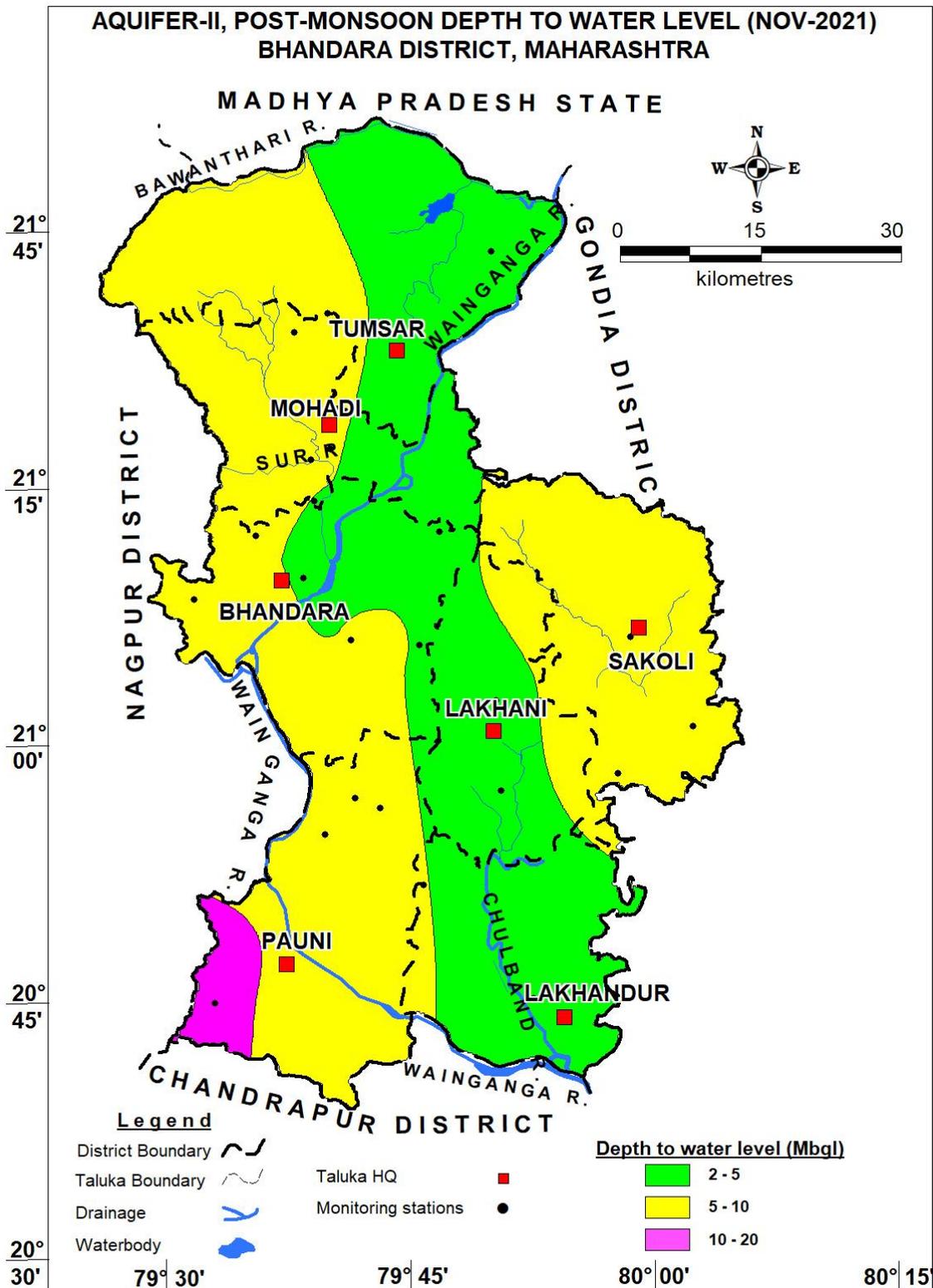


Figure 3. 4 DTWL, Deeper Aquifer (Nov. 2021)

### 3.3 WATER LEVEL TREND (2012-2021)

During pre-monsoon period, falling water level trend has been recorded at 68 stations ranging from 0.0094 (Dewhada, Mohadi block) to 0.69 m/year (Murmadi, Lakhni block) while Rising trend was observed in 30 stations varying from 0.0036 (Pawarkhairi, Tumsar block) to 0.4735 m/year (Daodipar

Khapa, Tumsar block).

During pre-monsoon period, decline in water level trend has been observed in 3182 sq. km. i.e., 78 % of the area covering major part of the district. Significant decline of more than 0.20 m/year has been observed in 1325 sq. km., i.e., 33% of the area in parts Lakhni, Sakoli, Bhandara, Mohadi and Pauni blocks and isolated patches are observed in Mohadi block. Rise in water level trend has been observed in 891 sq. km area as isolated patches in all the blocks except Lakhni block. (Fig.3.5)

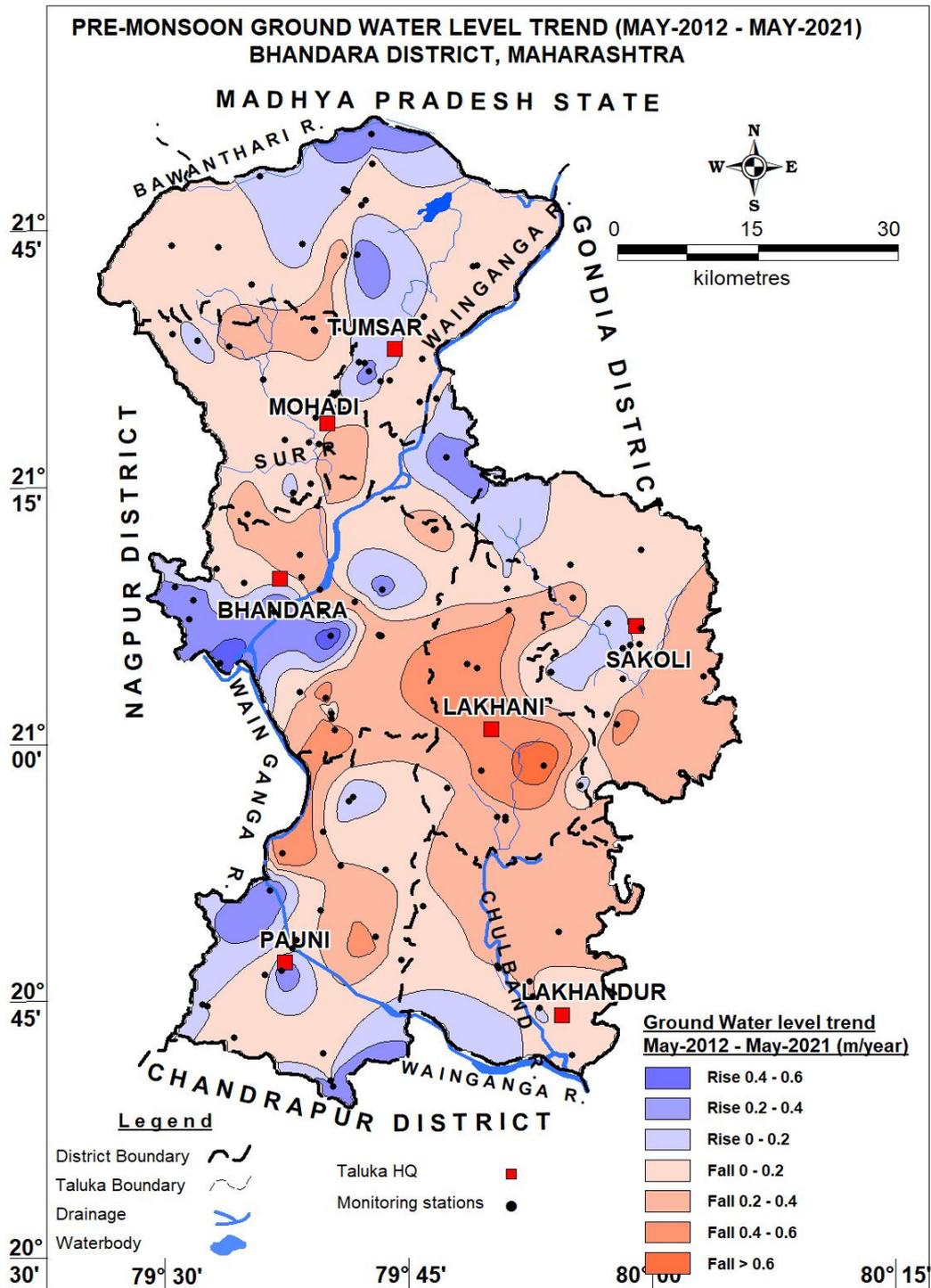
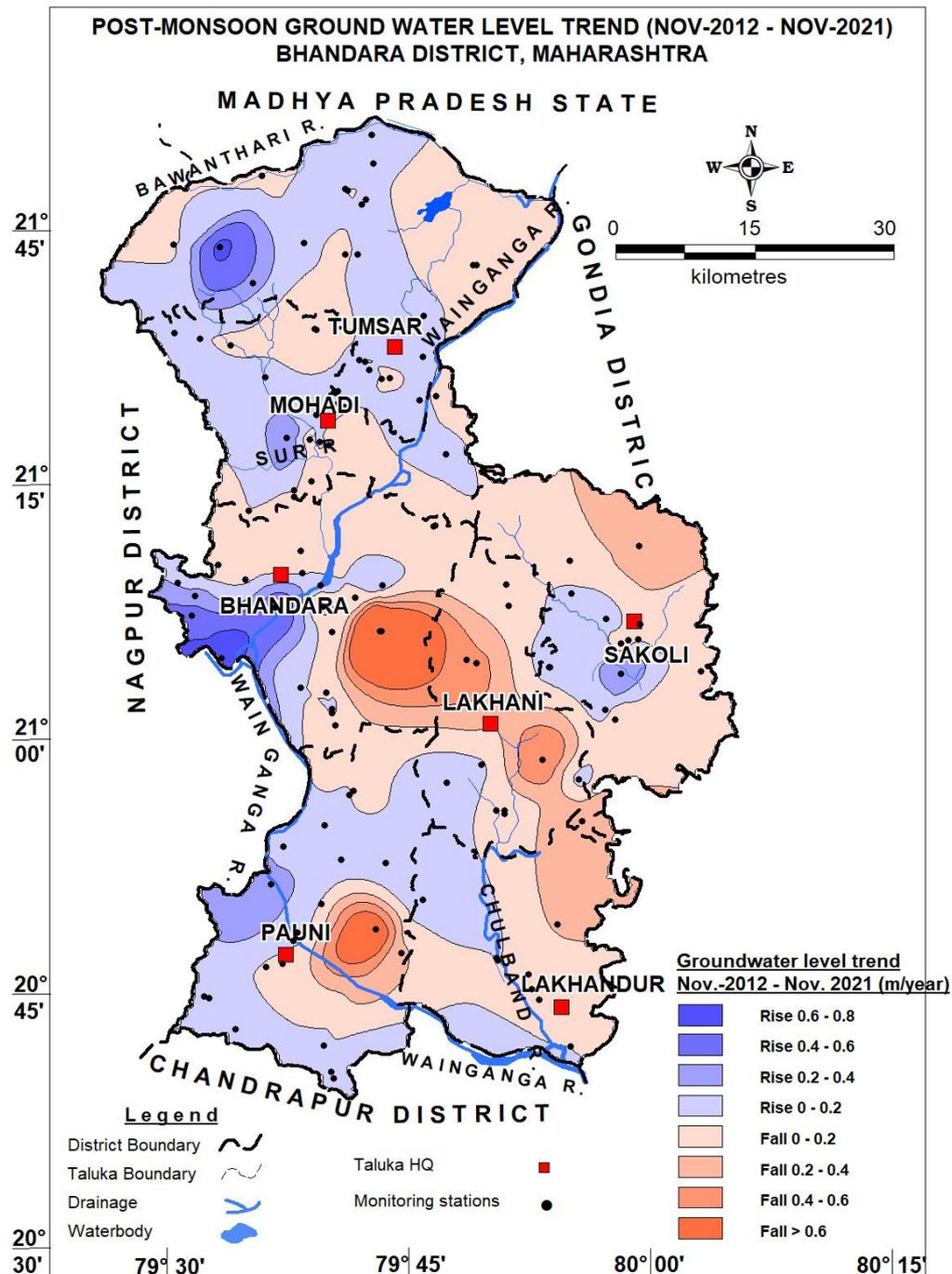


Figure 3. 5: Pre-monsoon Decadal Trend (2012-21)

Fall @>0.2m/year 1325 Sq. km. (about 33% area of the district)

During post monsoon period, rise in water level trend has been recorded at 50 stations and ranges from 0.0050 (Rajapur, Tumsar block) to 0.6697 m/year (Pipari, Bhandara block) while falling trend was observed at 49 stations varying from 0.0006 (Soni and Dighori, Lakhandur block) to 1.16 m/year (Dhargaon, Bhandara block). Rising water level trend has been observed in major part of Mohadi, Tumsar, Bhandara and pauni blocks and isolated parts of Sakoli and Lakhandur blocks covering about 1668 sq. km. area. Fall in water level trend has been observed in 2404 sq. km. area covering major part of the district. Significant decline, more than 0.20 m/year has been observed in 610 sq. km. area covering parts of Pauni, Lakhni, Sakoli and Lakhandur blocks. (Fig 3.6) These declines may be due to the exploitation of ground water or low and erratic rainfall received in these areas. Water level trend data (2012-21) of observation wells of CGWB and GSDA is given in Annexure-V.



**Figure 3. 6: Post monsoon Decadal Trend (2012-21)  
Fall @>0.2m/year 611 Sq. km. (about 15% of the district)**

### 3.4 HYDROGRAPH ANALYSIS

The variation in short term and long-term water level trends may be due to variation in natural recharge from rainfall and withdrawal of groundwater for various agricultural, domestic and industrial requirements. The analysis of hydrographs shows that the annual rising limbs in hydrographs indicate the natural recharge of groundwater regime due to monsoon rainfall, as the monsoon rainfall is the sole source of natural recharge to the ground water regime. However, continuous increase in the groundwater draft is indicated by the recessionary limb. The figure 3.7 shows selected hydrographs (time series) of water levels.

<p><b>Hydrograph (2012-21), village Adyal, Pauni Block, Bhandara District</b></p> <p> <math>y = -45.277x + 1385.6</math>      pre <math>y = 0.0845x + 2.36</math>      post <math>y = 0.0287x + 0.4847</math> </p> <p>             ANNUAL RF      Premonsson WI      Post monsoon WI         </p>	<p>Formation: Schist                  Type of Well: Dug Well                  Premonsoon and postmonsoon Water level shows rising trend @ 0.084 and 0.028 m/ year respectively.                  Declining Rainfall trend @45.27 mm/ year                  water level behaviour is not in conformity with rainfall.</p>
<p><b>Hydrograph (2012-21), village Mohadi, Mohadi Block, Bhandara District</b></p> <p> <math>RF y = -16.813x + 1183.2</math>      pre <math>y = -0.1021x + 2.3633</math>      post <math>y = 0.0461x + 0.5733</math> </p> <p>             ANNUAL RF      Premonsson WI      Post monsoon WI         </p>	<p>Formation: Granite Gneiss                  Type of Well: Dug Well                  Premonsoon Water level trend showing falling trend @ 0.0461 and postmonsoon water level showing rising trend 0.04 m/year respectively. rising Rainfall trend @16.81 mm/year water level behaviour in conformity with rainfall.</p>
<p><b>Hydrograph (2012-21), village Bhugaon, Lakhni Block, Bhandara District</b></p> <p> <math>y = 6.4127x + 1237</math>      pre <math>y = 0.0239x + 8.1967</math>      post <math>y = 0.0342x + 1.4333</math> </p> <p>             ANNUAL RF      Premonsson WI         </p>	<p>Formation: Schist                  Type of Well: Dug Well                  Premonsoon and postmoonsoon Water level trends showing rising trend @ 0.023 m/year and 0.034 m/year respectively.                  Rising Rainfall trend @6.41 mm/ year                  Water level behaviour in conformity with rainfall.</p>

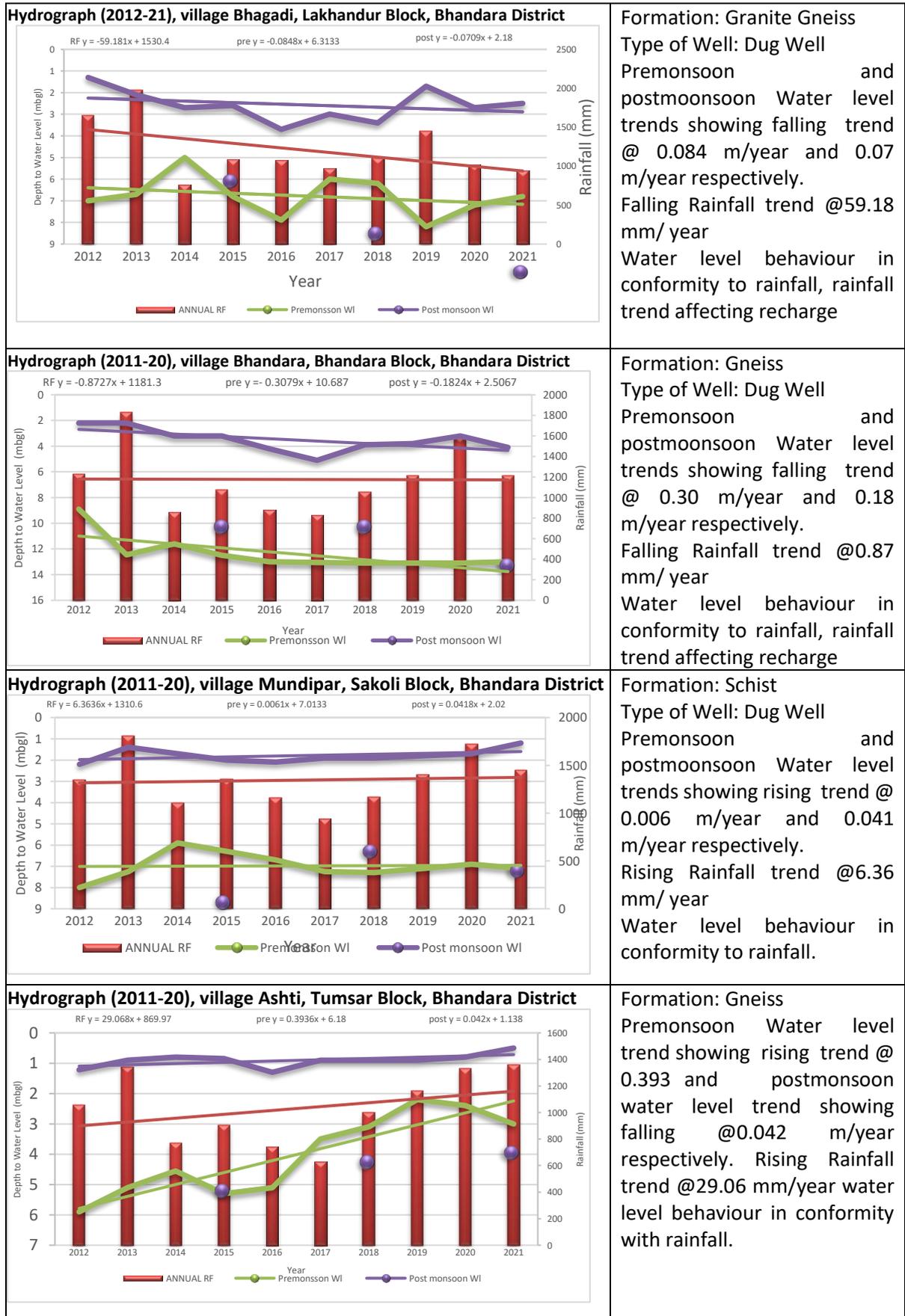


Figure 3. 7: Behavior of water level with time

#### 4. GROUND WATER QUALITY

Ground water samples are being collected every year from GWM wells during pre-monsoon period (May). Ground water quality data of 255 monitoring wells of CGWB and GSDA representing shallow aquifer has been utilised to decipher the quality scenario of shallow aquifer. 124 exploratory wells- tubewells/borewells data of CGWB and GSDA representing deeper aquifer has been utilised to decipher the quality scenario of deeper aquifer. The aquifer wise ranges of different chemical constituents present in ground water are given in Table 4.1. The details of chemical analysis are given in **Annexure VI and VII**.

**Table 4. 1: Aquifer wise ranges of chemical constituents in Bhandara district**

Constituents	Shallow aquifer		Deeper aquifer	
	Min	Max	Min	Max
pH	6.3	8.96	6.8	8.72
EC	209	4330	250	2410
TDS	35.7	1340	0	1510
TH	135.85	2771	40	856
Ca	25.25	267.65	12	114
Mg	2.5394	41.54	4	219
Na	15.3	88.69	13	92
K	0.75	51.25	1.05	460
CO <sub>3</sub>	0	0	12	18
HCO <sub>3</sub>	53.53	303.32	24.4	659
Cl	7.44	1350	3	515
SO <sub>4</sub>	0	165.24	2.11	146.32
NO <sub>3</sub>	0	183.13	1.256	180
F	0.01	1.475	0.002	1.48
Iron	BDL	2.7	0.001	0.79

#### Distribution of Electrical Conductivity in Shallow Aquifer:

The concentration of EC in shallow aquifer varies from 209 (Ekodi, Sakoli block) to 4330  $\mu\text{S}/\text{cm}$  (Dharmapuri, Mohadi block). Out of 255 samples collected from dug wells, only 13 samples are having EC more than 2250  $\mu\text{S}/\text{cm}$ . Concentration of EC >2250  $\mu\text{S}/\text{cm}$  has been observed in isolated patches in Lakhandur, Tumsar and Mohadi blocks covering 59 sq. km. area. The ground water is potable in major part of district except nitrate and fluoride affected villages. The distribution of electrical conductivity in shallow aquifers is shown in **Fig. 4.1** and analytical data is presented in **Table 4.2**.

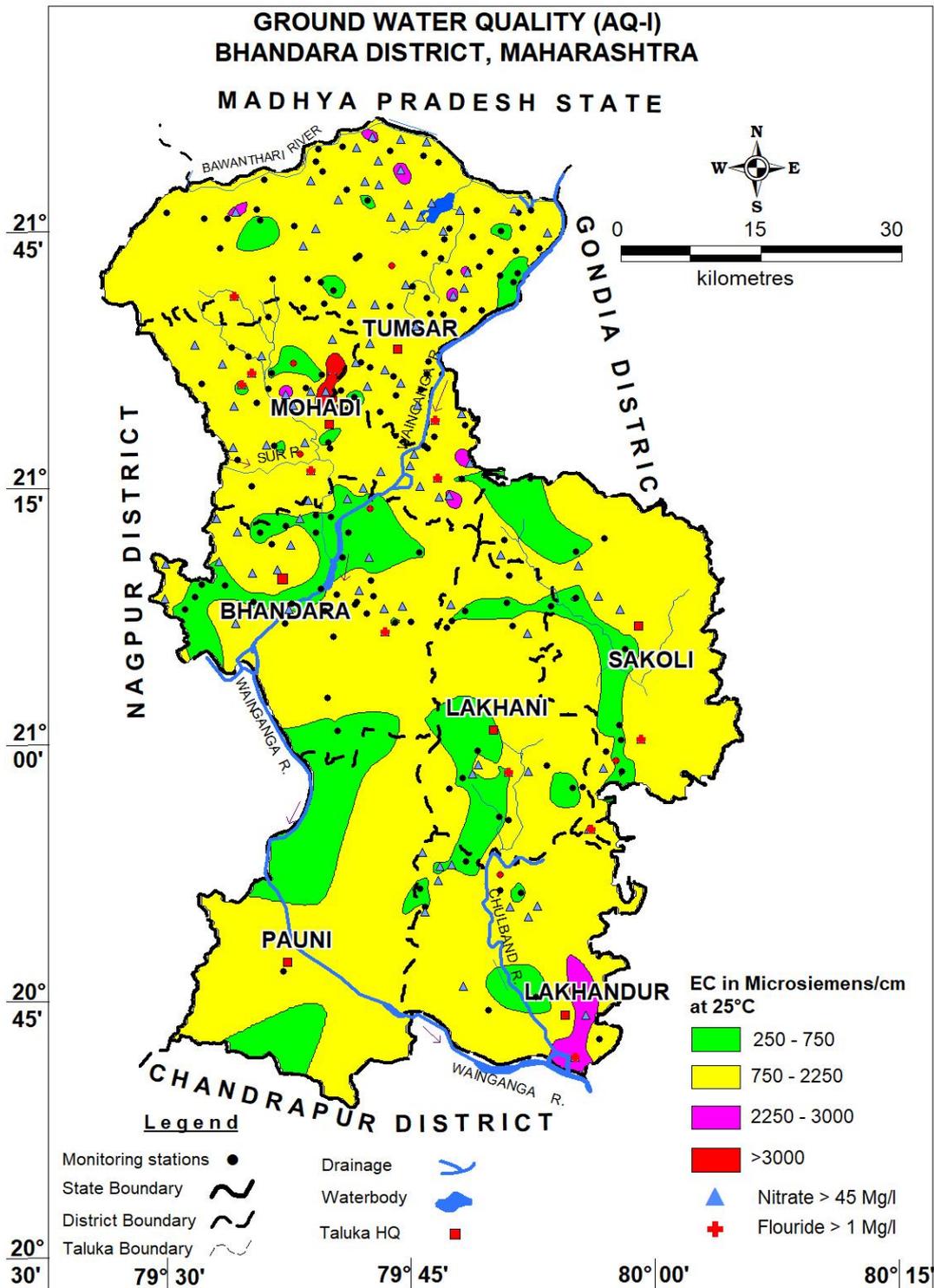


Figure 4. 1: Ground Water Quality, Aquifer-I  
(EC >2250  $\mu$ S/cm in 59 sq. km. area)

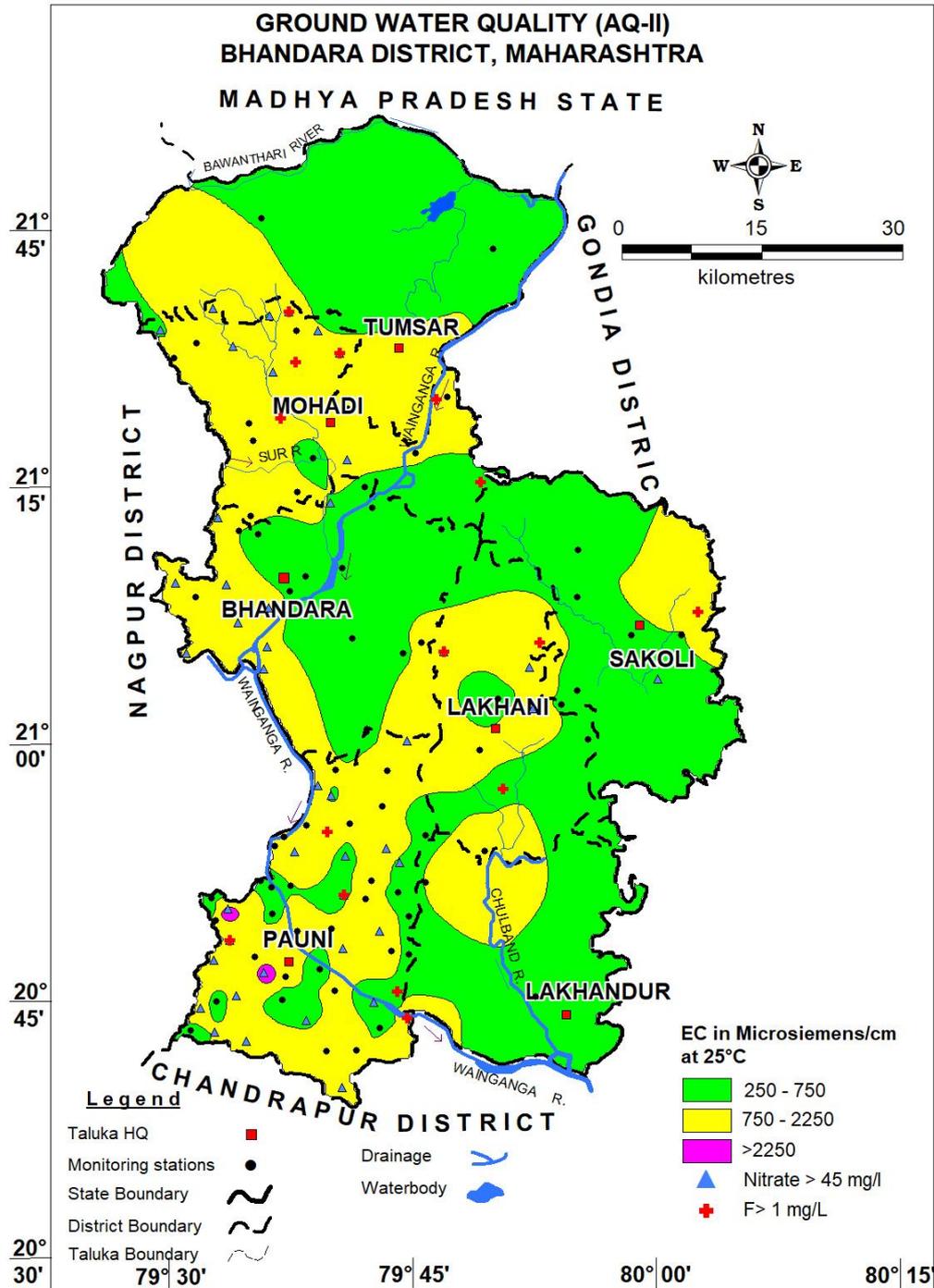
**Distribution of Electrical Conductivity in Deeper Aquifer:**

The concentration of EC in deeper aquifer varies from 250 (Pohara, Lakshmi block) to 2410  $\mu$ S/cm (Wahi, Pauni block). Out of 129 samples, only 3 samples are having EC more than 2250  $\mu$ S/cm. Concentration of EC >2250  $\mu$ S/cm has been observed in isolated patches in Pauni block covering 4 sq. km. The ground water is potable in major parts of the district except nitrate and fluoride affected villages. The distribution of electrical conductivity in deeper aquifers is shown in Fig. 4.2 and analytical

data is presented in Table 4.2.

**Table 4.2: Aquifer wise Electrical conductivity analytical data**

S.No.	EC ( $\mu\text{S/cm}$ )	shallow aquifer		Deeper Aquifer	
		No. of samples	% of samples	No. of samples	% of samples
1	< 250	2	0.78	1	0.81
2	>250-750	62	24.31	52	41.94
3	>750-2250	178	69.80	69	55.65
4	2250-3000	11	4.31	2	1.61
5	3000-5000	2	0.78	0	0.00
<b>Total samples</b>		<b>255</b>	<b>100%</b>	<b>124</b>	<b>100%</b>



**Figure 4. 2: Ground Water Quality, Aquifer-II**

### Nitrate:

Nitrogen in the form of dissolved nitrate, a nutrient for vegetation and the element is essential to all living beings. The major contribution in ground water is from sewage, waste disposal, nitrate fertilizer and decaying of organic matter. From shallow aquifer, 255 samples were analyzed and 106 samples showing nitrate concentrations exceeding the desirable limit of 45 mg/l. In Bhandara district nitrate concentration varies from 0.12 (Rampur hamesha, Tumsar block) to 183 mg/l (Chandpur, Tumsar block). As per BIS (2012) the desirable limit is 45 mg/l.

In deeper aquifer, 124 water, samples were analyzed, out of these 43 water samples show nitrate concentration exceeding the desirable limit of 45 mg/l. In deeper aquifer nitrate concentration ranges from 1.25 (Mujbi, Pauni block) to 180 mg/l (Pahungaon, Pauni block). The deeper aquifer is also affected by nitrate contamination; it may be due to percolation of nitrate contaminants from the ground surface as there are no other reasons for nitrate contamination in deeper aquifers. Aquifer wise nitrate concentration is given in Table 4.3.

### Fluoride:

In shallow aquifer, concentration of fluoride ranges from 0.01 to 1.47 mg/l. out of 255 samples analyzed, 18 samples show fluoride concentration more than 1 mg/l. In shallow aquifer, the highest concentration of fluoride is found in Sorna, Tumsar block (1.47 mg/l). In Deeper Aquifer, concentration of fluoride ranges from 0.002 to 1.48 mg/l. Out of 124 samples analyzed, 15 samples show fluoride concentration more than 1 mg/l. In Deeper aquifer, the highest concentration of fluoride is found in Jewnala (1.48 mg/L) in Bhandara block; it may be due to the geogenic reasons. Aquifer wise fluoride concentration is given in Table 4.3.

**Table 4. 2: Aquifer wise Nitrate and Fluoride concentration**

Block	No <sub>3</sub> > 45 mg/l		fluoride >1 mg/l	
	No of samples	No of samples	No of samples	No of samples
	Shallow Aquifer	Deeper Aquifer	Shallow Aquifer	Deeper Aquifer
Bhandara	26	9	2	1
Lakhandur	11	-	2	2
Lakhani	9	3	1	-
Mohadi	20	9	8	6
Pauni	-	21	-	5
Sakoli	8	1	3	1
Tumsar	32	-	2	-
<b>Grand Total</b>	<b>106</b>	<b>43</b>	<b>18</b>	<b>15</b>

### 4.1 SUITABILITY OF GROUND WATER FOR DRINKING PURPOSE

In shallow aquifer, 85.10% samples are having TDS below the desirable limit (DL), 14.90 % of samples have TDS concentration above the Desirable limit (DL) but below the MPL. The water from areas where TDS values are higher than MPL is not fit for drinking purpose if directly consumed without treatment. It is also seen that about 0.78 to 58.43 % samples are beyond the maximum permissible limit for the parameters like pH, TH, Ca, NO<sub>3</sub> and Cl and Fluoride indicating that the water is not suitable for drinking purpose. Concentration of Chemical constituents in shallow Aquifer is given in Table 4.4.

**Table 4. 3: Concentration of Chemical constituents in shallow Aquifer**

Parameter	Drinking water Standards (IS-10500-2012)		Total no of ground water samples	Shallow aquifer					
				Samples (<DL)		Samples (DL-MPL)		Samples (>MPL)	
	DL	MPL		No	%	No	%	No	%
	pH	6.5-8.5		-	255	242	94.90	-	-

Parameter	Drinking water Standards (IS-10500-2012)		Total no of ground water samples	Shallow aquifer					
				Samples (<DL)		Samples (DL-MPL)		Samples (>MPL)	
	DL	MPL		No	%	No	%	No	%
	TDS(mg/L)	500		2000	255	217	85.10	38	14.90
TH(mg/L)	300	600	255	14	5.49	92	36.08	149	58.43
Ca (mg/L)	75	200	23	9	39.13	12	52.17	2	8.70
Mg (mg/L)	30	100	23	19	82.61	4	17.39	-	0.00
Cl (mg/L)	250	1000	255	193	75.69	60	23.53	2	0.78
SO <sub>4</sub> (mg/L)	200	400	255	255	100.00	-	0.00	-	0.00
NO <sub>3</sub> (mg/L)	45	No relaxation	255	149	58.43	-	-	106	41.57
F (mg/L)	1	1.5	255	237	92.94	18	7.06	-	-

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

In Deeper aquifer, 45.16 % of samples have TDS concentration below the Desirable limit (DL) and 54.34% of samples have TDS concentration above the Desirable limit (DL) but below the MPL. It is also seen that about 2.42 to 44% samples are beyond the maximum permissible limit for the parameters like pH, TH, Mg and NO<sub>3</sub> indicating that the water is not suitable for drinking purpose. Concentration of Chemical constituents in Deeper Aquifer is given in **Table 4.5**.

**Table 4. 4: Concentration of Chemical Constituents in Deeper Aquifer**

Parameter	Drinking water Standards (IS-10500-2012)		Total no of ground water samples	Deeper aquifer					
				Samples (<DL)		Samples (DL-MPL)		Samples (>MPL)	
	DL	MPL		No	%	No	%	No	%
	pH	6.5-8.5		-	124	121	97.58		0.00
TDS(mg/L)	500	2000	124	56	45.16	68	54.84	-	0.00
TH(mg/L)	300	600	124	61	49.19	54	43.55	9	7.26
Ca (mg/L)	75	200	19	18	94.74	1	5.26	-	0.00
Mg (mg/L)	30	100	19	13	68.42	5	26.32	1	5.26
Cl (mg/L)	250	1000	124	103	83.06	21	16.94	-	0.00
SO <sub>4</sub> (mg/L)	200	400	100	100	100.00	-	0.00	-	0.00
NO <sub>3</sub> (mg/L)	45	No relaxation	98	55	56.12	-	-	43	43.88
F (mg/L)	1	1.5	98	83	84.69	15	15.31	-	0.00

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

## 4.2 SUITABILITY OF GROUND WATER FOR IRRIGATION

The quality of Irrigation water affects the productivity, yield and quality of the crops. The quality of irrigation water depends primarily on the presence of dissolved salts and their concentrations. The Electrical Conductivity (EC), Sodium Adsorption Ratio (SAR) and Residual Sodium Carbonate (RSC) are the most important quality criteria, which assess the water quality and its suitability for irrigation. In this section we are discussing about suitability of ground water for irrigation based on the Electrical Conductivity Parameter only.

### Electrical Conductivity (EC)

The concentration of dissolved ions in the water is represented by the electrical conductivity. The classification of water for irrigation, based on the EC values is given in Table 4.6 and details are as follows: -

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

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

**High Salinity Water (EC: 750 – 2250 µS/cm):** This water cannot be used on soils with restricted

drainage. Even with adequate drainage, special management for salinity control may be required and plants with good salt tolerance should be selected.

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

**Table 4. 5 Classification of Ground water for Irrigation based on EC values**

S. No	Water Quality Type	EC $\mu\text{S}/\text{cm}$	Shallow aquifer		Deeper Aquifer	
			No. of Samples	% of samples	No. of samples	% of samples
1	Low Salinity Water	< 250	2	0.78	1	0.81
2	Medium Salinity Water	>250-750	62	24.31	52	41.94
3	High Salinity Water	>750-2250	178	69.80	69	55.65
4	Very High Salinity Water	> 2250	13	5.10	2	1.61
<b>Total</b>			<b>255</b>		<b>124</b>	

In shallow aquifer, maximum numbers of samples fall under the category of high salinity type of water. In deeper aquifer, maximum numbers of samples fall under the category of medium to high salinity type of water. The areas where very high salinity prevails (>2250  $\mu\text{S}/\text{cm}$ ) ground water can be used for irrigation for very high salt tolerant crops and with proper soil and crop management practices.

## 5. GROUND WATER RESOURCES

### 5.1 GROUND WATER RESOURCES – AQUIFER-I

Central Ground Water Board and Ground Water Survey and Development Agency (GSDA) have jointly estimated the ground water resources of Bhandara district based on GEC-2015 methodology. Block wise ground water resources are given in Table 5.1, and graphical representations of the resources on the map are shown in **Figure-5.1**.

Ground Water Resource estimation was carried out for 4087.09 sq. km. area out of which 1055.93 sq. km. is under canal command and 2909.35 sq. km. is in non-command. About 122.13 sq. km. area is hilly and this is not considered for resource estimation. As per the estimation, the Annual extractable ground water resources is 858.04 MCM. The total Extraction is estimated at 261 MCM with irrigation sector having a draft of 224.14 MCM and Domestic use having draft of 36.48 MCM. industrial water requirements are worked out at 0.38 MCM. The net ground water availability for future use is estimated at 36.48 MCM. Stage of ground water development varies from 8.62 % (Lakhandur) to 57.37% (Mohadi). The overall stage of ground water development for the district is 30.42%. Block wise assessments indicate that all the blocks in the district fall under “Safe” category.

**Table 5. 1: Ground water resources, Aquifer-I (Shallow aquifer), Bhandara district (2020) (in MCM)**

Administrative Unit	Annual Extractable Ground Water Recharge	Annual Ground Water Extraction-irrigation use	Annual Ground Water Extraction-industrial use	Annual Ground Water Extraction-domestic use	Total Extraction	Annual GW Allocation for Domestic Use as on 2025	Net Ground Water Availability for future use	Stage of Ground Water Extraction	Category
Bhandara	83.19	28.33	0.13	6.70	35.16	6.70	48.03	42.26	safe
Lakhandur	366.35	27.30	0.00	4.30	31.59	4.30	334.75	8.62	safe
Lakhani	56.36	27.19	0.07	4.31	31.57	4.31	24.79	56.01	safe
Mohadi	57.15	28.24	0.13	4.42	32.79	4.42	24.36	57.37	safe
Pauni	147.26	49.64	0.00	4.98	54.62	4.98	92.64	37.09	safe
Sakoli	68.57	30.46	0.05	5.27	35.79	5.27	32.78	52.19	safe
Tumsar	79.16	32.99	0.00	6.50	39.49	6.50	39.67	49.88	safe
<b>Total</b>	<b>858.04</b>	<b>224.14</b>	<b>0.38</b>	<b>36.48</b>	<b>261.0</b>	<b>36.48</b>	<b>597.04</b>	<b>30.42</b>	<b>safe</b>

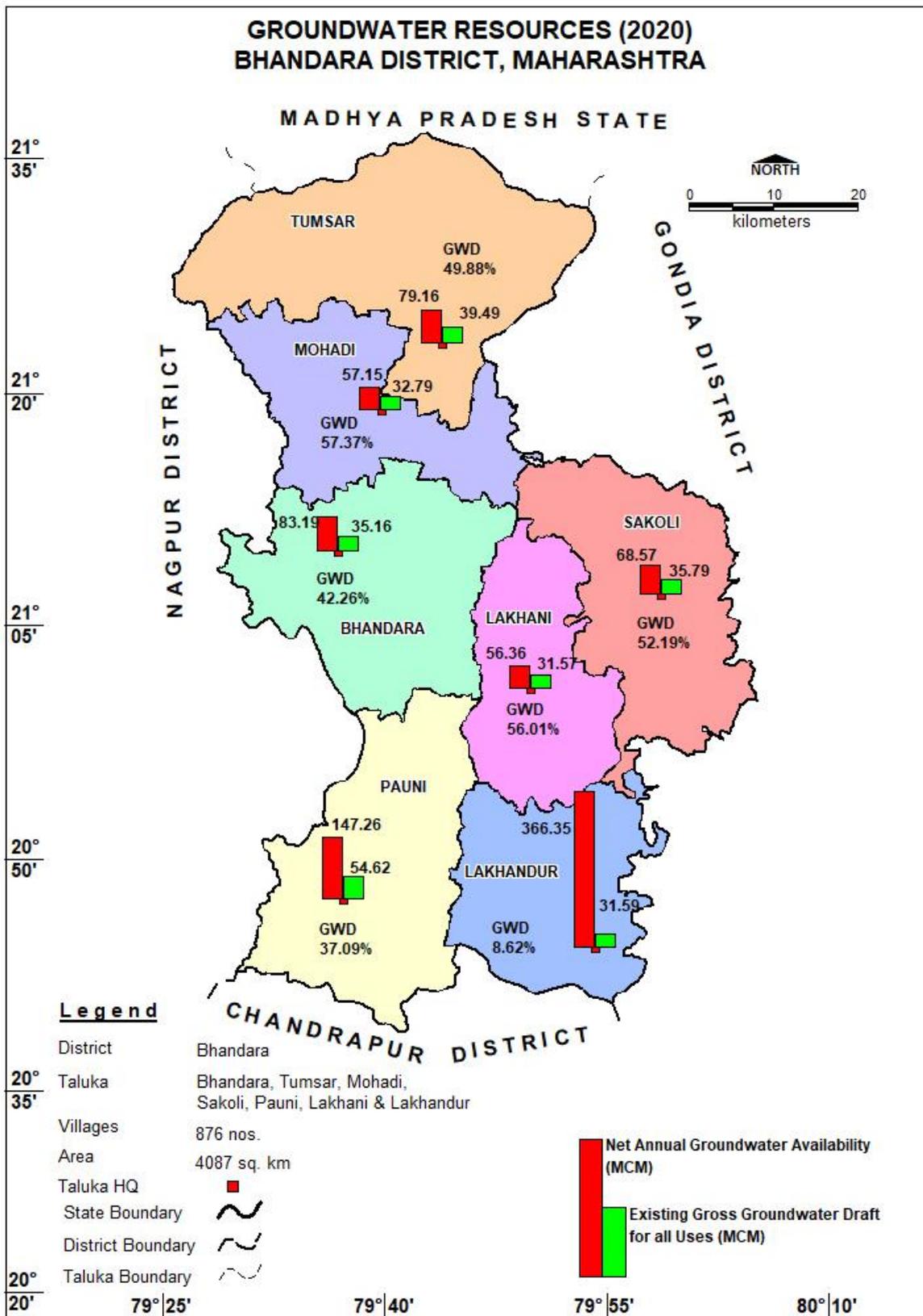


Figure 5. 1: Ground Water Resources (2020), Bhandara district

## 6. GROUND WATER RELATED ISSUES

### 6.1 DECLINING WATER LEVEL TREND

The ground water exploitation has resulted in decline of water levels over the period of time. In premonsoon season, decline in water level has been observed in 3182 sq. km., i.e., 78 % area of the district and decline of more than 0.20 m/year has been observed in 1325 sq. km., i.e., 33 % area covering in parts of Lakhni, Lakhandur, Bhandara, Mohadi and Pauni blocks (Fig 6.1). In post monsoon season, decline in water level has been observed in 2404 sq. km., i.e., 15 % area of the district and decline of more than 0.20 m/year has been observed in 611 sq. km., i.e., 15 % area covering in parts of Lakhni, Lakhandur, Bhandara and Pauni blocks (Fig 6.2). The decline may be because the area has experienced increased ground water draft and less annual rainfall received than the normal rainfall between the period from 2012-2021. (Fig 6.3)

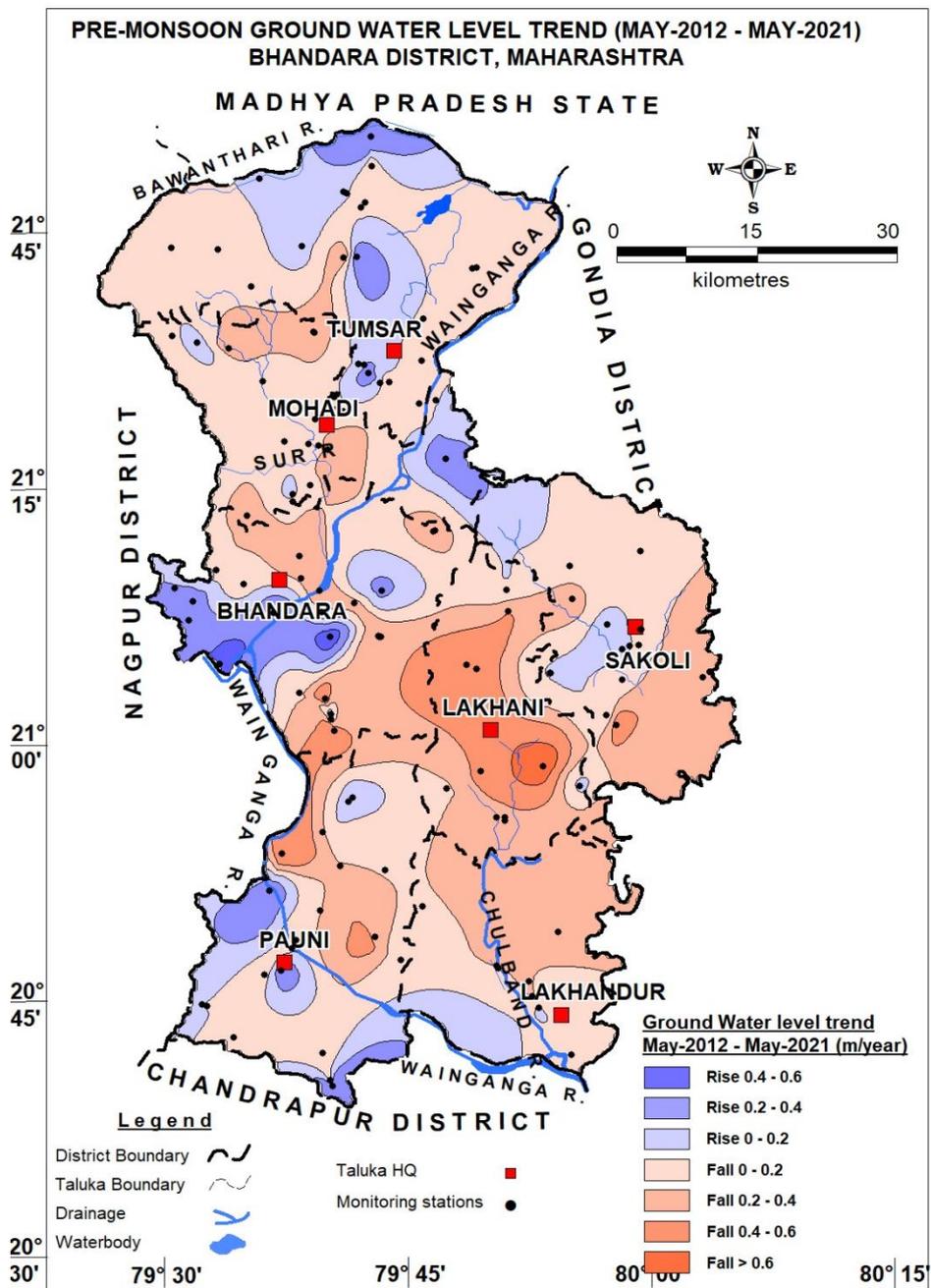
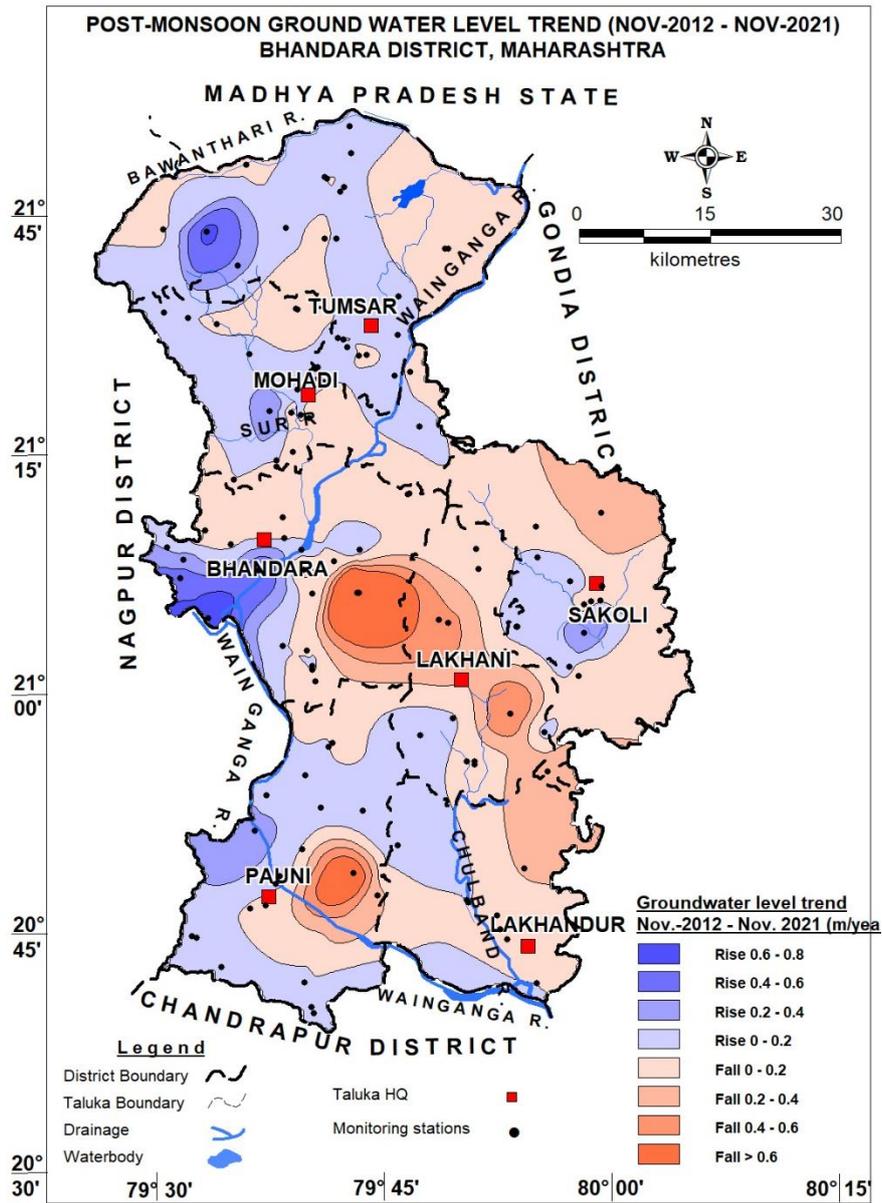
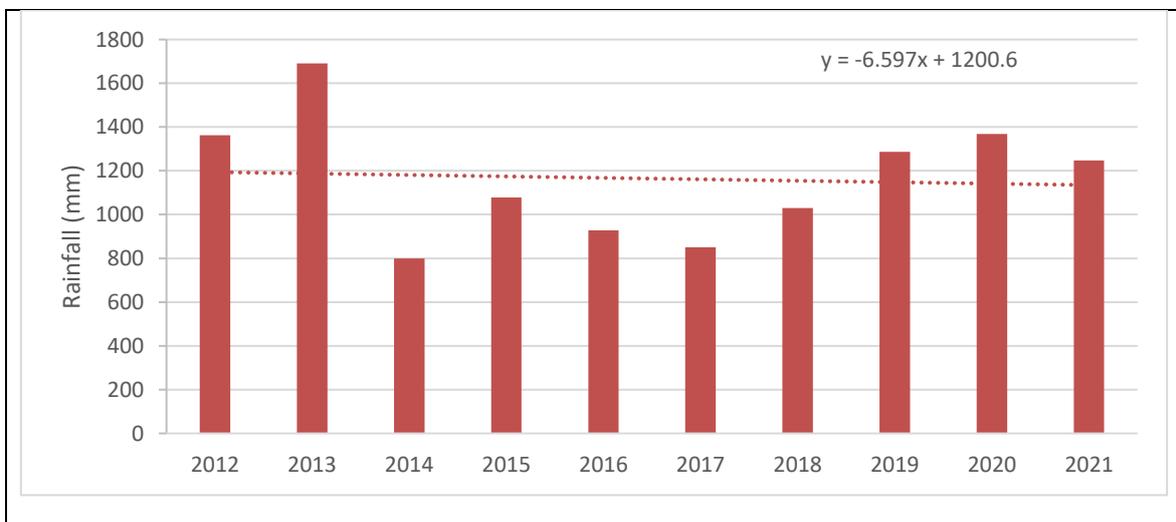


Figure 6. 1: Premonsoon Water level Trend (may 2012-21)



**Figure 6. 2: Post monsoon Water level Trend (Nov. 2012-21)**



**Figure 6. 3: Annual Rainfall 2012-2021**

## 6.2 DECLINING RAINFALL AND DROUGHTS

Based on the rainfall analysis from 1998 to 2021 it is observed that, eight times moderate droughts were faced by the Bhandara district. **(Table-1 & fig.1.6)**. Based on the block wise rainfall analysis from 1998 to 2021 it is observed that Bhandara, Mohadi and Tumsar blocks have experienced declining rainfall trend ranging from 8.8 to 15.03 mm/year. All the blocks experienced Moderate droughts 2 to 5 times during last 24 years period.

**Table 6. 1: Block wise Rainfall Analysis**

Category	Bhandara	Lakhandur	Lakhni	Mohadi	Pavni	Sakoli	Tumsar
Period	1998-2021	1998-2021	1998-2021	1998-2021	1998-2021	1998-2021	1998-2021
Normal Annual Rainfall (mm)	1254	1185	1207.7	1181.8	1147.1	1301.2	1113.1
Rainfall 2021 (mm)	1210	943.4	1316.6	1416.1	1086.7	1449.5	1360
Standard Deviation (mm)	317	344	347	380	321	265	336
Coefficient of Variation (%)	25%	29%	29%	32%	28%	20%	30%
Rainfall Trend (mm/Yr.)	<b>@-15.03</b> (1998-2021)	@+6.12 (1998-2021)	@+.10.98 (1998-2021)	<b>@-14.85</b> (1998-2021)	@+0.059 (1998-2021)	@+5.68 (1998-2021)	<b>@-8.8</b> (1998-2021)
<b>Departures (No. of years/% of year)</b>							
Positive	9/38%	10/42%	13/54%	10/42%	9/38%	12/50%	9/38%
Negative	15/62%	14/58%	11/46%	14/58%	15/62%	12/50%	15/62%
<b>Droughts</b>							
Moderate	4 times (2009, 2014, 2016, 2017)	5 times (1998, 2001, 2003,2008,2014)	3 times (2002, 2006,2014)	6 times (2003, 2006, 2009, 2014, 2016, 2017)	2 times (2003, 2014)	3 times (2003, 2008, 2017)	3 times (2014, 2016,2017)
Severe	-	-	1 time (2003)	-	-	-	1 time (2003)
Acute	-	-	-	-	-	-	-
<b>Normal &amp; Excess R/F (No. of years/% of year)</b>							
Normal	14/58%	13/54%	16/47%	15/63%	16/67%	18/76%	17/72%
Excess	6/25%	6/25%	4/17%	3/12%	6/25%	3/12%	3/12%

### 6.3 GROUND WATER QUALITY HAZARD

#### Fluoride:

High Fluoride concentration is noticed in Vindhyan sediments and Archean granite Gneiss in parts of all the blocks and mohad block is badly affected by fluoride contamination.

In shallow aquifer, concentration of fluoride ranges from 0.01 to 1.47 mg/l. out of 255 samples analyzed, 18 samples show fluoride concentration more than 1 mg/l (**Fig 6.4**). In shallow aquifer, the highest concentration of fluoride is found in Sorna, Tumsar block (1.47 mg/l).

In Deeper Aquifer, concentration of fluoride ranges from 0.002 to 1.48 mg/l. Out of 124 samples analyzed, 15 samples show fluoride concentration more than 1 mg/l (**Fig 6.5**). In Deeper aquifer, the highest concentration of fluoride is found in Jewnala (1.48 mg/L) in Bhandara block; it may be due to the geogenic reasons.

The ground water quality is mainly affected by high concentrations of fluoride above Desirable limit of BIS. Continuous intake of high fluoride concentration water causes dental and skeletal fluorosis. Thus, all the wells used for water supply should be first analysed for Fluoride contents and if the fluoride content is found beyond the desirable limit the ground water may be used for other purposes than drinking.

#### Measures:

- Fluoride free water supply schemes should be framed exclusively for drinking water purpose by tapping surface water and collector wells, wherever feasible.
- Proper well design in construction of tubewells and sealing of fluoride rich zones based on scientific methods.
- Open wells/shallow borewells should be located in the vicinity of surface water bodies.
- De-fluoridation techniques may be adopted with community involvement.
- As high sodium (which comes from domestic sewage besides from lithology) helps in retention and concentration of Fluoride in ground water, local agencies should make proper arrangement of lined drainage system for disposal of domestic waste.

#### Nitrate:

The major contribution in ground water is from sewage, waste disposal, nitrate fertilizer and decaying of organic matter. From shallow aquifer, 255 samples were analyzed and 106 samples showing nitrate concentrations exceeding the desirable limit of 45 mg/l (**Fig 6.4**). In Bhandara district nitrate concentration varies from 0.12 (Rampur hamesha, Tumsar block) to 183 mg/l (Chandpur, Tumsar block). As per BIS (2012) the desirable limit is 45 mg/l.

In deeper aquifer, 124 water, samples were analyzed, out of these 43 water samples show nitrate concentration exceeding the desirable limit of 45 mg/l (**Fig 6.5**). In deeper aquifer nitrate concentration ranges from 1.25 (Mujbi, Pauni block) to 180 mg/l (Pahungaon, Pauni block). The deeper aquifer is also affected by nitrate contamination; it may be due to percolation of nitrate contaminants from the ground surface as there are no other reasons for nitrate contamination in deeper aquifers.

#### Measures:

- Proper arrangement for disposal and treatment of domestic sewage, waste and wastewater in urban as well as rural areas is required.
- Proper lining of Nalas carrying domestic sewage, waste, selecting suitable impermeable geological sites for disposal of garbage.
- Proper management of animal excreta.

#### Uranium:

Uranium sampling was done in Bhandara district in water quality monitoring program under NHS monitoring during May 2019 for generating baseline data regarding this metal.

Total 23 ground water samples were collected from phreatic aquifers (dug wells) for Uranium analysis and uranium concentration varies from 1.28 ppb (Kawlewada, Lakhni block) to 47.98 ppb (Khairlangi, Tumsar block). As per WHO guidelines the permissible limit is 30 ppb. Out of 23 samples, only one sample (Khairlangi, Tumsar block) showing uranium concentration more than 30 ppb. The concentration of Uranium in groundwater is mainly due to natural conditions. Detailed study to be taken up by CGWB.

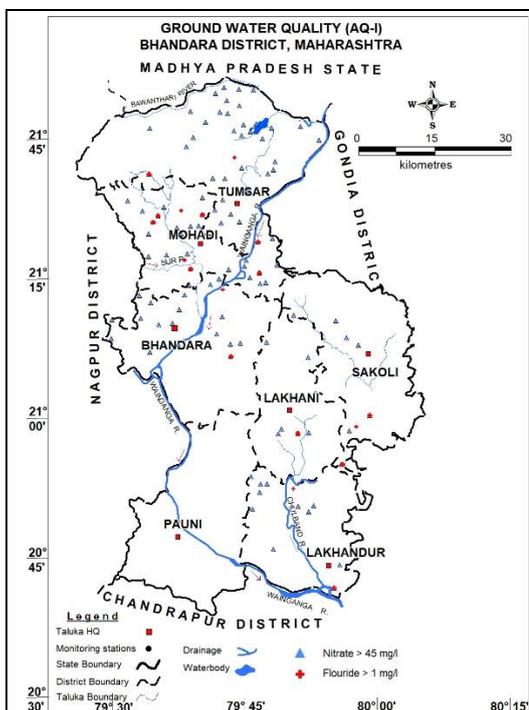


Figure 6. 4: GW quality Aq-I

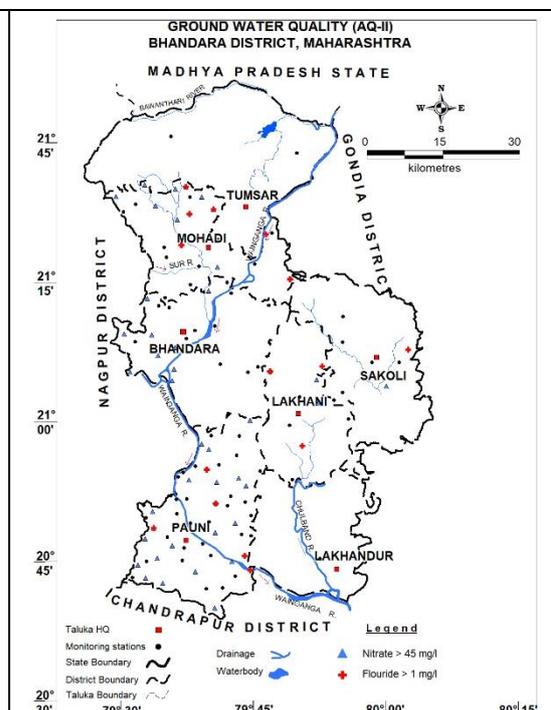


Figure 6. 5: GW quality Aq-II

Block	No of locations showing NO3 >45 mg/L	No of locations showing F >1 mg/L	Block	No of locations showing NO3 >45 mg/L	No of locations showing F >1 mg/L
Bhandara	26	2	Bhandara	9	1
Lakhandur	11	2	Lakhandur	-	2
Lakhani	9	1	Lakhani	3	-
Mohadi	20	8	Mohadi	9	6
Pauni	-	-	Pauni	21	5
Sakoli	8	3	Sakoli	1	1
Tumsar	32	2	Tumsar	-	-
<b>Grand Total</b>	<b>106</b>	<b>18</b>	<b>Grand Total</b>	<b>43</b>	<b>15</b>

#### 6.4 SUSTAINABILITY IN HARD ROCK AREAS

The major part of the district is occupied by hard rock formations i.e., 88% area of the district that inherently consist of limited extent of porous and pervious zone; absence of primary porosity; predominance of secondary porosity that has evolved from prevailing erratic joint pattern, absence of primary porosity and also, low rainfall results in poor sustainability of the aquifers. However, the erratic nature of existing joints/fractures pattern results in highly varying yield capacities of the aquifers in the area. In the area weathering is generally observed at 5 to 15 mbgl. The potential of the fracture zones reduces substantially below 100 m depth but due to high tectonic disturbances deep seated joints and fracture zones exist in the area. About 60% of area of the hard rock is having low yield potential (<1 lps).

## 6.5 GROUND WATER RESOURCES-Low Ground Water Development

Eventhough the district continue to be in safe category; the Stage of ground water development has increased over the period of time from 2008 to 2020 from 27.90% (2008) to 30.01 % (2020) but no significant changes in SOD has been observed over the time. In Bhandara district, Ground water draft for domestic and industrial purposes has continuously increased from 19.68 mcm to 36.88 mcm i.e., 53% increased from 2008 to 2020. Similarly Ground water draft of irrigation purposes has also increased from 141 mcm to 261 mcm i.e., 46% increased from 2008 to 2020. Low development of GW resources in irrigation sector may be due to surface water irrigated area is more and karif crops (rice-rainfed) are main crop in the area.

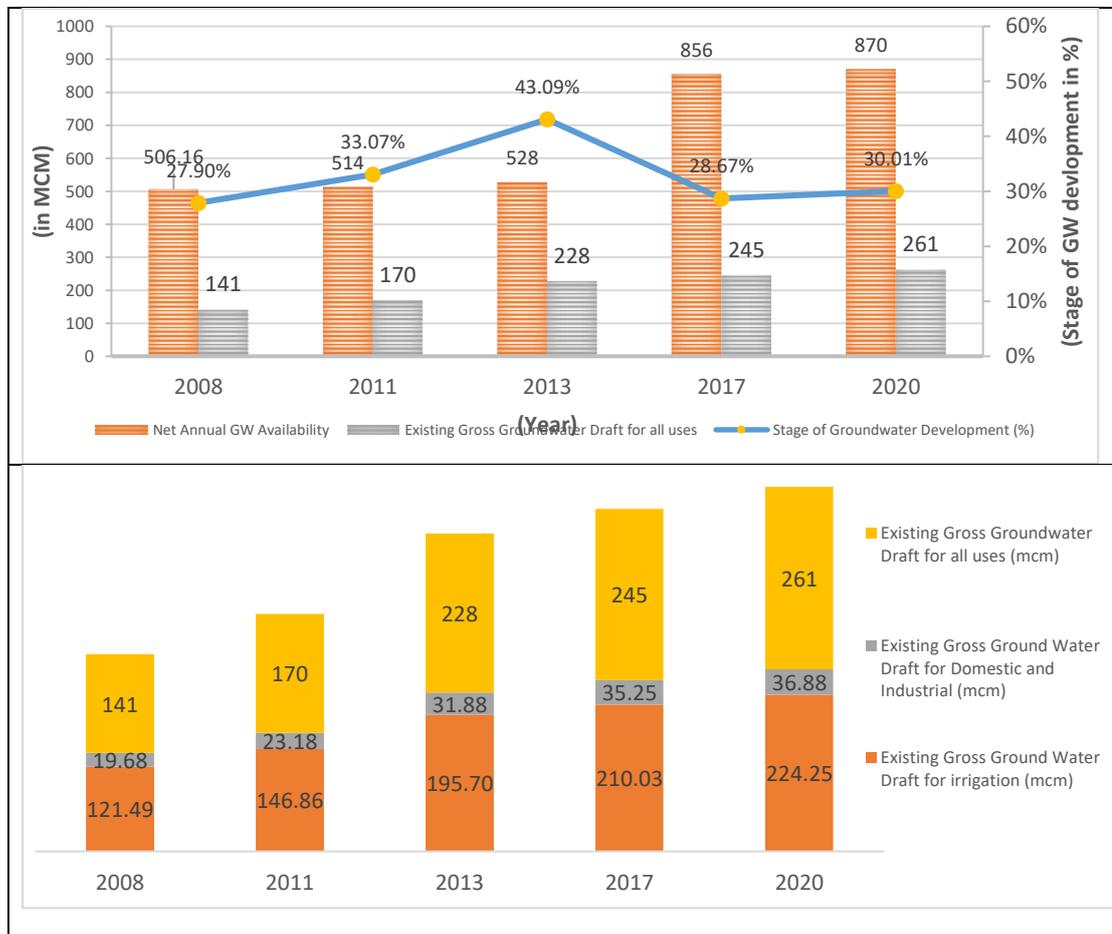


Figure 6. 6: Draft Vs Availability Over the time

## 7. GROUND WATER MANAGEMENT PLAN

A comprehensive ground water resources management plan has been proposed to arrest further decline in water levels. The management plan comprises two components namely supply-side management and demand side management. The supply side management is proposed based on surplus surface water availability and the unsaturated thickness of aquifer whereas the demand side management is proposed by use of micro irrigation techniques and change in cropping pattern.

### 7.1 SUPPLY SIDE MANAGEMENT

The supply side management of ground water resources can be done through the artificial recharge by utilization of surplus runoff available within river sub basins and micro watersheds. Also, it is necessary to understand the unsaturated aquifer volume available for

recharge. The unsaturated volume of aquifer was computed based on the area feasible for recharge, unsaturated depth below 3 mbgl and the specific yield of the aquifer. Out of 7 blocks, feasible area for AR is 1170.49 sq km in 5 blocks. The table 7.1 gives the block wise volume available for the recharge.

**Table 7. 1: Area feasible and volume available for Artificial Recharge**

Block	Geographical Area (Sq. km.)	Area feasible for recharge (sq. km.)	Unsaturated Volume (MCM)
Bhandara	659.50	-	-
Lakhandur	450.76	114.43	57.21
Lakhani	476.10	382.04	946.61
Mohadi	530.54	338.38	386.32
Pauni	652.21	269.47	2108.48
Sakoli	565.30	-	-
Tumsar	752.59	66.17	59.03
<b>TOTAL</b>	<b>4087.00</b>	<b>1170.49</b>	<b>3557.66</b>

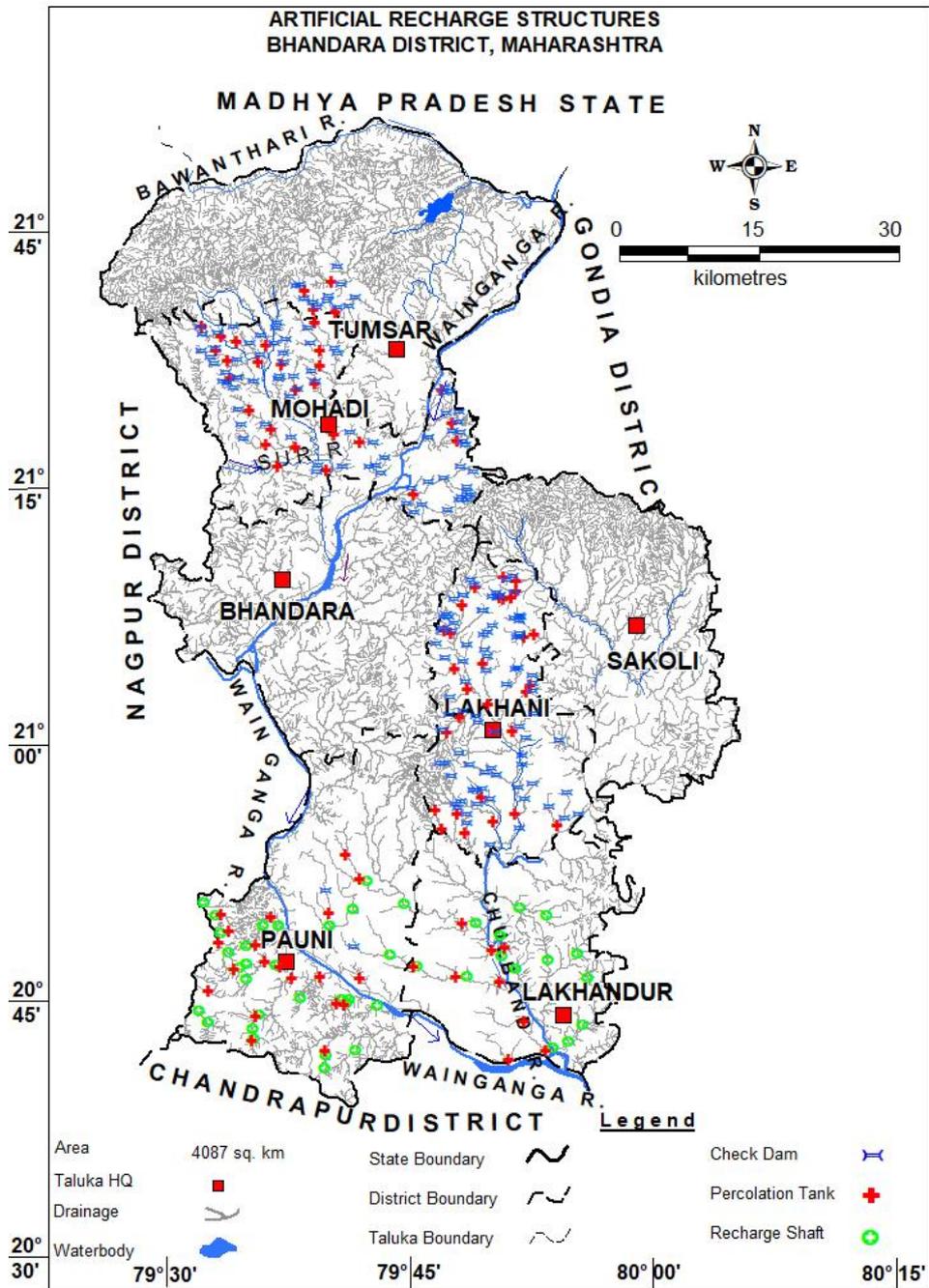
The total unsaturated volume available for artificial recharge is 3557.66 MCM ranging from 57.21 MCM in Lakhandur block to 2108.48 MCM in Bhandara block. The available surplus runoff can be utilized for artificial recharge through construction of percolation tanks, Check dams and Recharge shafts at suitable sites.

Thus, after taking into consideration all the factors, only 25.61 MCM of surplus water can be utilised for recharge, which is given in table 7.2. This surplus water can be utilized for constructing 89 percolation tanks, 175 check dams and 43 Recharge Shafts at suitable sites. The number of feasible artificial recharge structures was calculated by considering 0.20 MCM per percolation tanks, 0.03 MCM per check dam and 0.06 MCM per recharge shaft. This intervention should lead to recharge @ 75% efficiency of about 19.22 MCM/year. Tentative locations of these structures are given in **Fig. 7.1** and details also given in **Annexures VIII and IX**.

The rainwater harvesting in urban areas can be adopted in 25% of the household with 50 m<sup>2</sup> roof area. A total of 0.60 MCM potential can be generated by taking 80% runoff coefficient.

**Table 7.2: Proposed Artificial Recharge Structures**

Block	Geographical Area (sq. km.)	Area feasible for recharge (sq. km.)	Unsaturated Volume (MCM)	Surplus water available for AR (MCM)	Surplus water used for AR (MCM)	Proposed number of structures			Total Volume of Water expected to be recharged @ 75 % efficiency (MCM)			Total recharged @ 75 % efficiency (MCM)
						PT	CD	RS	PT	CD	RS	
<b>Bhandara</b>	659.5	-	-	-	-	-	-	-	-	-	-	-
<b>Lakhandur</b>	450.76	114.43	57.21	2.56	2.56	9	-	14	1.35	0	0.63	1.98
<b>Lakhani</b>	476.1	382.04	946.61	8.54	8.54	30	85	-	4.5	1.91	0	6.41
<b>Mohadi</b>	530.54	338.38	386.32	7.57	7.57	26	76	-	3.9	1.71	0	5.61
<b>Pauni</b>	652.21	269.47	2108.48	6.03	5.76	20	2	29	3	0.045	1.305	4.35
<b>Sakoli</b>	565.3	-	-	0.00	0.00	-	-	-	-	-	-	-
<b>Tumsar</b>	752.59	66.17	59.03	1.48	1.18	4	12	-	0.6	0.27	0	0.87
<b>TOTAL</b>	<b>4087</b>	<b>1170.49</b>	<b>3557.66</b>	<b>26.17</b>	<b>25.61</b>	<b>89</b>	<b>175</b>	<b>43</b>	<b>13.35</b>	<b>3.94</b>	<b>1.93</b>	<b>19.22</b>

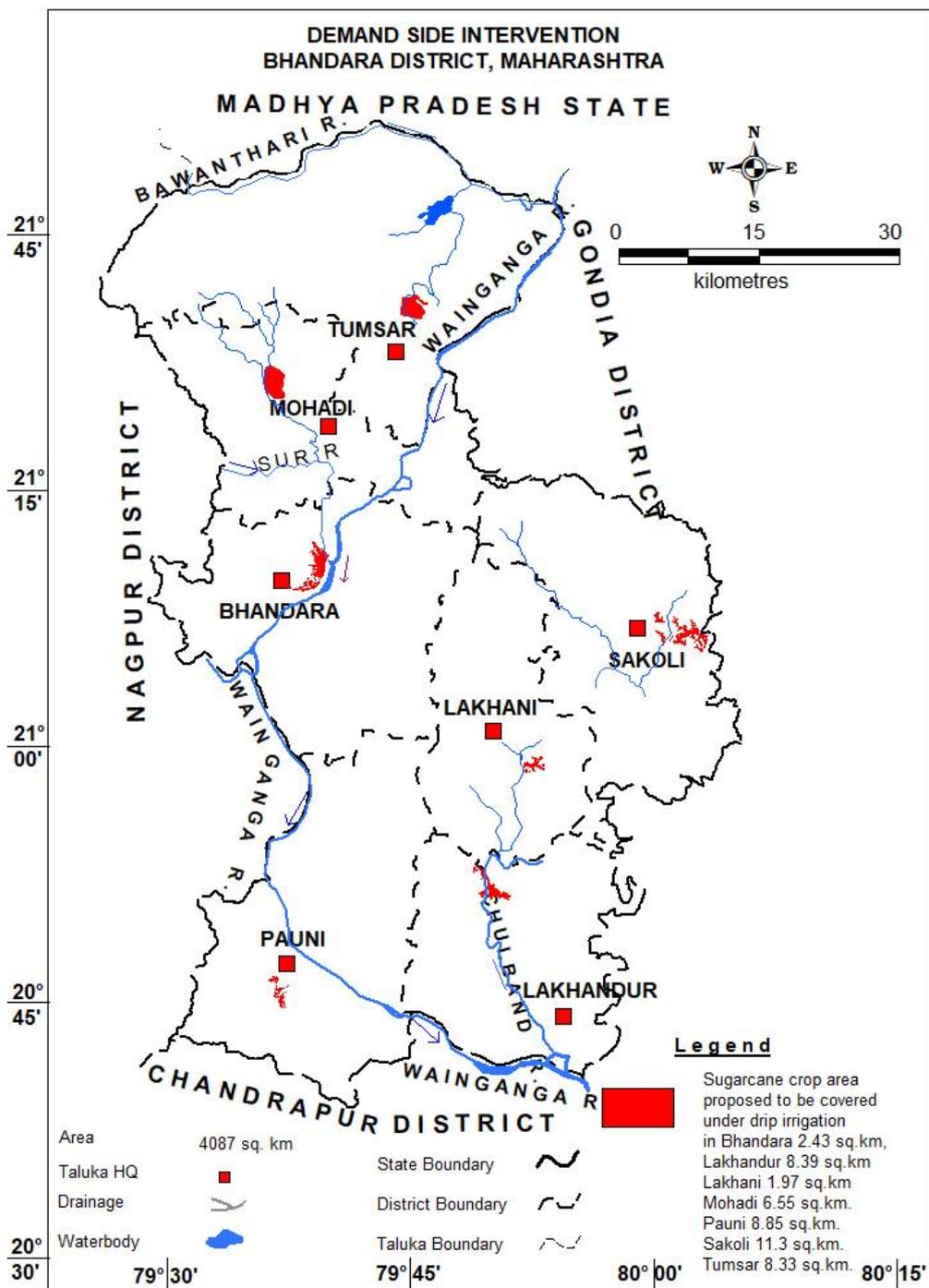


**Figure 7. 1: Location of Proposed Artificial Recharge structures**

## 7.2 DEMAND SIDE MANAGEMENT

The Demand Side Management is proposed in areas where the Stage of Ground Water Development is relatively high and adopting micro-irrigation techniques for water intensive crops (Sugarcane) or change in cropping pattern or both are required to save water.

In the district, micro-irrigation techniques, like drip irrigation techniques are proposed to be adopted in water intensive sugarcane crop covering 47.82 Sq. km. area in the district and that would save a total of 27.26 MCM water (Table.7.3). Change in cropping patterns is not proposed in any of the blocks. **Fig 7.2** depicts the proposed demand side interventions.



**Table 7. 3: Area proposed for Micro irrigation Techniques and water saving through Demand side interventions**

Block	Sugarcane crop area proposed to be covered under Drip (sq.km.)	Total Volume of Water expected to be saved (MCM)
Bhandara	2.43	1.39
Lakhandur	8.39	4.78
Lakhani	1.97	1.12
Mohadi	6.55	3.73

Block	Sugarcane crop area proposed to be covered under Drip (sq.km.)	Total Volume of Water expected to be saved (MCM)
Pauni	8.85	5.04
Sakoli	11.30	6.44
Tumsar	8.33	4.75
<b>TOTAL</b>	<b>47.82</b>	<b>27.26</b>

### 7.3 EXPECTED BENEFITS

The impact of implementation of groundwater management plans on the groundwater system in the district is evaluated and the outcome shows significant improvement in groundwater scenario in all blocks (Table 7.4).

**Table 7. 4: Expected benefits after management options**

Block	Water Recharged by Supply side intervention	Water saving by demand side interventions	Net Ground water availability (As per GWRE, 2020)	Total ground water draft (As per GWRE, 2020)	Ground water resources after supply side management	Ground water Draft after demand side management	Expected stage of Development
							(MCM)/year
Bhandara	-	1.39	83.19	35.16	83.19	33.77	40.60
Lakhandur	1.98	4.78	366.35	31.59	368.32	26.81	7.28
Lakhani	6.4125	1.12	56.36	31.57	62.75	30.44	48.50
Mohadi	5.61	3.73	57.15	32.79	62.75	29.05	46.29
Pauni	4.35	5.04	147.26	54.62	151.61	49.57	32.69
Sakoli	-	6.44	68.57	35.79	68.57	29.34	42.79
Tumsar	0.87	4.75	79.16	39.49	80.03	34.73	43.40
<b>TOTAL</b>	<b>19.22</b>	<b>27.26</b>	<b>858.04</b>	<b>261</b>	<b>877.23</b>	<b>233.74</b>	<b>26.65</b>

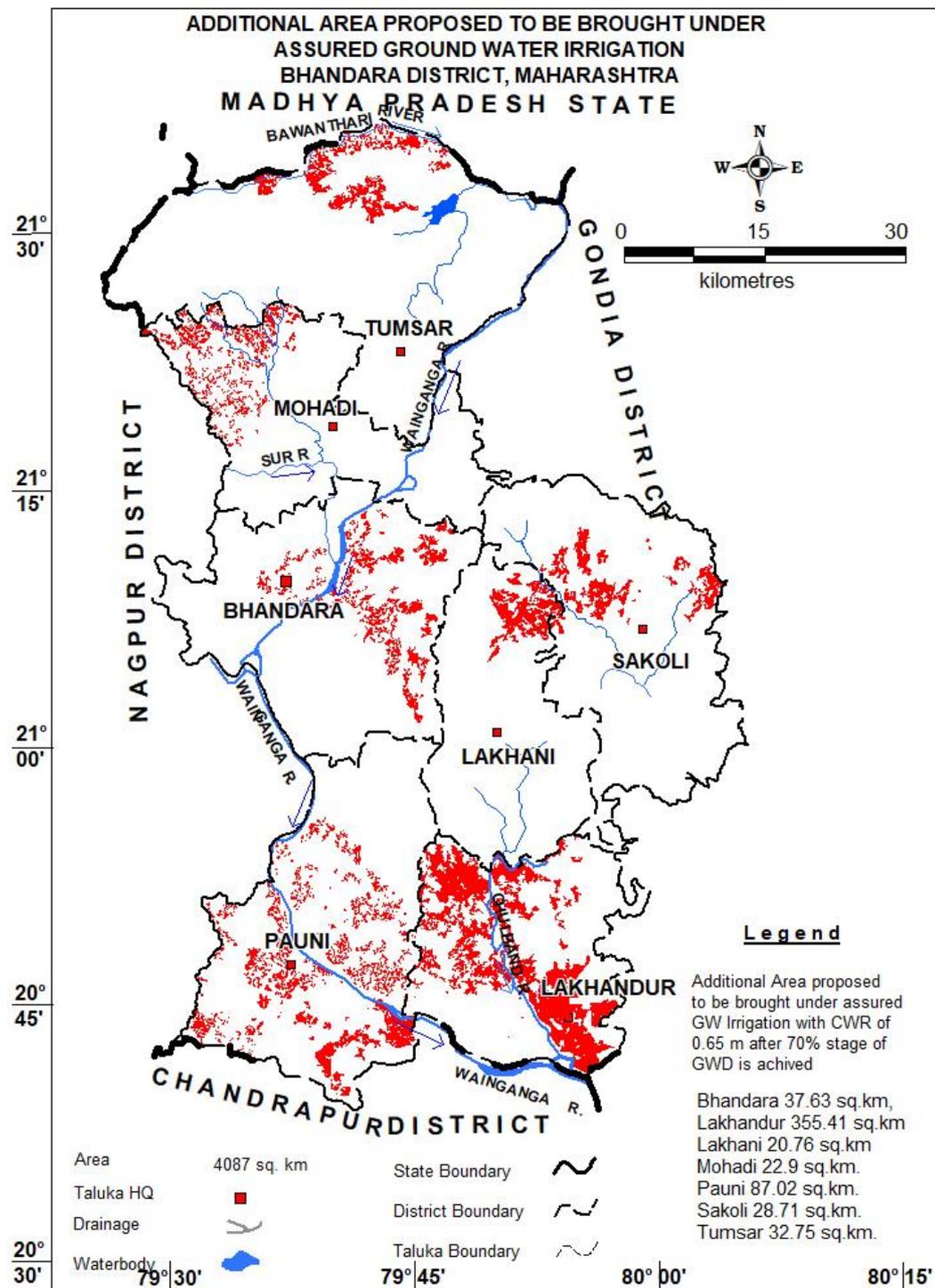
### 7.4 DEVELOPMENT PLAN

The ground water development plan has been proposed with the view of developing the additional ground water resources available after supply side interventions to bring the stage of ground water development up to 70%. The 380.32 MCM volume of ground water generated can bring additional 585.11 sq. km. Kharif Crop area under assured ground water irrigation with average crop water requirement of 0.65 m by constructing 22822 Dug wells and 3805 Bore wells. Block wise details are given in Table 7.5. The area feasible for ground development is shown in Fig. 7.3.

**Table 7. 5: Block wise additional area under assured GW Irrigation**

Block	Net Ground water availability (As per GWRE, 2020) (MCM)/year	Ground water resources after supply side management (MCM)/year	Ground water Draft after demand side management (MCM)/year	Expected stage of Development %	Balance GWR available for GW Development after STAGE OF GWD is brought to 70% (MCM)	Proposed No. of DW @1.5 ham for 90% of GWR Available)	Proposed No. of BW @1 ham for 10% of GWR Available )	Additional Area (sq.km.) proposed to be brought under assured GW irrigation with av. CWR of 0.65 m after 70% stage of GWD is achieved (Sq. km.)
Bhandara	83.19	83.19	33.77	40.60	24.46	1467	245	37.63
Lakhandur	366.35	368.32	26.81	7.28	231.02	13861	2310	355.41
Lakhani	56.36	62.75	30.44	48.50	13.50	810	135	20.76
Mohadi	57.15	62.75	29.05	46.29	14.88	893	149	22.89
Pauni	147.26	151.61	49.57	32.69	56.56	3394	566	87.02

Sakoli	68.57	68.57	29.34	42.79	18.66	1120	187	28.71
Tumsar	79.16	80.03	34.73	43.40	21.29	1277	213	32.75
<b>TOTAL</b>	<b>858.04</b>	<b>877.23</b>	<b>233.74</b>	<b>26.65</b>	<b>380.36</b>	<b>22822</b>	<b>3805</b>	<b>585.11</b>



**Figure 7. 3: Additional area Proposed to be bought under Assured GW irrigation**

## 8. SUM UP

The study was carried out based on the data available in-house as well as acquired from State Govt. departments and in pursuit to fill up the data gaps, generated data in-house; prepared GIS maps for various themes. All the available data was brought on GIS platform and an integrated approach was adopted for preparation of block wise aquifer maps and aquifer management plans of the district.

Bhandara district covering an area of about 4087 sq. km. with 122.03 sq. km. being hilly terrain is occupied by Archean formations. The stage of ground water development of the district is 30.42%. The area has witnessed declining water level, low rainfall and drought. Low yield potential of aquifers Ground Water Quality hazards (F and NO<sub>3</sub>) and Low development of GW resources are the major issues in the district. Declining water level trend of more than 0.20 m/year has been observed in 1325 sq. km. (33% area of the total area) during pre-monsoon period (2012-21). Declining water level trend of more than 0.20 m/year has been observed in 611 sq.km (15% area of the total area) during post monsoon period (2012-21). These declines may be due to less rainfall or exploitation of ground water resources.

The management plan has been proposed to manage the ground water resources and to arrest further decline in water levels. The management plan comprises two components namely supply-side management and demand side management.

As a part of Supply side Management, a total 89 Percolation tanks, 175 Check dams and 43 Recharge shafts are proposed, which will augment ground water resources to the tune of 19.22 MCM/year (13.35 MCM/year by Percolation tanks, 3.94 MCM/year by Check dams and 1.93 MCM/year by Recharge shafts)

As a part of Demand side Management, micro-irrigation techniques are to be adopted in 47.82 Sq. km. sugarcane area thereby saving a total of 27.26 MCM/year. Change in cropping patterns is not proposed in any of the blocks.

Since agriculture farming in the area is solely dependent on rainfall, automatic rain gauge stations can be installed in each gram panchayat for appropriate planning of crops irrigation.

Micro-irrigation techniques can be adopted in paddy cultivation also, that would be beneficial in conserving water resources as well as raising crop yield per acre and can bring larger area under assured cultivation. Drip irrigation can be more effective and efficient for paddy cultivation.

The ground water development plan has been proposed in view of the developing additional ground water resources available after supply side interventions to bring the stage of ground water development up to 70%. The 380.32 MCM/year volume of ground water generated can bring 585.11 sq. km. additional area under assured ground water irrigation with average crop water requirement of 0.65 m by constructing 22822 Dug wells and 3805 Bore wells.

IEC activities and capacity building activities needs to be aggressively propagated to establish the institutional framework for participatory ground water management. Under IEC activity one day Tier-III training on “water budgeting and management at local level” was conducted on 23<sup>th</sup>September 2022 at Bhandara, Bhandara district. A total of 101 trainees have

attended the training including 35 female participants. These types of programmes have helped the general public to understand the problems, that they will face in future if the ground water is continued to be exploited in unplanned way and also sewage wastes is not properly managed it may result in severe ground water Contamination.

These interventions also need to be supported by regulations for deeper aquifer and hence it is recommended to regulate/ban deeper tube wells/bore wells of more than 60 m depth in these blocks, so that the deeper ground water resources are protected for future generation and also serve as ground water sanctuary in times of distress/drought.

## INFORMATION, EDUCATION AND COMUNICATION (IEC) ACTIVITIES



Tier-III training programme at Bhandara District

**Annexure I: Salient Features of Ground Water Exploration (CGWB), Bhandara District**

S. No.	Block	Formation /Aquifer	Wells			Depth (mbgl)	SWL (mbgl)	Discharge (lps)	Zones (mbgl)	T m <sup>2</sup> /day	S
			EW	OW	PZ						
1.	Bhandara	Gneiss	5	0	1	40-500.10	1.92-9.98	0.14-2.64	34-225	0.23-0.72	
		Schist	5	1	0	73.85-200	2.1-12.73	traces-3.17	24.4-48.8	61	8.7x10 <sup>-4</sup>
2	Lakhandur	Gneiss	2	0	0	200-203.55	12.1-45.3	0.78	52-55		
		Schist	1	1	0	146.5-147.5	3.42-5.67	5.6 to 6.43	43.95-155	23.85	1.49x10 <sup>-4</sup>
3	Lakhni	Gneiss	1	0	0	172.1	3.75	0.38	107-111		
4	Mohadi	Schist	1	0	0	179.4	3.64	0.14	61-62	1.72	
		Gneiss	1	0	0	201	5.4	0.14			
		Alluvium		0	1	9.2	2.6	traces			
5	Pauni	Schist	2	2	1	40-201.6	4.22-10.25	traces-2.16	15-33.75	21	6.6x10 <sup>-4</sup>
		Gneiss	1	0	0	200	15	0.14	28-179		
6	Sakoli	Schist	2	0	0	104.7	8.8	traces	24-36.90		
		Granite	1	0	0	201.6					
7	Tumsar	Gneiss	2	1	0	97.7-135	5.34-30.8	0.14-8.77	30-70	35.25	2.4x10 <sup>-5</sup>
		Schist/ Quartzite	2	1	0	148-200	5.1-50.08	0.38-5.8	40-173	6.86	1.81x10 <sup>-4</sup>
<b>Total</b>			<b>26</b>	<b>6</b>	<b>3</b>	<b>9.2-500.10</b>	<b>1.92-50.08</b>	<b>Traces – 8.77</b>	<b>0.78-179</b>	<b>0.23-61</b>	<b>1.49x10<sup>-4</sup> to 2.4x10<sup>-5</sup></b>

**Annexure II: Details of GW exploration under of Bhandara district**

S.No.	Block	Village	Toposheet	Latitude	Longitude	Altitude (m asl)	Year	Type	Aquifer	Drilling depth (mbgl)	Aquifer Zones	SWL (mbgl)	discharge (lps)	T (m <sup>2</sup> /day)	S
1	Bhandara	Bhandara I	55O/12	21.1583	79.6542	252	2003-04	EW	J Granite Gneiss	189.1	44 -48	3	1.92		
2	Bhandara	Bhandara II	55O/12	21.1583	79.6542	252	2003-04	EW	J Granite Gneiss	500.1	42 -49 ,70 -74 ,390 -420 ,138 -140 ,460 -500	1.92	0.78		
3	Bhandara	Chandori	55O/12	21.0972	79.7014	261	1991-92	OW	F Schist/ Quartzite	73.85	39 -48.8	5.58	3.17		
4	Bhandara	Chandori	55O/12	21.0972	79.7014	261	1991-92	EW	F Schist/ Quartzite	200	24.4 -30.5	5.25	3.9	61	8.7x10 <sup>-4</sup>
5	Bhandara	Gadegaonraje	55O/16	21.0917	79.7722	279	1993-94	EW	Schist	196.45		12.73	-		
6	Bhandara	Jewnala	55P/13	20.9485	79.8532	246	2021-22	EW	F Gneiss	160.1	45-47	9.98	0.38	0.23	
7	Bhandara	Khursipar	55O/12	21.2	79.6056	263	1991-92	EW	Quartzite/F Schist/ Gneiss	189.4		8.5	0.78		
8	Bhandara	Koka	55O/16	21.2017	79.7944	277	1991-92	EW	F Schist	195		4.5	0.2		
9	Bhandara	Parsodi	55O/12	21.1397	79.5408	265	2021-22	EW	F Schist	200	37-38	2.1	traces		
10	Bhandara	Warthi	55O/12	21.2333	79.6667	252	2002-03	EW	W J F Gneiss	43.3	34 -40		-		
11	Bhandara	Warthi	55O/12	21.2333	79.6667	252	2002-03	EW	W J F Gneiss	433.85	218 -225 ,260 -264	3.09	2.64	0.72	
12	Bhandara	Warthi	55O/12	21.2333	79.6667	251	2011-12	Pz	F gneiss	40		3.6	0.14		
13	Lakhandur	Jaithapur	55P/13	20.8583	79.7722	240	1993-94	EW	F Gneiss	203.55		12.1	0.78		
14	Lakhandur	Lakhandur	55P/14	20.7458	79.8833	228	1993-94	OW	Fractured Schist	147.5	43.95-46.95,53-56,59. 15-65.25,154-155	3.42	5.6		
15	Lakhandur	Lakhandur	55P/14	20.7458	79.8833	228	1993-94	EW	Fractured Schist	146.5	43.95-46.95,53-56,59.15-65.25,154-155	5.67	6.43	23.85	1.497x10 <sup>-4</sup>
16	Lakhandur	Palasgaon	64C/4	21.0082	80.0519	254	2021-22	EW	F Gneiss			45.3			
17	Lakhni	Pohara	55O/16	21.0361	79.85	252	1991-92	EW	F Gneiss	172.1	107-111	3.75	0.38		

S.No.	Block	Village	Toposheet	Latitude	Longitude	Altitude (masl)	Year	Type	Aquifer	Drilling depth (mbgl)	Aquifer Zones	SWL (mbgl)	discharge (lps)	T (m <sup>2</sup> /day)	S
18	Mohadi	Dahegaon		21.2833	79.6833		2011-12	Pz	sand	9.2		2.6	traces		
19	Mohadi	Mohagaon	55O/11	21.2736	79.6639	259	1991-92	EW	F Gneiss	201		5.4	0.14		
20	Mohadi	Salai khurd	55O/11	21.3978	79.6486	293	2021-22	EW	F Schist	179.4	61-62	3.64	0.14	1.72	
21	Pauni	Adarsha Amgaon	55P/10	20.7458	79.5556	258	1991-92	EW	F Schist	201.6	21.60-36.90	10.25	0.42		
22	Pauni	Adarsha Amgaon	55P/10	20.7458	79.5556	258	1991-92	OW	F Schist	55.15	15.45-33.75	10.25	0.18		
23	Pauni	Adyal	55P/9	20.9433	79.7033	256	2011-12	Pz	schist	40		6.65	traces		
24	Pauni	Chichal	55P/09	20.9089	79.6717	245	2021-22	EW	F Gneiss	200	28.9-32,176.4-179.7	15	0.14		
25	Pauni	Chikhali	55P/09	20.9333	79.7292	249	1991-92	OW		122.25		4.32	2.16		
26	Pauni	Chikhali	55P/09	20.9333	79.7292	249	1991-92	EW		164.8		4.22	2.49	21	6.6x10 <sup>-4</sup>
27	Sakoli	Khairlanji	55O/16	21.0958	79.9889	251	1991-92	EW	F Granite	201.6	24-36.90	8.8	-		
28	Sakoli	Sanghari	55P/13	20.9633	79.9733	244	1993-94	EW	F Schist	104.7	56.1 -62.2		-		
29	Sakoli	Sanghari	55P/13	20.9633	79.9733	244	1993-94	EW		-			-		
30	Tumsar	Hardoli	55O/11	21.4156	79.6833	285	1992-93	OW	F Quartzite	148		5.25	3.17		
31	Tumsar	Hardoli	55O/11	21.4156	79.6833	285	1992-93	EW	F Quartzite	183.4		5.1	5.8	6.86	1.81x10 <sup>-4</sup>
32	Tumsar	Sindpuri	55O/15	21.4736	79.8528	270	1992-93	EW	F Gneiss	135	35-43, 64-68	5.71	8.77	35.25	2.4x10 <sup>-5</sup>
33	Tumsar	Sindpuri	55O/15	21.4736	79.8528	270	1992-93	OW	F Gneiss	97.7	62-68	5.34	0.78		
34	Tumsar	Station Toli	55O/15	21.36006	79.7582	262	2021-22	EW	F gneiss	200	42-43	30.8	0.14		
35	Tumsar	Pawnarkhairi	55O/10	21.535	79.7047	331	2021-22	EW	F schist	200	158-159	50.08	0.38		

### Annexure III: Water level Data of monitoring wells in Bhandara District

S.No.	Block	Village	Agency	Latitude	Longitude	DTW (mbgl)	
						May-21	Nov-21
1	Bhandara	Pahela	GSDA	21.0203	79.6822	10.35	7.25
2	Bhandara	Pahela	GSDA	21.0244	79.6822	3.2	0.2
3	Bhandara	Maudi Nawargaon	GSDA	21.0458	79.65	6.8	1.8
4	Bhandara	Pipari	GSDA	21.0756	79.5686	6.2	3.4
5	Bhandara	Dhargaon2	GSDA	21.1	79.7333	23.8	19.8
6	Bhandara	Dhargaon	GSDA	21.1003	79.7331	9.1	2.7
7	Bhandara	Kondhi (Sawari)	GSDA	21.1183	79.5378	4.5	0.6
8	Bhandara	Korambi	GSDA	21.125	79.625	7.6	3
9	Bhandara	Parsodi	GSDA	21.1375	79.5419	7.5	0.8
10	Bhandara	Dodmazari	GSDA	21.145	79.7369	2.7	0.9
11	Bhandara	Kardha	GSDA	21.1456	79.6725	8.9	1.2
12	Bhandara	Kharbi	GSDA	21.1503	79.5236	11.7	4.3
13	Bhandara	Fulmogra (Ashoknagar)	GSDA	21.1531	79.5944	3.4	0.9
14	Bhandara	Bhandara	GSDA	21.18	79.6525	13	4.1
15	Bhandara	Koka	GSDA	21.2019	79.7914	16.6	0.9
16	Bhandara	Pagora	CGWB	21.0083	79.6858	-	5.4
17	Bhandara	Shrinagar	CGWB	21.0403	79.6764	-	4.1
18	Bhandara	Bhandara	CGWB	21.1583	79.6542	-	5.1
19	Bhandara	Palari	CGWB	21.1333	79.7083	-	2.65
20	Bhandara	Ambadi	CGWB	21.125	79.675	-	4.8
21	Bhandara	Dhargaon-1	CGWB	21.0997	79.735	-	2.8
22	Bhandara	Koka (Kokha)	CGWB	21.2028	79.7928	-	7.38
23	Bhandara	Kharbi	CGWB	21.1675	79.5667	-	5.8
24	Bhandara	Daodipar Khapa	CGWB	21.1	79.6833	-	1.98
25	Lakhandur	Soni	GSDA	20.6883	79.9236	1.2	0.2
26	Lakhandur	Lakhandur	GSDA	20.7603	79.8814	5.5	0.9
27	Lakhandur	Bhagadi.	GSDA	20.7742	79.8497	6.8	2.5
28	Lakhandur	Dighori	GSDA	20.7767	79.8486	5.1	0.9
29	Lakhandur	Chichal	GSDA	20.7767	79.8486	8.9	0.8
30	Lakhandur	Dahegaon	GSDA	20.8083	79.9125	6.4	2.6
31	Lakhandur	Lakhandur	CGWB	20.7458	79.8847	-	1.85
32	Lakhandur	Masal	CGWB	20.8356	79.7733	-	1.9
33	Lakhandur	Lakhandur_Pz	CGWB	20.7347	79.8917	-	2.8
34	Lakhni	Palandur	GSDA	20.9214	79.8594	11.9	1.5
35	Lakhni	Bhugaon	GSDA	20.9508	79.9372	7.8	1.2
36	Lakhni	Dongargaon (Niharwani)	GSDA	20.9667	79.8361	9.4	1.3
37	Lakhni	Lakhani	GSDA	21.0706	79.8231	7.2	1.6
38	Lakhni	Salebhata	GSDA	21.1228	79.8672	10.1	2.7
39	Lakhni	Kesalwada Pawar	GSDA	21.1433	79.8656	6.2	1.6
40	Lakhni	Madgi	CGWB	20.95	79.8	-	1.82
41	Lakhni	Kawalewada	CGWB	20.9214	79.8511	-	2.5
42	Lakhni	Palandur	CGWB	20.9181	79.8597	-	4.85
43	Lakhni	Lakhani	CGWB	21.0667	79.8333	-	7.15
44	Lakhni	Murmadi	CGWB	20.9706	79.9003	-	4.2
45	Mohadi	Satona	GSDA	21.2203	79.5989	6	1.4
46	Mohadi	Warthi	GSDA	21.24	79.6464	4.3	0.9
47	Mohadi	Kardi.	GSDA	21.2725	79.8053	3.9	0.5
48	Mohadi	Dahegaon	GSDA	21.2869	79.6742	6.9	2.3
49	Mohadi	Pardi (Khodgaon)	GSDA	21.2894	79.6642	7.5	3.9
50	Mohadi	Chichkheda(Pardi)	GSDA	21.2917	79.6394	10	1.2
51	Mohadi	Mohadi	GSDA	21.3131	79.6714	1.6	0.1
52	Mohadi	Dewhada Bk.	GSDA	21.3297	79.7958	5.1	0.8
53	Mohadi	Andhalgaon	GSDA	21.3508	79.6181	7.9	2.7
54	Mohadi	Kandri	GSDA	21.3897	79.5508	3.3	0.8
55	Mohadi	Wasera	GSDA	21.3964	79.525	7.1	2.3
56	Mohadi	Usara	GSDA	21.3981	79.6708	12.1	1.2
57	Mohadi	Usarra	CGWB	21.3972	79.6722	-	2.15
58	Mohadi	Jamb	CGWB	21.3833	79.5833	-	3.45
59	Mohadi	Dahegaon_Pz	CGWB	21.2833	79.6833	-	3.4

S.No.	Block	Village	Agency	Latitude	Longitude	DTW (mbgl)	
						May-21	Nov-21
60	Mohadi	Dahegaon2	CGWB	21.2833	79.6833	-	3.05
61	Mohadi	Warthi_Pz	CGWB	21.2486	79.6647	-	2.2
62	Mohadi	Varti	CGWB	21.2333	79.6467	-	1.78
63	Pauni	Channewada	GSDA	20.6614	79.6778	5.3	0.8
64	Pauni	Chandi	GSDA	20.6675	79.6756	9.1	0.9
65	Pauni	Kanhalgaon (Somnala)	GSDA	20.6939	79.6681	5.1	0.7
66	Pauni	Bhuyar	GSDA	20.7108	79.5769	11.1	1
67	Pauni	Nilaj (Amgaon).	GSDA	20.7436	79.545	13.8	1.6
68	Pauni	Wahi	GSDA	20.7717	79.6092	9.1	0.9
69	Pauni	Dhamani(Lawadi)	GSDA	20.7833	79.75	17.1	16.8
70	Pauni	Pauni	GSDA	20.7969	79.6381	7.1	3
71	Pauni	Sindpuri(Ruyad)	GSDA	20.805	79.6422	13	5.2
72	Pauni	Asgaon	GSDA	20.8069	79.7236	20	16.9
73	Pauni	Palora (Bamani)	GSDA	20.8331	79.6678	12.5	12.5
74	Pauni	Thana (Korambhi)	GSDA	20.8533	79.6158	4.8	1.1
75	Pauni	Bhawad	GSDA	20.8719	79.7356	10.55	7.85
76	Pauni	Kondha	GSDA	20.8761	79.6889	10	0.5
77	Pauni	Gose Bk.	GSDA	20.8897	79.6297	11.8	0.4
78	Pauni	Chichal	GSDA	20.91	79.6722	15.05	11.45
79	Pauni	Adyal	GSDA	20.9394	79.6986	1.4	0.1
80	Pauni	Adyal_Pz	CGWB	20.9433	79.7033	-	1.9
81	Pauni	Pauni	CGWB	20.775	79.6264	-	2.55
82	Pauni	Nilaj	CGWB	20.7417	79.55	-	5.6
83	Sakoli	Khandala	GSDA	21.0192	79.9664	7.7	1.2
84	Sakoli	Kumbhali.	GSDA	21.0536	79.9831	17	1.9
85	Sakoli	Parsodi	GSDA	21.0547	80.0664	13.4	2.6
86	Sakoli	Mundipar	GSDA	21.0617	79.9083	7.1	1.2
87	Sakoli	Sakoli	GSDA	21.0864	79.9914	7.7	1.2
88	Sakoli	Sangaon	GSDA	21.0875	80.0014	12.7	0.5
89	Sakoli	Jamanapur	GSDA	21.1025	80.0033	14.1	2.8
90	Sakoli	Bodra	GSDA	21.1081	79.9689	8	2
91	Sakoli	Bampewada	GSDA	21.1658	79.9317	13	2.2
92	Sakoli	Sakra	CGWB	21.0092	79.9761	-	5
93	Sakoli	Sakoli	CGWB	21.0833	79.9833	-	1.16
94	Sakoli	Ekodi	CGWB	21.1333	79.9333	-	0.6
95	Sakoli	Mundipar Sadak	CGWB	21.0614	79.9092	-	2.1
96	Sakoli	Pitjhari	CGWB	21.1792	80.0042	-	4.1
97	Sakoli	Jamnapur	CGWB	21.1022	80.0036	-	6
98	Sakoli	Sangadi	CGWB	20.95	79.9833	-	5.48
99	Sakoli	Salebardi	CGWB	20.9097	79.9403	-	9.05
100	Tumsar	Chargaon	GSDA	21.3264	79.7789	13.3	8.8
101	Tumsar	Kharbi	GSDA	21.3347	79.6914	4.2	0.1
102	Tumsar	Kharabi	GSDA	21.3367	79.6936	7.19	4.09
103	Tumsar	Tudka	GSDA	21.3475	79.7392	8.2	3.6
104	Tumsar	Tudka	GSDA	21.3481	79.7483	5.5	1.3
105	Tumsar	Mangali (Tudka)	GSDA	21.3569	79.7269	0.7	0.2
106	Tumsar	Khapa (Tumsar)	GSDA	21.3653	79.7228	5.3	1
107	Tumsar	Koshti	GSDA	21.3686	79.7825	13.5	8.4
108	Tumsar	Sihora	GSDA	21.4581	79.8367	7.15	3.55
109	Tumsar	Chicholi (Bhondki).	GSDA	21.4703	79.7036	6.1	1.2
110	Tumsar	Bagheda	GSDA	21.4825	79.6608	5.8	0.1
111	Tumsar	Lendezari (Rongha).	GSDA	21.4828	79.5253	7.1	2.6
112	Tumsar	Gobarwahi	GSDA	21.5194	79.7219	1.9	0.1
113	Tumsar	Pawanarkharihamesha	GSDA	21.5331	79.7075	8	1.7
114	Tumsar	Chikhali (Kamkasur)	GSDA	21.5489	79.6181	5.5	0.9
115	Tumsar	Rajapur	GSDA	21.5592	79.7344	4.1	0.6
116	Tumsar	Ashti	GSDA	21.5878	79.7339	3	0.5
117	Tumsar	Gobarwahi	CGWB	21.5239	79.7264	-	1.7
118	Tumsar	Khair Langi	CGWB	21.4092	79.7844	-	4.5
119	Tumsar	Gaimukh	CGWB	21.4436	79.6072	-	1.65
120	Tumsar	Paunarkhairi	CGWB	21.535	79.7047	-	0.8
121	Tumsar	Landehhari	CGWB	21.48	79.5733	-	4.95

S.No.	Block	Village	Agency	Latitude	Longitude	DTW (mbgl)	
						May-21	Nov-21
122	Tumsar	Chicholi	CGWB	21.4708	79.7167	-	2.5
123	Tumsar	Sihora	CGWB	21.4583	79.8403	-	1.9
124	Tumsar	Tumsar Khapa	CGWB	21.3667	79.7167	-	2.75

**Annexure IV: Long term ground water level trend of monitoring wells in Bhandara District (2012-2021)**

S.No.	Block	Village	Agency	Pre-monsoon trend (m/year)		Post-monsoon trend (m/year)	
				Rise	Fall	Rise	Fall
1	Bhandara	Ambadi	CGWB		-0.1650		-0.2642
2	Bhandara	Bhandara	GSDA		-0.3079		-0.1824
3	Bhandara	Daodipar Khapa	CGWB	0.4735			-0.0398
4	Bhandara	Dhargaon	CGWB		-0.3068		-1.1617
5	Bhandara	Dodmazari	GSDA	0.2382		0.0439	
6	Bhandara	Fulmogra	GSDA		-0.0745		-0.0177
7	Bhandara	Kardha	GSDA		-0.3036	0.0830	
8	Bhandara	Kharbi	CGWB		-0.0863		-0.1994
9	Bhandara	Koka	GSDA		-0.3898	0.0797	
10	Bhandara	Koka (Kokha)	CGWB		-0.1547		-0.3416
11	Bhandara	Kondhi	GSDA	0.2456		0.4924	
12	Bhandara	Korambi	GSDA	0.3442		0.5170	
13	Bhandara	Nawargaon	GSDA		-0.1697	0.0133	
14	Bhandara	Pagora	CGWB		-0.4861		-0.1758
15	Bhandara	Pahela	GSDA	0.0724		0.1009	
16	Bhandara	Palari	CGWB		-0.2368		-0.0427
17	Bhandara	Parsodi	GSDA	0.2952		0.2759	
18	Bhandara	Pipari	GSDA	0.4317		0.6697	
19	Bhandara	Shrinagar	CGWB		-0.5491		-0.1067
20	Lakhandur	Bhagadi.	GSDA		-0.0848		-0.0709
21	Lakhandur	Chichal	GSDA		-0.4073	0.0079	
22	Lakhandur	Dighori	GSDA		-0.0861		-0.0006
23	Lakhandur	Lakhandur	CGWB		-0.2469		-0.0827
24	Lakhandur	Lakhandur_Pz	CGWB	0.0099			-0.0306
25	Lakhandur	Masal	CGWB			0.0929	
26	Lakhandur	Soni	GSDA		-0.0882		-0.0006
27	Lakhni	Bhugaon	GSDA	0.0239		0.0342	
28	Lakhni	Dongergaon Niharwani	GSDA		-0.4679	0.0109	
29	Lakhni	Kesalwada Pawar	GSDA		-0.0127		-0.0307
30	Lakhni	Lakhani	CGWB		-0.4986		-0.4483
31	Lakhni	Madgi	CGWB		-0.1884	0.0956	
32	Lakhni	Murmadi	CGWB		-0.6900		-0.5750
33	Lakhni	Palandur	CGWB		-0.3706		-0.0661
34	Lakhni	Salebhata	GSDA		-0.3945		-0.0821
35	Mohadi	Andhalgaon	GSDA		-0.0464	0.0419	
36	Mohadi	Bacchera	GSDA		-0.0301	0.0421	
37	Mohadi	Chichkheda(pardi)	GSDA		-0.0503	0.3220	
38	Mohadi	Dahegaon	GSDA		-0.0570	0.0682	
39	Mohadi	Dahegaon2	CGWB		-0.2449		-0.0364
40	Mohadi	Dewhada Bk.	GSDA		-0.0094		-0.0400
41	Mohadi	Jamb	CGWB		-0.3027		-0.0230
42	Mohadi	Kandri	GSDA	0.0764		0.0085	
43	Mohadi	Kardi.	GSDA	0.2955		0.0485	
44	Mohadi	Mohadi	GSDA		-0.1021	0.0461	
45	Mohadi	Pardi	GSDA		-0.1271		-0.0930
46	Mohadi	Satona	GSDA		-0.2497		-0.0010
47	Mohadi	Usara	GSDA		-0.2564		-0.0776
48	Mohadi	Usarra	CGWB		-0.2834		-0.1285
49	Mohadi	Varti	CGWB		-0.1020		-0.0492
50	Mohadi	Warthi	GSDA	0.0552		0.0068	
51	Mohadi	Warthi_Pz	CGWB		-0.1889		-0.0533
52	Pauni	Adyal	GSDA	0.0845		0.0287	
53	Pauni	Adyal_Pz	CGWB	0.1148			-0.0458
54	Pauni	Asgaon	CGWB		-0.4423		-0.8438
55	Pauni	Bhuyar	GSDA		-0.0521	0.0248	
56	Pauni	Chandi	GSDA		-0.0822	0.0358	
57	Pauni	Channewada	GSDA	0.2973		0.1439	
58	Pauni	Dhamani	GSDA		-0.0653		-0.2283
59	Pauni	Gose Bk.	GSDA		-0.5936	0.0527	
60	Pauni	Kanhalgaon (somnala)	GSDA		-0.1530	0.0152	

S.No.	Block	Village	Agency	Pre-monsoon trend (m/year)		Post-monsoon trend (m/year)	
				Rise	Fall	Rise	Fall
61	Pauni	Konda Kosara	CGWB		-0.2132		
62	Pauni	Kondha	GSDA		-0.2015	0.0855	
63	Pauni	Nilaj	CGWB		-0.0608	0.0758	
64	Pauni	Nilaj (Amgaon).	GSDA	0.0221		0.0376	
65	Pauni	Pauni	CGWB	0.3021			-0.0491
66	Pauni	Sindpuri(pauni)	GSDA		-0.1542	0.0603	
67	Pauni	Thana (Korambhi)	GSDA	0.3367		0.3206	
68	Pauni	Wahi	GSDA		-0.0752		-0.0067
69	Sakoli	Salebardi	CGWB		-0.3125		-0.3594
70	Sakoli	Bampewada	GSDA		-0.0891		-0.0806
71	Sakoli	Sangadi	CGWB		-0.2453		-0.1832
72	Sakoli	Bodra	GSDA	0.0821		0.0655	
73	Sakoli	Ekodi	CGWB		-0.3018	0.0195	
74	Sakoli	Jamanapur	GSDA	0.2612		0.0091	
75	Sakoli	Jamnapur	CGWB		-0.3714		-0.1910
76	Sakoli	Khandala	GSDA		-0.0242	0.0412	
77	Sakoli	Kumbhali.	GSDA		-0.1170	0.3694	
78	Sakoli	Mundipar	GSDA	0.0061		0.0418	
79	Sakoli	Parsodi	GSDA		-0.3785		-0.0703
80	Sakoli	Pitjhari	CGWB		-0.1385		-0.2473
81	Sakoli	Sakoli	CGWB	0.1568			-0.0678
82	Sakoli	Sakra	CGWB		-0.4557		-0.0997
83	Sakoli	Sangaon	GSDA		-0.1533		-0.0136
84	Tumsar	Ashti	GSDA	0.3936		0.0420	
85	Tumsar	Bagheda	GSDA	0.0385		0.0473	
86	Tumsar	Chargaon	GSDA		-0.1945	0.0933	
87	Tumsar	Chicholi	CGWB	0.2772		0.0667	
88	Tumsar	Chicholi (Bhondki).	GSDA		-0.3076		-0.0542
89	Tumsar	Chikhali (kamkasur)	GSDA	0.0355			-0.0233
90	Tumsar	Gobarwahi	GSDA		-0.0303	0.0400	
91	Tumsar	Khapa (Tumsar)	GSDA	0.2221			-0.0036
92	Tumsar	Koshti	GSDA		-0.0661	0.1394	
93	Tumsar	Landejhari	CGWB			0.6250	
94	Tumsar	Lendezari (Rongha).	GSDA		-0.1570		-0.0062
95	Tumsar	Mangali (Tudka)	GSDA	0.3712		0.0785	
96	Tumsar	Paunarkhairi	CGWB			0.1107	
97	Tumsar	Pawanarkharihamesha	GSDA	0.0036			-0.0267
98	Tumsar	Rajapur	GSDA		-0.1470	0.0050	
99	Tumsar	Sihora	CGWB		-0.0913		-0.1394
100	Tumsar	Tudka	GSDA		-0.0976		-0.0503
101	Tumsar	Tumsar Khapa	CGWB	0.0157		0.0339	

**Annexure V: Results of Chemical analysis of ground water samples, Shallow aquifers (May 2021)**

Sr No.	BLOCK	VILLAGE	Agency	Source	pH	EC	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F
						µS/cm												
1	LAKHANDUR	LAKHANDUR	CGWB	DW	6.8	350	35.7	227.50	25.25	2.54	40.1	3.87	-	95.16	7.44	18.00	31.00	0.23
2	PAUNI	PAUNI	CGWB	DW	7.6	762	122.4	495.30	40.4	19.93	88.69	3.16	-	303.32	27.30	19.00	23.00	0.08
3	LAKHANI	PALANDUR	CGWB	DW	7.1	829	260.1	439.00	44.9698	35.24	63.7	1.19	-	297.38	58.32	37.00	45.00	0.77
4	Sakoli	EKODI	CGWB	DW	7.3	209	86.7	135.85	45.45	10.02	15.3	3.2	-	65.42	12.41	43.00	18.00	0.20
5	SAKOLI	SAKOLI	CGWB	DW	7.6	625	142.8	406.25	45.45	23.66	23.9	2.8	-	190.32	27.30	15.00	4.00	0.06
6	MOHADI	DAHEGAON2	CGWB	DW	7.7	952	244.8	505.00	47.0138	30.38	61.71	12.05	-	285.48	95.54	34.00	5.00	0.37
7	TUMSAR	GOBARWAHI	CGWB	DW	7.7	676	137.7	439.40	50.5	21.19	64	1.76	-	178.43	57.07	26.00	37.00	0.23
8	SAKOLI	SAKRA	CGWB	DW	7.6	698	107.1	453.70	55.55	12.53	29.75	51.25	-	166.53	67.00	14.80	4.00	0.08
9	BHANDARA	PAGORA	CGWB	DW	8.1	586	137.7	380.90	70.7	16.28	69.7	12.2	-	297.38	17.37	26.00	37.00	0.23
10	Tumsar	LANDEJHARI	CGWB	DW	7.9	752	107.1	488.80	75.75	7.62	60.1	11.2	-	243.85	22.33	12.00	6.00	0.04
11	LAKHANDUR	MADGI	CGWB	DW	7.25	1031	147.9	670.15	85.85	15.08	61.75	35.09	-	166.53	84.37	35.00	27.00	0.68
12	TUMSAR	PAUNARKHAIRI	CGWB	DW	7.9	804	183.6	522.60	85.85	23.75	30.4	13.5	-	243.85	34.74	22.00	10.00	0.04
13	PAUNI	KAWALEWADA	CGWB	DW	7.5	544	127.5	353.60	90.9	8.89	19.36	17.5	-	136.79	34.74	34.00	10.40	0.05
14	BHANDARA	DAODIPAR KHAPA	CGWB	DW	7.7	1123	198.9	729.95	95.95	25.02	58.46	1	-	190.32	116.63	28.00	10.00	0.81
15	SAKOLI	MASAL	CGWB	DW	7.6	611	158.1	397.15	95.95	15.10	27.56	9.49	-	148.69	57.07	17.00	12.00	0.14
16	SAKOLI	MURMADI	CGWB	DW	7.7	840	183.6	546.00	106.05	18.84	41.49	16.96	-	178.43	99.26	28.00	10.00	0.17
17	BHANDARA	AMBADI	CGWB	DW	7.5	899	178.5	584.35	126.25	12.70	30	3.38	-	107.06	114.15	14.10	8.00	0.02
18	BHANDARA	PALARI	CGWB	DW	7.8	1124	198.9	730.60	146.45	12.75	42.49	0.75	-	53.53	143.93	27.00	32.00	0.44
19	TUMSAR	SIHORA	CGWB	DW	7.6	1231	234.6	800.15	146.45	21.42	47.1	4.01	-	166.53	121.59	26.00	37.00	0.01
20	Bhandara	SHRINAGAR	CGWB	DW	7.7	1589	295.8	1032.85	171.7	30.16	74.3	14.4	-	255.74	186.11	28.00	10.00	0.46
21	MOHADI	TUMSAR KHAPA	CGWB	DW	7.5	1365	244.8	887.25	191.9	12.85	86	2.2	-	160.58	178.67	35.00	40.00	0.68
22	TUMSAR	CHICHOLI	CGWB	DW	7.5	2201	306	1430.65	252.5	13.00	79.13	2.58	-	124.90	287.85	12.10	7.00	0.23
23	Mohadi	JAMB	CGWB	DW	7.7	1796	438.6	1167.40	267.65	41.54	83.9	25.5	-	231.95	215.89	146.00	10.00	0.55
24	BHANDARA	AJIMABAD	GSDA	DW	7.62	993	280	636.00	-	-	-	-	-	-	150	12.64	3.20	0.73
25	BHANDARA	AMGAON(BHUJ)	GSDA	DW	8.2	1017	240	661.00	-	-	-	-	-	-	150	6.61	95.15	0.93
26	BHANDARA	ARJUNI(PU)	GSDA	DW	8.06	439	200	290.00	-	-	-	-	-	-	75	4.93	19.45	0.56
27	BHANDARA	BHILEWADA	GSDA	DW	7.84	1081	280	706.00	-	-	-	-	-	-	175	20.08	0.00	0.19
28	BHANDARA	BHOJAPUR	GSDA	DW	8.36	1360	460	882.00	-	-	-	-	-	-	225	13.61	94.10	0.65
29	BHANDARA	BORGAON	GSDA	DW	8.12	1732	692	1125.00	-	-	-	-	-	-	325	12.52	117.85	0.42
30	BHANDARA	CHIKHALI	GSDA	DW	8.76	1590	460	1023.00	-	-	-	-	-	-	425	10.00	50.95	0.42
31	BHANDARA	CHITAPUR	GSDA	DW	7.77	667	220	433.00	-	-	-	-	-	-	100	8.43	22.60	0.61

Sr No.	BLOCK	VILLAGE	Agency	Source	pH	EC	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F
						µS/cm												
32	BHANDARA	CHOWA	GSDA	DW	8.67	622	220	404.00	-	-	-	-	-	-	80	4.00	52.51	0.32
33	BHANDARA	DABHA	GSDA	DW	8.17	645	200	420.00	-	-	-	-	-	-	100	12.65	42.10	0.51
34	BHANDARA	DAWDIPAR (BAJAR)	GSDA	DW	8.7	652	200	423.00	-	-	-	-	-	-	100	8.42	0.00	0.92
35	BHANDARA	DAWWA	GSDA	DW	8.44	973	240	633.00	-	-	-	-	-	-	180	9.13	31.65	0.73
36	BHANDARA	DHARGAON	GSDA	DW	8.23	996	504	632.00	-	-	-	-	-	-	220	10.24	50.09	1.00
37	BHANDARA	DIGHORI	GSDA	DW	7.91	808	240	526.00	-	-	-	-	-	-	125	10.53	23.10	0.34
38	BHANDARA	GOPIWADA	GSDA	DW	8.42	745	360	487.00	-	-	-	-	-	-	150	3.42	71.25	0.23
39	BHANDARA	HATTIDOI	GSDA	DW	7.69	1094	380	710.00	-	-	-	-	-	-	175	20.94	62.55	0.74
40	BHANDARA	JAMANI	GSDA	DW	8.24	578	200	338.00	-	-	-	-	-	-	75	10.58	33.55	0.43
41	BHANDARA	KARDHA	GSDA	DW	7.84	657	160	427.00	-	-	-	-	-	-	100	12.57	32.55	0.84
42	BHANDARA	KAWLEWADA	GSDA	DW	7.38	1598	460	1032.00	-	-	-	-	-	-	250	20.03	124.75	0.46
43	BHANDARA	KESALWADA	GSDA	DW	8.71	2010	320	1320.00	-	-	-	-	-	-	350	21.33	171.60	0.75
44	BHANDARA	KHAIRY/BETALA	GSDA	DW	8.06	933	240	615.00	-	-	-	-	-	-	150	18.93	86.15	0.56
45	BHANDARA	KHAMARI BU.	GSDA	DW	7.89	614	160	396.00	-	-	-	-	-	-	75	6.40	12.75	0.55
46	BHANDARA	KHAPA	GSDA	DW	8.6	830	364	536.00	-	-	-	-	-	-	175	8.30	130.40	0.43
47	BHANDARA	KHARADI	GSDA	DW	8.12	1444	400	940.00	-	-	-	-	-	-	225	18.94	86.20	0.73
48	BHANDARA	KHURSHIPAR	GSDA	DW	8.09	406	120	264.00	-	-	-	-	-	-	50	4.26	4.85	0.57
49	BHANDARA	KOTHURNA	GSDA	DW	7.74	672	200	436.00	-	-	-	-	-	-	100	12.72	61.65	0.46
50	BHANDARA	MADAGI	GSDA	DW	8.4	998	280	664.00	-	-	-	-	-	-	150	9.98	46.60	0.73
51	BHANDARA	MANDAVI	GSDA	DW	8.19	259	160	169.00	-	-	-	-	-	-	75	1.69	26.70	1.11
52	BHANDARA	MATORA	GSDA	DW	8.16	598	160	385.00	-	-	-	-	-	-	75	6.39	74.50	0.75
53	BHANDARA	MOHDURA	GSDA	DW	7.75	1233	240	797.00	-	-	-	-	-	-	175	14.80	61.25	0.92
54	BHANDARA	MUJABHI	GSDA	DW	8.34	1350	340	878.00	-	-	-	-	-	-	200	16.88	50.50	0.59
55	BHANDARA	NAWARGAON	GSDA	DW	8.7	918	340	591.00	-	-	-	-	-	-	175	7.55	70.90	0.64
56	BHANDARA	PAGORA	GSDA	DW	7.77	629	160	406.00	-	-	-	-	-	-	100	8.41	13.35	0.53
57	BHANDARA	PAHELA	GSDA	DW	8.83	693	220	445.00	-	-	-	-	-	-	150	4.30	15.05	0.41
58	BHANDARA	PALADI	GSDA	DW	7.79	1279	360	833.00	-	-	-	-	-	-	200	16.83	23.75	0.51
59	BHANDARA	PANDHARABODI	GSDA	DW	8.96	622	140	404.00	-	-	-	-	-	-	150	4.00	27.15	0.43
60	BHANDARA	PARSODI	GSDA	DW	8.3	559	180	359.00	-	-	-	-	-	-	75	5.59	21.55	0.42
61	BHANDARA	PURKABODI	GSDA	DW	8.16	844	200	535.00	-	-	-	-	-	-	125	8.44	31.65	0.51
62	BHANDARA	RAJEDAHEGAON	GSDA	DW	8.21	364	160	237.00	-	-	-	-	-	-	50	4.37	7.09	0.81
63	BHANDARA	RAWANWADI	GSDA	DW	8.65	1122	264	729.00	-	-	-	-	-	-	215	11.22	110.80	0.33
64	BHANDARA	SALEBARDI(PANDHI)	GSDA	DW	7.68	1397	340	906.00	-	-	-	-	-	-	225	18.71	168.15	0.75

Sr No.	BLOCK	VILLAGE	Agency	Source	pH	EC	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F
						µS/cm												
65	BHANDARA	SHAHAPUR	GSDA	DW	7.83	532	120	347.00	-	-	-	-	-	-	75	5.32	1.15	0.42
66	BHANDARA	SHIRSHI	GSDA	DW	8.01	707	200	459.00	-	-	-	-	-	-	100	14.01	79.90	0.93
67	BHANDARA	SIRASGHAT(PU)	GSDA	DW	8.59	320	80	208.00	-	-	-	-	-	-	50	3.20	17.78	0.39
68	BHANDARA	SONEGAON	GSDA	DW	8.01	786	240	497.00	-	-	-	-	-	-	100	12.70	42.95	0.33
69	BHANDARA	SONULI	GSDA	DW	7.75	1277	360	830.00	-	-	-	-	-	-	200	16.83	52.55	0.33
70	BHANDARA	SRINAGAR	GSDA	DW	8.47	1571	580	1021.00	-	-	-	-	-	-	450	10.21	119.55	0.52
71	BHANDARA	SUREWADA/PU.	GSDA	DW	8.36	481	240	313.00	-	-	-	-	-	-	75	4.81	13.20	0.63
72	BHANDARA	TAWEPAR	GSDA	DW	8.67	992	240	645.00	-	-	-	-	-	-	150	12.65	12.55	0.63
73	BHANDARA	TEKEPAR/DODMAZARI	GSDA	DW	7.94	987	240	655.00	-	-	-	-	-	-	150	12.66	110.15	0.22
74	BHANDARA	TEKEPAR/PU.	GSDA	DW	7.47	834	200	545.00	-	-	-	-	-	-	125	10.55	0.00	0.63
75	BHANDARA	THANA P.PUMP	GSDA	DW	7.96	584	180	379.00	-	-	-	-	-	-	75	6.38	25.05	0.78
76	BHANDARA	USARAGONDI	GSDA	DW	7.59	1788	660	1158.00	-	-	-	-	-	-	275	22.16	104.80	0.85
77	BHANDARA	USARIPAR	GSDA	DW	8.84	741	208	509.00	-	-	-	-	-	-	55	5.01	42.10	0.52
78	BHANDARA	WAKESHWAR	GSDA	DW	8.6	641	240	417.00	-	-	-	-	-	-	100	4.17	31.55	0.25
79	BHANDARA	YETEWABI	GSDA	DW	7.58	741	220	482.00	-	-	-	-	-	-	100	8.82	9.65	0.41
80	LAKHANDUR	BARWHA	GSDA	DW	7.8	909	200	590.00	-	-	-	-	-	-	125	6.00	28.00	0.20
81	LAKHANDUR	BELATI	GSDA	DW	7.9	1125	300	731.00	-	-	-	-	-	-	190	40.00	63.00	0.30
82	LAKHANDUR	BORGAON	GSDA	DW	7.1	810	384	526.00	-	-	-	-	-	-	100	9.00	51.00	0.50
83	LAKHANDUR	CHICHAL	GSDA	DW	7.4	602	220	391.00	-	-	-	-	-	-	100	30.00	32.00	0.20
84	LAKHANDUR	DOKESARANDI	GSDA	DW	7.8	768	280	499.00	-	-	-	-	-	-	135	7.00	60.00	0.10
85	LAKHANDUR	GHODEZARI	GSDA	DW	7.4	333	200	216.00	-	-	-	-	-	-	100	6.00	59.00	0.30
86	LAKHANDUR	HARDOLI	GSDA	DW	7.6	495	200	321.00	-	-	-	-	-	-	125	1.00	14.00	0.30
87	LAKHANDUR	INDORA	GSDA	DW	7.6	1888	560	1227.00	-	-	-	-	-	-	290	41.00	0.00	0.40
88	LAKHANDUR	JAIPUR	GSDA	DW	7.5	1563	400	1015.00	-	-	-	-	-	-	300	50.00	40.00	1.10
89	LAKHANDUR	KANHALGAON	GSDA	DW	7.1	2470	460	1605.00	-	-	-	-	-	-	335	36.00	47.00	0.40
90	LAKHANDUR	KONDHALA	GSDA	DW	7.2	527	200	342.00	-	-	-	-	-	-	50	1.00	41.00	0.10
91	LAKHANDUR	KUDEGAON	GSDA	DW	7.7	883	280	573.00	-	-	-	-	-	-	85	13.00	43.00	0.60
92	LAKHANDUR	MANEGAON	GSDA	DW	7.3	1485	480	965.00	-	-	-	-	-	-	200	71.00	52.00	0.10
93	LAKHANDUR	MASAL	GSDA	DW	7.3	849	280	551.00	-	-	-	-	-	-	100	17.00	55.00	0.60
94	LAKHANDUR	MURMADI	GSDA	DW	7	2170	820	1410.00	-	-	-	-	-	-	900	45.00	56.00	0.40
95	LAKHANDUR	PALEPENDHARI	GSDA	DW	7.5	1829	440	1118.00	-	-	-	-	-	-	300	0.00	64.00	0.80
96	LAKHANDUR	SONEGAON	GSDA	DW	7.5	717	280	466.00	-	-	-	-	-	-	110	61.00	58.00	0.20
97	LAKHANDUR	SONI	GSDA	DW	7.4	2490	796	1618.00	-	-	-	-	-	-	385	81.00	50.00	1.30

Sr No.	BLOCK	VILLAGE	Agency	Source	pH	EC	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F
						µS/cm												
98	LAKHANI	BHUGAON	GSDA	DW	7.6	976	240	634.00	-	-	-	-	-	-	150	5.00	36.00	0.80
99	LAKHANI	BORGAON	GSDA	DW	7.3	1589	480	1017.00	-	-	-	-	-	-	300	32.78	87.11	0.97
100	LAKHANI	CHIKHALABODI	GSDA	DW	7.44	1138	400	728.00	-	-	-	-	-	-	250	10.15	81.10	0.72
101	LAKHANI	DAITMANGALI	GSDA	DW	7.52	698	300	447.00	-	-	-	-	-	-	200	4.15	20.72	0.56
102	LAKHANI	DHANALA	GSDA	DW	8.18	2643	384	1692.00	-	-	-	-	-	-	225	87.25	68.45	0.72
103	LAKHANI	DONGARGAON NA	GSDA	DW	7.84	652	320	417.00	-	-	-	-	-	-	100	8.22	16.31	0.69
104	LAKHANI	GADPENDHARI	GSDA	DW	8.05	550	280	352.00	-	-	-	-	-	-	125	5.04	5.80	0.14
105	LAKHANI	GARADA	GSDA	DW	7.45	913	320	584.00	-	-	-	-	-	-	325	12.49	77.89	0.36
106	LAKHANI	GURDHA	GSDA	DW	7.2	703	260	456.00	-	-	-	-	-	-	150	20.00	61.00	1.30
107	LAKHANI	KANHALGAON	GSDA	DW	7.1	1725	700	1121.00	-	-	-	-	-	-	275	48.00	55.00	0.10
108	LAKHANI	KESALWADA RA	GSDA	DW	7.44	1491	440	954.00	-	-	-	-	-	-	100	34.25	97.88	0.22
109	LAKHANI	KHURSHIPAR	GSDA	DW	7.75	2154	560	1379.00	-	-	-	-	-	-	325	44.08	32.42	0.76
110	LAKHANI	MALKAZARI	GSDA	DW	7.71	2542	640	1627.00	-	-	-	-	-	-	320	70.25	97.00	0.67
111	LAKHANI	MANGALI	GSDA	DW	7.15	290	140	186.00	-	-	-	-	-	-	100	4.36	2.69	0.84
112	LAKHANI	MASALMETA	GSDA	DW	7.4	808	400	517.00	-	-	-	-	-	-	200	6.24	12.37	0.28
113	LAKHANI	MENDHA	GSDA	DW	7.8	449	116	291.00	-	-	-	-	-	-	25	7.00	3.00	0.20
114	LAKHANI	NILAGONDI	GSDA	DW	7.37	605	260	387.00	-	-	-	-	-	-	125	3.84	16.90	0.86
115	LAKHANI	RENGEPAR/KHOTA	GSDA	DW	7.84	660	200	422.00	-	-	-	-	-	-	150	6.34	5.03	0.55
116	LAKHANI	RENGOLA	GSDA	DW	7.69	693	240	444.00	-	-	-	-	-	-	250	6.17	74.18	0.68
117	LAKHANI	SONEKHARI	GSDA	DW	7.5	995	460	637.00	-	-	-	-	-	-	150	14.36	19.51	0.33
118	MOHADI	AKOLA	GSDA	DW	7.4	1113	360	712.00	-	-	-	-	-	-	250	15.30	30.15	0.28
119	MOHADI	ANDHALGAON	GSDA	DW	7.35	660	320	422.00	-	-	-	-	-	-	275	12.25	20.70	0.68
120	MOHADI	BETALA	GSDA	DW	7.6	2200	560	1408.00	-	-	-	-	-	-	200	24.86	91.82	0.82
121	MOHADI	BHIKARKHEDA	GSDA	DW	7.35	554	240	355.00	-	-	-	-	-	-	250	7.76	2.67	0.54
122	MOHADI	BORGAON(MUNDHARI)	GSDA	DW	6.99	2122	580	1358.00	-	-	-	-	-	-	290	57.81	91.53	0.21
123	MOHADI	BORI (PANJARA)	GSDA	DW	7.45	925	400	592.00	-	-	-	-	-	-	325	31.14	79.28	1.08
124	MOHADI	CHICHOLI	GSDA	DW	7.2	1972	560	1262.00	-	-	-	-	-	-	625	17.98	77.11	1.12
125	MOHADI	CHORKHAMARI	GSDA	DW	7.15	1651	640	1057.00	-	-	-	-	-	-	260	43.58	65.73	0.25
126	MOHADI	DHARMAPURI	GSDA	DW	7.4	4330	1020	2771.00	-	-	-	-	-	-	1350	96.93	87.10	0.37
127	MOHADI	DHUSALA	GSDA	DW	7.27	1060	360	678.00	-	-	-	-	-	-	120	10.47	27.59	0.25
128	MOHADI	DONGARGAON	GSDA	DW	7.78	1109	320	710.00	-	-	-	-	-	-	200	8.14	40.06	0.78
129	MOHADI	JAMBHALAPANI	GSDA	DW	7.5	2070	560	1325.00	-	-	-	-	-	-	275	30.94	82.11	0.92
130	MOHADI	JAMBHORA	GSDA	DW	7.71	593	260	380.00	-	-	-	-	-	-	275	2.92	26.24	0.65

Sr No.	BLOCK	VILLAGE	Agency	Source	pH	EC	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F
						µS/cm												
131	MOHADI	KANDRI	GSDA	DW	7.51	1154	680	739.00	-	-	-	-	-	-	500	24.11	98.11	0.57
132	MOHADI	KHAIRLANJI (JAMB)	GSDA	DW	7.45	2110	560	1350.00	-	-	-	-	-	-	550	25.27	87.14	0.75
133	MOHADI	KHAMARI BK	GSDA	DW	7.69	1124	280	719.00	-	-	-	-	-	-	275	10.74	31.40	0.83
134	MOHADI	KHODGAON	GSDA	DW	6.9	844	320	540.00	-	-	-	-	-	-	425	8.30	31.05	1.23
135	MOHADI	KISANPUR	GSDA	DW	7.5	529	220	339.00	-	-	-	-	-	-	275	5.61	6.62	0.61
136	MOHADI	MALIDA	GSDA	DW	7.65	1205	360	771.00	-	-	-	-	-	-	200	12.24	128.12	0.64
137	MOHADI	MANDESAR	GSDA	DW	7.71	2270	520	1453.00	-	-	-	-	-	-	400	19.44	85.10	0.91
138	MOHADI	MOHGAON (KARDI)	GSDA	DW	7.28	765	340	490.00	-	-	-	-	-	-	325	8.92	79.11	1.12
139	MOHADI	MUNDHARI BK	GSDA	DW	7.51	911	300	583.00	-	-	-	-	-	-	150	7.24	95.82	0.64
140	MOHADI	MUNDHARI KH	GSDA	DW	7.84	820	240	525.00	-	-	-	-	-	-	150	15.83	18.36	0.95
141	MOHADI	NAVEGAON BK.	GSDA	DW	7.73	1189	460	761.00	-	-	-	-	-	-	300	7.16	12.16	0.61
142	MOHADI	NERI	GSDA	DW	7.35	1115	240	714.00	-	-	-	-	-	-	300	12.26	31.40	0.64
143	MOHADI	NILAJ BK	GSDA	DW	7.81	1450	440	928.00	-	-	-	-	-	-	575	10.92	68.11	1.34
144	MOHADI	NILAJ KH	GSDA	DW	6.3	1558	400	997.00	-	-	-	-	-	-	350	21.12	20.28	0.26
145	MOHADI	PALDONGARI	GSDA	DW	7.6	540	300	346.00	-	-	-	-	-	-	150	4.16	6.13	1.33
146	MOHADI	PALORA (JAMBHORA)	GSDA	DW	7.6	1181	560	756.00	-	-	-	-	-	-	475	7.70	74.92	0.87
147	MOHADI	PARDI	GSDA	DW	7.55	1029	480	659.00	-	-	-	-	-	-	575	12.20	84.95	0.48
148	MOHADI	PIMPALGAON (KHAMARI	GSDA	DW	7.9	2645	520	1693.00	-	-	-	-	-	-	315	70.25	76.72	0.33
149	MOHADI	RAMPUR	GSDA	DW	8	704	220	451.00	-	-	-	-	-	-	200	7.55	32.32	0.76
150	MOHADI	SAKARLA	GSDA	DW	7.45	1037	480	664.00	-	-	-	-	-	-	150	7.04	30.75	0.84
151	MOHADI	SALEBARDI (PANDHARA	GSDA	DW	6.95	942	400	603.00	-	-	-	-	-	-	325	10.96	71.92	0.71
152	MOHADI	SIWANI	GSDA	DW	7.5	642	300	411.00	-	-	-	-	-	-	300	7.14	79.40	1.28
153	MOHADI	TADGAON	GSDA	DW	7.4	931	360	596.00	-	-	-	-	-	-	325	7.25	30.07	0.85
154	MOHADI	VIHIRGAON	GSDA	DW	7.22	4190	1340	2682.00	-	-	-	-	-	-	1075	97.70	74.90	1.18
155	MOHADI	WADEGAON	GSDA	DW	7.69	942	480	603.00	-	-	-	-	-	-	300	5.81	25.05	0.91
156	SAKOLI	BAMPEWADA	GSDA	DW	7.54	1318	280	843.00	-	-	-	-	-	-	200	16.84	88.20	0.58
157	SAKOLI	GIROLA	GSDA	DW	7.98	352	120	226.00	-	-	-	-	-	-	50	4.23	0.00	0.42
158	SAKOLI	KATANGDHARA	GSDA	DW	7.3	885	296	575.00	-	-	-	-	-	-	152	29.00	40.00	0.20
159	SAKOLI	KHANDALA	GSDA	DW	7.4	967	280	628.00	-	-	-	-	-	-	250	7.00	40.00	0.10
160	SAKOLI	PARASTOLA	GSDA	DW	7.91	1853	712	1204.00	-	-	-	-	-	-	325	24.20	48.30	0.32
161	SAKOLI	PINDKEPAR	GSDA	DW	8.07	1096	320	712.00	-	-	-	-	-	-	175	20.96	153.03	0.45
162	SAKOLI	SALEBARDI	GSDA	DW	7.6	1082	380	703.00	-	-	-	-	-	-	190	34.00	59.00	0.10
163	SAKOLI	SANGADI	GSDA	DW	7.3	229	120	148.00	-	-	-	-	-	-	50	4.00	2.00	0.10

Sr No.	BLOCK	VILLAGE	Agency	Source	pH	EC	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F
						µS/cm												
164	SAKOLI	SANGAON	GSDA	DW	7.4	564	320	366.00	-	-	-	-	-	-	95	4.00	1.00	1.20
165	SAKOLI	SASARA	GSDA	DW	7.2	2140	520	1391.00	-	-	-	-	-	-	300	45.00	46.00	0.30
166	SAKOLI	SIVANIBANDH	GSDA	DW	7.8	552	240	358.00	-	-	-	-	-	-	50	1.00	1.00	0.10
167	SAKOLI	SONEGAON	GSDA	DW	7.9	821	180	534.00	-	-	-	-	-	-	125	10.53	36.61	0.64
168	SAKOLI	USGAON	GSDA	DW	7.89	841	240	548.00	-	-	-	-	-	-	125	10.55	46.55	0.64
169	SAKOLI	YETGAON	GSDA	DW	6.5	1261	320	819.00	-	-	-	-	-	-	200	25.00	61.00	1.40
170	SAKOLI	ZADGAON	GSDA	DW	7.5	1986	460	1290.00	-	-	-	-	-	-	225	57.00	61.00	1.20
171	TUMSAR	AGRI	GSDA	DW	7.47	875	212	568.75	-	-	-	-	-	-	200	22.39	43.60	1.14
172	TUMSAR	ALESUR	GSDA	DW	8.01	2650	228	1722.50	-	-	-	-	-	-	115	11.24	60.33	0.22
173	TUMSAR	AMBAGAD	GSDA	DW	7.84	986	316	640.90	-	-	-	-	-	-	115	102.33	28.14	0.26
174	TUMSAR	ASALPANI	GSDA	DW	7.4	1320	272	858.00	-	-	-	-	-	-	200	41.32	59.44	0.07
175	TUMSAR	ASHTI	GSDA	DW	7.65	2379.69	288	1546.80	-	-	-	-	-	-	175	62.36	80.96	0.43
176	TUMSAR	BAMHANI	GSDA	DW	7.63	1056	580	686.40	-	-	-	-	-	-	210	4.68	39.07	0.11
177	TUMSAR	BAPERA (A)	GSDA	DW	7.55	2110	452	1371.50	-	-	-	-	-	-	270	12.78	31.54	0.32
178	TUMSAR	BAZARTOLA	GSDA	DW	7.78	1739	720	1130.35	-	-	-	-	-	-	190	21.65	37.02	0.02
179	TUMSAR	BHONDKI	GSDA	DW	7.75	938.462	252	610.00	-	-	-	-	-	-	210	55.04	3.57	0.13
180	TUMSAR	BINAKI	GSDA	DW	7.24	954	288	620.10	-	-	-	-	-	-	175	14.69	8.09	0.19
181	TUMSAR	BRAMHANTOLA	GSDA	DW	7.8	946	360	614.90	-	-	-	-	-	-	155	10.06	11.93	0.12
182	TUMSAR	CHANDMARA	GSDA	DW	8.32	780	304	507.00	-	-	-	-	-	-	425	45.63	1.29	0.04
183	TUMSAR	CHANDPUR	GSDA	DW	7.88	836	460	543.40	-	-	-	-	-	-	200	18.26	183.13	0.04
184	TUMSAR	CHARGAON	GSDA	DW	7.65	956	492	621.40	-	-	-	-	-	-	280	160.33	102.63	0.63
185	TUMSAR	CHIKHALA	GSDA	DW	8.4	2440	440	1586.00	-	-	-	-	-	-	165	44.86	94.47	0.05
186	TUMSAR	CHIKHALI	GSDA	DW	7.36	1474.6	340	958.49	-	-	-	-	-	-	125	32.24	3.33	0.13
187	TUMSAR	CHULHAD	GSDA	DW	7.15	833	364	541.45	-	-	-	-	-	-	155	20.20	1.00	0.06
188	TUMSAR	CHULHARDOH	GSDA	DW	7.57	1848	440	1201.20	-	-	-	-	-	-	190	28.04	38.88	0.36
189	TUMSAR	DAVEZARI (SI)	GSDA	DW	7.69	622	380	404.30	-	-	-	-	-	-	375	42.53	22.96	0.33
190	TUMSAR	DEORIDEO	GSDA	DW	7.08	952	360	618.80	-	-	-	-	-	-	130	31.32	41.23	0.17
191	TUMSAR	DEOSARRA	GSDA	DW	7.22	922	284	599.30	-	-	-	-	-	-	185	18.32	0.42	0.77
192	TUMSAR	DEWHADI	GSDA	DW	8.48	904	340	587.60	-	-	-	-	-	-	145	15.62	13.35	0.28
193	TUMSAR	DHAMLEWADA	GSDA	DW	7.6	1562	584	1015.30	-	-	-	-	-	-	205	120.24	101.63	0.01
194	TUMSAR	DHANEAGAON	GSDA	DW	7.85	1118.75	560	727.19	-	-	-	-	-	-	150	7.83	2.66	0.17
195	TUMSAR	DHUTERA	GSDA	DW	7.53	1695.31	276	1101.95	-	-	-	-	-	-	145	57.39	90.63	0.34
196	TUMSAR	DONGARI BK.	GSDA	DW	8.01	1120.31	380	728.20	-	-	-	-	-	-	200	25.63	22.26	0.09

Sr No.	BLOCK	VILLAGE	Agency	Source	pH	EC	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F
						µS/cm												
197	TUMSAR	DONGARLA	GSDA	DW	7.41	1644	316	1068.60	-	-	-	-	-	-	150	52.23	161.14	0.87
198	TUMSAR	GARKABHONGA	GSDA	DW	7.3	995.238	508	646.91	-	-	-	-	-	-	175	59.83	21.82	0.13
199	TUMSAR	GARRA	GSDA	DW	7.35	1204.62	244	783.00	-	-	-	-	-	-	260	21.65	52.36	0.14
200	TUMSAR	GONDEKHARI	GSDA	DW	7.48	622	328	404.30	-	-	-	-	-	-	220	45.63	17.05	0.60
201	TUMSAR	GONDITOLA	GSDA	DW	8.12	1876	384	1219.40	-	-	-	-	-	-	260	22.20	26.81	0.23
202	TUMSAR	GUDRI KH.	GSDA	DW	7.52	1969	740	1279.85	-	-	-	-	-	-	115	46.56	68.13	0.03
203	TUMSAR	HARDOLI (A)	GSDA	DW	7.56	958	304	622.70	-	-	-	-	-	-	140	28.61	2.81	0.17
204	TUMSAR	HARDOLI (SI)	GSDA	DW	7.59	2530	620	1644.50	-	-	-	-	-	-	165	55.18	45.15	0.24
205	TUMSAR	HASARA	GSDA	DW	7.79	795	212	516.75	-	-	-	-	-	-	180	25.47	115.87	0.04
206	TUMSAR	HINGNA	GSDA	DW	7.55	1087	600	706.55	-	-	-	-	-	-	250	16.82	35.65	0.22
207	TUMSAR	HIRAPUR HAMESHA	GSDA	DW	8.1	1210	452	786.50	-	-	-	-	-	-	260	18.63	24.33	0.13
208	TUMSAR	KAMKASUR	GSDA	DW	7.56	1168	312	759.20	-	-	-	-	-	-	250	9.72	43.14	0.10
209	TUMSAR	KARKAPUR	GSDA	DW	8.3	1240	360	806.00	-	-	-	-	-	-	200	23.67	12.99	0.25
210	TUMSAR	KHAIRLANJI (DONGARLA)	GSDA	DW	8.04	910	200	591.50	-	-	-	-	-	-	150	35.11	16.64	0.52
211	TUMSAR	KHANDAL	GSDA	DW	7.085	1356	644	881.40	-	-	-	-	-	-	60	23.33	151.28	0.07
212	TUMSAR	KHAPA (KHURD)	GSDA	DW	7.31	1219	400	792.35	-	-	-	-	-	-	105	51.91	10.38	0.14
213	TUMSAR	KHAPA DE	GSDA	DW	8.11	1325	180	861.25	-	-	-	-	-	-	390	23.14	51.67	0.35
214	TUMSAR	KHARBI	GSDA	DW	7.22	895	320	581.75	-	-	-	-	-	-	170	25.32	12.57	0.16
215	TUMSAR	KOSHTI	GSDA	DW	8.25	1228	520	798.20	-	-	-	-	-	-	140	125.33	22.88	0.03
216	TUMSAR	KURMUDA	GSDA	DW	7.43	1473.02	300	957.46	-	-	-	-	-	-	175	48.56	60.00	0.16
217	TUMSAR	LOBHI	GSDA	DW	7.36	1211	224	787.15	-	-	-	-	-	-	105	42.08	5.42	0.11
218	TUMSAR	MACHHERA	GSDA	DW	7.21	2436	240	1583.40	-	-	-	-	-	-	175	50.09	48.94	0.32
219	TUMSAR	MADGI	GSDA	DW	7.67	1064	292	691.60	-	-	-	-	-	-	150	28.45	5.62	0.46
220	TUMSAR	MAHALGAON	GSDA	DW	7.31	1489	420	967.85	-	-	-	-	-	-	140	18.07	85.43	0.96
221	TUMSAR	MANDHAL	GSDA	DW	7.84	1020	580	663.00	-	-	-	-	-	-	230	22.32	33.61	0.30
222	TUMSAR	MANGALI (SI.)	GSDA	DW	7.52	1050	340	682.50	-	-	-	-	-	-	160	64.22	8.51	0.21
223	TUMSAR	MANGALI(D)	GSDA	DW	7.62	852.381	496	554.05	-	-	-	-	-	-	130	31.67	44.82	0.23
224	TUMSAR	MITEWANI	GSDA	DW	7.6	892	340	579.80	-	-	-	-	-	-	165	95.63	166.08	0.43
225	TUMSAR	MOHAGAON (KHADAN)	GSDA	DW	7.6	1020	320	663.00	-	-	-	-	-	-	315	60.26	6.28	0.53
226	TUMSAR	MOHAGAON KHURD	GSDA	DW	8.02	1425	268	926.25	-	-	-	-	-	-	175	68.66	38.63	0.07
227	TUMSAR	MURALI	GSDA	DW	7.86	764	292	496.60	-	-	-	-	-	-	280	65.33	1.18	0.13
228	TUMSAR	NAKA DONGARI	GSDA	DW	7.58	1313.85	360	854.00	-	-	-	-	-	-	240	84.53	15.86	0.43
229	TUMSAR	NAWEGAON	GSDA	DW	7.85	1020	140	663.00	-	-	-	-	-	-	370	28.08	1.63	0.12

Sr No.	BLOCK	VILLAGE	Agency	Source	pH	EC	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F
						µS/cm												
230	TUMSAR	PACHARA	GSDA	DW	7.25	1960	460	1274.00	-	-	-	-	-	-	180	25.30	58.41	0.26
231	TUMSAR	PARASWADA (DEWHADI)	GSDA	DW	8.31	857	240	557.05	-	-	-	-	-	-	160	13.17	57.67	0.04
232	TUMSAR	PATHARI	GSDA	DW	7.63	958	488	622.70	-	-	-	-	-	-	115	135.63	68.99	0.62
233	TUMSAR	PIPARI CHUNNI	GSDA	DW	7.55	450	220	292.50	-	-	-	-	-	-	165	37.69	8.15	0.53
234	TUMSAR	PIpra (SAKHALI)	GSDA	DW	6.92	1288	340	837.20	-	-	-	-	-	-	210	24.50	61.78	0.37
235	TUMSAR	RAJAPUR	GSDA	DW	7.49	1468	520	954.20	-	-	-	-	-	-	155	63.26	110.37	0.80
236	TUMSAR	RAMPUR HAMESHA	GSDA	DW	7.68	1025	360	666.25	-	-	-	-	-	-	225	60.33	0.13	0.42
237	TUMSAR	RANERA	GSDA	DW	7.13	1684	512	1094.60	-	-	-	-	-	-	220	165.24	62.61	0.80
238	TUMSAR	RENGEPAR (PANJARA)	GSDA	DW	7.33	1178	320	765.70	-	-	-	-	-	-	245	25.63	24.96	0.69
239	TUMSAR	RUPERA	GSDA	DW	7.51	1541	344	1001.65	-	-	-	-	-	-	150	120.33	39.27	0.11
240	TUMSAR	SINDPURI	GSDA	DW	7.53	1523	200	989.95	-	-	-	-	-	-	145	65.26	41.98	0.62
241	TUMSAR	SITEPAR	GSDA	DW	7.45	1068	120	694.20	-	-	-	-	-	-	260	11.02	1.33	0.24
242	TUMSAR	SODIPUR	GSDA	DW	7.33	1464	728	951.60	-	-	-	-	-	-	150	13.33	152.63	0.04
243	TUMSAR	SONEGAON	GSDA	DW	7.28	2021	200	1313.65	-	-	-	-	-	-	190	58.63	40.24	0.49
244	TUMSAR	SORNA	GSDA	DW	7.55	1265	364	822.25	-	-	-	-	-	-	275	17.54	131.61	1.48
245	TUMSAR	STATIONTOLI	GSDA	DW	7.58	1227.69	340	798.00	-	-	-	-	-	-	130	87.63	63.16	0.03
246	TUMSAR	SUKALI (N)	GSDA	DW	7.65	1562	340	1015.30	-	-	-	-	-	-	375	36.99	82.54	0.05
247	TUMSAR	SUNDARTOLA	GSDA	DW	7.95	1318	480	856.70	-	-	-	-	-	-	265	42.33	177.49	0.03
248	TUMSAR	TAMASWADI (TUDKA)	GSDA	DW	8.1	1024	356	665.60	-	-	-	-	-	-	315	145.63	170.53	0.43
249	TUMSAR	TEMANI	GSDA	DW	7.15	1356	420	881.40	-	-	-	-	-	-	200	42.49	13.41	0.63
250	TUMSAR	TUDKA	GSDA	DW	7.62	1025	344	666.25	-	-	-	-	-	-	170	62.33	40.26	0.33
251	TUMSAR	VITPUR	GSDA	DW	7.98	1456	440	946.40	-	-	-	-	-	-	120	93.13	18.63	0.17
252	TUMSAR	WAHANI	GSDA	DW	7.32	748	368	486.20	-	-	-	-	-	-	170	12.18	25.50	0.08
253	TUMSAR	WANGI	GSDA	DW	8.18	449	276	291.85	-	-	-	-	-	-	155	20.36	10.49	0.29
254	TUMSAR	YEDARBUCHI	GSDA	DW	8.46	1173.44	376	762.73	-	-	-	-	-	-	220	52.63	60.37	0.13
255	TUMSAR	ZARLI	GSDA	DW	7.68	1135	284	737.75	-	-	-	-	-	-	225	42.80	3.93	0.25

**Annexure VI: Results of Chemical analysis of ground water samples, deeper aquifers**

S. No.	Block	Village	Agency	Type	pH	EC	TDS	TH	Ca	Mg	Na	K	CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sup>4</sup>	NO <sub>3</sub>	F	Iron
						µs/cm													
1	Bhandara	Chandori	CGWB	EW	7.7	300	0	125	28	13			-	155	12	-	-	-	-
2	Bhandara	Chandori	CGWB	OW	7.7	380	0	130	40	7			-	155	34	-	-	-	0.3
3	Bhandara	Jewnala	CGWB	EW	7.6	512	281	205	52	18	13	5.02	-	220	35	3	3	1.48	-
4	Bhandara	Khursipar	CGWB	EW	8.1	400	195	140	24	19	21	10	-	214	14	-	-	-	-
5	Bhandara	Koka	CGWB	EW	8.3	350	0	110	22	13			-	104	46	-	-	-	-
6	Bhandara	Parsodi	CGWB	EW	6.8	1152	938	110	16	17	92	460	-	659	220	22	34	0.37	
7	Lakhandur	Lakhandur	CGWB	EW	8	615	270	275	14	39	66	3	-	366	7.8	10			
8	Lakhandur	Lakhandur	CGWB	OW	8	570	265	210	16	41	32	3	-	311	18	-	-	-	-
9	Lakhni	Pohara	CGWB	EW	8.01	250	0	85	22	7			-	116	14	-	-	-	-
10	Mohadi	Mohagaon	CGWB	EW	8.25	400	210	70	22	4	56	6	-	201	21	-	-	-	-
11	Mohadi	Salai khurd	CGWB	EW	7.7	913	484	335	114	12	30	7.65	-	24.4	234	22	28	0.34	
12	Pauni	Adarsha Amgaon	CGWB	EW	7.8	400	220	175	36	21			-	122	50				
13	Pauni	Chichal	CGWB	EW	8	1455	781	490	48	90	21	1.05	-	299	213	13	1.5	1.4	
14	Pauni	Chikhali	CGWB	EW	8.4	1150	-	370	36.07	44.99			12	170.8	127.7	-	-	-	-
15	Pauni	Chikhali	CGWB	OW	7.1	740	-	275	64.06	51.07	-	-	-	201.3	191.5	-	-	-	-
16	Sakoli	Khairlanji	CGWB	EW	7.87	500	-	40	20	219	-	-	-	275	7	-	-	-	-
17	Tumsar	Hardoli	CGWB	OW	7.36	280	-	95	26	6	-	-	-	116	18	-	-	-	-
18	Tumsar	Hardoli	CGWB	EW	7.2	280	-	105	28	9	-	-	-	133	18	-	-	-	-
19	Tumsar	Sindpuri	CGWB	EW	8.65	380	180	130	12	24	23	8	18	146	3	29	-	-	-
20	BHANDARA	KHAIRY/BETALA	GSDA	BW	8.06	512	332	200	-	-	-	-	-	-	75	10.51	29.00	0.19	0.55
21	BHANDARA	TIDDI	GSDA	BW	7.08	997	648	320	-	-	-	-	-	-	150	12.65	51.61	0.20	0.20
22	BHANDARA	BERODI	GSDA	BW	7.8	729	471	220	-	-	-	-	-	-	100	8.47	36.61	0.32	0.11
23	BHANDARA	LAWESHWAR	GSDA	BW	8.06	740	481	200	-	-	-	-	-	-	100	8.48	62.80	0.39	0.10
24	BHANDARA	HATTIDOI	GSDA	BW	8.05	988	630	280	-	-	-	-	-	-	150	18.88	46.55	0.44	0.14
25	BHANDARA	GUNTHARA	GSDA	BW	8.44	725	462	280	-	-	-	-	-	-	175	7.91	35.40	0.45	0.62
26	BHANDARA	LOHARA	GSDA	BW	7.7	1421	899	360	-	-	-	-	-	-	200	16.90	141.86	0.46	0.11
27	BHANDARA	PINDKEPAR	GSDA	BW	8.55	678	439	160	-	-	-	-	-	-	50	6.87	36.15	0.56	0.59
28	BHANDARA	SHAHAPUR	GSDA	BW	7.4	1218	790	280	-	-	-	-	-	-	175	12.18	132.50	0.61	0.54
29	BHANDARA	MANDAVI	GSDA	BW	8.72	404	259	160	-	-	-	-	-	-	50	2.11	20.25	0.63	0.19
30	BHANDARA	SALEBARDI(PANDHI)	GSDA	BW	7.66	1654	1075	660	-	-	-	-	-	-	250	20.08	71.85	0.63	0.12
31	BHANDARA	KORAMBHI(DEVI)	GSDA	BW	7.7	1037	674	240	-	-	-	-	-	-	150	10.73	134.60	0.64	0.31

S. No.	Block	Village	Agency	Type	pH	EC	TDS	TH	Ca	Mg	Na	K	CO <sub>3</sub>	HCO <sub>3</sub>	Cl	SO <sub>4</sub>	NO <sub>3</sub>	F	Iron
						µs/cm													
32	BHANDARA	MAKARDHOKADA	GSDA	BW	8.16	792	517	240	-	-	-	-	-	-	125	10.58	50.85	0.67	0.19
33	BHANDARA	ARJUNI(PU)	GSDA	BW	8.35	736	475	160	-	-	-	-	-	-	100	7.63	20.50	0.74	0.19
34	BHANDARA	MOHDURA	GSDA	BW	8.46	764	496	220	-	-	-	-	-	-	100	8.50	8.60	0.83	0.12
35	BHANDARA	KHARBI	GSDA	BW	7.88	1301	846	360	-	-	-	-	-	-	200	16.85	86.35	0.92	0.62
36	LAKHANI	DHABETEKADI	GSDA	BW	7.74	1470	834	524	-	-	-	-	-	-	270	27.69	49.75	0.36	0.00
37	Lakhani	Pimpalgaon	GSDA	BW	7.46	1666	1083	560	-	-	-	-	-	-	260	49.99	59.92	0.83	0.12
38	Lakhani	Gadegaon	GSDA	BW	7.88	992	645	440	-	-	-	-	-	-	175	23.05	82.92	1.30	0.10
39	Lakhani	Samewada	GSDA	BW	7.82	1059	678	520	-	-	-	-	-	-	210	42.94	29.38	1.34	0.12
40	LAKHANI	MIREGAON	GSDA	BW	7.93	505	357	288	-	-	-	-	-	-	70	-	-	-	-
41	LAKHANI	DONGARGAON SA	GSDA	BW	7.72	1045	678	324	-	-	-	-	-	-	120	-	-	-	-
42	LAKHANI	WAKAL	GSDA	BW	7.77	1246	782	328	-	-	-	-	-	-	140	-	-	-	-
43	Mohadi	Warthi	GSDA	BW	7.78	1022	664	296	-	-	-	-	-	-	208	25.54	38.35	0.10	0.02
44	Mohadi	Hardoli	GSDA	BW	7.31	1203	782	620	-	-	-	-	-	-	350	45.62	34.94	0.14	0.06
45	Mohadi	Usarra	GSDA	BW	7.44	912	584	400	-	-	-	-	-	-	200	17.18	90.44	0.15	0.07
46	Mohadi	Andhalgaon	GSDA	BW	7.25	999	639	380	-	-	-	-	-	-	425	10.12	79.84	0.39	0.04
47	Mohadi	Khut Sawari	GSDA	BW	7.85	1412	918	428	-	-	-	-	-	-	215	19.43	25.46	0.45	0.11
48	Mohadi	Hivra	GSDA	BW	7.9	733	469	240	-	-	-	-	-	-	75	12.28	82.37	0.50	0.10
49	Mohadi	Deulgaon	GSDA	BW	7.68	1588	1016	440	-	-	-	-	-	-	300	26.18	68.96	0.54	0.04
50	Mohadi	Satona	GSDA	BW	7.98	1169	760	560	-	-	-	-	-	-	250	10.66	10.17	0.55	0.21
51	Mohadi	Jamb	GSDA	BW	7.42	1690	1082	420	-	-	-	-	-	-	300	29.44	101.44	0.58	0.06
52	Mohadi	Kanhalgaon(mundhari)	GSDA	BW	7.57	787	504	200	-	-	-	-	-	-	250	6.19	19.93	0.66	0.09
53	Mohadi	Narsinhatola	GSDA	BW	7	1503	977	496	-	-	-	-	-	-	275	32.14	36.86	0.67	0.01
54	Mohadi	Panjara(gramdan)	GSDA	BW	7.98	849	543	280	-	-	-	-	-	-	100	16.12	14.16	0.77	0.05
55	Mohadi	Tadgaon	GSDA	BW	7.55	740	474	320	-	-	-	-	-	-	325	7.23	81.10	0.80	0.05
56	Mohadi	Kandri	GSDA	BW	7.37	1264	809	540	-	-	-	-	-	-	325	23.48	32.95	0.83	0.04
57	Mohadi	Rohna	GSDA	BW	7.3	1290	826	360	-	-	-	-	-	-	275	16.29	89.14	0.89	0.19
58	Mohadi	Dewhada Bk	GSDA	BW	7.45	2158	1403	648	-	-	-	-	-	-	375	45.27	31.85	1.02	0.02
59	Mohadi	Salai Bk	GSDA	BW	7.51	1210	774	580	-	-	-	-	-	-	300	24.19	94.18	1.04	0.11
60	Mohadi	Sihari	GSDA	BW	7.4	1625	1040	480	-	-	-	-	-	-	475	10.28	74.98	1.12	0.06
61	Mohadi	Lendezari (jambhora)	GSDA	BW	7.1	524	335	280	-	-	-	-	-	-	300	3.41	3.76	1.23	0.08
62	Mohadi	Paldongari	GSDA	BW	7.68	848	543	360	-	-	-	-	-	-	200	6.10	20.87	1.27	0.06
63	Mohadi	Pimpalgaon (kanhalgaon)	GSDA	BW	7.48	1382	884	580	-	-	-	-	-	-	325	22.97	30.94	1.28	0.09

S. No.	Block	Village	Agency	Type	pH	EC	TDS	TH	Ca	Mg	Na	K	CO3	HCO <sub>3</sub>	Cl	SO <sup>4</sup>	NO <sub>3</sub>	F	Iron
						µs/cm													
64	PAUNI	NANDIKHEDA	GSDA	BW	7.93	575	383	328	-	-	-	-	-	-	85	56.36	5.69	0.00	0.09
65	PAUNI	DHAKUNDI	GSDA	BW	7.73	628	407	232	-	-	-	-	-	-	80	10.36	27.98	0.02	0.13
66	PAUNI	NAIGAON	GSDA	BW	8.07	1290	801	612	-	-	-	-	-	-	335	59.90	4.28	0.04	0.79
67	PAUNI	FANOLI	GSDA	BW	8.1	625	420	312	-	-	-	-	-	-	85	13.17	50.56	0.04	0.30
68	PAUNI	GUDEGAON	GSDA	BW	7.81	535	392	376	-	-	-	-	-	-	105	53.93	170.34	0.08	0.09
69	PAUNI	KODURLI (PAWANI)	GSDA	BW	8.16	611	468	244	-	-	-	-	-	-	65	54.14	26.81	0.11	0.03
70	PAUNI	WAHI	GSDA	BW	7.87	2410	1490	856	-	-	-	-	-	-	235	23.56	50.57	0.11	0.71
71	PAUNI	ASGAON	GSDA	BW	7.81	1046	819	540	-	-	-	-	-	-	175	6.46	48.74	0.12	0.24
72	PAUNI	DHAMANI	GSDA	BW	8.06	524	348	284	-	-	-	-	-	-	235	10.71	3.06	0.12	0.02
73	PAUNI	THANA (NAVEGAL)	GSDA	BW	7.29	635	420	236	-	-	-	-	-	-	115	3.49	6.56	0.13	0.00
74	PAUNI	PARSODI (GAIDONGRI)	GSDA	BW	8.12	502	326	276	-	-	-	-	-	-	80	18.56	24.41	0.13	0.15
75	PAUNI	KHAPARI (KORAMBHI)	GSDA	BW	8.09	2320	1510	656	-	-	-	-	-	-	515	4.88	55.52	0.13	0.24
76	PAUNI	MALCHI	GSDA	BW	7.5	1041	676	476	-	-	-	-	-	-	195	42.85	5.11	0.22	0.04
77	PAUNI	NISHTI	GSDA	BW	7.28	1034	672	456	-	-	-	-	-	-	115	33.78	105.22	0.24	0.48
78	PAUNI	KANHALGAON (SOMNALA)	GSDA	BW	7.61	1866	1213	592	-	-	-	-	-	-	280	21.21	42.67	0.25	0.27
79	PAUNI	BACHEWADI	GSDA	BW	7.42	653	420	276	-	-	-	-	-	-	90	8.48	9.77	0.25	0.15
80	PAUNI	SINDPURI (PAUNI)	GSDA	BW	7.71	946	617	372	-	-	-	-	-	-	65	88.69	24.23	0.26	0.01
81	PAUNI	SAUNDAL	GSDA	BW	7.91	1000	650	444	-	-	-	-	-	-	60	12.08	50.86	0.26	0.08
82	PAUNI	MENDHEGAON	GSDA	BW	7.88	789	513	364	-	-	-	-	-	-	175	11.59	52.45	0.26	0.03
83	PAUNI	SHIVNALA (GONDI)	GSDA	BW	7.87	1123	773	252	-	-	-	-	-	-	145	146.32	20.98	0.26	0.24
84	PAUNI	KHAKSI	GSDA	BW	7.4	681	477	272	-	-	-	-	-	-	80	16.19	8.26	0.27	0.01
85	PAUNI	SENDRI KH.	GSDA	BW	7.38	1054	739	488	-	-	-	-	-	-	135	20.15	31.61	0.29	0.23
86	PAUNI	PATHARI (CHICHAL)	GSDA	BW	7.52	815	530	292	-	-	-	-	-	-	85	75.09	18.00	0.32	0.05
87	PAUNI	KHAIRI (TIRRI)	GSDA	BW	7.59	966	628	380	-	-	-	-	-	-	160	62.33	40.26	0.33	0.33
88	PAUNI	BHUYAR	GSDA	BW	7.75	1015	659	484	-	-	-	-	-	-	245	30.66	53.61	0.36	0.01
89	PAUNI	BHENDALA	GSDA	BW	7.76	792	515	344	-	-	-	-	-	-	135	8.11	13.79	0.36	0.14
90	PAUNI	SEGAON	GSDA	BW	8.15	1088	708	428	-	-	-	-	-	-	115	38.16	60.36	0.36	0.13
91	PAUNI	PIMPALGAON (NIPANI)	GSDA	BW	8.15	1820	1183	684	-	-	-	-	-	-	455	4.83	56.45	0.37	0.11
92	PAUNI	KOSARA	GSDA	BW	7.72	619	423	268	-	-	-	-	-	-	45	65.33	144.36	0.37	0.08
93	PAUNI	MAHALGAON (PARSODI)	GSDA	BW	8.18	896	582	244	-	-	-	-	-	-	155	27.64	42.09	0.37	0.02

S. No.	Block	Village	Agency	Type	pH	EC	TDS	TH	Ca	Mg	Na	K	CO3	HCO <sub>3</sub>	Cl	SO <sup>4</sup>	NO <sub>3</sub>	F	Iron
						µs/cm													
94	PAUNI	GOSE BK.	GSDA	BW	7.79	1758	1143	572	-	-	-	-	-	-	255	75.25	60.60	0.37	0.53
95	PAUNI	NILAJ (AMGAON)	GSDA	BW	8.1	1160	753	404	-	-	-	-	-	-	235	41.42	53.58	0.45	0.00
96	PAUNI	THANA (KORAMBI)	GSDA	BW	7.57	410	336	212	-	-	-	-	-	-	80	13.05	4.00	0.46	0.00
97	PAUNI	SIRSALA	GSDA	BW	7.48	555	307	264	-	-	-	-	-	-	55	81.76	46.81	0.48	0.02
98	PAUNI	MENDHA (PUNARVASAN)	GSDA	BW	7.42	1095	691	492	-	-	-	-	-	-	175	37.69	8.15	0.53	0.24
99	PAUNI	SHIVNALA (WALANI)	GSDA	BW	7.85	1034	672	404	-	-	-	-	-	-	230	26.31	49.13	0.57	0.00
100	PAUNI	LAWADI	GSDA	BW	7.81	1083	677	296	-	-	-	-	-	-	180	17.37	26.04	0.62	0.62
101	PAUNI	BHIKARMINSI	GSDA	BW	7.63	632	451	332	-	-	-	-	-	-	55	10.09	21.35	0.65	0.05
102	PAUNI	SURBODI	GSDA	BW	7.59	735	478	300	-	-	-	-	-	-	120	12.32	52.50	0.66	0.00
103	PAUNI	PAHUNGAON	GSDA	BW	7.92	1605	1040	768	-	-	-	-	-	-	215	34.23	180.34	0.78	0.23
104	PAUNI	CHANNEWADA	GSDA	BW	7.21	841	549	420	-	-	-	-	-	-	125	74.52	87.37	0.79	0.12
105	PAUNI	MUJBI	GSDA	BW	7.66	499	364	296	-	-	-	-	-	-	75	8.53	1.26	0.99	0.21
106	PAUNI	VILAM	GSDA	BW	8.03	854	589	476	-	-	-	-	-	-	105	11.36	18.26	1.00	0.07
107	PAUNI	PALORA (CHAURAS)	GSDA	BW	7.9	690	463	344	-	-	-	-	-	-	65	20.15	63.92	1.01	0.16
108	PAUNI	KAWADSI (PARSODI)	GSDA	BW	7.65	905	530	424	-	-	-	-	-	-	75	30.55	175.85	1.15	0.12
109	PAUNI	PAUNA BK	GSDA	BW	7.4	607	394	248	-	-	-	-	-	-	75	4.52	20.83	1.37	0.11
110	PAUNI	SENDRI BK.	GSDA	BW	8.1	1062	700	180	-	-	-	-	-	-	55	-	-	-	-
111	PAUNI	KODURLI	GSDA	BW	7.83	601	390	272	-	-	-	-	-	-	80	-	-	-	-
112	PAUNI	ROHANA (WAHI)	GSDA	BW	8.08	580	377	316	-	-	-	-	-	-	85	-	-	-	-
113	PAUNI	DHANORI	GSDA	BW	7.88	886	575	244	-	-	-	-	-	-	105	-	-	-	-
114	PAUNI	NERALA	GSDA	BW	8.3	776	502	312	-	-	-	-	-	-	115	-	-	-	-
115	PAUNI	BETALA (PAUNI)	GSDA	BW	7.69	907	589	380	-	-	-	-	-	-	115	-	-	-	-
116	PAUNI	NEVEGAON ALIAS PALEPAR	GSDA	BW	7.92	926	601	372	-	-	-	-	-	-	125	-	-	-	-
117	PAUNI	KURZA	GSDA	BW	7.53	745	487	248	-	-	-	-	-	-	215	-	-	-	-
118	SAKOLI	LAWARI	GSDA	BW	7.86	369	239	160	-	-	-	-	-	-	50	4.24	49.85	0.29	0.11
119	SAKOLI	KITADI	GSDA	BW	7.89	534	348	160	-	-	-	-	-	-	75	6.38	11.00	0.33	0.14
120	SAKOLI	EKODI	GSDA	BW	8.07	413	265	160	-	-	-	-	-	-	50	4.27	5.85	0.43	0.19
121	SAKOLI	GIROLA	GSDA	BW	7.53	455	292	160	-	-	-	-	-	-	50	4.29		0.53	0.15
122	SAKOLI	WIRSHI	GSDA	BW	8.07	669	434	240	-	-	-	-	-	-	100	8.43	21.65	0.62	0.18
123	SAKOLI	BARADKINI	GSDA	BW	8.16	595	386	160	-	-	-	-	-	-	75	6.39	7.70	0.63	0.13
124	SAKOLI	KINHI/MOKHE	GSDA	BW	7.67	1698	1104	662.4	-	-	-	-	-	-	275	22.10	14.15	1.21	0.13

**Annexure VII: Location of proposed Percolation tanks in Bhandara district**

S.NO.	Village	Block	X	Y	Type of structure
1	Lakhandur	Bhagadi	79.850	20.759	Percolation tank
2	Lakhandur	Bhagadi	79.843	20.790	Percolation tank
3	Lakhandur	Chicholi	79.857	20.792	Percolation tank
4	Lakhandur	Irali Bk.	79.763	20.775	Percolation tank
5	Lakhandur	Irali Dambi	79.858	20.683	Percolation tank
6	Lakhandur	Opara	79.805	20.765	Percolation tank
7	Lakhandur	Sarandi Bk.	79.813	20.816	Percolation tank
8	Lakhandur	Sawargaon	79.875	20.720	Percolation tank
9	Lakhandur	Vihirgaon	79.896	20.691	Percolation tank
10	Lakhani	Borgaon	79.882	21.096	Percolation tank
11	Lakhani	Deori (Hemesha)	79.817	20.905	Percolation tank
12	Lakhani	Gondi	79.847	20.915	Percolation tank
13	Lakhani	Kawale Wada	79.870	20.922	Percolation tank
14	Lakhani	Kesalwada (pawar)	79.875	21.140	Percolation tank
15	Lakhani	Kesalwada (pawar)	79.875	21.150	Percolation tank
16	Lakhani	Kesalwada (pawar)	79.861	21.154	Percolation tank
17	Lakhani	Kesalwada (Waghaye)	79.809	21.065	Percolation tank
18	Lakhani	Khaurshipar	79.800	21.003	Percolation tank
19	Lakhani	Kinhi (Gadegaon)	79.807	21.100	Percolation tank
20	Lakhani	Kotali	79.793	20.909	Percolation tank
21	Lakhani	Kotali	79.810	20.924	Percolation tank
22	Lakhani	Kotali	79.787	20.927	Percolation tank
23	Lakhani	Lakhani	79.839	21.069	Percolation tank
24	Lakhani	Malkazari	79.813	21.018	Percolation tank
25	Lakhani	Mogara	79.869	21.003	Percolation tank
26	Lakhani	Murmadi (Hamesha)	79.834	20.940	Percolation tank
27	Lakhani	Palasgaon	79.912	20.911	Percolation tank
28	Lakhani	Parsodi	79.861	21.132	Percolation tank
29	Lakhani	Parsodi	79.870	21.134	Percolation tank
30	Lakhani	Parsodi	79.858	21.134	Percolation tank
31	Lakhani	Pauldawana	79.832	21.144	Percolation tank
32	Lakhani	Pohara	79.844	21.030	Percolation tank
33	Lakhani	Rengepar (kohali)	79.883	21.042	Percolation tank
34	Lakhani	Rengepar (kohali)	79.887	21.047	Percolation tank
35	Lakhani	Rengepar (kotha)	79.818	21.127	Percolation tank
36	Lakhani	Salebhata	79.870	21.134	Percolation tank
37	Lakhani	Samewada	79.893	21.097	Percolation tank
38	Lakhani	Sipewada	79.823	21.045	Percolation tank
39	Lakhani	Sonekhari	79.800	21.102	Percolation tank
40	Mohadi	Borgaon(mundhari)	79.770	21.236	Percolation tank
41	Mohadi	Dongargaon	79.650	21.340	Percolation tank
42	Mohadi	Dongargaon	79.670	21.346	Percolation tank
43	Mohadi	Jamb	79.568	21.379	Percolation tank
44	Mohadi	Jamb	79.589	21.388	Percolation tank
45	Mohadi	Jamb	79.573	21.393	Percolation tank
46	Mohadi	Kandri	79.555	21.403	Percolation tank
47	Mohadi	Kardi	79.816	21.288	Percolation tank
48	Mohadi	Khairlanji	79.580	21.369	Percolation tank
49	Mohadi	Khodgaon	79.649	21.284	Percolation tank
50	Mohadi	Malida	79.612	21.367	Percolation tank
51	Mohadi	Malida	79.620	21.384	Percolation tank
52	Mohadi	Mandesar	79.618	21.287	Percolation tank
53	Mohadi	Mohagaon (Devi)	79.680	21.262	Percolation tank
54	Mohadi	Mohagaon (Nilaj)	79.811	21.304	Percolation tank
55	Mohadi	Narsinhatola	79.801	21.337	Percolation tank
56	Mohadi	Navegaon	79.583	21.352	Percolation tank
57	Mohadi	Pachgaon	79.630	21.266	Percolation tank

S.NO.	Village	Block	X	Y	Type of structure
58	Mohadi	Paldongari	79.636	21.365	Percolation tank
59	Mohadi	Rampur	79.624	21.302	Percolation tank
60	Mohadi	Rohna	79.715	21.288	Percolation tank
61	Mohadi	Takala	79.671	21.406	Percolation tank
62	Mohadi	Tanga	79.676	21.378	Percolation tank
63	Mohadi	Vhirgaon	79.676	21.363	Percolation tank
64	Mohadi	Wadegaon	79.602	21.321	Percolation tank
65	Mohadi	Yeklara	79.689	21.296	Percolation tank
66	Pauni	Asgaon	79.599	20.730	Percolation tank
67	Pauni	Bhuyar	79.594	20.706	Percolation tank
68	Pauni	Chandakapur (I)	79.624	20.777	Percolation tank
69	Pauni	Gaidongari	79.572	20.813	Percolation tank
70	Pauni	Jogikheda (Hamesha)	79.577	20.775	Percolation tank
71	Pauni	Kanhalgaon (Somnala)	79.670	20.694	Percolation tank
72	Pauni	Kawadsi (Parsodi)	79.562	20.802	Percolation tank
73	Pauni	Khaksi	79.616	20.825	Percolation tank
74	Pauni	Khapari (Korambhi)	79.564	20.829	Percolation tank
75	Pauni	Kosambodi	79.600	20.799	Percolation tank
76	Pauni	Kosara	79.694	20.885	Percolation tank
77	Pauni	Kotalpar	79.550	20.754	Percolation tank
78	Pauni	Mokhara	79.675	20.829	Percolation tank
79	Pauni	Pauna Kh.	79.706	20.765	Percolation tank
80	Pauni	Rewani	79.665	20.767	Percolation tank
81	Pauni	Selari	79.636	20.766	Percolation tank
82	Pauni	Sendri Kh.	79.708	20.862	Percolation tank
83	Pauni	Sindhi	79.690	20.738	Percolation tank
84	Pauni	Sindhi	79.681	20.741	Percolation tank
85	Pauni	Wahi	79.609	20.783	Percolation tank
86	Tumsar	Ambagad	79.661	21.437	Percolation tank
87	Tumsar	Hardoli (Ambagad)	79.693	21.415	Percolation tank
88	Tumsar	Hardoli (Ambagad)	79.670	21.418	Percolation tank
89	Tumsar	Pawanara	79.689	21.445	Percolation tank

**Note: Construction of AR structures may be taken up at these sites after field checks/verification only**

**Annexure VIII: Location of proposed check dam in Bhandara district**

S.NO.	Block	Village	X	Y	Type of structure
1	Lakhani	Alesur	79.7919	20.9720	Check dam
2	Lakhani	Alesur	79.7978	20.9725	Check dam
3	Lakhani	Alesur	79.8730	21.0939	Check dam
4	Lakhani	Alesur	79.8759	21.0950	Check dam
5	Lakhani	Alesur	79.8762	21.0972	Check dam
6	Lakhani	Daitmangli	79.8093	21.1080	Check dam
7	Lakhani	Daitmangli	79.7985	21.1151	Check dam
8	Lakhani	Daitmangli	79.8037	21.1155	Check dam
9	Lakhani	Daitmangli	79.8012	21.1172	Check dam
10	Lakhani	Deori	79.8193	20.9215	Check dam
11	Lakhani	Deori (Hemesha)	79.8185	20.9133	Check dam
12	Lakhani	Dhanala	79.8171	21.0232	Check dam
13	Lakhani	Dighori	79.8769	20.9789	Check dam
14	Lakhani	Gadegaon	79.7990	21.0752	Check dam
15	Lakhani	Gadegaon	79.7897	21.0892	Check dam
16	Lakhani	Garada	79.8203	21.0509	Check dam
17	Lakhani	Ghodezari	79.8780	20.9366	Check dam
18	Lakhani	Gondsawari	79.8538	21.1331	Check dam
19	Lakhani	Gondsawari	79.8490	21.1340	Check dam
20	Lakhani	Kaneri	79.8496	21.0025	Check dam
21	Lakhani	Kanhalgaon	79.8765	20.9698	Check dam
22	Lakhani	Kawadsi	79.8429	20.9370	Check dam
23	Lakhani	Kesalwada (pawar)	79.8645	21.1497	Check dam
24	Lakhani	Khaurshipar	79.7948	21.0044	Check dam
25	Lakhani	Khedepar	79.8389	21.0965	Check dam
26	Lakhani	Khedepar	79.8433	21.0996	Check dam
27	Lakhani	Khedepar	79.8388	21.1202	Check dam
28	Lakhani	Khedepar	79.8391	21.1207	Check dam
29	Lakhani	Khurshipar	79.8708	21.1538	Check dam
30	Lakhani	Kinhi (Gadegaon)	79.7966	21.1008	Check dam
31	Lakhani	Kinhi (Gadegaon)	79.8060	21.1016	Check dam
32	Lakhani	Kolari	79.9221	20.9414	Check dam
33	Lakhani	Lakhani	79.8433	21.0759	Check dam
34	Lakhani	Macharana	79.8504	20.9604	Check dam
35	Lakhani	Macharana	79.8378	20.9627	Check dam
36	Lakhani	Macharana	79.8447	20.9661	Check dam
37	Lakhani	Malkazari	79.8023	21.0197	Check dam
38	Lakhani	Manegaon	79.8409	21.0616	Check dam
39	Lakhani	Mangali	79.8259	20.9452	Check dam
40	Lakhani	Mangali	79.8041	20.9595	Check dam
41	Lakhani	Mangali	79.8120	20.9819	Check dam
42	Lakhani	Masalmeta	79.8761	21.1106	Check dam
43	Lakhani	Masalmeta	79.8717	21.1125	Check dam
44	Lakhani	Mogara	79.8806	20.9955	Check dam
45	Lakhani	Mogara	79.8744	21.0073	Check dam
46	Lakhani	Murmadi	79.8349	20.9463	Check dam
47	Lakhani	Murmadi (CT)	79.8177	21.0710	Check dam
48	Lakhani	Murmadi (Hamesha)	79.8293	20.9317	Check dam
49	Lakhani	Murmadi (Hamesha)	79.8301	20.9450	Check dam
50	Lakhani	Nimgaon	79.8724	20.9473	Check dam
51	Lakhani	Nimgaon	79.8871	20.9504	Check dam
52	Lakhani	Palandur	79.8729	20.9080	Check dam
53	Lakhani	Palasgaon	79.9190	20.9173	Check dam
54	Lakhani	Palasgaon	79.9037	20.9276	Check dam
55	Lakhani	Parsodi	79.8573	21.1353	Check dam
56	Lakhani	Parsodi	79.8721	21.1378	Check dam
57	Lakhani	Parsodi	79.8537	21.1380	Check dam
58	Lakhani	Pauldawana	79.8315	21.1451	Check dam

S.NO.	Block	Village	X	Y	Type of structure
59	Lakhani	Pauldawana	79.8263	21.1503	Check dam
60	Lakhani	Pendhari	79.8325	21.0112	Check dam
61	Lakhani	Pendhari	79.8300	21.0180	Check dam
62	Lakhani	Pimpalgaon	79.8887	21.0570	Check dam
63	Lakhani	Pimpalgaon	79.8711	21.0627	Check dam
64	Lakhani	Pimpalgaon	79.8738	21.0637	Check dam
65	Lakhani	Rampuri	79.9152	20.9921	Check dam
66	Lakhani	Rengepar (kohali)	79.8883	21.0419	Check dam
67	Lakhani	Rengepar (kohali)	79.8880	21.0491	Check dam
68	Lakhani	Rengepar (kotha)	79.8095	21.1323	Check dam
69	Lakhani	Rengepar (kotha)	79.8181	21.1359	Check dam
70	Lakhani	Rengepar (kotha)	79.8181	21.1364	Check dam
71	Lakhani	Rengola	79.8225	20.9704	Check dam
72	Lakhani	Saigaon	79.8097	20.9289	Check dam
73	Lakhani	Saigaon	79.8065	20.9317	Check dam
74	Lakhani	Saigaon	79.8121	20.9344	Check dam
75	Lakhani	Salebhata	79.8781	21.1140	Check dam
76	Lakhani	Salebhata	79.8765	21.1149	Check dam
77	Lakhani	Sawari	79.8216	21.0869	Check dam
78	Lakhani	Seloti	79.8627	21.0482	Check dam
79	Lakhani	Shivani	79.8894	21.0190	Check dam
80	Lakhani	Singori	79.8485	21.1050	Check dam
81	Lakhani	Sipewada	79.8040	21.0360	Check dam
82	Lakhani	Sonekhari	79.7983	21.1035	Check dam
83	Lakhani	Vhirgaon	79.9331	20.9198	Check dam
84	Lakhani	Wakal	79.8420	20.8913	Check dam
85	Lakhani	Yetewahi	79.8403	21.0826	Check dam
86	Mohadi	Andhalgaon	79.6311	21.3499	Check dam
87	Mohadi	Andhalgaon	79.6326	21.3525	Check dam
88	Mohadi	Betala	79.7361	21.2568	Check dam
89	Mohadi	Betala	79.7239	21.2626	Check dam
90	Mohadi	Betala	79.7309	21.2637	Check dam
91	Mohadi	Bonde	79.7781	21.2248	Check dam
92	Mohadi	Borgaon(mundhari)	79.7683	21.2415	Check dam
93	Mohadi	Bothali	79.6702	21.2589	Check dam
94	Mohadi	Dawadipar (kardi)	79.8211	21.2866	Check dam
95	Mohadi	Dhop	79.6035	21.3848	Check dam
96	Mohadi	Dhop	79.6142	21.3930	Check dam
97	Mohadi	Dongardeo	79.7702	21.2177	Check dam
98	Mohadi	Dongardeo	79.7619	21.2257	Check dam
99	Mohadi	Dongargaon	79.6509	21.3401	Check dam
100	Mohadi	Dongargaon	79.6695	21.3469	Check dam
101	Mohadi	Dongargaon	79.6480	21.3523	Check dam
102	Mohadi	Dongargaon	79.6662	21.3568	Check dam
103	Mohadi	Hardoli	79.6176	21.3049	Check dam
104	Mohadi	Hardoli	79.5926	21.3058	Check dam
105	Mohadi	Jamb	79.5893	21.3694	Check dam
106	Mohadi	Jamb	79.5678	21.3803	Check dam
107	Mohadi	Jamb	79.5706	21.3957	Check dam
108	Mohadi	Jamb	79.5856	21.4019	Check dam
109	Mohadi	Jambhalapani	79.8178	21.3145	Check dam
110	Mohadi	Jambhora	79.8312	21.2563	Check dam
111	Mohadi	Kandri	79.5532	21.3788	Check dam
112	Mohadi	Kandri	79.5539	21.3951	Check dam
113	Mohadi	Kandri	79.5523	21.4024	Check dam
114	Mohadi	Kardi	79.8188	21.2611	Check dam
115	Mohadi	Kardi	79.8237	21.2822	Check dam
116	Mohadi	Kesalwada (Jambhora)	79.8238	21.2291	Check dam
117	Mohadi	Kesalwada (Jambhora)	79.8161	21.2295	Check dam

S.NO.	Block	Village	X	Y	Type of structure
118	Mohadi	Kesalwada (Jambhora)	79.8190	21.2315	Check dam
119	Mohadi	Khairlanji	79.5651	21.3657	Check dam
120	Mohadi	Khairlanji	79.5619	21.3719	Check dam
121	Mohadi	Khut Sawari	79.5943	21.2922	Check dam
122	Mohadi	Kushari	79.7050	21.2973	Check dam
123	Mohadi	Malida	79.6131	21.3739	Check dam
124	Mohadi	Mohagaon (Devi)	79.6711	21.2654	Check dam
125	Mohadi	Narsinhatola	79.8021	21.3332	Check dam
126	Mohadi	Narsinhatola	79.8086	21.3345	Check dam
127	Mohadi	Narsinhatola	79.8038	21.3383	Check dam
128	Mohadi	Navegaon	79.5747	21.3484	Check dam
129	Mohadi	Navegaon	79.5770	21.3564	Check dam
130	Mohadi	Navegaon Bk.	79.8187	21.2943	Check dam
131	Mohadi	Navegaon Bk.	79.8171	21.3052	Check dam
132	Mohadi	Nerla	79.6370	21.3655	Check dam
133	Mohadi	Nerla	79.6379	21.3745	Check dam
134	Mohadi	Nerla	79.6285	21.3847	Check dam
135	Mohadi	Nilaj Bk	79.8045	21.3135	Check dam
136	Mohadi	Nilaj Kh	79.7857	21.2901	Check dam
137	Mohadi	Palora (Jambhora)	79.8047	21.2196	Check dam
138	Mohadi	Palora (Jambhora)	79.8013	21.2499	Check dam
139	Mohadi	Panjara (Bori)	79.7845	21.2473	Check dam
140	Mohadi	Pardi	79.6439	21.2929	Check dam
141	MOHADI	Pimpalgaon	79.6434	21.3329	Check dam
142	Mohadi	Roha	79.7403	21.2711	Check dam
143	Mohadi	Roha	79.7289	21.2862	Check dam
144	Mohadi	Rohna	79.6959	21.2634	Check dam
145	Mohadi	Salai Bk	79.6926	21.3743	Check dam
146	Mohadi	Salai Bk	79.6903	21.3788	Check dam
147	Mohadi	Salai Kh.	79.6400	21.3886	Check dam
148	Mohadi	Salai Kh.	79.6301	21.3996	Check dam
149	Mohadi	Salai Kh.	79.6314	21.4051	Check dam
150	Mohadi	Salebardi	79.5897	21.3209	Check dam
151	Mohadi	Siwani	79.5857	21.3416	Check dam
152	Mohadi	Siwani	79.6068	21.3474	Check dam
153	Mohadi	Siwani	79.5783	21.3476	Check dam
154	Mohadi	Siwani	79.5888	21.3513	Check dam
155	Mohadi	Siwani	79.5899	21.3520	Check dam
156	Mohadi	Tanga	79.6652	21.3838	Check dam
157	Mohadi	Usara	79.6634	21.3990	Check dam
158	Mohadi	Usaripar	79.8105	21.2966	Check dam
159	Mohadi	Yelkazari	79.8281	21.2334	Check dam
160	Mohadi	Yelkazari	79.8248	21.2362	Check dam
161	Mohadi	Yelkazari	79.8250	21.2416	Check dam
162	Pauni	Lonhara	79.6721	20.8496	Check dam
163	Pauni	Walani	79.7007	20.7947	Check dam
164	Tumsar	Ambagad	79.6523	21.4404	Check dam
165	Tumsar	Ambagad	79.6560	21.4420	Check dam
166	Tumsar	Bapera (Ambagad)	79.6602	21.4279	Check dam
167	Tumsar	Dawezari	79.6851	21.4298	Check dam
168	Tumsar	Dawezari	79.6978	21.4404	Check dam
169	Tumsar	Hardoli (Ambagad)	79.6730	21.4195	Check dam
170	Tumsar	Hardoli (Ambagad)	79.6691	21.4243	Check dam
171	Tumsar	Hardoli (Ambagad)	79.6829	21.4253	Check dam
172	Tumsar	Mitewani	79.6936	21.4189	Check dam
173	Tumsar	Mitewani	79.7057	21.4195	Check dam
174	Tumsar	Mitewani	79.7123	21.4279	Check dam
175	Tumsar	Pawanara	79.6953	21.4584	Check dam

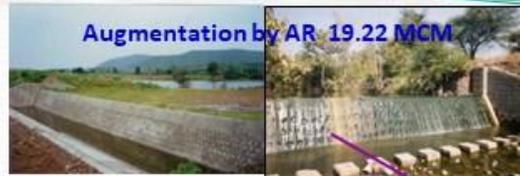
**Note: Construction of AR structures may be taken up at these sites after field checks/verification only**

**Annexure IX: Location of proposed check dam in Bhandara district**

S.NO.	Block	Village	X	Y	Type of structure
1	Lakhandur	Antergaon Kha.	Recharge shaft	79.866	20.771
2	Lakhandur	Awali	Recharge shaft	79.903	20.694
3	Lakhandur	Chichgaon	Recharge shaft	79.941	20.761
4	Lakhandur	Chicholi	Recharge shaft	79.851	20.784
5	Lakhandur	Dandegaon	Recharge shaft	79.850	20.804
6	Lakhandur	Irali Bk.	Recharge shaft	79.765	20.775
7	Lakhandur	Kanhalgaon	Recharge shaft	79.934	20.716
8	Lakhandur	Mandhal	Recharge shaft	79.826	20.816
9	Lakhandur	Manegaon	Recharge shaft	79.871	20.830
10	Lakhandur	Opara	Recharge shaft	79.816	20.764
11	Lakhandur	Pimpalgaon	Recharge shaft	79.899	20.779
12	Lakhandur	Pimpalgaon	Recharge shaft	79.930	20.785
13	Lakhandur	Piparwani	Recharge shaft	79.899	20.823
14	Lakhandur	Soni	Recharge shaft	79.919	20.699
15	Pauni	Asgaon	Recharge shaft	79.595	20.716
16	Pauni	Bhendara	Recharge shaft	79.676	20.816
17	Pauni	Bhojapur (Pauni)	Recharge shaft	79.693	20.744
18	Pauni	Bhuyar	Recharge shaft	79.595	20.707
19	Pauni	Brahmi	Recharge shaft	79.752	20.836
20	Pauni	Chichgaon	Recharge shaft	79.589	20.797
21	Pauni	Dhamangaon	Recharge shaft	79.570	20.792
22	Pauni	Gaidongari	Recharge shaft	79.564	20.810
23	Pauni	Garadapur	Recharge shaft	79.619	20.779
24	Pauni	Gudegaon	Recharge shaft	79.723	20.737
25	Pauni	Kanhalgaon (Somnala)	Recharge shaft	79.670	20.690
26	Pauni	Khairi (Diwan)	Recharge shaft	79.699	20.832
27	Pauni	Lawadi	Recharge shaft	79.737	20.786
28	Pauni	Mahalgaon (Parsodi)	Recharge shaft	79.558	20.828
29	Pauni	Nagangaon	Recharge shaft	79.607	20.817
30	Pauni	Nilaj (Amgaon)	Recharge shaft	79.539	20.735
31	Pauni	Nimgaon (Avalgaon)	Recharge shaft	79.588	20.780
32	Pauni	Panjarepar	Recharge shaft	79.548	20.724
33	Pauni	Parsodi (Gaidongri)	Recharge shaft	79.547	20.841
34	Pauni	Pauni (M Cl)	Recharge shaft	79.622	20.817
35	Pauni	Pradhan (Dhorap)	Recharge shaft	79.667	20.677
36	Pauni	Rajkota	Recharge shaft	79.589	20.765
37	Pauni	Rajkota	Recharge shaft	79.582	20.777
38	Pauni	Sendri Kh.	Recharge shaft	79.715	20.859
39	Pauni	Shivnala (Gondi)	Recharge shaft	79.699	20.694
40	Pauni	Sindhi	Recharge shaft	79.691	20.741
41	Pauni	Sindhi	Recharge shaft	79.686	20.744
42	Pauni	Singora (Hamesha)	Recharge shaft	79.601	20.730
43	Pauni	Sirsala	Recharge shaft	79.643	20.746

**Note: Construction of AR structures may be taken up at these sites after field checks/verification only**

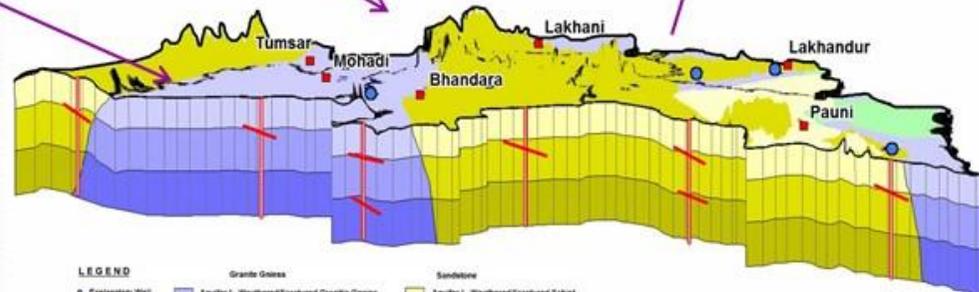
# PROPOSED MANAGEMENT PLAN



Aquifer I Resources –  
Dy- 858.04 MCM

## GW SCENARIO AFTER IMPLEMENTING

- A. Artificial Recharge  
GWA  $858.04 + 19.22$  MCM by AR = 877.26 MCM
- B. WUE- 27.26 MCM



LEGEND		
○ Exploratory Well	Granite Gneiss	Sandstone
■ Taluka HQ	Aquifer I - Weathered/Fractured Granite Gneiss	Aquifer I - Weathered/Fractured Schist
○ Drainage	Aquifer II - Jointed/Fractured Granite Gneiss	Aquifer II - Jointed/Fractured Schist
— Fractures	Granitic Gneiss	Compact Schist

## GW AVAILABLE FOR DEVELOPMENT PLAN

After SOD of 70% = 380.36 MCM

## PROBABLE BENEFITS AFTER IMPLEMENTING AR & WUE MEASURES

- Additional GW Resources by Supply side AR = 19.22 MCM
- Water saving through adopting (Micro Irrigation) = 27.26 MCM
- Balance GWR available for Development after SOD 70% – 380.36 MCM
- Assured GW Irrigation in ADDITIONAL 585.11 sq km area
- Even after above, SOD will be 70% (safe category)
- Increase in GW Availability & Sustainability