केंद्रीय 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

OSMANABAD, MAHARASHTRA

मध्य क्षेत्र, नागपुर

Central Region, Nagpur

AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN, OSMANABAD DISTRICT, MAHARASHTRA

(AAP 2018-19)

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OSMANABAD DISTRICT AT A GLANCE

1. GENERAL INFORMATION			
	Geographical Area	:	7569Sq. km.
	Administrative Divisions (2011)	:	Blocks-8; Osmanabad, Tuljapur, Umerga, Lohara, Bhum, Kalamb, Paranda and Washi.
	Villages (Census 2011)	:	728 Nos.
	Population	:	16,60,311
	Rainfall 2018	:	505.1mm
	Normal rainfall (1998-2018)	:	807.2 mm
	Long term rainfall Trend (1998-2018)	:	Falling trend 7.1 mm/year
2. GEOMORPHOLOGY AND DRAINAGE			
	Major Physiographic unit	:	Balaghat Plateau
	Major Drainage	:	Manjra and Sina Rivers
3. LAND USE (2012-13) *(sources: mahasdb.maharashtra.gov.in/district Report)*			
	Forest Area	:	40.63 Sq. km. (0.54 %)
	Cultivable Area	:	7229 Sq. km. (96.58 %)
	Net Area Sown	:	6401.80 Sq. km. (85.53 %)
	Area Sown more than Once		1889.16 Sq. km. (25.24%)
4.	**SOIL TYPE**	:	Shallow, Medium and Medium deep soils 64% area of the district is covered by clayey soil and 21 % Gravelly sandy clay soil.
5. PRINCIPAL CROPS (2017)			
	Pulses	:	3387.69 sq. km.
	Cereals	:	3059.39 sq. km.
	Oil Seeds	:	2362.36 sq. km.
	Sugarcane	:	350.00 sq. km.
	Cotton	:	203.55 sq. km.
6.	**HORTICULTURAL CROPS**		
	Mango	:	41.48 sq. km.
	Grapes	:	21.88 sq. km.
	Citrus fruit	:	12.88 sq. km.
	Banana	:	5.39 sq. km.
	Others	:	5.91 sq. km.
7. IRRIGATION BY DIFFERENT SOURCES (2013-14)- Nos. / Potential Created (ha)			
	Dug wells	:	47982/133535
	Tube wells/Bore wells	:	15834/40258
	Surface Flow Schemes	:	3428/6238
	Lift Irrigation Schemes		4708/11682
	Net Irrigated Area	:	1917.13 sq. km.
8. GROUND WATER MONITORING WELLS (As on March 2019)			
	Dug wells	:	39
	Piezometers	:	02
9. GEOLOGY			
	Recent	:	Alluvium (River Alluvium)
	Upper Cretaceous-Lower Eocene	:	Deccan Traps Basalt
10. HYDROGEOLOGY			
	Major Water Bearing Formation		Deccan Traps: Basalt weathered, amygdaloidal, fractured and jointed.

			Under phreatic, semi-confined to confined conditions
	Depth to water level in Shallow Aquifer		
	Pre-monsoon Depth to Water Level (May-2018)	:	1.1 to 28 mbgl
	Post-monsoon Depth to Water Level (Nov.-2018)	:	0.6 to 16.65 mbgl
	Depth to water level in Deeper Aquifer		
	Pre- monsoon Depth to Water Level (May-2018)	:	11 to 98.1 mbgl
	Post-monsoon Depth to Water Level (Nov.-2018)	:	6 to 32 mbgl
	Water level Trend (2009-18)		
	Pre- monsoon Water Level Trend (2009-2018)	:	Rise: 0.02 to 0.80 m/year
			Fall: 0.015 to 1.97 m/year
	Post-monsoon Water Level Trend (2009-2018)	:	Rise: 0.071 to 2.02 m/year
			Fall: 0.0043 to 1.96 m/year
11. GROUND WATER EXPLORATION (As on March 2019)			
			Basalt
	Wells Drilled	:	EW-59, OW-13 and 12 Pz **Total -84**
	Depth Range	:	30.0 to 204.15 mbgl
	Discharge	:	0.22 – 20.24 lps
	Drawdown	:	0.75 to 47.42 m
	Transmissivity	:	0.22 to 20.24 m^2/day
	Storativity	:	3.34 x 10^{-4} to 3.5 x 10^{-4}
12. GROUND WATER QUALITY			
	Good and suitable for drinking and irrigation purposes except Nitrate and Fluoride affected villages.		
	Type of Water	:	Ca-HCO_3 and Ca-Cl
13. DYNAMIC GROUND WATER RESOURCES- (2013)			
	Net Annual Ground Water Availability	:	922.13 MCM
	Total Draft (Irrigation + Domestic+ Industrial)	:	570.58 MCM
	Projected Demand (Domestic + Industrial)	:	44.97 MCM
	Stage of Ground Water Development	:	61.88 %
	Category		**Safe**
14.	**MAJOR GROUND WATER PROBLEMS AND ISSUES** • Declining water level trend of more than 0.2 m/year has been observed in majpr part of Paranda, Bhum, Washi, Tuljapur, Kalamb and Lohara blocks. • About 60% area of the district is having low yield potential (<1 lps) • In Osmanabad district increase in number of irrigation wells and stage of ground water development is observed over the period of time from 2004 to 2013 implying rising Irrigation draft. • Osmanabad District experiences low and deficient rainfall with frequent droughts.		
15.	**Aquifer Management Plan**		
	Supply side Management	:	Proposed AR structures: 243 Percolation tanks and 783 Check dams

	Demand side Management	:	55 sq. km. area proposed for Drip irrigation
	Expected Benefits	:	216.48 sq. km. area comes under Assured Ground Water Irrigation.

AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN, OSMANABAD DISTRICT, MAHARASHTRA

(AAP 2018-19)

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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 regulation 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 ground water 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 Osmanabad 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

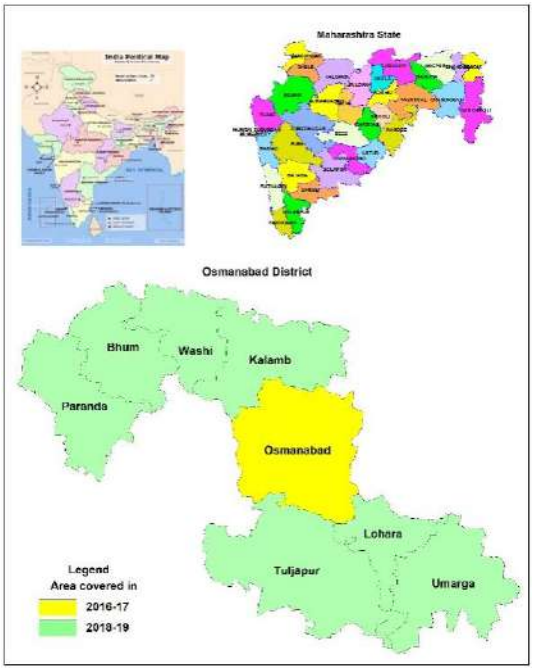
Osmanabad district is an administrative district in the Marathwada Region of Maharashtra State. It is situated in the southern part of the State abutting Andhra Pradesh in south and lies between north latitudes 17°37' and 18°42' and east longitude 75°16' and 76°47'. The total area of the district is 7569sq. km. and falls in parts of survey of India degree sheets 47 N & O and 58B &56C. It is located about 600 meters above the sea level. It is bounded by Solapur district to the South-West, by Ahmednagar district to North-West, by Beed district to the North and by Latur district to the East. The famous Tulja bhavani temple at Tuljapur is situated in Tuljapur block in Osmanabad district.

The district headquarters is located at Osmanabad Town. For administrative convenience, the district is divided into 8 blocks i.e., Osmanabad, Tuljapur, Umerga and Lohara in Osmanabad subdivision and Kalamb, Bhum, Paranda and Washi in Bhum subdivision. It has a total population of 16, 57,576 as per 2011 Census. The district has 8 towns/blocks and 728 villages. The district forms part of Godavari Basin and Manjra Sub basin. Manjra, Sina, Tirna, Bori, Benitura, Banganga are the main rivers flowing through the

district. The overall stage of ground water development for the district is 61.88 % district is categorized as safe as per Ground Water Resources Estimation 2013. The Administrative and Index map of the Osmanabad district is presented in **Fig. 1.1 and Fig. 1.2**.

Osmanabad district has been taken up under NAQUIM study in two Phases and was covered during the years 2016-17 and 2018-19.

I. Osmanabad blocks (1326 sq. km.) in AAP 2016-17
II. Osmanabad, Tuljapur, Umerga, Lohara, Kalamb, Bhum, Paranda and Washi blocks (5300 sq. km.) in AAP 2018-19.



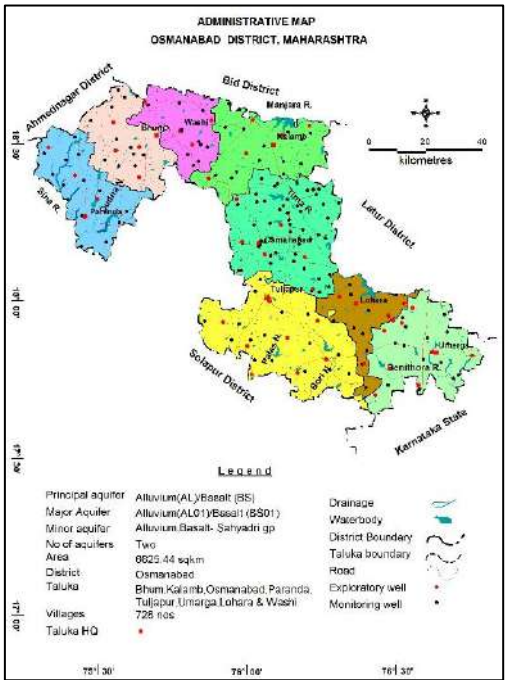


Figure 1. 1:Index map, Osmanabad District Figure 1. 2 : Administrative map, Osmanabad District

Ground water exploration in the district has been taken up in different phases since 1977-78. During 1977-78 under Sina-Man Project 9 EW and 6 OW were drilled while in 1994-95, 5 EW were drilled to study the post-Killari earthquake effect on ground water scenario in the district. Furthermore, during 1998, 12 Pzs were drilled under Hydrology Project and from 2001 to 2003, 34 EW and 5 OW were drilled under GW Exploration Programme.

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 17 exploratory wells and 6 observation wells have been constructed during the years 2016-17 and 2018-19. A total of 59 EWs, 13 OWs and 12 piezometers have been constructed till March 2019**.** Salient Features of Ground Water Exploration are given in **Annexure-I** and details of exploration under NAQUIM are given in **Annexure-II**.

To assess the ground water regime, 41 existing ground water monitoring stations were being monitored 4 times in a year. Based on data gap analysis additional 69 (17 KOWs and 52 micro level) and 93 KOWs were inventoried during 2016-17 and 2018-19 respectively, 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 KOWs and GWM wells are given in **Annexure-III**. Locations of existing ground water monitoring stations and exploratory wells are shown in **Fig. 1.3**.

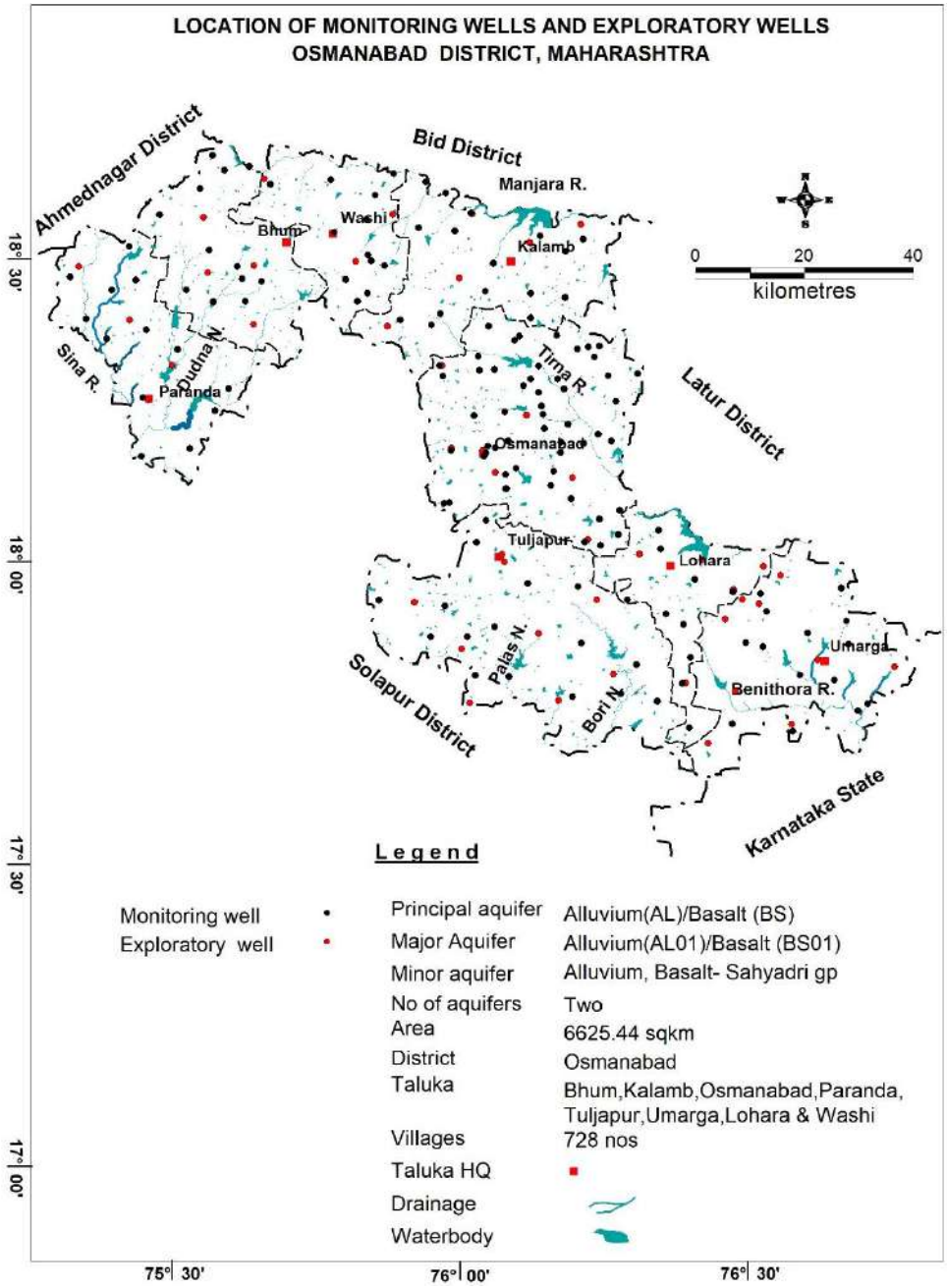


Figure 1. 3:Locations of Existing Exploratory and Ground Water Monitoring Wells

1.2 GEOMORPHOLOGY, DRAINAGE AND SOIL TYPES

The district forms part of Deccan Plateau, locally known as Balaghat Plateau, with slope towards southwest and south and has a varied topography consisting of hills, plains and undulating topography near river-banks. The district forms a part of Godavari (~45%) and Krishna (~55%) River basin. The Balaghat Plateau comprises of low-lying hills forming water divide between Krishna and Godavari basin. Many of the tributaries to Godavari River originate from the Balaghat Plateau. The northern Part of the districts is drained by Godavari River and Southern part, by the tributaries of Krishna River. Easterly flowing Manjra River drains the northern part and Tirna along with tributary Bhogavathi river drain the eastern part.

Sina River flowing towards south- south east before joining the Bhima River, a tributary of Krishna River, drains the western part. The Bori River flows through Tuljapur block and join the Sina river further south in Solapur district. Based on geomorphological setting and drainage pattern, the district is divided into 41 watersheds.

Major part of the Osmanabad district comes under moderately dissected plateau MDP (84%) & highly dissected plateau (10%) depending upon the extent of weathering and thickness of soil cover. The geomorphology of the area is shown in **Fig. 1.4 and** Drainage map is shown in **Fig. 1.5.**

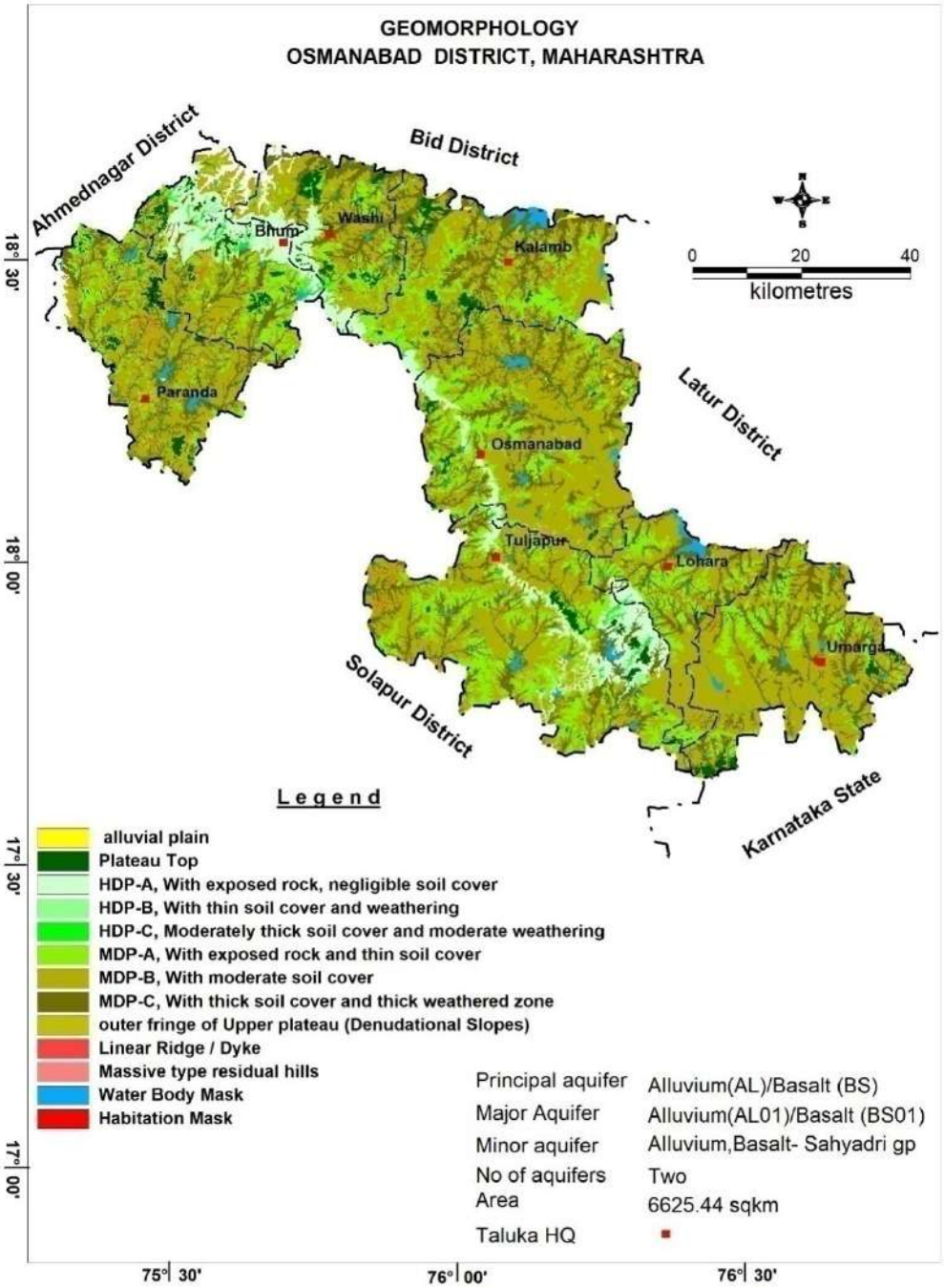


Figure 1. 4: Geomorphology, Osmanabad District

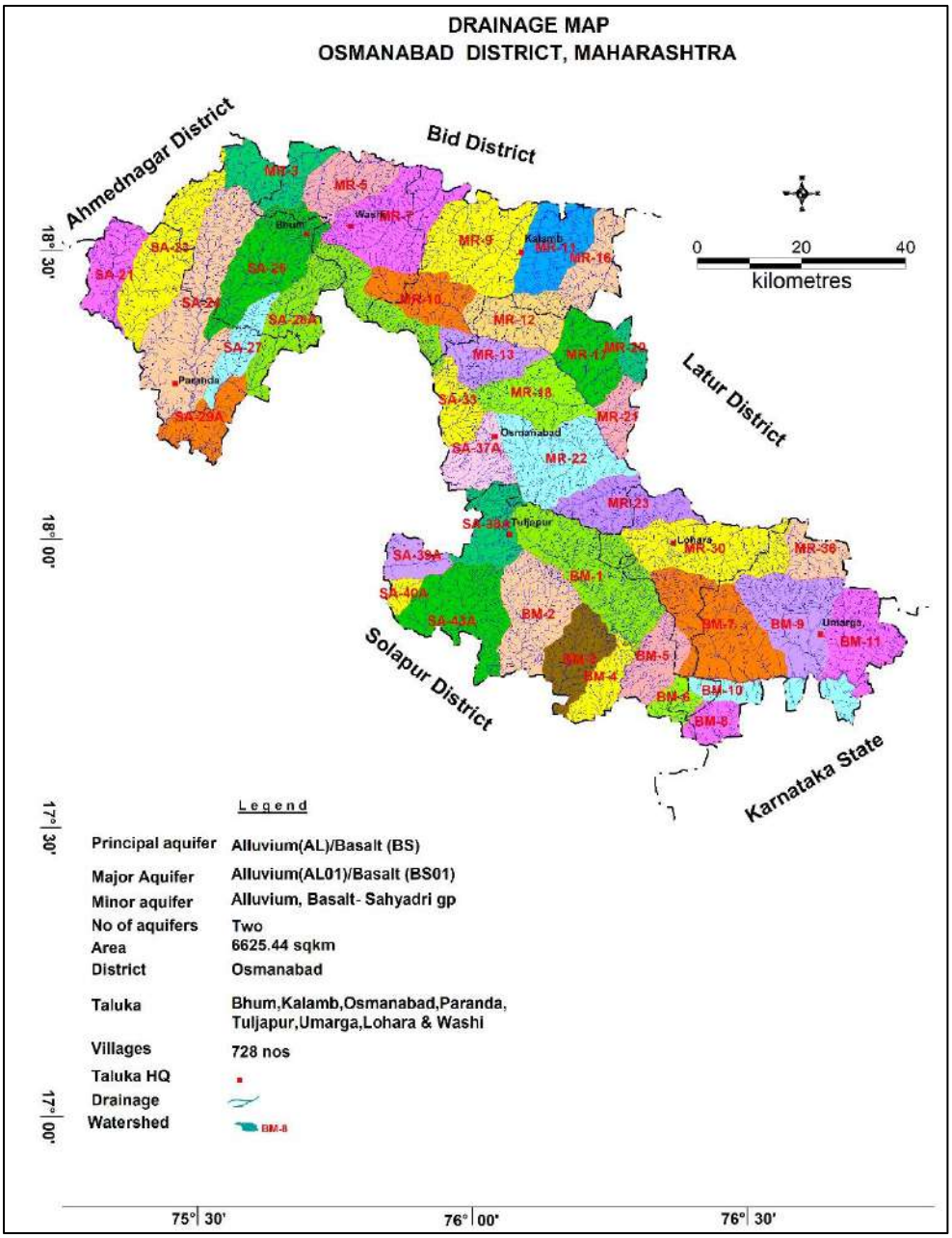


Figure 1. 5: Drainage, Osmanabad District

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 and topography.

The soil of the district is basically derived from Deccan Trap Basalt and the soils occurring in the district is broadly classified into three major types.

1. Shallow Soil
2. Medium Soil
3. Medium deep Soils

Shallow Soils occur in small patches in western and north-western parts of the district. These soils are light brown to dark grey in colour and loamy to clayey loamy in texture. Medium Soils are found in parts of Bhum, Kalamb and Osmanabad Blocks. They are

dark brown to dark grey in colour. Medium deep Soils occur in patches in Tuljapur Block. The colour of these soils varies from dark grey brown to very dark grey. They are clayey in texture. Major part of the district is covered with clayey soil (64%) & gravelly sandy clay (21%). Remaining part of the district is covered by Gravelly clay loam, Gravelly sandy loam, Gravelly sandy loam, Gravelly, Clay loam soils. The thematic map of soil distribution in the district is shown in **Fig. 1.6**. Depth of soil is more in the vicinity of main drainages and shallow away from river channels.

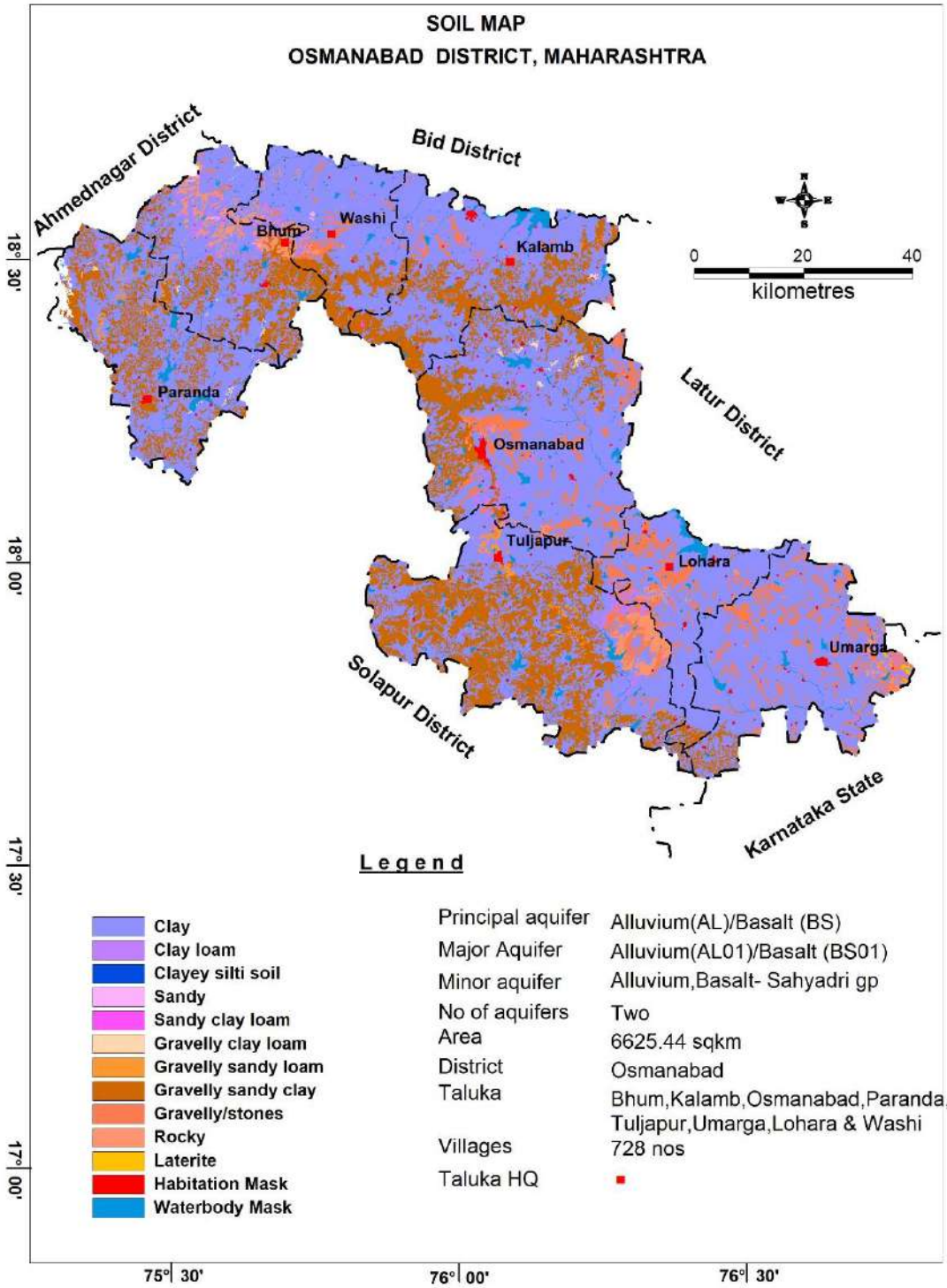


Figure 1. 6 : Soil, Osmanabad District

1.3 CLIMATE AND RAINFALL

The climate of the district is characterized by a hot summer and a general dryness throughout the year except during the south west monsoon season, which is from June to September while October and November constitute the post-monsoon season. The winter season commences towards the end of November when temperatures begin to fall rapidly. December is the coldest month and the mean minimum temperature during winter is 8.5°C. From the beginning of March, the daily temperature increases continuously. May is the hottest month with the mean maximum temperature of 42.5°C. With the onset of the south-west monsoon by the second week of June, the temperature falls appreciably.

North Western part of the district receives rainfall between 650 to 800 mm/year particularly in parts of Paranda & Bhum Block. The Northern part of the district in parts of Washi & Kalamb block rainfall between 750 to 800 mm/year is observed. In the central part of the district heavy rainfall is encountered between rainfalls between 800 to 850 mm/year in parts of Osmanabad block & Tuljapur block. Southern to South Western part of the district observes rainfall between 750 to 800 mm/year in parts of Tuljapur & Lohara Blocks. The South eastern part of the district receives lesser rainfall compared to the other parts i.e., less than 750 mm/year in Umerga and parts of Lohara blocks. The number of rainy days varying between 40 to 45 days. Common dry spells last for 2 to 10 weeks. Delayed onset and early cessation of S-W monsoon is very common. Rest of the district falls in Central Plateau assured rainfall zone and is characterized by rainfall of 700 to 900 mm/year.

The normal rainfall of the district is 807.2 mm spread over 54 rainy days in normal conditions. Annual rainfall data of 1998-2018 is analysed and presented in Fig. 1.7. This indicates that Minimum rainfall occurred in 2012 (400.7 mm) and maximum rainfall in 1998 (1155.9 mm). The rainfall trend analysis shows a falling trend @ 7.1 mm/year. The rainfall analysis show that the departure of annual rainfall from the normal rainfall, expressed in terms of percentage, varied from -50 to 43 percent. The departure percent analysed denotes the rainfall variation pattern occurred during the period. The area experienced 2 times (10%) excess rainfall, 12 times (57%) normal rainfall and 7 times (33%) moderate drought conditions as given in Table 1.1. The coefficient of variation of the annual rainfall from the mean rainfall has been observed to be 27% The isohyet map of the district is depicted in Figure 1.8.

The block wise annual rainfall data (1998-2018) of Osmanabad district is shown in Table 1.2. Based on rainfall data analysis it is observed that:

- Average Annual rainfall varies from 575.65 (Paranda block) to 703.59 mm (Umerga block).
- The Normal annual rainfall in the district varies between 608.1 mm in Paranda block and 818.2 mm in Osmanabad block.

Table 1. 1: Long Term Rainfall Analysis (1998 to 2018) of Osmanabad District

PERIOD = 1998 to 2018						**No. of years = 21**		
YEAR	**ANNUAL**	**NORMAL**	**DEPARTURE**	**No of Rainy days**	**CATEGORY**	**NORMAL RAINFALL = 807.2 mm**		
1998	1155.9	807.2	43	77	EXCESS	STANDARD DEVIATION = 192.46 mm		
1999	648.6	807.2	-20	56	NORMAL	COEFFICIENT OF VARIATION = 27%		
2000	812.5	807.2	1	55	Normal	MEAN=701.2		
2001	566.7	807.2	-30	51	MODERATE	MEDIAN=724.5		
2002	621.8	807.2	-23	58	NORMAL	SLOPE= -7.1 mm/Year		
2003	465.2	807.2	-42	45	MODERATE	INTERCEPT= 779.81 mm		
2004	724.5	807.2	-10	60	NORMAL	**EQUATION OF TREND LINE= -7.1494x + 779.81**		
2005	813.3	807.2	1	60	NORMAL	**CATEGORY**	**NUMBER OF**	**% OF TOTAL**

							YEARS	YEARS
2006	710.2	807.2	-12	59	NORMAL	**DEPARTURES**		
2007	777.4	807.2	-4	58	NORMAL	POSITIVE	5	24
2008	754.5	807.2	-7	47	NORMAL	NEGATIVE	16	76
2009	735.3	807.2	-9	60	NORMAL	**DROUGHTS**		
2010	1035.7	807.2	28	86	EXCESS	MODERATE	7	33
2011	540.2	807.2	-33	44	MODERATE	SEVERE	0	0
2012	400.7	807.2	-50	39	MODERATE	ACUTE	0	0
2013	726.2	807.2	-10	64	NORMAL	**NORMAL & EXCESS R/F**		
2014	505.2	807.2	-37	46	MODERATE	NORMAL	12	57
2015	477	807.2	-41	49	MODERATE	EXCESS	2	10
2016	868	807.2	8	58	NORMAL	**NOTE: Departure: EXCESS RAINFALL: > +25; NORMAL RAINFALL: +25 TO -25; MODERATE DROUGHT: -25 TO -50; SEVERE DROUGHT: -50 TO -75; ACUTE DROUGHT: < -75**		
2017	880.5	807.2	9	56	NORMAL			
2018	505.1	807.2	-37	42	MODERATE			

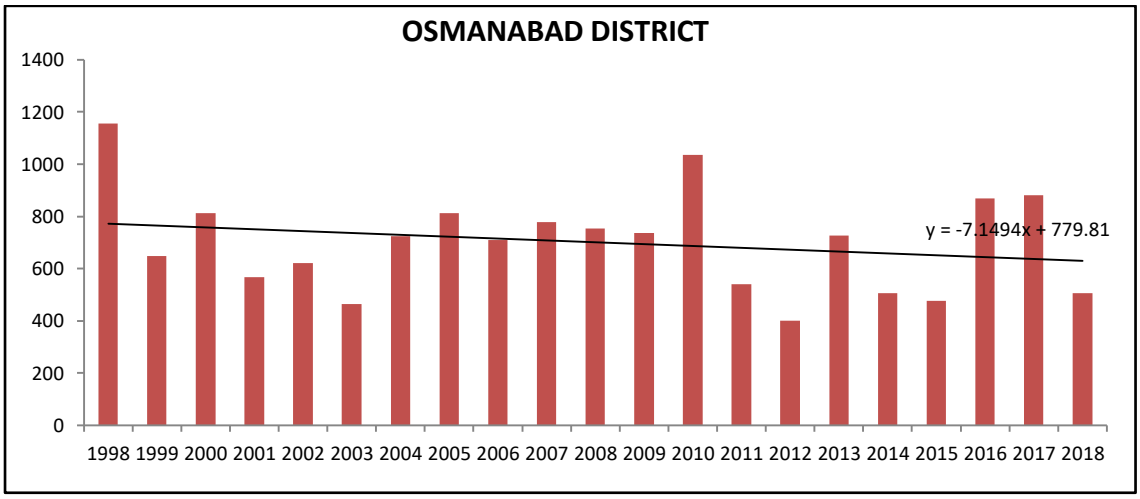


Figure 1. 7 : Annual Rainfall Pattern (1998-2018)

Table 1. 2: Block wise Annual rainfall data (2009-2018) (in mm)

Block	Normal RF	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	Average Rainfall (mm)
Osmanabad	818.2	658	1000.7	538	399.2	599.1	498.5	492.2	858.7	925.2	465.5	643.51
Tuljapur	768.9	767	971.4	568	433.7	752.2	572.1	487.2	884.6	708.9	559.8	670.49
Parranda	608.1	709	1006.8	530.8	369.6	497.5	478	401.4	678.4	797.7	287.3	575.65
Bhum	702.5	862	1089.3	475.7	382.9	542.9	479.4	401.4	830.6	1023.7	418.1	650.60
Kalamb	739.7	764.3	1044.4	459.8	426.2	519.7	392	404.5	766.9	809.2	429.7	601.67
Umarga	738.6	610	1013.2	534.5	334.1	606.8	501.2	543.6	1208.8	905.6	778.1	703.59
Lohara	678.5	601	1131	530.7	445.7	874.2	523.9	527.9	904.6	926.2	550.3	701.55
Washi	718.5	890	1018.6	668.9	407.5	560.1	595.3	491.3	833.7	843.4	463	677.18
District Av.		**732.66**	**1034.43**	**538.30**	**399.86**	**619.06**	**505.05**	**468.69**	**870.79**	**867.49**	**493.98**	

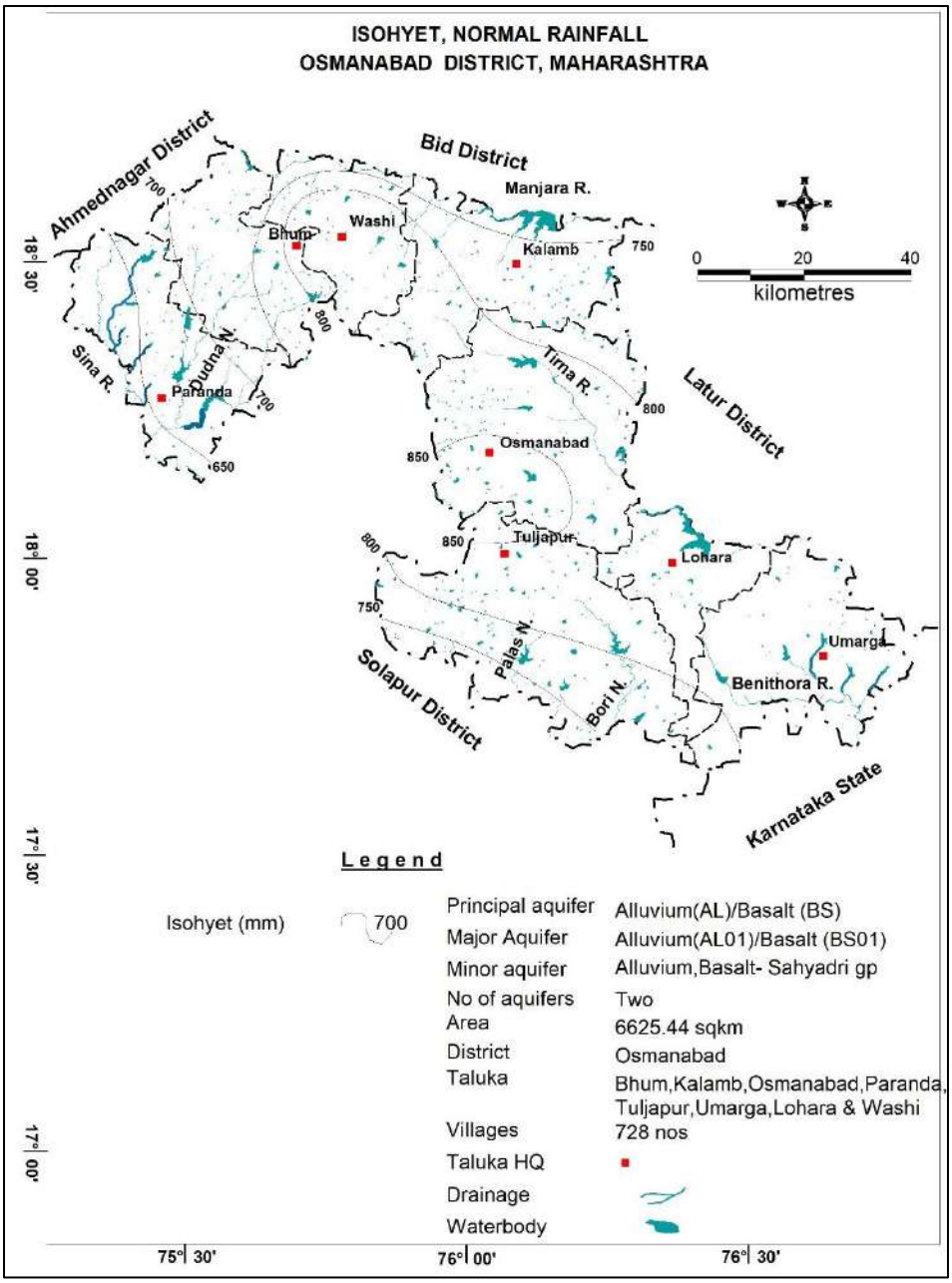


Figure 1. 8: Isohyet map of Osmanabad District

1.4 GEOLOGY

Geologically, Basalt formation (Deccan traps) is the major rock formation in the district. The major part of the district is underlain by a sequence of basaltic lava flows while alluvium occupies along the major Drainages. Laterites occurs as small isolated cappings on the lava flows in south eastern part of the district. The Deccan Trap has succession of flows in the elevation range and are normally horizontally disposed over a wide stretch and give rise to table land type of topography also known as plateau. These flows occur in layered sequence ranging in thickness from few centimeters to tens of meters. Each individual flow is massive at the bottom and vesicular/amygdaloidal towards the top. The flows are separated from each other by marker horizon known as bole bed. 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 Osmanabad district

Geologic Period	Age	Stratigraphic unit	Formation	Lithology	Nature and Characteristics
	Cenoozoic			Laterite	
68-62 Million years ago	Upper Cretaceous to Eocene	Deccan trap (Sahyadri Group)	Mahabaleshwar formation/Karanja Formation	Basalt hard, massive, vesicular, amygdaloidal varieties with inter-trappeans	Dark massive, fine grained hard compact rock, can be broken into blocks
			Purandargarh formation/Buldhana Formation		Dark, Massive, fine to medium grained, hard and compact
			Diveghat Formation/Chikhli Formation		Dark, Massive, fine to medium grained, hard and compact
			Indrayani Formation/Ajanta Formation		Dark grey, Massive, fine to medium grained, hard and compact

(GSI: DRM FIRST EDITION 2000)

Laterite:

Cainozoic occurs as small isolated capping on the lava flows. The base of the Laterite capping is at 600 m amsl.

DECCAN TRAP BASALT:

Major part of the district is occupied by Deccan trap basaltic lava flows of Upper Cretaceous to Eocene. The Deccan Trap of Sahyadri group is divided into four groups Lower Indrayani, Diveghat, Purandargarh & Mahabaleshwar formations. Each individual lava flow consists of lower massive part becoming vesicular /amygdaloidal towards top, ranges in their individual thickness from a few centimeters to tens of meters. The vesicles are invariably found filled with secondary minerals. The flows have wide variation in color and texture especially when they are amygdaloidal in nature with secondary mineral infillings such as Zeolites, Calcite, and Agate and Chalcedony etc. The red /green/black bole beds constituting the marker horizons separating the two flows were discontinuous and generally inconsistent.

The diveghat formation mainly occurs in the northwestern part and as an isolated patch in the western part comprises of Aa flows. The rock is generally dark massive fine grained and sparsely to moderately porphyritic. The Purandargarh formation overlies the Diveghat Formation and is well exposed around Bhum, Pathrur and southwest of Tuljapur. It comprises of Aa flows. The rocks of this formation are dark grey, fine grained and sparsely to moderately porphyritic. The youngest sequence of lava flows incudes the Mahabaleshwar formation and is extensively developed in the area between Tuljapur in the south and Kalamb in the north comprises of Aa lava. The rock is dark grey fine grained and moderately to highly porphyritic in nature.

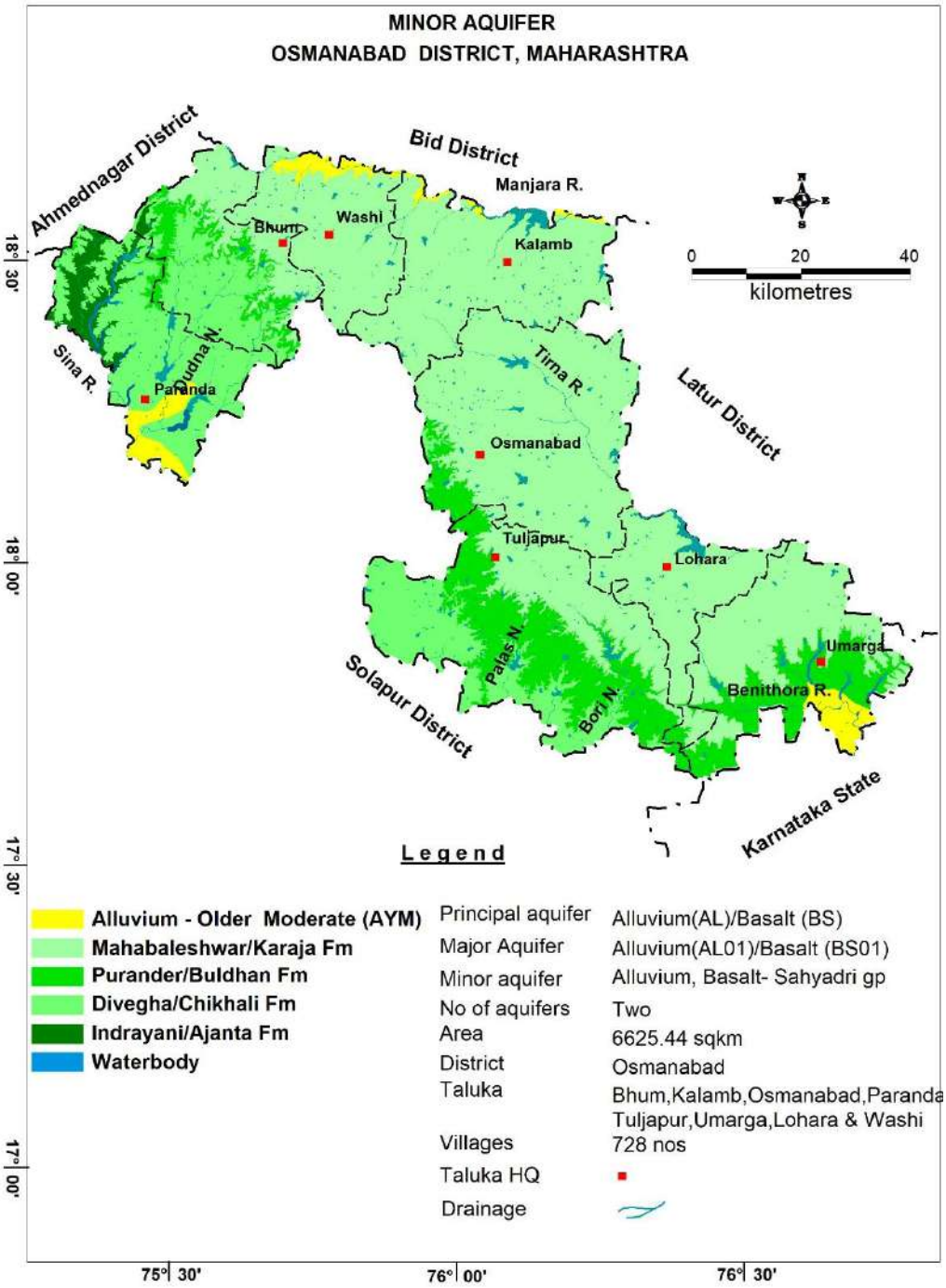


Figure 1.9: Geological Map, Osmanabad district

2. HYDROGEOLOGY

The major part of the district is constituted by a sequence of basaltic lava flows (Deccan Trap) and alluvium occupies a small portion. The alluvium cosisting of clay, Silt, Sand and Gravel occur along the course of major rivers. The thickness of alluvium varies up to few meters. The alluvium lies directly over the Basaltic lava flows. A map depicting hydrogeology of Osmanabad district is presented in **Fig. 2.1.**

Groundwater occurrence and movement in the area is influenced by its rock formations. The Groundwater potential of the area depends upon porosity and permeability (both primary and secondary) of rock formations. The entire district is underlain by the Basaltic lava flows of upper Cretaceous to lower Eocene age. The shallow Alluvial formation

of Recent age occurs as narrow stretch along the major rivers flowing in the area but it does not play much important role from ground water point of view. A map depicting the hydrogeological features is shown in **2.1**

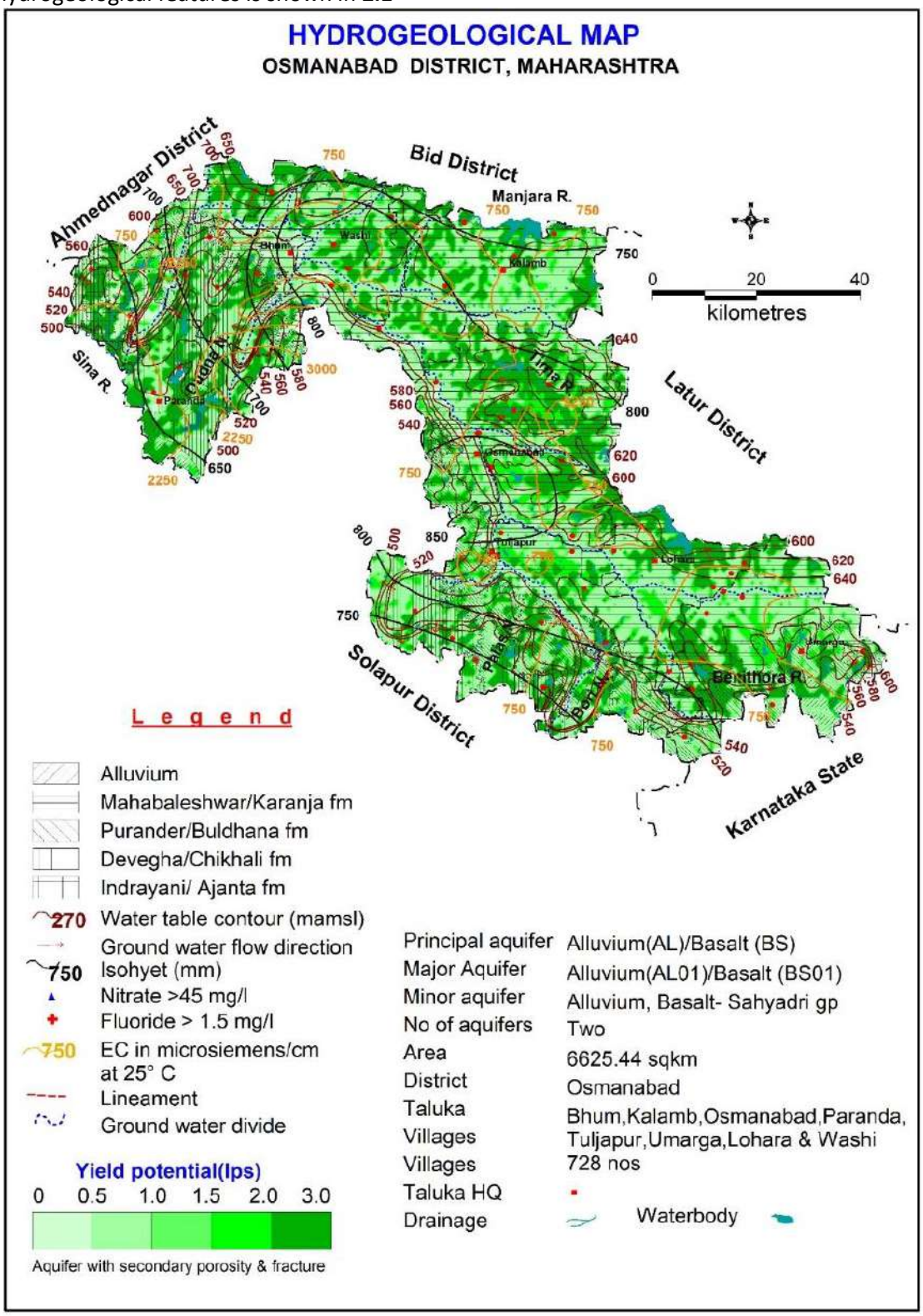


Figure 2. 1: Hydrogeology, Osmanabad District

Deccan Traps occurs as Basaltic lava flows, which are around 280 m thick, normally horizontally disposed over a wide stretch and give rise to table type of topography on weathering known as plateau. These flows occur in layered sequence ranging in thickness

from few metres to 55 m. Flows are represented by massive portion at bottom and vesicular portion at top and are separated from each other by marker bed known as bole bed. Ground water in Deccan Trap Basalt occurs under phreatic and semi-confined conditions. The weathered and fractured trap occurring in topographic lows forms the main aquifer. The alluvium occurs as small patches along banks, flood plains and meander of main rivers in which groundwater occurs under Phreatic and semi-confined conditions.

Deccan basalts are hydrogeologically in-homogeneous rocks. The weathered and jointed /fractured parts of the rock constitute the zone of ground water storage and flow. The existence of multiple aquifers is characteristic of basalt and is indicative of wide variation in the joint/fracture pattern and intensity. The yield of wells is a function of permeability and transmissivity of aquifer and it depends upon the degree of weathering, intensity of joints/fractures and topographic setting of the aquifer. Due to wide variation in secondary openings, the potential areas for ground water are generally local. In general Ground water occurs under phreatic/unconfined to semi-confined conditions in basalts. Shallow Aquifer is generally tapped by the dug wells and average depth of dug wells ranging between 12.00 to 15.00 m and yield varies up to 100 m^3/day. The deeper Aquifer is being tapped by bore wells with depth ranging from 56 to 162 m. However, the maximum numbers of bore wells are limited up to 60 m depth. The yield ranges up to 2.5 lps. Potential Aquifer are generally encountered at the contact of two flows.

WATER TABLE CONTOUR

Based on the data, a pre monsoon water table contour map has been prepared and presented in **figure 2.2**.

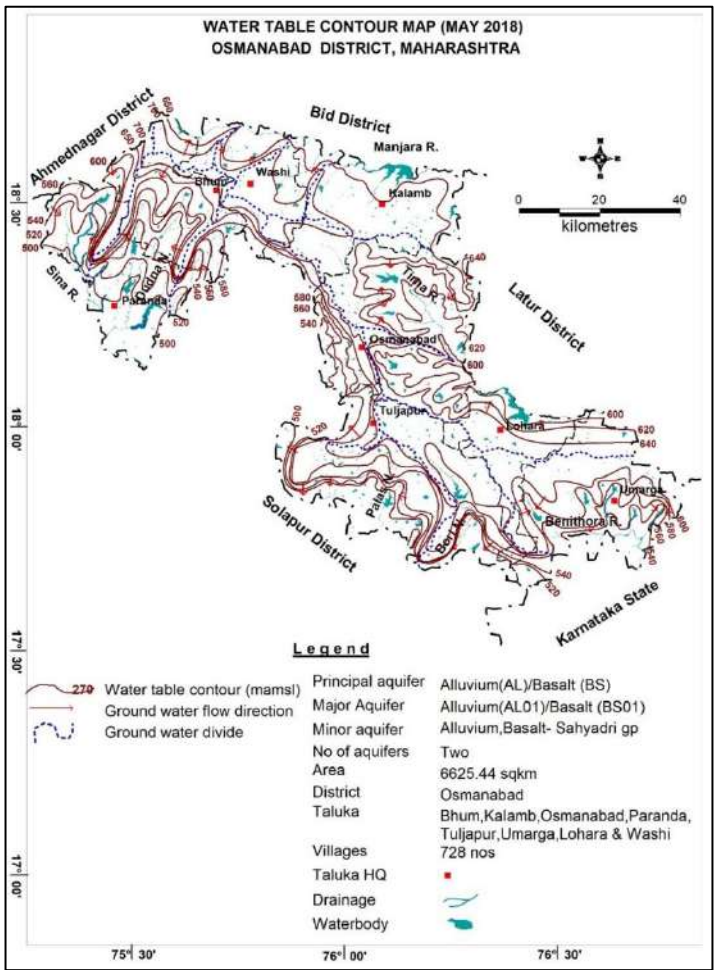


Figure 2. 2: Water Table Contour, Osmanabad district

The map depicts occurrence and movement of ground water in predominantly the basaltic areas. The ground water flow lines are marked to show the direction of ground water flow. The elevation of water table ranges from 520 to 700 m amsl and generally follows the topography. In general, the ground water movement is towards the Sina River. Though there is a hydraulic continuity between the trappean units, still due to the heterogeneous nature of the rock formation constituting the aquifer, there is wide variation in the water table gradient. The ground water movement is generally slow 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.

2.1 MAJOR AQUIFER SYSTEMS

A basalt formation constitutes the principal aquifers in the district (**Fig. 2.3).** Based on the ground water exploration carried out in the district and the data generated 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:

Alluvium

- Aquifer –I: up to 10 m (River Alluvium)

Basalt–

- Aquifer – I: up to 34 m
- Aquifer -II: up to 170 m

Aquifer-I: The aquifer-I in alluvium is observed up to 10 m bgl with water levels of 5 to 10 mbgl and thickness of granular zone varying from 5 to 8 m. The aquifer-I in Basalt formation occurs up to 34 m with thickness of weathered/fractured zone varying from 5 to 14 m and yield of the aquifer up to from 100 m^3/day.

Aquifer- II: Aquifer-II in Basalt formation is observed in the depth range of 85 to 170 mbgl with water levels of 6 to 70 mbgl and thickness of fractured zone varying from 0.5 to 12 m. The aquifer-II is exploited mainly by borewells and yield of the aquifer generally varies up to 2.5 lps. Depth of occurrence of Aquifer -II is depicted in **Fig. 2.6** and yield in the **Fig. 2.7.**

Table 2. 1: Aquifer Characteristic of Major aquifers of Osmanabad district

Major Aquifer	**Basalt**	
Type of Aquifer	**Aquifer-I**	**Aquifer-II**
Formation	Weathered/Fractured Basalt	Jointed/Fractured Basalt
Depth to bottom of Aquifer (mbgl)	9 to 34	85 to 170
Weathered/ Fractures zones encountered (mbgl)	up to 34	up to 170
Weathered/Fractured rocks thickness (m)	5 to 14	0.5 to 12
SWL (mbgl)	0.6 to 28	6 to 70
Transmissivity (m^2/day)	10 to 67	5 to 80
Specific Yield/ Storativity (Sy/S)	0.02	$1.0x10^{-4}$ to $5.5x10^{-5}$
Yield	up to 100 m^3/day	up to 2.5 lps
Sustainability	1 to 4 hrs	1 to 5 hrs

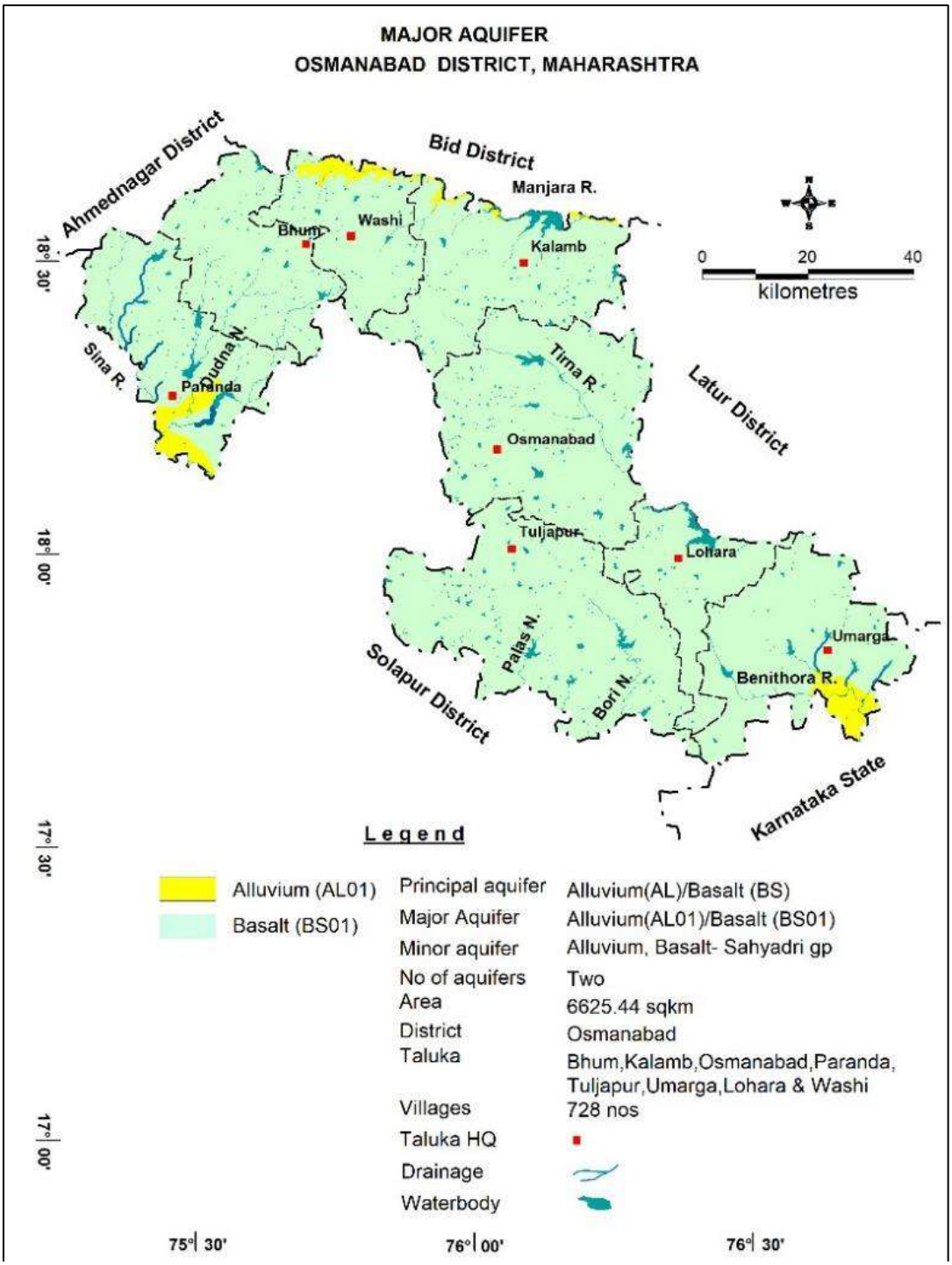


Figure 2. 3: Major Aquifers, Osmanabad district

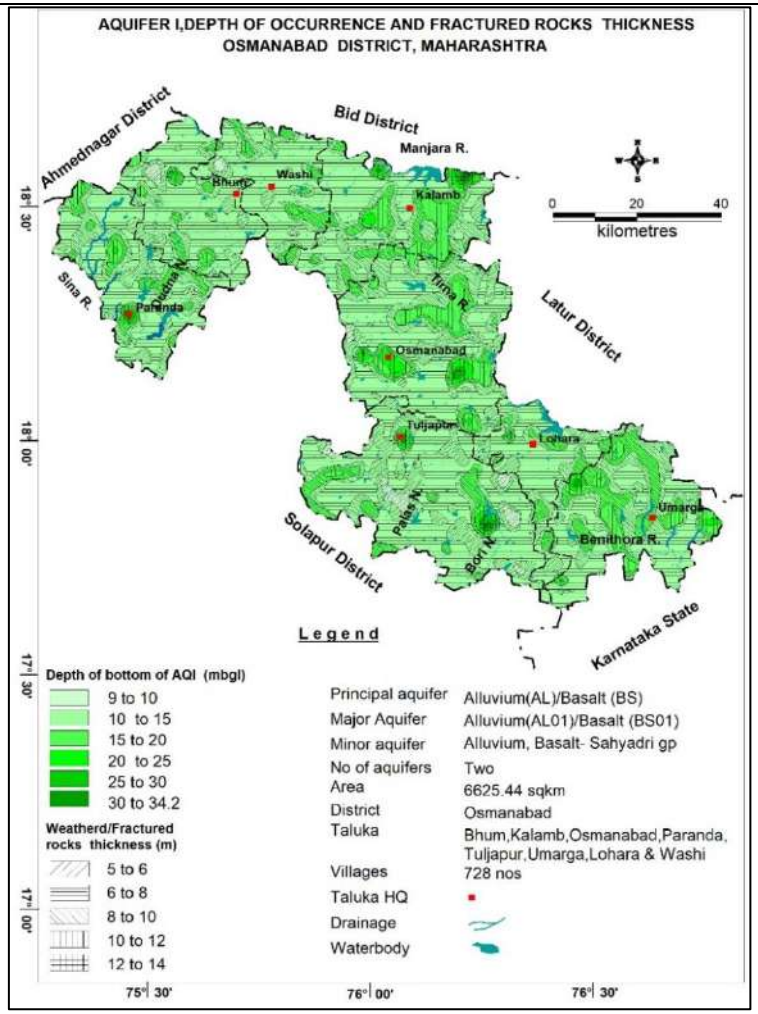


Figure 2. 4: Depth of Occurrence and Granular Zone/ Fractured rock thickness-Aquifer-I

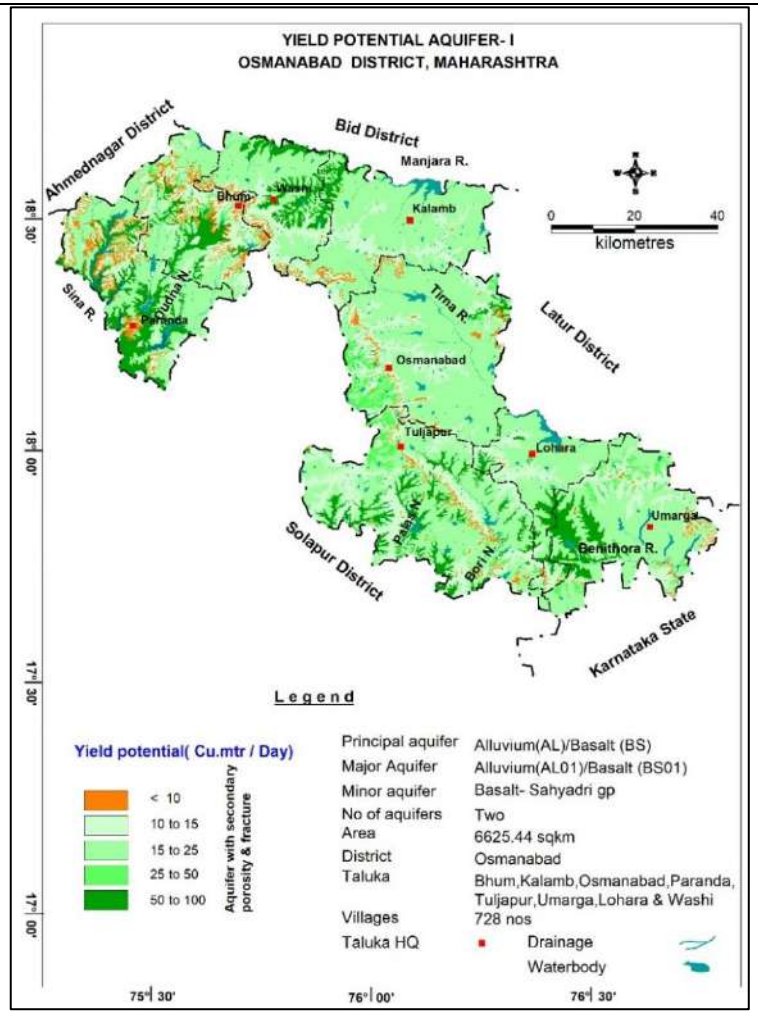


Figure 2. 5: Yield Potential Aquifer-I

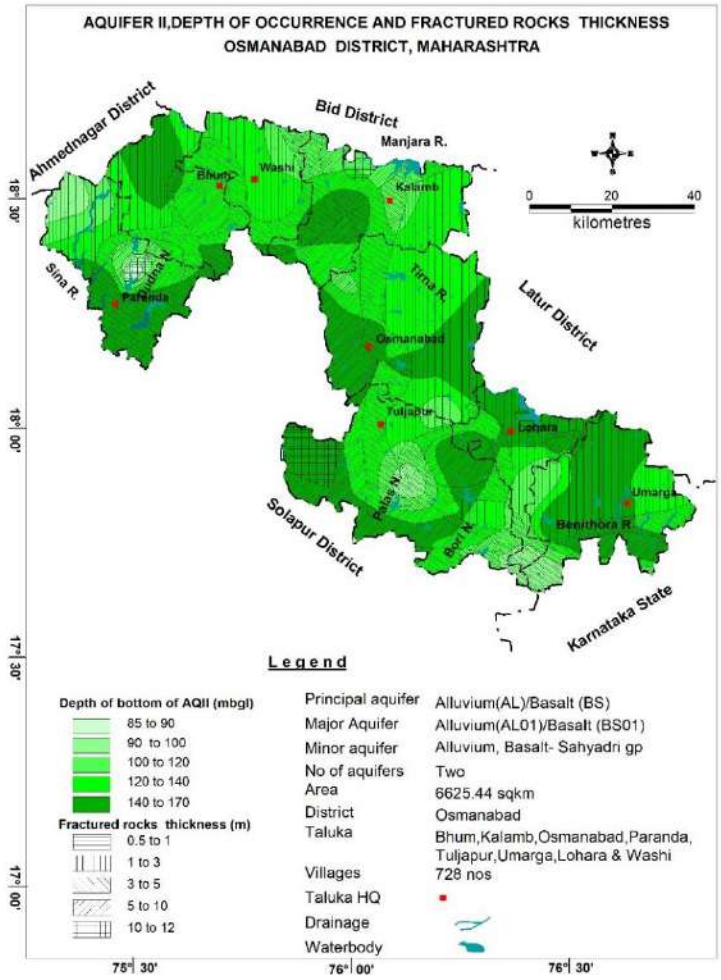


Figure 2. 6: Depth of Occurrence and Fractured rock thickness-Aquifer-II

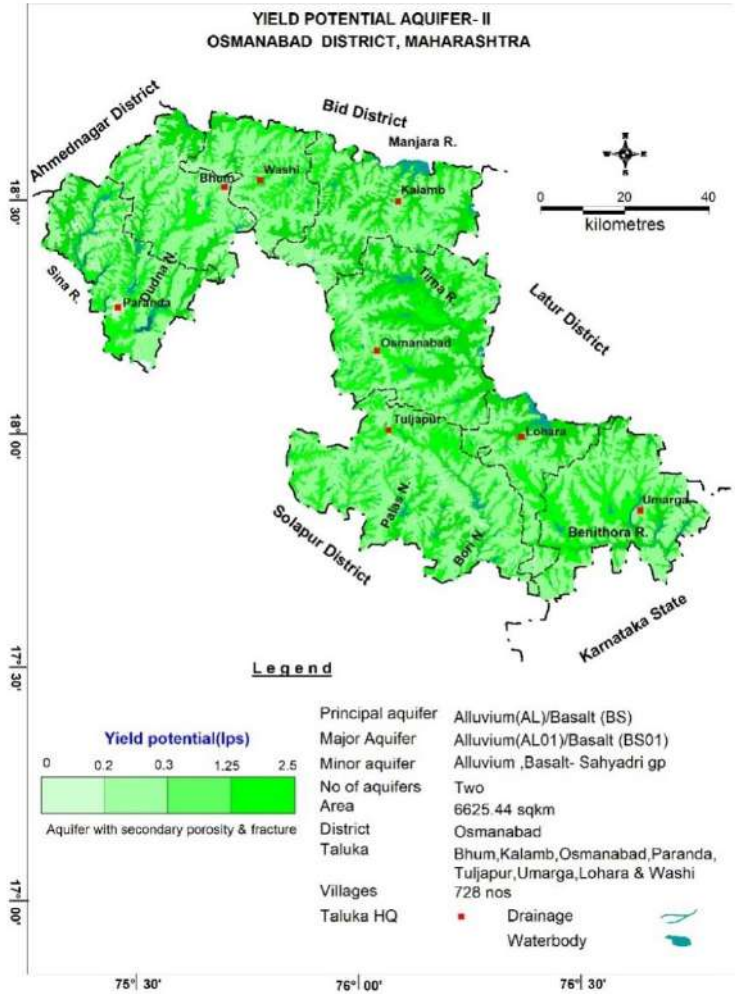


Figure 2. 7: Yield Potential, Aquifer-II

2.2 AQUIFER PARAMETERS

Aquifer parameters have been obtained from ground water exploration carried out in the district as well as from the pumping tests carried out on dug wells in Basalt formation. The transmissivity of shallow basaltic aquifers in the district is generally observed to be varying from0.22 to 20.24 m^2/day in hard rock area (Basalt). Specific capacity of well also gives an idea about the productivity of the well and is controlled by diameter and depth. In basaltic formation the specific capacity of dug wells is generally less than 200 lpm/m of drawdown with an average of 100 lpm/m of drawdown.

2.3 3-D AND 2-D AQUIFER DISPOSITION

Based on the existing data, aquifer disposition in 3D, Fence diagram, 3D Bar diagram, various hydrogeological sections have been prepared along section lines to understand the subsurface disposition of aquifer systems shown in Fig. 2.8 to 2.13.

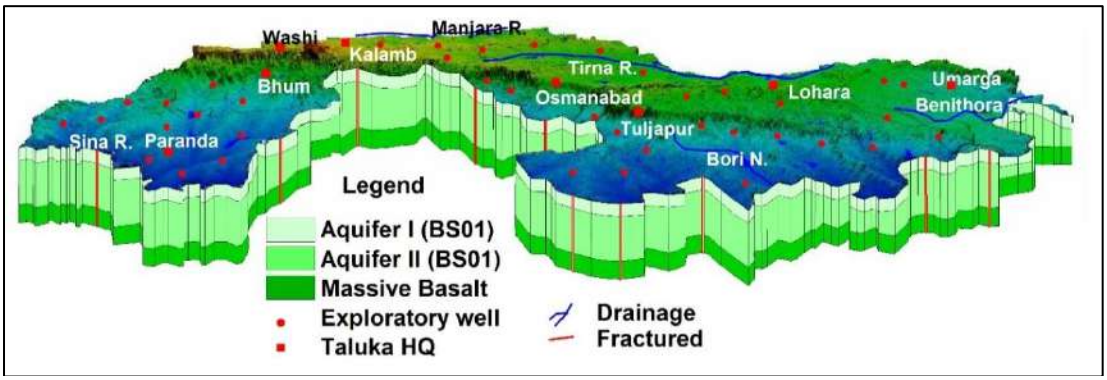


Figure 2. 8: 3D Aquifer Disposition

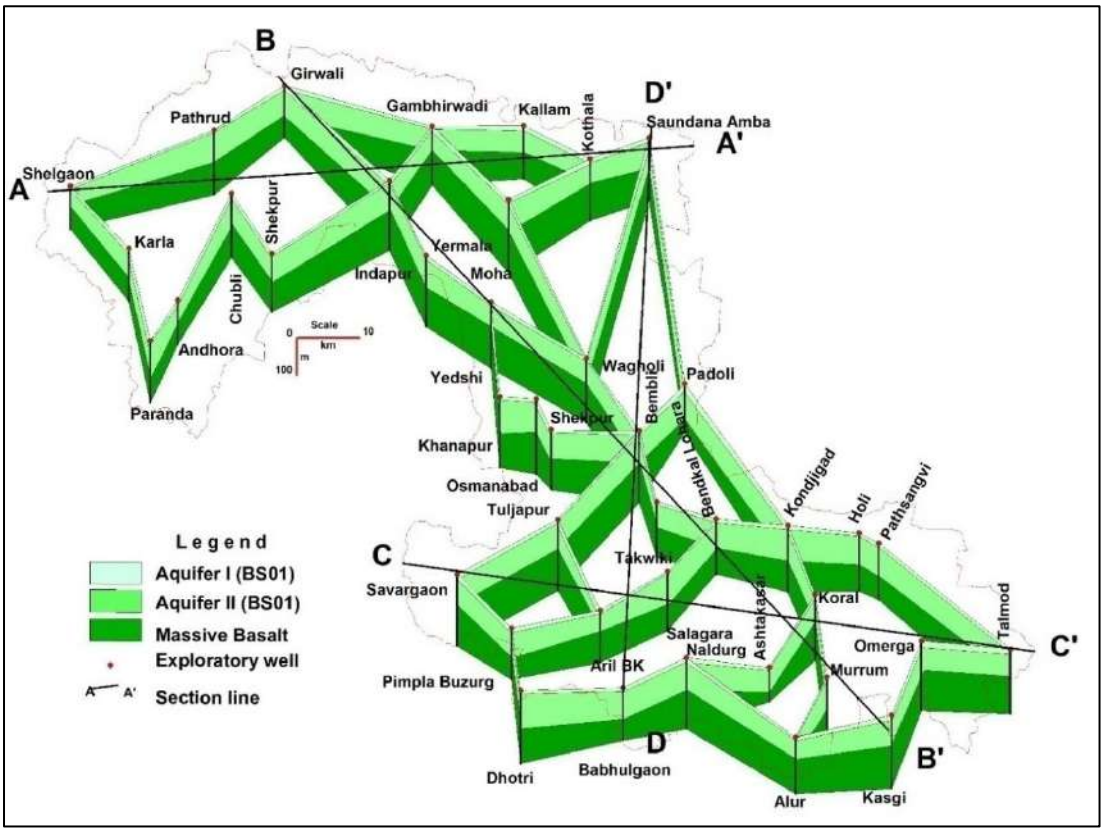


Figure 2. 9: 3D Fence Diagram

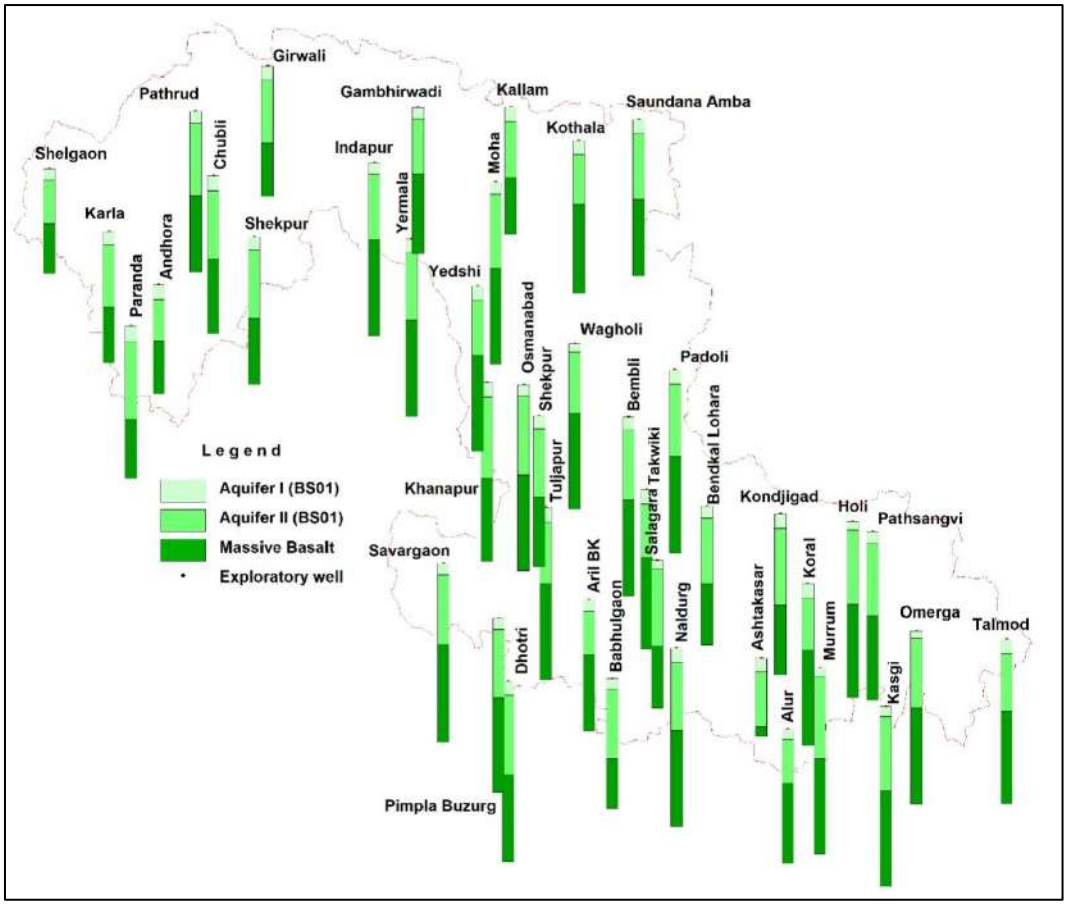


Figure 2. 10: 3D Bar Diagram

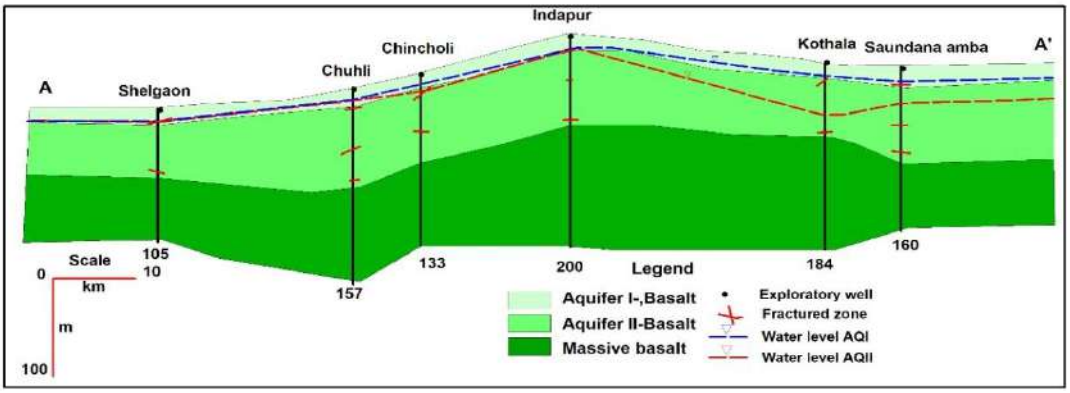


Figure 2. 11: Lithological section (A-A')

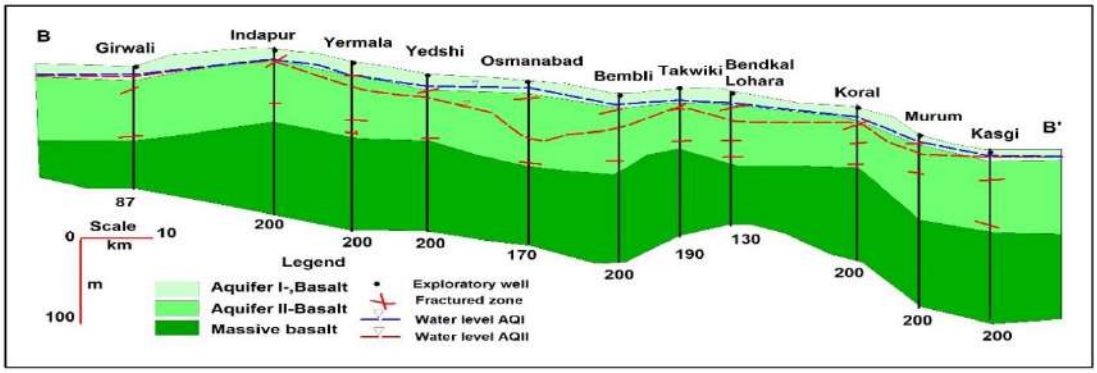


Figure 2. 12 : Lithological section (B-B')

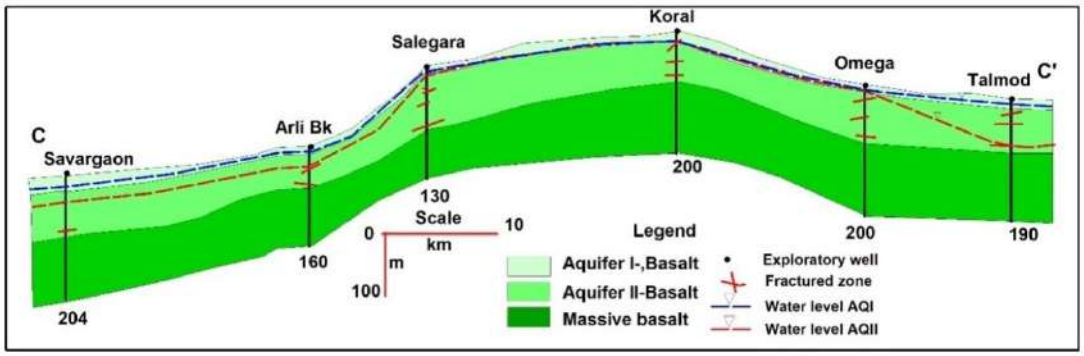


Figure 2. 13 : Lithological section (C-C')

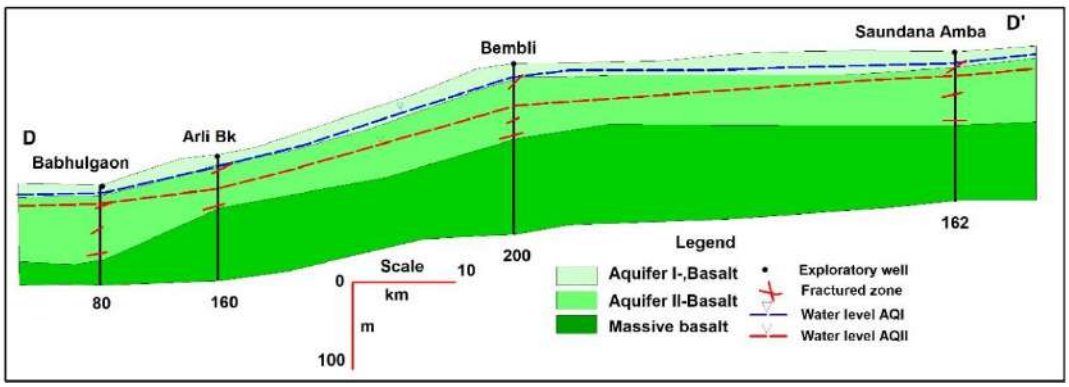


Figure 2. 14: Lithological section (D-D')

3. WATER LEVEL SCENARIO

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

Central Ground Water Board periodically monitors 41 Ground Water monitoring wells in Osmanabad district, four times a year i.e. in May (Pre monsoon), August, November (Post monsoon) and January. Apart from this under NAQUIM study;69 KOWs were established during 2016-17 and additional 93 KOWs were established and monitored during the year 2018-19. Apart from this data, data obtained from GSDA has also been used for preparation of depth to water level maps of the district. Pre-monsoon and post monsoon water level data are given in **Annexure-III**.

The depth to water levels in Osmanabad district during May 2018 were found ranging between 1.1 (Balsur, Umarga block) and 28 mbgl (Kaudgaon, Osmanabad block). Shallow water levels within 2 mbgl are observed in small isolated patch in Tuljapur and Umarga blocks covering89.71 sq. km. area of the district. Water levels between 2 and 5 mbgl covering about 1275 sq km area are observed in major part of the Tuljpaur block; part of Umerga and Lohara blocks. Apart from these, isolated patches are also observed in rest of the blocks except Osmanabad block. Water levels between 5 to10 mbgl have been observed in major part of the District. The depth to water level between 10 to 20 mbgl has been observed in major part of Osmanabad, Paranda, Bhum and Kalamb blocks and in small parts in rest of the blocks covering 2730 sq km area of the district. Deeper water levels of more than 20 mbgl are observed in isolated patches in Osmanabad and Tuljapur blocks covering about 15 sq km area of the districts. The pre monsoon depth to water level map is depicted in **Fig. 3.1.**

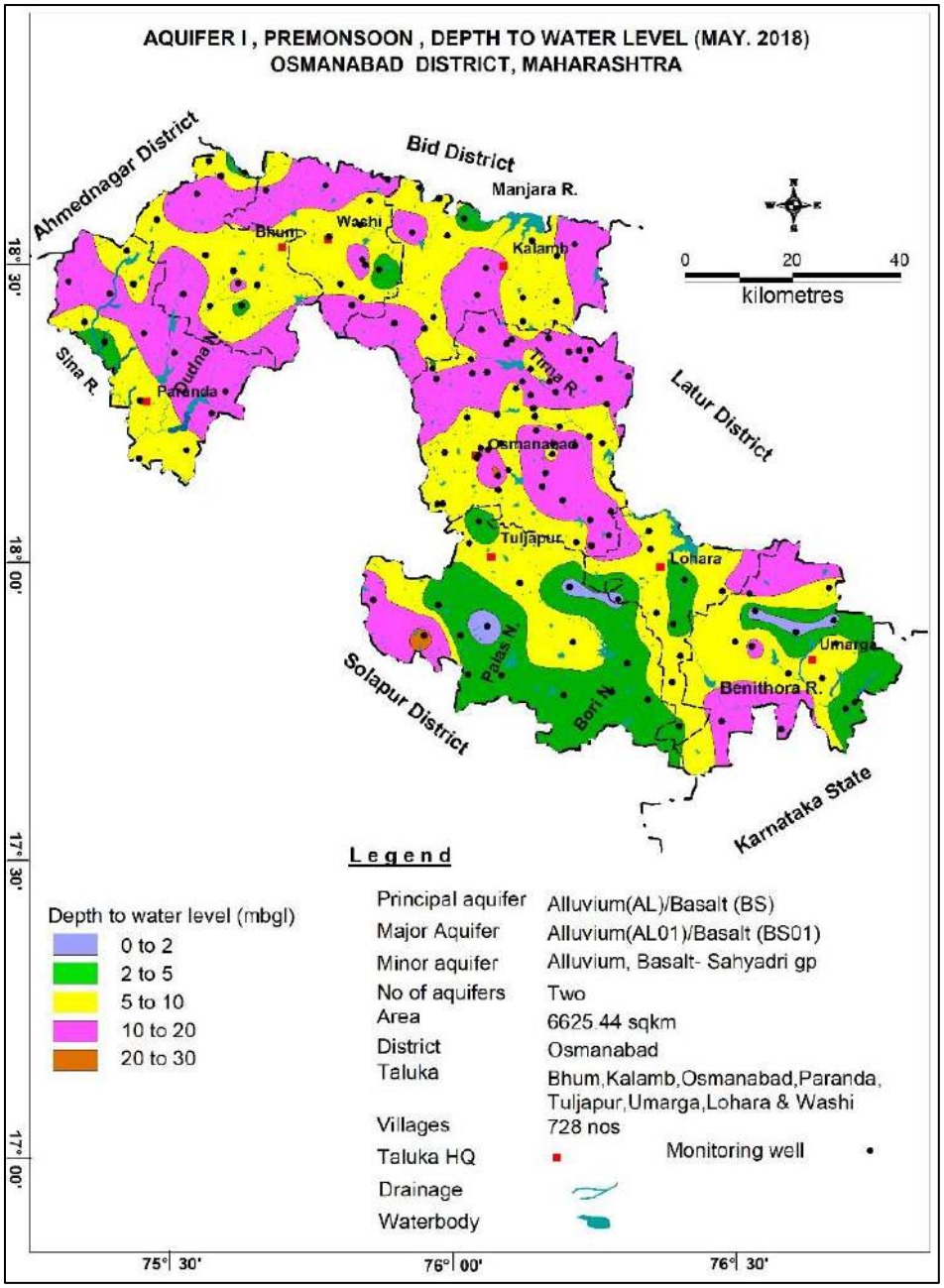


Figure 3. 1 : DTWL, Shallow Aquifer (May 2018)

The depth to water levels in Osmanabad district during Nov. 2018 were found ranging between 0.6 (Balwadi, Tuljapur block & Trikoli, Umarga block) and 16.65 mbgl (Warnalwadi, Umarga block). Shallow water level less than 2 mbgl has been observed in parts of Tuljapur block and in isolated parts of Lohara and Umarga blocks covering about 564 sq km area; Water level between2-5 mbgl has been observed in major parts Tuljapur, Osmanabad, blocks, parts of rest of the districts covering about 2860 sq km area of the district; Water levels between 5 and 10 mbgl are observed in major part of the Paranda, Bhum, Wasi, Kalamb and Umerga blocks covering about 3653 sq km area. The depth to water level between 10 to 20 mbgl has been observed in isolated patches over the entire district covering about 520 sq km area. Spatial variation in post monsoon depth to water levels is shown in **Fig. 3.2.**

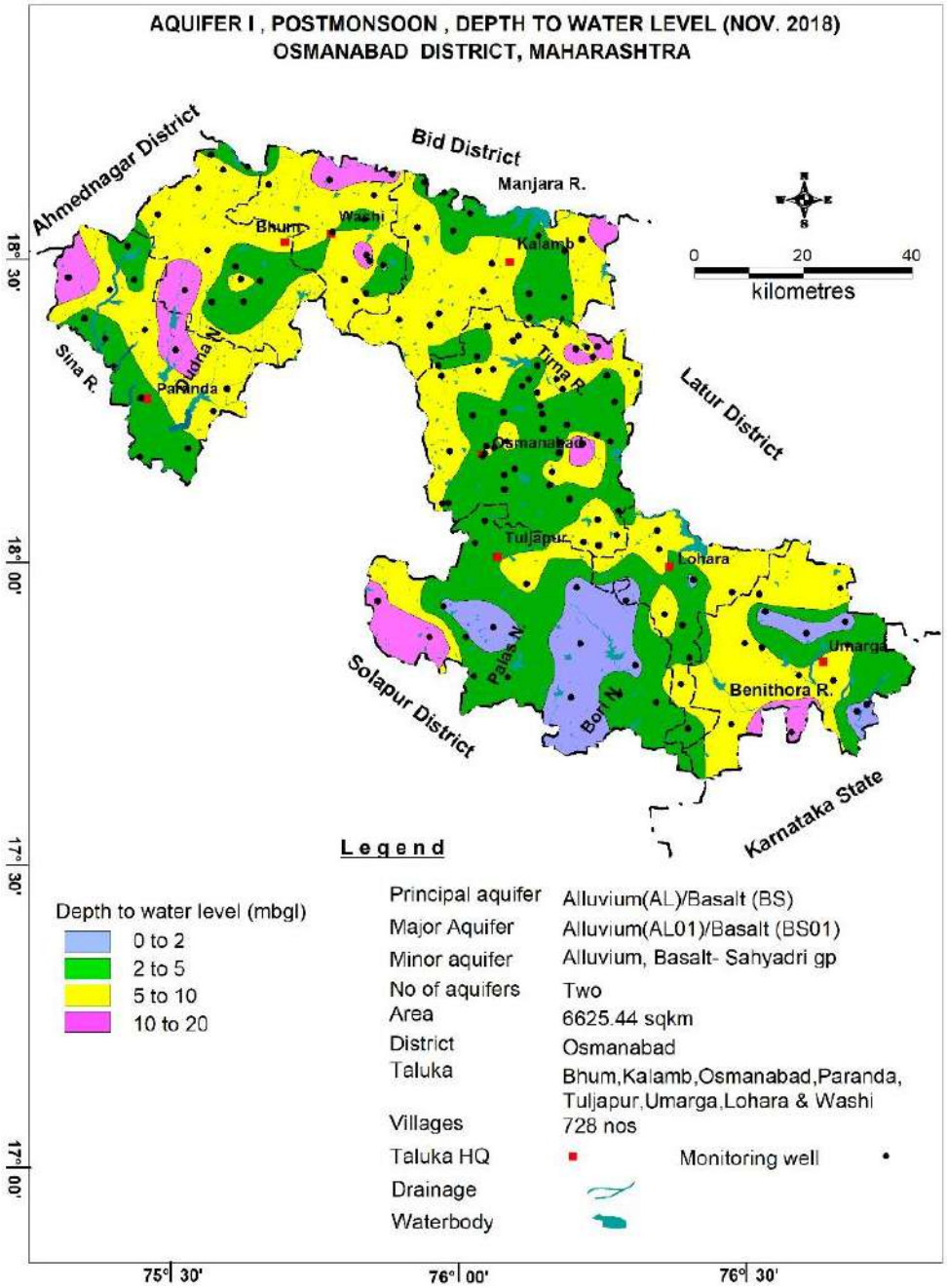


Figure 3. 2: DTWL, Shallow Aquifer (Nov. 2018)

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

Total 58 exploratory wells' data has been used for preparation of depth to water level maps of the district. The pre-monsoon (May 2018) depth to water level in Osmanabad District ranges from 11 (Kasgi, Umarga block) to 98.1 mbgl (Talmod, Umarga block). The depth to water level between 10 and 20 mbgl has been observed in isolated parts of Bhum, Paranda and Umarga blocks. Water level between 20 and 30 mbgl has been observed in major parts of Paranda, Bhum and Umerga Blocks and in small parts of all other blocks except Kalamb block. depth to water level between 30 and 40 mbgl has been observed in major parts of Tuljapur, Osmanabad, Kalamb, Lohara, Bhum, Washi blocks and in isolated parts of Paranda block. The deeper water level between 40 to 50 mbgl has been observed in Tuljapur, Osmanabad and Umerga blocks and in parts of Kalamb, Washi and Osmanabad districts. The deepest water level (>50 mbgl) has been observed in parts of Tuljapur and Umerga blocks and isolated parts of Washi, Kalamb and Osmanabad blocks. This may be due

to low potential of the aquifers in the district. The pre monsoon depth to water level for Aquifer -II is given in **Fig. 3.3.**

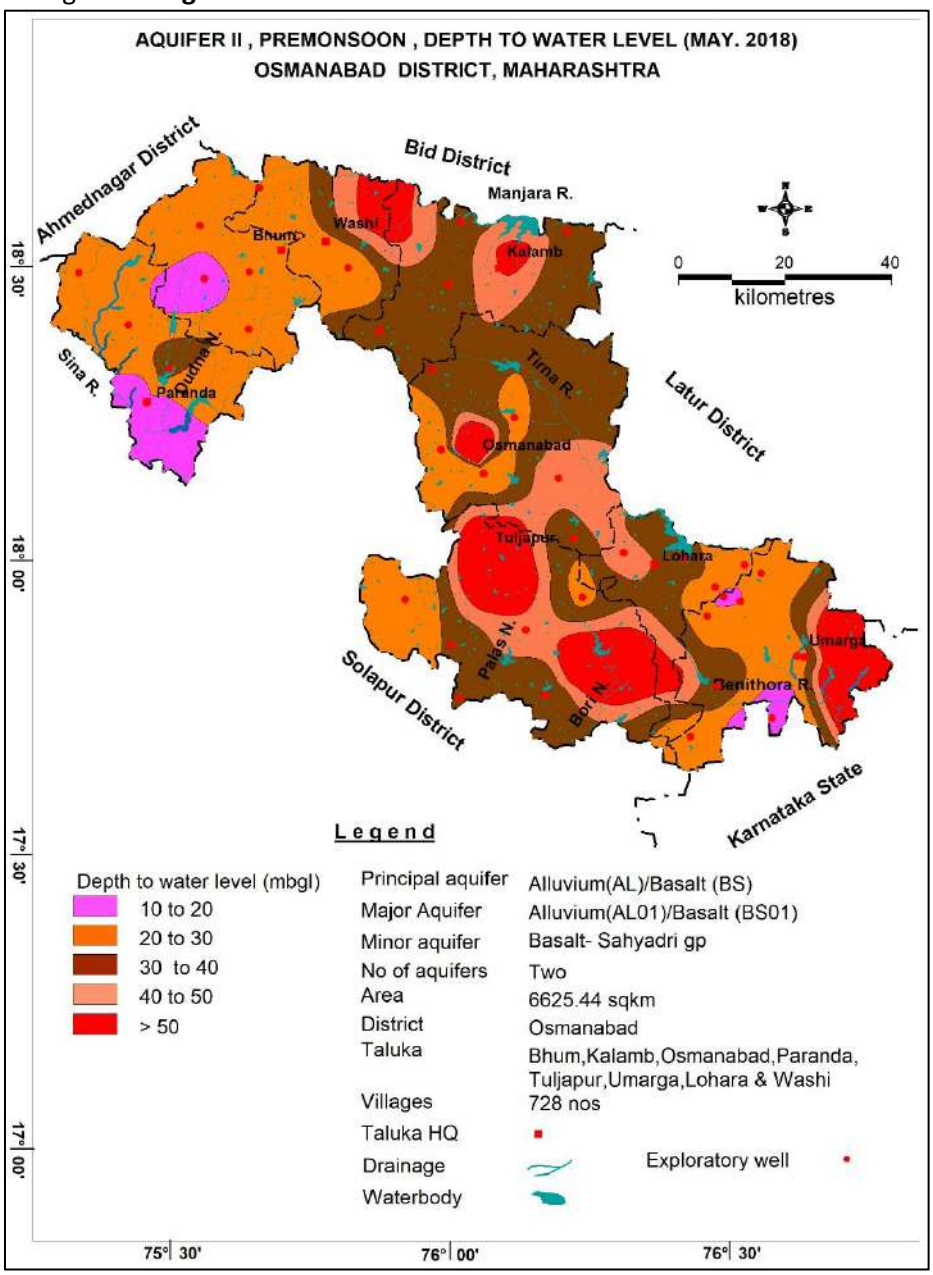


Figure 3. 3: DTWL, Deeper Aquifer (May 2018)

The post-monsoon (Nov. 2018) depth to water level in the district ranges from 6 (Indapur, Washi block) to 32.00 mbgl (Tuljapur, Tuljapur block). Depth to water level between 5 and 10 mbgl are observed in the major parts of Paranda, Bhum, Washi and Umarga blocks. Isolated patches are also observed in Osmanabad and Tuljapur blocks. The major parts of the district show water level between 10 and 20 mbgl. Water level between 20 and 30 mbgl are observed as isolated patches in all the blocks. The deepest water level between 30 and 40 mbgl are observed in isolated parts of Tuljapur block. The post monsoon depth to water level for Aquifer- II is given in **Fig. 3.4.**

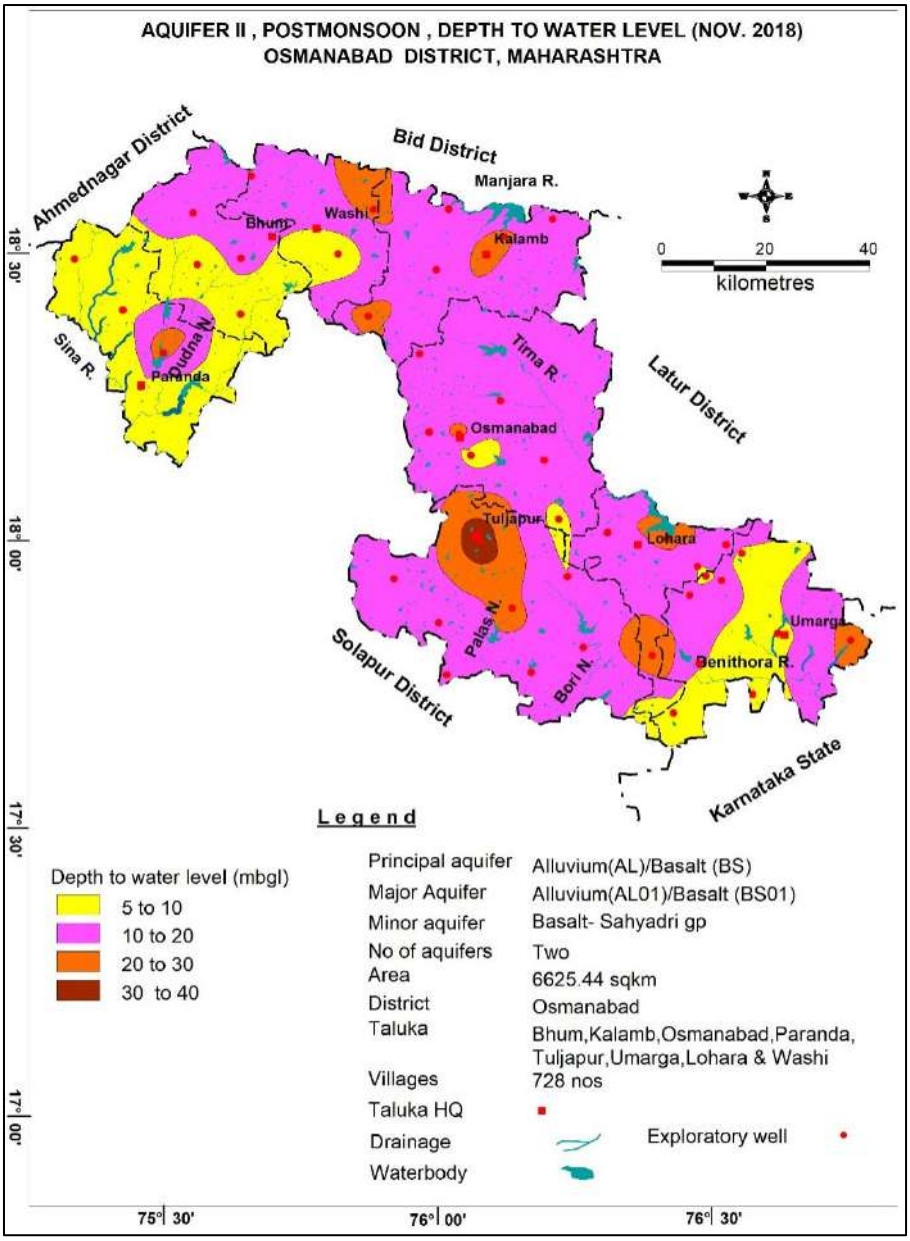


Figure 3. 4: DTWL, Deeper Aquifer (Nov. 2018)

3.3 WATER LEVEL TREND (2009-2018)

During pre-monsoon period, rising water level trend has been recorded at 34 stations ranging from 0.02 (Holi, Lohara block) to 0.80 m/year (Deo dhanaora, Kalamb block) while falling trend was observed in 80 stations varying from 0.015 (Anala, Paranda block) to 1.97 m/year (Shiradhone, Tuljapur block).

During pre-monsoon period, declining water level trend has been observed in about 6021 sq. km. area i.e., 79 % of the area. Significant decline of more than 0.20 m/year has been observed in 3817 sq. km., i.e., 50 % of the area covering major parts of Tuljapur, Lohara, Bhum, Washi, Osmanabad and Kalamb blocks and in Isolated parts of Umerga and Paranda blocks. Rise in water level trend has been observed in major parts of Umerga and Paranda blocks and in isolated patches in rest of the blocks covering about 1575 sq km i.e., 21% of the area. **(Fig.3.5)**

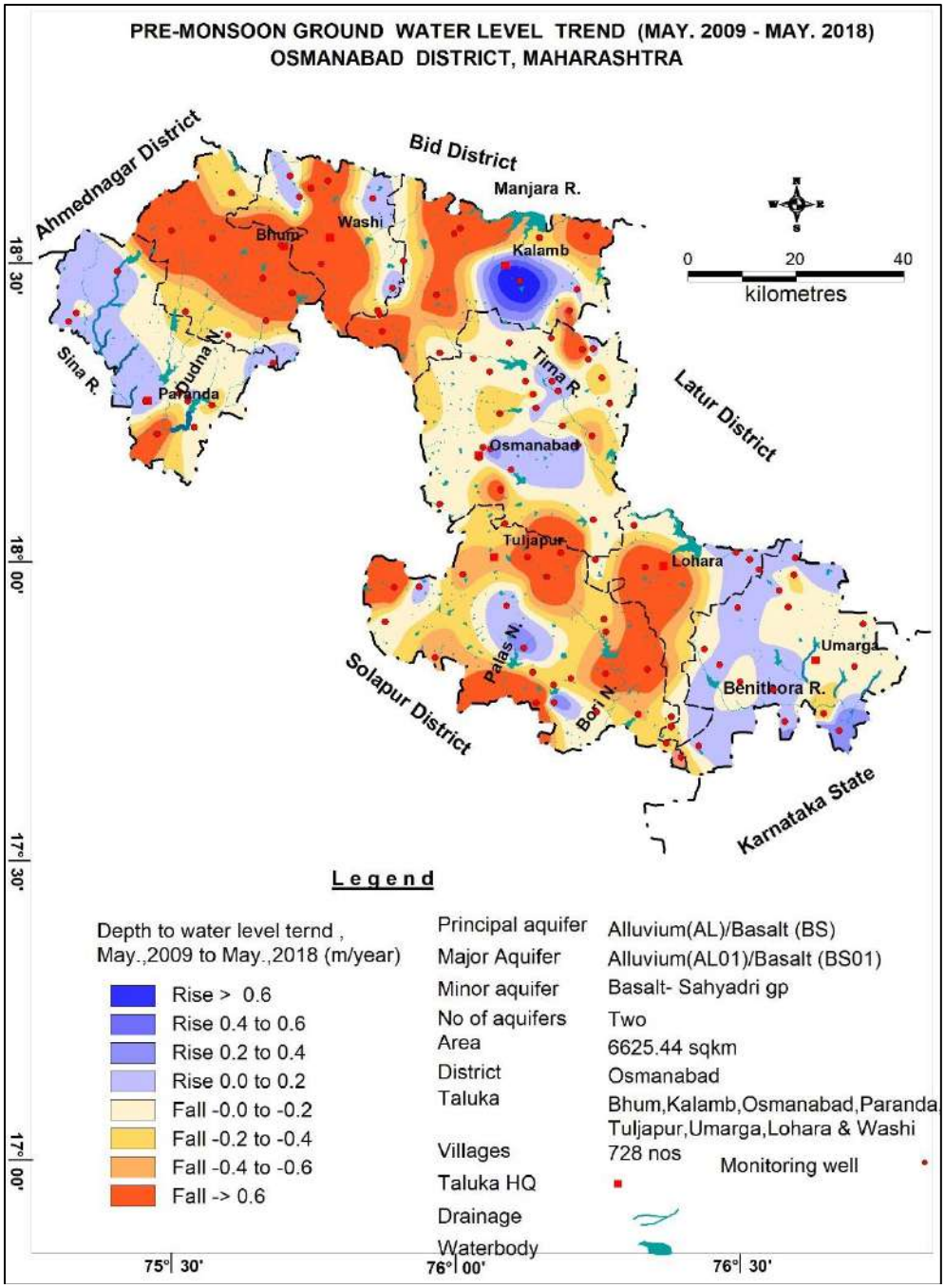


Figure 3. 5: Pre-monsoon Decadal Trend (2009-18) Fall @>0.2m/year 3817 Sq. km. (about 50 % area of the district)

During post monsoon period, rise in water level trend has been recorded at 51 stations and it ranges between 0.071 m/year (Sarola bk, Osmanabad block) to 2.02 (Salgara, Tuljapur block) while falling trend was observed at 177 stations varying from 0.0043 (Shiradhone, Tuljapur block) to 1.965 m/year (Gujnoor, Tuljapur block).

Rising water level trend has been observed in 1329 sq. km. area covering major parts of Umerga and Lohara blocks and isolated parts of Tuljapur, Osmanabad, Washi and Kalamb blocks.Fall in water level trend has been observed in 6268 sq. km. i.e., 83% of the area covering major part of the district. Significant decline, more than 0.20 m/year has been observed in 5215 sq. km. i.e., 69 % of the area covering major parts of Paranda, Bhum, Washi, Kalamb, Osmanabad and Tuljapur blocks and parts of Umerga and Lohara blocks. (Fig

3.6) These declines may be due to the exploitation of ground water or low and erratic rainfall recevied in these areas. Water level trend data (2009-18) of (GWM wells) observation wells of CGWB is given in Annexure-IV.

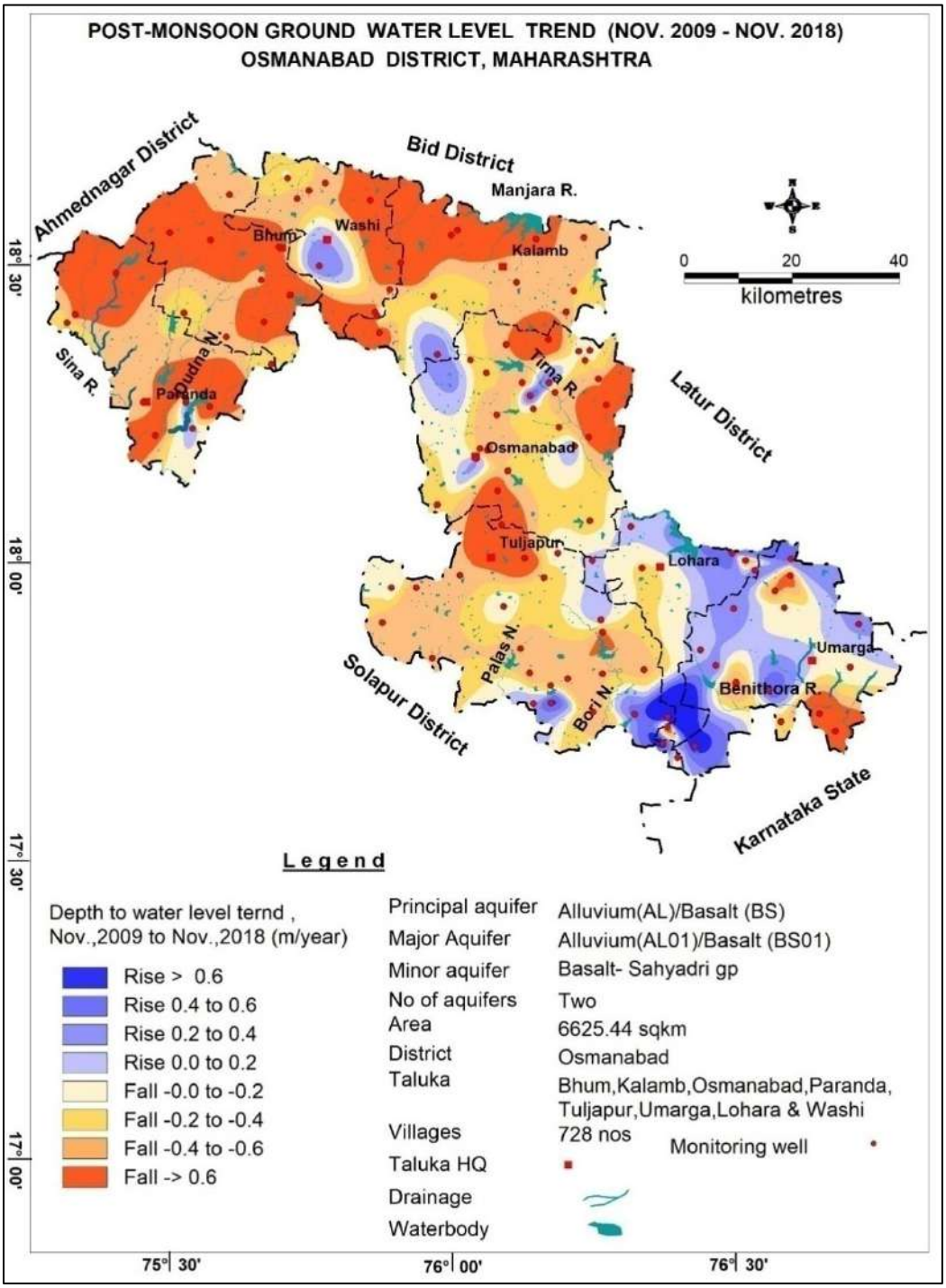


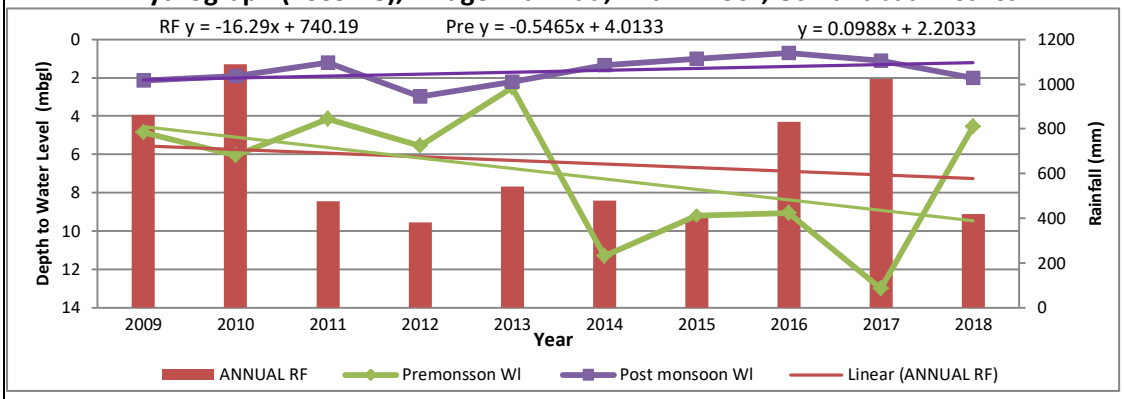
Figure 3. 6 : Post monsoon Decadal Trend (2009-18) Fall @>0.2m/year 5215 Sq. km. (about 69% of the district)

3.4 HYDROGRAPH ANALYSIS

The variation in short term and long-term water level trends may be due to variation in natural recharge due to rainfall and withdrawal of groundwater for various agricultural activities, domestic requirements and industrial needs. The analysis of hydrographs show that the annual rising limbs in hydrographs indicate the natural recharge of groundwater

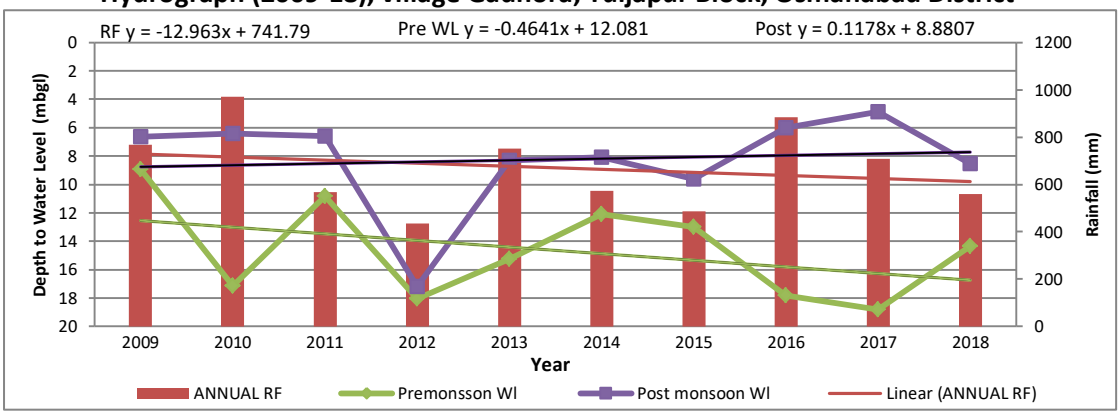
regime due to monsoon rainfall, as the monsoon rainfall is the sole source of natural recharge to the ground water regime. However, continuous increase in the groundwater draft is indicated by the recessionary limb. The figure 3.7 shows selected hydrographs (time series) of water levels.

Hydrograph (2009-18), village Wakwad, Bhum Block, Osmanabad District



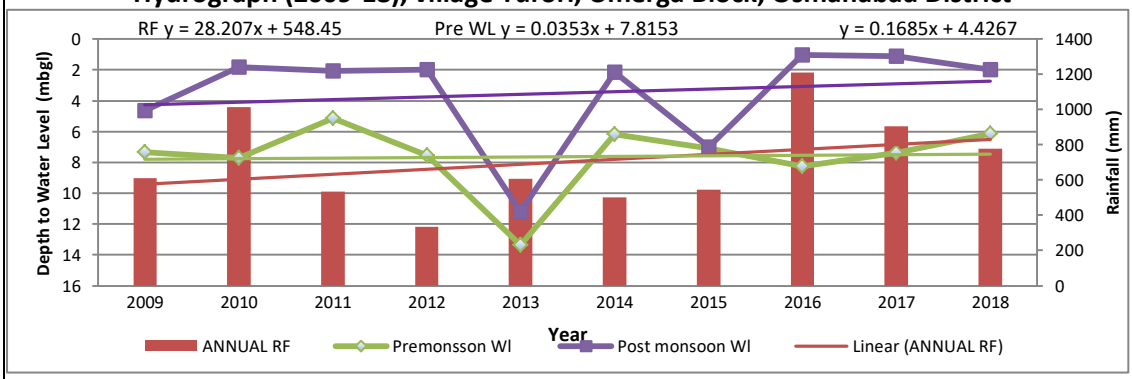
Pre monsoon Water level trend showing declining trend @ 0.54 m/year and post monsoon Water level trend showing Rising trend @ 0.098 m/ year.Declining Rainfall trend @16.29 mm/ year.Water level behaviour not in conformity with rainfall.

Hydrograph (2009-18), village Gadnora, Tuljapur Block, Osmanabad District



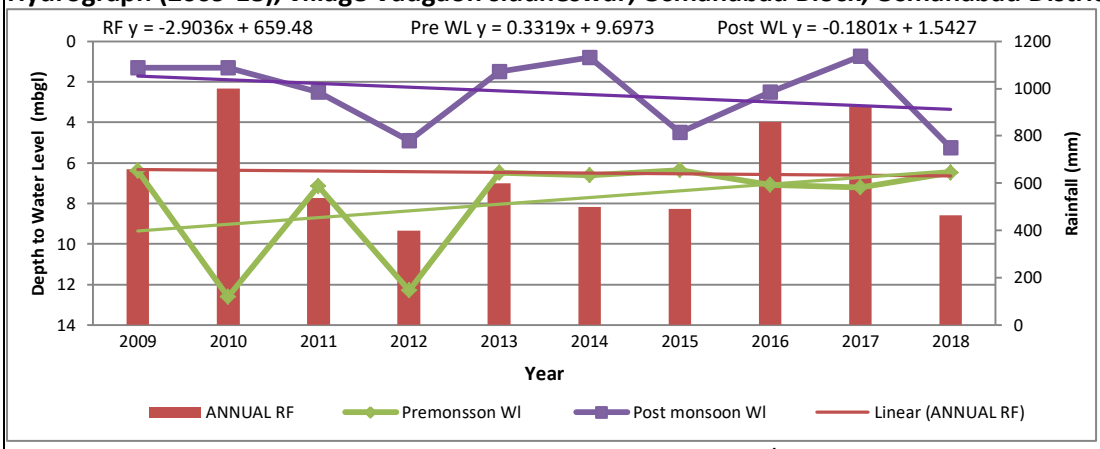
Pre monsoon depth to water level trend showing declining trend @ 0.46 m/year and post monsoon Water level trend showing Rising trend @ 0.11 m/ year .Declining Rainfall trend @12.96mm/ year. Water level behaviour not in conformity with rainfall, some other source of recharge , some artificial rechrge project, seems to have become affective resuting in post monsoon rising trend.

Hydrograph (2009-18), village Turori, Umerga Block, Osmanabad District



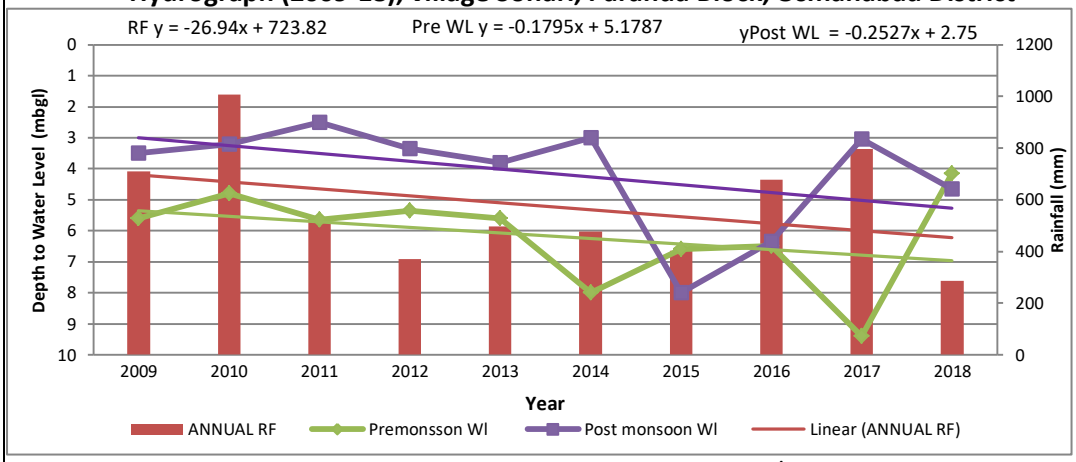
Pre monsoon Water level trend showing Rising trend @ 0.03 m/year and post monsoon Water level trend showing Rising trend @ 0.16 m/ year .Rising Rainfall trend @ 28.20 mm/ year. Water level behaviour in conformity with rainfall.

Hydrograph (2009-18), village Vadgaon siddheswar, Osmanabad Block, Osmanabad District



Pre monsoon Water level trend showing Rising trend @ 0.33 m/year and post monsoon Water level trend showing declining trend @ 0.18 m/ year.Falling Rainfall trend @ 2.90 mm/ year. Water level behaviour in conformity with rainfall,exploitation of ground water resources might have been reduced.

Hydrograph (2009-18), village Sonari, Paranda Block, Osmanabad District



Pre monsoon Water level trend showing Falling trend @ 0.17 m/year and post monsoon Water level trend showing falling trend @ 0.25 m/ year .Falling Rainfall trend @ 26.94 mm/ year. Water level behaviour in conformity with rainfall

Figure 3. 7: Behavior of water level with time

4. GROUND WATER QUALITY

Ground water sampling is being done every year from GWM wells during pre-monsoon period (May). The data gap analysis has been carried out to find out the adequacy of information on water quality and identified additional locations, 84 for shallow and 7 for deeper aquifers. Ground water quality data of 127 monitoring wells of CGWB and GSDA representing shallow aquifer have been utilised to decipher the quality scenario of shallow aquifer. 69 exploratory wells- tubewells/borewells data of CGWB and GSDA representing deeper aquifer have been utilised to decipher the quality scenario of deeper aquifer. The aquifer wise concentrations of different chemical constituents present in ground water are given in Table 4.1. The details of chemical analysis are given in Annexure V and VI.

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

Constituents	Shallow aquifer		Deeper aquifer	
	Min	Max	Min	Max
pH	7.2	10.0	7.1	9.52

Constituents	Shallow aquifer		Deeper aquifer	
	Min	Max	Min	Max
EC	248	7517	260	2990
TDS	131	3960	125	2208
TH	51	2478	35	1340
Calcium	10	368	2	445
Magnesium	6	426	1.22	89
Potassium	0.04	142	0.3	35
Sodium	3.48	536	8	450
Bi-carbonate	45	2688	18.3	780
Chloride	11	944	7	676
Sulphate	0.50	232	4	821
Nitrate	BDL	380	BDL	330
Fluoride	0.01	3.01	BDL	4.4
Iron	-	-	BDL	0.5

***BDL- below detection limit**

4.1 ELECTRICAL CONDUCTIVITY (EC)

Distribution of Electrical Conductivity in Shallow Aquifer:

The EC in shallow aquifer varies between 248 (Sulegaon, Lohara block) and 7517 µS/cm (Sirrzaw Panda, Paranda block). Out of 127 samples collected from dug wells, 7 samples are having EC more than 2250 µS/cm. EC >2250 µS/cm has been observed in 510 sq. km. area in major part of Paranda block and Isolated patch in Osmanabad block. The ground water is potable in major part of district. The distribution of electrical conductivity in shallow aquifers is shown in **Fig. 4.1** and analytical data is presented in Table 4.2.

Distribution of Electrical Conductivity in Deeper Aquifer:

The EC in deep aquifer varies between 260 (Salegaon Lohara block) and 2990 µS/cm (Irla, Osmanabad block). Out of 69 samples collected from tube wells/bore wells, 3 samples are having EC more than 2250 µS/cm. EC >2250 µS/cm has been observed in 185 sq. km. area as isolated patches in Tuljapur and Umerga blocks. The ground water is potable in major parts of the district. 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	shallow aquifer		Deeper Aquifer	
	(µS/cm)	No. of samples	% of samples	No. of samples	% of samples
1	< 250	1	0.78	0	-
2	>250-750	45	35.4	29	42.0
3	>750-2250	74	58.2	37	53.6
4	>2250-3000	4	3.15	3	4.35
5	>3000-5000	2	1.58	-	-
6	>5000	1	0.78	-	-
Total samples		**127**		**69**	

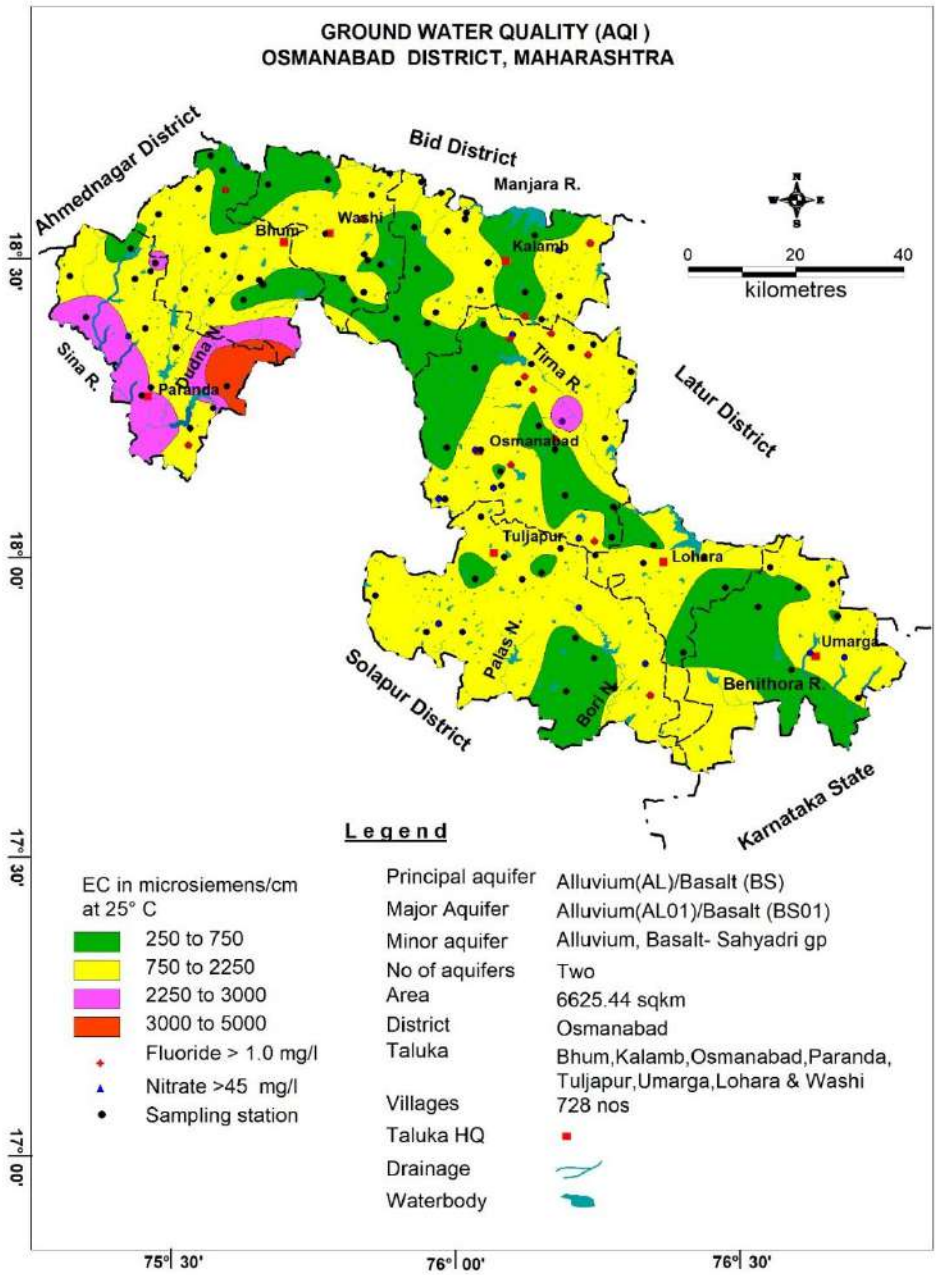


Figure 4. 1: Ground Water Quality, Aquifer-I (EC >2250 µS/cm in 510 sq. km. area)

Nitrate:

Nitrogen in the form of dissolved nitrate, is a nutrient for vegetation and an essential element to all life. The major contribution in ground water is from sewage, waste disposal, nitrate fertilizer and decaying of organic matter. From shallow aquifer, 127 samples were analyzed; out of this 13 water samples show the nitrate concentrations exceeding the desirable limit of 45 mg/l. In Osmanabad district nitrate concentration varies between BDL to 380 mg/l (Dhoki, Osmanabad block). As per BIS (2012) the desirable limit is 45 mg/l. The high concentration of Nitrate may be due to domestic waste and sewage effected pollution in the urban and rural parts of district.

In deeper aquifer, 69 wells were analyzed, out of this 7 water samples show nitrate concentration exceeding the desirable limit of 45 mg/l. In deeper Aquifer nitrate concentration ranges from BDL to 330 mg/l (Umerga, Umerga 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.

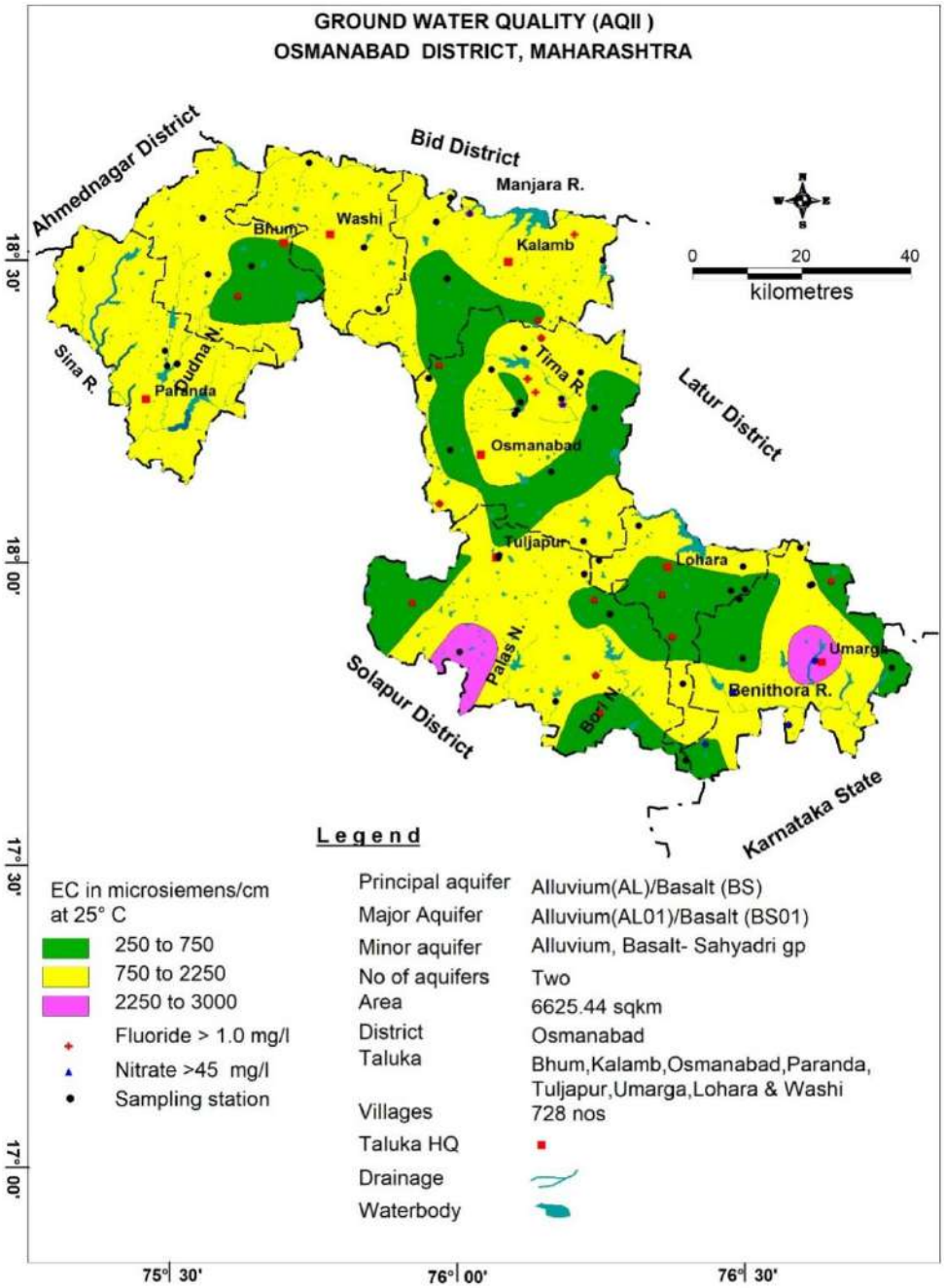


Figure 4. 2: Ground Water Quality, Aquifer-II (EC >2250 µS/cm in 185 sq. km. area)

Fluoride:

In shallow aquifer, concentration of fluoride ranges from 0.01 to 3.01 mg/l. out of 127 samples analyzed, only 4 samples show fluoride concentration more than 1.5 mg/l. In shallow aquifer, the highest concentration of fluoride is found in Loni Paranda, Paranda block (3.08 mg/l). In Deeper Aquifer, Concentration of fluoride ranges from BDL to 4.4 mg/l. Out of 69 samples analyzed, only 7 samples show fluoride concentration more than 1.5 mg/l. In Deeper aquifer, the highest concentration of fluoride is found in Andoor, Tuljapur Block (4.4 mg/l); it may be due to the geogenic reasons. Aquifer wise fluoride concentration is given in Table 4.3.

Table 4. 3: Aquifer wise Nitrate and Fluoride concentration

Block	No_3> 45 mg/l		fluoride >1.5 mg/l	
	No of samples	No of samples	No of samples	No of samples
	Shallow Aquifer	Deeper Aquifer	Shallow Aquifer	Deeper Aquifer
Osmanabad	6	1	1	5
Tuljapur	3	-	-	2
Umerga	2	4	-	-
Bhum	-	-	1	-
Paranda	1	-	1	-
Kalamb	1	2	1	-
Lohara	-	-	-	-
Washi	-	-	-	-
Total	**13**	**7**	**4**	**7**

4.2 SUITABILITY OF GROUND WATER FOR DRINKING PURPOSE

In shallow aquifer, 1.58 % samples are having TDS more than maximum permissible limit (MPL) and 98.42 % of samples have TDS concentration above the Desirable limit (DL) but below the MPL. The water from such area is not fit for drinking purpose if directly consumed without treatment. It is also seen that about 1.58 to 20.47 % samples are beyond the maximum permissible limit for the parameters like pH, TDS, TH, Ca, Mg, 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. 4: 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	-	127	-	-	125	98.42	2	1.58
TDS	500	2000	127	68	52.41	57	46.01	2	1.58
TH	300	600	127	41	32.28	60	47.24	26	20.47
Ca (mg/L)	75	200	127	58	45.66	46	36.22	6	18.12
Mg (mg/L)	30	100	127	46	36.22	69	54.33	12	9.44
Cl (mg/L)	250	1000	127	120	94.48	7	5.52	-	-
SO_4 (mg/L)	200	400	127	125	98.42	2	1.58	-	-
NO_3 (mg/L)	45	No relaxation	127	114	89.76	13	10.23	-	-
F (mg/L)	1	1.5	**127**	112	88.18	11	8.66	4	3.14

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

In Deeper aquifer, 4.35 % samples are having TDS more than maximum permissible limit (MPL) and 50.72 % of samples have TDS concentration above the Desirable limit (DL) but below the MPL. The water from such area is not fit for drinking purpose if directly consumed without treatment. It is also seen that about 4.35 to 17.39 % samples are beyond the maximum permissible limit for the parameters like pH, TDS, TH, Ca, SO_4, NO_3 and Fluoride 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. 5: 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	-	69	1	1.45	56	81.16	12	17.39
TDS	500	2000	69	31	44.93	35	50.72	3	4.35

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	%
TH	300	600	69	34	49.28	27	39.13	8	11.59
Ca (mg/L)	75	200	69	41	59.42	22	31.88	6	8.70
Mg (mg/L)	30	100	69	43	62.32	26	37.68	-	0.00
Cl (mg/L)	250	1000	69	59	85.51	10	14.49	-	0.00
SO_4 (mg/L)	200	400	69	59	85.51	5	7.25	5	7.25
NO_3 (mg/L)	45	No relaxation	69	60	86.96	9	13.04		0.00
F (mg/L)	1	1.5	**69**	46	66.67	13	18.84	10	14.49

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

4.3 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.

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

Table 4. 6 Classification of Ground water for Irrigation based on EC values

S. No	Water Quality Type	EC in µS/cm	Shallow aquifer		Deeper Aquifer	
			No. of Samples	% of samples	No. of samples	% of samples
1	Low Salinity Water	< 250	1	0.78	0	0.00
2	Medium Salinity Water	>250-750	45	35.44	29	42.02
3	High Salinity Water	>750-2250	74	58.27	37	53.63
4	Very High Salinity Water	> 2250	7	5.51	3	4.38
Total			**127**	**100**	**69**	**100**

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

Sodium Adsorption Ratio (SAR)

Excess of sodium in water render it unsuitable for irrigation on soil containing exchangeable Calcium and Magnesium ions. Soil containing exchangeable Calcium and Magnesium takes up sodium of irrigation water in exchange for Calcium and Magnesium, the ratio reflects the Sodium hazard. The SAR indicates the relative activity of the Sodium ions in exchange reactions with the soil. The main problem with high sodium concentration is its effect on soil permeability; hardening of soil & water irrigation system. Sodium also contributes directly to the total salinity of the water and may be toxic to sensitive crops such as fruit trees. The higher value of SAR indicates soil structure damage.

In shallow aquifer, out of 127 samples analyzed and all samples are having SAR value less than 10. In deeper aquifer, out of 69 samples analyzed and all samples are having SAR value less than 10. The classification of ground water samples based on SAR values for its suitability for irrigation purpose is shown in Table 4.7.

Table 4. 7: Classification of Ground water for Irrigation based on SAR values

Characteristics	Quality	SAR value							
	Total Number of GW samples	< 10		10-18		18-26		> 26	
		Good		Good to Permissible		Doubtful		Bad (Unsuitable)	
		No	%	No	%	No	%	No	%
Shallow Aquifer	127	127	100	-	-	-	-	-	-
Deeper Aquifer	69	69	100	-	-	-	-	-	-
Total	**196**	**196**	100	**-**	**-**	-	-	-	-

Residual Sodium Carbonate (RSC)

Residual Sodium Carbonate (RSC) is considered to be superior to SAR as a measure of sodacity particularly at low salinity levels. Calcium reacts with bi-carbonate and precipitate as $CaCO_3$. Magnesium salt is more soluble and so there are fewer tendencies for it to precipitate. When calcium and magnesium are lost from the water, the proportion of sodium is increased resulting in the increase in sodium hazard. This hazard is evaluated in terms of RSC. The classification of ground water samples based on RSC values for its suitability for irrigation purpose is shown in Table 4.8.

Table 4. 8: Classification of Ground water for Irrigation based on RSC values

Characteristics	Quality	RSC values (meq/L)					
		< 1.25		1.25-2.50		> 2.50	
		Good		Doubtful		Bad (Unsuitable)	
	Total No of GW samples	No	%	No	%	No	%
Shallow Aquifer	127	126	99.21	1	0.79	-	-
Deeper Aquifer	69	68	98.55	1	1.45	-	-
Total	**196**	**194**	**98.88**	**2**	**1.12**	**-**	**-**

In shallow aquifer, it is observed that out of 127 samples, only 1 sample (Gojwada, Tuljapur block) shows RSC values more than 1.25 meq/L indicating that the ground water of the area is not suitable for irrigation while in deeper aquifer, out of 69 samples, 1 sample (Kilaj, Tuljapur block)show RSC more than 1.25 meq/L indicating that the ground water of the area is not suitable for irrigation.

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 Osmanabad district based on GEC-97 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 7569 sq. km. area out of which 402.45 sq. km. is under command and 6313.83 sq. km. is non-command. About 718.67 sq. km. area is hilly and this is not considered for resource estimation. As per the estimation, the net annual ground water availability comes to be 922.13 MCM. The gross draft for all uses is estimated at 570.58 MCM with irrigation sector being the major consumer having a draft of 547.52 MCM. The domestic and industrial water requirements are worked at 23.05 MCM. The net ground water availability for future irrigation is estimated at 44.47MCM. Stage of ground water development varies from 46.65 % (Tuljapur) to 87.57% (Osmanabad). The overall stage of ground water development for the district is 61.88%. Block wise assessments indicate that except Osmanabad block, which falls under "Semi-Critical", rest of the talukas are safe.

Table 5. 1: Ground water resources-2013 (ham), Aquifer-I (Shallow Aquifer)

Administrative Unit	Command / Non-Command / Total	Net Annual Ground Water Availability	Existing Gross Ground Water Draft for irrigation	Existing Gross Ground Water Draft for domestic and industrial water supply	Existing Gross Ground Water Draft for All uses	Provision for domestic and industrial requirement supply to 2025	Net Ground Water Availability for future irrigation development	Stage of Ground Water Development (%) /Category
Bhum	Command	400.44	430.55	18.23	448.79			
	Non-Command	4868.08	2613.79	102.64	2716.44			
	Total	5268.52	3044.35	120.88	3165.23	243.04	1909.11	60.08/Safe
Kalamb	Command	199.18	281.63	23.13	304.76			
	Non-Command	11362.05	8184.63	317.55	8502.17			
	Total	11561.23	8466.25	340.68	8806.93	664.65	2339.27	76.18/Safe
Lohara	Command	438.89	547.85	24.99	572.84			
	Non-Command	7340.47	3372.28	145.65	3517.92			
	Total	7779.36	3920.13	170.64	4090.76	344.37	3460.04	52.58/Safe
Umerga	Command	939.23	930.55	53.35	983.91			
	Non-Command	13037.49	6171.98	281.51	6453.49			
	Total	13976.72	7102.53	334.87	7437.40	626.95	6347.46	53.21/Safe
Osmanabad	Command	1547.38	3153.80	70.40	3224.19			
	Non-Command	14196.14	10202.45	359.33	10561.78			
	Total	15743.52	13356.25	429.73	13785.97	758.47	1883.27	87.57/Semi critical
Paranda	Command	854.56	812.89	32.89	845.78			
	Non-Command	9657.63	4521.93	205.04	4726.97			
	Total	10512.19	5334.82	237.93	5572.75	473.48	4774.59	53.01/Safe
Tuljapur	Command	1861.05	2133.48	98.78	2232.26			
	Non-Command	17841.49	6567.73	392.16	6959.89			
	Total	19702.54	8701.21	490.94	9192.15	975.09	10029.63	46.65/Safe
Washi	Command	510.36	798.00	23.03	821.04			
	Non-Command	7158.89	4028.96	156.93	4185.88			
	Total	7669.25	4826.96	179.96	5006.92	360.99	2483.60	65.29/Safe
Total	**Command**	**6751.09**	**9088.75**	**344.81**	**9433.56**			
	Non-Command	**85462.25**	**45663.74**	**1960.81**	**47624.55**			
	Total	**92213.34**	**54752.49**	**2305.61**	**57058.11**	**4447.04**	**33226.98**	**61.88 % / Safe**

5.2 GROUND WATER RESOURCES – AQUIFER-II

The ground water resources of Aquifer-II (Basalt) were also assessed to have the correct quantification of resources so that proper management strategy can be framed. The total resources of aquifer-II have been estimated as 187.53 MCM. Block wise summarized Ground Water Resources of Aquifer-II are given in **Table 5.2.**

Table 5. 2: Ground Water Resources of Aquifer-II (Deeper aquifer) (Ham)

Block	Aquifer	Area (Sqkm)	Mean Thickness (m)	Average of Sy	Average of S	Resources above confining layer (mcm)	Resource with in confining Aquifer (mcm)	Total Resources (MCM)
Bhum	Basalt Aq-II	432.21	4.5	0.0042	0.0004	3.466	7.200	10.666
Kalamb	Basalt Aq-II	628.32	6.125	0.0044	0.0002	2.673	10.216	12.890
Lohara	Basalt Aq-II	482.85	3.5625	0.0031	0.0004	4.702	2.715	7.417
Osmanabad	Basalt Aq-II	1325.83	4.5	0.0033	0.0004	8.202	14.215	22.418
Paranda	Basalt Aq-II	983.94	6.125	0.0031	0.0004	7.612	22.631	30.242
Tuljapur	Basalt Aq-II	1342.26	6.125	0.0044	0.0003	7.665	55.656	63.322
Umarga	Basalt Aq-II	894.43	4.5	0.0042	0.0004	5.657	20.960	26.616
Washi	Basalt Aq-II	535.17	4.5	0.0033	0.0005	5.660	8.300	13.960
Grand Total		**6625.01**				**45.639**	**141.893**	**187.532**

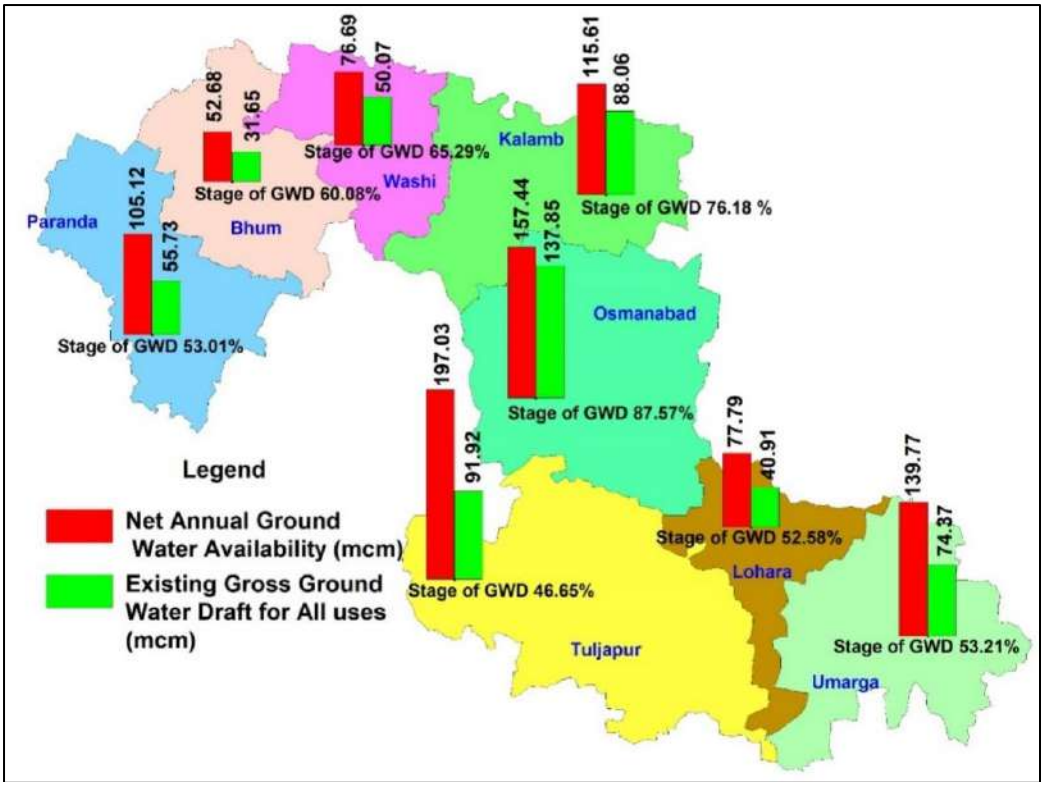
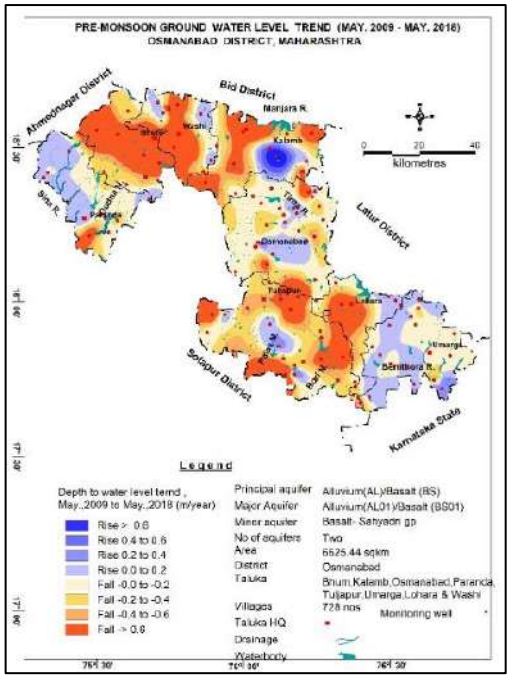


Figure 5. 1: Ground Water Resources (2013), Osmanabad district

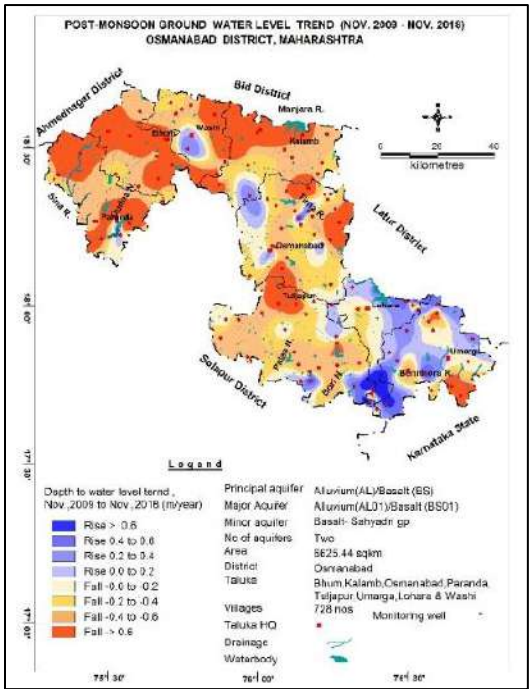
6. GROUND WATER RELATED ISSUES

6.1 Declining Water Level trend

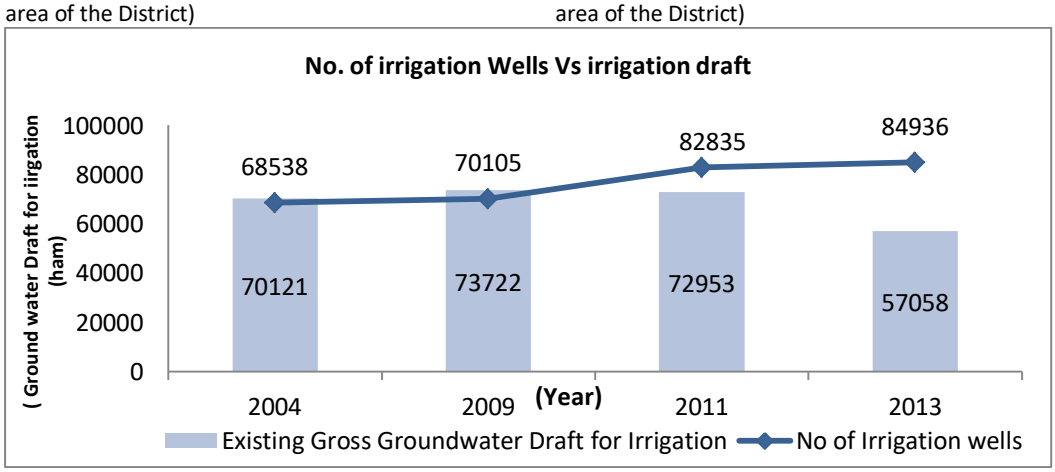
The ground water exploitation has resulted in decline of water levels over the period of time. In pre monsoon season, decline of more than 0.20 m/year has been observed in 3817 sq. km., i.e., 50 % of the area covering major parts of Tuljapur, Lohara, Bhum, Washi, Osmanabad, Paranda and Kalamb blocks and Isolated parts in Umerga block. In post monsoon season, decline of more than 0.20 m/year has been observed 5215 sq. km. i.e., 69 % of the area covering in major parts of Paranda, Bhum, Washi, Kalamb, Osmanabad and Tuljapur blocks and parts of Umerga and Lohara blocks. The decline may be because the area has experienced increased irrigation draft and number of irrigation wells, in addition to this has received continously less annual rainfallthan the normal rainfall between the period from 2009-18.



Pre monsoon Fall @>0.2/year in 3815 Sq. km. (50% area of the District)



Post monsoon Fall@>0.2/year in 5215 Sq. km. (69% area of the District)



6.2 RAINFALL AND DROUGHTS

The short-term rainfall analysis for the period 2009-2018 indicates that average rainfall of Osmanabad District is 701.2 mm and Normal rainfall of the districts is 807.2mm. **The rainfall analysis for last ten years is showing deficient rainfall/ Moderate drought condition in the years 2011, 2012, 2014, 2015 and 2018.** It is observed that the District experiences low and deficient rainfall with frequent droughts.

District	YEAR	ANNUAL	NORMAL	DEPARTURE	No of Rainy days	CATEGORY
Osmanabad	2009	735.3	807.2	-9	60	NORMAL
	2010	1035.7	807.2	28	86	EXCESS
	2011	540.2	807.2	-33	44	MODERATE
	2012	400.7	807.2	-50	39	MODERATE
	2013	726.2	807.2	-10	64	NORMAL
	2014	505.2	807.2	-37	46	MODERATE
	2015	477	807.2	-41	49	MODERATE
	2016	868	807.2	8	58	NORMAL
	2017	880.5	807.2	9	56	NORMAL
	2018	505.1	807.2	-37	42	MODERATE

6.4 SUSTANABILITY:

The major part of the district is occupied by basaltic rock formation that inherently consist of limited extent of porous and pervious zone; predominance of secondary porosity that has evolved from prevailing erratic joint pattern and also 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, depth of potential aquifers is generally restricted up to 30 m. The potential of the fracture zones reduces substantially below 100 m depth. This causes reduction in the well yield drastically during the summers. About 60% of area of the district is having low yield potential (<1 lps).

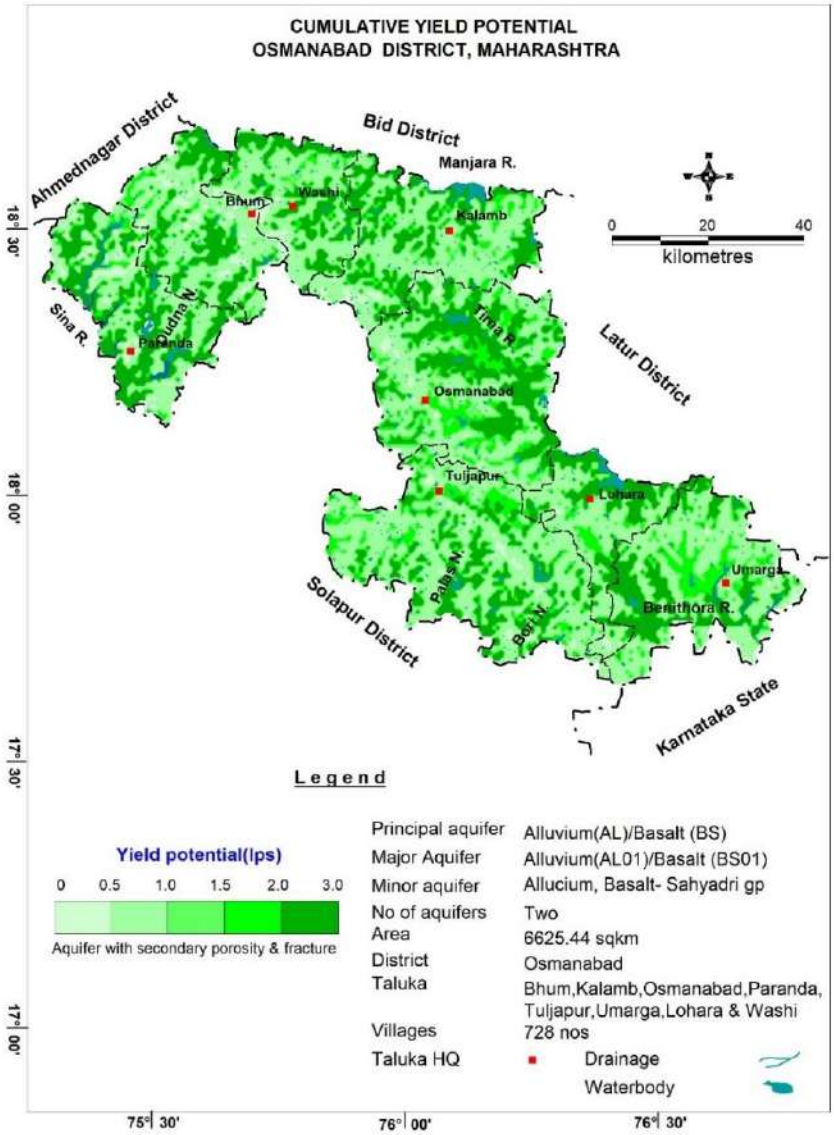
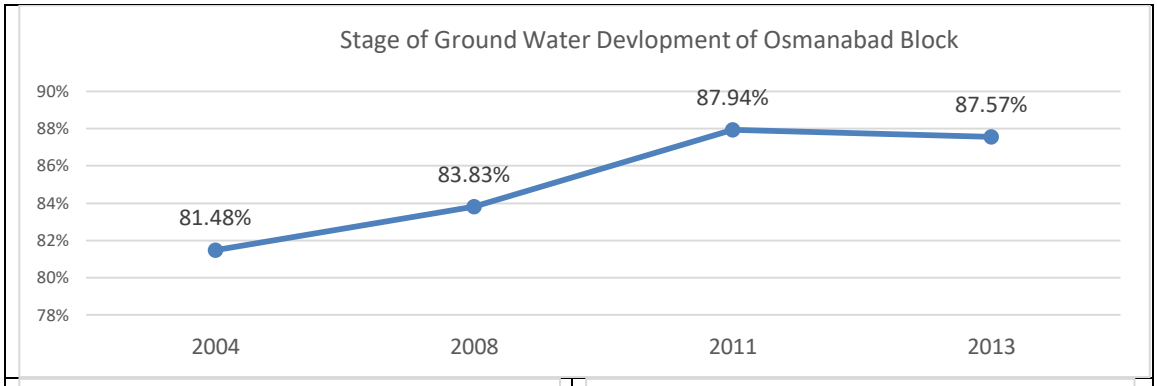
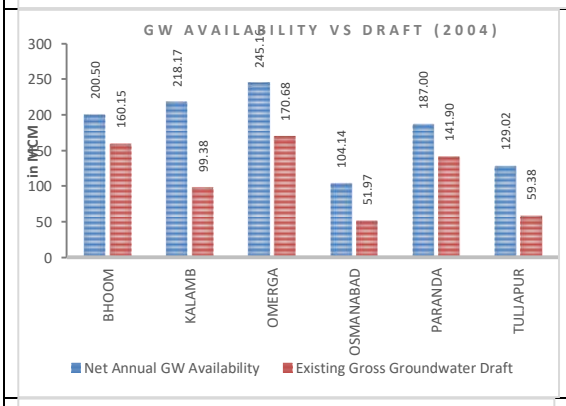


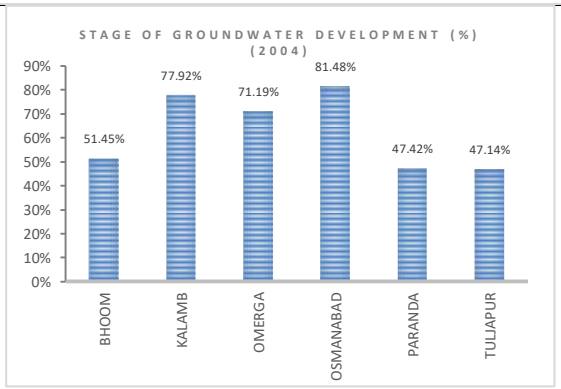
Figure 6. 1: Cumulative yield Potential

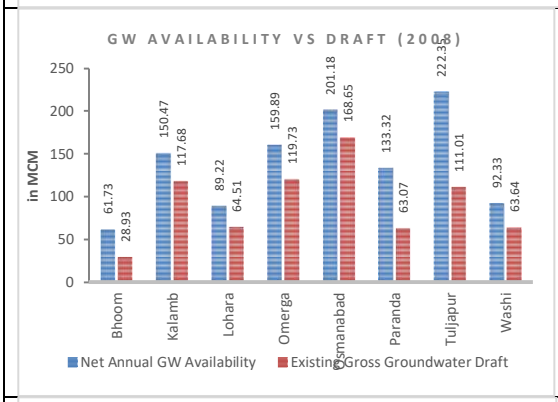
6.5 EXPLOITATION OF GROUND WATER RESOURCES

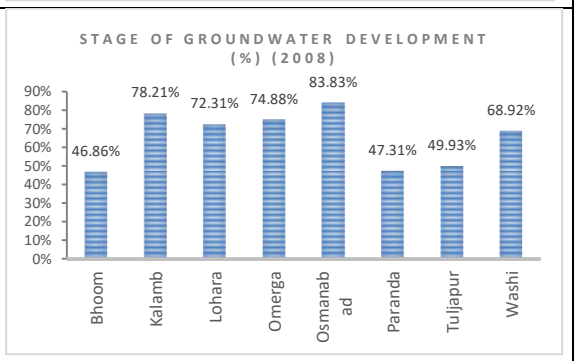
Stage of ground water development has increased over the period of time from 2004 to 2013 in Bhum, Kalamb, Paranda and Osmanabad Blocks **(fig. 6.2).** The main reason for ground water excessive draft is for irrigation purpose. The draft has increased from 2004 to 2013 in respect net recharge**.** Also, the gap between the availability of ground water and draft is reducing over the period from 2004 to 2013. This provides very limited scope for ground water development particularly in irrigation sector.

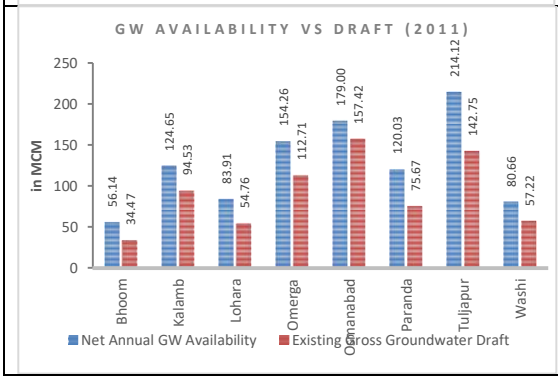

Stage of Ground Water Devlopment of Osmanabad Block
90%
88%
86%
84%
82%
80%
78%
81.48%
83.83%
87.94%
87.57%
2004
2008
2011
2013

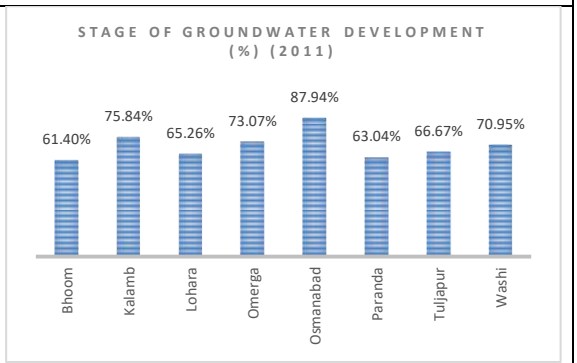

GW AVAILABILITY VS DRAFT (2004)
in MCM
300
250
200
150
100
50
0
200.50
160.15
218.17
99.38
245.16
170.68
104.14
51.97
187.00
141.90
129.02
59.38
BHOOM
KALAMB
OMERGA
OSMANABAD
PARANDA
TULJAPUR
Net Annual GW Availability
Existing Gross Groundwater Draft


STAGE OF GROUNDWATER DEVELOPMENT (%) (2004)
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
51.45%
77.92%
71.19%
81.48%
47.42%
47.14%
BHOOM
KALAMB
OMERGA
OSMANABAD
PARANDA
TULJAPUR


GW AVAILABILITY VS DRAFT (2008)
in MCM
250
200
150
100
50
0
61.73
28.93
150.47
117.68
89.22
64.51
159.89
119.73
201.18
168.65
133.32
63.07
222.38
111.01
92.33
63.64
Bhoom
Kalamb
Lohara
Omerga
Osmanabad
Paranda
Tuljapur
Washi
Net Annual GW Availability
Existing Gross Groundwater Draft


STAGE OF GROUNDWATER DEVELOPMENT (%) (2008)
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
46.86%
78.21%
72.31%
74.88%
83.83%
47.31%
49.93%
68.92%
Bhoom
Kalamb
Lohara
Omerga
Osmanabad
Paranda
Tuljapur
Washi


GW AVAILABILITY VS DRAFT (2011)
in MCM
250
200
150
100
50
0
56.14
34.47
124.65
94.53
83.91
54.76
154.26
112.71
179.00
157.42
120.03
75.67
214.12
142.75
80.66
57.22
Bhoom
Kalamb
Lohara
Omerga
Osmanabad
Paranda
Tuljapur
Washi
Net Annual GW Availability
Existing Gross Groundwater Draft


STAGE OF GROUNDWATER DEVELOPMENT (%) (2011)
61.40%
75.84%
65.26%
73.07%
87.94%
63.04%
66.67%
70.95%
Bhoom
Kalamb
Lohara
Omerga
Osmanabad
Paranda
Tuljapur
Washi

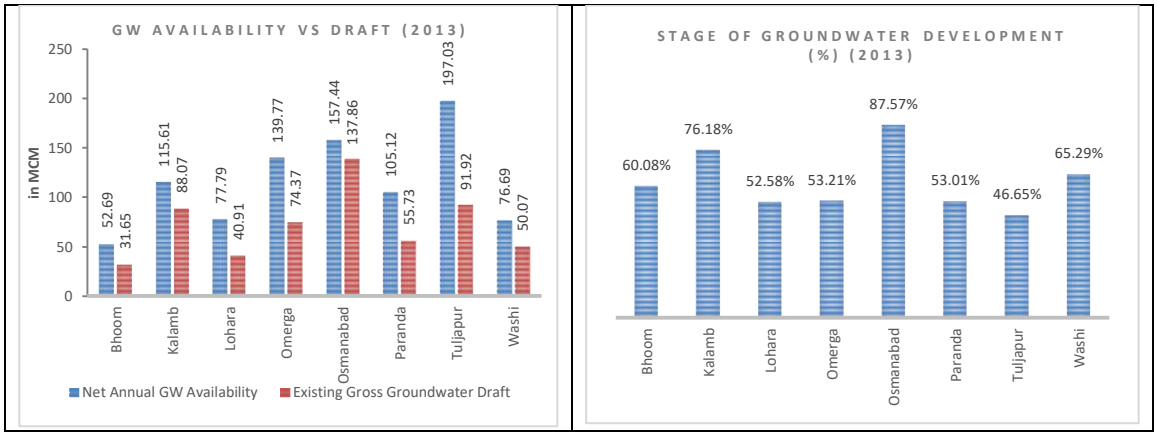


Figure 6. 2: Draft Vs Availability Over the time

7. GROUND WATER MANAGEMENT PLAN

The management plan has been proposed to manage the ground water resources 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 5 mbgl and the specific yield of the aquifer. 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)
Bhum	516.69	432.20	864.4
Kalamb	935.23	675.10	1350.19
Lohara	525.85	186.44	372.89
Osmanabad	1325.86	626.58	1253.16
Paranda	1126.41	753.39	1506.78
Tuljapur	1579.32	1256.22	2512.44
Umerga	973.47	400.74	801.48
Washi	586.17	586.17	1172.34
Grand Total	**7569.00**	**4916.84**	**9833.67**

The total unsaturated volume available for artificial recharge is 9833.67 MCM ranging from 372.89 MCM in Lohara block to 2512.44 MCM in Tuljapur block. The available surplus runoff can be utilized for artificial recharge through construction of percolation tanks and Check dams at suitable sites.

Thus, after taking into consideration all the factors, only 72.08 MCM of surplus water can be utilised for recharge, which is given in table 7.2. This surplus water can be utilized for constructing 243percolation tanks and 783check dams at suitable sites. The number of feasible artificial recharge structures was calculated by considering 0.20 MCM per percolation tanks and 0.03 MCM per check dam. This intervention should lead to recharge @ 75% efficiency of about 54.07 MCM/year. Tentative locations of these structures are given in **Fig. 7.1** and details also given in **Annexures VII and VIII.**

The rainwater harvesting in urban areas can be adopted in 25% of the household with 50 m^2 roof area. A total of 2.54 MCM potential can be generated by taking 80% runoff coefficient.

Table 7.2: Proposed Artificial Recharge Structures

Block	Geo graphical 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	PT	CD	
Bhum	516.69	432.20	864.4	10.18	5.088	17	56	2.55	1.26	**3.81**
Kalamb	935.23	675.10	1350.19	15.9	11.92	42	117	6.30	2.63	**8.93**
Lohara	525.85	186.44	372.89	4.39	3.29	11	37	1.65	0.83	**2.48**
Osmanabad	1325.86	626.58	1253.16	14.75	14.75	58	105	8.70	2.36	**11.06**
Paranda	1126.41	753.39	1506.78	17.74	8.87	24	137	3.60	3.08	**6.68**
Tuljapur	1579.32	1256.22	2512.44	29.58	14.79	54	132	8.10	2.97	**11.07**
Umerga	973.47	400.74	801.48	9.44	7.08	22	89	3.30	2.00	**5.30**
Washi	586.17	586.17	1172.34	12.6	6.3	15	110	2.25	2.48	**4.73**
Grand Total	**7569.00**	**4916.84**	**9833.67**	**114.58**	**72.08**	**243**	**783**	**36.4**	**17.62**	**54.07**

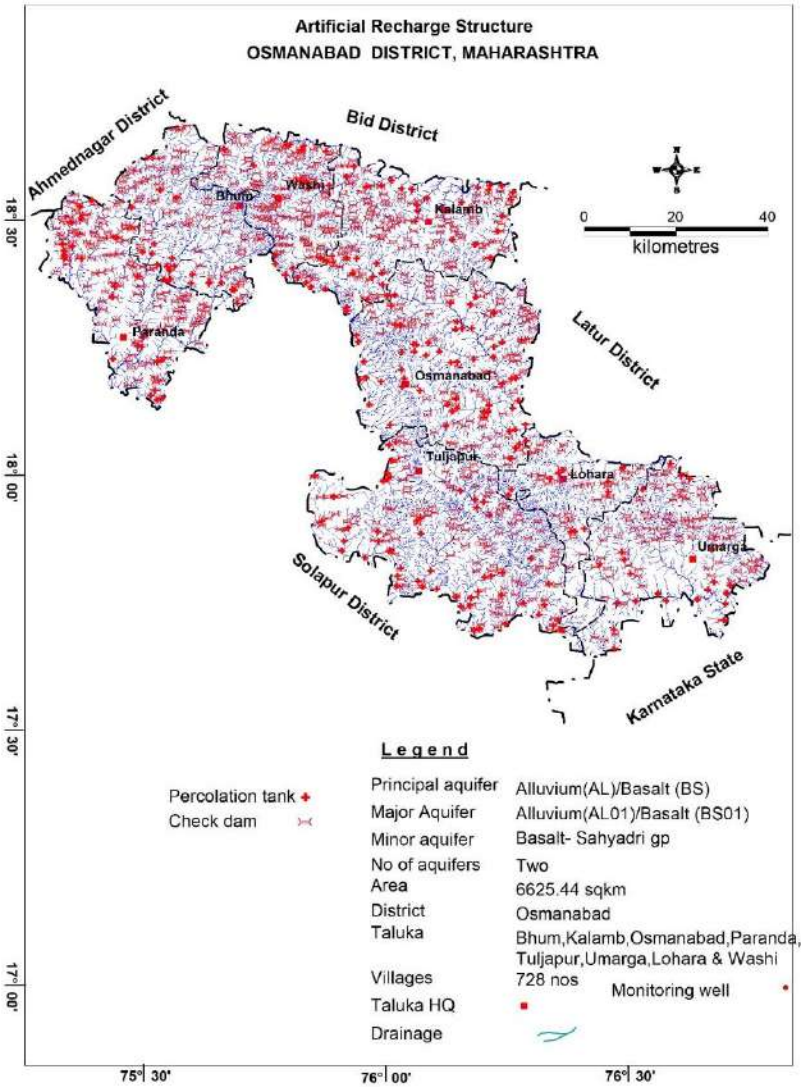


Figure 7. 1: Location of Proposed Artificial Recharge structures

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/Citrus/Banana) 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 55 Sq. km. area in all blocks and that would save a total of 27.95 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.

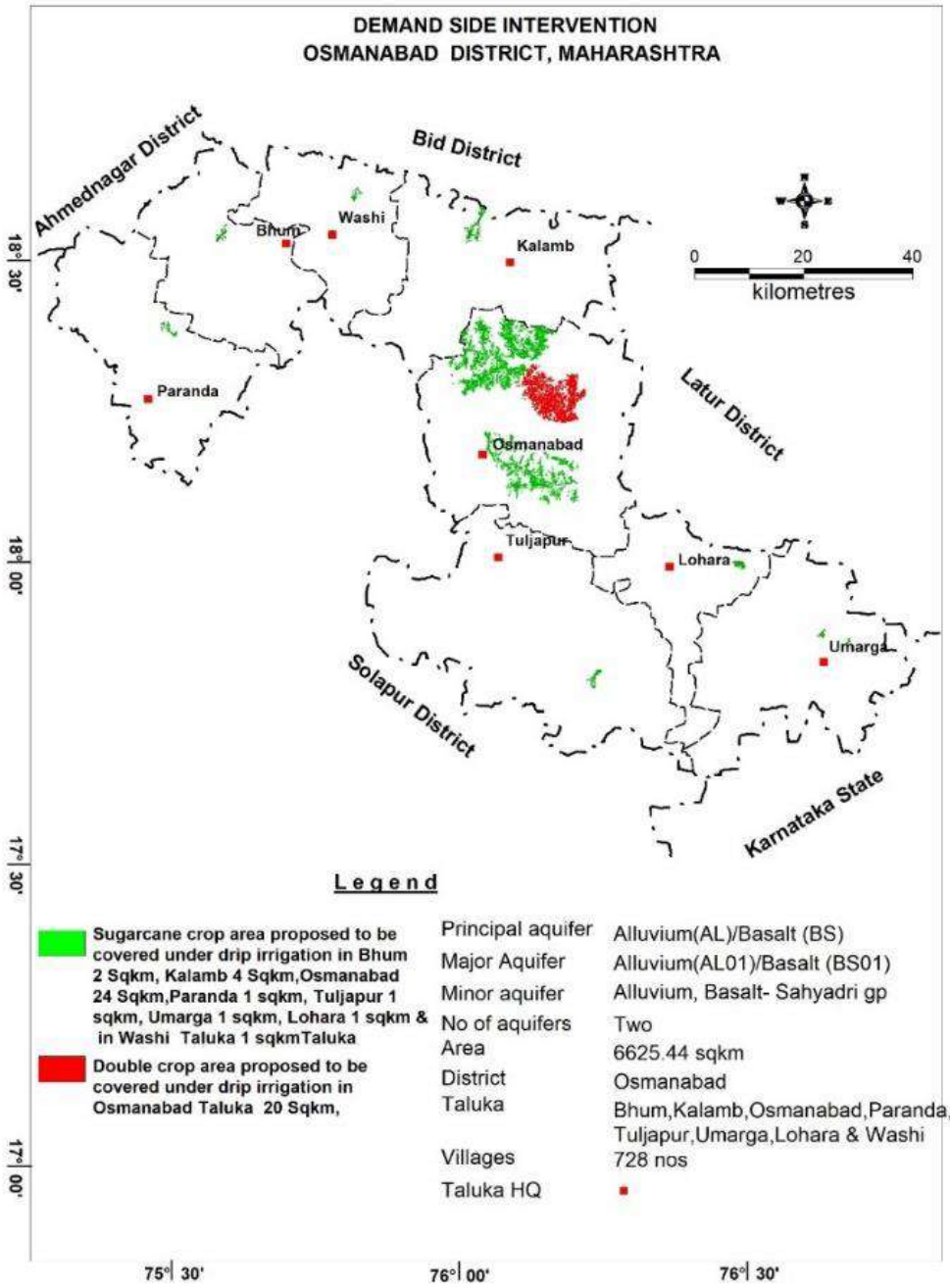


Figure 7. 2: Demand Side Intervention

Table 7.3: Area proposed for Micro irrigation Techniques and water saving through Demand side interventions

Block	MICROIRRIGATION TECHNIQUES		
	Sugarcane Area proposed (Sq. Km.)	Double crop Area proposed (Sq. Km.)	Volume of Water saved (MCM)
Bhum	2		1.14
Kalamb	4		2.28
Lohara	1		0.57
Osmanabad	24	20	21.68
Paranda	1		0.57
Tuljapur	1		0.57
Umarga	**1**		0.57
Washi	1		0.57
Grand Total	**35**	**20**	**27.95**

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 7.3). The Stage of ground water development gets reduced and comes below 70%.

Table 7. 3: Expected benefits after management options

Block	Water Recharged by Supply side intervention (MCM)/year	Water saving by demand side interventions (MCM)/year	Net Ground water availability (As per GWRE, 2013) (MCM)/year	Total ground water draft (As per GWRE, 2013) (MCM)/year	Ground water resources after supply side management (MCM)/year	Ground water Draft after demand side management (MCM)/year	Expected stage of Development %
Bhum	3.81	1.14	52.69	31.65	56.50	30.51	54.01
Kalamb	8.93	2.28	115.61	88.07	124.54	85.79	68.88
Lohara	2.48	0.57	77.79	40.91	80.28	40.34	50.25
Osmanabad	11.06	21.68	157.44	137.86	168.50	116.18	68.95
Paranda	6.68	0.57	105.12	55.73	111.80	55.16	49.33
Tuljapur	11.07	0.57	197.03	91.92	208.10	91.35	43.90
Umerga	5.30	0.57	139.77	74.37	145.07	73.80	50.87
Washi	4.73	0.57	76.69	50.07	81.42	49.50	60.80
Total	**54.07**	**27.95**	**922.13**	**570.58**	**976.20**	**542.63**	**55.59**

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 140.71 MCM volume of ground water generated can bring additional 216.48 sq. km. Kharif Crop area under assured ground water irrigation with average crop water requirement of 0.65 m by constructing 8441 Dug wells and 1408 Bore wells. Block wise details are given in Table 7.4. The area feasible for ground development is shown in Fig. 7.3.

Table 7. 4: Block wise additional area under assured GW Irrigation

Block	Net Ground water availability (As per GWRE, 2013) (MCM)/year	Ground water resources after supply side management (MCM)/tear	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)
Bhum	52.69	56.50	30.51	**54.01**	9.04	542	90	13.91
Kalamb	115.61	124.54	85.79	**68.88**	1.39	83	14	2.14
Lohara	77.79	80.28	40.34	**50.25**	15.85	951	159	24.38
Osmanabad	157.44	168.50	116.18	**68.95**	1.77	106	18	2.73
Paranda	105.12	111.80	55.16	**49.33**	23.10	1386	231	35.54
Tuljapur	197.03	208.10	91.35	**43.90**	54.32	3259	543	83.57
Umerga	139.77	145.07	73.80	**50.87**	27.75	1665	278	42.69
Washi	76.69	81.42	49.50	**60.80**	7.49	449	75	11.52
Grand Total	**922.13**	**976.20**	**542.63**	**55.59**	**140.71**	**8441**	**1408**	**216.48**

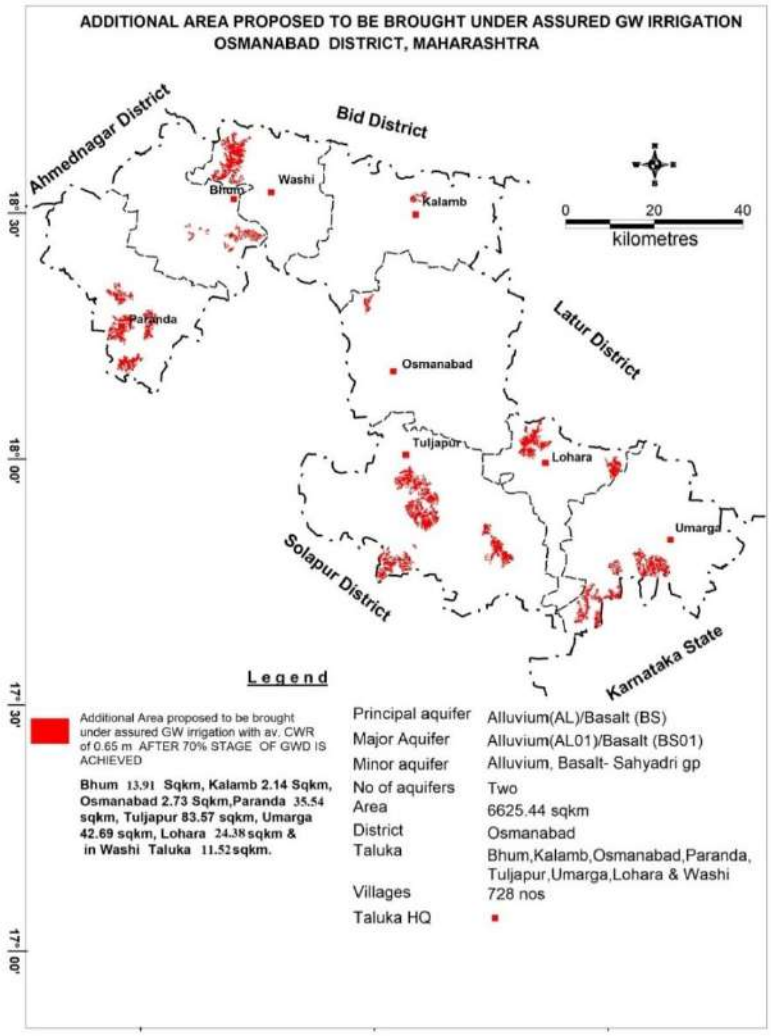


Figure 7. 3: Additional area Proposed to be bought under Assured GW irrigation

8. SUM UP

A thorough study was carried out based on data gap analysis, data generated in-house; data acquired from State Govt. departments and GIS maps prepared 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 Osmanabad district.

Osmanabad district covering an area of about 7569sq. km. with 853sq. km. being hilly area. The stage of ground water development of the district is 61.88%. The area has witnessed relatively high exploitation of ground water resource, declining water level, low rainfall and drought and low yield potential of aquifers. Declining water level trend of more than 0.20 m/year has been observed in 3817 sq. km. (50% area of the total area) during pre-monsoon (2009-18). Declining water level trend of more than 0.20 m/year has been observed in 5215 sq.km (69% area of the total area) during post monsoon (2009-18). These declines may be due to less rainfall or exploitation of ground water resources more than the annual recharge in these areas.

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 243Percolation tanks and 783Check dams are proposed, which will augment ground water resources to the tune of 54.07 MCM/year (36.4MCM/year by Percolation tanks and 17.62 MCM/year by Check dams)

As a part of Demand side Management, micro-irrigation techniques are to be adopted in55Sq. km. area thereby saving a total of 27.95 MCM/year. Change in cropping patterns is not proposed in any of the blocks.

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 140.71 MCM/year volume of ground water generated can bring 216.48sq. km. additional area under assured ground water irrigation with average crop water requirement of 0.65 m by constructing 8441 Dug wells and 1408 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 12thDecember 2018 at Tuljapur, Osmanabad district. A total of 164 trainees have attended the training including 32 female participants. Apart from this, total three, one day Public Interaction Programme (PIP) on “Discussion on Groundwater Issues” was conducted at Yermala village, Kalamb Block, Tuljapur village, Tuljapur block and leet Village, Bhum block of Osmanabad district. 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 resulting in 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 & COMMUNICATION (IEC) ACTIVITIES





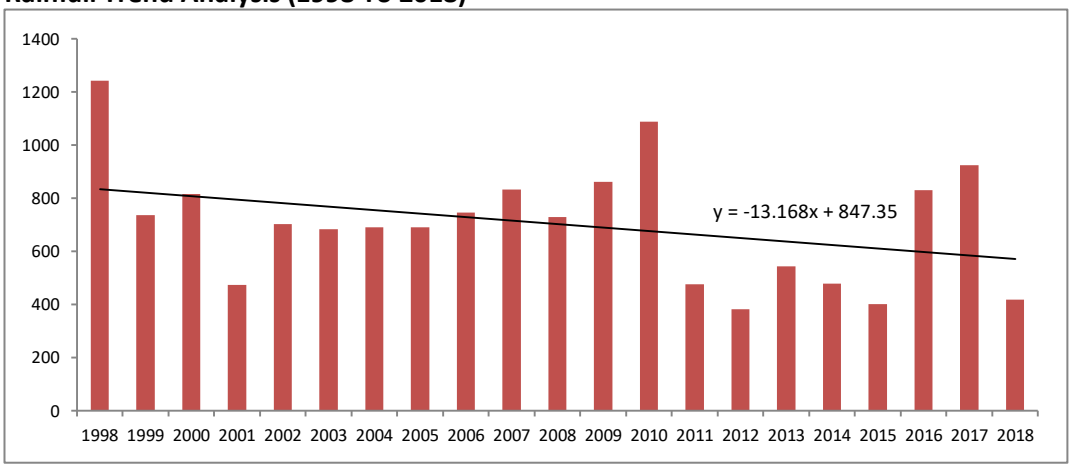

Village level Public Interaction Programme on "Ground Water Issues., Yermala Village, Kalamb Block, Ieet village, Bhum block and Tuljapur village at Tuljapur block.

TIER III TRAINING ON "LOCAL LEVELWATERBUDGETING ANDMANAGEMENT" AT TULJAPUR BLOCK, OSMANABAD DISTRICT

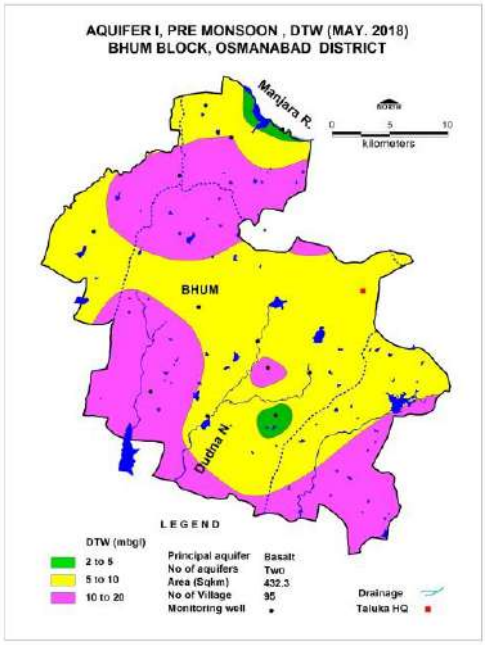
BLOCK WISE AQUIFER MAPS AND MANAGEMENT PLAN

1. **BHUM BLOCK**
2. **KALAMB BLOCK**
3. **LOHARA BLOCK**
4. **OSMANABAD BLOCK**
5. **PARANDA BLOCK**
6. **TULJAPUR BLOCK**
7. **UMERGA BLOCK**
8. **WASHI BLOCK**

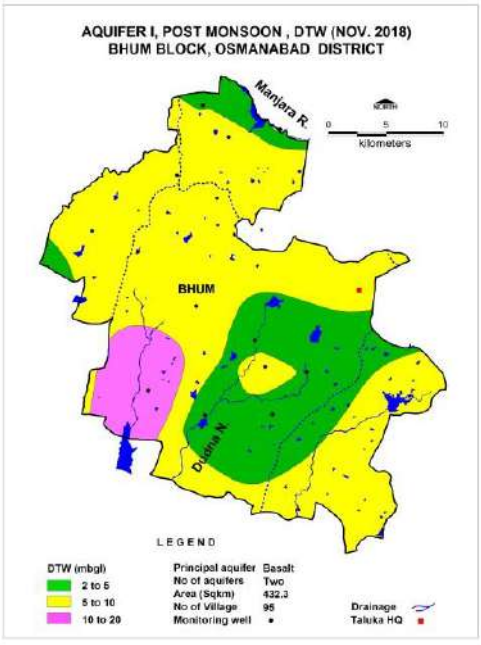
9. AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN, BHUM BLOCK, OSMANABAD DISTRICT, MAHARASHTRA

1. SALIENT FEATURES		
1.1 Introduction		
Block Name	**BHUM**	
Geographical Area (Sq. km.)	763.50 Sq. km.	
Hilly Area (Sq. km.)	84.49 Sq. km.	
Poor Ground Quality Area (Sq. km.)	Nil	
Population (2011)	1,36,745	
Climate	Sub-Tropical	
1.2 Rainfall Analysis		
Normal Rainfall	702.5 mm	
Annual Rainfall (2018)	418.1 mm	
Decadal Average Annual Rainfall (2009-18)	650.60 mm	
Long Term Rainfall Analysis (1998-2018)	Falling Trend 13.168 mm/year Probability of Normal and Excess Rainfall- 57% & 14%. Probability of Droughts-: 29 % Moderate droughts	
Rainfall Trend Analysis (1998 To 2018)  *EQUATION OF TREND LINE: Y= -13.168x + 847.35*		
1.3. Geomorphology, Soil & Geology		
Geomorphic Unit	Plateau (Moderately to highly dissected)	
Soil	Clayey and Gravel sandy clay soil	
Geology	Deccan Traps (Basalt) Age: Late Cretaceous to Eocene	
1.4. Hydrology & Drainage		
Drainage	Tributaries of Sina and Manjra rivers	
Hydrology ***(Reference year: DSA 2016-2017)***	Major project	Nil
	Medium project	**Completed:** 04; Khadeswar project generating a gross irrigation potential of 1765 ha, Gross Storage capacity of 10.84 MCM. Ramganga project generating a gross irrigation potential of 1157 ha, Gross Storage capacity

		of 6.136 MCM. Banganga project generating a gross irrigation potential of 1087 ha, Gross Storage capacity of 5.93 MCM. Sangameswar project generating a gross irrigation potential of 2688 ha, Gross Storage capacity of 16.820 MCM. Ongoing: Nil
	Irrigation Project (0-100Ha.)	Completed:161 small Irrigation projects covering an area of 5688 ha has been completed at Zilla parishad level
1.5. Land Use, Agriculture, Irrigation & Cropping Pattern		
Geographical Area	763.5 Sq. km.	
Forest Area	7.83 Sq. km.	
Cultivable Area	1027.40 Sq. km.	
Double Cropped Area	263.37 Sq. km.	
Area under Irrigation – Surface Water	146.42 Sq. km.	
Area under Irrigation – Ground Water	6.18 Sq. km.	
Principal Crops *(Reference year 2017)*	**Crop Type**	**Area (Sq. km.)**
	Pulses	390.40
	Cereals	371.44
	Oil Seeds	170.55
	Cotton	55.31
	Sugarcane	21.13
Horticultural Crops	Mango	3.50
	Citrus fruit	1.96
	Grapes	1.75
	Banana	0.65
	Others	0.65
1.6. Water Level Behavior		
1.6.1. Aquifer-I/Shallow Aquifer		
Pre-Monsoon (May-2018)	**Post-Monsoon (November-2018)**	
Water level less than 5 mbgl has been observed in small isolated patches in central and north eastern part of the block whereas water level in the range of 5 to 10 mbgl is observed in major part of the block. Deeper water level in the range of 10 to 20 mbgl is observed in the southern, western and northern part of the block covering 313.24 sq. km. area of the block.	Water level less than 5 mbgl has been observed in south central and north eastern part of the block while Water level in the range of 5 to 10 mbgl is observed in major part of the block whereas water level in the range of 10 to 20 mbgl is observed as isolated patches in western parts of block covering 60.24 sq. km. area of the block.	
Pre-Monsoon Water Level (May 2018)	**Post-Monsoon Water Level (Nov. 2018)**	



WL> 10 mbgl 313.24 sq. km.

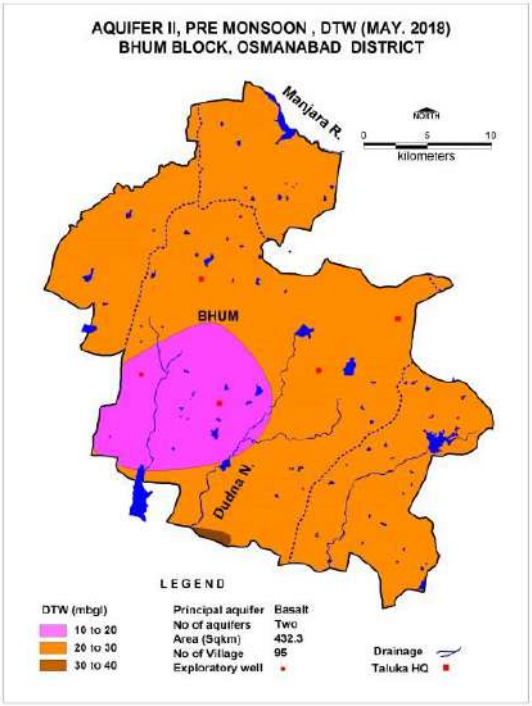


WL >10 mbgl 60.24 sq. km.

1.6.2. Aquifer-II/Deeper Aquifer

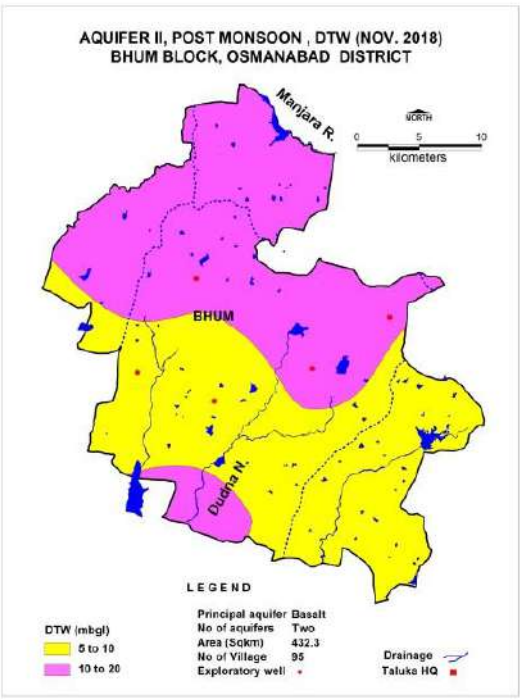
Pre-Monsoon (May-2018)	**Post-Monsoon (November-2018)**
Water level between 10-20 mbgl is observed as isolated patch in the west central part of the block. Water level between 20-30 mbgl is observed in the entire block covering about645 sq. km. area of the block.	Water level between 5-10 mbgl is observed in southern part of the block covering major area of the block. Water level between 10-20 mbgl is observed in north eastern and north western parts of the block covering about 381 sq. km. area of the block,

Pre-Monsoon Water Level (May 2018)



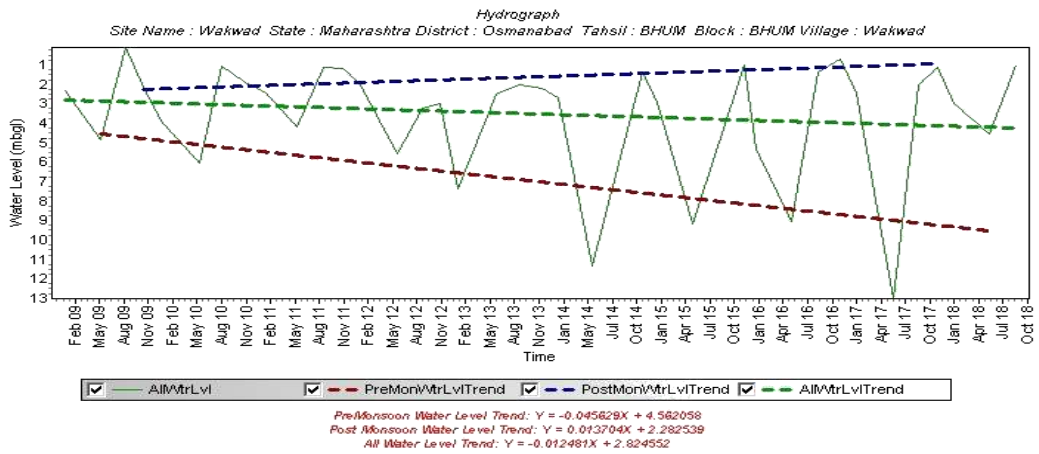
WL>20 mbgl 645 sq. km.

Post-Monsoon Water Level (Nov.-2018)



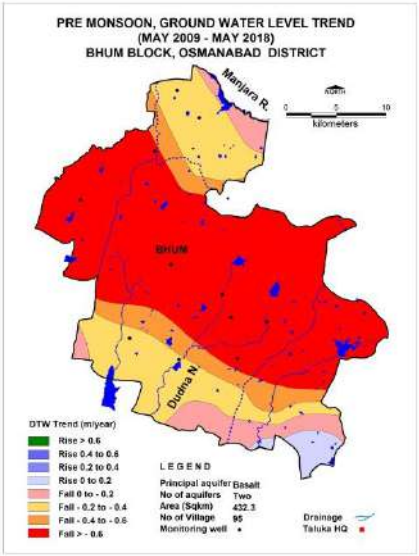
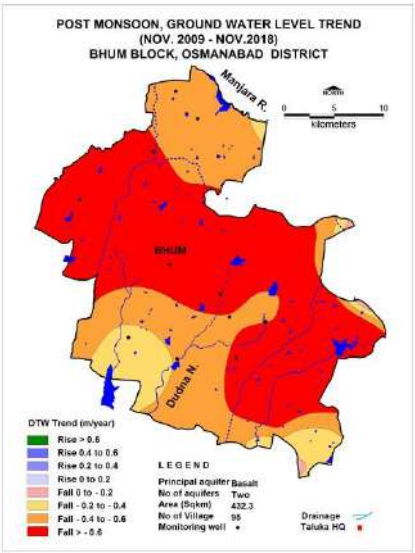
WL>10 mbgl 381 sq. km.

1.7. Hydrographs



Hydrograph shows Pre-monsoon falling water level trend @0.547 m/year and Post monsoon Rising water level trend @0.164 m/yr.

1.8. Water Level Trend (2009-18)

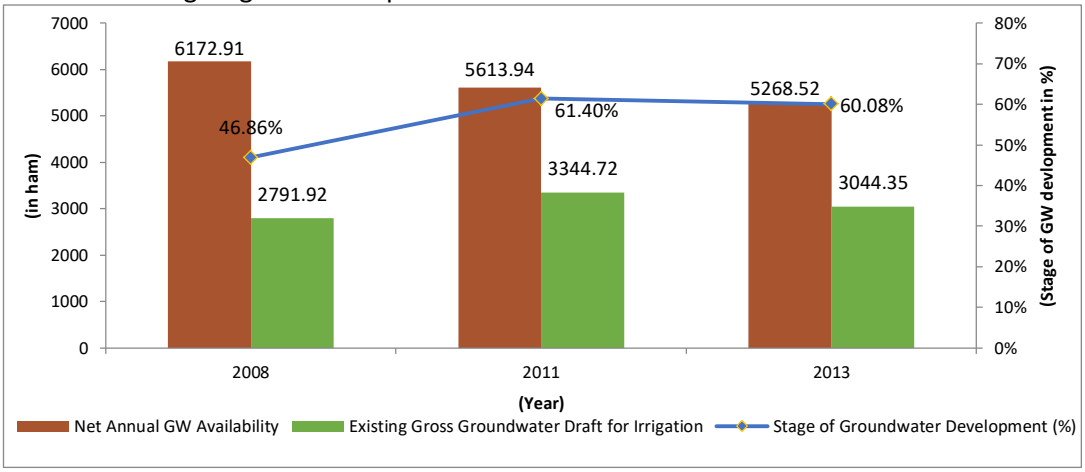
Pre-Monsoon trend	**Post-Monsoon trend**
Falling 0.1813 to 1.4261 m/year	Falling 0.1200 to 1.4172 m/year
Decline in water level has been observed in entire block. Decline in water level up to 0.6 m/year has been observed in southern and north eastern peripheral parts of the block while decline in water level more than 0.6 m/year has been observed in central part of the block covering about 458 sq km area.	Decline in water level has been observed in entire block. Decline in water level up to 0.6 m/year has been observed in north eastern, west central, western and southern parts of the block while decline in water level more than 0.6 m/year has been observed in major part of the block covering about 440 sq km area.
Pre-Monsoon Water Level Trend (2009-18)	**Post-Monsoon Water Level Trend (2009-18)**
	
Declining trend @>0.2 m/yr 690 sq. km.	**Declining trend @>0.2 m/yr 761 sq. km.**

2. Ground Water Issues

Exploitation of Ground Water: -

The draft for irrigation has increased from 27.91 to 30.44 MCM even when the net ground water availability has decreased in Bhum block over the time and as a result the stage of ground water development has also increased over the period of time from 2008 to 2013 from 46.86 % to 60.08%**.**However, the draft has reduced from 2011 to 2013 even though the

net ground water availabiluty conitnued to decline; but the decline in draft has resulted in control on rising stage of development.



Declining water level Trend and Deeper Water Level: -

- Pre monsoon (2009-18), decline in water level trend more than 0.2 m/year is observed in 99 % area of the block.
- Post monsoon (2009-18), decline in water level trend more than 0.2 m/year is observed in about 761 sq. km. covering about 90 % area of the block.

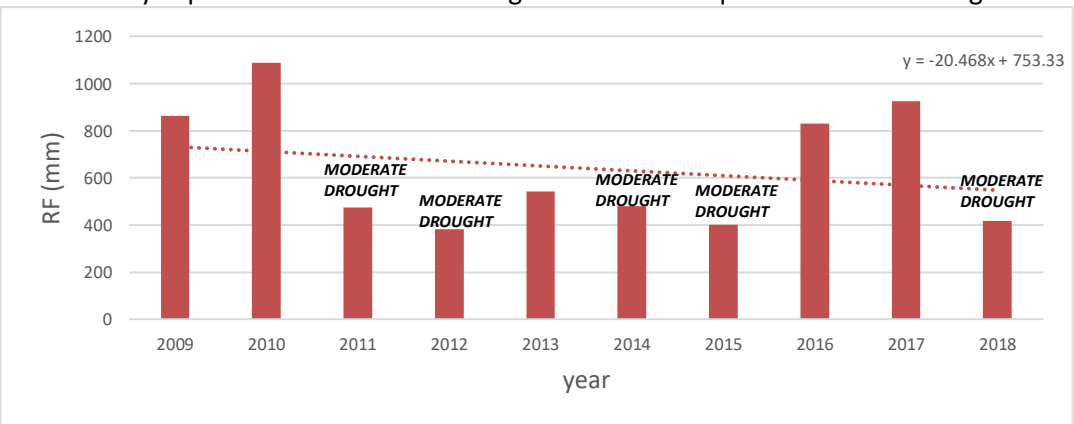
Low yielding Aquifer resulting poor sustainability: -

Limited extent of porous and pervious zone because of predominance of secondary porosity that has evolved from prevailing erratic joint pattern and also the absence of primary porosity results in poor sustainability of the aquifers. About 55 % area of the block has low yield potential (< 1 lps) and can sustain pumping only for 1 to 1.5 hrs.

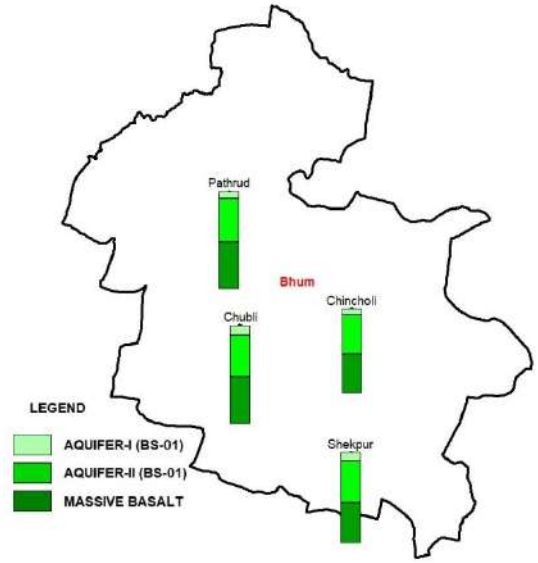
Low Rainfall and Drought: -

The long-term rainfall analysis for the period 1998-2018 indicates that normal rainfall of Bhum block is702.5 mm, in addition, it indicates a falling trend @ 13.16 mm/year with 29% probability of moderate drought.

Based on the short-term rainfall data from 2009-2018 for the block was also analysed and it indicates that average rainfall is 650.6 mm. The rainfall from last ten years showing the area continuously experienced low and declining rainfall with frequent moderate droughts.

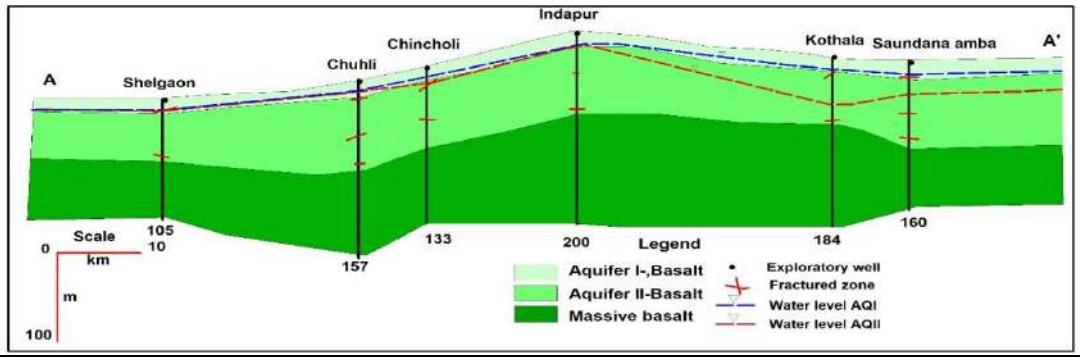


3. AQUIFER DISPOSITION	
3.1. Number of Aquifers	• Basalt –Aquifer-I, Aquifer-II
3.2. Lithological disposition	



3.3. Cross Section

Section AA'



3.4. Basic Aquifer Characteristics

Major Aquifers	Basalt (Deccan Traps)	
Type of Aquifer (Phreatic/Semi confined/Confined)	Aquifer-I (Phreatic)	Aquifer-II (Semi confined/confined)
Depth to bottom of Aquifer (mbgl)	10 to 15	92 to 150
Weathered/Fractured zones encountered (mbgl)	up to 15	up to 150
Weathered/fractured rocks thickness (m)	5 to 10	0.5 to 10
SWL (mbgl)	3.5 to 22.50	10 to 25
Yield	up to 80 m^3/day	up to 1.5 lps
Specific Yield/ Storativity (Sy/S)	0.020to 0.025	3.70 x10^{-4} to 3.0 x10^{-5}
Transmissivity (T)	10.50 to 35.50 m^2/day	12.50 to 60.70 m^2/day
Sustainability	2 to 3 hrs	1 to 3 hrs

4. GROUND WATER QUALITY

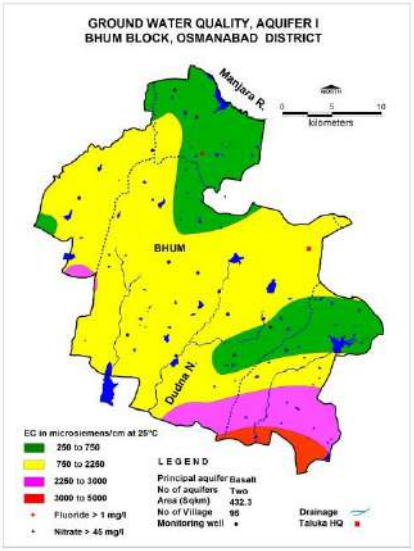
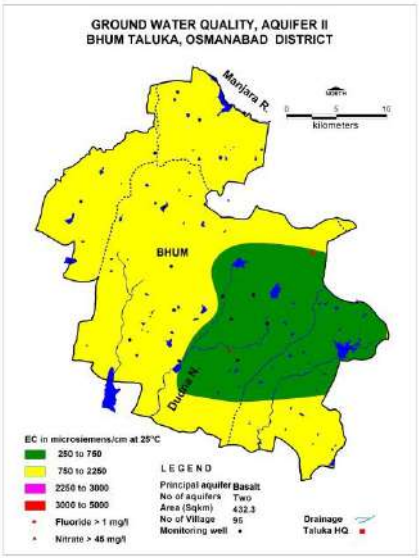
4.1 Aquifer-I/ Shallow Aquifer

EC values up to 750 µS/cm are observed in northern and eastern parts of the block. EC values between 750 and 2250 µS/cm are observed in major part of the block. EC values more than 2250 have been observed in southern part of the block. Ground water is suitable for all purposes in major part of the block except fluoride affected village Itr (F=2.1 mg/L).

4.2 Aquifer II/Deeper Aquifer

EC up to 750 µS/cm is observed as isolated patch in east central part of the block. EC values

between 750 and 2250 µS/cm are observed in major part of the block. Ground water is suitable for all purposes except fluoride affected Golegaon village (F=1.01 mg/L)

Phreatic Aquifer (Aquifer-I)	**Semi confined/Confined Aquifer (Aquifer II)**
	

5. GROUND WATER RESOURCE	
5.1 Aquifer-I/ Shallow Aquifer	
Ground Water Recharge Worthy Area (Sq. km.)	432.20
Total Annual Ground Water Recharge (MCM)	55.46
Natural Discharge (MCM)	2.77
Net Annual Ground Water Availability (MCM)	52.68
Existing Gross Ground Water Draft for irrigation (MCM)	30.44
Existing Gross Ground Water Draft for domestic and industrial water supply (MCM)	1.20
Existing Gross Ground Water Draft for All uses (MCM)	31.65
Provision for domestic and industrial requirement supply to 2025(MCM)	2.43
Net Ground Water Availability for future irrigation development (MCM)	19.09
Stage of Ground Water Development (%)	60.08
Category	**SAFE**

5.2 Aquifer-II/Deeper Aquifer

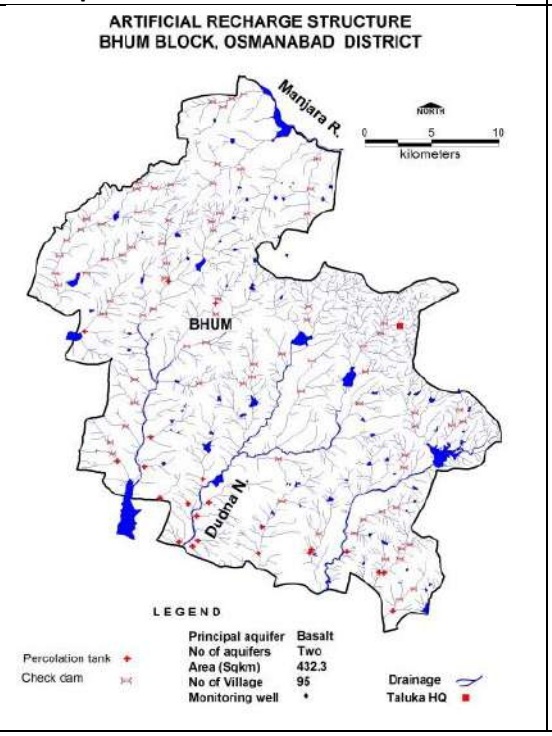
Semi confined/Confined Aquifer (Basalt)

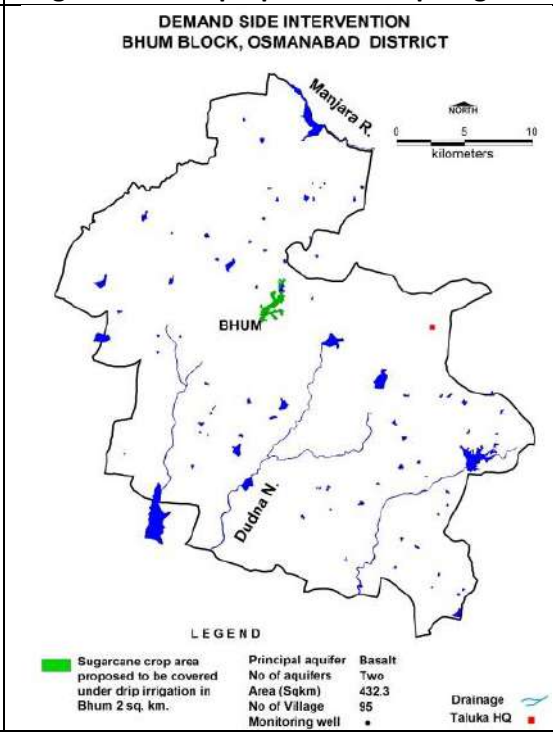
Total Area (Sq. km.)	Mean aquifer thickness (m)	Average (Sy/S)	Piezometric Head (m above confining layer)	Total Resource (MCM)
432.21	4.5	0.0042/0.0004	15.66	10.666

6.0. GROUND WATER RESOURCE ENHANCEMENT	
Available Resource (MCM)	52.69
Gross Annual Draft (MCM)	31.65
6.1. Supply Side Management	
SUPPLY (MCM)	
Agricultural Supply -GW	30.44
Agricultural Supply -SW	131.77
Domestic Supply - GW	1.21

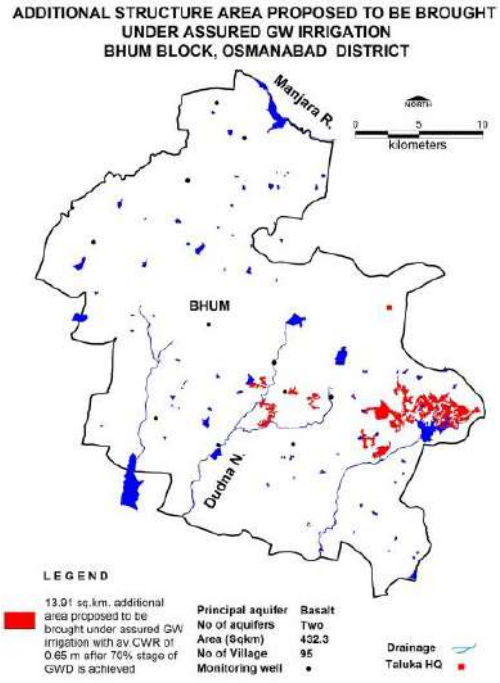
Domestic Supply - SW	0.30	
Total Supply	163.72	
Area of Block (Sq. km.)	516.69	
Area suitable for Artificial recharge (Sq. km.)	432.2	
Type of Formation	Hard rock	
Area feasible for Artificial Recharge (WL >5mbgl) (Sq. km.)	432.2	
Volume of Unsaturated Zone (MCM)	864.4	
Average Specific Yield	0.02	
Volume of Sub Surface Storage Space available for Artificial Recharge (MCM)	17.29	
Surplus water Available (MCM)	10.18	
Proposed Structures	Percolation Tank (Av. Gross Capacity-100 TCM*2 fillings = 200 TCM)	Check Dam (Av. Gross Capacity-10 TCM * 3 fillings = 30 TCM)
Number of Structures	17	56
Volume of Water expected to be conserved / recharged @ 75% efficiency (MCM)	2.55	1.26
Proposed Structures		
RTRWH Structures – Urban Areas		
Households to be covered (25% with 50 m^2area)	7400	
Total RWH potential (MCM)	0.24	
Rainwater harvested / recharged @ 80% runoff co-efficient	0.19 Economically not viable & Not Recommended	
6.2. Demand Side Management		
Micro irrigation techniques		
Sugarcane Area proposed for drip irrigation (sq. km.)		2
Volume of Water Saving by use of drip (MCM) Surface Flooding req- 2.45 m. Drip Req. - 1.88, WUE- 0.57 m		1.14
Alternate Sources		Nil
Proposed Cropping Pattern change		
Irrigated area under Water Intensive Crop (ha)		Not proposed
Water Saving by Change in Cropping Pattern		Nil
6.3. EXPECTED BENEFITS		
Net Ground Water Availability (MCM)		52.69
Additional GW resources available after Supply side interventions (MCM)		3.81
Ground Water Availability after Supply side intervention		56.5
Existing Ground Water Draft for All Uses (MCM)		31.65
GW draft after Demand Side Interventions (MCM)		30.51
Present stage of Ground Water Development (%)		60.07
Expected Stage of Ground Water Development after interventions (%)		54
Other Interventions Proposed, if any		
Alternate Water Sources Available		Nil
Recommendation		
Ground water development is recommended to bring the stage of ground water development from 54 % to 60.07%		
6.4. Development Plan		

Volume of water available for GWD to 70% (MCM)	9.04
Proposed Number of DW (@ 1.5 ham for 90% of GWR Available for development)	542
Proposed Number of BW (@ 1 ham for 10% of GWR Available for development)	90
Additional Area to be brought under assured GW irrigation with av. CWR of 0.65 m (sq. km.)	13.91
Regulatory Measures	**Nil**
Supply Side Interventions	**Demand Side Interventions**
Proposed locations for AR structures	**Sugarcane Area proposed for drip Irrigation**

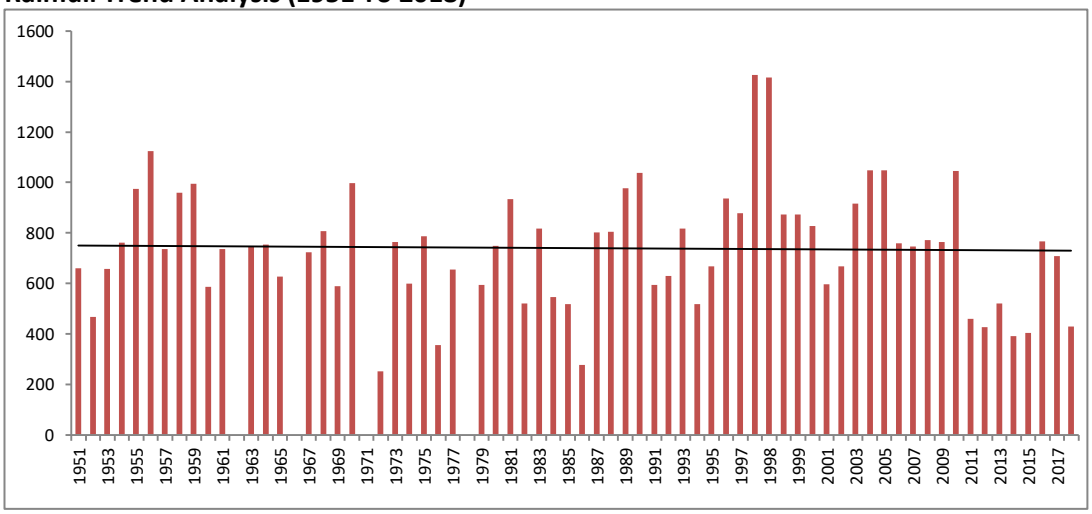


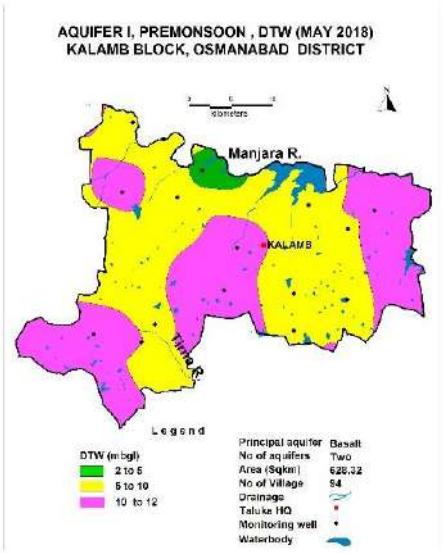
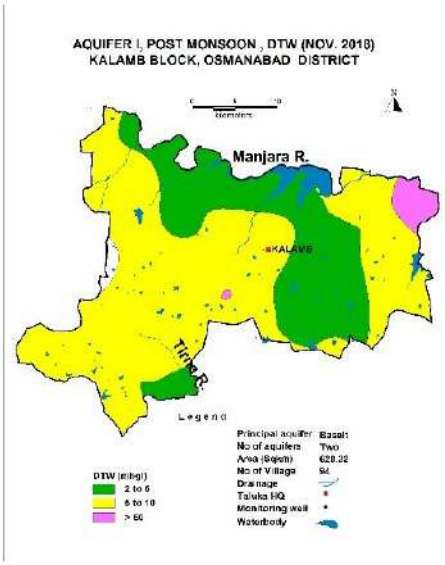


***Expected Benefits*: Additional area proposed to be bought under assured GW Irrigation**

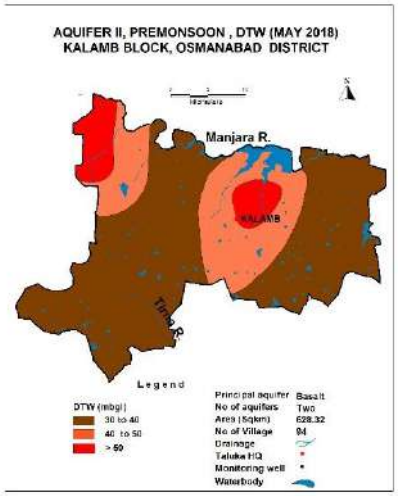
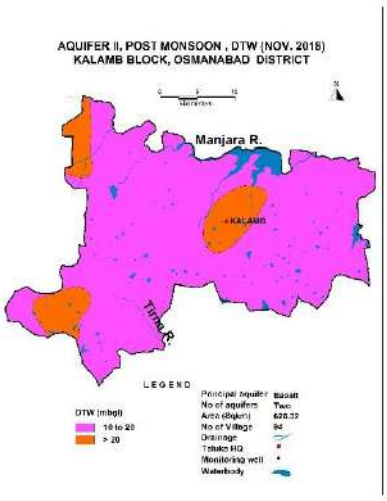


10. AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN, KALAMB BLOCK, OSMANABAD DISTRICT, MAHARASHTRA

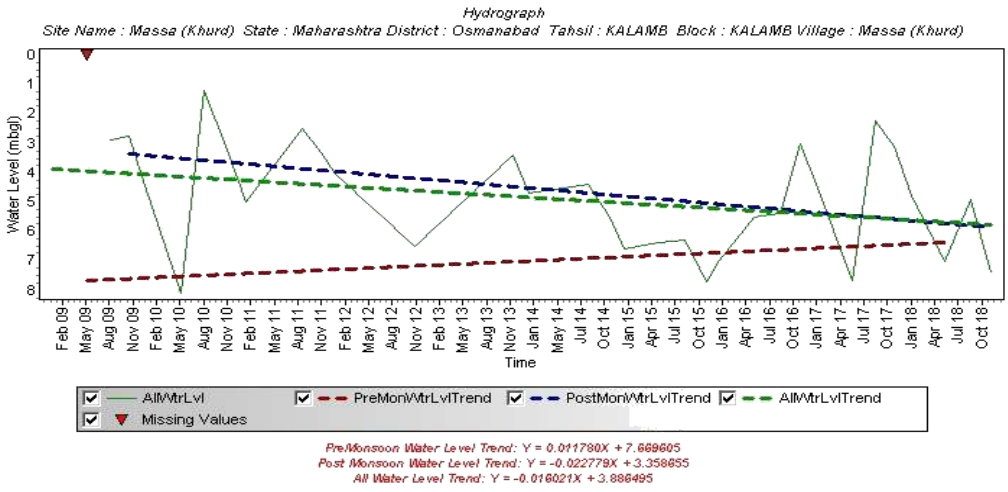
1. SALIENT FEATURES		
1.1 Introduction		
Block Name	**KALAMB**	
Geographical Area (Sq. km.)	935.23 Sq. km.	
Hilly Area (Sq. km.)	78.64 Sq. km.	
Poor Ground Quality Area (Sq. km.)	Nil	
Population (2011)	2,17,687	
Climate	Sub-Tropical	
1.3 Rainfall Analysis		
Normal Rainfall	739.7 mm	
Annual Rainfall (2018)	429.7 mm	
Decadal Average Annual Rainfall (2009-18)	601.67 mm	
Long Term Rainfall Analysis (1951-2018)	Falling Trend @0.29 mm/year Probability of Normal and Excess Rainfall- 57% & 21%. Probability of Droughts: 17% Moderate and 5% severe	
Rainfall Trend Analysis (1951 To 2018)  *EQUATION OF TREND LINE: Y= -0.2917x +750.36*		
1.3. Geomorphology, Soil & Geology		
Major Geomorphic Unit	Moderately dissected Plateau	
Soil	Clayey and Gravel sandy clayey soil	
Geology	Deccan Traps (Basalt) Age: Late Cretaceous to Eocene	
1.4. Hydrology & Drainage		
Drainage	Tirna and Manjra rivers	
Hydrology ***(Reference year: 2016-2017)***	Major project	Nil
	Medium project	**Completed: 01; Raigavhan** project generating a gross irrigation potential of 2040 ha, Gross Storage capacity of 12.703 MCM. **Ongoing: Nil**
	Irrigation Project	**Completed**: 251 small irrigation projects covering an area of 7849 ha has been

		(0-100 Ha.)	completed at local level
1.5. Land Use, Agriculture, Irrigation & Cropping Pattern			
Geographical Area		935.23 Sq. km.	
Forest Area		4.98 Sq. km.	
Cultivable Area		806.60 Sq. km.	
Net Sown Area		835.51 Sq. km.	
Double Cropped Area		565.29 Sq. km.	
Area under Irrigation	Surface Water	136.22 Sq. km.	
	Ground Water	11.02 Sq. km.	
Principal Crops *(Reference year 2017)*		**Crop Type**	**Area (Sq. km.)**
		Oil Seeds	481.00
		Pulses	458.41
		Cereals	341.06
		Sugarcane	50.71
		Cotton	43.19
		Mango	11.11
Horticultural Crops		Citrus fruit	1.38
		Banana	0.70
		Grapes	0.49
		Others	2.36
1.6. Water Level Behavior			
1.6.1. Aquifer-I/Shallow Aquifer			
Pre-Monsoon (May-2018)		**Post-Monsoon (November-2018)**	
Water level less than 5 mbgl has been observed as isolated patch in the northern part of the block. Water level in the range of 5 to 10 mbgl is observed in major part of block. Deeper water level in the range of 10 to 20 mbgl is observed in eastern, Western and south-central parts of the block covering 398 sq. km. area of the block.		Water level less than 5 mbgl has been observed as continuous patch from north to southern part of the block while water level between 5 to 10 mbgl is observed in major part of the block. Water level more than 10 mbgl is observed as small part in eastern part of the block covering 24.90 sq.km area.	
Pre-Monsoon Water Level (May 2018)		**Post-Monsoon Water Level (Nov. 2018)**	
			
WL> 10 mbgl 398 sq. km.		**WL >10 mbgl 24.90 sq. km.**	

1.6.2. Aquifer-II/Deeper Aquifer

Pre-Monsoon (May-2018)	Post-Monsoon (November-2018)
Water level between 30to 40 mbgl has been observed in major part of the block while water level more than 40 mbgl has been observed in isolated patches around Kalamb town and north western part of the block covering about 317 sq km area.	Water level between 10 to 20 mbgl is observed in almost over the entire block whereas water level more than 20 mbgl is observed as isolated patches in central and south western part of block covering about 111 sq km area.
Pre-Monsoon Water Level (May 2018)	**Post-Monsoon Water Level (Nov.-2018)**
	
WL>40 mbgl 317 sq. km.	**WL>20 mbgl 111 sq. km.**

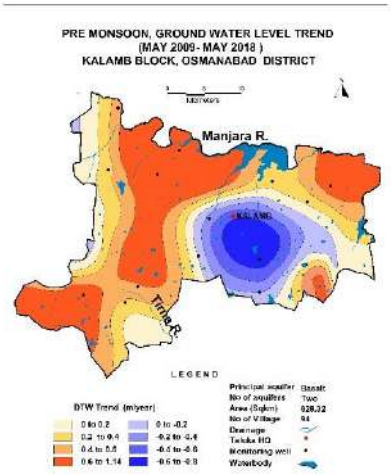
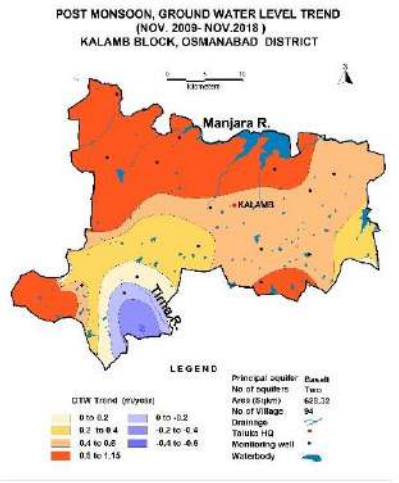
1.7. Hydrographs



Hydrograph shows Pre-monsoon rising water level trend @0.1413 m/year and Post monsoon falling water level trend @0.2733 m/year.

1.8. Water Level Trend (2009-18)

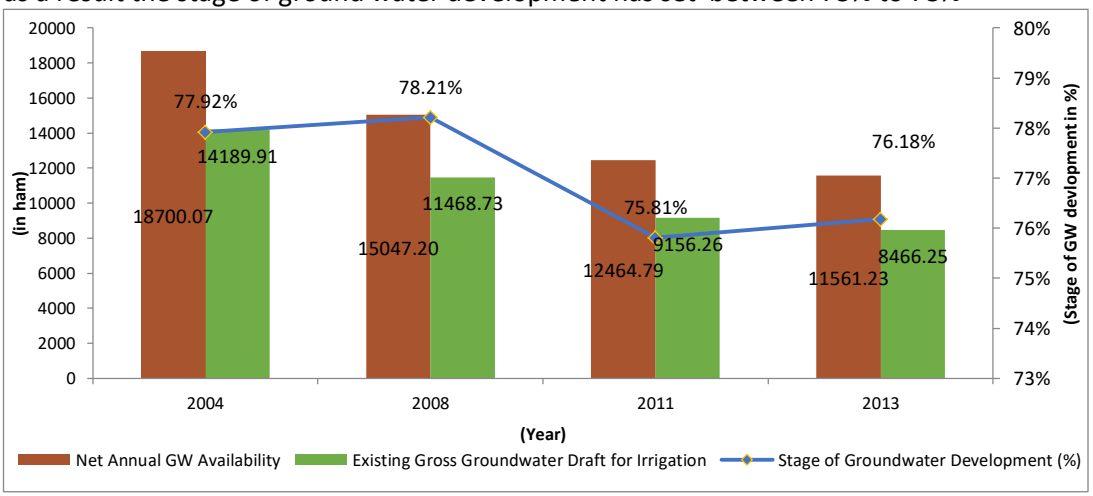
Pre-Monsoon trend	**Post-Monsoon trend**
Rising 0.050 to 0.802 m/year Falling 0.045 to 1.338 m/year	Rising 0.369 to 0.449 m/year Falling 0.049 to 1.242 m/year
Major part of the block shows decline in water level. Declining trend up to 0.2 m/year has been observed in central and south eastern parts of the block while decline more than 0.2 m/year has been	Major part of the block shows declines in water level. Declining trend up to 0.2 m/year has been observed in south western part of the block while decline more than 0.2 m/year has been observed in major part of the block

observed in major part of the block covering about 623 sq km area. Rise in water level has been observed in isolated patch in south central part of the block.	covering about 848 sq km area. Rise in water level has been observed in isolated patch in southern part of the block.
Pre-Monsoon Water Level Trend (2009-18)	**Post-Monsoon Water Level Trend (2009-18)**
	
Declining trend @>0.2 m/yr 623 sq. km.	**Declining trend @>0.2 m/yr 848 sq. km.**

2. Ground Water Issues

Exploitation of Ground Water: -

The draft for irrigation has decreased from 141.89 MCM to 84.66 MCM and the net ground water availability has also decreased in Kalambblock over the time. Also, the gap between the availability of ground water and draft is reducing over the period from 2004 to 2013.and as a result the stage of ground water development has set between 75% to 78%



Declining water level Trend and Deeper Water Level: -

- Pre monsoon (2009-18), decline in water level trend more than 0.2 m/year is observed in about 623 sq. km. covering about 65 % area of the block.
- Post monsoon (2009-18), decline in water level trend more than 0.2 m/year is observed in about 848 sq. km. covering about 89 % area of the block.

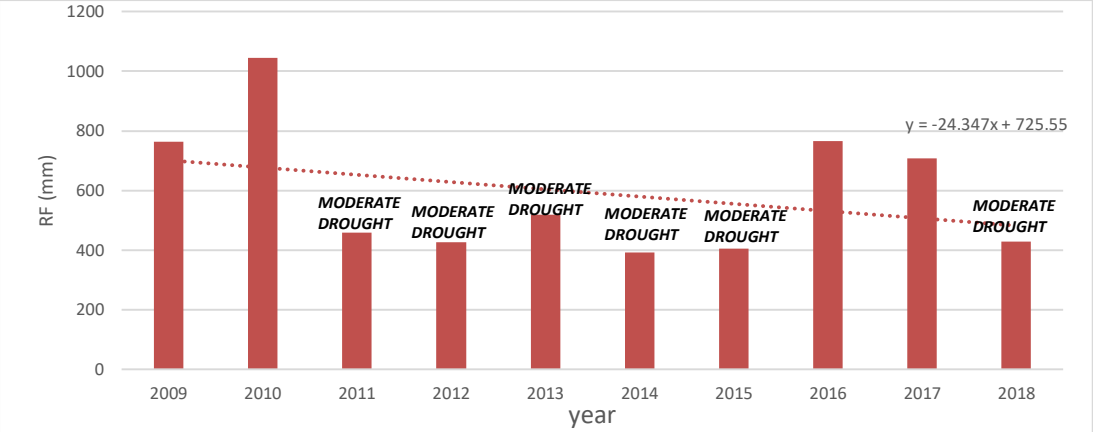
Low yielding Aquifer resulting poor sustainability: -

Limited extent of porous and pervious zone because of predominance of secondary porosity that has evolved from prevailing erratic joint pattern and also absence of primary porosity results in poor sustainability of the aquifers. About 48 % area of the block has low yield potential (< 1 lps) and can sustain pumping only for 1 to 1.5 hrs.

Low Rainfall and Drought: -

The long-term rainfall analysis for the period 1951-2018 indicates that normal rainfall of Kalamb block is 737.9 mm, and indicates a falling trend @ 0.29 mm/year with 17% probability of moderate and 5% Severe droughts.

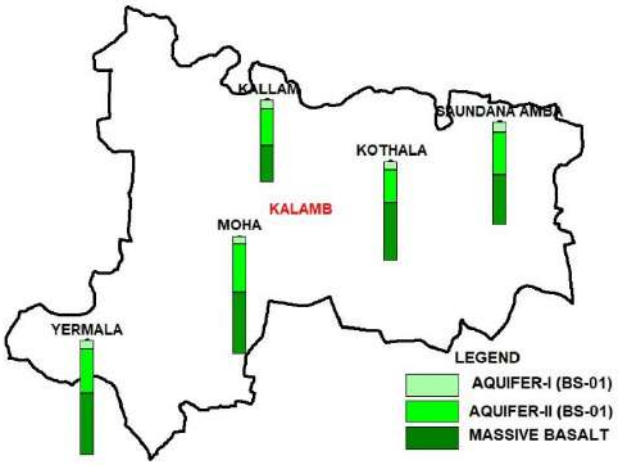
Based on the short-term rainfall data from 2009-2018of the block was also analysed and it indicates that average rainfall is 601.67 mm. The rainfall from last ten years shows that the area continuously experienced low and declining rainfall with frequent moderate droughts.



3. AQUIFER DISPOSITION

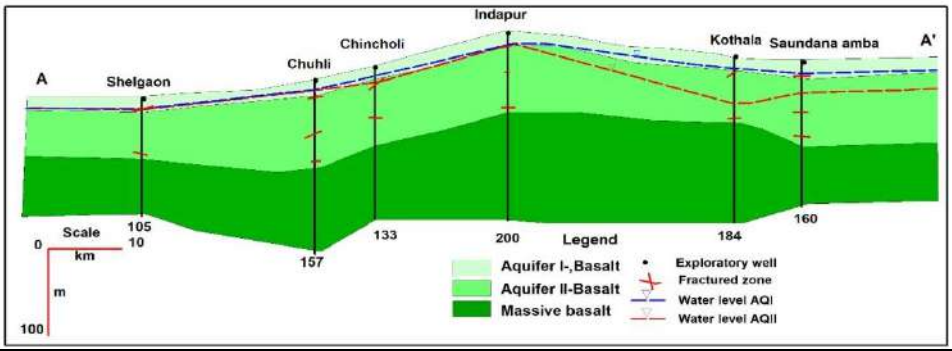
3.1. Number of Aquifers	Basalt –Aquifer-I, Aquifer-II

3.2. Lithological disposition

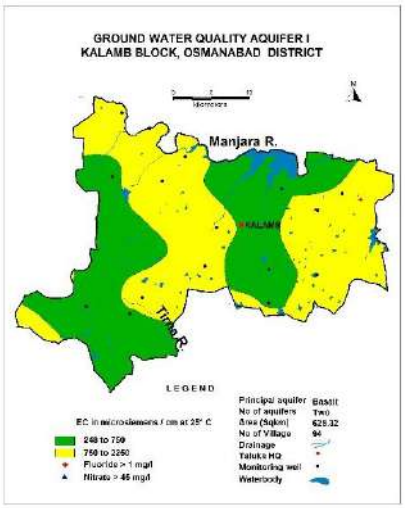
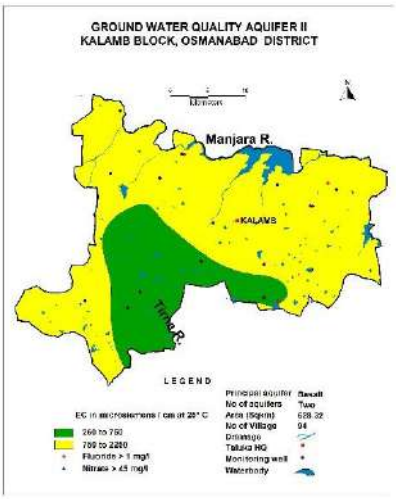


3.3. Cross Section

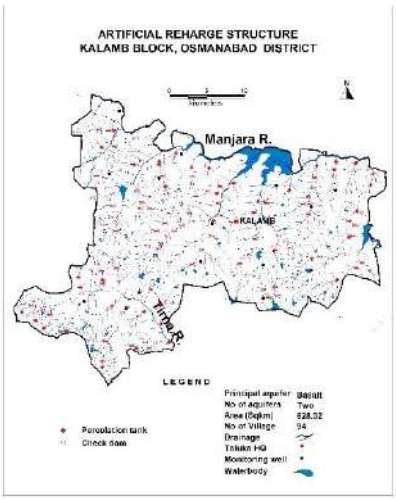
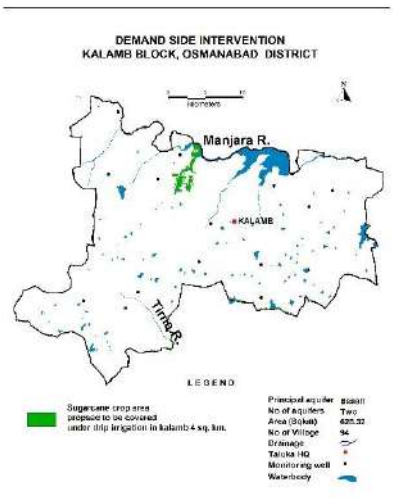
Section AA'



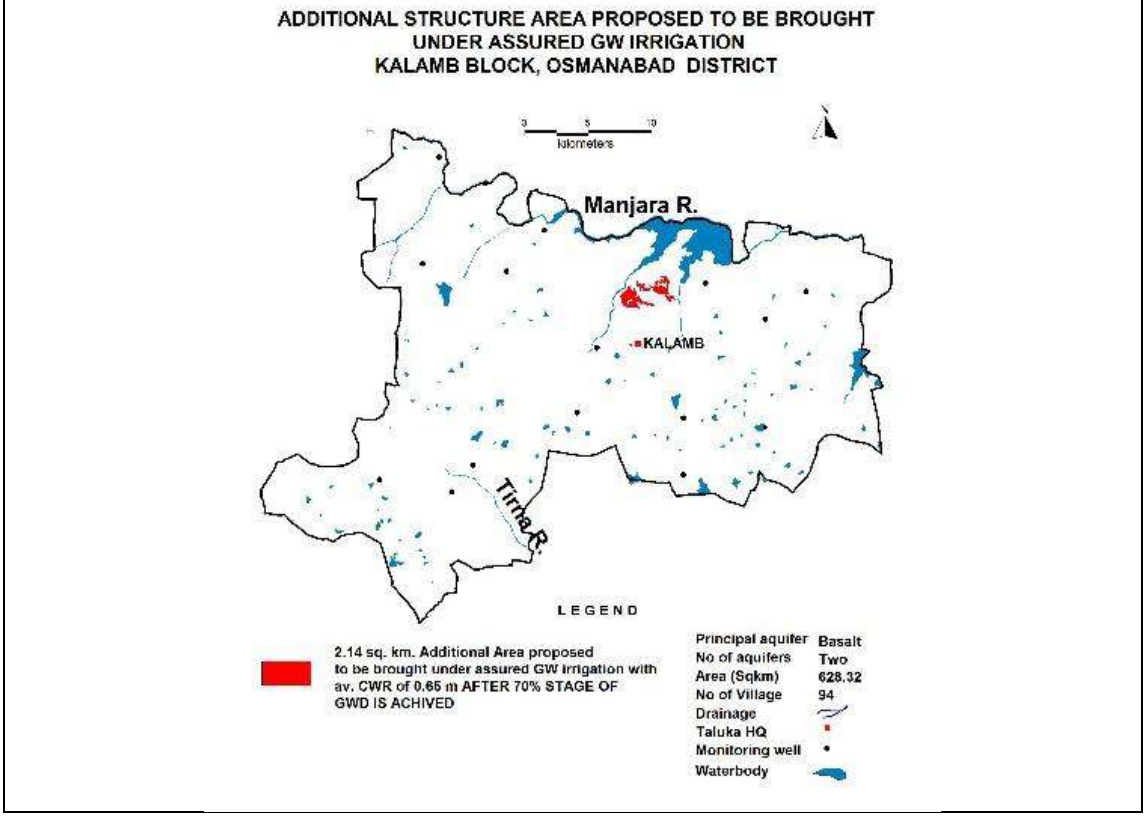
3.4. Basic Aquifer Characteristics		
Major Aquifers	Basalt (Deccan Traps)	
Type of Aquifer (Phreatic/Semi confined/Confined)	Aquifer-I (Phreatic)	Aquifer-II (Semiconfined/confined)

Depth to bottom of Aquifer (mbgl)	10 to 30	90 to 140
Weathered/Fractured zone encountered (mbgl)	up to 30	up to 140
Weathered/Fractured rocks thickness (m)	7 to 13	3 to 10
SWL (mbgl)	2.6 to15.52	7 to 40
Yield	up to 75 m^3/day	up to 2.3 lps
Specific Yield/ Storativity (Sy/S)	0.022 to 0.027	3.5 x10^{-4} to 3.9 x10^{-5}
Transmissivity (T)	11 to 48.50 m^2/day	6.50 to 55.11 m^2/day
Sustainability	1to 2 hrs	1 to 3 hrs
4. GROUND WATER QUALITY		
Phreatic Aquifer (Aquifer-I)	**Semi confined/Confined Aquifer (Aquifer II)**	
		
4.1 Aquifer-I/ Shallow Aquifer		
EC up to 750 µS/cm is observed in western half and eastern part of the block. EC values between 750 to 2250 µS/cm are observed in major part of the block. Ground water is suitable for all purposes in major part of the block except Nitrate and fluoride affected villages. Fluoride contamination is found in Deolali, Kalamb (F=1.8 mg/L) village hence ground water in the village is not suitable for drinking purpose without treatment.		
4.2 Aquifer II/Deeper Aquifer		
EC up to 750 µS/cm is observed in Central and southern parts of the block. EC values between 750 to 2250 µS/cm are observed in major part of the block. Ground water is suitable for all purposes in major part of the block except Nitrate and Fluoride affected villages. Fluoride contamination is found in Kolhegaon (F=1.4 mg/L) and Kalamb villages (F=1.17 mg/L) hence ground water in these villages are not suitable for drinking purpose without treatment.		
5. GROUND WATER RESOURCE		
5.1 Aquifer-I/ Shallow Aquifer		
Ground Water Recharge Worthy Area (Sq. km.)	856.58	
Total Annual Ground Water Recharge (MCM)	121.70	
Natural Discharge (MCM)	6.08	
Net Annual Ground Water Availability (MCM)	115.61	
Existing Gross Ground Water Draft for irrigation (MCM)	84.66	

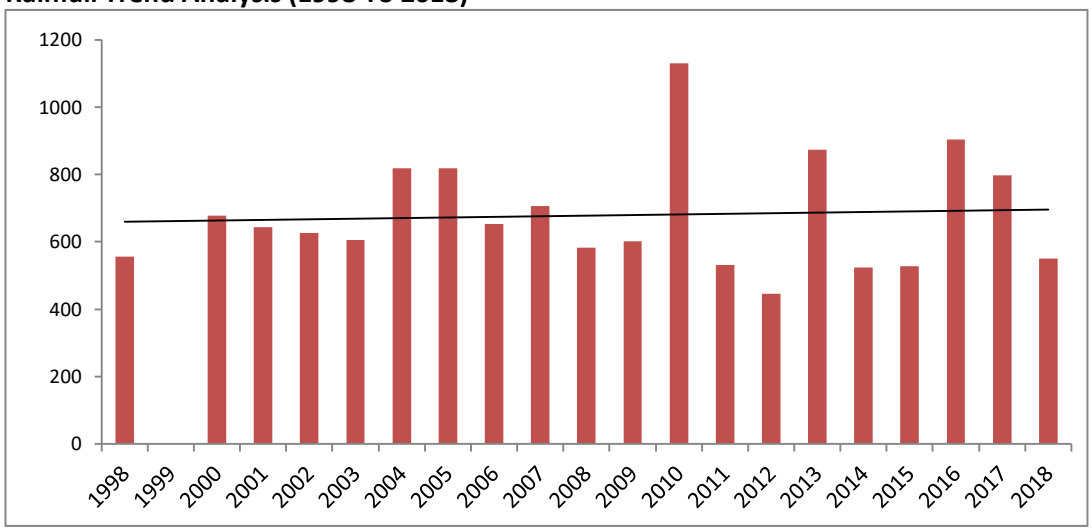
Existing Gross Ground Water Draft for domestic and industrial water supply (MCM)			3.40	
Existing Gross Ground Water Draft for All uses (MCM)			88.06	
Provision for domestic and industrial requirement supply to 2025(MCM)			6.64	
Net Ground Water Availability for future irrigation development (MCM)			23.39	
Stage of Ground Water Development (%)			76.18	
Category			**SAFE**	
5.2 Aquifer-II/Deeper Aquifer				
Semi confined/Confined Aquifer (Basalt)				
Total Area (Sq. km.)	Mean aquifer thickness (m)	Average (Sy/S)	Piezometric Head (m above confining layer)	Total Resource (MCM)
628.32	6.125	0.0044/0.0002	13.75	12.89
6.0. GROUND WATER RESOURCE ENHANCEMENT				
Available Resource (MCM)			115.61	
Gross Annual Draft (MCM)			88.07	
6.1. Supply Side Management				
SUPPLY (MCM)				
Agricultural Supply -GW			84.66	
Agricultural Supply -SW			122.6	
Domestic Supply - GW			3.41	
Domestic Supply - SW			0.85	
Total Supply			**211.52**	
Area of Block (Sq. km.)			935.23	
Area suitable for Artificial recharge (Sq. km.)			675.10	
Type of Formation			Hard rock	
Area feasible for Artificial Recharge (WL >5mbgl) (Sq. km.)			675.10	
Volume of Unsaturated Zone (MCM)			1350.19	
Average Specific Yield			0.02	
Volume of Sub Surface Storage Space available for Artificial Recharge (MCM)			27.00	
Surplus water Available (MCM)			15.90	
Proposed Structures			Percolation Tank (Av. Gross Capacity-100 TCM*2 fillings = 200 TCM)	Check Dam (Av. Gross Capacity-10 TCM * 3 fillings = 30 TCM)
Number of Structures			42	117
Volume of Water expected to be conserved / recharged @ 75% efficiency (MCM)			6.3	2.63
Proposed Structures				
RTRWH Structures – Urban Areas				
Households to be covered (25% with 50 m^2area)			11700	
Total RWH potential (MCM)			0.3516	
Rainwater harvested / recharged @ 80%			0.2813	

runoff co-efficient	Economically not viable & Not Recommended
6.2. Demand Side Management	
Micro irrigation techniques	
Sugarcane Area proposed for drip irrigation (sq. km.)	4
Volume of Water Saving by use of drip (MCM) Surface Flooding req- 2.45 m. Drip Req. - 1.88, WUE- 0.57 m	2.28
Alternate Sources	Nil
Proposed Cropping Pattern change	
Irrigated area under Water Intensive Crop (ha)	Not proposed
Water Saving by Change in Cropping Pattern	Nil
6.3. EXPECTED BENEFITS	
Net Ground Water Availability (MCM)	115.61
Additional GW resources available after Supply side interventions (MCM)	8.93
Ground Water Availability after Supply side intervention	124.54
Existing Ground Water Draft for All Uses (MCM)	88.07
GW draft after Demand Side Interventions (MCM)	85.79
Present stage of Ground Water Development (%)	76.18
Expected Stage of Ground Water Development after interventions (%)	68.88
Other Interventions Proposed, if any	
Alternate Water Sources Available	Nil
Recommendation	
Ground water development is recommended to bring the stage of ground water development from 68.88 % to 70%	
6.4. Development Plan	
Volume of water available for GWD to 70% (MCM)	1.39
Proposed Number of DW (@ 1.5 ham for 90% of GWR Available for development)	83
Proposed Number of BW (@ 1 ham for 10% of GWR Available for development)	14
Additional Area to be brought under assured GW irrigation with av. CWR of 0.65 m (sq. km.)	2.14
Regulatory Measures	**Nil**
Supply Side Interventions	**Demand Side Interventions**
Proposed locations for AR structures	**Sugarcane Area proposed for drip Irrigation**
	

***Expected Benefits*: Additional area proposed to be bought under assured GW Irrigation**



11. AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN, LOHARA BLOCK, OSMANABAD DISTRICT, MAHARASHTRA

1. SALIENT FEATURES		
1.1 Introduction		
Block Name	**LOHARA**	
Geographical Area (Sq. km.)	525.85 Sq. km.	
Hilly Area (Sq. km.)	43.00 Sq. km.	
Poor Ground Quality Area (Sq. km.)	Nil	
Population (2011)	1,16,712	
Climate	Sub-Tropical	
1.4 Rainfall Analysis		
Normal Rainfall	678.5 mm	
Annual Rainfall (2018)	550.30 mm	
Decadal Average Annual Rainfall (2009-2018)	701.50mm	
Long Term Rainfall Analysis (1998 to 2018)	Rising Trend: 1.8444 mm/year Probability of Normal and Excess Rainfall: 80% & 15%. Probability of Drought: 5 % Moderate Drought	
Rainfall Trend Analysis (1998 To 2018)		
		
EQUATION OF TREND LINE: Y= 1.8444x + 657.38		
1.3. Geomorphology, Soil & Geology		
Major Geomorphic Unit	Moderately dissected plateau	
Soil	Clayey, Gravelly, and Gravelly sandy clay soils	
Geology	Deccan Traps (Basalt) Age: Upper Cretaceous to Eocene	
1.4. Hydrology & Drainage		
Drainage	Tirna river; tributary of Manjra River	
Hydrology ***(Reference year: DSA 2016-17)***	Major project	Completed: Lower Terna Project (1989), generating a gross irrigation Potential of 6525 ha, Total storage capacity of 121.19 MCM. **Ongoing:** NIL
	Irrigation Project	**Completed**: 61 Small irrigation projects covering an area of 1768 ha have been

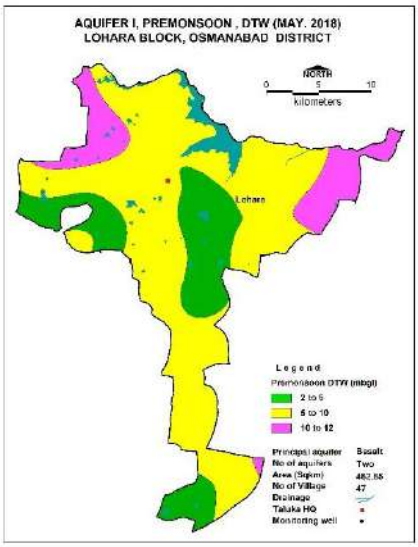
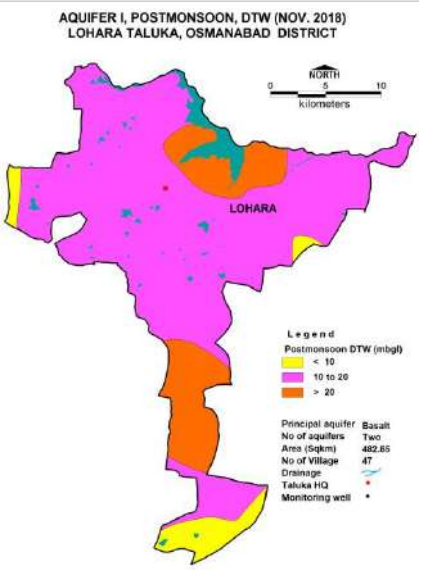
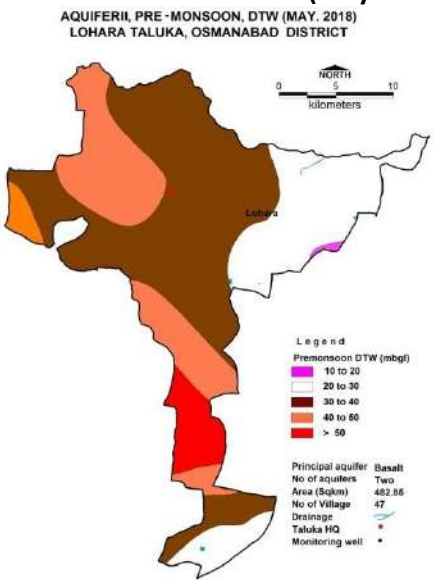
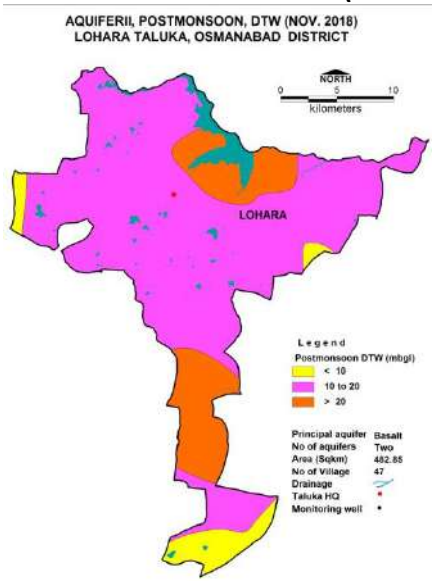
	(0-100 Ha.)	completed at Zilla Parishad level.
	Irrigation Project (101-250 Ha.)	**NIL**

1.5. Land Use, Agriculture, Irrigation & Cropping Pattern			
Geographical Area		525.85 Sq. km.	
Forest Area		3.97 Sq. km.	
Cultivable Area		850.91 Sq. km.	
Net Sown Area		469.01 Sq. km.	
Double Cropped Area		381.90 Sq. km.	
Area under Irrigation	Surface Water	41.51 Sq. km.	
	Ground Water	2.78 Sq. km.	
Principal Crops ***(Reference year 2017)***		**Crop Type**	**Area (Sq. km.)**
		Pulses	308.16
		Oil Seeds	185.70
		Cereals	145.57
		Sugarcane	20.04
Horticultural Crops		Mango	1.51
		Citrus fruit	1.08
		Grapes	1.05
		Banana	0.30
		Others	0.35

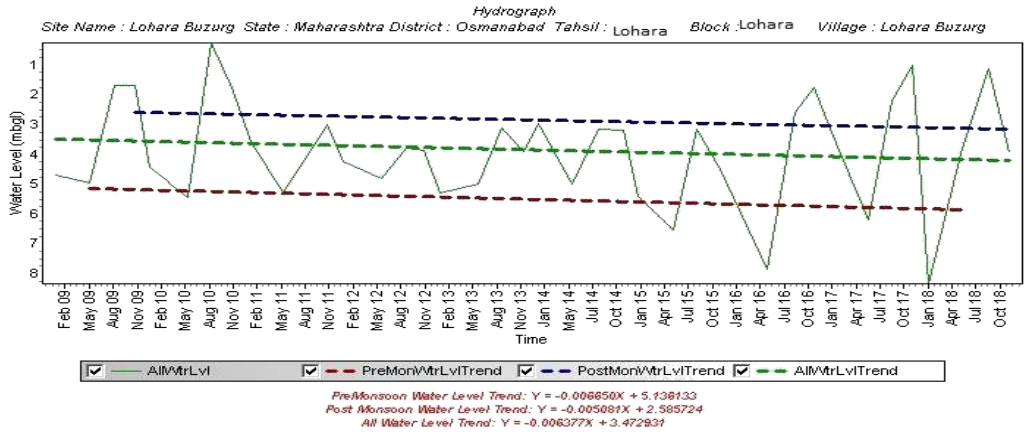
1.6. Water Level Behavior

1.6.1. Aquifer-I/Shallow Aquifer

Pre-Monsoon (May-2018)	**Post-Monsoon (November-2018)**
Water level less than 2 mbgl is seen in eastern fringe of the block covering 4.5 sq km area. Water level between 2-5 mbgl is seen in south central , western and central parts of the block covering an area of 110 sq km. Water level 5-10 mbgl is observed in major parts of the district covering an area of 351 sq km whereas water level >10 is observed at northwest and eastern fringes of the block covering an area of 68 sq km.	Water levels less than 2 mbgl is observed at southwestern and central part of block covering an area of 21 sq km, whereas water level between 2-5 mbgl is seen in southwestern, central and southern parts of block as a continuous patch covering an area of 199 sq km whereas water level >5 mbgl is observed in major part of block covering an area of 312 sq km of the block.

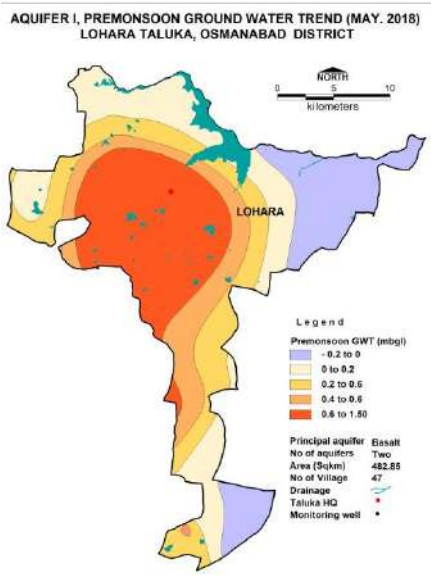
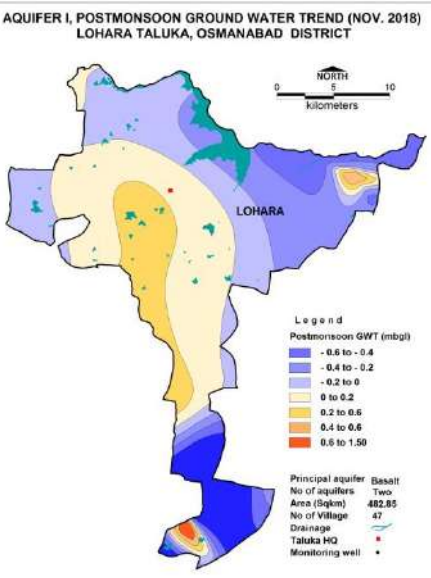
Pre-Monsoon Water Level (May 2018)	**Post-Monsoon (November-2018)**
	
WL> 10 mbgl 68 sq. km.	**WL >5 mbgl 312 sq. km.**
1.6.2. Aquifer-II/Deeper Aquifer	
Pre-Monsoon (May-2018)	**Post-Monsoon (November-2018)**
Water level <20 mbgl is observed in eastern part of the block covering an area of 1.58 sq km. Water level between 20-30 mbgl is observed in eastern part of the block covering an area of 130 sq km; Water level between 30-40 mbgl is observed as continuous patch from north to south covering an area of 256 sq km; Water level between 40-50mbgl is seen in northwestern part of the block covering an area of 114 sq km. water level >50 mbgl is seen in southern part of the block covering 29 sq km area.	Water level <10 mbgl is observed in western part of the block covering an area of 31 sq km. Water level between 10-20 mbgl is observed in major part of the block covering an area of 404 sq km; whereas water level between >20 is seen in isolated patches in southern and northern parts of block covering an area of 97 sq km of the block.
Pre-Monsoon Water Level (May 2018)	**Post-Monsoon Water Level (Nov-2018)**
	
WL>50 mbgl 29 sq. km.	**WL>20 mbgl 97 sq. km.**

1.7. Hydrographs



Hydrograph shows Pre-monsoon falling water level trend @0.0798 m/year and Post monsoon falling water level trend @0.0609 m/yr.

1.8. Water Level Trend (2009-18)

Pre-Monsoon trend	**Post-Monsoon trend**
Rising 0.02 to 0.08 m/year Falling 0.11 to 1.09 m/year	Rising 0.21 to 0.70 m/year Falling 0.108 to 0.99 m/year
Major part of the block shows declining trend. Rising trend up to 0.2 m/year has been observed in small patch in eastern part of the block whereas decline in water level up to 0.2 m/year has been observed as continuous patch in east central part of the block. Declining water level trend >0.2 m/year has been observed in major parts of the block covering about 322 sq km area.	Rising water level trend is observed in eastern half of the block whereas declining trend has been observed in western half of the district. Decline in water level more than 0.2m/year is observed in western part of the block covering about 67 sq km area.
Pre-Monsoon Water Level Trend (2009-18)	**Post-Monsoon Water Level Trend (2009-18)**
	

2. Ground Water Issues

Declining water level Trend and Deeper Water Level: -

- Pre monsoon (2009-18), decline in water level trend more than 0.2 m/year is observed in about 322 sq. km. covering about 60 % area of the block.

- Post monsoon (2009-18), decline in water level trend up to 0.2 is observed in about 67 sq. km. covering about 13 % area of the block.

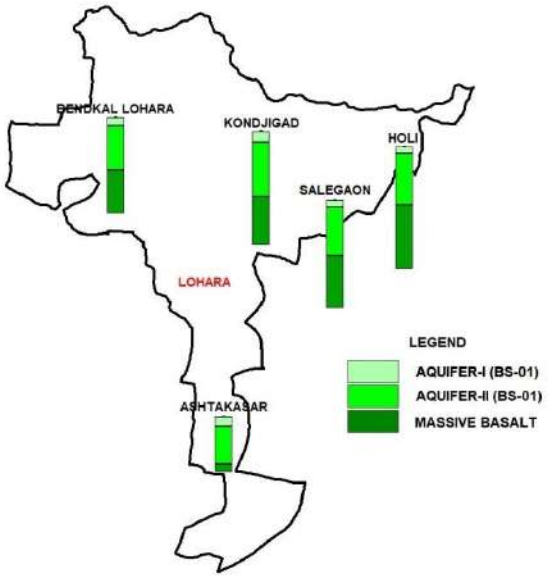
- **Low yielding Aquifer resulting poor sustainability: -**

Limited extent of porous and pervious zone, because of predominance of secondary porosity that has evolved from prevailing erratic joint pattern and also the absence of primary porosity results in poor sustainability of the aquifers. About 46 % area of the block has low yield potential (< 1 lps) and can sustain pumping only for 1 to 1.5 hrs.

3. AQUIFER DISPOSITION

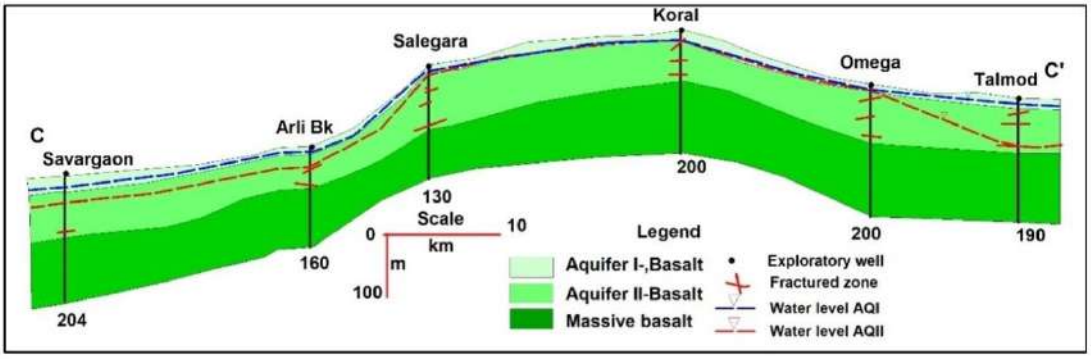
3.1. Number of Aquifers	• Basalt –Aquifer-I, Aquifer-II

3.2. Lithological disposition

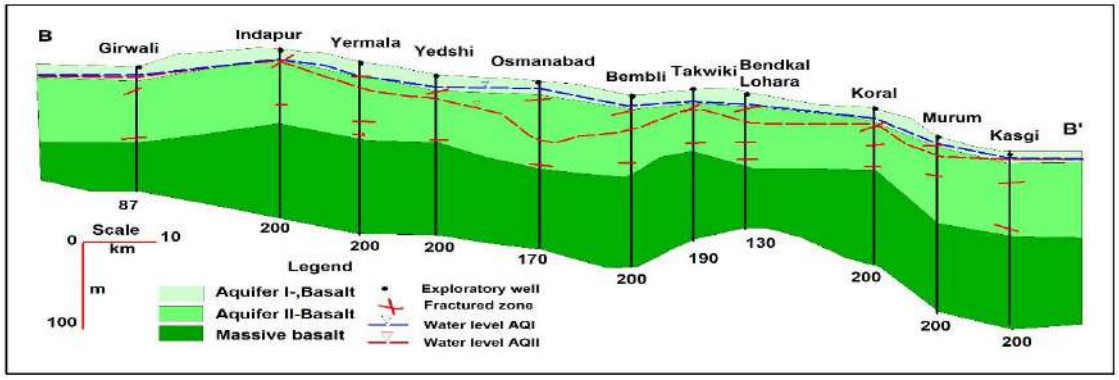


3.3. Cross Section

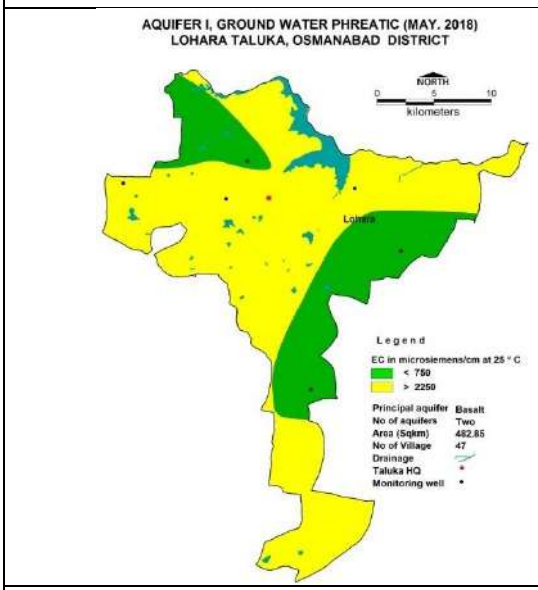
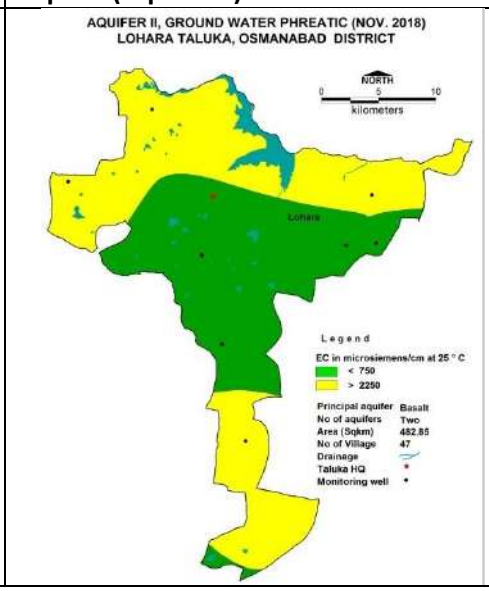
Section CC'



Section BB'

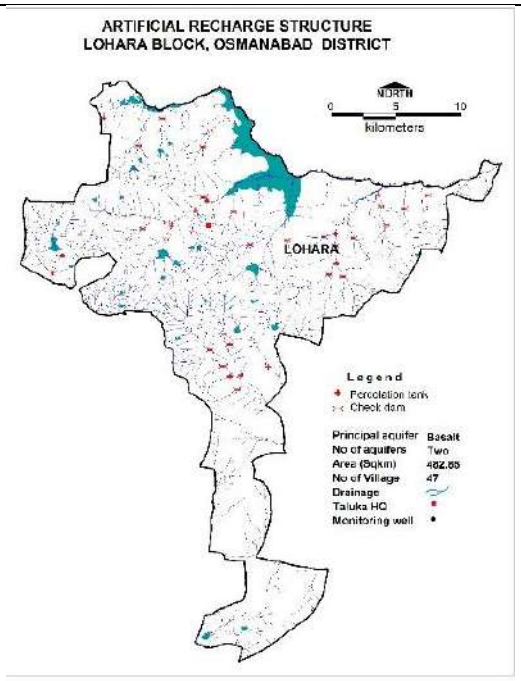


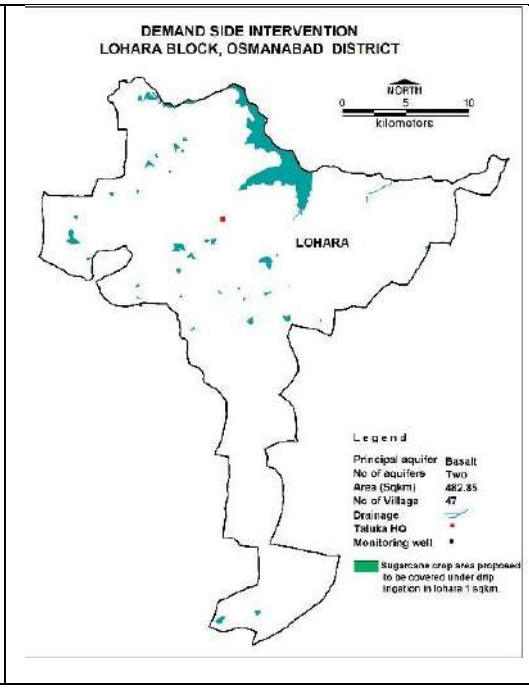
3.4. Basic Aquifer Characteristics

Major Aquifers	Basalt (Deccan Traps)	
Type of Aquifer (Phreatic/Semi confined/Confined)	Aquifer-I (Phreatic)	Aquifer-II (Semiconfined/confined)
Depth to bottom of Aquifer (mbgl)	10 to 20	110 to 150
Weathered/Fractured encountered (mbgl)	up to 20	up to 150
Weathered/Fractured rocks thickness (m)	5 to 10	1 to 10
SWL (mbgl)	1.5 to 9.88	10 to 53
Yield	up to 65 m^3/day	up to 1.5 lps
Specific Yield/ Storativity (Sy/S)	0.022 to 0.0265	3.28 x10^{-4} to 3.33 x10^{-5}
Transmissivity (T)	9.25 to 62.15 m^2/day	10.85 to 120.32 m^2/day
Sustainability	1 to 2 hrs	1 to 3 hrs
4. GROUND WATER QUALITY		
Phreatic Aquifer (Aquifer-I)	**Semi confined/Confined Aquifer(Aquifer II)**	
		
4.1 Aquifer-I/ Shallow Aquifer		
EC up to 750 µS/cm is observed in northern and southern part of the block covering an area of 144 sq km whereas EC values between 750 to 2250 µS/cm is observed in major part of the block covering an area of 388 sq km. Ground water is suitable for all purposes in major part of the block.		
4.2 Aquifer II/Deeper Aquifer		
EC values up to 750 µS/cm are observed in central part of the block covering an area of 243 sq km whereas EC value between 750 to 2250 µS/cm are observed in major part of the block in northern and southern part of the block as a continuous patch covering an area of 289 sq km. Ground water is suitable for all purposes in major part of the block except nitrate affected villages.		
5. GROUND WATER RESOURCE		
5.1 Aquifer-I/ Shallow Aquifer		
Ground Water Recharge Worthy Area (Sq. km.)	482.85	
Total Annual Ground Water Recharge (MCM)	81.88	
Natural Discharge (MCM)	4.09	
Net Annual Ground Water Availability (MCM)	77.79	

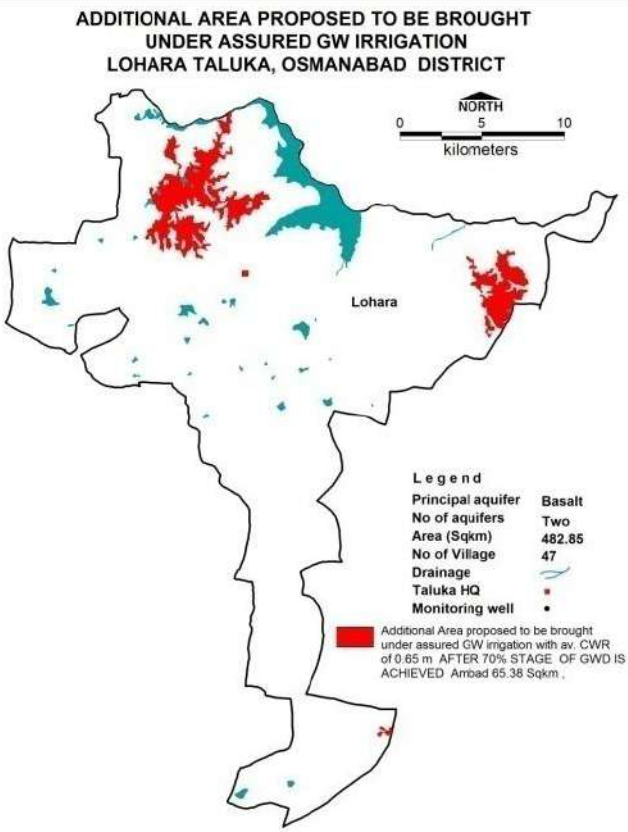
Existing Gross Ground Water Draft for irrigation (MCM)			39.20	
Existing Gross Ground Water Draft for domestic and industrial water supply (MCM)			1.70	
Existing Gross Ground Water Draft for All uses (MCM)			40.90	
Provision for domestic and industrial requirement supply to 2025(MCM)			3.44	
Net Ground Water Availability for future irrigation development (MCM)			34.62	
Stage of Ground Water Development (%)			52.58	
Category			**SAFE**	
5.2 Aquifer-II/Deeper Aquifer				
Semi confined/Confined Aquifer (Basalt)				
Total Area (Sq. km.)	Mean aquifer thickness (m)	Average (Sy/S)	Piezometric Head (m above confining layer)	Total Resource (MCM)
482.85	3.56	0.0031/0.0004	20	7.41
6.0. GROUND WATER RESOURCE ENHANCEMENT				
Available Resource (MCM)			77.79	
Gross Annual Draft (MCM)			40.91	
6.1. Supply Side Management				
SUPPLY (MCM)				
Agricultural Supply -GW			39.2	
Agricultural Supply -SW			89.3	
Domestic Supply - GW			1.71	
Domestic Supply - SW			0.4275	
Total Supply			**130.64**	
Area of Block (Sq. km.)			525.85	
Area suitable for Artificial recharge (Sq. km.)			186.44	
Type of Formation			Hard rock	
Area feasible for Artificial Recharge (WL >5mbgl) (Sq. km.)			186.44	
Volume of Unsaturated Zone (MCM)			372.886	
Average Specific Yield			0.02	
Volume of Sub Surface Storage Space available for Artificial Recharge (MCM)			7.45772	
Surplus water Available (MCM)			4.39	
Proposed Structures			Percolation Tank (Av. Gross Capacity-100 TCM*2 fillings = 200 TCM)	Check Dam (Av. Gross Capacity-10 TCM * 3 fillings = 30 TCM)
Number of Structures			11	37
Volume of Water expected to be conserved /			1.65	0.8325

recharged @ 75% efficiency (MCM)		
Proposed Structures		
RTRWH Structures – Urban Areas		
Households to be covered (25% with 50 m^2area)	6,500	
Total RWH potential (MCM)	0.227	
Rainwater harvested / recharged @ 80% runoff co-efficient	0.182 Economically not viable & Not Recommended	
6.2. Demand Side Management		
Micro irrigation techniques		
Sugarcane crop area (20.04), about 1 sq km area is ground water irrigated ,100 % ground water irrigated (1 sq km) proposed to be covered under Drip (sq.km.)		1
Volume of Water expected to be saved (MCM). Surface Flooding req- 2.45 m. Drip Req. - 1.88, WUE- 0.57 m		0.57
Alternate Sources		Nil
Proposed Cropping Pattern change		
Irrigated area under Water Intensive Crop (ha)		Not proposed
Water Saving by Change in Cropping Pattern		Nil
6.3. EXPECTED BENEFITS		
Net Ground Water Availability (MCM)		77.79
Additional GW resources available after Supply side interventions (MCM)		2.4825
Ground Water Availability after Supply side intervention		80.2725
Existing Ground Water Draft for All Uses (MCM)		40.91
GW draft after Demand Side Interventions (MCM)		40.34
Present stage of Ground Water Development (%)		52.59
Expected Stage of Ground Water Development after interventions (%)		50.25
Other Interventions Proposed, if any		
Alternate Water Sources Available		Nil
Recommendation		
Ground water development is recommended to bring the stage of ground water development from 50.25 % to 70%		
6.4. Development Plan		
Volume of water available for GWD to 70% (MCM)		15.85
Proposed Number of DW (@ 1.5 ham for 90% of GWR Available)		951
Proposed Number of BW (@ 1 ham for 10% of GWR Available)		159
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.		24.39
Regulatory Measures	**60 m**	
Supply Side Interventions	**Demand Side Interventions**	
Proposed locations for AR structures	**Sugarcane Area proposed for drip Irrigation**	

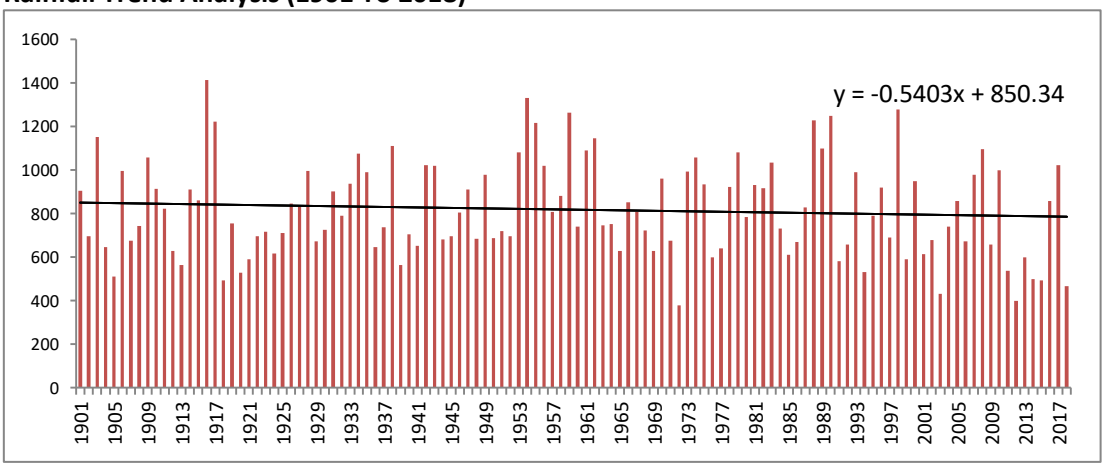




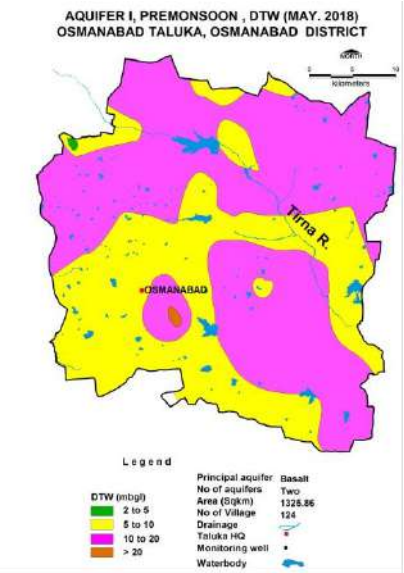
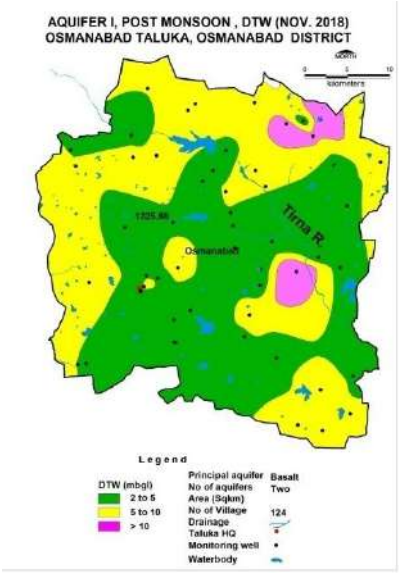
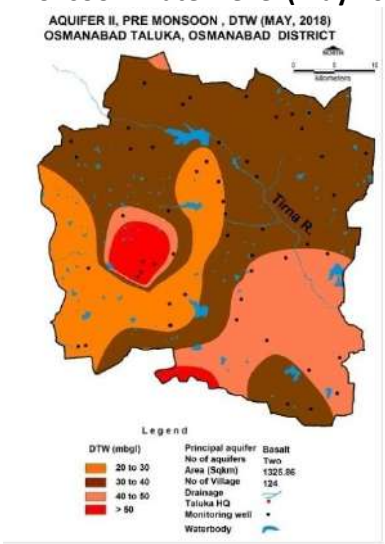
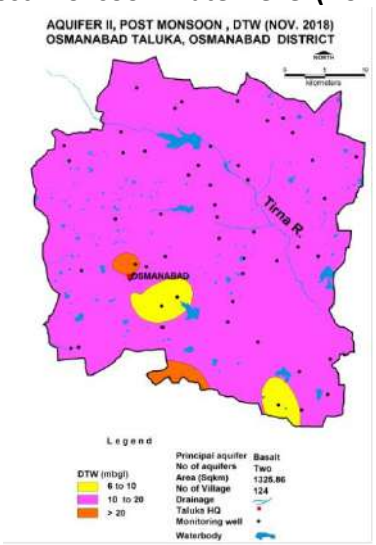
***Expected Benefits*: Additional area proposed to be bought under assured GW Irrigation**



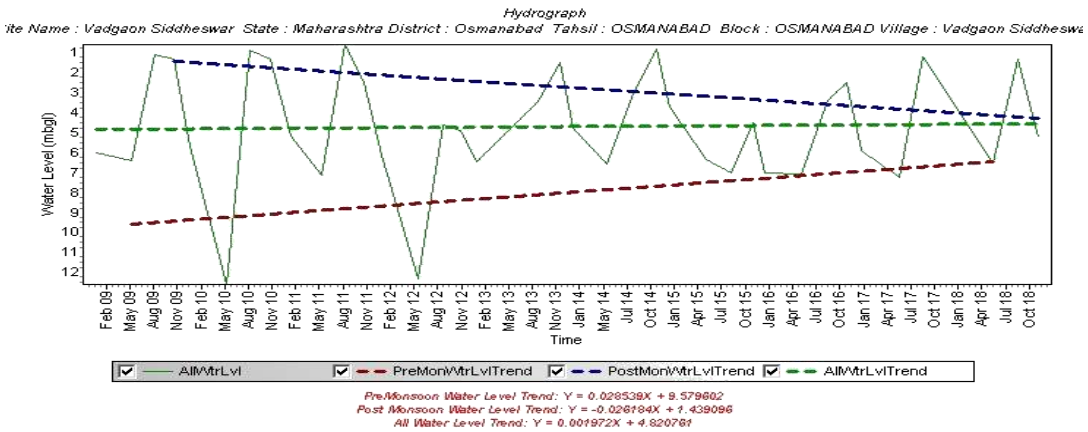
12. AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN, OSMANABAD BLOCK, OSMANABAD DISTRICT, MAHARASHTRA

2. SALIENT FEATURES		
1.1 Introduction		
Block Name	**Osmanabad**	
Geographical Area (Sq. km.)	1325.86 Sq. km.	
Hilly Area (Sq. km.)	137.42 Sq. km.	
Poor Ground Quality Area (Sq. km.)	Nil	
Population (2011)	40,5736	
Climate	Sub-Tropical	
1.5 Rainfall Analysis		
Normal Rainfall	818.2 mm	
Annual Rainfall (2018)	465.5 mm	
Decadal Average Annual Rainfall (2009-18)	643.51 mm	
Long Term Rainfall Analysis (1901-2018)	Declining Trend 0.5403 mm/year Probability of Normal and Excess Rainfall- 63% & 19%. Probability of Droughts-: 16% Moderate & 2% Severe	
Rainfall Trend Analysis (1901 To 2018)  *EQUATION OF TREND LINE: Y= -0.5403X+850.34*		
1.3. Geomorphology, Soil & Geology		
Major Geomorphic Unit	Plateau (Moderately dissected)	
Soil	Clayey and clayey loam soil. Around the drainage lines sandy loam soil is observed.	
Geology	Deccan Traps (Basalt) Age: Late Cretaceous to Eocene	
1.4. Hydrology & Drainage		
Drainage	Terna River and its tributaries; Terna river is a tributary of Manjra River	
Hydrology ***(Reference year: DSA 2016-17)***	Major project	**Completed**: Lower Terna Project (1989), generating a gross irrigation Potential of 6525 ha, Total storage capacity of 121.19 MCM.

		Ongoing: NIL
	Medium Project:	**Completed 03 no's project**: Rui Project (1987), generating a gross irrigation Potential of 2326 ha, Total storage capacity of 8.94 MCM. Tirna Project (1965), generating a gross irrigation Potential of 1982 ha, Total storage capacity of 20.544 MCM. Wagholi/kajla Project (1992), generating a gross irrigation Potential of 1338 ha, Total storage capacity of 12.70 MCM.
	Irrigation Project (0-100 Ha.)	**Completed**: 416 Small irrigation projects covering an area of 14451 ha has been completed at zilla parishad level.
	Irrigation Project (101-250 Ha.)	**Completed**: 4 Small irrigation projects covering an area of 503 ha has been completed at zilla parishad level.
1.5. Land Use, Agriculture, Irrigation & Cropping Pattern		
Geographical Area	1325.86Sq. km.	
Forest Area	4.93Sq. km.	
Cultivable Area	1314.34Sq. km.	
Net Sown Area	1226.52Sq. km.	
Double Cropped Area	87.82Sq. km.	
Area under Irrigation – Surface Water	237.26Sq. km.	
Area under Irrigation – Ground Water	8.89Sq. km.	
Principal Crops *(Reference year 2017)*	**Crop Type**	**Area (Sq. km.)**
	Pulses	623.03
	Oil Seeds	540.90
	Cereals	494.61
	Sugarcane	54.95
	Cotton	2.62
Horticultural Crops	Mango	12.50
	Grapes	7.00
	Citrus fruit	3.72
	Banana	0.89
	Others	0.30
1.6. Water Level Behavior		
1.6.1. Aquifer-I/Shallow Aquifer		
Pre-Monsoon (May-2018)	**Post-Monsoon (November-2018)**	
Water levels less than 10 mbgl have been observed in southern half of the block	Water levels less than 5 mbgl are observed in major part of the block; water levels in the	

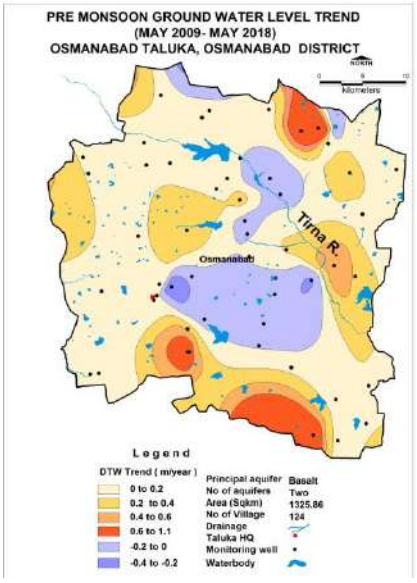
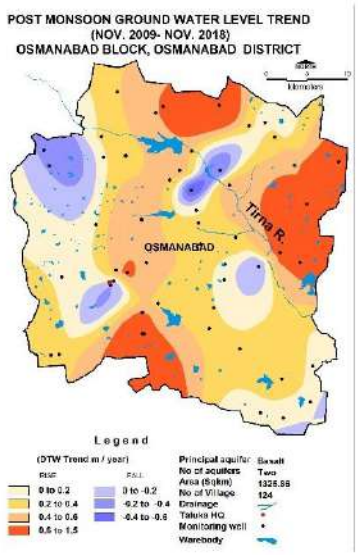
whereas water levels in the range of 10 to 20 mbgl are observed in major part of the block covering about 808 sq km area. Deeper water levels (>20 mbgl) are observed in isolated patches in South central part of the block covering 2.51 sq. km. area of the block.	range of 5 to 10 mbgl are observed in northern part of the block whereas water level more than 10 mbgl is observed as isolated patches in central and north eastern parts of block covering 51.15 sq. km. area of the block.
Pre-Monsoon Water Level (May 2018)  **WL> 20 mbgl 2.51sq. km.**	**Post-Monsoon Water Level (Nov. 2018)**  **WL >10 mbgl 51.15sq. km.**
1.6.2. Aquifer-II/Deeper Aquifer	
Pre-Monsoon (May-2018)	**Post-Monsoon (November-2018)**
Water levels between 20-30 mbgl are observed in smaller part in western part of the block. Water levels between 30-40 mbgl are observed in major part of the block covering 766 sq km area; water levels more than 40 mbgl have been observed in southern part of the block and cover about 339 sq. km. area of the block.	Water levels<10 mbgl are observed in isolated patches in central and southern parts of the block. Water levels between 10-20 mbgl are observed in entire block whereas Water levels>20 mbgl are observed as one small isolated patch in west central part of the block covering 20.60 sq. km area.
Pre-Monsoon Water Level (May 2018)  **WL>30 mbgl 1105sq. km.**	**Post-Monsoon Water Level (Nov-2018)**  **WL>20 mbgl 20.60sq. km.**

1.7. Hydrographs



Hydrograph shows Pre-monsoon rising water level trend @0.342 m/year and Post monsoon falling water level trend @0.314 m/yr.

1.8. Water Level Trend (2009-18)

Pre-Monsoon trend	**Post-Monsoon trend**
Rising 0.044 to 0.350 m/year Falling 0.06 to 1.325 m/year	Rising 0.0712 to 0.566 m/year Falling 0.0482 to 0.1.4 m/year
Major part of the block shows declining trend up to 0.2 m/year covering about 724 sq km area while rising trend up to 0.2 m/year has been observed in central part of the block covering 207 sq km area of the block. Declining water level trend >0.2 m/year has been observed in northern, southern, eastern peripheral parts of the block and isolated patch in central part of the block covering about 424 sq. km. (32%) area of the block.	Decline in water level up to 0.2 m/year has been observed in western, central and south eastern parts of the block while rising trend up to 0.2 m/year has been observed as isolated patches in western, central and southern parts of the block. Declining trend > 0.2 m/year has been observed in major part of the block prominently in the eastern half and southern parts of the block covering about 944 sq.km. (71%) area.
Pre-Monsoon Water Level Trend (2009-18)	**Post-Monsoon Water Level Trend (2009-18)**
	
Declining trend @>0.2 m/yr 424sq. km.	**Declining trend @>0.2 m/yr 944sq. km.**

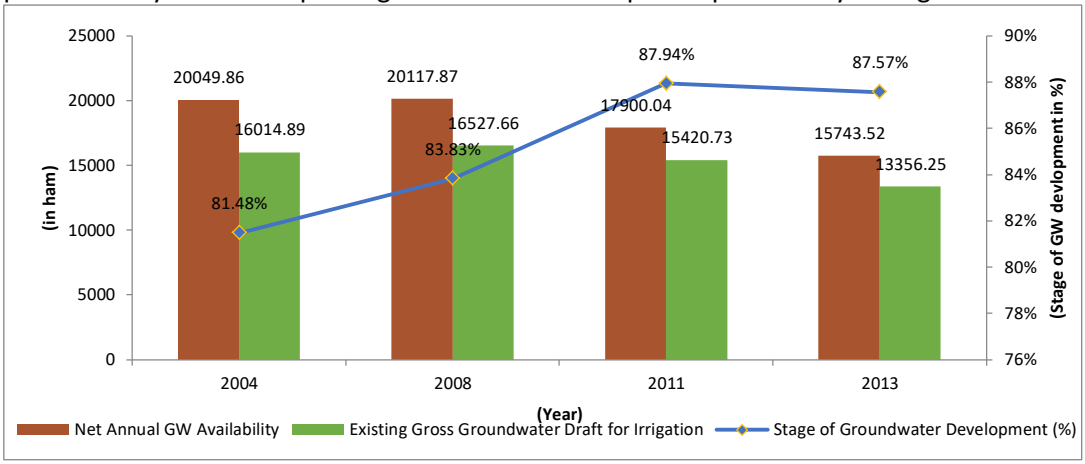
2. Ground Water Issues

Exploitation of Ground Water: -

The draft for irrigation has decreased from 200.49 (2004) to 157.43 MCM (2013). however

there was an increase in draft from 2004 to 2008 and thereafter started decresing and in 2013 reached 157.43 mcm i.e., below 2004 but the incessant decline in net availability of ground water has resulted in the rise of the stage of ground water development over the period of time from 2004 to 2013 from 81.48 % to 87.57%**.**

The main reason for ground water draft is for irrigation purpose. The gap between the availability of ground water and draft is reducing over the period from 2004 to 2013. This provides very limited scope for ground water development particularly in irrigation sector.



Declining water level Trend and Deeper Water Level: -

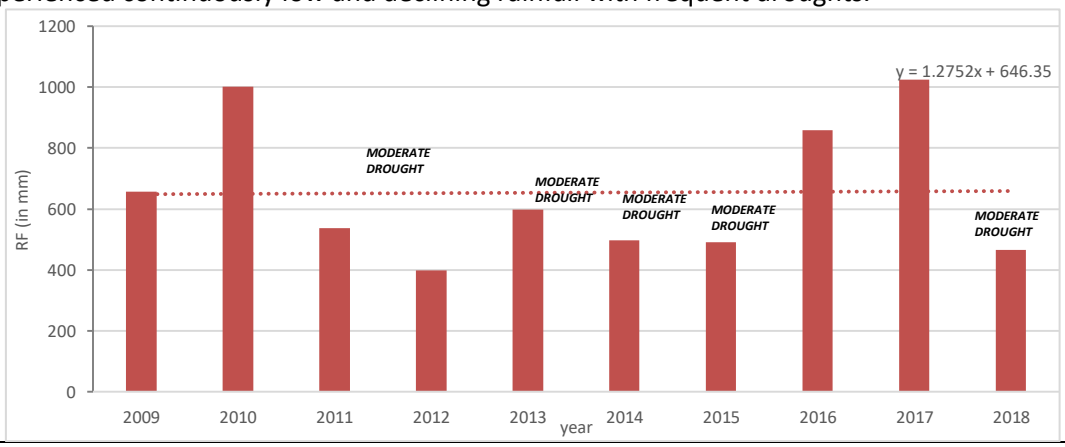
- Pre monsoon (2009-18), decline in water level trend more than 0.2 m/year is observed in about 424sq. km. covering about 32 % area of the block.
- Post monsoon (2009-18), decline in water level trend more than 0.2 m/year is observed in about 944sq. km. covering about 71 % area of the block.

Low yielding Aquifer resulting poor sustainability: -

About **1093.71 sq km** (about 82.48 % of the total area of the block, Yield less than 25 m^3/day) covering major parts of the block mostly due to restricted depth of weathering in Aquifer-I. Limited aquifer potential of Aquifer-II is seen in about **1012 sq km** having yield potential less than 1.5 lps (about 76.32 % of the total area of the Block, Yield less than 1.5 lps) Sustainability of both the aquifers is limited and the wells normally sustain pumping of 0.5 to 3 hours.

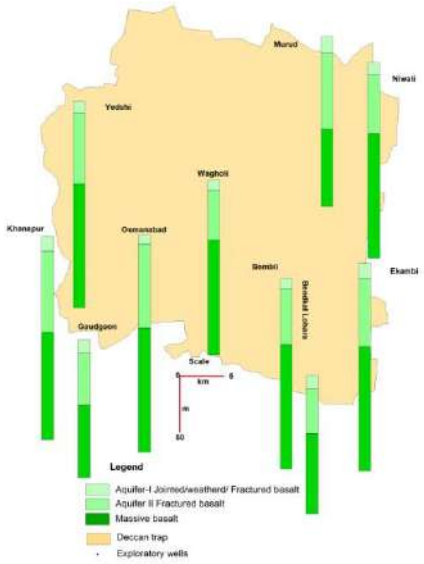
Low rainfall and drought: the long-term rainfall data for 118 years (1901-2018) was analysed and it indicates that normal rainfall of the block is 818.2 mm. Declining Trend is observed at 0.54 mm/year.

The short-term rainfall analysis for the period 2009-2018 indicates that average rainfall of Osmanabad Block is 643.51 mm. The rainfall from last ten years shows that the area experienced continuously low and declining rainfall with frequent droughts.



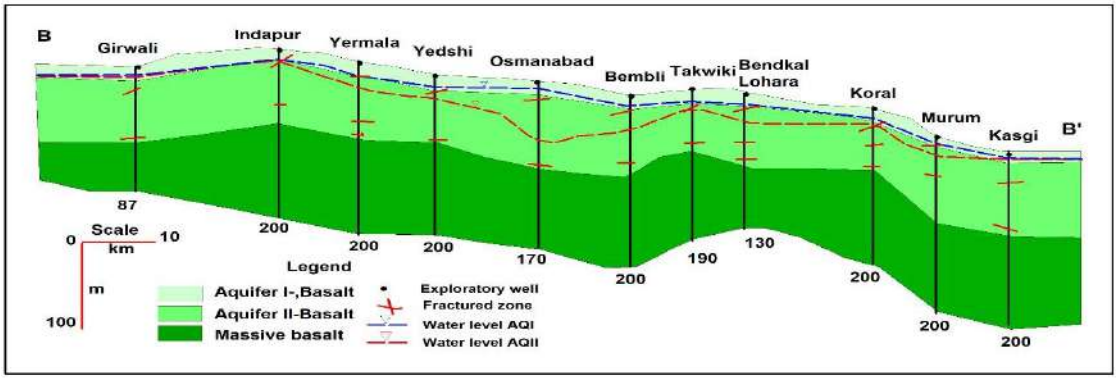
3. AQUIFER DISPOSITION	
3.1. Number of Aquifers	• Basalt –Aquifer-I, Aquifer-II

3.2. Lithological disposition

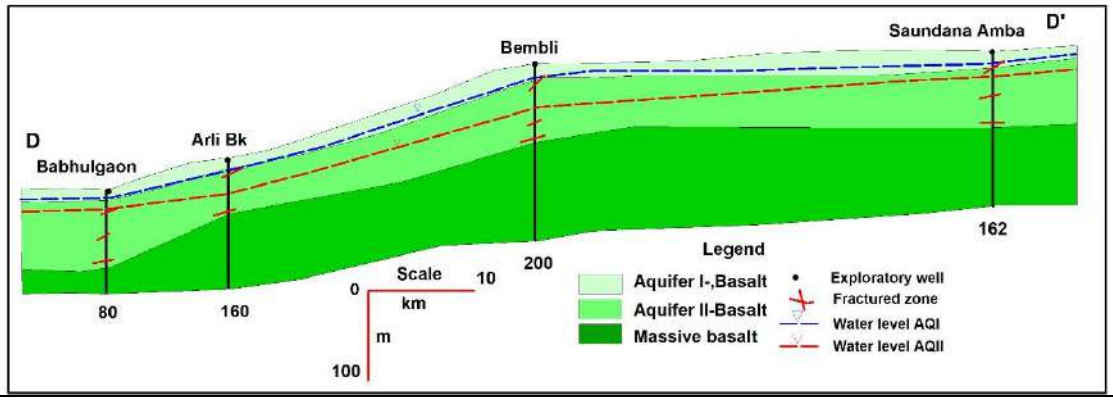


3.3. Cross Section

Section BB'



Section DD'



3.4. Basic Aquifer Characteristics

Major Aquifers	Basalt (Deccan Traps)	
Type of Aquifer (Phreatic/Semi confined/Confined)	Aquifer-I (Phreatic)	Aquifer-II (Semi confined/confined)
Depth to bottom of Aquifer (mbgl)	5-28	20-135
Weathered/Fractured zones encountered (mbgl)	up to 28	up to 135
Weathered/fractured rocks thickness (m)	5.64 to 14	18 to 11.36
SWL (mbgl)	1.3 to 25	7.38 to 55

Yield	up to 83 m^3/day	up to 1.65 lps
Specific Yield/ Storativity (Sy/S)	0.021 to 0.0275	3.21 x10^{-4} to 3.57 x10^{-5}
Transmissivity (T)	12.50 to 50.64 m^2/day	10.85 to 62.35 m^2/day
Sustainability	1 to 2 hrs	1 to 3 hrs

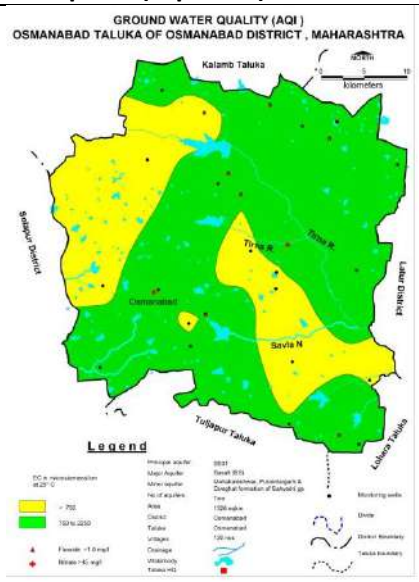
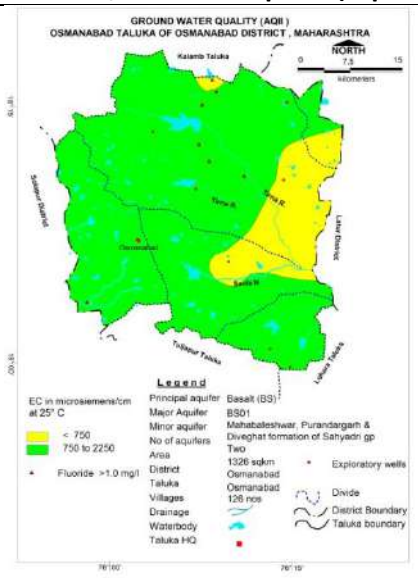
4. GROUND WATER QUALITY

4.1 Aquifer-I/ Shallow Aquifer

EC values up to 750 µS/cm are observed in north western, central and southern parts of the block; EC values between 750 to 2250 µS/cm are observed in major part of the block and EC more than 2250 µS/cm has been observed in isolated patch in east central part of the block covering about 30 sq km area. Ground water is suitable for all purposes in major part of the block except Nitrate affected villages namely Rajuri, Vadgaon Siddheswar, Dhoki, Osmanabad, Takiwiki, Chilvadi villages. Fluoride contamination is found in Goverdhan wadi village (F=1.7 mg/L) hence ground water in these villages is not suitable for drinking purpose without treatment.

4.2 Aquifer II/Deeper Aquifer

EC up to 750 µS/cm is observed in northern, southern and western parts of the block. EC values between 750 to 2250 µS/cm are observed in major part of the block. Ground water is suitable for all purposes in major part of the block except nitrate and fluoride affected villages. Fluoride contamination is found in Irla (1.6 mg/L), Goverdhan wadi (1.7 mg/L), and Yedsi (2.7mg/L) villages hence ground water in these villages are not suitable for drinking purpose without treatment.

Phreatic Aquifer (Aquifer-I)	**Semi confined/Confined Aquifer (Aquifer II)**
	

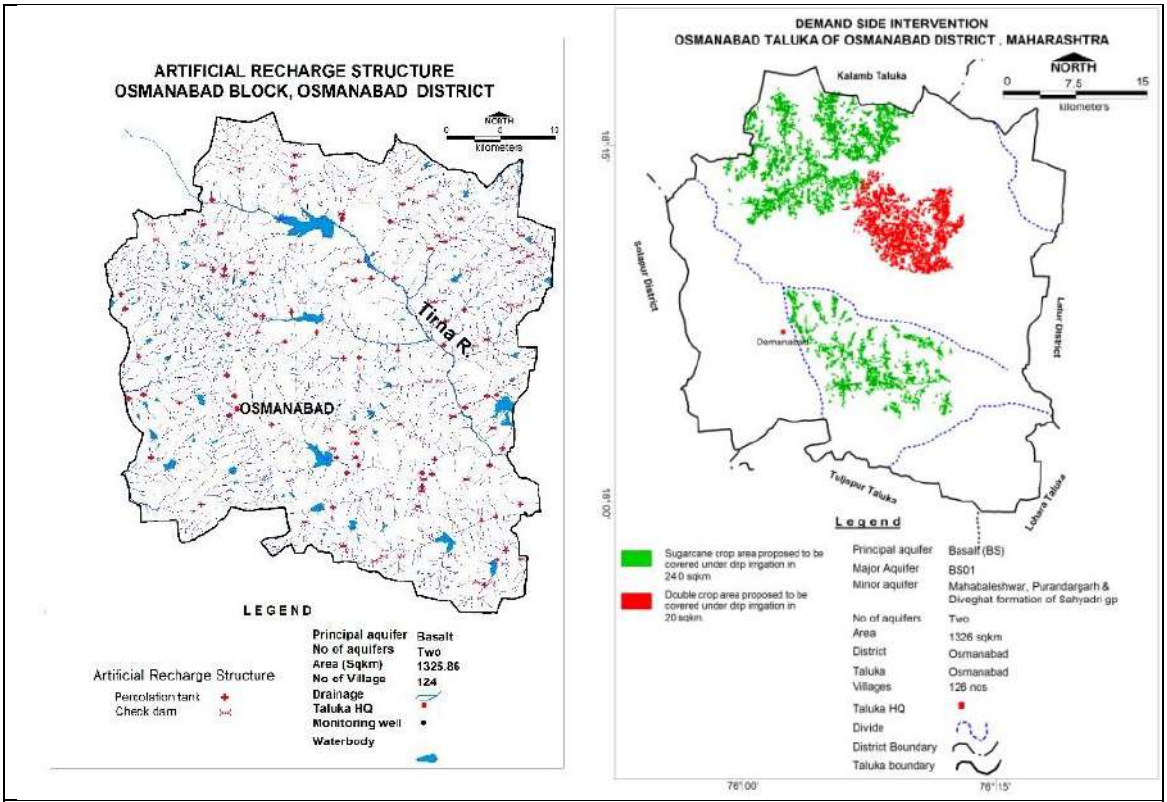
5. GROUND WATER RESOURCE

5.1 Aquifer-I/ Shallow Aquifer

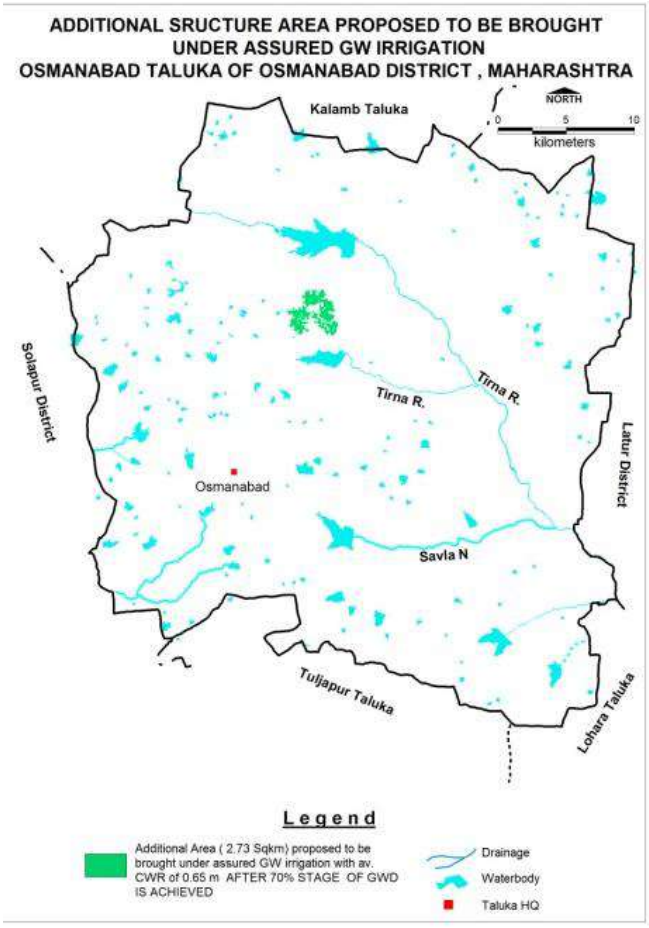
Ground Water Recharge Worthy Area (Sq. km.)	1188.44
Total Annual Ground Water Recharge (MCM)	165.72
Natural Discharge (MCM)	8.28
Net Annual Ground Water Availability (MCM)	157.44
Existing Gross Ground Water Draft for irrigation (MCM)	137.86
Existing Gross Ground Water Draft for domestic and industrial water supply (MCM)	4.29

Existing Gross Ground Water Draft for All uses (MCM)			137.85	
Provision for domestic and industrial requirement supply to 2025(MCM)			7.58	
Net Ground Water Availability for future irrigation development (MCM)			18.83	
Stage of Ground Water Development (%)			87.57	
Category			**Semi Critical**	
5.2 Aquifer-II/Deeper Aquifer				
Semi confined/Confined Aquifer (Basalt)				
Total Area (Sq. km.)	Mean aquifer thickness (m)	Average (Sy/S)	Piezometric Head (m above confining layer)	Total Resource (MCM)
1325.83	4.5	0.0033/0.0004	16.66	22.41
6.0. GROUND WATER RESOURCE ENHANCEMENT				
Available Resource (MCM)			157.44	
Gross Annual Draft (MCM)			137.86	
6.1. Supply Side Management				
SUPPLY (MCM)				
Agricultural Supply -GW			133.56	
Agricultural Supply -SW			213.50	
Domestic Supply - GW			4.30	
Domestic Supply - SW			1.08	
Total Supply			**352.44**	
Area of Block (Sq. km.)			1325.86	
Area suitable for Artificial recharge (Sq. km.)			626.58	
Type of Formation			**Hard rock**	
Area feasible for Artificial Recharge (WL >5mbgl) (Sq. km.)			626.58	
Volume of Unsaturated Zone (MCM)			1253.15	
Average Specific Yield			0.02	
Volume of Sub Surface Storage Space available for Artificial Recharge (MCM)			25.06	
Surplus water Available (MCM)			14.75	
Proposed Structures			Percolation Tank (Av. Gross Capacity-100 TCM*2 fillings = 200 TCM)	Check Dam (Av. Gross Capacity-10 TCM * 3 fillings = 30 TCM)
Number of Structures			58	105
Volume of Water expected to be conserved / recharged @ 75% efficiency (MCM)			8.7	2.36
Proposed Structures				
RTRWH Structures – Urban Areas				
Households to be covered (25% with 50 m^2area)			21300	
Total RWH potential (MCM)			0.685	
Rainwater harvested / recharged @ 80% runoff co-efficient			0.548 Economically not viable & Not Recommended	

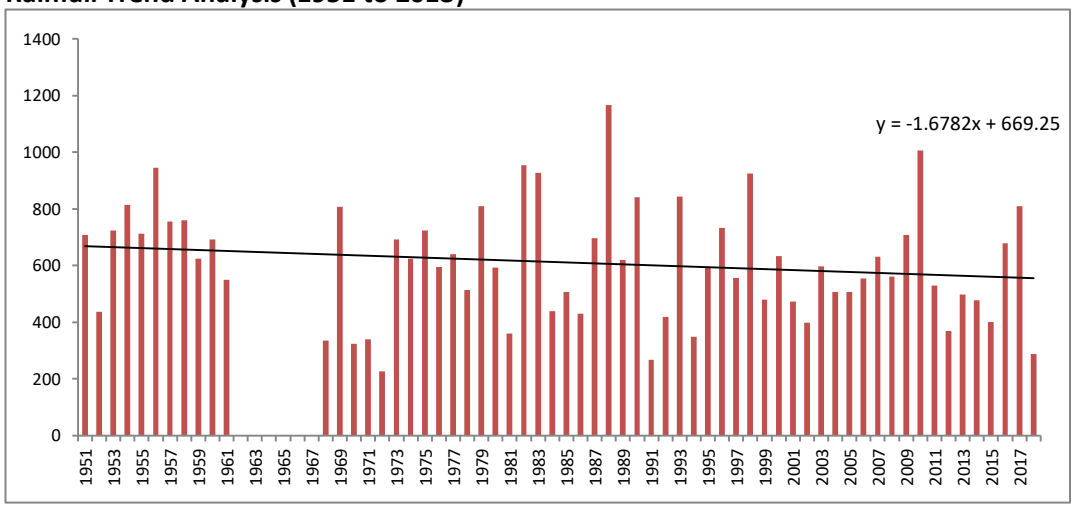
6.2. Demand Side Management	
Micro irrigation techniques	
Sugarcane Area proposed for drip irrigation (sq. km.)	24
Volume of Water Saving by use of drip (MCM) Surface Flooding req- 2.45 m. Drip Req. - 1.88, WUE- 0.57 m	13.68
Double Cropped Area proposed for drip irrigation (sq. km.)	20
Volume of Water Saving by use of drip (MCM), WUE- 0.40 m	8.0
Alternate Sources	Nil
Proposed Cropping Pattern change	
Irrigated area under Water Intensive Crop (ha)	Not proposed
Water Saving by Change in Cropping Pattern	Nil
6.3. EXPECTED BENEFITS	
Net Ground Water Availability (MCM)	157.44
Additional GW resources available after Supply side interventions (MCM)	11.06
Ground Water Availability after Supply side intervention	168.50
Existing Ground Water Draft for All Uses (MCM)	137.86
GW draft after Demand Side Interventions (MCM)	116.18
Present stage of Ground Water Development (%)	87.56
Expected Stage of Ground Water Development after interventions (%)	68.95
Other Interventions Proposed, if any	
Alternate Water Sources Available	Nil
Recommendation	
Ground water development is recommended to bring the stage of ground water development from 68.95 % to 70%	
6.4. Development Plan	
Volume of water available for GWD to 70% (MCM)	1.77
Proposed Number of DW (@ 1.5 ham for 90% of GWR Available for development)	106
Proposed Number of BW (@ 1 ham for 10% of GWR Available for development)	18
Additional Area to be brought under assured GW irrigation with av. CWR of 0.65 m (sq. km.)	2.73
Regulatory Measures	**60 m**
Supply Side Interventions	**Demand Side Interventions**
Proposed locations for AR structures	**Sugarcane Area proposed for drip Irrigation**

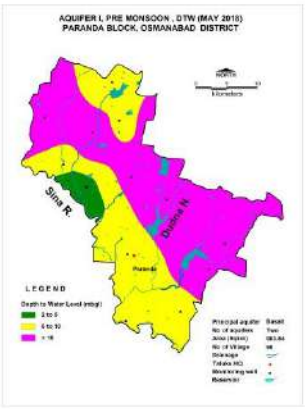
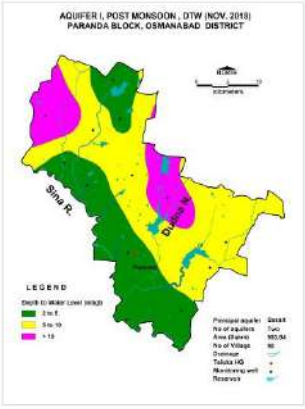


***Expected Benefits*: Additional area proposed to be bought under assured GW Irrigation**

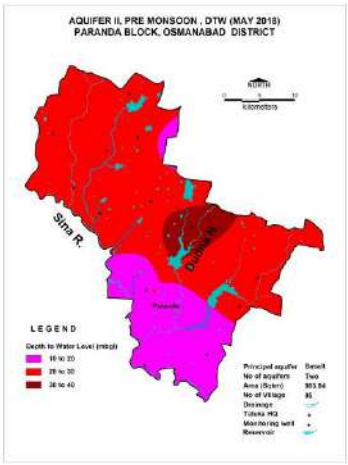
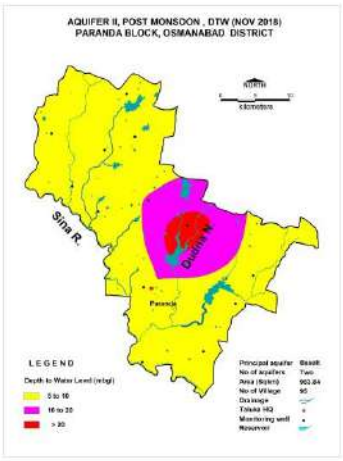


13. AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN, PARANDA BLOCK, OSMANABAD DISTRICT, MAHARASHTRA

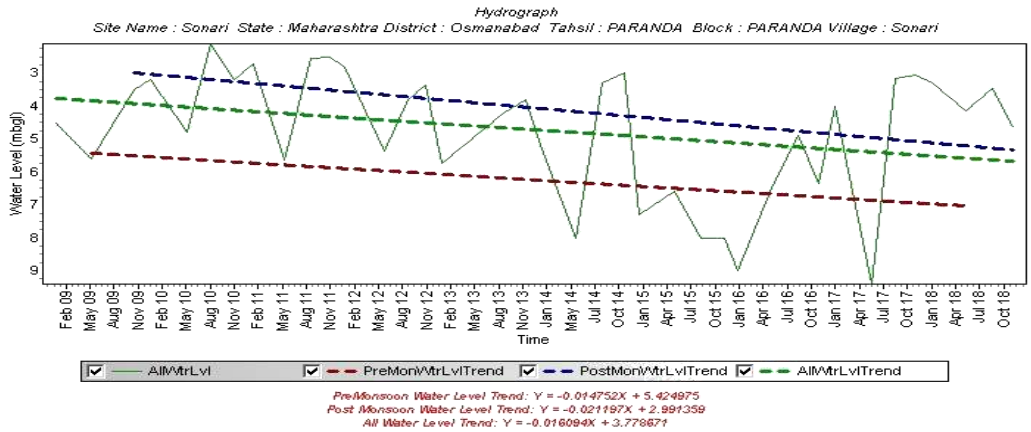
1. SALIENT FEATURES		
1.1 Introduction		
Block Name	**PARANDA**	
Geographical Area (Sq. km.)	1126.41 Sq. km.	
Hilly Area (Sq. km.)	142.47 Sq. km.	
Poor Ground Quality Area (Sq. km.)	Nil	
Population (2011)	1,40,148	
Climate	Sub-Tropical	
1.2 Rainfall Analysis		
Normal Rainfall	608.1 mm	
Annual Rainfall (2018)	287.3mm	
Decadal Average Annual Rainfall (2009-18)	575.65 mm	
Long Term Rainfall Analysis (1951-2018)	Declining Trend: 1.67 mm/year Probability of Normal and Excess Rainfall:55% & 21% Probability of Droughts: 19% Moderate and 5% Severe	
Rainfall Trend Analysis (1951 to 2018)		
		
EQUATION OF TREND LINE: Y= -1.6782X +669.25		
1.3. Geomorphology, Soil & Geology		
Major Geomorphic Unit	Moderately Dissected Plateau	
Soil	Clayey and Gravelly sandy clay soil	
Geology	Deccan Traps (Basalt) Age: Late Cretaceous to Eocene	
1.4. Hydrology & Drainage		
Drainage	Sina river and its tributaries	
Hydrology ***(Reference DSA Year: June 2016-17)***	Major project	**Nil**
	Medium project	**Completed:** 03; Chandni, Khaspur and Satak irrigation projects generating a gross irrigation Potential of 2924, 2975 and2826 ha. Gross Storage Capacity of 23.870 13.59 and 3.009 MCM respectively.
	Irrigation	**Completed:** 01 irrigation projects; generating

		Project (100-250 Ha)	a gross irrigation Potential of 133 ha, Gross
		Irrigation Project (<100 Ha)	**Completed:** 165 irrigation projects; generating a gross irrigation Potential of 6239 ha,
1.5. Land Use, Agriculture, Irrigation & Cropping Pattern			
Geographical Area		1126.41 Sq. km.	
Forest Area		4.66 Sq. km.	
Cultivable Area		1710.56 Sq. km.	
Net Sown Area		1221.44 Sq. km.	
Double Cropped Area		489.12 Sq. km.	
Area under Irrigation	Surface Water	208.53 Sq. km.	
	Ground Water	11.84 Sq. km.	
Principal Crops *(Reference year 2017)*		**Crop Type**	**Area (Sq. km.)**
		Cereals	355.97
		Pulses	277.03
		Oil Seeds	94.72
		Sugarcane	82.81
		Cotton	49.80
Horticultural Crops		Mango	2.50
		Citrus fruits	1.63
		Banana	0.55
		Others	0.45
1.6. Water Level Behavior			
1.6.1. Aquifer-I/Shallow Aquifer			
Pre-Monsoon (May-2018)		**Post-Monsoon (November-2018)**	
Water level less than 5 mbgl have been observed in isolated patch in western part of the block; Water levels between 5 to 10 mbgl have been observed in western and north eastern parts of the block whereas water levels more than 10 mbgl have been observed in major part of the block covering about 481 sq. km. area.		Water levels less than 5 mbgl has been observed In western peripheral and north eastern part of the block; water levels between 5 to 10 mbgl have been observed in major part of the block whereas water levels more than 10 mbgl have been observed as isolated patches in northern peripheral part and eastern part of the block covering about 140 sq. km. area.	
Pre-Monsoon Water Level (May 2018)		**Post-Monsoon Water Level (Nov. 2018)**	
			
WL>10 mbgl 481 sq. km.		**WL>10 mbgl 140 sq. km.**	

1.6.2. Aquifer-II/Deeper Aquifer

Pre-Monsoon (May-2018)	Post-Monsoon (November-2018)
Water level less than 20 mbgl is observed in southern part of the block; water levels between 20-30 mbgl have been observed in major part of the block Whereas more than 30 mbgl has been observed in isolated patch in east central part of the block and cover 55.61 sq. km. area of the block.	Water level less than 10 mbgl is observed in major part of the block. Water level between 10 to 20 mbgl has been observed in isolated patch in central part of the block whereas more than 20 mbgl has been observed as isolated patch in central part of the block and cover 29.28 sq. km. area.
Pre-Monsoon Water Level (May 2018)	**Post-Monsoon Water Level (Nov.-2018)**
	
WL> 30 mbgl 55.61 sq. km.	**WL> 20 mbgl 29.28 sq. km.**

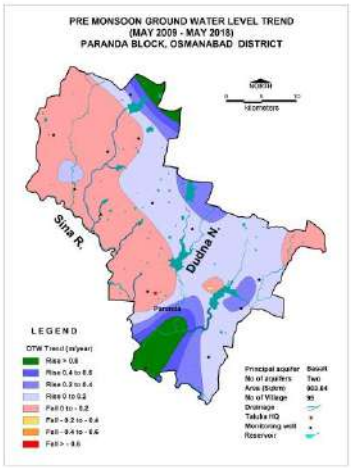
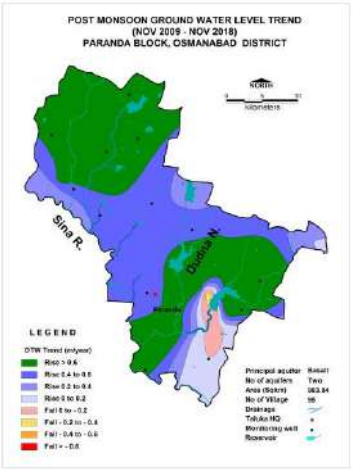
1.7. Hydrograph



Hydrograph shows Pre-monsoon declining water level trend @ 0.177 m/year and Post monsoon declining water level trend @ 0.254 m/year

1.8. Water Level Trend (2009-18)

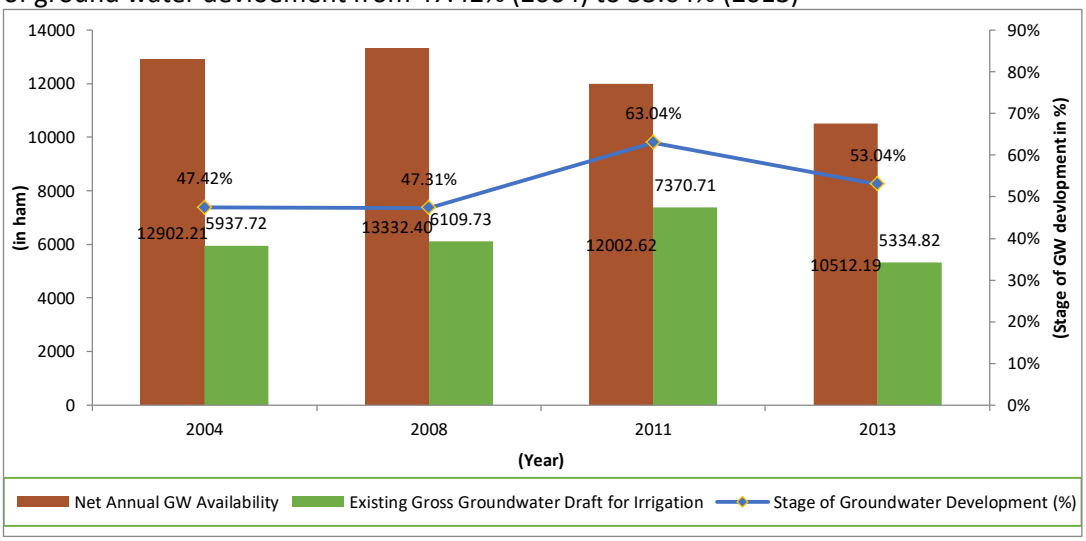
Pre-Monsoon trend	**Post-Monsoon trend**
Rising 0.080 to 0.276 m/year Falling 0.015 to 0848 m/year	Rising 0.227 to 0.397 m/year Falling 0.035 to 1.766 m/year
Major part of the block shows declining trend up to 0.2 m/year while rise in water level up to 0.2 m/year have been observed in northern and western parts of the block. Declining trend more than 0.2 m/ year has been observed in eastern and southern	Declining water level trend up to 0.2 m/year has been observed in small patch in southern part of the block while rise in water level up to 0.2 m/year has been observed in isolated patch in southern part of the block. Decline more than 0.2 m/year has been observed in

parts of the block covering about 167 sq. km. area.	almost entire block covering 798 sq km area.
Pre-Monsoon Water Level Trend (2009-18)	**Post-Monsoon Water Level Trend (2009-18)**
	
Declining trend @>0.2 m/year 167 sq. km.	**Declining trend @>0.2 m/year 798 sq. km.**

2. Ground Water Issues

Exploitation of Ground Water: -

The stage of ground water development has continuously increased from 47.42% (2004) to 63.04% (2011) there after decrease in the stage of devlopement from 63.04% (2011) to 53.04 % (2013) is observed. It is observed that the gap between the net availability of ground water and draft is reducing over the period from 2004 to 2013 resulting in increase in Stage of ground water devloement from 47.42% (2004) to 53.04% (2013)



Declining water level Trend:

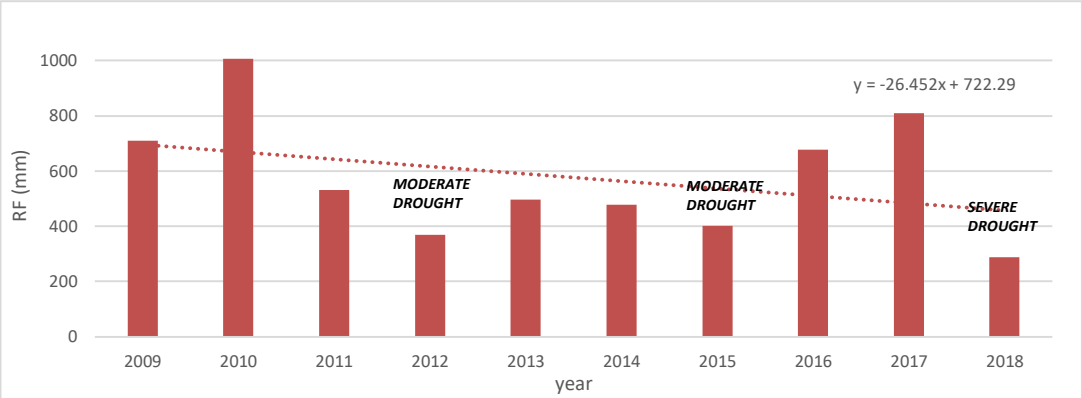
- Pre monsoon (2009-18): Decline in water level trend more than 0.2 m/year is observed in about 322.70 sq. km. covering about 30% area of the block.
- Post monsoon (2009-18): Decline in water level trend more than 0.2 m/year is observed in about 798 sq. km. covering about 91% area of the block.

Low rainfall and Droughts: -

The long-term rainfall analysis for the period 1951-2018 indicates that normal rainfall of Paranda block is 608.1 mm and it indicates a falling rainfall trend @ 1.67 mm/year with 19% probability of moderate and 5% Severe droughts.

Based on the short-term rainfall data from 2009-2018 for the block the rainfall analysis indicates that average rainfall is 575.65 mm. The rainfall from last ten years shows the area continuously experienced low and declining rainfall with frequent moderate/severe

droughts.

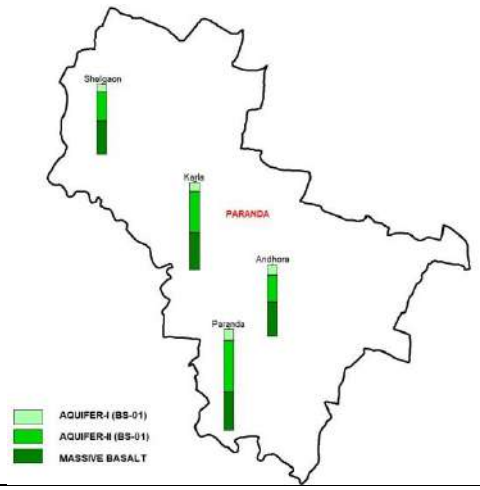


Low yielding Aquifer resulting poor sustainability:

Limited extent of porous and pervious zone, because of predominance of secondary porosity that has evolved from prevailing erratic joint pattern and also the absence of primary porosity, results in poor sustainability of the aquifers. About 41% area of the block has low yield potential (< 1 lps) and can sustain pumping only for 1-1.5 hrs.

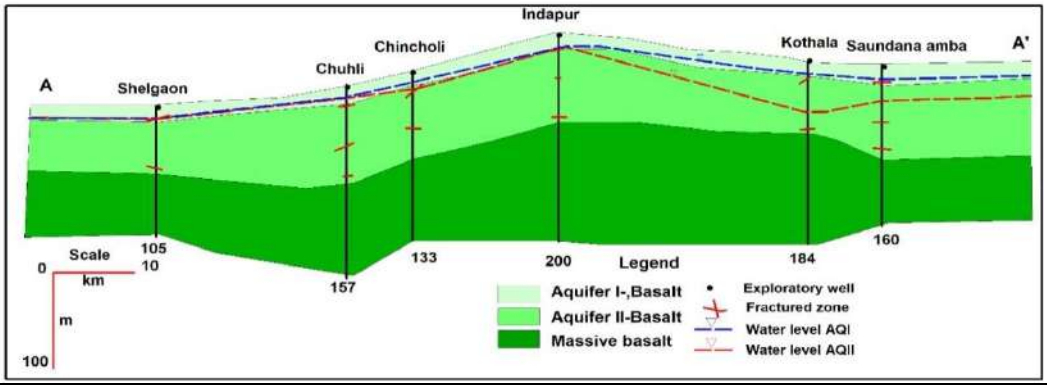
3. AQUIFER DISPOSITION	
3.1. Number of Aquifers	Basalt –Aquifer-I, Aquifer-II

3.2. Lithological disposition



3.3. Cross Section

Section AA'



3.4. Basic Aquifer Characteristics		
Major Aquifers	**Basalt (Deccan Traps)**	
Type of Aquifer (Phreatic/Semi confined/Confined)	Aquifer-I (Phreatic)	Aquifer-II (Semiconfined/confined)
Depth to bottom of Aquifer (mbgl)	9 to 34	85 to 170

Weathered/Fractured zones encountered (mbgl)	up to 34	up to 170
Weathered/Fractured rocks thickness (m)	5 to 14	1 to 12
SWL (mbgl)	8.65 to 18.7	8 to 21.8
Specific yield/Storativity (S)	0.022 to 0.0242	2.56×10^{-4} to 3.12×10^{-5}
Transmissivity (T)	9.25 to 35.60 m^2/day	10.85 to 50.23 m^2/day
Yield	up to 60.50m^3/day	up to to 1.50 lps
Sustainability	2 to 3 hrs	1 to 3 hrs

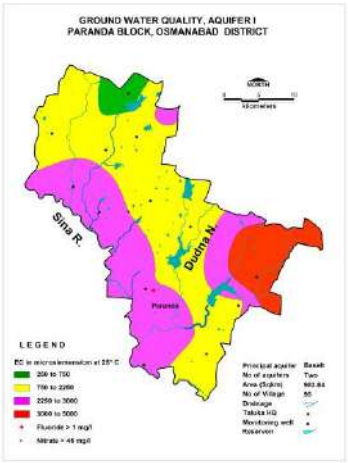
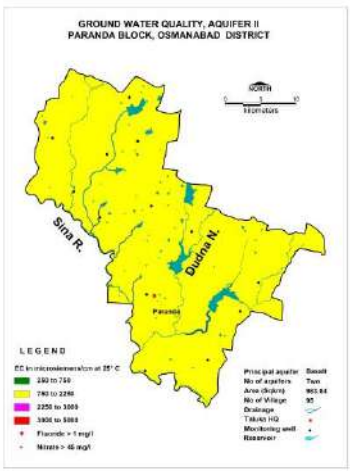
4. GROUND WATER QUALITY

4.1 Aquifer-I/ Shallow Aquifer

EC up to 750 µS/cm is observed in small patch in northern part of the block and EC values between 750 to 2250 µS/cm is observed in major part of the block. Western and southern parts of the block shows EC more than 2250 µS/cm. Ground water is suitable for all purposes except Sonari village having nitrate more than 45 mg/L; Loni parana village are affected by Fluoride contamination and ground water is not suitable for drinking purpose without treatment.

4.2 Aquifer II/Deeper Aquifer

EC values between 750 to 2250 µS/cm are observed in entire block. Ground water is suitable for all purposes.

Phreatic Aquifer (Aquifer-I)	**Semi confined/Confined Aquifer (Aquifer II)**
 **EC > 2250 µS/cm covering 397 sq. km.**	

5. GROUND WATER RESOURCE

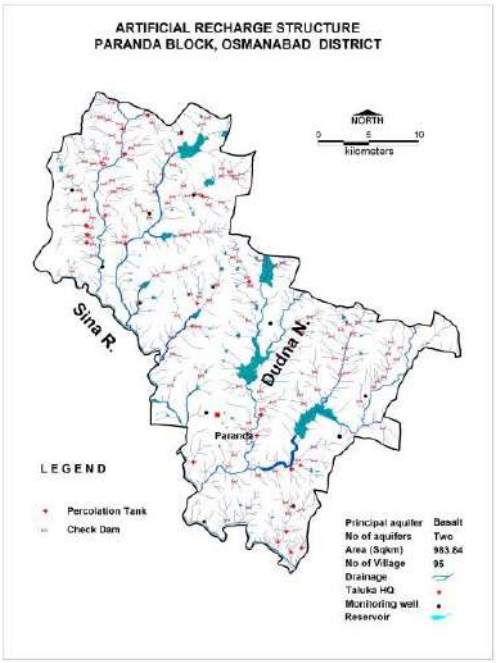
5.1 Aquifer-I/ Shallow Aquifer

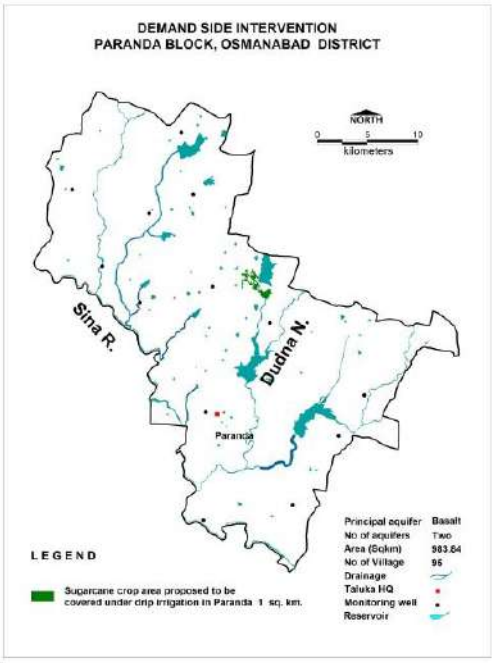
Ground Water Recharge Worthy Area (Sq. km.)	983.94
Total Annual Ground Water Recharge (MCM)	110.65
Natural Discharge (MCM)	5.53
Net Annual Ground Water Availability (MCM)	105.12
Existing Gross Ground Water Draft for irrigation (MCM)	53.34
Existing Gross Ground Water Draft for domestic and industrial water supply (MCM)	2.37
Existing Gross Ground Water Draft for All uses (MCM)	55.72
Provision for domestic and industrial requirement supply to 2025(MCM)	4.73
Net Ground Water Availability for future irrigation development (MCM)	47.74
Stage of Ground Water Development (%)	53.01

Category				**SAFE**
5.2 Aquifer-II/Deeper Aquifer				
Semi confined/Confined Aquifer (Basalt)				
Total Area (Sq. km.)	Mean aquifer thickness (m)	Av (Sy/S)	Piezometric Head (m above confining layer)	Total Resource (MCM)
983.94	6.125	0.0031/0.0004	18	30.24
6.0. GROUND WATER RESOURCE MANAGEMENT				
Available Resource (MCM)				105.12
Gross Annual Draft (MCM)				55.72
6.1. Supply Side Management				
SUPPLY (MCM)				
Agricultural Supply -GW				53.35
Agricultural Supply -SW				187.50
Domestic Supply - GW				2.38
Domestic Supply - SW				0.60
Total Supply				**244.34**
Area of Block (Sq. km.)				1126.41
Area suitable for Artificial recharge (Sq. km.)				753.39
Type of Formation				Hard Rock
Area feasible for Artificial Recharge (WL >5mbgl) (Sq. km.)				753.39
Volume of Unsaturated Zone (MCM)				1506.78
Average Specific Yield				0.02
Volume of Sub Surface Storage Space available for Artificial Recharge (MCM)				30.135
Surplus water Available (MCM)			17.74	
Proposed Structures			Percolation Tank (Av. Gross Capacity-100 TCM*2 fillings = 200 TCM)	Check Dam (Av. Gross Capacity-10 TCM * 3 fillings = 30 TCM)
Number of Structures			24	137
Volume of Water expected to be conserved / recharged @ 75% efficiency (MCM)			3.6	3.08
Proposed Structures				
RTRWH Structures – Urban Areas				
Households to be covered (25% with 50 m^2area)				7300
Total RWH potential (MCM)				0.21
Rainwater harvested / recharged @ 80% runoff co-efficient				0.17
Economically not viable & Not Recommended				
6.2. Demand Side Management				
Micro irrigation techniques				
Sugarcane crop area proposed for drip irrigation (sq. km.)				1
Volume of Water Saving by use of drip (MCM) Surface Flooding req- 2.45 m. Drip Req. - 1.88, WUE- 0.57 m				0.57
Proposed Cropping Pattern change				
Irrigated area under Water Intensive Crop (ha)				Not proposed
Water Saving by Change in Cropping Pattern				Nil
Alternate Sources				Nil

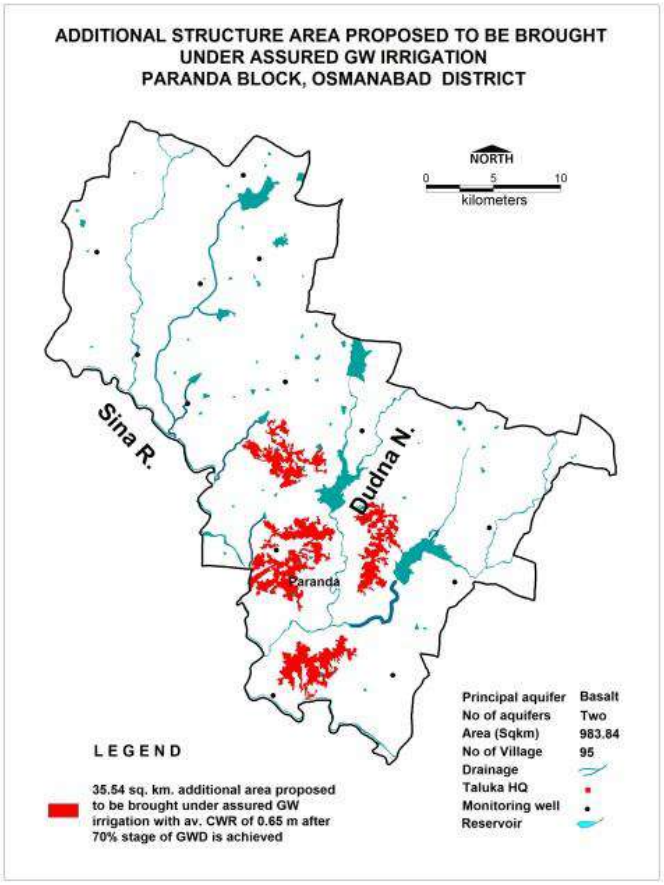
6.3. EXPECTED BENEFITS	
Net Ground Water Availability (MCM)	105.12
Additional GW resources available after Supply side interventions (MCM)	6.68
Ground Water Availability after Supply side intervention	111.80
Existing Ground Water Draft for All Uses (MCM)	55.73
GW draft after Demand Side Interventions (MCM)	55.16
Present stage of Ground Water Development (%)	53.02
Expected Stage of Ground Water Development after interventions (%)	49.34
Other Interventions Proposed, if any	
Alternate Water Sources Available	Nil
Recommendation	
Ground water development is recommended to bring the stage of ground water development from 49.34% to 70%	
6.4. Development Plan	
Volume of water available for GWD to 70% (MCM)	23.1
Proposed Number of DW (@ 1.5 ham for 90% of GWR Available for development)	1386
Proposed Number of BW (@ 1 ham for 10% of GWR Available for development)	231
Additional Area to be brought under assured GW irrigation with av. CWR of 0.65 m (sq. km.)	35.54

Regulatory Measures	**60 m**
Supply Side Interventions	**Demand Side Interventions**
Proposed locations for AR structures	**Sugarcane Area proposed for drip Irrigation**

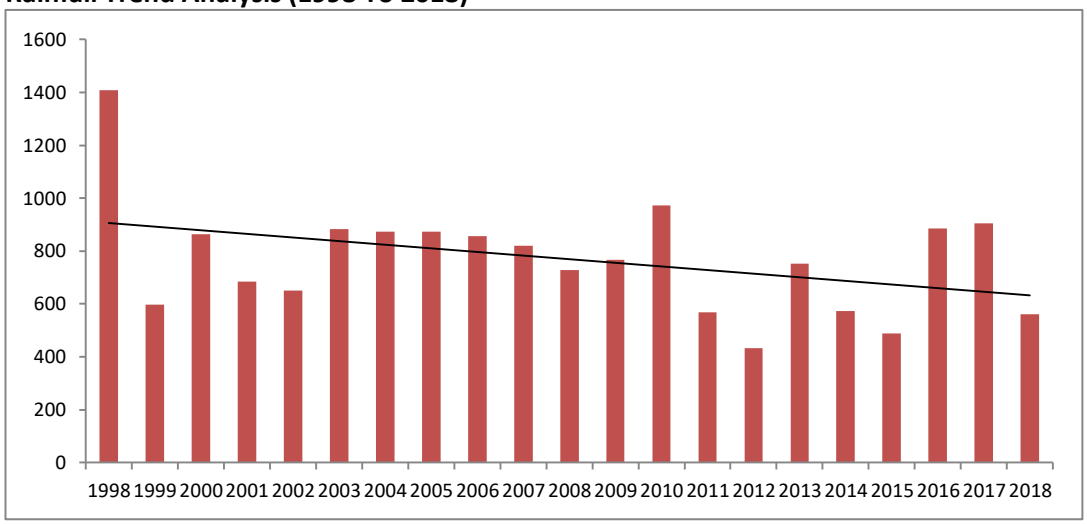




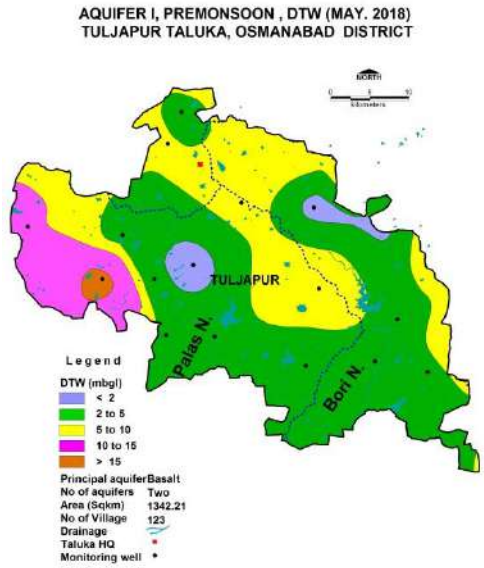
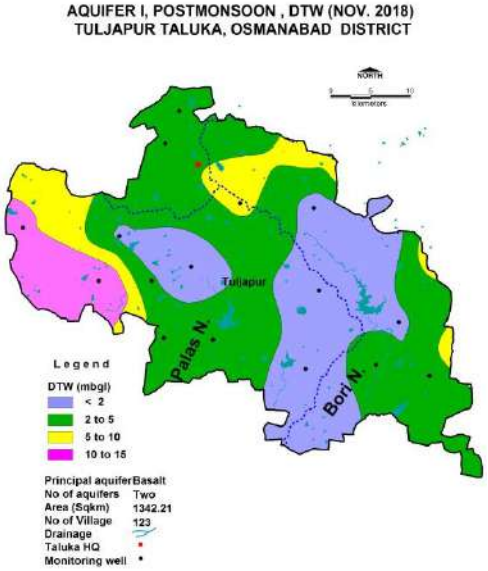
***EXPECTED BENEFITS*: ADDITIONAL AREA PROPOSED TO BE BOUGHT UNDER ASSURED GW IRRIGATION**

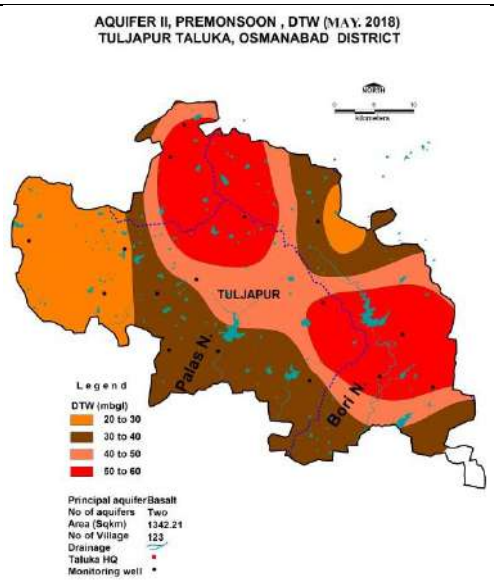

ADDITIONAL STRUCTURE AREA PROPOSED TO BE BROUGHT
UNDER ASSURED GW IRRIGATION
PARANDA BLOCK, OSMANABAD DISTRICT
NORTH
0
5
10
kilometers
Sina R.
Dudna N.
Paranda
LEGEND
35.54 sq. km. additional area proposed to be brought under assured GW irrigation with av. CWR of 0.65 m after 70% stage of GWD is achieved
Principal aquifer Basalt
No of aquifers Two
Area (Sqkm) 983.84
No of Village 95
Drainage
Taluka HQ
Monitoring well
Reservoir

14. AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN, TULJAPUR BLOCK, OSMANABAD DISTRICT, MAHARASHTRA

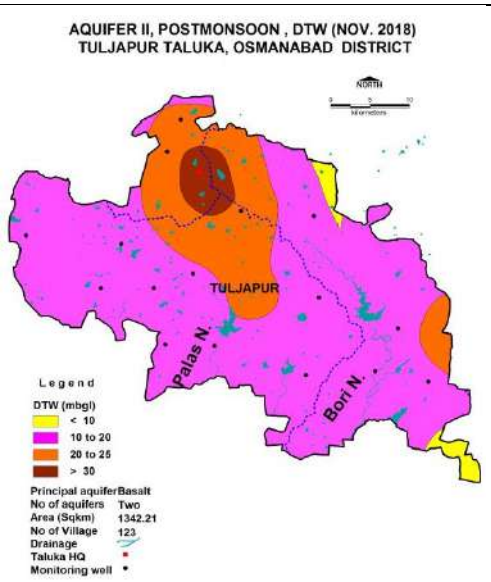
3. SALIENT FEATURES		
1.1 Introduction		
Block Name	**TULJAPUR**	
Geographical Area (Sq. km.)	1579.32 Sq. km.	
Hilly Area (Sq. km.)	237.11 Sq. km.	
Poor Ground Quality Area (Sq. km.)	Nil	
Population (2011)	2,78,879	
Climate	Sub-Tropical	
1.6 Rainfall Analysis		
Normal Rainfall	768.9 mm	
Annual Rainfall (2018)	559.8 mm	
Decadal Average Annual Rainfall (2009-2018)	670.49 mm	
Long Term Rainfall Analysis (1998 to 2018)	Declining Trend: -13.73 mm/year Probability of Normal and Excess Rainfall- 66% & 10%. Probability of Drought-: 24 % Moderate drought	
Rainfall Trend Analysis (1998 To 2018)		
		
EQUATION OF TREND LINE: Y= -13.737x + 920.01		
1.3. Geomorphology, Soil & Geology		
Major Geomorphic Unit	Plateau (Moderately to highly dissected)	
Soil	Clayey, Gravel sandy Clay and Gravelly soils	
Geology	Deccan Traps (Basalt) Age: Upper Cretaceous to Eocene	
1.4. Hydrology & Drainage		
Drainage	Bori and Harni rivers, tributaries of Bhima river	
Hydrology ***(Reference year: DSA 2016-17)***	Major project	Nil
	Medium project	**Completed:** 04; Paras- Nilegaon project generating a gross irrigation Potential of 1321 ha, Total Storage Capacity of 1.55 MCM. Khandala Project generating a gross irrigation Potential of 1636 ha, Total Storage Capacity of

		6.26 MCM. Kurunoor Project generating a gross irrigation Potential of 3644 ha, Total Storage Capacity of 35.25 MCM. Harni Project generating a gross irrigation Potential of 1680 ha, Total Storage Capacity of 12.58 MCM. **Ongoing: Nil**
	Irrigation Project (0-100 Ha.)	**Completed**: 242 Small irrigation projects covering an area of 8012 ha have been completed at zilla parishad level.
	Irrigation Project (101-250 Ha.)	**Completed**: 11 Small irrigation projects covering an area of 1460 ha have been completed at Local level.
1.5. Land Use, Agriculture, Irrigation & Cropping Pattern		
Geographical Area	1579.32 Sq. km.	
Forest Area	10.23 Sq. km.	
Cultivable Area	1288.41 Sq. km.	
Net Sown Area	1134.42 Sq. km.	
Double Cropped Area	153.99 Sq. km.	
Area under Irrigation – Surface Water	219.81 Sq. km.	
Area under Irrigation – Ground Water	8.07 Sq. km.	
Principal Crops ***(Reference year 2017)***	**Crop Type**	**Area (Sq. km.)**
	Cereals	658.80
	Pulses	577.12
	Oil Seeds	361.56
	Sugarcane	58.19
Horticultural Crops	Mango	5.61
	Banana	10.50
	Grapes	9.46
	Citrus fruit	2.71
	Others	0.75
1.6. Water Level Behavior		
1.6.1. Aquifer-I/Shallow Aquifer		
Pre-Monsoon (May-2018)		**Post-Monsoon (November-2018)**
Water levels less than 2 mbgl are observed in small pockets in west central and eastern part of the block covering 52 sq km, whereas water levels between 2-5 mbgl have been observed in major part of the block covering 828 sq km area. Water levels between 5-10 mbgl have been observed as northern half of the block covering 476 sq km. Water level between 10-15 mbgl is seen in western part of the		Water levels less than 2 mbgl are observed in southern and central parts of the block covering 459 sq km of area. Majority of the block is covered by the water levels between 2-5 mbgl over the 755 sq km of the area. 169 sq km is covered by water levels between 5-10 mbgl at western, north eastern and southeastern parts of the district. Deeper water levels between 10-20 mbgl are seen in western part of the block covering an area of

block covering 137 sq km Water level > 15 mbgl is seen in very small isolated patch located at southwestern part of the block covering an area of 13 sq km.	123 sq km.
Pre-Monsoon Water Level (May 2018)  **WL> 10 mbgl 151 sq. km.**	**Post-Monsoon Water Level (Nov. 2018)**  **WL >10 mbgl 123 sq. km.**
1.6.2. Aquifer-II/Deeper Aquifer	
Pre-Monsoon (May-2018)	**Post-Monsoon (November-2018)**
Water levels between 20-30 mbgl are observed in western part of the block. Water levels between 30-40 mbgl are observed as continuous patch from northwest to southeast following the border of the block with Solapur District; 40-50 mbgl water level is observed as a continuous patch from north to southeast; more than 50 mbgl water levels have been observed as two big isolated patches in northern and eastern part of the block covering an area of 450 sq km.	Water level <10 mbgl is observed as isolated patch in north eastern part of the block. Water level between 10-20 mbgl is observed almost throughout the block covering 1129.24sq km area of the block. Water levels between 20-30 mbgl are observed in northern and southern eastern parts of the block whereas Water level >30 mbgl is observed in northern part of the block as a small isolated patch.
Pre-Monsoon Water Level (May 2018)	**Post-Monsoon Water Level (Nov.-2018)**

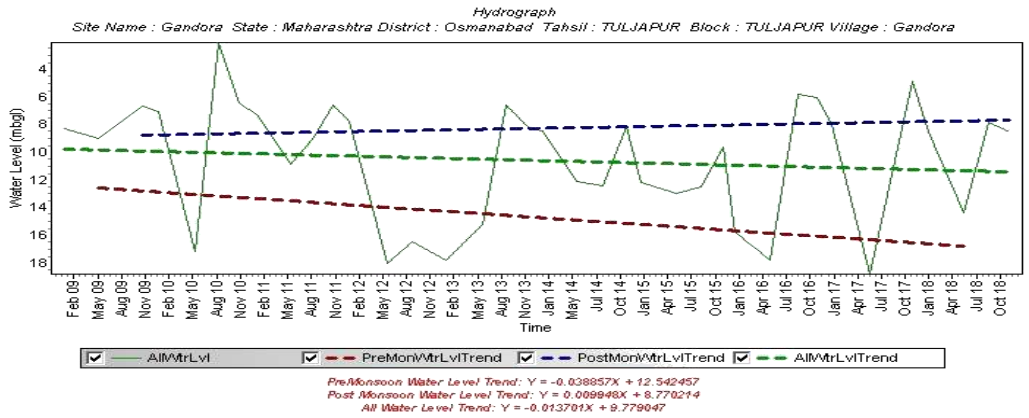


WL>50 mbgl 450 sq. km.



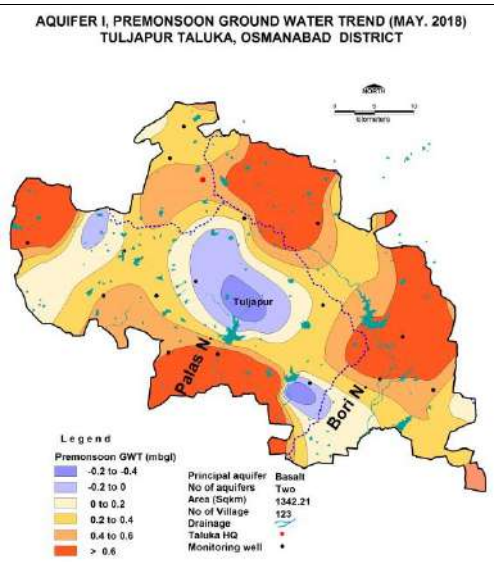
WL >30 mbgl 48.71 sq. km.

1.7. Hydrographs

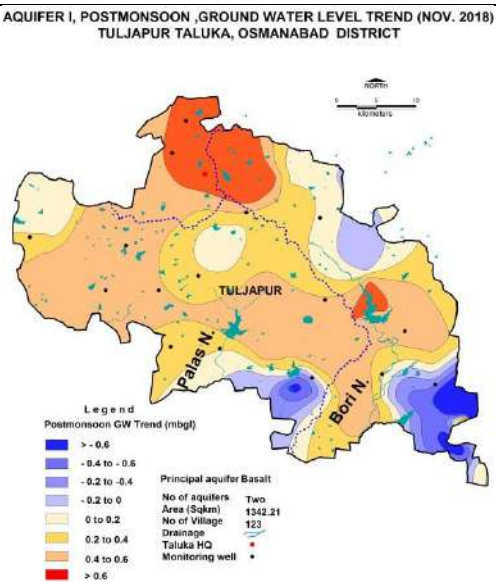


Hydrograph shows Pre-monsoon falling water level trend @0.466 m/year and Post monsoon rising water level trend @0.1193 m/yr.

1.8. Water Level Trend (2009-18)	
Pre-Monsoon trend Rising 0.08 to 0.395 m/year Falling 0.02 to 1.97 m/year	**Post-Monsoon trend** Rising 0.11 to 2.02 m/year Falling 0.004 to 1.96 m/year
Declining trend is observed in major part of the block. Declining trend up to 0.2 m/year is observed in western and eastern part of the block whereas rise in water level is observed in central and southern parts of block. Declining trend more than 0.2 m/year is observed in major parts of the block covering about 1129 sq km area.	Major part of the block shows declines in water level. Rise in water levels up to 0.2 m/year is observed in southern and eastern parts of the block whereas decline in water level trend is observed in southern, western and eastern parts of the block. Declining trend > 0.2 m/year has been observed in major part of the block covering about 1087 sq.km of area.
Pre-Monsoon Water Level Trend (2009-18)	**Post-Monsoon Water Level Trend (2009-18)**



Declining trend @>0.2 m/yr 1129 sq. km.



Declining trend @>0.2 m/yr 1087 sq. km.

2. Ground Water Issues

Declining water level Trend: -

- Pre monsoon (2009-18), decline in water level trend more than 0.2 m/year is observed in about 1129 sq. km. covering about 75 % area of the block.
- Post monsoon (2009-18), decline in water level trend more than 0.4 m/year is observed in about 1087 sq. km. covering about 72 % area of the block.

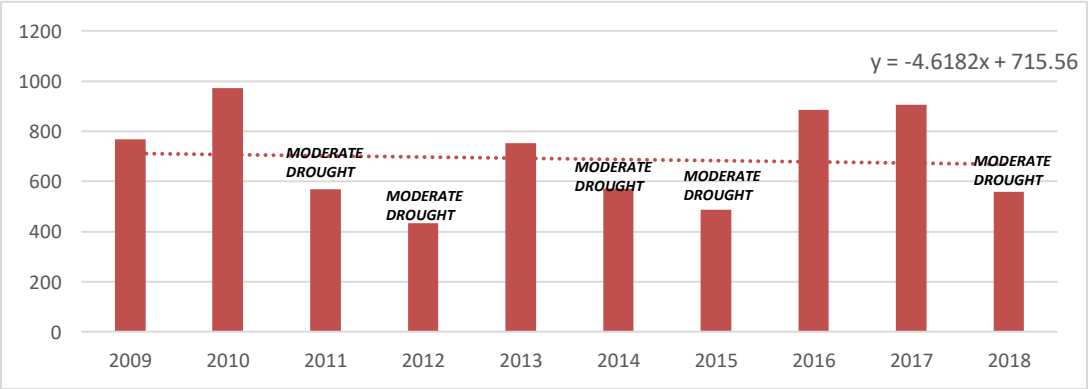
Low yielding Aquifer resulting poor sustainability: -

Limited extent of porous and pervious zone, because of predominance of secondary porosity that has evolved from prevailing erratic joint pattern and also the absence of primary porosity results in poor sustainability of the aquifers. About 53 % area of the block has low yield potential (< 1 lps) and can sustain pumping only for 1 to 1.5 hrs.

Low Rainfall and Drought: -

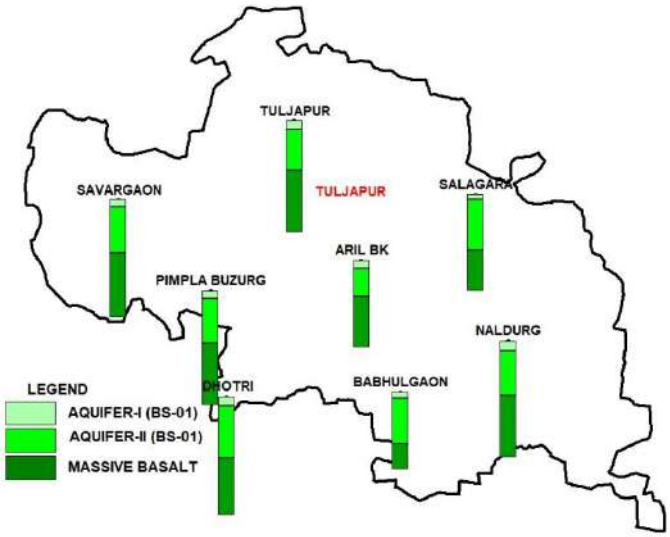
The long-term rainfall analysis for the period 1998-2018 indicates that normal rainfall of Tuljapur block is 768.9 mm, In addition, it indicates a falling trend @ 13.73 mm/year with 24% probability of moderate drought.

Based on the short-term rainfall data from 2009-2018 for the block, the analysis indicates that average rainfall is 670.49 mm. The rainfall from last ten years shows that the area continuously experienced low and declining rainfall with frequent moderate droughts.



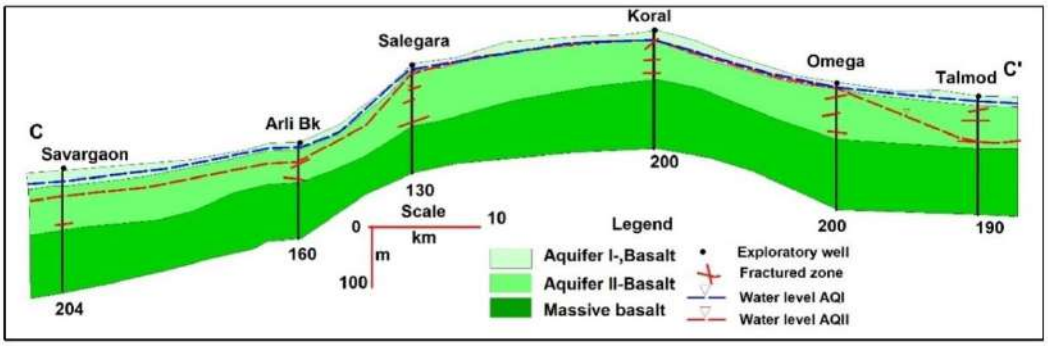
3. AQUIFER DISPOSITION

3.1. Number of Aquifers	Basalt –Aquifer-I, Aquifer-II
3.2. Lithological disposition	

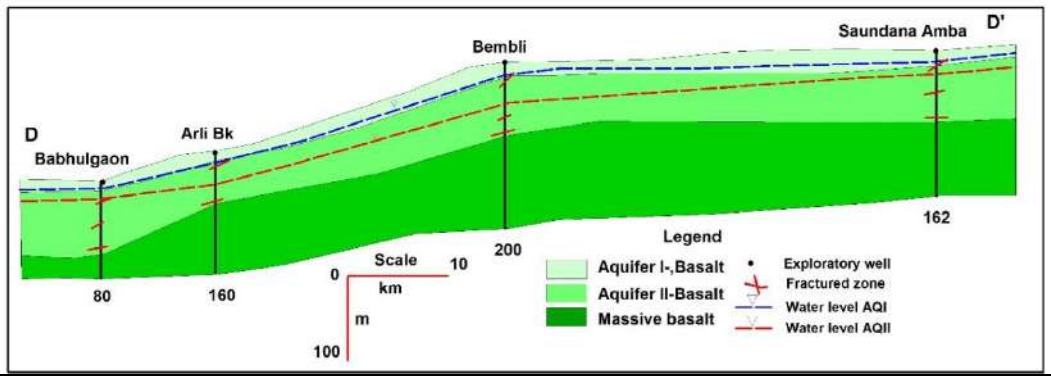


3.3. Cross Section

Section CC'

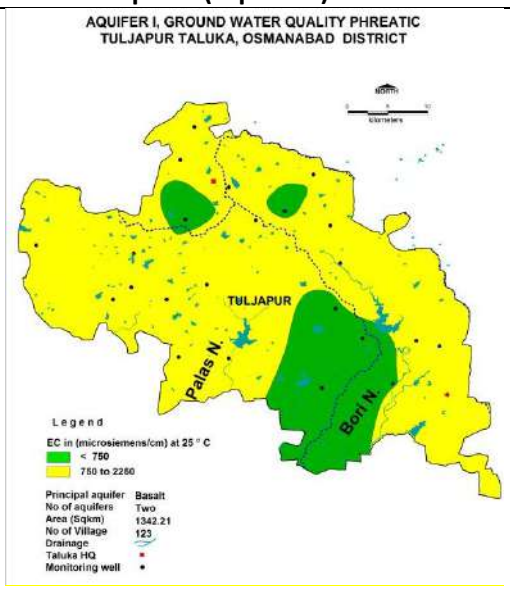
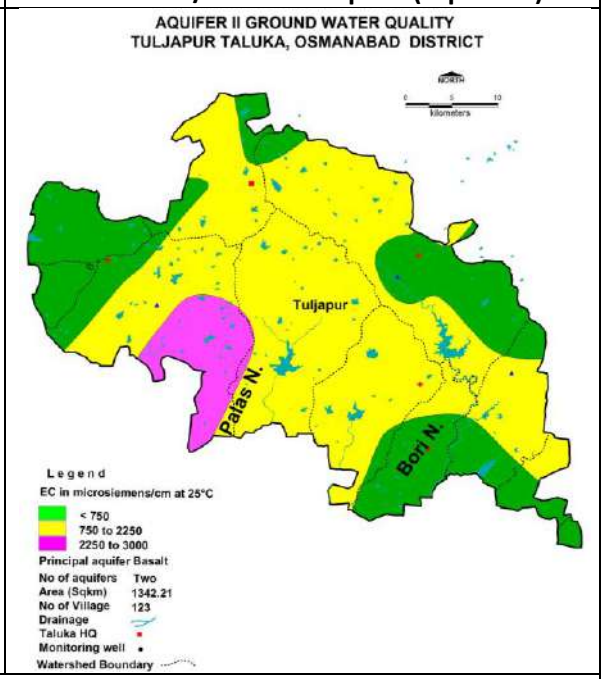


Section DD'



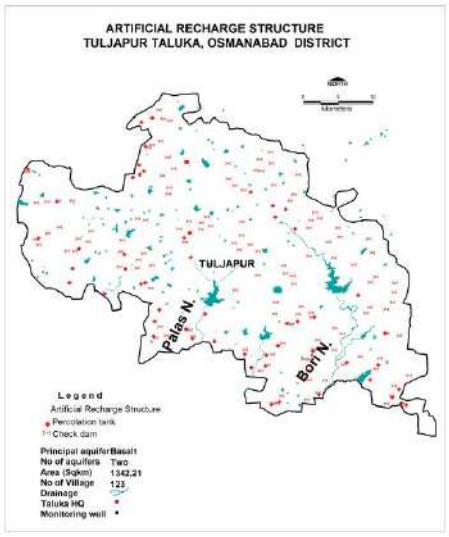
3.4. Basic Aquifer Characteristics

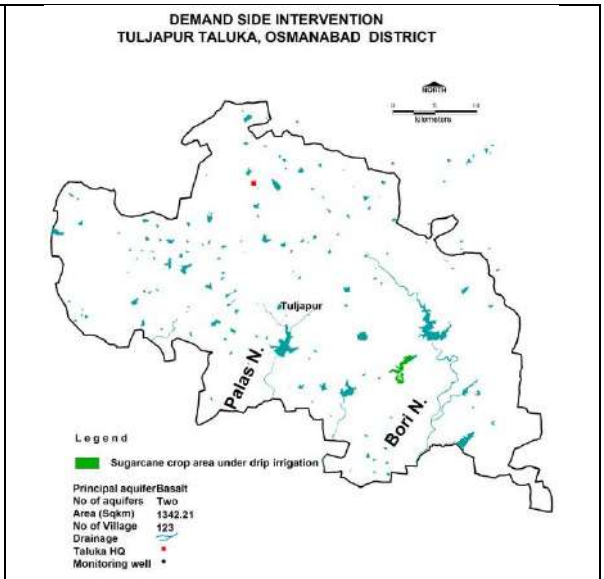
Major Aquifers	Basalt (Deccan Traps)	
Type of Aquifer (Phreatic/Semi confined /Confined)	Aquifer-I (Phreatic)	Aquifer-II (Semiconfined/confined)
Depth to bottom of Aquifer (mbgl)	10 to 34	90 to 170
Weathered/Fractured zones encountered (mbgl)	Upto 34	up to 170
Weathered/Fractured rocks thickness (m)	6 to 12	1 to 10
SWL (mbgl)	0.6 to 18.65	7 to 86
Yield	up to 100 m^3/day	up to 2.5 lps

Specific Yield/ Storativity (Sy/S)	0.019 to 0.028	3.34 x10^{-4} to 3.5 x10^{-5}
Transmissivity (T)	9.25 to 89.04 m^2/day	10.85 to 131.11 m^2/day
Sustainability	up to 100 m^3/day	up to to 2.5 lps
4. GROUND WATER QUALITY		
Phreatic Aquifer (Aquifer-I)	**Semi confined/Confined Aquifer(Aquifer II)**	
		
4.1 Aquifer-I/ Shallow Aquifer		
EC values between 250-750 µS/cm are observed in southern part and isolated patch in northern part of the block. EC values between 750 to 2250 µS/cm are observed in major part of the block. Ground water is suitable for all purposes in major part of the block except Nitrate and Fluoride affected villages. Hence ground water in these village is not suitable for drinking purpose without treatment.		
4.2 Aquifer II/Deeper Aquifer		
EC values up to 750 µS/cm are observed in northern, western, southern and eastern parts of the block. EC values between 750 to 2250 µS/cm are observed in major part of the block. EC values between 2250 to 3000 µS/cm are seen in south western part of the block. Ground water is suitable for all purposes in major part of the block except fluoride affected villages and villages; hence ground water in these village is not suitable for drinking purpose without treatment.		
5. GROUND WATER RESOURCE		
5.1 Aquifer-I/ Shallow Aquifer		
Ground Water Recharge Worthy Area (Sq. km.)	1342.21	
Total Annual Ground Water Recharge (MCM)	207.39	
Natural Discharge (MCM)	10.36	
Net Annual Ground Water Availability (MCM)	197.02	
Existing Gross Ground Water Draft for irrigation (MCM)	87.01	
Existing Gross Ground Water Draft for domestic and industrial water supply	4.90	

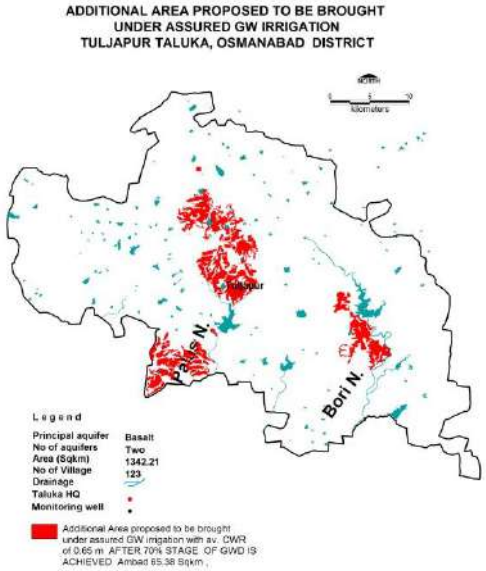
(MCM)				
Existing Gross Ground Water Draft for All uses (MCM)			91.92	
Provision for domestic and industrial requirement supply to 2025(MCM)			9.75	
Net Ground Water Availability for future irrigation development (MCM)			100.29	
Stage of Ground Water Development (%)			46.65	
Category			**SAFE**	
5.2 Aquifer-II/Deeper Aquifer				
Semi confined/Confined Aquifer (Basalt)				
Total Area (Sq. km.)	Mean aquifer thickness (m)	Average (Sy/S)	Piezometric Head (m above confining layer)	Total Resource (MCM)
1342.26	6.125	0.0044/0.0003	15	63.32
6.0. GROUND WATER RESOURCE ENHANCEMENT				
Available Resource (MCM)			197.03	
Gross Annual Draft (MCM)			91.92	
6.1. Supply Side Management				
SUPPLY (MCM)				
Agricultural Supply -GW			87.01	
Agricultural Supply -SW			184.08	
Domestic Supply - GW			4.91	
Domestic Supply - SW			1.23	
Total Supply			**277.23**	
Area of Block (Sq. km.)			1579.32	
Area suitable for Artificial recharge (Sq. km.)			1256.22	
Type of Formation			Hard rock	
Area feasible for Artificial Recharge (WL >5mbgl) (Sq. km.)			1256.22	
Volume of Unsaturated Zone (MCM)			2512.44	
Average Specific Yield			0.02	
Volume of Sub Surface Storage Space available for Artificial Recharge (MCM)			50.24	
Surplus water Available (MCM)			29.58	
Proposed Structures			Percolation Tank (Av. Gross Capacity-100 TCM*2 fillings = 200 TCM)	Check Dam (Av. Gross Capacity-10 TCM * 3 fillings = 30 TCM)
Number of Structures			54	132
Volume of Water expected to be conserved / recharged @ 75% efficiency (MCM)			8.1	2.97
Proposed Structures				
RTRWH Structures – Urban Areas				
Households to be covered (25% with 50 m^2area)			14300	

Total RWH potential (MCM)	0.479
Rainwater harvested / recharged @ 80% runoff co-efficient	0.383 Economically not viable & Not Recommended
6.2. Demand Side Management	
Micro irrigation techniques	
Sugarcane Area proposed for drip irrigation (sq. km.)	1
Volume of Water Saving by use of drip (MCM) Surface Flooding req- 2.45 m. Drip Req. - 1.88, WUE- 0.57 m	0.57
Alternate Sources	Nil
Proposed Cropping Pattern change	
Irrigated area under Water Intensive Crop (ha)	Not proposed
Water Saving by Change in Cropping Pattern	Nil
6.3. EXPECTED BENEFITS	
Net Ground Water Availability (MCM)	197.03
Additional GW resources available after Supply side interventions (MCM)	11.07
Ground Water Availability after Supply side intervention	208.1
Existing Ground Water Draft for All Uses (MCM)	91.92
GW draft after Demand Side Interventions (MCM)	91.35
Present stage of Ground Water Development (%)	46.65
Expected Stage of Ground Water Development after interventions (%)	43.90
Other Interventions Proposed, if any	
Alternate Water Sources Available	Nil
Recommendation	
Ground water development is recommended to bring the stage of ground water development from 43.90 % to 70%	
6.4. Development Plan	
Volume of water available for GWD to 70% (MCM)	54.32
Proposed Number of DW (@ 1.5 ham for 90% of GWR Available for development)	3259
Proposed Number of BW (@ 1 ham for 10% of GWR Available for development)	543
Additional Area to be brought under assured GW irrigation with av. CWR of 0.65 m (sq. km.)	83.57
Regulatory Measures	**60 m**
Supply Side Interventions	**Demand Side Interventions**
Proposed locations for AR structures	**Sugarcane Area proposed for drip Irrigation**

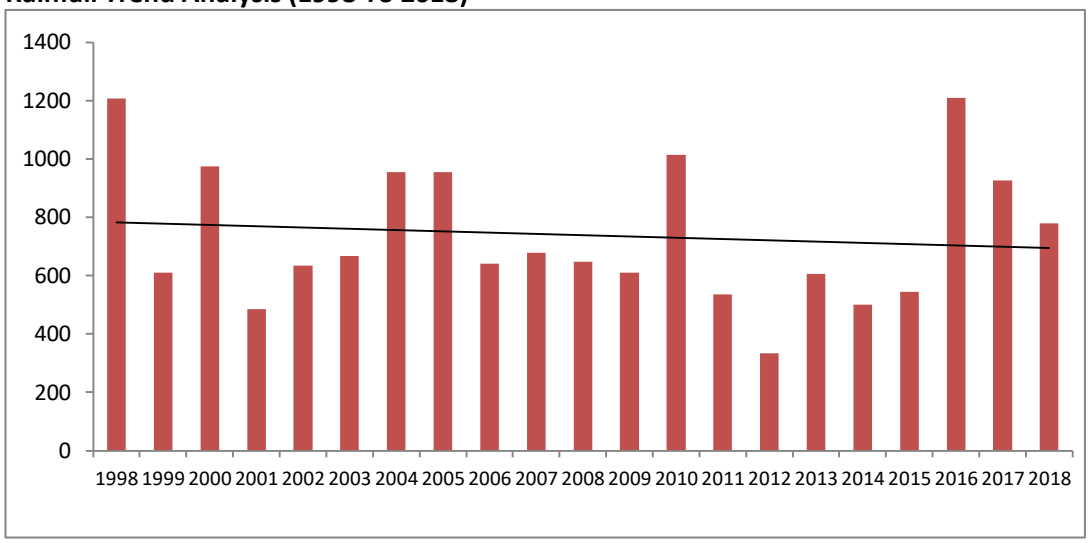




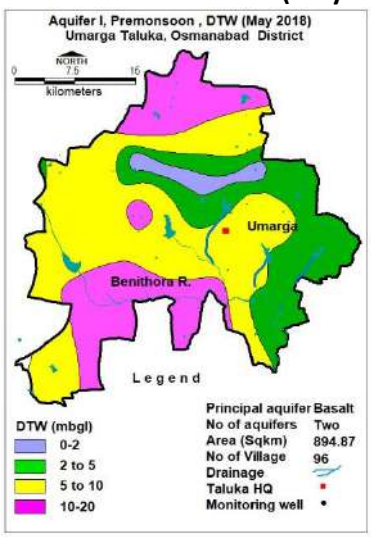
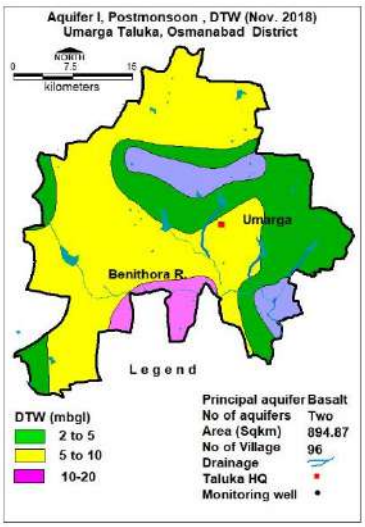
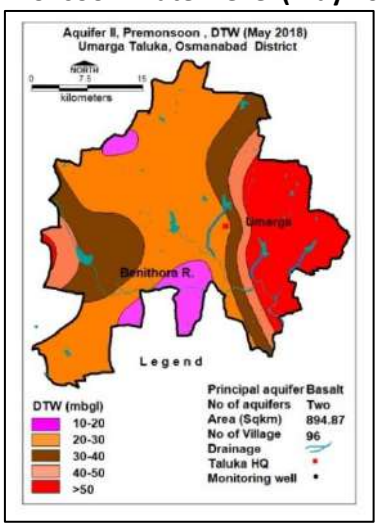
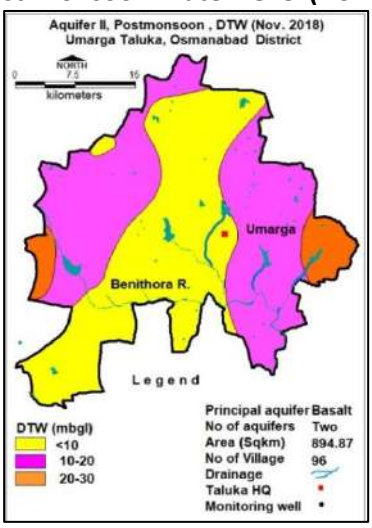
***Expected Benefits*: Additional area proposed to be bought under assured GW Irrigation**



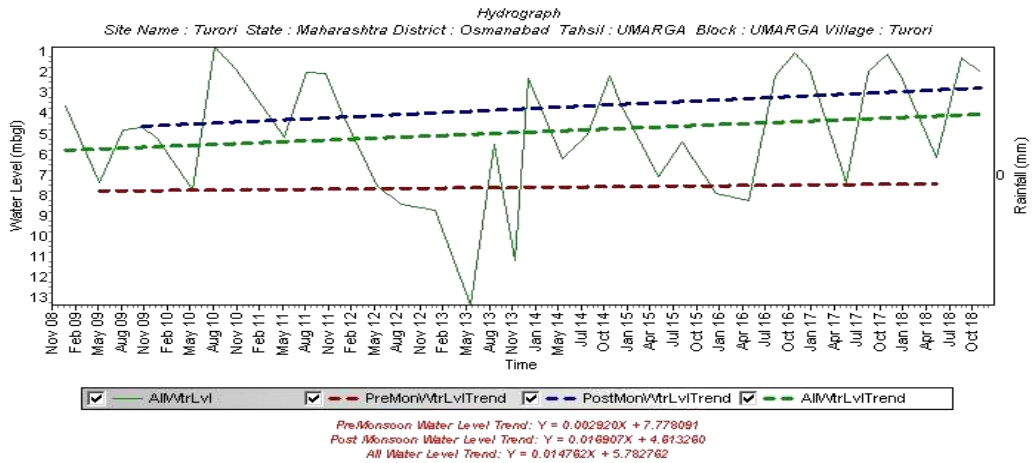
15. AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN, UMERGA BLOCK, OSMANABAD DISTRICT, MAHARASHTRA

4. SALIENT FEATURES		
1.1 Introduction		
Block Name	**UMERGA**	
Geographical Area (Sq. km.)	973.47 Sq. km.	
Hilly Area (Sq. km.)	78.60 Sq. km.	
Poor Ground Quality Area (Sq. km.)	Nil	
Population (2011)	2,69,519	
Climate	Sub-Tropical	
1.7 Rainfall Analysis		
Normal Rainfall	738.6 mm	
Annual Rainfall (2018)	778.1 mm	
Decadal Average Annual Rainfall (2009-2018)	703.59 mm	
Long Term Rainfall Analysis (1998 to 2018)	Declining Trend -4.31 mm/year Probability of Normal and Excess Rainfall- 43 % & 33 %. Probability of Droughts-: 19 % Moderate & 5 % Severe	
Rainfall Trend Analysis (1998 To 2018)		
		
EQUATION OF TREND LINE: Y= -4.3116x + 786.02		
1.3. Geomorphology, Soil & Geology		
Major Geomorphic Unit	Moderately dissected Plateau	
Soil	Clayey, Gravelly and Gravelly sandy clayey soil	
Geology	Deccan Traps (Basalt) Age: Upper Cretaceous to Eocene	
1.4. Hydrology & Drainage		
Drainage	Benithora river, tributary of Bhima River	
Hydrology ***(Reference year: DSA 2016-17)***	Major project	Completed: Turori Project (1989), generating a gross irrigation Potential of 1590 ha, Total storage capacity of 7.664 MCM. **Ongoing:** NIL
	Medium project	**Completed:** 02; Benitura projects generating a gross irrigation Potential of 2293 ha, total

		Storage Capacity of 12.84 MCM Jekekur project generating a gross irrigation Potential of 1584 ha, Total Storage Capacity of 10.176 MCM **Ongoing: Nil**
	Irrigation Project (0-100 Ha.)	**Completed**: 139 Small irrigation projects covering an area of 3836 ha has been completed at zilla parishad level.
	Irrigation Project (101-250 Ha.)	**Completed**: 2 Small irrigation projects covering an area of 228 ha has been completed at Local level.
1.5. Land Use, Agriculture, Irrigation & Cropping Pattern		
Geographical Area	973.47 Sq. km.	
Forest Area	10.74 Sq. km.	
Cultivable Area	876.16 Sq. km.	
Net Sown Area	876.16 Sq. km.	
Double Cropped Area	500.09 Sq. km.	
Area under Irrigation – Surface Water	120.19 Sq. km.	
Area under Irrigation – Ground Water	7.10 Sq. km.	
Principal Crops ***(Reference year 2017)***	**Crop Type**	**Area (Sq. km.)**
	Cereals	447.75
	Pulses	542.34
	Oil Seeds	323.30
	Sugarcane	50.16
Horticultural Crops	Mango	2.48
	Banana	0.58
	Grapes	0.55
	Citrus fruit	0.05
1.6. Water Level Behavior		
1.6.1. Aquifer-I/Shallow Aquifer		
Pre-Monsoon (May-2018)		**Post-Monsoon (November-2018)**
Water level less than 2 mbgl has been observed in small isolated patch in central part of the block covering an area of 32 sq km whereas water level in the range of 2-5 mbgl is seen in central and eastern part of the block covering an area of 238 sq km. water level between 5-10 mbgl is observed in major part of the block covering an area of 476 sq km. Deeper water level >10 mbgl is seen in southern and northern part of block covering an area of 252 sq km.		Water levels less than 2 mbgl are observed in small isolated patch in central and south eastern part of the block covering an area of 82 sq km; water level in the range of 2-5 mbgl is observed in central and eastern part of the block covering an area of 295 sq km. water level between 5-10 mbgl is major part of block covering an area of 575 sq km. water level >10 is seen in southern fringes of the block covering an area of 45 sq km.

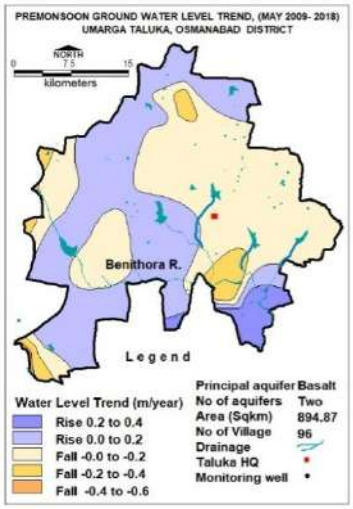
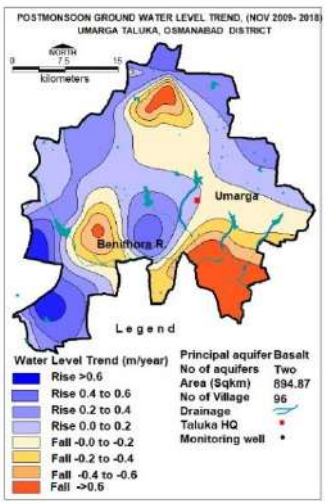
Pre-Monsoon Water Level (May 2018)	**Post-Monsoon Water Level (Nov. 2018)**
	
WL>10 mbgl 252 sq. km.	**WL >10 mbgl 45 sq. km.**
1.6.2. Aquifer-II/Deeper Aquifer	
Pre-Monsoon (May-2018)	**Post-Monsoon (November-2018)**
Water level <20 mbgl is observed in smaller part in southern and northern part of the block covering an area of 62 sq km. Water level between 20-30 mbgl is observed as continuous patch from north to south covering an area of 474 sq km; Water level between 30-40 mbgl is observed in southwestern and as thin continuous patch from north to south covering an area of 192 sq km. water level between 40-50 mbgl is seen in western and eastern parts of the block covering an area of 77 sq km. deeper water level > 50 mbgl is seen eastern part of the block covering an area of 194 sq km.	Water level <10 mbgl is seen as continuous patch from northeast to southwest covering an area of 454 sq km. Water level between 10-20 mbgl is observed in major part of block covering an area of 479 sq km. Water level >20 mbgl is observed in eastern and western part of the block and cover 65 sq. km. area of the block.
Pre-Monsoon Water Level (May 2018)	**Post-Monsoon Water Level (Nov.-2018)**
	
WL>50 mbgl 194 sq. km.	**WL>20 mbgl 65 sq. km.**

1.7. Hydrographs



Hydrograph shows Pre-monsoon rising water level trend @0.035 m/year and Post monsoon rising water level trend @0.202 m/yr.

1.8. Water Level Trend (2009-18)

Pre-Monsoon trend	**Post-Monsoon trend**
Rising 0.031 to 0.384 m/year Falling 0.034 to 0.387 m/year	Rising 0.080 to 1.178 m/year Falling 0.0052 to 1.805 m/year
Major part of the block shows falling trend up to 0.2 m/year covering about 480 sq km area whereas rise in water level has been observed as continuous patch from north to south of the block covering about 426 sq km area of the block. Rising trend more than 0.2 m/year has been observed in southern part of the block while decline in water level >0.2 m/year has been observed in isolated patches in southern part and isolated patched in northern parts of the block covering about 51 sq km area.	Major part of the block shows rising water level. Rising trend more than 0.2 m/year has been observed in southwestern, northern and southern part of the block covering 567 sq km. Fall in water level up to 0.2 m/year has been observed in eastern half and southern part of the block while decline in water level >0.2 m/year has been observed in southern and northern parts of the block covering about 220 sq km area.
Pre-Monsoon Water Level Trend (2009-18)	**Post-Monsoon Water Level Trend (2009-18)**
	
Declining trend @>0.2 m/yr 51sq. km.	**Declining trend @>0.2 m/yr 220 sq. km.**

2. Ground Water Issues

Declining water level Trend: -

- Post monsoon (2009-18), decline in water level trend more than 0.2 m/year is observed in about 220 sq. km. covering about 22 % area of the block.

Ground Water Quality:

- **Nitrate Contamination**: In deeper aquifer 33% of wells are also showing nitrate contamination (NO_3>45 mg/L).

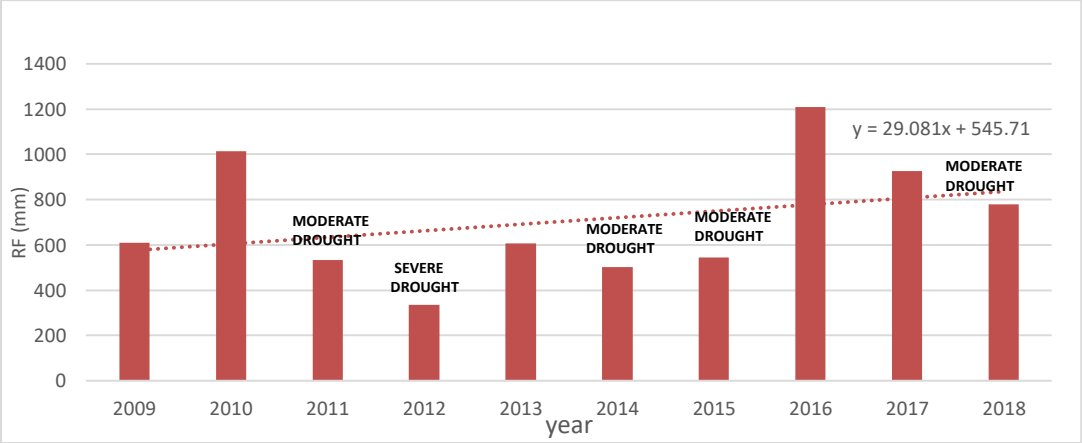
Low yielding Aquifer resulting poor sustainability: -

Limited extent of porous and pervious zone because of predominance of secondary porosity that has evolved from prevailing erratic joint pattern and also absence of primary porosity results in poor sustainability of the aquifers. About 46 % area of the block has low yield potential (< 1 lps) and can sustain pumping only for 1 to 1.5 hrs.

Low rainfall and Droughts: -

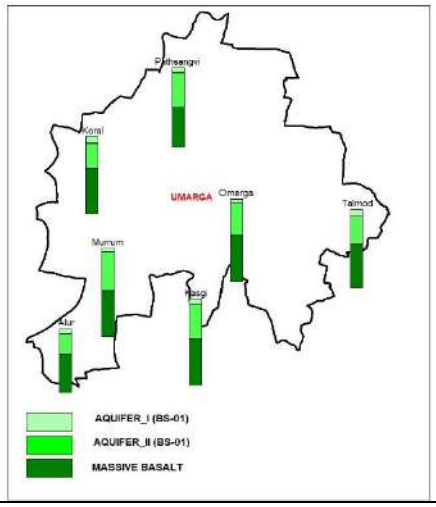
The long-term rainfall analysis for the period 1998-2018 indicates that normal rainfall of washi block is 736.8 mm, In addition, its indicates a falling rainfall trend @ 4.31 mm/year with 19% probability of moderate and 5 5 severe droughts.

Based on the short-term rainfall data from 2009-2018 for the block was also analysed and it indicates that average rainfall is 703.59 mm. The rainfall from last ten years showing the area continuously experienced low and declining rainfall with frequent droughts.



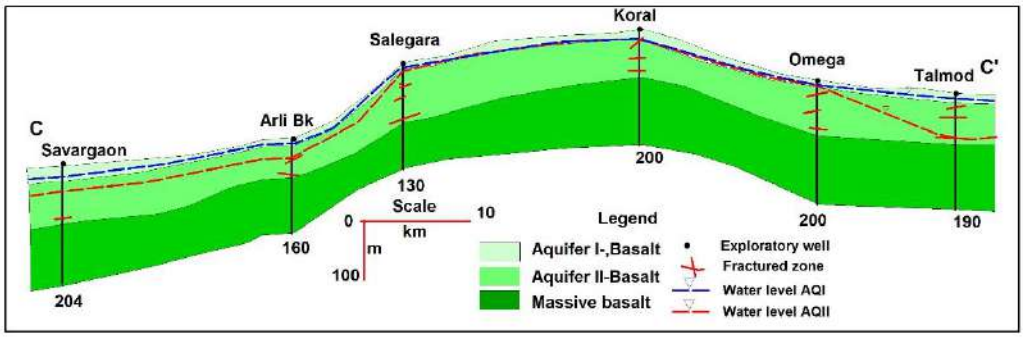
3. AQUIFER DISPOSITION	
3.1. Number of Aquifers	Basalt –Aquifer-I, Aquifer-II

3.2. Lithological disposition



3.3. Cross Section

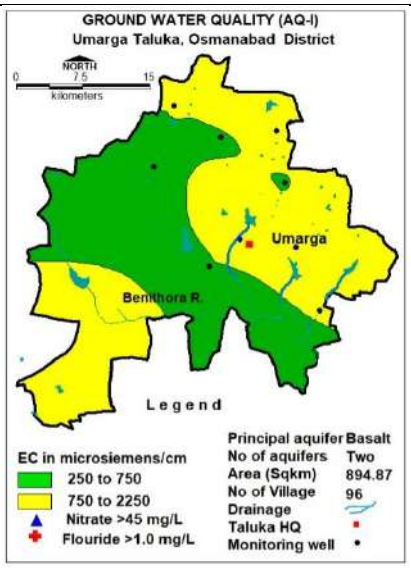
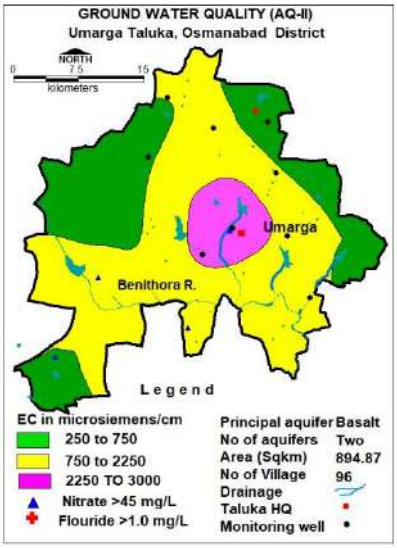
Section



3.4. Basic Aquifer Characteristics

Major Aquifers	Basalt (Deccan Traps)	
Type of Aquifer (Phreatic/Semi confined/Confined)	Aquifer-I (Phreatic)	Aquifer-II (Semiconfined/confined)
Depth to bottom of Aquifer (mbgl)	12 to 30	95 to 145
Weathered/Fractured zones encountered (mbgl)	Upto 30	up to 145
Weathered/Fractured rocks thickness (m)	8to 12	4 to 9
SWL (mbgl)	0.6 to 18.65	7 to 66
Yield	up to 70 m^3/day	up to 1.75 lps
Specific Yield/ Storativity (Sy/S)	0.023 to 0.025	2.65 x10^{-4} to 3.05 x10^{-5}
Transmissivity (T)	12.25 to 35.04 m^2/day	10.85 to 60.11 m^2/day
Sustainability	1 to 2.50 hrs	up to to 3.00 hrs

4. GROUND WATER QUALITY

Phreatic Aquifer (Aquifer-I)	**Semiconfined/Confined Aquifer(Aquifer II)**
	

4.1 Aquifer-I/ Shallow Aquifer

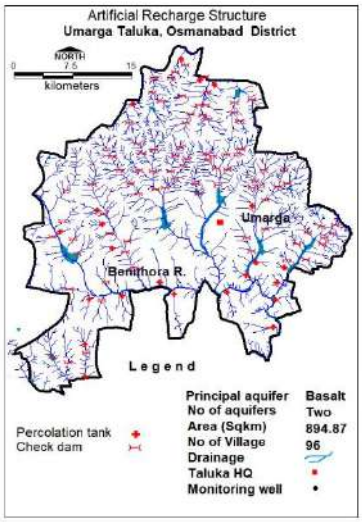
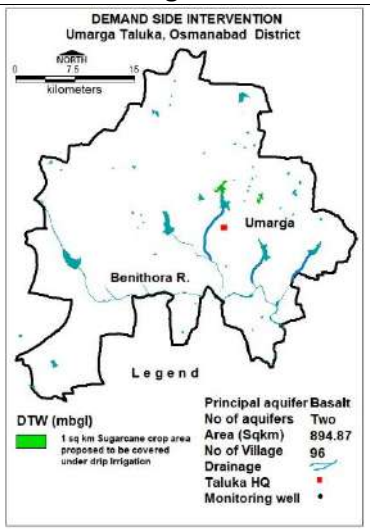
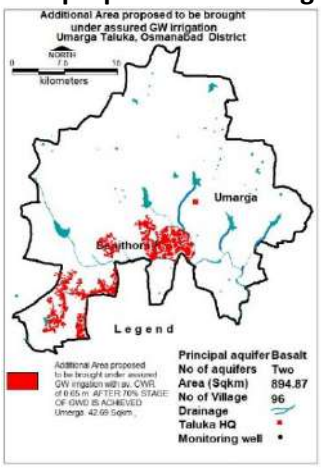
EC up to 750 µS/cm is observed as continuous patch from northwest to southeast part covering an area of 431 sq km. EC values between 750 to 2250 µS/cm are observed in eastern and southern part of the block covering area of 568 sq km. Ground water is suitable for all purposes in major part of the block except Nitrate affected villages.

4.2 Aquifer II/Deeper Aquifer

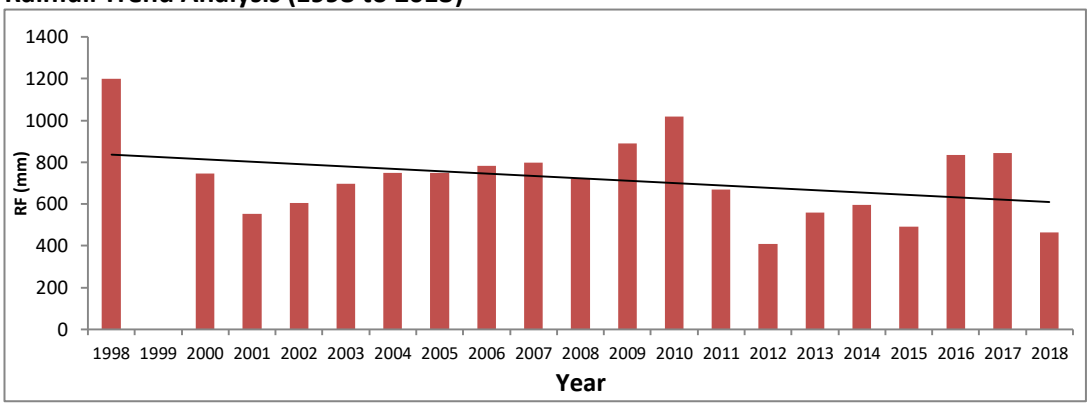
EC up to 750 µS/cm is observed in northwestern and northeastern peripheral parts of the

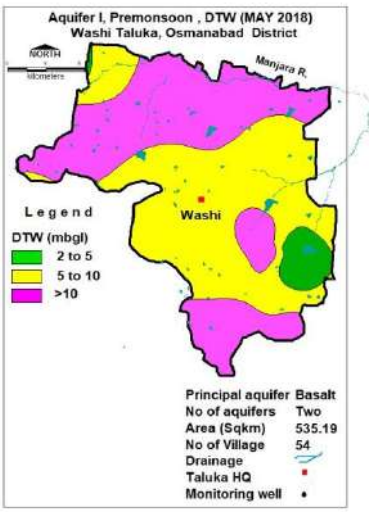
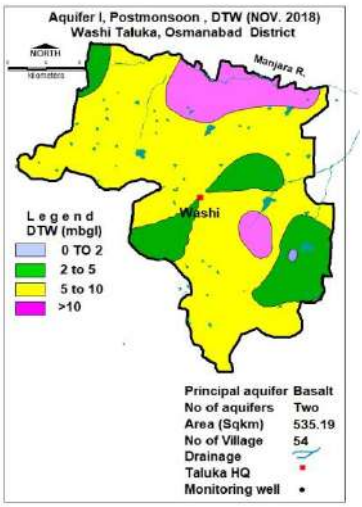
block covering an area of 314 sq km. EC values between 750 to 2250 µS/cm are observed in major part of the block covering an area of 603 sq km. EC values > 2250 µS/cm is seen in central part of the block as isolated patch covering an area of 81 sq km. Ground water is suitable for all purposes in major part of the block except fluoride affected villages.				
5. GROUND WATER RESOURCE				
5.1 Aquifer-I/ Shallow Aquifer				
Ground Water Recharge Worthy Area (Sq. km.)			894.87	
Total Annual Ground Water Recharge (MCM)			147.12	
Natural Discharge (MCM)			7.35	
Net Annual Ground Water Availability (MCM)			139.76	
Existing Gross Ground Water Draft for irrigation (MCM)			71.02	
Existing Gross Ground Water Draft for domestic and industrial water supply (MCM)			3.34	
Existing Gross Ground Water Draft for All uses (MCM)			74.37	
Provision for domestic and industrial requirement supply to 2025(MCM)			6.26	
Net Ground Water Availability for future irrigation development (MCM)			63.47	
Stage of Ground Water Development (%)			53.21	
Category			**SAFE**	
5.2 Aquifer-II/Deeper Aquifer				
Semi confined/Confined Aquifer (Basalt)				
Total Area (Sq. km.)	Mean aquifer thickness (m)	Average (Sy/S)	Piezometric Head (m above confining layer)	Total Resource (MCM)
894.43	4.5	0.0042/0.0004	18.33	26.61
6.0. GROUND WATER RESOURCE ENHANCEMENT				
Available Resource (MCM)			139.77	
Gross Annual Draft (MCM)			74.37	
6.1. Supply Side Management				
SUPPLY (MCM)				
Agricultural Supply -GW			71.03	
Agricultural Supply -SW			95.00	
Domestic Supply - GW			3.35	
Domestic Supply - SW			0.84	
Total Supply			**170.22**	
Area of Block (Sq. km.)			973.47	
Area suitable for Artificial recharge (Sq. km.)			400.74	
Type of Formation			Hard rock	
Area feasible for Artificial Recharge (WL >5mbgl) (Sq. km.)			400.74	
Volume of Unsaturated Zone (MCM)			801.478	
Average Specific Yield			0.02	
Volume of Sub Surface Storage Space available for Artificial Recharge (MCM)			16.03	

Surplus water Available (MCM)	9.44	
Proposed Structures	Percolation Tank (Av. Gross Capacity-100 TCM*2 fillings = 200 TCM)	Check Dam (Av. Gross Capacity-10 TCM * 3 fillings = 30 TCM)
Number of Structures	22	89
Volume of Water expected to be conserved / recharged @ 75% efficiency (MCM)	3.3	2.00
Proposed Structures		
RTRWH Structures – Urban Areas		
Households to be covered (25% with 50 m^2area)	13,800	
Total RWH potential (MCM)	0.485	
Rainwater harvested / recharged @ 80% runoff co-efficient	0.388 Economically not viable & Not Recommended	
6.2. Demand Side Management		
Micro irrigation techniques		
Sugarcane crop area (50.16), about 1 sqkm area is ground water irrigated ,100 % ground water irrigated (1 sqkm) proposed to be covered under Drip (sq.km.)	1	
Volume of Water expected to be saved (MCM). Surface Flooding req- 2.45 m. Drip Req. - 1.88, WUE- 0.57 m	0.57	
Alternate Sources	Nil	
Proposed Cropping Pattern change		
Irrigated area under Water Intensive Crop (ha)	Not proposed	
Water Saving by Change in Cropping Pattern	Nil	
6.3. EXPECTED BENEFITS		
Net Ground Water Availability (MCM)	139.77	
Additional GW resources available after Supply side interventions (MCM)	5.30	
Ground Water Availability after Supply side intervention	145.07	
Existing Ground Water Draft for All Uses (MCM)	74.37	
GW draft after Demand Side Interventions (MCM)	73.80	
Present stage of Ground Water Development (%)	53.21	
Expected Stage of Ground Water Development after interventions (%)	50.87	
Other Interventions Proposed, if any		
Alternate Water Sources Available	Nil	
Recommendation		
Ground water development is recommended to bring the stage of ground water development from 50.87 % to 70%		
6.4. Development Plan		

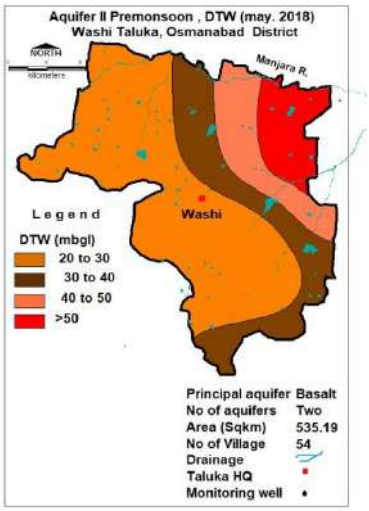
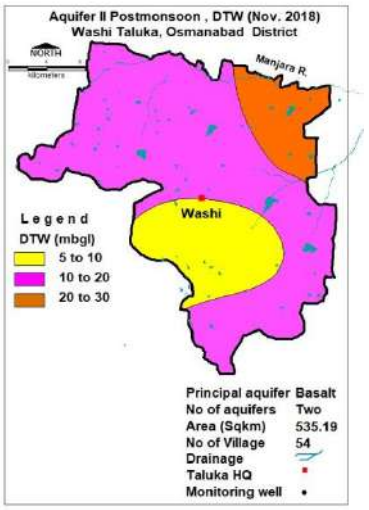
Volume of water available for GWD to 70% (MCM)	27.75
Proposed Number of DW (@ 1.5 ham for 90% of GWR Available)	1665
Proposed Number of BW (@ 1 ham for 10% of GWR Available)	278
Additional Area (sq.km.) proposed to be brought under assured GW irrigation with av. CWR of 0.65 m AFTER 70% STAGE OF GWD IS ACHIEVED.	42.69
Regulatory Measures	**60 m**
Supply Side Interventions	**Demand Side Interventions**
Proposed locations for AR structures	**Sugarcane Area proposed for drip Irrigation**
	
***Expected Benefits*: Additional area proposed to be bought under assured GW Irrigation** 		

16. AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN, WASHI BLOCK, OSMANABAD DISTRICT, MAHARASHTRA

1. SALIENT FEATURES		
1.1 Introduction		
Block Name	**WASHI**	
Geographical Area (Sq. km.)	586.17Sq. km.	
Hilly Area (Sq. km.)	50.98 Sq. km.	
Poor Ground Quality Area (Sq. km.)	Nil	
Population (2011)	92,150	
Climate	Sub-Tropical	
1.2 Rainfall Analysis		
Normal Rainfall	718.5 mm	
Annual Rainfall (2018)	463mm	
Decadal Average Annual Rainfall (2009-18)	677.18 mm	
Long Term Rainfall Analysis (1998-2018)	Declining Trend 11.33 mm/year Probability of Normal and Excess Rainfall - 55% & 21% Probability of Droughts -: 19% Moderate and 5% Severe	
Rainfall Trend Analysis (1998 to 2018)  ***EQUATION OF TREND LINEy = -11.335x + 848.28***		
1.3. Geomorphology, Soil & Geology		
Major Geomorphic Unit	Moderately and highly dissected Plateau	
Soil	Clayey and Gravelly sandy clay soil	
Geology	Deccan Traps (Basalt) Age: Late Cretaceous to Eocene	
1.4. Hydrology & Drainage		
Drainage	Manjra river and its tributaries	
Hydrology ***(Reference DSA Year: June 2016-17)***	Major project	**Nil**
	Medium project	**Completed:** 03; Chandni and Khaspur and Satak irrigation projects generating a gross irrigation Potential of 2924 ha, and 2975, 2826 Gross Storage Capacity of 23.870 MCM 13.59 and 3.009 respectively.
	Irrigation Project (100-250 Ha)	**Completed:** 01 irrigation projects; generating a gross irrigation Potential of 133 ha.

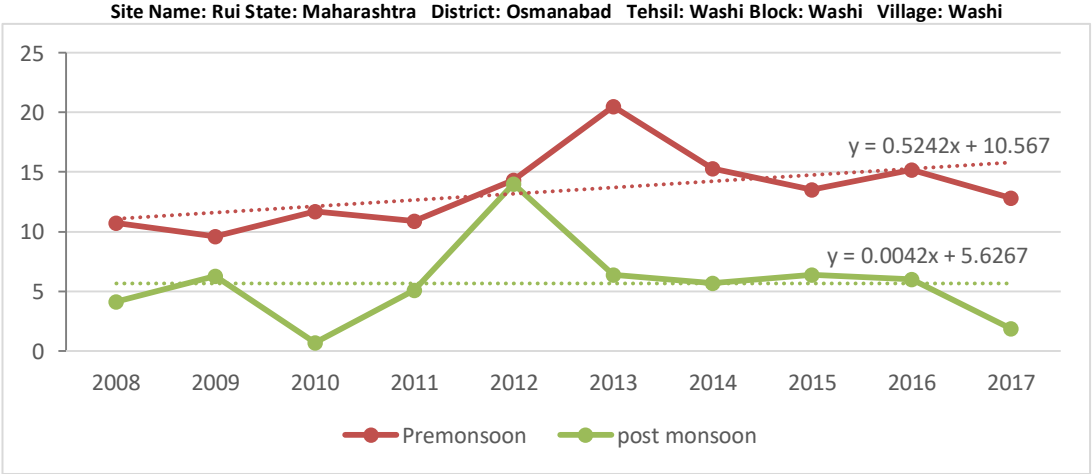
		Irrigation Project (<100 Ha)	**Completed:** 165 irrigation projects; generating a gross irrigation Potential of 6239 ha.
1.5. Land Use, Agriculture, Irrigation & Cropping Pattern			
Geographical Area		586.17Sq. km.	
Forest Area		5.09 Sq. km.	
Cultivable Area		752.85 Sq. km.	
Net Sown Area		477.66 Sq. km.	
Double Cropped Area		275.19 Sq. km.	
Area under Irrigation	Surface Water	35.53 Sq. km.	
	Ground Water	1.48 Sq. km.	
Principal Crops *(Reference year 2017)*		**Crop Type**	**Area (Sq. km.)**
		Cereals	244.49
		Pulses	211.20
		Oil Seeds	204.63
		Sugarcane	12.01
		Cotton	52.63
Horticultural Crops		Mango	2.27
		Citrus fruits	0.35
		Banana	0.67
		Grapes	0.28
1.6. Water Level Behavior			
1.6.1. Aquifer-I/Shallow Aquifer			
Pre-Monsoon (May-2018)		**Post-Monsoon (November-2018)**	
Water level less than 5 mbgl has been observed in isolated patch in eastern part of the block; Water level between 5 to 10 mbgl has been observed in central part of the block whereas water levels more than 10 mbgl have been observed in northern and southern part of the block covering about 272 sq. km. area.		Water levels less than 5 mbgl have been observed in central, western and eastern parts of the block; water levels between 5 to 10 mbgl have been observed in major part of the block whereas water levels more than 10 mbgl have been observed as isolated patches in northern and central parts of the block covering about 76 sq. km. area.	
Pre-Monsoon Water Level (May 2018)		**Post-Monsoon Water Level (Nov. 2018)**	
			
WL>10 mbgl 272 sq. km.		**WL>10 mbgl 76 sq. km.**	

1.6.2. Aquifer-II/Deeper Aquifer

Pre-Monsoon (May-2018)	Post-Monsoon (November-2018)
Water levels between 20 to 30 mbgl are observed in southern half of the block; water levels more than 30 mbgl have been observed in eastern half of the block covering about 270 sq. km. area of the block.	Water levels less than 10 mbgl are observed in western part of the block. Water levels between 10 to 20 mbgl have been observed in major part of the block whereas more than 20 mbgl has been observed as isolated patch in north eastern part of the block and cover 69 sq. km. area.
Pre-Monsoon Water Level (May 2018)	**Post-Monsoon Water Level (Nov.-2018)**
	
WL> 30 mbgl 270 sq. km.	**WL> 20 mbgl 69 sq. km.**

1.7. Hydrograph

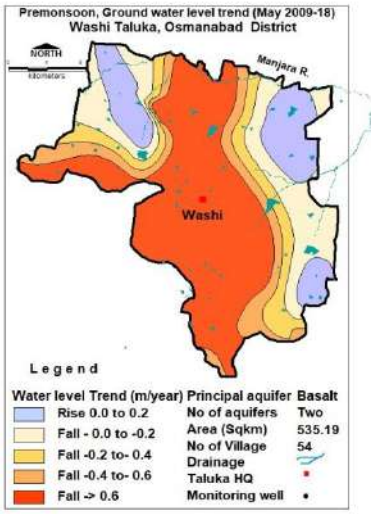
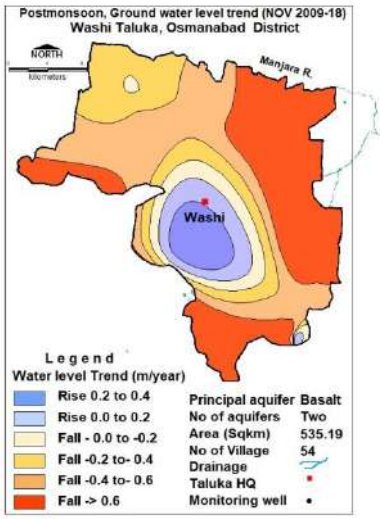
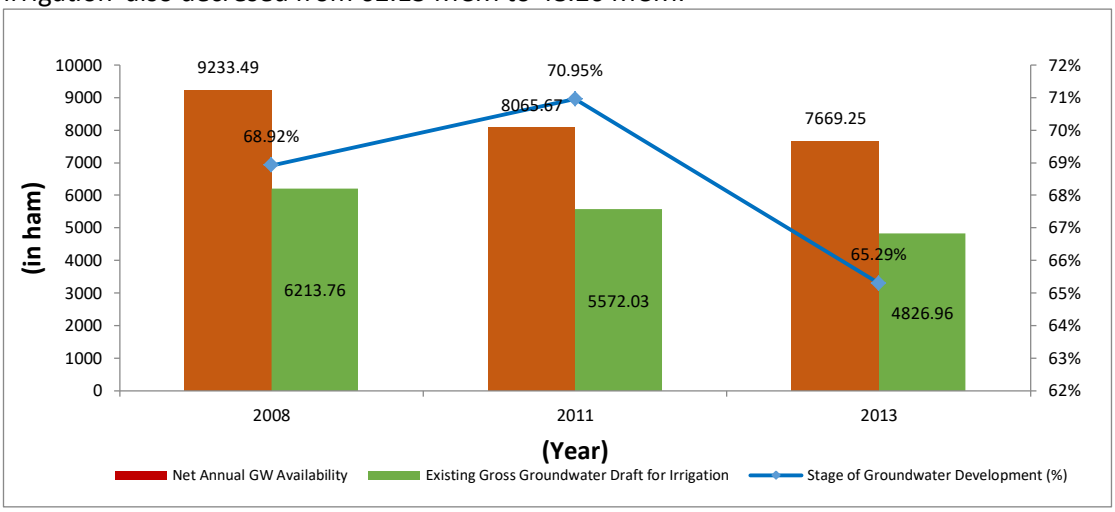
Site Name: Rui State: Maharashtra District: Osmanabad Tehsil: Washi Block: Washi Village: Washi



Hydrograph shows Pre-monsoon Rising water level trend @ 0.52 m/year and Post monsoon rising water level trend @ 0.0042 m/year

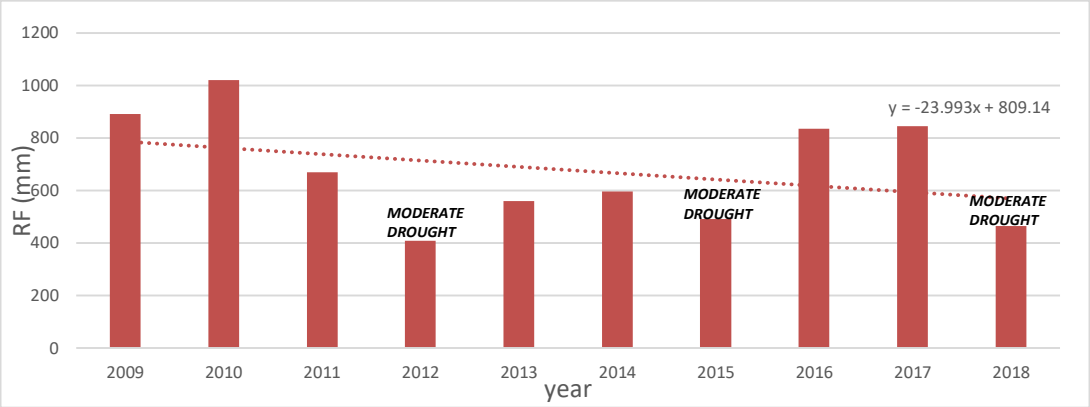
1.8. Water Level Trend (2009-18)

Pre-Monsoon trend	**Post-Monsoon trend**
Rising 0.0216 to 0.19 m/year Falling 0.12 to 1.65 m/year	Rising 0.073 to 0.622 m/year Falling 0.071 to 1.770 m/year
Decline in water level up to 0.2 m/year has been observed in eastern and north western parts of the block while rise in water level up to 0.2 m/year has been observed in	Declining water level trend up to 0.2 m/year has been observed in west central part of the block while rise in water level up to 0.2 m/year has been observed in isolated patch

isolated patches in northern and eastern parts of the block. Declining trend more than 0.2 m/year has been observed in major part of the block covering about 409 sq. km. area.	in western part of block. Decline more than 0.2 m/year has been observed in major part of the block covering 490 sq km area.
Pre-Monsoon Water Level Trend (2009-18)  **Declining trend @>0.2 m/year 409 sq. km.**	**Post-Monsoon Water Level Trend (2009-18)**  **Declining trend @>0.2 m/year 490 sq. km.**
2. Ground Water Issues	
Exploitation of Ground Water: - The stage of ground water development has increased from 2009 to 2011 and afterwards decreased from 70.95% to 65.29% from 2011 to 2013 in Washi block**.** Further, the net ground water availability decreased from 92.33 MCM to 76.69 MCM and the draft for irrigation also decresed from 62.13 MCM to 48.26 MCM.  **Declining water level Trend : -** • Pre monsoon (2009-18): decline in water level trend more than 0.2 m/year is observed in about 409 sq. km. covering about 67% area of the block. • Post monsoon (2009-18): decline in water level trend more than 0.2 m/year is observed in about 490 sq. km. covering about 80 % area of the block. **Low rainfall and Droughts:** The long-term rainfall analysis for the period 1998-2018 indicates that normal rainfall of Washi block is 718.5 mm, and also indicates a falling rainfall trend @ 11.33 mm/year with	

15% probability of moderate drought.

Based on the short-term rainfall data from 2009-2018 for the block, the analysis indicates that average rainfall is 677.18 mm. The rainfall from last ten years shows that the area continuously experienced low and declining rainfall with frequent moderate droughts.



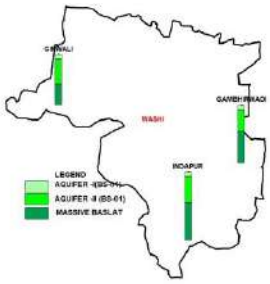
Low yielding Aquifer resulting poor sustainability:

Limited extent of porous and pervious zone, because of predominance of secondary porosity that has evolved from prevailing erratic joint pattern and also the absence of primary porosity, results in poor sustainability of the aquifers. About 51% area of the block has low yield potential (< 1 lps) and can sustain pumping only for 1-1.5 hrs.

3. AQUIFER DISPOSITION

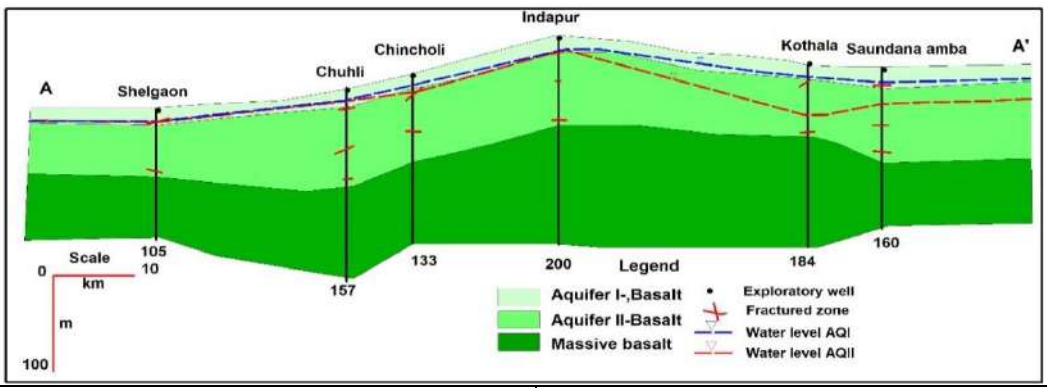
3.1. Number of Aquifers	Basalt –Aquifer-I, Aquifer-II

3.2. Lithological disposition



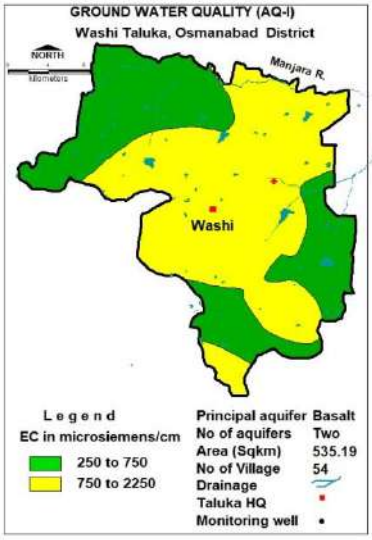
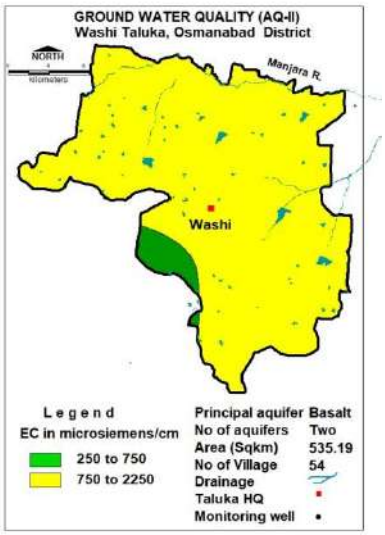
3.3. Cross Section

Section AA'



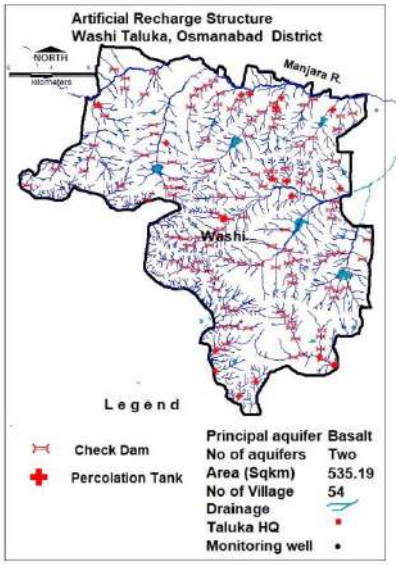
3.4. Basic Aquifer Characteristics

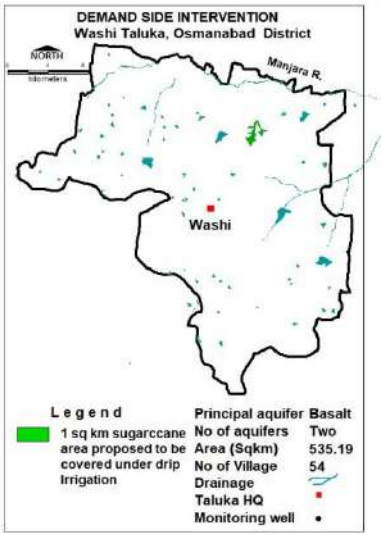
Major Aquifers	**Basalt (Deccan Traps)**	
Type of Aquifer (Phreatic/Semi confined/Confined)	Aquifer-I (Phreatic)	Aquifer-II (Semiconfined/confined)
Depth to bottom of Aquifer (mbgl)	12 to 28	95 to 145
Weathered/Fractured zones encountered (mbgl)	up to 28	up to 145

Weathered/Fractured rocks thickness (m)	5 to 11	1 to 10
SWL (mbgl)	3.50 to 18.7	8 to 21.8
Specific yield/Storativity (S)	0.021 to 0.026	3.35×10^{-4} to 3.65×10^{-5}
Transmissivity (T)	15.00 to 70.50 m^2/day	15.00 to 110.00 m^2/day
Yield	up to 90 m^3/day	up to to 2.5 lps
Sustainability	2 to 4 hrs	1 to 5 hrs
4. GROUND WATER QUALITY		
4.1 Aquifer-I/ Shallow Aquifer		
EC values up to 750 µS/cm are observed in northern and southern parts of the block and EC values between 750 to 2250 µS/cm are observed in major part of the block. Ground water is suitable for all purposes except Pimpalgaon village having Fluoride more than 1 mg/L.		
4.2 Aquifer II/Deeper Aquifer		
EC up to 750 µS/cm is observed in western part of the block and EC value between 750 to 2250 µS/cm is observed in entire block. Ground water is suitable for all purposes.		
Phreatic Aquifer (Aquifer-I)	**Semi confined/Confined Aquifer (Aquifer II)**	
		
5. GROUND WATER RESOURCE		
5.1 Aquifer-I/ Shallow Aquifer		
Ground Water Recharge Worthy Area (Sq. km.)	535.18	
Total Annual Ground Water Recharge (MCM)	80.72	
Natural Discharge (MCM)	4.03	
Net Annual Ground Water Availability (MCM)	76.69	
Existing Gross Ground Water Draft for irrigation (MCM)	48.26	
Existing Gross Ground Water Draft for domestic and industrial water supply (MCM)	1.79	
Existing Gross Ground Water Draft for All uses (MCM)	50.06	
Provision for domestic and industrial	3.60	

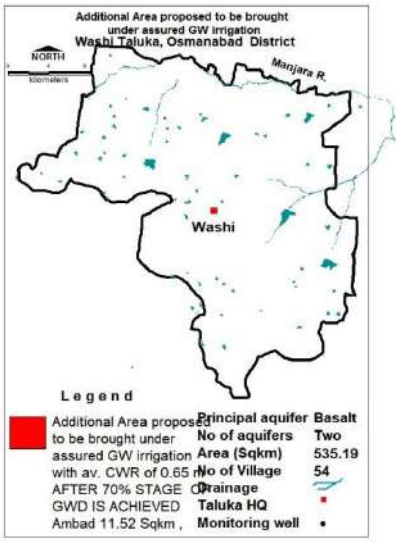
requirement supply to 2025(MCM)				
Net Ground Water Availability for future irrigation development (MCM)			24.83	
Stage of Ground Water Development (%)			65.29	
Category			**SAFE**	
5.2 Aquifer-II/Deeper Aquifer				
Semi confined/Confined Aquifer (Basalt)				
Total Area (Sq. km.)	Mean aquifer thickness (m)	Av (Sy/S)	Piezometric Head (m above confining layer)	Total Resource (MCM)
535.17	4.5	0.0033/0.0005	19	13.96
6.0. GROUND WATER RESOURCE MANAGEMENT				
Available Resource (MCM)			76.69	
Gross Annual Draft (MCM)			50.07	
6.1. Supply Side Management				
SUPPLY (MCM)				
Agricultural Supply -GW			48.27	
Agricultural Supply -SW			31.9	
Domestic Supply - GW			1.8	
Domestic Supply - SW			0.45	
Total Supply			**82.42**	
Area of Block (Sq. km.)			1126.41	
Area suitable for Artificial recharge (Sq. km.)			586.17	
Type of Formation			Hard Rock	
Area feasible for Artificial Recharge (WL >5mbgl) (Sq. km.)			586.17	
Volume of Unsaturated Zone (MCM)			1070.36	
Average Specific Yield			0.02	
Volume of Sub Surface Storage Space available for Artificial Recharge (MCM)			21.40	
Surplus water Available (MCM)			12.60	
Proposed Structures			Percolation Tank (Av. Gross Capacity-100 TCM*2 fillings = 200 TCM)	Check Dam (Av. Gross Capacity-10 TCM * 3 fillings = 30 TCM)
Number of Structures			15	110
Volume of Water expected to be conserved / recharged @ 75% efficiency (MCM)			2.25	2.48
Proposed Structures				
RTRWH Structures – Urban Areas				
Households to be covered (25% with 50 m^2area)			5235	
Total RWH potential (MCM)			0.485	
Rainwater harvested / recharged @ 80% runoff co-efficient			0.388 Economically not viable & Not Recommended	
6.2. Demand Side Management				
Micro irrigation techniques				

Sugarcane crop area proposed for drip irrigation (sq. km.)	1
Volume of Water Saving by use of drip (MCM) Surface Flooding req- 2.45 m. Drip Req. - 1.88, WUE- 0.57 m	0.57
Proposed Cropping Pattern change	
Irrigated area under Water Intensive Crop (ha)	Not proposed
Water Saving by Change in Cropping Pattern	Nil
Alternate Sources	Nil
6.3. EXPECTED BENEFITS	
Net Ground Water Availability (MCM)	76.69
Additional GW resources available after Supply side interventions (MCM)	4.725
Ground Water Availability after Supply side intervention	81.45
Existing Ground Water Draft for All Uses (MCM)	50.07
GW draft after Demand Side Interventions (MCM)	49.50
Present stage of Ground Water Development (%)	65.29
Expected Stage of Ground Water Development after interventions (%)	60.80
Other Interventions Proposed, if any	
Alternate Water Sources Available	Nil
Recommendation	
Ground water development is recommended to bring the stage of ground water development from 60.80% to 70%	
6.4. Development Plan	
Volume of water available for GWD to 70% (MCM)	7.49
Proposed Number of DW (@ 1.5 ham for 90% of GWR Available for development)	449
Proposed Number of BW (@ 1 ham for 10% of GWR Available for development)	75
Additional Area to be brought under assured GW irrigation with av. CWR of 0.65 m (sq. km.)	11.52
Regulatory Measures	**60 m**
Supply Side Interventions	**Demand Side Interventions**
Proposed locations for AR structures	**Sugarcane Area proposed for drip Irrigation**





***EXPECTED BENEFITS*: ADDITIONAL AREA PROPOSED TO BE BOUGHT UNDER ASSURED GW IRRIGATION**



ANNEXURES

Annexure I: Salient Features of Ground Water Exploration, Osmanabad District

S. No.	Block	Formation	Wells			Depth (mbgl)	SWL (mbgl)	Discharge (lps)	Draw- Down (m)	Zones (mbgl)
			EW	OW	Pz					
1	Osmanabad	Basalt	8	6	2	30.00- 200.00	6.2-97.80	0.14-12.00	10.53-14.71	4.06-162.20
2	Tuljapur	Basalt	11	--	5	75.00-204.15	8.9-74.05	0.38-2.8	NA	5.00-141.40
3	Umerga	Basalt	12	1	1	39.00-200.00	7.72-98.1	0.02-14.89	NA	9.00-120.00
4	Kallam	Basalt	10	2	2	30.00-200.00	5.60-54.85	0.14-14.88	NA	9.00-118.00
5	Bhum	Basalt	6	--	1	69.00-158.50	17.30-27.05	0.38-4.24	0.75	11.00-99.20
6	Paranda	Basalt	6	3	1	105.30-145.05	3.11-23.40	1.03-8.70	12.51-47.42	9.80-98.85
7	Lohara	Basalt	3	--	--	117.20-130.00	45.77-53.80	0.79-13.7	NA	56.00-114.00
8	Washi	Basalt	3	1	-	200.00	Dry	-	-	-
	Total		**59**	**13**	**12**	**30.00-204.15**	**3.11-98.10**	**0.02-14.88**	**0.75-47.42**	**4.06-162.20**

AnnexureII: Details of GW exploration under NAQUIM in Osmanabad district

Sl. No	Block	Village	Type of Well	Lattitude	Longitude	Altitude (amsl)	Year	Depth Drilled (m)	Depth of casing (mbgl)	Aquifer zones encountered (mbgl)	Aquifer	SWL (mbgl)	Discharge (lps)	DD(m)	Transmissivity (m2/day)	Storativity
1	Kalamb	Shiradhon	EW	18°30'48.20"	76°11'08.80"	658	2018-19	200	23.5	65.00-70.30	FMB	60.5	0.14	21	7.65	-
2	Kalamb	Itkur	EW	18°34'15.00"	75°54'35.00"	670	2018-19	200	17.5	39.00-43.00	FVB	34.4	3.17	15.5	9	-
3	Kalamb	Itkur	OW	18°34'15.00"	75°54'35.00"	670	2018-19	200	17.5	45.00-49.50	FMB	45	1.37	-	-	-
4	Kalamb	Sapnai	EW	18°24'32.24"	75°55'37.70"	691	2018-19	200	23.5	77.00 - 78.00, 150.00 - 151.00	FMB	70.5	2.16	-	-	-
5	Kalamb	Yermala	EW	18°23'35.57"	75°52'16.50"	708	2018-19	200	18.5	115-119.00	FMB	>100	traces	-	-	-
6	Wasi	Para	EW	18°37'53.00"	75°49'16.00"	688	2018-19	200	18.5	93.00 - 96.00	FMB	90	0.014	-	-	-
7	Wasi	Dasmegaon	EW	18°31'39.90"	75°49'30.50"	708	2018-19	141.8	17.5	13.70-14.70	FMB	8.4	12.18	17.5	18.2	-
8	Wasi	Dasmegaon	OW	18°31'39.90"	75°49'30.50"	708	2018-19	134	17.5	123.00 - 124.00	FMB	9.5	12.18	-	-	-
9	Bhum	Ramakund	EW	18°33'5.60"	75°42'54.40"	726	2018-19	200	23.5	85.00-89.00	FVB	80	traces	-	-	-
10	Bhum	Ieet	EW	18°37'17.01"	75°42'54.40"	720	2018-19	200	17.5	77.70 - 80.80	FMB	>100	traces	-	-	-
11	Paranda	Donja	EW	18°23'49.7"	75°36'01.08"	531	2018-19	200	17.5	93.00-96.00	FMB	90	traces	-	-	-
12	Tuljapur	Barul	EW	17°58'5.68"	76°09'24.79"	616	2018-19	200	29.5	44.00-50.30	FMB	>50	0.14	-	-	-
13	Tuljapur	Yedola	EW	17°46'53.50"	76°17'23.00"	537	2018-19	200	17.5	48.00-50.00	FMB	111.3	0.14	-	-	-
14	Osmanabad	Bembli	EW	76.195	18.1394	-	2016-17	200	11.2			18	1.37	-	-	-
15	Osmanabad	Osmanabad	EW	76.0397	18.1847	-	2016-17	200	5.8	37 -41 ,120 -135	F VB	86.7	0.78	-	-	-
16	Osmanabad	Wagholi	OW	76.1156	18.2428	-	2016-17	185.5	15.6			28.68	1.05	-	-	-
17	Osmanabad	Yedshi	OW	75.9681	18.3247	-	2016-17	200	11.7	50.05 -54.15 ,112.05 -114.05	F VB	34.44	0.78	-	-	-
18	Osmanabad	Bendkal Lohara	EW	76.2233	18.0381	-	2016-17	130	5.6	56 -60 ,71 -73	F MB	45.77	1.37	-	-	-
19	Osmanabad	Khanapur	PZ	75.9424	18.1869	-	2016-17	173.6	-	4.06 -10 ,62.92 -65 ,167 -169 ,128.91 -131	Basalt	22.25	2.4	-	-	-
20	Osmanabad	Gaudgaon	EW	75.9789	18.0938	-	2016-17	117.2	5.8	70 -84	F AB	69.28	-	-	-	-
21	Osmanabad	Niwali	EW	76.2909	18.3647	-	2016-17	200				32	-	-	-	-
22	Osmanabad	Murud	OW	76.2269	18.3751	-	2016-17	125	30	89.90-93.00&122-123	FVB	70	-	-	-	-
23	Osmanabad	Ekambi	EW	76.2812	18.1553	-	2016-17	200				35	-	-	-	-

Annexure III : Details of GW monitoring wells and KOWs in Osmanabad district (CGWB)

Well no	Village	Block	AQUIFER	Depth (M)	Diameter(M)	MP (MAGL)	Lining (M)	Nature of Lining	Total Thickness weatherd portion (m)	Depth to Fractures (mbgl)	Thickness of fracture zone	SOIL THICKNESS	D.T.W. May 2018 (Mbgl)	EC May 2018	D.T.W. Nov 2018 (Mbgl)	EC Nov 2018
1	Andrud	Bhum	FMB	14.55	8.5	0	0		1.5	10	4.55	1	10.05	520	7.75	480
2	Bhum(Rural)	Bhum	FMB	9.05	6	0.4	8.1		8.1	8.1	0.95	0.5	8.1	834	4.8	795
3	Chinchpur (Dhange)	Bhum	FMB	14.3	12.8	0	0		2	7	7.3	1	7.79	1170	3.35	1050
4	Golegaon	Bhum	VB	9.1	4	0	0		2	2.4	6.7	0.5	4.4	345	2.8	380
5	Jejla	Bhum	FMB	11.82	8.1	1	8.4		8.4	9	2.82	0.5	9.8	733	6.2	710
6	Jotibachiwadi	Bhum	FMB	21.6	6	0.85	17.3		12	18	3.6	1	13.4	1106	8.5	1075
7	Nipani	Bhum	FMB	13.6	6.1	0.7	6.5		6.5	6.8	6.8	0.5	6.8	525	4.93	512
8	Pandharewadi(N.V.)	Bhum	FMB	7.8	8.1	0.3	2.2		2.2	2.5	5.3	0.5	2.9	578	1.86	568
9	Panhalwadi	Bhum	FMB	14.82	6.1	0.5	10.7		10.7	11	3.82	0.5	9.11	703	7.36	698
10	Rameshwar/UDRUP	Bhum	FMB	13.72	12	0.75	7.65		7.65	8	5.72	0.5	7.15	820	3.64	791
11	Walwad	Bhum	VB	23.65	10	0.5	3.5		3.5	18	5.65	1	18.15	700	14.9	720
12	Warewadgaon	Bhum	FMB	13.1	8	0.45	7.4		7.4	12	1.1	0.5	12.05	1091	7.64	949
13	Adhala	Kalamb	FMB	9.5	12.5	0	0		1.5	6	3.5	0.5	6.6	973	3.48	1010
14	Andora/HASEGAON	Kalamb	FMB	14.36	6.1	0	0		1.5	7	7.36	1	7.35	1154	3.65	1100
15	Borgaon Bk.	Kalamb	FMB	10.1	6.1	0	0		0.5	2	8.1	0.25	5	558	3.5	610
16	Deolali	Kalamb	FMB	10.6	5.2	0	0		2	6	4.6	0.5	6.3	600	4.3	580
17	Gaur	Kalamb	VB	10.5	9.1	0	0		1.75	9	1.5	0.5	9.3	846	8.26	832
18	Hingangaon	Kalamb	VB	10.8	6.1	0	0		2.25	6	4.8	0.5	6.52	418	4.7	450
19	Kalamb URBAN	Kalamb	VB	8.7	6	0.7	4		4	4	4.7	0.5	4.1	790	2.6	731
20	Khamaswadi	Kalamb	FMB	16.6	6.8	0	7.5		7.5	15	1.6	1	15.52	738	10.05	705
21	Khondala	Kalamb	FMB	11.7	6.1	0.9	7.2		7.2	8	3.7	0.5	8.2	1298	3.78	1152
22	Kothalwadi/KANHARWADI	Kalamb	VB	14.05	8.5	0	0		2	10	4.05	0.5	11.1	623	8.1	596
23	Mangrul	Kalamb	FMB	17.7	8.1	0.6	3.5		3.5	13	4.7	0.5	13.05	766	8.52	780
24	Shelgaon Divani	Kalamb	FMB	18.1	9.5	0	0		2.5	10	8.1	1	10.05	628	7.05	615
25	Shiradhon	Kalamb	VB	7.82	1.8	0.1	5		5	6	1.82	0.25	6.62	1608	4.21	1500
26	Tadgaon	Kalamb	FMB	18	9.3	0	0		2.5	14	4	0.5	14	635	9.9	630
27	Uplai	Kalamb	VB	17.9	8	0	0		1.5	12	5.9	1	14.2	505	8.45	486
28	Wadgaon (Shirdhon)	Kalamb	VB	8.5	3.5	0.2	3.6		3.6	5	3.5	0.5	5.3	788	3.25	716
29	**Achaler**	Lohara	VB	6.35	4.00	0.75	3.42	Stone					4.6	1527	3.25	29.5
30	**Ashti Kasar**	Lohara	FMB	12.03	2.60	0.65	9.40	Concrete					9.88	1396	8.55	28.8
31	**Bhagwatwadi/ (Mahadikwadi)**	Lohara	FMB	15.00	10.00	0.00	0.00	Nil					9.6	1130	8.5	28.5
32	**Bhosga**	Lohara	VB	10.60	10.00	1.65	6.00	Concrete					6.6	402	4.3	25.1
33	**Dhanori**	Lohara	VB	6.50	6.45	0.50	3.00	Stone					2.28	1487	1.8	24.4
34	**Jevli (North)**	Lohara	VB	9.80	5.70	0.75	6.40	Stone					4.15	721	4.05	27.9
35	**Koregaon Wadi**	Lohara	FMB	7.03	3.35	0.78	2.83	Concrete					1.82	1174	1.5	28.4
36	**Salegaon**	Lohara	FMB	12.00	6.50	1.20	10.8	Concrete					9.5	271	8.3	28.6

Well no	Village	Block	AQUIFER	Depth (M)	Diameter(M)	MP (MAGL)	Lining (M)	Nature of Lining	Total Thickness weatherd portion (m)	Depth to Fractures (mbgl)	Thickness of fracture zone	SOIL THICKNESS	D.T.W. May 2018 (Mbgl)	EC May 2018	D.T.W. Nov 2018 (Mbgl)	EC Nov 2018
							0									
37	**Wadgaon wadi**	Lohara	FMB	12.12	6.30	0.70	8.86	Stone					7.8	1365	7.3	25.2
38	Ambewadi	Osmanabad		28									16		7	
39	Arni	Osmanabad		14									14		12.4	
40	Bamni	Osmanabad	WB	13	12	1	3.3	Motor					12.8	680	3.3	892
41	Bembli	Osmanabad	FB	8.8	8.5	0.9	5.8	Motor					7.55	701	3.2	441
42	Bhandari	Osmanabad	FB	13	11.15	1	4.6	Motor					11.2	778	4.4	745
43	Bhandarwadi	Osmanabad		12.6									12.5		5.1	
44	Borgaon	Osmanabad		9.5									9.5		2	
45	Chikhali	Osmanabad	WFB	15.5	8	1.5	11.2	Motor					13.9	890	3.1	508
46	Chilvadi	Osmanabad	FB	8.7	10.5	GL	4.5	Motor					7.3	850	2.15	1704
47	Chilwadi	Osmanabad		9.5									9.5		5	
48	Dhoki	Osmanabad											10.7		10.02	
49	Dhoki	Osmanabad		13.7									13.7		8.1	
50	Ghantangri	Osmanabad		15									9.4		3.2	
51	Goverdhanwadi	Osmanabad		14.4									15		3.1	
52	Hinglajwadi	Osmanabad	FMB	8	4	GL	0.7	Rope and bucket					6.8	670	2.45	2351
53	Jagji	Osmanabad		13.4									13.4		10.7	
54	Jagji	Osmanabad	FMB	16.7	14.5	0.8	2.3	Motor					16.6	1088	12.1	471
55	Kajla2	Osmanabad											6.4		2.1	
56	Karajkheda	Osmanabad											17.19		5.33	
57	Kaudgaon	Osmanabad		18.5									11.6		8	
58	Kaudgaon	Osmanabad		28									28		7	
59	Keshegaon	Osmanabad		8.5	10	0.5	3.8	Motor					11		4.4	839
60	Khamgaon	Osmanabad		9									9		2.5	
61	Khanapur-1	Osmanabad											8.35		8	
62	Khed	Osmanabad		8.9									8.9		4.1	
63	Khed	Osmanabad	FB	18	14	GL	10	Motor					16.6	750	9.2	739
64	Kond	Osmanabad		17									12.4		3.8	
65	Kond	Osmanabad	WFB	18	10	GL	9	Motor					17.5	772	6.23	1747
66	Lasona	Osmanabad		11.5									10		6.1	
67	Malkaranja	Osmanabad		11									11		6.5	
68	Nitali	Osmanabad		10.1									10		3.8	
69	Osmanabad	Osmanabad		17.6									12.1		4.1	
70	Osmanabad-1	Osmanabad											9.19		9	
71	Padoli (a)	Osmanabad		17.8									17.8		15.4	
72	Patoda	Osmanabad		10.35									10.3		9.6	
73	Rajuri	Osmanabad		9									9		2.5	
74	Ruibhar	Osmanabad		10.5									9.4		2.7	
75	Sancha	Osmanabad											7.71		6	

Well no	Village	Block	AQUIFER	Depth (M)	Diameter(M)	MP (MAGL)	Lining (M)	Nature of Lining	Total Thickness weatherd portion (m)	Depth to Fractures (mbgl)	Thickness of fracture zone	SOIL THICKNESS	D.T.W. May 2018 (Mbgl)	EC May 2018	D.T.W. Nov 2018 (Mbgl)	EC Nov 2018
76	Sarola (bk)	Osmanabad		10.5									10.5		4.9	
77	Sarola Bk.	Osmanabad	WFB	13.6	6	0.4	8.3	Motor					12.8	726	2.65	678
78	Shekapur	Osmanabad	FB	23m dug well and bore well 28m	10	8mbgl(constructing well)	5	Motor					23	820	2.5	969
79	Shingoli	Osmanabad	FMB	7	3	GL	7	Rope and bucket					9		2.2	664
80	Tadawala K	Osmanabad		16.8	11.5	0.7	5.9	Motor					15.3	820	5.2	1838
81	Takali Bembali	Osmanabad	WFB	7.4	8.3	0.6	4	Motor					7	980	4.43	1373
82	Takiwiki	Osmanabad											7.14		6.55	
83	Takwiki	Osmanabad		11.9									11.2		3.1	
84	Ter	Osmanabad											8.96		4.5	
85	Toramba	Osmanabad	FB	14.5	9.1	1	6	Rope and bucket					11.5	899	9.85	1296
86	Tugaon	Osmanabad		10									10		4.8	
87	Vadgaon Siddheswar	Osmanabad											6.35		4.5	
88	Wadgaon (s)	Osmanabad		13.4									11.3		2.9	
89	Wanewadi	Osmanabad		15.6									14.2		5.4	
90	Yedshi	Osmanabad											4.64		4	
91	Yedsi	Osmanabad	FB	18	12.7	GL	13.4	Motor					20		6.52	1299
92	Chinchpur Bk./JAKTEWADI	Paranda	VB	7.1	8	0	5		5	5.3	1.8	0.5	5.3	627	2.9	582
93	Donja	Paranda	FMB	10.9	2.8	0.8	0		1.5	5	5.9	0.5	5.3	2110	3.65	2200
94	Jakhepimpri	Paranda	FMB	24.1	10.2	0.4	5.45		5.45	15	9.1	1	16.72	999	11.5	1050
95	Kandari	Paranda	FMB	12	3.25	0.6	11.4		11.4	11.5	0.5	1	11.59	1217	8.95	1355
96	Kaundgaon	Paranda	FMB	8.1	10	0.7	2.5		2.5	4	4.1	0.5	4.1	1520	2	1600
97	Kokarwadi	Paranda	FMB	25.6	10	1.3	3.1		3.1	18	7.6	0.5	18.7	818	15.65	900
98	Loni	Paranda	FMB	11.6	10	0.6	5.3		5.3	6	5.6	0.5	6.7	1414	4	1365
99	PARANDA URBAN	Paranda	FMB	8.55	9.2	0	5.8		5.8	6	2.55	0.5	6.2	2316	4.1	2500
100	Ratanpur	Paranda	VB	9.63	2	0.7	8		8	8	1.63	1	7.82	889	3.9	870
101	Sirsao	Paranda	VB	25.1	7.9	0	8.2		8.2	15	10.1	0.5	15.92	2744	8.6	2755
102	Wakadi	Paranda	FMB	22.6	8.1	0.65	4.7		4.7	15	7.6	0.5	16.1	1335	9.1	1435
103	Wangegavhan	Paranda	FMB	9.25	7.5	0.55	5.5		5.5	5.85	3.4	0.5	5.85	1472	3.15	1521
104	Watephal	Paranda	VB	18.05	7.4	0.6	4.1		4.1	14	4.05	0.5	15.15	715	8.25	685
105	**Balwadi**	Tuljapur	FMB	10.00	10*10	0.90	2.00	Concrete					1.8	499	0.6	30.6
106	**Bhatangli**	Tuljapur	VB	15.50	12.00	0.00	0.00	Nil					6.93	475	5.65	24.8
107	**Chivri**	Tuljapur	VB	10.50	8.10	0.55	6.62	Concrete					7.45	493	1.5	30.3
108	**Dalimb**	Tuljapur	VB	12.60	12.00	0.00	0.00	Nil					6.75	112	6	29.4
109	Dhekri	Tuljapur	FMB	8.18	1.42		3.65	Concrete					5.32	1425	4.8	28.6

Well no	Village	Block	AQUIFER	Depth (M)	Diameter(M)	MP (MAGL)	Lining (M)	Nature of Lining	Total Thickness weatherd portion (m)	Depth to Fractures (mbgl)	Thickness of fracture zone	SOIL THICKNESS	D.T.W. May 2018 (Mbgl)	EC May 2018	D.T.W. Nov 2018 (Mbgl)	EC Nov 2018
110	**Dhotri**	Tuljapur	FMB	8.90	13.00	0.65	4.25	Concrete					4.15	723	3.45	26.9
111	**Gunjewadi**	Tuljapur	FMB	25.50	3.00	0.00	3.95	Stone					21	1084	14	29.1
112	**Jalkotwadi (Murta)**	Tuljapur	FMB	9.10	13.00	0.00	Nil	Nil					4	637	1.9	27.9
113	**Kamtha**	Tuljapur	FMB	6.28	3.20	0.30	6.00	Stone					3.78	1151	3.2	28.7
114	**KashtiKhurd**	Tuljapur	FMB	16.23	10.00	1.05	10.32	Concrete					9.27	686	5.9	25
115	**Katgaon**	Tuljapur	FMB	8.60	10.00	0.00	0.00	Nil					4.35	897	3.8	30
116	**Koregaon**	Tuljapur	FMB	17.23	2.27 arm length	1.20	4.00	Concrete					1.32	955	0.65	25.5
117	**Nilegaon**	Tuljapur	FMB	8.10	10.00	1.10	6.00	Concrete					2.2	416	1.2	29.9
118	**Pangdharwadi**	Tuljapur	VB	15.48	12.20*9.35	1.00	3..50	Stone					3.6	902	1.9	29.5
119	**Pimpla Khurd**	Tuljapur	FMB	9.35	10.50	0.30	9.00	Stone					2.45	2083	2.1	29.6
120	**Tirth Khurd**	Tuljapur	FMB	7.45	9.40	0.00	6.00	Stone					6.23	967	5.3	26.9
121	**Wadgaon DEO**	Tuljapur	FMB	7.60	10.00	0.00	0.00	Nil					1.6	698	1.4	29
122	**Wanewadi**	Tuljapur	FMB	14.00	13.10		0.00	Nil					10.4	945	10.3	28
123	**Yadola**	Tuljapur	FMB	10.53	10.00	0.50	8.00	Concrete					3	744	2.45	26.9
124	**Balsur (Kardura)**	Umarga	FMB	3.50	10.00	0.00	0.00	Nil					1.1	635	0.9	28.6
125	**Belamb**	Umarga	FMB	13.30	6.50	11.15	11.00	Stone					11.15	1286	8.7	27.6
126	**Chincholi Jahangir**	Umarga	VB	14.70	12.00	1.12	2.65	Concrete					9.26	473	8.5	26.7
127	**Gunjoti**	Umarga	FMB	15.25	12.00	0.00	0.00	Nil					6.3	666	5.3	29.4
128	**Malgi east**	Umarga	VB	6.50	12.00	0.00	0.00	Nil					2.1	572	1.9	27
129	**Malgiwadi**	Umarga	FMB	5.50	12.00	1.05	3.50	Concrete					2.35	1243	0.9	26.7
130	**Mulaj**	Umarga	FMB	11.97	8.00	0.80	6.00	Concrete					6.8	442	5.1	28.5
131	**Murum (Rural)**	Umarga	VB	13.40	15.00	1.15	6.00	Concrete					3.42	1625	2.15	28
132	Samudral	Umarga	VB	14.50	10.00	0.00	0.00	Nil					10.7	907	9.76	24.7
133	**Trikoli**	Umarga	FMB	6.60	8.55	0.40	3.00	Concrete					1.2	692	0.6	28.4
134	**Warnal wadi**	Umarga	FMB	25.65	12.00	0.65	3.87	Concrete					18.65	462	16.65	28.4
135	**Yeli**	Umarga	FMB	21.20	12.00	0.45	3.70	Concrete					10.85	424	5.05	29.5
136	Anjan Sonda	Washi	FMB	14.15	4.2	0	11		11	11.2	2.95	0.75	11.3	642	7.45	610
137	Bavi	Washi	VB	8.8	6	0	0		1.75	2	6.8	0.25	2.3	522	1.9	510
138	Bori	Washi	VB	7.2	8	0	0		2	4	3.2	0.5	7	752	5.1	684
139	Gojwada	Washi	VB	13.4	9	0.2	2		2	11	2.4	0.35	13	408	12.6	450
140	Gojwada	Washi	AB	14.8	7	0.5	4.7		4.7	10	4.8	0.5	13	1106	11.5	1100
141	Kadaknathwadi	Washi	FMB	23	10.5	0.25	9.7		9.7	13	10	1	13.16	534	9.5	501
142	Lakhangaon	Washi	VB	15.45	6.7	0.3	12.05		8	9	6.45	0.5	13	731	10.5	721
143	Pimpalgaon(k)	Washi	FMB	13.4	5	0.3	11.4		11	11	2.4	0.5	11.9	1104	11	1120
144	Pimpalgaon(L)	Washi	FMB	9.4	6	0.4	6.5		6.5	6.5	2.9	0.5	5.6	720	3.6	780
145	Sarola Washi (Mandwa)	Washi	FMB	21.45	3.4	0.25	7.2		7.2	8	13.45	0.25	8.8	861	7.9	820

Well no	Village	Block	AQUIFER	Depth (M)	Diameter(M)	MP (MAGL)	Lining (M)	Nature of Lining	Total Thickness weatherd portion (m)	Depth to Fractures (mbgl)	Thickness of fracture zone	SOIL THICKNESS	D.T.W. May 2018 (Mbgl)	EC May 2018	D.T.W. Nov 2018 (Mbgl)	EC Nov 2018
146	Terkheda	Washi	FMB	13.5	7	0.7	8.6		8.6	8.6	4.9	0.5	8.6	1219	4.6	1199
147	Washi Urban	Washi	FMB	8.3	1.2	0.3	5		5	5	3.3	0.25	7	902	5	894

Annexure IV:long term ground Water trend (2009-2018)

Villages	District	Pre monsoon (m/year)		Post monsoon (m/year)	
		Rising	Falling	Rising	Falling
Anala	Osmanabad	0.1505			0.575
Massa (Khurd)	Osmanabad				0.2694
Kukadgaon	Osmanabad		0.6836		0.5781
Wakwad	Osmanabad		0.5397	0.1621	
Washi-1	Osmanabad		0.3213	0.913	
Pathrud3	Osmanabad			0.2173	
Vadgaon Siddheswar	Osmanabad	0.3375			0.3097
Osmanabad-1	Osmanabad		0.0903	0.104	
Khanapur-1	Osmanabad		0.5011		
Sanja	Osmanabad	0.0739			0.302
Pimpalwandi	Osmanabad		0.2059		0.5634
Paranda-1	Osmanabad		0.18	0.1761	
Yedshi	Osmanabad	0.3789			0.4147
Sonari	Osmanabad		0.1745		0.2507
Dhoki	Osmanabad		0.12		0.3772
Yermala_Pz	Osmanabad	0.0014			1.3131
Dhorala-1	Osmanabad		0.5924	0.2013	
Itkal_Pz	Osmanabad		0.1411	0.4208	
Andur	Osmanabad		0.3725		
Turori	Osmanabad	0.0345		0.2	
Suratgaon-1	Osmanabad		0.0972	0.1456	
Gandora	Osmanabad		0.4596	0.1176	
Mouje Barul	Osmanabad		0.1011		0.1621
Lohara Buzurg	Osmanabad		0.0786		0.0601
Tuljapur-3	Osmanabad		0.342		
Takiwiki	Osmanabad	0.0889			0.2968
Karajkheda	Osmanabad			0.1218	

Annexure V: Chemical analysis of ground water samples, Shallow aquifers

SN	Block	Village	PH	EC	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F
				µs/cm	Mg/l											
1	Bhum	Andorud	7.2	597	317	300.90	61.32	35.24	12	0.39	0	285.48	31.01875	24	19	0.69
2	Bhum	Bhum Town	7.4	954	503	464.10	57.23	76.56	14	0.69	0	428.22	80.64875	27	35	0.53
3	Bhum	Chinchpur	7.7	1493	792	622.20	73.59	104.51	36	1.2	0	553.1175	169.9828	46	37	0.71
4	Bhum	Golegaol	7.5	348	184	153.00	49.06	7.29	6	0.27	0	124.8975	11.16675	18	28	0.6
5	Bhum	Jejla	7.6	794	421	418.20	44.97	72.91	12	0.33	0	386.5875	88.09325	25	14	0.75
6	Bhum	Joti Wadi	7.6	1233	653	550.80	61.32	94.79	14	1.29	0	612.5925	43.42625	24	27	0.4
7	Bhum	Nipaivi	7.6	564	299	316.20	49.06	46.18	9	0.17	0	255.7425	28.53725	27	36	0.63
8	Bhum	Pandrewadi	7.6	624	330	321.30	42.93	51.04	11	1.15	0	315.2175	33.50025	23	36	0.55
9	Bhum	Panhalwadi	7.5	774	410	331.50	49.06	49.82	13	0.93	0	350.9025	26.05575	9	37	0.62
10	Bhum	Walwad	7.7	768	407	362.10	53.15	54.68	11	0.11	0	303.3225	45.90775	47	37	0.84
11	Bhum	Ware Wadgaon	7.5	1334	704	622.20	53.15	116.66	14	0.23	0	612.5925	98.01925	46	20	0.49
12	Kalamb	Uplai Kalamb	7.9	518	275	270.30	44.97	37.67	14	0.34	0	285.48	18.61125	0	33	0.6
13	Kalamb	Adhali Kalamb	7.7	1100	583	515.10	75.63	77.77	36	0.54	0	523.38	120.3528	27	20	0.5
14	Kalamb	Boregaon Kalamb	7.6	567	301	260.10	47.01	34.03	14	0.49	0	255.7425	35.98175	13	17	0.6
15	Kalamb	Deolali Kalamb	7.7	646	342	316.20	42.93	49.82	21	0.41	0	303.3225	40.94475	32	36	1.8
16	Kalamb	Gaur Kalamb	7.3	967	514	453.90	51.10	77.77	28	2.17	0	487.695	70.72275	19	0	0.69
17	Kalamb	Hingangaon Kalamb	7.4	453	240	163.20	40.88	14.58	21	0.88	0	190.32	21.09275	11	0	0.57
18	Kalamb	Kalamp Town	7.6	889	471	367.20	83.81	37.67	75	3.12	0	434.1675	60.79675	23	38	0.33
19	Kalamb	Khamaswadi Kalamb	7.7	803	427	402.90	26.57	80.20	17	0.39	0	422.2725	48.38925	31	0	0.53
20	Kalamb	Khondala Kalamb	7.6	1634	866	729.30	108.34	109.37	46	7.34	0	654.225	234.5018	32	36	0.48
21	Kalamb	Kothar Wadi Kalamb	7.5	682	361	285.60	81.76	19.44	5	1.07	0	255.7425	35.98175	15	36	0.33
22	Kalamb	Mangrul Kalamb	7.6	807	429	387.60	87.90	40.10	11	0.37	0	416.325	48.38925	0.5	32	0.43
23	Kalamb	Shelgaon Kalamb	7.8	691	365	326.40	51.10	47.39	15	0.62	0	315.2175	38.46325	11	36	0.6
24	Kalamb	Shirdhon Kalamb	7.7	2216	1178	999.60	247.33	91.14	33	5.29	0	927.81	219.6128	26	37	0.28
25	Kalamb	Wadgaon Kalamb	7.7	834	440	367.20	73.59	43.75	14	1.49	0	368.745	50.87075	0	33	0.35
26	Lohara	Bhagwatwadi	7.5	1199	635	453.90	104.25	46.18	51	1.15	0	469.8525	90.57475	46	39	0.04
27	Lohara	Bhosja Kow	7.7	408	215	153.00	44.97	9.72	17	0.42	0	190.32	11.16675	2	12	0.47
28	Lohara	Sulegaon	7.6	248	131	102.00	26.57	8.51	9	0.12	0	77.3175	11.16675	16	18	0.07
29	Osmanabad	Tadgaon Kalamb	7.7	659	347	306.00	87.90	20.66	22	0.62	0	297.375	53.35225	36	36	0.19
30	Paranda	Donja Paranda	7.4	3620	1913	1540.20	306.61	184.71	62	33.76	0	1207.343	442.9478	79	37	0.32
31	Paranda	Jhake Pimpri	7.6	1256	666	622.20	149.22	59.54	12	0.83	0	594.75	110.4268	45	29	0.43
32	Paranda	Kardani Parade	7.8	1536	810	724.20	120.60	100.86	36	4.66	0	791.0175	132.7603	18	37	0.79

SN	Block	Village	PH	EC	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F
				µs/cm	Mg/l											
33	Paranda	Kokatwadi	7.7	905	479	402.90	108.34	31.60	38	0.44	0	475.8	53.35225	30	36	0.58
34	Paranda	Loni Paranda	7.8	1903	1011	831.30	91.98	143.39	95	0.35	0	648.2775	209.6868	110	37	3.01
35	Paranda	Paranda Urban	7.5	4806	2541	2157.30	306.61	331.75	135	0.49	0	1718.828	686.1348	65	38	0.31
36	Paranda	Ratnapur Paranda	7.6	1052	593	453.90	116.51	38.89	63	0.53	0	582.855	70.72275	2	37	0.55
37	Paranda	Sirrzaw Panda	7.4	7517	3960	2478.60	275.95	426.54	536	0.32	0	2688.27	944.2108	115	37	0.43
38	Paranda	Wakri Paranda	7.7	1895	1005	612.00	224.85	12.15	162	1.62	0	582.855	204.7238	75	36	0.61
39	Tuljapur	Chivri Kow	7.4	512	271	265.20	59.28	27.95	12	0.48	0	249.795	21.09275	11	23	0.05
40	Tuljapur	Gojwada	7.7	1326	702	464.10	106.29	47.39	121	0.44	0	648.2775	137.7233	0	32	0.37
41	Tuljapur	Kamtha Kow	7.5	1167	617	443.70	89.94	52.25	92	1.95	0	582.855	75.68575	0	37	0.03
42	Tuljapur	Khshti Khurd Kow	7.6	701	372	331.50	61.32	42.53	21	0.48	0	368.745	33.50025	21	29	0.1
43	Tuljapur	Niregaon Kow	7.8	419	222	178.50	51.10	12.15	15	0.51	0	226.005	11.16675	16	6	0.01
44	Tuljapur	Pimpla Khurd	7.5	2260	1193	775.20	167.61	85.06	131	3.12	0	648.2775	269.2428	150	28	0.02
45	Tuljapur	Thirth Khurd Kow	7.5	988	424	357.00	83.81	35.24	64	1.25	0	493.6425	65.75975	0	36	0.06
46	Tuljapur	Wadgaon Wadi	7.4	1468	780	647.70	94.03	98.43	26	3.65	0	618.54	130.2788	47	39	0.17
47	Tuljapur	Yadola Kow	7.7	734	389	306.00	61.32	36.46	61	0.39	0	368.745	33.50025	38	15	0.03
48	Umarga	Balsur Kow	7.2	661	350	306.00	96.07	15.80	13	0.56	0	285.48	38.46325	31	19	0.09
49	Umarga	Gunjoti	7.7	687	366	260.10	81.76	13.37	31	1.18	0	344.955	45.90775	14	22	0.67
50	Umarga	Malgi East	7.5	764	404	224.40	98.12	-4.86	61	0.95	0	273.585	55.83375	19	21	0.04
51	Umarga	Murum Kow	7.8	1794	952	642.60	63.37	115.44	82	0.48	0	648.2775	224.5758	44	17	1.05
52	Umarga	Trikoli	7.6	723	385	331.50	91.98	24.30	27	0.62	0	356.85	48.38925	36	37	0.02
53	Washi	Anjan Sonda	7.6	694	367	295.80	53.15	38.89	41	0.36	0	297.375	70.72275	0	33	0.52
54	Washi	Bavi	7.5	553	294	183.60	83.81	-6.08	60	0.41	0	285.48	31.01875	0	26	0.42
55	Washi	Bori	7.7	740	392	280.50	81.76	18.23	71	0.33	0	404.43	50.87075	0	20	0.22
56	Washi	Ganjewadi	7.5	1131	602	494.70	104.25	55.90	19	0.92	0	487.695	125.3158	45	39	0.01
57	Washi	Gojwada Washi	7.7	426	226	153.00	61.32	0.00	35	0.46	0	190.32	21.09275	5	36	0.36
58	Washi	Karaknath	7.8	544	289	168.30	63.37	2.43	56	0.31	0	285.48	21.09275	0	13	0.39
59	Washi	Lakhangaon	7.6	717	379	265.20	83.81	13.37	61	1.12	0	374.6925	53.35225	0	35	0.26
60	Washi	Pimpalgaon	7.6	789	416	336.60	61.32	43.75	51	1.8	0	368.745	55.83375	10	36	1.09
61	Washi	Pimpalgaon	7.7	1269	673	474.30	73.59	69.27	79	0.63	0	529.3275	172.4643	0	21	0.21
62	Washi	Sarolr	7.8	972	518	413.10	96.07	41.32	62	0.32	0	523.38	85.61175	4	37	0.23
63	Washi	Terkteda Washi	7.6	1469	778	571.20	73.59	92.36	96	1.15	0	624.4875	160.0568	24	32	0.44
64		Hasegaon Kalamb	7.6	1440	762	724.20	91.98	117.87	16	0.31	0	648.2775	184.8718	32	15	0.56
65		Jaktewadi Kalamb	7.8	658	350	270.30	71.54	21.87	46	0.63	0	315.2175	40.94475	25	17	0.56
66		Jate Paal	7.8	811	430	377.40	77.68	43.75	35	0.27	0	315.2175	85.61175	27	36	1.32

SN	Block	Village	PH	EC	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F
				µs/cm	Mg/l											
67		Kukkadgaon	7.6	2108	1120	805.80	210.54	66.84	96	1.17	0	909.9675	202.2423	75	20	0.57
68		Nag Pawada	7.6	2043	1081	841.50	183.97	91.14	112	1.03	0	945.6525	236.9833	76	27	0.67
69		Warud	7.7	884	468	418.20	40.88	75.34	18	0.08	0	362.7975	70.72275	33	37	0.63
70		Washi	7.7	1115	590	469.20	87.90	59.54	91	0.68	0	606.645	105.4638	26	36	0.25
71	Osmanabad	Jagji	8	980	627.2	159.00	120.00	10.00	140	0.1	0	93	105	232	36	0.659
72	Osmanabad	Khed	8.1	562	359.68	199.00	149.00	12.00	40	0.14	0	229	39	32	11	0.361
73	Osmanabad	Sarou	8.1	508	325.12	209.00	110.00	24.00	21	0.07	0	190	36	12	27	0.67
74	Osmanabad	Bamni	8.2	621	397.44	214.00	164.00	12.00	48	0.13	0	171	67	63	27	0.42
75	Osmanabad	Chilwadi	8.3	1432	916.48	413.00	134.00	68.00	141	0.87	34	268	195	150	25	0.361
76	Osmanabad	Toramba	8	1137	727.68	428.00	244.00	45.00	61	1.32	0	224	177	108	33	1.36
77	Osmanabad	Shekapur	8.1	480	307.2	154.00	134.00	5.00	45	0.36	0	88	59	54	24	0.656
78	Osmanabad	Takli	8.1	1009	645.76	229.00	129.00	24.00	114	1.84	0	224	139	113	13	0.625
79	Osmanabad	Bembli	8.3	597	382.08	100.00	60.00	10.00	81	0.2	10	205	36	72	7	0.511
80	Osmanabad	Tadavale	8.3	820	524.8	194.00	120.00	18.00	103	0.84	19	171	100	81	24	0.539
81	Osmanabad	Hinglajwadi	8.3	1194	764.16	388.00	249.00	34.00	86	8.18	29	283	116	117	32	0.285
82	Osmanabad	Chikali	8.1	482	308.48	125.00	75.00	12.00	56	0.45	0	132	59	31	7	1.07
83	Osmanabad	Bhandari	8.2	733	469.12	199.00	149.00	12.00	80	0.19	0	151	134	50	7	0.398
84	Osmanabad	Kond	8	957	612.48	388.00	189.00	48.00	40	0.16	0	244	126	77	32	0.271
85	Osmanabad	Vadgaon Siddheswar	7.5	1227	141	600.00	132.26	65.62	3.48	0.43	0	530.7	113.44	13	10	0.4
86	Osmanabad	Osmanabad-1	7.3	1317	1041	600.00	56.11	111.80	14.18	0.04	0	329.4	92.17	232	21	0.47
87	Osmanabad	Khanapur-1	8	629	395	295.00	52.10	40.10	4.12	0.16	0	195.2	38.995	78	39	0.7
88	Osmanabad	Dhola[T-07]	8.3	615	394	120.00	32.00	9.72	70	6	3.16	169	70	34	7	1.4
89	Osmanabad	Ruibhar	7.7	920	589	368.00	86.40	36.94	14	1	0	244	106	71	13	1.4
90	Osmanabad	Goverdhanwadi	7.6	963	616	408.00	128.00	21.38	12	1	0	256	120	48	20	1.7
91	Osmanabad	Wanewadi	7.6	771	493	232.00	65.60	16.52	50	2	1.12	299	72	33	5	1.5
92	Osmanabad	Malkaranja	7.6	1472	942	576.00	115.20	69.98	36	18	0	281	200	63	40	1.2
93	Osmanabad	Shiradhone	10	770	501	136.00	48.00	3.89	75.9	19	31.2	45	138	12.1	0.4	0.82
94	Osmanabad	Rajuri	7.7	2960	1894	812.00	188.80	82.62	93	55	0	388	476	126	83	1.5
95	Osmanabad	Jagji	7.5	1002	641	448.00	112.00	40.82	17	2	0	281	110	52	19	1.3
96	Osmanabad	Arni	8.6	900	576	376.00	74.00	47.00	54	1	34	218	114	103	5	0.3
97	Osmanabad	Kanagara	8.1	991	625	384.00	72.00	49.57	59.1	0.8	0	195	108	142	11.9	0.73
98		Lohara Buzurg	7.9	1464	776	673.00	186.00	50.00	38	9	0	511	190	18	30	0.12
99		Vadgaon Siddheswar	7.6	1091	545	485.00	110.00	50.00	42	10.7	0	381	110	31	50	0.12
100		Kukadgaon	7.8	2562	1359	729.00	204.00	52.00	229	47.7	0	553	490	23	30	0.25

SN	Block	Village	PH	EC	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F
				µs/cm	Mg/l											
101		Dhoki	7.6	2304	1221	974.00	172.00	130.00	93	2.6	0	309	311	76	380	0.21
102		Dhorala-1	8	774	410	209.00	63.00	12.00	74	2.7	0	232	68	20	40	0.45
103		Osmanabad-1	7.8	1276	676	393.00	74.00	50.00	109	3.8	0	488	105	22	80	0.3
104		Karajkheda	8	477	253	204.00	57.00	15.00	26	1.3	0	250	26	2	16	0.32
105		Khanapur-1	8.1	474	251	138.00	41.00	9.00	41	1.9	0	208	24	29	12	0.2
106		Shiradhon	8.3	1572	836	464.00	125.00	36.00	136	20.8	53	482	158	3	60	0.27
107		Kalamb-1	7.8	736	386	383.00	84.00	41.00	22	3.9	0	339	61	2	36	0.18
108		Bhum-1	8.1	490	260	179.00	59.00	7.00	30	4	0	214	29	11	9	0.14
109		It-1	8.1	346	183	51.00	10.00	6.00	59	2.9	0	131	36	12	6	2.1
110		Ter	8.1	819	434	301.00	41.00	47.00	21	4	0	357	46	25	5	0.52
111		Makni	8.1	956	506	357.00	102.00	24.00	39	3.7	0	297	93	16	42	0.32
112		Pethsangavi	8	766	406	265.00	51.00	33.00	58	1.6	0	333	51	8	40	0.25
113		Babhalsur-1	7.8	709	375	337.00	74.00	36.00	23	3.4	0	327	41	0	40	0.22
114		Gandora	7.9	2234	1184	959.00	368.00	10.00	26	10.4	0	690	175	160	70	0.22
115		Turori	7.8	1369	725	510.00	65.00	83.00	79	2.8	0	440	140	35	48	0.32
116		Takiwiki	8.6	1149	609	428.00	164.00	5.00	36	11.3	59	357	66	33	48	0.19
117		Massa (Khurd)	7.3	356	188	153.00	47.00	9.00	18	11.2	0	190	24	3	9	0.08
118		Pimpalwandi	8.1	1932	1025	678.00	231.00	24.00	58	19.8	0	595	235	60	40	0.6
119		Mouje Barul	7.9	673	356	332.00	63.00	41.00	28	1.2	0	351	26	21	30	0.59
120		Sonari	7.9	2249	1193	454.00	82.00	60.00	223	63.2	0	517	244	23	220	0.38
121		Tuljapur-3	8.2	829	439	214.00	72.00	9.00	90	2.6	0	297	78	13	22	0.81
122		Suratgaon-1	8	2156	1143	541.00	102.00	68.00	129	142.7	0	565	237	66	60	0.26
123		Andur	8.1	449	238	250.00	57.00	26.00	19	1	0	309	16	19	6	0.18
124		Sarola	8.1	651	345	270.00	69.00	23.00	30	7.3	0	303	53	0	10	0.17
125		Umerga	8	1507	798	413.00	78.00	52.00	100	6.1	0	565	133	10	46	0.38
126		Jalkot-3	7.6	1188	630	479.00	86.00	63.00	36	1	0	297	133	32	68	0.14
127		Chilvadi	8.2	1009	534	372.00	61.00	52.00	64	3.3		357	86	26	80	0.3

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

SN	Block	Village	Type	pH	EC	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F	Fe
					µs/cm	(mg/L)												
1	Osmanabad	Irla[ts-05]	BW	7.5	2990	2208	416	49.6	71	150	35	0	363.6	266	47	84	1.6	0.2
2	Umarga	Umerga	EW	7.3	2980	1758	1160	329	83	144	4	0	305	621	94	330	0.44	0
3	Parli	Pimpla Buzurg	EW	8.25	2680	1705	310	124.25	0	450.8	1.96	0	33.56	290.77	821.31	0	1.8	
4	Osmanabad	Irla[ts-05]	BW	7.5	2200	1408	416	49.6	70.956	150	35	0	364	266	47	25	1.6	0.2
5	Washi	Hatola[ts-10]	BW	7.4	1844	1180	868	275	43	80	0	0	384	335	126	10	0.86	0
6	Umarga	Murrum	EW	7.2	1810	1062	615	184	38	131	3	0	354	294	52	182	0.95	0
7	Paranda	Pachpimpla	BW	7.65	1700	1088	888	269	53	51	7	22	426	277	282	6	0.4	0.2
8	Paranda	Rajuri	BW	7.68	1630	1043	1340	445	56	238	13	39	409	676	548	6	0.5	0.3
9	Osmanabad	Wagholi	BW	7.66	1560	998	1132	307	89	60	2.6	28	780	188	369	3	0.5	0.3
10	Osmanabad	Wagholi	BW	7.66	1560	998	1132	307	89	60	2.6	28	780	188	369	3	0.5	0.3
11	Osmanabad	Gorewadi[t-09]	BW	7.7	1476	945	436	136	23.328	82	2	0	337	222	16	28	1.5	0.2
12	Bhum	Shelgaon	BW	7.31	1358	869	432	136	22	135	0	0	139	315	112	7	0.46	0.1
13	Lohara	Ashtakasar	EW	9.52	1300	670	375	128	13	124	3.2	24	Nil	142	132	19	0.75	0
14	Kalamb	Kallam	EW	7.6	1270	732	275	76	21	160	1.8	0	348	156	62	81	0.53	0
15	Osmanabad	Kaudgaon	BW	7.5	1250	800	224	64	15.552	40	3	0	273	30	12	7	0.1	0.19
16	Umarga	Sawalsoor	BW	7.82	1213	776	632	168	52	29	1.1	45	411	127	105	5	0.4	0.3
17	Kalamb	Raigavan	BW	7.62	1155	739	528	142	42	21	1.8	39	173	177	94	5	0.3	0.1
18	Mulshi	Chubli	EW	7.7	1125	730	120	44.09	2.43	207	0.78	0	91.52	127.66	303.55	0	1.16	
19	Kalamb	Kallam	OW	7.8	1060	622	190	56	12	150	1.5	0	256	142	63	68	1.17	0
20	Tuljapur	Andoor[t-11]	BW	7.5	1060	689	336	97.6	22.4	95.2	0.9	0	102.5	168	144.9	14.7	4.4	0.1
21	Osmanabad	Takwala[ts-04]	BW	8.3	1002	651	368	97.6	30.1	58.5	0.8	0	156.2	110	147.8	15.4	0.44	0.2
22	Mulshi	Pathrud	EW	8.8	1000	630	55	20.04	1.22	195.5	2.35	6	54.91	102.83	271.85	0	1.4	
23	Osmanabad	Chitwadi[ts-03]	BW	8	1000	640	408	41.6	73.9	34	2	0	296.5	124	66	13	1.1	0.2
24	Osmanabad	Kanagara	BW	8.1	991	625	384	72	49.572	59.1	0.8	0	195	108	142	11.9	0.73	0.13
25	Osmanabad	Goverdhanwadi	BW	7.6	963	616	408	128	21.384	12	1	0	256	120	48	20	1.7	0.2
26	Velhe	Andhora	EW	9.3	940	560	50	20.04	0	184	0.39	12	18.3	180.85	154.18	0	0	
27	Tuljapur	Babhulgaon	OW	7.4	930	477	355	58	51	51	0.4	0	348	92	45	5	0.49	0
28	Umarga	Konajigad	EW	8.1	920	546	100	20	12	166	2	0	43	245	75	4	NA	0
29	Tuljapur	Babhulgaon	EW	7.8	910	484	320	50	47	57	0.5	0	287	103	45	38	0.41	0
30	Tuljapur	Petsangvi	BW	7.66	910	582	528	162	30	86	0.4	34	122	296	164	3	0.4	0.4
31	Osmanabad	Arni	BW	8.6	900	576	376	74	47	54	1	34	218	114	103	5	0.3	0.1
32	Umarga	Kasgi	EW	7.9	900	502	270	36	44	80	1	0	336	39	73	60	0.6	0
33	Washi	Ratnapur[ts-01]	BW	7.2	889	578	328	83.2	29.2	54	0.8	0	185.4	104	70.4	13	0.85	0.2
34	Lohara	Kanegaon	BW	7.65	860	550	300	99	13	123	0.5	39	249	87	157	6	0.6	0.3
35	Washi	Zinnar	BW	7.54	860	550	388	142	8	65	7	39	369	79	55	4	0.4	0.3
36	Kalamb	Hawargaon[t-01]	BW	9	817	531	299	83.2	22.1	55.5	0.8	23.5	184	92	47	10.6	0.52	0.2

SN	Block	Village	Type	pH	EC	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F	Fe
					µs/cm	(mg/L)												
37	Tuljapur	Tuljapur	EW	9.52	800	NA	170	38	18	NA	NA	NA	195	99	NA	3	0.48	0
38	Umarga	Kawatha[t-03]	BW	9.52	799	519	244	94.4	1.9	82.2	0.9	23.6	135	156	12	2.9	0.97	0.2
39	Kalamb	Stra[ts-02]	BW	9	793	515	280	49.6	37.9	56	1.4	39.4	123.7	106	41.1	9.27	0.98	0.4
40	Osmanabad	Yedshi	BW	7.6	771	493	232	65.6	16.524	50	2	1.12	299	72	33	5	1.5	0.1
41	Kalamb	Kolhegaon[t-06]	BW	7.6	730	467	344	83.2	33	13	1	0.9	239.1	60	40	12	1.4	0.2
42	Umarga	Alur	EW	8	730	390	280	46	40	36	0.5	0	287	46	15	63	0.52	0
43	Tuljapur	Tuljapur	EW	9.52	720	NA	105	32	6	NA	NA	NA	177	96	NA	33	0.74	0
44	Umarga	Talmod	EW	7.9	720	428	115	32	9	110	1.5	0	79	142	92	2	0.76	0
45	Tuljapur	Kilaj	BW	7.8	714	457	380	109	26	108	8.5	39	493	74	41	4	0.4	0.5
46	Osmanabad	Ambewadi	BW	7.1	710	454	420	125	26	30	3.3	45	307	79	46	5	0.2	0.2
47	Tuljapur	Bolegaon	BW	7.81	695	445	372	109	24	45	3.5	28	352	55	43	4	0.4	0.2
48	Kalamb	Moha	BW	7.45	680	435	408	61	62	25	1.1	28	232	119	57	6	0.4	0.3
49	Osmanabad	Yedshi	EW	7.2	650	350	35	10	2	131	20	0	67	156	7	5	2.71	0
50	Tuljapur	Salagara	EW	7.9	650	367	180	60	7	63	1	0	232	60	26	32	1.79	0
51	Osmanabad	Yeoti	BW	7.52	610	390	352	69	44	34	8.1	34	298	71	34	5	0.3	0.3
52	Osmanabad	Wagholi	OW	7.7	600	302	230	62	18	18	1	0	281	28	11	23	0.4	0
53	Osmanabad	Yedshi	OW	7.2	600	315	50	12	5	104	1.5	0	61	152	4	5	2.1	0
54	Barshi	Khanapur	EW	0	550	240	0	0	0	0	0	0	0	14.18	0	0	0	
55	Bhum	Chincholi	EW	7.8	550	300	210	58	16	31	0.4	0	256	25	32	NA	0.49	0
56	Bhum	Chincholi	Exploration	7.8	550	300	210	58.12	15.81	31.05	0.39	0	256.24	24.82	31.7	0	0.49	0
57	Osmanabad	Wagholi	EW	7.6	540	276	210	56	17	15	0.7	0	244	28	10	26	0.48	0
58	Lohara	Samudral	BW	7.6	520	333	324	99	19	79	5.1	22	310	137	24	1	1.1	0.4
59	Umarga	Sawalsoor[bs-34]	BW	8	487	317	204	30.4	31.1	29.2	0.3	1.4	150.5	56	26.7	6.02	0.4	0.2
60	Umarga	Naichakur[t-05]	BW	8.1	485	315	208	33.6	30.1	32.7	0.3	1.8	154.1	60	23.9	4.5	1.07	0.2
61	Tuljapur	Savargaon	EW	8.9	480	285	0	6	2.43	98.9	0.78	12	79.31	67.37	58.6	0	1.2	
62	Tuljapur	Gujnoor	BW	8.95	422	270	300	72	29	51	2.2	22	238	71	54	2	1.5	0.4
63	Lohara	Babalsoor[t-04]	BW	8.6	404	263	168	20.8	28.2	33.6	0.4	3.7	100.1	64	30.6	6.91	0.92	0.2
64	Umarga	Kaldeo Nimbala	EW	7.5	380	190	150	38	13	17	2	0	214	7	NA	NA	NA	0
65	Umarga	Kaldeo Nimbala	Exploration	7.5	380	190	150	38	13	17	2	0	214	7	0	0	0	0
66	Lohara	Kaddora	EW	8.2	320	187	35	8	4	55	2	0	79	46	18	13	1.34	0
67	Bhum	Golegaon	BW	7.7	267	170.88	128	2	29.9	0	0	0	112.2	154	77	2	1.01	0.3
68	Osmanabad	Kaudgaon	BW	7.5	263	168.32	224	64	15.6	0	0	0	273.3	30	12	7	0.1	0.2
69	Lohara	Salegaon	Exploration	7.65	260	125	110	18	16	8	1	0	128	11	5	0	0	0

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

SN	Name of village	Block	Longitude	Latitude	Type of structure
1	Dahiphal	Bhum	75.7277	18.6061	Percolation tank
2	Ganegaon	Bhum	75.5177	18.4331	Percolation tank
3	Girawali	Bhum	75.667	18.6387	Percolation tank
4	Jamb	Bhum	75.5678	18.5426	Percolation tank
5	Pathrud	Bhum	75.5343	18.5576	Percolation tank
6	Pimpalgaon	Bhum	75.5485	18.4084	Percolation tank
7	Pimpalgaon	Bhum	75.5591	18.4248	Percolation tank
8	Samangaon	Bhum	75.4983	18.4371	Percolation tank
9	Walwad	Bhum	75.5218	18.453	Percolation tank
10	Adsulwadi	Kalamb	75.9338	18.6047	Percolation tank
11	Awad Shirpura	Kalamb	76.19	18.5625	Percolation tank
12	Bangarwadi	Kalamb	75.8176	18.3866	Percolation tank
13	Baratewadi	Kalamb	75.9317	18.3946	Percolation tank
14	Bhosa	Kalamb	75.9721	18.3876	Percolation tank
15	Borgaon Kh	Kalamb	76.231	18.4771	Percolation tank
16	Dahiphal	Kalamb	75.9398	18.4238	Percolation tank
17	Diksal	Kalamb	76.0322	18.5605	Percolation tank
18	Diksal	Kalamb	76.054	18.5596	Percolation tank
19	Gambhirwadi	Kalamb	75.8832	18.5679	Percolation tank
20	Gaur	Kalamb	75.9921	18.3951	Percolation tank
21	Gaur	Kalamb	75.9805	18.4142	Percolation tank
22	Haladgaon	Kalamb	75.9933	18.373	Percolation tank
23	Hasegaon (Shirdho	Kalamb	76.1374	18.4612	Percolation tank
24	Hawargaon	Kalamb	75.9593	18.5642	Percolation tank

SN	Name of village	Block	Longitude	Latitude	Type of structure
25	Itkur	Kalamb	75.9183	18.5851	Percolation tank
26	Jaiphal	Kalamb	76.2405	18.508	Percolation tank
27	Kadaknathwadi	Kalamb	75.7717	18.4306	Percolation tank
28	KALAMB URBAN	Kalamb	75.9909	18.5676	Percolation tank
29	KALAMB URBAN	Kalamb	76.0122	18.5775	Percolation tank
30	Khadki	Kalamb	76.0851	18.5418	Percolation tank
31	Kothala	Kalamb	76.1159	18.5202	Percolation tank
32	Kothala	Kalamb	76.1231	18.5196	Percolation tank
33	Lakhangaon	Kalamb	75.7947	18.6469	Percolation tank
34	Mangrul	Kalamb	76.06	18.4969	Percolation tank
35	Mangrul	Kalamb	76.0654	18.5176	Percolation tank
36	Masobachiwadi	Kalamb	75.7926	18.3918	Percolation tank
37	Masobachiwadi	Kalamb	75.8075	18.4045	Percolation tank
38	Masobachiwadi	Kalamb	75.7717	18.4137	Percolation tank
39	Nipani	Kalamb	76.1841	18.4513	Percolation tank
40	Pangaon	Kalamb	75.889	18.4286	Percolation tank
41	Para	Kalamb	75.8258	18.6361	Percolation tank
42	Para	Kalamb	75.8306	18.6444	Percolation tank
43	Para	Kalamb	75.8028	18.6475	Percolation tank
44	Pimpalgaon Dola	Kalamb	76.0639	18.5293	Percolation tank
45	Pimpalgaon(k)	Kalamb	75.8766	18.6345	Percolation tank
46	Pimpalgaon(L)	Kalamb	75.8352	18.5737	Percolation tank
47	Pimpalgaon(L)	Kalamb	75.8401	18.5616	Percolation tank
48	Ranjani	Kalamb	76.2585	18.5395	Percolation tank
49	Ranjani	Kalamb	76.2621	18.5528	Percolation tank

SN	Name of village	Block	Longitude	Latitude	Type of structure
50	Ratnapur	Kalamb	75.8776	18.4186	Percolation tank
51	Ratnapur	Kalamb	75.8649	18.4253	Percolation tank
52	Sanjitpur	Kalamb	75.9195	18.4255	Percolation tank
53	Saundana Amba	Kalamb	76.2122	18.5579	Percolation tank
54	Saundana Amba	Kalamb	76.2145	18.5673	Percolation tank
55	Shelgaon(Jagir)	Kalamb	75.9622	18.3438	Percolation tank
56	Shiradhon	Kalamb	76.1557	18.5338	Percolation tank
57	Sonegaon	Kalamb	75.8228	18.5761	Percolation tank
58	Uplai	Kalamb	75.8911	18.417	Percolation tank
59	Uplai	Kalamb	75.8744	18.3649	Percolation tank
60	Wadgaon(Jagir)	Kalamb	75.9192	18.3211	Percolation tank
61	Wadgaon(Jagir)	Kalamb	75.9189	18.3285	Percolation tank
62	Wakdi Istal	Kalamb	76.2394	18.5661	Percolation tank
63	Wathawada	Kalamb	76.2157	18.426	Percolation tank
64	Yerandgaon	Kalamb	76.0035	18.3512	Percolation tank
65	Yermala	Kalamb	75.8451	18.3679	Percolation tank
66	Yermala	Kalamb	75.8352	18.3773	Percolation tank
67	Alni	Osmanabad	76.0193	18.2935	Percolation tank
68	Ambejawalga	Osmanabad	75.9549	18.2215	Percolation tank
69	Ambejawalga	Osmanabad	75.9457	18.1869	Percolation tank
70	Ansurda	Osmanabad	76.1451	18.1486	Percolation tank
71	Ansurda	Osmanabad	76.1367	18.1248	Percolation tank
72	Arni	Osmanabad	76.2224	18.317	Percolation tank
73	Bhanasgaon	Osmanabad	75.9395	18.2734	Percolation tank
74	Bhanasgaon	Osmanabad	75.9429	18.2607	Percolation tank

SN	Name of village	Block	Longitude	Latitude	Type of structure
75	Bhikar Sarola	Osmanabad	76.1856	18.3481	Percolation tank
76	Borgaon Raje	Osmanabad	76.2216	18.2306	Percolation tank
77	Chikhali	Osmanabad	76.1475	18.2211	Percolation tank
78	Chikhali	Osmanabad	76.1815	18.2265	Percolation tank
79	Dharur	Osmanabad	76.1243	18.0959	Percolation tank
80	Dhutta	Osmanabad	76.2732	18.145	Percolation tank
81	Gogaon	Osmanabad	76.2548	18.0852	Percolation tank
82	Irla	Osmanabad	76.1779	18.2866	Percolation tank
83	Irla	Osmanabad	76.1579	18.2866	Percolation tank
84	Junoni	Osmanabad	75.9652	18.1379	Percolation tank
85	Kakaspur	Osmanabad	76.2885	18.0983	Percolation tank
86	Kanagara	Osmanabad	76.24	18.1789	Percolation tank
87	Karajkheda	Osmanabad	76.2896	18.0666	Percolation tank
88	Karajkheda	Osmanabad	76.276	18.0601	Percolation tank
89	Karajkheda	Osmanabad	76.268	18.0525	Percolation tank
90	Karajkheda	Osmanabad	76.2668	18.0883	Percolation tank
91	Kasbe Tadwale	Osmanabad	76.0185	18.3521	Percolation tank
92	Kaudgaon(ambejawalaga)	Osmanabad	75.9589	18.1899	Percolation tank
93	Keshegaon	Osmanabad	76.1471	18.1309	Percolation tank
94	Khamgaon	Osmanabad	76.0113	18.3311	Percolation tank
95	Khanapur	Osmanabad	75.9905	18.1827	Percolation tank
96	Khed	Osmanabad	76.0298	18.2942	Percolation tank
97	Kolewadi	Osmanabad	76.1435	18.2851	Percolation tank
98	Lasona	Osmanabad	76.2396	18.2603	Percolation tank
99	Mahadevwadi	Osmanabad	76.2108	18.1237	Percolation tank

SN	Name of village	Block	Longitude	Latitude	Type of structure
100	Mahadevwadi	Osmanabad	76.2132	18.1363	Percolation tank
101	Nandurga	Osmanabad	76.2616	18.1305	Percolation tank
102	OSMANABAD	Osmanabad	76.0338	18.1728	Percolation tank
103	OSMANABAD	Osmanabad	76.0382	18.1888	Percolation tank
104	OSMANABAD	Osmanabad	76.0318	18.2059	Percolation tank
105	Panwadi	Osmanabad	76.1744	18.334	Percolation tank
106	Ramwadi	Osmanabad	76.1475	18.3007	Percolation tank
107	Ruibhar	Osmanabad	76.1275	18.1378	Percolation tank
108	Sakanewadi	Osmanabad	76.1102	18.2417	Percolation tank
109	Sakanewadi	Osmanabad	76.0826	18.2337	Percolation tank
110	Sangvi	Osmanabad	76.2232	18.2508	Percolation tank
111	Sarola Bk.	Osmanabad	76.1339	18.2204	Percolation tank
112	Shekapur	Osmanabad	76.0706	18.1644	Percolation tank
113	Surdi	Osmanabad	76.0093	18.0979	Percolation tank
114	Takali Bembali	Osmanabad	76.268	18.1895	Percolation tank
115	Takali Bembali	Osmanabad	76.2592	18.1888	Percolation tank
116	Ter	Osmanabad	76.1331	18.3365	Percolation tank
117	Toramba	Osmanabad	76.2572	18.0312	Percolation tank
118	Umaregavhan	Osmanabad	76.2027	18.1132	Percolation tank
119	Umaregavhan	Osmanabad	76.2027	18.1248	Percolation tank
120	Upla	Osmanabad	76.059	18.2417	Percolation tank
121	Upla	Osmanabad	76.0566	18.2558	Percolation tank
122	Upla	Osmanabad	76.0634	18.2554	Percolation tank
123	Upla	Osmanabad	76.033	18.2402	Percolation tank
124	Wagholi	Osmanabad	76.0878	18.2584	Percolation tank

SN	Name of village	Block	Longitude	Latitude	Type of structure
125	Aliyabadwadi	Paranda	75.4754	18.5239	Percolation tank
126	Antargaon	Paranda	75.5542	18.4001	Percolation tank
127	Asu	Paranda	75.5282	18.2209	Percolation tank
128	Asu	Paranda	75.5372	18.224	Percolation tank
129	Chinchpur Bk.	Paranda	75.3931	18.5378	Percolation tank
130	Chinchpur Bk.	Paranda	75.3695	18.5256	Percolation tank
131	Deolali	Paranda	75.6872	18.3619	Percolation tank
132	Deolali	Paranda	75.6833	18.3623	Percolation tank
133	Deolali	Paranda	75.6932	18.3367	Percolation tank
134	Devangra	Paranda	75.6606	18.3764	Percolation tank
135	Dudhi	Paranda	75.4995	18.2695	Percolation tank
136	Ida	Paranda	75.5551	18.3836	Percolation tank
137	Ida	Paranda	75.5517	18.3799	Percolation tank
138	Kanadi	Paranda	75.5632	18.4093	Percolation tank
139	Karanja	Paranda	75.4364	18.2272	Percolation tank
140	Katewadi	Paranda	75.3366	18.4305	Percolation tank
141	Katewadi	Paranda	75.336	18.4237	Percolation tank
142	Katewadi	Paranda	75.3354	18.4387	Percolation tank
143	Khasgaon	Paranda	75.4875	18.2524	Percolation tank
144	Kumbheja	Paranda	75.4355	18.349	Percolation tank
145	Mankeshwar	Paranda	75.6361	18.3777	Percolation tank
146	Mankeshwar	Paranda	75.6346	18.3753	Percolation tank
147	Nalgaon	Paranda	75.5381	18.1502	Percolation tank
148	Pandharewadi	Paranda	75.3712	18.5029	Percolation tank
149	Parewadi	Paranda	75.3721	18.4228	Percolation tank

SN	Name of village	Block	Longitude	Latitude	Type of structure
150	Pida	Paranda	75.5419	18.3826	Percolation tank
151	Pistamwadi	Paranda	75.4887	18.3887	Percolation tank
152	Ratanpur	Paranda	75.4442	18.4657	Percolation tank
153	Sakat Bk.	Paranda	75.5286	18.4119	Percolation tank
154	Shelgaon	Paranda	75.3497	18.4955	Percolation tank
155	Shirala	Paranda	75.5156	18.1556	Percolation tank
156	Shirala	Paranda	75.5237	18.165	Percolation tank
157	Sonari	Paranda	75.44	18.3691	Percolation tank
158	Songiri	Paranda	75.4959	18.251	Percolation tank
159	Tandulwadi	Paranda	75.353	18.4478	Percolation tank
160	Tandulwadi	Paranda	75.3333	18.4521	Percolation tank
161	Wanewadi	Paranda	75.5279	18.1465	Percolation tank
162	Wangi Bk.	Paranda	75.5981	18.375	Percolation tank
163	Wangi Kh.	Paranda	75.6007	18.3926	Percolation tank
164	Apsinga	Tuljapur	76.0208	18.0643	Percolation tank
165	Bornadiwadi (Tul.	Tuljapur	76.1542	17.9683	Percolation tank
166	Bornadiwadi Naldu	Tuljapur	76.2014	17.9464	Percolation tank
167	Bornadiwadi Naldu	Tuljapur	76.1876	17.9364	Percolation tank
168	Dahitna	Tuljapur	76.2462	17.7073	Percolation tank
169	Deosinga (Tul)	Tuljapur	76.1843	17.9512	Percolation tank
170	Dhekri	Tuljapur	76.0117	18.0278	Percolation tank
171	Dhotri	Tuljapur	76.024	17.8018	Percolation tank
172	Dhotri	Tuljapur	76.0304	17.8167	Percolation tank
173	Fulwadi	Tuljapur	76.2173	17.8017	Percolation tank
174	Fulwadi	Tuljapur	76.2033	17.7992	Percolation tank

SN	Name of village	Block	Longitude	Latitude	Type of structure
175	Fulwadi	Tuljapur	76.2401	17.8074	Percolation tank
176	Ghandura	Tuljapur	76.2139	17.9208	Percolation tank
177	Hangarga (Naldurg	Tuljapur	76.3361	17.7866	Percolation tank
178	Hippargavara	Tuljapur	76.2595	17.9713	Percolation tank
179	Hippargavara	Tuljapur	76.2526	17.9594	Percolation tank
180	Itkal	Tuljapur	76.1459	17.7597	Percolation tank
181	Jalkotwadi	Tuljapur	75.9134	17.8699	Percolation tank
182	Katgaon	Tuljapur	76.0754	17.7797	Percolation tank
183	Katgaon	Tuljapur	76.0667	17.7918	Percolation tank
184	Katgaon	Tuljapur	76.0926	17.8116	Percolation tank
185	Kati	Tuljapur	75.8921	17.9565	Percolation tank
186	Katri	Tuljapur	76.0065	18.0587	Percolation tank
187	Kemwadi	Tuljapur	75.8676	17.9093	Percolation tank
188	Keshegaon	Tuljapur	76.1739	17.7441	Percolation tank
189	Keshegaon	Tuljapur	76.1755	17.7584	Percolation tank
190	Keshegaon	Tuljapur	76.1554	17.7423	Percolation tank
191	Khadki	Tuljapur	76.0227	17.7827	Percolation tank
192	Khanapur	Tuljapur	76.1051	17.7761	Percolation tank
193	Khudawadi	Tuljapur	76.238	17.7636	Percolation tank
194	Khuttewadi	Tuljapur	75.853	17.998	Percolation tank
195	Kumbhari	Tuljapur	76.0715	17.9161	Percolation tank
196	Kumbhari	Tuljapur	76.0643	17.9099	Percolation tank
197	Kunsawali	Tuljapur	76.364	17.6939	Percolation tank
198	Kunsawali	Tuljapur	76.358	17.6962	Percolation tank
199	Lohagaon	Tuljapur	76.2843	17.7488	Percolation tank

SN	Name of village	Block	Longitude	Latitude	Type of structure
200	Masala Kh.	Tuljapur	75.9947	17.9879	Percolation tank
201	Masala Kh.	Tuljapur	76.0042	17.9912	Percolation tank
202	Murta	Tuljapur	76.2996	17.8359	Percolation tank
203	Nandgaon	Tuljapur	76.3156	17.7265	Percolation tank
204	Nandgaon	Tuljapur	76.3268	17.7454	Percolation tank
205	Nilegaon	Tuljapur	76.1927	17.6982	Percolation tank
206	Nilegaon	Tuljapur	76.1821	17.6944	Percolation tank
207	Pimpala Bk.	Tuljapur	76.0058	17.85	Percolation tank
208	Pimpala Bk.	Tuljapur	76.0119	17.8518	Percolation tank
209	Sarati	Tuljapur	76.1909	17.7703	Percolation tank
210	Sawargaon	Tuljapur	75.922	17.8956	Percolation tank
211	Shiradhon	Tuljapur	76.0031	18.0036	Percolation tank
212	Shiradhon	Tuljapur	76.0098	17.9957	Percolation tank
213	Sindgaon	Tuljapur	76.3455	17.7035	Percolation tank
214	Sindgaon	Tuljapur	76.355	17.7144	Percolation tank
215	Suratgaon	Tuljapur	75.9833	17.8886	Percolation tank
216	Suratgaon	Tuljapur	75.9849	17.8694	Percolation tank
217	Tamalwadi	Tuljapur	75.9565	17.8377	Percolation tank
218	Wadgaon Kati	Tuljapur	75.9091	17.8518	Percolation tank
219	Yamgarwadi	Tuljapur	76.0728	17.8844	Percolation tank
220	Belamb	Umarga	76.4768	17.7473	Percolation tank
221	Bendga	Umarga	76.6426	17.7554	Percolation tank
222	Bhusni	Umarga	76.5045	17.8062	Percolation tank
223	Bori	Umarga	76.6269	17.9925	Percolation tank
224	Chincholi Bhuyar	Umarga	76.4923	17.8335	Percolation tank

SN	Name of village	Block	Longitude	Latitude	Type of structure
225	Dalimb	Umarga	76.4866	17.8489	Percolation tank
226	Dhanora Dagad	Umarga	76.7008	17.7466	Percolation tank
227	Diggi	Umarga	76.6982	17.7156	Percolation tank
228	Guruwadi	Umarga	76.6771	17.7897	Percolation tank
229	Jewali	Umarga	76.3895	17.8884	Percolation tank
230	Jewali	Umarga	76.4093	17.8942	Percolation tank
231	Jewali	Umarga	76.3815	17.8876	Percolation tank
232	Kader	Umarga	76.5615	17.7672	Percolation tank
233	Kantekur	Umarga	76.5161	17.7515	Percolation tank
234	Kasgi	Umarga	76.5784	17.7534	Percolation tank
235	Kawatha	Umarga	76.5872	18.0223	Percolation tank
236	Kesar Jawalga	Umarga	76.4712	17.6592	Percolation tank
237	Kesar Jawalga	Umarga	76.471	17.6959	Percolation tank
238	Lohara Bk.	Umarga	76.3389	17.9922	Percolation tank
239	Lohara kh.	Umarga	76.3564	18.0028	Percolation tank
240	Lohara kh.	Umarga	76.3648	18.0091	Percolation tank
241	Malgi	Umarga	76.711	17.7834	Percolation tank
242	Malgi	Umarga	76.703	17.7674	Percolation tank
243	Matola kh.	Umarga	76.6097	17.9982	Percolation tank
244	Mulaj	Umarga	76.6723	17.8543	Percolation tank
245	Samudral	Umarga	76.5298	17.9709	Percolation tank
246	Sangvi Bhikar	Umarga	76.6649	17.7747	Percolation tank
247	Sastur	Umarga	76.489	18.0136	Percolation tank
248	Tawshigad	Umarga	76.4583	17.9866	Percolation tank
249	Toramba	Umarga	76.4588	17.9662	Percolation tank

SN	Name of village	Block	Longitude	Latitude	Type of structure
250	Tugaon	Umarga	76.4419	17.8247	Percolation tank

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

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

SN	Name of village	Block	Longitude	Latitude	Type of structure
1	Alni	Osmanabad	76.0105	18.2968	Check Dam
2	Ansurda	Osmanabad	76.1431	18.1501	Check Dam
3	Ansurda	Osmanabad	76.1443	18.1379	Check Dam
4	Arni	Osmanabad	76.2092	18.3109	Check Dam
5	Arni	Osmanabad	76.216	18.3223	Check Dam
6	Bamani	Osmanabad	76.206	18.0721	Check Dam
7	Bamani	Osmanabad	76.1987	18.0965	Check Dam
8	Bamaniwadi	Osmanabad	76.1843	18.0554	Check Dam
9	Bamaniwadi	Osmanabad	76.1691	18.0554	Check Dam
10	Bamaniwadi	Osmanabad	76.1611	18.0516	Check Dam
11	Bavi Dhoki	Osmanabad	76.0526	18.2998	Check Dam
12	Bavi(osmanabad)	Osmanabad	76.1004	18.0835	Check Dam
13	Bembli	Osmanabad	76.1835	18.1646	Check Dam
14	Bembli	Osmanabad	76.1943	18.1551	Check Dam
15	Bembli	Osmanabad	76.1963	18.1973	Check Dam
16	Bhadachiwadi	Osmanabad	76.0261	18.3238	Check Dam
17	Bhikar Sarola	Osmanabad	76.1967	18.3489	Check Dam
18	Bhikar Sarola	Osmanabad	76.1919	18.3611	Check Dam
19	Borkheda	Osmanabad	76.2172	18.2011	Check Dam
20	Borkheda	Osmanabad	76.2076	18.2007	Check Dam
21	Bukanwadi	Osmanabad	76.1411	18.3599	Check Dam
22	Dakwadi (n.v.)	Osmanabad	76.1347	18.2991	Check Dam
23	Dharur	Osmanabad	76.1335	18.0634	Check Dam
24	Dharur	Osmanabad	76.1383	18.06	Check Dam
25	Dhoki	Osmanabad	76.0902	18.3801	Check Dam
26	Dhoki	Osmanabad	76.089	18.3702	Check Dam
27	Dhoki	Osmanabad	76.0914	18.3588	Check Dam
28	Gaundgaon	Osmanabad	76.1419	18.1589	Check Dam
29	Jagji	Osmanabad	76.236	18.336	Check Dam
30	Jagji	Osmanabad	76.2376	18.3447	Check Dam
31	Jagji	Osmanabad	76.2108	18.3553	Check Dam
32	Kanagara	Osmanabad	76.25	18.1821	Check Dam
33	Kanagara	Osmanabad	76.2296	18.1718	Check Dam
34	Kanagara	Osmanabad	76.2209	18.1902	Check Dam
35	Kanagara	Osmanabad	76.264	18.1618	Check Dam
36	Karajkheda	Osmanabad	76.2632	18.0333	Check Dam
37	Karajkheda	Osmanabad	76.2896	18.0421	Check Dam
38	Karajkheda	Osmanabad	76.29	18.0535	Check Dam
39	Karajkheda	Osmanabad	76.2752	18.0489	Check Dam
40	Karajkheda	Osmanabad	76.2536	18.074	Check Dam
41	Kasbe Tadwale	Osmanabad	76.0378	18.3915	Check Dam
42	Kasbe Tadwale	Osmanabad	76.0438	18.3774	Check Dam
43	Keshegaon	Osmanabad	76.1457	18.1022	Check Dam
44	Keshegaon	Osmanabad	76.1739	18.106	Check Dam

SN	Name of village	Block	Longitude	Latitude	Type of structure
45	Keshegaon	Osmanabad	76.1639	18.095	Check Dam
46	Khamgaon	Osmanabad	76.0314	18.3337	Check Dam
47	Khamgaon	Osmanabad	76.0097	18.3337	Check Dam
48	Khed	Osmanabad	76.0293	18.2888	Check Dam
49	Khed	Osmanabad	76.0402	18.2926	Check Dam
50	Khed	Osmanabad	76.032	18.3063	Check Dam
51	Kini	Osmanabad	76.0606	18.3055	Check Dam
52	Kond	Osmanabad	76.3025	18.2877	Check Dam
53	Kond	Osmanabad	76.2892	18.2998	Check Dam
54	Kond	Osmanabad	76.2965	18.3052	Check Dam
55	Kond	Osmanabad	76.2824	18.3112	Check Dam
56	Kond	Osmanabad	76.2896	18.3223	Check Dam
57	Kond	Osmanabad	76.3005	18.3162	Check Dam
58	Kond	Osmanabad	76.3065	18.3105	Check Dam
59	Kond	Osmanabad	76.2836	18.3264	Check Dam
60	Kumalwadi	Osmanabad	75.9881	18.2774	Check Dam
61	Mahadevwadi	Osmanabad	76.206	18.1471	Check Dam
62	Mahalingi	Osmanabad	76.1489	18.2124	Check Dam
63	Mahalingi	Osmanabad	76.1775	18.1965	Check Dam
64	Mulewadi	Osmanabad	76.089	18.3143	Check Dam
65	Nandurga	Osmanabad	76.2415	18.1198	Check Dam
66	Nitali	Osmanabad	76.2828	18.2603	Check Dam
67	Nitali	Osmanabad	76.2876	18.2637	Check Dam
68	Nitali	Osmanabad	76.2949	18.2675	Check Dam
69	Nitali	Osmanabad	76.2792	18.2641	Check Dam
70	Padoli	Osmanabad	76.2488	18.2302	Check Dam
71	Padoli	Osmanabad	76.2708	18.2333	Check Dam
72	Padoli	Osmanabad	76.272	18.2234	Check Dam
73	Padoli	Osmanabad	76.2622	18.2213	Check Dam
74	Palaswadi	Osmanabad	76.0837	18.1495	Check Dam
75	Palsap	Osmanabad	76.1813	18.3754	Check Dam
76	Panwadi	Osmanabad	76.1803	18.3325	Check Dam
77	Patoda	Osmanabad	76.2316	18.0801	Check Dam
78	Pawarwadi	Osmanabad	76.0802	18.2937	Check Dam
79	Ruibhar	Osmanabad	76.1239	18.1444	Check Dam
80	Ruibhar	Osmanabad	76.1199	18.1611	Check Dam
81	Samudrawani	Osmanabad	76.2592	18.2359	Check Dam
82	Sangvi	Osmanabad	76.2128	18.2667	Check Dam
83	Shekapur	Osmanabad	76.0598	18.1742	Check Dam
84	Sumbha	Osmanabad	76.2295	18.3202	Check Dam
85	Takali Bembali	Osmanabad	76.272	18.1953	Check Dam
86	Takali Bembali	Osmanabad	76.2836	18.2032	Check Dam
87	Takwiki	Osmanabad	76.228	18.0562	Check Dam
88	Takwiki	Osmanabad	76.2196	18.0371	Check Dam
89	Tawaraj Kheda	Osmanabad	76.2792	18.3527	Check Dam
90	Tawaraj Kheda	Osmanabad	76.2828	18.3618	Check Dam

SN	Name of village	Block	Longitude	Latitude	Type of structure
91	Ter	Osmanabad	76.1323	18.3401	Check Dam
92	Ter	Osmanabad	76.1291	18.3527	Check Dam
93	Thodsarwadi	Osmanabad	76.093	18.3477	Check Dam
94	Toramba	Osmanabad	76.2532	18.0208	Check Dam
95	Toramba	Osmanabad	76.2496	18.0337	Check Dam
96	Umaregavhan	Osmanabad	76.2023	18.1094	Check Dam
97	Umaregavhan	Osmanabad	76.2039	18.1197	Check Dam
98	Upla	Osmanabad	76.0538	18.2911	Check Dam
99	Wadgaon	Osmanabad	76.0866	18.1178	Check Dam
100	Wagholi	Osmanabad	76.098	18.2657	Check Dam
101	Wakharwadi	Osmanabad	76.0918	18.3892	Check Dam
102	Yedsi	Osmanabad	75.9777	18.3067	Check Dam
103	Yedsi	Osmanabad	75.9697	18.3188	Check Dam
104	Yedsi	Osmanabad	75.9657	18.3318	Check Dam
105	Yeoti	Osmanabad	76.2476	18.2937	Check Dam
106	Anjan Sonda	Bhum	75.6631	18.6042	Checkdam
107	Arsoli	Bhum	75.6957	18.4061	Checkdam
108	Arsoli	Bhum	75.6856	18.4031	Checkdam
109	Bavi	Bhum	75.5475	18.5139	Checkdam
110	Bavi	Bhum	75.5612	18.5166	Checkdam
111	Bhongiri	Bhum	75.6728	18.5139	Checkdam
112	Bhongiri	Bhum	75.674	18.4971	Checkdam
113	BHUM URBAN	Bhum	75.6696	18.4758	Checkdam
114	Bori	Bhum	75.788	18.4644	Checkdam
115	Brahmagaon	Bhum	75.7494	18.6366	Checkdam
116	Brahmagaon	Bhum	75.7523	18.6465	Checkdam
117	Brahmagaon	Bhum	75.7563	18.6518	Checkdam
118	Chincholi	Bhum	75.6282	18.4838	Checkdam
119	Chumbli	Bhum	75.5564	18.4891	Checkdam
120	Dahiphal	Bhum	75.7161	18.6214	Checkdam
121	Dahiphal	Bhum	75.7169	18.6137	Checkdam
122	Dokewadi	Bhum	75.6399	18.6395	Checkdam
123	Dudhodi	Bhum	75.5331	18.5695	Checkdam
124	Dudhodi	Bhum	75.5303	18.5828	Checkdam
125	Dudhodi	Bhum	75.5347	18.5984	Checkdam
126	Ghatnandur	Bhum	75.6294	18.584	Checkdam
127	Ghatnandur	Bhum	75.6037	18.5703	Checkdam
128	Ghatpimpari	Bhum	75.6547	18.5836	Checkdam
129	Ghatpimpari	Bhum	75.6599	18.5936	Checkdam
130	Giralgaon	Bhum	75.5363	18.622	Checkdam
131	Giralgaon	Bhum	75.5246	18.6197	Checkdam
132	Giralgaon	Bhum	75.5118	18.6194	Checkdam
133	Giralgaon	Bhum	75.5138	18.6235	Checkdam
134	Girawali	Bhum	75.6667	18.637	Checkdam
135	Golegaon	Bhum	75.7828	18.5078	Checkdam
136	Golegaon	Bhum	75.7948	18.5048	Checkdam

SN	Name of village	Block	Longitude	Latitude	Type of structure
137	Gormala	Bhum	75.5877	18.4888	Checkdam
138	Gormala	Bhum	75.5937	18.4933	Checkdam
139	Hadongi	Bhum	75.7093	18.4602	Checkdam
140	Hadongi	Bhum	75.7089	18.4693	Checkdam
141	Hiwara	Bhum	75.735	18.461	Checkdam
142	Hiwara	Bhum	75.7406	18.4713	Checkdam
143	Hiwara	Bhum	75.743	18.4633	Checkdam
144	Indapur	Bhum	75.8105	18.5033	Checkdam
145	Indapur	Bhum	75.8253	18.501	Checkdam
146	Isrup(N.V.)	Bhum	75.7723	18.4819	Checkdam
147	It	Bhum	75.6326	18.6026	Checkdam
148	It	Bhum	75.635	18.6194	Checkdam
149	Izora	Bhum	75.7081	18.5958	Checkdam
150	Jaiwantnagar	Bhum	75.5238	18.5386	Checkdam
151	Jaiwantnagar	Bhum	75.5162	18.5348	Checkdam
152	Jamb	Bhum	75.5696	18.5459	Checkdam
153	Jamb	Bhum	75.568	18.5356	Checkdam
154	Jawalka	Bhum	75.7627	18.6092	Checkdam
155	Jotibachiwadi	Bhum	75.5664	18.6228	Checkdam
156	Jotibachiwadi	Bhum	75.5652	18.5977	Checkdam
157	Kanheri	Bhum	75.7531	18.4987	Checkdam
158	Kanheri	Bhum	75.7438	18.5018	Checkdam
159	Kanheri	Bhum	75.7354	18.5059	Checkdam
160	Kanheri	Bhum	75.7551	18.5056	Checkdam
161	Kawadewadi (N.V.)	Bhum	75.8072	18.5795	Checkdam
162	Kelewadi	Bhum	75.7446	18.5254	Checkdam
163	Kelewadi	Bhum	75.7362	18.5261	Checkdam
164	Khanapur	Bhum	75.7804	18.4671	Checkdam
165	Lanjeshwar	Bhum	75.5881	18.6829	Checkdam
166	Naliwadgaon	Bhum	75.513	18.6037	Checkdam
167	Nandgaon	Bhum	75.8008	18.4496	Checkdam
168	Nandgaon	Bhum	75.7884	18.4511	Checkdam
169	Nandgaon	Bhum	75.7787	18.4511	Checkdam
170	Nipani	Bhum	75.5732	18.6746	Checkdam
171	Nipani	Bhum	75.5792	18.6799	Checkdam
172	Nipani	Bhum	75.5656	18.678	Checkdam
173	Pakhrud	Bhum	75.5857	18.6327	Checkdam
174	Pakhrud	Bhum	75.5692	18.6361	Checkdam
175	Pangri	Bhum	75.7643	18.6549	Checkdam
176	Pangri	Bhum	75.7695	18.6591	Checkdam
177	Pardi	Bhum	75.7707	18.4911	Checkdam
178	Pardi	Bhum	75.7659	18.4979	Checkdam
179	Pargaon	Bhum	75.6904	18.6522	Checkdam
180	Pargaon	Bhum	75.6912	18.6606	Checkdam
181	Pargaon	Bhum	75.6812	18.6682	Checkdam
182	Pathasangvi	Bhum	75.5106	18.4914	Checkdam

SN	Name of village	Block	Longitude	Latitude	Type of structure
183	Pathrud	Bhum	75.5327	18.5596	Checkdam
184	Rameshwar	Bhum	75.6362	18.5044	Checkdam
185	Ramkund	Bhum	75.7101	18.5581	Checkdam
186	Rui	Bhum	75.7085	18.6473	Checkdam
187	Rui	Bhum	75.7165	18.6655	Checkdam
188	Saramkundi	Bhum	75.7338	18.5756	Checkdam
189	Saramkundi	Bhum	75.733	18.5623	Checkdam
190	Saramkundi	Bhum	75.729	18.5688	Checkdam
191	Saramkundi	Bhum	75.739	18.5684	Checkdam
192	Saramkundi	Bhum	75.733	18.5901	Checkdam
193	Sawargaon	Bhum	75.5086	18.5805	Checkdam
194	Sawargaon	Bhum	75.5018	18.5752	Checkdam
195	Sonnewadi	Bhum	75.6728	18.6294	Checkdam
196	Sukta	Bhum	75.6326	18.5314	Checkdam
197	Sukta	Bhum	75.6334	18.5405	Checkdam
198	Tandulwadi	Bhum	75.7651	18.5829	Checkdam
199	Tandulwadi	Bhum	75.7651	18.5913	Checkdam
200	Ulup	Bhum	75.615	18.5089	Checkdam
201	Umachiwadi	Bhum	75.5664	18.5916	Checkdam
202	Umachiwadi	Bhum	75.5712	18.603	Checkdam
203	Wakwad	Bhum	75.6848	18.5226	Checkdam
204	Wakwad	Bhum	75.6872	18.5291	Checkdam
205	Walha	Bhum	75.4949	18.4419	Checkdam
206	Walha	Bhum	75.4933	18.4495	Checkdam
207	Walwad	Bhum	75.5106	18.4762	Checkdam
208	Walwad	Bhum	75.5042	18.4602	Checkdam
209	Wanjarwadi	Bhum	75.7013	18.4324	Checkdam
210	Wanjarwadi	Bhum	75.7021	18.4408	Checkdam
211	Warud	Bhum	75.5949	18.5017	Checkdam
212	Washi	Bhum	75.7767	18.5616	Checkdam
213	Washi	Bhum	75.7687	18.5299	Checkdam
214	Washi	Bhum	75.7763	18.5334	Checkdam
215	Washi	Bhum	75.7844	18.5421	Checkdam
216	Washi	Bhum	75.7775	18.5452	Checkdam
217	Washi	Bhum	75.7964	18.5437	Checkdam
218	Washi	Bhum	75.749	18.5197	Checkdam
219	Washi	Bhum	75.7571	18.5261	Checkdam
220	Washi	Bhum	75.7755	18.5265	Checkdam
221	Washi	Bhum	75.7659	18.52	Checkdam
222	Washi	Bhum	75.7711	18.5467	Checkdam
223	Washi	Bhum	75.7928	18.56	Checkdam
224	Yasawandi	Bhum	75.6868	18.5696	Checkdam
225	Adhala	Kalamb	75.9317	18.6158	Checkdam
226	Adsulwadi	Kalamb	75.9277	18.6047	Checkdam
227	Andora	Kalamb	75.9642	18.5019	Checkdam
228	Andora	Kalamb	75.9666	18.5114	Checkdam

SN	Name of village	Block	Longitude	Latitude	Type of structure
229	Andora	Kalamb	75.969	18.519	Checkdam
230	Andora	Kalamb	75.9791	18.5114	Checkdam
231	Andora	Kalamb	75.9742	18.5267	Checkdam
232	Andora	Kalamb	75.9634	18.5328	Checkdam
233	Andora	Kalamb	75.9614	18.5404	Checkdam
234	Babhalgaon	Kalamb	75.9301	18.4474	Checkdam
235	Baratewadi	Kalamb	75.9277	18.3918	Checkdam
236	Bavi	Kalamb	75.8671	18.5067	Checkdam
237	Bavi	Kalamb	75.8739	18.5117	Checkdam
238	Bavi	Kalamb	75.8839	18.5136	Checkdam
239	Bavi	Kalamb	75.8731	18.4838	Checkdam
240	Bavi	Kalamb	75.8803	18.4816	Checkdam
241	Bavi	Kalamb	75.8887	18.4835	Checkdam
242	Bavi	Kalamb	75.8944	18.4778	Checkdam
243	Bavi	Kalamb	75.8775	18.4751	Checkdam
244	Bhogaji	Kalamb	75.9036	18.6044	Checkdam
245	Bhogaji	Kalamb	75.9148	18.6059	Checkdam
246	Borda	Kalamb	76.0156	18.4985	Checkdam
247	Borda	Kalamb	76.0039	18.5049	Checkdam
248	Borgaon Kh	Kalamb	76.2356	18.4779	Checkdam
249	Borgaon(Dhane)	Kalamb	75.8775	18.5562	Checkdam
250	Borwanti	Kalamb	76.1107	18.5065	Checkdam
251	Chorakhali	Kalamb	75.9241	18.3522	Checkdam
252	Dahiphal	Kalamb	75.9369	18.4402	Checkdam
253	Dasmegaon	Kalamb	75.8341	18.533	Checkdam
254	Deodhanora	Kalamb	76.1047	18.4558	Checkdam
255	Deolali	Kalamb	76.1372	18.4174	Checkdam
256	Deolali	Kalamb	76.1384	18.4071	Checkdam
257	Deolali	Kalamb	76.1288	18.4048	Checkdam
258	Deolali	Kalamb	76.1228	18.4143	Checkdam
259	Diksal	Kalamb	76.0324	18.5404	Checkdam
260	Diksal	Kalamb	76.0332	18.5495	Checkdam
261	Dongrewadi	Kalamb	75.859	18.6431	Checkdam
262	Ekurka	Kalamb	76.14	18.4851	Checkdam
263	Ekurka	Kalamb	76.1304	18.4924	Checkdam
264	Ekurka	Kalamb	76.1272	18.5015	Checkdam
265	Gambhirwadi	Kalamb	75.8783	18.5905	Checkdam
266	Ghatgaon	Kalamb	76.2311	18.5404	Checkdam
267	Ghatgaon	Kalamb	76.2364	18.556	Checkdam
268	Ghodki	Kalamb	75.8743	18.5497	Checkdam
269	Ghodki	Kalamb	75.8755	18.5425	Checkdam
270	Gojwada	Kalamb	75.8398	18.4941	Checkdam
271	Gojwada	Kalamb	75.837	18.5048	Checkdam
272	Gojwada	Kalamb	75.8446	18.5071	Checkdam
273	Gojwada	Kalamb	75.8365	18.5155	Checkdam
274	Gojwada	Kalamb	75.8221	18.5189	Checkdam

SN	Name of village	Block	Longitude	Latitude	Type of structure
275	Gojwada	Kalamb	75.8402	18.4877	Checkdam
276	Govindpur	Kalamb	76.0927	18.4455	Checkdam
277	Hasegaon (Shirdhon	Kalamb	76.1565	18.4642	Checkdam
278	Hasegaon (Shirdhon	Kalamb	76.1513	18.4714	Checkdam
279	Hasegaon Kej	Kalamb	76.0003	18.5301	Checkdam
280	Hasegaon Kej	Kalamb	75.9991	18.5377	Checkdam
281	Hasegaon Kej	Kalamb	75.9951	18.5503	Checkdam
282	Hawargaon	Kalamb	75.9686	18.5685	Checkdam
283	Hawargaon	Kalamb	75.9622	18.5632	Checkdam
284	Itkur	Kalamb	75.9305	18.5739	Checkdam
285	Itkur	Kalamb	75.9241	18.5697	Checkdam
286	Itkur	Kalamb	75.912	18.5503	Checkdam
287	Jaiphal	Kalamb	76.2452	18.5072	Checkdam
288	Jaiphal	Kalamb	76.2544	18.5312	Checkdam
289	Jawala Kh.	Kalamb	76.1123	18.4749	Checkdam
290	Jawala Kh.	Kalamb	76.1155	18.4878	Checkdam
291	Kadaknathwadi	Kalamb	75.7767	18.4324	Checkdam
292	KALAMB URBAN	Kalamb	75.9907	18.564	Checkdam
293	Kanherwadi	Kalamb	75.9321	18.5145	Checkdam
294	Kanherwadi	Kalamb	75.9321	18.5286	Checkdam
295	Karanjkalla	Kalamb	76.0678	18.5377	Checkdam
296	Khamaswadi	Kalamb	76.0593	18.449	Checkdam
297	Khamaswadi	Kalamb	76.0328	18.4444	Checkdam
298	Khamaswadi	Kalamb	76.0148	18.4566	Checkdam
299	Khamaswadi	Kalamb	76.0453	18.4615	Checkdam
300	Khamaswadi	Kalamb	76.0573	18.4779	Checkdam
301	Khamkarwadi	Kalamb	75.865	18.4423	Checkdam
302	Khamkarwadi	Kalamb	75.8663	18.448	Checkdam
303	Kherda	Kalamb	76.0196	18.4909	Checkdam
304	Khondala	Kalamb	75.9614	18.596	Checkdam
305	Kothala	Kalamb	76.1272	18.5179	Checkdam
306	Lakhangaon	Kalamb	75.786	18.6351	Checkdam
307	Lakhangaon	Kalamb	75.7928	18.6419	Checkdam
308	Lakhangaon	Kalamb	75.7735	18.6385	Checkdam
309	Lakhangaon	Kalamb	75.7759	18.648	Checkdam
310	Mandva	Kalamb	75.9028	18.5078	Checkdam
311	Mandva	Kalamb	75.9068	18.5238	Checkdam
312	Mangrul	Kalamb	76.0682	18.5027	Checkdam
313	Mangrul	Kalamb	76.0457	18.4973	Checkdam
314	Massa (kh)	Kalamb	75.9361	18.4844	Checkdam
315	Massa (kh)	Kalamb	75.9381	18.4954	Checkdam
316	Massa (kh)	Kalamb	75.9305	18.5008	Checkdam
317	Massa (kh)	Kalamb	75.9433	18.4848	Checkdam
318	Moha	Kalamb	75.9979	18.4939	Checkdam
319	Moha	Kalamb	75.9879	18.4844	Checkdam
320	Moha	Kalamb	75.9766	18.4669	Checkdam

SN	Name of village	Block	Longitude	Latitude	Type of structure
321	Moha	Kalamb	75.9935	18.4688	Checkdam
322	Moha	Kalamb	76.0007	18.4787	Checkdam
323	Moha	Kalamb	76.0104	18.484	Checkdam
324	Moha	Kalamb	75.9899	18.4631	Checkdam
325	Nagulgaon	Kalamb	76.1424	18.4783	Checkdam
326	Naigaon	Kalamb	76.24	18.4402	Checkdam
327	Naigaon	Kalamb	76.2472	18.4467	Checkdam
328	Nipani	Kalamb	76.1942	18.4535	Checkdam
329	Padoli	Kalamb	76.2067	18.4512	Checkdam
330	Padoli	Kalamb	76.2191	18.4566	Checkdam
331	Padoli	Kalamb	76.2287	18.4566	Checkdam
332	Pangaon	Kalamb	75.9088	18.4326	Checkdam
333	Para	Kalamb	75.8229	18.6191	Checkdam
334	Para	Kalamb	75.8253	18.6271	Checkdam
335	Para	Kalamb	75.8261	18.6335	Checkdam
336	Para	Kalamb	75.8133	18.6324	Checkdam
337	Para	Kalamb	75.8233	18.64	Checkdam
338	Para	Kalamb	75.851	18.6377	Checkdam
339	Pathardi	Kalamb	75.9345	18.5861	Checkdam
340	Pimpalgaon Dola	Kalamb	76.0525	18.5324	Checkdam
341	Pimpalgaon(k)	Kalamb	75.8831	18.629	Checkdam
342	Pimpalgaon(k)	Kalamb	75.894	18.6316	Checkdam
343	Pimpalgaon(L)	Kalamb	75.8349	18.5745	Checkdam
344	Pimpalgaon(L)	Kalamb	75.8345	18.5848	Checkdam
345	Pimpalgaon(L)	Kalamb	75.8659	18.565	Checkdam
346	Pimpalgaon(L)	Kalamb	75.857	18.5673	Checkdam
347	Pimpalgaon(L)	Kalamb	75.8474	18.5726	Checkdam
348	Pimpalgaon(L)	Kalamb	75.8494	18.5806	Checkdam
349	Pimpalgaon(L)	Kalamb	75.841	18.5608	Checkdam
350	Pimpalwadi	Kalamb	75.8016	18.6122	Checkdam
351	Pimpalwadi	Kalamb	75.804	18.6255	Checkdam
352	Raigavhan	Kalamb	76.2384	18.4909	Checkdam
353	Raigavhan	Kalamb	76.2311	18.497	Checkdam
354	Ranjani	Kalamb	76.262	18.5457	Checkdam
355	Ratnapur	Kalamb	75.8663	18.4233	Checkdam
356	Ratnapur	Kalamb	75.8654	18.432	Checkdam
357	Ratnapur	Kalamb	75.8767	18.4199	Checkdam
358	Sanjitpur	Kalamb	75.9192	18.4215	Checkdam
359	Sanjitpur	Kalamb	75.9176	18.4364	Checkdam
360	Sanjitpur	Kalamb	75.912	18.4452	Checkdam
361	Sapnai	Kalamb	75.9377	18.4002	Checkdam
362	Sarola Washi	Kalamb	75.8141	18.5696	Checkdam
363	Sarola(Mandva)	Kalamb	75.8478	18.6035	Checkdam
364	Sarola(Mandva)	Kalamb	75.8586	18.6103	Checkdam
365	Satvaiwadi	Kalamb	75.8494	18.4282	Checkdam
366	Satvaiwadi	Kalamb	75.841	18.4248	Checkdam

SN	Name of village	Block	Longitude	Latitude	Type of structure
367	Selu	Kalamb	75.8807	18.6183	Checkdam
368	Shelgaon Divani	Kalamb	75.9449	18.3865	Checkdam
369	Shelgaon Divani	Kalamb	75.951	18.3934	Checkdam
370	Shelgaon(Jagir)	Kalamb	75.9734	18.3518	Checkdam
371	Shelgaon(Jagir)	Kalamb	75.9562	18.3469	Checkdam
372	Shelgaon(Jagir)	Kalamb	75.9787	18.3438	Checkdam
373	Shelka Dhanora	Kalamb	76.0292	18.5061	Checkdam
374	Shelka Dhanora	Kalamb	76.0324	18.4966	Checkdam
375	Shiradhon	Kalamb	76.1818	18.4943	Checkdam
376	Shiradhon	Kalamb	76.1794	18.5042	Checkdam
377	Shiradhon	Kalamb	76.181	18.5168	Checkdam
378	Shiradhon	Kalamb	76.1729	18.5168	Checkdam
379	Shiradhon	Kalamb	76.1794	18.5251	Checkdam
380	Shiradhon	Kalamb	76.1854	18.5358	Checkdam
381	Shiradhon	Kalamb	76.187	18.5484	Checkdam
382	Sonegaon	Kalamb	75.8233	18.5749	Checkdam
383	Sonegaon	Kalamb	75.8181	18.5821	Checkdam
384	Sonegaon	Kalamb	75.8229	18.5821	Checkdam
385	Tadgaon	Kalamb	76.2091	18.5339	Checkdam
386	Tadgaon	Kalamb	76.2119	18.5495	Checkdam
387	Terkheda	Kalamb	75.843	18.4408	Checkdam
388	Terkheda	Kalamb	75.8386	18.4503	Checkdam
389	Terkheda	Kalamb	75.8398	18.4541	Checkdam
390	Terkheda	Kalamb	75.8337	18.4595	Checkdam
391	Terkheda	Kalamb	75.8301	18.4633	Checkdam
392	Uplai	Kalamb	75.9048	18.4071	Checkdam
393	Uplai	Kalamb	75.8919	18.4094	Checkdam
394	Wadgaon (Shirdhon)	Kalamb	76.199	18.4459	Checkdam
395	Wadji	Kalamb	75.7808	18.4366	Checkdam
396	Wagholi	Kalamb	75.9967	18.3979	Checkdam
397	Wakdikej	Kalamb	75.9493	18.5541	Checkdam
398	Wanewadi	Kalamb	75.9654	18.3823	Checkdam
399	Wathawada	Kalamb	76.2063	18.4231	Checkdam
400	Wathawada	Kalamb	76.2119	18.4242	Checkdam
401	Yerandgaon	Kalamb	75.9899	18.3507	Checkdam
402	Yermala	Kalamb	75.8534	18.3835	Checkdam
403	Yermala	Kalamb	75.8442	18.3899	Checkdam
404	Yermala	Kalamb	75.8353	18.3884	Checkdam
405	Yermala	Kalamb	75.8297	18.3953	Checkdam
406	Aleshwar	Paranda	75.3217	18.398	Checkdam
407	Ambi	Paranda	75.4885	18.536	Checkdam
408	Anala	Paranda	75.4495	18.4332	Checkdam
409	Anala	Paranda	75.4388	18.433	Checkdam
410	Anala	Paranda	75.4312	18.4309	Checkdam
411	Anala	Paranda	75.4255	18.4304	Checkdam
412	Antarwali	Paranda	75.4765	18.5992	Checkdam

SN	Name of village	Block	Longitude	Latitude	Type of structure
413	Antarwali	Paranda	75.4725	18.5919	Checkdam
414	Antarwali	Paranda	75.4873	18.5961	Checkdam
415	Arangaon	Paranda	75.5342	18.3534	Checkdam
416	Arangaon	Paranda	75.546	18.3569	Checkdam
417	Ashta	Paranda	75.615	18.41	Checkdam
418	Asu	Paranda	75.5497	18.2407	Checkdam
419	Asu	Paranda	75.5497	18.2285	Checkdam
420	Asu	Paranda	75.5349	18.2289	Checkdam
421	Awar Pimpri	Paranda	75.4747	18.2098	Checkdam
422	Awar Pimpri	Paranda	75.4695	18.2235	Checkdam
423	Bawachi	Paranda	75.4993	18.2902	Checkdam
424	Bawachi	Paranda	75.5108	18.2812	Checkdam
425	Bhandgaon	Paranda	75.6316	18.3296	Checkdam
426	Bhotra	Paranda	75.4147	18.2956	Checkdam
427	Birobachiwadi	Paranda	75.4933	18.5444	Checkdam
428	Bodakha	Paranda	75.5405	18.2796	Checkdam
429	Bodakha	Paranda	75.5365	18.2872	Checkdam
430	Chinchpur Bk.	Paranda	75.3666	18.5299	Checkdam
431	Chinchpur Bk.	Paranda	75.3561	18.5337	Checkdam
432	Chinchpur Bk.	Paranda	75.3488	18.536	Checkdam
433	Chinchpur Bk.	Paranda	75.3665	18.5129	Checkdam
434	Chinchpur Bk.	Paranda	75.3596	18.5195	Checkdam
435	Chinchpur Bk.	Paranda	75.3972	18.5312	Checkdam
436	Chinchpur Bk.	Paranda	75.3538	18.499	Checkdam
437	Chinchpur Bk.	Paranda	75.3587	18.5488	Checkdam
438	Chinchpur Kh.	Paranda	75.4003	18.469	Checkdam
439	Chinchpur Kh.	Paranda	75.3968	18.4755	Checkdam
440	Chinchpur Kh.	Paranda	75.4161	18.4645	Checkdam
441	Dahitana	Paranda	75.5528	18.2918	Checkdam
442	Dandegaon	Paranda	75.4564	18.555	Checkdam
443	Deogaon Bk.	Paranda	75.445	18.5296	Checkdam
444	Deogaon Bk.	Paranda	75.4498	18.5353	Checkdam
445	Deogaon Kh.	Paranda	75.4747	18.2334	Checkdam
446	Deolali	Paranda	75.6985	18.3715	Checkdam
447	Deolali	Paranda	75.6997	18.3784	Checkdam
448	Deolali	Paranda	75.7053	18.381	Checkdam
449	Deolali	Paranda	75.6981	18.3441	Checkdam
450	Deolali	Paranda	75.7081	18.3509	Checkdam
451	Deolali	Paranda	75.6884	18.3711	Checkdam
452	Deulgaon	Paranda	75.3422	18.422	Checkdam
453	Deulgaon	Paranda	75.3423	18.412	Checkdam
454	Dhagpimpri	Paranda	75.5132	18.2192	Checkdam
455	Dhotri	Paranda	75.3288	18.4704	Checkdam
456	Domgaon	Paranda	75.415	18.3393	Checkdam
457	Dudhi	Paranda	75.501	18.2744	Checkdam
458	Gharagaon	Paranda	75.5508	18.3078	Checkdam

SN	Name of village	Block	Longitude	Latitude	Type of structure
459	Golegaon	Paranda	75.6122	18.4385	Checkdam
460	Hingangaon Bk.	Paranda	75.614	18.2575	Checkdam
461	Hingangaon Kh.	Paranda	75.3713	18.429	Checkdam
462	Hingangaon Kh.	Paranda	75.3925	18.424	Checkdam
463	Jagdalwadi	Paranda	75.3398	18.4281	Checkdam
464	Jakatewadi	Paranda	75.4237	18.521	Checkdam
465	Jakhepimpri	Paranda	75.4936	18.3701	Checkdam
466	Jamgaon	Paranda	75.4435	18.3043	Checkdam
467	Jawala (N.)	Paranda	75.569	18.3197	Checkdam
468	Jawala (N.)	Paranda	75.5663	18.3396	Checkdam
469	Jawala (N.)	Paranda	75.5755	18.3454	Checkdam
470	Jawala (N.)	Paranda	75.5822	18.3505	Checkdam
471	Jawala (N.)	Paranda	75.5915	18.3524	Checkdam
472	Jawala (N.)	Paranda	75.5863	18.3421	Checkdam
473	Jawala (N.)	Paranda	75.5782	18.3291	Checkdam
474	Jejla	Paranda	75.4893	18.5721	Checkdam
475	Jejla	Paranda	75.4765	18.563	Checkdam
476	Kandalgaon	Paranda	75.5802	18.3069	Checkdam
477	Kandalgaon	Paranda	75.579	18.3189	Checkdam
478	Kandalgaon	Paranda	75.575	18.3055	Checkdam
479	Kandari	Paranda	75.4587	18.3858	Checkdam
480	Kandari	Paranda	75.4414	18.3752	Checkdam
481	Kandari	Paranda	75.4509	18.372	Checkdam
482	Karla	Paranda	75.4286	18.4009	Checkdam
483	Katewadi	Paranda	75.3394	18.4371	Checkdam
484	Kaundgaon	Paranda	75.3846	18.3704	Checkdam
485	Khasapuri	Paranda	75.4797	18.295	Checkdam
486	Khasgaon	Paranda	75.4835	18.2571	Checkdam
487	Khasgaon	Paranda	75.4887	18.2624	Checkdam
488	Kokarwadi	Paranda	75.3199	18.4831	Checkdam
489	Kukkadgaon	Paranda	75.4732	18.4835	Checkdam
490	Kukkadgaon	Paranda	75.4707	18.4872	Checkdam
491	Kukkadgaon	Paranda	75.4625	18.4832	Checkdam
492	Kukkadgaon	Paranda	75.4632	18.4899	Checkdam
493	Kukkadgaon	Paranda	75.4813	18.4852	Checkdam
494	Kukkadgaon	Paranda	75.4759	18.481	Checkdam
495	Kumbheja	Paranda	75.4404	18.3483	Checkdam
496	Lohara	Paranda	75.4678	18.1752	Checkdam
497	Loni	Paranda	75.5257	18.1813	Checkdam
498	Loni	Paranda	75.5377	18.1843	Checkdam
499	Loni	Paranda	75.5228	18.191	Checkdam
500	Loni	Paranda	75.5287	18.1874	Checkdam
501	Malakapur	Paranda	75.4624	18.4597	Checkdam
502	Malakapur	Paranda	75.4504	18.4577	Checkdam
503	Mugaon	Paranda	75.412	18.3971	Checkdam
504	Mugaon	Paranda	75.4005	18.3942	Checkdam

SN	Name of village	Block	Longitude	Latitude	Type of structure
505	Pachpimpla	Paranda	75.4875	18.3535	Checkdam
506	Pandharewadi	Paranda	75.3779	18.5082	Checkdam
507	Pandharewadi	Paranda	75.3832	18.5108	Checkdam
508	Pandharewadi	Paranda	75.3771	18.4977	Checkdam
509	Parewadi	Paranda	75.3662	18.424	Checkdam
510	Pistamwadi	Paranda	75.4865	18.3926	Checkdam
511	Pistamwadi	Paranda	75.4899	18.3852	Checkdam
512	Rajuri	Paranda	75.5376	18.3438	Checkdam
513	Rajuri	Paranda	75.5274	18.33	Checkdam
514	Ratanpur	Paranda	75.4481	18.4644	Checkdam
515	Ratanpur	Paranda	75.4402	18.4671	Checkdam
516	Ratanpur	Paranda	75.4305	18.4656	Checkdam
517	Rohkal	Paranda	75.4794	18.4067	Checkdam
518	Rohkal	Paranda	75.4997	18.4073	Checkdam
519	Rohkal	Paranda	75.4763	18.4178	Checkdam
520	Rohkal	Paranda	75.4727	18.4105	Checkdam
521	Rosa	Paranda	75.4161	18.3239	Checkdam
522	Sakat Bk.	Paranda	75.5132	18.4016	Checkdam
523	Sakat Bk.	Paranda	75.5203	18.4054	Checkdam
524	Sawargaon	Paranda	75.6728	18.3978	Checkdam
525	Sawargaon	Paranda	75.6663	18.3886	Checkdam
526	Shekhapur	Paranda	75.6411	18.3882	Checkdam
527	Shelgaon	Paranda	75.3608	18.4694	Checkdam
528	Shelgaon	Paranda	75.3525	18.4929	Checkdam
529	Shelgaon	Paranda	75.3458	18.5058	Checkdam
530	Shelgaon	Paranda	75.3337	18.4963	Checkdam
531	Shelgaon	Paranda	75.3668	18.4723	Checkdam
532	Shelgaon	Paranda	75.342	18.4941	Checkdam
533	Shelgaon	Paranda	75.3518	18.4762	Checkdam
534	Shelgaon	Paranda	75.3595	18.4793	Checkdam
535	Shelgaon	Paranda	75.3717	18.4713	Checkdam
536	Shelgaon	Paranda	75.3306	18.5046	Checkdam
537	Shirala	Paranda	75.4883	18.1866	Checkdam
538	Sirsao	Paranda	75.6198	18.311	Checkdam
539	Sirsao	Paranda	75.6157	18.3033	Checkdam
540	Sirsao	Paranda	75.6097	18.2992	Checkdam
541	Sirsao	Paranda	75.6056	18.2943	Checkdam
542	Sirsao	Paranda	75.6191	18.3239	Checkdam
543	Sirsao	Paranda	75.6276	18.3194	Checkdam
544	Sonari	Paranda	75.4333	18.3772	Checkdam
545	Sonari	Paranda	75.4208	18.3585	Checkdam
546	Takmodwadi	Paranda	75.4165	18.4932	Checkdam
547	Takmodwadi	Paranda	75.4117	18.5034	Checkdam
548	Tandulwadi	Paranda	75.3242	18.4527	Checkdam
549	Tandulwadi	Paranda	75.3542	18.4567	Checkdam
550	Tandulwadi	Paranda	75.3411	18.4457	Checkdam

SN	Name of village	Block	Longitude	Latitude	Type of structure
551	Tandulwadi	Paranda	75.3364	18.4527	Checkdam
552	Tandulwadi	Paranda	75.3333	18.4629	Checkdam
553	Tintraj	Paranda	75.4544	18.5626	Checkdam
554	Tintraj	Paranda	75.4572	18.5748	Checkdam
555	Tintraj	Paranda	75.4624	18.5851	Checkdam
556	Undegaon	Paranda	75.4072	18.4849	Checkdam
557	Undegaon	Paranda	75.4266	18.4744	Checkdam
558	Wadner	Paranda	75.4968	18.2155	Checkdam
559	Wakadi	Paranda	75.5927	18.2815	Checkdam
560	Watephal	Paranda	75.384	18.4571	Checkdam
561	Watephal	Paranda	75.3902	18.452	Checkdam
562	Watephal	Paranda	75.3948	18.4456	Checkdam
563	Watephal	Paranda	75.4121	18.4591	Checkdam
564	Yenegaon	Paranda	75.6222	18.3345	Checkdam
565	Aliyabad	Tuljapur	76.3103	17.8126	Checkdam
566	Aliyabad	Tuljapur	76.3156	17.8198	Checkdam
567	Andur	Tuljapur	76.2362	17.8134	Checkdam
568	Andur	Tuljapur	76.2222	17.8211	Checkdam
569	Andur	Tuljapur	76.1868	17.8115	Checkdam
570	Andur	Tuljapur	76.1878	17.8266	Checkdam
571	Andur	Tuljapur	76.2125	17.8504	Checkdam
572	Apsinga	Tuljapur	76.0303	18.0748	Checkdam
573	Apsinga	Tuljapur	76.0361	18.0632	Checkdam
574	Apsinga	Tuljapur	76.045	18.0613	Checkdam
575	Arali Bk.	Tuljapur	76.1641	17.8923	Checkdam
576	Arali Bk.	Tuljapur	76.1435	17.8738	Checkdam
577	Arali Bk.	Tuljapur	76.1387	17.8941	Checkdam
578	Arali Kh.	Tuljapur	76.1533	17.9005	Checkdam
579	Arali Kh.	Tuljapur	76.1417	17.913	Checkdam
580	Bijanwadi	Tuljapur	76.1426	17.9306	Checkdam
581	Bornadiwadi (Tul.)	Tuljapur	76.1447	17.9713	Checkdam
582	Chikundra	Tuljapur	76.2662	17.8843	Checkdam
583	Chincholi	Tuljapur	76.1321	17.9027	Checkdam
584	Chivari	Tuljapur	76.2014	17.8638	Checkdam
585	Chivari	Tuljapur	76.2112	17.8607	Checkdam
586	Chivari	Tuljapur	76.1988	17.8736	Checkdam
587	Dahitna	Tuljapur	76.2547	17.7258	Checkdam
588	Dahitna	Tuljapur	76.2449	17.7101	Checkdam
589	Dhekri	Tuljapur	76.0326	18.0346	Checkdam
590	Dhekri	Tuljapur	76.0202	18.0297	Checkdam
591	Dhekri	Tuljapur	76.016	18.0255	Checkdam
592	Dhotri	Tuljapur	76.0315	17.7952	Checkdam
593	Fulwadi	Tuljapur	76.2373	17.8072	Checkdam
594	Fulwadi	Tuljapur	76.2183	17.8114	Checkdam
595	Fulwadi	Tuljapur	76.2093	17.7986	Checkdam
596	Ghandura	Tuljapur	76.2333	17.9226	Checkdam

SN	Name of village	Block	Longitude	Latitude	Type of structure
597	Gulhalli	Tuljapur	76.2305	17.701	Checkdam
598	Haglur	Tuljapur	76.2332	17.8863	Checkdam
599	Hangarga (Naldurg)	Tuljapur	76.3554	17.7838	Checkdam
600	Hangarga (Naldurg)	Tuljapur	76.3378	17.7864	Checkdam
601	Hippargatad	Tuljapur	76.1336	17.8422	Checkdam
602	Honala	Tuljapur	76.1615	17.9964	Checkdam
603	Honala	Tuljapur	76.169	17.9958	Checkdam
604	Horti	Tuljapur	76.3185	17.8903	Checkdam
605	Horti	Tuljapur	76.2933	17.8753	Checkdam
606	Horti	Tuljapur	76.3137	17.9085	Checkdam
607	Itkal	Tuljapur	76.1464	17.7651	Checkdam
608	Jalkot	Tuljapur	76.3464	17.8264	Checkdam
609	Jalkot	Tuljapur	76.3376	17.8174	Checkdam
610	Jalkotwadi	Tuljapur	76.3496	17.8516	Checkdam
611	Jalkotwadi	Tuljapur	76.3484	17.8394	Checkdam
612	Jawalga Mesai	Tuljapur	76.1825	18.0061	Checkdam
613	Jawalga Mesai	Tuljapur	76.186	17.9777	Checkdam
614	Kakramba	Tuljapur	76.1234	18.0057	Checkdam
615	Karla	Tuljapur	76.2182	17.9914	Checkdam
616	Katgaon	Tuljapur	76.0755	17.7824	Checkdam
617	Katgaon	Tuljapur	76.0716	17.7907	Checkdam
618	Kati	Tuljapur	75.9127	17.9577	Checkdam
619	Kati	Tuljapur	75.8947	17.9573	Checkdam
620	Kati	Tuljapur	75.8785	17.9565	Checkdam
621	Kemwadi	Tuljapur	75.88	17.9151	Checkdam
622	Kemwadi	Tuljapur	75.8637	17.9076	Checkdam
623	Kemwadi	Tuljapur	75.868	17.9006	Checkdam
624	Keshegaon	Tuljapur	76.1674	17.7385	Checkdam
625	Keshegaon	Tuljapur	76.1771	17.7455	Checkdam
626	Keshegaon	Tuljapur	76.1835	17.7594	Checkdam
627	Khadki	Tuljapur	76.0261	17.7808	Checkdam
628	Khadki	Tuljapur	76.0404	17.7837	Checkdam
629	Khandala	Tuljapur	76.181	18.0199	Checkdam
630	Khudawadi	Tuljapur	76.2397	17.7657	Checkdam
631	Khudawadi	Tuljapur	76.2448	17.7782	Checkdam
632	Khuttewadi	Tuljapur	75.8522	17.9949	Checkdam
633	Kilaj	Tuljapur	76.275	17.911	Checkdam
634	Kilaj	Tuljapur	76.2723	17.9222	Checkdam
635	Kilaj	Tuljapur	76.2591	17.9043	Checkdam
636	Kumbhari	Tuljapur	76.0708	17.9311	Checkdam
637	Kumbhari	Tuljapur	76.087	17.9206	Checkdam
638	Kumbhari	Tuljapur	76.0715	17.916	Checkdam
639	Kumbhari	Tuljapur	76.0581	17.9208	Checkdam
640	Kumbhari	Tuljapur	76.065	17.9041	Checkdam
641	Lohagaon	Tuljapur	76.3024	17.7562	Checkdam
642	Lohagaon	Tuljapur	76.2796	17.7461	Checkdam

SN	Name of village	Block	Longitude	Latitude	Type of structure
643	Malumbra	Tuljapur	76.0014	17.9346	Checkdam
644	Malumbra	Tuljapur	76.012	17.9327	Checkdam
645	Mangrul	Tuljapur	76.088	17.929	Checkdam
646	Mangrul	Tuljapur	76.095	17.9371	Checkdam
647	Mangrul	Tuljapur	76.1	17.925	Checkdam
648	Murta	Tuljapur	76.3238	17.8596	Checkdam
649	Murta	Tuljapur	76.3159	17.8523	Checkdam
650	NALDURG URBAN	Tuljapur	76.2678	17.7932	Checkdam
651	NALDURG URBAN	Tuljapur	76.2782	17.7863	Checkdam
652	Nandgaon	Tuljapur	76.3237	17.7408	Checkdam
653	Nandgaon	Tuljapur	76.3288	17.7543	Checkdam
654	Nilegaon	Tuljapur	76.196	17.7061	Checkdam
655	Nilegaon	Tuljapur	76.1904	17.6959	Checkdam
656	Nilegaon	Tuljapur	76.1847	17.6962	Checkdam
657	Pimpala Bk.	Tuljapur	76.0192	17.8444	Checkdam
658	Pimpala Kh.	Tuljapur	76.0208	17.8742	Checkdam
659	Pimpala Kh.	Tuljapur	76.0004	17.8708	Checkdam
660	Pimpala Kh.	Tuljapur	76.0025	17.8814	Checkdam
661	Pimpala Kh.	Tuljapur	76.0096	17.8895	Checkdam
662	Salgara Divti	Tuljapur	76.2472	17.9351	Checkdam
663	Salgara Divti	Tuljapur	76.2416	17.9421	Checkdam
664	Salgara Divti	Tuljapur	76.2355	17.9323	Checkdam
665	Salgara Maddi	Tuljapur	76.3683	17.7321	Checkdam
666	Sangvi Kati	Tuljapur	75.9803	17.9068	Checkdam
667	Sarati	Tuljapur	76.1977	17.7732	Checkdam
668	Sarola	Tuljapur	76.0428	17.9661	Checkdam
669	Sawargaon	Tuljapur	75.8954	17.9234	Checkdam
670	Sawargaon	Tuljapur	75.917	17.8924	Checkdam
671	Sawargaon	Tuljapur	75.9207	17.9084	Checkdam
672	Sawargaon	Tuljapur	75.9344	17.9046	Checkdam
673	Sawargaon	Tuljapur	75.9386	17.9181	Checkdam
674	Sawargaon	Tuljapur	75.9061	17.8926	Checkdam
675	Shahapur	Tuljapur	76.2342	17.753	Checkdam
676	Shahapur	Tuljapur	76.2263	17.7533	Checkdam
677	Shahapur	Tuljapur	76.2335	17.7396	Checkdam
678	Shahapur	Tuljapur	76.2336	17.7266	Checkdam
679	Shahapur	Tuljapur	76.2248	17.7289	Checkdam
680	Sindfal	Tuljapur	76.0442	17.9745	Checkdam
681	Sindfal	Tuljapur	76.0347	17.9898	Checkdam
682	Sindfal	Tuljapur	76.0501	17.9986	Checkdam
683	Sindfal	Tuljapur	76.042	18.0135	Checkdam
684	Sindgaon	Tuljapur	76.3484	17.7187	Checkdam
685	Sindgaon	Tuljapur	76.345	17.706	Checkdam
686	Sindgaon	Tuljapur	76.338	17.6958	Checkdam
687	Suratgaon	Tuljapur	75.9767	17.872	Checkdam
688	Suratgaon	Tuljapur	75.978	17.8917	Checkdam

SN	Name of village	Block	Longitude	Latitude	Type of structure
689	Tirth Bk.	Tuljapur	76.133	17.9769	Checkdam
690	Tirth Bk.	Tuljapur	76.1239	17.986	Checkdam
691	Wadgaon Deo	Tuljapur	76.208	17.9577	Checkdam
692	Wadgaonlakh	Tuljapur	76.166	18.0116	Checkdam
693	Wagdari	Tuljapur	76.2669	17.7651	Checkdam
694	Wanegaon	Tuljapur	76.2124	17.9657	Checkdam
695	Wanewadi	Tuljapur	75.8646	17.955	Checkdam
696	Yewati	Tuljapur	76.1638	17.8613	Checkdam
697	Alur	Umarga	76.4318	17.6816	Checkdam
698	Babalsur	Umarga	76.5926	17.9495	Checkdam
699	Babalsur	Umarga	76.5987	17.9597	Checkdam
700	Balsur	Umarga	76.5534	17.8935	Checkdam
701	Balsur	Umarga	76.5549	17.9187	Checkdam
702	Balsur	Umarga	76.5401	17.915	Checkdam
703	Balsur	Umarga	76.5367	17.8948	Checkdam
704	Belamb	Umarga	76.4915	17.7462	Checkdam
705	Bendkal	Umarga	76.3071	17.9991	Checkdam
706	Bhosga	Umarga	76.4067	17.8441	Checkdam
707	Bhusni	Umarga	76.5221	17.814	Checkdam
708	Bhusni	Umarga	76.52	17.8018	Checkdam
709	Bhusni	Umarga	76.5301	17.7827	Checkdam
710	Bori	Umarga	76.6184	17.9849	Checkdam
711	Chakur	Umarga	76.6507	17.9724	Checkdam
712	Chakur	Umarga	76.6718	17.9758	Checkdam
713	Chinchkota	Umarga	76.7133	17.7915	Checkdam
714	Chincholi Bhuyar	Umarga	76.4943	17.8452	Checkdam
715	Chincholi Bhuyar	Umarga	76.5006	17.8227	Checkdam
716	Chincholi Jahagir	Umarga	76.6707	17.8022	Checkdam
717	Chirewadi	Umarga	76.6508	17.9611	Checkdam
718	Dabka	Umarga	76.6652	17.8172	Checkdam
719	Dalimb	Umarga	76.4801	17.8785	Checkdam
720	Dhaktiwadi	Umarga	76.7683	17.8229	Checkdam
721	Dhaktiwadi	Umarga	76.7589	17.8172	Checkdam
722	Dhanori	Umarga	76.4231	17.982	Checkdam
723	Dhanori	Umarga	76.4101	17.9792	Checkdam
724	Dhanori	Umarga	76.3961	17.9789	Checkdam
725	Diggi	Umarga	76.6928	17.7143	Checkdam
726	Ekurga	Umarga	76.5784	17.8844	Checkdam
727	Ekurga	Umarga	76.5744	17.8936	Checkdam
728	Ekurgawadi	Umarga	76.589	17.9002	Checkdam
729	Ekurgawadi	Umarga	76.5793	17.9117	Checkdam
730	Ekurgawadi	Umarga	76.5941	17.9079	Checkdam
731	Gugalgaon	Umarga	76.6286	17.8969	Checkdam
732	Gugalgaon	Umarga	76.6422	17.8959	Checkdam
733	Handral	Umarga	76.7139	17.8804	Checkdam
734	Hippargarao	Umarga	76.7368	17.7933	Checkdam

SN	Name of village	Block	Longitude	Latitude	Type of structure
735	Holi	Umarga	76.5259	18.0132	Checkdam
736	Jagadalwadi	Umarga	76.7714	17.8326	Checkdam
737	Jakekur	Umarga	76.5561	17.873	Checkdam
738	Jakekur	Umarga	76.5674	17.8754	Checkdam
739	Jawalga Bet	Umarga	76.5847	17.9215	Checkdam
740	Jewali	Umarga	76.3867	17.8785	Checkdam
741	Jewali	Umarga	76.3763	17.8946	Checkdam
742	Jewali	Umarga	76.3813	17.9098	Checkdam
743	Kaddora	Umarga	76.5344	17.9258	Checkdam
744	Kalnimbala	Umarga	76.5035	17.9104	Checkdam
745	Kalnimbala	Umarga	76.497	17.9191	Checkdam
746	Kalnimbala	Umarga	76.513	17.8947	Checkdam
747	Kanegaon	Umarga	76.3072	18.0431	Checkdam
748	Kanegaon	Umarga	76.3149	18.0475	Checkdam
749	Kanegaon	Umarga	76.3183	18.0585	Checkdam
750	Kanegaon	Umarga	76.3324	18.0663	Checkdam
751	Kasti Bk.	Umarga	76.367	18.0583	Checkdam
752	Kasti Bk.	Umarga	76.3618	18.0466	Checkdam
753	Kawatha	Umarga	76.5913	18.0158	Checkdam
754	Kawatha	Umarga	76.5796	18.0079	Checkdam
755	Kesar Jawalga	Umarga	76.451	17.6753	Checkdam
756	Kesar Jawalga	Umarga	76.4728	17.6867	Checkdam
757	Khed	Umarga	76.3841	18.0017	Checkdam
758	Kolnur Pandari	Umarga	76.3794	17.8183	Checkdam
759	Kolsur Gunjoti	Umarga	76.7389	17.8239	Checkdam
760	Kolsur kalyani	Umarga	76.7255	17.811	Checkdam
761	Koral	Umarga	76.4592	17.8943	Checkdam
762	Koregaon	Umarga	76.6313	17.8777	Checkdam
763	Koregaonwadi	Umarga	76.6044	17.88	Checkdam
764	Kunhali	Umarga	76.7102	17.8954	Checkdam
765	Kunhali	Umarga	76.7037	17.8755	Checkdam
766	Lohara Bk.	Umarga	76.3353	17.9943	Checkdam
767	Lohara Bk.	Umarga	76.335	17.9825	Checkdam
768	Lohara Bk.	Umarga	76.3216	17.9982	Checkdam
769	Lohara Bk.	Umarga	76.318	17.9897	Checkdam
770	Lohara kh.	Umarga	76.3621	18.0116	Checkdam
771	Lohara kh.	Umarga	76.3554	17.9868	Checkdam
772	Madaj	Umarga	76.6249	17.9102	Checkdam
773	Madaj	Umarga	76.6185	17.9065	Checkdam
774	Madaj	Umarga	76.6166	17.914	Checkdam
775	Mahalingraywadi	Umarga	76.4439	17.8366	Checkdam
776	Matola kh.	Umarga	76.6152	18.0018	Checkdam
777	Mulaj	Umarga	76.6821	17.8767	Checkdam
778	Mulaj	Umarga	76.6753	17.8828	Checkdam
779	Mulaj	Umarga	76.6717	17.8752	Checkdam
780	Mulaj	Umarga	76.6877	17.8605	Checkdam

SN	Name of village	Block	Longitude	Latitude	Type of structure
781	Murshadpur	Umarga	76.4953	17.9928	Checkdam
782	MURUM URBAN	Umarga	76.4966	17.7669	Checkdam
783	MURUM URBAN	Umarga	76.4523	17.7592	Checkdam
784	Narangwadi	Umarga	76.5749	18.0007	Checkdam
785	Narangwadi	Umarga	76.5877	17.9798	Checkdam
786	Narangwadi	Umarga	76.6084	17.9696	Checkdam
787	Peth Sangvi	Umarga	76.552	17.9838	Checkdam
788	Peth Sangvi	Umarga	76.5535	18.0006	Checkdam
789	Peth Sangvi	Umarga	76.5622	17.9738	Checkdam
790	Phanepur	Umarga	76.367	17.9061	Checkdam
791	Rampur	Umarga	76.526	17.8803	Checkdam
792	Salegaon	Umarga	76.4633	17.9569	Checkdam
793	Samudral	Umarga	76.5234	17.9549	Checkdam
794	Samudral	Umarga	76.5245	17.9491	Checkdam
795	Sastur	Umarga	76.4912	18.0053	Checkdam
796	Sastur	Umarga	76.5084	18.004	Checkdam
797	Sawalsur	Umarga	76.6128	17.9582	Checkdam
798	Sawalsur	Umarga	76.6163	17.9694	Checkdam
799	Sawalsur	Umarga	76.6188	17.9533	Checkdam
800	Sawalsur	Umarga	76.6567	17.9518	Checkdam
801	Sundarwadi	Umarga	76.4567	17.8159	Checkdam
802	Sundarwadi	Umarga	76.4618	17.7996	Checkdam
803	Talmod	Umarga	76.7561	17.8306	Checkdam
804	Tawshigad	Umarga	76.4501	17.9843	Checkdam
805	Tawshigad	Umarga	76.4579	17.9782	Checkdam
806	Thorliwadi	Umarga	76.7566	17.8109	Checkdam
807	Toramba	Umarga	76.4535	17.9584	Checkdam
808	Toramba	Umarga	76.4364	17.9496	Checkdam
809	Trikoli	Umarga	76.6865	17.8948	Checkdam
810	Tugaon	Umarga	76.432	17.8191	Checkdam
811	Turori	Umarga	76.6879	17.8278	Checkdam
812	Udatpur	Umarga	76.4717	17.9835	Checkdam
813	Udatpur	Umarga	76.4662	17.9968	Checkdam
814	UMARGA URBAN	Umarga	76.6072	17.8683	Checkdam
815	Vilaspur pandhari	Umarga	76.3754	17.9239	Checkdam
816	Vilaspur pandhari	Umarga	76.3771	17.9168	Checkdam
817	Wadgaon	Umarga	76.3515	17.92	Checkdam
818	Wagdari	Umarga	76.6415	17.9127	Checkdam
819	Wagdari	Umarga	76.6546	17.9134	Checkdam
820	Wagdari	Umarga	76.6591	17.9198	Checkdam
821	Yeli	Umarga	76.5357	17.868	Checkdam
822	Yenegur	Umarga	76.4492	17.8719	Checkdam

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