केंद्रीय भूमि जल बोर्ड

जल संसाधन, नदी विकास और गंगा संरक्षण मंत्रालय

भारत सरकार

Central Ground Water Board

Ministry of Water Resources, River Development and Ganga Rejuvenation

Government of India

Report

on

AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN

Washim District, Maharashtra

मध्यक्षेत्र, नागपुर

Central Region, Nagpur

AQUIFER MAPS AND GROUND WATER MANAGEMENT PLANS, WASHIM DISTRICT, MAHARASHTRA
(AAP 2018-19)

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WASHIM DISTRICT AT A GLANCE

1. GENERAL INFORMATION			
	Geographical Area	:	5196 sq.km
	Administrative Divisions (2011)	:	6 (Washim, Risod, Manora, Malegaon, Mangrulpir, Karanja)
	Villages	:	789
	Population (2011)	:	1197160 Lac
	Average Annual Rainfall (2008-2017)	:	
	Rainfall	:	900-1000 mm
	Actual Rainfall 2018	:	783.10 mm
2. GEOMORPHOLOGY			
	Major Physiographic unit	:	
	Major Drainage	:	Painganga river (Tributaries: Chandrabhaga, Katepurna,Uma, Bebla, Adan, Nigurna, Arunavati, Pus)
3. LAND USE (2016-17) (source: mahasdb.maharashtra.gov.in/district Report)			
	Forest Area	:	370.68 sq. km.
	Net Area Sown	:	3876.67 sq. km.
	Cultivable Area	:	4234.30 sq. km.
4.	**SOIL TYPE**	:	Medium black and Deep black soil.
5. PRINCIPAL CROPS (2016-17)			
	Soyabean	:	2323.14sq. km.
	Cotton	:	669.78sq. km.
	Jowar	:	175.65 sq. km.
	Total Pulses	:	1151.27 sq. km.
		:	
IRRIGATION BY DIFFERENT SOURCES (2016-17) **– Nos. / Potential Created (ha)**			
	Dugwells	:	14206/16546
	Minor Irrigation (ZP)	:	385/18061 ha
	Medium Irrigation		2/5585
	Net Irrigated Area	:	40192 ha
7. GROUND WATER MONITORING WELLS (2018)			
	Dugwells	:	39
	Piezometers	:	07
8. GEOLOGY			
	Recent	:	Alluvium
	Upper Cretaceous-Lower Eocene	:	Deccan Trap Basalt
9. HYDROGEOLOGY			
	Water Bearing Formation	:	Basalt- weathered/fractured/ jointed vesicular/massive, under. phreatic and semi-confined to confined conditions. Alluvium-

			Sand and Gravel under phreatic and semi-confined to confined conditions.
	Pre-monsoon Depth to Water Level (May-2018)	:	3.2 mbgl (Jamkheda)-40.0 mbgl(Manora)
	Post-monsoon Depth to Water Level (Nov.-2018)	:	1.8 mbgl (Jamkheda)- 11.5 mbgl (Shirpur)
	Pre-monsoon Water Level Trend (2008-2017)	:	Rise : 0.016 m/yr (Kenwad)-0.467 m/yr (karanja)
			Fall : 0.050 m/yr (Loni) – 4.356 m/yr (Manora)
	Post-monsoon Water Level Trend (2008-2017)	:	Rise : 0.0167 m/yr (Sakhar Doha) – 0.732 m/yr (karanja)
			Fall : 0.0163 m/yr (Risod)-0.467 m/yr (Rithad)
10. GROUND WATER EXPLORATION (March, 2018)			
	Wells Drilled	:	EW-28, OW-12, Pz-6
	Depth Range	:	30.00 to 208.65 m bgl
	Discharge	:	0.025 – 9.84 lps
	Storativity	:	3.1×10^{-3} to 6.6×10^{-6}
	Transmissivity	:	8.10 to 1638.73 m^2/day (Basalt)
11. GROUND WATER QUALITY			
	Good and suitable for drinking and irrigation purpose, however localized nitrate contamination is observed.		
	Type of Water	:	Ca-Cl and Ca-HCO_3
12. DYNAMIC GROUND WATER RESOURCES(ham)- (2013)			
	Net Annual Ground Water Availability	:	57053.45
	Total Draft (Irrigation + Domestic+ Industrial)	:	21788.94
	Projected Demand (Domestic + Industrial)	:	3230.75
	Stage of Ground Water Development	:	38.19
	Overall Category		**Safe**
16. MAJOR GROUND WATER PROBLEMS AND ISSUES			
	Ground water quality is adversely affected by nitrate contamination. Declining water level trend both pre-monsoon and post-monsoon		

AQUIFER MAPS AND GROUND WATER MANAGEMENT PLANS, WASHIM DISTRICT, MAHARASHTRA

1. INTRODUCTION

National Aquifer Mapping (NAQUIM) has been taken up in XII five year plan by CGWB to carry out detailed hydrogeological investigation on toposheet scale of 1:50,000. 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 & unsustainable nature of hard rock aquifers, over exploitation of once ample alluvial aquifers, lack of regulation mechanism has a negative effect on ground water scenario of the Country in last decade or so. Thus, prompting the paradigm shift from "traditional groundwater development concept" to "modern groundwater management concept".

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

Washim district is one of the eleven districts of Vidarbha Region and is located in the eastern region of Vidharbha of Maharashtra State. Washim district was formed on 1 July 1998. Washim was once known as Vatsagulma, the capital of the Vatsagulma line of Vakataka dynasty. In the year 1905 during the period of the British Raj Washim district was bifurcated into two separate districts, namely, Akola District and Yavatmal District. It again became a district in 1998. The district headquarters is located at Washim town. This district is divided into 3 sub-divisions, namely, Washim, Mangrulpir and Karanja. These are further divided into 6 talukas.

The talukas are Malegaon, Mangrulpir, Karanja, Manora, Washim and Risod. Washim is located in the eastern part of Vidharbha. Akola on its north, Amravati in the northeast, Hingoli is on the south, Buldhana is on the west, Yavatmal is on the east. The river Penganga is the main river in the district. It flows through the tehsil of Risod. Later flowing through the boundaries of Washim and Hingoli districts Kasa is the main tributary of

Panganga. The area of Kas River is about 1 km from the village of Sheelgaon Rajgure. Arunavati River and its suburbs originate in Washim taluka and flow through Mangrulpir and Manora talukas in Yavatmal district. The origin of the Katepuna River is in the hills of the district and, it travels north to Akola district through the Tehsil.

Washim district has been taken up under NAQUIM study during the year 2018-19. The total area of the district is about 5,150 sq. km. The district is categorized as safe as per Ground Water Resources Estimation as on March 2013. The Administrative and Index map of the study area is presented in **Figure 1.1 (a & b).** Central Ground Water Board has taken up several studies in the district since 1982 to 2003 including Systematic Hydrogeological Survey, Reappraisal Hydrogeological Studies, etc. The data generated have been shared with the Central, State agencies as well as with the stake holders in the form of reports, maps etc.

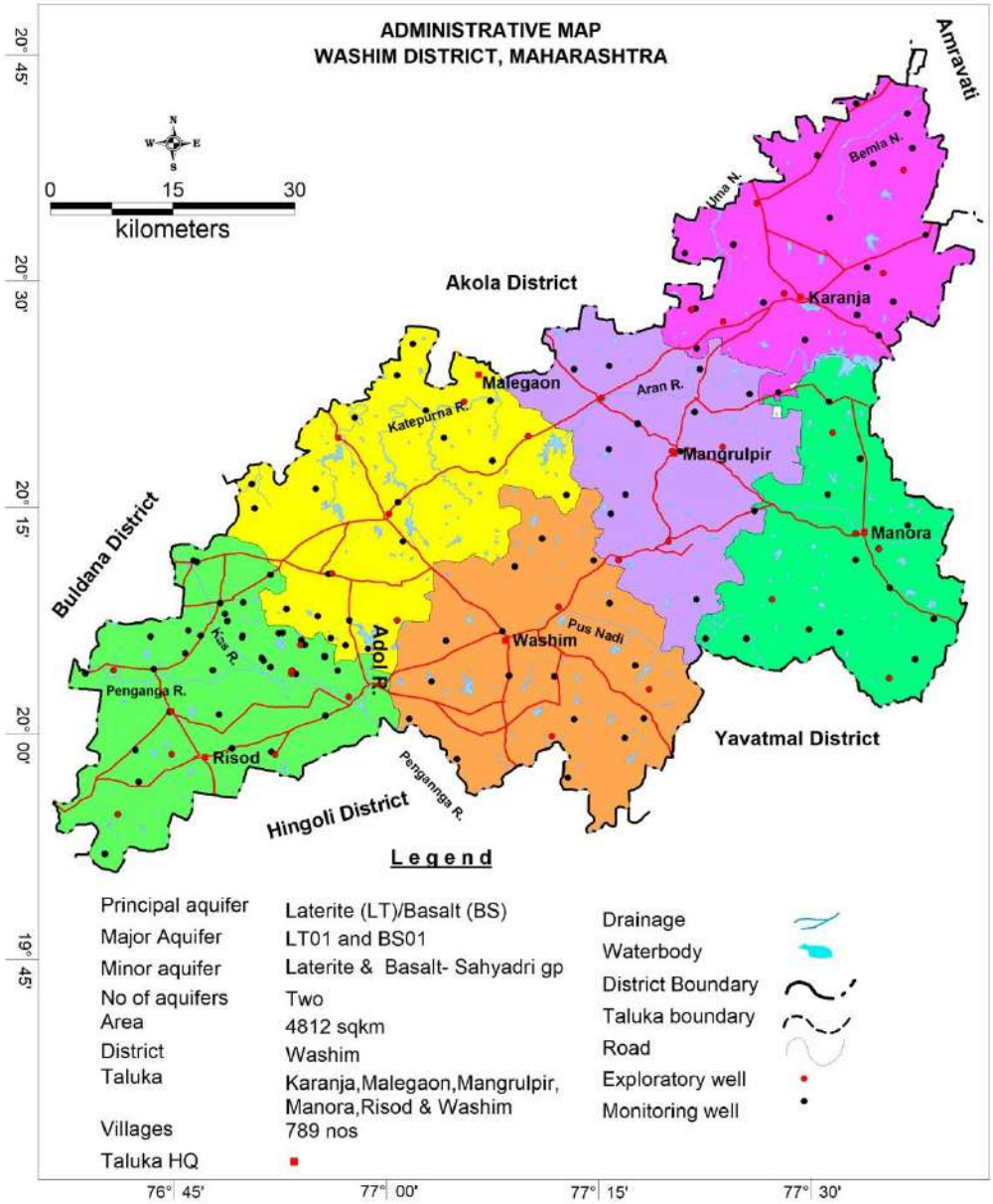


Figure 1.1. Administrative map of Washim District

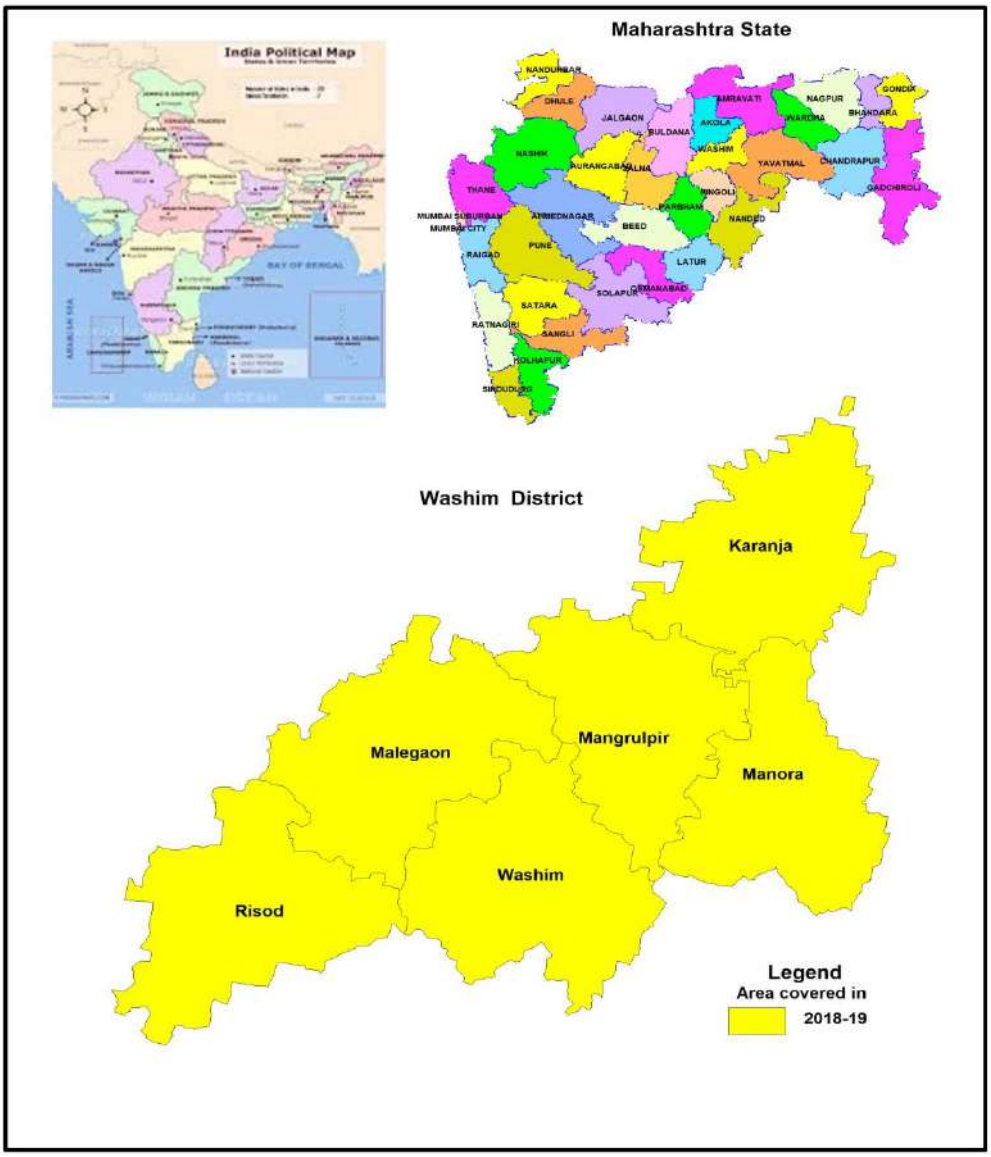


Figure 1.2. An Index map of Washim District

1.2 Geomorphology, Drainage and Soil Types

The district forms part of Deccan Plateau with slope towards southeast from Sahayadri hills and has a varied topography consisting of hills, plains and undulating topography near riverbanks. The district forms a part of Godavari and Tapi basins. The Balaghat Plateau comprises of low-lying hills forming water divide. Many of the tributaries to Godavari and Tapi rivers originate from the Balaghat Plateau. Penganga River is the main river flowing through the district. Other rivers are Adol, Aran, Kapsi, Nirguna and Mun. Based on geomorphological setting and drainage pattern, the district is divided into 36 watersheds. The soil of the district is basically derived from Deccan Trap Basalt and major part of the district is occupied by medium black soil of 25-50 cm depth occurring in the plains in entire south western, north eastern and northern parts of the district, whereas the shallow black soil of 7.5 to 25 cm depth occur in restricted hilly parts of the district in central elongated part and the northern peripheral part.

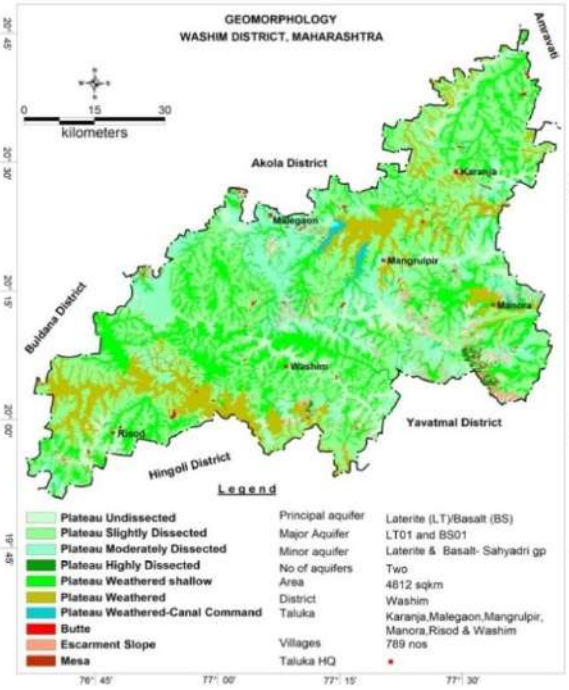


Figure 1.3: Geomorphology

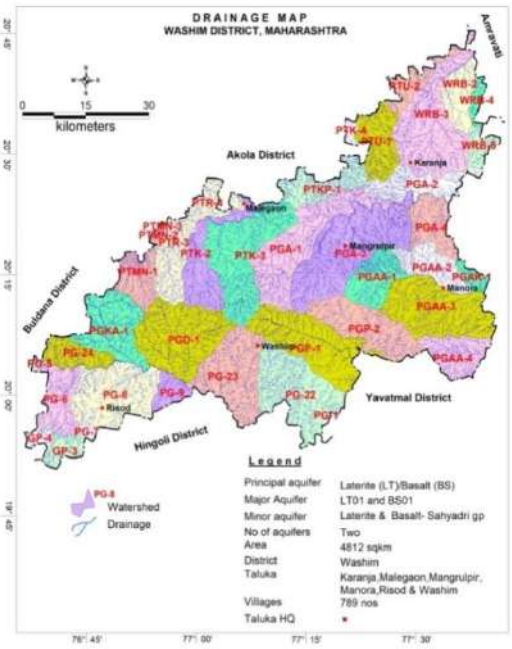


Figure 1.4: Drainage

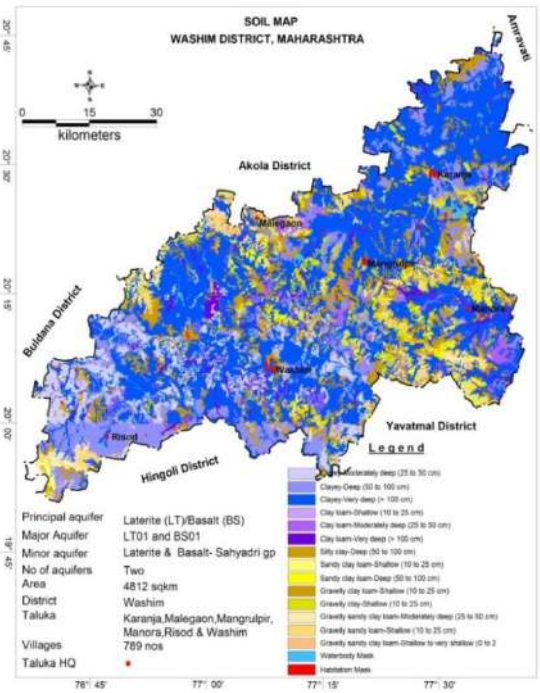


Figure 1.5: Soil

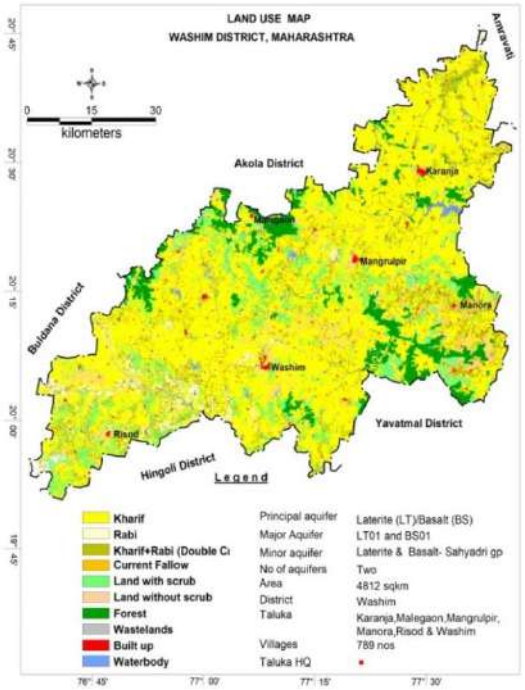


Figure 1.6: Land Use

1.3 Climate and Rainfall

The climate of the district is characterized by a hot summer and general dryness throughout the year except during the south-west monsoon season, i.e., June to September. The mean minimum temperature is 12.1°C and mean maximum temperature is 42.8°C. May is the hottest month. With the arrival of south-west monsoon in the district by around mid-June there is an appreciable drop in the day temperature and the weather becomes pleasant. With the withdrawal of the monsoon by the end of September day temperatures rise a little in October. Both day and night temperatures begin to drop rapidly by November. December is the coldest month with the mean daily minimum and maximum temperatures at 11.18°C and 30.02°C respectively.

Rainfall is not uniform in all the blocks of the district. The district normal rainfall for the year is 924.3 mm. The decadal average rainfall for the district ranges from 591.5 mm (2017) to 1334.7 mm (2002). District decadal average rainfall for the period 1998-2018 is presented in **Table 1** and depicted in **Figure 1.8.** The long term rainfall analysis (1998-2018) is presented in **Table 2.**

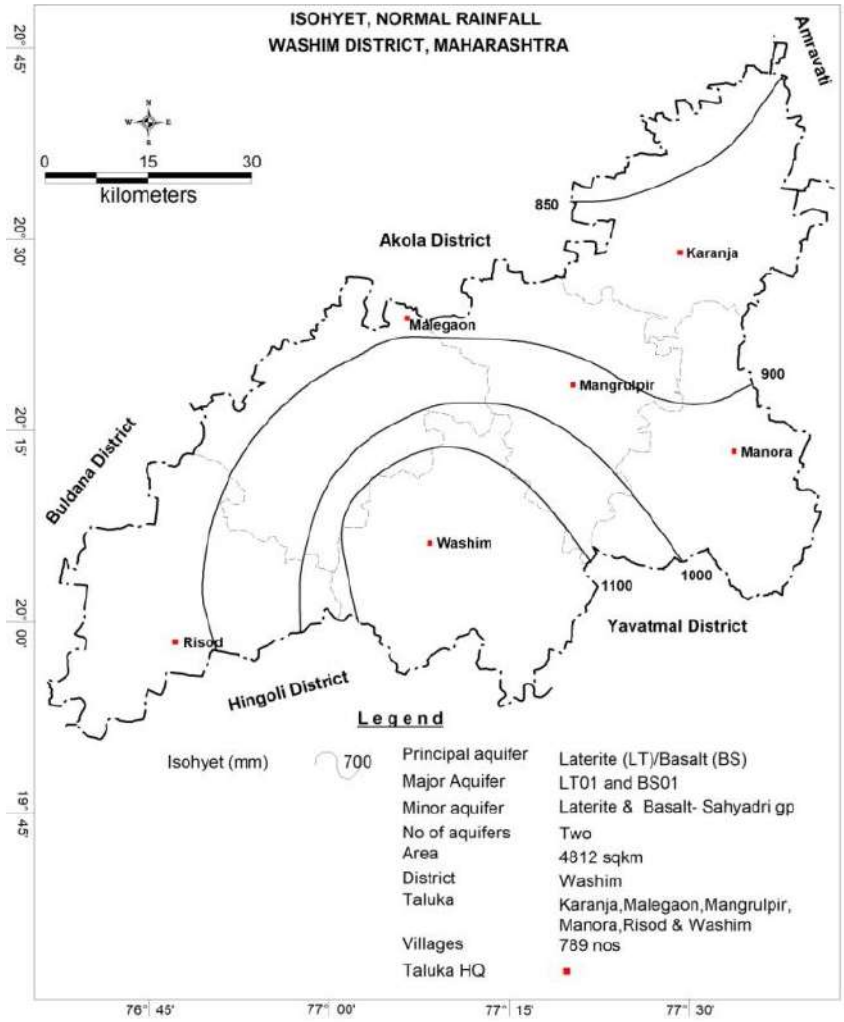


Figure 1.7: Isohyetal map of Washim District

Table 1.1: Long term (1998-2018) Rainfall Analysis, Washim district, Maharashtra

YEAR	AVERAGE Rainfall (mm)	NORMAL Rainfall (mm)	DEPARTURE (%)	CATEGORY
1998	1039.6	924.3	12.47	NORMAL
1999	1039.6	924.3	12.47	NORMAL
2000	607.4	924.3	-34.28	MODERATE
2001	919.3	924.3	-0.54	NORMAL
2002	1334.7	924.3	44.40	EXCESS
2003	819.4	924.3	-11.34	NORMAL
2004	635	924.3	-31.29	MODERATE
2005	975.8	924.3	5.57	NORMAL
2006	1188.4	924.3	28.57	EXCESS
2007	830.4	924.3	-10.15	NORMAL
2008	659.6	924.3	-28.63	MODERATE
2009	634.6	924.3	-31.34	MODERATE
2010	1072.7	924.3	16.05	NORMAL

2011	726.8	924.3	-21.36	NORMAL
2012	846.6	924.3	-8.40	NORMAL
2013	846.6	924.3	-8.40	NORMAL
2014	607.2	924.3	-34.30	MODERATE
2015	758.5	924.3	-17.93	NORMAL
2016	905.9	924.3	-1.99	NORMAL
2017	591.5	924.3	-36.00	MODERATE
2018	783.1	924.3	-15.27	NORMAL

(Source-website of Maharashtra Government: mahaagri.gov.in)

Table 1.2: Long term (1998-2018) Rainfall Analysis, Washim district, Maharashtra

Period	1998 to 2018		
No. of years	21		
Normal rainfall	924.3	**Mean**:	848.7
Standard deviation	204.63 mm	**Median**:	830.4
Coefficient of variation	24.1 %	**Mode**:	1039.6
Slope	-12.847 mm/year	**No of years**:21	
Intercept	990.02		
Equation of trend line	**y = -12.847x + 990.02**		

CATEGORY	NUMBER OF YEARS	% OF TOTAL YEARS
DEPARTURES		
POSITIVE	6	29
NEGATIVE	15	71
DROUGHTS		
MODERATE	6	29
SEVERE	0	0
ACUTE	0	0
NORMAL & EXCESS R/F		
NORMAL	13	62
EXCESS	2	9

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

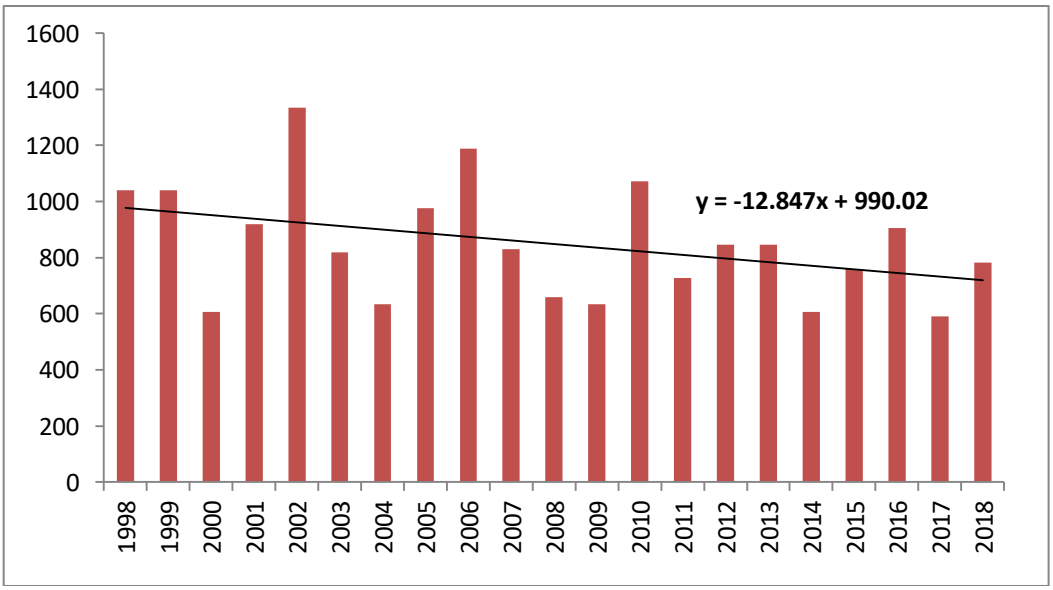


Figure 1.8: Long term annual rainfall (1998-2018)

1.4 Geology

Geologically, the area is occupied by Recent River Alluvium and Basaltic lava flows known as Deccan Traps belonging to Cretaceous to Eocene (68-62 m.y.), with patches of inter-trappean beds. The generalized geological sequence occurring in the area is given in **Table 1.3** and the geological map is shown in **Figure 1.9.**

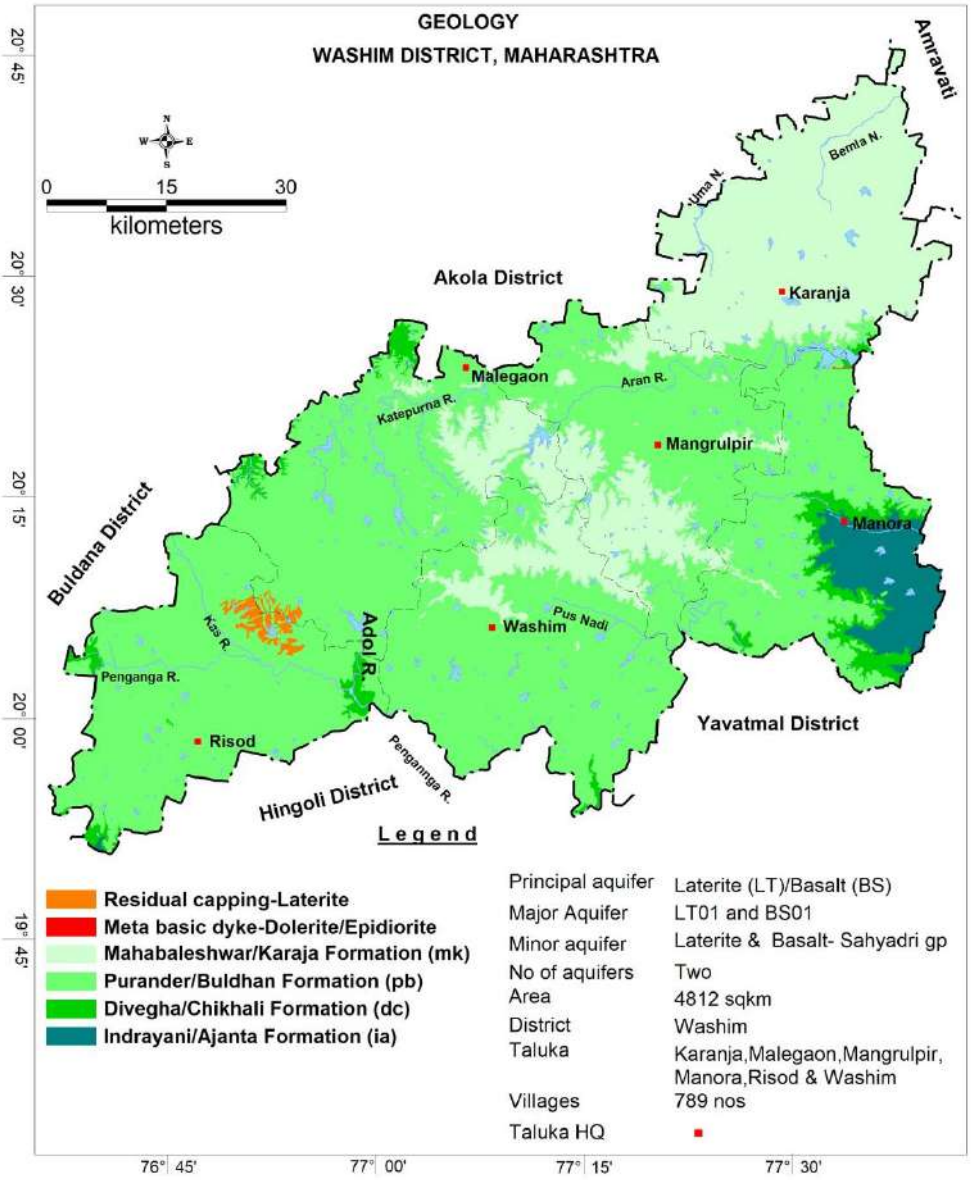


Figure 1.9a: Geological Map, Washim district

Alluvium:

The alluvium cover deposited during Recent to Quaternary period is restricted to the banks of Penganga River and comprises of sand, silt, clay and gravels.

Table 1.3: Generalized Geological sequence Washim district

Age	Formation	Lithology
Recent-Quaternary	Alluvium	Sand, silt and Gravel
Eocene-Upper Cretaceous	Deccan trap Volcanic lava flows with inter-trappean beds.	Basalt

Deccan Trap Basalt:

Deccan trap basalts of Upper Cretaceous- Eocene period occupy almost 100% area of the district. The Basaltic lava flow comprises of two types of flows viz., "Pahoehoe" flows and "aa" flows. "Pahoehoe" flows are compound flows with several unit of varied thickness from a meter to several meters thick. Each unit shows a basal section massive Basalt followed by vesicular Basalt in the upper unit. The vesicles are spherical and filled with zeolites, cherts or quartz. The "Pahoehoe" flow is generally altered and shows grey, purple and red colors. Upper surface of "Pahoehoe" flow is reddish and shows curved or twisted rope like structures.

The other type of flow, which is at basal section, has a thin layer of clinker block of vesicular trap cemented in glass, zeolite or pulverised rock. Mainly the flow comprises of dark grey massive Basalt, flow breccia, consisting of sub-rounded zeolites and pulverised rock at the top. Top surface of "aa" flows shows elongated or twisted vesicles filled with zeolite, quartz or chert. In "aa" flows massive Basalt is hard, resistant and shows spheroidal weathering while the brecciated Basalt weathers deeply.

2. HYDROGEOLOGY

Basalt forms the main aquifers in the district. Based on the existing data and the data generated it is observed that there is two aquifer Systems in Basalt prevailing in the district.

2.1 Major Aquifer System

Deccan Traps occurs as Basaltic lava flows, which are normally horizontally disposed over a wide stretch and give rise to tableland type of topography, on weathering also known as plateau. These flows occur in layered sequence ranging in thickness from few metres to 50 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 form the main aquifer in the district. The vesicular portion of different lava flow varies in thickness from 8 to 10 m and forms the potential zones.

Deccan Trap Basalt of upper Cretaceous to lower Eocene age is the major rock formation in the district covering entire district. Although, Alluvium occurs along the major river in the district but it does not form potential aquifer except locally. A map depicting hydrogeological features is presented in **Figure 2.1.**

Deccan basalts are hydro geologically 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 function of the 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 localized. In general Ground water occurs under phreatic/unconfined to semi-confined conditions in basalts. Shallow Aquifer is generally tapped by the dug wells of 5 to 35 m depth, water levels range from 3 to 21 m bgl and yield varies from 10 to 100 m^3/day. The deeper Aquifer is being tapped by borewells with depth 40 m bgl and the water level from 8 to 11 m bgl. Based on Ground Water Exploration, aquifer wise characteristics are given in **Table 2.1.** Maps depicting aquifer wise depth of occurrence and fractured/granular zone's thickness and yield potential are shown in **Figure 2.2 and 2.3** respectively.

The occurrence of red bole beds plays major role in local hydrogeological conditions. It is observed that in Washim district red bole encountered different depth ranes as shown in following table.

S. no.	Village	Taluka	Depth Range of Red Bole	Thickness of Red Bole
1	Kinhiraja	Malegaon	102.00-111.30 m bgl	9.3 m
2	Dhanora Kh.	Mangrulpir	187.50-188.50 m bgl	1.00 m
3	Dapuri	Risod	111.30-112.30 m bgl	1.00 m
4	Pangarkhed	Malegaon	93.00-102.10 m bgl	9.1 m

Contacts: Basalt flows and red bole, near village Girda, Karanja Block/taluka, Washim District

Red bole encountered (93 to 102 m bgl) at EW at Pangarkhed, Malegaon Taluka, Washim district

Table 2.1: Aquifer Characteristic of Washim district

Major Aquifer	**Basalt (Deccan Traps)**	
Type of Aquifer	**Aquifer-I**	**Aquifer-II**
Formation	Weathered/Fractured Basalt	Jointed / Fractured Basalt
Depth of Occurrence (mbgl)	8 to 18	70 to 194
SWL (mbgl)	2.1 to 25	9.0 to 90
Weathered / Fractured rocks thickness (m)	5 to 14	0.5 to 12
Fractures encountered (mbgl)	Upto 25	Upto 165
Yield	10 to 100 m^3/day	10 to 100 lpm
Sustainability	1 to 3 hrs	0.5 to 3 hrs
Transmissivity (m^2/day)	30 to 131.80 m^2/day	25 to 210 m^2/day
Specific Yield/ Storativity (Sy/S)	0.018 % to 0.05%	1.2 x10--4 to 3.57 X 10--4
Suitability for drinking/ irrigation	Suitable for both (except high EC and Nitrate affected villages) drinking & agriculture	

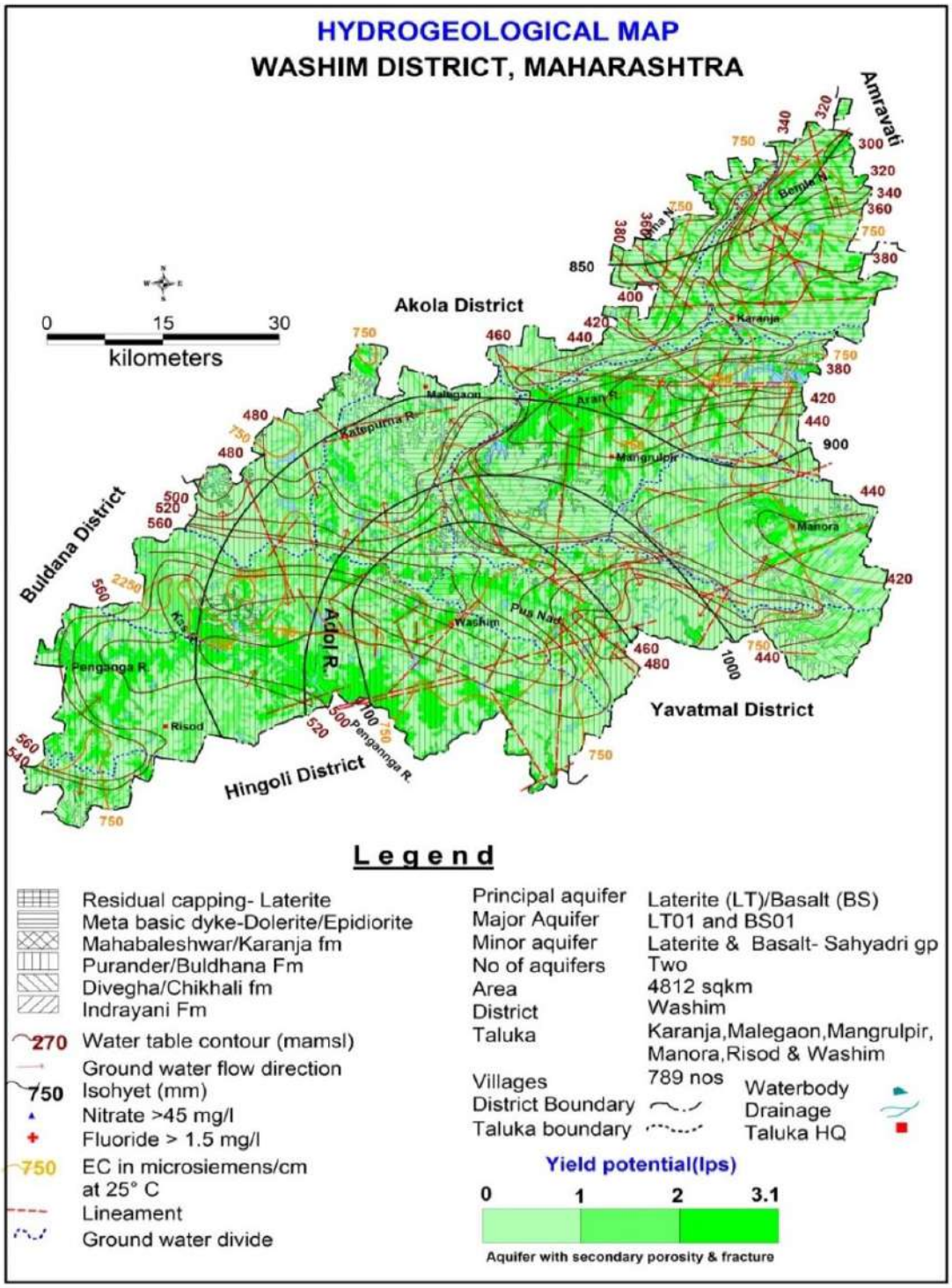


Figure 2.1- Hydrogeology

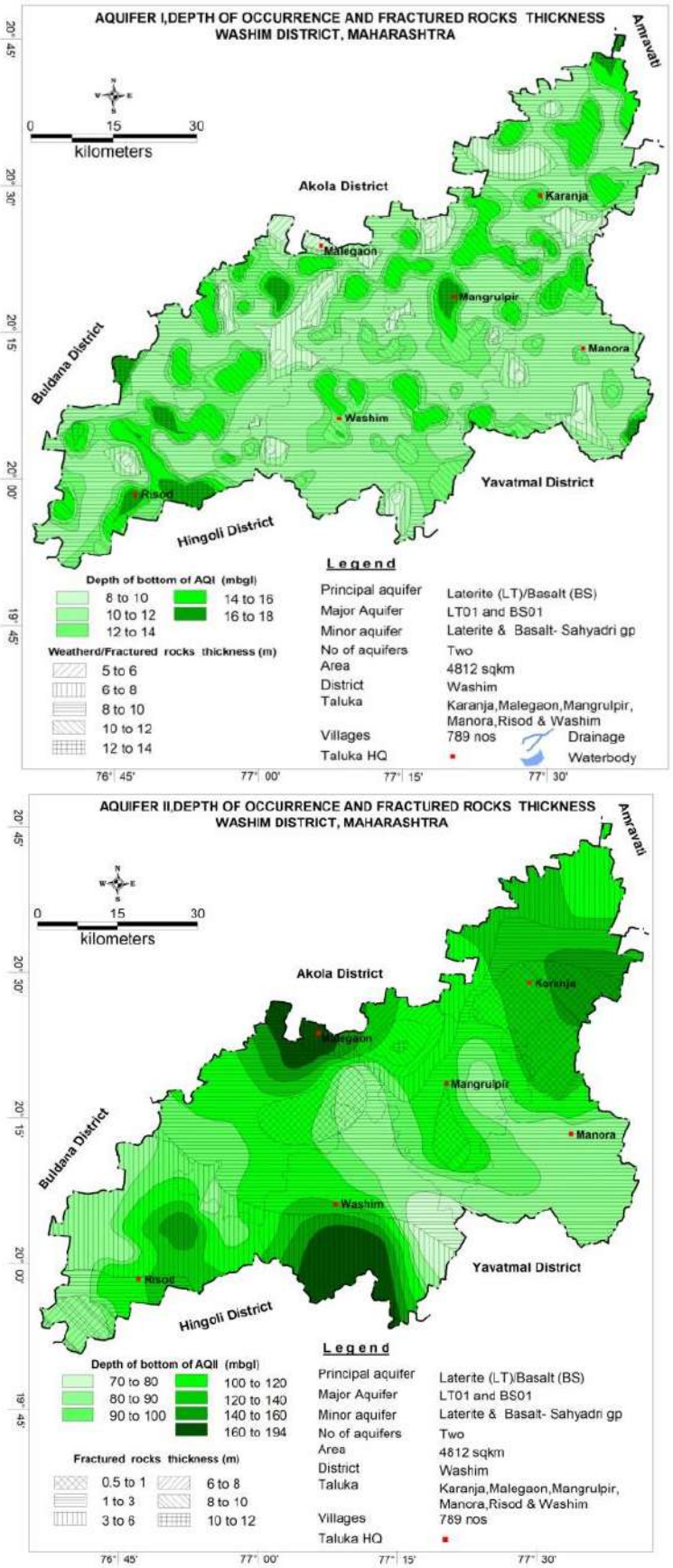


Figure 2.2: Aquifer wise Depth of occurrence and fractured rock thickness

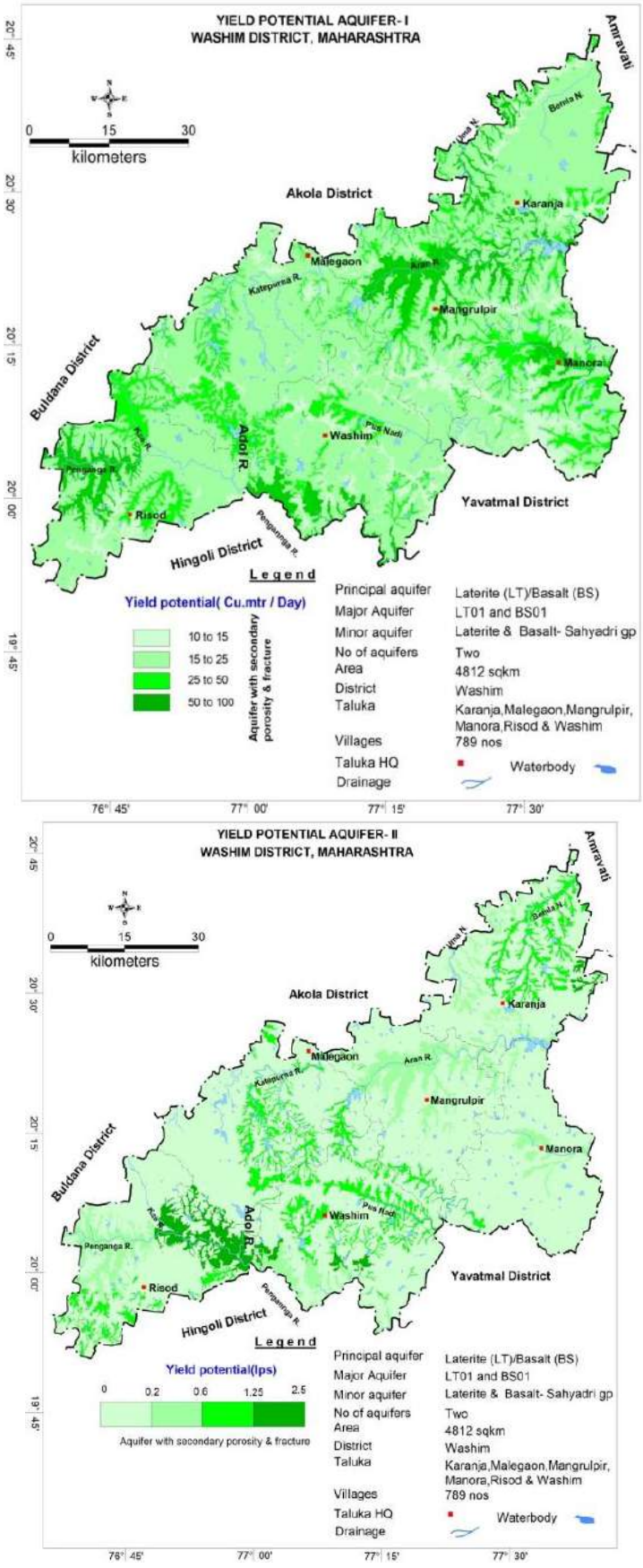


Figure 2.3: Aquifer wise yield Potential

2.2 Aquifer Parameters

Aquifer parameters are available from historic data of ground water exploration carried out in the district as well as from the pumping tests. Pumping tests conducted on wells in the district show that transmissivity of shallow aquifer in basalts ranges from 30 to 80 m^2/day, specific capacity of wells ranges from 75 to 200 lpm/m. with an average of about 110 lpm/m. The specific capacity of wells and transmissivity in alluvium ranges from 130 to 2050 lpm/m and 120 to 210 m^3 / day respectively. On an average, specific yield of basalt aquifers comes to be only 2%.

2.2.1 Specific Yield Tests

To estimate the aquifer parameters of shallow aquifer (Aquifer-I) in the area, 2 pumping tests on open dug wells have been conducted during the year 2018-19. The data has been analyzed by Kumarswamy method. The salient features of pumping tests are given in **Table 2.2**. The discharge of the wells ranged from 240 to 300 lpm for pumping duration of 60 to 120 minutes.

The drawdown observed at the end of the pumping ranged from 1.6 to 2.8 m and the residual drawdown for the 1st minute was observed to be ranging from 0.3 to 0.2 m. The aquifer parameter values estimated by Kumarswamy method are observed to be well within the general range of values for weathered and jointed basalt i.e., the transmissivity value was observed from 31.73 to 131.80 m^2/day, whereas the specific yield 0.018 % to 0.05 %, whereas specific capacity values ranged from 150 to 107.14 lpm/m.

Table 2.2: Salient features of pumping tests – shallow aquifer (dug well) using Kumarswamy method

S. No.	Village	Diameter (m)	Depth (mbgl)	SWL (mbgl)	Q (lpm)	Pt (min)	DD (m)	RDD (m)	C (lpm/m)	T m2/day	Sy
1	Dapuri kh.	5.7	17.2	11.1	240	60	1.6	0.3	150.00	31.73	0.018
2	Wasari	5.5	20	12.3	300	120	2.8	0.2	107.14	131.80	0.05

Here, SWL – Static Water Level, Q – Discharge, Pt - Pumping duration, D/D – Drawdown, RDD - Residual drawdown, C - Specific Capacity, T – Transmissivity, Sy - Specific Yield

2.3 Soil Infiltration Tests

To estimate the actual rate of infiltration of various soil cover and their impact on recharge to ground water, 6 infiltration tests have been conducted at Risod, Borhala phata, Chehel, Nagartas, Dadgaon and Loni Arab in various soil types. The data has been analyzed and the salient features of the infiltration tests are presented in **Table 2.3**, whereas the data is presented in **Annexure-VI** and the plots of soil infiltration tests are presented in **Figure 2.4**. The duration of the test ranged from 90 to 140 minutes, the depth of water infiltrated varied from 0.10 cm to 0.60 cm and the final infiltration rate in the area ranged from 0.60 cm/hr at Loni Arab to 3.60 cm/hr at Borhala phata.

Table 2.3: Salient Features of Infiltration Tests

S. No.	Village	Date	Duration (min)	Water Level (cm agl)	Final Infiltrated Water Depth (cm)	Final Infiltration Rate (cm/hr)
	Borhala phata	12.02.2019	140	29.40	0.60	3.60
	Risod	13.02.2019	110	29.70	0.30	1.80
	Chehel	14.02.2019	100	29.80	0.20	1.20
	Nagartas	14.02.2019	90	29.70	0.30	1.80
	Dadgaon	15.02.2019	100	29.50	0.50	3.00
	Loni Arab	15.02.2019	100	29.90	0.10	0.60

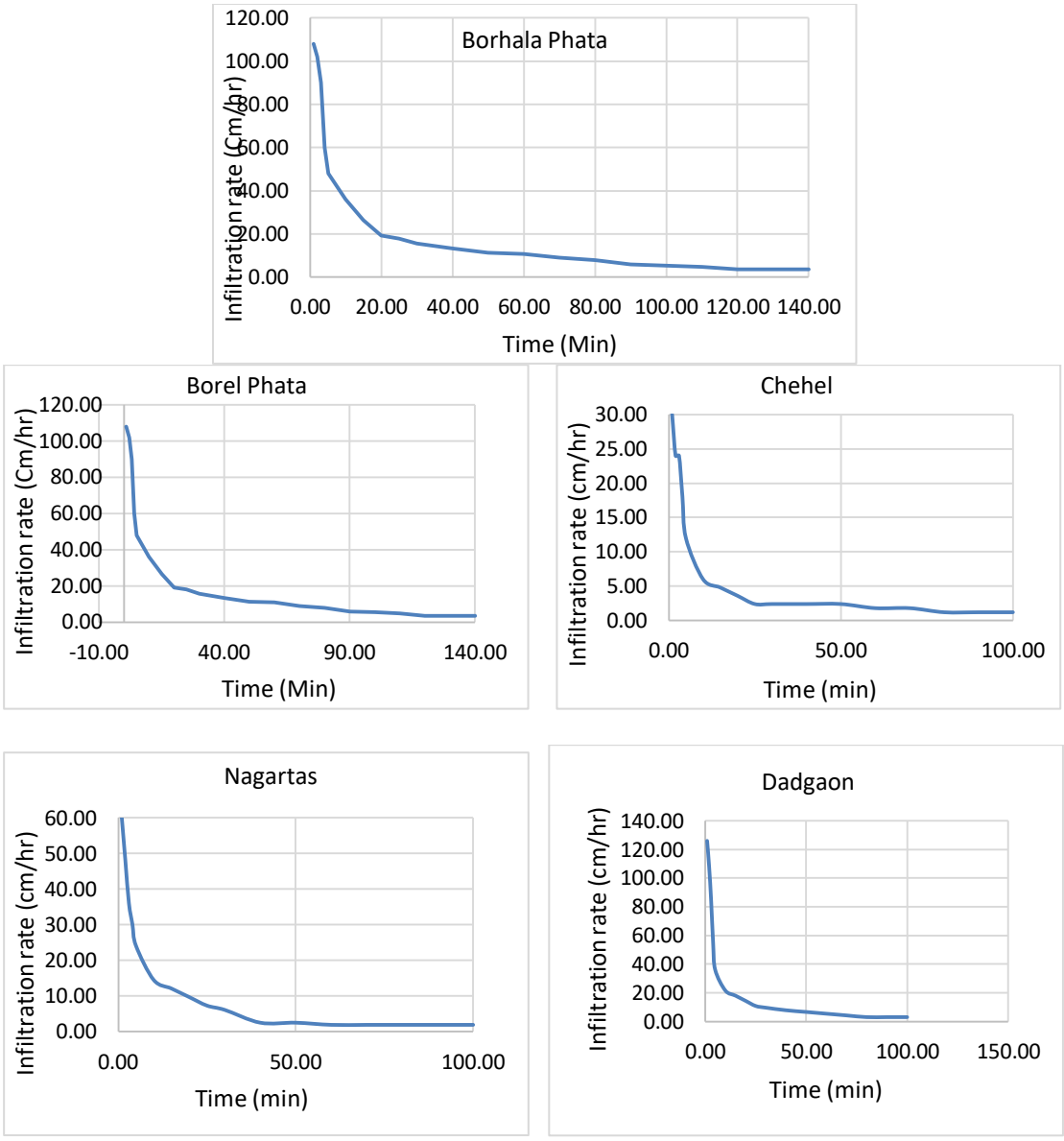


Figure 2.4: Soil Infiltration test

2.4 3-D and 2-D Aquifer Disposition

Based on the existing data, aquifer disposition in 3D, Fence diagram, 3D Bar diagram and few hydrogeological sections have been prepared along section lines shown in **Figure 2.5, 2.6, 2.7 and 2.8 (a to d)** to understand the subsurface disposition of aquifer system.

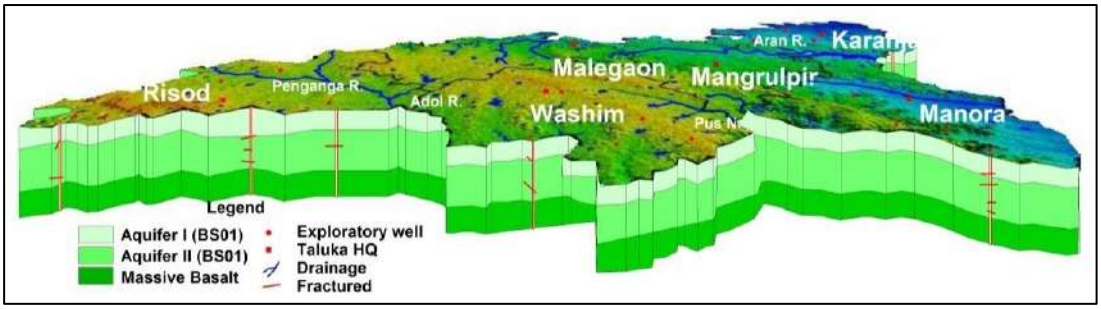


Figure 2.5 -3D Aquifer Disposition

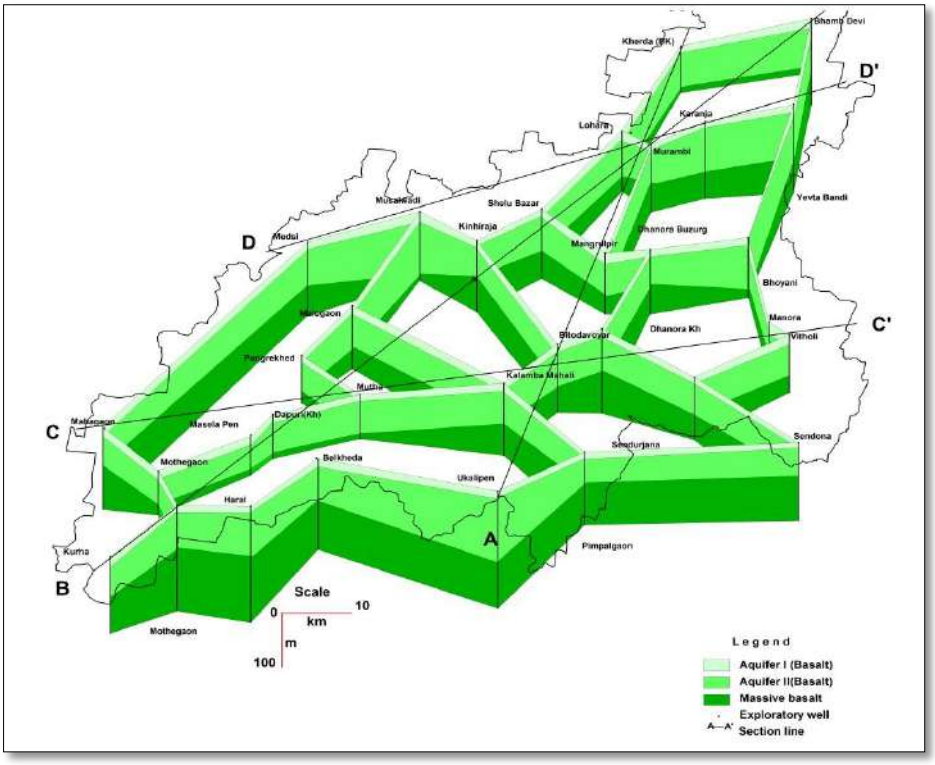


Figure 2.6: 3D Fence Diagram

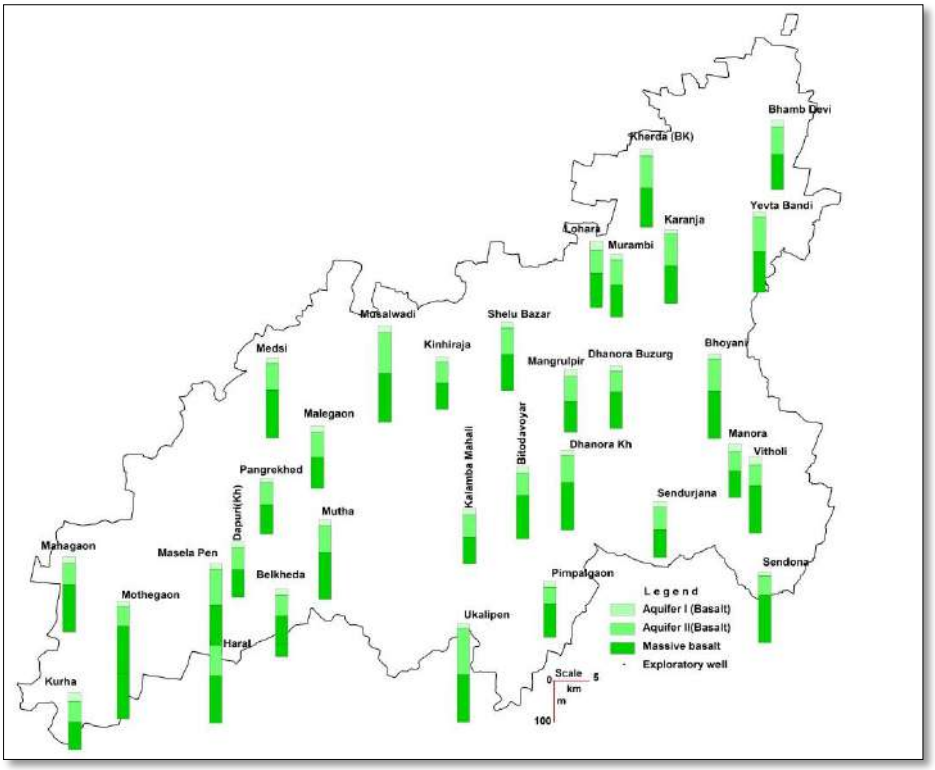


Figure 2.7: 3D Bar Diagram

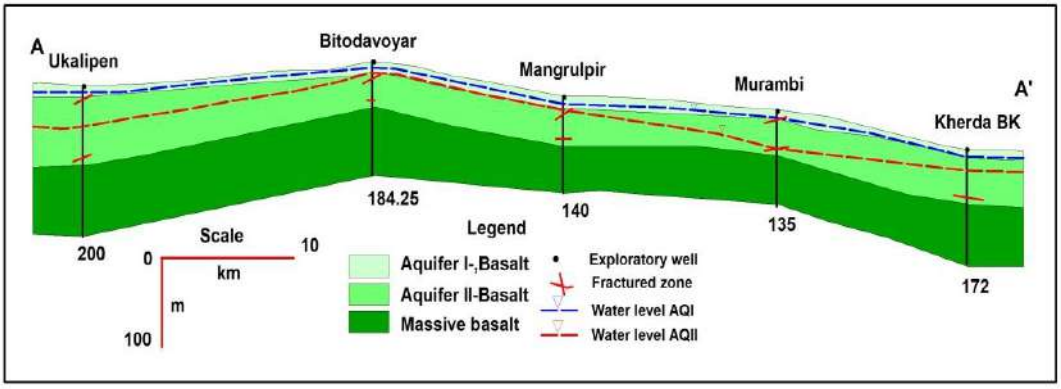


Figure 2.8 (a): Lithological section along A – A'

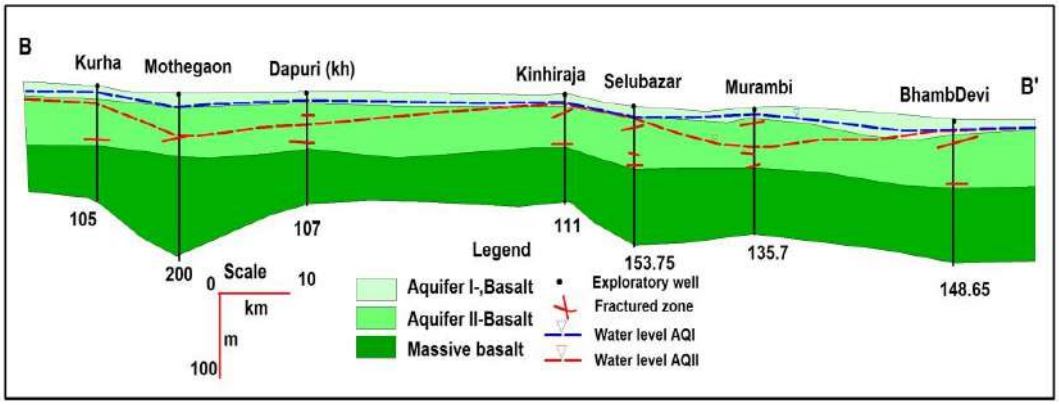


Figure 2.8 (b): Lithological section along B – B'

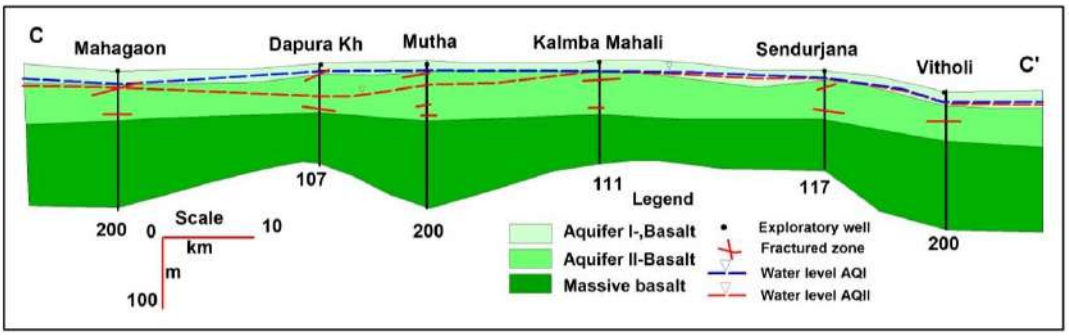


Figure 2.8 (c): Lithological section along C – C'

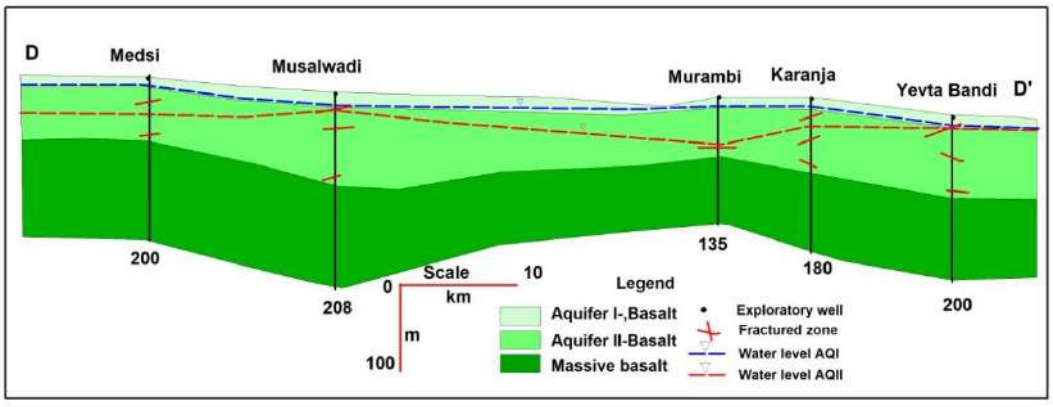


Figure 2.8 (d): Lithological section along D – D'

3. WATER LEVEL SCENARIO

3.1 Depth to water level (Aquifer-I /Shallow Aquifer)

Central Ground Water Board periodically monitors 46 Ground Water Monitoring Wells (GWMWs) including 39 dugwells and 7 piezometers in the Washim district, four times a year i.e. in January, May (Pre-monsoon), August and November (Post-monsoon). Apart from this under NAQUIM study; 113 KOW were also established and monitored during the year 2018. These data have been used for preparation of depth to water level maps of the district. Pre-monsoon and post-monsoon water levels along with long-term water level trends (2009-2018) are given in **Annexure-VI**.

3.1.1 Depth to Water Level – Pre-monsoon (May-2018)

The depth to water levels in aquifer-I(Shallow aquifer) Washim district during May 2018 ranges between 2.9 mbgl (Kokalgaon, Washim block) and 21.9 mbgl (Govardhan, Risod block). The depth to water levels between 5 to 10 and 10 to 20 mbgl are observed in entire district covering all the blocks. The Deeper water levels i.e., 20 to 30 mbgl are observed as isolated patches, in almost all the blocks. The pre-monsoon depth to water level map is depicted in **Figure 3.1.**

3.1.2 Depth to Water Level – Post monsoon (Nov-2018)

The depth to water levels in Washim district during Nov. 2018 ranges between near ground level / 0.9 mbgl at Dhodap Bk., and Wanoja Risodbock and 15.23 mbgl (Hisai, Mangrulpir Block). Shallow water levels within 5 m bgl observed in entire district covering all blocks and moderate water level 5 to 10 mbgl are observed in North-East and North-West parts and in patches in East and South-West parts of the district. Deeper water levels 10 to 20 m bgl are observed as small isolated patch in Mangrulpir and Risod blocks. Spatial variation in post-monsoon depth to water levels is shown in **Figure 3.2.**

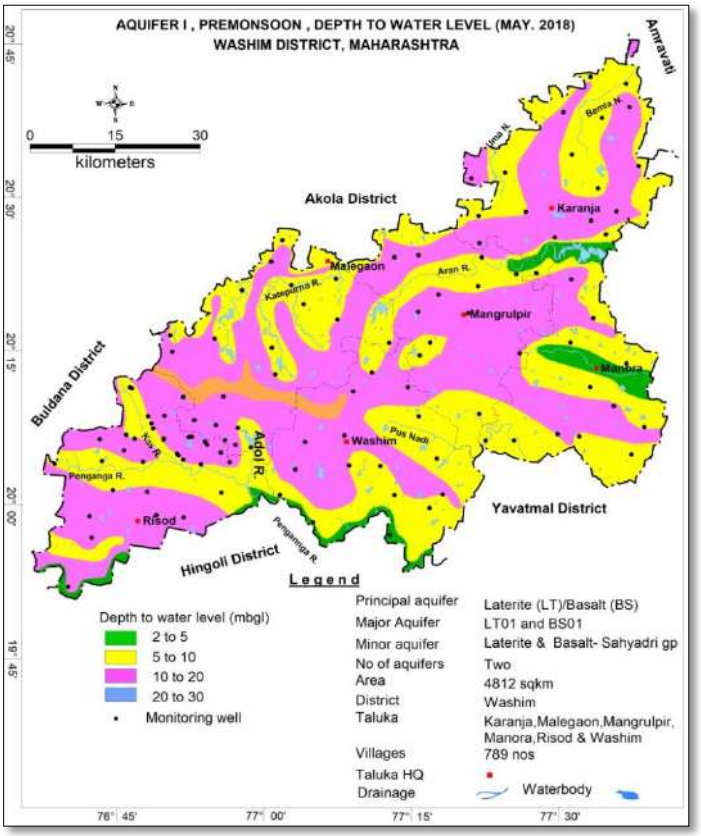


Figure3.1: DTWL Aquifer-I Shallow aquifer (May 2018)

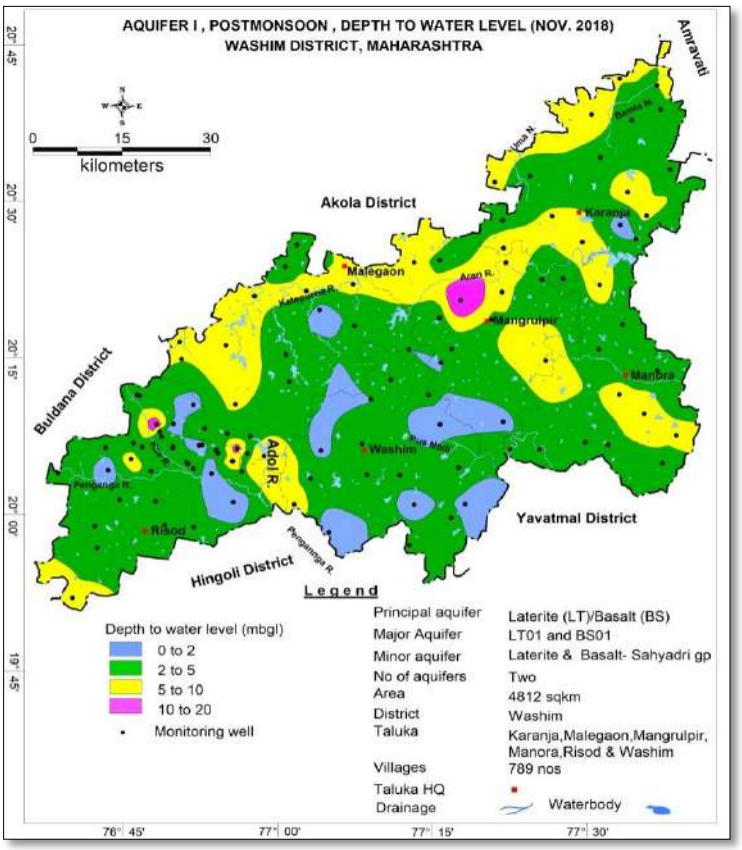


Figure 3.2: DTWL Aquifer-I(Shallow aquifer (November 2018)

3.2 Depth to water level (Aquifer-II / Deeper Aquifer)

3.2.1 Pre-monsoon Depth to Water Level (May-2018)

In Aquifer-II (Deeper Aquifer), the pre-monsoon depth to water levels, in Washim District during May 2018, range from 15.00 (Sendurjana, Manora block) to 100 mbgl (Dhanora Kh., Mangrulpir block). The depth to water level less than 20 mbgl is observed only in some parts of Manora, Washim, Malegaon, Mangrulpir and Karanja blocks. The major parts of the district show depth to water level between 20 and 40 mbgl. The deeper water level between 40 and 50 mbgl are observed in Washim, Mangrulpir, Risod and Karanja blocks. The deepest water level (>50 mbgl) has been observed in isolated parts of Washim, Mangrulpir, Risod and Karanja blocks of the district. This may be due to overexploitation of ground water. The pre-monsoon depth to water level for Aquifer -II is given in **Figure 3.3.**

3.2.2 Post-monsoon Depth to Water Level (Nov.-2018)

In Aquifer-II, the post-monsoon depth to water levels in Washim District during Nov. 2018 range between 2.00 (Haral, Risod block) and 53.00 mbgl (Dhanora Kh., Mangrulpir block). Depth to water level less than 10 m bgl has been observed in central part of the district covering parts of Washim, Malegaon, Mangrulpir and Manora blocks also in some parts in Northeast and Southwest parts of the district. The major part of the district shows deeper water levels ranging between 10 and 20 mbgl. The deepest water level of more than 20 mbgl upto 50 mbgl are observed in isolated patches in Karanja, Malegaon, Risod and Mangrulpir blocks. The deepest water level more than 50 mbgl is observed in an isolated patch in Mangrulpir block. The post-monsoon depth to water level for Aquifer –II is given in **Figure 3.4.**

3.3 Water Level Trend (2009-2018)

During pre-monsoon, rise in water level trend has been recorded at 58 stations and ranges from 0.016 (Karli, Manora block) to 2.212 m/year (Agarwadi, Manora block) while falling trend was observed in 22 stations varying from 1.524 (Medshi, Malegaon block) to 0.020 m/year (Kherda Bk., Karanja block). During pre-monsoon, declining water level trend has been observed in area covering almost all blocks. Rise in water level trend has been observed in area covering small parts of Risod, Malegaon, Karanja and Manora blocks of the district **(Figure 3.5)**.

During post-monsoon, rise in water level trend has been recorded at 41 stations and it ranges between 0.018 m/year (Tondgaon, Washim block) to 0.585(Washim, Washim block) while falling trend was observed in 39 stations varying from 1.454 (Mohjaba, Risod block) to 0.011 m/year (Kekatumra, Washim block). Rising water level trend has been observed in covering major parts of Risod , Malegaon and MAnora blocks of the district while small areas of Washim, Mangrulpir and Karanja blocks.Fall in water level trend has been observed in the central, Western and North east parts of the district covering major pats of Washim, Mangrulpir, Malegaon and Karanja also small portion of the Manora and Risod blocks**(Figure 3.6).**

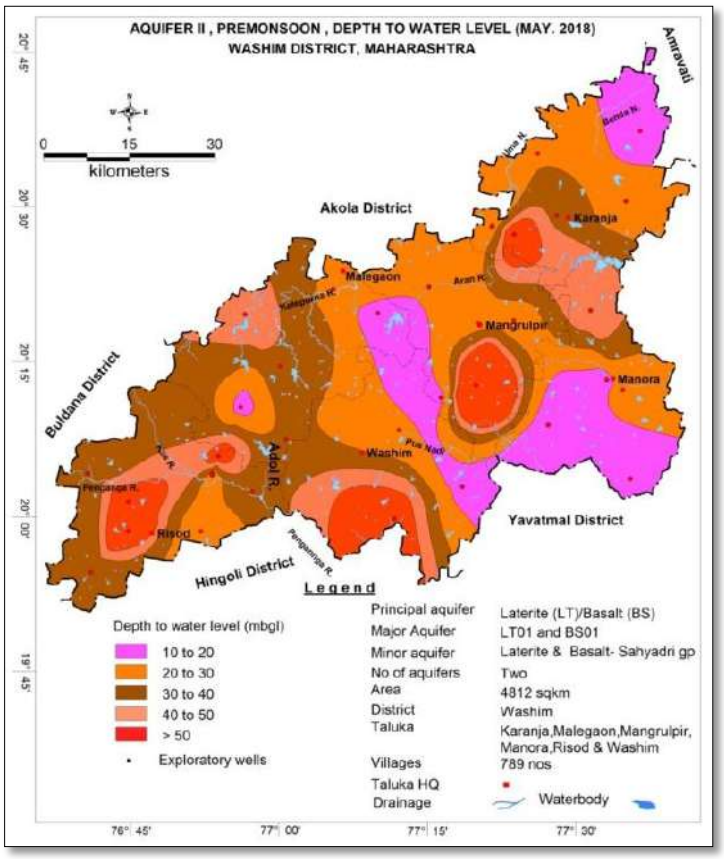


Figure 3.3: DTWL Aquifer-II deeper aquifer (May 2018)

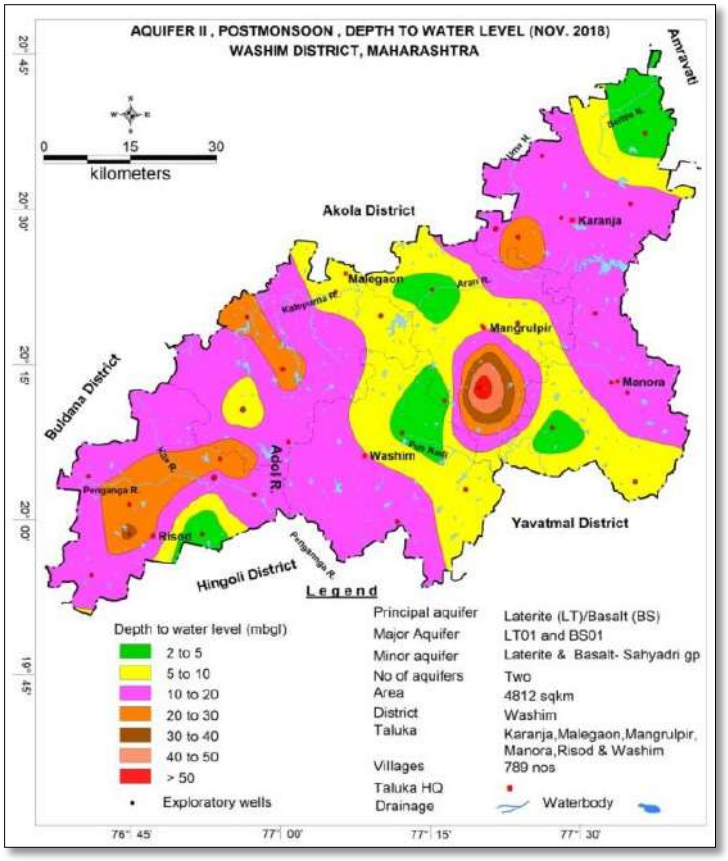


Figure 3.4: DTWL Aquifer-II deeper aquifer (Nov. 2018)

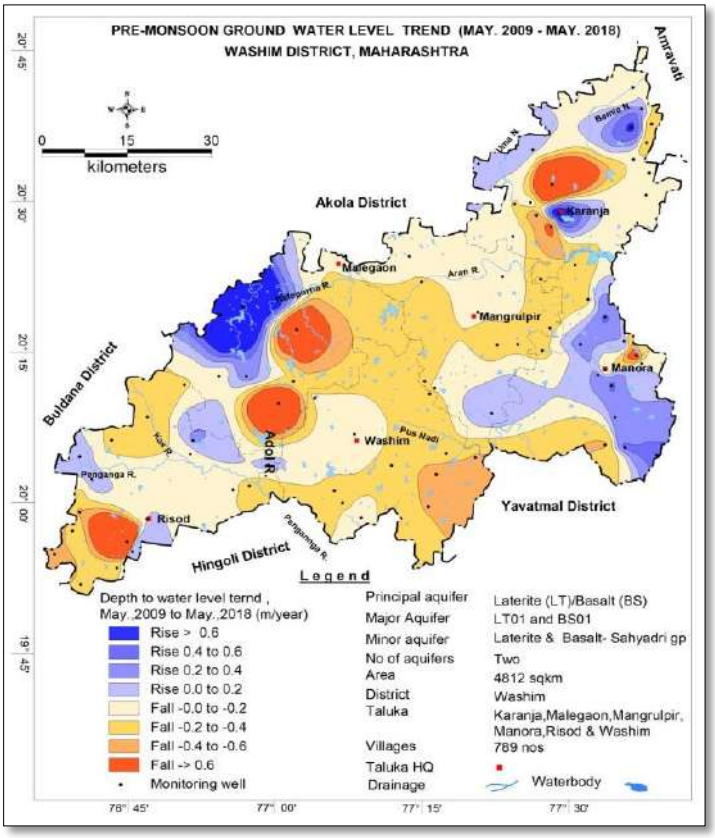


Figure3.5: Pre-monsoon decadal trend (Shallow aquifer) (2009-18)

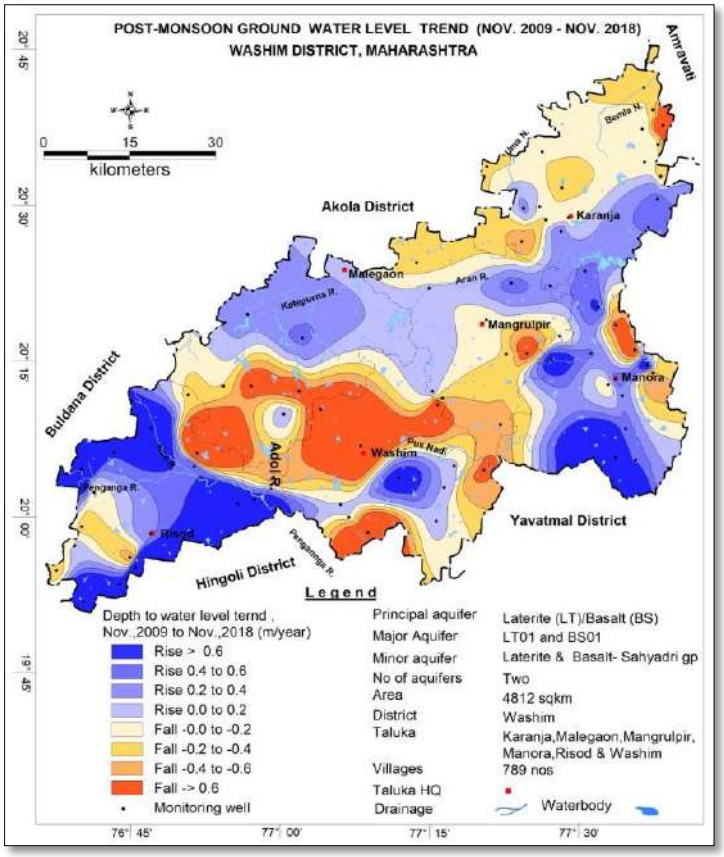


Figure 3.6: Post-monsoon decadal trend (Shallow aquifer) (2009-18)

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 (**Figure 3.7 a to 3.7 f**). However, continuous increase in the groundwater draft is indicated by the recessionary limb.

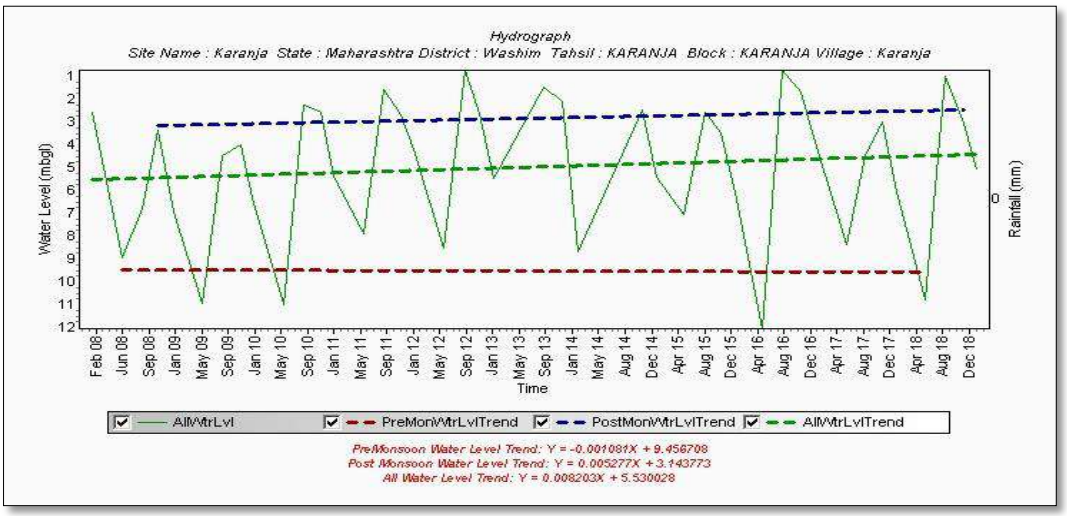


Figure 3.7 a: Hydrograph (2008-18), Karanja, Karanja Block, Washim District

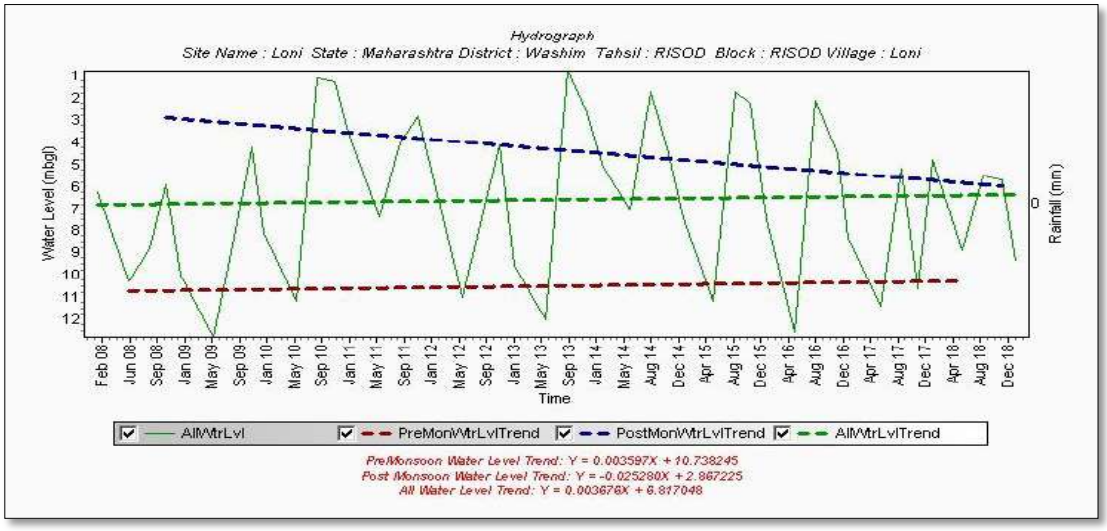


Figure 3.7 b: Hydrograph (2008-18), Loni, Risod Block, Washim District

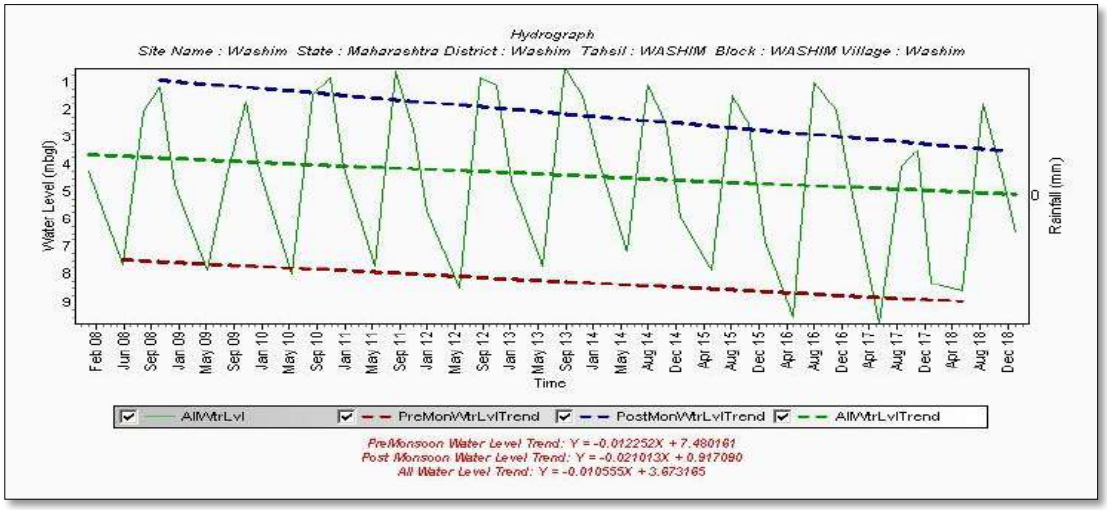


Figure 3.7 c: Hydrograph (2008-18), Washim, Washim Block, Washim District

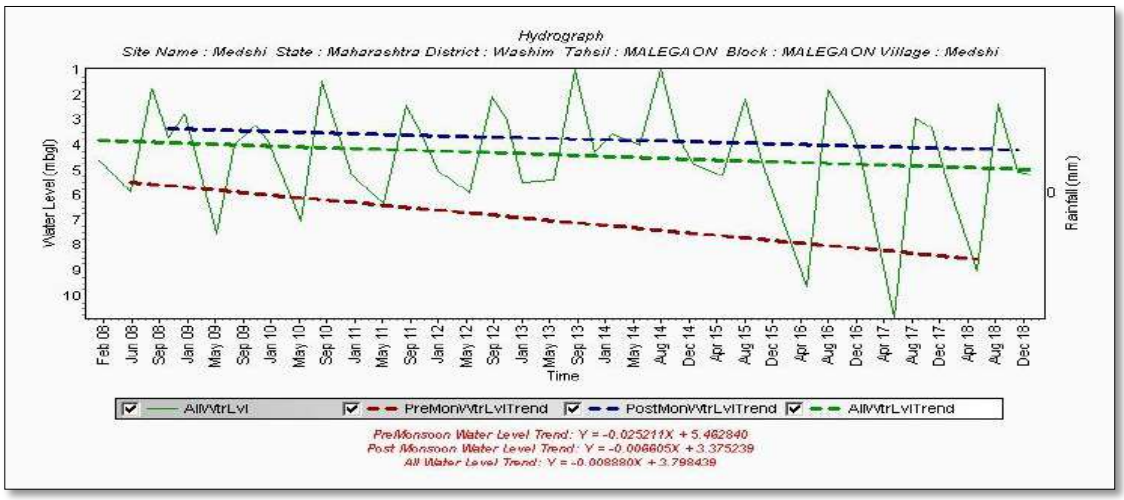


Figure 3.7 d: Hydrograph (2008-18), Medshi, Malegon Block, Washim District

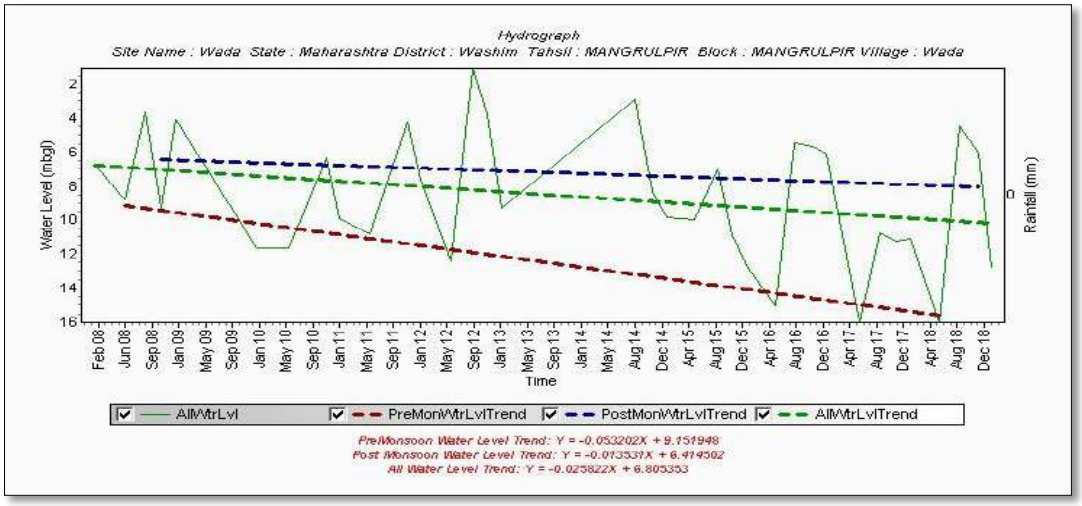


Figure 3.7 e: Hydrograph (2008-18), Wada, Mangrulpir Block, Washim District

4. GROUND WATER QUALITY

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. To decipher the ground water quality scenario, 131 samples from aquifer-I / shallow aquifer and 86 from aquifer – II / deeper aquifers have been utilised including monitoring wells/exploratory wells, tubewells/borewells of CGWB and GSDA; data from earlier studies. The aquifer wise ranges of different chemical constituents present in ground water are given in **Table 4.1**. The details of chemical analysis are given in **Annexure VI and VII**.

Table 4.1: Aquifer wise ranges of chemical constituents in Washim district

Constituents	Aquifer-I / Shallow aquifer			Aquifer-II / Deeper aquifer		
	Min	Max	Avg.	Min	Max	Avg.
pH	6.7	9.6	7.7	6.6	10.9	7.9
EC	354	2650	930	384	2650	929
TDS	187	1800	546.11	254	1800	563
TH	104	844	343.3	75	680	285
Ca	6.4	233	63.91	6.4	126	32
Mg	2.4	142.9	44.4	2.0	142.9	50
Na	8	368	46.9	8.0	294	72
K	0.1	121	9.2	0.1	195	11.2
CO3	0.1	57.6	2.8	0.1	57.6	5
HCO3	34.2	613	227.6	31.0	561.2	189
Cl	11	365	99	18	404	114
SO4	4	235	52.429	4	244	53
NO3	0.5	320	39.418	1.7	434	39.63
F	0.05	6	0.4	0.01	6	0.55
Fe	0.1	0.3	0.1	0.1	0.3	0.08

4.1 Electrical Conductivity (EC)

4.1.1 Distribution of Electrical Conductivity in Aquifer-I / Shallow Aquifer:

The concentration of EC in shallow aquifer varies between 354 (Bitoda, Washim block) and 2650µS/cm (Netansa, Risod block). Out of 132 samples collected from dug wells, 5

samples are having EC in range of 2000 to 3000 µS/cm observed in 22.05 sq km area.EC in the range 250-750 µS/cm covering 1500 sq km area in major parts of Washim, Manora and Karanja blocks and small parts of Risod, Malegaon & Mangrulpir blocks. The ground water is potable.EC in the range 750-2250 µS/cm covering 3635 sq.km area in covering almost all blocks of the district. The distribution of electrical conductivity in aquifer – I / shallow aquifers is shown in **Figure 4.1.**

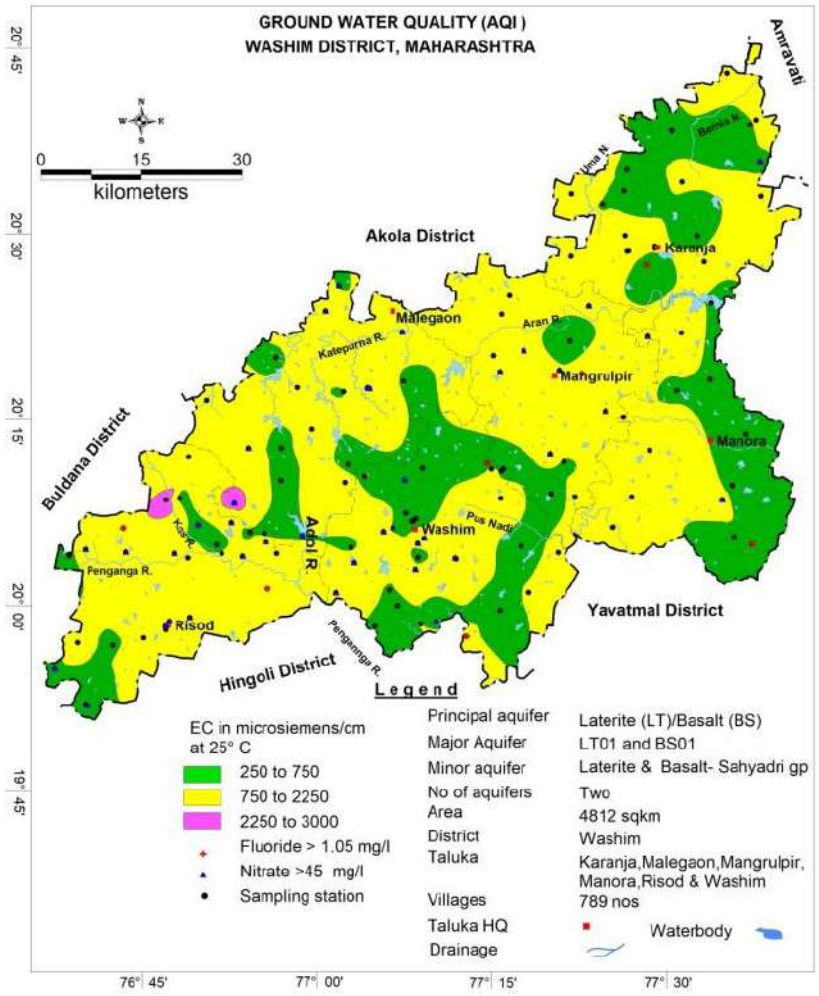


Figure 4.1: Ground water quality, Aquifer-I / Shallow aquifer

4.1.2 Distribution of Electrical Conductivity in Aquifer-II / Deeper Aquifer:

The concentration of EC in deep aquifer varies between 384 (Zodga, Malegaon block) and 2650 µS/cm (Netansa, Risod block). Out of 86 samples collected from tube wells/bore wells, 2 samples are having EC in range of 2000 to 3000µS/cm observed in 19.91 sq km area in Risod block. EC in the range 250-750 µS/cm covering 1234 sq km area in major parts of Washim, Manora, Malegaon and Karanja blocks and small parts of Risod and Mangrulpir blocks. The ground water is potable.EC in the range 750-2250 µS/cm covering 3904 sq.km area in covering almost all blocks of the district. The distribution of electrical conductivity in aquifer – I / shallow aquifers is shown in **Figure 4.1.**

4.2 Nitrate

Nitrogen in the form of dissolved nitrate nutrient for vegetation, and the element is essential to all life. The major contribution in ground water is from sewage, waste disposal, nitrate fertilizer and decaying of organic matter. As per BIS (2012) the desirable limit is 45 mg/l. In aquifer – I / shallow aquifer, nitrate concentration varies between 0.5 to 320 mg/l. Out of 131 samples40 water samples show the nitrate concentrations exceeding the

desirable limit of 45 mg/l (**Figure 4.1)**. The high concentration of Nitrate may be due to domestic waste and sewage in the urban and rural parts of district. In aquifer – II / deeper aquifer, nitrate concentration varies between 1.7 to 434 mg/l. Out of 86 samples analyzed 18 water samples show nitrate concentration exceeding the desirable limit of 45 mg/l (**Figure 4.2)**. The deeper aquifer affected by nitrate contamination may be due to percolation of nitrate contaminants from the ground surface as there are no other reasons for nitrate contamination in deeper aquifers.

4.3 Fluoride

In aquifer – I / shallow aquifer, concentration of fluoride ranges from 0.05 to 6.0 mg/l. Out of 132 samples were analyzed, only two samples show fluoride concentration more than 1.5 mg/l. The highest concentration of fluoride is found in Panvihir village, Karanja block (6.0 mg/l). In aquifer – II / deeper Aquifer, concentration of fluoride ranges from 0.01 to 6.0 mg/l. Out of 86 samples analyzed, three samples show fluoride concentration more than 1.5 mg/l. The highest concentration of fluoride is found in Panvihir village, Karanja block (6.0 mg/l), it may due to the lithological reason only.

4.4 Suitability of ground water for drinking purpose

In aquifer-I / shallow aquifer, Ca, Mg, NO_3&TH is found beyond the maximum permissible limit while most of the parameters as within MPL (**Table 4.2**). About 1 % of samples have fluoride concentration above the MPL. The water from such area is not fit for drinking purpose if directly consumed without treatment. For rest of the area ground water quality is good and fit for drinking purpose except few locations.

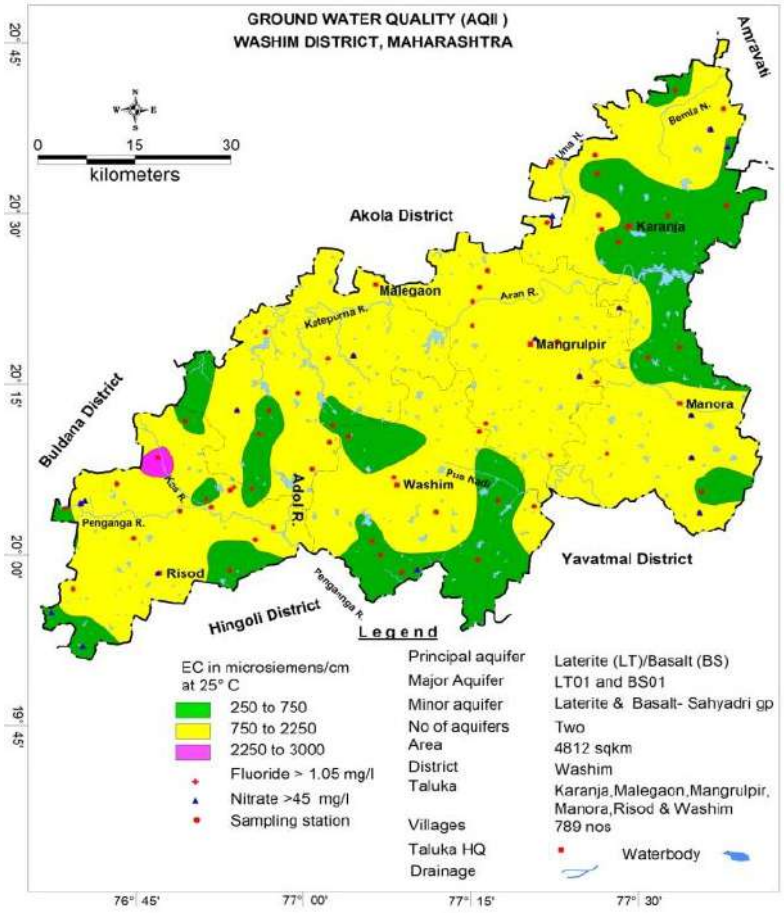


Figure 4.2: Ground water quality, Aquifer-II/Deeper aquifer

Table 4.2: Concentration of Chemical constituents in aquifer-I/shallow Aquifer

Parameter	Drinking water Standards (IS-10500-2012)		Total no of ground water samples	Aquifer-I/Shallow aquifer					
				Samples (<DL)		Samples (DL-MPL)		Samples (>MPL)	
	DL	MPL		No	%	No	%	No	%
pH	6.5-8.5	-	131	0	0	98	74.81	16	12.21
TDS	500	2000	131	67	51.15	57	43.51	0	0.00
TH	300	600	131	59	45.04	62	47.33	10	7.63
Ca (mg/L)	75	200	131	86	65.65	44	33.59	1	0.76
Mg (mg/L)	30	100	131	45	34.35	80	61.07	6	4.58
Cl (mg/L)	250	1000	131	123	93.89	8	6.11	0	0.00
SO_4 (mg/L)	200	400	131	129	98.47	2	1.53	0	0.00
NO_3 (mg/L)	45	No relaxation	131	92	70.23	-	-	39	29.77
F (mg/L)	1	1.5	131	125	95.42	4	3.05	2	1.53

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

Likewise, in aquifer-II / deeper aquifer, TH, NO_3, & Mg found more than maximum permissible limit (MPL) and about 3 % of samples have fluoride concentration above the MPL. The water from such area is not fit for drinking purpose if directly consumed without treatment (**Table 4.3**). For rest of the area ground water quality is good and fit for drinking purpose except few locations.

Table 4.3: Concentration of Chemical constituents in Deeper Aquifer

Parameter	Drinking water Standards (IS-10500-2012)		Total no of ground water samples	Aquifer-II/Deeper aquifer					
				Samples (<DL)		Samples (DL-MPL)		Samples (>MPL)	
	DL	MPL		No	%	No	%	No	%
pH	6.5-8.5	-	86	0	0.00	67	77.91	19	22.09
TDS	500	2000	86	40	46.51	44	51.16	0	0.00
TH	300	600	86	58	67.44	25	29.07	3	3.49
Ca (mg/L)	75	200	86	85	98.84	1	1.16	0	0.00
Mg (mg/L)	30	100	86	21	24.42	60	69.77	5	5.81
Cl (mg/L)	250	1000	86	80	93.02	6	6.98	0	0.00
SO_4 (mg/L)	200	400	86	84	97.67	2	2.33	0	0.00
NO_3 (mg/L)	45	No relaxation	86	68	79.07	-	-	18	20.93
F (mg/L)	1	1.5	86	71	82.56	3	3.49	3	3.49

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

4.5 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 Absorption Ratio (SAR) and Residual Sodium Carbonate (RSC) are the most important quality criteria, which asses the water quality and its suitability for irrigation.

Electrical Conductivity (EC)

The amount of dissolved ions in the water is represented by the electrical conductivity. As discussed in 4.1 with reference to Figure 4.2 & 4.3, the classification of water for irrigation based on the EC values is given in Table 4.4 and discussed as follows: -

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

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

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

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

In aquifer-I/shallow aquifer as well as in aquifer-II/deeper aquifer, maximum numbers of samples fall under the category of medium to high to high salinity type of water. While the areas with very high salinity prevails (>2250 µS/cm), very high salt tolerant crops and with proper soil and crop management practices are recommended (**Figure 4.1 & 4.2**).

Table 4.4: Classification of Ground water for Irrigation based on EC values

S. No	Water Quality Type	EC in µS/cm	Aquifer-I / shallow aquifer		Aquifer-II / Deeper Aquifer	
			No. of Samples	% of samples	No. of samples	% of samples
1	Low Salinity Water	< 250	0	0	0	0
2	Medium Salinity Water	>250-750	56	42.74	30	34.89
3	High Salinity Water	>750-2250	73	55.73	54	62.79
4	Very High Salinity Water	> 2250	2	1.53	2	2.32
Total			**131**	**100**	**86**	**100**

4.6 Sodium Absorption 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 aquifer-I /shallow aquifer, 100 % of samples falls in 'Good' category While 99 % samples from aquifer-II/deeper aquifer falls in Good category and only 1% samples falls in good to permissible category whereas no sample fall in bad category. The classification of ground water samples based on SAR values for its suitability for irrigation purpose is shown in **Table 4.5**.

Table 4.5: Classification of Ground water for Irrigation based on SAR values

Characteristics	Total Number of GW samples	SAR value							
		< 10		10-18		18-26		> 26	
		Good		Good to Permissible		Doubtful		Bad (Unsuitable)	
		No	%	No	%	No	%	No	%
Aquifer-I/ Shallow Aquifer	131	131	100	-	-	-	-	-	-
Aquifer-II/ Deeper Aquifer	86	85	99	1	1	-	-	-	-

4.7 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 4.6**.

In aquifer-I/shallow aquifer, it is observed that only 1% samples shows RSC values within 'Bad' category while only 99 % fall in 'good' category indicating that the ground water of the area is suitable for irrigation. In aquifer-II/deeper aquifer, about 92% samples show RSC less than 1.25 meq/L indicating ground water of the area is suitable for irrigation while about 7 % samples fall in 'doubtful to Unsuitable' category and 1% samples fall in 'bad' category indicating that the ground water of the area is bad and not suitable for irrigation.

Table 4.6: Classification of Ground water for Irrigation based on RSC values

Characteristics	Total No of GW samples	RSC values (meq/L)					
		< 1.25		1.25-2.50		> 2.50	
		Good		Doubtful		Bad (Unsuitable)	
		No	%	No	%	No	%
Aquifer-I / Shallow Aquifer	131	129	99	-	-	2	1
Aquifer-II / Deeper Aquifer	86	79	92	6	7	1	1

5. GROUND WATER RESOURCES

5.1 Ground Water Resources – Aquifer-I

Central Ground Water Board and Groundwater Surveys and Development Agency (GSDA) have jointly estimated the ground water resources of Washim 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 **Figure5.1**.

Ground Water Resources estimation was carried out for 4811.96 sq. km. area out of which 273.47 sq. km. is under command and 4538.48 sq. km. is non-command. As per the estimation, the net annual ground water availability comes to be 570.53 MCM. The gross draft for all uses is estimated at 217.88MCM with irrigation sector being the major consumer having a draft of 201.73 MCM. The domestic and industrial water requirements are worked at 16.15MCM. The net ground water availability for future irrigation is estimated at 336.49 MCM. The Stage of ground water development varies from 26.94 % (Mangrulpir) to 60.2% (Karanja). The overall stage of ground water development for the district is 38.19 % (SAFE Category). Block wise assessments indicate that all the blocks in the district fall under "Safe" category.

Table 5.1 Ground water resources, Aquifer-I (Shallow aquifer), Washim district (2013)

(Values in ham)

Administrative block	Command/ Non-command	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 Groundwater draft for all uses	Provision for domestic and industrial requirement supply to 2025	Net ground water availability for future irrigation development	Stage of Groundwater development (%) / Category
Karanja	Command	543.57	132.24	17.73	149.97			
Karanja	Non Command	7155.81	4210.25	274.77	4485.02			
Karanja	Total	7699.37	4342.50	292.50	4634.99	592.17	2895.11	60.20 / Safe
Malegaon	Command	848.93	50.71	56.25	106.95			
Malegaon	Non Command	8222.00	2913.29	282.38	3195.66			
Malegaon	Total	9070.93	2963.99	338.62	3302.62	675.15	5629.35	36.41 / Safe
Mangrulpir	Command	1645.56	185.77	59.11	244.88			
Mangrulpir	Non Command	8189.66	2204.51	200.06	2404.57			
Mangrulpir	Total	9835.22	2390.28	259.17	2649.45	527.81	6714.82	26.94 / Safe
Manora	Command	1807.16	216.96	60.51	277.47			
Manora	Non Command	6571.96	2297.19	159.87	2457.06			
Manora	Total	8379.12	2514.15	220.38	2734.53	418.88	5307.79	32.64 / Safe
Risod	Command	1285.87	335.47	36.59	372.07			
Risod	Non Command	11016.91	4267.89	199.90	4467.79			
Risod	Total	12302.78	4603.37	236.49	4839.86	473.90	7099.70	39.34 / Safe
Washim	Command	1337.30	215.92	56.49	272.41			
Washim	Non Command	8428.75	3143.37	211.72	3355.09			
Washim	Total	9766.04	3359.28	268.22	3627.50	542.84	6002.36	37.14 / Safe

5.2 Ground Water Resources – Aquifer-II

The ground water resource of Aquifer-II was also assessed to have the correct quantification of resources so that proper management strategy can be framed. Block wise summarized Ground Water Resources of Aquifer-II is given in **Table 5.2**.

Table 5.2: Ground Water Resources of Aquifer-II (Deeper aquifer)

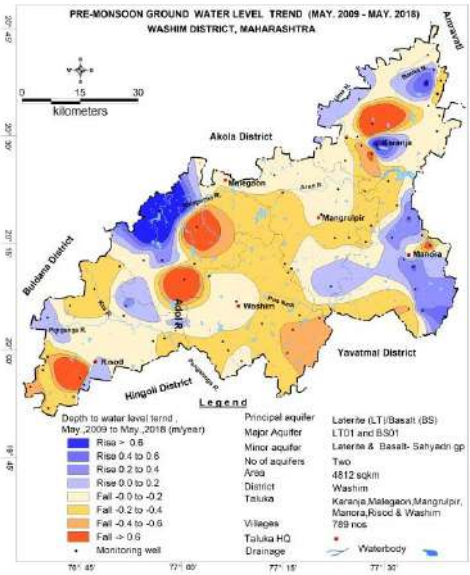
SN	Taluka	Mean thickness (m)	Area in sq km	PZ (maconfing layer)	Sy	S	Resource above confining layer (MCM)	Resource in confining aquifer (MCM)	Total Aquifer (MCM)
1	Karanja	7.00	0.253	40	0.009	0.00002	0.000	0.016	0.0162
2	Karanja	0.75	265.773	30	0.005	0.00001	0.041	0.997	1.0381
3	Karanja	0.75	0.530	40	0.002	0.00005	0.001	0.001	0.0019
4	Karanja	2.00	222.988	35	0.005	0.00006	0.445	2.230	2.6747
5	Karanja	4.50	329.319	30	0.009	0.00002	0.198	13.337	13.535
6	Malegaon	0.75	174.986	40	0.002	0.00001	0.036	0.262	0.2989
7	Malegaon	2.00	542.360	35	0.005	0.00005	1.025	5.424	6.4487

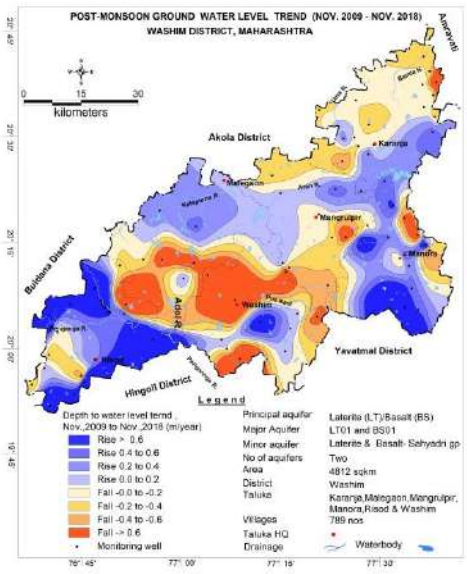
SN	Taluka	Mean thickness (m)	Area in sq km	PZ (maconfing layer)	Sy	S	Resource above confining layer (MCM)	Resource in confining aquifer (MCM)	Total Aquifer (MCM)
8	Malegaon	4.50	129.088	40	0.009	0.00006	0.294	5.228	5.5224
9	Mangrulpir	7.00	111.237	35	0.005	0.00006	0.222	3.893	4.1152
10	Mangrulpir	9.00	62.240	30	0.002	0.00006	0.106	1.120	1.2267
11	Mangrulpir	11.00	4.867	35	0.009	0.00001	0.001	0.482	0.4827
12	Mangrulpir	0.75	68.076	50	0.005	0.00001	0.018	0.255	0.2730
13	Mangrulpir	2.00	375.210	40	0.002	0.00005	0.810	1.501	2.3113
14	Mangrulpir	4.50	88.367	30	0.009	0.00006	0.151	3.579	3.7300
15	Manora	0.75	114.298	42	0.005	0.00002	0.096	0.429	0.5246
16	Manora	2.00	588.843	20	0.002	0.00002	0.236	2.355	2.5909
17	Manora	2.00	1.605	30	0.005	0.00002	0.001	0.016	0.0170
18	Risod	0.75	92.805	40	0.002	0.00002	0.074	0.139	0.2135
19	Risod	2.00	122.113	40	0.009	0.00006	0.278	2.198	2.4765
20	Risod	4.50	634.542	45	0.005	0.00001	0.148	14.277	14.425
21	Washim	0.75	15.076	25	0.002	0.00001	0.002	0.023	0.0246
22	Washim	2.00	403.144	30	0.005	0.00005	0.653	4.031	4.6845
23	Washim	4.50	464.214	50	0.009	0.00005	1.253	18.801	20.054

6. GROUND WATER RELATED ISSUES

6.1 Declining Water Levels

The ground water exploitation has resulted in decline of water levels over the period of time. In pre-monsoon season, declining water level trend has been observed in about 3978.8 sq km area covering major part of Washim, Mangrulpir, Risod blocks and parts of karanja, Malegaon and Manora blocks. In post-monsoon season, decline has been observed in about 2668.7 sq.km area covering major parts of Washim, Karanja and Risod blocks and parts in Malegoan, Manora and Mangrulpir blocks.





Pre-monsoon Fall in 5142 Sq km area **Post-monsoon Fall 4894.18 Sq km area**

6.2 Rainfall and Droughts

Based on the short term rainfall analysis from 1998 to 2018 it is observed that severe drought was observed in one year while three year moderate drought were faced in

the Washim district. It is observed that all the blocks have experienced declining rainfall trend ranging from 6.84 to 13.14 mm/year; except Mangrulpir block. Severe droughts have been observed in Manora and Washim blocks. All the blocks experienced Moderate droughts. Thus, Washim district is facing frequent droughts since long which is ultimately responsible for less ground water recharge and non-availability of surface & ground water for irrigation.

7. GROUND WATER MANAGEMENT PLAN

The aquifer 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. 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 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)
Karanja	865.57	818.86	157.16
Malegaon	936.36	846.43	15.67
Mangrulpir	785.69	710	596.84
Manora	777.93	704.88	1236.83
Risod	874.94	849.24	229.15
Washim	919.72	882.45	125
Total	**513124**	**4811.86**	**2360.65**

The total unsaturated volume available for artificial recharge is 2360.65MCM and it ranges from 15.67 MCM in Malegaon block to 1236.83 MCM in Manora block. The available surplus runoff can be utilized for artificial recharge through construction of percolation tanks and Check dams at suitable sites (**Figure 7.1**).

Thus, after taking into consideration all the factors, 22.519 MCM of surplus water can be utilised for recharge, which is given in **Table 7.2**. This surplus water can be utilized for constructing 61 percolation tanks and 151 check 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 16.73 MCM/year. The tentative locations of these structures are given in **Figure 7.**1 and details also given in **Annexure VIII and IX**.

The rainwater harvesting in urban areas can be adopted in 25% of the household with 50 sq. km roof area. A total of 1.4631 MCM potential can be generated by taking 80% runoff coefficient. However, it is economically not viable & hence, not recommended.

Table 7.2: Proposed Artificial Recharge Structures

Block	Geographical Area (sq. km.)	Area feasible for recharge (sq. km.)	Unsaturated Volume (MCM)	Surplus water available for AR (MCM)	Proposed number of structures		Total Volume of Water expected to be recharged@ 75 % efficiency (MCM)		Total recharged @ 75 % efficiency (MCM)
					PT	CD	PT	CD	
Karanja	865.57	818.86	157.16	1.498	04	11	0.8	0.33	1.13
Malegaon	936.36	846.43	15.67	0.149	0	04	0	0.12	0.12
Mangrulpir	785.69	710	596.84	5.498	14	40	2.8	1.2	4.0
Manora	777.93	704.88	1236.83	11.79	35	60	7	1.8	8.8
Risod	874.94	849.24	229.15	2.184	05	21	1	0.63	1.63
Washim	919.72	882.45	125	1.4	03	15	0.6	0.45	1.05
Total	**513124**	4811.86	2360.65	**22.519**	**61**	**151**	**12.2**	**4.53**	**16.73**

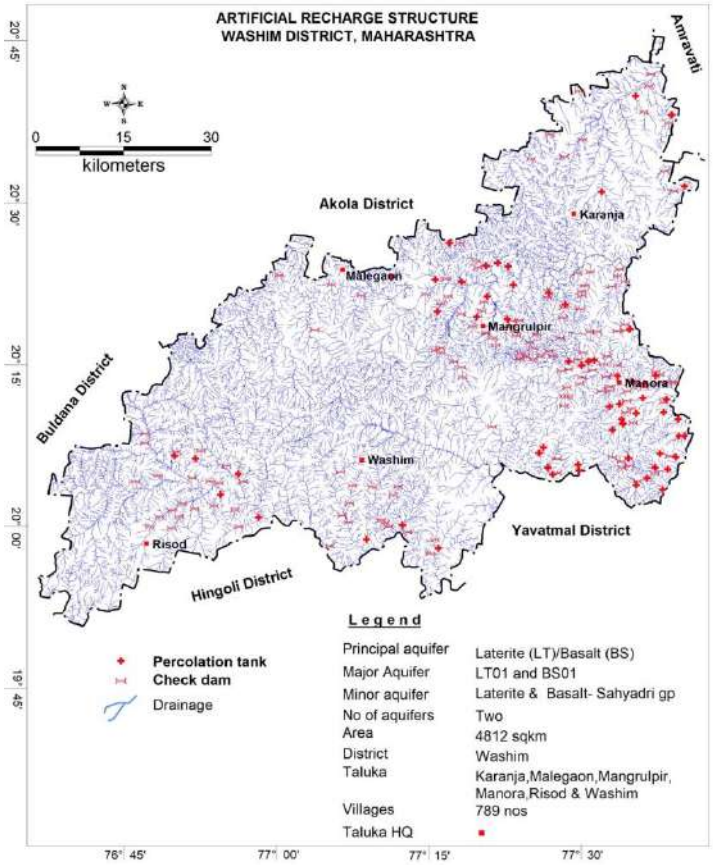


Figure 7.1: Location of Proposed Artificial Recharge structures

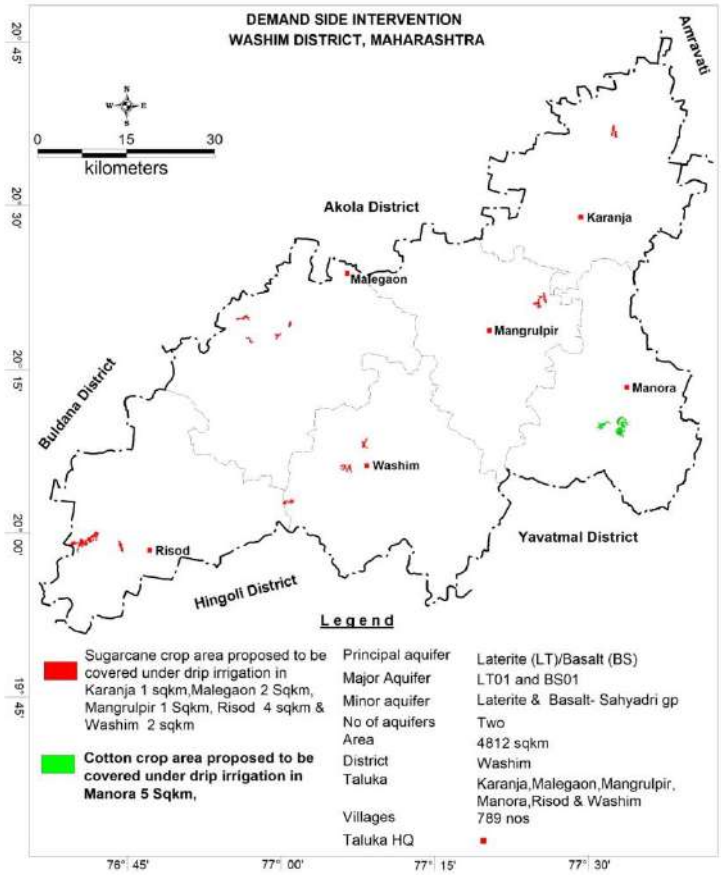


Figure 7.2: Proposed Demand side intervention, Washim district

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 or change in cropping pattern or both are required to save water. **Figure 7.2** depicts the proposed demand side interventions in the area. The micro-irrigation techniques are proposed to be adopted in 15 Sq. Km area in entire district by saving a total of 7 MCM as given **Table 7.3.** No change in cropping patterns is proposed in any of the blocks.

Table 7.3: Demand side interventions proposed

Block	MICRO IRRIGATION TECHNIQUES		CROPPING PATTERN CHANGE	
	Sugarcane or Chilli cropped Area proposed (Sq. Km.)	Volume of Water saved (MCM)	Area under Water Intensive crops (Sq. Km.)	Volume of Water saved by change in cropping pattern (MCM)
Karanja	1	0.57	Nil	Nil
Malegaon	2	1.14	Nil	Nil
Mangrulpir	1	0.57	Nil	Nil
Manora	5	1.3	Nil	Nil
Risod	4	2.28	Nil	Nil
Washim	2	1.14	Nil	Nil
Total	**15**	**7**	**Nil**	**Nil**

7.3 Expected Benefits

The impact of groundwater management plans on the groundwater system in the district after its implementation is evaluated and the outcome shows significant improvement in groundwater scenario in all blocks as given in the **Table 7.4**.

Table 7.4: Expected benefits after management options

Block	Water Recharged by Supply side intervention (MCM)	Water saving by demand side interventions (MCM)	Net Ground water availability (MCM)	Total ground water draft (MCM)	Ground water resources after supply side management (MCM) (2+4)	Ground water Draft after demand side management (MCM) (5-3)	Expected stage of Development (%) [(7/6)*100]	Current Stage of GW Development (%)
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	9
Karanja	1.13	0.57	98.35	26.49	99.48	25.92	59.33	60.20
Malegaon	0.12	1.14	83.79	27.34	83.91	26.2	36.36	36.41
Mangrulpir	4.0	0.57	90.70	33.02	94.7	32.45	25.88	26.94
Manora	8.8	1.3	97.66	36.27	106.46	34.97	29.53	32.64
Risod	1.63	2.28	123.02	48.39	124.65	46.11	38.83	39.34
Washim	1.05	1.14	76.99	46.34	78.04	45.2	36.75	37.14
Total	**16.73**	**7**	570.53	217.88	587.26	210.88	37.10	**38.19**

7.4 Development Plan

The ground water development plan is proposed in 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 200.195 MCM volume of ground water generated can bring 308 sq km additional area under assured ground water irrigation with average crop water requirement of 0.65 m by constructing 12012 Dug wells and 1335 Borewells. The area feasible for ground development is shown in **Figure 7.3** while block wise details are given in **Table 7.5**.

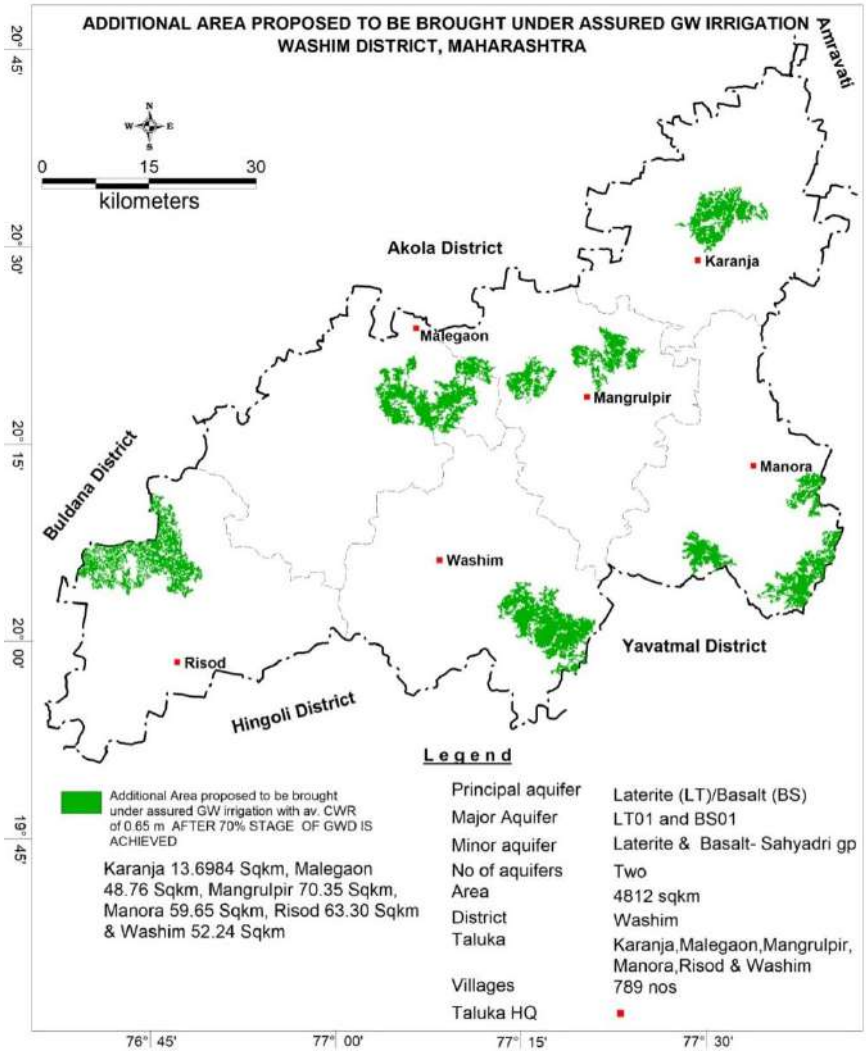


Figure 7.3: Additional area Proposed to be bought under Assured GW irrigation

Table 7.5: Block wise additional area under assured GW Irrigation

lock	Current Stage of GW Developme nt (%)	Net Ground water availabilit y (MCM)	Ground water resources after supply side manageme nt (MCM)	Ground water Draft after demand side manageme nt (MCM)	Expected stage of Developm ent %	Balance GWR availabl e for GW Develop ment after STAGE OF GWD is brought to 70% (MCM)	Propose d No. of DW @1.5 ham for 90% of GWR Availabl e)	Propo sed No. of BW @1.5 ham for 10% of GWR Availa ble)	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)
Karanja	60.20	98.35	99.48	25.92	59.33	8.904	534	59	13.69
Malegaon	36.41	83.79	83.91	26.2	36.36	31.694	1902	211	48.76
Mangrulp ir	26.94	90.70	94.7	32.45	25.88	45.725	2743	304	70.35
Manora	32.64	97.66	106.46	34.97	29.53	38.773	2326	258	59.65
Risod	39.34	123.02	124.65	46.11	38.83	41.142	2469	274	63.30
Washim	37.14	76.99	78.04	45.2	36.75	33.957	2037	226	52.24
Total	38.19	570.53	587.26	210.88	37.10	200.195	12012	1335	308

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 Washim district.

Washim district covering an area of 5196 Sq.km, out of this 25.11 sq km (0.48 %) is hilly area. Geologically, the area is occupied by Basalt and local river Alluvium. The Stage of ground water development varies from 26.94 % (Karanja) to 60.2 % (Washim). The overall stage of ground water development for the district is 38.19 % (SAFE Category). The area has witnessed declining water level, irregular rainfall and frequent droughts, and low yield potential aquifers are the major issues in the district. Declining water level trend has been observed in 5142 sq km during pre-monsoon while it is 4894.18 sq km during post monsoon.

The occurrence of red bole beds plays major role in local hydrogeological conditions. It is observed that in Wshim district red bole encountered at various depth ranges.

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 61 Percolation tanks and 151 Check dams are proposed, which will augment ground water resources to the tune of **16.73** MCM (12.2 MCM by Percolation tanks and, 4.53 MCM by Check dams).

As a part of **Demand Side Management**, the micro-irrigation techniques are proposed to be adopted in 15 Sq. Km area in entire district by saving a total of 7 MCM.

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 200.195 MCM volume of ground water generated can bring 308 sq km additional area under assured ground water irrigation with average crop water requirement of 0.65 m by constructing 12012 Dug wells and 1335 Borewells.

These interventions also need to be supported by regulation for deeper aquifer and hence it is recommended to regulate/ban deeper tubewells/borewells 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. IEC activities and capacity building activities needs to be aggressively propagated to establish the institutional framework for participatory ground water management.

BLOCK WISE AQUIFER MAPS AND MANAGEMENT PLAN

I. KARANJA BLOCK

II. MALEGAON BLOCK

III. MANGRULPIR BLOCK

IV. MANORA BLOCK

V. RISOD BLOCK

VI. WASHIMBLOCK

9.1 AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN, KARANJA BLOCK, WASHIM DISTRICT, MAHARASHTRA

1. SALIENT FEATURES

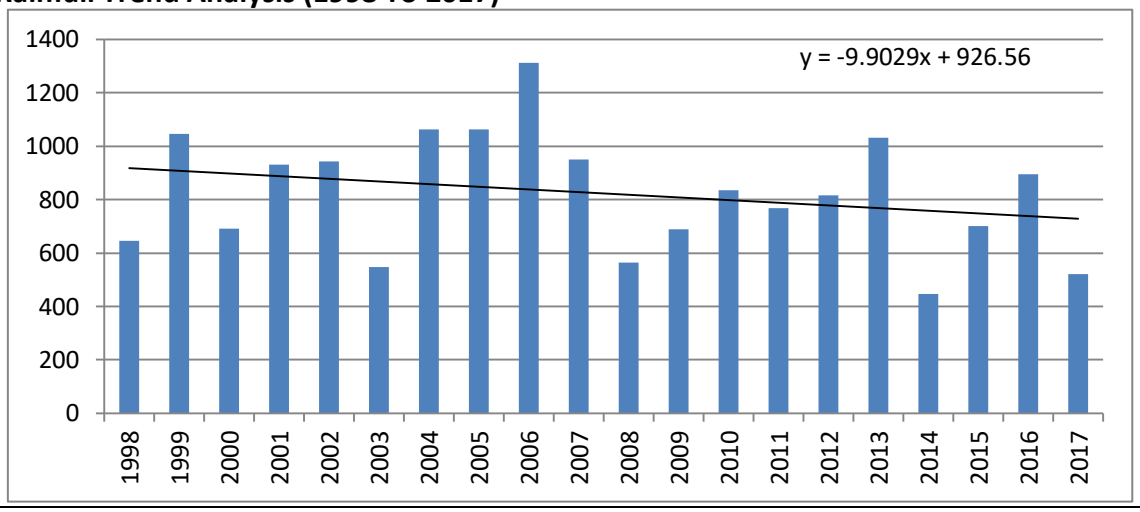
1.1 Introduction

Block Name	Karanja
Geographical Area (Sq. Km.)	865.57
Hilly Area (Sq. Km)	46.70
Population (2011)	213824
Climate	Monsoon Tropical

1.2 Rainfall Analysis

Normal Rainfall	875 mm
Annual Rainfall (2017)	521 mm
Decadal Average Annual Rainfall (2008-17)	744.1 mm
Long Term Rainfall Analysis (1998-2017)	Falling trend -9.9 mm/year. Probability of Normal/Excess Rainfall- 70% / 5%. Probability of Drought (Moderate/Severe/Acute)-: 25% Moderate / Severe& Acute –nil.

Rainfall Trend Analysis (1998 To 2017)



1.3. Geomorphology, Soil & Geology

Geomorphic Unit	Plateau, weathered (shallow) slightly dissected; Butte at some places (central and North-eastern part of the block).
Geology	Deccan Traps (Basalt) Age: Late Cretaceous to Eocene
Soil	Deep to very deep BCS consisting mostly of clay and loam, 50-100 cm and at some places >100 cm thick.

1.4. Hydrology & Drainage

Drainage	Aran river in the south of the block and its tributaries	
Hydrology	Major and Medium projects	None
	Minor Irrigation Projects(Local)	11
	Minor Irrigation Projects(ZP Level)	237
		PT-12, KT-43, UGB-2

1.5. Land Use, Agriculture, Irrigation & Cropping Pattern

Forest Area		33.33 Sq. Km.
Cultivable Area		729.73 Sq. Km.
Net Sown Area		704.01 Sq. Km.
Double Cropped Area		25.72 Sq. km
Area under Irrigation	Surface Water	7.36Sq. Km.
	Ground Water	21.34aSq. Km.

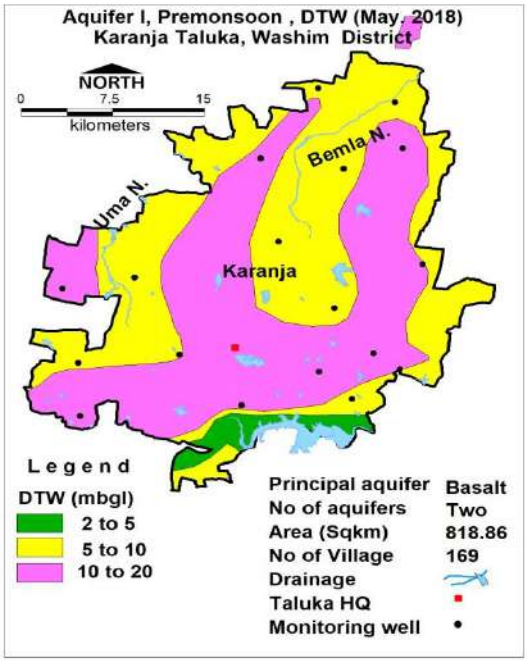
Area under Drip & Sprinkler Irrigation	0.1854 Sq. Km.	
Principal Crops	**Crop Type**	**Area (Sq. Km.)***(Reference year 2016-17)*
	Cotton	111
	Cereals	33.24
	Pulses	170
	Oil Seeds	424.72
Horticultural Crops	Citreous fruit	-
	Others	-

1.6. Water Level Behavior

1.6.1 Aquifer-I (Shallow Aquifer)

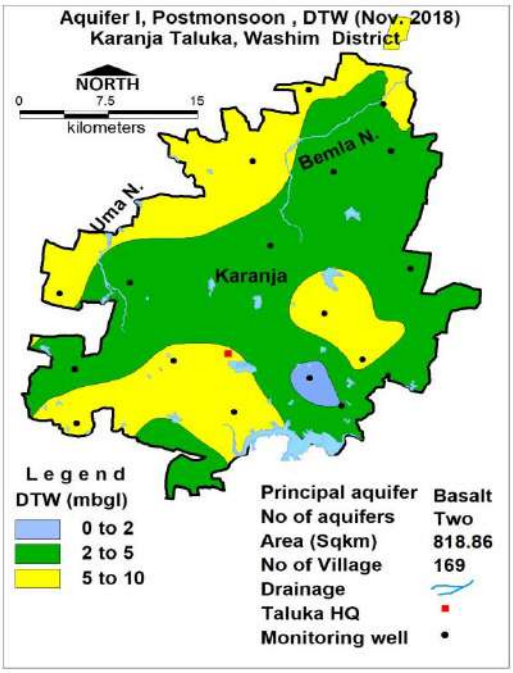
Pre-Monsoon (May-2018)

DTWL 05 to 20 mbgl is observed in entire block except in few isolated small patches of the block where water level in the range of 2 to 5 mbgl is observed.



Post-Monsoon (November-2018)

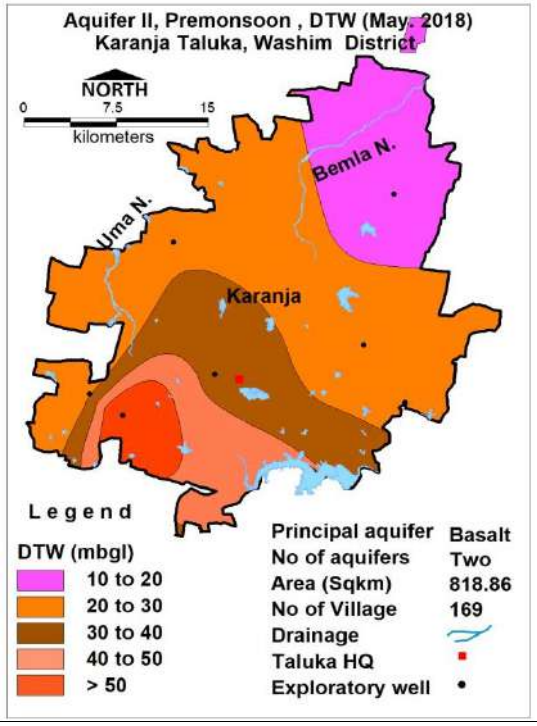
DTWL less than 2 mbgl is observed in isolated patches in south eastern part of the block. Water level in the range of 2 to 5 mbgl is observed in the entire block except in some patches in North-western, south-western and in one isolated patch in south-eastern part of the block where water level ranges between 5 to 10 mbgl.

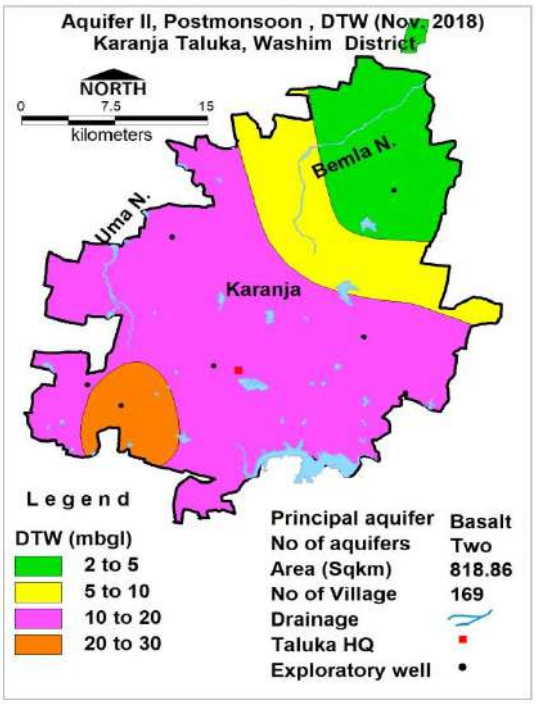


1.6.2 Water Level Behavior – Aquifer-II (Deeper Aquifer)

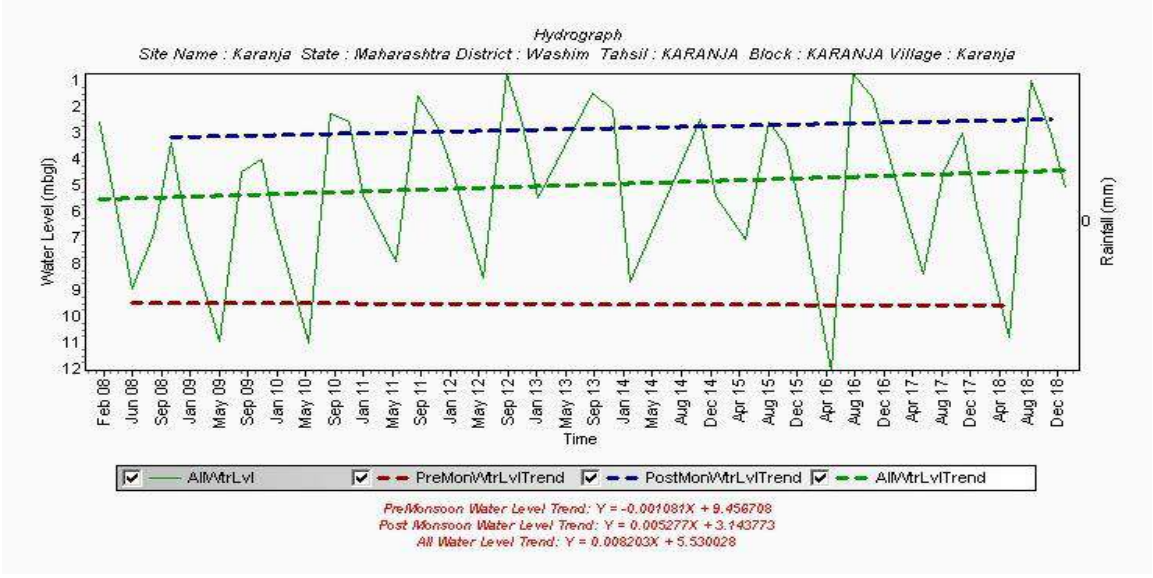
Pre-Monsoon (May-2018) DTWL 10-20 mbgl is observed in northern-eastern part of the block. DTWL 20-40 mbgl is observed in central, eastern and western parts of the block. Southern- western part has DTWL 40-50 mbgl engulfing small patch of >50 mbgl.

Post-Monsoon (November-2018) DTWL 10-20 mbgl is observed in major part of the block. Northern and north-eastern part shows the water level below 10 mbgl. In the South- western part one patch of DTWL 20-30 mbgl is observed.





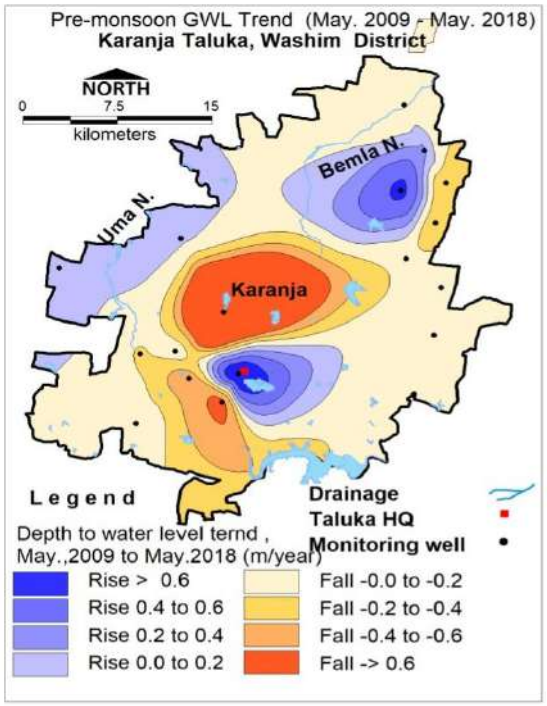
1.7. Hydrographs

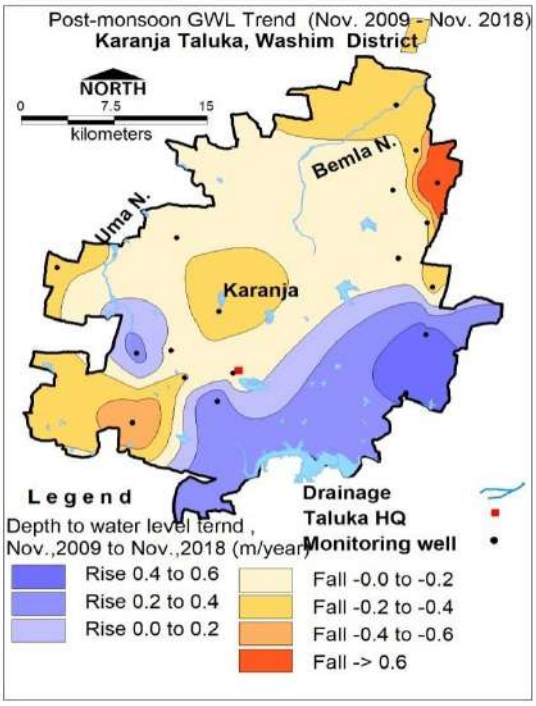


Hydrograph shows Pre-monsoon declining water level trend @ m/year	Hydrograph shows Post- monsoon rising water level trend @ m/year

1.8. Water Level Trend (2009-18)

1.8.1 Pre-Monsoon trend Falling 0.02 (Kherda bk.) to 1.5(Medshi) m/year Rising 0.016 (Karli) to 2.21 (Agarwadi) m/year	**1.8.2 Post-Monsoon trend** Rising 0.019(Tondgaon) to 1.59 (Washim) m/year; Falling 0.012 (Kekatumra) to 1.4 (Mohajabandi) m/year
Major part of the block shows falling water level trend up to 0.6 m/year (646.47 sq km). Rising trend upto 0.2 m/year has been observed in North-western part of the block as well as in North-east and South-central part of the block in patches (212.86 sq km). The central part show falling trend 0.2 to 0.6 m/year.	Major part of the block shows falling trend up to 0.6 m/year (578 sq.km) while rising trend of 0.2 to 0.6 m/year has been observed in South and south-western part of the block, also rising trend of 0.2 to 0.4 m/year has been observed in south-western part in small patches. Falling trend > 0.6 m/year has been observed in north-eastern part border area of the block in a patch.





2. Ground Water Issues

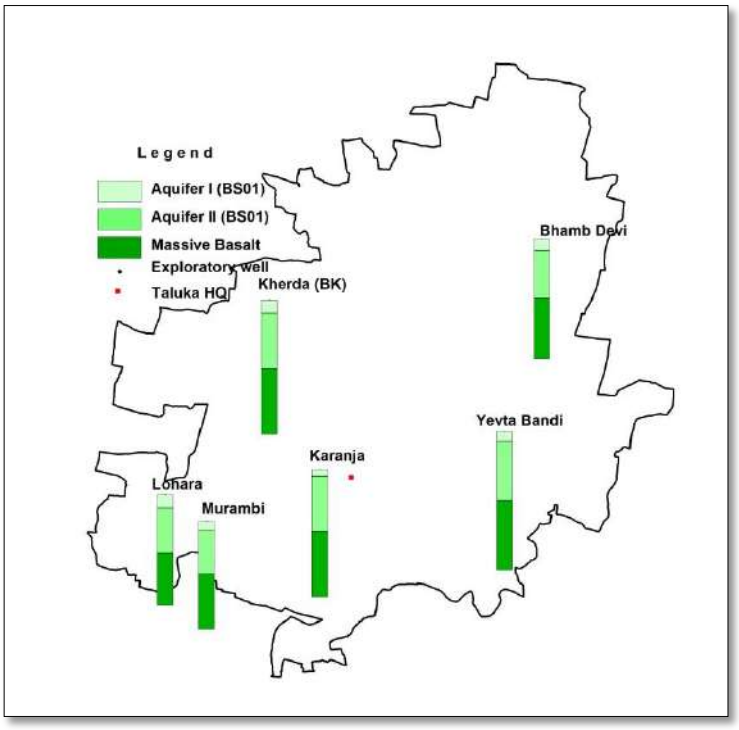
i. Declining Water Level trend is observed in 302 sq. km. area of the block.

ii. Frequent droughts (25% Moderate droughts) which is ultimately responsible for less ground water recharge and non-availability of surface & ground water for irrigation.

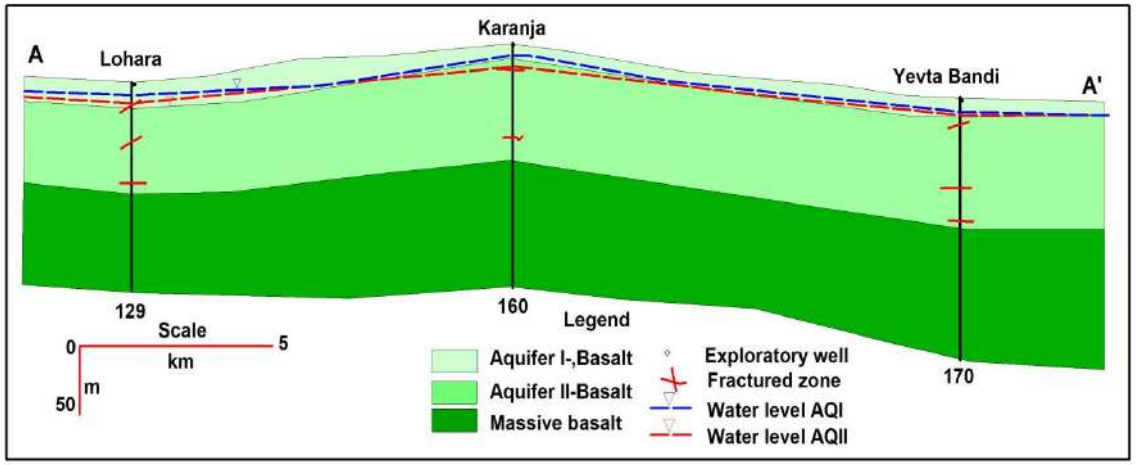
3. AQUIFER DISPOSITION

3.1. Number of Aquifers	Basalt –Aquifer-I (Phreatic / Shallow aquifer) -Aquifer-II (Semi-confined / confined / Deeper aquifer)

3.2. Lithological Disposition



3.3. Cross Sections – Section AA'

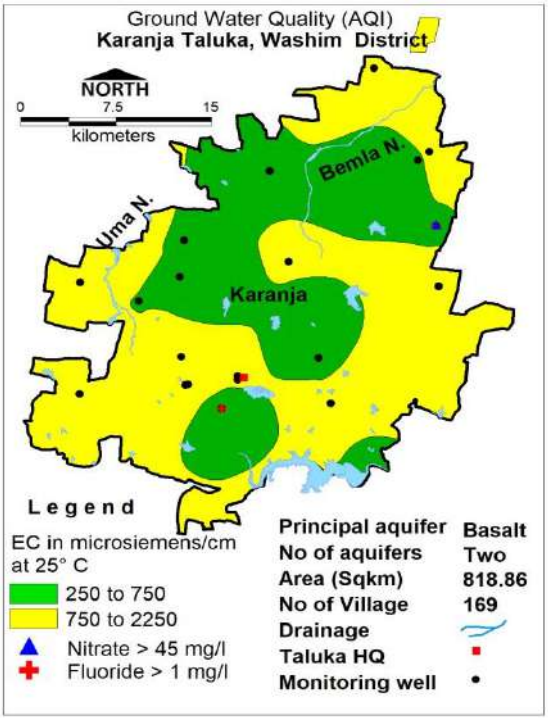


3.4. Aquifer Characteristics

Major Aquifers	Basalt (Deccan Traps)	
Type of Aquifer (Phreatic/Semi-confined/Confined)	Basalt –Aquifer-I (Phreatic / Shallow aquifer)	Basalt –Aquifer-II (Semi-confined / confined / Deeper aquifer)
Static Water Level (m bgl)	2.1 – 21.00	15 – 43
Depth of Occurrence (mbgl)	9-25	70 – 130
weathered/fractured rocks thickness (m)	5- 14	1 – 3
Yield	10 – 100 m^3/day	10-100 lpm
Specific yield/ Storativity (S)	0.019 to 0.028	0.000245 -0.0000145
Transmissivity (T)	30-40 m^2/day	25-210 m^2/day

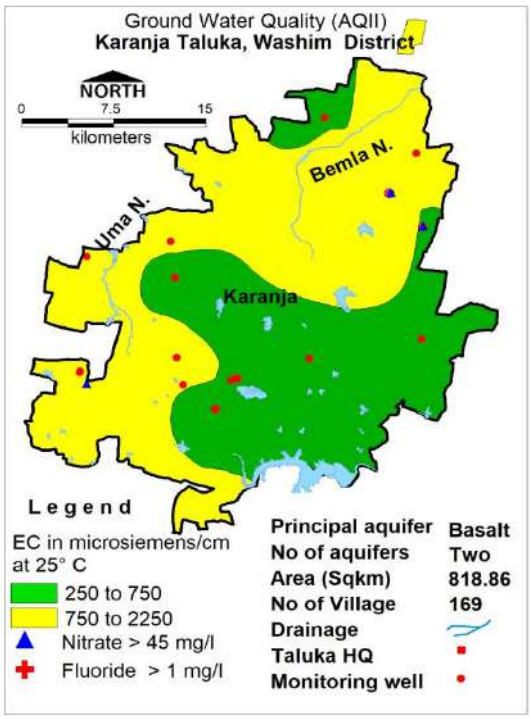
4. GROUND WATER QUALITY

4.1 Phreatic Aquifer (Aquifer-I/ Shallow aquifer)



EC ranging from 750 to 2250 µS/cm has been observed in major part of block covering about

4.2 Semi-confined/Confined Aquifer (Aquifer II/ Deeper aquifer)



EC ranging from 750 to 2250 µS/cm has been observed in Northern, northeast and northwest as

515.8 sq. km area of the block whereas EC ranging from 250 to 750 µS/cm observed in northern and southern parts of the block in patches (339.1 sq.km) and Ground water is suitable for all purpose. Few villages are also affected by Nitrate and Fluoride contaminations.	well as in south western parts of the block covering about 490.8 sq. km area of the block whereas EC ranging from 250 to 750 µS/cm observed in Central, south-eastern parts of the block also in north border area in mall patch(363.7 sq.km). Ground water is suitable for all purpose. However, few villages are also affected by Nitrate and Fluoride contaminations.

5. GROUND WATER RESOURCE

5.1 Aquifer-I/ Shallow Phreatic Aquifer (Basalt)

Ground Water Recharge Worthy Area (Sq. Km.)	818.86
Total Annual Ground Water Recharge (MCM)	81.0460
Natural Discharge (MCM)	4.0523
Net Annual Ground Water Availability (MCM)	76.99
Existing Gross Ground Water Draft for irrigation (MCM)	43.42
Existing Gross Ground Water Draft for domestic and industrial water supply(MCM)	29.25
Existing Gross Ground Water Draft for All uses(MCM)	46.35
Provision for domestic and industrial requirement supply to 2025(MCM)	59.22
Net Ground Water Availability for future irrigation development(MCM)	28.95
Stage of Ground Water Development (%)	60.20
Category	**SAFE**

5.2 Aquifer-II (Semi-confined/Confined Deeper Basaltic Aquifer)

Total Area (Sq. Km.)	Mean aquifer thickness (m)	SY	S	Piezometric Head (m above confining layer)	Total Resource (MCM)
1109	2	0.005	0.0000145	50	11.89242

6.0. GROUND WATER MANAGEMENT

6.1. Supply Side Management

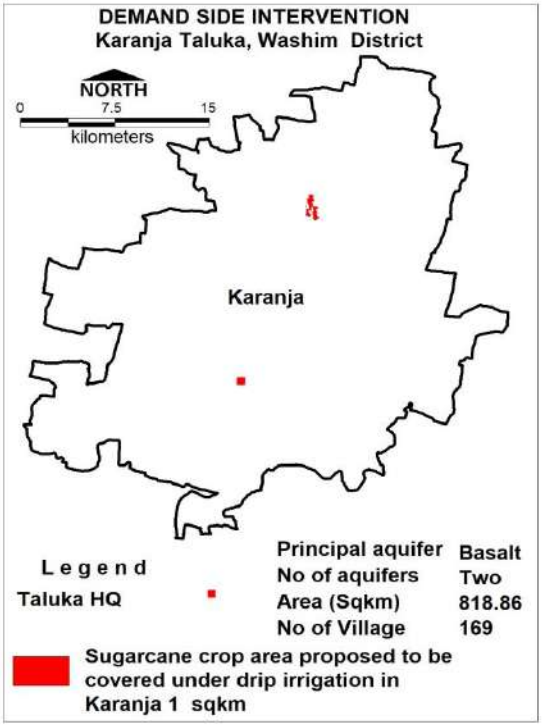
SUPPLY (MCM)

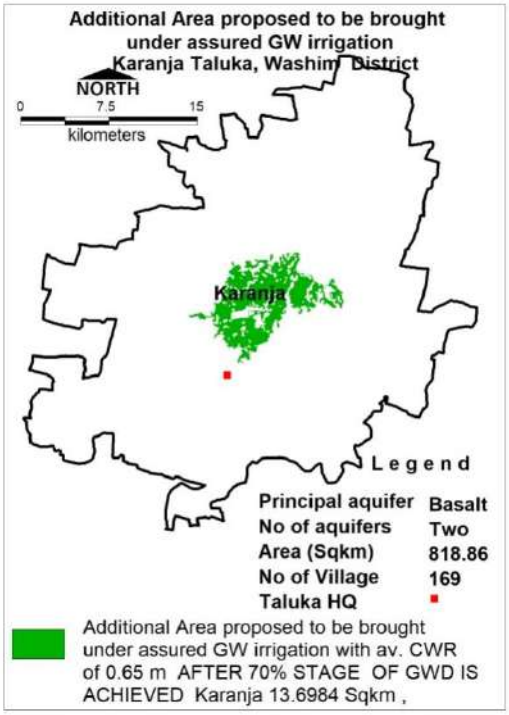
Available Resource (MCM)	76.99
Gross Annual Draft (MCM)	46.35
Agricultural Demand –GW	43.43
Agricultural Demand –SW	4.95
Domestic Demand – GW	2.92
Domestic Demand – SW	0.73
Total Demand	**52.03**
Area of Block (Sq. Km.)	865.57
Area suitable for Artificial recharge (Sq. Km)	818.86
Type of Aquifer	Hard Rock
Area feasible for Artificial Recharge (WL >5mbgl) (Sq. Km.)	321.3
Volume of Unsaturated Zone (MCM)	157.16
Average Specific Yield	0.02
Volume of Sub Surface Storage Space available for Artificial Recharge (MCM)	
Surplus water Available (MCM)	1.498

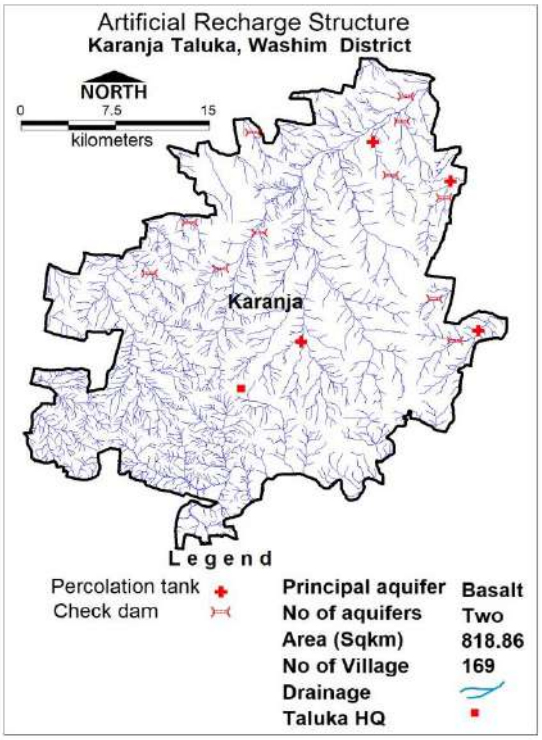
Proposed Structures	Percolation Tank (Av. Gross Capacity-100 TCM*2 fillings = 200 TCM)	Check Dam (Av. Gross Capacity-10 TCM * 3 fillings = 30 TCM)
Number of Structures	4	11
Volume of Water expected to be conserved / recharged @ 75% efficiency (MCM)	0.8	0.33

RTRWH Structures – Urban Areas	
Households to be covered (25% with 50 m^2 area)	11900
Total RWH potential (MCM)	0.336175
Rainwater harvested / recharged @ 80% runoff co-efficient	0.26894

However, it is economically not viable & hence, not recommended.	
6.2. Demand Side Management	
Micro irrigation techniques	
Sugarcane crop area (7) ,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
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)	76.99
Additional GW resources available after Supply side interventions (MCM)	8.904
Ground Water Availability after Supply side intervention(MCM)	117.71
Existing Ground Water Draft for All Uses (MCM)	46.35
GW draft after Demand Side Interventions (MCM)	39.90
Present stage of Ground Water Development (%)	60.20 %
Expected Stage of Ground Water Development after interventions (%)	59.33 %
Other Interventions Proposed, if any	
Alternate Water Sources Available	Nil
6.4. Development Plan	
Volume of water available for GWD after stage of GWD brought to 70% (MCM)	8.904
Proposed Number of DW (@ 1.5 ham for 90% of GWR Available)	534
Proposed Number of BW (@ 1.5 ham for 10% of GWR Available)	59
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	13.69846
Regulatory Measures	60m borewells/tube wells



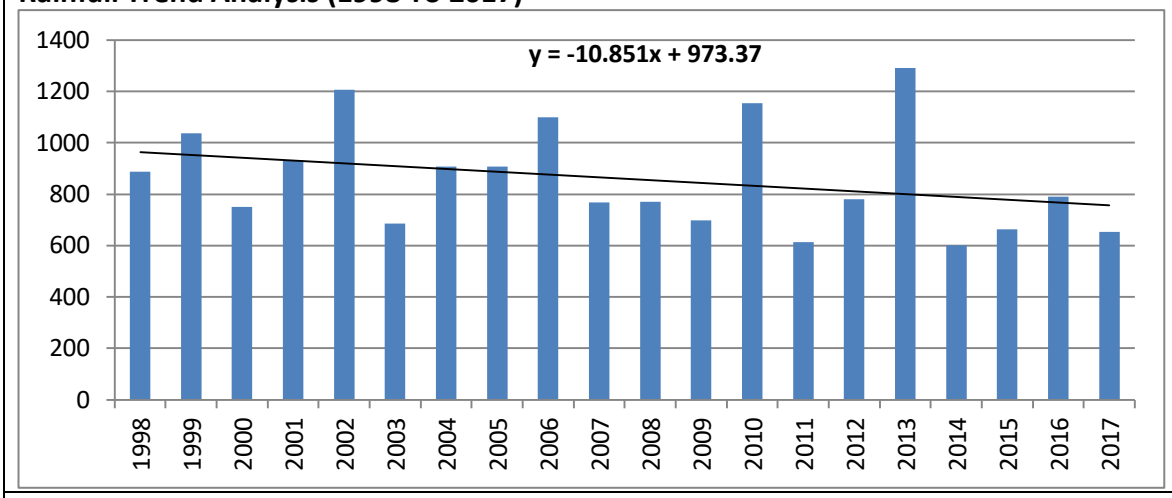



Artificial Recharge Structure
Karanja Taluka, Washim District
NORTH
0
7.5
15
kilometers
Karanja
Legend
Percolation tank
Check dam
Principal aquifer
Basalt
No of aquifers
Two
Area (Sqkm)
818.86
No of Village
169
Drainage
Taluka HQ

9.2 AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN, MALEGAON BLOCK, WASHIM DISTRICT, MAHARASHTRA

1. SALIENT FEATURES		
1.1 Introduction		
Block Name		Malegaon
Geographical Area (Sq. Km.)		936.36
Hilly Area (Sq. Km)		89.9292
Population (2011)		189051
Climate		Monsoon Tropical
1.2 Rainfall Analysis		
Normal Rainfall		966.9 mm
Annual Rainfall (2017)		652.3 mm
Decadal Average Annual Rainfall (2008-17)		789.8 mm
Long Term Rainfall Analysis (1998-2017)	Insignificantly falling trend -10.85 mm/year. Probability of Rainfall : 65% Normal rainfall and 5% Excess rainfall Probability of Drought-: 30% Moderate Drought	

Rainfall Trend Analysis (1998 To 2017)



1.3. Geomorphology, Soil & Geology		
Geomorphic Unit	Plateau (Un-dissected to moderately Dissected) with weathered thickness ranging from 0 to 5 m.	
Geology	Deccan Traps (Basalt) Age: Upper Cretaceous to Lower Eocene	
Soil	Shallow, BCS consisting mostly of clay and loam, 0-25 cm thick.	
1.4. Hydrology & Drainage		
Drainage	Tributaries of Godavari river in the North, north-east, south, south-east and central part of the block; Tributaries of Tapi river in western part of the block.	
Hydrology	Major projects	None
	Medium projects	01
	Minor Irrigation Projects(Local)	14
	Minor Irrigation Projects(ZP Level)	206
		PT-30, KT-33, UGB-2
1.5. Land Use, Agriculture, Irrigation & Cropping Pattern		
Forest Area	128.52 Sq. Km.	
Cultivable Area	722.63 Sq. Km.	
Net Sown Area	661.83 Sq. Km.	
Double Cropped Area	35.2 Sq. Km.	
Area under Irrigation – Surface Water	12.89Sq. Km.	
Area under Irrigation – Ground	19.3 Sq. Km.	

Water		
Area under Drip & Sprinkler Irrigation		
Principal Crops	**Crop Type**	**Area (Sq. Km.)***(Reference year 2016-17)*
	Cotton	3.72
	Cereals	38.92
	Pulses	234.81
	Oil Seeds	522.76
Horticultural Crops	Sugarcane	0.02
	Citreous fruit	-
	Others	-

1.6. Water Level Behavior

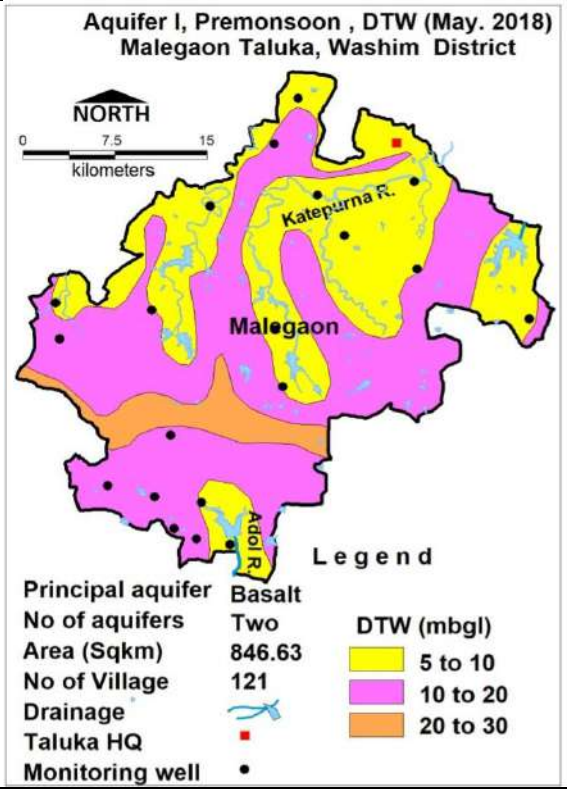
1.6.1 Aquifer-I (Shallow Aquifer)

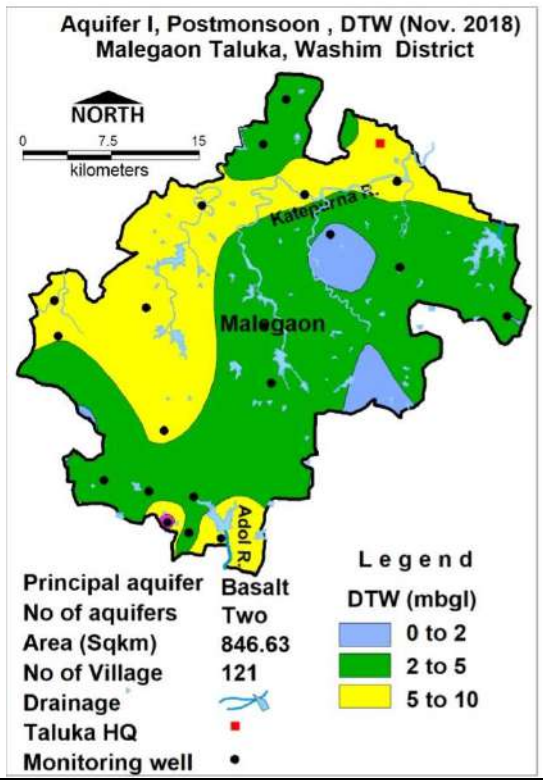
Pre-Monsoon (May-2018)

DTWL 10 to 20 mbgl is observed in major parts of the block while water level in the range of 5 to 10 mbgl is observed in northern, northwestern & north eastern parts. Deeper DTWL >20 mbgl is observed as in a long narrow horizontal patch in southern part.

Post-Monsoon (November-2018)

DTWL less than 2 mbgl are observed as isolated patches in north-east and south-east parts of the block. DTWL less than 5 mbgl is observed in entire block except western and small area in north-east and north-west part of the block where DTWL ranging 5 to 10.





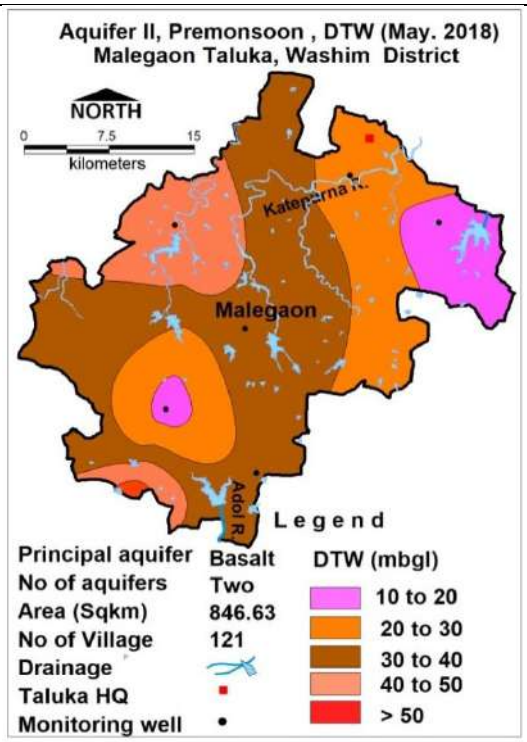
1.6.2 Water Level Behavior– Aquifer-II (Deeper Aquifer)

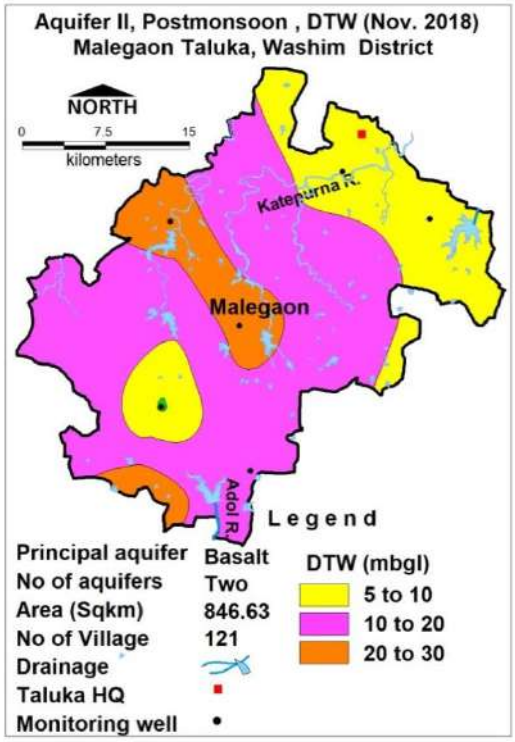
Pre-Monsoon (May-2018)

DTWL 30-40 mbgl is observed in major part engulfing small patch of 10-20 and 20-30 mbgl. Northwestern &small area in southwestern has DTWL 40-50 mbgl. DTWL 10-20 mbgl in a patch is observed in north-eastern part of the block. DTWL >50 mbgl is observed in some part of Wasri and Kotha villages.

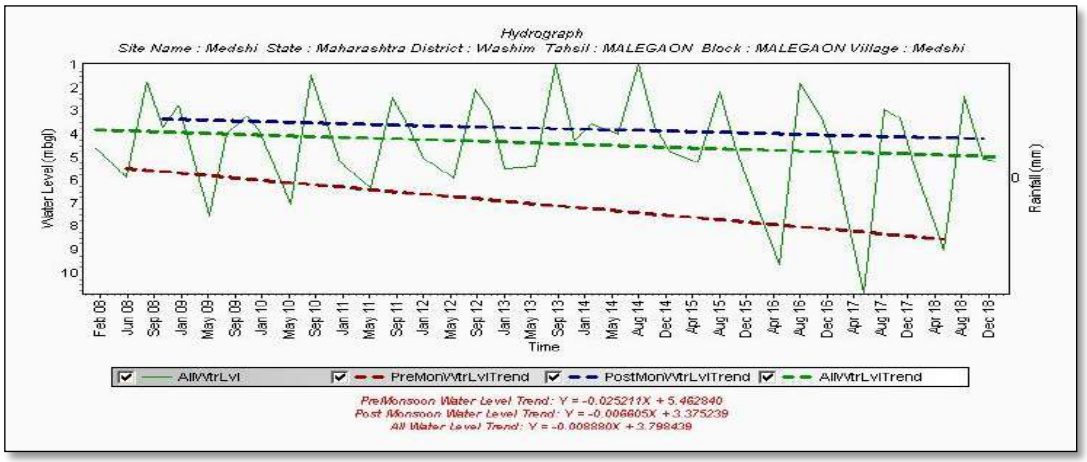
Post-Monsoon (November-2018)

DTWL 10-20 mbgl is observed in major part of block. DTWL 5-10 mbgl is observed in north-eastern part as well as in an isolated patch in south west part of the block. Deeper DTWL is observed in central, north-western and in small patch in the south-western part of the block.





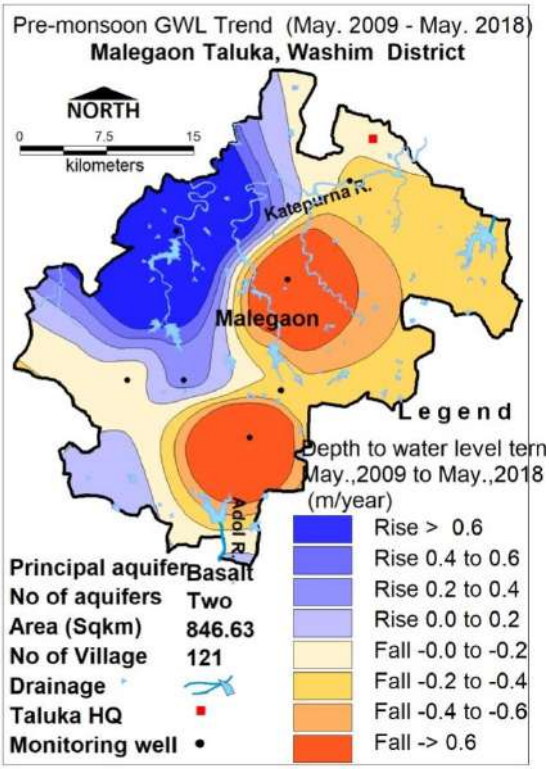
Hydrographs

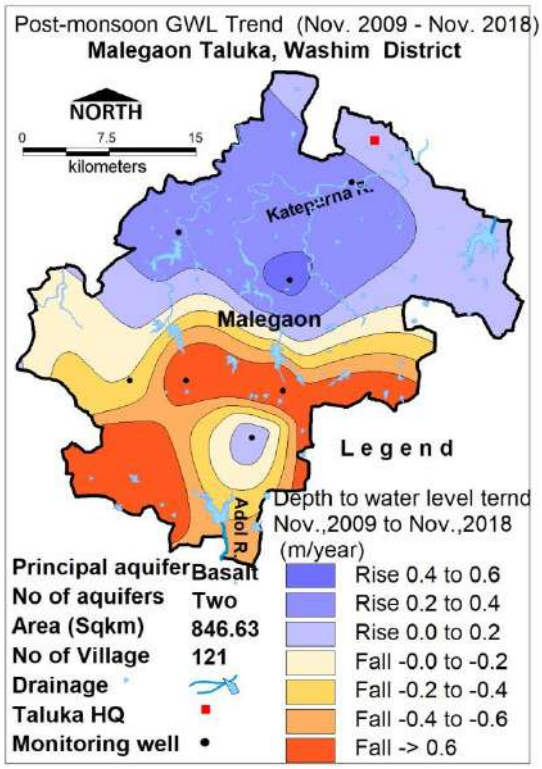


Hydrograph shows Pre-monsoon falling water level trend @ 0.3 m/year.	Hydrograph shows Post- monsoon rising water level trend @ 0.0894 m/year

1.8. Water Level Trend (2009-18)

1.8.1 Pre-Monsoon trend	**1.8.2 Post-Monsoon trend**
Rising @0.12 m/year (Dongarkinhi) to 1.5 m/year (Karanji); Falling 0.2(Ekamba) to 1.5 (Medshi) m/year.	Rising 0.2 (Dongarkinhi) to 0.8 (Zodga bk.) m/year; Falling 0.1 (Karanji) to 0.4 (Dava) m/year
Major part of the block shows falling water level trend up to 0.6 m/year (620 sq km) except rising trend 0.2-0.6 mbgl (317 sq km) in northwest part of the block and 0.0-0.2 in patch in the south-western part of the block .Falling trend>0.6 m/year has been observed in Central and southern part of the block.	Northern, North-east and north-west part of the block shows rising trend 0.2 to 0.6 m/year (484.30 sq km) while falling trend 0.2 to 0.6 m/year (453.53 sq km) has been observed in Southern, southwestern and southeastern part of the block. A small isolated patch of rising trend is found in the southern part of the block.





2. Ground Water Issues

i. Block shows declining water level trend up to 0.6 m/year.

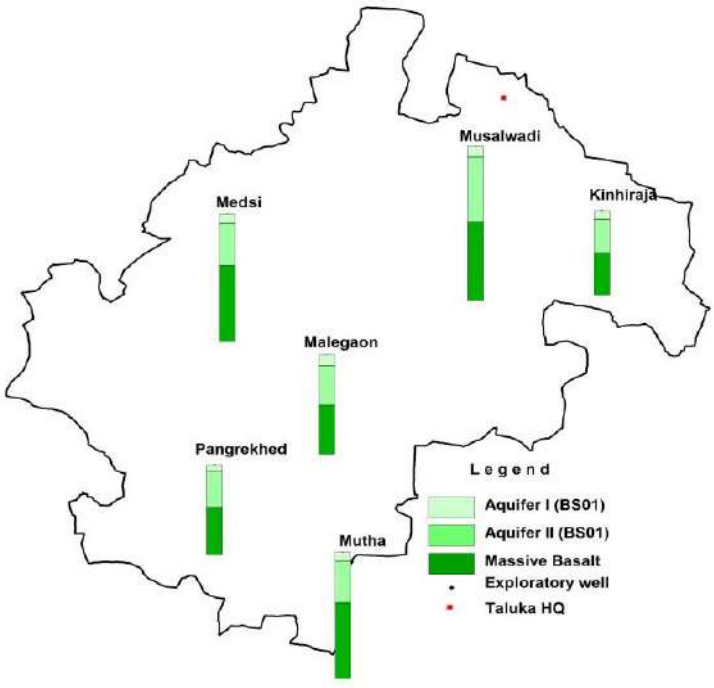
ii. Frequent droughts (30% Moderate) which is ultimately responsible for less ground water recharge and non-availability of surface & ground water for irrigation.

iii. Less ground water potential basaltic aquifer.

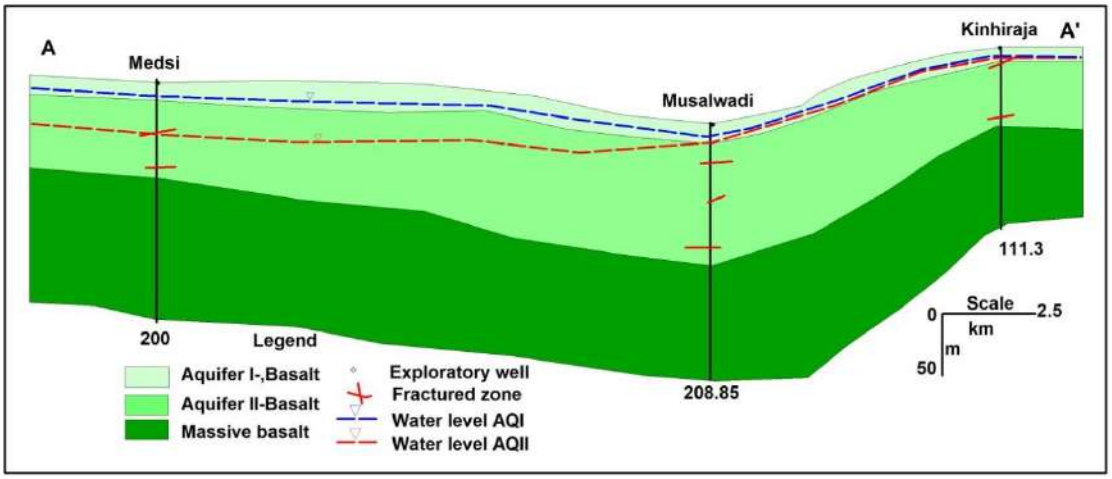
3. AQUIFER DISPOSITION

3.1. Number of Aquifers	Basalt –Aquifer-I (Phreatic / Shallow aquifer) Basalt –Aquifer-II (Semi-confined / confined / Deeper aquifer)

3.2. Lithological Disposition



3.3. Cross Sections – Section AA'

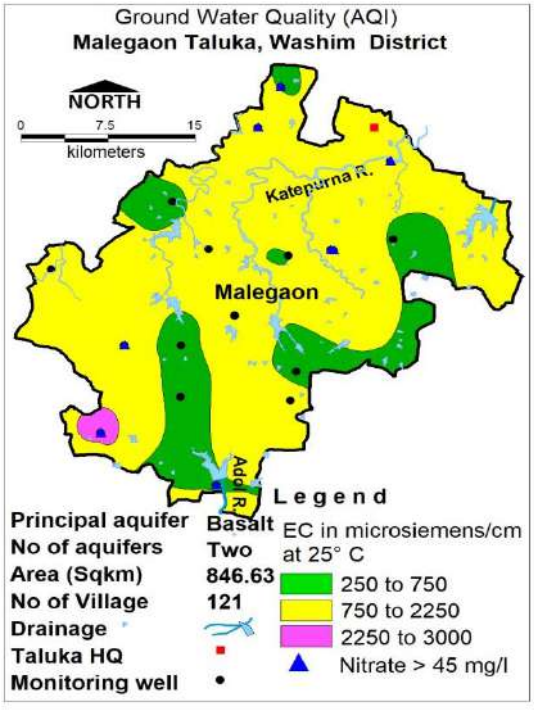


3.4. Aquifer Characteristics

Major Aquifers	Basalt (Deccan Traps)	
Type of Aquifer (Phreatic/Semi-confined/Confined)	Basalt –Aquifer-I (Phreatic / Shallow aquifer)	Basalt –Aquifer-II (Semi-confined / confined / Deeper aquifer)
Static Water Level (m bgl)	5.7 – 20.1	17.95 – 35
Depth of Occurrence (mbgl)	9 – 25	55 – 130
weathered/fractured rocks thickness (m)	5 – 14	1 – 4
Yield	10 – 100 m^3/day	10-100 lpm
Specific yield/ Storativity (S)	0.02	0.0000145 -0.00005
Transmissivity (T)	20-70 m^2/day	30 – 150 m^2/day

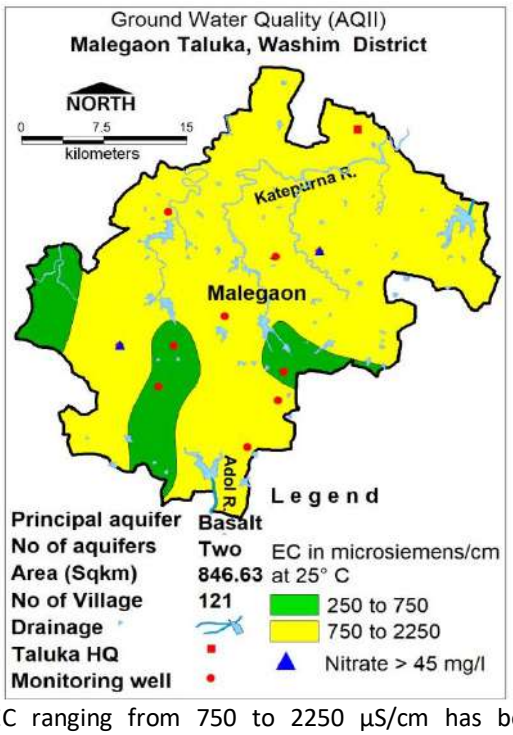
4. GROUND WATER QUALITY

4.1 Phreatic Aquifer (Aquifer-I/ Shallow aquifer)



EC ranging from 750 to 2250 µS/cm has been

4.2 Semi-confined/Confined Aquifer (Aquifer II/ Deeper aquifer)



EC ranging from 750 to 2250 µS/cm has been

observed in major part of block covering about 751.6 sq km area of the block & ground water is suitable for all purpose. Ground water with EC ranges from 2250 to 3000 µS/cm is observed in 9.5 sq.km area in an isolatd patch in south western part while EC<750 is observed in 176.7 sq.km area in southern, southwestern part of the block. Also small isolated patches are observed in north, north western and central part of the block. The ground water is fit & suitable for all purpose except where the villages are affected by Nitrate contamination.	observed in major part of block covering about 810.6 sq.km area of the block & ground water is suitable for all purpose. Whereas, EC ranging from 250 to 750 has been observed in southern, south-western and south-eastern part of the block in patches (127.2 sq.km). Few villages are affected by Nitrate contamination.

5. GROUND WATER RESOURCE

5.1 Aquifer-I/ Shallow Phreatic Aquifer (Basalt)

Ground Water Recharge Worthy Area (Sq. Km.)	846.43
Total Annual Ground Water Recharge (MCM)	95.48
Natural Discharge (MCM)	4.77
Net Annual Ground Water Availability (MCM)	90.709
Existing Gross Ground Water Draft for irrigation (MCM)	29.639
Existing Gross Ground Water Draft for domestic and industrial water supply(MCM)	3.3862
Existing Gross Ground Water Draft for All uses(MCM)	33.0262
Provision for domestic and industrial requirement supply to 2025(MCM)	6.7515
Net Ground Water Availability for future irrigation development(MCM)	56.2935
Stage of Ground Water Development (%)	36.41
Category	**SAFE**

5.2 Aquifer-II (Semi-confined/Confined Deeper Basaltic Aquifer)

Total Area (Sq. Km.)	Mean aquifer thickness (m)	SY	S	Piezometric Head (m above confining layer)	Total Resource (MCM)
534.3	1.5	0.005	0.0000145	26.5	4.212634

6.0. GROUND WATER RESOURCE ENHANCEMENT

6.1. Supply Side Management

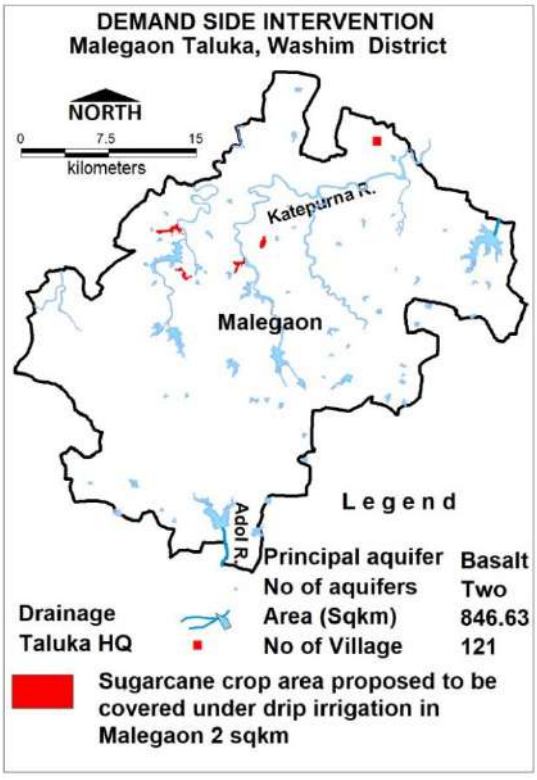
SUPPLY (MCM)

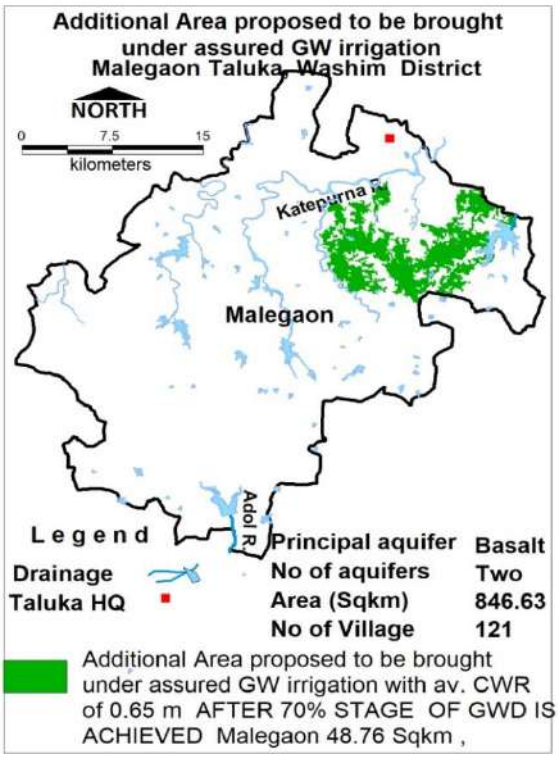
Available Resource (MCM)	90.7
Gross Annual Draft (MCM)	33.02
Agricultural Demand –GW	29.63
Agricultural Demand –SW	4.12
Domestic Demand – GW	3.38
Domestic Demand – SW	0.845
Total Demand	**37.975**
Area of Block (Sq. Km.)	936.36
Area suitable for Artificial recharge (Sq. Km)	846.43
Type of Aquifer	Hard Rock
Area feasible for Artificial Recharge (WL >5mbgl) (Sq. Km.)	299.6
Volume of Unsaturated Zone (MCM)	15.67
Average Specific Yield	0.02
Volume of Sub Surface Storage Space available for Artificial Recharge (MCM)	0.3134
Surplus water Available (MCM)	0.149

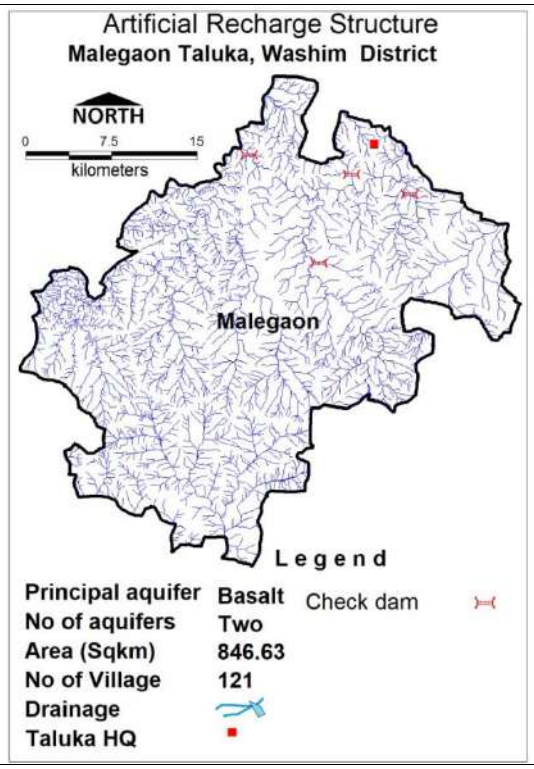
Proposed Structures	Percolation Tank (Av. Gross Capacity-100 TCM*2 fillings = 200 TCM)	Check Dam (Av. Gross Capacity-10 TCM * 3 fillings = 30 TCM)
Number of Structures	0	4
Volume of Water expected to be conserved / recharged @ 75% efficiency (MCM)	0	0.12

RTRWH Structures – Urban Areas	

Households to be covered (25% with 50 m^2 area)	10300
Total RWH potential (MCM)	0.290975
Rainwater harvested / recharged @ 80% runoff co-efficient	0.23278
However, it is economically not viable & hence, not recommended.	
6.2. Demand Side Management	
Micro irrigation techniques	
Sugarcane crop area (12) ,about 2 sqkm area is ground water irrigated ,100 % ground water irrigated (2 sqkm) proposed to be covered under Drip (sq.km.)	2
Volume of Water expected to be saved (MCM). Surface Flooding req- 0.36 m. Drip Req. - 0.24, WUE- 0.12 m	1.14
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)	90.709
Additional GW resources available after Supply side interventions (MCM)	31.694
Ground Water Availability after Supply side intervention(MCM)	
Existing Ground Water Draft for All Uses (MCM)	33.0262
GW draft after Demand Side Interventions (MCM)	
Present stage of Ground Water Development (%)	36.41
Expected Stage of Ground Water Development after interventions (%)	36.36
Other Interventions Proposed, if any	
Alternate Water Sources Available	Nil
6.4. Development Plan	
Volume of water available for GWD after stage of GWD brought to 70% (MCM)	31.694
Proposed Number of DW (@ 1.5 ham for 90% of GWR Available)	1902
Proposed Number of BW (@ 1.5 ham for 10% of GWR Available)	211
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	48.76
Regulatory Measures	60m borewells/tube wells






Artificial Recharge Structure
Malegaon Taluka, Washim District
NORTH
0
7.5
15
kilometers
Malegaon
Legend
Principal aquifer
Basalt
No of aquifers
Two
Area (Sqkm)
846.63
No of Village
121
Drainage
Taluka HQ
Check dam

9.3 AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN, MANGRULPIR BLOCK, WASHIM DISTRICT, MAHARASHTRA

1. SALIENT FEATURES

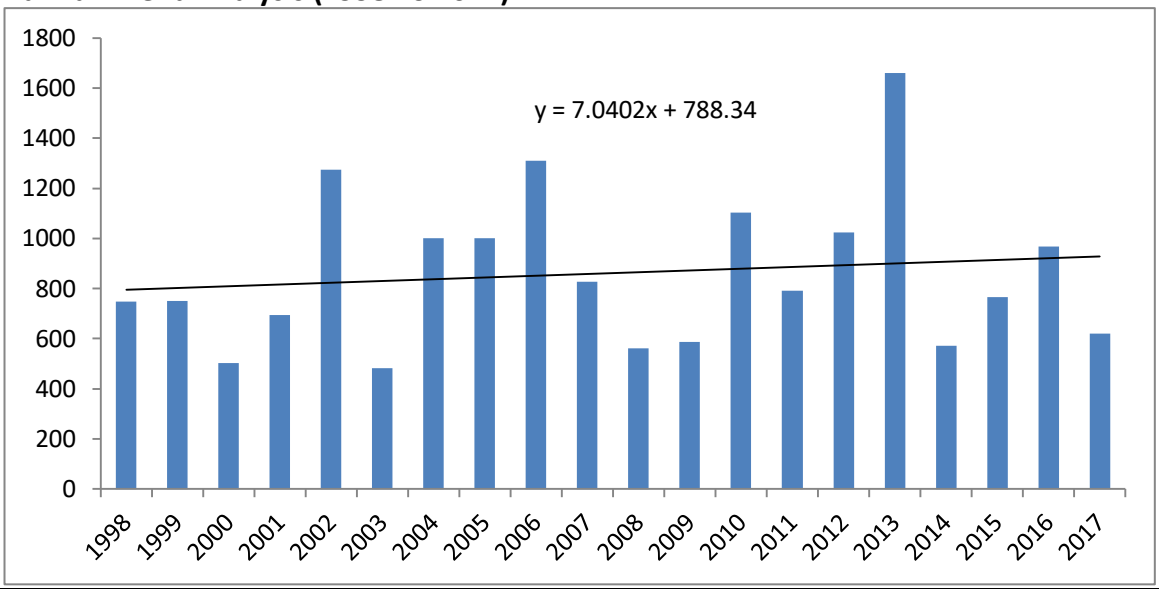
1.1 Introduction

Block Name	Mangrulpir
Geographical Area (Sq. Km.)	785.69
Hilly Area (Sq. Km)	68.7947
Population (2011)	175208
Climate	Monsoon Tropical

Rainfall Analysis

Normal Rainfall	901.7 mm
Annual Rainfall (2017)	619.8 mm
Decadal Average Annual Rainfall (2008-17)	852.28 mm
Long Term Rainfall Analysis (1998-2017)	Rising trend 7.04 mm/year. Probability of Rainfall : 55% Normal Rainfall; 15 % Excess Rainfall Probability of Drought: 30 % Moderate Drought

Rainfall Trend Analysis (1998 To 2017)



1.3. Geomorphology, Soil & Geology

Geomorphic Unit	Slightly dissected to moderately dissected ,weathered plateau with weathered thickness ranging from 0 to 5 m.
Geology	Deccan Traps (Basalt) Age: Upper Cretaceous to Lower Eocene
Soil	Very deep Clay, >100 cm thick.

1.4. Hydrology & Drainage

Drainage	Tributaries of Godavari river in the entire part of the block except in north-western part where tributaries of Tapi river exist.	
Hydrology	Major and Medium project	Nil
	Minor Irrigation Projects(Local)	12
	Minor Irrigation Projects(ZP Level)	242
		PT-24, KT-16, UGB-4

1.5. Land Use, Agriculture, Irrigation & Cropping Pattern

Forest Area		38.13 Sq. Km.
Cultivable Area		645.07 Sq. Km.
Net Sown Area		604.47 Sq. Km.
Double Cropped Area		28.06Sq. Km.
Area under	Surface Water	25.93 Sq. Km.

Irrigation	Ground Water	53.77 Sq. Km.	
Area under Drip & Sprinkler Irrigation		0.0185 Sq. Km. (1.85 hac)	
Principal Crops		**Crop Type**	**Area (Sq. Km.)***(Reference year 2016-17)*
		Cotton	7.63
		Cereals	37.23
		Pulses	189.21
		Oil Seeds	441.40
		Sugarcane	0.01
		Citreous fruit	-
		Others	-

1.6. Water Level Behavior

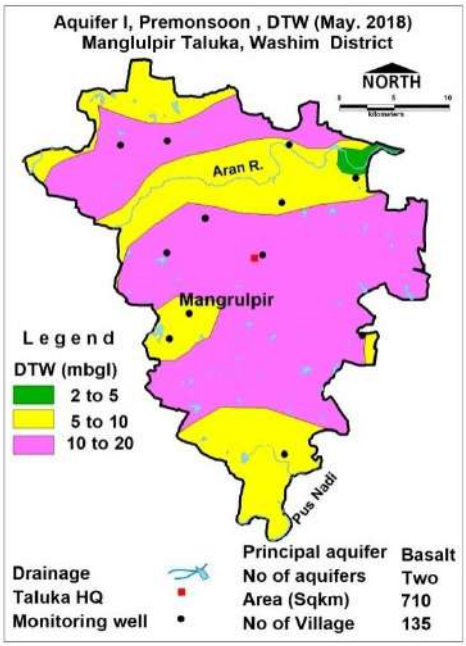
1.6.1 Aquifer-I (Shallow Aquifer)

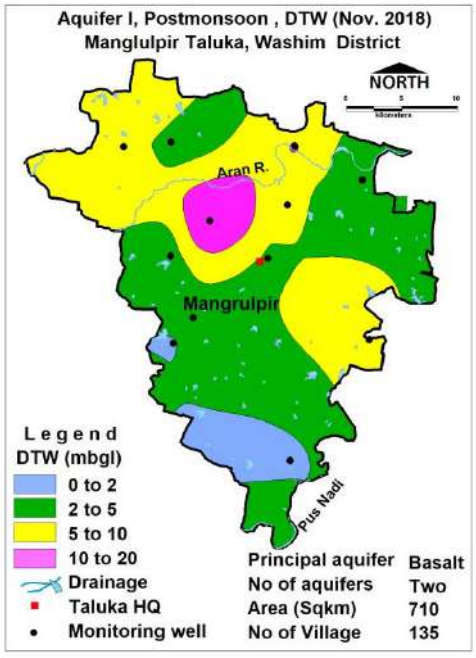
Pre-Monsoon (May-2018)

DTWL 10 to 20 mbgl is observed in entire block engulfing DTWL patches of 5 to 10 mbgl. Shallow DTWL 2-5 mbgl is observed as isolated patch in north-eastern part of the block near Amgavhan village.

Post-Monsoon (November-2018)

Water level in the range of 0 to 2 mbgl is observed in southern part and in small isolated patch in south-western part of the block. DTWL 2 to 10 mbgl is observed in major part of the block. Water level in the range of 10 to 20 mbgl is observed only as small isolated patch in north-central part of the block.





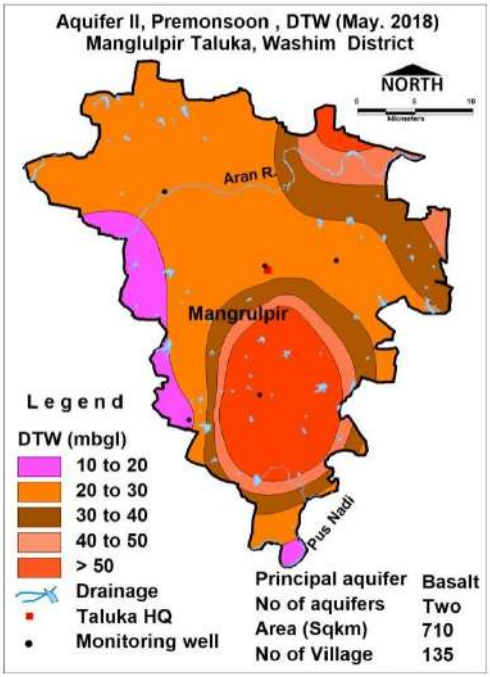
1.6.2 Water Level Behavior - Aquifer-II (Deeper Aquifer)

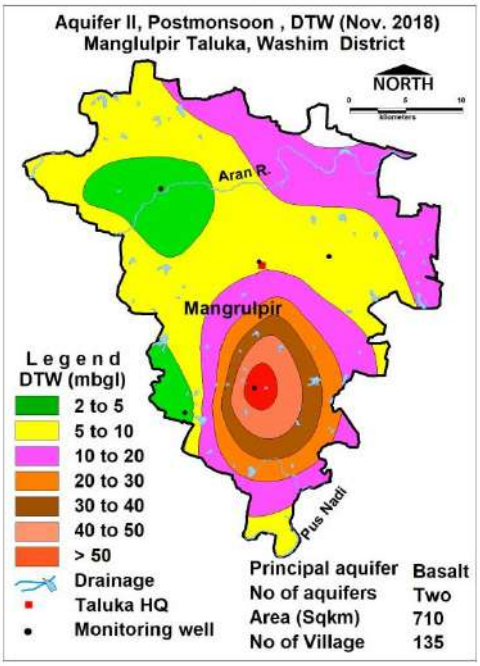
Pre-Monsoon (May-2018)

DTWL 20-30 mbgl is observed in major part of the block. DTWL >30 mbgl is observed in the southern, south- central and north-eastern parts of the block.

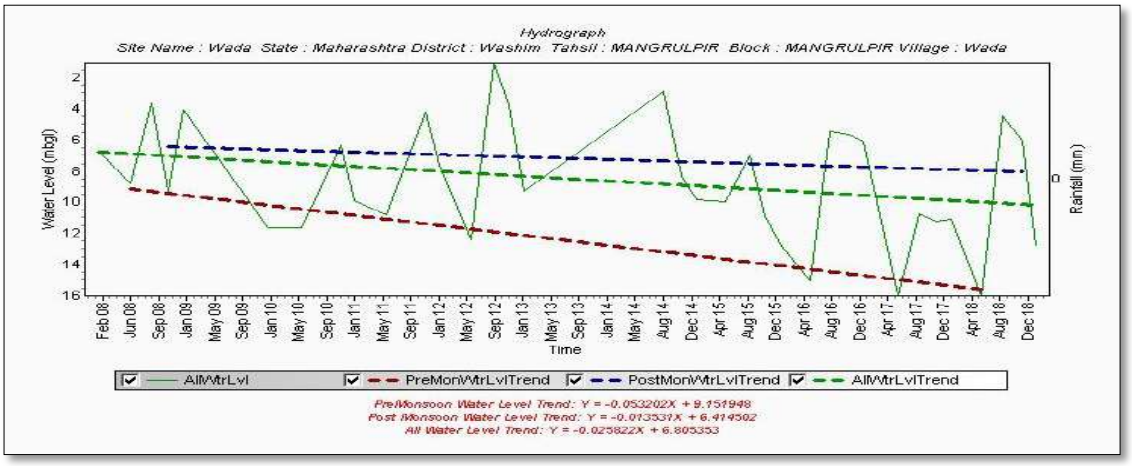
Post-Monsoon (November-2018)

DTWL 5-10 mbgl is observed in major part engulfing small patch of DTWL 2 - 5 mbgl in north west and south west parts of the block. South and South-central part has DTWL 20-40 mbgl and small patch of DTWL >50 mbgl.





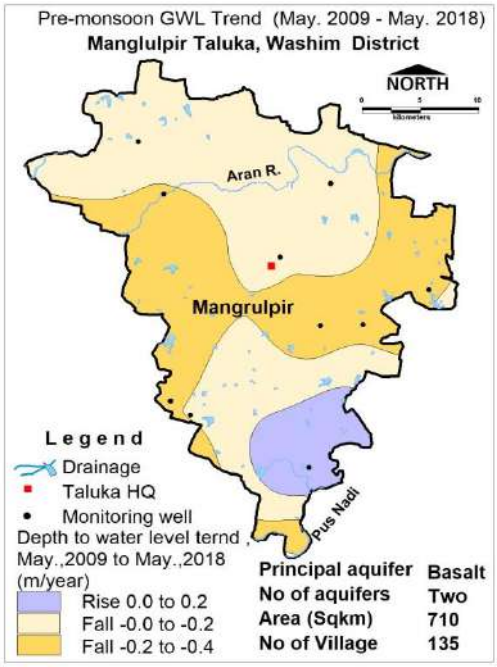
1.7. Hydrographs

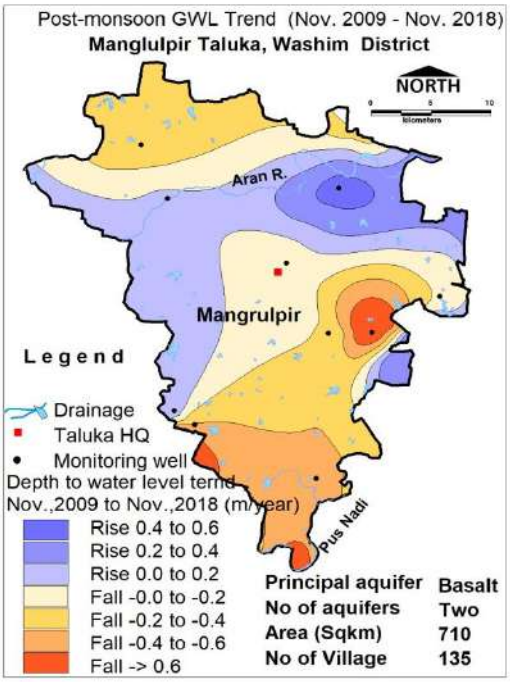


Hydrograph shows Pre-monsoon falling water level trend @ 0.6 m/year	Hydrograph shows Post- monsoon falling water level trend @ 0.12 m/year

1.8. Water Level Trend (2008-17)

Pre-Monsoon trend	**Post-Monsoon trend**
Rising 0.05 m/year (Poti) to 0.26 m/year (Kalamba); Falling 0.1 m/year (Dabhadi)	Rising 0.1 (Mangrulpir) to 0.78 (Jogaldari) m/year; Falling 0.02 (Shelu Kh.) to 0.4 (Poti) m/year
Major area shows falling water level trend up to 0.4 m/year (714 sq km). Rising trend upto 0.2 m/year has been observed in Southern part in 559 sqkm area.	Major part of the block shows falling trend up to 0.6 m/year (507.94 sq km) while rising trend upto 0.6 m/year (276.76 sq km) has been observed in central, eastern and western part of the block.





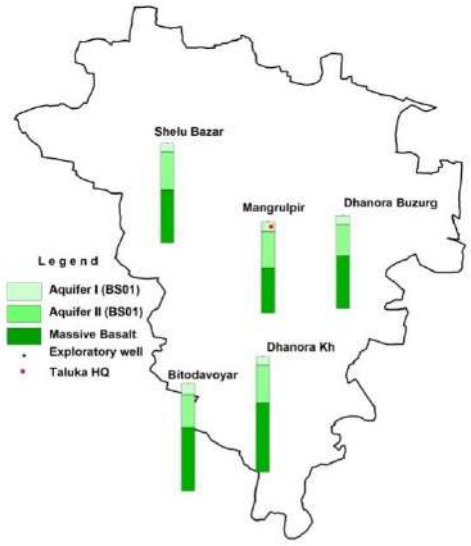
2. Ground Water Issues

1. Block shows declining water level trend up to 0.4 m/year.
2. Frequent droughts (30% Moderate) which is ultimately responsible for less ground water recharge and non-availability of surface & ground water for irrigation.
3. Less ground water potential basaltic aquifer.

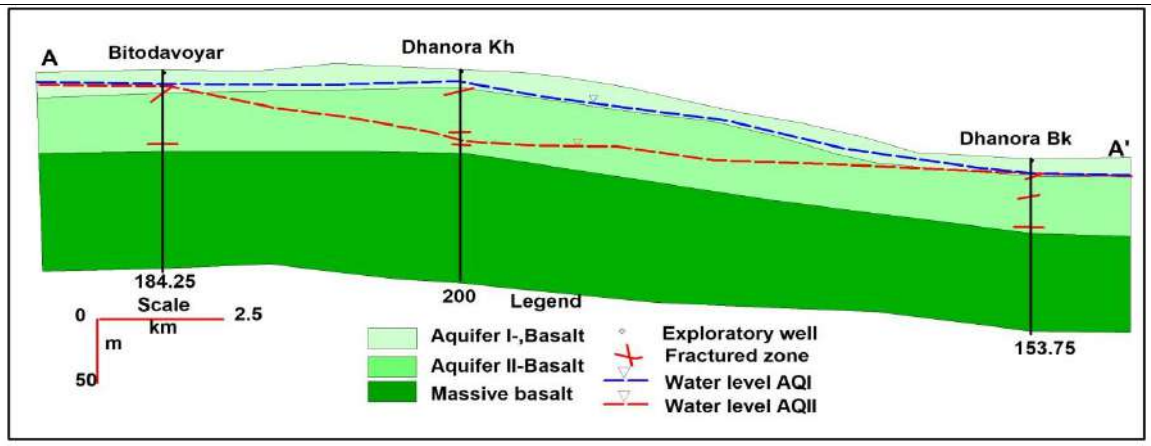
3. AQUIFER DISPOSITION

3.1. Number of Aquifers	Basalt –Aquifer-I (Phreatic / Shallow aquifer) –Aquifer-II (Semi-confined / confined / Deeper aquifer)

3.2. Lithological Disposition



3.3. Cross Sections - Section CC'

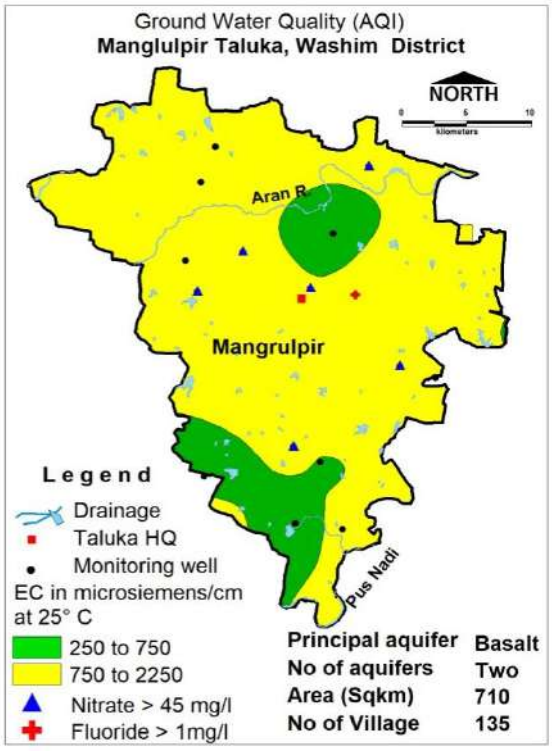


3.4. Aquifer Characteristics

Major Aquifers	**Basalt (Deccan Traps)**	
Type of Aquifer (Phreatic/Semi-confined/Confined)	Basalt –Aquifer-I (Phreatic / Shallow aquifer)	Basalt –Aquifer-II (Semi-confined / confined / Deeper aquifer)
Static Water Level (m bgl)	3 – 22	17 - 50
Depth of Occurrence (mbgl)	9 - 25	70 - 130
weathered/fractured rocks thickness (m)	5 - 14	0.5 - 4
Yield	10 – 100 m^3/day	10-100 lpm
Specific yield/ Storativity (S)	0.02	0.000245 -0.0000145
Transmissivity (T)	0.41 - 80 m^2/day	5 - 30 m2/day

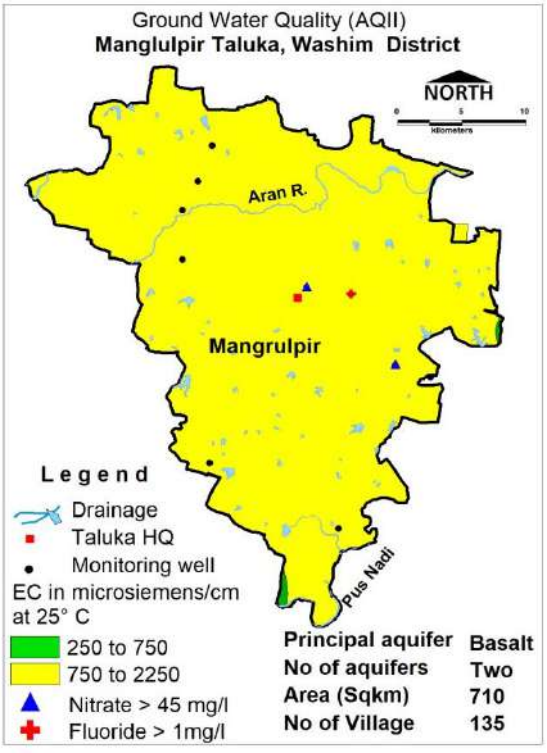
4. GROUND WATER QUALITY

4.1 Phreatic Aquifer (Aquifer-I/ Shallow aquifer)



EC ranging from 750 to 2250 µS/cm has been observed in major part of block covering about

4.2 Semi-confined/Confined Aquifer (Aquifer II/ Deeper aquifer)



EC ranging from 750 to 2250 µS/cm has been observed in entire part of block covering about

675.3 sq.km area of the block & ground water is suitable for all purpose. Patches of EC ranging 250-750 µS/cm are observed in north-central and south-western parts of the block (115nsq.km) . Few villages are also affected by Nitrate and Fluoride contamination.	787.5 sq. km area of the block & ground water is suitable for all purpose except a small patch of EC ranging from 250-750µS/cm in the southern part at the border(2.3 sq.km). Few villages are also affected by Nitrate and Fluoride contamination.

5. GROUND WATER RESOURCE

5.1 Aquifer-I/ Shallow Phreatic Aquifer (Basalt)

Ground Water Recharge Worthy Area (Sq. Km.)	710.08
Total Annual Ground Water Recharge (MCM)	103.52
Natural Discharge (MCM)	5.18
Net Annual Ground Water Availability (MCM)	98.3521
Existing Gross Ground Water Draft for irrigation (MCM)	23.90
Existing Gross Ground Water Draft for domestic and industrial water supply(MCM)	2.59
Existing Gross Ground Water Draft for All uses(MCM)	26.49
Provision for domestic and industrial requirement supply to 2025(MCM)	5.278
Net Ground Water Availability for future irrigation development(MCM)	67.1482
Stage of Ground Water Development (%)	26.94
Category	**SAFE**

5.2 Aquifer-II (Semi-confined/Confined Deeper Basaltic Aquifer)

Total Area (Sq. Km.)	Mean aquifer thickness (m)	SY	S	Piezometric Head (m above confining layer)	Total Resource (MCM)
1273	2.4	0.005	0.0000145	70	16.5681

6.0. GROUND WATER RESOURCE ENHANCEMENT

6.1. Supply Side Management

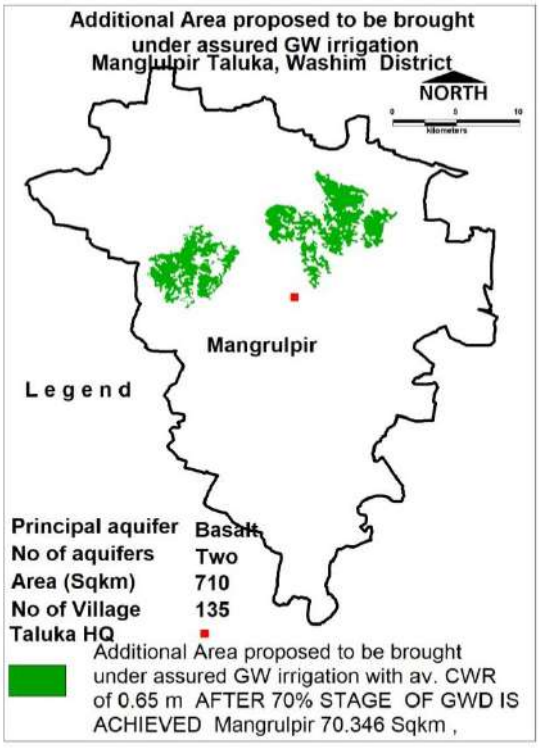
SUPPLY (MCM)

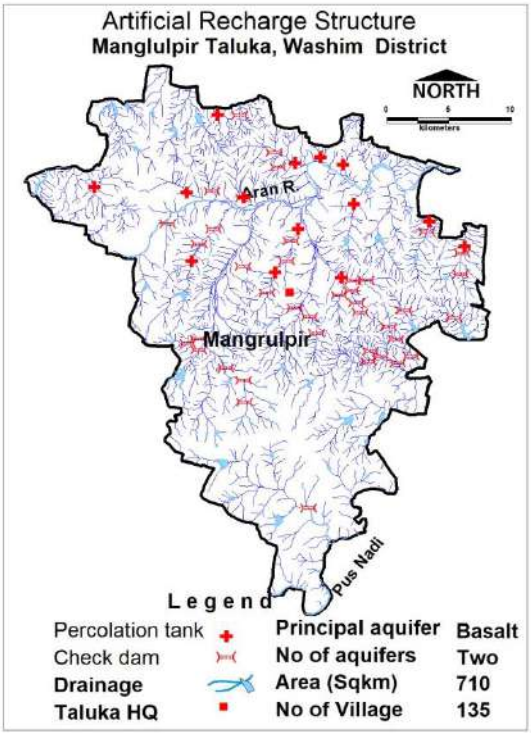
Available Resource (MCM)	98.35
Gross Annual Draft (MCM)	26.49
Agricultural Demand –GW	23.9
Agricultural Demand –SW	13.6
Domestic Demand – GW	2.59
Domestic Demand – SW	0.6475
Total Demand	**40.7375**
Area of Block (Sq. Km.)	785.69
Area suitable for Artificial recharge (Sq. Km)	710.08
Type of Aquifer	Hard Rock
Area feasible for Artificial Recharge (WL >5mbgl) (Sq. Km.)	80.48
Volume of Unsaturated Zone (MCM)	596.84
Average Specific Yield	0.02
Volume of Sub Surface Storage Space available for Artificial Recharge (MCM)	11.94
Surplus water Available (MCM)	5.498

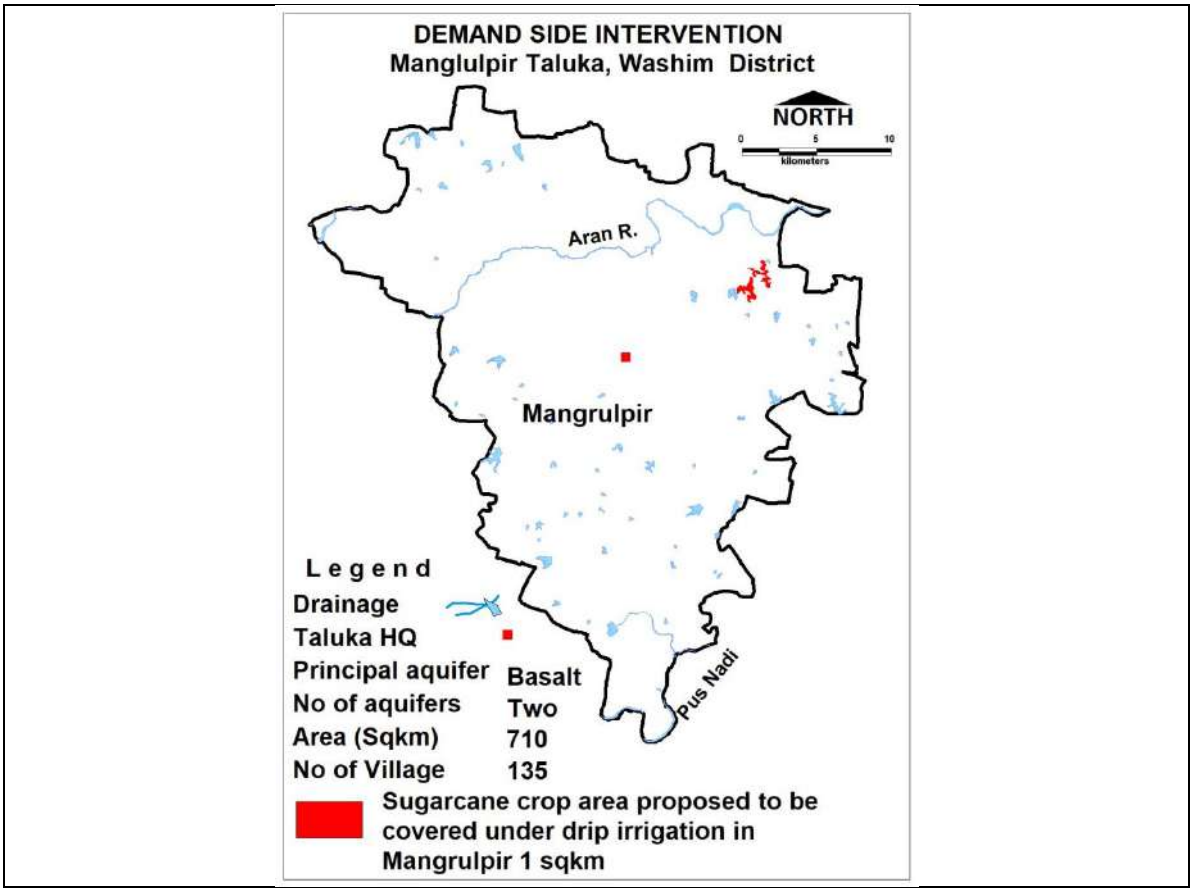
Proposed Structures	Percolation Tank (Av. Gross Capacity-100 TCM*2 fillings = 200 TCM)	Check Dam (Av. Gross Capacity-10 TCM * 3 fillings = 30 TCM)
Number of Structures	14	40
Volume of Water expected to be conserved / recharged @ 75% efficiency (MCM)	2.8	1.2

RTRWH Structures – Urban Areas	
Households to be covered (25% with 50 m^2 area)	9540
Total RWH potential (MCM)	0.269505
Rainwater harvested / recharged @ 80% runoff co-efficient	0.215604
However, it is economically not viable & hence, not recommended.	

6.2. Demand Side Management	
Micro irrigation techniques	
Sugarcane crop area (6) , 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
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)	98.3521
Additional GW resources available after Supply side interventions (MCM)	45.725
Ground Water Availability after Supply side intervention(MCM)	
Existing Ground Water Draft for All Uses (MCM)	26.49
GW draft after Demand Side Interventions (MCM)	
Present stage of Ground Water Development (%)	26.94
Expected Stage of Ground Water Development after interventions (%)	25.88
Other Interventions Proposed, if any	
Alternate Water Sources Available	Nil
6.4. Development Plan	
Volume of water available for GWD after stage of GWD brought to 60% (MCM)	45.725
Proposed Number of DW (@ 1.5 ham for 90% of GWR Available)	2743
Proposed Number of BW (@ 1.5 ham for 10% of GWR Available)	305
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	70.346
Regulatory Measures	60m borewells/tube wells






DEMAND SIDE INTERVENTION
Manglulpir Taluka, Washim District
NORTH
0 5 10
kilometers
Aran R.
Mangrulpir
Pus Nadi
Legend
Drainage
Taluka HQ
Principal aquifer Basalt
No of aquifers Two
Area (Sqkm) 710
No of Village 135
Sugarcane crop area proposed to be covered under drip irrigation in Mangrulpir 1 sqkm

9.4 AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN, MANORA BLOCK, WASHIM DISTRICT, MAHARASHTRA

1. SALIENT FEATURES

1.1 Introduction

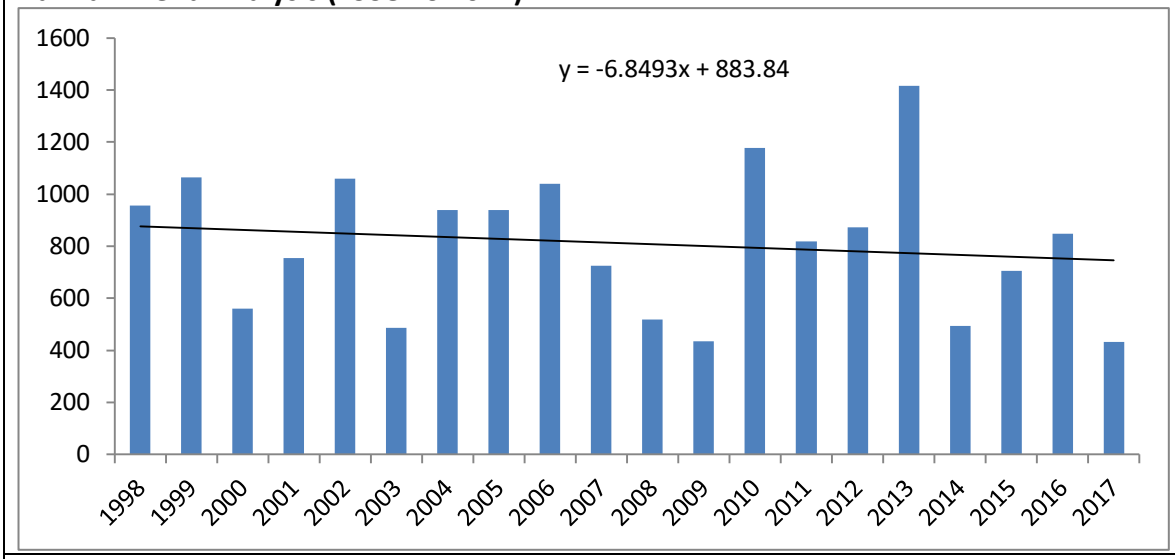
Block Name	Manora
Geographical Area (Sq. Km.)	777.93
Hilly Area (Sq. Km)	73.0485
Population (2011)	156344
Climate	Monsoon Tropical

2 Rainfall Analysis

Normal Rainfall	883.1 mm
Annual Rainfall (2017)	431.6 mm
Decadal Average Annual Rainfall (2008-17)	762.68 mm

Long Term Rainfall Analysis (1998-2017)	Significantly falling trend -6.84 mm/year. Probability of Rainfall : 55% Normal Rainfall; 15 % Excess Rainfall Probability of Drought: 25% Moderate Drought & 5% Severe Drought

Rainfall Trend Analysis (1998 To 2017)



1.3. Geomorphology & Geology

Geomorphic Unit	Plateau slightly dissected to moderately dissected and weathered with weathered thickness ranging from 0 to 5 m.
Geology	Deccan Traps (Basalt) Age: Late Cretaceous to Eocene
Soil	Very deep BCS consisting mostly of clay and loam, >100 cm thick.

1.4. Hydrology & Drainage

Drainage	Arunavati river, tributary of Painganga river, Godavari river basin with sub-dendritic to dendritic drainage.	
Hydrology	Major and Medium project	Nil
	Minor Irrigation Projects(Local)	5
	Minor Irrigation Projects(ZP Level)	176
		PT-19, KT-16, UGB-0

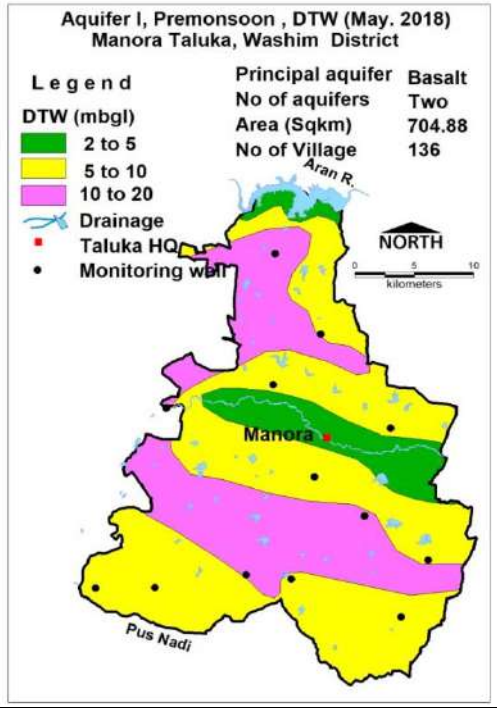
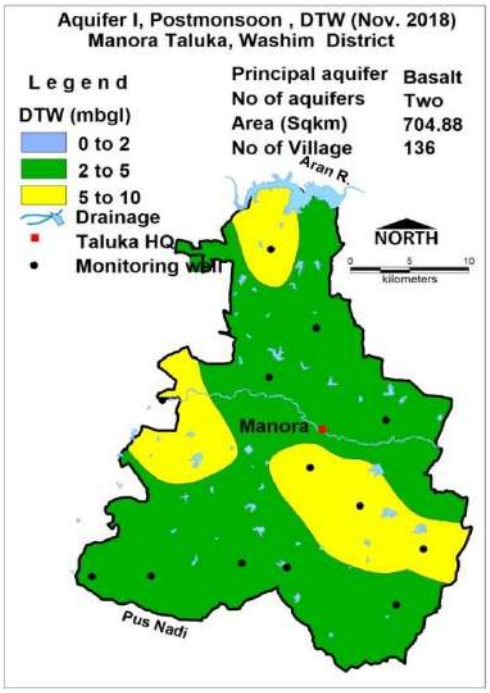
1.5. Land Use, Agriculture, Irrigation & Cropping Pattern

Forest Area		130.33 Sq. Km.
Cultivable Area		584.71 Sq. Km.
Net Sown Area		563.7 Sq. Km.
Double Cropped Area		10.2
Area under Irrigation	Surface Water	25.7 sq km
	Ground Water	12.43 sq km

Area under Drip & Sprinkler Irrigation		
Principal Crops	**Crop Type**	**Area (Sq. Km.)***(Reference year 2016-17)*
	Cotton	62.01
	Cereals	55.35
	Pulses	189.22
	Oil Seeds	324.09
	Sugarcane	0.03
	Citreous fruit	-
	Others	-

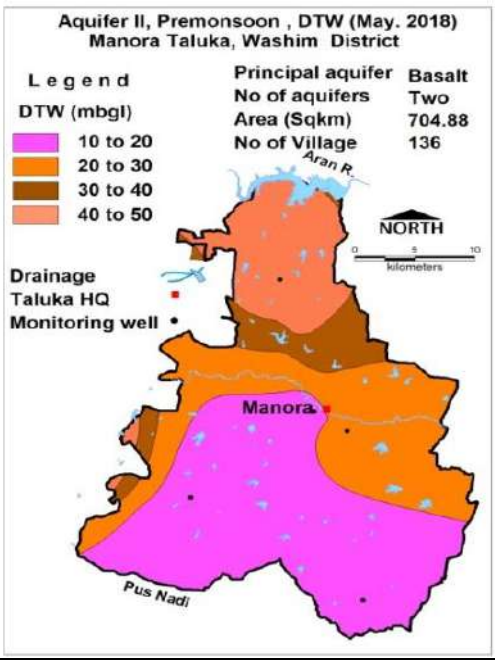
1.6. Water Level Behavior

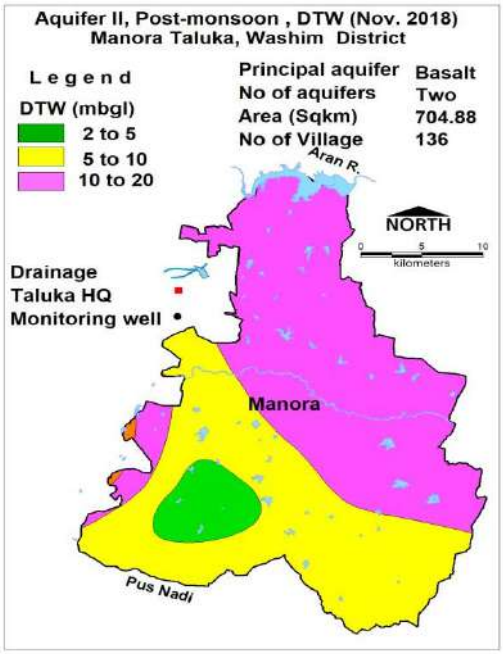
1.6.1 Aquifer-I (Shallow Aquifer)

Pre-Monsoon (May-2018) DTWL 5 to 10 mbgl is observed in major area engulfing DTWL 10 to 20 mbgl. DTWL 2 to 5 mbgl is observed in Central-eastern and western part in long continues patch.	**Post-Monsoon (November-2018)** DTWL 2 to 5 mbgl is observed in major part. DTWL of 5 to 10 mbgl is observed as patches in western, Northern and south-eastern part of the block.
	

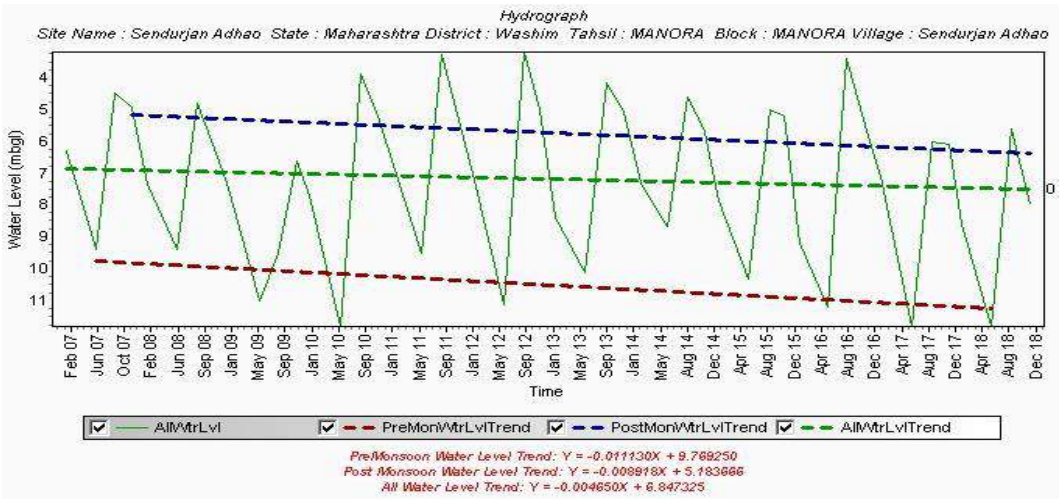
1.6.2 Water Level Behavior - Aquifer-II (Deeper Aquifer)

Pre-Monsoon (May-2018) DTWL 10-20 mbgl is observed in major part. DTWL 20-30 mbgl is observed in eastern, western and south-western part of the block. North part has deeper DTWL i.e., 30 to 50 mbgl.	**Post-Monsoon (November-2018)** DTWL 2-5 mbgl is observed in an isolated patch south west part of the block. DTWL 5-10 mbgl is observed in South, south-west and south-east part of the block whereas DTWL 10-20 mbgl is observed in North, East parts of the block and some area in western part of the block.





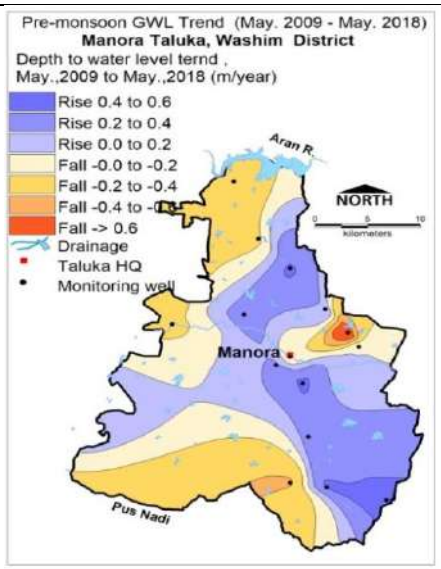
Hydrographs

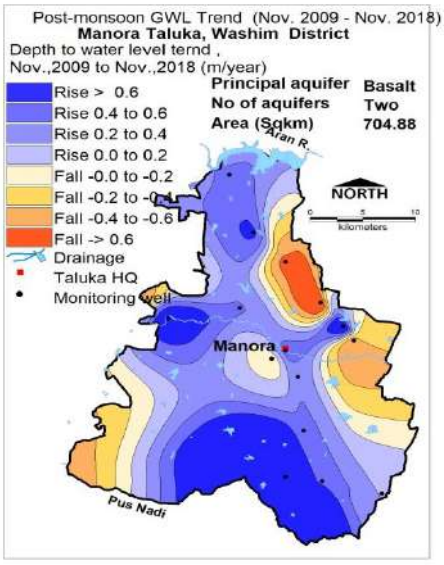


Hydrograph shows Pre-monsoon declining water level trend @ 0.132 m/year	Hydrograph shows Post- monsoon declining water level trend @ 0.108 m/year

1.8. Water Level Trend (2008-17)

Pre-Monsoon trend	**Post-Monsoon trend**
Rising 0.02 m/year (Karli) to 0.9 m/year (Borva) Falling 0.18 m/year (Sawargaon) to 0.42 m/year (Vitholi).	Rising 0.09 m/year (Somathana) to 0.82 m/year (Sawargaon); Falling 0.19 m/year (Dhawanda) to 1.39 m/year (Fulumri).
Major area shows falling water level trend up to 0.6 m/year (399.75 sq km) in southern, Southwest, Northern, North-west and eastern part of the block. Rising trend upto 0.6 m/year has been observed in central, north-east, south west and north-east in 378.34 sqkm area.	Major part of the block shows rising trend up to 0.6 m/year (566.6 sq km) while falling trend upto 0.6 m/year (211.33 sq km) has been observed in East, north east and southwestern part in small patches.





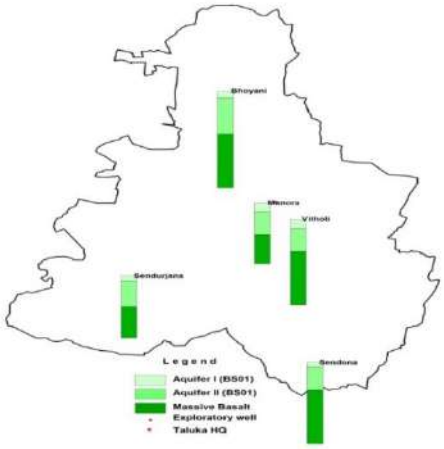
2. Ground Water Issues

1. Block shows declining water level trend up to 0.4 m/year
2. frequent droughts (5% sever & 25% Moderate) which is ultimately responsible for less ground water recharge and non-availability of surface & ground water for irrigation.
3. Less ground water potential basaltic aquifer.

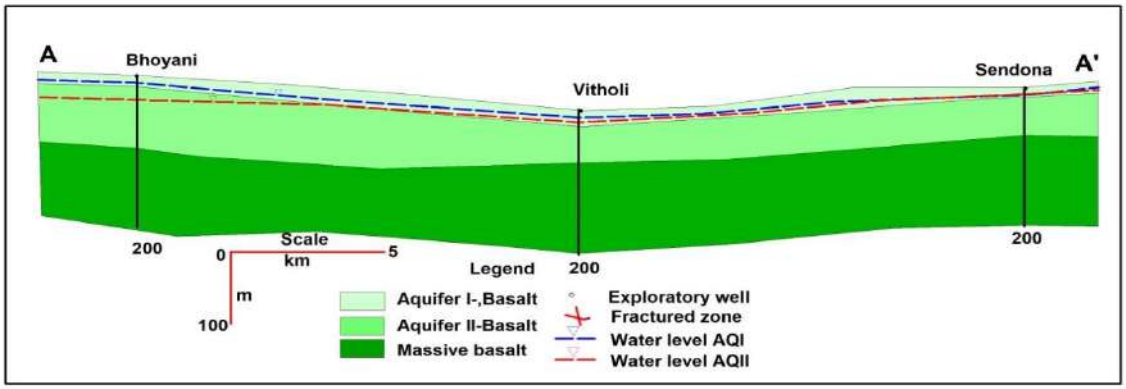
3. AQUIFER DISPOSITION

3.1. Number of Aquifers	Basalt –Aquifer-I (Phreatic / Shallow aquifer) Basalt –Aquifer-II (Semi-confined / confined / Deeper aquifer)

3.1 Lithological Disposition



3.3. Cross Sections - Section CC'

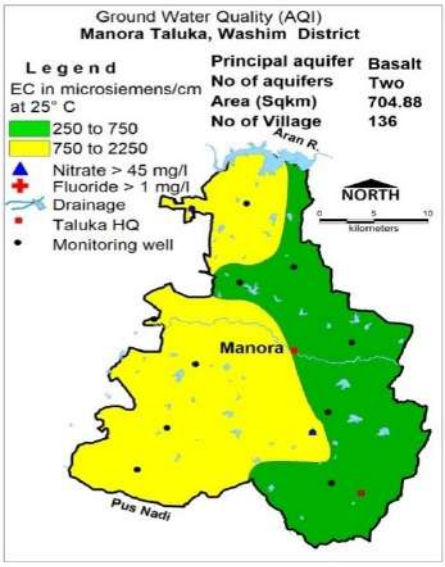


3.4. Aquifer Characteristics

Major Aquifers	**Basalt (Deccan Traps)**	
Type of Aquifer (Phreatic/Semi-confined/Confined)	Basalt –Aquifer-I (Phreatic / Shallow aquifer)	Basalt –Aquifer-II (Semi-confined / confined / Deeper aquifer)
Static Water Level (mbgl)	5 - 19	21 - 50
Depth of Occurrence (mbgl)	10 - 25	70 - 165
weathered/fractured rocks thickness (m)	8 – 14	1 - 4
Yield	10 – 100 m^3/day	0.5 - 1.25 lps
Specific yield/ Storativity (S)	0.019 – 0.028	0.00003 -0.00005
Transmissivity (T)	40 - 50 m^2/day	20 - 60 m2/day

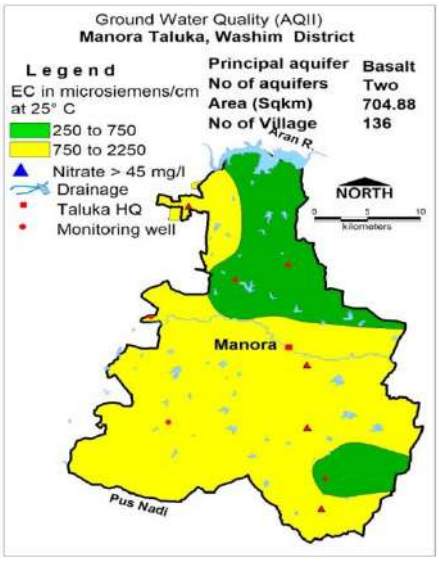
4. GROUND WATER QUALITY

4.1 Phreatic Aquifer (Aquifer-I/ Shallow aquifer)



EC ranging 750 to 2250 µS/cm has been observed in major part of the block (442 sq km) while EC ranging 250 to 750 µS/cm is observed in rest of the part(336.2 sq.km). The ground water is suitable for all purpose. Few villages are also affected by nitrate & fluoride contamination.

4.2 Semi-confined/Confined Aquifer (Aquifer II/ Deeper aquifer)



EC ranging from 750 to 2250 µS/cm has been observed in major part (580.9 sq.km) while EC ranging from 250 to 750 µS/cm is observed in north, north-east part and in small patch in south-east part of the block (197.3). The ground water is suitable for all purpose. Few villages are also affected by nitrate and fluoride contamination.

5. GROUND WATER RESOURCE

5.1 Aquifer-I/ Shallow Phreatic Aquifer (Basalt)

Ground Water Recharge Worthy Area (Sq. Km.)	704.88
Total Annual Ground Water Recharge (MCM)	88.201
Natural Discharge (MCM)	4.410
Net Annual Ground Water Availability (MCM)	83.79
Existing Gross Ground Water Draft for irrigation (MCM)	25.1415
Existing Gross Ground Water Draft for domestic and industrial water supply(MCM)	2.2038
Existing Gross Ground Water Draft for All uses(MCM)	27.3453
Provision for domestic and industrial requirement supply to 2025(MCM)	4.1888
Net Ground Water Availability for future irrigation development(MCM)	56.2935
Stage of Ground Water Development (%)	32.64
Category	**Safe**

5.2 Aquifer-II (Semi-confined/Confined Deeper Basaltic Aquifer)

Total Area (Sq. Km.)	**Mean aquifer thickness (m)**	**SY**	**S**	**Piezometric Head (m above confining**	**Total Resource (MCM)**

				layer)	
1089.67	2.4	0.005	0.0000145	25	13.47105

6.0. GROUND WATER RESOURCE ENHANCEMENT

6.1. Supply Side Management

SUPPLY (MCM)

Available Resource (MCM)		83.79
Gross Annual Draft (MCM)		27.34
Agricultural Demand –GW		25.24
Agricultural Demand –SW		16.7
Domestic Demand – GW		2.2
Domestic Demand – SW		0.55
Total Demand		**44.69**
Area of Block (Sq. Km.)		777.93
Area suitable for Artificial recharge (Sq. Km)		704.88
Type of Aquifer		Hard rock
Area feasible for Artificial Recharge (WL >5mbgl) (Sq. Km.)		210.7
Volume of Unsaturated Zone (MCM)		1236.83
Average Specific Yield		0.02
Volume of Sub Surface Storage Space available for Artificial Recharge (MCM)		24.74
Surplus water Available (MCM)		11.79
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	35	60
Volume of Water expected to be conserved / recharged @ 75% efficiency (MCM)	7	1.8
RTRWH Structures – Urban Areas		
Households to be covered (25% with 50 m^2 area)		8800
Total RWH potential (MCM)		0.2486
Rainwater harvested / recharged @ 80% runoff co-efficient		0.1988
However, it is economically not viable & hence, not recommended.		

6.2. Demand Side Management

Micro irrigation techniques	
Cotton crop area (31.17) ,about 50 sqkm area is ground water irrigated , 10 % ground water irrigated (5 sqkm) proposed to be covered under Drip (sq.km.)	5
Volume of Water expected to be saved (MCM). Surface Flooding req- 2.45 m. Drip Req. - 1.88, WUE- 0.57 m	1.3
Proposed Cropping Pattern change	
Irrigated area under Water Intensive Crop(ha)	Not proposed
Water Saving by Change in Cropping Pattern	Nil

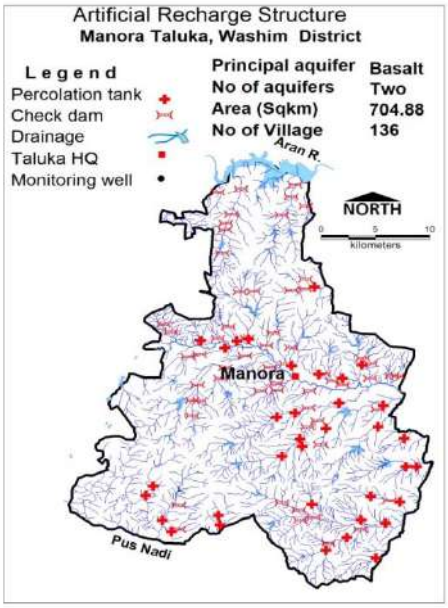
6.3 EXPECTED BENEFITS

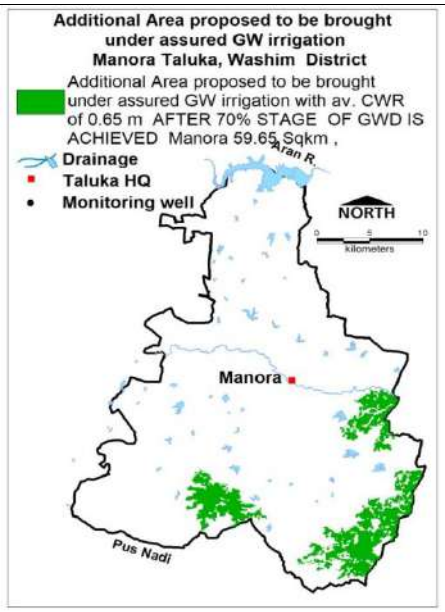
Net Ground Water Availability (MCM)	83.79
Additional GW resources available after Supply side interventions (MCM)	38.773
Ground Water Availability after Supply side intervention(MCM)	
Existing Ground Water Draft for All Uses (MCM)	
GW draft after Demand Side Interventions (MCM)	
Present stage of Ground Water Development (%)	32.64
Expected Stage of Ground Water Development after interventions (%)	29.53
Other Interventions Proposed, if any	
Alternate Water Sources Available	Nil

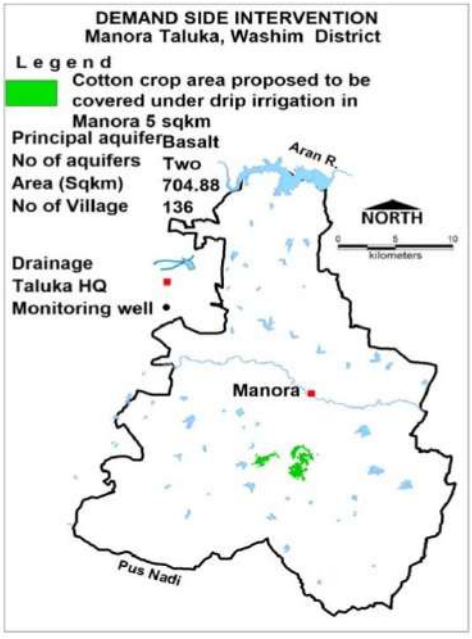
6.4 Development Plan

Volume of water available for GWD after stage of GWD brought to 60% (MCM)	38.773

Proposed Number of DW (@ 1.5 ham for 90% of GWR Available)	2326
Proposed Number of BW (@ 1.5 ham for 10% of GWR Available)	258
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	59.650
Regulatory Measures	60m borewells/tube wells



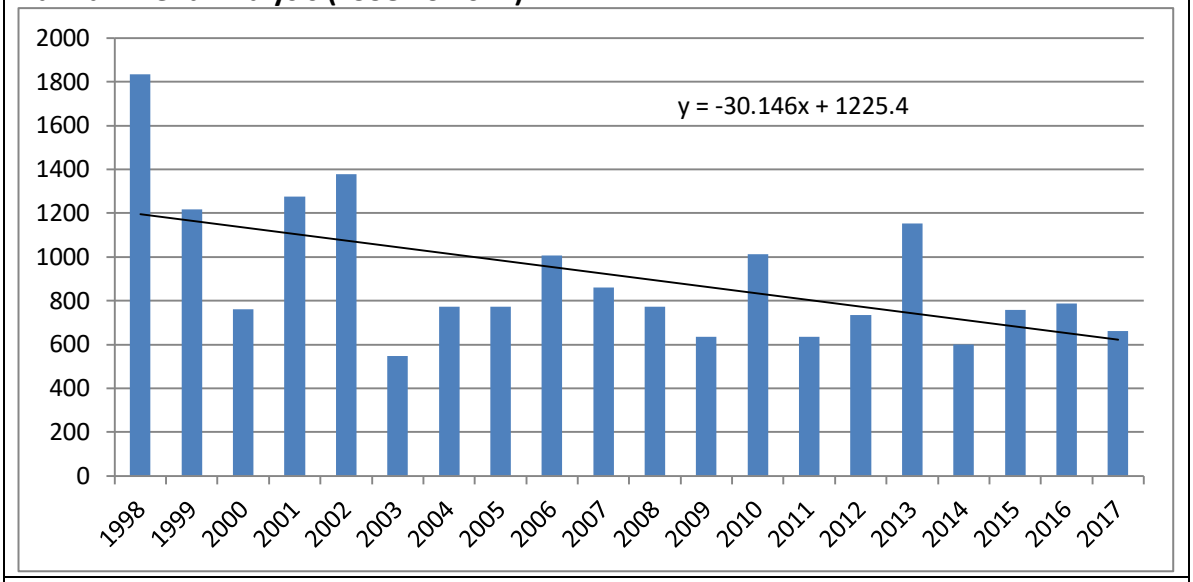




9.5 AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN, RISOD BLOCK, WASHIMDISTRICT, MAHARASHTRA

1. SALIENT FEATURES		
1.1 Introduction		
Block Name		Risod
Geographical Area (Sq. Km.)		874.94
Hilly Area (Sq. Km)		2569.81
Population (2011)		207545
Climate		Monsoon Tropical
1.2 Rainfall Analysis		
Normal Rainfall		880 mm
Annual Rainfall (2017)		663 mm
Decadal Average Annual Rainfall (2008-17)		794.48 mm
Long Term Rainfall Analysis (1998-2017)	Falling trend -30.14 mm/year. Probability of Rainfall : 55 % Normal Rainfall; 20 % Excess Rainfall Probability of Drought: 25 % Moderate Drought	

Rainfall Trend Analysis (1998 To 2017)



1.3. Geomorphology & Geology		
Geomorphic Unit	Plateau (slightly dissected to moderately dissected and weathered plateau) with weathered thickness ranging from 0 to 5 m.	
Geology	Deccan Traps (Basalt) Age: Late Cretaceous to Eocene	
Soil	Moderately deep BCS consisting mostly of clay, 25-100 cm thick.	
1.4. Hydrology & Drainage		
Drainage	Penganga river, Godavari river basin with sub-dendritic to dendritic drainage.	
Hydrology	Major and Medium project	Nil
	Minor Irrigation Projects(Local)	10
	Minor Irrigation Projects(ZP Level)	337
		PT-15, KT-32, UGB-2

1.5. Land Use, Agriculture, Irrigation & Cropping Pattern		
Forest Area		19.19 Sq. Km.
Cultivable Area		714.71 Sq. Km.
Net Sown Area		629.75 Sq. Km.
Double Cropped Area		149.3
Area under Irrigation	Surface Water	38.1 Sq. Km.
	Ground Water	17.93 Sq. Km.

Area under Drip & Sprinkler Irrigation	ha	
Principal Crops	**Crop Type**	**Area (Sq. Km.)** *(Reference year 2016-17)*
	Cotton	0.76
	Cereals	6424
	Pulses	401.87
	Oil Seeds	563.24
Horticultural Crops	Sugarcane	0.8
	Citreous fruit	-
	Others	0.03

1.6 Water Level Behavior

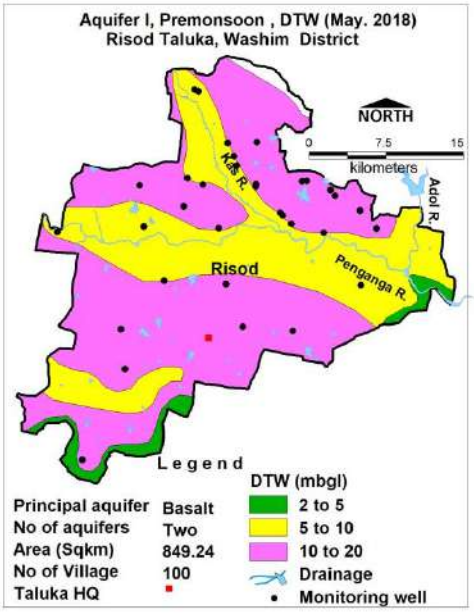
1.6.1 Aquifer-I (Shallow Aquifer)

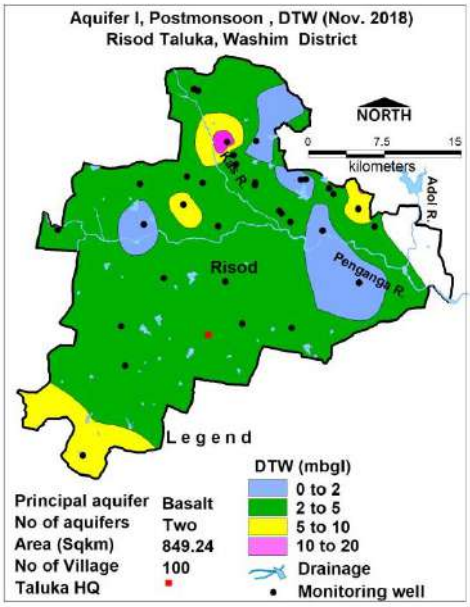
Pre-Monsoon (May-2017)

DTWL 10 to 20 mbgl is observed in major part while DTWL 5 to 10 mbgl is observed in Central, eastern, north and north-western part. DTWL 2 to 5 mbgl observed in small patches in north-west and eastern part near border.

Post-Monsoon (November-2017)

DTWL 2 to 5 mbgl is observed in major part. DTWL of 5 to 10 mbgl is observed as isolated patches in north and north-west part also in south west part of the block. While DTWL 0 to 2 mbgl in isolated patch in north- west part and also in south west and western part of the block.





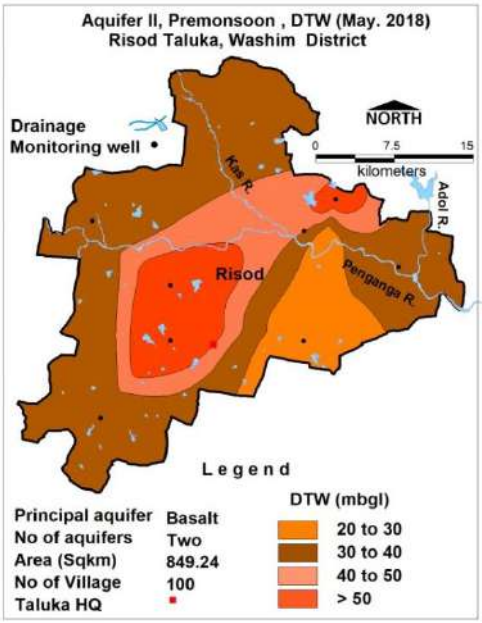
1.6.2 Water Level Behavior - Aquifer-II (Deeper Aquifer)

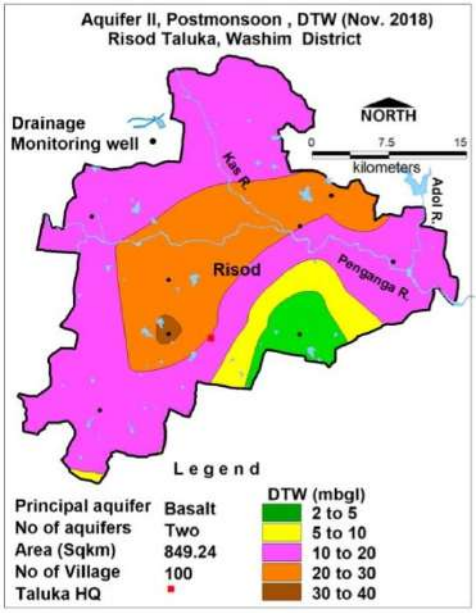
Pre-Monsoon (May-2018)

DTWL 30 to 40 mbgl is observed in major part. DTWL 20 to 30 mbgl is observed in south east part whereas DTWL 40 to 50 mbgl is observed in central and north eastern part engulfing a patch of DTWL of > 50 m bgl.

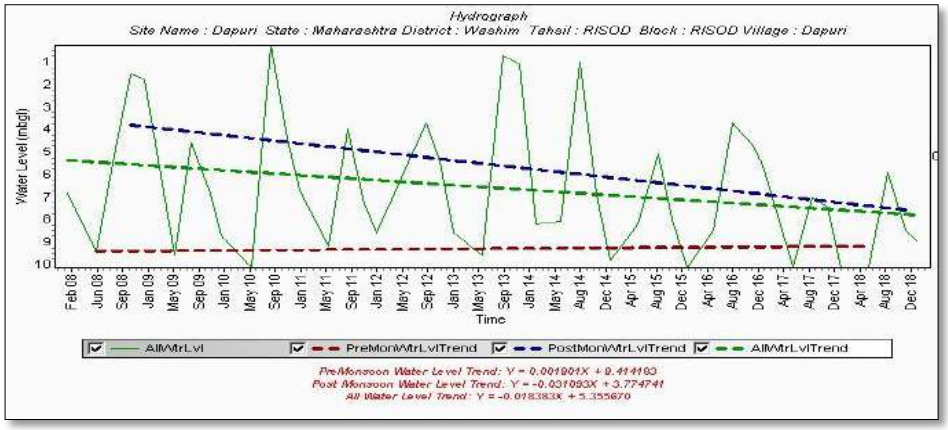
Post-Monsoon (November-2018)

DTWL 10-20 mbgl is observed in major part. DTWL 20-30 mbgl is observed in central and north-eastern part of the block. NW part engulfing a small isolated patch of DTWL of 30 to 40 m bgl. DTWL 2 to 5 mbgl is observed in south east part near border.





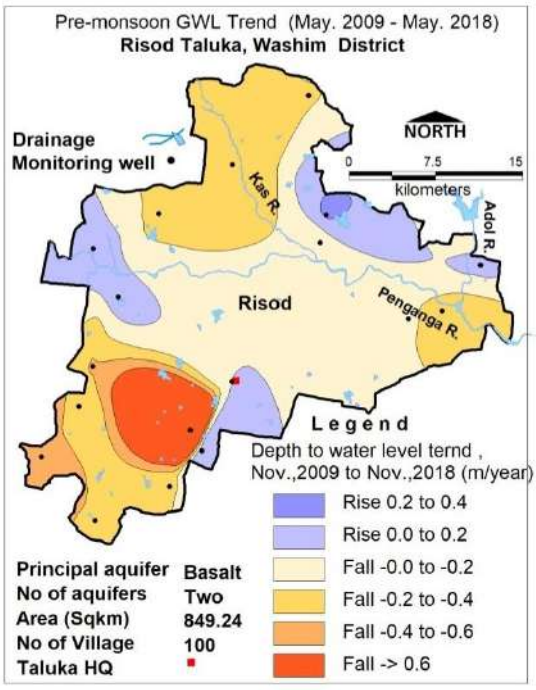
1.7. Hydrograph

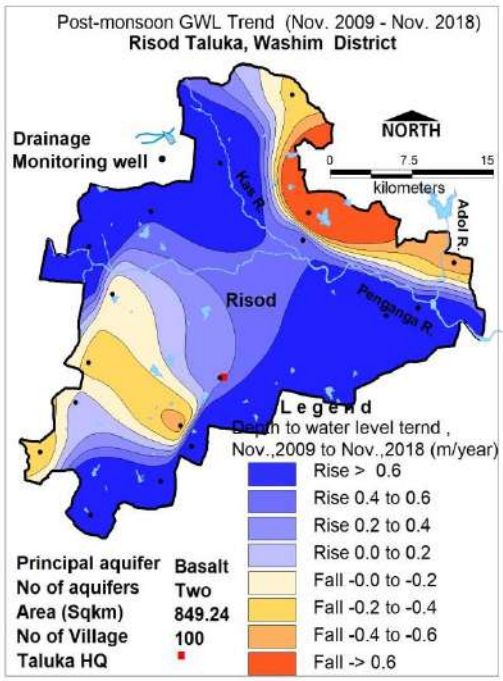


Hydrograph shows Pre-monsoon rising water level trend @ 0.024 m/year	Hydrograph shows Post- monsoon falling water level trend @ 0.372 m/year

1.8. Water Level Trend (2009-18)

1.8.1 Pre-Monsoon trend	**1.8.2 Post-Monsoon trend**
Rising 0.17m/year (Wanoja) to 2.21 m/year (Agarwadi) , Falling 0.04 m/year (Degaon) to 0.22 m/year (Risod)	Rising 0.12 m/year (Wakad) to 1.45m/year (khandala); Falling 0.07 m/year (Mop) to 1.5 m/year (Mohajabandi)
Major area shows falling trend upto 0.6 m/year (729.83 sq km) area except few patches of rising trend upto 0.4 observed in south , west and north east near borders (134.6 sq.km).	Major area shows rising trend of > 0.6 m/year (645.53 sq.km) while falling trend upto 0.6 is observed in rest part in north-east and south-west part of the block (218.94 sq.km).





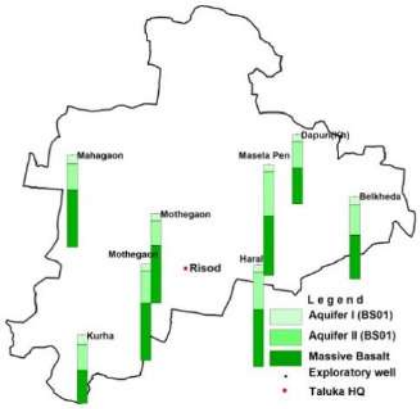
2. Ground Water Issues

1. Block shows declining water level trend up to 0.4 m/year
2. Frequent droughts (25% Moderate) which is ultimately responsible for less ground water recharge and non-availability of surface & ground water for irrigation.
3. Less ground water potential basaltic aquifer.

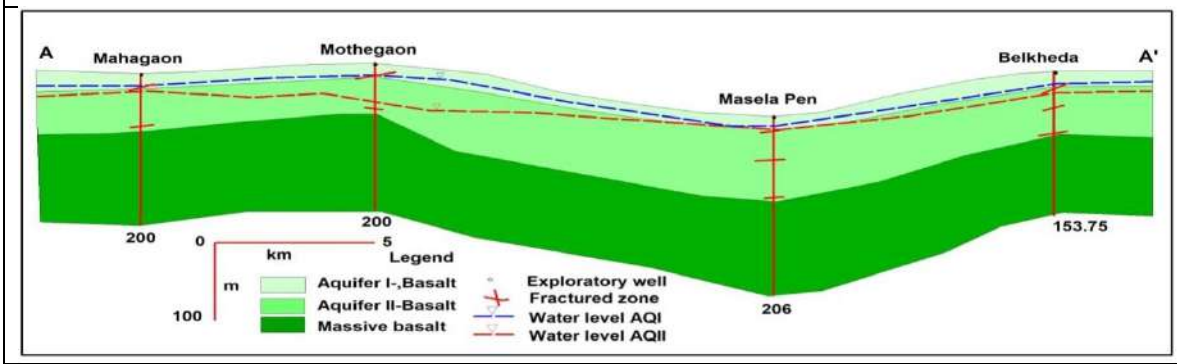
3. AQUIFER DISPOSITION

3.1. Number of Aquifers	Basalt –Aquifer-I (Phreatic / Shallow aquifer) Basalt –Aquifer-II (Semi-confined / confined / Deeper aquifer)

3.2. Lithological Disposition



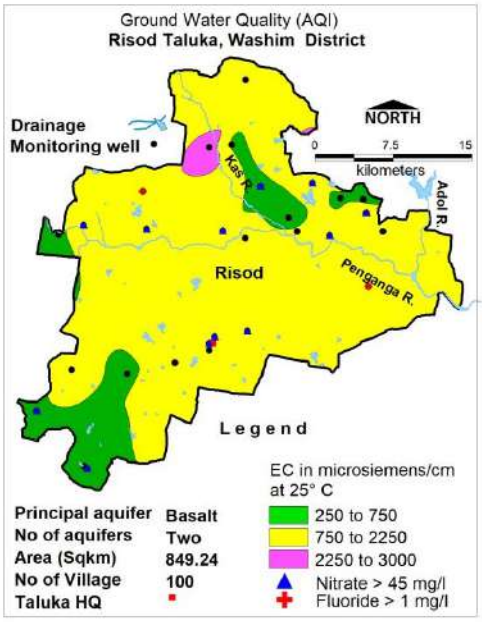
3.3. Cross Sections - Section CC'



3.4. Aquifer Characteristics		
Major Aquifers	**Basalt (Deccan Traps)**	
Type of Aquifer (Phreatic/Semi-confined/Confined)	Basalt –Aquifer-I (Phreatic / Shallow aquifer)	Basalt –Aquifer-II (Semi-confined / confined / Deeper aquifer)
Static Water Level (mbgl)	8 - 19	21 - 50
Depth of Occurrence (mbgl)	9 - 25	70 - 165
weathered/fractured rocks thickness (m)	6 – 14	1 - 4
Yield	10 – 100 m^3/day	0.2 - 0.75 lps
Specific yield/ Storativity (S)	0.018 – 0.20	0.0000145
Transmissivity (T)	20 - 50 m^2/day	20 - 60 m2/day

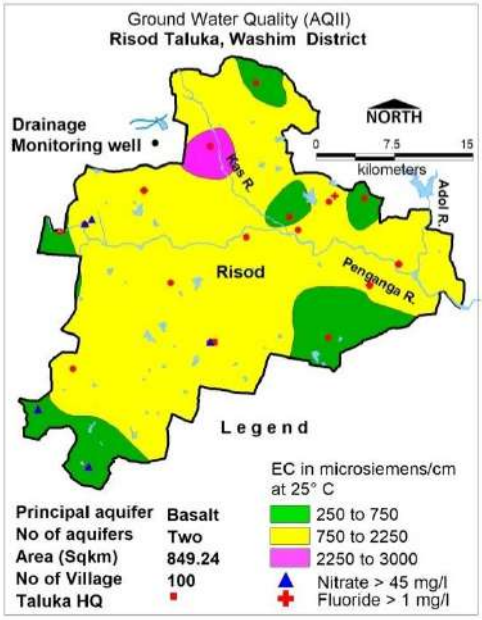
4. GROUND WATER QUALITY

4.1 Phreatic Aquifer (Aquifer-I/ Shallow aquifer)



EC ranging 750-2250 µS/cm has been observed in major part (740.5 sq.km) & EC ranging 250 to 750 µS/cm (111.4 sq km) in patches in south-west, north-east and western part near borders. The ground water is suitable for all purpose. One isolated patch of EC ranging 2250-3000 µS/cm is observed in northern part of the block(12.54 sq.km). Ground water is suitable for irrigation purpose with proper salinity control measures. However the water from such area is not fit for drinking purpose without treatment. Few villages are also affected by nitrate and fluoride contamination.

4.2 Semi-confined/Confined Aquifer (Aquifer II/ Deeper aquifer)



EC ranging 750 - 2250 µS/cm has been observed in major part (697.9 sq. km) except EC ranging 250 - 750 µS/cm in) in patches in south-west, north-east and western and eastern parts near borders(147 sq.km). The ground water is suitable for all purpose. One isolated patch of EC ranging 2250-3000 µS/cm is observed in northern part of the block (19.47sq.km).Ground water is suitable for irrigation purpose with proper salinity control measures. However the water from such area is not fit for drinking purpose without treatment. Few villages are also affected by fluoride and nitrate contamination.

5. GROUND WATER RESOURCE

5.1 Aquifer-I/ Shallow Phreatic Aquifer (Basalt)

Ground Water Recharge Worthy Area (Sq. Km.)	849.24
Total Annual Ground Water Recharge (MCM)	129.51
Natural Discharge (MCM)	6.49
Net Annual Ground Water Availability (MCM)	123.02
Existing Gross Ground Water Draft for irrigation (MCM)	46.0337

Existing Gross Ground Water Draft for domestic and industrial water supply(MCM)	2.3649
Existing Gross Ground Water Draft for All uses(MCM)	48.3986
Provision for domestic and industrial requirement supply to 2025(MCM)	4.739
Net Ground Water Availability for future irrigation development(MCM)	70.997
Stage of Ground Water Development (%)	39.34
Category	**SAFE**

5.2 Aquifer-II (Semi-confined/Confined Deeper Basaltic Aquifer)

Total Area (Sq. Km.)	Mean aquifer thickness (m)	SY	S	Piezometric Head (m above confining layer)	Total Resource (MCM)
693.81	2	0.005	0.0000145	38	7.32

6.0. GROUND WATER RESOURCE ENHANCEMENT

6.1. Supply Side Management

SUPPLY (MCM)

Available Resource (MCM)		123.03
Gross Annual Draft (MCM)		48.4
Agricultural Demand –GW		46.03
Agricultural Demand –SW		24.77
Domestic Demand – GW		2.36
Domestic Demand – SW		0.59
Total Demand		**73.75**
Area of Block (Sq. Km.)		874.94
Area suitable for Artificial recharge (Sq. Km)		849.24
Type of Aquifer		Hard rock
Area feasible for Artificial Recharge (WL >5mbgl) (Sq. Km.)		78.69
Volume of Unsaturated Zone (MCM)		229.15
Average Specific Yield		0.02
Volume of Sub Surface Storage Space available for Artificial Recharge (MCM)		4.6
Surplus water Available (MCM)		2.184
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	5	21
Volume of Water expected to be conserved / recharged @ 75% efficiency (MCM)	1	0.63
RTRWH Structures – Urban Areas		
Households to be covered (25% with 50 m^2 area)		10800
Total RWH potential (MCM)		0.3051
Rainwater harvested / recharged @ 80% runoff co-efficient		0.24408
However, it is economically not viable & hence, not recommended.		

6.2. Demand Side Management

Micro irrigation techniques	
Sugarcane crop area (84) ,about 5 sqkm area is ground water irrigated ,100 % ground water irrigated (5 sqkm) proposed to be covered under Drip (sq.km.)	4
Volume of Water expected to be saved (MCM). Surface Flooding req- 2.45 m. Drip Req. - 1.88, WUE- 0.57 m	2.28
Proposed Cropping Pattern change	
Irrigated area under Water Intensive Crop(ha)	Not proposed
Water Saving by Change in Cropping Pattern	Nil

6.4. Expected Benefits

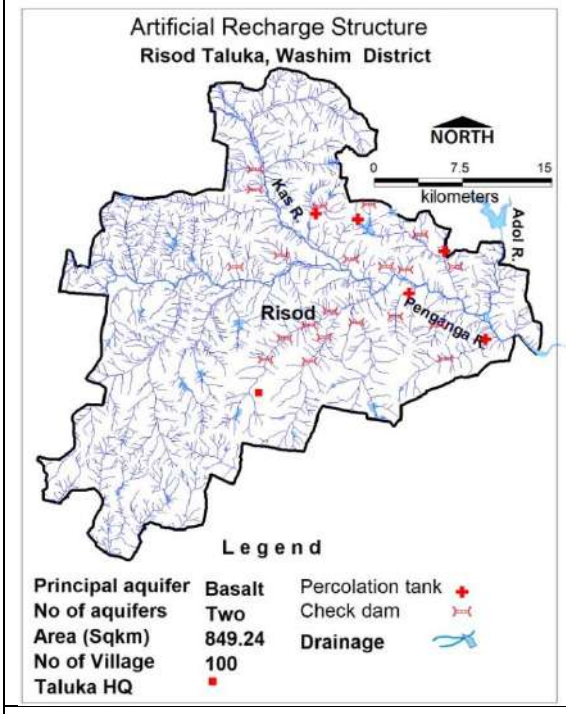
Net Ground Water Availability (MCM)	123.02
Additional GW resources available after Supply side interventions (MCM)	41.142
Ground Water Availability after Supply side intervention(MCM)	

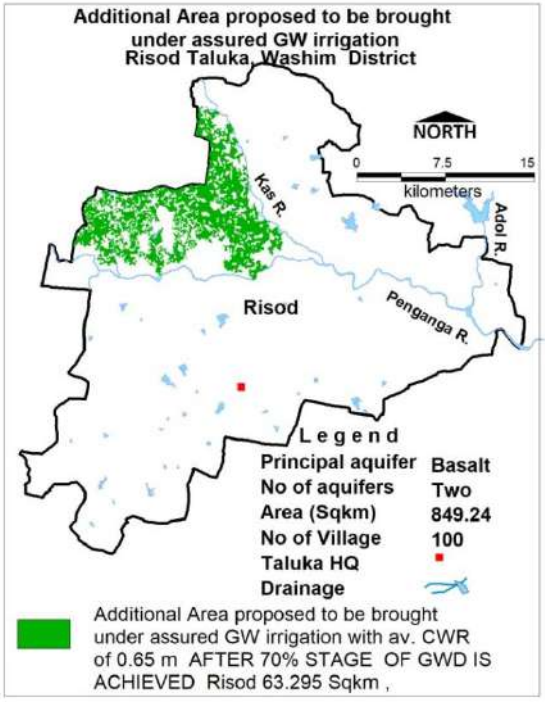
Existing Ground Water Draft for All Uses (MCM)	48.3986
GW draft after Demand Side Interventions (MCM)	
Present stage of Ground Water Development (%)	39.34
Expected Stage of Ground Water Development after interventions (%)	
Other Interventions Proposed, if any	
Alternate Water Sources Available	Nil

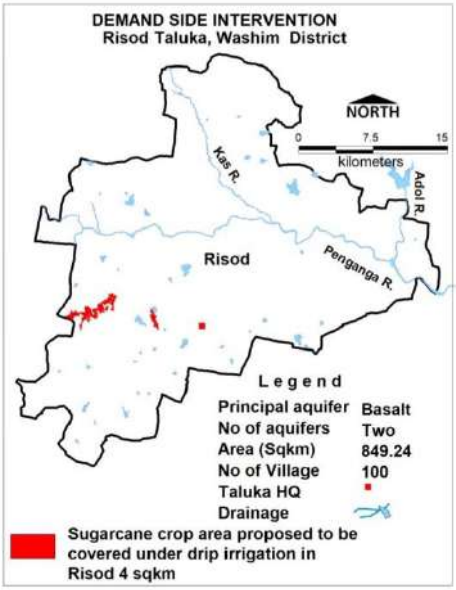
6.4. Development Plan

Volume of water available for GWD after stage of GWD brought to 70% (MCM)	41.142
Proposed Number of DW (@ 1.5 ham for 90% of GWR Available)	2469
Proposed Number of BW (@ 1.5 ham for 10% of GWR Available)	274
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	63.2953846

Regulatory Measures	60m borewells/tube wells



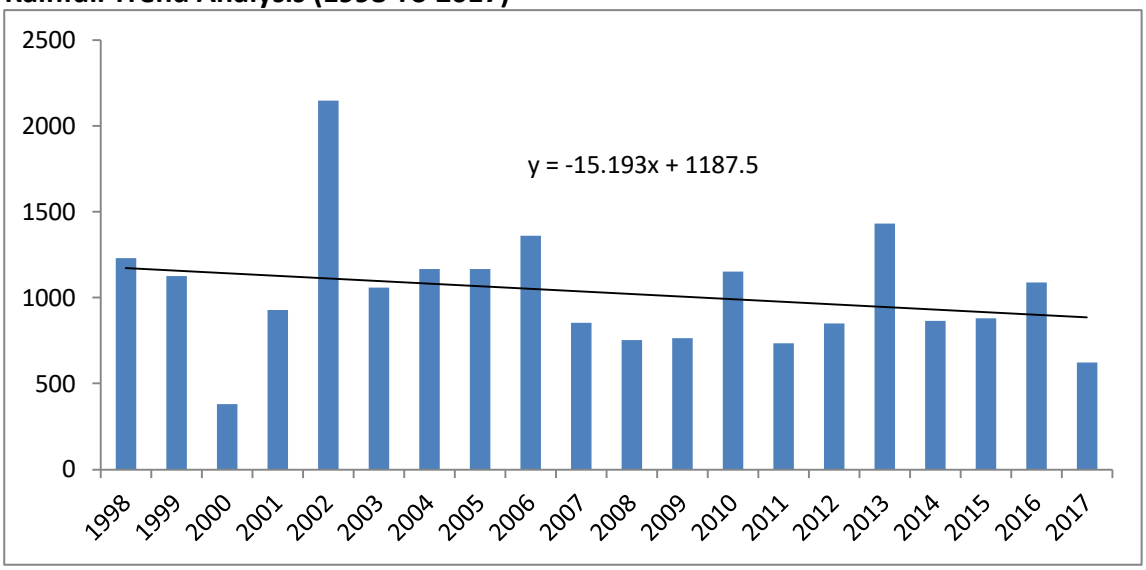




9.6 AQUIFER MAPS AND GROUND WATER MANAGEMENT PLAN, WASHIM BLOCK, WASHIM DISTRICT, MAHARASHTRA

1. SALIENT FEATURES		
1.1 Introduction		
Block Name		Washim
Geographical Area (Sq. Km.)		919.72
Hilly Area (Sq. Km)		37.2609
Population (2011)		255188
Climate		Monsoon Tropical
1.2 Rainfall Analysis		
Normal Rainfall		1038.6 mm
Annual Rainfall (2017)		624.3 mm
Decadal Average Annual Rainfall (2008-17)		909.78 mm
Long Term Rainfall Analysis (1998-2017)	Falling trend: -15.193 mm/year. Probability of Rainfall : 60% Normal Rainfall; 15 % Excess Rainfall Probability of Drought: 20% Moderate Drought & 5% Severe Drought	

Rainfall Trend Analysis (1998 To 2017)



1.3. Geomorphology, Soil & Geology		
Geomorphic Unit	Plateau (Un-dissected to slightly dissected) with weathered thickness ranging from 0 to 5 m.	
Geology	Deccan Traps (Basalt) Age: Late Cretaceous to Eocene	
Soil	Major area shows BCS consisting mostly of clay >100 cm thick. Clay with thickness 50-100 cm is observed in southern part of the block. At certain places gravelly clay loam of 10-25 cm is observed.	
1.4. Hydrology & Drainage		
Drainage	Pus river, tributary of Painganga river, Godavari basin.	
Hydrology	Major and Medium project	Nil
	Minor Irrigation Projects(Local)	6
	Minor Irrigation Projects(ZP Level)	368
		PT-34, KT-7, UGB-1

1.5. Land Use, Agriculture, Irrigation & Cropping Pattern		
Forest Area		21.18 Sq. Km.
Cultivable Area		806.86Sq. Km.
Net Sown Area		712.91 Sq. Km.
Double Cropped Area		109.15 Sq. Km.
Area under	Surface Water	38.73Sq. Km.

Irrigation	Ground Water	40.69 Sq. Km.	
Area under Drip & Sprinkler Irrigation			
Principal Crops		**Crop Type**	**Area (Sq. Km.)***(Reference year 2016-17)*
		Cotton	1.18
		Cereals	61.54
		Pulses	303.12
		Oil Seeds	599.99
Horticultural Crops		Sugarcane	0.18
		Citreous fruit	-
		Others	-

1.6. Water Level Behavior

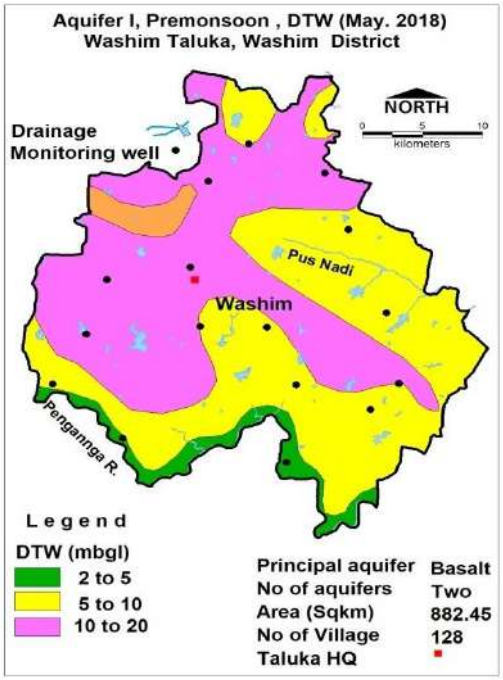
1.6.1 Aquifer-I (Shallow Aquifer)

Pre-Monsoon (May-2018)

Major area is showing DTWL 10 to 20 m bgl in Western and North- western part of block. Rest of the part is showing DTWL 10 to 20 m bgl in East and South east part of Washim block also Small patches are present in northern part of the block. Whereas, in the southern boundary DTWL 2 to 5 m bgl are seen.

Post-Monsoon (November-2018)

DTWL 2- 5 mbgl is observed in major part. DTWL of 5 to 10 mbgl is observed as a small patch near border in the west part of the block. Area with DTWL 0-2 mbgl is observed as isolated patches in SE, SW, NE, NW parts of the block.



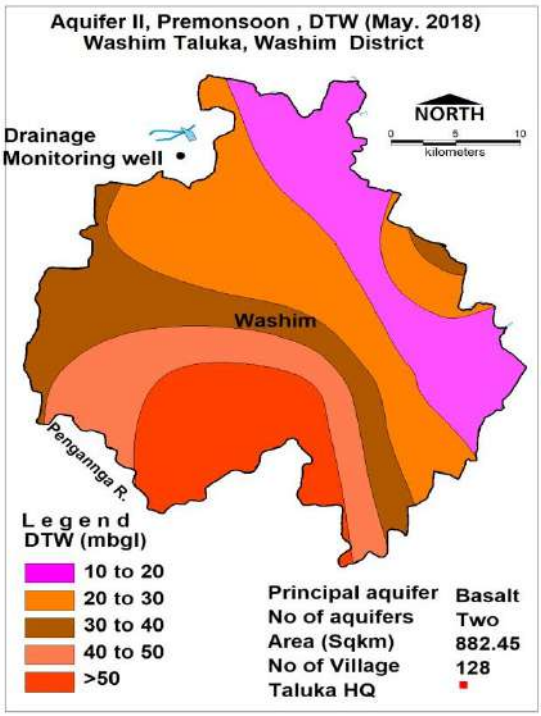
1.6.2 Water Level Behavior - Aquifer-II (Deeper Aquifer)

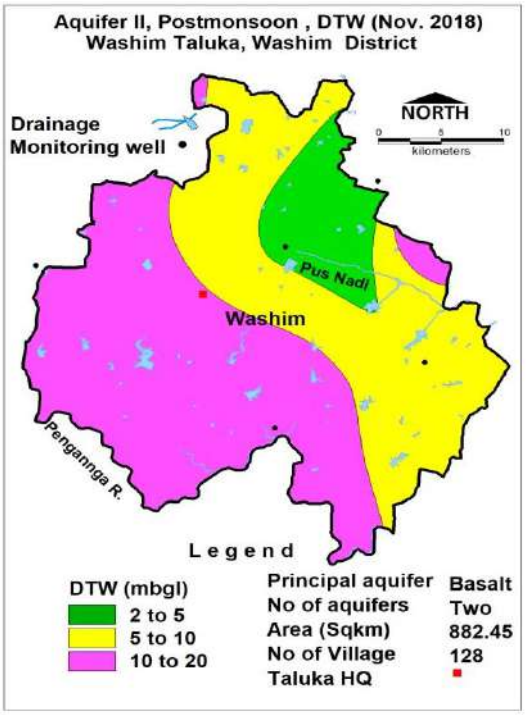
Pre-Monsoon (May-2018)

DTWL 10-20 mbgl is observed in North-East part. DTWL >50 mbgl is observed as Patch in Northern part. Strips of DTWL 20-30 ; 30-40 and 40-50 mbgl are running NW-SE of the block.

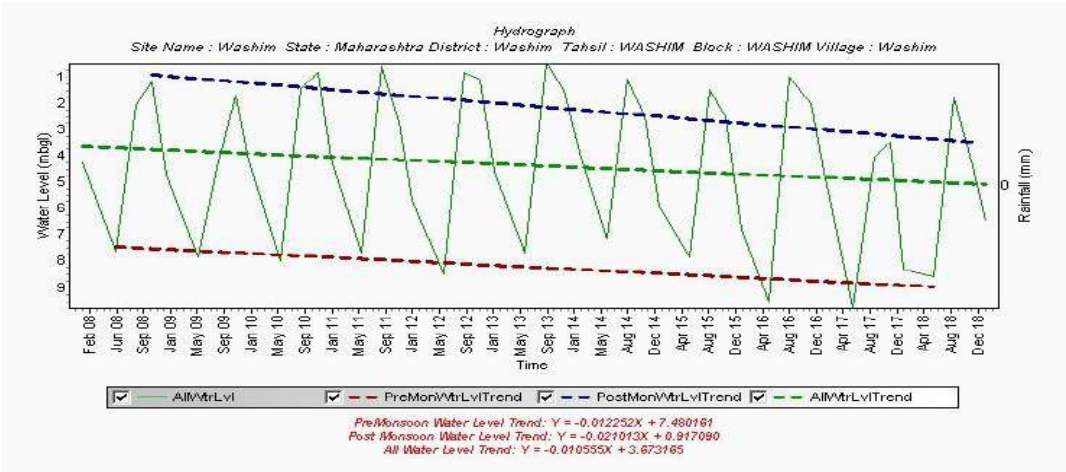
Post-Monsoon (November-2018)

DTWL 10-20 mbgl is observed in major part. DTWL 5-10 mbgl is observed as strip running NE-SE part engulfing a patch of DTWL of 2-5 m bgl in the NE part of block.





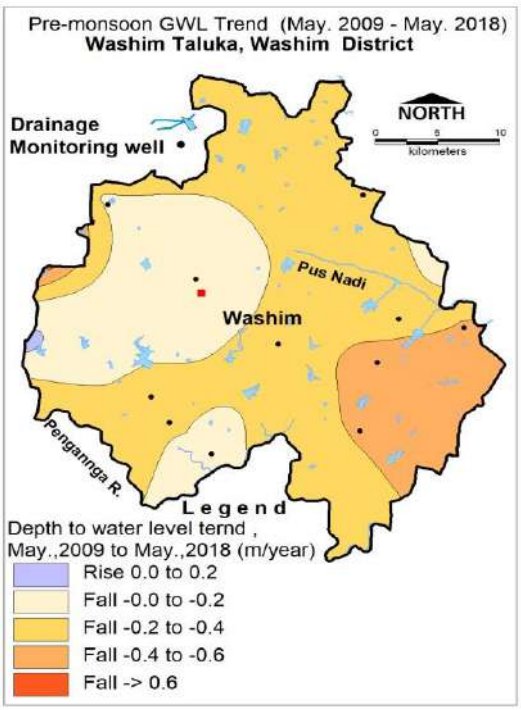
1.7. Hydrographs

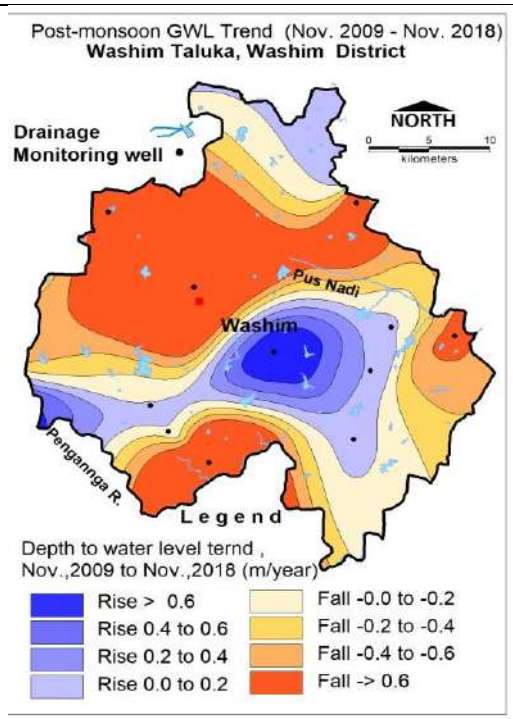


Hydrograph shows Pre-monsoon falling water level trend @ 0.144 m/year.	Hydrograph shows Post- monsoon falling water level trend @ 0.252 m/year.

1.8. Water level Trend (2009-18)

Pre-Monsoon trend Rising 0.11m/year (Washim) to 0.56 m/year (Pimpalgaon).	**Post-Monsoon trend** Rising 0.01 m/year (Tondgaon) to 1.58 m/year(Washim); Falling 0.01 m/year (Kekatumra) to 0.77 m/year (Falegaon).
Entire block shows falling trend upto 0.6 m/year covering 923.6 sq. km area. Only 10 sq km area in western boundary is showing rising trend upto 0.2 m/y.	Major area shows falling water level trend up to >0.6 m/year (701.9 sq. km) whereas, in central south-western and northern part of the block rising water level trend ranging from 0.2 to >0.6 m/year is observed (222.59 sq.km).





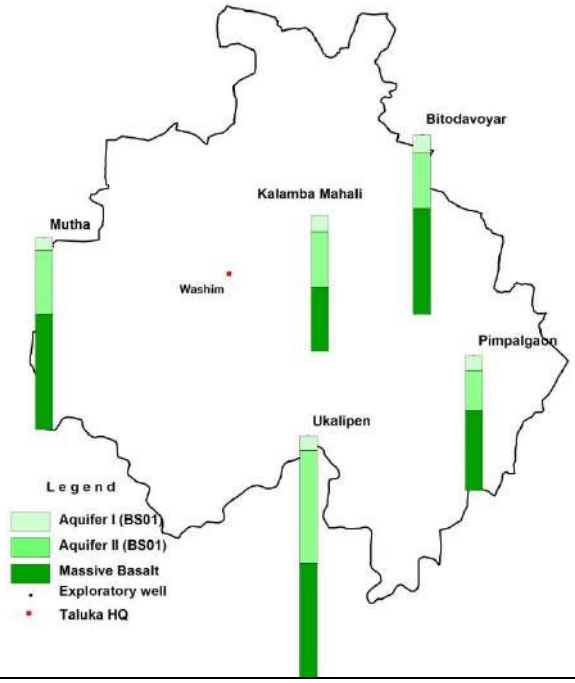
2. Ground Water Issues

1. Block shows declining water level trend ranging from 0.2 to >0.6 m/year during pre-monsoon as well as in post-monsoon.
2. Frequent droughts (5 % sever & 20 % Moderate) which is ultimately responsible for less ground water recharge and non-availability of surface & ground water for irrigation.
3. Less ground water potential basaltic aquifer.

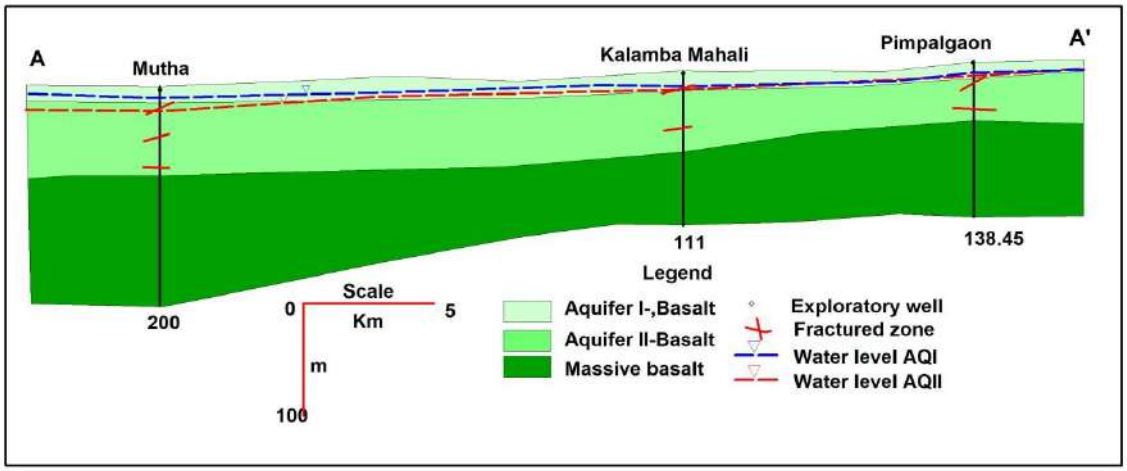
3. AQUIFER DISPOSITION

3.1. Number of Aquifers	Basalt –Aquifer-I (Phreatic / Shallow aquifer) Basalt –Aquifer-II (Semi-confined / confined / Deeper aquifer)

3.2. Bar Diagram



3.3. Cross Sections - Section AA'

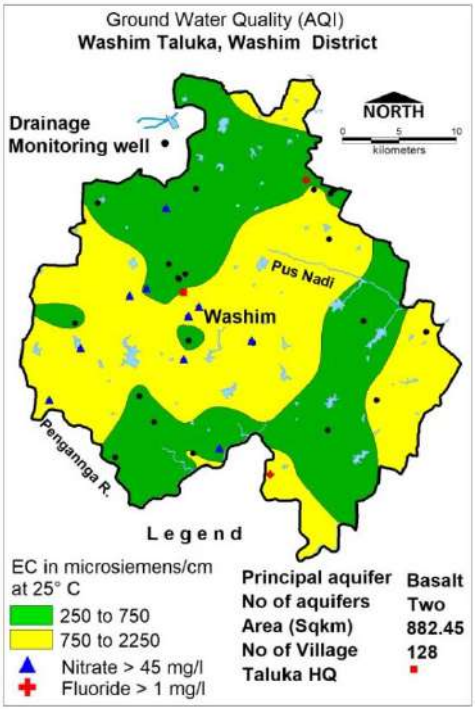


3.4. Aquifer Characteristics

Major Aquifers	**Basalt (Deccan Traps)**	
Type of Aquifer (Phreatic/Semi-confined/Confined)	Basalt –Aquifer-I (Phreatic / Shallow aquifer)	Basalt –Aquifer-II (Semi-confined / confined / Deeper aquifer)
Static Water Level (mbgl)	6.6 – 19.8	21 - 55
Depth of Occurrence (mbgl)	9 - 25	55 - 165
weathered/fractured rocks thickness (m)	5 – 14	0.5 - 6
Yield	10 – 200 m^3/day	0 – 1.25 lps
Specific yield/ Storativity (S)	0.20	0.0000245 to 0.00005
Transmissivity (T)	30 - 50 m^2/day	20 - 40 m2/day

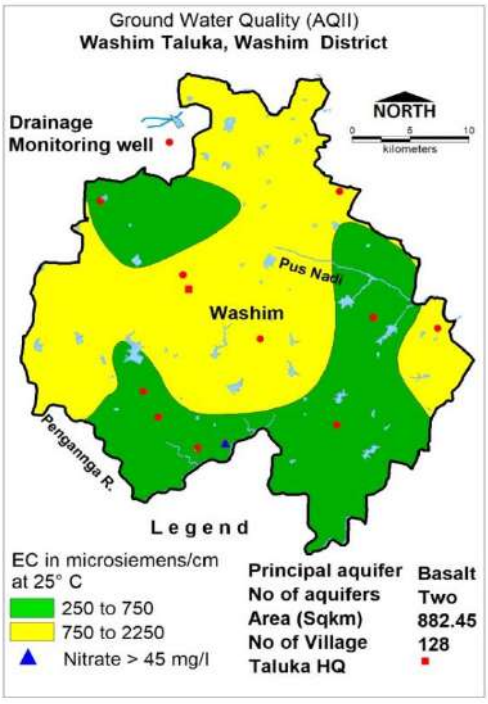
4. GROUND WATER QUALITY

4.1 Phreatic Aquifer (Aquifer-I/ Shallow aquifer)



EC ranging upto 750-2250 µS/cm has been observed in major part (503.5 sq km) & EC ranging 250 to 750

4.2 Semi-confined/Confined Aquifer (Aquifer II/ Deeper aquifer)



EC ranging 750-2250 µS/cm has been observed in major part (529.3 sq km) except EC ranging 250 -

µS/cm (421.9 sq km)is observed in north, south, south-east-west and eastern part of the block. The ground water is suitable for all purpose. Few villages are also affected by nitrate & fluoride contamination.	750µS/cm in 396.1 sq. km area in southern, north-west and some area in eastern part of the block. The ground water is suitable for all purpose. Few villages are affected by nitrate contamination.

5. GROUND WATER RESOURCE & EXTRACTION

5.1 Aquifer-I/ Shallow Phreatic Aquifer (Basalt)

Ground Water Recharge Worthy Area (Sq. Km.)	882.4591
Total Annual Ground Water Recharge (MCM)	102.80
Natural Discharge (MCM)	5.14
Net Annual Ground Water Availability (MCM)	97.66
Existing Gross Ground Water Draft for irrigation (MCM)	33.59
Existing Gross Ground Water Draft for domestic and industrial water supply(MCM)	2.682
Existing Gross Ground Water Draft for All uses(MCM)	36.275
Provision for domestic and industrial requirement supply to 2025(MCM)	5.428
Net Ground Water Availability for future irrigation development(MCM)	60.023
Stage of Ground Water Development (%)	37.14
Category	**SAFE**

5.1 Aquifer-II (Semi-confined/Confined Deeper Basaltic Aquifer)

Total Area (Sq. Km.)	Mean aquifer thickness (m)	SY	S	Piezometric Head (m above confining layer)	Total Resource (MCM)
1238.92	4.15	0.005	0.0000145	43	26.48

6.0. GROUND WATER RESOURCE ENHANCEMENT

6.1. Supply Side Management

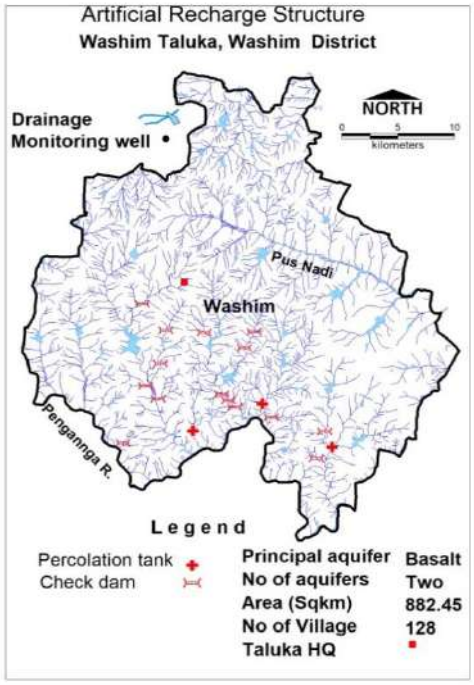
SUPPLY (MCM)

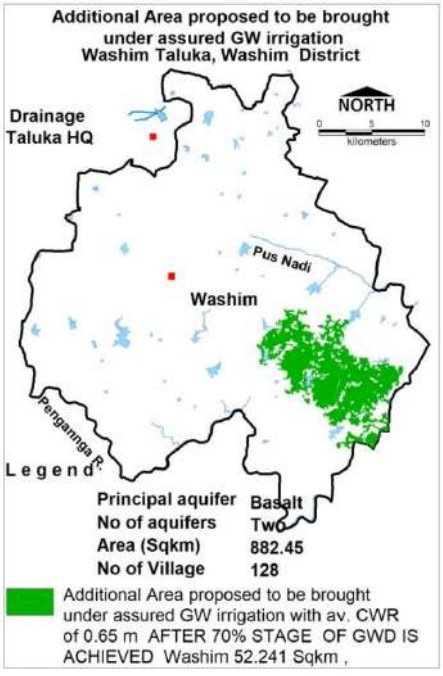
Available Resource (MCM)	97.66
Gross Annual Draft (MCM)	36.28
Agricultural Demand –GW	33.59
Agricultural Demand –SW	25.2
Domestic Demand – GW	2.68
Domestic Demand – SW	0.67
Total Demand	67.9225
Area of Block (Sq. Km.)	919.72
Area suitable for Artificial recharge (Sq. Km)	882.4591
Type of Aquifer	Hard rock
Area feasible for Artificial Recharge (WL >5mbgl) (Sq. Km.)	33
Volume of Unsaturated Zone (MCM)	125
Average Specific Yield	0.02
Volume of Sub Surface Storage Space available for Artificial Recharge (MCM)	2.5
Surplus water Available (MCM)	1.4

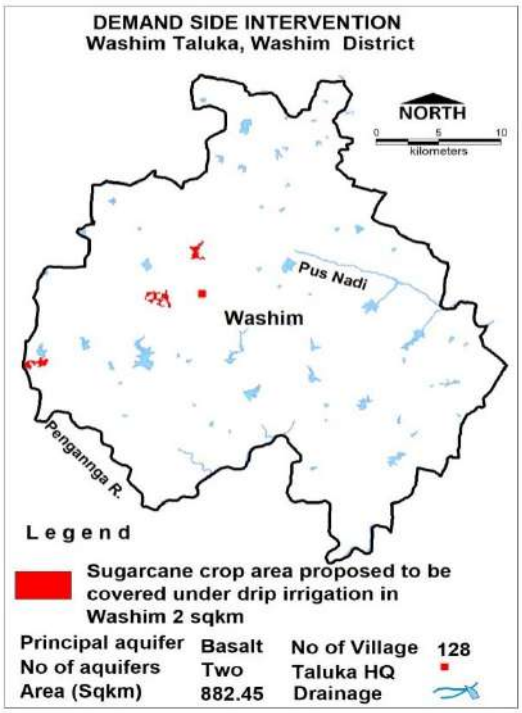
Proposed Structures	Percolation Tank (Av. Gross Capacity-100 TCM*2 fillings = 200 TCM)	Check Dam (Av. Gross Capacity-10 TCM * 3 fillings = 30 TCM)
Number of Structures	3	15
Volume of Water expected to be conserved / recharged @ 75% efficiency (MCM)	0.6	0.45

RTRWH Structures – Urban Areas	
Households to be covered (25% with 50 m^2 area)	13400
Total RWH potential (MCM)	0.37855
Rainwater harvested / recharged @ 80% runoff co-efficient	0.30284
However, it is economically not viable & hence, not recommended.	

6.2. Demand Side Management	
Micro irrigation techniques	
Sugarcane crop area (25) ,about 2 sqkm area is ground water irrigated ,100 % ground water irrigated (2 sqkm) proposed to be covered under Drip (sq.km.)	2
Volume of Water expected to be saved (MCM). Surface Flooding req- 0.36 m. Drip Req. - 0.24, WUE- 0.12 m	1.14
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)	97.66
Additional GW resources available after Supply side interventions (MCM)	33.957
Ground Water Availability after Supply side intervention(MCM)	
Existing Ground Water Draft for All Uses (MCM)	36.275
GW draft after Demand Side Interventions (MCM)	
Present stage of Ground Water Development (%)	37.14
Expected Stage of Ground Water Development after interventions (%)	36.75
Other Interventions Proposed, if any	
Alternate Water Sources Available	Nil
6.4. Development Plan	
Volume of water available for GWD after stage of GWD brought to 60% (MCM)	33.957
Proposed Number of DW (@ 1.5 ham for 90% of GWR Available)	2037
Proposed Number of BW (@ 1.5 ham for 10% of GWR Available)	226
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	52.24153846
Regulatory Measures	60m borewells/tube wells






DEMAND SIDE INTERVENTION
Washim Taluka, Washim District
NORTH
0 5 10
kilometers
Pus Nadi
Washim
Penganga R.
Legend
Sugarcane crop area proposed to be covered under drip irrigation in Washim 2 sqkm
Principal aquifer Basalt
No of aquifers Two
Area (Sqkm) 882.45
No of Village 128
Taluka HQ
Drainage

PANCHAYAT LEVEL

AQUIFER MANAGEMENT PLAN

I. **CHICHAMBA PEN**

II. **DAPURI KH**

III. **GOWARDHAN**

IV. **TIWALI**

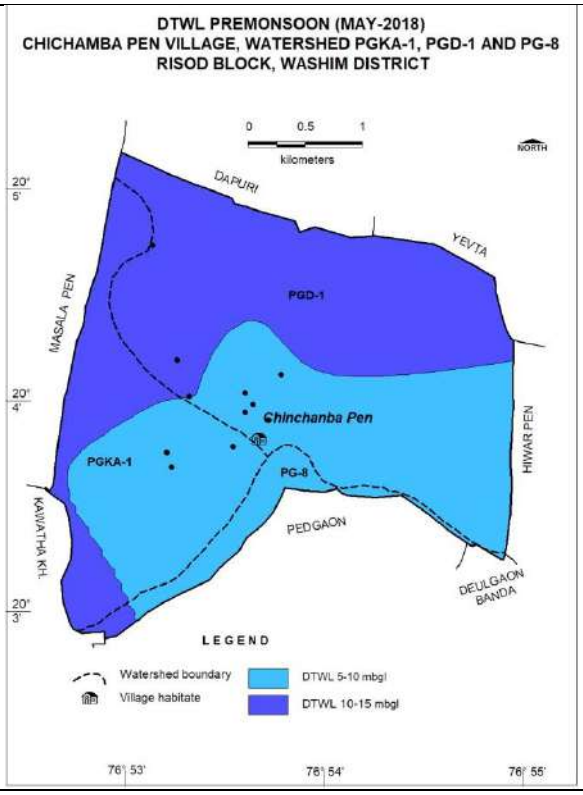
V. **WAGHI KH**

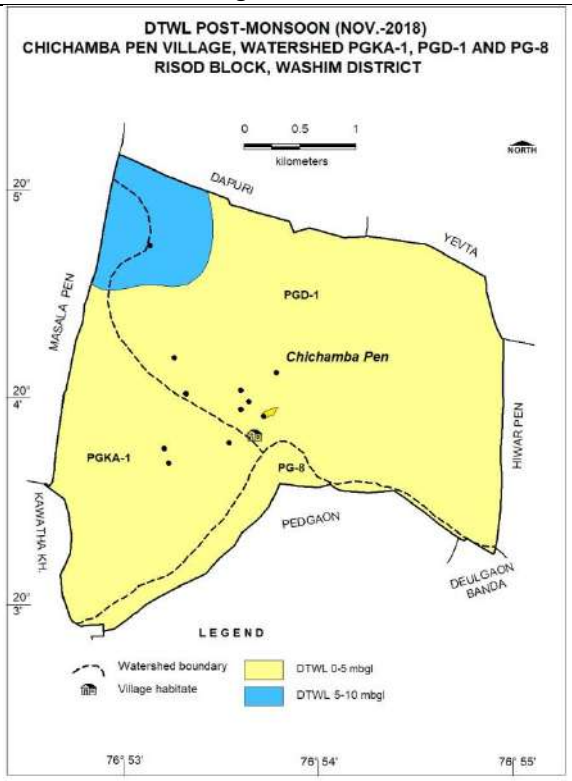
VI. **YEVTA**

10.1 PANCHAYAT LEVEL AQUIFER MANAGEMENT PLAN, WATERSHEDS PGKA-1, PGD-1, PG-8, VILLAGE CHICHAMBA PEN, RISOD BLOCK, WASHIM DISTRICT, MAHARASHTRA

1. SALIENT FEATURES		
1.1 Introduction		
Village Name		Chichamba pen
Geographical Area (Sq. Km.)		11.18 sq km
Hilly Area (Sq. Km)		Nil
Population (Predicted -2018)		3000
Climate		Monsoon Tropical
Normal Rainfall (mm) (nearest rain gauge station-Risod)		880 mm
Annual Rainfall (mm) 2009-18 (nearest rain gauge station-Risod)		880 mm
1.2. Geomorphology, Soil & Geology		
Geomorphic Unit	Plateau (slightly to moderately dissected).	
Geology	Deccan Traps (Basalt) Age: Late Cretaceous to Eocene	
Soil	BCS consisting mostly of clay >100 cm and loam 25-50 cm thick. At some places Sandy clay loam of 50-100 cm.	
1.3. Hydrology & Drainage		
Watershed	PGKA-1 (3.772Sq.km.), PGD-1(6.909 Sq.km.), PG-8 (0.4943 Sq.km.)	
Drainage	Godavari basin, Penganga River with sub-dendritic to parallel drainage pattern. 1st Order Stream – 20.06 km 2nd Order Stream – 4.10 km 3rd Order Stream – 1.63 km 4th Order Stream – 4.34 km	
Irrigation Project (Major/Medium/Minor etc.)	Nil	
WC structures (PT / KT / CD / FP etc.)	06-CD, 1-KTW, 09-LBS, 01-PT	
1.4. Land Use, Agriculture, Irrigation & Cropping Pattern		
Specifics		**Area (Sq. Km.)**
Forest Area		Nil
Cultivable Area		870 ha
Net Sown Area		865 ha
Double Cropped Area		Nil
Irrigation Dug wells		105
Irrigation Bore wells		70
Area under Drip & Sprinkler Irrigation		Nil
Area under Irrigation	Surface Water	Nil
	Ground Water	865 ha
Principal Crops *(Reference year 2017-18)*	Soyabean	729 ha
	Pulses (*Tur*)	65 ha
	Pulses (*Udad*)	15 ha
	Pulses (*Moong*)	8 ha
	Turmeric	40 ha
	Cotton	3 ha
	Citreous fruit	2-4 ha
	Other	5 ha
1.5. Water Level Behavior : Aquifer-I (Shallow Aquifer)		
Pre-Monsoon (May-2018) Based on pre-monsoon data of 11 Key Observation wells in and around the village it is observed that in the north, north-west and north-east part the DTWL ranges	**Post-Monsoon (November-2018)** Based on post-monsoon data of 11 Key Observation wells in and around the village it is observed that entire area of the village shows DTWL in the range	

between 10-15 mbgl whereas in the south south-eat and south-west DTWL ranges between 5-10 mbgl.	of 0-5 mbgl except in the north-western part a patch of DTWL ranging 5-10 mbgl is observed. A small isolated patch of the DTWL 5-10 mbgl is observed in the center of the village.





2. Ground Water Issues

1. Declining water level.
2. Non-availability of surface and Groundwater for irrigation.
3. Less ground water potential basaltic aquifer.

3. AQUIFER DISPOSITION

3.1. Number of Aquifers	Basalt –Aquifer-I (Phreatic / Shallow aquifer)

3.2. Aquifer Characteristics

Major Aquifers	**Basalt (Deccan Traps)**
Type of Aquifer	Basalt –Aquifer-I (Phreatic / Shallow aquifer)
Static Water Level (mbgl)	10.0
Depth of Occurrence (mbgl)	10.0
weathered/fractured rocks thickness (m)	10.0-14.60
Specific yield (Sy)	0.02

4. GROUND WATER QUALITY: Phreatic Aquifer (Aquifer-I/ Shallow aquifer)

Except Nitrate, which is above MPL, rests of the parameters are within MPL. The quality of ground water is good and fit for drinking, domestic and irrigation purpose.

PH	EC	TDS	TH	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F
7.5	947	502	337	72	38	64	5.7	0	309	66	29	47	0.31

5. GROUND WATER RESOURCES- Aquifer-I/ Shallow Phreatic Aquifer (Basalt)

5. 1 Water budgeting

A. Water availability

Area (ha)	1118.00
Rainfall (m)	0.88
Water precipitated, ham, (Area X RF)	983.84
90 % of precipitations (ham)	885.46
AR recharge by artificial recharge structure	0.4072

Runoff (2.5%)(RF-AR) (ham)	22.13
Evaporation (35%) (ham)	309.91
Water retain in ground Tank, Nala etc. (5%) (ham)	44.27
Recharge to phreatic aquifer (10%) (ham)	88.55
Enhance soil moisture, utilised by root system (ham)	265.64
Total Water availability (MCM)	**3.99**
B. Requirement	
Domestic @60 lpcd X total person(3000) (MCM)	0.07
Animal @40 lpad X total animal (1111) (MCM)	0.02
Irrigation water applied (MCM)	2.20
Non agriculture use (MCM)	0.09
Total Requirement (MCM)	**2.37**
C. GW available for Planning (MCM)	**1.61**
Stage of GW Development (%)	**59.52**

6.0. GROUND WATER RESOURCE MANAGEMENT

6.1. Supply Side Management

SUPPLY (MCM)

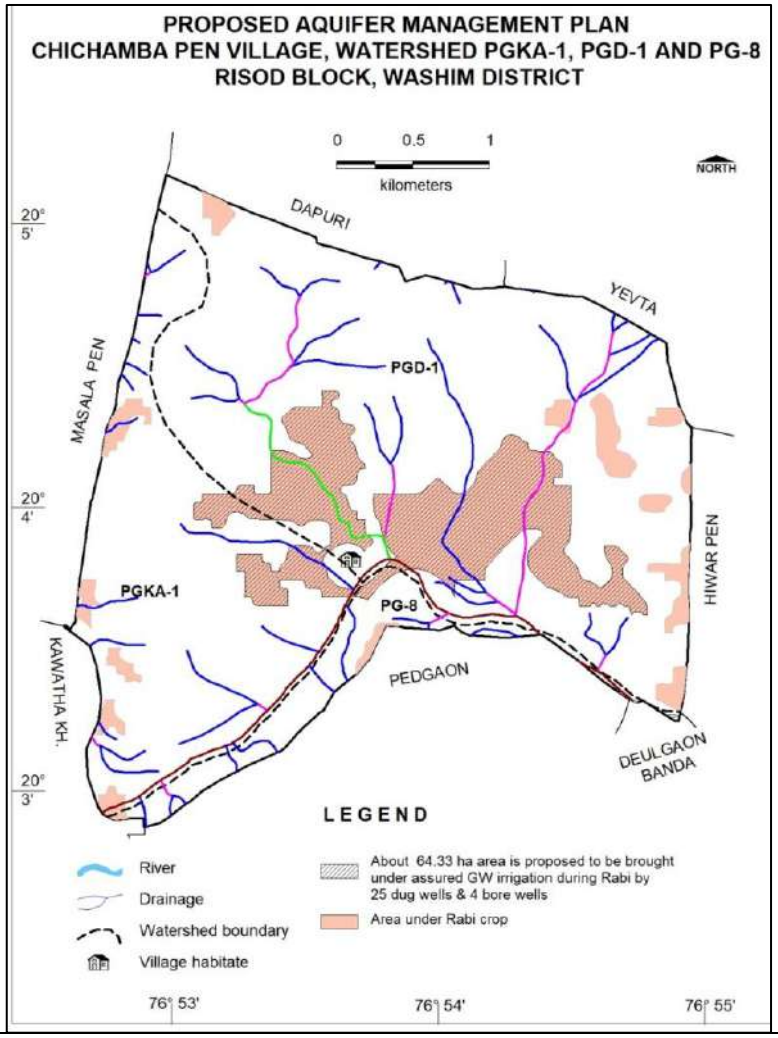
Available Resource (MCM)	3.99
Agricultural Supply –GW	1.10
Agricultural Supply -SW	0.00
Domestic Supply - GW	0.08
Domestic Supply - SW	0.00
Non agriculture use (MCM)	0.09
Total GW availability (MCM)	2.72
Gross Annual Draft (MCM)	2.20
Area of Block (Sq. Km.)	11.18
Area suitable for Artificial recharge (Sq. Km)	11.18
Type of Aquifer	Hard rock
Area feasible for Artificial Recharge (WL >5mbgl) (Sq. Km.)	0.95
Volume of Unsaturated Zone (MCM)	0.000001995
Average Specific Yield	0.02
Volume of Sub Surface Storage Space available for Artificial Recharge (MCM)	0.0000000339
Surplus water Available (MCM)	22.13

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	Not Proposed	Not Proposed
Volume of Water expected to be conserved / recharged @ 75% efficiency (MCM)		
Specific Recommendations As per State Govt. Resolution, segment wise nala/stream (on 2nd and 3rd order streams /nala's) desilting, deepening and widening upto 3 m depth or upto weathered rock considering the local hydrogeological condition without disturbing the ecology/aquifer/environmental flow of nala/stream.		Not Proposed
Considering average nala deepening of 1 m depth, additional storage		--
Considering average nala deepening of 1 m depth, additional recharge @ 75%		--

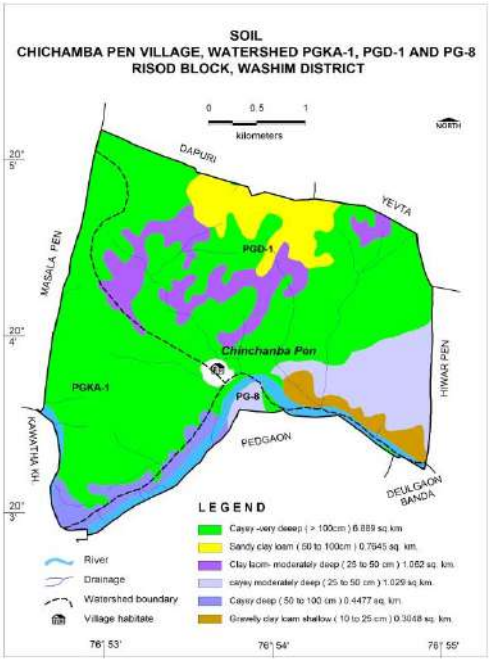
RTRWH Structures	
Households to be covered (25% with 50 m^2 area)	227
Total RWH potential (MCM)	0.0000499
Rainwater harvested / recharged @ 80% runoff co-efficient	0.0000400
However, RTRWH is economically not viable & not Recommended.	

6.2. Demand Side Management	
Micro irrigation techniques	
Area is proposed to be covered under Drip	Not Proposed
Proposed Cropping Pattern change	
Irrigated area under Water Intensive Crop(ha)	Not proposed
6.3. Expected Benefits	
Net Ground Water Availability (MCM)	3.99
Additional GW resources available after Supply side interventions (MCM)	0.00
Ground Water Availability after Supply side intervention(MCM)	3.99
Existing Ground Water Draft for All Uses (MCM)	2.37
GW draft after Demand Side Interventions (MCM)	0.00
Present stage of Ground Water Development (%)	59.52
Expected Stage of Ground Water Development after interventions (%)	59.52
Other Interventions Proposed, if any	
Alternate Water Sources Available	Nil
6.4. Development Plan	
Volume of water available for GWD after stage of GWD brought to 60% (MCM)	0.42
Proposed Number of DW (@ 1.5 ham for 90% of GWR Available)	25
Proposed Number of BW (@ 1.0 ham for 10% of GWR Available)	4
Area (ha) proposed to be brought under assured GW irrigation with avg. CWR of 0.65 m after 60% stage of gwd is achieved	64.33
Regulatory Measures	**60m borewells/tube wells**

Panchayat Management Plan

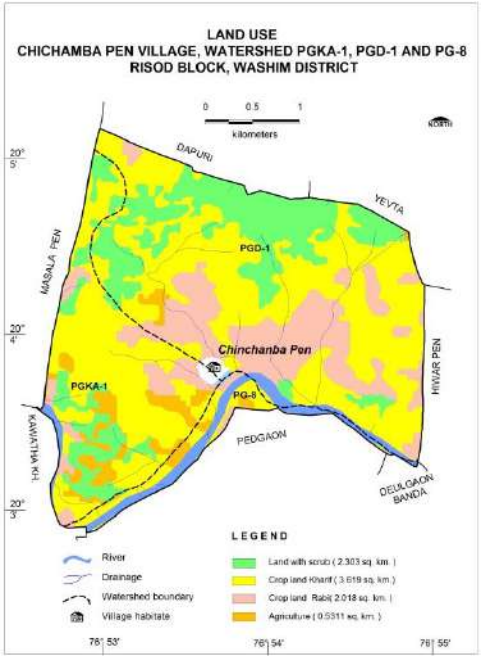


Soil map



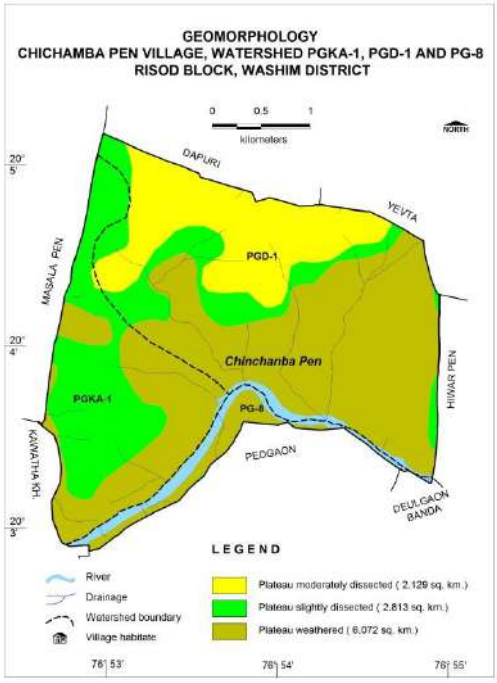
In the village major area is covered by Clayey soil of the thickness >100 cm covering 6.889 sq.km area whereas in some parts such as in north side sandy clay loamy soil is observed with a thickness 50 to 100cm. Similarly in central and northwest and small area in north east clay loam soil is observed of the thickness 25-50 cm. Gravelly clay loam of shallow thickness is observed along the Penganga river in south eastern side.

Landuse map



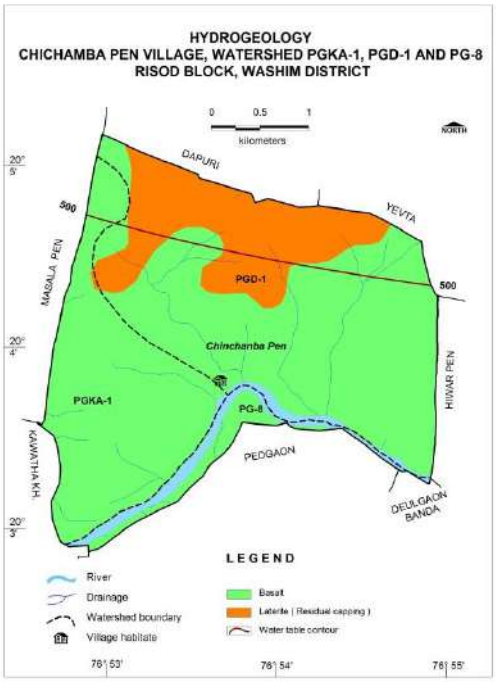
In the village major cultivable land is under Kharif cropping pattern covering 3.619 sq.km. 2.018 sq.km area is under Rabi crops whereas 2.026 sq.km area is double cropped.

Geomorphology & Drainage map



Major part of the village shows weathered plateau in the south, east and south-west part of the village while slightly to moderately dissected plateau is observed in north, west and north-west parts.

Hydro-geology map



Entire village is covered by Deccan trap Basalt except in the small part in north-west and north, north-east part of the village is covered by residual Laterite capping.

Panchayat Level Aquifer Management Plan

Village – Chichambapen, Risod Block, Washim District

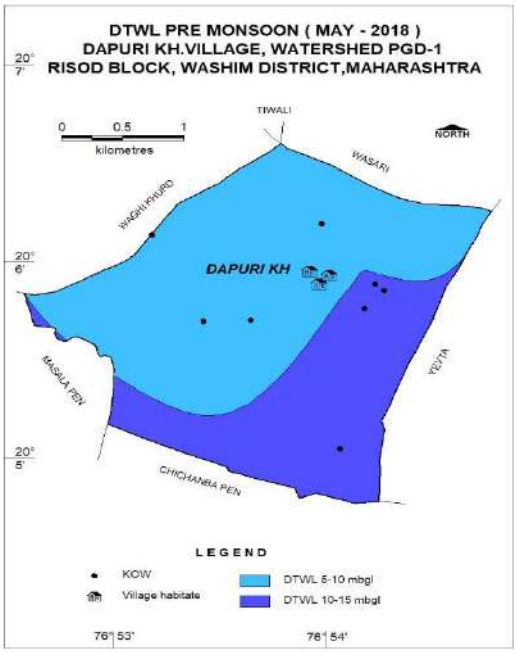
Aquifer (Prominent Lithology)	Current Scenario	Geology / Basalt flow	Geomorphology	Ground water quality	Recommendations for Aquifer Development					Aquifer Management Plan
					Type/number	Zones/Depth to be tapped	HP of pump to be lowered	Pumping Hours	Yield (Cu. m / Day)	
Aquifer I (Basalt-Weathered and fractures)	870 ha cultivable land, 6 CD, 1 PT, 9 LBS, 1 KTW, 1 PWS scheme, 7 DW(d), 105 DW (i), Pre-monsoon DTWL~ 5-15 m bgl. Post-monsoon DTWL~ 1-7 m bgl. SOD-59.52%	DT Basalt (Sahyadri Group), Aa/ pahoehoe / simple basaltic lava flows (Buldhana / Purandargarh Formation)	Plateau (slightly dissected to moderately dissected) with weathered thickness ranging from 0 to 7 m. BCS-25 to 100 cm.	Quality of ground water is good and fit for drinking, domestic and irrigation purpose; All parameters are within MPL except Nitrate contamination.	Dug well / 25	Depth Range of Zones : 6 – 15 m	3 to 5	1 to 4	< 10 – 200 m^3/day Or 0.7 ham/year	1. About 64.33 ha area is proposed to be brought under assured GW irrigation during Rabi. 2. The DW should be used for irrigation purpose. 3. Desilting of existing water conservation and artificial recharge structures.
Aquifer II (Basalt-Jointed & Fractures)	70 BW(i) Nil BW (d) DTWL~ 15-35 m bgl.	As above	--	Not assessed	Bore well / 4	Depth : 60 m	3 to 5	3 to 8	0.14-2.16 lps	1. The BW should be used for drinking purpose. 2. BW should not be drilled down below the red bole and depth not more than 60 m

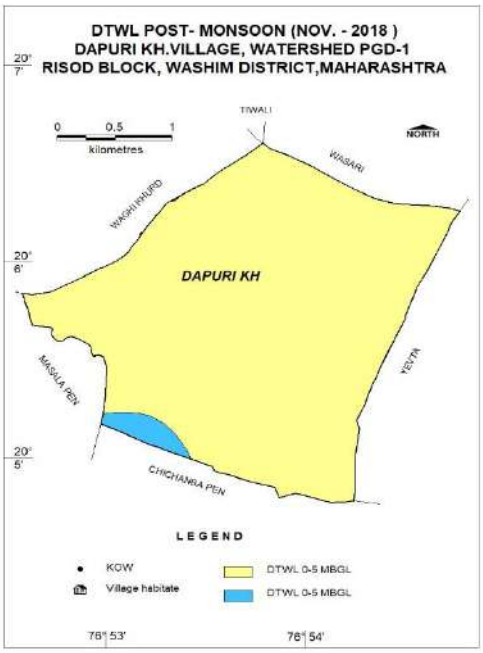
Note: DW (d) = Dug well Domestic; DW (i) = Dug Well Irrigation; BW(d) = Bore Well Domestic; BW(i) = Bore Well Irrigation

10.2 PANCHAYAT LEVEL AQUIFER MANAGEMENT PLAN, WATERSHEDS PGD-1, VILLAGE DAPURI KH. RISOD BLOCK, WASHIM DISTRICT, MAHARASHTRA

1. SALIENT FEATURES			
1.1 Introduction			
Village Name			Dapuri Kh
Geographical Area (Sq. Km.)			7.12
Hilly Area (Sq. Km.)			Nil
Population (Current year -2018)			2000
Climate			Monsoon Sub-Tropical
Normal Rainfall (mm) (nearest rain gauge station-Risod)			880
Annual Rainfall (mm) 2009-18 (nearest rain gauge station-Risod)			880
1.2. Geomorphology, Soil & Geology			
Geomorphic Unit	Plateau (slightly dissected to moderately dissected, Weathered).		
Geology	Deccan Traps (Basalt) Age: Late Cretaceous to Eocene		
Soil	BCS consisting mostly of clay >100 cm and Gravelly clay loam 10-25 cm thick. At some places Sandy clay loam of 50-100 cm and clayey of 25 to 50 cm thick.		
1.3. Hydrology & Drainage			
Watershed		PGD-1 (7.12 sq. Km)	
Drainage		Godavari basin with dendritic to sub-dendritic drainage pattern. 1st Order Stream – 11.704 km 2nd Order Stream – 4.679 km 3rd Order Stream – 4.779 km 4th Order Stream –0.2909 km	
Irrigation Project (Major/Medium/Minor etc.)		Nil	
WC structures (PT / KT / CD / FP etc.)		05-CD, 02-PT, 01-Vill farm	
1.4. Land Use, Agriculture, Irrigation & Cropping Pattern			
Specifics			**Area**
Forest Area			Nil
Cultivable Area			596.49 ha
Net Sown Area			596.00 ha
Double Cropped Area			Nil
Irrigation Dug wells			68
Irrigation Bore wells			128
Area under Drip & Sprinkler Irrigation			Nil
Area under Irrigation	Surface Water		Nil
	Ground Water		596.41 ha
Principal Crops *(Reference year 2018)*	Soyabean		476 ha
	Pulses (*Tur*)		61 ha
	Pulses (*Udad*)		10 ha
	Pulses (*Moong*)		11 ha
	Jawari		11 ha
	Cotton		1 ha
	Other		13.25 ha
	Sugarcane, Turmeric and Orange		13.0 ha
1.5. Water Level Behavior : Aquifer-I (Shallow Aquifer) In the village, 08 KOW were established to decipher the water level scenario.			
Pre-Monsoon (May-2018) In the entire village shows the DTWL ranges		**Post-Monsoon (November-2018)** Entire area of the village shows DTWL in the range of 0-5	

between 5-10 mbgl whereas in the south, south-east DTWL ranges between 5-10 mbgl.	mbgl DTWL. A small isolated patch of the DTWL 5-10 mbgl is observed in the south-west of the village.





GROUND WATER ISSUES

1. Declining water level.
2. Non-availability of surface water for irrigation.
3. Less ground water potential basaltic aquifer.
4. Water stress situation during lean period (March to June)**.**

AQUIFER DISPOSITION

3.1. Number of Aquifers	Basalt –Aquifer-I (Phreatic / Shallow aquifer)

3.2. Aquifer Characteristics

Major Aquifers	**Basalt (Deccan Traps)**
Type of Aquifer	Basalt –Aquifer-I (Phreatic / Shallow aquifer)
Static Water Level (mbgl)	11.00
Depth of Occurrence (mbgl)	11.00-20.00
weathered thickness (m)	0- 10.00
Specific yield (Sy)	0.02 (norms)

GROUND WATER QUALITY: Phreatic Aquifer (Aquifer-I/ Shallow aquifer)

All the rest parameters are within the desirable/Permissible limits of BIS Drinking Water Standards IS- 10500-2012. Hence the ground water is ***suitable*** for drinking purposes & also can be used for agricultural purposes& other domestic use purposes.

PH	EC	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F
7.4	665	352	306	37	51	15	4.3	0	184	46	39	29	0.28

GROUND WATER RESOURCES- Aquifer-I/ Shallow Phreatic Aquifer (Basalt)

5. 1 Water budgeting

A. Water availability

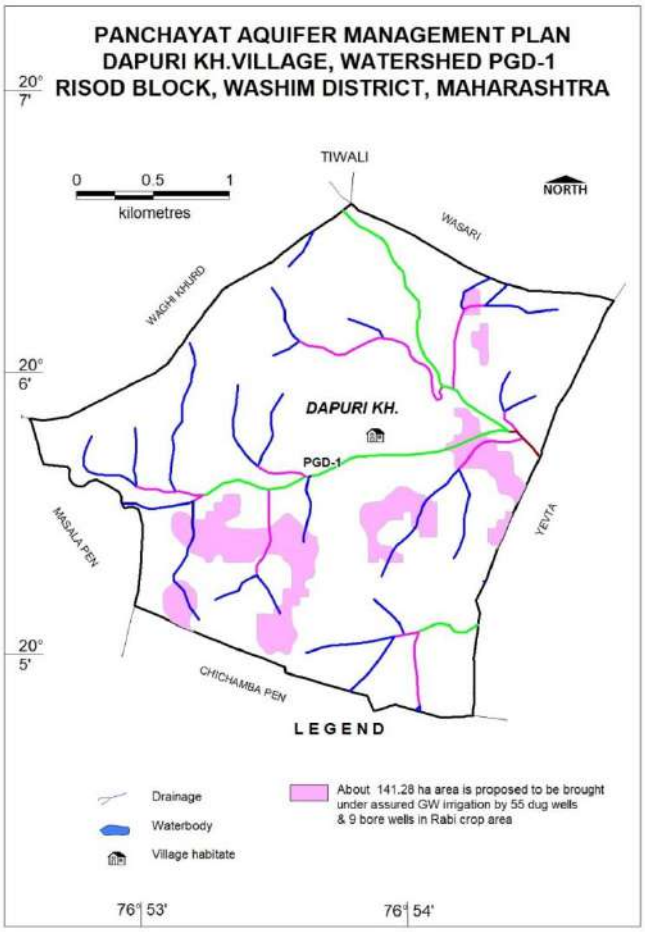
Area (ha)	712.2
Rainfall (m)	0.88
Water precipitated, ham, (Area X RF)	626.74
90 % of precipitations (ham)	564.06
AR recharge by artificial recharge structure	0.8060
Runoff (2.5%)(RF-AR) (ham)	14.0814
Evaporation (35%) (ham)	197.4218

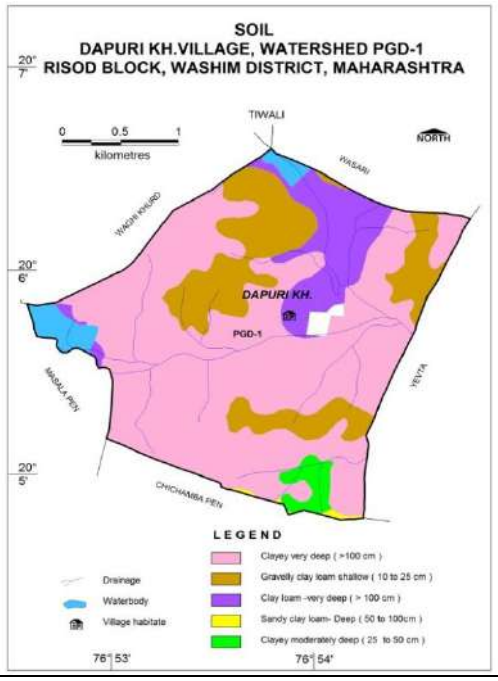
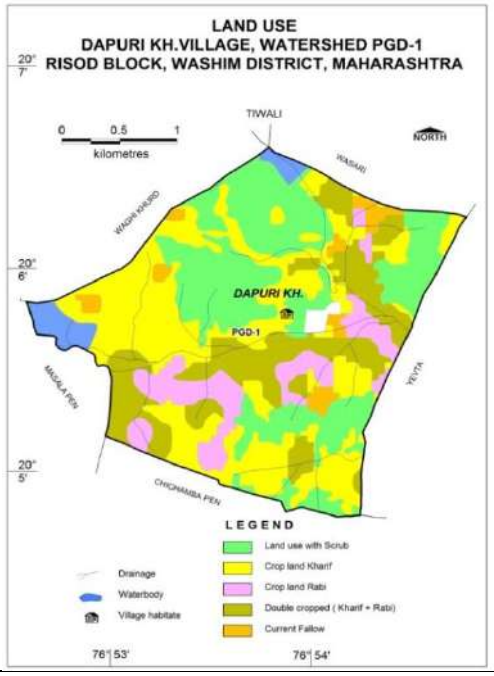
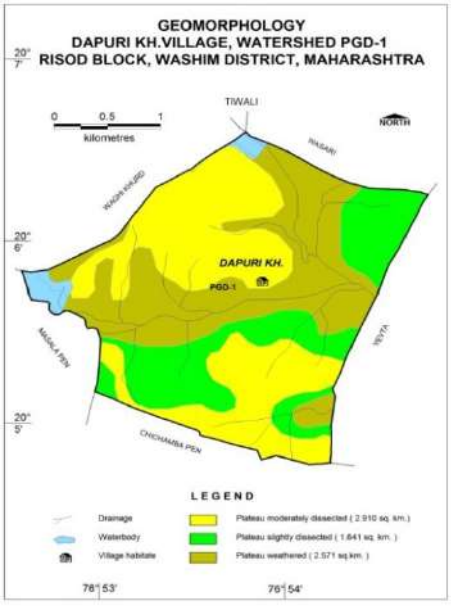
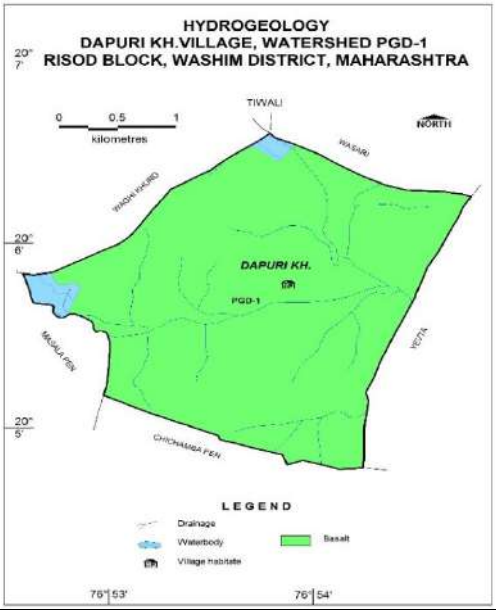
Water retain in ground Tank, Nala etc. (5%) (ham)	28.2031
Recharge to phreatic aquifer (10%) (ham)	56.4062
Enhance soil moisture, utilised by root system (ham)	169.2187
Total Water availability (MCM)	**2.5463**
B. Requirement	
Domestic @60 lpcd X total person(3000) (MCM)	0.0438
Animal @40 lpad X total animal (1111) (MCM)	0.0070
Irrigation water applied (MCM)	0.7569
Non agriculture use (MCM)	0.0564
Total Requirement (MCM)	**0.8641**
C. GW available for Planning (MCM)	**1.6823**
Stage of GW Development (%)	**33.93**

GROUND WATER RESOURCE MANAGEMENT	
6.1. Supply Side Management	
SUPPLY (MCM)	
Available Resource (MCM)	2.55
Agricultural Supply –GW	0.76
Agricultural Supply -SW	0.00
Domestic Supply - GW	0.05
Domestic Supply - SW	0.00
Non agriculture use (MCM)	0.06
Total GW availability (MCM)	1.68
Gross Annual Draft (MCM)	0.76
Area of village (Sq. Km.)	7.12
Area suitable for Artificial recharge (sq km)	7.12
Type of Aquifer	Hard rock
Area feasible for Artificial Recharge (WL >5mbgl) (Sq. Km.)	0.15
Volume of Unsaturated Zone (MCM)	0.000000315
Average Specific Yield	0.02
Volume of Sub Surface Storage Space available for Artificial Recharge (MCM)	0.0000000063
Surplus runoff considered for planning (MCM) @ 100%	14.08
Proposed AR Structures (**Check Dam** (@ Rs.30 lakh, Av. Gross Capacity-10 TCM * 3 fillings = 30 TCM))	Not proposed
Proposed AR Structures **Gabbion**	Not proposed
Proposed AR Structures **Other**	Not proposed
Volume of Water expected to be conserved / recharged @ 75% efficiency (MCM)	Total of above
Specific Recommendations - As per State Govt. Resolution, segment wise nala/stream desilting, deepening and widening upto 3 m depth or upto weathered rock considering the local hydrogeological condition without disturbing the ecology/aquifer/environmental flow of nala/stream.	
Considering average nala deepening of 1 m depth, additional storage	0.00
Considering average nala deepening of 1 m depth, additional recharge @ 75%	0.00
RTRWH Structures	
Households to be covered (Pakka House only)	330
Total RWH potential (MCM) (25% with 50 m2 area)	0.0000499
Rainwater harvested / recharged @ 80% runoff co-efficient (MCM)	0.0000400
However, RTRWH is economically not viable & not Recommended	
6.2. Demand Side Management	
Micro irrigation techniques	
Area is proposed to be covered under Drip	Not proposed
Volume of Water expected to be saved (MCM). Surface Flooding req- 0.36 m. Drip Req. - 0.24, WUE- 0.12 m	--
Proposed Cropping Pattern change	

Irrigated area under Water Intensive Crop(ha)	Not proposed
Water Saving by Change in Cropping Pattern	
6.3. Expected Benefits	
Net Ground Water Availability (MCM)	2.55
Additional GW resources available after Supply side interventions (MCM)	0.00
Ground Water Availability after Supply side intervention(MCM)	2.55
Existing Ground Water Draft for All Uses (MCM)	0.86
GW draft after Demand Side Interventions (MCM)	0.00
Present stage of Ground Water Development (%)	33.93
Expected Stage of Ground Water Development after interventions (%)	33.93
Other Interventions Proposed, if any	
Alternate Water Sources Available	Nil
6.4. Development Plan	
Volume of water available for GWD after stage of GWD brought to 60% (MCM)	0.92
Proposed Number of DW (@ 1.5 ham for 90% of GWR Available)	55
Proposed Number of BW (@ 1.0 ham for 10% of GWR Available)	9
Area (ha) proposed to be brought under assured GW irrigation with av. CWR of 0.65 m after 70% stage of gwd is achieved	141.28

Panchayat Management Plan



Soil map	**Landuse map**
	
In the village major area is covered by Clayey Very deep soil of the thickness >100 cm whereas in some parts such as in north-east and east, south side Gravelly clay loamy soil is observed with a thickness 10 to 25cm. Similarly in north-east and west, clay loam soil is observed of the thickness >100 cm. Small part of sandy clay loam of thickness 50-100cm and clayey moderately deep of the thickness 25-50 cm observed in south side.	In the village major cultivable land is under Kharif cropping pattern covering 2.389 sq.km. 0.7100 sq.km area is under Rabi crops whereas 1.351 sq.km area is double cropped.
Geomorphology & Drainage map	**Hydro-geology map**
	
Major part of the village shows plateau moderately dissected in the north-west and south-east of the village while plateau weathered is observed in center and north-east parts of the village. The small part North-east and middle part of village is covered by plateau slightly dissected.	Entire village is covered by Deccan trap Basalt.

Panchayat Level Aquifer Management Plan

Village – Dapuri, Risod Taluka, Washim District

Aquifer (Prominent Lithology)	Current Scenario	Geology / Basalt flow	Geomorphology	GW quality	Recommendations for Aquifer Development					Aquifer Management Plan
					Type	Zones/Depth to be tapped	HP of pump to be lowered	Pumping Hours	Yield (Cu. m / Day)	
Aquifer I (Basalt-Weathered and fractures)	596.41 ha cultivable land by GW, 5 CD, 02 PT, 1 village farm, 1 PWS scheme, 5 DW(d), 68 DW (i), Pre monsoon DTWL~ 5-15 m bgl. Post monsoon DTWL~ 1-7 m bgl. SOD-33.93%	DT Basalt (Sahyadri Group), Aa /pahoehoe /simple basaltic lava flows (Buldana / Purandargarh Formation)	Plateau (slightly dissected to moderately dissected) with weathered thickness ranging from 0 to 7 m. BCS-25 to 100 cm.	quality of ground water is good and fit for drinking, domestic and irrigation purpose; All parameters are within MPL	Dug well 55	Depth Range of Zones : 6 – 15 m	3 to 5	1 to 4	< 10 – 200 m^3/day Or 0.7 ham/year	1. About 141.28 ha area is proposed to be brought under assured GW irrigation during Rabi. 2. Desilting of existing water conservation and artificial recharge structures. 3. The DW should be used for irrigation purpose.
Aquifer II (Basalt-Jointed & Fractures)	128 BW(i), Nil BW (d), HP-Nil DTWL~ 15-35 m bgl.	As above	--	Not assessed	Bore well 09	Depth : 60 m	3 to 5	1 to 3	0.14-2.16 lps	1. The BW should be used for drinking purpose. 2. The BW should not be drilled down below the red bole.

Note: DW(d)= Dug well Domestic; DW (i)= Dug Well Irrigation; BW(d)= Bore Well Domestic; BW(i)= Bore Well Irrigation

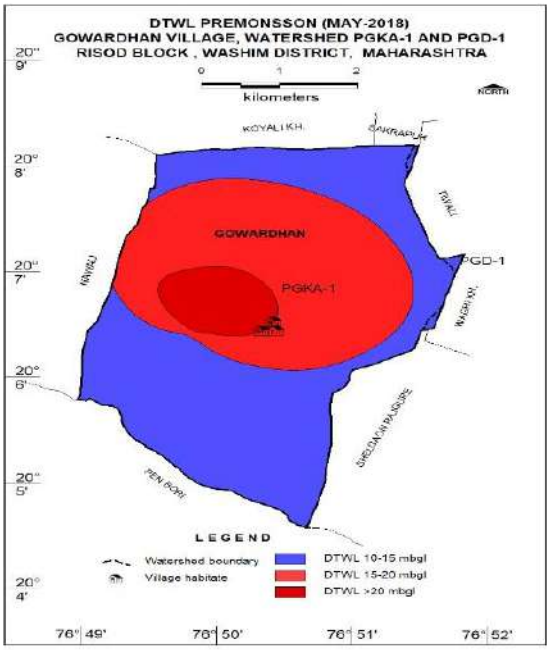
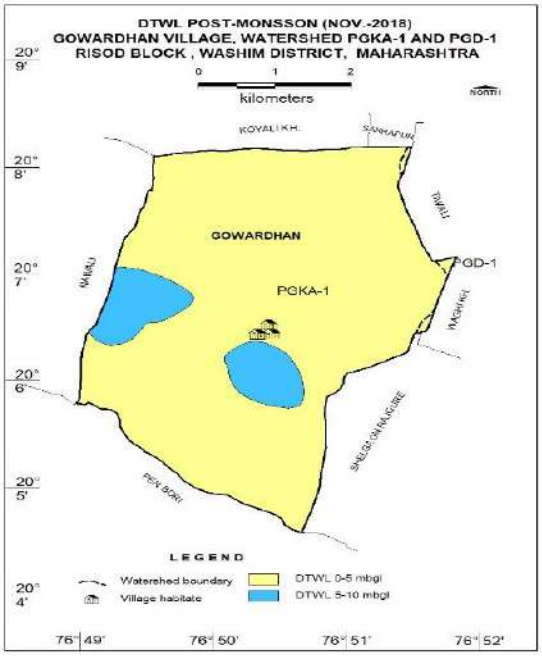
10.3 PANCHAYAT LEVEL AQUIFER MANAGEMENT PLAN, WATERSHEDSPGKA-1, VILLAGE GOWARDHAN, RISOD BLOCK, WASHIM DISTRICT, MAHARASHTRA

1. SALIENT FEATURES		
1.1 Introduction		
Village Name		Gowardhan
Geographical Area (Sq. Km.)		20.94 sq km
Hilly Area (Sq. Km.)		Nil
Population (Current year -2018)		3902
Climate		Monsoon Sub-Tropical
Normal Rainfall(mm)(nearest rain gauge station-Risod)		880
Annual Rainfall (mm) 2009-18(nearest rain gauge station-Risod)		880
1.2. Geomorphology, Soil & Geology		
Geomorphic Unit	Plateau (Weathered, moderately dissected, slightly dissected Weathered shallow).	
Geology	Deccan Traps (Basalt) Age: Late Cretaceous to Eocene	
Soil	BCS consisting mostly of Clayey-Very deep (> 100 cm), Gravelly clay loam (10 to 25 cm) and clayey (50 to 100 cm) thick. At some places Clay loam-moderately deep (25 to 50 cm).	
1.3. Hydrology & Drainage		
Watershed		PGKA-1 (20.94 sq. Km).
Drainage		Godavari basin; Penganga River with dendritic to sub-dendritic drainage pattern. 1st Order Stream – 37.787 km 2nd Order Stream– 10.744 km 3rd Order Stream–8.247 km 4th order Stream- 3.815 km
Irrigation Project (Major/Medium/Minor etc.)		Nil
WC structures (PT/KT/CD/FP etc.)		05-CD, 02-PT, 00- Village Pond, other-20
1.4. Land Use, Agriculture, Irrigation & Cropping Pattern		
Specifics		**Area**
Forest Area		Nil
Cultivable Area		1600.00 ha
Net Sown Area		1400.00 ha
Double Cropped Area		20
Irrigation Dug wells		225
Irrigation Bore wells		260
Area under Drip & Sprinkler Irrigation		Nil
Area under Irrigation	Surface Water	Nil
	Ground Water	1600.00 ha
Principal Crops	Soyabean	900 ha

(Reference year 2018)	Pulses (*Tur*)	300 ha
	Pulses (Udad)	100 ha
	Pulses (Mug)	100 ha
	Gram, Wheat	960 ha
	Vegetables	20 ha

1.5. Water Level Behavior : Aquifer-I (Shallow Aquifer)

In the village, 11 KOW were established to decipher the water level scenario.

Pre-Monsoon (May-2018)	**Post-Monsoon (November-2018)**
Most of the area of the village DTWL ranges 15-20 mbgl whereas In the Center part of the village DTWL ranges >20mbgl. In the south and north side of the village DTWL ranges 10-15 mbgl.	Entire area of the village shows DTWL in the range of 0-5 mbgl except in north-west small part a patch of DTWL ranging 5-10 mbgl is observed. A small isolated patch of the DTWL 5-10 mbgl is observed in the center of the village.
	

2. Ground Water Issues

Declining water level.

Non availability of surface water for irrigation.

Less ground water potential basaltic aquifer.

Water stress situation during lean period (March to June).

3. AQUIFER DISPOSITION

3.1. Number of Aquifers	Basalt –Aquifer-I (Phreatic / Shallow aquifer)

3.2. Aquifer Characteristics

Major Aquifers	**Basalt (Deccan Traps)**
Type of Aquifer	Basalt –Aquifer-I (Phreatic / Shallow aquifer)
Static Water Level (m bgl)	14-21
Depth of Occurrence (m bgl)	10-20
weathered thickness (m)	0- 10.00
Specific yield (Sy)	0.02

4. GROUND WATER QUALITY: Phreatic Aquifer (Aquifer-I/ Shallow aquifer)

Except Nitrate, all the rest parameters are within the desirable/Permissible limits of BIS Drinking Water Standards IS- 10500-2012. Hence the ground water is suitable for drinking purposes & also can be used for agricultural purposes & other domestic use.

PH	EC	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F
7.7	652	345	265	55	30	24	3.1	0	256	19	14	47	0.28

5. GROUND WATER RESOURCES- Aquifer-I/ Shallow Phreatic Aquifer (Basalt)

5. 1 Water budgeting

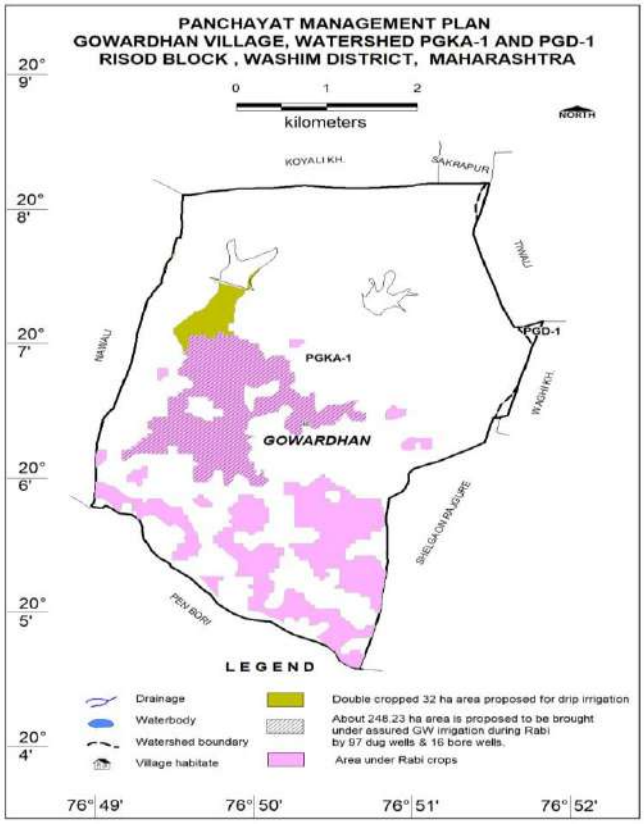
A. Water availability	
Area (ha)	2094.00
Rainfall (m)	0.88
Water precipitated, ham, (Area X RF)	1842.72
90 % of precipitations (ham)	1658.45
AR recharge by artificial recharge structure	0.8060
Runoff (2.5%)(RF-AR) (ham)	41.4411
Evaporation (35%) (ham)	580.4568
Water retain in ground Tank, Nala etc. (5%) (ham)	82.9224
Recharge to phreatic aquifer (10%) (ham)	165.8448
Enhance soil moisture, utilised by root system (ham)	497.5344
Total Water availability (MCM)	**7.4711**
B. Requirement	
Domestic @60 lpcd X total person(3000) (MCM)	0.0964
Animal @40 lpad X total animal (1111) (MCM)	0.0084
Irrigation water applied (MCM)	4.3536
Non agriculture use (MCM)	0.1658
Total Requirement (MCM)	**4.6242**
C. GW available for Planning (MCM)	**2.8468**
Stage of GW Development (%)	**61.90**

6.0. GROUND WATER RESOURCE MANAGEMENT

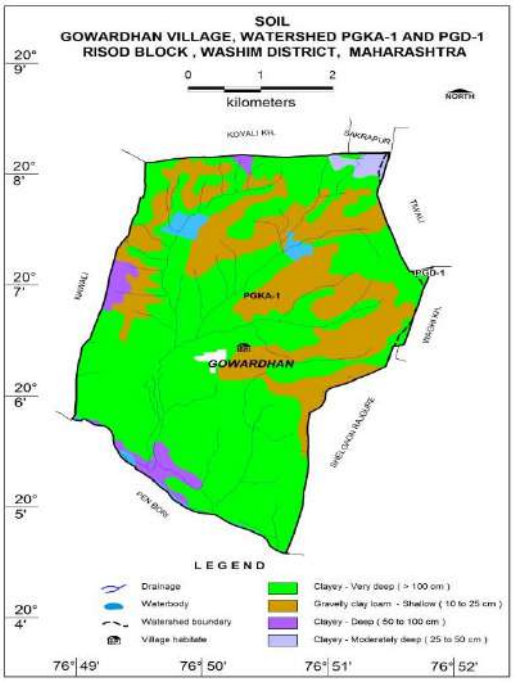
6.1. Supply Side Management

SUPPLY (MCM)	
Available Resource (MCM)	7.47
Agricultural Supply –GW	4.35
Agricultural Supply -SW	0.00
Domestic Supply - GW	0.10
Domestic Supply - SW	0.00
Non agriculture use (MCM)	0.17
Total GW availability (MCM)	2.85
Gross Annual Draft (MCM)	4.35
Area of village (Sq. Km.)	20.94
Area suitable for Artificial recharge (sq km)	20.94
Type of Aquifer	Hard rock
Area feasible for Artificial Recharge (WL >5mbgl) (Sq. Km.)	1.94
Volume of Unsaturated Zone (MCM)	0.000004074
Average Specific Yield	0.02
Volume of Sub Surface Storage Space available for Artificial Recharge (MCM)	0.00000008148
Surplus runoff considered for planning (MCM) @ 100%	41.44
Proposed AR Structures (**Check Dam** (@ Rs.30 lakh, Av. Gross Capacity-10 TCM * 3 fillings = 30 TCM))	Not proposed
Proposed AR Structures **Gabbion**	Not proposed
Proposed AR Structures **Other**	Not proposed

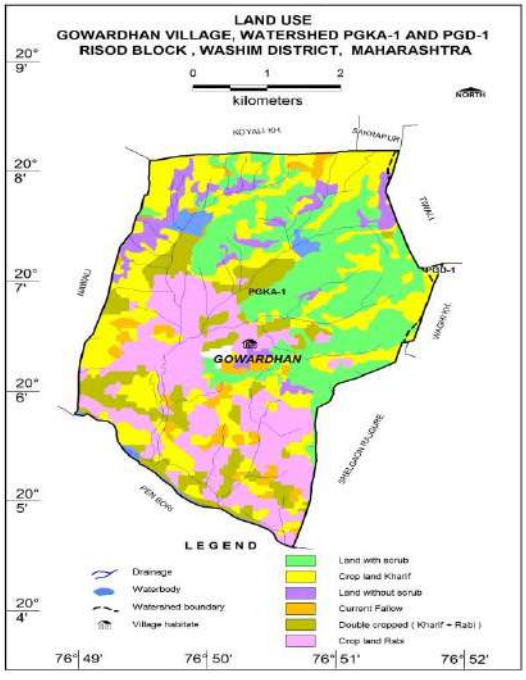
Volume of Water expected to be conserved / recharged @ 75% efficiency (MCM)	-
Specific Recommendations - As per State Govt. Resolution, segment wise nala/stream desilting, deepening and widening upto 3 m depth or upto weathered rock considering the local hydrogeological condition without disturbing the ecology/aquifer/environmental flow of nala/stream.	--
Considering average nala deepening of 1 m depth, additional storage	--
Considering average nala deepening of 1 m depth, additional recharge @ 75%	--
RTRWH Structures	
Households to be covered (Pakka House only)	227
Total RWH potential (MCM) (25% with 50 m2 area)	0.0000499
Rainwater harvested / recharged @ 80% runoff co-efficient (MCM)	0.0000400
However, RTRWH is economically not viable & not Recommended	
6.2. Demand Side Management	
Micro irrigation techniques	
Area is proposed to be covered under Drip	3.2
Volume of Water expected to be saved (MCM). Surface Flooding req- 1.4 m. Drip Req. - 0.95, WUE- 0.45 m	1.44
Proposed Cropping Pattern change	
Irrigated area under Water Intensive Crop(ha)	Not proposed
Water Saving by Change in Cropping Pattern	
6.3. Expected Benefits	
Net Ground Water Availability (MCM)	7.47
Additional GW resources available after Supply side interventions (MCM)	1.44
Ground Water Availability after above intervention(MCM)	8.91
Existing Ground Water Draft for All Uses (MCM)	4.62
GW draft after Demand Side Interventions (MCM)	0.00
Present stage of Ground Water Development (%)	61.90
Expected Stage of Ground Water Development after interventions (%)	51.89
Other Interventions Proposed, if any	
Alternate Water Sources Available	Nil
6.4. Development Plan	
Volume of water available for GWD after stage of GWD brought to 70% (MCM)	1.61
Proposed Number of DW (@ 1.5 ham for 90% of GWR Available)	97
Proposed Number of BW (@ 1.0 ham for 10% of GWR Available)	16
Area (ha) proposed to be brought under assured GW irrigation with av. CWR of 0.65 m after 70% stage of gwd is achieved	248.23
Regulatory Measures	**60m borewells/tube wells**
Panchayat Management Plan	



Soil map

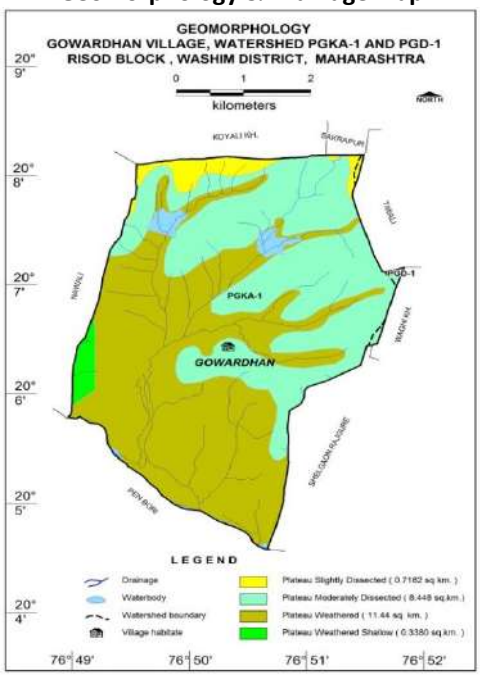
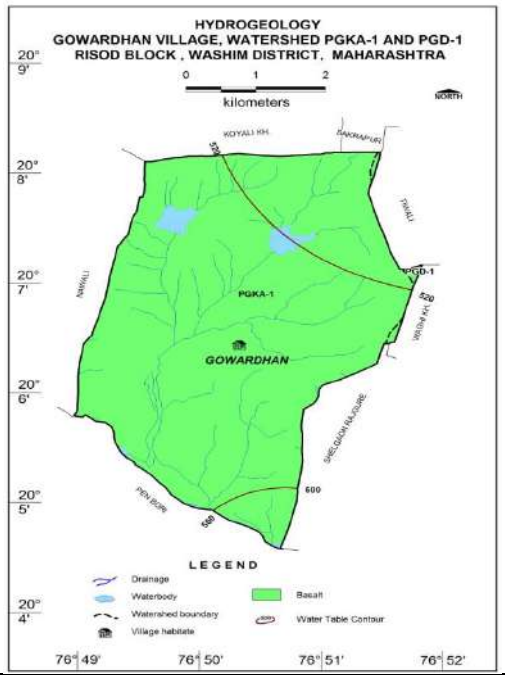


Landuse map



In the village major area is covered by Clayey soil of the thickness >100 cm whereas in some parts such as in North-east and North-West Gravelly Clay loam soil is observed with a thickness 10 to 25cm. Similarly small patches in North and South, west Clayey deep soil of the thickness 50- 100 cm and small area in North-West clay moderately deep soil is observed of the thickness 25-50 cm.

In the village major cultivable land is under Kharif cropping pattern covering 6.01 sq. km. 4.689 sq.km area is under Rabi crops whereas 2.390 sq.km area is double cropped.

Geomorphology & Drainage map	**Hydro-geology map**
	
Major part of the village shows plateau weathered of the village while plateau moderately dissected is observed in north-eastern part of the village, some patches slightly dissected north side of the village. Small part of village is plateau weathered shallow in the West side.	Entire village is covered by Deccan trap Basalt with Aa /pahoehoe /simple basaltic lava flows of Buldhana / Purandargarh Formation.

Panchayat Level Aquifer Management Plan

Village – Gowardhan, RisodTaluka, Washim District

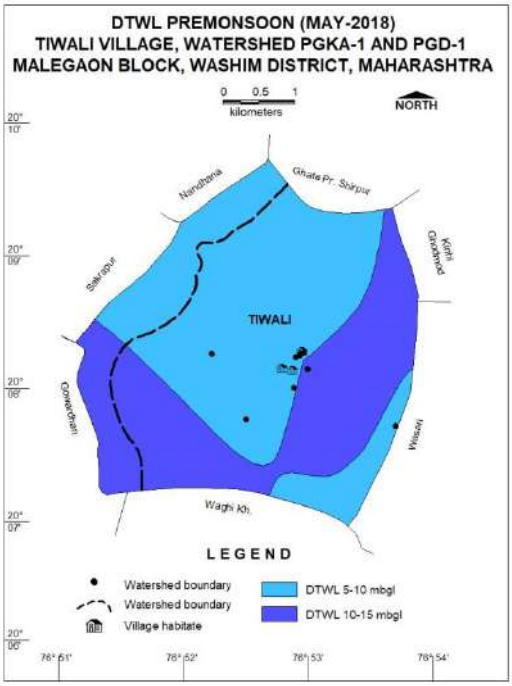
Aquifer (Prominent Lithology)	Current Scenario	Geology / Basalt flow	Geomorphology	GW quality	Recommendations for Aquifer Development					Aquifer Management Plan
					Type	Zones/Depth to be tapped	HP of pump to be lowered	Pumping Hours	Yield (Cu. m / Day)	
Aquifer I (Basalt-Weathered and fractures)	1600.00 ha cultivable land,01-MI Tank, 5-CD, 02-PT , 20-other , 1 PWS scheme, 8 DW(d), 225 DW (i), Pre-monsoon DTWL~ 10-21 m bgl. Post-monsoon DTWL~ 2-8m bgl.	DT Basalt (Sahyadri Group), Aa /pahoehoe /simple basaltic lava flows (Buldana / Purandargarh Formation)	Plateau (weathered, moderately dissected, Slightly dissected) with weathered thickness ranging from 0 to 7 m. BCS-25 to 100 cm.	Quality of ground water is good and fit for drinking, domestic and irrigation purpose; All parameters are within MPL except Nitrate contamination.	Dug wells-97	Depth Range of Zones : 6 – 15 m	3 to 5	1 to 4	< 10 – 200 m^3/day Or 0.7 ham/year	1. About 248.23 ha area is proposed to be brought under assured GW irrigation during Rabi. 2. About 320 ha area under Wheat & perennial crops is proposed for drip irrigation. 3. Desilting of existing water conservation and artificial recharge structures. 4. The DW should be used for irrigation purpose.
Aquifer II (Basalt-Jointed & Fractures)	260 BW(i), 04 BW (d) DTWL~ 15-35 m bgl.	As above	--		Bore wells-16	Depth : 60 m	3 to 5	1 to 3	0.14-2.16 lps	1. The BW should be used for drinking purpose. 2. BW should not be drilled down below the red bole.

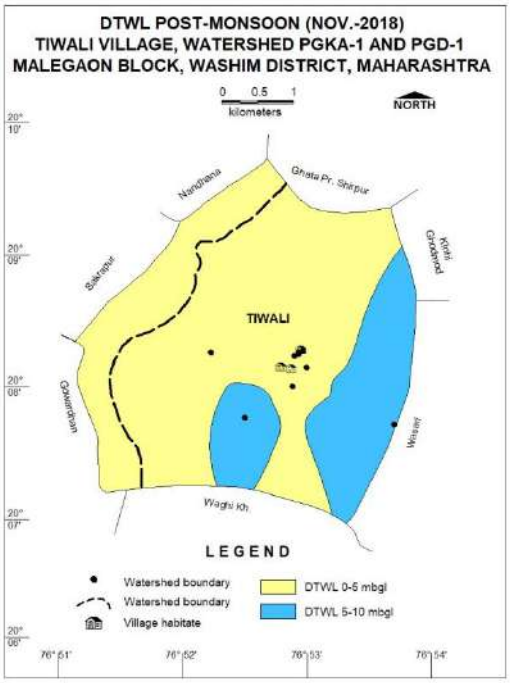
Note: DW(d)= Dug well Domestic; DW (i)= Dug Well Irrigation; BW(d)= Bore Well Domestic; BW(i)= Bore Well Irrigation

10.4 PANCHAYAT LEVEL AQUIFER MANAGEMENT PLAN, WATERSHEDS PGKA-1 AND PGD-1, VILLAGE TIWALI, MALEGAON BLOCK, WASHIM DISTRICT, MAHARASHTRA

1. SALIENT FEATURES			
1.1 Introduction			
Village Name			Tiwali
Geographical Area (Sq. Km.)			16.47
Hilly Area (Sq. Km.)			Nil
Population (Current year -2018)			4350
Climate			Monsoon Sub-Tropical
Normal Rainfall (mm) (nearest rain gauge station-Malegaon)			966.9
Average Annual Rainfall (mm) 2009-18 (nearest rain gauge station-Malegaon)			797.36
1.2. Geomorphology, Soil & Geology			
Geomorphic Unit	Plateau (slightly dissected to moderately dissected).		
Geology	Deccan Traps (Basalt) Age: Late Cretaceous to Eocene		
Soil	BCS consisting mostly of clay >100 cm and loam 25-50 cm thick. At some places Sandy clay loam of 50-100 cm.		
1.3. Hydrology & Drainage			
Watershed		PGKA-1 (3.022 Sq.km.), PGD-1 (13.76 Sq.km.)	
Drainage		Godavari basin; Dendritic to sub-dendritic drainage pattern. 1st Order Stream – 14.714 km 2nd Order Stream – 8.105 km 3rd Order Stream – 0.1803 km	
Irrigation Project (Major/Medium/Minor etc.)		Nil	
WC structures (PT / KT / CD / FP etc.) *CFP-Community Farm pond		05-CD, *CFP-04, 01-PT	
1.4. Land Use, Agriculture, Irrigation & Cropping Pattern ***(Data collected field /Irrigation Dept)***			
Specifics			**Area**
Forest Area			Nil
Cultivable Area			1592.50 ha
Net Sown Area			1550 ha
Double Cropped Area			250 ha
Irrigation Dug wells			42
Irrigation Bore wells			42
Area under Drip & Sprinkler Irrigation			Nil
Area under Irrigation	Surface Water		Nil
	Ground Water		1592.50 ha
Principal Crops *(Reference year 2018)*	Soyabean		1377 ha
	Pulses (*Tur*)		105 ha
	Pulses (*Udad*)		29 ha
	Pulses (*Moong*)		10.40 ha
	Turmeric		4 ha
	Cotton		4 ha
	Fruits		13.30 ha
	Hybrid		2.60 ha
	Other		4.60 ha
1.5. Water Level Behavior : Aquifer-I (Shallow Aquifer) In the village, 9 KOW were established to decipher the water level scenario.			

Pre-Monsoon (May-2018)	**Post-Monsoon (November-2018)**
In the north, north-west, north-east and central part the DTWL ranges between 5-10 mbgl whereas in the east, southeast and south-west DTWL ranges between 10-15 mbgl.	Major area of the village shows DTWL in the range of 0-5 mbgl except in the South-east and small area in east DTWL ranging 5-10 mbgl is observed.





2. GROUND WATER ISSUES

Declining water level.
Non-availability of surface water for irrigation.
Less ground water potential basaltic aquifer.
Water stress situation during lean period (March to June)

3. AQUIFER DISPOSITION

3.1. Number of Aquifers	Basalt –Aquifer-I (Phreatic / Shallow aquifer)

3.2. Aquifer Characteristics

Major Aquifers	**Basalt (Deccan Traps)**
Type of Aquifer	Basalt –Aquifer-I (Phreatic / Shallow aquifer)
Static Water Level (mbgl)	10.00
Depth of Occurrence (mbgl)	10.00-14.00
weathered thickness (m)	0- 7.00

4. GROUND WATER QUALITY: Phreatic Aquifer (Aquifer-I/ Shallow aquifer)

PH	EC	TDS	TH	Ca	Mg	Na	K	CO_3	HCO_3	Cl	SO_4	NO_3	F
7.4	2435	1290	326	108	13	368	6.6	0	607	264	85	60	0.71

After ground water analysis it is observed that,
The groundwater is brackish & not suitable for irrigation. Irrigation water must be applied in excess to provide considerable leaching.
The groundwater is affected by nitrates. Hence, the ground water is not suitable for drinking purposes.

5. GROUND WATER RESOURCES- Aquifer-I/ Shallow Phreatic Aquifer (Basalt)

5. 1 Water budgeting

A. Water availability

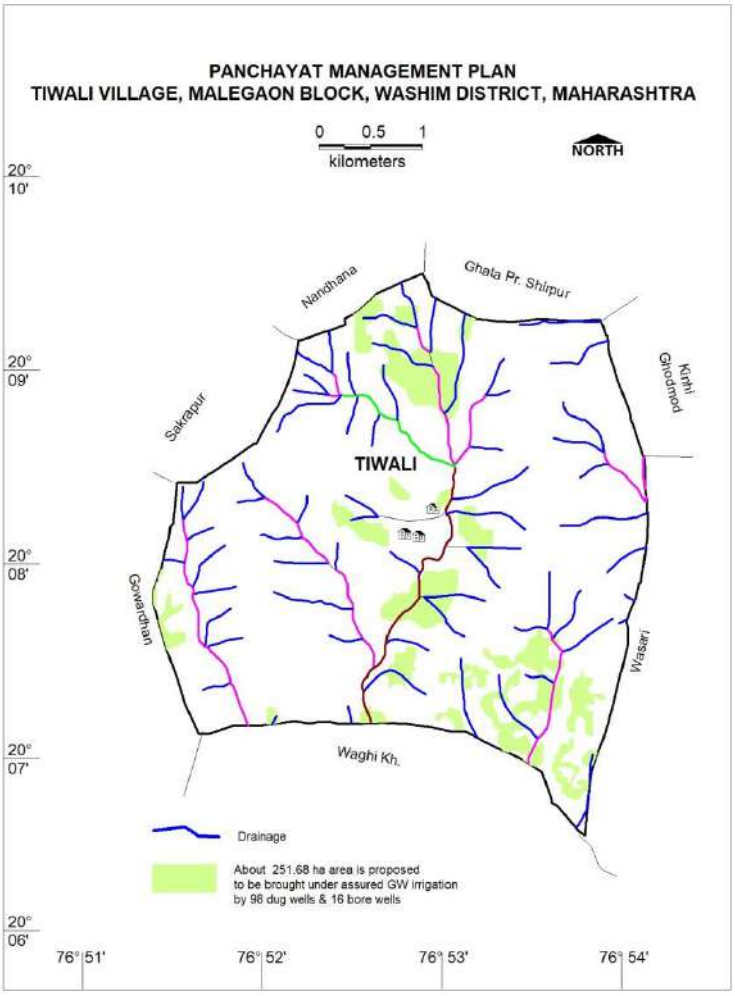
Area (ha)	1647.00
Rainfall (m)	0.85
Water precipitated, ham, (Area X RF)	1399.95
90 % of precipitations (ham)	1259.96
AR recharge by artificial recharge structure	0.4060
Runoff (2.5%)(RF-AR) (ham)	31.4887

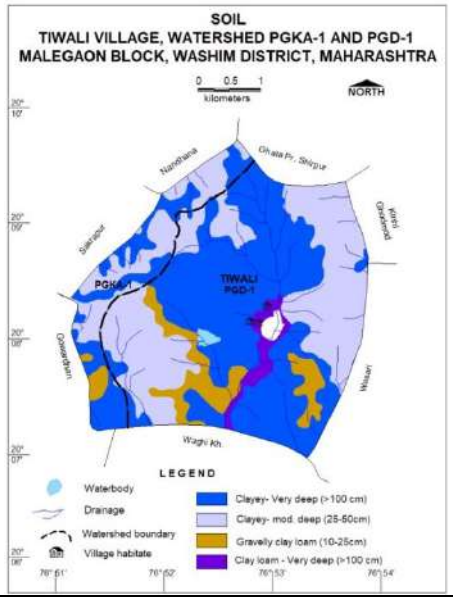
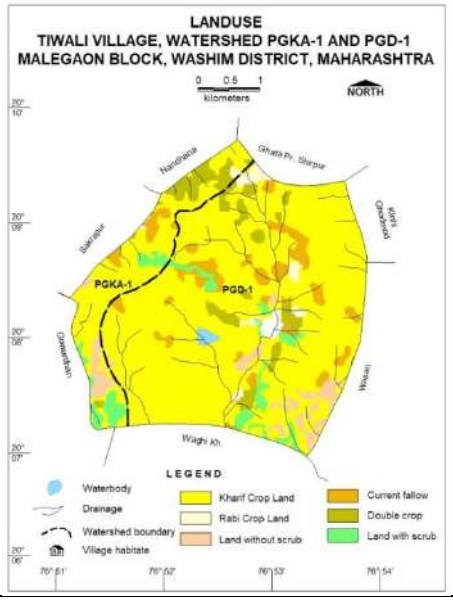
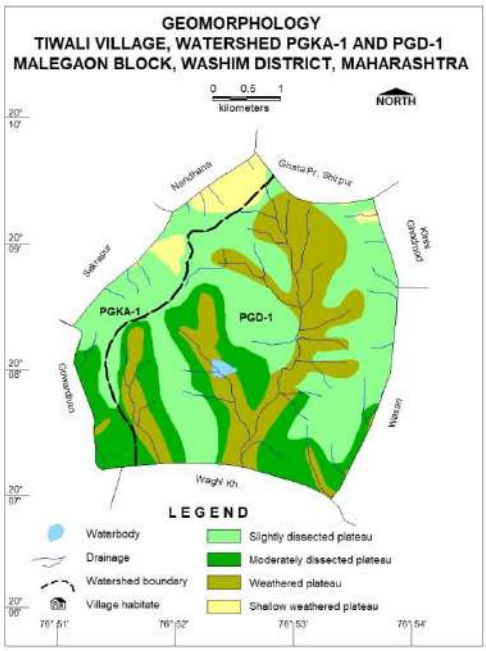
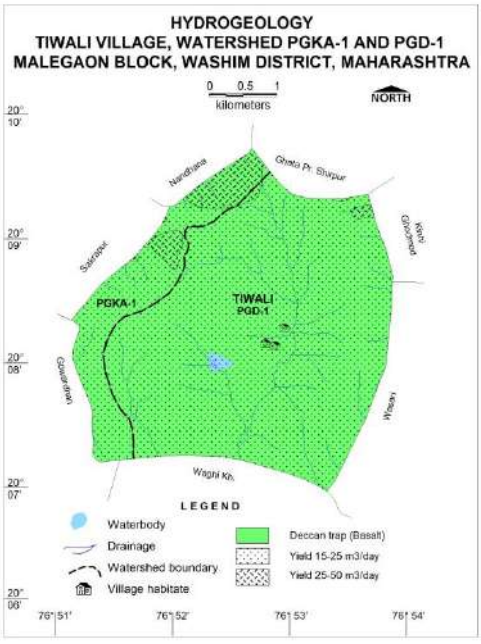
Evaporation (35%) (ham)	440.9843
Water retain in ground Tank, Nala etc. (5%) (ham)	62.9978
Recharge to phreatic aquifer (10%) (ham)	125.9955
Enhance soil moisture, utilised by root system (ham)	377.9865
Total Water availability (MCM)	**5.6739**
B. Requirement	
Domestic @60 lpcd X total person(3000) (MCM)	0.10
Animal @40 lpad X total animal (1111) (MCM)	0.03
Irrigation water applied (MCM)	2.08
Non agriculture use (MCM)	0.13
Total Requirement (MCM)	**2.34**
C. GW available for Planning (MCM)	**3.34**
Stage of GW Development (%)	**41.19**

6.0. GROUND WATER RESOURCE MANAGEMENT	
6.1. Supply Side Management	
SUPPLY (MCM)	
Available Resource (MCM)	5.67
Agricultural Supply –GW	2.07
Agricultural Supply -SW	0.00
Domestic Supply - GW	0.13
Domestic Supply - SW	0.00
Non agriculture use (MCM)	0.13
Total GW availability (MCM)	**3.35**
Gross Annual Draft (MCM)	**5.65**
Area of village (Sq. Km.)	16.47
Area suitable for Artificial recharge (sq km)	16.47
Type of Aquifer	Hard rock
Area feasible for Artificial Recharge (WL >5mbgl) (Sq. Km.)	4.119
Volume of Unsaturated Zone (MCM)	0.000010297500
Average Specific Yield	0.02
Volume of Sub Surface Storage Space available for Artificial Recharge (MCM)	0.000000205950
Surplus runoff considered for planning (MCM) @ 100%	31.49
Proposed AR Structures (**Check Dam** (@ Rs.30 lakh, Av. Gross Capacity-10 TCM * 3 fillings = 30 TCM))	Not proposed
Proposed AR Structures **Gabbion**	Not proposed
Proposed AR Structures **Other**	Not proposed
Volume of Water expected to be conserved / recharged @ 75% efficiency (MCM)	Not proposed
Specific Recommendations - As per State Govt. Resolution, segment wise nala/stream desilting, deepening and widening upto 3 m depth or upto weathered rock considering the local hydrogeological condition without disturbing the ecology/aquifer/environmental flow of nala/stream.	4.98
Considering average nala deepening of 1 m depth, additional storage	4.98
Considering average nala deepening of 1 m depth, additional recharge @ 75%	3.74
RTRWH Structures	
Households to be covered (Pakka House only)	3970
However, RTRWH is economically not viable & not Recommended	
6.2. Demand Side Management	
Micro irrigation techniques	
Area is proposed to be covered under Drip	Not proposed
Volume of Water expected to be saved (MCM). Surface Flooding req- 0.36 m. Drip Req. - 0.24, WUE- 0.12 m	-
Proposed Cropping Pattern change	
Irrigated area under Water Intensive Crop(ha)	Not proposed
Water Saving by Change in Cropping Pattern	

6.3. Expected Benefits	
Net Ground Water Availability (MCM)	5.67
Additional GW resources available after Supply side interventions (MCM)	3.74
Ground Water Availability after Supply side intervention(MCM)	9.41
Existing Ground Water Draft for All Uses (MCM)	5.65
GW draft after Demand Side Interventions (MCM)	0.00
Present stage of Ground Water Development (%)	99.52
Expected Stage of Ground Water Development after interventions (%)	60.02
Other Interventions Proposed, if any	
Alternate Water Sources Available	Nil
6.4. Development Plan	
Volume of water available for GWD after stage of GWD brought to 60% (MCM)	Nil
Proposed Number of DW (@ 1.5 ham for 90% of GWR Available)	Nil
Proposed Number of BW (@ 1.5 ham for 10% of GWR Available)	Nil
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	Nil
Regulatory Measures	**60m borewells/tube wells**

Panchayat Management Plan



Soil map	**Landuse map**
	
In the village major area is covered by Clayey soil of the thickness >100 cm covering 8.357 sq.km area whereas in east, south-west, north-east, north-west parts patches of clayey soil of the thickness 25-50 cm covering 6.528 sq. km area is observed. In some parts such as in south, south-east and south-west side gravelly clay loam is observed with a thickness 10 to 25 cm covering 1.339 sq.km area. Similarly in south-central part one long patch of clay loam of the thickness >100cm is observed.	In the village major cultivable land is under Kharif cropping pattern covering 12.80 sq.km. 0.2737 sq.km area is under Rabi crops whereas 1.013 sq.km area is double cropped.
Geomorphology & Drainage map	**Hydro-geology map**
	
Major part of the village shows slightly dissected plateau while moderately dissected plateau is observed in south, south-west and south-east parts. Drainage is of dendritic to sub dendritic type.	Entire village is covered by Deccan trap Basalt. Major part of the village shows moderate yield of 10-20 % covering 15.93 sq.km area whereas small patches of high yield of 50-60% are observed in north, north-west and a small patch in north-east covering 0.8450 sq. km area.

Panchayat Level Aquifer Management Plan

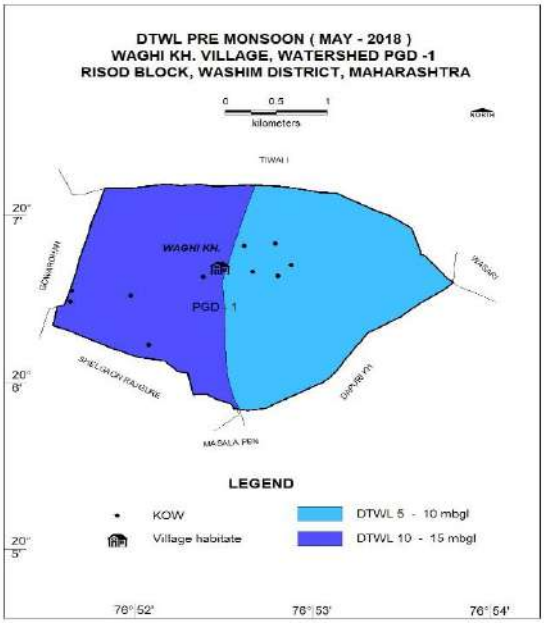
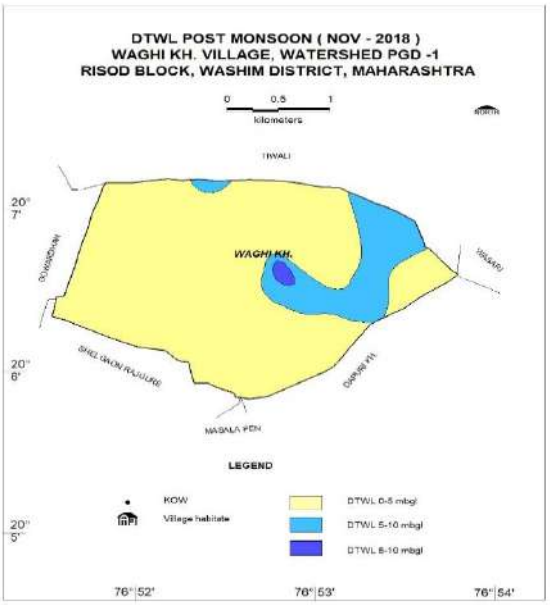
Village – Tiwali, Malegaon Taluka, Washim District

Aquifer (Prominent Lithology)	Current Scenario	Geology / Basalt flow	Geomorphology	Ground water quality	Recommendations for Aquifer Development					Aquifer Management Plan
					Type/number	Zones/Depth to be tapped	HP of pump to be lowered	Pumping Hours	Yield (Cu. m / Day)	
Aquifer I (Basalt-Weathered and fractures)	1592.50 ha cultivable land by GW, 05 CD, *CFP-04, 01-PT , DW(d), 42 DW (i), Pre monsoon DTWL~ 5-15 m bgl. Post monsoon DTWL~ 0-10 m bgl. SOD – 41.19%	DT Basalt (Sahyadri Group), Aa/ pahoehoe / simple basaltic lava flows (Buldhana / Purandargarh Formation)	Plateau (slightly dissected to moderately dissected).	The GW is brackish. Other parameters are within MPL except Nitrate contamination. GW is unsuitable for drinking & irrigation purpose; domestic	Dug well / 98	Depth Range of Zones : 6 – 15 m	3 to 5	1 to 4	< 10 – 200 m^3/day Or 0.7 ham/year	i. About 251.68 ha area is proposed to be brought under assured GW irrigation during Rabi. ii. The DW should be used for irrigation purpose. iii. Desilting of existing water conservation and artificial recharge structures.
Aquifer II (Basalt-Jointed & Fractures)	70 BW(i) Nil BW (d) DTWL~ 15-35 m bgl.	As above	--	Not assessed	Bore well / 16	Depth : 60 m	3 to 5	3 to 8	0.14-2.16 lps	1. The BW should be used for drinking purpose. 2. BW should not be drilled down below the red bole and depth not more than 60 m

Note: DW(d)= Dug well Domestic; DW (i)= Dug Well Irrigation; BW(d)= Bore Well Domestic; BW(i)= Bore Well Irrigation

10.5 PANCHAYAT LEVEL AQUIFER MANAGEMENT PLAN, WATERSHEDS PGD-1, PGKA-1, VILLAGE WAGHI KH, RISOD BLOCK, WASHIM DISTRICT, MAHARASHTRA

1. SALIENT FEATURES			
1.1 Introduction			
Village Name			Waghi Kh
Geographical Area (Sq. Km.)			6.557 sq km
Hilly Area (Sq. Km.)			Nil
Population (Current year -2018)			2474
Climate			Monsoon Sub-Tropical
Normal Rainfall (mm) (nearest rain gauge station-Risod)			880
Annual Rainfall (mm) 2009-18 (nearest rain gauge station-Risod)			880
1.2. Geomorphology, Soil & Geology			
Geomorphic Unit	Plateau (slightly dissected to moderately dissected, Weathered).		
Geology	Deccan Traps (Basalt) Age: Late Cretaceous to Eocene		
Soil	BCS consisting mostly of Clayey-Very deep (> 100 cm), Clayey-Moderately deep (25 to 50 cm) and Gravelly clay loam-Shallow (10 to 25 cm) thick. At some places Clay loam-Very deep (> 100 cm).		
1.3. Hydrology & Drainage			
Watershed	PGD-1 (5.169 Sq.km.), PGKA-1(0.6562 Sq.km.).		
Drainage	Godavari basin; Penganga River with dendritic to sub-dendritic drainage pattern. 1st Order Stream – 7.564 km 2nd Order Stream – 5.13 km 3rd Order Stream – 2.84 km		
Irrigation Project (Major/Medium/Minor etc.)	01 Minor Irrigation Tank		
WC structures (PT / KT / CD / FP etc.)	05-CD, 01-PT, 01- Village Pond		
1.4. Land Use, Agriculture, Irrigation & Cropping Pattern			
Specifics			Area
Forest Area			Nil
Cultivable Area			490.99 ha
Net Sown Area			490.90 ha
Double Cropped Area			Nil
Irrigation Dug wells			36
Irrigation Bore wells			21
Area under Drip & Sprinkler Irrigation			Nil
Area under Irrigation	Surface Water		Nil
	Ground Water		490.90 ha
Principal Crops *(Reference year 2018)*	Soyabean		396.59 ha
	Pulses (*Tur*)		58 ha
	Jawar		3 ha
	Turmeric		29 ha
	Wheat		16 ha
	Gram		35 ha
	Others		19 ha
1.5. Water Level Behavior : Aquifer-I (Shallow Aquifer) In the village, 10 KOW were established to decipher the water level scenario.			
Pre-Monsoon (May-2018) In the western part the DTWL ranges between 10-15		**Post-Monsoon (November-2018)** Entire area of the village shows DTWL in the range of 0-	

mbgl whereas in the eastern side DTWL ranges between 5-10 mbgl.	5 mbgl except in north-eastern part a patch of DTWL ranging 5-10 mbgl is observed. A small isolated patch of the DTWL 5-10 mbgl is observed in the north of the village.
	

2. Ground Water Issues

Declining water level. *(Based on block wise DTWL trend from CGWB/GSDA data)*
Less ground water potential basaltic aquifer.
Water stress situation during lean period (March to June)

3. AQUIFER DISPOSITION

3.1. Number of Aquifers	Basalt –Aquifer-I (Phreatic / Shallow aquifer)

3.2. Aquifer Characteristics

Major Aquifers	Basalt (Deccan Traps)
Type of Aquifer	Basalt –Aquifer-I (Phreatic / Shallow aquifer)
Static Water Level (mbgl)	07-12.00
Depth of Occurrence (mbgl)	7-15.00
weathered thickness (m)	0- 7.00
Specific yield (Sy)	0.02

4. GROUND WATER QUALITY: Phreatic Aquifer (Aquifer-I/ Shallow aquifer)

Except Nitrate, all the rest parameters are within the desirable/Permissible limits of BIS Drinking Water Standards IS- 10500-2012. Hence the ground water is *suitable* for drinking purposes & also can be used for agricultural purposes & other domestic use purposes.

PH	EC	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F
7.2	954	504	423	157	7	15	5.1	0	297	63	60	47	0.12

5. GROUND WATER RESOURCES- Aquifer-I/ Shallow Phreatic Aquifer (Basalt)

5. 1 Water budgeting

A. Water availability

Area (ha)	655.7
Rainfall (m)	0.88
Water precipitated, ham, (Area X RF)	577.02
90 % of precipitations (ham)	519.31
AR recharge by artificial recharge structure	0.4072
Runoff (2.5%)(RF-AR) (ham)	12.9727
Evaporation (35%) (ham)	181.7600
Water retain in ground Tank, Nala etc. (5%) (ham)	25.9657

Recharge to phreatic aquifer (10%) (ham)	51.9314
Enhance soil moisture, utilised by root system (ham)	155.7943
Total Water availability (MCM)	0.0026
B. Requirement	
Domestic @60 lpcd X total person(3000) (MCM)	0.0542
Animal @40 lpad X total animal (1111) (MCM)	0.0047
Irrigation water applied (MCM)	1.0079
Non agriculture use (MCM)	0.0519
Total Requirement (MCM)	**1.1187**
C. GW available for Planning (MCM)	**1.2223**
Stage of GW Development (%)	**47.79**

6.0. GROUND WATER RESOURCE MANAGEMENT

6.1. Supply Side Management

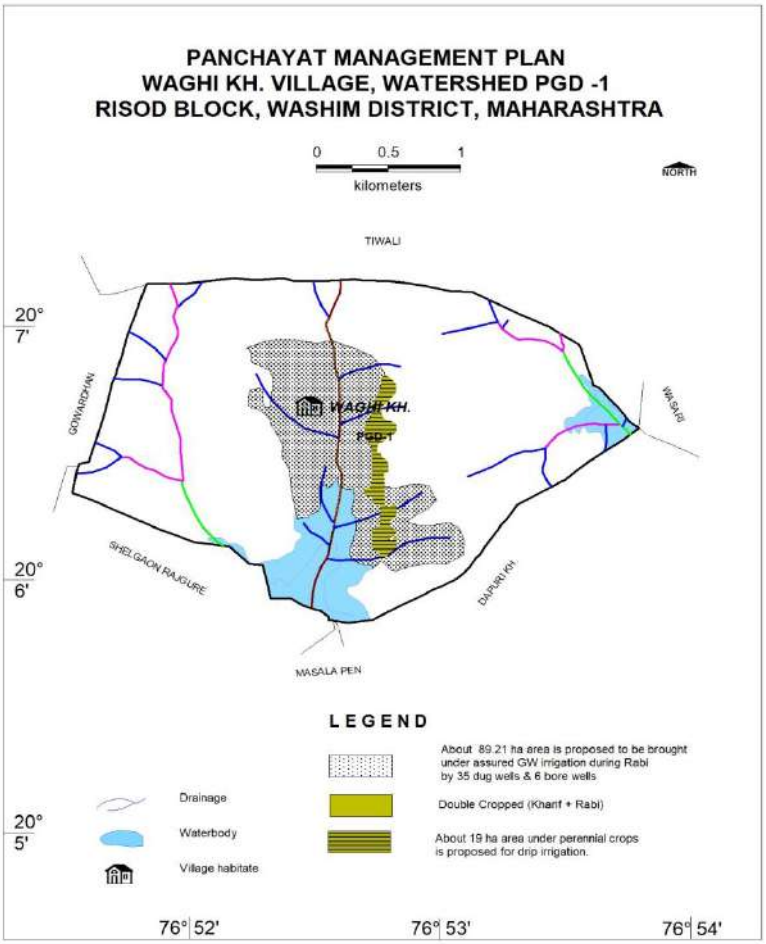
SUPPLY (MCM)	
Available Resource (MCM)	2.34
Agricultural Supply –GW	1.01
Agricultural Supply -SW	0.00
Domestic Supply - GW	0.06
Domestic Supply - SW	0.00
Non agriculture use (MCM)	0.05
Total GW availability (MCM)	**1.22**
Gross Annual Draft (MCM)	**1.01**
Area of village (Sq. Km.)	6.56
Area suitable for Artificial recharge (sq km)	6.56
Type of Aquifer	Hard rock
Area feasible for Artificial Recharge (WL >5mbgl) (Sq. Km.)	1.02
Volume of Unsaturated Zone (MCM)	0.000002142
Average Specific Yield	0.02
Volume of Sub Surface Storage Space available for Artificial Recharge (MCM)	3.99E-08
Surplus runoff considered for planning (MCM) @ 100%	12.97
Proposed AR Structures (Check Dam (@ Rs.30 lakh, Av. Gross Capacity-10 TCM * 3 fillings = 30 TCM))	Not proposed
Proposed AR Structures Gabbion	Not proposed
Proposed AR Structures Other	Not proposed
Volume of Water expected to be conserved / recharged @ 75% efficiency (MCM)	
Specific Recommendations - As per State Govt. Resolution, segment wise nala/stream desilting, deepening and widening upto 3 m depth or upto weathered rock considering the local hydrogeological condition without disturbing the ecology/aquifer/environmental flow of nala/stream.	0.00
Considering average nala deepening of 1 m depth, additional storage	0.00
Considering average nala deepening of 1 m depth, additional recharge @ 75%	0.00
RTRWH Structures	
Households to be covered (Pakka House only)	396
Total RWH potential (MCM) (25% with 50 m2 area)	0.0000499
Rainwater harvested / recharged @ 80% runoff co-efficient (MCM)	0.0000400
However, RTRWH is economically not viable & not Recommended	

6.2. Demand Side Management

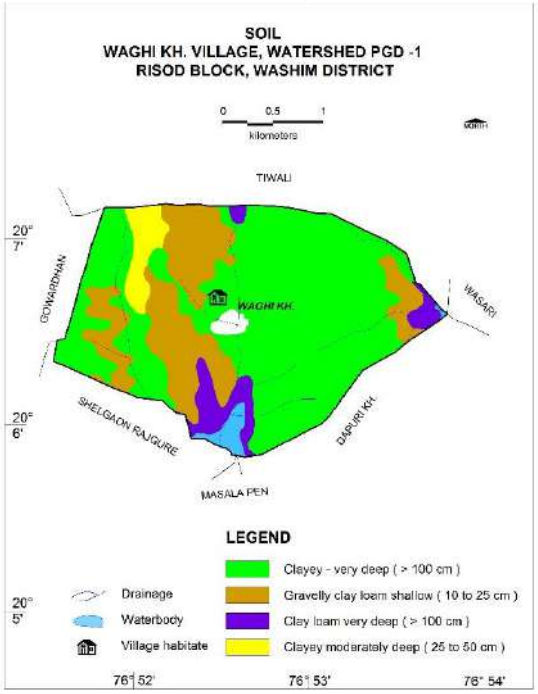
Micro irrigation techniques	
Area is proposed to be covered under Drip (sq km)	0.19
Volume of Water expected to be saved (MCM). Surface Flooding req- 1.4 m. Drip Req. - 0.95, WUE- 0.45 m	0.09
Proposed Cropping Pattern change	
Irrigated area under Water Intensive Crop(ha)	Not proposed

Water Saving by Change in Cropping Pattern	
6.3. Expected Benefits	
Net Ground Water Availability (MCM)	2.34
Additional GW resources available after Supply side interventions (MCM)	0.09
Ground Water Availability after above intervention(MCM)	2.43
Existing Ground Water Draft for All Uses (MCM)	1.12
GW draft after Demand Side Interventions (MCM)	0.09
Present stage of Ground Water Development (%)	47.79
Expected Stage of Ground Water Development after interventions (%)	46.10
Other Interventions Proposed, if any	
Alternate Water Sources Available	Nil
6.4. Development Plan	
Volume of water available for GWD after stage of GWD brought to 70% (MCM)	0.58
Proposed Number of DW (@ 1.5 ham for 90% of GWR Available)	35
Proposed Number of BW (@ 1.0 ham for 10% of GWR Available)	6
Area (ha) proposed to be brought under assured GW irrigation with av. CWR of 0.65 m after 60% stage of gwd is achieved	89.21

Panchayat Management Plan

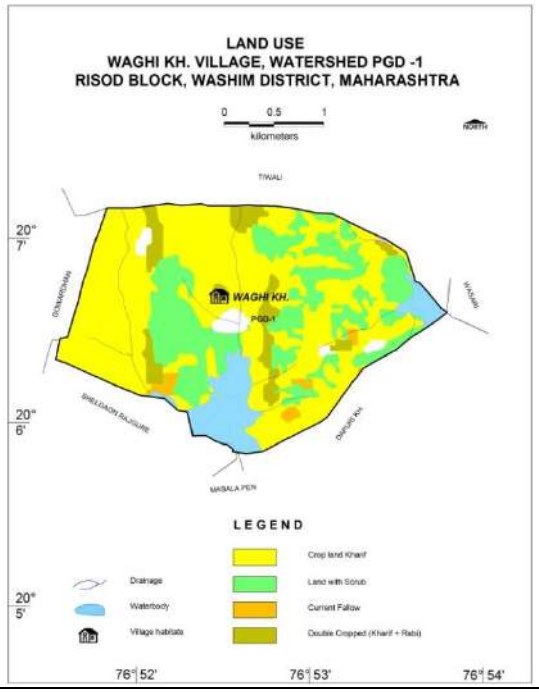


Soil map



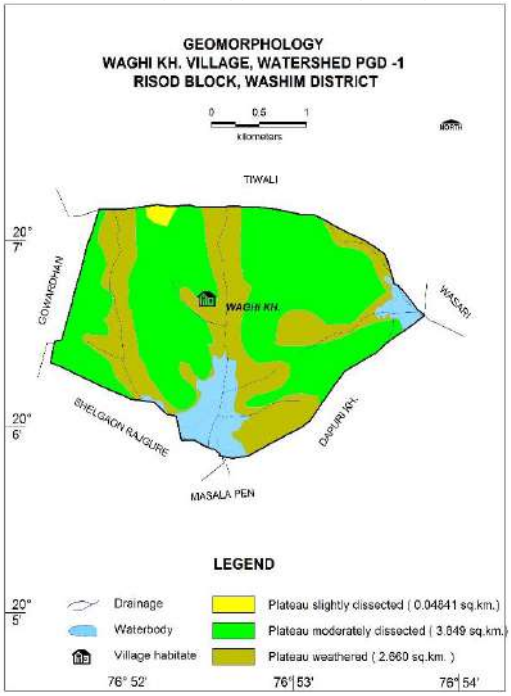
In the village major area is covered by Clayey soil of the thickness >100 cm whereas in some parts such as in North-West and South-West Gravelly Clay loam soil is observed with a thickness 10 to 25cm. Similarly in North and South, East Clay loam very deep soil of the thickness > 100cm and small area in North-West clay moderately deep soil is observed of the thickness 25-50 cm.

Landuse map



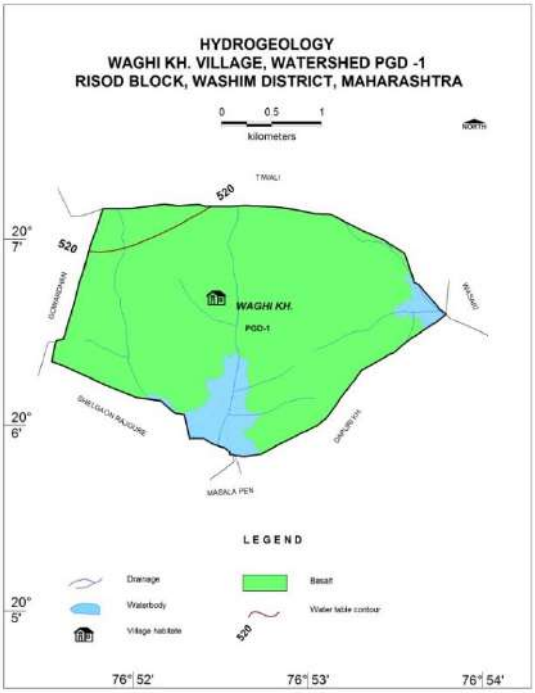
In the village major cultivable land is under Kharif cropping pattern covering 3.976 sq.km. 1.781 sq.km area is under Rabi crops whereas 0.4357 sq.km area is double cropped.

Geomorphology & Drainage map



Major part of the village shows plateau moderately dissected of the village while plateau weathered is observed in Center part of the village, some patches

Hydro-geology map



Entire village is covered by Deccan trap Basalt

west and east of the village. Small parts of village is plateau slightly dissected in the North-West side.	

Panchayat Level Aquifer Management Plan

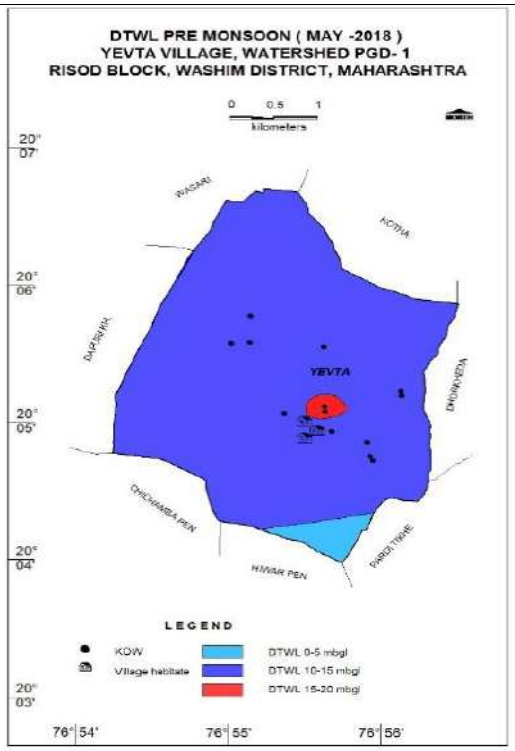
Village – Waghi Kh, Risod Taluka, Washim District

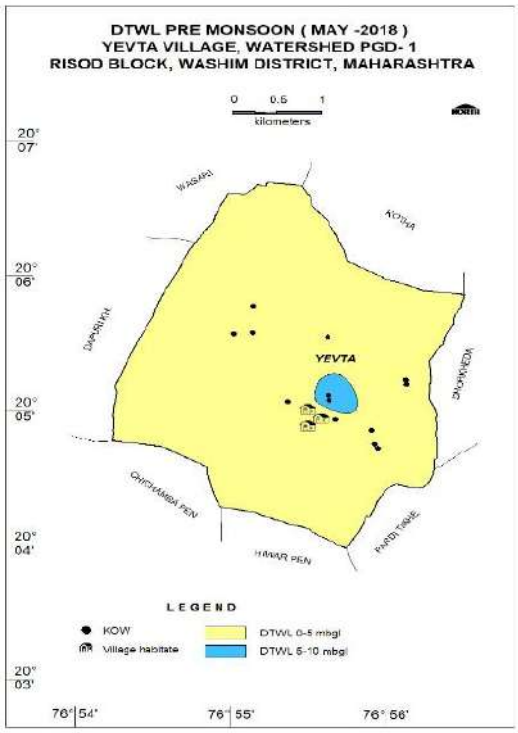
Aquifer (Prominent Lithology)	Current Scenario	Geology / Basalt flow	Geomorphology	GW quality	Recommendations for Aquifer Development					Aquifer Management Plan
					Type	Zones/Depth to be tapped	HP of pump to be lowered	Pumping Hours	Yield (Cu. m / Day)	
Aquifer I (Basalt-Weathered and fractures)	490.90 ha cultivable land,01-MI Tank, 5-CD, 1-PT , 1-vill Pond, 01-KTW , 1 PWS scheme, 5 DW(d), 36 DW (i), Pre-monsoon DTWL~ 7-12 m bgl. Post-monsoon DTWL~ 1-13m bgl.	DT Basalt (Sahyadri Group), Aa /pahoehoe /simple basaltic lava flows (Buldana / Purandargarh Formation)	Plateau (slightly dissected to moderately dissected) with weathered thickness ranging from 0 to 7 m. BCS-25 to 100 cm.	quality of ground water is good and fit for drinking, domestic and irrigation purpose; All parameters are within MPL except Nitrate contamination	Dug wells 35	Depth Range of Zones : 6 – 15 m	3 to 5	1 to 4	< 10 – 200 m^3/day Or 0.7 ham/year	1. About 19 ha area under perennial crops is proposed for drip irrigation. 2. About 89.21 ha area is proposed to be brought under assured GW irrigation during Rabi. 3. Desilting of existing water conservation and artificial recharge structures. 4. The DW should be used for irrigation purpose.
Aquifer II (Basalt-Jointed & Fractures)	21 BW(i), 04 BW (d) DTWL~ 15-35 m bgl.	As above	--	Not assessed	Bore wells 06	Depth : 60 m	3 to 5	1 to 3	0.14-2.16 lps	1. The BW should be used for drinking purpose. 2. BW should not be drilled down below the red bole.

Note: DW(d)= Dug well Domestic; DW (i)= Dug Well Irrigation; BW(d)= Bore Well Domestic; BW(i)= Bore Well Irrigation

10.6 PANCHAYAT LEVEL AQUIFER MANAGEMENT PLAN, WATERSHEDS PGD-1, VILLAGE YEVATA, RISOD BLOCK, WASHIM DISTRICT, MAHARASHTRA

1. SALIENT FEATURES		
1.1 Introduction		
Village Name		Yevata
Geographical Area (Sq. Km.)		12.13 sq km
Hilly Area (Sq. Km.)		Nil
Population (Current year -2018)		3000
Climate		Monsoon Sub-Tropical
Normal Rainfall (mm) (nearest rain gauge station-Risod)		880
Annual Rainfall (mm) 2009-18 (nearest rain gauge station-Risod)		880
1.2. Geomorphology, Soil & Geology		
Geomorphic Unit	Plateau (Weathered, slightly dissected, moderately dissected).	
Geology	Deccan Traps (Basalt) Age: Late Cretaceous to Eocene	
Soil	BCS consisting mostly of Clayey-Very deep (> 100 cm), Clayey-Moderately deep (25 to 50 cm) and Gravelly clay loam-Shallow (10 to 25 cm) thick. At some places Clay loam (25-50 cm) and sandy clay loam (50 to 100 cm) thick.	
1.3. Hydrology & Drainage		
Watershed	PGD-1 (12.13 Sq.km.)	
Drainage	Godavari basin; Penganga River with dendritic to sub-dendritic drainage pattern. 1st Order Stream – 21.050 km 2nd Order Stream – 6.343 km 3rd Order Stream – 5.156 km 4th Order Stream – 3.893 km	
Irrigation Project (Major/Medium/Minor etc.)	Nil	
WC structures (PT / KT / CD / FP etc.)	01-CD, 01-PT, 01- Village pond	
1.4. Land Use, Agriculture, Irrigation & Cropping Pattern		
Specifics		**Area**
Forest Area		Nil
Cultivable Area		1037.11 ha
Net Sown Area		1037.11 ha
Irrigation Dug wells		55
Irrigation Bore wells		78
Area under Drip & Sprinkler Irrigation		Nil
Area under Irrigation	Surface Water	Nil
	Ground Water	1037.11 ha
Principal Crops *(Reference year 2018)*	Soyabean	800 ha
	Pulses (*Tur*)	237 ha
	Gram	500 ha
	Wheat	200 ha
	Vegetables	10 ha
1.5. Water Level Behavior : Aquifer-I (Shallow Aquifer) In the village, 11 KOW were established to decipher the water level scenario.		
Pre-Monsoon (May-2018) Entire area of the village shows DTWL ranges between 10-15 mbgl whereas small isolated part in the middle of the village shows DTWL ranges between 15-20 mbgl. A small part of the DTWL 0-5 mbgl is observed in the south side of the village	**Post-Monsoon (November-2018)** Entire area of the village shows DTWL in the range of 0-5 mbgl except in center part a small isolated patch of DTWL ranging 5-10 mbgl is observed.	





2. GROUND WATER ISSUES

Declining water level. Non availability of surface water for irrigation
Less ground water potential basaltic aquifer.
Water stress situation during lean period (March to June).

3. AQUIFER DISPOSITION

3.1. Number of Aquifers	Basalt –Aquifer-I (Phreatic / Shallow aquifer)
3.2. Aquifer Characteristics	
Major Aquifers	**Basalt (Deccan Traps)**
Type of Aquifer	Basalt –Aquifer-I (Phreatic / Shallow aquifer)
Static Water Level (mbgl)	10.00-15.00
Depth of Occurrence (mbgl)	10-25.00
weathered thickness (m)	0- 10.00
Specific yield (Sy)	*0.02 (norms)*

4. GROUND WATER QUALITY: Phreatic Aquifer (Aquifer-I/ Shallow aquifer)

Nitrate, TH and Mg parameters are above permissible limit, rest of parameters are within the desirable/Permissible limits of BIS Drinking Water Standards IS- 10500-2012. Hence the ground water is not suitable for drinking purposes but can be used for domestic and agricultural uses

PH	EC	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F
7.3	2174	1153	719	178	66	76	58.2	0	351	145	79	320	0.33

5. GROUND WATER RESOURCES- Aquifer-I/ Shallow Phreatic Aquifer (Basalt)

5. 1 Water budgeting

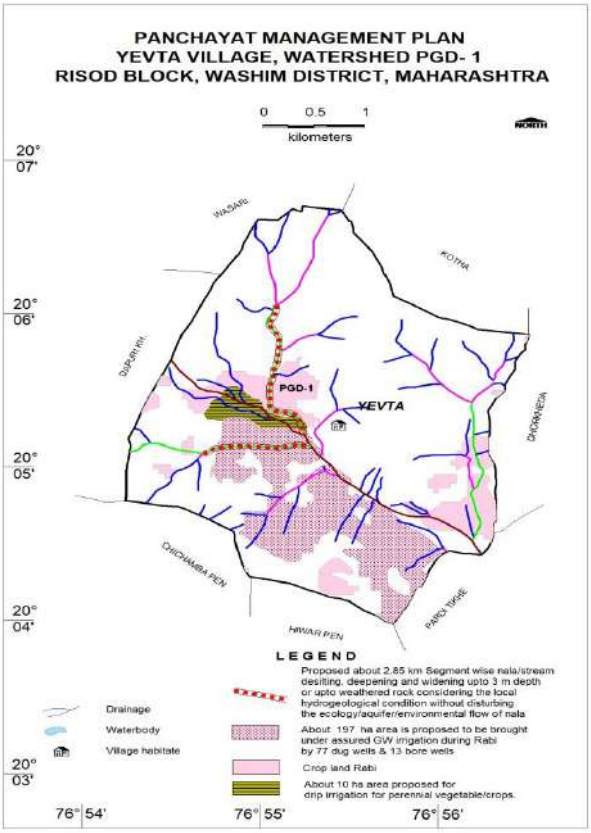
A. Water availability

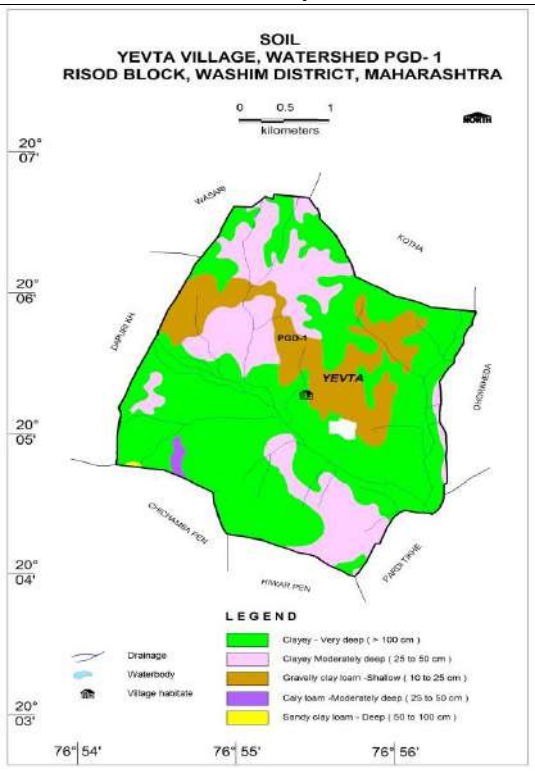
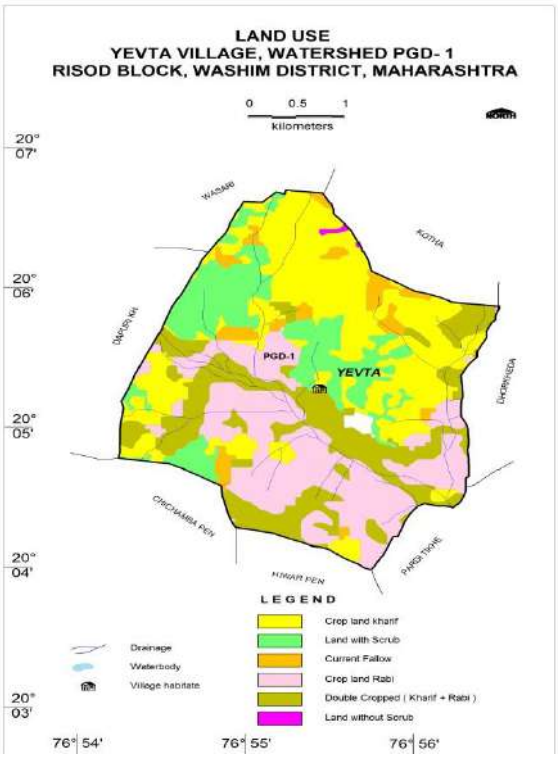
Area (ha)	1213.00
Rainfall (m)	0.88
Water precipitated, ham, (Area X RF)	1067.44
90 % of precipitations (ham)	960.70
AR recharge by artificial recharge structure	0.4012
Runoff (2.5%)(RF-AR) (ham)	24.0074
Evaporation (35%) (ham)	336.2436
Water retain in ground Tank, Nala etc. (5%) (ham)	48.0348
Recharge to phreatic aquifer (10%) (ham)	96.0696
Enhance soil moisture, utilised by root system (ham)	288.2088

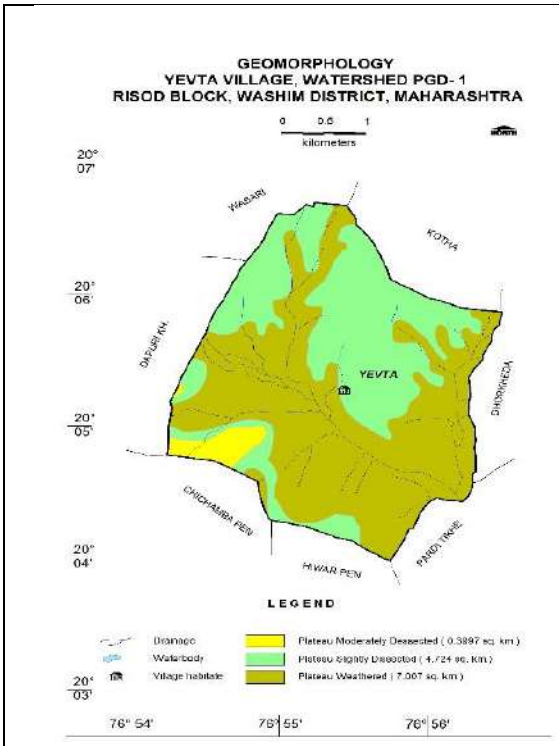
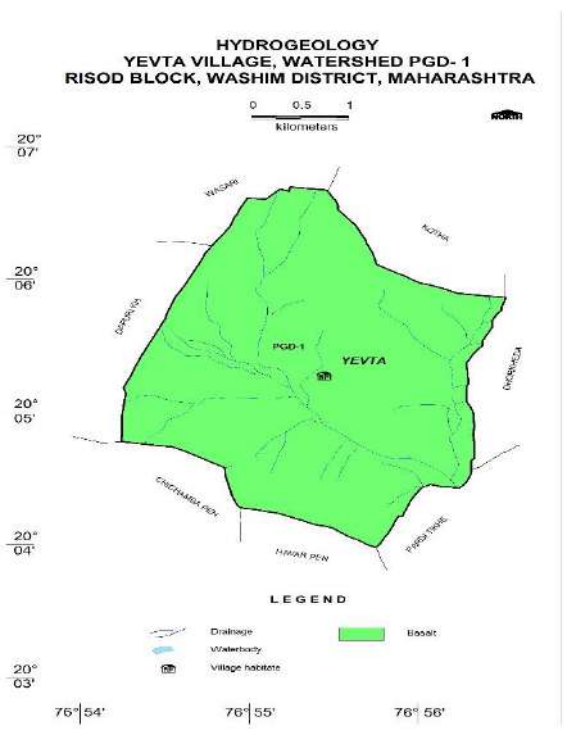
Total Water availability (MCM)	**4.3271**
B. Requirement	
Domestic @60 lpcd X total person(3000) (MCM)	0.0657
Animal @40 lpad X total animal (1111) (MCM)	0.0150
Irrigation water applied (MCM)	3.0994
Non agriculture use (MCM)	0.0961
Total Requirement (MCM)	**3.2762**
C. GW available for Planning (MCM)	**1.05**
Stage of GW Development (%)	**75.71**
6. GROUND WATER RESOURCE MANAGEMENT	
6.1. Supply Side Management	
SUPPLY (MCM)	
Available Resource (MCM)	4.33
Agricultural Supply –GW	3.10
Agricultural Supply -SW	0.00
Domestic Supply - GW	0.08
Domestic Supply - SW	0.00
Non agriculture use (MCM)	0.10
Total GW availability (MCM)	1.05
Gross Annual Draft (MCM)	3.28
Area of village (Sq. Km.)	12.13
Area suitable for Artificial recharge (sq km)	12.13
Type of Aquifer	Hard rock
Area feasible for Artificial Recharge (WL >5mbgl) (Sq. Km.)	0.2
Volume of Unsaturated Zone (MCM)	0.00000042
Average Specific Yield	0.02
Volume of Sub Surface Storage Space available for Artificial Recharge (MCM)	8.4E-09
Surplus runoff considered for planning (MCM) @ 100%	24.01
Proposed AR Structures (**Check Dam** (@ Rs.30 lakh, Av. Gross Capacity-10 TCM * 3 fillings = 30 TCM))	Not proposed
Proposed AR Structures **Gabbion**	Not proposed
Proposed AR Structures **Other**	Not proposed
Volume of Water expected to be conserved / recharged @ 75% efficiency (MCM)	
Specific Recommendations - As per State Govt. Resolution, segment wise nala/stream desilting, deepening and widening upto 3 m depth or upto weathered rock considering the local hydrogeological condition without disturbing the ecology/aquifer/environmental flow of nala/stream. 25 % nala of 2^{nd} & 3^{rd} order is proposed.	2.85
Considering average nala deepening of 1 m depth, additional storage	2.85
Considering average nala deepening of 1 m depth, additional recharge @ 75%	2.14
RTRWH Structures	
Households to be covered (Pakka House only)	210
Total RWH potential (MCM) (25% with 50 m2 area)	0.0000499
Rainwater harvested / recharged @ 80% runoff co-efficient (MCM)	0.0000400
However, RTRWH is economically not viable & not Recommended	
6.2. Demand Side Management	
Micro irrigation techniques	
Area is proposed to be covered under Drip (sq km)	0.1
Volume of Water expected to be saved (MCM). Surface Flooding req- 0.36 m. Drip Req. - 0.24, WUE- 0.12 m	0.045
Proposed Cropping Pattern change	
Irrigated area under Water Intensive Crop(ha)	Not proposed
Water Saving by Change in Cropping Pattern	
6.3. Expected Benefits	

Net Ground Water Availability (MCM)	4.33
Additional GW resources available after Supply side interventions (MCM)	2.18
Ground Water Availability after Supply side intervention(MCM)	6.51
Existing Ground Water Draft for All Uses (MCM)	3.28
GW draft after Demand Side Interventions (MCM)	0.00
Present stage of Ground Water Development (%)	75.71
Expected Stage of Ground Water Development after interventions (%)	50.33
Other Interventions Proposed, if any	
Alternate Water Sources Available	Nil
6.4. Development Plan	
Volume of water available for GWD after stage of GWD brought to 70% (MCM)	1.28
Proposed Number of DW (@ 1.5 ham for 90% of GWR Available)	77
Proposed Number of BW (@ 1.0 ham for 10% of GWR Available)	13
Area (ha) proposed to be brought under assured GW irrigation with av. CWR of 0.65 m after 70% stage of gwd is achieved	197.01

Panchayat Management Plan



Soil map	Landuse map
	
In the village major area is covered by Clayey soil of the thickness >100 cm whereas in some parts such as in north-west and south-east Clay soil is observed with a thickness 25 to 50 cm. Similarly in north-east Gravelly Clay loam of the thickness 10-25 cm observed. The small isolated patches observed in south-west sandy clay loam and clay loam thickness 50 to 100 & 25-50 cm.	In the village major cultivable land is under Kharif cropping pattern covering 3.907 sq.km. 3.136 sq.km area is under Rabi crops whereas 2.500 sq.km area is double cropped.
Geomorphology & Drainage map	**Hydro-geology map**

	
Major part of the village shows plateau weathered of the village while plateau slightly dissected is observed in north-east and north-west of the village. A small isolated patch observed plateau moderately dissected in south- west of the village.	Entire village is covered by Deccan trap Basalt.

Panchayat Level Aquifer Management Plan

Village –Yevata, Risod Taluka, Washim District

Aquifer (Prominent Lithology)	Current Scenario	Geology / Basalt flow	Geomorphology	GW quality	Recommendations for Aquifer Development					Aquifer Management Plan
					Type	Zones/Depth to be tapped	HP of pump to be lowered	Pumping Hours	Yield (Cu. m / Day)	
Aquifer I (Basalt-Weathered and fractures)	1037.11 ha cultivable land, 01-CD, 1-PT , 1-other, 1 PWS scheme, 5 DW(d), 55 DW (i), Pre-monsoon DTWL~ 10-15 m bgl. Post-monsoon DTWL~ 1-8.0 mbgl.	DT Basalt (Sahyadri Group), Aa /pahoehoe /simple basaltic lava flows (Buldana / Purandargarh Formation)	Plateau (weathered, slightly dissected, moderately dissected) with weathered thickness ranging from 0 to 7 m. BCS-25 to 100 cm.	quality of ground water is not suitable for drinking but it can be used domestic and irrigation purpose; Nitrate, TH and Mg are above Permissible limit, Remaining parameters are within MPL	Dug well / 77	Depth Range of Zones : 6 – 15 m	3 to 5	1 to 4	< 10 – 200 m^3/day Or 0.7 ham/year	1. Proposed about 2.85 km Segment wise nala/stream desilting, deepening and widening upto 3 m depth or upto weathered rock considering the local hydrogeological condition without disturbing the ecology/aquifer/environmental flow of nala/stream. 2. About 10 ha area proposed for drip irrigation for perennial vegetable/crops. 3. About 197 ha area is proposed to be brought under assured GW irrigation during Rabi. 4. Desilting of existing water conservation and artificial recharge structures. 5. The DW should be used for irrigation purpose. 6.
Aquifer II (Basalt-Jointed & Fractures)	78 BW(i), 25 BW (d) DTWL~ 15-35 m bgl.	As above	--	Not assessed	Bore well / 13	Depth : 60 m	3 to 5	3 to 8	0.14-2.16 lps	1. The BW should be used for drinking purpose. 2. BW should not be drilled down below the red bole.

Note: DW(d)= Dug well Domestic; DW (i)= Dug Well Irrigation; BW(d)= Bore Well Domestic; BW(i)= Bore Well Irrigation

ANNEXURES

Annexure-I: Salient Features of Ground Water Exploration, Washim District

S. no.	Village	Type of Well	Taluka	Year	Lat_Dec	Long_ Dec	Altitude (m a MSL)	Topo sheet	Depth drilled (mbgl)	Depth of casing (mbgl)	Aquifer zones encountered (mbgl)	Aquifer	Pre SWL (mbgl)	Post SWL (mbgl)	Discharge (lps)	DD (m)
1.	Haral	EW	Risod	2018-19	19.9766	76.8688	525	56 A/13 1B	200	25	126.50-129.60	FMB	24	2	0.14	70
2.	Shelu Bazar	OW	Mangrulpir	1998-99	20.3708	77.2528	434.6	55H/07	30	7.25	6.5 -8 ,13.45 -14	W Basalt	21	2.66	3.17	
3.	Shelu Bazar	OW	Mangrulpir	1998-99	20.3708	77.2528	434.6	55H/07	30	5.6	5 -8 ,13 -13.5	W Basalt	21	2.85	5.94	
4.	Shelu Bazar	EW	Mangrulpir	1998-99	20.3708	77.2528	434.6	55H/07	153.75	7.3	5.5 -7.35 ,13 -13.5 ,59.15 -62.25 ,22 -23	W Basalt	20.7	3	9.84	
5.	Bhamb Devi	EW	Karanja	1997-98	20.6225	77.6083	349	55H/10	148.65	7.35	8 -10.35 ,27 -28.65	F J MB	17	3.05	1.37	
6.	Shelu Bazar	OW	Mangrulpir	1998-99	20.3708	77.2528	434.6	55H/07	153.75	6.9	5 -8 ,19 -19.5	W Basalt	21	3.14	7.76	
7.	Bitodavoyar	EW	Mangrulpir	1997-98	20.1917	77.2731	536.3	55H/08	184.25	3.25	35 -40.85	VB	19	3.2	1.73	
8.	Sendurjana	EW	Manora	1997-98	20.1478	77.4539	513.7	55H/12	117.15	5.95	8 -10.35	J F MB	15	4	1.05	
9.	Kalamba Mahali	EW	Washim	1999-00	20.1397	77.2028	533.8	55H/04	111.05	5.75	07-Jun	J MB	21	4.6	-	
10.	Pangrekhed	EW	Malegaon	2018-19	20.1769	76.9358	543	56 D/16 1C	123.5	18	3-7.60, 28.90-32	FMB	18	4.9	0.025	
11.	Pimpalgaon	EW	Washim	1999-00	20.0486	77.3089	544.7	55H/08	138.45	4	68 -69	J MB	18	5.15	-	
12.	Dhanora Buzurg	EW	Mangrulpir	1997-98	20.3167	77.3958	449.9	55H/08	153.75	8.5	19.55 -25.65	W VB	25	5.7	-	
13.	Musalwadi	EW	Malegaon	1999-00	20.3667	77.0917	410.2	55H/03	208.65	49.93	10 -11 ,170 -171	J MB	28	7.6	-	
14.	Sendona	EW	Manora	1998-99	20.0611	77.5917	417.6	55H/12	200	-	5 -7.35 ,57 -59.15	J MB	15	7.8	1.37	
15.	Mangrulpir	Pz	Mangrulpir	2011-12	20.3122	77.3364	448.4		40				27	9.2	Traces	
16.	Yevta Bandi	Pz	Karanja	2011-12	20.5086	77.5847	388		40				24	11.7	Traces	
17.	Masela Pen	EW	Digras	1998-99	20.0686	77.8644	313	55D/16	200	2	129.35 -132.35 ,154 -155	W F VB	28.25	12	2.16	

S. no.	Village	Type of Well	Taluka	Year	Lat_Dec	Long_Dec	Altitude (m a MSL)	Topo sheet	Depth drilled (mbgl)	Depth of casing (mbgl)	Aquifer zones encountered (mbgl)	Aquifer	Pre SWL (mbgl)	Post SWL (mbgl)	Discharge (lps)	DD (m)
18.	Manora	Pz	Manora	2011-12	20.2208	77.5525	365.2		40				18	12.5	0.5	
19.	Vitholi	EW	Manora	1998-99	20.2042	77.5792	367.9	55H/07	200	5.5	35 -37.85 ,84 -86.65	W MB	23	12.75	-	
20.	Masela Pen	OW	Digras	1998-99	20.0686	77.8644	313	55D/16	172.05	2.25	54 -55 ,153 -154	W VB	26.55	13	2.16	
21.	Masela Pen	OW	Digras	1998-99	20.0686	77.8644	313	55D/16	206	3.21			28	13	-	
22.	Kherda (BK)	EW	Karanja	2000-01	20.5861	77.4361	358.5	55H/06	172.05	5.5	37 -44	F VB	29	13.23	1.37	
23.	Kherda (BK)	OW	Karanja	2000-01	20.5861	77.4361	358.5	55H/06	40.05	5.5	37.5 -40.5	F VB	29	13.23	1.37	
24.	Lohara	EW	Barshitakli	1997-98	20.4958	77.3722	399.7	55H/07	129.35	11	30 -33	F VB	23	17	4.43	
25.	Ukalipen	EW	Washim	2018-19	19.9968	77.1947	487	56 E/11C	200	25	93.0-96.0, 190.60-193.60	VFB	57.2	17	2.16	
26.	Belkheda	OW	Risod	1998-99	20.0403	76.9556	499.1	55D/16	60	2.25	24 -27 ,46.95 -48.95	F Basalt	35	17.04	5.94	
27.	Belkheda	EW	Risod	1998-99	20.0403	76.9556	499.1	55D/16	153.75	3.9	22.57 -25.67 ,28.68 -31.77 ,54.07 -55 ,43.97 -46.97	F Basalt	35	17.13	4	
28.	Mutha	EW	Malegaon	1998-99	20.1250	77.0125	525	55H/04	200	6.25	4 -6.5 ,42 -44	W J MB	32	17.57	0.78	
29.	Lohara	OW	Barshitakli	1997-98	20.4958	77.3722	399.7	55H/07	104.95	9	30 -33	F VB	26.85	18	3.77	
30.	Mahagaon	EW	Mehkar	1998-99	20.3264	76.6694	501.6	55D/12	200	6.25	7 -10 ,35 -37	F Basalt	33	18	3.7	
31.	Bhoyani	EW	Manora	2018-19	20.3324	77.5252	455	55 H/11 2A	200	18	10.60 -13.70, 53.30-56.40	FMB	48	19	0.025	
32.	Malegaon	Pz	Malegaon	2011-12	20.2425	77.0028	521		40				37	21	Traces	
33.	Medsi	EW	Malegaon	1998-99	20.3264	76.9436	460.4	55D/15	200	2.7	59.25 -62.25	W VB	45	21	0.56	
34.	Murambi	EW	Karanja	2018-19	20.4553	77.3965	427	55H/7 1B	135.7	18	10.60-13.70	FMB	62	26	0.025	
35.	Mothegaon	EW	Risod	2018-19	20.0242	76.7469	521	55 D/12 3C	200	25	74.70-77.70	FMB	60	27	3.17	
36.	Dapuri(Kh)	OW	Risod	2018-19	20.0982	76.8982	522	57 D/16 2B	107.2	25	10.60-13-70, 59.40-62.50	VFB	54.5	29	4.43	

S. no.	Village	Type of Well	Taluka	Year	Lat_Dec	Long_ Dec	Altitude (m a MSL)	Topo sheet	Depth drilled (mbgl)	Depth of casing (mbgl)	Aquifer zones encountered (mbgl)	Aquifer	Pre SWL (mbgl)	Post SWL (mbgl)	Discharge (lps)	DD (m)
37.	Dapuri(Kh)	EW	Risod	2018-19	20.0982	76.8982	520	56 D/16 2B	124	25	59.40-62.50	VFB	55.08	29	3.17	
38.	Mothegaon	OW	Risod	2018-19	19.9769	76.7469	521	56 D/12 3C	200	25	108.20-111.30	FMB	70	31	0.14	
39.	Dhanora Kh	EW	Magrulpir	2018-19	20.2117	77.3322	536	55 H/8 1A	200	18	7.60-10.60	FMB	100	53	0.025	
40.	Karanja	Pz	Karanja	2011-12	20.4861	77.4681	424		40				38	14	Traces	
41.	Kinhiraja	EW	Malegaon	2018-19	20.3284	77.1669	511	55 H/3 3c	111.3	7.6	19.80-22.80	FMB	18	9	0.025	
42.	Kurha	Pz	Risod	2011-12	19.9103	76.6836	549		40				33	11	Traces	

Annexure-II: Details of KOWs in Washim district

Sl. no.	District	Taluka	Site name	Latitude	Longitude	D.T.W. (Pre - 2018) (m bgl)	D.T.W. (Post - 2018) (m bgl)	RL Pre	EC (Pre - 2018) (micromhos)	EC (Post - 2018) (micromhos)
1	Washim	Karanja	Dhotra	20.6966	77.5529	7.40	5.10	332.60	1270.00	1620.00
2	Washim	Karanja	Donad Bk	20.5512	77.6350	14.50	4.00	370.50	1105.00	1660.00
3	Washim	Karanja	Ganeshpur	20.5150	77.5656	8.80	6.50	394.20	775.00	1420.00
4	Washim	Karanja	Girda	20.4348	77.4926	11.35	7.50	418.65	1122.00	1510.00
5	Washim	Karanja	Hinganwadi	20.6853	77.6132	9.25	5.00	311.75	885.00	1020.00
6	Washim	Karanja	Kamathwada	20.4623	77.5537	7.00	1.00	412.00	1616.00	2660.00
7	Washim	Karanja	Kupti	20.5699	77.5218	9.20	3.00	348.80	881.00	1070.00
8	Washim	Karanja	Lohara	20.4696	77.3639	8.80	3.70	396.20	1300.00	1725.00
9	Washim	Karanja	Mahagaon	20.5310	77.3513	10.35	5.50	375.65	1940.00	4515.00
10	Washim	Karanja	Nagalwadi	20.6470	77.6193	12.50	5.00	324.50	699.00	1100.00
11	Washim	Karanja	Parwa Kohar	20.5401	77.4083	9.60	3.95	364.40	803.00	1105.00
12	Washim	Karanja	Pimpri Modak	20.6299	77.5726	8.70	2.50	325.30	1360.00	3000.00
13	Washim	Karanja	Shevti	20.4257	77.3653	10.90	8.20	422.10	603.00	1050.00
14	Washim	Karanja	Somthana	20.4398	77.5794	6.35	2.00	390.65	905.00	1550.00
15	Washim	Karanja	Takli Kh	20.6389	77.5076	13.60	7.60	424.40	811.00	1050.00
16	Washim	Karanja	Tuljapur	20.4763	77.4439	9.15	5.15	430.85	1292.00	1600.00
17	Washim	Karanja	Umbarda	20.4774	77.5963	15.70	5.45	388.30	1019.00	3135.00
18	Washim	Malegaon	Amani	20.2124	77.0192	7.80	2.90	517.20	2222.00	2332.00
19	Washim	Malegaon	Bhildurga	20.2758	76.8417	8.50	7.40	435.50	880.00	594.00
20	Washim	Malegaon	Borala S.	20.0933	76.9781	11.00	9.20	500.00	700.00	711.00
21	Washim	Malegaon	Deothan (khamb)	20.3958	77.0125	10.08	4.40	392.92	1370.00	1335.00
22	Washim	Malegaon	Dhorkheda	20.0975	76.9517	10.30	3.80	517.70	1450.00	1812.00
23	Washim	Malegaon	Kherkheda	20.3572	77.0464	8.00	5.43	449.00	1120.00	1318.00
24	Washim	Malegaon	Kotha	20.1053	76.9342	15.80	11.10	511.20	895.00	924.00
25	Washim	Malegaon	Masala (Kh.)	20.1128	77.1367	10.90	4.43	470.10	425.00	503.00

Sl. no.	District	Taluka	Site name	Latitude	Longitude	D.T.W. (Pre - 2018) (m bgl)	D.T.W. (Post - 2018) (m bgl)	RL Pre	EC (Pre - 2018) (micromhos)	EC (Post - 2018) (micromhos)
26	Washim	Malegaon	Mungala	20.2703	76.9167	10.30	9.20	503.70	530.00	726.00
27	Washim	Malegaon	Nagartas	20.2556	77.0136	7.80	2.55	495.20	970.00	824.00
28	Washim	Malegaon	Pangarkhed	20.1761	76.9317	11.90	5.35	541.10	750.00	1008.00
29	Washim	Malegaon	Pangrabandi	20.4306	77.0311	9.00	4.20	356.00	697.00	826.00
30	Washim	Malegaon	Shelgaon B.	20.2786	76.7806	16.80	5.13	497.20	830.00	1182.00
31	Washim	Malegaon	Tiwali	20.1375	76.8822	10.70	4.50	548.30	2190.00	265.00
32	Washim	Malegaon	Udi	20.3267	77.0678	7.60	1.60	355.40	1440.00	1352.00
33	Washim	Malegaon	Umardari	20.3014	77.1244	3.00	2.10	465.00	610.00	642.00
34	Washim	Malegaon	Wadiramrao	20.3675	77.1222	16.50	5.54	376.50	870.00	852.00
35	Washim	Malegaon	Waghi Bk.	20.1250	76.9558	5.90	2.90	510.10	1350.00	840.00
36	Washim	Malegaon	Wakalwadi	20.3489	76.9625	9.50	5.40	430.50		791.00
37	Washim	Malegaon	Wasari	20.1294	76.9189	8.60	3.40	531.40	-	562.00
38	Washim	Mangrulpir	Belkhed	20.3553	77.3625	9.10	5.90	419.90	640.00	921.00
39	Washim	Mangrulpir	Chikhlagad	20.2458	77.4331	10.90	6.40	410.10	790.00	834.00
40	Washim	Mangrulpir	Dabhadi	20.1481	77.3647	3.60	1.76	484.40	460.00	458.00
41	Washim	Mangrulpir	Hisai	20.3422	77.2956	15.90	15.23	413.10	840.00	1092.00
42	Washim	Mangrulpir	Khadi	20.3753	77.4275	11.20	2.70	389.80	580.00	597.00
43	Washim	Mangrulpir	Mangrulpir	20.3119	77.3458	12.00	4.80	410.00		1224.00
44	Washim	Mangrulpir	Motsawanga	20.2431	77.2639	9.00	1.85	480.00		
45	Washim	Mangrulpir	Pimpri (kh.)	20.3139	77.2617	10.30	3.85	434.70	1140.00	704.00
46	Washim	Mangrulpir	Saikheda	20.2639	77.2811	8.50	4.55	434.50	1750.00	1194.00
47	Washim	Mangrulpir	Shendurjana	20.4061	77.2619	10.00	3.10	403.00	920.00	1519.00
48	Washim	Mangrulpir	Shivni	20.4028	77.3689	12.00	10.10	392.00	720.00	783.00
49	Washim	Mangrulpir	Vanoja	20.4025	77.2211	12.40	8.20	429.60	1090.00	1182.00
50	Washim	Manora	Asola Bk	20.2641	77.5193	6.70	2.00	381.30	1296.00	2780.00
51	Washim	Manora	Dapura	20.3666	77.5207	12.50	6.50	425.50	1345.00	1177.00

Sl. no.	District	Taluka	Site name	Latitude	Longitude	D.T.W. (Pre - 2018) (m bgl)	D.T.W. (Post - 2018) (m bgl)	RL Pre	EC (Pre - 2018) (micromhos)	EC (Post - 2018) (micromhos)
52	Washim	Manora	Dhamni	20.3772	77.4613	13.30	2.55	398.70	937.00	1090.00
53	Washim	Manora	Gavha	20.1918	77.5526	7.75	5.60	382.25	435.00	720.00
54	Washim	Manora	Gondegaon	20.0819	77.6225	8.25	4.40	370.75	739.00	900.00
55	Washim	Manora	Gosta	20.1049	77.4235	5.80	3.10	428.20	1064.00	1160.00
56	Washim	Manora	Karli	20.2298	77.6138	7.90	2.60	365.10	506.00	940.00
57	Washim	Manora	Kupta	20.3034	77.5577	6.00	2.20	446.00	1373.00	1150.00
58	Washim	Manora	Mahuli	20.1611	77.5929	12.45	8.55	380.55	539.00	760.00
59	Washim	Manora	Palodi	20.1150	77.4972	10.95	2.65	506.05	720.00	830.00
60	Washim	Manora	Ratanwadi	20.1117	77.5338	6.40	3.60	444.60	448.00	780.00
61	Washim	Manora	Vai	20.1265	77.6444	9.80	5.30	366.20	1059.00	2050.00
62	Washim	Manora	Vatphal	20.1046	77.3758	8.90	3.00	462.10	650.00	600.00
63	Washim	Risod	Bhar Jahagir	19.9463	76.7084	14.70	2.00	538.30	604.00	680.00
64	Washim	Risod	Chinchanba Pen	20.0657	76.8934	10.00	1.60	495.00	910.00	707.00
65	Washim	Risod	Dapuri	20.1032	76.8998	5.50	2.50	507.50	770.00	650.00
66	Washim	Risod	Dapuri	20.0980	76.9039	11.20	2.10	498.80	580.00	503.00
67	Washim	Risod	Dhodap Bk.	20.0713	76.7261	5.20	0.90	511.80	891.00	645.00
68	Washim	Risod	Dhodap Kh.	20.0696	76.7954	12.30	4.50	509.70	677.00	636.00
69	Washim	Risod	Gobhani.	20.0888	76.7631	8.00	6.00	523.00	952.00	680.00
70	Washim	Risod	Gohagaon	20.0665	76.6453	7.20	4.60	518.80	710.00	1369.00
71	Washim	Risod	Gowardhan	20.1059	76.8301	14.40	2.40	497.60	531.00	545.00
72	Washim	Risod	Gowardhan	20.1081	76.8302	21.90	2.80	488.10	493.00	550.00
73	Washim	Risod	Haral	19.9798	76.8643	10.40	2.50	509.60	760.00	768.00
74	Washim	Risod	Koyali Bk.	20.1441	76.8042	16.00	12.00	503.00	615.00	690.00
75	Washim	Risod	Koyali Kh.	20.1448	76.8312	4.00	1.70	526.00	450.00	671.00
76	Washim	Risod	Kuksa	20.1894	76.7767	4.40	2.00	529.60	525.00	667.00
77	Washim	Risod	Kuksa	20.1910	76.7731	9.60	3.05	521.40	650.00	712.00

Sl. no.	District	Taluka	Site name	Latitude	Longitude	D.T.W. (Pre - 2018) (m bgl)	D.T.W. (Post - 2018) (m bgl)	RL Pre	EC (Pre - 2018) (micromhos)	EC (Post - 2018) (micromhos)
78	Washim	Risod	Lehani	20.1070	76.7222	9.30	2.50	529.70	658.00	670.00
79	Washim	Risod	Mangrul Sanak	20.1078	76.7809	12.40	2.00	507.60	575.00	574.00
80	Washim	Risod	Masala Pen	20.0731	76.8633	14.80	2.40	492.20	960.00	873.00
81	Washim	Risod	Mohjabandi	19.8667	76.6683	11.00	5.85	494.00	540.00	777.00
82	Washim	Risod	Mothegaon	20.0238	76.7446	9.10	3.70	510.90	434.00	822.00
83	Washim	Risod	Nandhana	20.1752	76.8636	9.00	1.60	538.00	855.00	2108.00
84	Washim	Risod	Nawali	20.1324	76.8099	10.50	1.60	514.50	631.00	635.00
85	Washim	Risod	Nawali	20.1242	76.8126	13.00	3.00	508.00	690.00	678.00
86	Washim	Risod	Palaskhed	20.0209	76.8024	10.90	3.10	515.10	474.00	500.00
87	Washim	Risod	Pardi Tikhe	20.0694	76.9425	9.30	4.70	494.70	1674.00	1752.00
88	Washim	Risod	Sawad	19.9834	76.8181	17.70	4.25	508.30	320.00	997.00
89	Washim	Risod	Shelgaon Rajgure	20.0832	76.8528	10.10	5.30	499.90	850.00	657.00
90	Washim	Risod	Shelgaon Rajgure	20.0807	76.8554	11.00	2.80	501.00	720.00	682.00
91	Washim	Risod	Shelu Khadse	19.9813	76.7044	11.80	2.60	531.20	945.00	832.00
92	Washim	Risod	Wadji	20.1136	76.7666	9.50	3.45	527.50	670.00	790.00
93	Washim	Risod	Waghi Kh.	20.1110	76.8777	7.00	1.70	538.00	745.00	707.00
94	Washim	Risod	Waghi Kh.	20.1105	76.8731	12.20	1.40	531.80	880.00	1130.00
95	Washim	Risod	Wanoja	20.0196	76.9280	6.00	0.90	513.00	778.00	712.00
96	Washim	Risod	Yevta	20.0846	76.9274	14.80	6.05	509.20	870.00	887.00
97	Washim	Risod	Yevta	20.0853	76.9273	15.70	8.05	506.30	1210.00	1064.00
98	Washim	WASHIM	Atkali	20.0164	77.0269	7.70	7.00	481.30	740.00	808.00
99	Washim	WASHIM	Falegaon Thet	20.0632	77.1975	7.30	3.10	536.70	940.00	910.00
100	Washim	WASHIM	Ghota	19.9951	77.2802	6.80	2.90	503.20	472.00	358.00
101	Washim	WASHIM	Kajlamba	20.1441	77.2628	9.60	1.00	523.40	825.00	803.00
102	Washim	WASHIM	Khandala Kh.	20.0574	77.0534	12.40	3.80	500.60	1022.00	1262.00
103	Washim	WASHIM	Kokalgaon	19.9714	77.0827	2.90	1.10	486.10	1130.00	643.00

Sl. no.	District	Taluka	Site name	Latitude	Longitude	D.T.W. (Pre - 2018) (m bgl)	D.T.W. (Post - 2018) (m bgl)	RL Pre	EC (Pre - 2018) (micromhos)	EC (Post - 2018) (micromhos)
104	Washim	WASHIM	Panchala	20.0639	77.1444	9.10	4.30	532.90	520.00	504.00
105	Washim	WASHIM	Pardi Takmor	20.1911	77.2438	3.40	2.60	548.60	428.00	1668.00
106	Washim	WASHIM	Sapli	20.0166	77.3029	8.00	1.20	540.00	455.00	495.00
107	Washim	WASHIM	Sawanga Jahagir	20.2153	77.1831	9.90	4.30	494.10	1669.00	1187.00
108	Washim	WASHIM	Shirputi	20.0158	77.2208	5.20	1.30	488.80	532.00	523.00
109	Washim	WASHIM	Songavhan	19.9511	77.2133	3.80	3.20	494.20	698.00	373.00
110	Washim	Washim	Soyata	20.2636	77.2119	7.00	2.00	503.00	650.00	521.00
111	Washim	WASHIM	Surala	20.1843	77.1508	7.90	2.00	561.10	737.00	739.00
112	Washim	WASHIM	Umra Kapase	20.0750	77.2929	8.50	5.00	533.50	512.00	614.00
113	Washim	WASHIM	Wakli Jahagir	20.1027	77.0698	**8.30**	**1.70**	535.70	1715.00	1450.00

Annexure-III: Details of GW monitoring wells in Washim district

S.No.	DISTRICT	Block_Name	SITE_NAME	TOPOSHEET	Lattitude	Longitude	SITE_TYPE	Depth of Well (mbgl)	Dia. (m)	Geology	Aquifer Type	DTWL May-18 (mbgl)	DTWL Nov. 2018 (mbgl)
	Wasim	Mangrulpir	Aasegaon	55 H/8	20°8'59"N	77°20'5"E	DW	10	4.00	DTB	Unconfined	9.99	3.5
	Wasim	Washim	Bitoda (Bhoyar)	55H/08	20°11'0"N	77°16'0"E	DW	12.5	2.30	DTB	Unconfined	12.49	7.9
	Wasim	Risod	Chikli	55H/16	20°0'30"N	76°53'30"E	DW	9.75	2.75	DTB	Unconfined	9.74	6.7
	Wasim	Risod	Dapuri	55D/16	20°6'0"N	76°54'0"E	DW	10.15	4.33	DTB	Unconfined	10.14	8.5
	Wasim	Washim	Deothana	56 E/1	19°58'10"N	77°7'54"E	DW	15.24	7.50	DTB	Unconfined	-	3.7
	Wasim	Karanja	Dhanaj Khurd	55H/10	20°43'0"N	77°35'10"E	DW	11	3.70	DTB	Unconfined	10.99	6.4
	Wasim	Mangrulpir	Dhanora	55 H/8	20°12'14"N	77°19'59"E	DW	14.15	4.80	DTB	Unconfined	14.14	8.05
	Wasim	Malegaon	Dharpimpri	55 D/16	20°12'7"N	76°53'32"E	DW	8	3.50	DTB	Unconfined	5.9	4.3
	Wasim	Manora	Giroli	55 H/8	20°12'31"N	77°28'32"E	DW	11	1.90	DTB	Unconfined	10.99	4
	Wasim	Malegaon	Jamkheda	55 H/3	20°16'40"N	77°5'10"E	DW	9	3.00	DTB	Unconfined	3.2	1.8
	Wasim	Malegaon	Jaulka Rly	55 H/3	20°17'32"N	77°4'20"E	DW	5.3	1.90	DTB	Unconfined	5.29	3.1
	Wasim	Washim	Kalamba Mahal	55 H/4	20°8'14"N	77°12'21"E	DW	9	2.50	DTB	Unconfined	8.99	6.2
	Wasim	Karanja	Kamargaon	55H/10	20°36'50"N	77°30'10"E	DW	10.75	3.52	DTB	Unconfined	6.8	4.2
	Wasim	Karanja	Karanja	55H/07	20°29'0"N	77°29'0"E	DW	13	3.86	DTB	Unconfined	10.8	3.05
	Wasim	Karanja	Karanja_Pz	55 H/7	20°29'10"N	77°28'57"E	BW	40	0.15	DTB	Unconfined	8	7.4
	Wasim	Risod	Kenwad	55D/16	20°12'0"N	76°49'0"E	DW	12	4.57	DTB	Unconfined	11.99	4.4
	Wasim	Malegaon	Kinhi Raja	55H/03	20°19'40"N	77°9'50"E	DW	9.5	3.43	DTB	Unconfined	9.49	4.3
	Wasim	Washim	Kondala Jhambre	55 H/4	20°10'6"N	77°7'32"E	DW	12.2	3.00	DTB	Unconfined	12.19	8
	Wasim	Risod	Kurha_Pz	56 A/9	19°54'37"N	76°41'1"E	BW	40	0.15	DTB	Unconfined	-	6
	Wasim	Risod	Loni	56A/09	19°54'55"N	76°37'30"E	DW	12.95	4.57	DTB	Unconfined	8.9	5.7
	Wasim	Malegaon	Malegaon	55D/14	20°14'0"N	76°59'0"E	DW	11.9	3.20	DTB	Unconfined	11.89	7
	Wasim	Malegaon	Malegaon_Pz	55 H/4	20°12'33"N	77°0'10"E	BW	40	0.15	DTB	Unconfined	10.6	6.7

S.No.	DISTRICT	Block_Name	SITE_NAME	TOPOSHEET	Lattitude	Longitude	SITE_TYPE	Depth of Well (mbgl)	Dia. (m)	Geology	Aquifer Type	DTWL May-18 (mbgl)	DTWL Nov. 2018 (mbgl)
	Wasim	Mangrulpir	Mangrulpir_Pz	55 H/7	20°18'44"N	77°20'11"E	BW	40	0.15	DTB	Unconfined	14.5	8.5
	Wasim	Manora	Manora_Pz	55 H/12	20°13'15"N	77°33'4"E	BW	40	0.15	DTB	Unconfined	40	7.6
	Wasim	Malegaon	Medshi	55D/15	20°20'0"N	76°56'30"E	DW	10.9	4.60	DTB	Unconfined	9	5.05
	Wasim	Malegaon	Ridhora	55 D/15	20°17'35"N	76°58'18"E	DW	11.2	5.60	DTB	Unconfined	11.19	2.7
	Wasim	Risod	Risod	56A/13	19°58'0"N	76°47'0"E	DW	11.8	2.30	DTB	Unconfined	8.9	5.05
	Wasim	Risod	Rithad	55D/16	20°3'0"N	76°59'0"E	DW	16	4.40	DTB	Unconfined	15.99	7
	Wasim	Mangrulpir	Sakhar Doha	55H/07	20°16'0"N	77°24'0"E	DW	14	2.00	DTB	Unconfined	10	7
	Wasim	Mangrulpir	Sangaon	55H/08	20°11'35"N	77°21'10"E	DW	12.4	2.75	DTB	Unconfined	12.39	4.9
	Wasim	Washim	Sawargaon Barde	55 H/4	20°10'12"N	77°4'11"E	DW	9	3.00	DTB	Unconfined	8.99	3.1
	Wasim	Manora	Sendurjan Adhao	55H/04	20°8'45"N	77°27'0"E	DW	11.8	1.70	DTB	Unconfined	11.79	8
	Wasim	Karanja	Shaha	55H/06	20°31'30"N	77°28'0"E	DW	14.25	1.78	DTB	Unconfined	14.24	9.25
	Wasim	Mangrulpir	Shelu Bazar-1	55 H/3	20°20'6"N	77°14'45"E	DW	8.7	3.00	DTB	Unconfined	8.69	8.6
	Wasim	Karanja	Sheluwada-1	55 H/7	20°26'16"N	77°24'13"E	DW	14	2.65	DTB	Unconfined	13.99	10.4
	Wasim	Washim	Tondgaon	55 H/4	20°0'4"N	77°7'18"E	DW	15	4.50	DTB	Unconfined	7.9	6
	Wasim	Karanja	Vilegaon (Kherda)	55H/06	20°35'10"N	77°26'35"E	DW	7.45	2.20	DTB	Unconfined	7.44	3.7
	Wasim	Mangrulpir	Wada	55H/07	20°22'0"N	77°20'0"E	DW	16	3.63	DTB	Unconfined	15.99	6
	Wasim	Risod	Wakad	55 D/12	20°2'23"N	76°41'45"E	DW	12.2	8.70	DTB	Unconfined	8.2	9.9
	Wasim	Washim	Washim	55H/04	20°7'0"N	77°8'30"E	DW	12.2	3.66	DTB	Unconfined	8.6	4.4
	Wasim	Karanja	Yevta Bandi_Pz	55 H/10	20°30'31"N	77°35'5"E	BW	40	0.15	DTB	Unconfined	11.7	9.5

Annexure IV: Soil Infiltration Test

Soil Infiltration Test _I

Date	12.02.2019
Unique ID No	
Village	Borel Phata
Location	In the field of vasanth rao ambore, By the side of gujarati hotel
Taluka	Washim
District	Washim
Coordinates	20°02'44.3", 77°08'21.1"
Elevation / RL (mamsl)	543
Initial Water Level (cm)	30
Geology	Deccan Basalt
Soil type	Yellowish clay
Final Infiltration Rate (cm/hr)	3.60

Sl.No.	Clock time	Duration(m)	Cumulative time (minutes)	Water level depth(cm)	Infiltrated water Depth (cm)	Infiltration rate(cm/hr)
1	16.15	1.00	1.00	28.20	1.80	108.00
2	16.16	1.00	2.00	28.30	1.70	102.00
3	16.17	1.00	3.00	28.50	1.50	90.00
4	16.18	1.00	4.00	29.00	1.00	60.00
5	16.19	1.00	5.00	29.20	0.80	48.00
6	16.24	5.00	10.00	27.00	3.00	36.00
7	16.29	5.00	15.00	27.80	2.20	26.40

Sl.No.	Clock time	Duration(m)	Cumulative time (minutes)	Water level depth(cm)	Infiltrated water Depth (cm)	Infiltration rate(cm/hr)
8	16.34	5.00	20.00	28.40	1.60	19.20
9	16.39	5.00	25.00	28.50	1.50	18.00
10	16.44	5.00	30.00	28.70	1.30	15.60
11	16.54	10.00	40.00	27.80	2.20	13.20
12	17.04	10.00	50.00	28.10	1.90	11.40
13	17.14	10.00	60.00	28.20	1.80	10.80
14	17.24	10.00	70.00	28.50	1.50	9.00
15	17.34	10.00	80.00	28.70	1.30	7.80
16	17.44	10.00	90.00	29.00	1.00	6.00
17	17.54	10.00	100.00	29.10	0.90	5.40
18	18.04	10.00	110.00	29.20	0.80	4.80
19	18.14	10.00	120.00	29.40	0.60	3.60
20	18.24	10.00	130.00	29.40	0.60	3.60
21	18.34	10.00	140.00	29.40	0.60	3.60

Soil Infiltration Test_II

Date	13.02.2019
Unique ID No	
Village	Risod
Location	In the field of Siva gharjana Carrier Academy
Taluka	Risod
District	Washim
Coordinates	19°58'56.7", 76°48'33.7"

Elevation / RL (mamsl) 527
Initial Water Level (cm) 30
Geology Deccan Basalt
Soil type Black cotton
Final Infiltration Rate (cm/hr) 1.80

Sl.No.	Clock time	Duration (m)	Cumulative time (minutes)	Water level depth(cm)	Infiltrated water Depth (cm)	Infiltration rate(cm/hr)
1	15.15	1.00	1.00	29.20	0.80	48.00
2	15.16	1.00	2.00	29.40	0.60	36.00
3	15.17	1.00	3.00	29.60	0.40	24.00
4	15.18	1.00	4.00	29.70	0.30	18.00
5	15.19	1.00	5.00	29.80	0.20	12.00
6	15.24	5.00	10.00	29.40	0.60	7.20
7	15.29	5.00	15.00	29.40	0.60	7.20
8	15.34	5.00	20.00	29.50	0.50	6.00
9	15.39	5.00	25.00	29.60	0.40	4.80
10	15.44	5.00	30.00	29.60	0.40	4.80
11	15.54	10.00	40.00	29.20	0.80	4.80
12	16.04	10.00	50.00	29.30	0.70	4.20
13	16.14	10.00	60.00	29.40	0.60	3.60
14	16.24	10.00	70.00	29.50	0.50	3.00
15	16.34	10.00	80.00	29.60	0.40	2.40
16	16.44	10.00	90.00	29.70	0.30	1.80
17	16.54	10.00	100.00	29.70	0.30	1.80

18	17.04	10.00	110.00	29.70	0.30	1.80

Soil Infiltration Test_III

Date	14.02.2019
Unique ID No	
Village	Chehel
Location	In the field of vasanth rao naik asaram school
Taluka	Mangrulpir
District	Washim
Coordinates	20°18'46.1", 77°23'23.6"
Elevation / RL (mamsl)	451
Initial Water Level (cm)	25
Geology	Deccan Basalt
Soil type	Clay
Final Infiltration Rate (cm/hr)	1.20

Sl.No.	Clock time	Duration(m)	Cumulative time (minutes)	Water level depth(cm)	Infiltrated water Depth (cm)	Infiltration rate(cm/hr)
1	14.05	1.00	1.00	29.50	0.50	30.00
2	14.06	1.00	2.00	29.60	0.40	24.00
3	14.07	1.00	3.00	29.60	0.40	24.00
4	14.08	1.00	4.00	29.70	0.30	18.00
5	14.09	1.00	5.00	29.80	0.20	12.00
6	14.14	5.00	10.00	29.50	0.50	6.00
7	14.19	5.00	15.00	29.60	0.40	4.80

Sl.No.	Clock time	Duration(m)	Cumulative time (minutes)	Water level depth(cm)	Infiltrated water Depth (cm)	Infiltration rate(cm/hr)
8	14.24	5.00	20.00	29.70	0.30	3.60
9	14.29	5.00	25.00	29.80	0.20	2.40
10	14.34	5.00	30.00	29.80	0.20	2.40
11	14.54	10.00	40.00	29.60	0.40	2.40
12	15.04	10.00	50.00	29.60	0.40	2.40
13	15.09	10.00	60.00	29.70	0.30	1.80
14	15.14	10.00	70.00	29.70	0.30	1.80
15	15.19	10.00	80.00	29.80	0.20	1.20
16	15.24	10.00	90.00	29.80	0.20	1.20
17	15.29	10.00	100.00	29.80	0.20	1.20

Soil Infiltration Test _IV

Date	14.02.2019
Unique ID No	
Village	Nagardas
Location	In the field of shoka kadase, near by trijunction of the road
Taluka	Malegaon

District	Washim
Coordinates	20°15'20.0", 77°00'48.3"
Elevation / RL (mamsl)	512
Initial Water Level (cm)	30
Geology	Deccan Basalt
Soil type	Clay
Final Infiltration Rate (cm/hr)	1.80

Sl.No.	**Clock time**	**Duration(m)**	**Cumulative time (minutes)**	**Water level** depth(cm)	**Infiltrated water Depth (cm)**	**Infiltration rate(cm/hr)**
1	10.01	1.00	1.00	29.00	1.00	60.00
2	10.02	1.00	2.00	29.20	0.80	48.00
3	10.03	1.00	3.00	29.40	0.60	36.00
4	10.04	1.00	4.00	29.50	0.50	30.00
5	10.05	1.00	5.00	29.60	0.40	24.00
6	10.10	5.00	10.00	28.80	1.20	14.40
7	10.15	5.00	15.00	29.00	1.00	12.00
8	10.20	5.00	20.00	29.20	0.80	9.60
9	10.25	5.00	25.00	29.40	0.60	7.20
10	10.30	5.00	30.00	29.50	0.50	6.00
11	10.40	10.00	40.00	29.60	0.40	2.40
12	10.50	10.00	50.00	29.60	0.40	2.40
13	11.00	10.00	60.00	29.70	0.30	1.80
14	11.10	10.00	70.00	29.70	0.30	1.80
15	11.20	10.00	80.00	29.70	0.30	1.80

16	11.30	10.00	90.00	29.70	0.30	1.80
17	11.40	10.00	100.00	29.70	0.30	1.80

Soil Infiltration Test _V

Date	15.02.2019
Unique ID No	
Village	Dadgaon
Location	In the field of Gade, Near by pump house
Taluka	Karanja
District	Washim
Coordinates	20°27'07.4", 77°31'09.9"
Elevation / RL (mamsl)	425
Initial Water Level (cm)	30
Geology	Deccan Basalt
Soil type	Black cotton
Final Infiltration Rate (cm/hr)	3.00

Sl.No.	Clock time	Duration(m)	Cumulative time (minutes)	Water level depth(cm)	Infiltrated water Depth (cm)	Infiltration rate(cm/hr)
1	10.01	1.00	1.00	27.90	2.10	126.00
2	10.02	1.00	2.00	28.20	1.80	108.00
3	10.03	1.00	3.00	28.60	1.40	84.00
4	10.04	1.00	4.00	29.10	0.90	54.00
5	10.05	1.00	5.00	29.40	0.60	36.00
6	10.10	5.00	10.00	28.20	1.80	21.60
7	10.15	5.00	15.00	28.50	1.50	18.00
8	10.20	5.00	20.00	28.80	1.20	14.40
9	10.25	5.00	25.00	29.10	0.90	10.80
10	10.30	5.00	30.00	29.20	0.80	9.60
11	10.40	10.00	40.00	28.70	1.30	7.80
12	10.50	10.00	50.00	28.90	1.10	6.60

Sl.No.	Clock time	Duration(m)	Cumulative time (minutes)	Water level depth(cm)	Infiltrated water Depth (cm)	Infiltration rate(cm/hr)
13	11.00	10.00	60.00	29.10	0.90	5.40
14	11.10	10.00	70.00	29.30	0.70	4.20
15	11.20	10.00	80.00	29.50	0.50	3.00
16	11.30	10.00	90.00	29.50	0.50	3.00
17	11.40	10.00	100.00	29.50	0.50	3.00

Soil Infiltration Test _VI

Date	15.02.2019
Unique ID No	
Village	Loni Arab
Location	In the field of Vijay ramrao Andhale
Taluka	Karanja
District	Washim
Coordinates	20°33'29.8", 77°35'45.9"
Elevation / RL (mamsl)	374
Initial Water Level (cm)	30
Geology	Deccan Basalt
Soil type	Clay
Final Infiltration Rate (cm/hr)	0.60

Sl.No.	Clock time	Duration(m)	Cumulative time (minutes)	Water level depth(cm)	Infiltrated water Depth (cm)	Infiltration rate(cm/hr)
1	10.01	1.00	1.00	29.00	1.00	60.00
2	10.02	1.00	2.00	29.50	0.50	30.00
3	10.03	1.00	3.00	29.70	0.30	18.00

Sl.No.	Clock time	Duration(m)	Cumulative time (minutes)	Water level depth(cm)	Infiltrated water Depth (cm)	Infiltration rate(cm/hr)
4	10.04	1.00	4.00	29.70	0.30	18.00
5	10.05	1.00	5.00	29.80	0.20	12.00
6	10.10	5.00	10.00	29.60	0.40	4.80
7	10.15	5.00	15.00	29.70	0.30	3.60
8	10.20	5.00	20.00	29.70	0.30	3.60
9	10.25	5.00	25.00	29.60	0.40	4.80
10	10.30	5.00	30.00	29.50	0.50	6.00
11	10.40	10.00	40.00	29.60	0.40	2.40
12	10.50	10.00	50.00	29.70	0.30	1.80
13	11.00	10.00	60.00	29.70	0.30	1.80
14	11.10	10.00	70.00	29.80	0.20	1.20
15	11.20	10.00	80.00	29.90	0.10	0.60
16	11.30	10.00	90.00	29.90	0.10	0.60
17	11.40	10.00	100.00	29.90	0.10	0.60

Annexure-V: Chemical analysis of ground water samples, Aquifer- I / Shallow aquifers

SN	Block_	Village_	Lat	Log	PH	EC_AQI	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F	Fe	SAR	RSC
1	Risod	Bhar Jahagir	19.9463	76.7084	7.5	633	335	229.5	44.97	27.95	49.71	2.74	0	237.90	26.06	29	37	0.45	0	1.172	-0.648
2	Risod	Chinchanba Pen	20.0657	76.8934	7.5	947	502	336.6	71.54	37.67	64.33	5.73	0	309.27	65.76	29	47	0.31	0	1.235	-1.607
3	Risod	Dapuri	20.098	76.9039	7.4	665	352	306	36.79	51.04	15.1	4.25	0	184.37	45.91	39	29	0.28	0	0.331	-3.017
4	Risod	Dhodap Bk.	20.0712	76.7261	7.5	759	402	331.5	53.15	47.39	15.91	1.02	0	261.69	38.46	27	47	0.57	0	0.322	-2.267
5	Risod	Dhodap Kh.	20.0696	76.7954	7.5	759	402	280.5	63.37	29.16	33.24	1.44	0	237.90	45.91	33	45	0.69	0	0.691	-1.668
6	Risod	Gohagaon	20.0665	76.6453	7.7	514	272	229.5	47.01	26.73	21.09	4.09	0	237.90	16.13	20	23	0.27	0	0.494	-0.651
7	Risod	Gowardhan	20.1081	76.8302	7.7	652	345	265.2	55.19	30.38	23.57	3.12	0	255.74	18.61	14	47	0.28	0	0.512	-1.067
8	Risod	Koyali Bk.	20.1441	76.8042	7.6	651	346	280.5	67.45	26.73	24.19	3.8	0	261.69	23.57	37	27	0.19	0	0.497	-1.283
9	Risod	Mohjabandi	19.8667	76.6683	7.5	376	196	163.2	55.19	6.08	17.12	6.5	0	178.43	18.61	4	4	0.22	0	0.429	-0.335
10	Risod	Sawad	19.9834	76.8181	7.3	925	490	438.6	114.47	36.46	13.53	1.51	0	267.64	70.72	37	46	0.3	0	0.219	-4.336
11	Risod	Waghi Kh.	20.111	76.8777	7.2	954	504	423.3	157.39	7.29	14.77	5.12	0	297.38	63.28	60	47	0.12	0	0.225	-3.595
12	Risod	Yevta	20.0853	76.9273	7.3	2174	1153	719.1	177.84	65.62	76.18	58.22	0	350.90	145.17	79	320	0.33	0	0.973	-8.539
13	Risod	Pardi Tikhe	20.0694	76.9425	7.3	854	452	382.5	118.56	20.66	22.13	1.86	0	249.80	70.72	39	19	0.44	0	0.370	-3.533
14	Washim	Atkali	20.0164	77.0269	7.2	2161	1146	754.8	186.01	69.27	77.61	70.75	0	446.06	177.43	87	180	0.16	0	0.968	-7.688
15	Washim	Falegaon Thet	20.0632	77.1975	7.3	857	452	397.8	106.29	31.60	10.82	0.99	0	237.90	55.83	41	46	0.2	0	0.183	-4.015
16	Washim	Kajlamba	20.1441	77.2628	7.4	1237	656	550.8	145.13	44.96	23.05	5.3	0	297.38	135.24	53	16	0.22	0	0.332	-6.082
17	Washim	Khandala Kh.	20.0574	77.0534	7.4	1405	744	413.1	167.62	-1.22	136.4	3.26	0	416.33	107.95	65	78	0.68	0	2.055	-1.456
18	Washim	Kokalgaon	19.9714	77.0827	7.8	572	303	147.9	28.62	18.23	53.74	2.33	0	178.43	31.02	40	8	0.35	0	1.582	-0.006
19	Washim	Panchala	20.0639	77.1444	7.3	461	244	153	42.93	10.94	20.68	11.49	0	154.64	26.06	32	7	0.22	0	0.558	-0.511
20	Washim	Pardi Takmor	20.1911	77.2438	7.2	518	274	163.2	40.88	14.58	31.55	4.94	0	142.74	31.02	64	2	1.05	0	0.844	-0.904
21	Washim	Sapli	20.0166	77.3029	7.6	803	425	351.9	96.07	26.73	18.05	1.87	0	226.01	53.35	89	5	0.23	0	0.323	-3.299
22	Washim	Songavhan	19.9578	77.2133	7.6	872	462	351.9	75.63	38.89	43.46	3.53	0	327.11	43.43	69	6	1.22	0	0.815	-1.619
23	Washim	Surala	20.1842	77.1508	7.8	714	378	321.3	67.45	36.46	27.1	2.49	0	190.32	53.35	80	32	0.58	0	0.534	-3.253
24	Washim	Borla	20.0484	77.1405	7.3	1101	584	321.3	42.93	51.04	107.9	3.69	0	243.85	102.98	69	60	0.46	0	2.277	-2.349
25	Washim	Panchala 2	20.0827	77.1441	7.3	926	490	402.9	108.34	31.60	21.03	2.29	0	220.06	73.20	55	46	0.2	0	0.353	-4.409
26	Washim	Sukandi	20.0901	77.1531	7.3	1280	678	504.9	147.17	32.81	33.75	1.62	0	231.95	137.72	54	64	0.19	0	0.497	-6.256
27	Washim	Washim	20.1243	77.1277	7.5	689	365	270.3	83.81	14.58	19.26	1.46	0	249.80	18.61	21	34	0.21	0	0.383	-1.295
28	Risod	Mangawadi	19.9562	76.7521	7.4	1488	789	300.9	112.42	4.86	164.7	9.53	0	285.48	165.02	73	38	0.17	0	2.968	-1.341
29	Risod	Risod	19.9782	76.7883	7.5	821	435	249.9	67.45	19.44	61.85	1.85	0	237.90	65.76	26	46	0.76	0	1.316	-1.073
30	Risod	Ghota	20.9964	76.8596	7.5	632	335	255	61.32	24.30	32.12	2.44	0	285.48	11.17	30	25	0.45	0	0.693	-0.386
31	Washim	Nagtana	20.078	77.0489	7.5	689	365	255	85.85	9.72	25.02	6.2	0	237.90	31.02	43	3	0.31	0	0.502	-1.193
32	Washim	Jambhurna	20.0989	77.0946	7.7	1313	696	453.9	89.94	54.68	68.68	2.87	0	297.38	122.83	72	92	0.25	0	1.150	-4.122
33	Washim	Washim-2	20.1044	77.1088	7.8	579	307	249.9	40.88	35.24	20.18	1.54	0	237.90	11.17	23	46	0.27	0	0.469	-1.044
34	Washim	Pardi takmore-2	20.1833	77.2499	7.4	1022	542	402.9	104.25	34.03	37.99	2.93	0	297.38	63.28	62	30	0.3	0	0.642	-3.137

SN	Block_	Village_	Lat	Log	PH	EC_AQI	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F	Fe	SAR	RSC
35	Malegaon	Borala S.	20.0933	76.9781	7.2	742	393	306	81.76	24.30	13.82	1.21	0	208.16	35.98	57	48	0.38	0	0.266	-2.676
36	Malegaon	Tiwali	20.1375	76.8822	7.4	2435	1290	326.4	108.34	13.37	367.9	6.55	0	606.65	264.28	85	60	0.71	0	6.548	3.428
37	Malegaon	Bhildurga	20.2758	76.8417	7.2	980	519	428.4	89.94	48.61	23.19	11.63	0	208.16	110.43	70	5	0.25	0	0.396	-5.084
38	Malegaon	Deothan (khamb)	20.3958	77.0125	7.3	1562	827	591.6	128.78	64.41	30.23	16.62	0	434.17	98.02	85	47	0.28	0	0.436	-4.621
39	Malegaon	Pangrabandi	20.4306	77.0311	7.4	743	394	357	79.72	37.67	10.93	2.28	0	303.32	21.09	42	46	0.27	0	0.202	-2.113
40	Malegaon	Masala (Kh.)	20.1128	77.1367	7.7	475	251	183.6	40.88	19.44	14.06	1.98	0	178.43	21.09	12	13	0.26	0	0.362	-0.719
41	Malegaon	Umardari	20.3014	77.1244	7.1	704	373	275.4	89.94	12.15	17.14	1.77	0	237.90	26.06	38	42	0.26	0	0.333	-1.597
42	Malegaon	Wadiramrao	20.3675	77.1222	7.3	935	495	351.9	104.25	21.87	17.19	2.12	0	297.38	40.94	43	47	0.25	0	0.302	-2.137
43	Malegaon	Hisai	20.3422	77.2956	7.4	927	491	306	77.68	26.73	66.32	1.66	0	416.33	26.06	41	47	0.36	0	1.292	0.741
44	Malegaon	Pimpri (kh.)	20.3139	77.2617	7	1427	755	612	159.44	51.04	32.46	7.12	0	535.28	80.65	20	120	0.69	0	0.445	-3.397
45	Malegaon	Belkhed	20.3553	77.3625	7.2	499	369	255	71.54	18.23	12.98	1.07	0	166.53	23.57	36	40	0.41	0	0.271	-2.347
46	Malegaon	Shivali	20.4028	77.3889	7.5	872	462	346.8	102.20	21.87	24.3	1.55	0	309.27	35.98	43	46	0.31	0	0.431	-1.840
47	Karanja	Takli Kh	20.6389	77.5076	7.9	727	385	367.2	85.85	36.46	12	0.82	0	356.85	26.06	27	34	0.66	0	0.217	-1.443
48	Karanja	Nagalwadi	20.647	77.6192	7.7	601	319	300.9	57.23	37.67	16	0.61	0	255.74	53.35	24	34	0.63	0	0.331	-1.769
49	Karanja	Parwa Kohar	20.5401	77.4083	7.6	728	386	357	81.76	36.46	9	0.31	0	368.75	26.06	13	26	0.66	0	0.166	-1.043
50	Karanja	Donad Bk	20.5512	77.635	7.4	972	515	464.1	124.69	36.46	9	0.38	0	327.11	68.24	71	36	0.51	0	0.141	-3.872
51	Karanja	Lohara	20.4696	77.3639	7.7	1336	706	555.9	110.38	66.84	24	0.74	0	434.17	110.43	22	37	0.69	0	0.363	-3.901
52	Karanja	Tuljapur	20.4763	77.4439	7.6	1764	937	810.9	233.03	54.68	16	0.31	0	547.17	276.69	37	35	0.51	0	0.187	-7.181
53	Karanja	Kamathwada	20.4623	77.5537	7.7	1076	1099	510	159.44	26.73	15	6	0	190.32	184.87	62	30	0.54	0	0.217	-7.052
54	Manora	Dapura	20.3666	77.5207	7.8	1621	859	770.1	85.85	132.46	11	0.6	0	612.59	155.09	51	37	0.6	0	0.153	-5.150
55	Manora	Karli	20.2298	77.6138	7.8	451	239	255	63.37	23.09	9	0.18	0	249.80	11.17	22	10	0.63	0	0.193	-0.973
56	Manora	Mahuli	20.1611	77.5929	7.7	463	246	204	61.32	12.15	9	0.21	0	202.22	26.06	16	9	0.59	0	0.207	-0.751
57	Manora	Gosta	20.1049	77.4235	7.6	1076	569	504.9	98.12	61.98	12	0.38	0	463.91	68.24	23	36	0.52	0	0.191	-2.401
58	Manora	Gondegaon	20.0819	77.6225	7.7	668	355	311.1	24.53	59.54	33	0.31	0	315.22	68.24	27	0.5	3.57	0	0.748	-0.959
59	Karanja	Kupti	20.5699	77.5218	7.6	768	407	351.9	40.88	59.54	8	0.75	0	356.85	38.46	20	37	0.6	0	0.164	-1.094
60	Risod	Risod	19.9667	76.7833	0	1997	1057	630	142.28	66.84	116.71	37.6	0	359.90	365.14	171	42	0.07	0	1.616	-6.714
61	Risod	Kenwad	20.2	76.8167	0	1125	600	455	106.21	46.18	71.3	6.1	0	176.90	191.43	197	42	0.21	0	1.154	-6.211
62	Malegaon	Medshi	20.3333	76.9417	0	707	376	305	76.15	27.95	30.03	23.51	0	189.10	106.35	107	32.4	0.09	0	0.586	-3.008
63	Malegaon	Ridhora	20.2931	76.9717	0	962	512	355	68.14	44.96	51.81	16.5	0	292.80	116.99	60	44	0.08	0	0.982	-2.307
64	Malegaon	Jaulka Rly	20.2922	77.0722	0	2076	1103	745	166.33	80.20	72.86	10.55	24	298.90	283.60	233	56	0.07	0	0.929	-9.217
65	Washim	Kondala Jhambre	20.1683	77.1256	0	551	290	260	58.12	27.95	26.48	1.21	0	268.40	42.54	15.6	59.7	0.08	0	0.572	-0.806
66	Washim	Washim	20.1167	77.1417	0	496	263	195	52.10	15.80	30.46	8.01	0	128.10	95.72	51	9.91	0.06	0	0.734	-1.805
67	Washim	Bitoda (Bhoyar)	20.1833	77.2667	0	354	187	155	42.08	12.15	25.77	5.59	0	183.00	53.18	9.32	9.49	0.09	0	0.694	-0.104
68	Mangrulpir	Dhanora	20.2039	77.3331	0	919	491	365	90.18	34.03	34.31	18	0	201.30	152.44	83	59.7	0.08	0	0.614	-4.009
69	Mangrulpir	Aasegaon	20.1497	77.3347	0	472	250	225	52.10	23.09	23.07	2.98	0	195.20	60.27	23.5	16.61	0.32	0	0.532	-1.305
70	Mangrulpir	Sangaon	20.1931	77.3528	0	734	390	365	90.18	34.03	20.2	1.91	0	128.10	145.35	93.2	30	0.09	0	0.361	-5.209

SN	Block_	Village_	Lat	Log	PH	EC_AQI	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F	Fe	SAR	RSC
71	Karanja	Vilegaon (Kherda)	20.5861	77.4431	0	704	376	275	68.14	25.52	49.31	10.67	0	256.20	88.63	34.9	34	0.24	0	1.016	-1.307
72	Manora	Sendurjan Adhao	20.1458	77.45	0	916	483	425	120.24	30.38	58	31.91	0	420.90	116.99	85.8	43.8	0.14	0	0.936	-1.612
73	Manora	Giroli	20.2086	77.4756	0	1620	856	565	152.30	44.96	73.69	11.34	0	390.40	191.43	176	41	0.21	0	1.041	-4.915
74	Karanja	Karanja	20.4833	77.4833	0	950	510	380	82.16	42.53	75.32	6.48	0	213.50	138.26	163	43	0.09	0	1.353	-4.108
75	Karanja	Dhanaj Khurd	20.7167	77.5861	0	898	477	450	94.19	52.25	33.56	4.52	0	311.10	134.71	120	9.49	0.12	0	0.557	-3.909
76	Darwha	Manbha	20.3436	77.6325	9.6	697	457	260	32.40	43.50	36	2	13.62	36.39	150.00	49	10	0.1	0.1	0.848	-4.149
77	Karanja	Dhanaj Bk	20.6536	77.6283	8.7	1063	698	236	17.60	46.66	70	8	9.6	107.36	140.00	68	31	0.1	0.1	1.819	-2.639
78	Karanja	Dhotra Deshmukh	20.5972	77.6333	7	685	457	240	26.80	42.04	42	15	0.113	119.88	84.00	13	55	1	0.2	1.042	-2.830
79	Karanja	Karanja	20.4803	77.4833	7.4	702	461	112	24.00	12.64	38.5	0.7	0.292	123.70	46.00	15	12.5	0.5	0	1.276	-0.202
80	Karanja	Kherda	20.4969	77.5442	8.3	483	316	228	35.20	34.02	10	0.1	2.134	113.77	90.00	22	16	0.5	0.3	0.245	-2.623
81	Karanja	Kherda Bk.	20.5583	77.4394	9	451	296	174	8.00	37.42	41	4	12.33	131.17	60.00	21	24	0.1	0.1	1.280	-0.918
82	Karanja	Panvihir	20.4583	77.4708	7.5	438	285	260	24.00	48.60	37	2	0.29	97.69	70.00	89	8	6	0.1	0.899	-3.588
83	Karanja	Sohol	20.4975	77.4408	8.2	1131	743	424	35.20	81.65	59	6	28.8	405.04	170.00	21	12	0.1	0.1	1.134	-0.879
84	Karanja	Tuljapur	20.4767	77.4456	9	766	306	104	8.40	20.17	29	5	9.237	98.26	50.00	19	7	0.09	0.1	1.128	-0.161
85	Malegaon	Davha	20.2875	77.0375	6.9	746	489	160	16.00	29.16	30	9	0.06	79.94	78.00	30	14	0.6	0.1	0.922	-1.887
86	Malegaon	Dongarkinhi	20.2117	76.9019	8.7	1196	786	410	13.20	91.61	91	15	9.6	102.48	174.00	48	100	0.4	0.1	1.880	-6.199
87	Malegaon	Ekamba	20.2117	76.9489	8.9	453	298	180	20.80	31.10	39	3	6.087	81.52	50.00	85	21	0.5	0.1	1.113	-2.060
88	Malegaon	Jaulka	20.2917	77.075	6.7	1485	976	512	67.20	83.59	112	32	0	112.24	194.00	56	148	0.6	0.3	1.867	-8.399
89	Malegaon	Karanji	20.165	77.0394	7.5	1548	1017	680	50.80	134.38	116	48	0	434.32	154.00	235	5	0.6	0.2	1.775	-6.478
90	Malegaon	Malegaon	20.2369	76.9933	7.6	1642	1078	556	54.40	102.06	59	2	0	380.64	244.00	64	31	0.1	0.1	0.975	-4.879
91	Malegaon	Zodaga	20.1894	77.0444	8.4	384	252	188	32.00	26.24	36	5	3.365	142.51	44.00	22	8	0.4	0.3	0.956	-1.311
92	Mangrulpir	Dabhadi	20.1458	77.3694	7.3	889	573	268	20.40	52.73	24	6	0	112.24	86.00	26	41	0.5	0.01	0.584	-3.519
93	Mangrulpir	Jogaldari	20.2614	77.4122	7.1	965	633	288	16.00	60.26	66	21	0	82.96	90.00	35	90	0.7	0.1	1.585	-4.399
94	Mangrulpir	Kalamba	20.3117	77.3792	8.6	980	642	488	51.20	87.48	41	37	57.6	203.74	94.00	93	10	1.4	0.3	0.718	-4.499
95	Mangrulpir	Mangrulpir	20.3164	77.3458	7.7	806	530	480	50.00	86.27	46	1	0	92.72	164.00	21	63	0.8	0.05	0.813	-8.079
96	Mangrulpir	Pimpalgaon	20.4167	77.275	8.6	1146	752	290	26.80	54.19	65	6	19.2	97.60	155.00	78	32	0.1	0.1	1.496	-3.559
97	Mangrulpir	Sheloo Kh.	20.3361	77.2528	9.2	897	574	116	18.40	17.01	197	1.4	0	334.28	78.00	76	12	0.1	0	6.730	3.160
98	Mangrulpir	Wanoja	20.3917	77.2642	7.7	1140	746	328	15.20	70.47	37	15	19.2	34.16	166.00	61	40	0.9	0.2	0.841	-5.359
99	Manora	Bhuli	20.1417	77.5792	8.6	1106	726	364	14.00	79.95	75	5	0	117.12	114.00	17	105	0.05	0.1	1.633	-5.359
100	Manora	Dhavanda	20.1417	77.5792	6.7	1411	928	504	70.40	79.70	67	10	0	117.12	210.00	36	105	0.9	0.1	1.117	-8.159
101	Manora	Kupta	20.3042	77.5625	9.2	566	372	190	12.80	38.39	42	7	12.34	82.86	60.00	35	40	0.1	0.1	1.226	-2.030
102	Manora	Parwa	20.2889	77.5147	7.2	686	447	320	36.00	55.89	21	9	0.107	71.89	210.00	36	16	0.8	0.1	0.451	-5.217
103	Manora	Sakhardoh	20.2528	77.4386	7.2	880	576	232	11.60	49.33	25	11	0	219.60	62.00	14	20	0.2	0.1	0.673	-1.039
104	Manora	Shaha	20.3617	77.4722	7	975	639	332	35.20	59.29	59	20	0	97.60	130.00	32	79	0.7	0.1	1.252	-5.039
105	Manora	Umari Bk.	20.0917	77.5958	8.9	484	317	140	10.80	27.46	40	4	10.81	144.79	26.00	6	25	0.1	0.01	1.346	-0.066

SN	Block_	Village_	Lat	Log	PH	EC_AQI	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F	Fe	SAR	RSC
106	Mehkar	Gohagaon	20.0681	76.6458	8	421	275	220	17.20	43.01	19	6	0.372	39.58	106.00	14	28	0.4	0.1	0.509	-3.738
107	Murtijapur	Janori	20.5986	77.3469	8.1	1222	802	130	48.00	2.43	239	1.3	0	61.00	284.00	185	1.7	0.7	0	6.572	-1.600
108	Risod	Degaon	20.0636	76.8161	8.3	980	643	448	51.20	77.76	35	64	7.2	78.08	220.00	35	31	0.6	0.3	0.634	-7.439
109	Risod	Lehani	20.1039	76.7225	7.8	1663	1091	420	57.60	67.07	65	3	0	561.20	130.00	12	8	1.1	0.1	1.190	0.801
110	Risod	Loni Bk.	19.9144	76.6253	8.1	687	451	276	8.80	61.72	110	8	1.683	142.25	54.00	152	69	0.07	0.1	2.771	-3.131
111	Risod	Mahagaon	20.0747	76.6683	7.4	1712	1125	572	17.20	128.55	121	30	0	73.20	270.00	83	150	0.7	0.2	2.122	-10.238
112	Risod	Masalapen	20.0694	76.8639	6.7	818	537	224	22.40	40.82	25	11	0	102.48	90.00	15	35	0.8	0.1	0.650	-2.799
113	Risod	Mohaja Bandi	19.8647	76.6714	7.6	547	360	298	20.40	60.02	65	7	0.708	189.27	26.00	73	75	0.6	0.1	1.513	-2.833
114	Risod	Mop	19.95	76.6575	7.6	962	633	408	71.20	55.89	59	19	0	222.04	134.00	85	23	0.4	0.1	1.060	-4.519
115	Risod	Netansa	20.1419	76.7833	8.3	2650	1800	612	19.20	137.05	129	12	38.4	336.72	244.00	33	10	0.5	0	2.183	-5.438
116	Risod	Risod	19.9725	76.7828	7.5	1825	1345	620	12.80	142.88	33	17	0	112.24	360.00	66	50	0.5	0.1	0.562	-10.558
117	Risod	Shelgaon	20.0811	76.8561	8.6	490	322	200	6.40	44.71	50	9	5.043	134.76	34.00	70	12	0.6	0.1	1.479	-1.622
118	Risod	Wanoja	20.0217	76.9292	8.4	764	502	372	24.00	75.82	41	35	16.8	102.48	140.00	95	8	1	0.1	0.858	-5.199
119	Risod	Yeota	20.0969	76.9247	8.1	559	357	212	34.00	30.86	19	121	5.365	180.48	46.00	39	34	0.3	0	0.479	-1.102
120	Washim	Bitoda Teli	20.1806	77.2639	6.9	772	507	184	18.00	33.78	22	13	0	92.72	70.00	29	25	0.9	0.1	0.632	-2.160
121	Washim	Ekamba	20.0708	77.3444	7.3	897	527	236	12.00	50.06	24	8	0	161.04	86.00	24	7	0.1	0.1	0.640	-2.079
122	Washim	Falegaon	20.0622	77.1989	8.1	1512	992	530	67.20	87.97	65	3	19.2	214.72	270.00	88	31	0.1	0.1	1.070	-6.439
123	Washim	Kekatumra	20.02	77.1033	8.5	719	473	240	26.80	42.04	45	2	3.921	131.92	110.00	29	31	0.2	0.2	1.117	-2.506
124	Washim	Rajgaon	19.9747	77.1478	8.7	753	495	260	34.40	42.28	39	2	6.648	141.10	134.00	20	24	0.1	0.1	0.912	-2.665
125	Washim	Sawargaon Barade	20.1731	77.0681	8.2	491	322	150	16.00	26.73	25	4	2.817	189.10	20.00	6	12	0.1	0.1	0.789	0.194
126	Washim	Sukali	19.9778	77.1703	8.2	541	346	172	27.60	25.03	39	1.4	1.702	114.22	40.00	23	33	0.2	0	1.092	-1.510
127	Washim	Sukali	19.9778	77.1703	8.8	569	373	212	6.80	47.39	89	8	5.581	94.10	42.00	6	100	0.1	0.1	2.557	-2.511
128	Washim	Tondgaon	19.9994	77.1156	8.8	665	436	184	16.00	34.99	34	5	8.045	135.64	60.00	5	28	0.1	0.1	0.988	-1.188
129	Washim	Umara Kapase	20.0792	77.2917	8.6	483	317	198	26.80	31.83	16	1	7.207	192.59	40.00	4	15	0.1	0.1	0.427	-0.562
130	Washim	Warla	19.9931	77.2617	8.5	482	316	184	14.00	36.21	32	1	3.344	112.50	56.00	32	23	0.5	0.1	0.940	-1.724
131	Washim	Washim	20.1136	77.1356	7.5	837	540	440	56.00	72.90	15	1	0	161.04	120.00	16	22	0.9	0.1	0.271	-6.159

Annexure-VI: Chemical analysis of ground water samples, Aquifer- II / Deeper aquifers

SN	Block_	Village_	Lat	Log	PH	EC	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F	Fe	SAR	RSC
1		Risod	19.9725	76.7828	7.5	1825	1345	620	13	143	33	17	0	112	360	66	50	0.5	0.1	0.56	-10.56
2		Mahagaon	20.0747	76.6683	7.4	1712	1125	572	17	129	121	30	0	73	270	83	150	0.7	0.2	2.12	-10.24
3		Jaulka	20.2917	77.075	6.7	1485	976	512	67	84	112	32	0	112	194	56	148	0.6	0.3	1.87	-8.40
4		Dhavanda	20.1417	77.5792	6.7	1411	928	504	70	80	67	10	0	117	210	36	105	0.9	0.1	1.12	-8.16
5		Mangrulpir	20.3164	77.3458	7.7	806	530	480	50	86	46	1	0	93	164	21	63	0.8	0.05	0.81	-8.08
6		Degaon	20.0636	76.8161	8.3	980	643	448	51	78	35	64	7	78	220	35	31	0.6	0.3	0.63	-7.44
7		Karanji	20.165	77.0394	7.5	1548	1017	680	51	134	116	48	0	434	154	235	5	0.6	0.2	1.78	-6.48
8		Falegaon	20.0622	77.1989	8.1	1512	992	530	67	88	65	3	19	215	270	88	31	0.1	0.1	1.07	-6.44
9		Dongarkinhi	20.2117	76.9019	8.7	1196	786	410	13	92	91	15	10	102	174	48	100	0.4	0.1	1.88	-6.20
10		Washim	20.1136	77.1356	7.5	837	540	440	56	73	15	1	0	161	120	16	22	0.9	0.1	0.27	-6.16
11		Netansa	20.1419	76.7833	8.3	2650	1800	612	19	137	129	12	38	337	244	33	10	0.5	0	2.18	-5.44
12		Wanoja	20.3917	77.2642	7.7	1140	746	328	15	70	37	15	19	34	166	61	40	0.9	0.2	0.84	-5.36
13		Bhuli	20.1417	77.5792	8.6	1106	726	364	14	80	75	5	0	117	114	17	105	0.05	0.1	1.63	-5.36
14	Karanja	Bhamb Devi		20.623	77.608	7.5	2270	NA	560	126	60	136	195	0	360	206	188	434	0.7	0	2.00
15		Parwa	20.2889	77.5147	7.2	686	447	320	36	56	21	9	0	72	210	36	16	0.8	0.1	0.45	-5.22
16		Wanoja	20.0217	76.9292	8.4	764	502	372	24	76	41	35	17	102	140	95	8	1	0.1	0.86	-5.20
17		Shaha	20.3617	77.4722	7	975	639	332	35	59	59	20	0	98	130	32	79	0.7	0.1	1.25	-5.04
18		Malegaon	20.2369	76.9933	7.6	1642	1078	556	54	102	59	2	0	381	244	64	31	0.1	0.1	0.98	-4.88
19		Mop	19.95	76.6575	7.6	962	633	408	71	56	59	19	0	222	134	85	23	0.4	0.1	1.06	-4.52
20		Kalamba	20.3117	77.3792	8.6	980	642	488	51	87	41	37	58	204	94	93	10	1.4	0.3	0.72	-4.50
21		Jogaldari	20.2614	77.4122	7.1	965	633	288	16	60	66	21	0	83	90	35	90	0.7	0.1	1.58	-4.40
22		Manbha	20.3436	77.6325	9.6	697	457	260	32	43	36	2	14	36	150	49	10	0.1	0.1	0.85	-4.15
23		Gohagaon	20.0681	76.6458	8	421	275	220	17	43	19	6	0	40	106	14	28	0.4	0.1	0.51	-3.74
24		Panvihir	20.4583	77.4708	7.5	438	285	260	24	49	37	2	0	98	70	89	8	6	0.1	0.90	-3.59
25		Pimpalgaon	20.4167	77.275	8.6	1146	752	290	27	54	65	6	19	98	155	78	32	0.1	0.1	1.50	-3.56
26		Dabhadi	20.1458	77.3694	7.3	889	573	268	20	53	24	6	0	112	86	26	41	0.5	0.01	0.58	-3.52
27		Loni Bk.	19.9144	76.6253	8.1	687	451	276	9	62	110	8	2	142	54	152	69	0.07	0.1	2.77	-3.13
28	Mehkar	Mahagaon		20.326	76.669	7.8	660	390	200	38	40	32	2	0	134	71	60	79	0.63	0	0.74
29		Mohaja Bandi	19.8647	76.6714	7.6	547	360	298	20	60	65	7	1	189	26	73	75	0.6	0.1	1.51	-2.83
30		Dhotra Deshmukh	20.5972	77.6333	7	685	457	240	27	42	42	15	0	120	84	13	55	1	0.2	1.04	-2.83
31		Masalapen	20.0694	76.8639	6.7	818	537	224	22	41	25	11	0	102	90	15	35	0.8	0.1	0.65	-2.80
32		Haral	19.9769	76.8917	8.1	514	273	249.9	18	49	9	0.74	0	137	76	13	33	0.01	0	0.23	-2.68
33		Rajgaon	19.9747	77.1478	8.7	753	495	260	34	42	39	2	7	141	134	20	24	0.1	0.1	0.91	-2.66
34		Dhanaj Bk	20.6536	77.6283	8.7	1063	698	236	18	47	70	8	10	107	140	68	31	0.1	0.1	1.82	-2.64
35		Kherda	20.4969	77.5442	8.3	483	316	228	35	34	10	0.1	2	114	90	22	16	0.5	0.3	0.24	-2.62
36		Sukali	19.9778	77.1703	8.8	569	373	212	7	47	89	8	6	94	42	6	100	0.1	0.1	2.56	-2.51
37		Kekatumra	20.02	77.1033	8.5	719	473	240	27	42	45	2	4	132	110	29	31	0.2	0.2	1.12	-2.51
38		Dapuri	20.0981	77.8981	8.1	944	500	418.2	33	80	33	1.36	0	351	103	8	39	0.41	0	0.65	-2.48

SN	Block_	Village_	Lat	Log	PH	EC	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F	Fe	SAR	RSC
39		Bitoda Teli	20.1806	77.2639	6.9	772	507	184	18	34	22	13	0	93	70	29	25	0.9	0.1	0.63	-2.16
40	Malegaon	Medsi	20.326	76.944	7.8	820	490	205	44	23	94	2	0	122	113	120	35	0.57	0	2.30	-2.09
41		Ekamba	20.0708	77.3444	7.3	897	527	236	12	50	24	8	0	161	86	24	7	0.1	0.1	0.64	-2.08
42		Ekamba	20.2117	76.9489	8.9	453	298	180	21	31	39	3	6	82	50	85	21	0.5	0.1	1.11	-2.06
43		Kupta	20.3042	77.5625	9.2	566	372	190	13	38	42	7	12	83	60	35	40	0.1	0.1	1.23	-2.03
44	Risod	Belkheda	20.04	76.956	6.8	1460	885	140	40	10	276	2	0	55	404	110	15	2	0	7.73	-1.92
45		Haral	19.9769	76.8917	8.6	517	273	249.9	16	50	9	0.73	18	149	73	18	6	0.06	0	0.23	-1.90
46		Davha	20.2875	77.0375	6.9	746	489	160	16	29	30	9	0	80	78	30	14	0.6	0.1	0.92	-1.89
47		Dapuri	20.0981	77.8981	8.4	833	441	351.9	41	60	37	1.1	18	274	103	0	37	1.66	0	0.76	-1.87
48	Barshitakli	Lohara	20.496	77.372	6.8	1320	NA	140	38	11	230	3.7	0	61	252	244	2	0.25	0	6.52	-1.81
49		Dapuri	20.0981	77.8981	8	872	460	331.5	20	67	39	1.18	0	291	73	38	40	0.04	0	0.87	-1.74
50		Warla	19.9931	77.2617	8.5	482	316	184	14	36	32	1	3	112	56	32	23	0.5	0.1	0.94	-1.72
51		Shelgaon	20.0811	76.8561	8.6	490	322	200	6	45	50	9	5	135	34	70	12	0.6	0.1	1.48	-1.62
52		Janori	20.5986	77.3469	8.1	1222	802	130	48	2	239	1.3	0	61	284	185	1.7	0.7	0	6.57	-1.60
53		Sukali	19.9778	77.1703	8.2	541	346	172	28	25	39	1.4	2	114	40	23	33	0.2	0	1.09	-1.51
54	Malegaon	Mutha	20.125	77.013	7.2	1200	640	405	40	74	92	1	0	403	113	100	20	0.45	0	1.78	-1.48
55		Zodaga	20.1894	77.0444	8.4	384	252	188	32	26	36	5	3	143	44	22	8	0.4	0.3	0.96	-1.31
56		Tondgaon	19.9994	77.1156	8.8	665	436	184	16	35	34	5	8	136	60	5	28	0.1	0.1	0.99	-1.19
57		Mathgaon		20.0242	76.7469	10.9	880	469	367.2	18	77	19	14.07	18	333	56	17	10	0.05	0	0.41	
58	Karanja	Kherda (BK)		20.586	77.436	6.6	850	501	100	32	5	143	1.1	0	55	209	75	8	0.57	0	4.63	
59		Yeota	20.0969	76.9247	8.1	559	357	212	34	31	19	121	5	180	46	39	34	0.3	0	0.48	-1.10
60		Dapuri	20.0981	77.8981	7.6	974	516	316.2	20	63	62	1.16	0	315	115	0	40	0.79	0	1.42	-1.05
61		Sakhardoh	20.2528	77.4386	7.2	880	576	232	12	49	25	11	0	220	62	14	20	0.2	0.1	0.67	-1.04
62	Risod	Pangrakhed		20.1769	76.9358	7.6	649	344	295.8	33	51	8	1.21	0	297	34	12	39	0.12	0	0.18	
63		Kherda Bk.	20.5583	77.4394	9	451	296	174	8	37	41	4	12	131	60	21	24	0.1	0.1	1.28	-0.92
64	Digras	Masela Pen		20.069	77.864	9.4	1450	720	85	26	5	294	2	9	31	109	110	36	NA	0	10.42	
65		Sohol	20.4975	77.4408	8.2	1131	743	424	35	82	59	6	29	405	170	21	12	0.1	0.1	1.13	-0.88
66	Karanja	Kherda (BK)		20.586	77.436	7	810	477	85	30	2	141	0.6	0	61	198	70	5	0.54	0	4.87	
67	Risod	Pangrakhed		20.1769	76.9358	7.8	668	353	290.7	16	60	8	1	0	309	34	0	39	0.12	0	0.19	
68		Umara Kapase	20.0792	77.2917	8.6	483	317	198	27	32	16	1	7	193	40	4	15	0.1	0.1	0.43	-0.56
69		Karanja	20.4803	77.4833	7.4	702	461	112	24	13	38.5	0.7	0	124	46	15	12.5	0.5	0	1.28	-0.20
70		MOTHEGAON		20.0242	76.7469	7.3	891	472	295.8	45	44	76	0.63	0	345	91	18	23	0.53	0	1.64	
71		Tuljapur	20.4767	77.4456	9	766	306	104	8	20	29	5	9	98	50	19	7	0.09	0.1	1.13	-0.16
72		Umari Bk.	20.0917	77.5958	8.9	484	317	140	11	27	40	4	11	145	26	6	25	0.1	0.01	1.35	-0.07
73	Barshitakli	Lohara	20.496	77.372	7.9	810	NA	185	36	23	101	1	0	232	36	26	106	0.44	0	2.65	0.11
74		Sawargaon Barade	20.1731	77.0681	8.2	491	322	150	16	27	25	4	3	189	20	6	12	0.1	0.1	0.79	0.19
75	Manora	Senaona	20.061	77.592	8.1	1040	540	325	40	57	82	4	0	421	57	45	63	NA	0	1.71	0.21
76	Manora	Senaurjana		20.148	77.454	7.3	840	413	300	98	14	55	1.4	0	415	25	12	37	0.7	0	1.02	
77		Lehani	20.1039	76.7225	7.8	1663	1091	420	58	67	65	3	0	561	130	12	8	1.1	0.1	1.19	0.80

SN	Block_	Village_	Lat	Log	PH	EC	TDS	TH	Ca	Mg	Na	K	CO3	HCO3	Cl	SO4	NO3	F	Fe	SAR	RSC
78	Mangrulpir	Bitodavoyar		20.192	77.273	7.2	1130	564	160	60	2	186	0.9	0	244	124	61	8	0.7	0	4.61
79	Manora	Vitholi	20.204	77.579	8.4	940	575	75	26	2	179	3	0	165	142	80	49	NA	0	6.62	1.24
80	Mangrulpir	Shelu Bazar		20.371	77.253	8.3	1000	550	260	38	40	108	2	0	397	35	100	28	NA	0	2.49
81	Digras	Masela Pen		20.069	77.864	8.4	970	580	125	38	7	163	8	6	226	128	80	37	NA	0	4.79
82	Mangrulpir	Shelu Bazar		20.371	77.253	8.3	1010	535	255	32	43	115	2	0	403	39	100	21	NA	0	2.72
83	Mangrulpir	Shelu Bazar		20.371	77.253	8.1	970	520	260	46	35	104	2	0	427	39	60	19	NA	0	2.34
84	Akot	Dhanora Buzurg		20.968	77.129	7	700	357	175	62	5	81	1.4	0	342	18	15	3	0.8	0	1.94
85	Mangrulpir	Shelu Bazar		20.371	77.253	8.3	1110	625	235	28	40	147	2	0	415	43	125	31	NA	0	3.66
86		Sheloo Kh.	20.3361	77.2528	9.2	897	574	116	18	17	197	1.4	0	334	78	76	12	0.1	0	6.73	3.16

Annexure-VII: Water Level of Ground water monitoring wells (2018) with long term trend (2009-2018)

S. no.	District	Taluka	Village	Latitude	Longitude	Depth (mbgl)	Pre-monsoon DTW (May-18) (m bgl)	Pre trend (m /year)	Post-monsoon DTW (Nov-18) (m bgl)	Post trend (m /year)
1	Washim	KARANJA	Bhamdevi	20.6225	77.60694	11.4	10.8	-0.62849	7.3	0.073004
2	Washim	KARANJA	Dhanaj bk.	20.6536	77.625	9	7.7	-0.21998	4.7	0.302671
3	Washim	KARANJA	Dhotra deshmukh.	20.5972	77.63333	8.8	6.4	0.299791	4.7	0.18
4	Washim	KARANJA	Donad bk.	20.5472	77.63778	7.5	7.5	0.029899	5.2	0.234628
5	Washim	KARANJA	Janori	20.5625	77.34694	9.9	9.8	-0.12	5.1	0.226652
6	Washim	KARANJA	Karanja	20.4802	77.48333	13	11.6	-0.78562	5.9	0.062113
7	Washim	KARANJA	Kherda bk.	20.5855	77.43944	8.3	7.7	-0.02078	4.3	0.18
8	Washim	KARANJA	Manbha	20.5102	77.6325	9.2	9	0.18	3.5	-0.4324
9	Washim	KARANJA	Meha	20.6283	77.64167	9.2	8.2	0.35	5.4	1.032161
10	Washim	KARANJA	Nimbha	20.5694	77.61111	8.9	8.9	0.16	6.4	0.106976
11	Washim	KARANJA	Panvihir	20.4583	77.47083	10.35	8	0.628803	4.3	-0.33581
12	Washim	KARANJA	Poha	20.4958	77.40833	10.1	9.6	0.21	2.1	-0.24175
13	Washim	KARANJA	Rahati	20.6888	77.60972	8.4	8.4	0.17	6.9	0.23
14	Washim	KARANJA	Shaha	20.5283	77.47222	14	12.9	1.932649	9.6	0.291038
15	Washim	KARANJA	Sheluwada	20.4416	77.40528	8.35	8.35	0.1	6.1	0.549098
16	Washim	KARANJA	Sohol	20.4980	77.43528	7.5	7.4	0.1	5.8	0.055167
17	Washim	KARANJA	Tuljapur	20.4766	77.44556	9.7	8	0.491711	5.3	0.21
18	Washim	MALEGAON	Amana	20.3638	77.08889	7.2	6.8	0.21	1.1	-0.23
19	Washim	MALEGAON	Dava	20.2875	77.0375	9.1	7.5	1.074942	2.5	-0.43
20	Washim	MALEGAON	Dongarkinhi	20.2097	76.905	10.9	9.8	0.12	2.9	0.21
21	Washim	MALEGAON	Ekamba	20.2097	76.95139	10.8	9.8	-0.27522	4.3	0.784629
22	Washim	MALEGAON	Karanji	20.165	77.00611	14.05	13.8	1.51953	4.8	-0.11318
23	Washim	MALEGAON	Medshi	20.325	76.94583	11.7	7	-1.52449	2.3	-0.28609

S. no.	District	Taluka	Village	Latitude	Longitude	Depth (mbgl)	Pre-monsoon DTW (May-18) (m bgl)	Pre trend (m /year)	Post-monsoon DTW (Nov-18) (m bgl)	Post trend (m /year)
24	Washim	MALEGAON	Zodga bk	20.2013	77.03194	8.5	8.5	0.23	3.2	0.810556
25	Washim	MANGRULPIR	Bitoda bhoyar	20.1902	77.27222	11.3	10.7	0.165481	5.8	0.407357
26	Washim	MANGRULPIR	Borva kh	20.2902	77.46861	6.1	5.8	0.23	5.5	0.18
27	Washim	MANGRULPIR	Dabhadi	20.1486	77.36944	12.2	11.7	-0.12	6.4	0.44947
28	Washim	MANGRULPIR	Ichori	20.2013	77.25556	8.7	8.1	0.25	4.7	-0.08077
29	Washim	MANGRULPIR	Jogaldari	20.2625	77.41389	10	8.8	0.22	5.9	0.78516
30	Washim	MANGRULPIR	Kalamba	20.2616	77.37917	9.8	9.7	0.26	2.6	0.21
31	Washim	MANGRULPIR	Mangrulpir	20.3163	77.34583	12.5	10.4	0.188837	5.6	0.107468
32	Washim	MANGRULPIR	Poti	20.375	77.3875	14.3	11.7	0.05857	5.8	-0.45587
33	Washim	MANGRULPIR	Shelu kh,	20.3666	77.25	12.8	8.35	0.21	2.5	-0.02719
34	Washim	MANGRULPIR	Wanoja	20.4083	77.22917	8.2	7.2	0.1	4.2	0.33
35	Washim	MANORA	Asola	20.2625	77.52083	10.65	9.1	-0.26	6.2	-0.41
36	Washim	MANORA	Bhoyani	20.3375	77.53333	7.8	7.5	0.22	3.4	-0.6225
37	Washim	MANORA	Bhuli	20.1416	77.57917	11.7	11.1	-0.29	6.3	-0.44201
38	Washim	MANORA	Borva bk.	20.2444	77.61528	13.5	7.5	0.86218	4.2	-0.99939
39	Washim	MANORA	Dhawanda	20.0791	77.65056	10.6	9.5	-0.41	9.5	-0.19133
40	Washim	MANORA	Fulumri	20.0958	77.5625	8	6.2	0.41	4.3	-1.38857
41	Washim	MANORA	Inzori	20.3944	77.51111	18.25	14.6	0.363088	5.3	-0.40676
42	Washim	MANORA	Karli	20.2305	77.625	8.4	5	0.016032	1.7	0.54
43	Washim	MANORA	Khadi dhamni	20.3708	77.45278	10.3	10	0.28	5.7	-0.33757
44	Washim	MANORA	Kupta	20.3083	77.5625	8	5.7	-0.41237	3.8	0.653727
45	Washim	MANORA	Manora	20.2208	77.5625	6.7	6.5	0.14	3.4	-0.45
46	Washim	MANORA	Sakhardoh	20.2527	77.45528	8.7	7.8	0.23	7.6	-0.8169
47	Washim	MANORA	Sawargaon kh.	20.2680	77.59444	7.8	5.6	-0.18015	3.6	0.815086

S. no.	District	Taluka	Village	Latitude	Longitude	Depth (mbgl)	Pre-monsoon DTW (May-18) (m bgl)	Pre trend (m /year)	Post-monsoon DTW (Nov-18) (m bgl)	Post trend (m /year)
48	Washim	MANORA	Somthana	20.2125	77.55	6.2	5.7	-0.21	4.1	0.085294
49	Washim	MANORA	Umri bk	20.0916	77.59583	14.1	12.1	-0.41	6.4	-0.53682
50	Washim	MANORA	Vitholi	20.1944	77.57361	9	7.7	-0.42	4.5	-0.36735
51	Washim	RISOD	Agarwadi	19.9352	76.74861	12.85	12.4	2.212866	2.8	0.458712
52	Washim	RISOD	Asegaon pen	20.0277	76.95694	8.2	5.7	0.329588	2	-0.86147
53	Washim	RISOD	Borkhedi	19.9847	76.66778	8.2	7.7	0.41	2.1	0.257937
54	Washim	RISOD	Chichamba bhar	19.8913	76.73111	11.65	10.9	0.24	3.1	-0.73903
55	Washim	RISOD	Degaon	20.0636	76.98889	11.35	10	-0.03858	1.9	0.50037
56	Washim	RISOD	Gohogaon	19.9730	76.78278	10.7	10.1	0.22	2.2	-0.10485
57	Washim	RISOD	Kalamgavan	20.1958	76.84639	10.2	10.2	0.21	1.9	0.246618
58	Washim	RISOD	Kankarwadi	19.9188	76.75806	8.35	8.3	-0.09	2.1	-1.10139
59	Washim	RISOD	Khandala	20.1027	76.86111	9.5	5.4	-0.21	2.8	1.446711
60	Washim	RISOD	Lehani	20.1038	76.7225	14.4	13	0.245536	2.5	-0.62
61	Washim	RISOD	Loni bk.	19.9144	76.62528	13.5	11.8	0.597861	2.1	0.35339
62	Washim	RISOD	Mahagaon	20.0763	76.66806	13	13	-0.13795	4.3	-1.3067
63	Washim	RISOD	Mohajabandi	19.8647	76.66972	10.6	10.1	0.374215	1.7	-1.49489
64	Washim	RISOD	Mop	19.9536	76.65611	12.6	10.9	0.239065	3.9	-0.06514
65	Washim	RISOD	Netansa	20.1419	76.78333	9.5	8	0.37899	3.1	-1.41147
66	Washim	RISOD	Risod	19.9730	76.78278	12.8	8	-0.22	2.7	-0.65
67	Washim	RISOD	Shelgaon	20.0811	76.85611	8.6	8.1	0.17	2.8	-0.55776
68	Washim	RISOD	Wakad	20.0388	76.68861	11.35	10.1	-0.07103	1.9	0.121269
69	Washim	RISOD	Wanoja	20.0216	76.92917	7.35	7.35	0.165362	2.2	-1.16194
70	Washim	WASHIM	Bithoda teli	20.1805	77.26389	12.2	8.9	0.329761	5.1	0.858135
71	Washim	WASHIM	Ekamba	20.075	77.34167	10.8	9.6	0.41	5.4	0.65386

S. no.	District	Taluka	Village	Latitude	Longitude	Depth (mbgl)	Pre-monsoon DTW (May-18) (m bgl)	Pre trend (m /year)	Post-monsoon DTW (Nov-18) (m bgl)	Post trend (m /year)
72	Washim	WASHIM	Falegaon	20.0622	77.19889	9.9	9.8	0.22	5.2	-0.77963
73	Washim	WASHIM	Kekatumra	20.02	77.10139	7.9	7.2	0.23	3.2	-0.01165
74	Washim	WASHIM	Pimpalgaon	20.0472	77.275	9.25	9.25	0.556026	3.8	-0.18897
75	Washim	WASHIM	Rajgaon	19.9747	77.14778	5.7	5.7	0.18	3.8	1.422145
76	Washim	WASHIM	Sawargaon barde	20.1730	77.06806	7.7	7.6	0.19	5.1	1.012821
77	Washim	WASHIM	Tondgaon	19.9994	77.11556	8.8	7.8	0.21	4.1	0.01888
78	Washim	WASHIM	Umarakapse	20.0819	77.29167	8.5	8.2	0.25	3.1	-0.03167
79	Washim	WASHIM	Warla	19.9930	77.26167	10.5	10.5	0.41	4.3	-0.07874
80	Washim	WASHIM	Washim	20.1136	77.13556	15.16	12.3	0.113899	4.4	1.585677

Annexure VIII: Location of proposed Check dams in Washim district

S.N.	Village	Taluka	District	X	Y	Structure
1	Amboda	Karanja	Washim	77.6112	20.6795	Checkdam
2	Antrakhed	Karanja	Washim	77.4725	20.5704	Checkdam
3	Bhambdevi	Karanja	Washim	77.6029	20.6395	Checkdam
4	Donad Bk.	Karanja	Washim	77.6363	20.548	Checkdam
5	Kamargaon	Karanja	Washim	77.502	20.5968	Checkdam
6	Khanapur	Karanja	Washim	77.4488	20.6046	Checkdam
7	Manbha	Karanja	Washim	77.6519	20.517	Checkdam
8	Meha	Karanja	Washim	77.6435	20.6229	Checkdam
9	Palana	Karanja	Washim	77.4179	20.567	Checkdam
10	Rahati	Karanja	Washim	77.6143	20.6977	Checkdam
11	Sukali	Karanja	Washim	77.497	20.6711	Checkdam
12	Jaulka	Malegaon	Washim	77.0625	20.3025	Checkdam
13	Marsul	Malegaon	Washim	77.004	20.3875	Checkdam
14	Musalwadi	Malegaon	Washim	77.0898	20.372	Checkdam
15	Wadiramrao	Malegaon	Washim	77.1385	20.3564	Checkdam
16	Borwha kh.	Mangrulpir	Washim	77.4658	20.2903	Checkdam
17	Chandhai	Mangrulpir	Washim	77.421	20.2749	Checkdam
18	Chandhai	Mangrulpir	Washim	77.4154	20.2838	Checkdam
19	Chehel	Mangrulpir	Washim	77.3867	20.3102	Checkdam
20	Chikhali	Mangrulpir	Washim	77.2455	20.358	Checkdam
21	Chincholi	Mangrulpir	Washim	77.3539	20.1534	Checkdam
22	Dhanora bk.	Mangrulpir	Washim	77.3984	20.3178	Checkdam
23	Dhanora bk.	Mangrulpir	Washim	77.3876	20.317	Checkdam
24	Gimbha	Mangrulpir	Washim	77.4447	20.3523	Checkdam
25	Jogaldari	Mangrulpir	Washim	77.409	20.2624	Checkdam
26	Jogaldari	Mangrulpir	Washim	77.4012	20.2663	Checkdam
27	Jogaldari	Mangrulpir	Washim	77.3998	20.2587	Checkdam
28	Jogaldari	Mangrulpir	Washim	77.4224	20.2577	Checkdam
29	Junapani	Mangrulpir	Washim	77.433	20.2626	Checkdam
30	Kanzara	Mangrulpir	Washim	77.2697	20.3436	Checkdam
31	Kasola	Mangrulpir	Washim	77.3048	20.2297	Checkdam
32	Kasola	Mangrulpir	Washim	77.3037	20.2454	Checkdam
33	Kawathal	Mangrulpir	Washim	77.472	20.3374	Checkdam
34	Kawathal	Mangrulpir	Washim	77.4706	20.3222	Checkdam
35	Kothari	Mangrulpir	Washim	77.4268	20.2958	Checkdam
36	Lawana	Mangrulpir	Washim	77.3937	20.2945	Checkdam
37	Mohgavan	Mangrulpir	Washim	77.3034	20.3274	Checkdam
38	Murtijapur	Mangrulpir	Washim	77.3369	20.3316	Checkdam
39	Nimbi	Mangrulpir	Washim	77.2695	20.2673	Checkdam
40	Nimbi	Mangrulpir	Washim	77.2686	20.2752	Checkdam
41	Nimbi	Mangrulpir	Washim	77.2608	20.272	Checkdam
42	Pardi Tad	Mangrulpir	Washim	77.2809	20.3546	Checkdam
43	Pedgaon	Mangrulpir	Washim	77.3271	20.4095	Checkdam

S.N.	Village	Taluka	District	X	Y	Structure
44	Pedgaon	Mangrulpir	Washim	77.3009	20.4367	Checkdam
45	Pedgaon	Mangrulpir	Washim	77.3303	20.399	Checkdam
46	Pethkhudawatpur	Mangrulpir	Washim	77.3435	20.2976	Checkdam
47	Rahit	Mangrulpir	Washim	77.3906	20.3013	Checkdam
48	Renkapur	Mangrulpir	Washim	77.3775	20.3065	Checkdam
49	Saikheda	Mangrulpir	Washim	77.2906	20.254	Checkdam
50	Sonkhas	Mangrulpir	Washim	77.3218	20.3084	Checkdam
51	Tapovan Bk.	Mangrulpir	Washim	77.2796	20.3817	Checkdam
52	Tarhala	Mangrulpir	Washim	77.3038	20.3768	Checkdam
53	Umari	Mangrulpir	Washim	77.36	20.2791	Checkdam
54	Wadha	Mangrulpir	Washim	77.3405	20.3457	Checkdam
55	Warud Bk.	Mangrulpir	Washim	77.3547	20.2911	Checkdam
56	Asola Bk.	Manora	Washim	77.5205	20.257	Checkdam
57	Chausala	Manora	Washim	77.5511	20.3699	Checkdam
58	Devthana	Manora	Washim	77.5324	20.2086	Checkdam
59	Dhamni	Manora	Washim	77.5405	20.2303	Checkdam
60	Dhanora Bhuse	Manora	Washim	77.5009	20.356	Checkdam
61	Dhanora Bk.	Manora	Washim	77.636	20.1916	Checkdam
62	Dongargaon	Manora	Washim	77.497	20.2201	Checkdam
63	Eklara	Manora	Washim	77.5433	20.2619	Checkdam
64	Fulumari	Manora	Washim	77.5511	20.1063	Checkdam
65	Fulumari	Manora	Washim	77.5661	20.0995	Checkdam
66	Giroli	Manora	Washim	77.472	20.1999	Checkdam
67	Giroli	Manora	Washim	77.4786	20.1997	Checkdam
68	Giroli	Manora	Washim	77.4767	20.2143	Checkdam
69	Gondegaon.	Manora	Washim	77.6207	20.0818	Checkdam
70	Gundi	Manora	Washim	77.5371	20.2499	Checkdam
71	Hiwara Bk.	Manora	Washim	77.5037	20.2671	Checkdam
72	Inzori	Manora	Washim	77.5148	20.3934	Checkdam
73	Jamni	Manora	Washim	77.5065	20.3707	Checkdam
74	Jamni	Manora	Washim	77.5015	20.3623	Checkdam
75	Jawala Bk.	Manora	Washim	77.4945	20.2569	Checkdam
76	Karli	Manora	Washim	77.6224	20.2386	Checkdam
77	Karli	Manora	Washim	77.6293	20.2337	Checkdam
78	Khandala	Manora	Washim	77.4984	20.3346	Checkdam
79	Kheda Abai	Manora	Washim	77.5012	20.2298	Checkdam
80	Kondoli	Manora	Washim	77.5185	20.241	Checkdam
81	Kupta	Manora	Washim	77.5594	20.3006	Checkdam
82	Kupta	Manora	Washim	77.5714	20.3019	Checkdam
83	Kupta	Manora	Washim	77.5717	20.3108	Checkdam
84	Mahuli	Manora	Washim	77.5853	20.1594	Checkdam
85	Mhasni	Manora	Washim	77.5722	20.3777	Checkdam
86	Mhasni	Manora	Washim	77.5591	20.3864	Checkdam
87	Mhasni	Manora	Washim	77.5625	20.3971	Checkdam
88	Mohgaon	Manora	Washim	77.514	20.2993	Checkdam

S.N.	Village	Taluka	District	X	Y	Structure
89	Rui	Manora	Washim	77.46	20.1043	Checkdam
90	Rui	Manora	Washim	77.46	20.082	Checkdam
91	Sakhardoh	Manora	Washim	77.4533	20.263	Checkdam
92	Sakhardoh	Manora	Washim	77.4786	20.242	Checkdam
93	Sakhardoh	Manora	Washim	77.4681	20.24	Checkdam
94	Sawali	Manora	Washim	77.6458	20.1082	Checkdam
95	Sewadasnagar	Manora	Washim	77.653	20.2224	Checkdam
96	Sewadasnagar	Manora	Washim	77.629	20.2201	Checkdam
97	Sewadasnagar	Manora	Washim	77.648	20.2227	Checkdam
98	Shendona	Manora	Washim	77.5923	20.0692	Checkdam
99	Shinganapur	Manora	Washim	77.4469	20.2695	Checkdam
100	Someshwar Nagar	Manora	Washim	77.5789	20.0927	Checkdam
101	Someshwar Nagar	Manora	Washim	77.5672	20.0901	Checkdam
102	Somthana	Manora	Washim	77.5469	20.2094	Checkdam
103	Somthana	Manora	Washim	77.546	20.2156	Checkdam
104	Talap Bk.	Manora	Washim	77.5884	20.2243	Checkdam
105	Talap Bk.	Manora	Washim	77.5959	20.218	Checkdam
106	Talap Bk.	Manora	Washim	77.6045	20.2143	Checkdam
107	Terka	Manora	Washim	77.5263	20.2996	Checkdam
108	Umarda	Manora	Washim	77.4948	20.3906	Checkdam
109	Vilegaon	Manora	Washim	77.472	20.1861	Checkdam
110	Vitholi	Manora	Washim	77.5745	20.1931	Checkdam
111	Vitholi	Manora	Washim	77.5739	20.1759	Checkdam
112	Vitholi	Manora	Washim	77.5825	20.1814	Checkdam
113	Vitholi	Manora	Washim	77.5753	20.2086	Checkdam
114	Watod	Manora	Washim	77.555	20.2334	Checkdam
115	Watod	Manora	Washim	77.5597	20.2481	Checkdam
116	Bhokarkhed	Risod	Washim	76.8277	20.0245	Checkdam
117	Bibkhed	Risod	Washim	76.7923	19.9983	Checkdam
118	Chinchanba Pen	Risod	Washim	76.8901	20.0689	Checkdam
119	Chinchanba Pen	Risod	Washim	76.906	20.0663	Checkdam
120	Dhodap Kh.	Risod	Washim	76.8051	20.0773	Checkdam
121	Gobhani.	Risod	Washim	76.7684	20.0684	Checkdam
122	Gowardhan	Risod	Washim	76.8366	20.1145	Checkdam
123	Kawatha Kh.	Risod	Washim	76.8659	20.0266	Checkdam
124	Koyali Kh.	Risod	Washim	76.938	19.9988	Checkdam
125	Masala Pen	Risod	Washim	76.862	20.0744	Checkdam
126	Mohaja Ingole	Risod	Washim	76.84	20.015	Checkdam
127	Netanasa	Risod	Washim	76.7837	20.1273	Checkdam
128	Netanasa	Risod	Washim	76.784	20.1427	Checkdam
129	Palaskhed	Risod	Washim	76.8079	20.0143	Checkdam
130	Pardi Tikhe	Risod	Washim	76.9458	20.0687	Checkdam
131	Pedgaon	Risod	Washim	76.8973	20.031	Checkdam
132	Sawad	Risod	Washim	76.828	19.997	Checkdam

S.N.	Village	Taluka	District	X	Y	Structure
133	Wadi Raital	Risod	Washim	76.845	20.0349	Checkdam
134	Waghi Kh.	Risod	Washim	76.8759	20.116	Checkdam
135	Wanoja	Risod	Washim	76.9316	20.0239	Checkdam
136	Yevta	Risod	Washim	76.9177	20.093	Checkdam
137	Falegaon Thet	Washim	Washim	77.1995	20.0609	Checkdam
138	Jambhrun Bhite	Washim	Washim	77.1046	20.084	Checkdam
139	Kekatumra	Washim	Washim	77.1073	20.0162	Checkdam
140	Kokalgaon	Washim	Washim	77.0881	19.9693	Checkdam
141	Krishna	Washim	Washim	77.2143	19.9905	Checkdam
142	Mohgawhan Dube	Washim	Washim	77.1912	20.0476	Checkdam
143	Panchala	Washim	Washim	77.1572	20.0604	Checkdam
144	Tamsala	Washim	Washim	77.1199	20.0348	Checkdam
145	Tondgaon	Washim	Washim	77.1179	20.0055	Checkdam
146	Ukalipen	Washim	Washim	77.1831	19.9992	Checkdam
147	Ukalipen	Washim	Washim	77.1778	20.0044	Checkdam
148	Ukalipen	Washim	Washim	77.172	20.0096	Checkdam
149	Wai	Washim	Washim	77.2525	19.9568	Checkdam
150	Warla	Washim	Washim	77.2597	19.979	Checkdam
151	Washim	Washim	Washim	77.1246	20.062	Checkdam

Annexure IX: Location of proposed Percolation tanks in Washim district

S.N.	Village	Taluka	District	X	Y	Structure
1	Kherda Pr. Karanja	Karanja	Washim	77.5341	20.5162	Percolation Tank
2	Meha	Karanja	Washim	77.6485	20.6351	Percolation Tank
3	Tamaswadi	Karanja	Washim	77.5892	20.6643	Percolation Tank
4	Wadgaon [Range]	Karanja	Washim	77.6697	20.5245	Percolation Tank
5	Baldeo	Mangrulpir	Washim	77.3282	20.3232	Percolation Tank
6	Gimbha	Mangrulpir	Washim	77.4466	20.3598	Percolation Tank
7	Kanzara	Mangrulpir	Washim	77.2639	20.3313	Percolation Tank
8	Kawathal	Mangrulpir	Washim	77.4736	20.342	Percolation Tank
9	Nagi	Mangrulpir	Washim	77.2603	20.3807	Percolation Tank
10	Pangri	Mangrulpir	Washim	77.2839	20.4368	Percolation Tank
11	Poghat	Mangrulpir	Washim	77.3435	20.4019	Percolation Tank
12	Poti	Mangrulpir	Washim	77.3887	20.3723	Percolation Tank
13	Pur	Mangrulpir	Washim	77.1892	20.3849	Percolation Tank
14	Shivni	Mangrulpir	Washim	77.38	20.4011	Percolation Tank
15	Swasin	Mangrulpir	Washim	77.3789	20.3196	Percolation Tank
16	Tarhala	Mangrulpir	Washim	77.3037	20.3773	Percolation Tank
17	Umardoh	Mangrulpir	Washim	77.3628	20.4063	Percolation Tank
18	Wadha	Mangrulpir	Washim	77.3458	20.3546	Percolation Tank
19	Amkinhi	Manora	Washim	77.6338	20.0557	Percolation Tank
20	Asola Bk.	Manora	Washim	77.5215	20.256	Percolation Tank
21	Bhuli	Manora	Washim	77.5689	20.1579	Percolation Tank
22	Chakur	Manora	Washim	77.5667	20.1647	Percolation Tank
23	Dhanora Bk.	Manora	Washim	77.6357	20.176	Percolation Tank
24	Dhanora Bk.	Manora	Washim	77.6405	20.1953	Percolation Tank
25	Dhawanda	Manora	Washim	77.6424	20.0879	Percolation Tank
26	Dhoni	Manora	Washim	77.4967	20.086	Percolation Tank
27	Dhoni	Manora	Washim	77.4951	20.0947	Percolation Tank
28	Fulumari	Manora	Washim	77.5775	20.1051	Percolation Tank
29	Gadegaon	Manora	Washim	77.6589	20.165	Percolation Tank
30	Galamgaon	Manora	Washim	77.5898	20.1744	Percolation Tank
31	Gavha	Manora	Washim	77.5625	20.1885	Percolation Tank
32	Gavha	Manora	Washim	77.5463	20.1846	Percolation Tank
33	Gogjai	Manora	Washim	77.621	20.0905	Percolation Tank

S.N.	Village	Taluka	District	X	Y	Structure
34	Gondegaon.	Manora	Washim	77.6082	20.0745	Percolation Tank
35	Gosta	Manora	Washim	77.431	20.113	Percolation Tank
36	Hatoli	Manora	Washim	77.5511	20.1488	Percolation Tank
37	Hiwara Bk.	Manora	Washim	77.5112	20.2545	Percolation Tank
38	Jawala Kh.	Manora	Washim	77.5006	20.2479	Percolation Tank
39	Karkheda	Manora	Washim	77.6015	20.1974	Percolation Tank
40	Karli	Manora	Washim	77.6218	20.2323	Percolation Tank
41	Kupta	Manora	Washim	77.58	20.3041	Percolation Tank
42	Poharadevi	Manora	Washim	77.6293	20.1122	Percolation Tank
43	Rohna	Manora	Washim	77.4795	20.2547	Percolation Tank
44	Rui	Manora	Washim	77.4536	20.0798	Percolation Tank
45	Rui	Manora	Washim	77.4455	20.0902	Percolation Tank
46	Sawali	Manora	Washim	77.655	20.1069	Percolation Tank
47	Shendona	Manora	Washim	77.5898	20.063	Percolation Tank
48	Shendurjana (A)	Manora	Washim	77.4377	20.1216	Percolation Tank
49	Talap Bk.	Manora	Washim	77.5836	20.2236	Percolation Tank
50	Talap Bk.	Manora	Washim	77.6043	20.22	Percolation Tank
51	Waigaul	Manora	Washim	77.6605	20.1391	Percolation Tank
52	Waigaul	Manora	Washim	77.6694	20.1391	Percolation Tank
53	Watod	Manora	Washim	77.5597	20.2315	Percolation Tank
54	Gowardhan	Risod	Washim	76.8333	20.1087	Percolation Tank
55	Pedgaon	Risod	Washim	76.9085	20.0485	Percolation Tank
56	Waghi Kh.	Risod	Washim	76.867	20.1045	Percolation Tank
57	Warud Topha	Risod	Washim	76.9706	20.0135	Percolation Tank
58	Yevta	Risod	Washim	76.9372	20.0804	Percolation Tank
59	Rajgaon	Washim	Washim	77.1475	19.9792	Percolation Tank
60	Ukalipen	Washim	Washim	77.2065	20.0015	Percolation Tank
61	Wai	Washim	Washim	77.2658	19.9659	Percolation Tank

Annexure X: Photographs

High yielding EW at Dapuri Q=3.17 lps Risod taluka, Washim District

High yielding OW at Dapuri Q=4.43 lps, Risod taluka, Washim District

Artesian EW (Auto flow) at EW Haral, Risod taluka, Washim District with Q=0.14 lps

Release of training module: L to R, Dr. Bhushan Lamsoge, Sh. Ulhas Bund, Sh. P. K. Parchure, Sh. S. S. Kadu and Sh. D Venkateswaran.

Trainee Participants attending

Marathi booklet on "GW information of Washim district" was release by guest (From L to R) Smt Jyotitai More, Member, panchayat samiti, Risod, Smt. Chayatai sunil Patil, sabhapati, panchayat samiti, Risod; Dr. Bhushan Lamsoge, sr. Hg. CGWB, Nagpur and Shivshankar Bharsakade, BDO, Risod.

Sh. Shivshankar Bharsakade, BDO, Risod, addressing to the participants