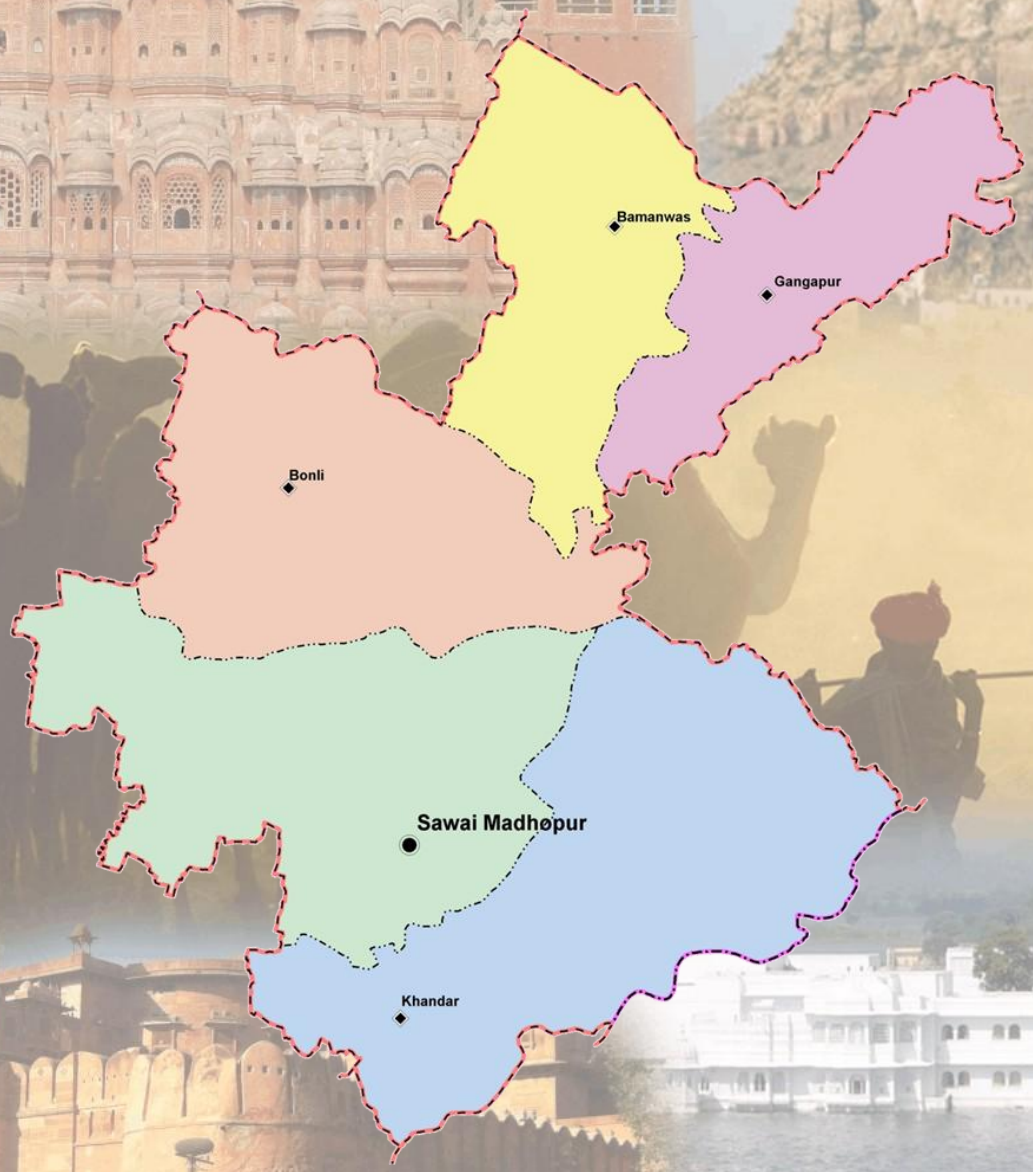
Ground Water Department,
Rajasthan

Hydrogeological Atlas of Rajasthan

Sawai Madhopur District

European Union
State Partnership Programme



2013

ROLTA
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Hydrogeological Atlas of Rajasthan

Sawai Madhopur District

Contents:

2013

ADMINISTRATIVE SETUP

DISTRICT – SAWAI MADHOPUR

Location:

Sawai Madhopur district is located in the eastern part of Rajasthan. It is bounded in the north by Dausa and northeast by Karauli districts, in the east by state of Madhya Pradesh, South by Kota while Tonk district constitutes its western boundary. It stretches between 25° 44' 00.90" to 26° 43' 34.33" north latitude and 75° 58' 36.70'' to 76° 59' 04.98'' east longitude covering area of 5,051.9 sq kms. The district is part of three river basins viz. 'Banas River Basin', 'Chambal River Basin' and 'Gambhir River Basin'. Of these, the Banas River basin is most prominent and drains significantly large part of the district in central and northern parts whereas the Chambal River drains in southern part of the district. The Gambhir river basin occupies small area in the northeastern corner.

Administrative Set-up:

Sawai Madhopur district is administratively divided into five blocks. The following table summarizes the basic statistics of the district at block level.

S. No.	Block Name	Population (Based on 2001 census)	Area (sq km)	% of District Area	Total Number of Towns and Villages
1	Bamanwas	1,49,429	772.6	15.3	150
2	Bonli	2,09,833	1,049.0	20.7	180
3	Gangapur	2,84,605	633.2	12.5	124
4	Khandar	1,55,383	1,392.4	27.5	181
5	Sawai Madhopur	3,13,303	1,204.7	24	163
Total		**11,12,553**	**5,051.9**	**100.0**	**798**

The district has 798 towns and villages of which five are block headquarters as well.

Climate:

The climate of the district can be classified as sub-humid. It is characterized by very hot summers and very cold winters with fairly good rainfall during south-west monsoon period. In May, the maximum temperature may sometimes go up to 47 °C and winter temperatures dipping down to 2 °C. The potential evapotranspiration rates are high, especially during May and June. The mean annual rainfall of the district is 606.6mm. The most of the rainfall is received during the monsoon months.

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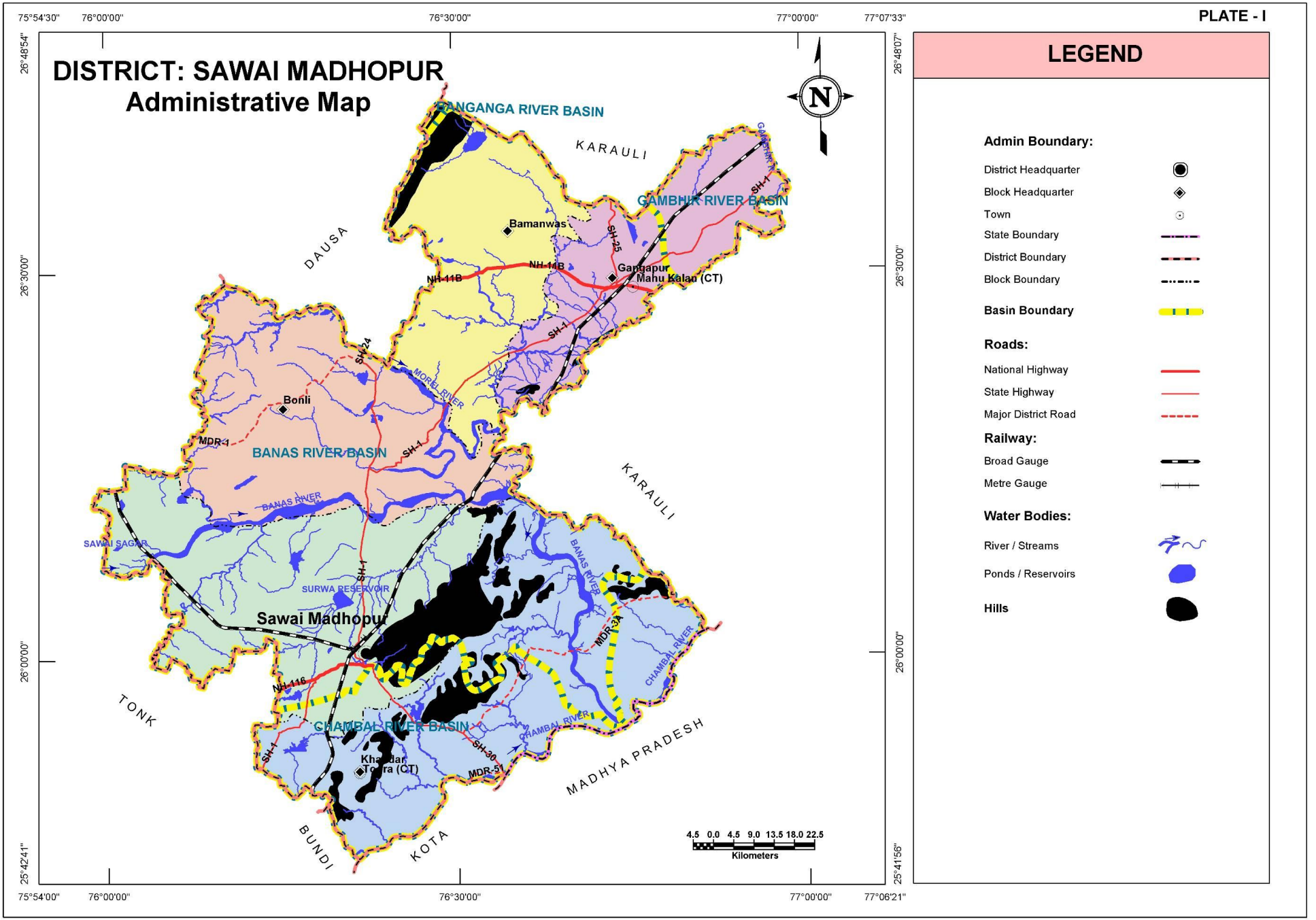
PLATE - I



LEGEND

Admin Boundary:

- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary
- **Basin Boundary**

Roads:

- National Highway
- State Highway
- Major District Road

Railway:

- Broad Gauge
- Metre Gauge

Water Bodies:

- River / Streams
- Ponds / Reservoirs
- **Hills**

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TOPOGRAPHY

DISTRICT – SAWAI MADHOPUR

The district can be divided into three distinct physiographic units, viz. hilly terrain, alluvial plain with isolated hills and alluvial plains. The hilly terrain occupies the south and south eastern part with NE-SWtrending ridges. The isolated hill occupies southwest and central part of the district and alluvial plain area occupies north, northeast and western parts of the district having relatively flat and gently sloping topography. The major rivers of the district are Banas, Chambal and Morel which creates very good drainage system along with their tributaries. The general topographic elevation in the district is between 250 m to 300 m above mean sea level. Elevation ranges from a minimum of 164.4 m above mean sea level in Khandar block in the southern part of the district to a maximum of 541.4 m above mean sea level in Bamanwas block in northern part of the district.

Table: Block wise minimum and maximum elevation

S. No.	Block Name	Min. Elevation (m amsl)	Max. Elevation (m amsl)
1	Bamanwas	218.7	541.4
2	Bonli	204.2	449.3
3	Gangapur	219.1	428.6
4	Khandar	164.4	492.7
5	Sawai Madhopur	213.0	505.0

RAINFALL

The district receives very good rainfall. The general distribution of rainfall across can be visualized from isohyets presented in the Plate – III. Low rainfall is seen in northeastern and western part of the district which gradually increases towards central and southern areas. The general variation of the rainfall in the district has been in the range of 700 to 1000 mm rainfall in the year 2010. The annual average rainfall was 838.6 mm based on the data of available blocks. Highest annual rainfall was in Bamanwas block (1,175.3 mm) whereas lowest in Bonli block (595.8 mm).

Table: Block wise annual rainfall statistics (derived from year 2010 meteorological station data)

Block Name	Minimum Annual Rainfall (mm)	Maximum Annual Rainfall (mm)	Average Annual Rainfall (mm)
Bamanwas	657.2	1,175.3	908.1
Bonli	595.8	1,006.7	793.8
Gangapur	619.5	982.9	755.6
Khandar	711.4	1,060.5	854.5
Sawai Madhopur	663.5	1,119.2	880.9

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Rajasthan

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PLATE - II

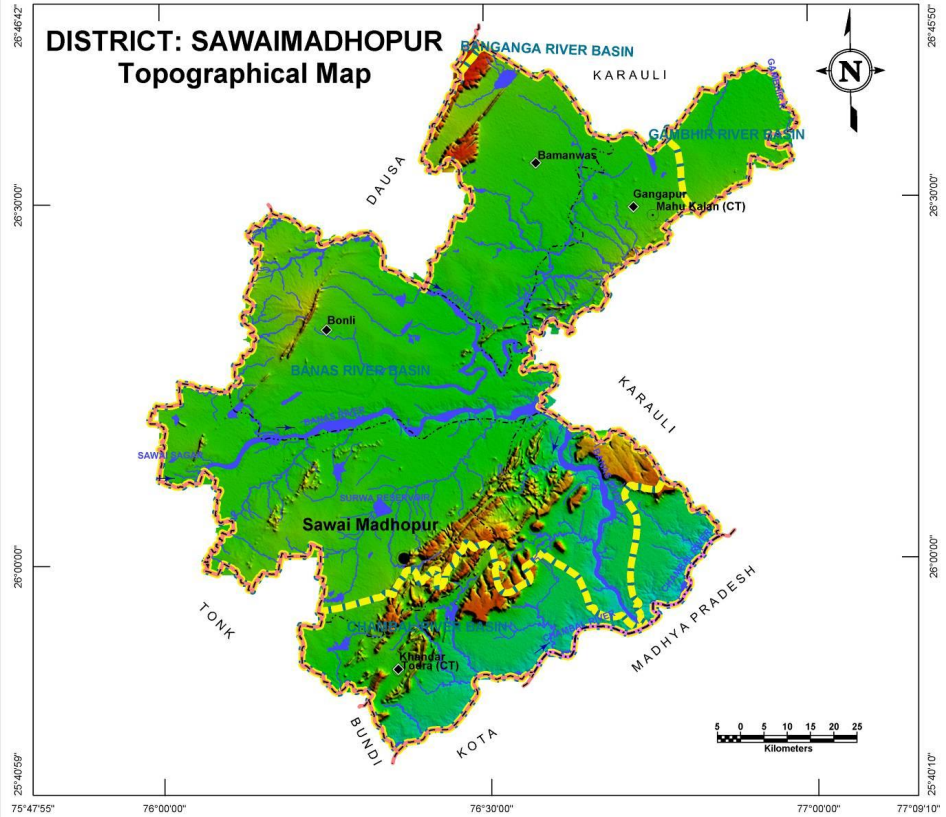
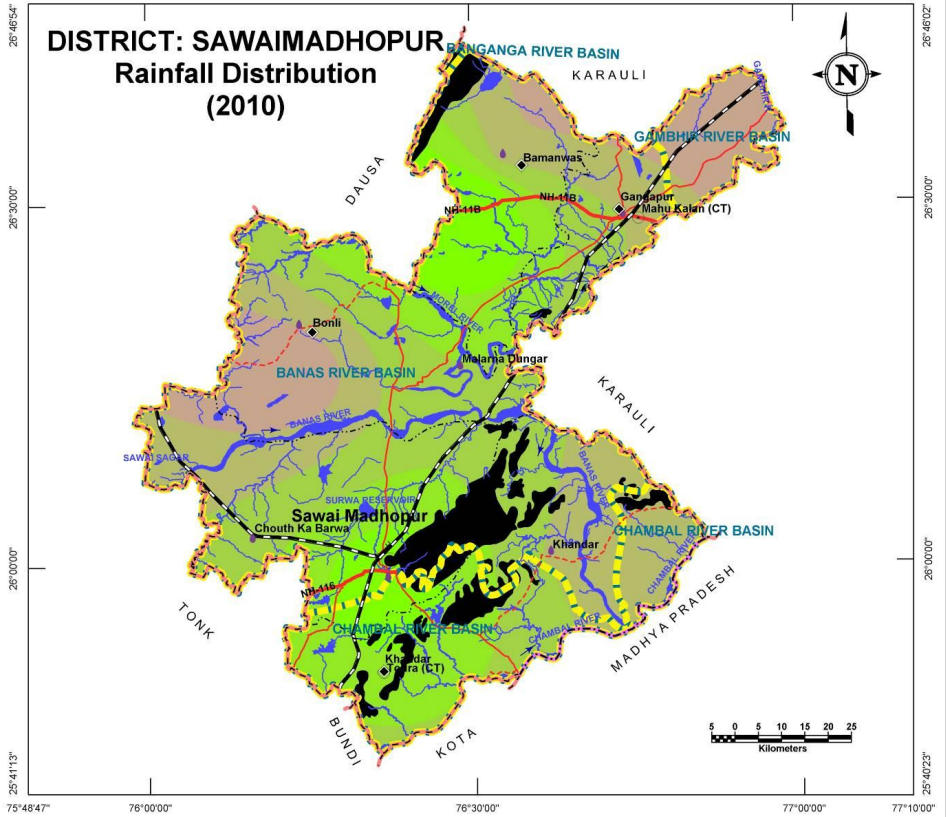


PLATE - III



LEGEND

Admin Boundary:
- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary

Basin Boundary

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Elevation (m amsl):
541, 500, 450, 400, 350, 300, 250, 200, 164

Source : SRTM DEM

LEGEND

Admin Boundary:
- District Headquarter
- Block Headquarter
- Town
- Raingauge Stations
- State Boundary
- District Boundary
- Block Boundary

Basin Boundary

Roads:
- National Highway
- State Highway
- Major District Road

Railway:
- Broad Gauge
- Metre Gauge

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Hills

Isohyets (mm):
- 500-600
- 600-700
- 700-800
- 800-900
- 900-1000
- > 1000

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GEOLOGY AND GEOMORPHOLOGY

DISTRICT – SAWAI MADHOPUR

Geology

The district is mostly covered withfluvial and wind-blown sand which as seen in north, northeast and central parts of the district. The district exposes rocks of Vindhyan, Delhi and Bhilwara Super Group. The Vindhyan Super Group is divided into Bhander, Rewa, Sand and Satola Groups which consist of sandstone, shale and limestone. Alwar Group is a part of Delhi Super Group which occupies the northwestern part of the district. Alwar Group consists of quartzite, conglomerate and mica schist. Bhilwara Super Group is divided into Ranthambhore, Jahazpur, Hindoli and Mangalwar complex which is exposed in the west and southwestern parts of the district. Bhilwara Super Group consists of quartzite, slate, dolomite, phyllite, schist and amphibolite rock formation.

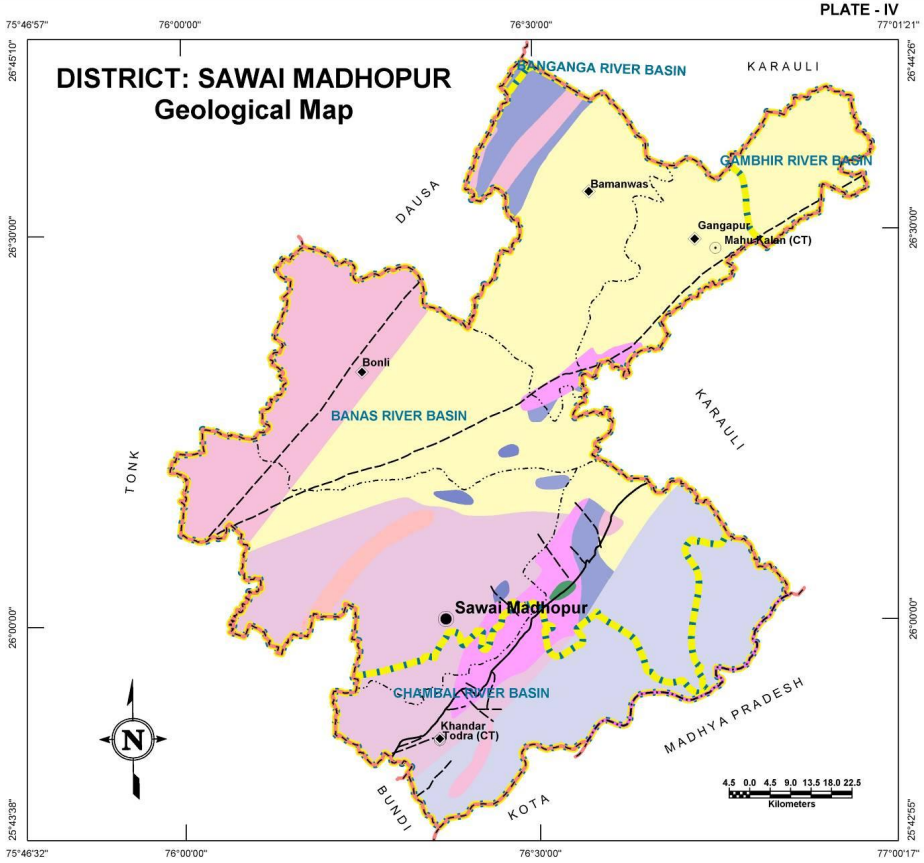
Super Group	Group	Formation
	Recent to Sub-Recent	Dune sand, soil and Alluvium
--X--------X--------X--------X---Unconformity---X--------X--------X-------X--		
Vindhyan	Bhander	Limestones and Shales
	Rewa	Conglomerate
	Sand	Limestone, Shale, Sandstone, Siltstone
	Satola	
--X--------X--------X--------X---Unconformity---X--------X--------X-------X--		
	Semri	Limestone, Conglomerate
--X--------X--------X--------X---Unconformity---X--------X--------X-------X--		
Delhi	Alwar	Quartzite/Conglomerate and Mica Schist
--X--------X--------X--------X---Unconformity---X--------X--------X-------X--		
Bhilwara	Ranthambore	Quartzite, Shales, Slates
		Dolerite sills & dykes
	Jahazpur	Dolomite, ferruginous, chert, carbonaceous, phyllite, ferruginous phyllites with thin band of conglomerate, gritty quartzite & quartzite
	Hindoli	Shale, Slate, Schist, Quartzite, Phyllite
	Mangalwar Complex	Migmatites gneiss, garnetiferous mica schist, sillimanite mica-schist, impure marble and amphibolite

Geomorphology

Table: Geomorphologic units, their description and distribution

Origin	Landform Unit	Description
Aeolian	Sandy Plain	Formed of aeolian activity, wind-blown sand with gentle sloping to undulating plain, comprising of coarse sand, fine sand, silt and clay.
Denudational	Buried Pediment	Pediment covers essentially with relatively thicker alluvial, colluvial or weathered materials.
	Intermontane Valley	Depression between mountains, generally broad & linear, filled with colluvial deposits.
	Pediment	Broad gently sloping rock flooring, erosional surface of low relief between hill and plain, comprised of varied lithology, criss-crossed by fractures and faults.
Fluvial	Alluvial Plain	Mainly undulating landscape formed due to fluvial activity, comprising of gravels, sand, silt and clay. Terrain mainly undulating, produced by extensive deposition of alluvium.
	Flood Plain	The surface or strip of relatively smooth land adjacent to a river channel formed by river and covered with water when river over flows its bank. Normally subject to periodic flooding.
	Paleochannel	Mainly buried on abandoned stream/river courses, comprising of coarse textured material of variable sizes.
	Valley Fill	Formed by fluvial activity, usually at lower topographic locations, comprising of boulders, cobbles, pebbles, gravels, sand, silt and clay. The unit has consolidated sediment deposits.
	Ravine	Small, narrow, deep, depression, smaller than gorges, larger than gulley, usually carved by running water.
Structural	Plateau	Formed over varying lithology with extensive, flat, landscapes, bordered by escarpment on all sides. Essentially formed horizontally layered rocky marked by extensive flat top and steep slopes. It may be criss crossed by lineament.
Hills	Denudational, Structural Hill, Linear Ridge	Steep sided, relict hills undergone denudation, comprising of varying lithology with joints, fractures and lineaments. Linear to arcuate hills showing definite trend-lines with varying lithology associated with folding, faulting etc. Long narrow low-lying ridge usually barren, having high run off may form over varying lithology with controlled strike.

PLATE - IV



LEGEND

Admin Boundary:
- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary

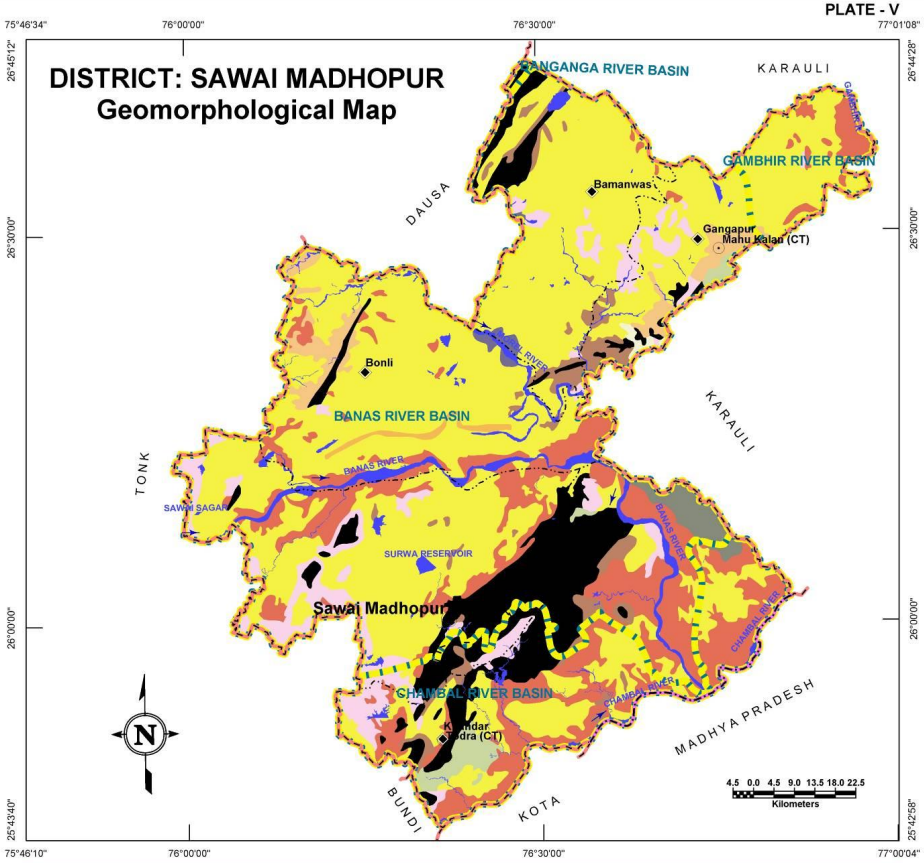
Basin Boundary

Structural Features:
- Fault
- Great Boundary Fault

Geology:
- Alluvium and Wind blown sand
- Alwar Group
- Ranthambhor Group
- Jahazpur Group
- Hindoli Group
- Mangalwar Complex
- Bhander Group
- Rewa Group
- Sand Group
- Satola Group
- Dolerite sills & dykes

Source: District Resource Map of Rajasthan - GSI

PLATE - V



LEGEND

Admin Boundary:
- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary

Basin Boundary

Water Bodies:
- River/Ponds/Reservoirs

Structural Features:
- Fault/Fractures/Lineament

Hills:
- Structural/Denudational/Linear Ridge

Landform Units:

Fluvial Origin:
- Alluvial Plain
- Valley Fill
- Flood Plain
- Ravine
- Palaeochannel

Denudational Origin:
- Pediment
- Burried Pediment
- Intermontane Valley

Aeolian Origin:
- Sandy Plain

Structural Origin:
- Plateau

Source: Ground Water Atlas of Rajasthan - SRSAC & GWD, Rajasthan

AQUIFERS

DISTRICT – SAWAI MADHOPUR

Wide variety of lithologic material forms aquifers in the district (Plate – VI). Sandy and silty constituents within Older Alluvium for aquifers in unconsolidated sediments which occupy about 54% of district area and distributed as a central NE-SW trending belt running parallel and east of Aravali range as well as occurring as a large patch in the eastern part of the district along with some isolated clusters near western border. Weathered, fractured and jointed openings in hard rocks along with solution cavities specifically in limestone create secondary openings that store ground water. Among hard rock aquifers, Phyllites are most widespread, occupying about 17% of the district area and present in western part of the district. Other important hard rock aquifers are Shale, Limestone and Quartzite in order of spatial coverage and seen in central and eastern part of the district.

Table: aquifer potential zones their area and their description

Aquifer in Potential Zone	Area (sq km)	% age of district	Description of the unit/Occurrence
Older Alluvium	2,707.7	53.6	This litho unit comprises of mixture of heterogeneous fine to medium grained sand, silt and kankar.
Limestone	410.1	8.2	In general, it is fine to medium grained, grey, red yellowish, pink or buff in colour.
Phyllite	876.2	17.3	These include meta sediments and represented by carbonaceous phyllite.
Shale	497.1	9.8	Grey, light green and purple in colour and mostly splintery in nature.
Quartzite	181.1	3.6	Medium to coarse grained and varies from feldspathic grit to sericitic quartzite.
Hills	379.7	7.5	
Total	**5,051.9**	**100.0**	

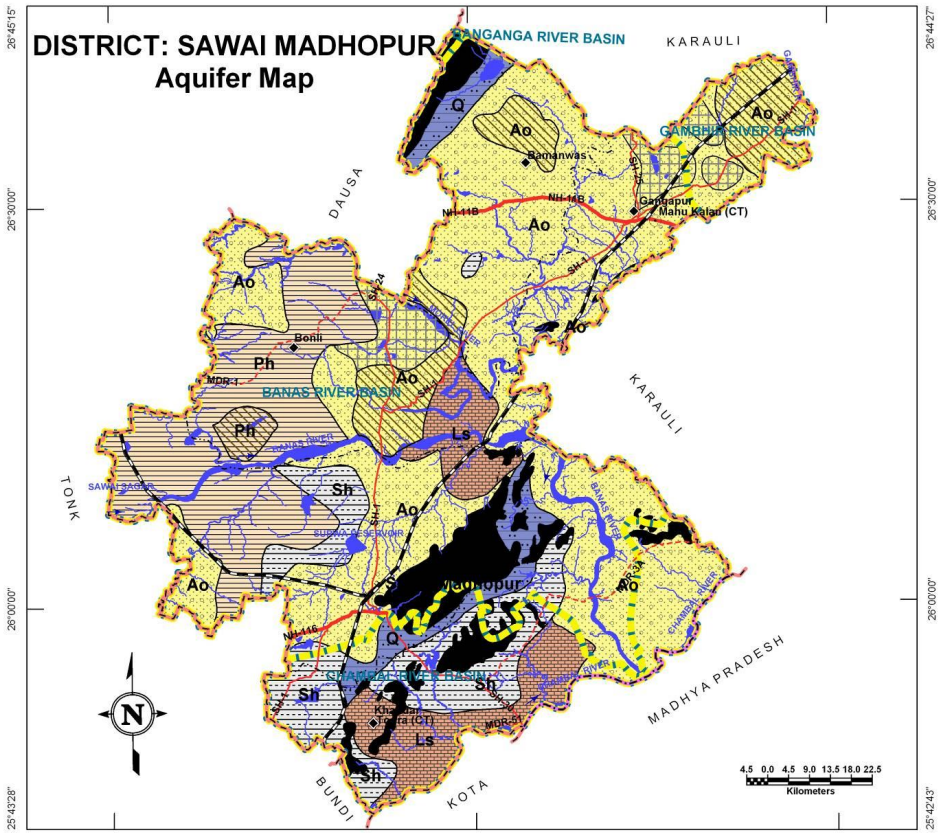
STAGE OF GROUND WATER DEVELOPMENT

Being a predominantly fresh ground water area coupled with good population and availability of agriculture land, the ground water exploitation is also very high and the ground water resource assessment studies reveal that all the blocks of the district have already exhausted the dynamic ground water resource and all the blocks fall within 'Over Exploited' category on the basis of stage of development exceeding more than 100%.

Categorization on the basis of stage of development of GW	Block Name
Over Exploited	Bamanwas, Bonli, Gangapur, Sawai Madhopur, Khandar

Basis for categorization: Ground water development >100% - Over-Exploited.

PLATE - VI



LEGEND

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- State Boundary
- District Boundary
- Block Boundary
- **Basin Boundary**

Roads:
- National Highway
- State Highway
- Major District Road

Railway:
- Broad Gauge
- Metre Gauge

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Hills

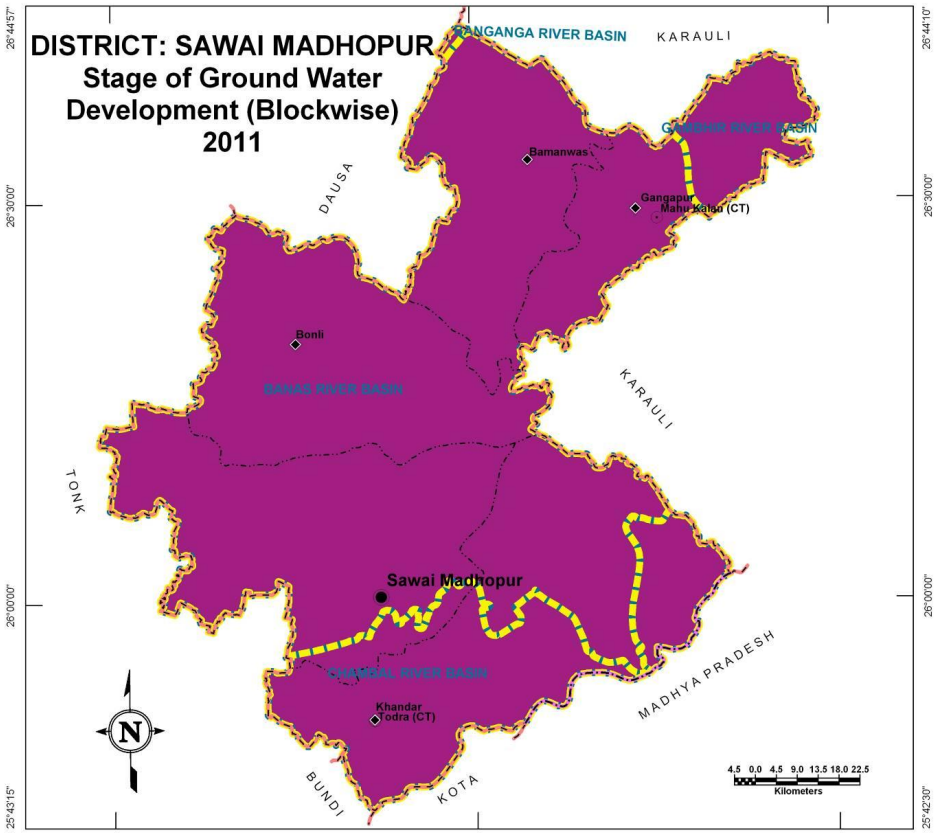
Non Potential Zone

Command Area

Aquifer:
- Older Alluvium
- Limestone
- Phyllite
- Shale
- Quartzite

Source: Ground Water Potential Zone Map - GWD, Rajasthan

PLATE - VII



LEGEND

Admin Boundary:
- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary
- **Basin Boundary**

Stage of Ground Water Development:
- Over-Exploited

Source: Ground Water Department, Rajasthan

LOCATION OF EXPLORATORY AND GROUND WATER MONITORING WELLS DISTRICT – SAWAI MADHOPUR

Sawai Madhopur district has a well distributed network of exploratory wells (106) and ground water monitoring stations (90) in the district owned by RGWD (56 and 66 respectively) and CGWB (50 and 24 respectively). The exploratory wells have formed the basis for delineation of subsurface aquifer distribution scenario in three dimensions. Benchmarking and optimization studies suggest that for optimal ground water level monitoring just one additional well is required to be added in Khandar block and for water quality monitoring, 115 additional wells must be added to the network for strengthening.

Table: Block wise count of wells (existing and recommended)

Block Name	Exploratory Wells			Ground Water Monitoring Stations			Recommended additional wells for optimization of monitoring network	
	CGWB	RGWD	Total	CGWB	RGWD	Total	Water Level	Water Quality
Bamanwas	8	5	**13**	3	13	**16**	0	27
Bonli	13	5	**18**	8	15	**23**	0	17
Gangapur	7	9	**16**	4	12	**16**	0	24
Khandar	11	18	**29**	6	9	**15**	1	28
Sawai Madhopur	11	19	**30**	3	17	**20**	0	19
Total	**50**	**56**	**106**	**24**	**66**	**90**	**1**	**115**

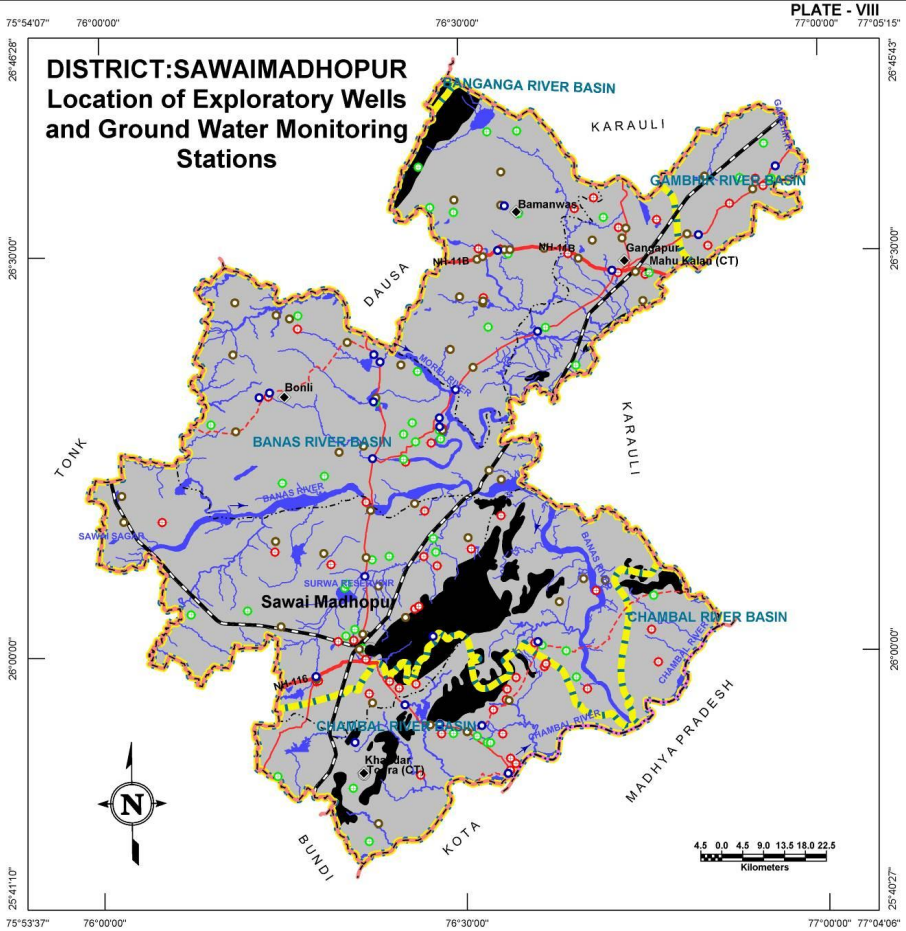
DEPTH TO WATER LEVEL (PRE MONSOON – 2010)

10m interval has been adopted to depict the depth to ground water levels in Sawai Madhopur district as shown in Plate – IX. Depth to water level varies from less than 10m below ground level to more than 50mbgl. Southern part of the district i.e., Sawai Madhopur – Khandar region shows deeper water levels of 20m - 50m in general, which even reaches to>50m bgl. Northwards, the water level is moderately deep which is about 20-30m bgl in Bamanwas – Gangapur – Bonliregion, and some isolated locations in the northern part of Bamanwas and Gangapur blocks havedepth to water level at even less than 10m bgl.

Depth to water level (mbgl)	Block wise area coverage (sq km) *					Total Area (sq km)
	Bamanwas	Bonli	Gangapur	Khandar	Sawai Madhopur	
< 10	63.8	5.4	137.7	-	1.7	**208.6**
10-20	600.6	733.4	390	383.3	302	**2,409.3**
20-30	45.8	285.5	74.3	746.1	556.2	**1,707.9**
30-40	-	24.7	23.7	63	143.8	**255.2**
40-50	-	-	0.2	3.6	71.5	**75.3**
> 50	-	-	-	-	15.9	**15.9**
Total	**710.2**	**1,049.0**	**625.9**	**1,196.0**	**1,091.1**	**4,672.2**

* The area covered in the derived maps is less than the total district area since the hills have been excluded from interpolation/contouring.

PLATE - VIII



LEGEND

Admin Boundary:
- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary
- **Basin Boundary**

Roads:
- National Highway
- State Highway
- Major District Road

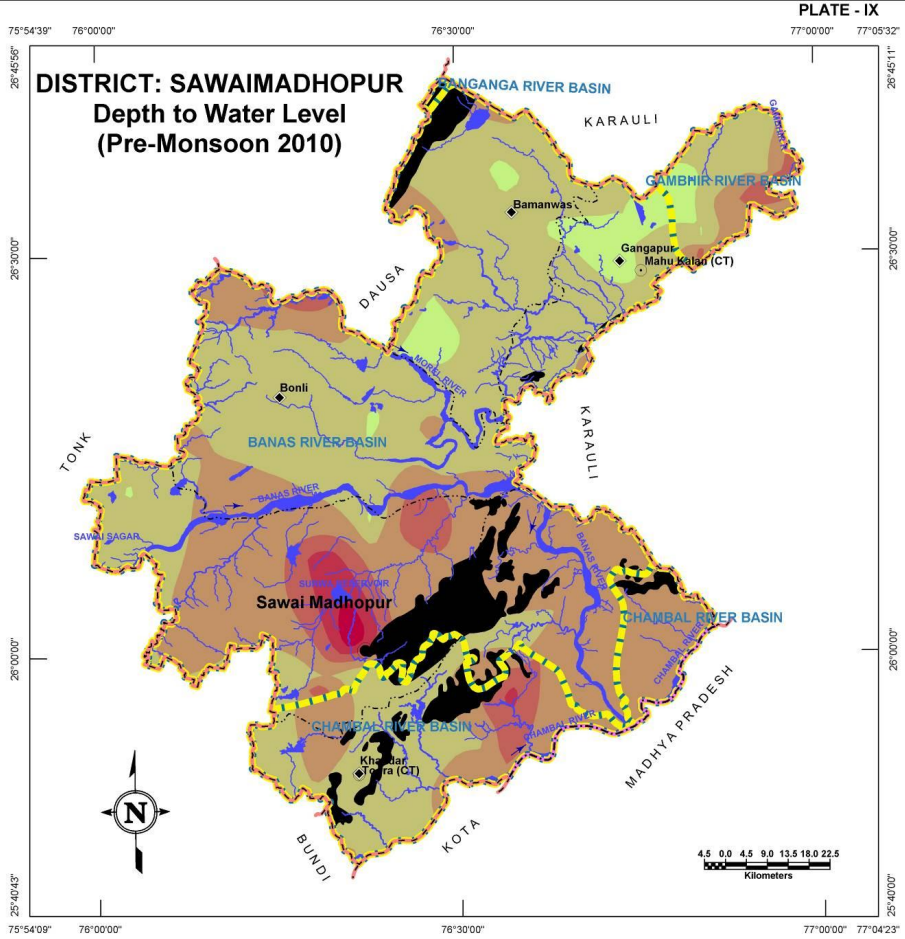
Railway:
- Broad Gauge
- Metre Gauge

Water Bodies:
- River / Streams
- Ponds / Reservoirs
- **Hills**

Exploratory Wells:
- CGWB
- RGWD

Ground Water Monitoring Stations:
- CGWB
- RGWD

PLATE - IX



LEGEND

Admin Boundary:
- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary
- **Basin Boundary**

Water Bodies:
- River / Streams
- Ponds / Reservoirs
- **Hills**

Depth to Water Level (m bgl):
- < 10
- 10 - 20
- 20 - 30
- 30 - 40
- 40 - 50
- > 50

WATER TABLE ELEVATION (PRE MONSOON – 2010) DISTRICT – SAWAI MADHOPUR

The water table elevation map as presented in Plate – X demonstrates the distribution of ground water table and its flow direction. The central part around hills east of Sawai Madhopur city and the area in the northwestern part of the district have very high water table elevations i.e., above 280m amsl reaching upto 320m amsl also. The low elevationsi.e., <200m amslare seen in the southeastern part of the district in Khandar block.

Table: Block wise area covered in each water table elevation range

Water table elevation Range (m amsl)	Block wise area coverage (sq km)					Total Area (sq km)
	Bamanwas	Bonli	Gangapur	Khandar	Sawai Madhopur	
< 200	-	-	-	183.1	-	**183.1**
200 - 220	1.7	139.5	48.2	685.3	105.1	**979.9**
220 - 240	191.5	260.0	235.4	196.9	344.1	**1,227.9**
240 - 260	384.6	448.3	293.8	86.3	562.0	**1,775.0**
260 - 280	112.8	198.6	48.5	22.2	51.3	**433.4**
280 - 300	19.6	2.6	-	13.9	22.2	**58.3**
300 - 320	-	-	-	8.1	6.1	**14.1**
> 320	-	-	-	0.2	0.3	**0.6**
Total	**710.2**	**1,049.0**	**625.9**	**1,196.0**	**1,091.1**	**4,672.2**

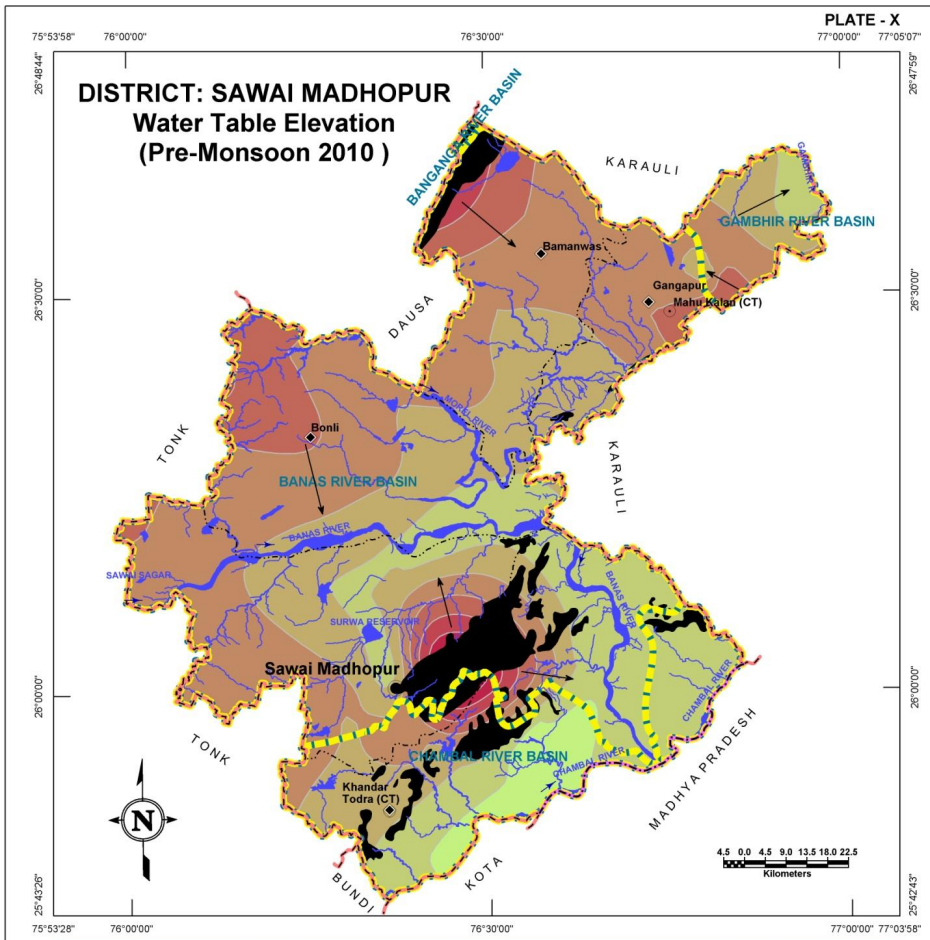
WATER LEVEL FLUCTUATION (PRE TO POST MONSOON 2010)

A 2m contour interval reveals ground water level fluctuation in the district from -8 m to+18m as seen in Plate XI. The –ve fluctuation areas (indicated by pink and red regions) are due to over exploitation of ground water in some localized pocket in Khandar block in the southeastern part of the district. Rest of the district has shown a general to significant rise in ground water level in the post monsoon season with respect to pre monsoon season. Maximum rise of more than 18m is noticed in southern part of Sawai Madhopur block. General variation in the district has been in the range of 0m to about 10m in most parts.

Table: Block wise area covered in each water fluctuation zone

Block Name	Block wise area coverage (sq km) within water level fluctuation range (m)														Total Area (sq km)
	-8 to -6	-6 to -4	-4 to -2	-2 to 0	0 to 2	2 to 4	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14 to 16	16 to 18	> 18	
Bamanwas	-	-	-	-	239.8	454.1	16.3	-	-	-	-	-	-	-	**710.2**
Bonli	-	-	-	1.9	225	463.7	204.3	78.4	56.8	18.9	-	-	-	-	**1,049.00**
Gangapur	-		-	-	239.5	386.4	-	-	-	-	-	-	-	-	**625.9**
Khandar	2	24.3	40.7	41.6	47.3	323	266.7	201.4	106.7	76.1	40.2	22.2	3.8	-	**1,196.00**
Sawai Madhopur	-	-	-	-	66.1	336.7	160.7	133.6	217.5	101.5	42.4	21.2	9.7	1.7	**1,091.10**
Total	**2**	**24.3**	**40.7**	**43.5**	**817.7**	**1,963.90**	**648**	**413.4**	**381**	**196.5**	**82.6**	**43.4**	**13.5**	**1.7**	**4,672.20**

PLATE - X



LEGEND

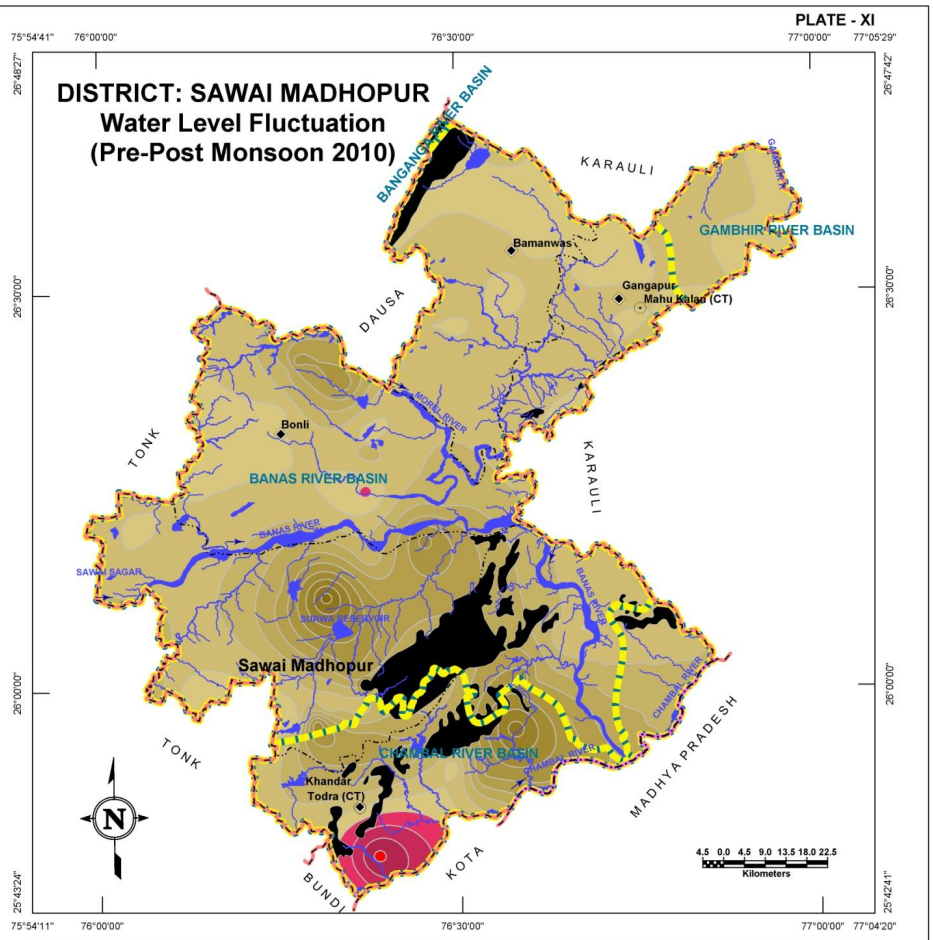
Admin Boundary:

- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary
- **Basin Boundary**
- **Water Bodies:**
- River / Streams
- Ponds / Reservoirs
- **Hills**
- **Water Table Elevation**

Water Table Elevation (m amsl):

- < 200
- 200 - 220
- 220 - 240
- 240 - 260
- 260 - 280
- 280 - 300
- 300 - 320
- > 320

PLATE - XI



LEGEND

Admin Boundary:

- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary
- **Basin Boundary**
- **Water Bodies:**
- River / Streams
- Ponds / Reservoirs
- **Hills**

Water Level Fluctuation (m):

- < -6
- -6 to -4
- -4 to -2
- -2 to 0
- 0 to 2
- 2 to 4
- 4 to 6
- 6 to 8
- 8 to 10
- 10 to 12
- 12 to 14
- 14 to 16
- 16 to 18
- > 18

GROUND WATER ELECTRICAL CONDUCTIVITY DISTRIBUTION DISTRICT – SAWAI MADHOPUR

The electrical conductivity (at 25°C) distribution map is presented in Plate – XII. The areas with low EC values in ground water (<2000 µS/cm) are shown in yellow color which occupy almost 83% of the district area indicating that, by and large the ground water in this district is suitable for domestic purposes. The areas with moderately high EC values (2000 -4000 µS/cm) are shown in green color and occupy 14% of the district area, largely northern part of the district and around Bonli. Remaining 4% of the district area has high EC values in ground water (>4000 µS/cm, in red color) largely in the northern part in Gangapur and Bamanwas blocks where the ground water is not suitable for domestic purpose.

Table: Block wise area of Electrical conductivity distribution

Electrical Conductivity Ranges (µS/cm at 25°C) (Ave. of years 2005-09)	Block wise area coverage (sq km)										Total Area (sq km)
	Bamanwas		Bonli		Gangapur		Khandar		Sawai Madhopur		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
< 2000	332.1	46.8	934.3	89.1	362.9	58.0	1,177.8	98.5	1,057.4	96.9	**3,864.5**
2000-4000	249.2	35.1	114.7	10.9	224.9	35.9	18.2	1.5	33.7	3.1	**640.7**
>4000	128.9	18.1	-	-	38.1	6.1	-	-	-	-	**167.0**
Total	**710.2**	**100.0**	**1,049.0**	**100.0**	**625.9**	**100.0**	**1,196.0**	**100.0**	**1,091.1**	**100.0**	**4,672.2**

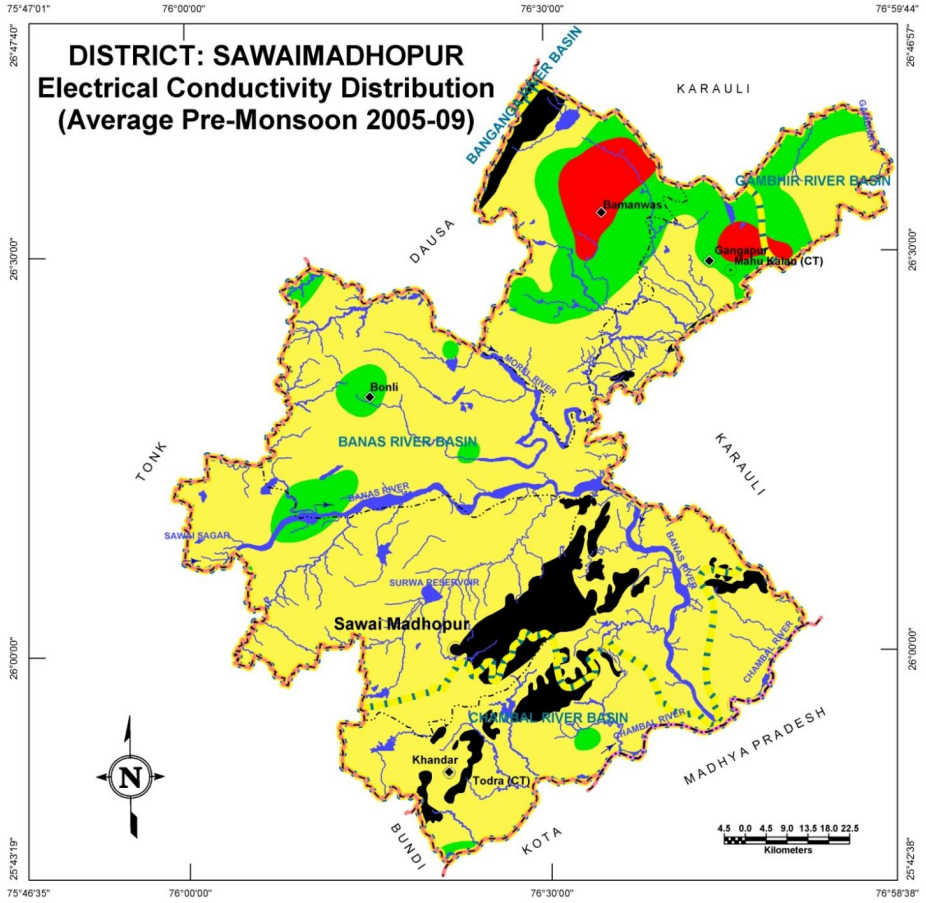
GROUND WATER CHLORIDE DISTRIBUTION

The distribution of chloride concentration is similar in pattern to that of EC. The yellow colored regions in Plate – XIII are low chloride areas (<250 mg/l) occupying approximately 75% of the district area and is suitable for domestic purposes. The areas with moderately high chloride concentration (250-1000mg/l) are shown in green color that occupies approximately 24% of the district area, largely northern part of the district and around Bonli. The remaining negligibly small area (< 0.01%) of the district has high chloride concentration exceeding 1000 mg/l.

Table: Block wise area of Chloride distribution

Chloride Concentration Range (mg/l) (Ave. of years 2005-09)	Block wise area coverage (sq km)										Total Area (sq km)
	Bamanwas		Bonli		Gangapur		Khandar		Sawai Madhopur		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
< 250	266.6	38.0	793.1	76.0	316.9	51.0	1,148.9	96.0	958.4	87.9	**3,483.9**
250-1000	378.0	53.0	255.9	24.0	308.9	49.0	47.1	4.0	132.7	12.1	**1,122.6**
> 1000	65.6	9.0	-	-	0.1	-	-	-	-	-	**65.7**
Total	**710.2**	**100.0**	**1,049.0**	**100.0**	**625.9**	**100.0**	**1,196.0**	**100.0**	**1,091.1**	**100.0**	**4,672.2**

PLATE - XII



LEGEND

Admin Boundary:

- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary

Basin Boundary

Water Bodies:

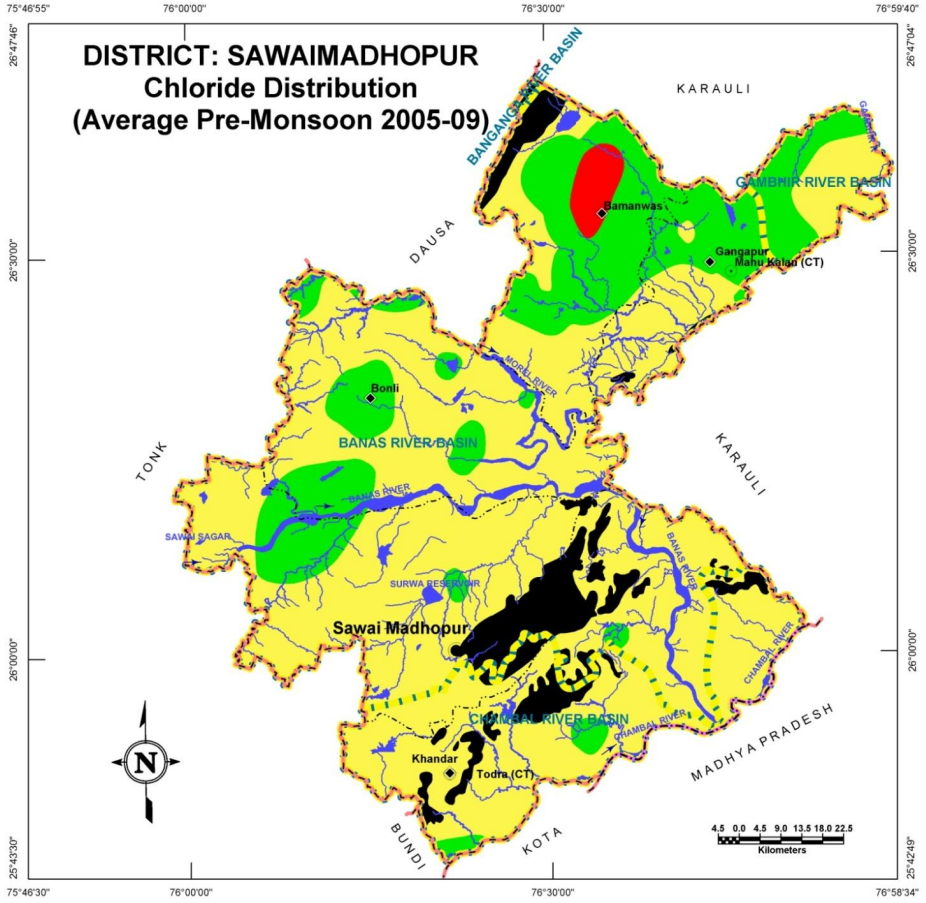
- River / Streams
- Ponds / Reservoirs

Hills

Electrical Conductivity (µS/cm at 25°C):

- < 2000
- 2000-4000
- >4000

PLATE - XIII



LEGEND

Admin Boundary:

- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary

Basin Boundary

Water Bodies:

- River / Streams
- Ponds / Reservoirs

Hills

Chloride Concentration (mg/l):

- < 250
- 250 - 1000
- > 1000

GROUND WATER FLUORIDE DISTRIBUTION DISTRICT – SAWAI MADHOPUR

The Fluoride concentration map is presented in Plate – XIV.The areas with low concentration (i.e.,>1.5 mg/l) are shown in yellow color which occupy almost 76% of the district area which is suitable for domestic purpose. The areas with moderately high concentration (1.5-3.0 mg/l) are shown in green color that occupies approximately 19% of the district area, largely in the northern and western part of the district. Remaining part of the district (approximately 5%) has high Fluoride concentration (>3.0 mg/l) as shown in red color. These high Fluoride areas are scattered as four different patches in western and northwestern parts of the district and unsuitable for domestic purposes.

Table: Block wise area of Fluoride distribution

Fluoride concentration Range (mg/l) (Ave. of years 2005-09)	Block wise area coverage (sq km)										Total Area (sq km)
	Bamanwas		Bonli		Gangapur		Khandar		Sawai Madhopur		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
< 1.5	454.5	64.0	739.4	70.5	392.6	62.7	1,190.8	99.6	775.8	71.1	**3,553.1**
1.5-3.0	204.6	28.8	272.5	26.0	233.3	37.3	5.2	0.4	185.6	17.0	**901.2**
> 3.0	51.1	7.2	37.1	3.5	-	-	-	-	129.7	11.9	**217.9**
Total	**710.2**	**100.0**	**1,049.0**	**100.0**	**625.9**	**100.0**	**1,196.0**	**100.0**	**1,091.1**	**100.0**	**4,672.2**

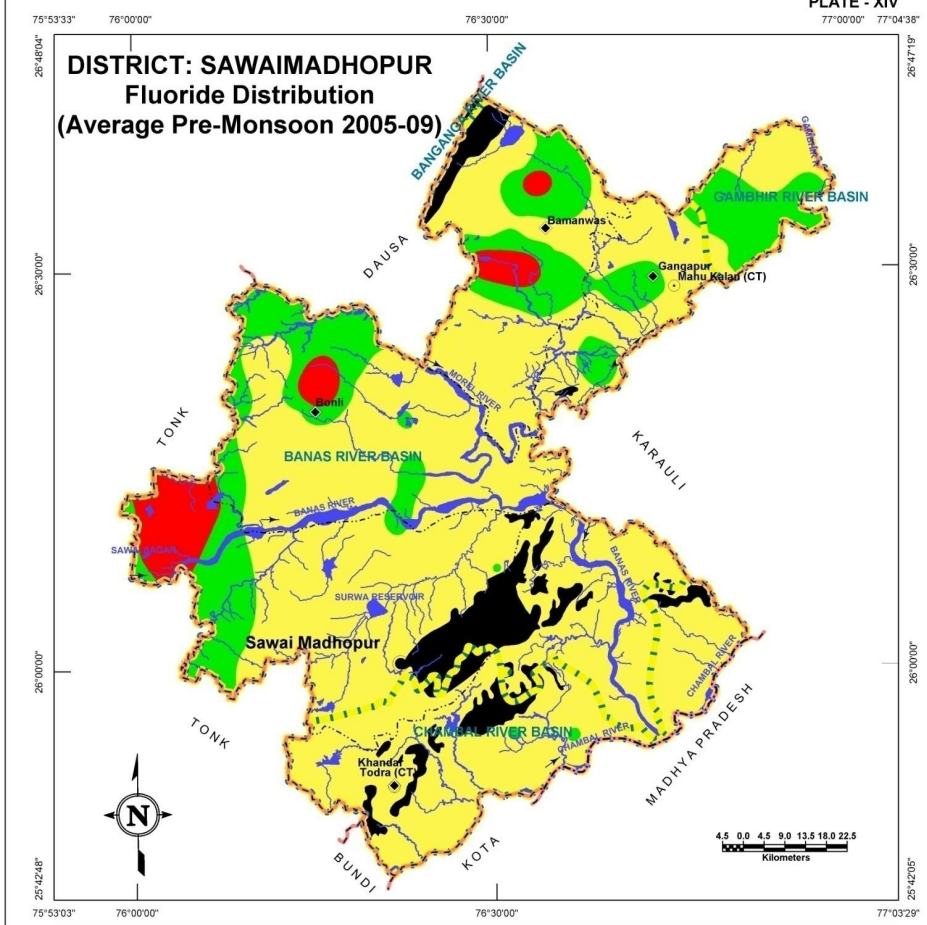
GROUND WATER NITRATE DISTRIBUTION

High nitrate concentration in ground water renders it unsuitable for agriculture purposes. Plate–XV shows distribution of Nitrate in ground water. High nitrate concentration (>100 mg/l) areas are seen in red colour in the map which occupies about 23% of the district area in scattered patches spread all over the district resulting into the ground water in such areas remaining unsuitable for agriculture purpose. Moderately high nitrate concentration (50 – 100 mg/l) is shown in green color (38% of the district area) and the areas with low concentration nitrate (<50 mg/l) are shown in yellow color seen to occupy approximately 39% of the district area and the latter being most suitable for agriculture.

Table: Block wise area of Nitrate distribution

Nitrate concentration Range(mg/l) (Ave. of years 2005-09)	Block wise area coverage (sq km)										Total Area (sq km)
	Bamanwas		Bonli		Gangapur		Khandar		Sawai Madhopur		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
< 50	319.2	45.0	283.2	27.0	140.5	22.5	732.8	61.3	362.2	33.2	**1,837.9**
50-100	185.5	26.1	463.9	44.2	230.3	36.7	381.1	31.8	507.8	46.5	**1,768.6**
>100	205.5	28.9	301.9	28.8	255.1	40.8	82.1	6.9	221.1	20.3	**1,065.7**
Total	**710.2**	**100.0**	**1,049.0**	**100.0**	**625.9**	**100.0**	**1,196.0**	**100.0**	**1,091.1**	**100.0**	**4,672.2**

PLATE - XIV



LEGEND

Admin Boundary:

- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary

Basin Boundary

Water Bodies:

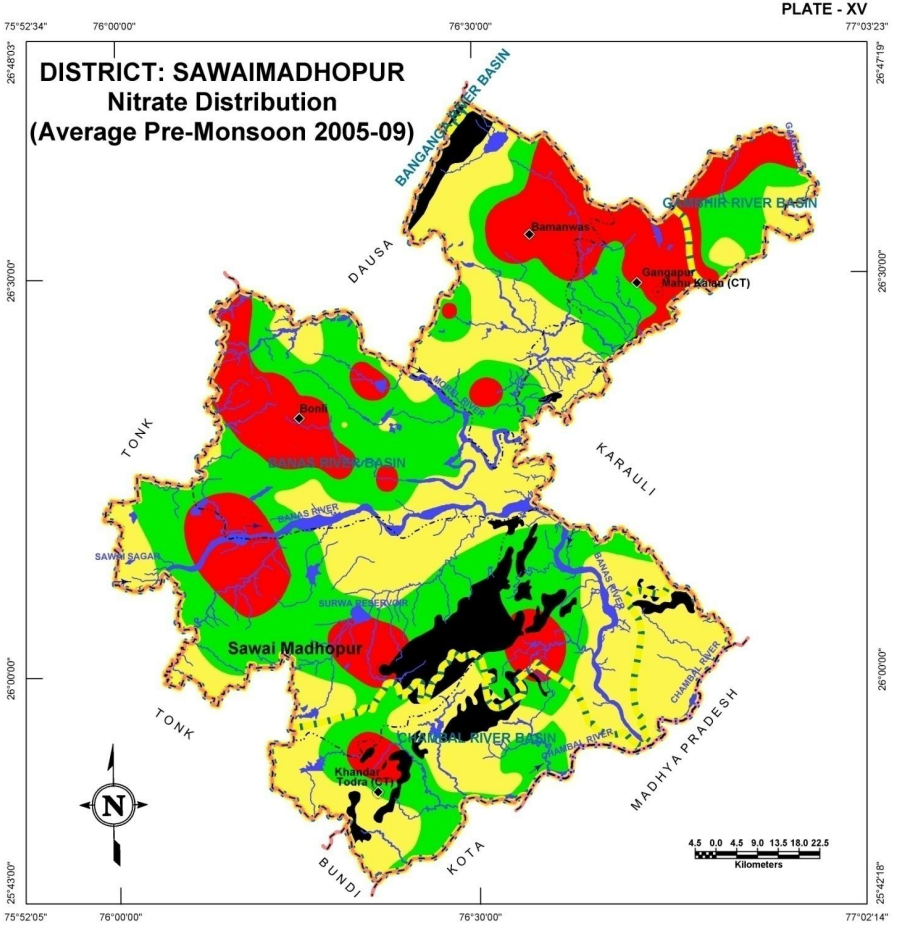
- River / Streams
- Ponds / Reservoirs

Hills

Fluoride Concentration (mg/l):

- < 1.5
- 1.5-3.0
- >3.0

PLATE - XV



LEGEND

Admin Boundary:

- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary

Basin Boundary

Water Bodies:

- River / Streams
- Ponds / Reservoirs

Hills

Nitrate Concentration (mg/l):

- < 50
- 50-100
- >100

DEPTH TO BEDROCK

DISTRICT – SAWAI MADHOPUR

Plate–XVI depicts the distribution of bedrock depth below ground level. The thick alluvial deposits are underlain by bedrock of different lithology and age. The beginning of massive bedrock has been considered for defining top of bedrock surface. The major rocks types occurring in the district are Phyllite,Limestone, Shale and Quartzite. These rocks are overlain by alluvial deposits of sand, clay, silt and admixture of these in different proportions and thicknesses. The map reveals that the bedrock surface is highly undulating in the northeastern part whereas is relatively flat towards west and southwest varying from about 40m bgl to more than 60m bgl. Shallow bedrock depth is found in the Sawai Madhopur area (less than 20m bgl). Deepest occurrence of bedrock (indicating high alluvial thickness) is found in Gangapur and Khandar blocks where the depth of occurrence observed more than 60m bgl.

Depth to bedrock (m bgl)	Block wise area coverage (sq km)										Total Area (sq km)
	Bamanwas		Bonli		Gangapur		Khandar		Sawai Madhopur		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
< 20	0	0	0	0	0	0	0	0	2.6	0	**2.6**
20-40	465.6	65.6	972.8	93.0	58.1	9.3	1,014.6	84.8	1009.2	93.0	**3,520.3**
40-60	244.6	34.4	76.2	7.0	520.9	83.3	181.4	15.2	79.3	7.0	**1,102.4**
> 60	0	0	0	0	46.9	7.4	0	0	0	0	**46.9**
Total	**710.2**	**100.0**	**1049.0**	**100.0**	**625.9**	**100.0**	**1196.0**	**100.0**	**1091.1**	**100.0**	**4,672.2**

UNCONFINED AQUIFER

Alluvial areas

Northernmost part of the district has thick alluvial aquifers forming unconfined aquifers there with 20m to more than 40m thickness. Perusal of Plate – XVII reveals a moderate thickness of upto 30m bgl in the area with pockets of more thick (>40m) unconfined alluvial aquifer material in the MahuKalan city. Shallow thicknesses of alluvial materials are encountered towards southeastern, central and western fringe of the district with less than 10m thickness.

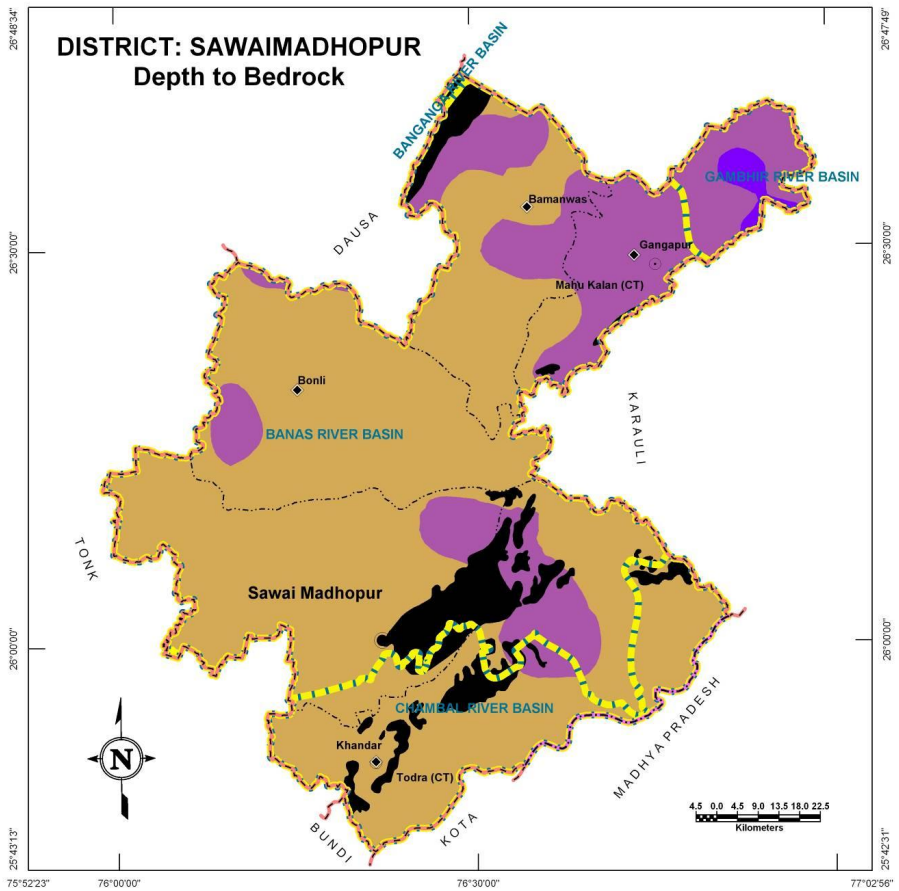
Unconfined aquifer Thickness (m)	Block wise Area coverage (sq km)					Total Area (sq km)
	Bamanwas	Bonli	Gangapur	Khandar	Sawai Madhopur	
< 10	203.7	457.7	96.0	506.4	303.8	**1,567.6**
10-20	339.3	26.7	283.0	4.0	58.5	**711.5**
20-30	89.2	-	192.8	-	7.4	**289.4**
30-40	8.5	-	52.0	-	0.2	**60.7**
> 40	-	-	2.1	-	-	**2.1**
Total	**640.7**	**484.4**	**625.9**	**510.4**	**369.9**	**2,631.3**

Hard rock areas

Weathered, fractured and jointed rock formations occurring at shallower depths constitute good unconfined aquifers. Such aquifers are mainly located in the western,central and southern parts of the district with isolated occurrence in the northwestern part ranging in thickness from less than 10 meter to more than 30 meter. The maximum thickness of aquifer materials in hardrock (more than 30m) has been reported from Bamanwas, Bonli and Sawai Madhopur blocks however, covering very limited area.

Unconfined aquifer Thickness (m)	Block wise Area coverage (sq km)					Total Area (sq km)
	Bamanwas	Bonli	Gangapur	Khandar	Sawai Madhopur	
< 10	68.2	355.4	-	525.0	371.9	**1,320.5**
10-20	-	157.6	-	147.8	276.6	**582.0**
20-30	0.8	35.8	-	12.8	72.1	**121.5**
> 30	0.5	15.8	-	-	0.6	**16.9**
Total	**69.5**	**564.6**	**-**	**685.6**	**721.2**	**2,040.9**

PLATE - XVI



LEGEND

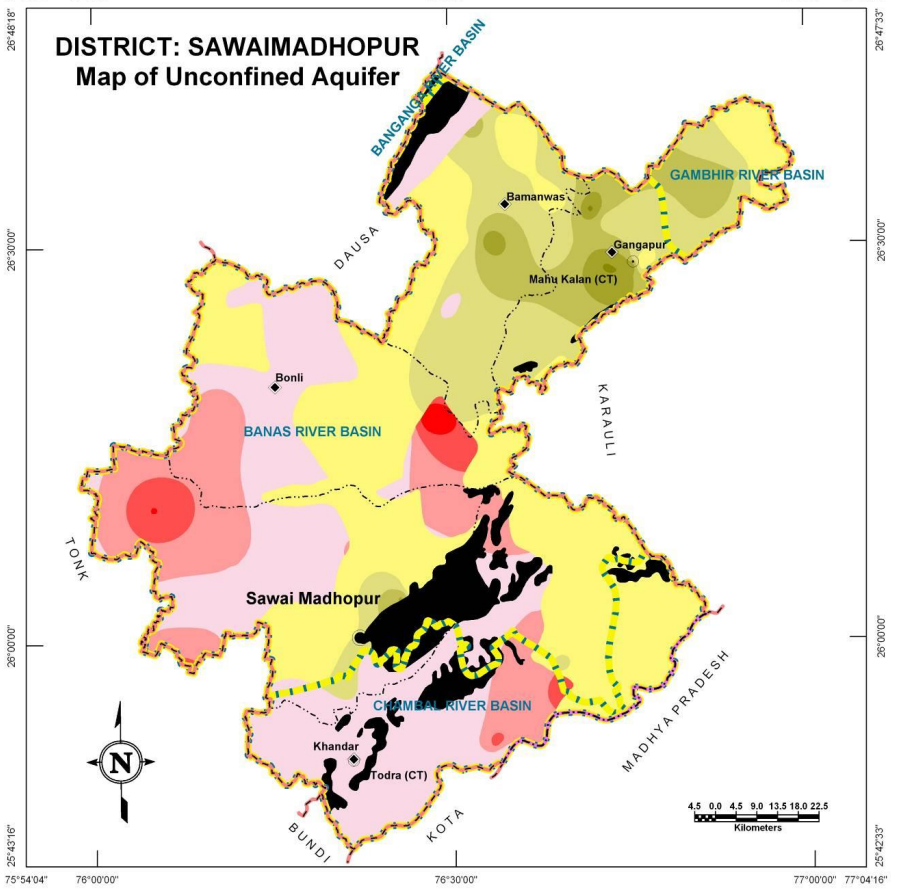
Admin Boundary:

- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary
- **Basin Boundary**
- **Hills**

Depth of Bedrock (m bgl):

- <20
- 20-40
- 40-60
- >60

PLATE - XVII



LEGEND

Admin Boundary:

- District Headquarter
- Block Headquarter
- Town
- State Boundary
- District Boundary
- Block Boundary
- **Basin Boundary**
- **Hills**

Aquifer Thickness (m):

Alluvial Area	Weathered & Fractured Zone in Hardrock Area
<10	<10
10-20	10-20
20-30	20-30
30-40	>30
>40	

Glossary of terms

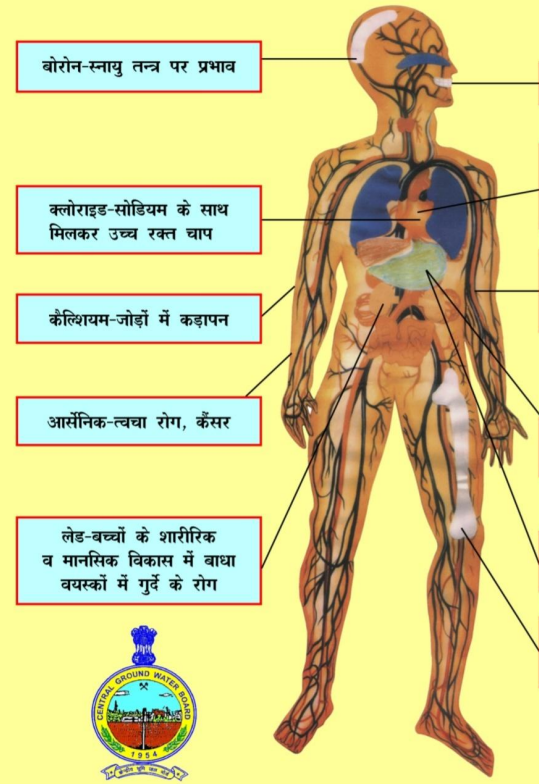
S. No.	Technical Terms	Definition
1	AQUIFER	A saturated geological formation which has good permeability to supply sufficient quantity of water to a Tube well, well or spring.
2	ARID CLIMATE	Climate characterized by high evaporation and low precipitation.
3	ARTIFICIAL RECHARGE	Addition of water to a groundwater reservoir by man-made activity
4	CLIMATE	The sum total of all atmospheric or meteorological influences principally temperature, moisture, wind, pressure and evaporation of a region.
5	CONFINED AQUIFER	A water bearing strata having confined impermeable overburden. In this aquifer, water level represents the piezometric head.
6	CONTAMINATION	Introduction of undesirable substance, normally not found in water, which renders the water unfit for its intended use.
7	DRAWDOWN	The drawdown is the depth by which water level is lowered.
8	FRESH WATER	Water suitable for drinking purpose.
9	GROUND WATER	Water found below the land surface.
10	GROUND WATER BASIN	A hydro-geologic unit containing one large aquifer or several connected and interrelated aquifers.
11	GROUNDWATER RECHARGE	The natural infiltration of surface water into the ground.
12	HARD WATER	The water which does not produce sufficient foam with soap.
13	HYDRAULIC CONDUCTIVITY	A constant that serves as a measure of permeability of porous medium.
14	HYDROGEOLOGY	The science related with the ground water.
15	HUMID CLIMATE	The area having high moisture content.
16	ISOHYET	A line of equal amount of rainfall.
17	METEOROLOGY	Science of the atmosphere.
18	PERCOLATION	It is flow through a porous substance.
19	PERMEABILITY	The property or capacity of a soil or rock for transmitting water.
20	pH	Value of hydrogen-ion concentration in water. Used as an indicator of acidity (pH < 7) or alkalinity (pH > 7).
21	PIEZOMETRIC HEAD	Elevation to which water will rise in a piezometers.
22	RECHARGE	It is a natural or artificial process by which water is added from outside to the aquifer.
23	SAFE YIELD	Amount of water which can be extracted from groundwater without producing undesirable effect.
24	SALINITY	Concentration of dissolved salts.
25	SEMI-ARID	An area is considered semiarid having annual rainfall between 10-20 inches.
26	SEMI-CONFINED AQUIFER	Aquifer overlain and/or underlain by a relatively thin semi-pervious layer.
27	SPECIFIC YIELD	Quantity of water which is released by a formation after its complete saturation.
28	TOTAL DISSOLVED SOLIDS	Total weight of dissolved mineral constituents in water per unit volume (or weight) of water in the sample.
29	TRANSMISSIBILITY	It is defined as the rate of flow through an aquifer of unit width and total saturation depth under unit hydraulic gradient. It is equal to product of full saturation depth of aquifer and its coefficient of permeability.
30	UNCONFINED AQUIFER	A water bearing formation having permeable overburden. The water table forms the upper boundary of the aquifer.
31	UNSATURATED ZONE	The zone below the land surface in which pore space contains both water and air.
32	WATER CONSERVATION	Optimal use and proper storage of water.
33	WATER RESOURCES	Availability of surface and ground water.
34	WATER RESOURCES MANAGEMENT	Planned development, distribution and use of water resources.
35	WATER TABLE	Water table is the upper surface of the zone of saturation at atmospheric pressure.
36	ZONE OF SATURATION	The ground in which all pores are completely filled with water.
37	ELECTRICAL CONDUCTIVITY	Flow of free ions in the water at 25C mu/cm.
38	CROSS SECTION	A Vertical Projection showing sub-surface formations encountered in a specific plane.
39	3-D PICTURE	A structure showing all three dimensions i.e. length, width and depth.
40	GWD	Ground Water Department
41	CGWB	Central Ground Water Board
42	CGWA	Central Ground Water Authority
43	SWRPD	State Water Resources Planning Department
44	EU-SPP	European Union State Partnership Programme
45	TOPOGRAPHY	Details of drainage lines and physical features of land surface on a map.
46	GEOLOGY	The science related with the Earth.
47	GEOMORPHOLOGY	The description and interpretation of land forms.
48	PRE MONSOON SURVEY	Monitoring of Ground Water level from the selected DKW/Piezometer before Monsoon (carried out between 15th May to 15th June)
49	POST-MONSOON SURVEY	Monitoring of Ground Water level from the selected DKW/Piezometer after Monsoon (carried out between 15th October to 15th November)
50	PIEZOMETER	A non-pumping small diameter bore hole used for monitoring of static water level.
51	GROUND WATER FLUCTUATION	Change in static water level below ground level.
52	WATER TABLE	The static water level found in unconfined aquifer.
53	DEPTH OF BED ROCK	Hard & compact rock encountered below land Surface.
54	G.W. MONITORING STATION	Dug wells selected on grid basis for monitoring of state water level.
55	EOLIAN DEPOSITS	Wind-blown sand deposits

(Contd…)

Ground Water Department,
Rajasthan

European Union
State Partnership Programme

भूजल में घुले मुख्य तत्वों की अधिकता का मानव शरीर पर दुष्प्रभाव



- बोरोन-स्नायु तन्त्र पर प्रभाव
- क्लोराइड-सोडियम के साथ मिलकर उच्च रक्त चाप
- कैल्शियम-जोड़ों में कड़ापन
- आर्सेनिक-त्वचा रोग, कैंसर
- लेड-बच्चों के शारीरिक व मानसिक विकास में बाधा वयस्कों में गुर्दे के रोग
- फ्लोराइड - दंत क्षरण
- सोडियम-हृदय, गुर्दा व रक्त परिसंचरण रोगों से ग्रसित लोगों को हानिकारक
- नाइट्रेट-नवजात शिशुओं में ब्लू बेबी बीमारी (मेथमोग्लोबिनिमिया)
- सल्फेट-अधिकता में मैग्नेशियम के साथ मिलकर दस्तावर
- आयरन-आयरन जीवाणु से आमाशय संबंधी रोग
- फ्लोराइड-जोड़ों में अकड़न, हड्डियों में मुड़ाव

केन्द्रीय भूमि जल बोर्ड,
पश्चिमी क्षेत्र, जयपुर
जल संसाधन मंत्रालय
भारत सरकार
e-mail:cgwbwr@sancharnet.in

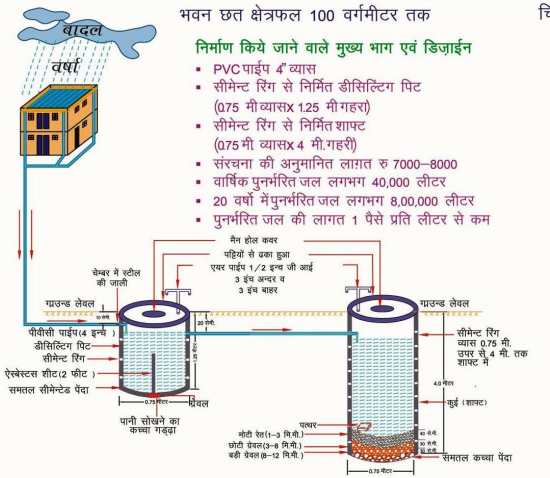
भूजल अमूल्य है इसे प्रदूषित न करें।

चित्र–1

भवन छत क्षेत्रफल 100 वर्गमीटर तक

निर्माण किये जाने वाले मुख्य भाग एवं डिज़ाईन

- PVC पाईप 4" व्यास
- सीमेन्ट रिंग से निर्मित डीसिल्टिंग पिट (0.75 मी.व्यास x 1.25 मी.गहरा)
- सीमेन्ट रिंग से निर्मित शाफ्ट (0.75 मी व्यास x 4 मी.गहरी)
- संरचना की अनुमानित लाग़त रु 7000–8000
- वार्षिक पुनर्भरित जल लगभग 40,000 लीटर
- 20 वर्षो में पुनर्भरित जल लगभग 8,00,000 लीटर
- पुनर्भरित जल की लागत 1 पैसे प्रति लीटर से कम

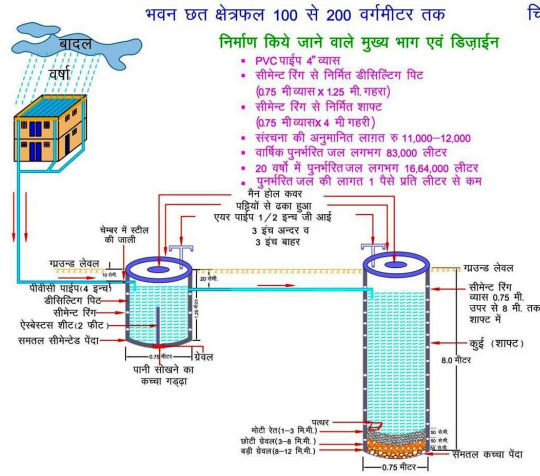


चित्र–2

भवन छत क्षेत्रफल 100 से 200 वर्गमीटर तक

निर्माण किये जाने वाले मुख्य भाग एवं डिज़ाईन

- PVC पाईप 4" व्यास
- सीमेन्ट रिंग से निर्मित डीसिल्टिंग पिट (0.75 मी.व्यास x 1.25 मी. गहरा)
- सीमेन्ट रिंग से निर्मित शाफ्ट (0.75 मी.व्यास x 4 मी गहरी)
- संरचना की अनुमानित लाग़त रु 11,000–12,000
- वार्षिक पुनर्भरित जल लगभग 83,000 लीटर
- 20 वर्षो में पुनर्भरित जल लगभग 16,64,000 लीटर
- पुनर्भरित जल की लागत 1 पैसे प्रति लीटर से कम

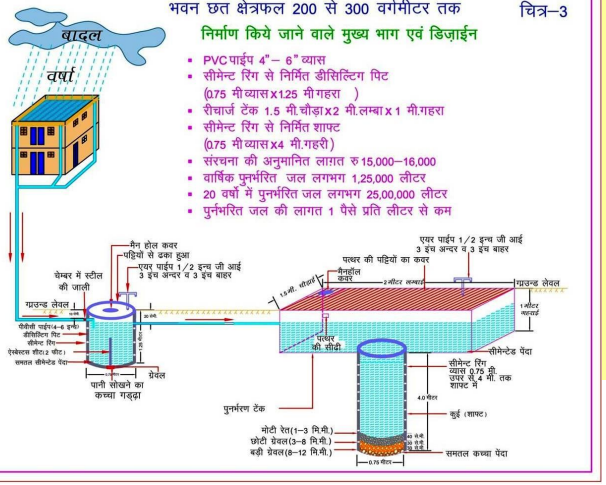


चित्र–3

भवन छत क्षेत्रफल 200 से 300 वर्गमीटर तक

निर्माण किये जाने वाले मुख्य भाग एवं डिज़ाईन

- PVC पाईप 4"– 6" व्यास
- सीमेन्ट रिंग से निर्मित डीसिल्टिंग पिट (0.75 मी.व्यास x 1.25 मी.गहरा)
- रीचार्ज टेंक 1.5 मी.चौड़ा x 2 मी.लम्बा x 1 मी.गहरा
- सीमेन्ट रिंग से निर्मित शाफ्ट (0.75 मी व्यास x 4 मी.गहरी)
- संरचना की अनुमानित लाग़त रु 15,000–16,000
- वार्षिक पुनर्भरित जल लगभग 1,25,000 लीटर
- 20 वर्षो में पुनर्भरित जल लगभग 25,00,000 लीटर
- पुनर्भरित जल की लागत 1 पैसे प्रति लीटर से कम

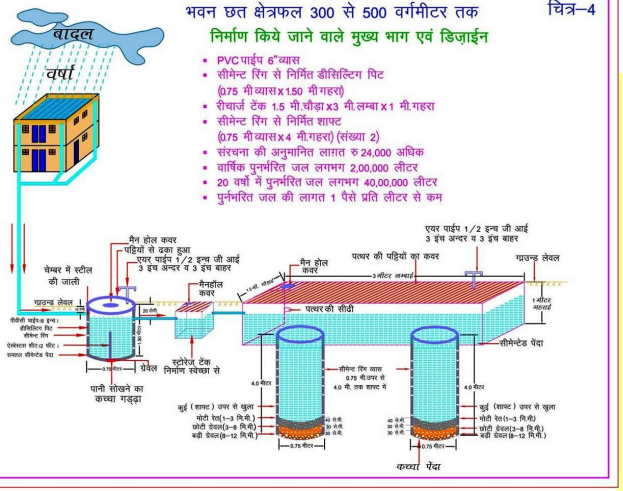


चित्र–4

भवन छत क्षेत्रफल 300 से 500 वर्गमीटर तक

निर्माण किये जाने वाले मुख्य भाग एवं डिज़ाईन

- PVC पाईप 6" व्यास
- सीमेन्ट रिंग से निर्मित डीसिल्टिंग पिट (0.75 मी.व्यास x 1.50 मी.गहरा)
- रीचार्ज टेंक 1.5 मी.चौड़ा x 3 मी.लम्बा x 1 मी.गहरा
- सीमेन्ट रिंग से निर्मित शाफ्ट (0.75 मी.व्यास x 4 मी.गहरा) (संख्या 2)
- संरचना की अनुमानित लाग़त रु 24,000 अधिक
- वार्षिक पुनर्भरित जल लगभग 2,00,000 लीटर
- 20 वर्षो में पुनर्भरित जल लगभग 40,00,000 लीटर
- पुर्नभरित जल की लागत 1 पैसे प्रति लीटर से कम



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Myths and Facts about Ground Water

S No	Myths	Facts
1	What is Ground Water • an underground lake • a net work of underground rivers • a bowl filled with water	Water which occurs below the land in geological formations/rocks is Ground water
2	Ground Water occurs everywhere beneath the Land Surface	Not really, it depends on the nature of rock formation
3	There is a relationship between ground water and surface water	Not all the places. Near streams/rivers there is relation
4	Groundwater is not renewable resource	It is renewable source and every year it is being recharged through rain/applied irrigation etc
5	Ground water is unlimited and deeper you drill more discharge	It is limited to annual recharge from rain/applied irrigation. The discharge may not increase if you go deeper
6	Ground Water moves rapidly	The movement of ground water is very slow
7	Ground water pumped from wells is thousands of years old	Generally the ground water being tapped through wells is a few years old
8	If water taste good—it is safe to drink	It may have other chemicals e.g. fluoride, nitrates etc which are harmful
9	Water from free flowing tube wells is very pure	This water can also be contaminated so test before use
10	If I recharge my TW/DW/HP it will not benefit me	It will also benefit you and also adjoing wells
11	There is no static ground water resources in Rajasthan	Rajasthan is also having Static GW resources, and being tapped in most of areas as GW annual withdrawal is more than annual recharge
12	I cannot meet annual cooking and drinking water requirement by rain water harvesting	The water requirement for drinking and cooking is only 8 lit/day. You can harvest this water for family of 5 persons from roof top or paved area of 75 Sq m to meet annual requirement
13	You can increase ground water recharge	This can be done by harvesting the rain water and storing in sub surface reservoir (GW) by constructing the recharge structures
14	You cannot use abandoned TW/HP/DW for ground water recharge	These should be used as recharge structures as harvested rain water is directly put into GW reservoir
15	Putting waste near HP/TW will not cause any problem	Such actions will pollute wells and water

ROLTA

Rolta India Limited

Central & Registered Office
Rolta Tower A,
Rolta Technology Park,
MIDC, Andheri (East),
Mumbai - 400 093
Tel : +91 (22) 2926 6666, 3087 6543
Fax : +91 (22) 2836 5992
Email : indsales@rolta.com

www.rolta.com