Ground Water Department,
Rajasthan

Hydrogeological Atlas of Rajasthan
Rajsamand District

European Union
State Partnership Programme

2013

ROLTA
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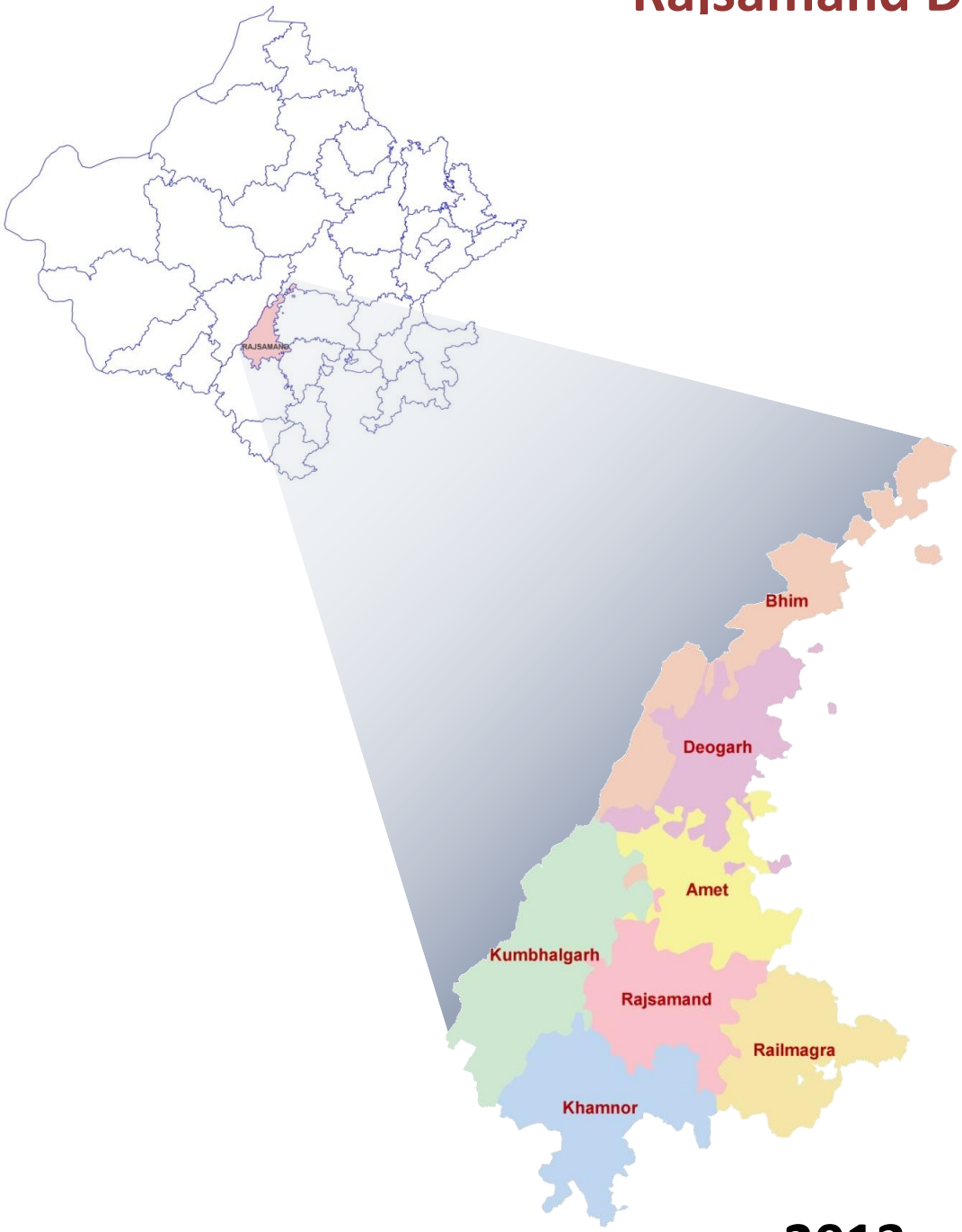
Hydrogeological Atlas of Rajasthan

Rajsamand District



Contents:

2013

ADMINISTRATIVE SETUP

DISTRICT – RAJSAMAND

Location:

Rajsamand district is located in the southern part of Rajasthan. It is bounded in the north by Ajmer district, in the east by Bhilwara and Chittaurgarh districts, south by Udaipur district and by the Pali district in the west. It stretches between 23° 31' 49.64" to 24° 30' 16.57" north latitude and 74° 13' 19.93'' to 74° 58' 59.58'' east longitude covering area of 4,629.3 sq kms. The district is systematically drained by two major riversviz. Banas and Luni thus the district is part of two river basins wherein significantly large part in the east is part of 'Banas River Basin' and a narrow strip west of Aravali range is part of 'Luni River Basin'.

Administrative Set-up:

Rajsamand district is administratively divided into seven 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	Amet	1,04,834	540.6	11.7	138
2	Bhim	1,37,578	685.3	14.8	133
3	Deogarh	94,370	595.1	12.8	135
4	Khamnor	2,09,421	728.2	15.7	191
5	Kumbhalgarh	1,31,346	884.2	19.1	164
6	Railmagra	1,13,268	590.3	12.8	95
7	Rajsamand	1,96,207	605.6	13.1	136
Total		**9,87,024**	**4,629.3**	**100.0**	**992**

Rajsamand district has 992 towns and villages, of which seven are block headquarters as well.

Climate:

The district experiences arid to semi-arid type of climate. The winter season sets in by the middle of November, when both day and night temperatures begin to drop steadily up to month of January. January is the coldest month with mean daily minimum temperature of 7.8 °C. The day and night temperatures rise rapidly from February to May. May is the hottest month of the year with mean daily maximum temperature of 38.6 °C. Average annual rainfall in this district is 549.2 mm. Almost 93% of the total annual rainfall is received during the southwest monsoon which enters the district in the third or fourth week of June and withdraws in the mid of September.

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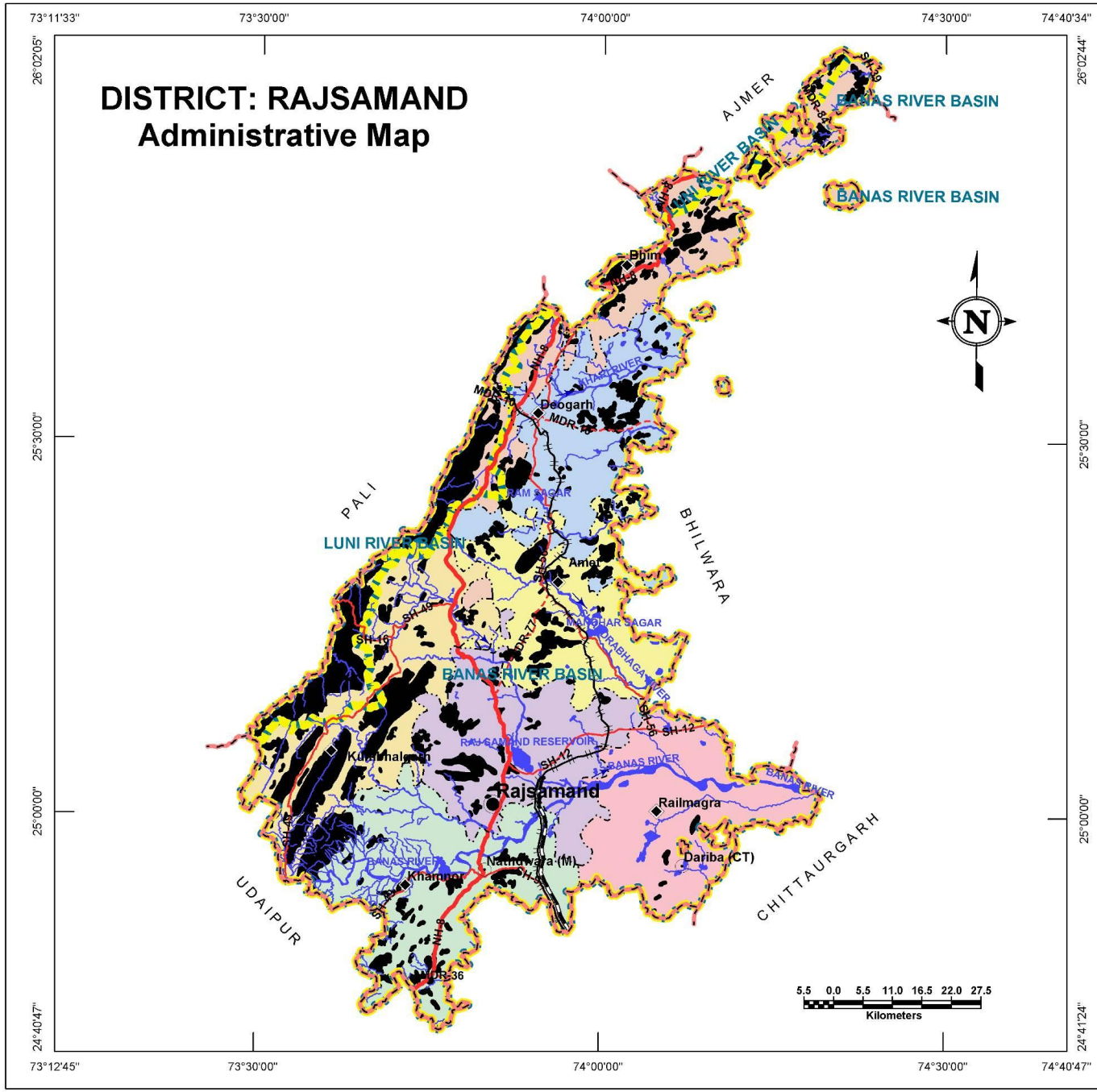
PLATE - I

DISTRICT: RAJSAMAND
Administrative Map



LEGEND

Admin Boundary:

- District Headquarter
- Block Headquarter
- Town
- 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 – RAJSAMAND

The district demonstrates ridge valley topography in western part i.e. in the Aravalli hills running in the NE – SWdirection. The central and eastern part of the district is relatively plain area forming the foothill part of Aravalli ranges. The general slope of the terrain is towards the east. The major river of the district is Banas with its tributaries i.e. Khari and Chandrabhaga creating very good drainage system in the area. The general topographic elevation in the district is between 500 to 625 m above mean sea level. Elevation ranges from a lowest of 376m above mean sea level in Bhim block in the NW part of the district to highest of 1,294m above mean sea level In Kumbhalgarh block in South-West part of the district.

Table: Block wise minimum and maximum elevation

S. No.	Block Name	Min. Elevation (m amsl)	Max. Elevation (m amsl)
1	Amet	515.0	934.9
2	Bhim	376.0	920.9
3	Deogarh	533.6	937.8
4	Khamnor	511.4	1,199.4
5	Kumbhalgarh	419.3	1,294.0
6	Railmagra	458.2	563.1
7	Rajsamand	505.2	967.1

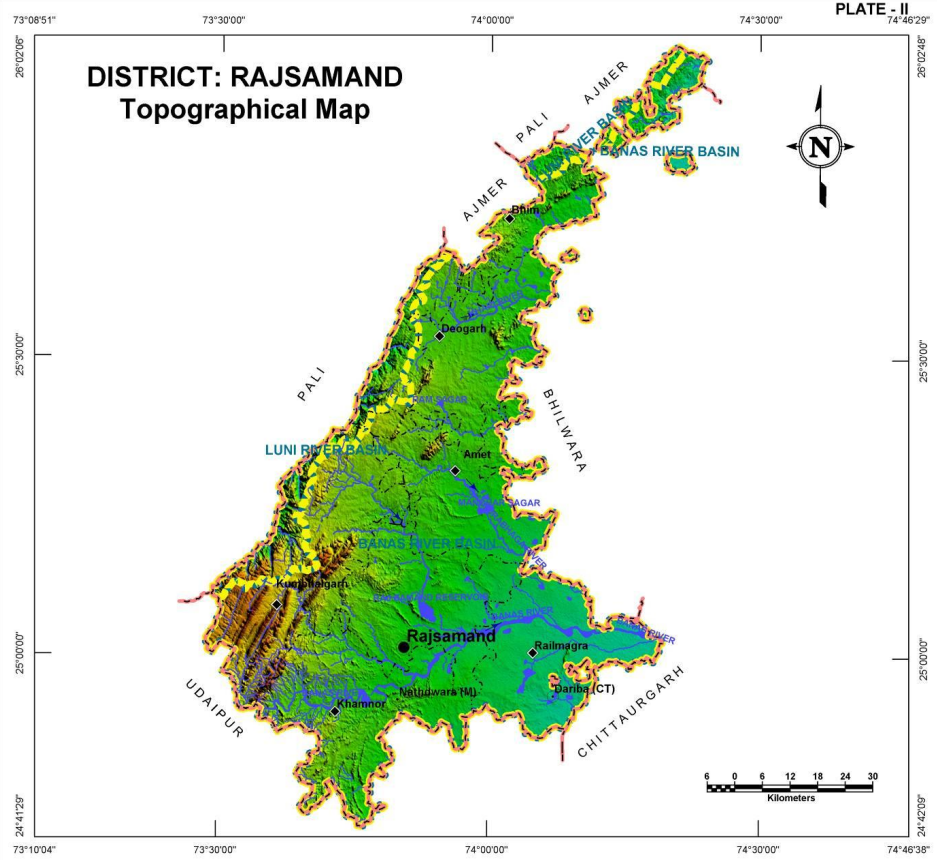
RAINFALL

The district receives very good rainfall during the monsoon months.The general distribution of rainfall across can be visualized from isohyets presented in the Plate – III. Rainfall is highest in the southwestern part and gradually reduces towards northeast. Most of the district received rainfall in the general range of 600-1000mm. The annual average rainfall was thus 808.4 mm based on the data of available blocks. Highest average annual rainfall was noticed in Khamnor block (1,081.1 mm) whereas lowest was in Bhim block (290.4 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)
Amet	651.9	876.8	727.2
Bhim	290.4	762.8	616.0
Deogarh	621.6	751.5	705.7
Khamnor	874.8	1,070.1	1,013.2
Kumbhalgarh	691.6	1,081.8	932.8
Railmagra	609.5	882.7	734.0
Rajsamand	736.3	1,038.2	929.7

PLATE - II



LEGEND

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

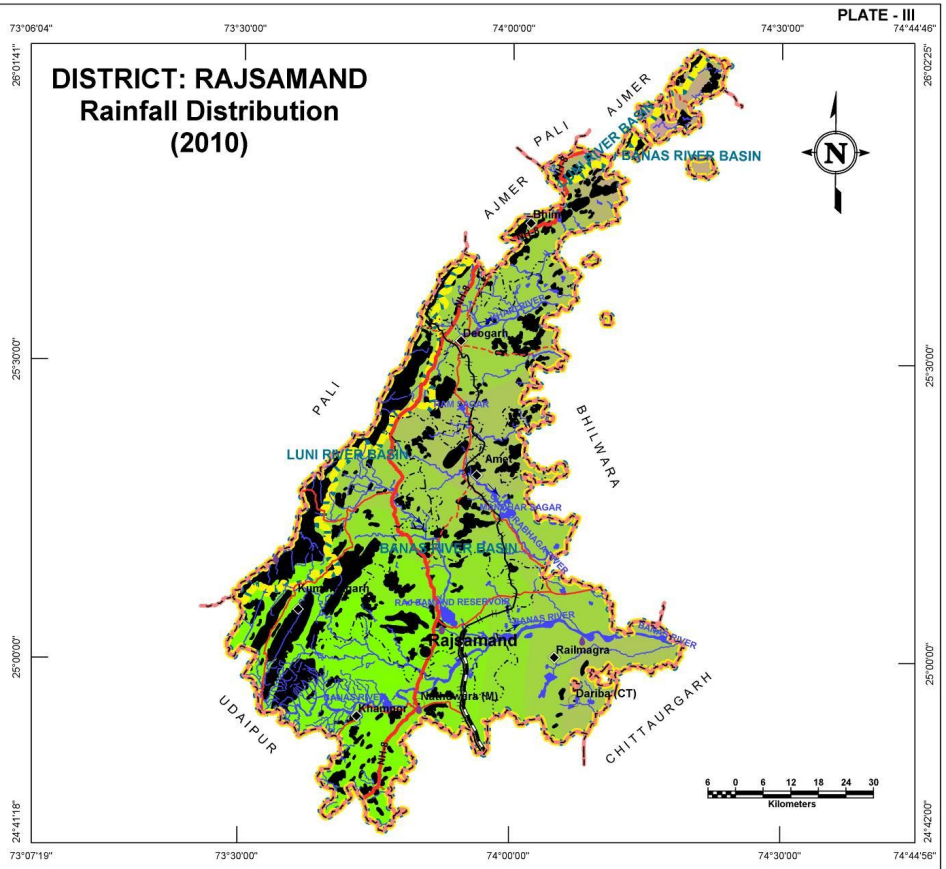
Basin Boundary

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Elevation (m amsl):
1,294 – 1,250 – 1,125 – 1,000 – 875 – 750 – 625 – 500 – 376

Source : SRTM DEM

PLATE - III



LEGEND

Admin Boundary:
- District Headquarter
- Block Headquarter
- Town
- Raingauge Stations
- 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):
- 200-300
- 300-400
- 400-500
- 500-600
- 600-700
- 700-800
- 800-900
- 900-1000
- > 1000

GEOLOGY

DISTRICT – RAJSAMAND

The district exposes rocks belonging to the Delhi, Aravalli and Bhilwara Super Groups. The Delhi Super Group is divided into Kumbhalgarh and Gogunda Groups which consists of Calc-schist, calc-gneiss, quartzite, biotite schist, hornblende-schist and calc-silicate rocks. Delhi Super Grouprocks are exposed in thewestern boundary of the district. Aravalli Super Group is divided into Jharol, Dovda, Nathdwara, Barilake and Kankroli Group. Rock formationsin this Group consist ofphyllite, mica schist, quartzite, dolomitic marble, amphibolites etc. AravalliSuper Group is exposed in southern part of the district encompassing Railmagra, Khamnor, Kumbhalgarh and Rajsamand blocks. Bhilwara Super Group is divided into Mangalwar complex and Sandmata complex which consists of migmatitic gneiss, mica schist, amphibolites, granulite, dolomite marble and ultramafic rocks. This Group is exposed in eastern and southeastern parts of the district covering Railmagra, Amet and Deogarh blocks.

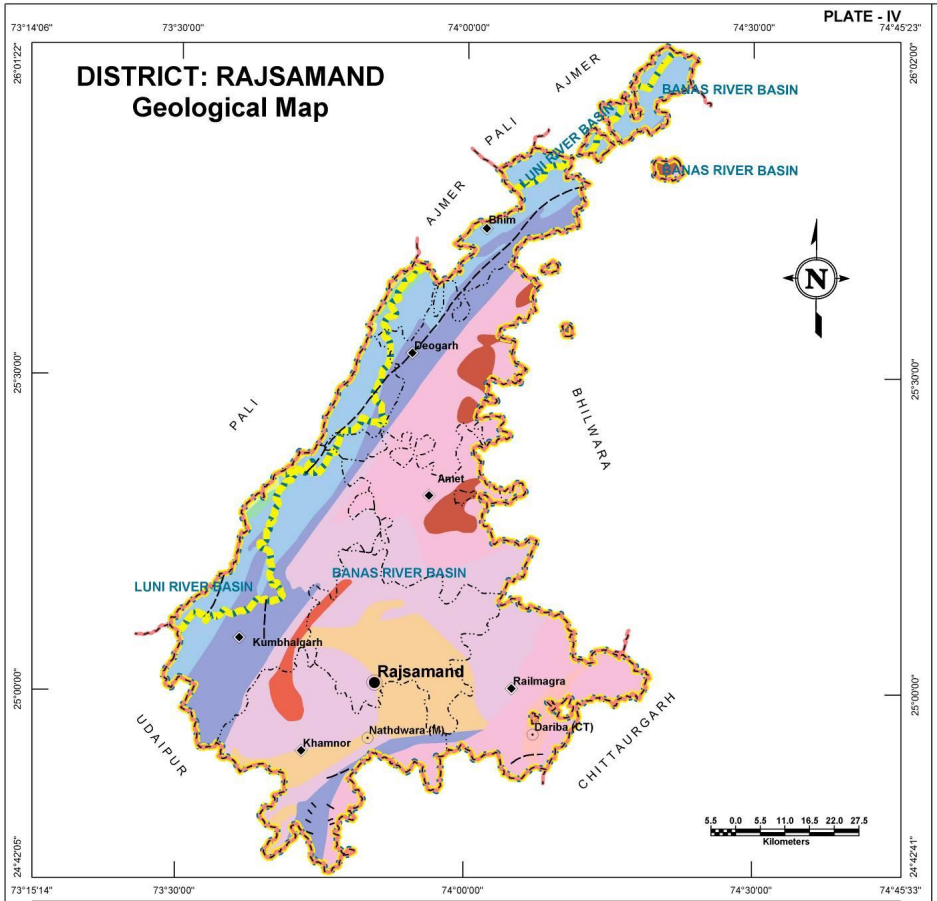
Super Group	Group	Formation
	Recent to Sub-recent	Alluvium, sand, silt and clay
--X--------X--------X--------X---Unconformity---X--------X--------X-------X--		
Delhi	Kumbhalgarh	Calc-schist, calc-gneiss, marble, garnet-biotite schist, mica-schist &migmatites.
	Gogunda	Quartzite, biotite schist, calc-schist, hornblende-schist &calc-silicate rocks.
Aravalli	Jharol	Chlorite-phyllite, phyllite, mica schist, quartzite, dolomitic marble.
	Dovda	Amphibolite, hornblende schist, calc-schist, calc-silicate rocks and migmatites.
	BariLake	Meta basic volcanics
	Kankroli	Chlorite-phyllite, phyllite, muscovite-biotite schist, dolomite, dolomite marble, meta-conglomerate, meta-arkose, quartzite, hornblende-schist, amphibole-gneiss and migmatites.
--X--------X--------X--------X---Unconformity---X--------X--------X-------X--		
Bhilwara	Mangalwar complex	Migmatites gneiss, garnetiferrous mica schist, sillimanite mica-schist, impure marble and amphibolite
	Sandmata complex	Paragneiss, granulite, amphibolite, biotite-schist, dolomite marble, quartzite and ultramafic rocks.

GEOMORPHOLOGY

Table: Geomorphologic units, their description and distribution

Origin	Landform Unit	Description
Denudational	Buried Pediment	Pediment covers essentially with relatively thicker alluvial, colluvial or weathered materials.
	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.
	Alluvial Plain (Sandy)	Flat to gentle undulating plain formed due to fluvial activity, mainly consists of gravels, sand, silt and clay with unconsolidated material of varying lithology, predominantly sand along river.
	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.
	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.
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
- District Boundary
- Block Boundary

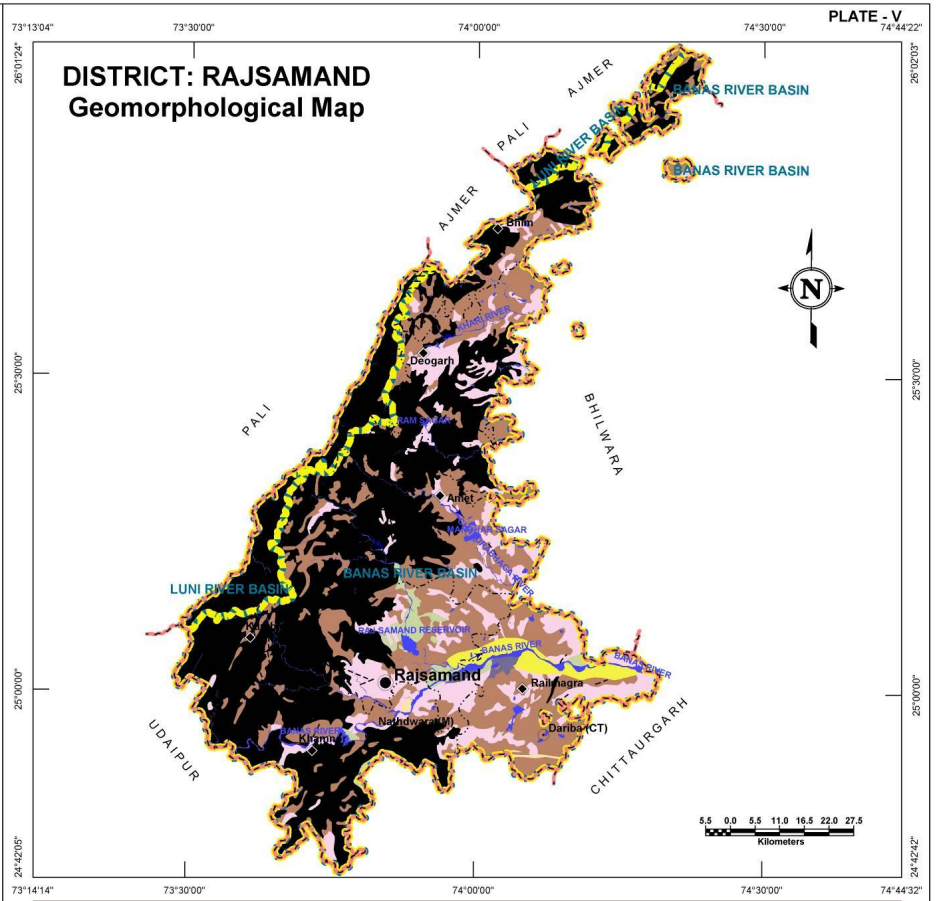
Basin Boundary

Structural Features:
- Fault

Geology:
- Kumbhalgarh Group
- Gogunda Group
- Jharol Group
- Dovda Group
- Nathdwara Group
- Barilake Group
- Kankroli Group
- Pur-Banera Group
- Rajpura-Dariba Group
- Mangalwar Complex
- Sand Mata Complex
- Erinpura Granite & Gneiss
- Sendra-Ambaji Granite & Gneiss
- Phulad Ophiolite Suite
- Udaipur/Salumbar/Udaisagar/Darwal Granite
- Acidic Rocks

Source: District Resource Map of Rajasthan - GSI

PLATE - V



LEGEND

Admin Boundary:
- District Headquarter
- Block Headquarter
- Town
- 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
- Alluvial Plain (Sandy)
- Valley Fill
- Flood Plain

Denudational Origin:
- Pediment
- Burried Pediment

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

AQUIFERS

DISTRICT – RAJSAMAND

There are only two aquifer types in the district and both these occupy almost equal areas in terms of spatial distribution. There are no aquifers in alluvial formations and the hardrock aquifers in schistose rocks and BGC occupy 41% area each while the remaining 18% is hills. Weathered, fractured and jointed openings in hardrocks lead to formation of aquifers in them. The schistose aquifers are seen as NE-SW trending belt adjacent and parallel to Aravali ranges in the western part of the district and also in the eastern part of the district as large patch. The area in between the two schistose aquifer regions lies the NE-SW trending, wide central belt of BGC, interspersed with hills and occasionally by schist aquifers.

Table: aquifer potential zones their area and their description

Aquifer in Potential Zone	Area (sq km)	% age of district	Description of the unit/Occurrence
Schist	1,898.6	41.0	Medium to fine grained compact rock. The litho units are soft, friable and have closely spaced cleavage.
BGC	1,891.3	40.9	Grey to dark coloured, medium to coarse grained rocks.
Hills	839.4	18.1	
Total	**4,629.3**	**100.0**	

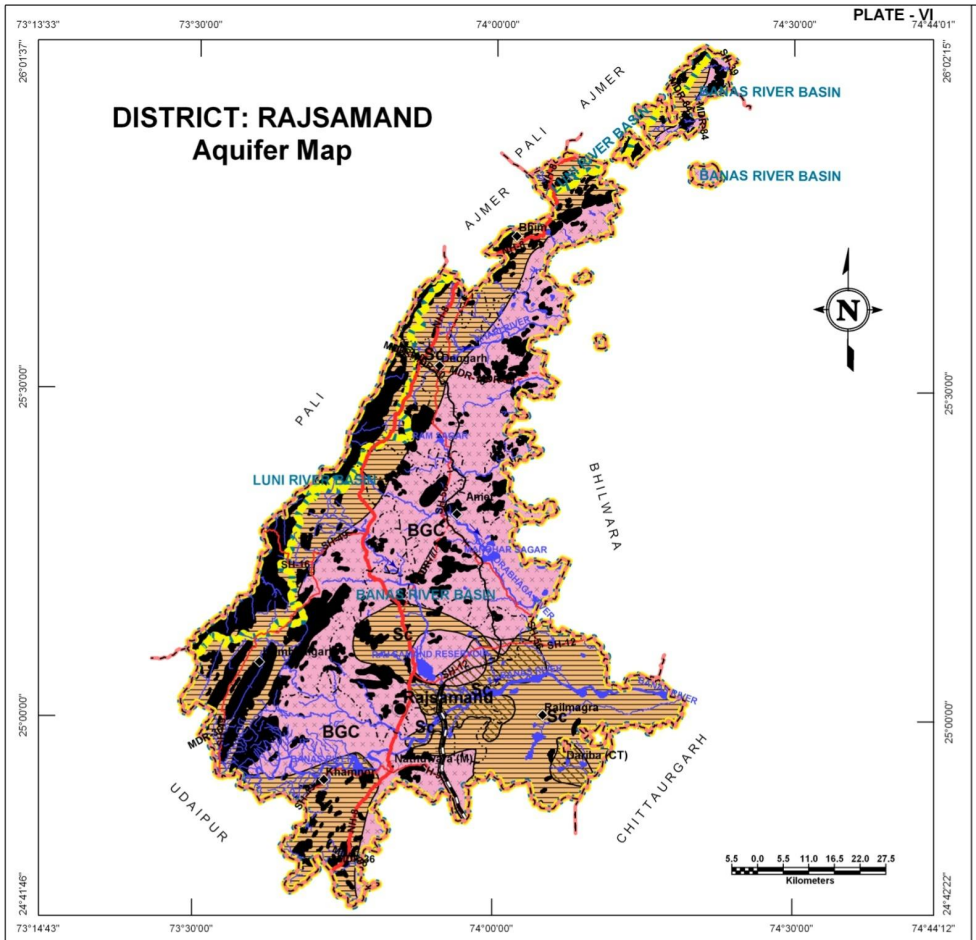
STAGE OF GROUND WATER DEVELOPMENT

The volume of water that can be retained in hardrock aquifers is relatively small and recharge during monsoon seasons is also less. Ground water resource assessment studies and then the categorization of blocks on the basis of current stage of development also indicate that the ground water resources in the district are under severe stress. All the 7 blocks of the district fall within 'Over Exploited' category implying ground water development exceeding the dynamic resources.

Categorization on the basis of stage of development of GW	Block Name
Over Exploited	Railmagra, Khamnor, Amet, Deogarh, Bhim, Kumbhalgarh, Rajsamand

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

PLATE - VI



LEGEND

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

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

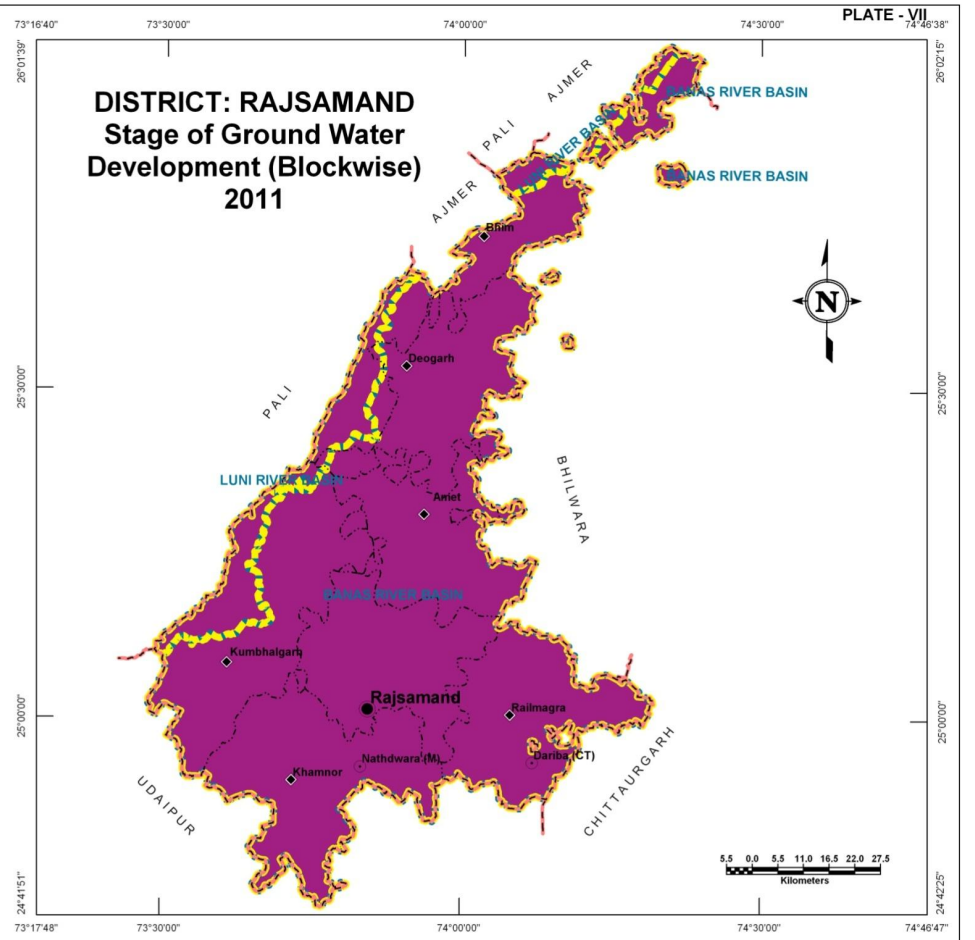
Railway:
- Broad Gauge
- Metre Gauge

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

Aquifer:
- Schist
- BGC

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 – RAJSAMAND

Rajsamand district has a well distributed network of exploratory wells (94) and ground water monitoring stations (255) in the district owned by RGWD (74 and 227 respectively) and CGWB (20 and 28 respectively). The exploratory wells have formed the basis for delineation of subsurface aquifer distribution scenario in three dimensions. Benchmarking and optimization studies suggest that ground water level monitoring network is sufficiently distributed for appropriate monitoring but for water quality, 9 wells are recommended to be added to existing network for optimum monitoring of the aquifers.

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
Amet	5	7	**12**	3	27	**30**	0	5
Bhim	1	11	**12**	7	32	**39**	0	0
Deogarh	4	10	**14**	1	32	**33**	0	0
Khamnor	1	17	**18**	3	41	**44**	0	3
Kumbhalgarh	4	8	**12**	8	34	**42**	0	0
Railmagra	3	9	**12**	4	28	**32**	0	0
Rajsamand	2	12	**14**	2	33	**35**	0	1
Total	**20**	**74**	**94**	**28**	**227**	**255**	**0**	**9**

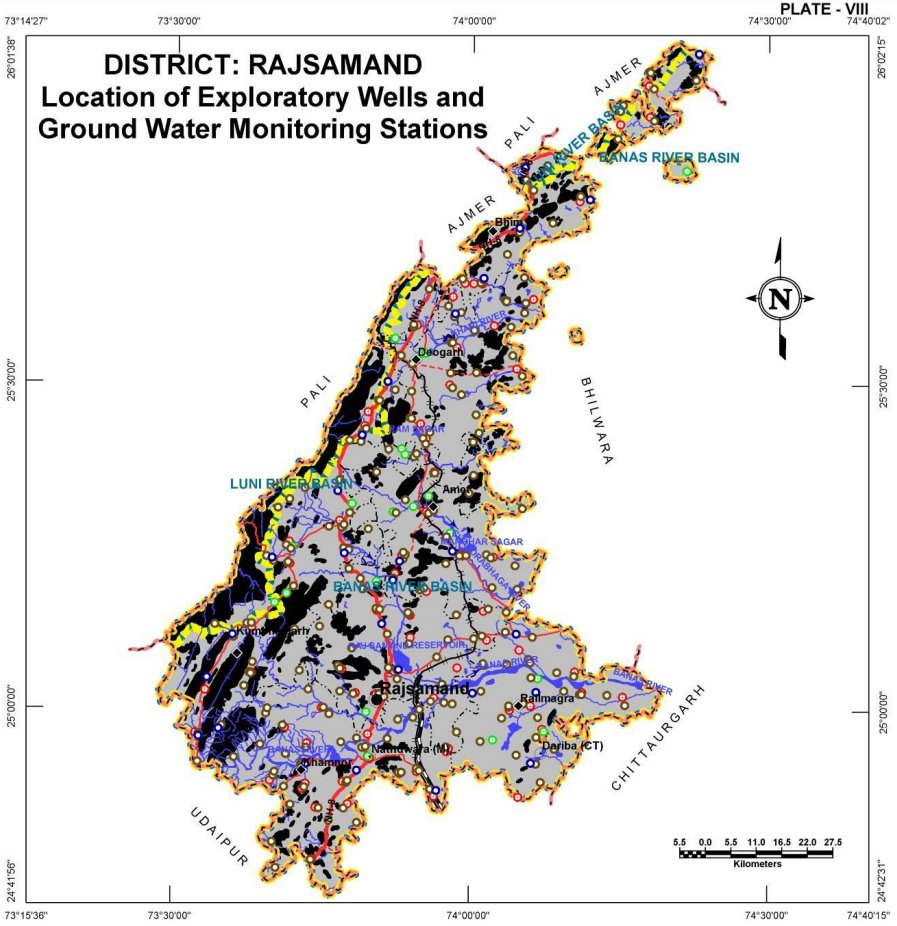
DEPTH TO WATER LEVEL (PRE MONSOON – 2010)

In spite of being a predominantly hard rock area, the district shows moderate variation in depth to ground water levels ranging from less than 10m below ground level to about 30m bgl. The areas with ground water depth being less than 10m bgl are very limited in spatial extent and just about 12 sq kms in area, mostly in Railmagra and Rajsamand blocks. Similarly, the more than 30m deep ground water level areas are also just about 11 sq kms in the district, mostly in Amet and Railmagra districts. Therefore on excluding the hilly areas, more than 99% of the district has depth to ground water level ranges between 10 – 30m bgl.

Depth to water level range (mbgl)	Block wise area coverage (sq km) *							Total Area (sq km)
	Amet	Bhim	Deogarh	Khamnor	Kumbhalgarh	Railmagra	Rajsamand	
< 10	-	-	0.2	1.4	0.2	7.1	3.2	**12.1**
10-20	327.0	444.7	513.3	526.1	474.2	339.0	524.5	**3,148.8**
20-30	140.6	30.0	12.5	123.8	53.8	237.5	20.0	**618.2**
> 30	8.8	-	-	-	-	2.0	-	**10.8**
Total	**476.4**	**474.7**	**526.0**	**651.3**	**528.2**	**585.6**	**547.7**	**3,789.9**

* 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
- District Boundary
- Block Boundary

Basin Boundary

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

Railway:
- Broad Gauge
- Metre Gauge

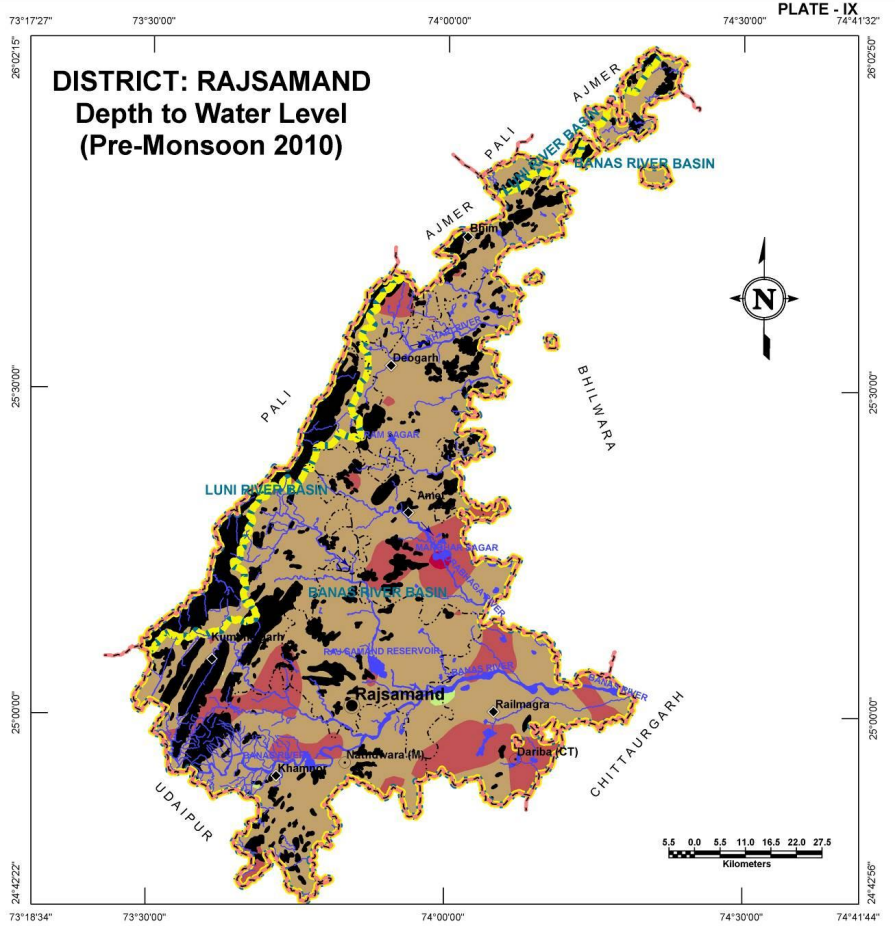
Water Bodies:
- River / Streams
- Ponds / Reservoirs

Hills

Exploratory Wells:
- CGWB
- RGWD

Ground Water Monitoring Stations:
- CGWB
- RGWD

PLATE - IX



LEGEND

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

WATER TABLE ELEVATION (PRE MONSOON – 2010) DISTRICT – RAJSAMAND

Water table elevation map is shown in Plate – X. The regional flow direction indicated in the map is from southwest to east and northeast. The flow gradients are steeper in western part and relatively flatter in the eastern/southeastern part of the district. The water table elevation is highest in southwest part of Kumbhalgarh block reaching to >920m amsl whereas lowest elevation (<440m amsl) is seen in the Railmagra and Bhim blocks of the district. The broad variation of ground water table is however, seen to be in between 440m amsl to 720m amsl.

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

Block Name	Block wise area coverage (sq km) within water table elevation range (m amsl)														Total Area (sq km)
	< 440	440 - 480	480 - 520	520 - 560	560 - 600	600 - 640	640 - 680	680 - 720	720 - 760	760 - 800	800 - 840	840 - 880	880 - 920	> 920	
Amet	-	-	75.1	157.9	149.6	55.2	29.0	9.6	-	-	-	-	-	-	**476.4**
Bhim	0.3	46.0	79.6	116.5	101.8	78.7	30.7	15.8	5.3	-	-	-	-	-	**474.7**
Deogarh	-	-	8.2	47.0	203.1	189.6	50.1	24.8	3.2	-	-	-	-	-	**526.0**
Khamnor	-	-	27.8	182.7	170.3	152.6	88.6	22.6	6.7	-	-	-	-	-	**651.3**
Kumbhalgarh	-	-	0.2	6.0	9.2	51.2	85.4	133.4	86.9	58.4	35.8	27.3	33.0	1.4	**528.2**
Railmagra	-	351.1	231.7	2.8	-	-	-	-	-	-	-	-	-	-	**585.6**
Rajsamand	-	-	125.7	238.7	124.5	47.8	10.8	0.2	-	-	-	-	-	-	**547.7**
Total	**0.3**	**397.1**	**548.3**	**751.6**	**758.5**	**575.1**	**294.6**	**206.4**	**102.1**	**58.4**	**35.8**	**27.3**	**33.0**	**1.4**	**3,789.9**

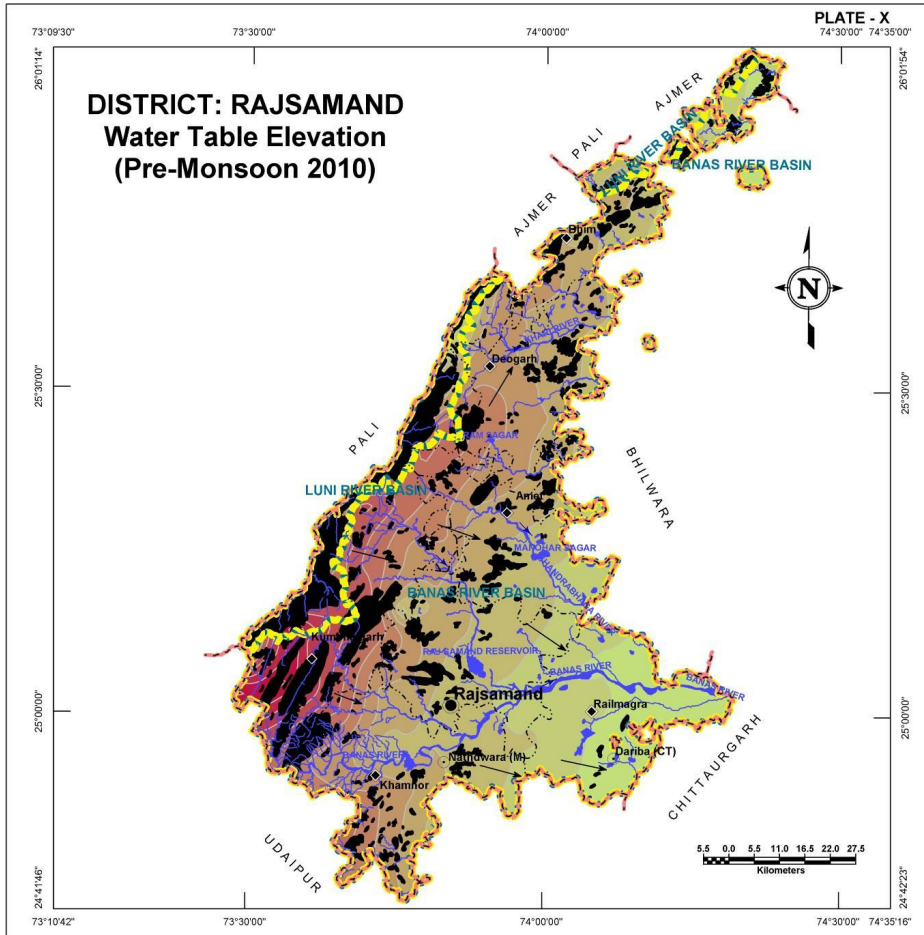
WATER LEVEL FLUCTUATION (PRE TO POST MONSOON 2010)

A 2m contour interval adopted to visualize the ground water level fluctuation reveals that water levels have risen in the post monsoon season as compared to pre monsoon levels in the district. The general rise is between 2 to 12m as seen in Plate – XI, however occasionally reaching to a maximum of 16m as noticed in the eastern part of Amet block.

Table: Block wise area covered in each water fluctuation zone

Water level fluctuation range (m)	Block wise area coverage (sq km)						
	Amet	Bhim	Deogarh	Khamnor	Kumbhalgarh	Railmagra	Rajsamand
< 2	1.1	-	16.9	-	0.5	0.7	1.5
2 to 4	21.0	18.4	1.1	0.5	8.9	42.8	11.8
4 to 6	59.1	32.2	59.7	14.0	18.8	160.9	39.7
6 to 8	111.2	88.1	92.7	58.4	68.2	177.3	114.4
8 to 10	138.8	136.8	152.2	270.9	187.5	128.1	206.5
10 to 12	123.9	112.1	137.3	184.9	129.4	59.6	128.3
12 to 14	17.8	70.8	50.7	79.8	100.0	12.3	45.0
14 to 16	3.4	16.3	13.2	40.3	14.9	3.9	0.5
> 16	0.1	-	2.2	2.5	-	-	-
Total	**476.4**	**474.7**	**526.0**	**651.3**	**528.2**	**585.6**	**547.7**

PLATE - X



LEGEND

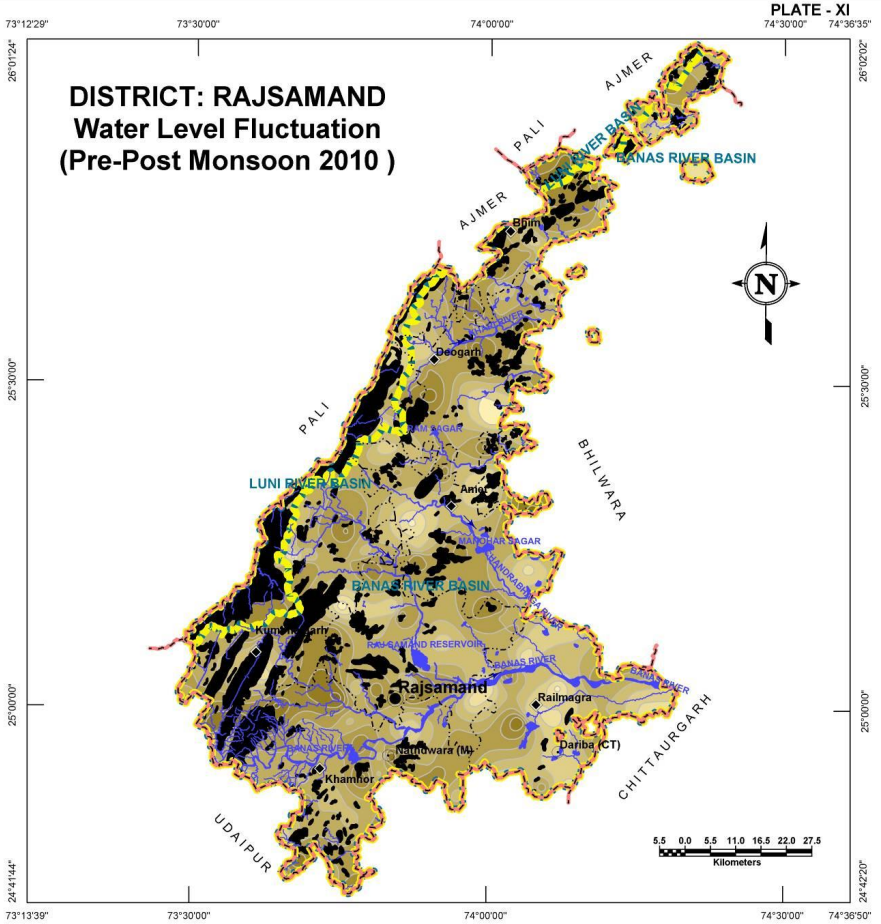
Admin Boundary:

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

Water Table Elevation (m amsl):

< 440	680 - 720
440 - 480	720 - 760
480 - 520	760 - 800
520 - 560	800 - 840
560 - 600	840 - 880
600 - 640	880 - 920
640 - 680	> 920

PLATE - XI



LEGEND

Admin Boundary:

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

Water Level Fluctuation (m):

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

GROUND WATER ELECTRICAL CONDUCTIVITY DISTRIBUTION DISTRICT – RAJSAMAND

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 and occupy almost 64% of the district area indicating that, by and large the ground water in the district is suitable for domestic purposes. The areas with moderately high EC values (2000 - 4000 µS/cm) are shown in green color occupying 34% of the district area, largely southern part of the district. Together these two i.e., those areas where EC<4000 µS/cm occupy 98% of the district area. Remaining part of the district approximately 4% has high EC values in ground water (>4000 µS/cm), and such areas are largely seen scattered in northern and eastern part of the district 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)
	Amet		Bhim		Deogarh		Khamnor		Kumbhalgarh		Railmagra		Rajsamand		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
< 2000	226.7	47.6	386.0	81.3	462.0	87.8	416.1	63.8	475.2	90.0	237.7	40.6	219.1	40.0	**2,422.8**
2000-4000	247.1	51.9	77.0	16.2	48.5	9.2	228.9	35.2	53.0	10.0	319.7	54.6	295.6	54.0	**1,269.8**
>4000	2.6	0.5	11.7	2.5	15.5	3.0	6.3	1.0	-	-	28.2	4.8	33.0	6.0	**97.3**
Total	**476.4**	**100.0**	**474.7**	**100.0**	**526.0**	**100.0**	**651.3**	**100.0**	**528.2**	**100.0**	**585.6**	**100.0**	**547.7**	**100.0**	**3,789.9**

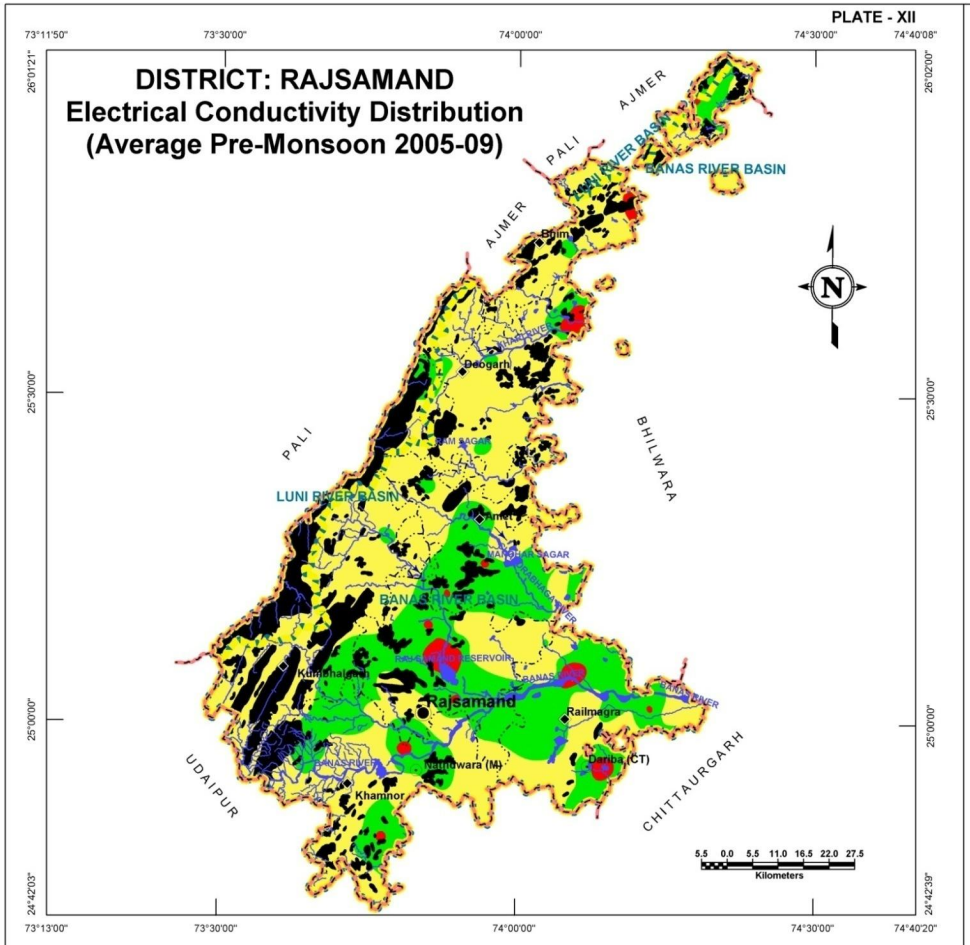
GROUND WATER CHLORIDE DISTRIBUTION

The district largely seems to have fairly good ground water for domestic consumption since only 1% of the district areas has shown high chloride concentration (>1000 mg/l) in ground water seen as red coloured patches in the southern part of the district, Plate – XIII, where the ground water is unsuitable for domestic purpose.The green colored regions in the map are such areas where chloride concentration is moderately high (250-1000 mg/l) occupies approximately 60% of the district area and the areas with low chloride concentration (<250 mg/l) are shown in yellow color and occupies approximately 39% of the district area, which is suitable for domestic purpose.

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)
	Amet		Bhim		Deogarh		Khamnor		Kumbhalgarh		Railmagra		Rajsamand		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
< 250	89.9	19.0	300.8	63.4	314.1	60.0	175.5	27.0	419.9	80.0	138.6	24.0	49.2	9.0	**1,488.0**
250-1000	385.6	81.0	172.6	36.3	209.3	40.0	464.2	71.0	108.3	20.0	435.1	74.0	486.7	89.0	**2,261.8**
> 1000	0.9	-	1.3	0.3	2.6	-	11.6	2.0	-	-	11.9	2.0	11.8	2.0	**40.1**
Total	**476.4**	**100.0**	**474.7**	**100.0**	**526.0**	**100.0**	**651.3**	**100.0**	**528.2**	**100.0**	**585.6**	**100.0**	**547.7**	**100.0**	**3,789.9**

PLATE - XII



LEGEND

Admin Boundary:

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

Basin Boundary

Water Bodies:

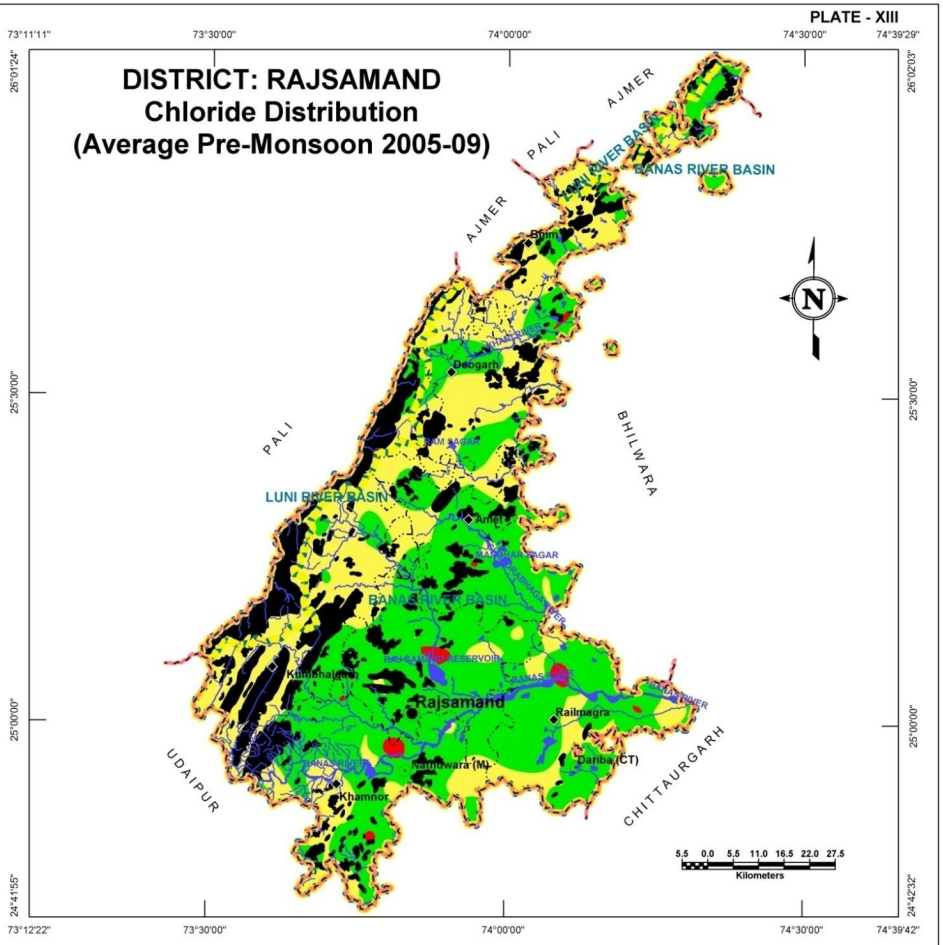
- River / Streams
- Ponds / Reservoirs

Hills

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

- < 2000
- 2000-4000
- >4000

PLATE - XIII



LEGEND

Admin Boundary:

- District Headquarter
- Block Headquarter
- Town
- 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 – RAJSAMAND

Interestingly, in spite of half of the district being primarily gneissic terrain the Fluoride concentration seen in ground water samples is not that high. The fluoride concentration map is presented in Plate – XIV where the high fluoride concentration areas are seen as small isolated patches in the eastern part of Bhim block and in the western part of Railmagra blocks where the concentration is more than 3mg/l.The areas with low concentration (i.e.,>1.5 mg/l) are shown in yellow color and 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 and occupy approximately 22% of the district area, largely around Railmagra and northern part of Amet.

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)
	Amet		Bhim		Deogarh		Khamnor		Kumbhalgarh		Railmagra		Rajsamand		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
< 1.5	394.2	82.7	341.3	71.9	331.7	63.1	649.9	99.8	465.9	88.2	258.1	44.1	472.3	86.2	**2,913.4**
1.5-3.0	81.8	17.2	107.8	22.7	170.2	32.3	1.4	0.2	62.3	11.8	319.7	54.6	73.1	13.4	**816.3**
> 3.0	0.4	0.1	25.6	5.4	24.1	4.6	-	-	-	-	7.8	1.3	2.3	0.4	**60.2**
Total	**476.4**	**100.0**	**474.7**	**100.0**	**526.0**	**100.0**	**651.3**	**100.0**	**528.2**	**100.0**	**585.6**	**100.0**	**547.7**	**100.0**	**3,789.9**

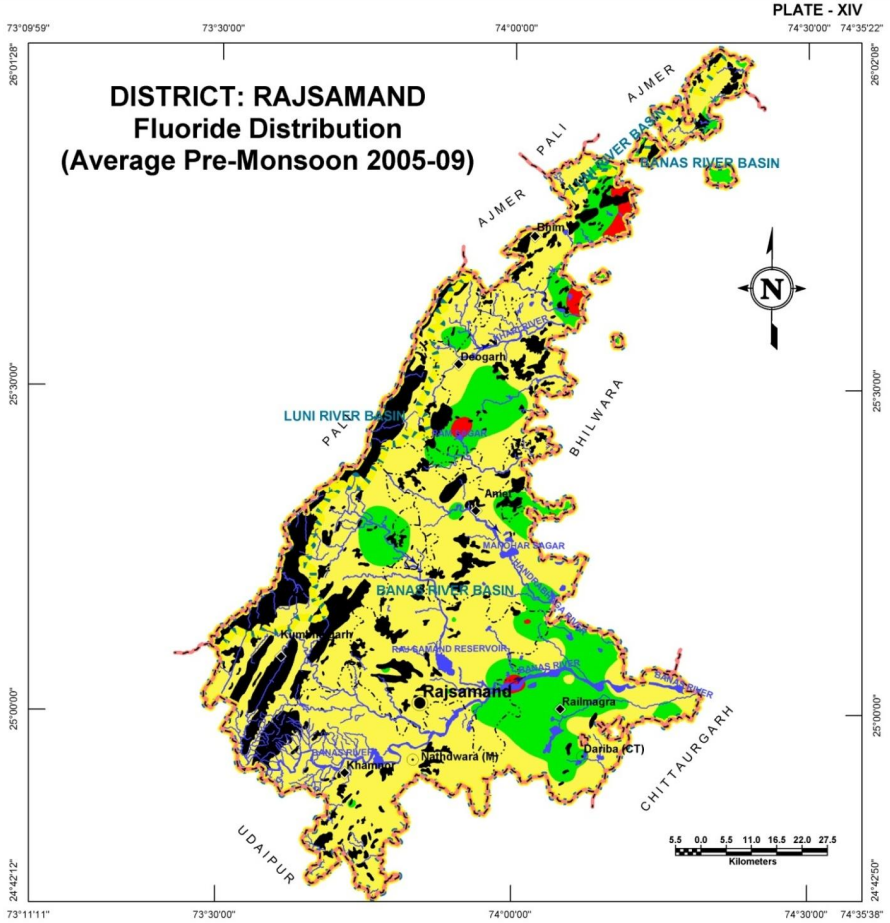
GROUND WATER NITRATE DISTRIBUTION

High nitrate concentration in ground water renders it unsuitable for agriculture purposes. Plate – XV shows distribution of Nitrate in ground water. Low nitrateconcentration (<50 mg/l) is shown in yellow color and occupies approximately 38% of the district area which is suitable for agriculture purpose. The areas with moderately high nitrate concentration (50-100 mg/l) are shown in green color also occupy about 38% of the district area. Remaining part of the district area is covered with high nitrate concentration (>100 mg/l) which is shown in red colored patches, largely southern and eastern part of the district as continuous as well as isolated patches where the ground water is not suitable for agriculture purpose.

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)
	Amet		Bhim		Deogarh		Khamnor		Kumbhalgarh		Railmagra		Rajsamand		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
< 50	122.0	25.6	360.1	75.9	189.6	36.0	164.2	25.2	254.0	48.1	248.5	42.4	95.4	17.4	**1,433.7**
50-100	210.6	44.2	105.5	22.2	233.4	44.4	339.7	52.2	219.5	41.5	140.4	24.0	193.2	35.3	**1,442.5**
>100	143.8	30.2	9.1	1.9	103.0	19.6	147.4	22.6	54.7	10.4	196.7	33.6	259.1	47.3	**913.7**
Total	**476.4**	**100.0**	**474.7**	**100.0**	**526.0**	**100.0**	**651.3**	**100.0**	**528.2**	**100.0**	**585.6**	**100.0**	**547.7**	**100.0**	**3,789.9**

PLATE - XIV



LEGEND

Admin Boundary:

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

Basin Boundary

Water Bodies:

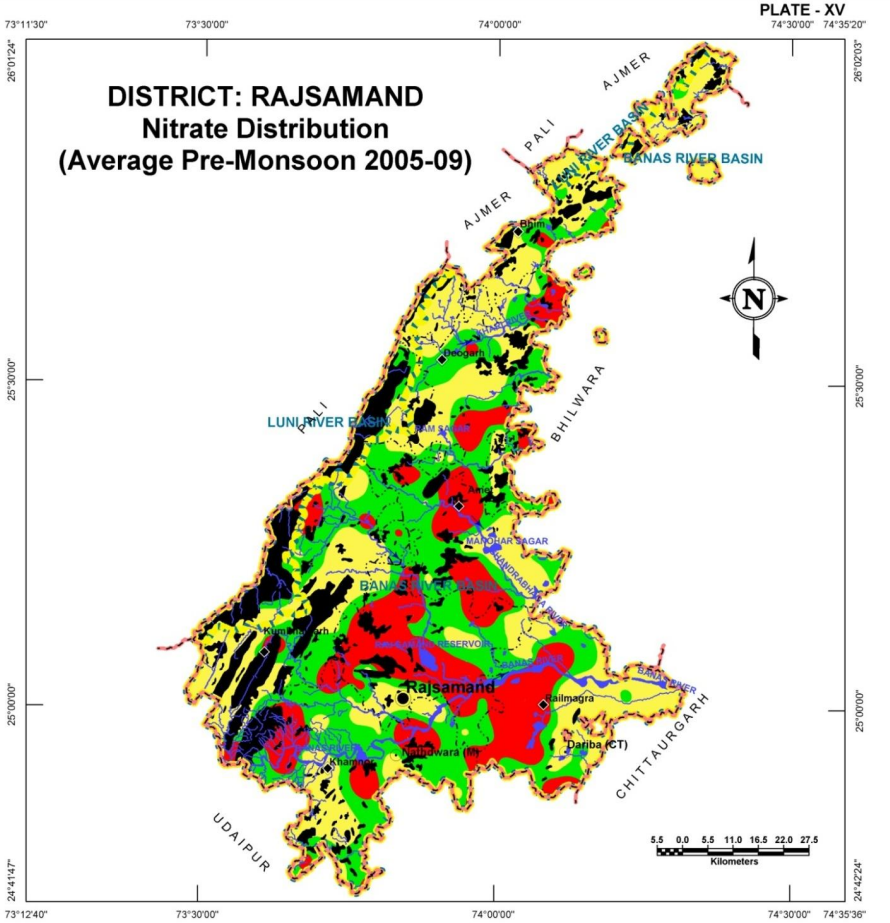
- River / Streams
- Ponds / Reservoirs

Hills

Fluoride Concentration (mg/l):

- < 1.5
- 1.5-3.0
- > 3.0

PLATE - XV



LEGEND

Admin Boundary:

- District Headquarter
- Block Headquarter
- Town
- 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 – RAJSAMAND

Plate – XVI depicts the bedrock depth below ground level in Rajsmand district. The beginning of massive bedrock has been considered for defining top of bedrock surface. It varies from less than 20 below ground level to more than 80m bgl. The major rocks types constituting the bedrock are schist and gneiss (BGC). On perusal of the map of depth to bed rock it is seen that the bedrock occurs at shallow depths in southern parts of the district whereas northwards, the depth to bedrock increases reaching to depths of about 80m bgl. In most parts of the district the depth to bedrock varies from of 20m – 60 m bgl, in general. Bedrock deeper than 80 mbgl is only seen in Railmagra block.

Depth to bedrock (mbgl)	Block wise area coverage (sq km)														Total Area (sq km)
	Amet		Bhim		Deogarh		Khamnor		Kumbhalgarh		Railmagra		Rajsamand		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
< 20	146.9	30.8	14.0	3.0	-	-	389.7	59.8	136.5	26.0	10.8	2.0	211.5	39.0	**909.4**
20-40	329.5	69.2	394.3	83.0	399.6	76.0	261.6	40.2	391.7	74.0	401.0	68.0	336.2	61.0	**2,513.9**
40-60	-	-	66.4	14.0	126.4	24.0	-	-	-	-	143.5	25.0	-	-	**336.3**
60-80	-	-	-	-	-	-	-	-	-	-	16.5	3.0	-	-	**16.5**
> 80	-	-	-	-	-	-	-	-	-	-	13.8	2.0	-	-	**13.8**
Total	**476.4**	**100.0**	**474.7**	**100.0**	**526.0**	**100.0**	**651.3**	**100.0**	**528.2**	**100.0**	**585.6**	**100.0**	**547.7**	**100.0**	**3,789.9**

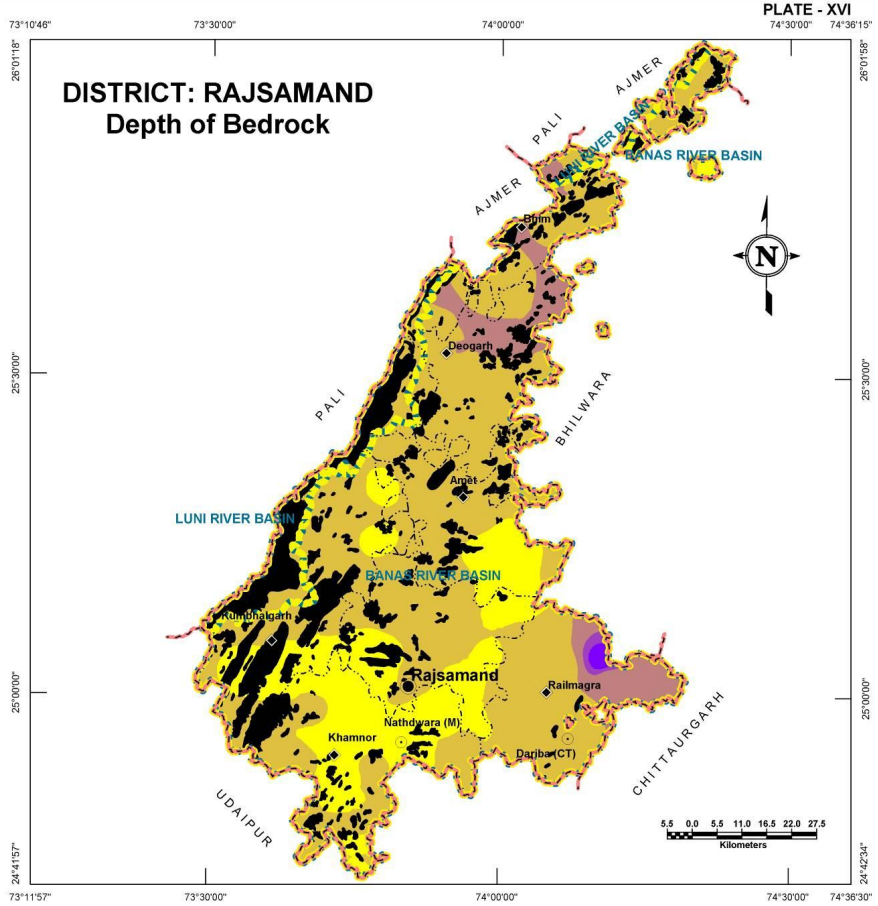
UNCONFINED AQUIFER

Unconfined aquifer hardrock areas

Aquifers in the district are predominantly formed in weathered, fractured and jointed rock formations occurring at shallower depths and these constitute good unconfined aquifers. The thickness of aquifers thus formed varies from less than 10m to around 100m. In the northern, eastern and southeastern parts of the district, there are three isolated pockets of very high thickness of unconfined aquifer in hardrocks but are of very limited spatial extent. Otherwise, most part of the district has moderate to low thickness of aquifers in hardrock ranging in thickness between about 10m to 40m, in general.

Unconfined aquifer Thickness (m)	Block wise Area coverage (sq km)							Total Area (sq km)
	Amet	Bhim	Deogarh	Khamnor	Kumbhalgarh	Railmagra	Rajsamand	
<10	148.1	98.2	79.6	168.5	123.6	106.4	66.4	**790.8**
10-20	163.2	179.7	148.7	148.5	100.1	249.6	124.8	**1,114.6**
20-30	133.0	70.2	115.5	210.4	168.0	147.6	177.2	**1,021.9**
30-40	30.6	42.3	96.4	80.7	113.0	27.4	139.2	**529.6**
40-50	1.5	40.6	59.1	19.8	22.8	18.7	38.4	**200.9**
50-60	-	26.3	16.8	11.0	0.7	13.6	1.2	**69.6**
60-70	-	9.4	5.2	6.5	-	9.6	0.5	**31.2**
70-80	-	3.7	3.1	4.0	-	7.1	-	**17.9**
80-90	-	2.8	1.5	1.9	-	4.0	-	**10.2**
>90	-	1.5	0.1	-	-	1.6	-	**3.2**
Total	**476.4**	**474.7**	**526.0**	**651.3**	**528.2**	**585.6**	**547.7**	**3,789.9**

PLATE - XVI



LEGEND

Admin Boundary:

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

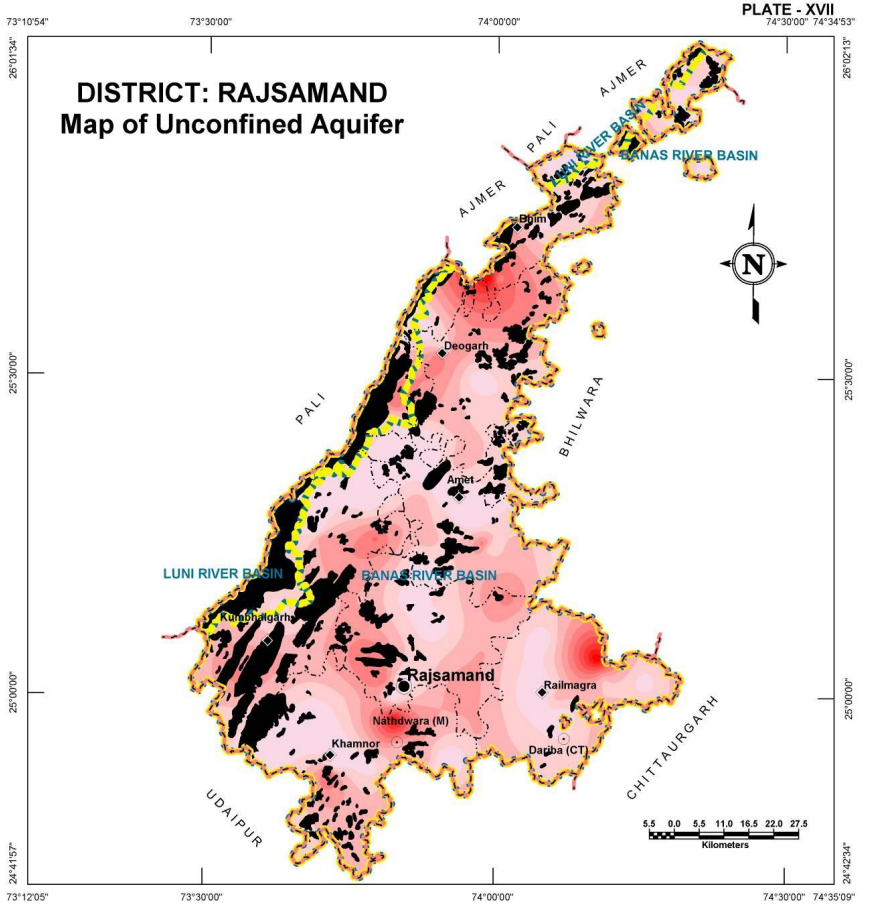
Basin Boundary

Hills

Depth of Bedrock (m bgl):

- <20
- 20-40
- 40-60
- 60-80
- >80

PLATE - XVII



LEGEND

Admin Boundary:

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

Basin Boundary

Hills

Aquifer Thickness (m):

Weathered & Fractured Zone in Hardrock Area

- <10
- 10-20
- 20-30
- 30-40
- 40-50
- 50-60
- 60-70
- 70-80
- 80-90
- >90

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.

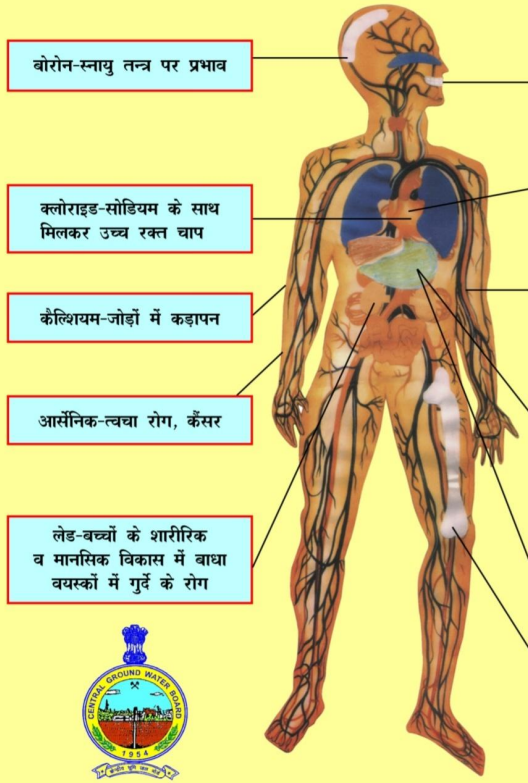
(Contd…)

S. No.	Technical Terms	Definition
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

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

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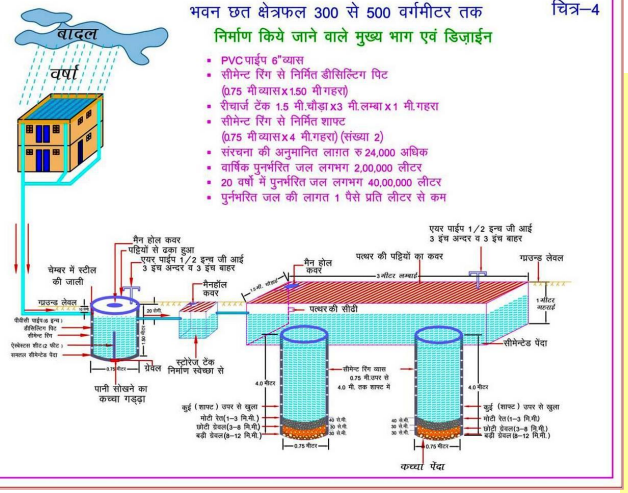
भारत सरकार
e-mail:cgwbwr@sancharnet.in

भूजल अमूल्य है इसे प्रदूषित न करें।

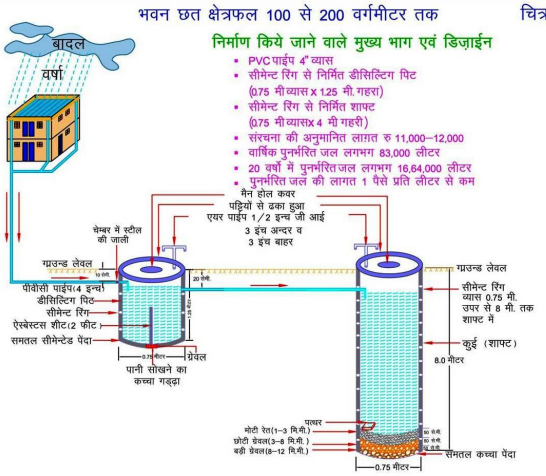
चित्र–4
भवन छत क्षेत्रफल 300 से 500 वर्गमीटर तक
निर्माण किये जाने वाले मुख्य भाग एवं डिज़ाईन

- PVC पाईप 6" व्यास
- सीमेन्ट रिंग से निर्मित डीसिल्टिंग पिट (0.75 मी.व्यास x 1.50 मी गहरा)
- रीचार्ज टैंक 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 लागत रु 24,000 अधिक
- वार्षिक पुनर्भरित जल लगभग 2,00,000 लीटर
- 20 वर्षों में पुनर्भरित जल लगभग 40,00,000 लीटर
- पुर्नभरित जल की लागत 1 पैसे प्रति लीटर से कम



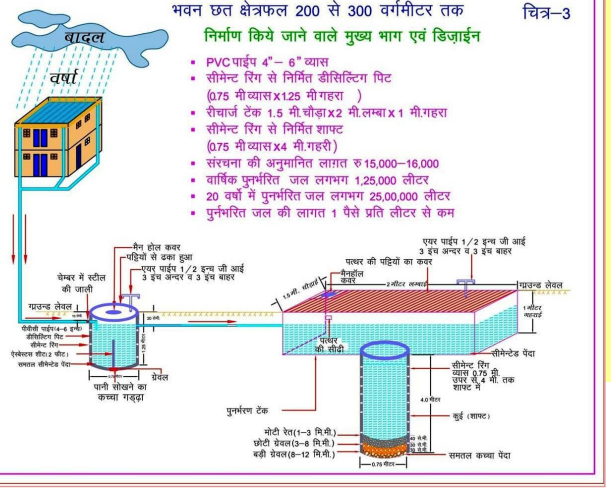
चित्र–2
भवन छत क्षेत्रफल 100 से 200 वर्गमीटर तक
निर्माण किये जाने वाले मुख्य भाग एवं डिज़ाईन

- 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 लागत रु 11,000–12,000
- वार्षिक पुनर्भरित जल लगभग 83,000 लीटर
- 20 वर्षों में पुनर्भरित जल लगभग 16,64,000 लीटर
- पुनर्भरित जल की लागत 1 पैसे प्रति लीटर से कम



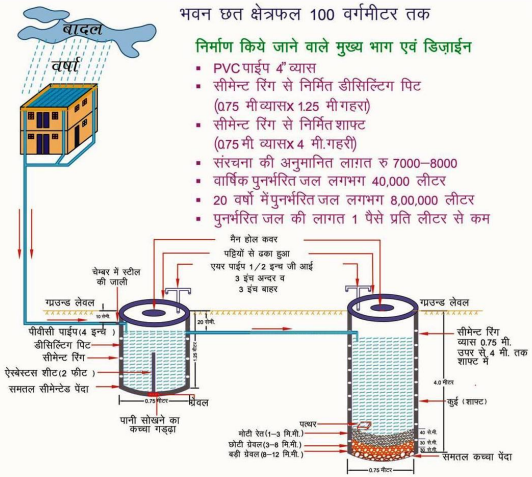
चित्र–3
भवन छत क्षेत्रफल 200 से 300 वर्गमीटर तक
निर्माण किये जाने वाले मुख्य भाग एवं डिज़ाईन

- PVC पाईप 4" – 6" व्यास
- सीमेन्ट रिंग से निर्मित डीसिल्टिंग पिट (0.75 मी.व्यास x 1.25 मी.गहरा)
- रीचार्ज टैंक 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 लागत रु 15,000–16,000
- वार्षिक पुनर्भरित जल लगभग 1,25,000 लीटर
- 20 वर्षों में पुनर्भरित जल लगभग 25,00,000 लीटर
- पुर्नभरित जल की लागत 1 पैसे प्रति लीटर से कम



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 लागत रु 7000–8000
- वार्षिक पुनर्भरित जल लगभग 40,000 लीटर
- 20 वर्षों में पुनर्भरित जल लगभग 8,00,000 लीटर
- पुनर्भरित 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

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