

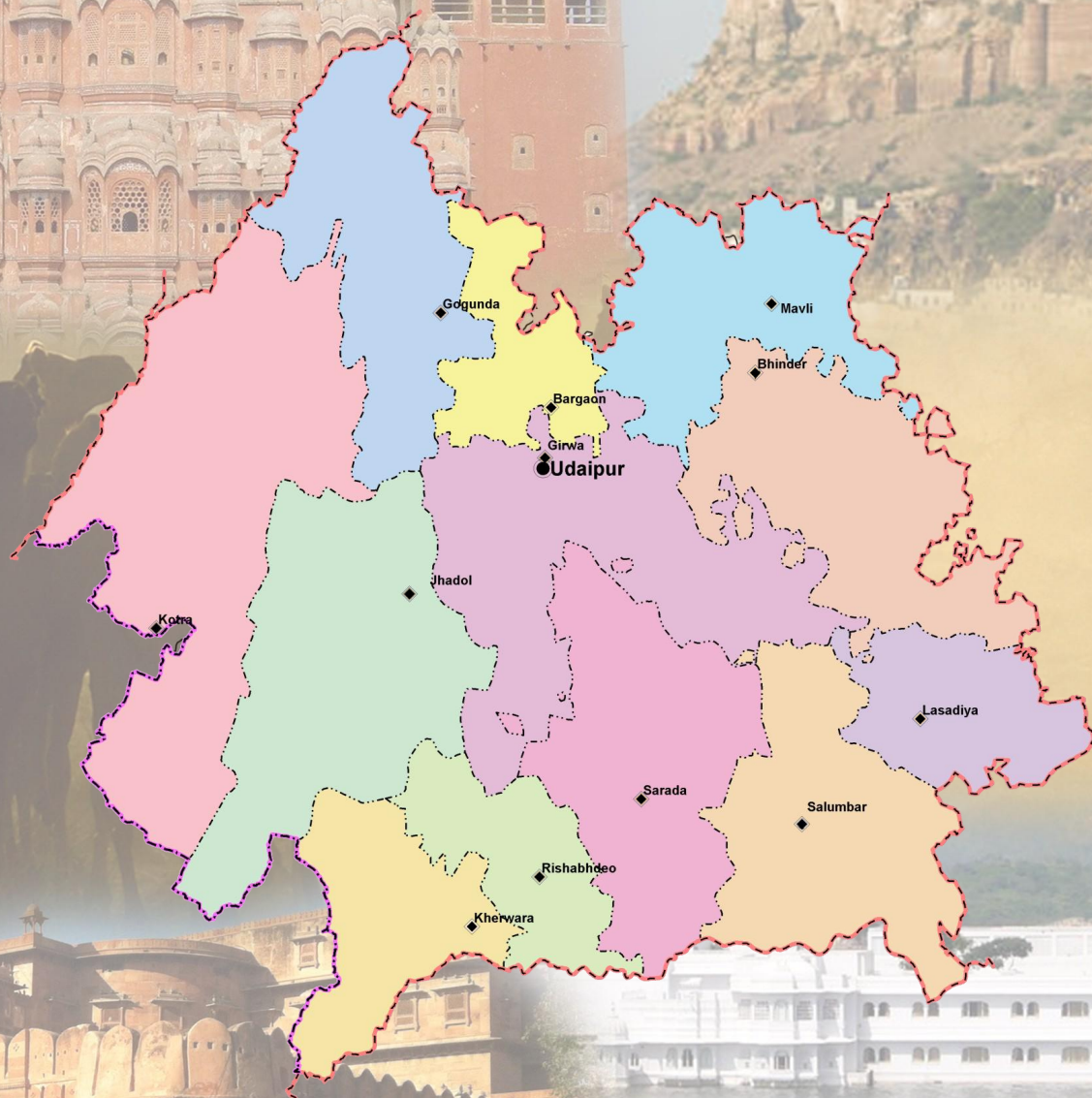


Ground Water Department,  
Rajasthan

# Hydrogeological Atlas of Rajasthan Udaipur District



European Union  
State Partnership Programme



2013

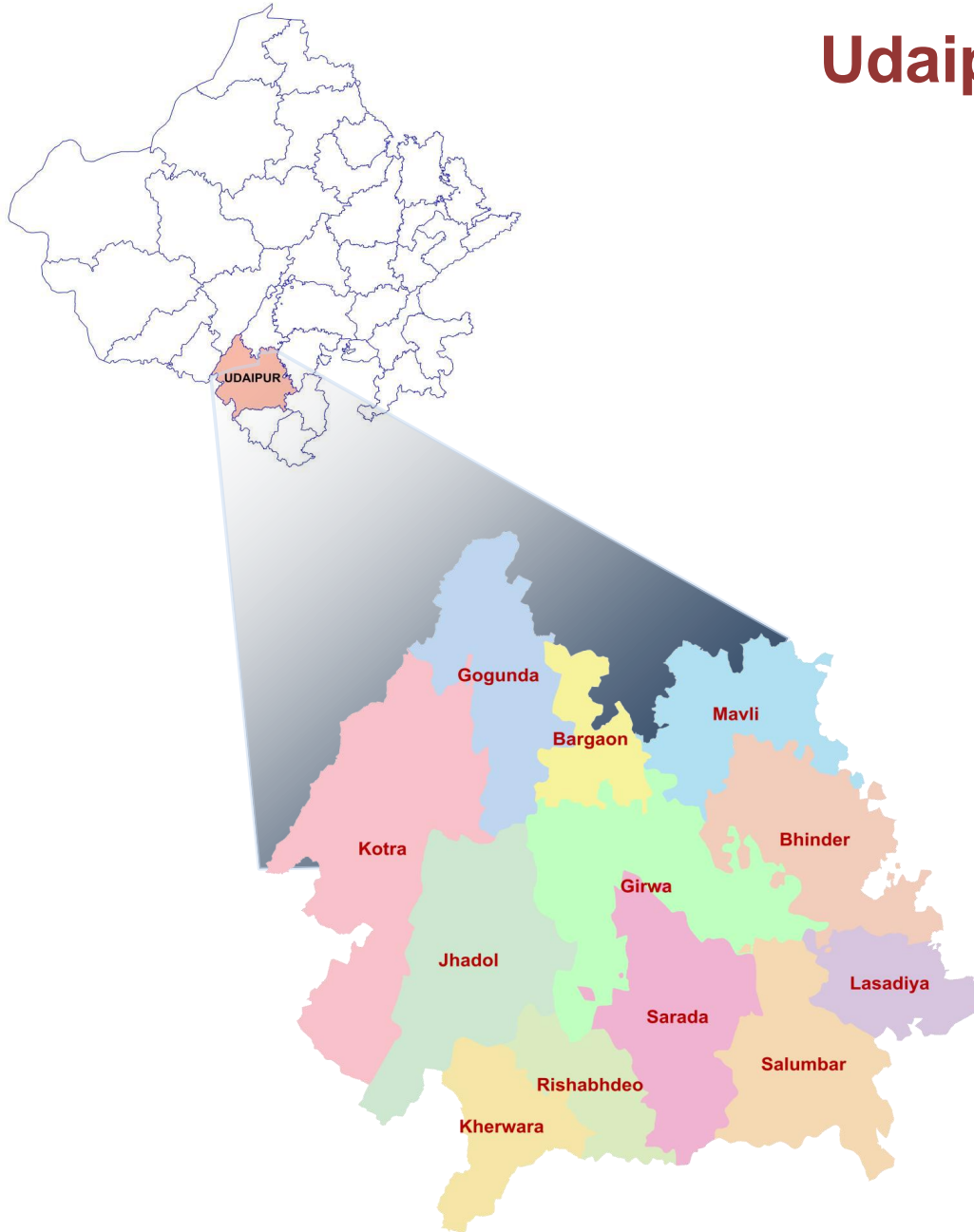


ROLTA  
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# Hydrogeological Atlas of Rajasthan

## Udaipur District

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## ADMINISTRATIVE SETUP

## DISTRICT – UDAIPUR

### Location:

Udaipur district is located in the southern part of Rajasthan. It is bounded in the North by Pali and Rajsamand districts, in the East by Chittaurgarh district, in the South by Dungarpur and partly by Banaswara districts and in the West by Sirohi district and Gujarat state. It stretches between 23° 48' 05.79" to 25° 06' 16.75" North latitude and 73° 01' 23.10" to 74° 26' 20.87" East longitude covering an approximate area of 11,773 sq kms. The important rivers of Udaipur district are Jokham, Sabarmati, Som, Berach and Sei which are parts of three major river basins of Rajasthan viz. Sabarmati, Mahe and Banas. In addition, there are a large number of local streams originating from Aravalli range.

### Administrative Set-up:

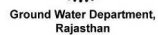
Administratively, Udaipur district is part of Udaipur division. This district is divided into 12 blocks. The following table summarizes the basic statistics of the district at block level.

S. No.	Block Name	Population (Based on 2001 census)	Area (Sq.km)	% of Block Area	Total Number of Towns and Villages
1	Bargaon	1,23,802	449.4	3.8	107
2	Bhinder	2,30,818	1,077.4	9.2	286
3	Girwa	6,17,061	1,372.6	11.7	181
4	Gogunda	1,51,575	992.6	8.4	148
5	Jhadol	1,93,810	1,337.2	11.4	258
6	Kherwara	1,58,702	622.8	5.3	172
7	Kotra	1,83,504	1,894.7	16.1	304
8	Lasadiya	61,483	545.3	4.5	89
9	Mavli	2,13,796	836.4	7.1	150
10	Rishabhdeo	1,10,274	505.6	4.3	82
11	Salumbar	2,12,492	1,024.9	8.7	235
12	Sarada	2,23,380	1,114.0	9.5	187
<b>Total</b>		<b>24,80,697</b>	<b>11,772.9</b>	<b>100.0</b>	<b>2,199</b>

Udaipur district has 2,199 towns and villages of which 12 are block headquarters as well. Total population of the district is approximately 24, 80,697.

### Climate:

Udaipur district has a sub-humid climate. There are three distinct seasons in a year. The winter season encompassing four months from November to February are mild and pleasant, with temperature ranging between 0°C (Mount Abu) to 18°C with little or no humidity. In Dec-Jan months occasional cold waves bring down the temperatures significantly. March is a pleasant transition month to summer. The summer months from April to June, record average daily temperatures of around 37°C. May and June are the hottest months when temperature reaches up to 48°C. Annually, most of the rainfall is received during the monsoon season which extends from June (end of June) to September.





## TOPOGRAPHY

The district has an undulating topography. Western part of the district has high hills which are part of Aravalli ranges with intervening valleys, while the eastern part has relatively low hills and broader plains. Elevation ranges from a minimum of 16m above mean sea level in Salumbar block in the southeastern part of the district and maximum of 1290m amsl in Gogunda block in the northwestern part of the district. The hills are generally in the form of north east – south west trending ridges. Physiographically, the district has 4 physical divisions, namely Valley fills, Pediment, Buried pediment and Structural hills.

S. No.	Block Name	Min. Elevation (m amsl)	Max. Elevation (m amsl)
1	Bargaon	563.5	1,055.9
2	Bhinder	317.9	545.5
3	Girwa	307.2	1,057.3
4	Gogunda	475.4	1,290.0
5	Jhadol	251.9	1,053.3
6	Kherwara	275.3	658.6

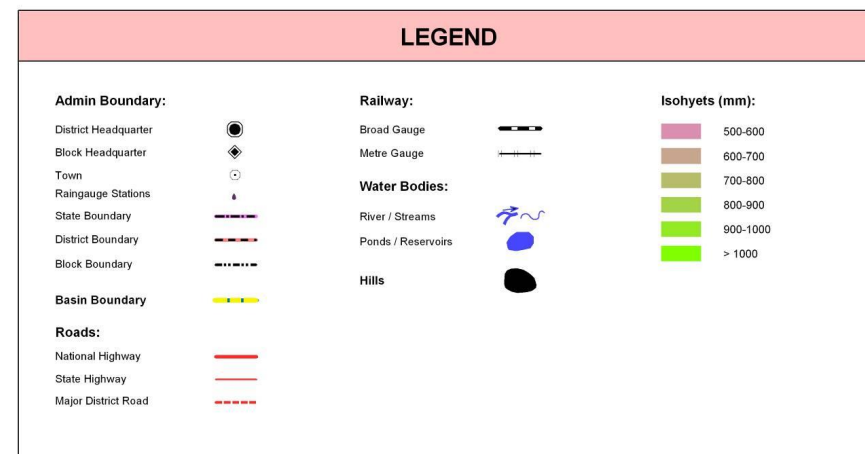
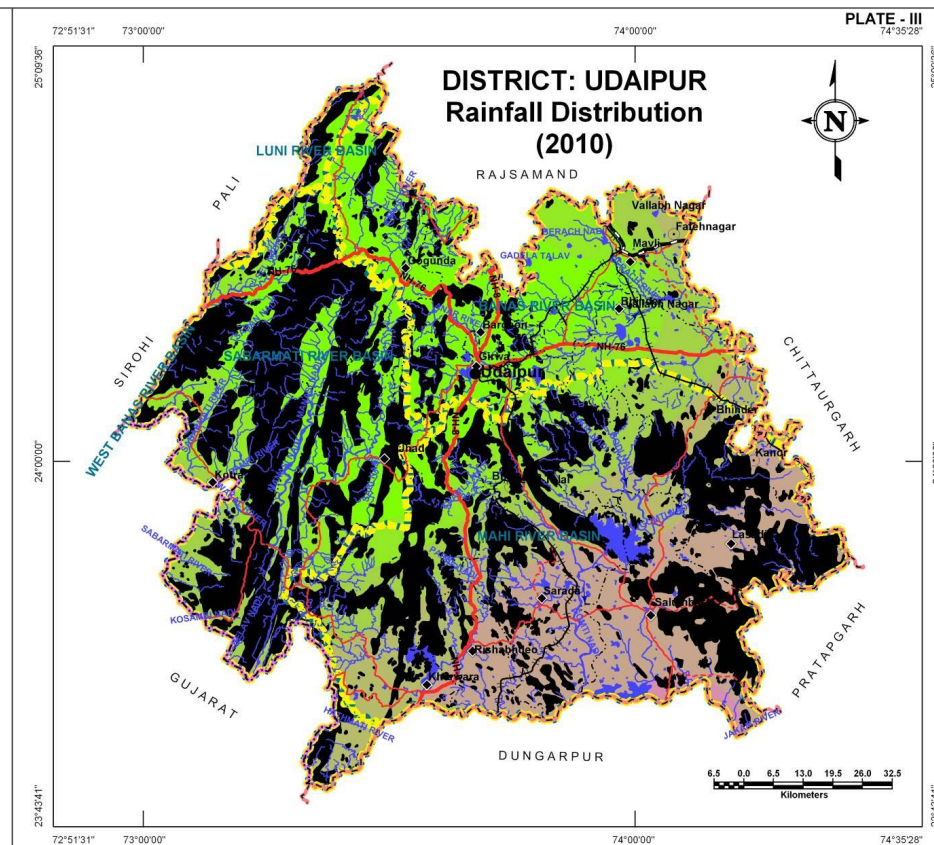
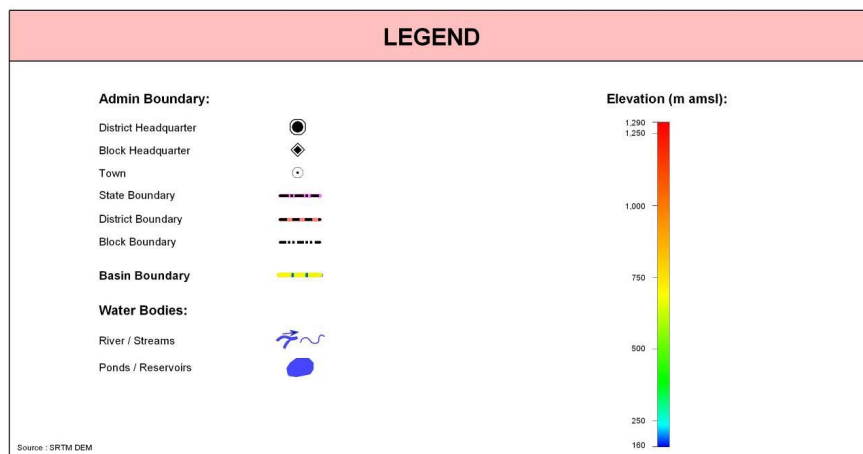
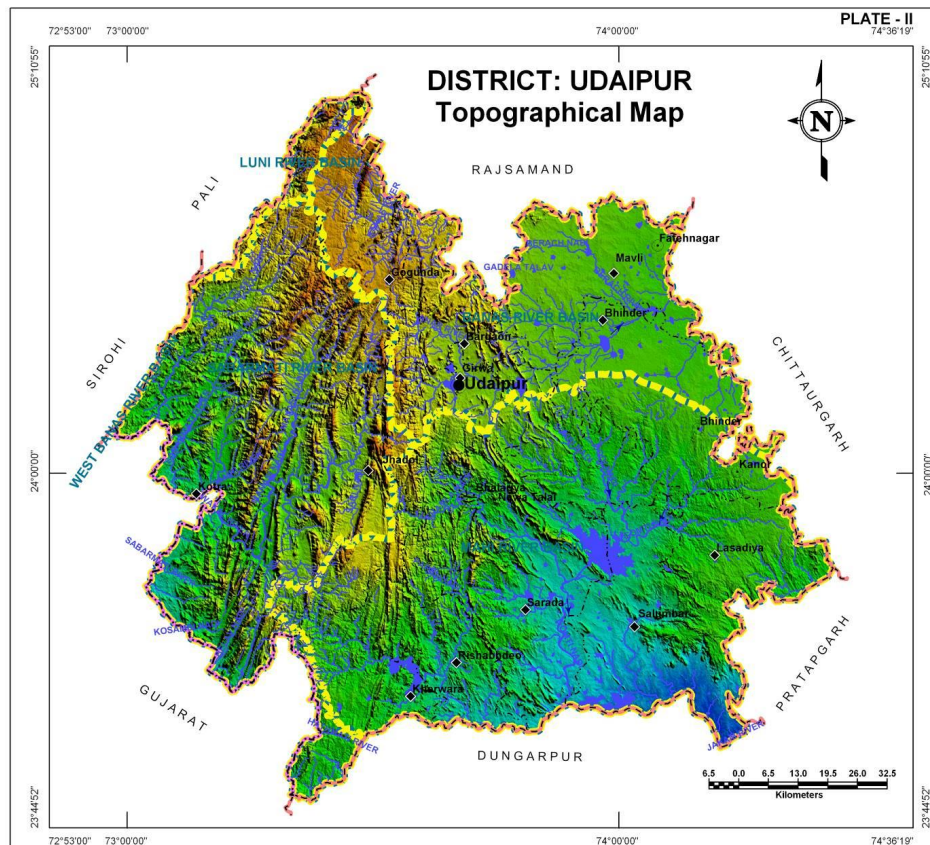
S. No.	Block Name	Min. Elevation (m amsl)	Max. Elevation (m amsl)
7	Kotra	242.2	1,134.4
8	Lasadiya	296.2	569.0
9	Mavli	450.6	811.9
10	Rishabhdeo	222.7	755.3
11	Salumbar	160.0	519.6
12	Sarada	203.7	853.4

## RAINFALL

The district receives fairly good rainfall in the majority of blocks and slightly less in some (like Lasadiya). Average annual rainfall in Udaipur district was about 817mm based on the data of available blocks. Total annual rainfall was highest in Jhadol block (1,162.9 mm) whereas minimum was in Salumbar block (577.7 mm). The western part being hilly, receives rainfall in general, above 800 mm, gradually reducing towards southeast reaching its minimum in southern part of Salumbar block.

**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)
Bargaon	1,021.0	1,087.7	1,053.9
Bhinder	620.8	1,023.7	824.4
Girwa	721.8	1,129.8	949.2
Gogunda	970.4	1,106.9	1,046.3
Jhadol	788.7	1,162.9	984.9
Kherwara	692.5	868.0	760.7
Kotra	808.5	1,109.1	970.1
Lasadiya	618.7	736.7	653.7
Mavli	620.5	1,049.5	943.0
Rishabhdeo	649.7	906.6	733.4
Salumbar	577.7	765.5	646.0
Sarada	601.3	1,003.2	725.4





## GEOLOGY

## DISTRICT – UDAIPUR

In Udaipur district the Bhilwara Super group of Arachean age are the oldest formation exposed. The central and western part of the district is occupied by the younger formations of Aravalli Super Group and Delhi Super Group of Proterozoic age. Thin veneer of Quaternary and Recent alluvium overlies most of the formations in isolated patches, along river courses and in the shallow depressions. The generalized stratigraphic succession of the district is given in table below.

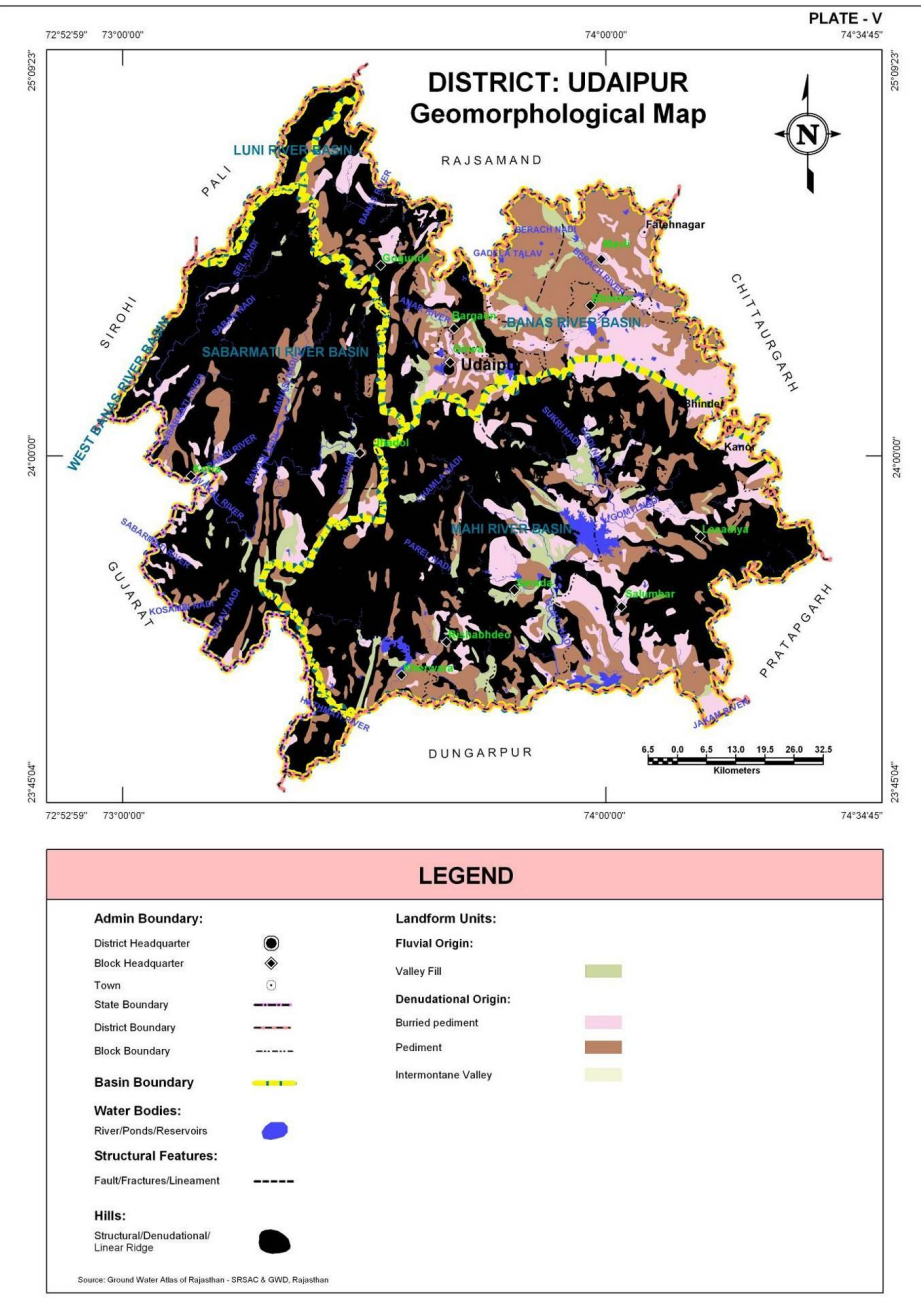
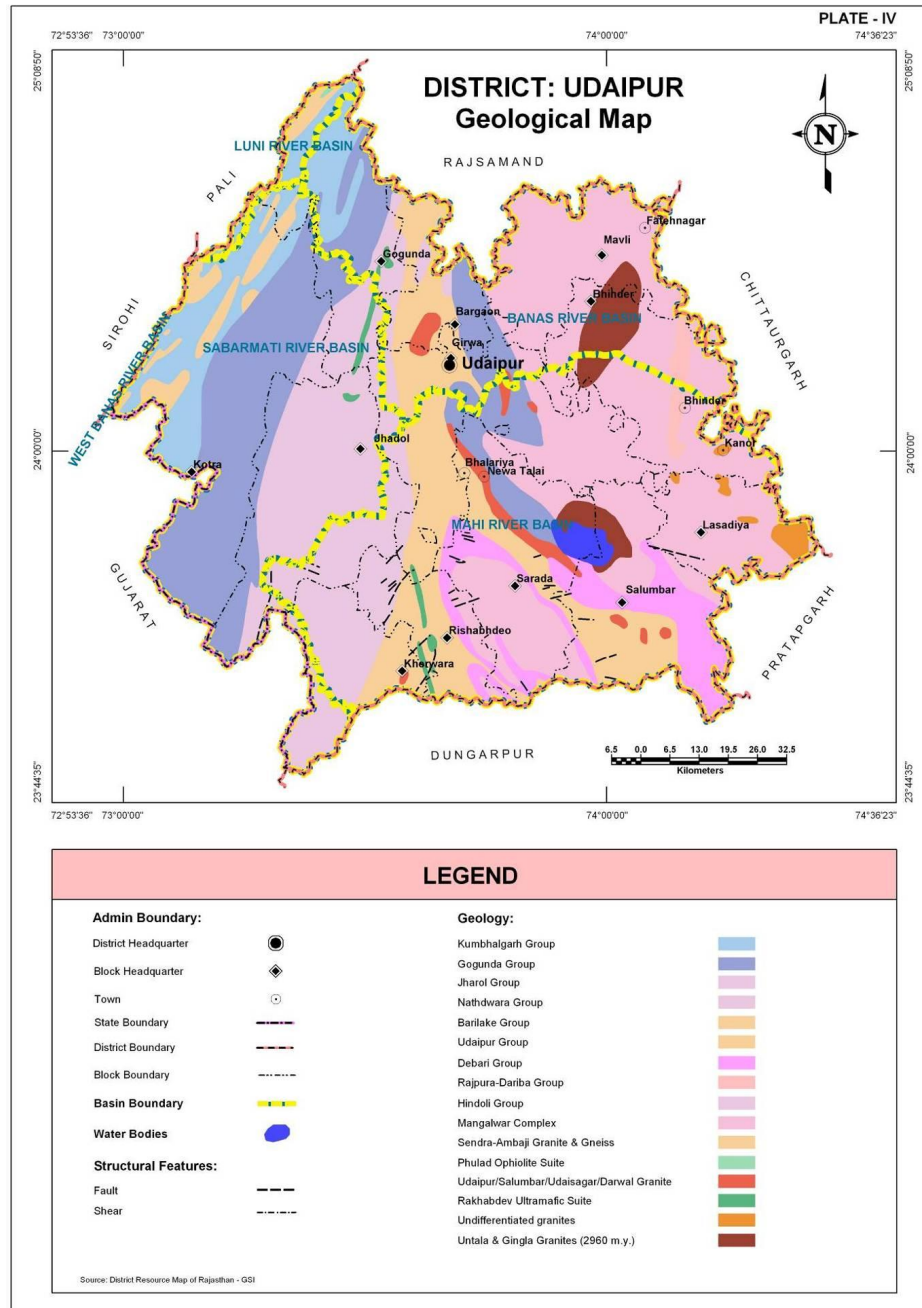
**Table: Geologic succession**

Super Group	Group	Formation
Delhi	Gogunda	Calc-schists, gneisses, mica-schists, garnetiferous biotite-schists, quartzites & migmatites
	Rikhabdeo ultramafic suite	Serpentinite, talc-chlorite-schist, actinolite-tremolite schist & asbestos
	Jharol	Chlorite-mica schist, calc schist & quartzite
Aravalli	Bari lake	Meta volcanics, chlorite schists, amphibolite, quartzite & conglomerate
	Udaipur	Phyllite, mica schists, meta siltstone, quartzite, dolomite, gneisses & migmatites
	Debari	Meta arkose, quartzite, phyllite, dolomitic marble & dolomite
-----X-----X-----X-----X-----X---Unconformity---X-----X-----X-----X-----X-----		
Bhilwara	Mangalwar complex	Migmatites, gneisses, quartzite, felspathic garneti ferrous mica schists & para amphibolites

## GEOMORPHOLOGY

**Table: Geomorphologic units, their description and distribution**

Origin	Landform Unit	Description of Lithology
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.
	Intermontane valley	Depression between mountains, generally broad & linear, filled with colluvial deposits.
Fluvial	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	Structural Hills	Linear to arcuate hills showing definite trend-lines with varying lithology associated with folding, faulting etc.





## AQUIFERS

## DISTRICT – UDAIPUR

There is a variety of aquifer forming material in Udaipur district all within hard rocks. Weathered/fractured/jointed hardrock constitutes good aquifers within phyllite, schist, BGC, gneiss and quartzite. Of all these most prominent is phyllite aquifer occupying about 29% of the district area. BGC aquifer is also very important aquifer and occupies about 23% area of the district in eastern part. The district has prominent hill and therefore, about 38% of it is non-potential zone.

**Table: Block wise area of aquifer potential zones and their description**

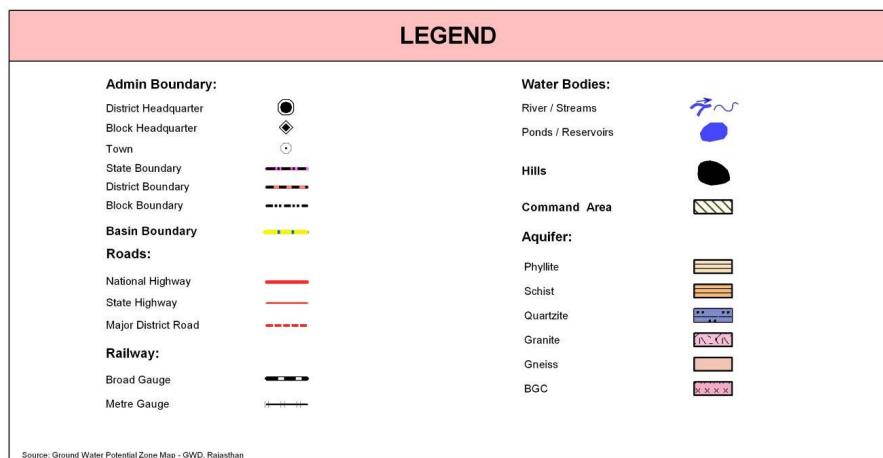
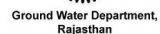
Aquifer in Potential Zone	Area (sq km)	% age of district	Description of the unit/Occurrence
Schist	738.2	6.3	Medium to fine grained compact rock. The litho-units are soft, friable and have closely spaced cleavage. This forms major water bearing formation under weathered/fractured conditions and found in the western and northwestern parts of the district within the Kotra and Gogunda blocks.
Phyllite	3,461.7	29.4	These include meta sediments and represented by carbonaceous phyllite. This forms one of the most widespread aquifer type in Udaipur district covering nearly half of the district.
Quartzite	141.0	1.2	Medium to coarse grained and varies from feldspathic grit to sericitic quartzite. It forms aquifers along the border of Jhadol and Kotra blocks in the western part of the district.
Grainitic Gneiss	298.1	2.5	Grey to dark coloured, medium to coarse grained rocks. Its weathered and fractured part constitutes aquifers in the southwestern part of the district occupying major parts of Udaipur and Bhinder blocks in the eastern parts of the district.
BGC	2,664.5	22.6	Grey to dark coloured, medium to coarse grained rocks. When weathered and fractured, it forms good aquifers in the district. It occupies large tracts in Mavli, Udaipur, Lasadiya, Sarada and Salumbar blocks.
Non Potential zone	4,469.4	38.0	Hills and intervening valleys
<b>Total</b>	<b>11,772.9</b>	<b>100.0</b>	

## STAGE OF GROUND WATER DEVELOPMENT

Ground water resource assessment studies led to categorization of the blocks into different categories based on stage of development. The ground water appears to be under stress as except for two blocks (Kotra and Salumbar) which fall within Semi critical category (i.e., less than 90% development) all the other blocks fall either within Critical or in Over Exploited category as development has either reached 100% or has exceeded indicating that aquifers have exhausted of their dynamic ground water resource.

Categorization on the basis of stage of development of ground water	Block Name
Semi Critical	Kotra, Salumbar
Critical	Kherwara, Rishabhdeo, Jhadol, Sarada, Lasadiya
Over Exploited	Bargaon, Gogunda, Mavli, Bhinder, Girwa

**Basis for categorization:** Ground water development 70 - 90% then Semi critical; >90% but <=100% - Critical and >=100% - Over-Exploited.





## LOCATION OF EXPLORATORY AND GROUND WATER MONITORING WELLS

## DISTRICT – UDAIPUR

Udaipur district has a well distributed network of exploratory wells (142) and ground water monitoring stations (372) in the district owned by RGWD (81 and 320 respectively) and CGWB (61 and 52 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 21 additional wells in different blocks 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
Bargaon	4	8	12	5	23	28	0	0
Bhinder	8	12	20	6	41	47	0	6
Girwa	6	12	18	11	37	48	0	3
Gogunda	2	10	12	1	34	35	0	0
Jhadol	2	10	12	7	31	38	0	1
Kherwara	8	3	11	3	15	18	0	0
Kotra	-	4	4	1	23	24	0	0
Lasadiya	3	2	5	2	15	17	0	0
Mavli	6	9	15	4	34	38	0	7
Rishabhdeo	4	3	7	1	11	12	0	0
Salumbar	11	3	14	6	28	34	0	1
Sarada	7	5	12	5	28	33	0	3
<b>Total</b>	<b>61</b>	<b>81</b>	<b>142</b>	<b>52</b>	<b>320</b>	<b>372</b>	<b>0</b>	<b>21</b>

## DEPTH TO WATER LEVEL (PRE MONSOON – 2010)

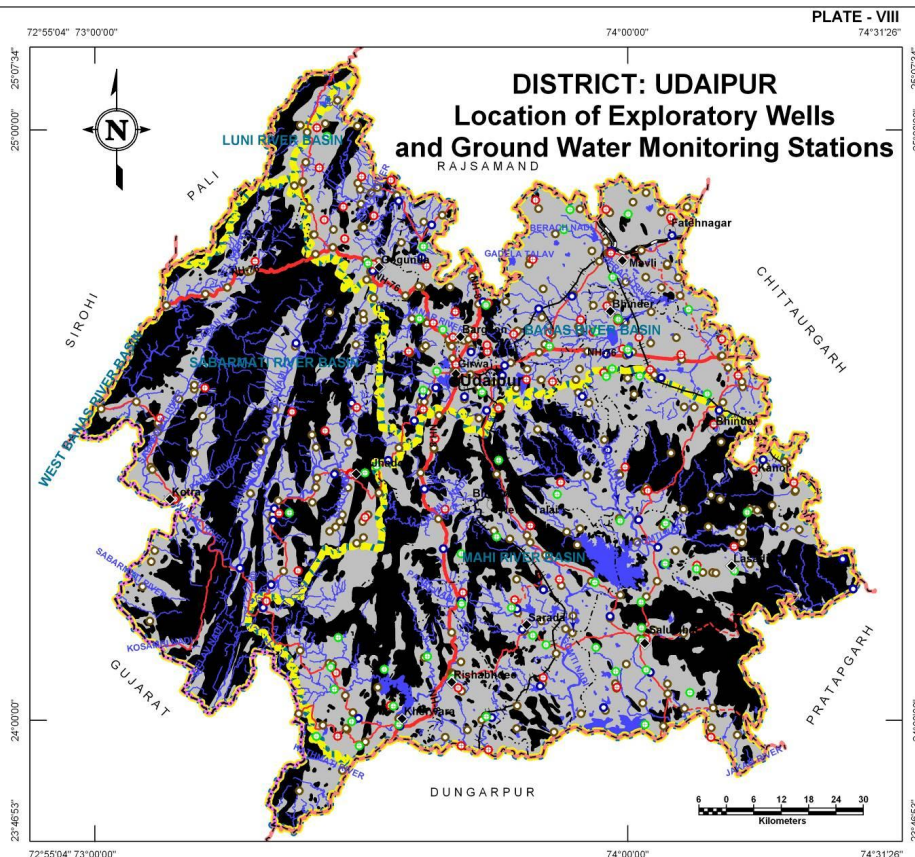
In spite of being a predominantly hard rock area, the district shows moderate variation in depth to ground water levels from less than 10m bgl to around 40m bgl. Shallow water levels are seen in the southwestern part of the district within Kotra block. Deeper water levels of more than 30m bgl are found in Girwa, Gogunda, Bhinder Jhadol and Mavli. Good part of the district is hilly.

Depth to water level (m bgl)	Block wise area coverage (sq km) *												Total Area (sq km)
	Bargaon	Bhinder	Girwa	Gogunda	Jhadol	Kherwara	Kotra	Lasadiya	Mavli	Rishabhdeo	Salumbar	Sarada	
< 10	26.2	2.1	34.8	13.1	97.4	5.0	149.2	0.1	0.7	-	10.7	-	339.4
10-20	256.5	576.8	600.5	475.2	290.5	99.3	312.9	126.6	592.4	63.1	308.5	276.5	3,978.8
20-30	47.7	260.8	223.9	89.2	227.6	336.9	256.7	80.1	220.0	275.3	372.0	511.4	2,901.6
30-40	-	13.0	23.9	21.2	11.0	-	-	-	7.6	-	-	-	76.7
>40	-	-	0.0	0.4	6.6	-	-	-	-	-	-	-	7.0
<b>Total</b>	<b>330.4</b>	<b>852.7</b>	<b>883.1</b>	<b>599.1</b>	<b>633.1</b>	<b>441.2</b>	<b>718.8</b>	<b>206.8</b>	<b>820.8</b>	<b>338.4</b>	<b>691.2</b>	<b>787.9</b>	<b>7,303.5</b>

\* 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

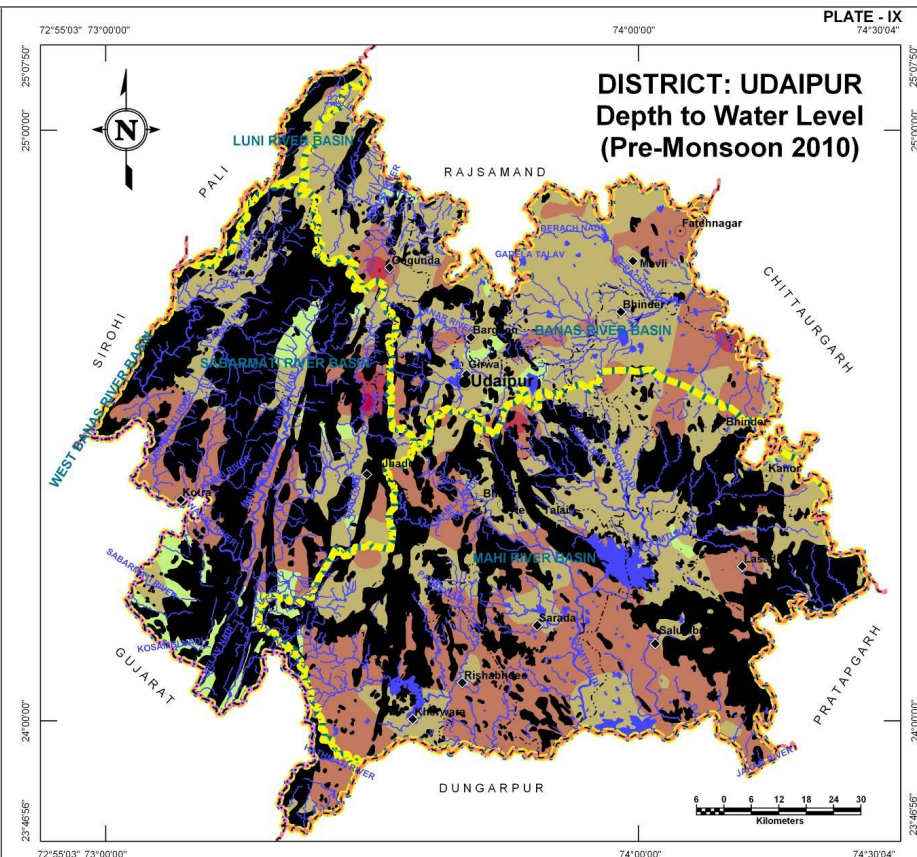
#### Railway:

- 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



## WATER TABLE ELEVATION (PRE MONSOON – 2010)

Water table elevation (above mean sea level, amsl) variation is quite large in the district. While the minimum water table elevation (<180m amsl) is seen in the southeastern most part of the district in Salumbar block, the maximum elevation (920m amsl) is observed in the northwestern part of the district in Gogunda Block. The general ground water flow direction thus is indicated to be from northwest to southeastern direction.

## DISTRICT – UDAIPUR

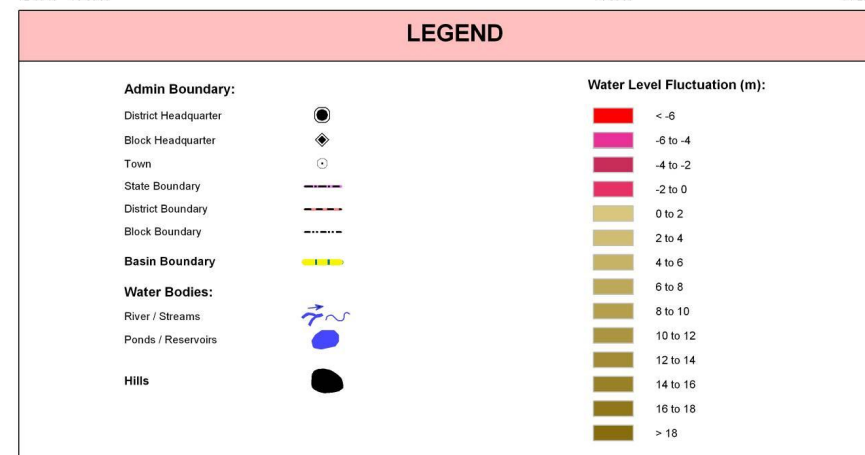
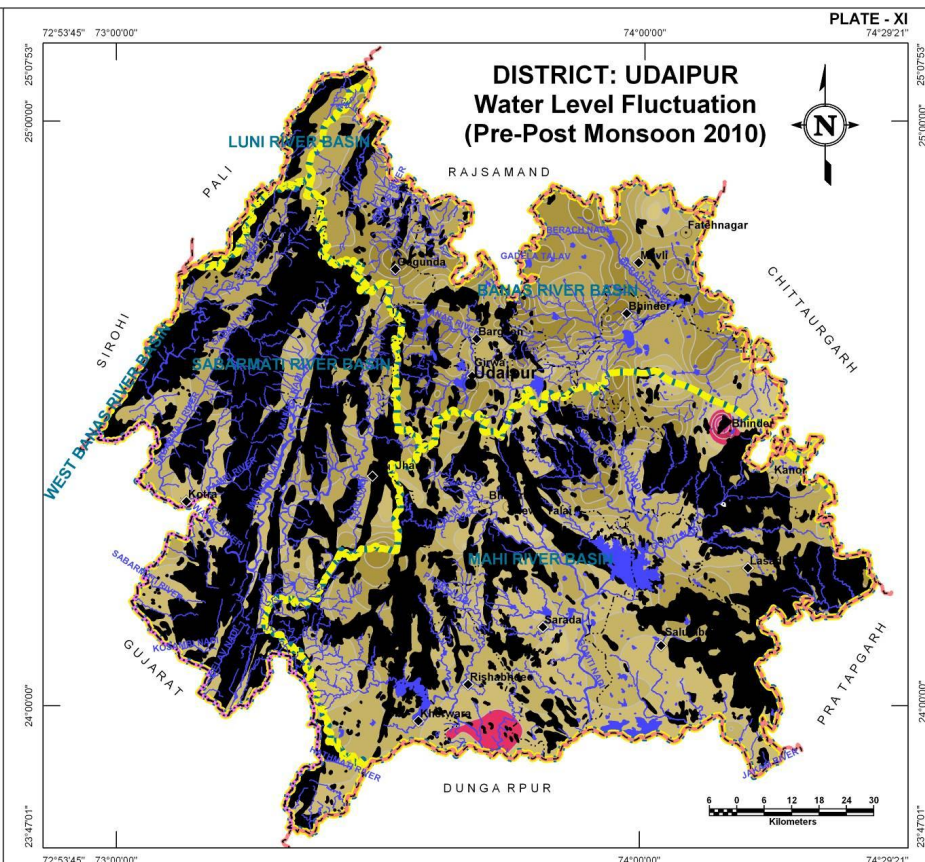
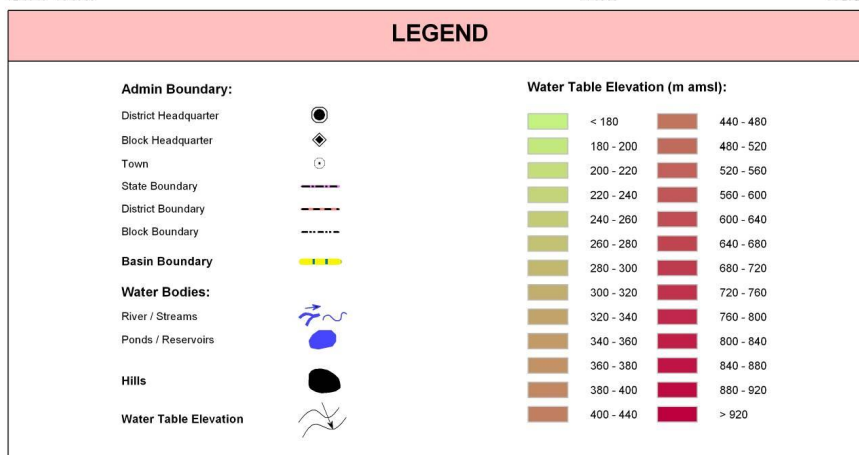
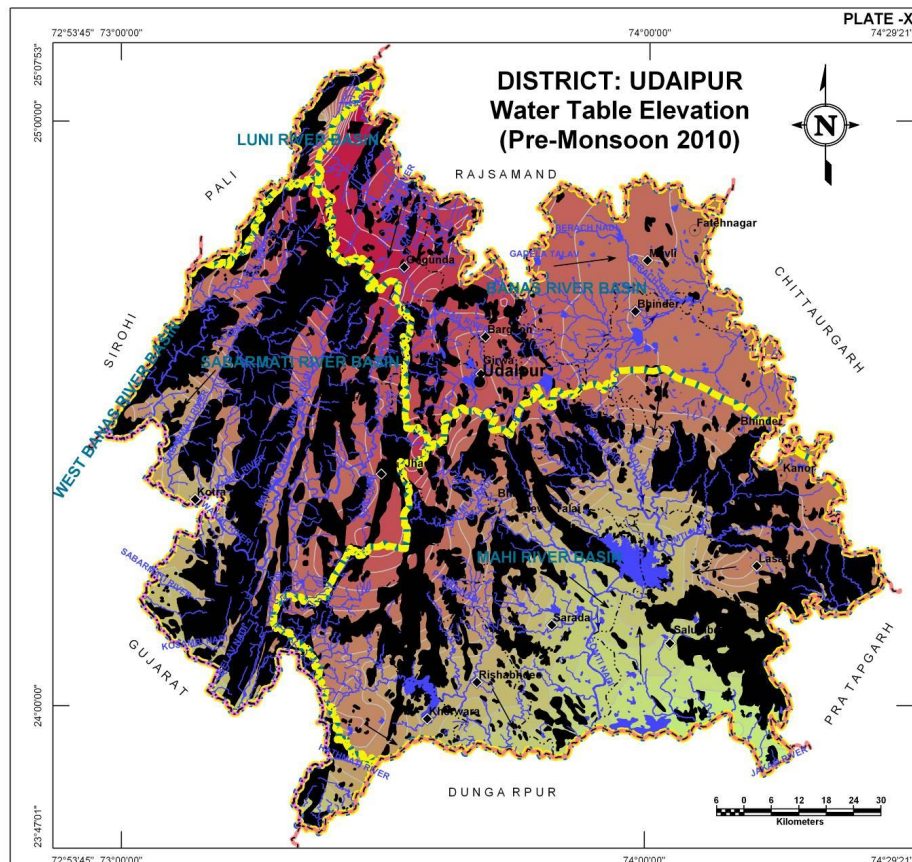
**Table: Block wise area covered in each water table elevation range**

Block Name	Block wise area coverage (sq km) Water table elevation range (m amsl)																					Total Area (sq km)	
	<180	180-200	200-220	220-240	240-260	260-280	280-300	300-320	320-340	340-360	360-380	380-400	400-440	440-480	480-520	520-560	560-600	600-640	640-680	680-720	720-760		760-920
Bargaon	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.6	50.4	73.9	103.3	66.7	27.3	8.2	330.4
Bhinder	-	-	-	-	-	-	-	0.4	3.7	-	8.8	13.0	66.4	610.1	150.3	-	-	-	-	-	-	-	852.7
Girwa	-	-	-	-	-	-	3.2	53.8	68.2	38.3	23.4	30.5	93.9	82.0	94.3	163.5	112.9	69.4	21.8	15.3	11.7	0.9	883.1
Gogunda	-	-	-	-	-	-	-	-	-	1.5	1.3	0.9	2.3	3.0	4.2	5.7	18.7	20.0	33.8	76.8	104.4	326.5	599.1
Jhadol	-	-	-	-	-	10.5	8.2	4.4	3.4	1.0	0.7	9.1	47.3	89.7	183.9	123.5	91.9	59.3	0.2	-	-	-	633.1
Kherwara	-	-	-	2.0	4.9	6.1	26.2	61.1	38.6	56.6	57.0	86.5	96.2	6.0	-	-	-	-	-	-	-	-	441.2
Kotra	-	-	-	-	-	5.0	55.9	80.6	74.4	85.9	50.9	31.5	54.6	39.8	53.4	91.8	49.1	25.3	10.9	3.1	-	6.6	718.8
Lasadiya	-	-	-	-	-	-	-	6.4	10.5	11.2	27.1	46.3	72.2	33.1	-	-	-	-	-	-	-	-	206.8
Mavli	-	-	-	-	-	-	-	-	-	-	-	-	-	236.2	361.3	189.4	30.9	3.0	-	-	-	-	820.8
Rishabhdeo	-	-	-	1.9	37.6	51.2	70.3	85.4	25.7	19.3	17.3	7.7	8.0	10.2	2.6	1.2	-	-	-	-	-	-	338.4
Salumbar	20.5	114.5	155.3	104.2	54.0	35.5	108.7	62.6	21.2	12.9	1.8	-	-	-	-	-	-	-	-	-	-	-	691.2
Sarada	-	-	3.7	120.9	131.9	160.1	127.4	65.4	35.4	34.5	22.1	32.5	33.7	15.4	4.9	-	-	-	-	-	-	-	787.9
Total Area	20.5	114.5	159.0	229.0	228.4	268.4	399.9	420.1	281.1	261.2	210.4	258.0	474.6	1,125.5	854.9	575.7	353.9	250.9	170.0	161.9	143.4	342.2	7,303.5

## WATER LEVEL FLUCTUATION (PRE TO POST MONSOON 2010)

A 2m contour interval adopted to visualize the ground water level fluctuation reveals a fall of 6 m in one area to rise in other areas reaching upto 18m, as seen in Plate – XI. The negative fluctuation areas (indicated by pink and red regions) are the areas where overexploitation is taking place and even after monsoon recharge water level has not risen and has actually gone down with respect to pre-monsoon levels. Such large ground water depletion areas are located in the southernmost part of the district Rishabhdev and in the eastern part near Bhinder. 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 region. Maximum rise of more than 18m is noticed around Malvi area. In general, high recharge indicated by large +ve fluctuation values are in Banas river basin area as compared to other two basins in the district.

Water level fluctuation range (m)	Block wise area coverage (sq km)												Total Area (sq km)
	Bargaon	Bhinder	Girwa	Gogunda	Jhadol	Kherwara	Kotra	Lasadiya	Mavli	Rishabhdeo	Salumbar	Sarada	
-6 to 0	-	26.5	-	-	-	-	-	-	-	60.6	-	4.9	92.0
0 to 2	-	78.4	8.2	-	14.6	3.5	1.0	-	9.7	-	9.5	66.1	191.0
2 to 4	2.4	98.7	124.8	-	110.6	158.7	247.2	11.2	24.8	136.2	359.8	443.2	1,717.6
4 to 6	33.6	109.8	233.2	14.5	203.2	220.6	219.3	50.2	45.1	118.1	195.4	232.7	1,675.7
6 to 8	81.9	197.5	212.1	189.2	177.5	58.4	177.3	115.8	126.1	17.6	85.1	41.0	1,479.5
8 to 10	90.8	142.1	162.2	248.0	71.4	-	73.9	25.5	207.2	5.4	41.4	-	1,067.9
10 to 12	78.4	106.9	98.1	101.8	38.5	-	0.1	4.1	257.7	0.5	-	-	686.1
12 to 14	32.8	67.5	40.1	31.2	17.3	-	-	-	122.0	-	-	-	310.9
14 to 16	10.5	24.4	4.4	11.6	-	-	-	-	24.1	-	-	-	75.0
16 to 18	-	0.9	-	2.8	-	-	-	-	3.4	-	-	-	7.1
> 18	-	-	-	-	-	-	-	-	0.7	-	-	-	0.7
<b>Total</b>	<b>330.4</b>	<b>852.7</b>	<b>883.1</b>	<b>599.1</b>	<b>633.1</b>	<b>441.2</b>	<b>718.8</b>	<b>206.8</b>	<b>820.8</b>	<b>338.4</b>	<b>691.2</b>	<b>787.9</b>	<b>7,303.5</b>



## GROUND WATER ELECTRICAL CONDUCTIVITY DISTRIBUTION

## DISTRICT – UDAIPUR

Average of EC values observed during Pre-Monsoon season between years 2005-09 are plotted and presented in Plate – XII. Yellow coloured region shows EC values (below 2000  $\mu\text{S}/\text{cm}$  at 25°C) occupies major part of Udaipur district which indicates that largely ground water is fresh and suitable for drinking purpose and other uses. Northeastern part of the district in Bhinder and Malvi blocks High EC areas ( $>4000 \mu\text{S}/\text{cm}$  at 25°C) are seen along with small areas near Salumbar and Sarada.

Electrical Conductivity Ranges ( $\mu\text{S}/\text{cm}$ at 25°C) (Ave. of years 2005-09)	Block wise area coverage (sq km)																								Total Area (sq km)
	Bargaon		Bhinder		Girwa		Gogunda		Jhadol		Kherwara		Kotra		Lasadiya		Mavli		Rishabhdeo		Salumbar		Sarada		
	Area	age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
< 2000	312.2	94.5	452.3	53.0	800.8	90.7	599.1	100.0	613.5	96.9	441.2	100.0	718.8	100.0	206.8	100.0	323.4	39.4	338.4	100.0	552.4	79.9	664.6	84.4	6,023.5
2000-4000	18.2	5.5	280.7	32.9	78.5	8.9	-	-	19.6	3.1	-	-	-	-	-	-	458.5	55.9	-	-	134.7	19.5	116.8	14.8	1,107.0
> 4000	-	-	119.7	14.1	3.8	0.4	-	-	-	-	-	-	-	-	-	-	38.9	4.7	-	-	4.1	0.6	6.5	0.8	173.0
Total	330.4	100.0	852.7	100.0	883.1	100.0	599.1	100.0	633.1	100.0	441.2	100.0	718.8	100.0	206.8	100.0	820.8	100.0	338.4	100.0	691.2	100.0	787.9	100.0	7,303.5

## GROUND WATER CHLORIDE DISTRIBUTION

The Plate – XIII shows Chloride distribution in Udaipur district. A perusal reveals that predominantly, chloride concentration in ground water of the district is low ( $<250\text{mg}/\text{l}$ ). Moderate concentration is observed in the northeastern and central parts of the district where the 250- 1000  $\text{mg}/\text{l}$  of chloride is present in ground water (in green colour). Red colour ( $>1000 \text{mg}/\text{l}$  of chloride) areas are unsuitable for drinking purposes. Such areas are seen in Bhinder block and small areas in Mavli, Sarada and Salumbar blocks.

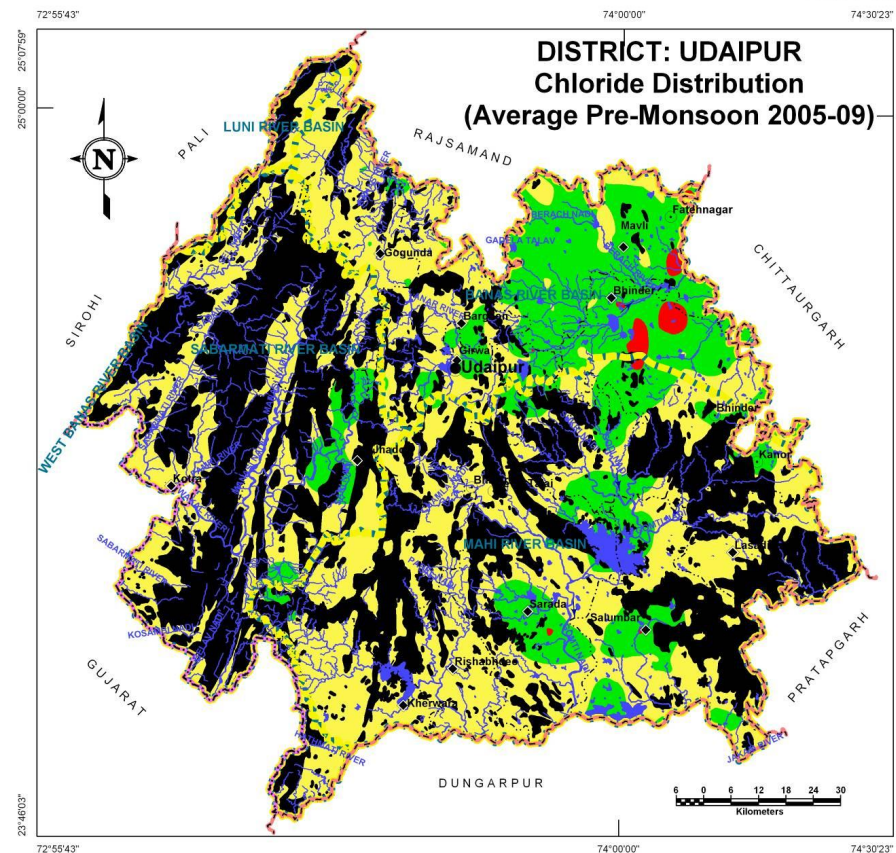
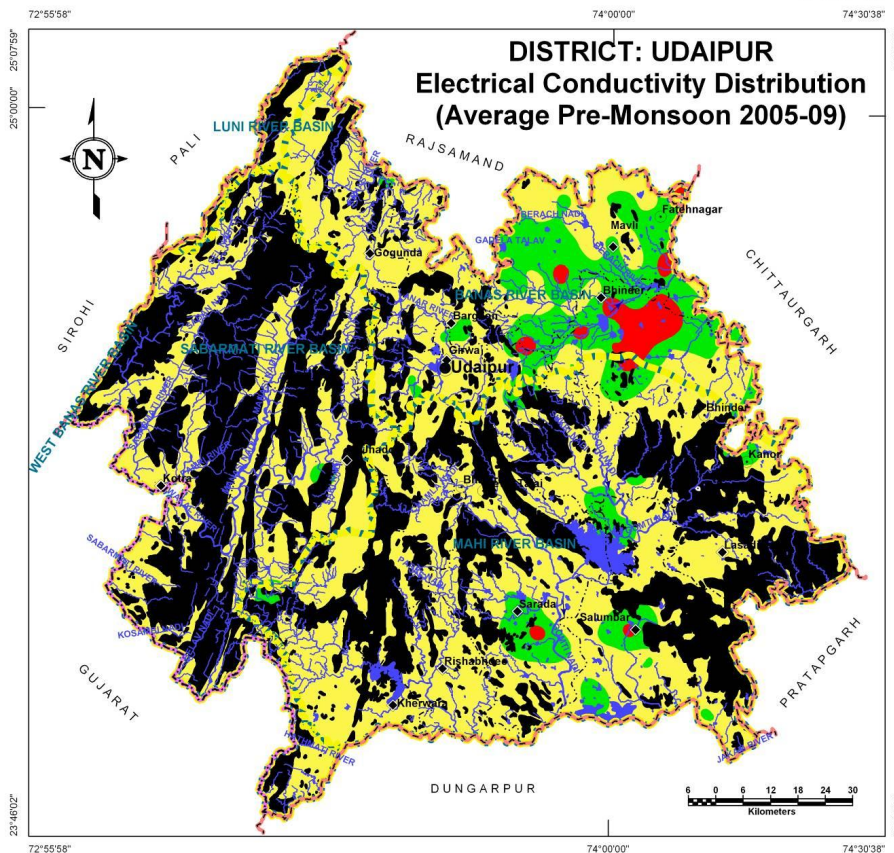
Chloride Concentration Range (mg/l) (Ave. of years 2005-09)	Block wise area coverage (sq km)																							Total Area (sq km)	
	Bargaon		Bhinder		Girwa		Gogunda		Jhadol		Kherwara		Kotra		Lasadiya		Mavli		Rishabhdeo		Salumbar		Sarada		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area		%age
< 250	286.3	86.6	292.3	34.3	590.3	66.8	593.9	99.1	485.5	76.7	438.8	99.5	718.8	100.0	206.8	100.0	97.0	11.8	338.4	100.0	442.2	64.0	553.0	70.2	5,043.3
250-1000	44.1	13.4	508.8	59.7	292.6	33.2	5.2	0.9	147.6	23.3	2.4	0.5	-	-	-	-	704.7	85.9	-	-	248.2	35.9	233.6	29.6	2,187.2
> 1000	-	-	51.6	6.1	0.2	-	-	-	-	-	-	-	-	-	-	-	19.1	2.3	-	-	0.8	0.1	1.3	0.2	73.0
Total	330.4	100.0	852.7	100.1	883.1	100.0	599.1	100.0	633.1	100.0	441.2	100.0	718.8	100.0	206.8	100.0	820.8	100.0	338.4	100.0	691.2	100.0	787.9	100.0	7,303.5





PLATE - XII

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

**Electrical Conductivity ( $\mu\text{S}/\text{cm}$  at  $25^\circ\text{C}$ ):**

- < 2000
- 2000-4000
- > 4000

**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 – UDAIPUR

Most part of the district has low Fluoride concentration in ground water that is below 1.5 mg/l. There are very few localized pockets in which high concentration i.e., more than 3mg/l was recorded which fall within Bhinder and Sarada blocks. There are narrow patches in between these two high and low concentration areas where the concentration is moderate (1.5-3 mg/l) and these fall within the Kherwara, Sarada, Salumbar and Bhinder blocks of the district.

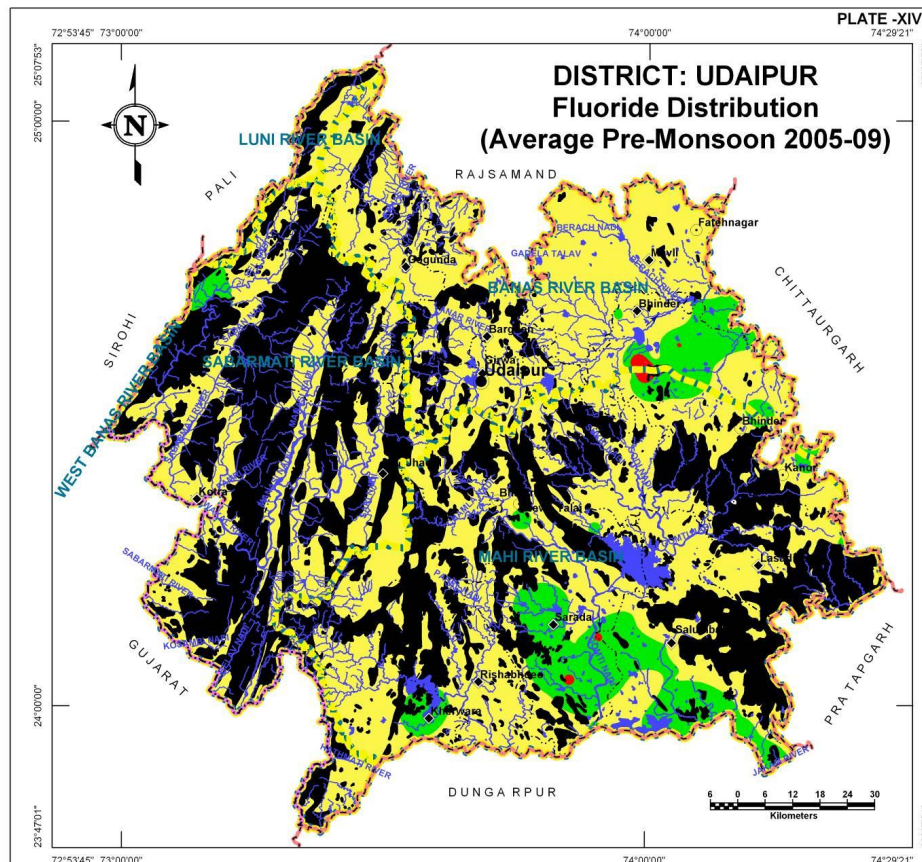
Fluoride concentration range (mg/l) (Ave. of years 2005-09)	Block wise area coverage (sq km)																								Total Area (sq km)
	Bargaon		Bhinder		Girwa		Gogunda		Jhadol		Kherwara		Kotra		Lasadiya		Mavli		Rishabhdeo		Salumbar		Sarada		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
< 1.5	330.4	100.0	591.7	69.4	883.1	100.0	599.1	100.0	633.1	100.0	391.7	88.8	681.1	94.7	204.0	98.6	773.5	94.2	335.0	99.0	438.1	63.4	494.6	62.8	6,355.4
1.5-3.0	-	-	245.4	28.8	-	-	-	-	-	-	49.5	11.2	37.7	5.3	2.8	1.4	44.9	5.5	3.4	1.0	250.9	36.3	290.0	36.8	924.6
> 3.0	-	-	15.6	1.8	-	-	-	-	-	-	-	-	-	-	-	-	2.4	0.3	-	-	2.2	0.3	3.3	0.4	23.5
Total	330.4	100.0	852.7	100.0	883.1	100.0	599.1	100.0	633.1	100.0	441.2	100.0	718.8	100.0	206.8	100.0	820.8	100.0	338.4	100.0	691.2	100.0	787.9	100.0	7,303.5

## GROUND WATER NITRATE DISTRIBUTION

Apart from some localized pockets in the western parts, most of the western and central part of the district has low Nitrate concentration (<50 mg/l) in ground water and some areas with moderate concentration (50-100 mg/l). The eastern part predominantly has very high concentration of Nitrate as indicated by red coloured regions in Plate – XV. Rishabhdeo and Kherwara are the two blocks in which > 90% of the area sows high Nitrate concentration whereas, Malvi block has highest area falling within low Nitrate concentration zone.

Nitrate concentration Range (mg/l) (Ave. of years 2005-09)	Block wise area coverage (sq km)																								Total Area (sq km)
	Bargaon		Bhinder		Girwa		Gogunda		Jhadol		Kherwara		Kotra		Lasadiya		Mavli		Rishabhdeo		Salumbar		Sarada		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
< 50	79.2	24.0	171.5	20.1	205.8	23.3	183.9	30.7	191.3	30.2	44.2	10.0	235.3	32.4	45.2	22.0	313.8	38.2	7.8	2.3	195.2	28.3	284.2	36.1	1,957.4
50-100	0.6	0.2	658.2	77.2	186.8	21.2	44.9	7.5	27.7	4.4	-	-	34.7	4.9	139.6	67.3	409.7	49.9	-	-	305.9	44.2	126.8	16.1	1,934.9
> 100	250.6	75.8	23.0	2.7	490.5	55.5	370.3	61.8	414.1	65.4	397.0	90.0	448.8	62.7	22.0	10.7	97.3	11.9	330.6	97.7	190.1	27.5	376.9	47.8	3,411.2
Total	330.4	100.0	852.7	100.0	883.1	100.0	599.1	100.0	633.1	100.0	441.2	100.0	718.8	100.0	206.8	100.0	820.8	100.0	338.4	100.0	691.2	100.0	787.9	100.0	7,303.5





### LEGEND

#### Admin Boundary:

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

#### Basin Boundary

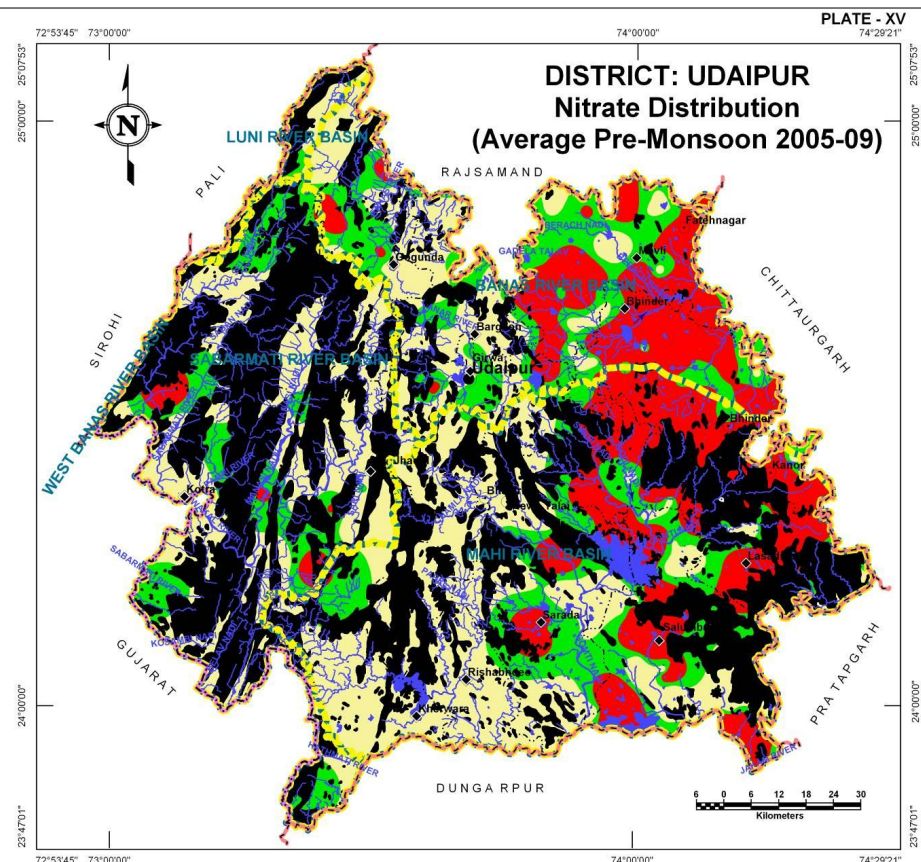
#### Water Bodies:

- River / Streams
- Ponds / Reservoirs

#### Hills

#### Fluoride Concentration(mg/l):

- < 1.5
- 1.5-3.0
- > 3.0



### 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 – UDAIPUR

Depth to bedrock map of Udaipur district (Plate – XVI) reveals wide variation of more than 100m below ground level reaching a maximum depth of more than 100m in the eastern, southern and northern part of the district. Areas around Gogunda, Girwa, Mavli, Rishabhdeo and along the tri-junction of Sarada, Salumbar and Udaipur blocks indicate the occurrence of bedrock at very deep levels. In the northeastern part in Bhinder block and around Gogunda in the northwest, moderately deep bedrock depths are encountered. Shallow bedrock depth is mostly found in northwestern part (of Gogunda block), southwestern part (in Kotra block), south of Udaipur extending upto middle of Salumbar block through Sarada; and around Fatehnagar.

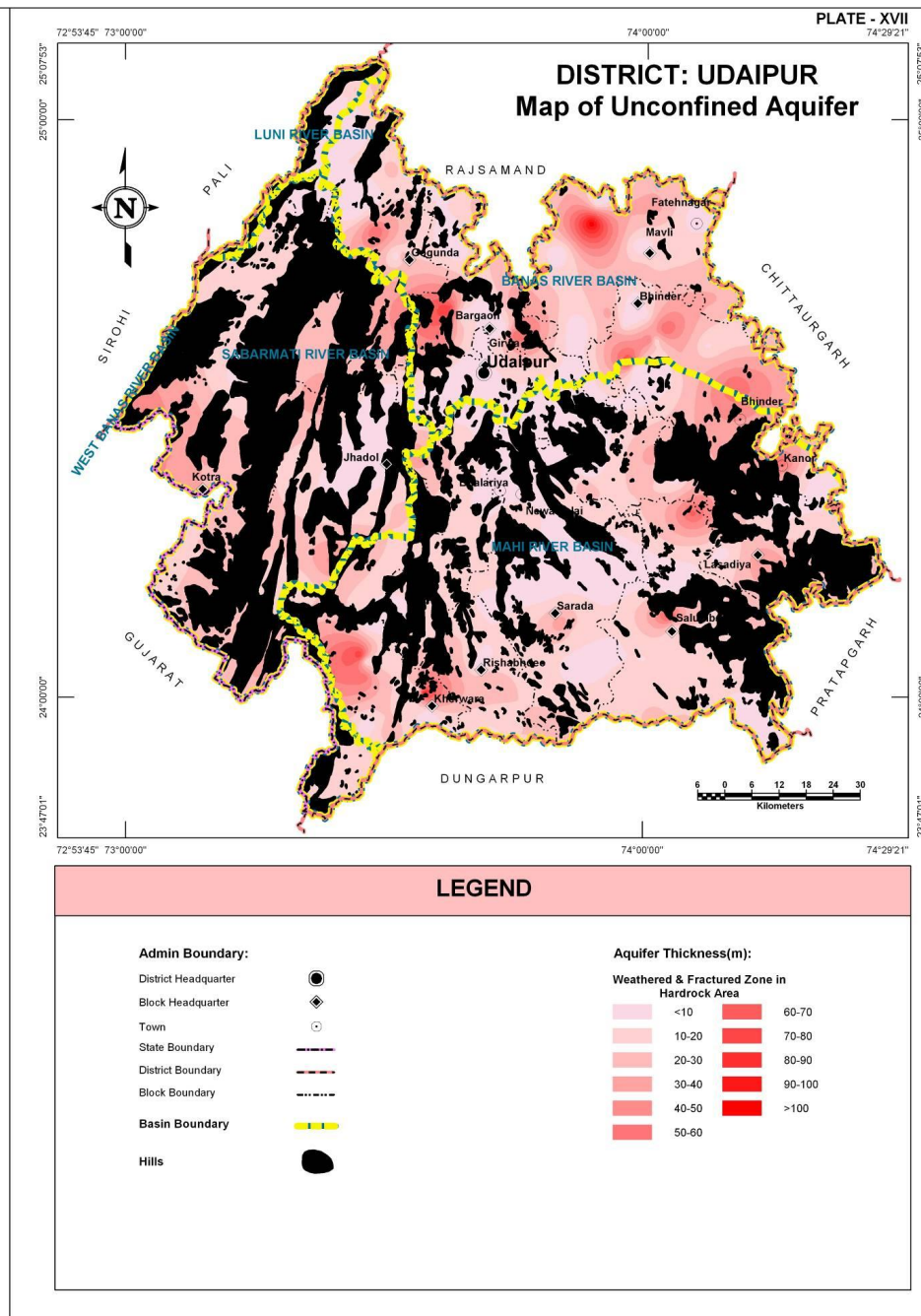
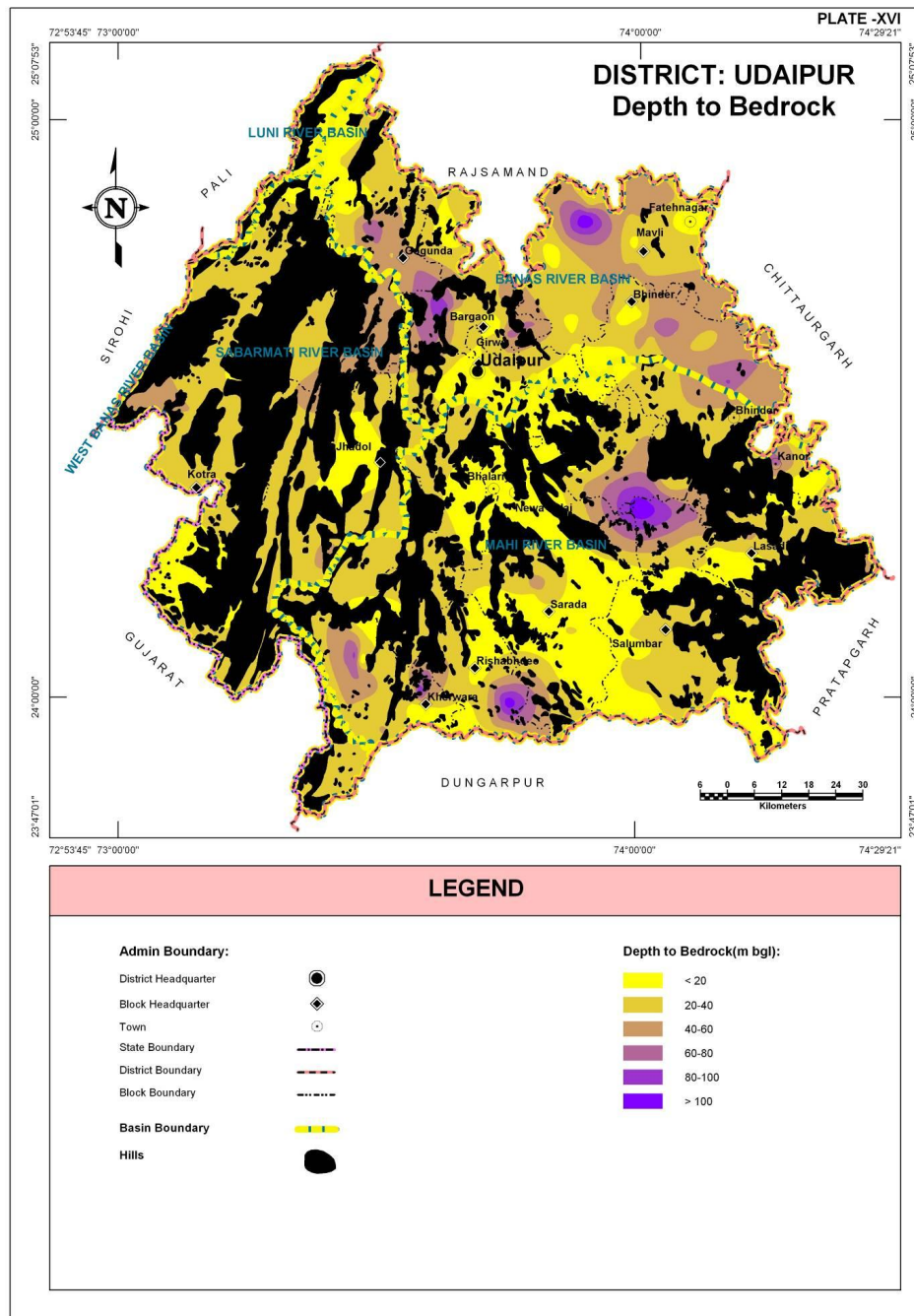
Depth to bedrock range (m bgl)	Block wise area coverage (sq km)																						Total Area (sq km)		
	Bargaon		Bhinder		Girwa		Gogunda		Jhadol		Kherwara		Kotra		Lasadiya		Mavli		Rishabhdeo		Salumbar			Sarada	
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age		Area	%age
< 20	92.9	28.1	-	-	28.6	3.2	286.3	47.8	105.1	16.6	-	-	130.5	18.2	-	-	242.1	29.5	-	-	-	-	-	-	885.5
20-40	237.5	71.9	155.7	18.1	429.0	48.6	312.8	52.2	409.6	64.7	14.0	3.1	552.6	76.8	-	-	518.5	63.2	52.2	15.4	49.1	7.1	160.6	20.4	2,891.6
40-60	-	-	515.8	60.5	141.9	16.1	-	-	116.5	18.4	148.6	33.8	35.7	5.0	62.2	29.9	60.2	7.3	103.5	30.6	265.0	38.4	274.3	34.8	1,723.7
60-80	-	-	167.8	19.8	200.4	22.7	-	-	1.9	0.3	264.3	59.9	-	-	40.6	19.7	-	-	79.8	23.6	142.0	20.5	217.8	27.6	1,114.6
80-100	-	-	12.7	1.5	78.1	8.8	-	-	-	-	14.3	3.2	-	-	79.2	38.4	-	-	82.4	24.3	116.5	16.8	113.2	14.4	496.4
> 100	-	-	0.7	0.1	5.1	0.6	-	-	-	-	-	-	-	-	24.8	12.0	-	-	20.5	6.1	118.6	17.2	22.0	2.8	191.7
Total	330.4	100.0	852.7	100.0	883.1	100.0	599.1	100.0	633.1	100.0	441.2	100.0	718.8	100.0	206.8	100.0	820.8	100.0	338.4	100.0	691.2	100.0	787.9	100.0	7,303.5

## 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. The northeastern part has very thick zones especially in Mavli, and Bhinder blocks and occasionally in Bargaon, Kherwara blocks. Rest of the blocks have moderate to low thickness of aquifers in hardrock. Sarada and Salumbar blocks have generally low thickness of unconfined aquifers in hardrocks.

Unconfined aquifer Thickness (m)	Block wise area coverage (sq km)												Total Area (sq km)
	Bargaon	Bhinder	Girwa	Gogunda	Jhadol	Kherwara	Kotra	Lasadiya	Mavli	Rishabhdeo	Salumbar	Sarada	
<10	92.2	120.7	343.8	194.8	135.9	30.9	14.3	24.3	86.5	41.4	119.3	394.6	1,598.7
10-20	107	161.6	347.6	148.5	243.8	181.5	296.2	87.5	243.7	183.2	407.4	328.3	2,736.3
20-30	59.1	194	148.4	125.4	208.1	78.4	283.6	58.9	314.8	97.6	104.5	59.3	1,732.1
30-40	21.2	227.2	35.5	88.2	44.9	47	100.4	26.7	101.8	11.1	31.2	5.7	740.9
40-50	16.8	110.9	7.8	35.3	0.4	44.9	24.3	7.5	27.9	5.1	18.6	-	299.5
50-60	19.8	35.2	0	6.9	-	43.9	-	1.9	17.8	0	9.2	-	134.7
60-70	9.8	2.9	-	-	-	12.1	-	-	11.9	-	1.0	-	37.7
70-80	4.5	0.2	-	-	-	2.1	-	-	8.2	-	-	-	15.0
80-90	-	-	-	-	-	0.4	-	-	4.9	-	-	-	5.3
90-100	-	-	-	-	-	-	-	-	2.6	-	-	-	2.6
> 100	-	-	-	-	-	-	-	-	0.7	-	-	-	0.7
<b>Total</b>	<b>330.4</b>	<b>852.7</b>	<b>883.1</b>	<b>599.1</b>	<b>633.1</b>	<b>441.2</b>	<b>718.8</b>	<b>206.8</b>	<b>820.8</b>	<b>338.4</b>	<b>691.2</b>	<b>787.9</b>	<b>7,303.5</b>



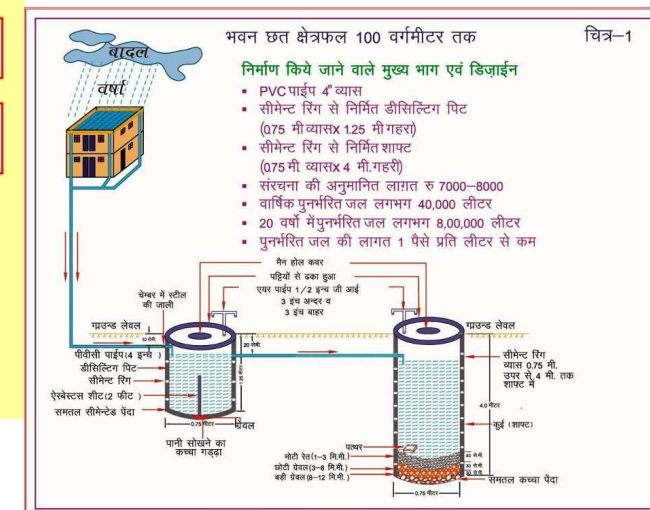
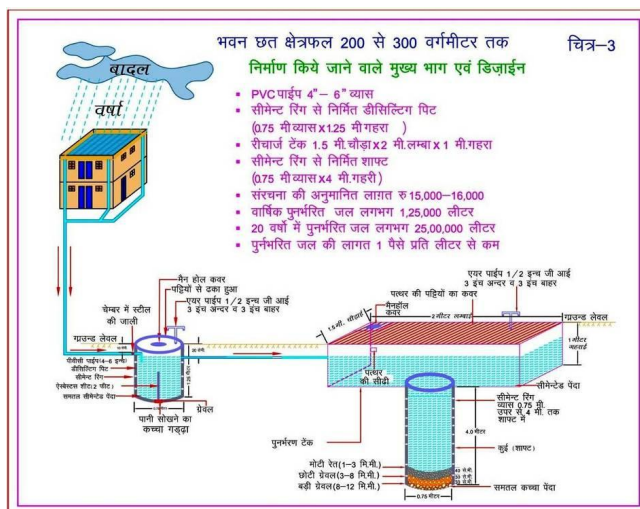
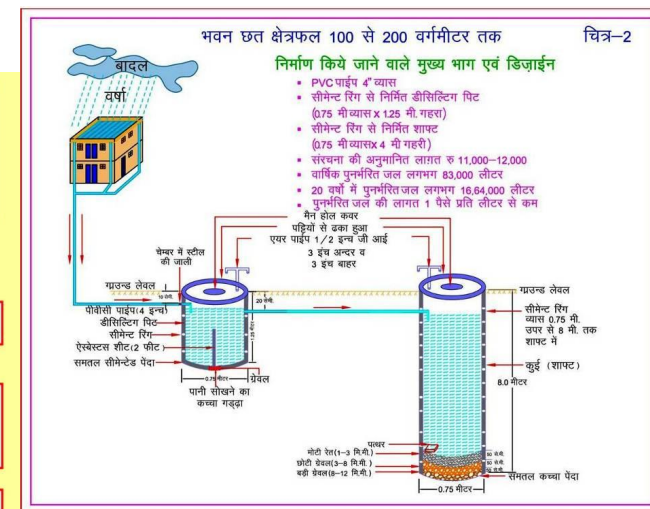
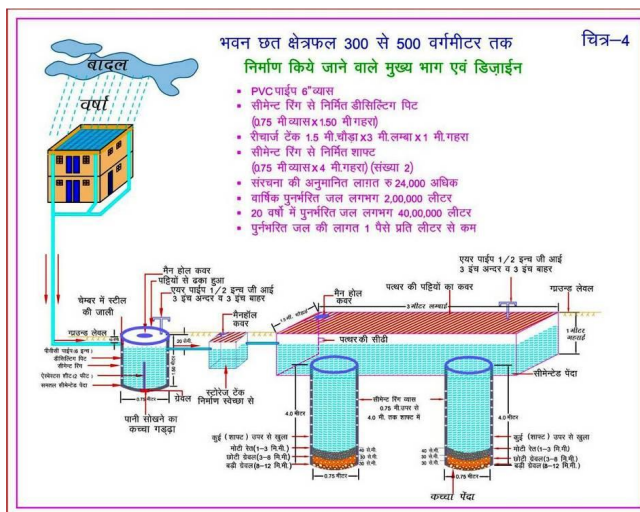
## Glossary of terms

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 ground water 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	GROUND WATER 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 ground water 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 it's complete saturation.
28	TOTAL DISSOLVED SOLIDS	Total weight of dissolved mineral constituents in water per unit volume (or weight) of water in the sample.

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

(Contd...)





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

### बोरोन-स्नायु तन्त्र पर प्रभाव

फ्लोराइड - दंत क्षरण

क्लोराइड-सोडियम के साथ

सोडियम-हृदय, गुर्दा व रक्त  
परिसंचरण रोगों से  
ग्रसित लोगों को हानिकारक

### कैल्शियम-जोड़ों में कड़ापन

नाइट्रेट-नवजात शिशुओं में  
ब्लू बेबी बीमारी  
(मेथेमोग्लोबिनिमिया)

आर्सेनिक-त्वचा रोग, कैंसर

सल्फेट-अधिकता में मैग्नेशियम के साथ मिलकर दस्तावर

लेड-बच्चों के शारीरिक  
व मानसिक विकास में बाधा  
वयस्कों में गर्दे के रोग

आयरन-आयरन जीवाणु से  
आमाशय संबंधी रोग

फ्लोराइड-जोड़ों में अकड़न,  
हड्डियों में मृदाव



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**भूजल अमूल्य है इसे प्रदूषित न करें।**





### Myths and Facts about Ground Water

S No	Myths	Facts
1	What is Ground Water <ul style="list-style-type: none"><li>• an underground lake</li><li>• a net work of underground rivers</li><li>• a bowl filled with water</li></ul>	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 adjoining 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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