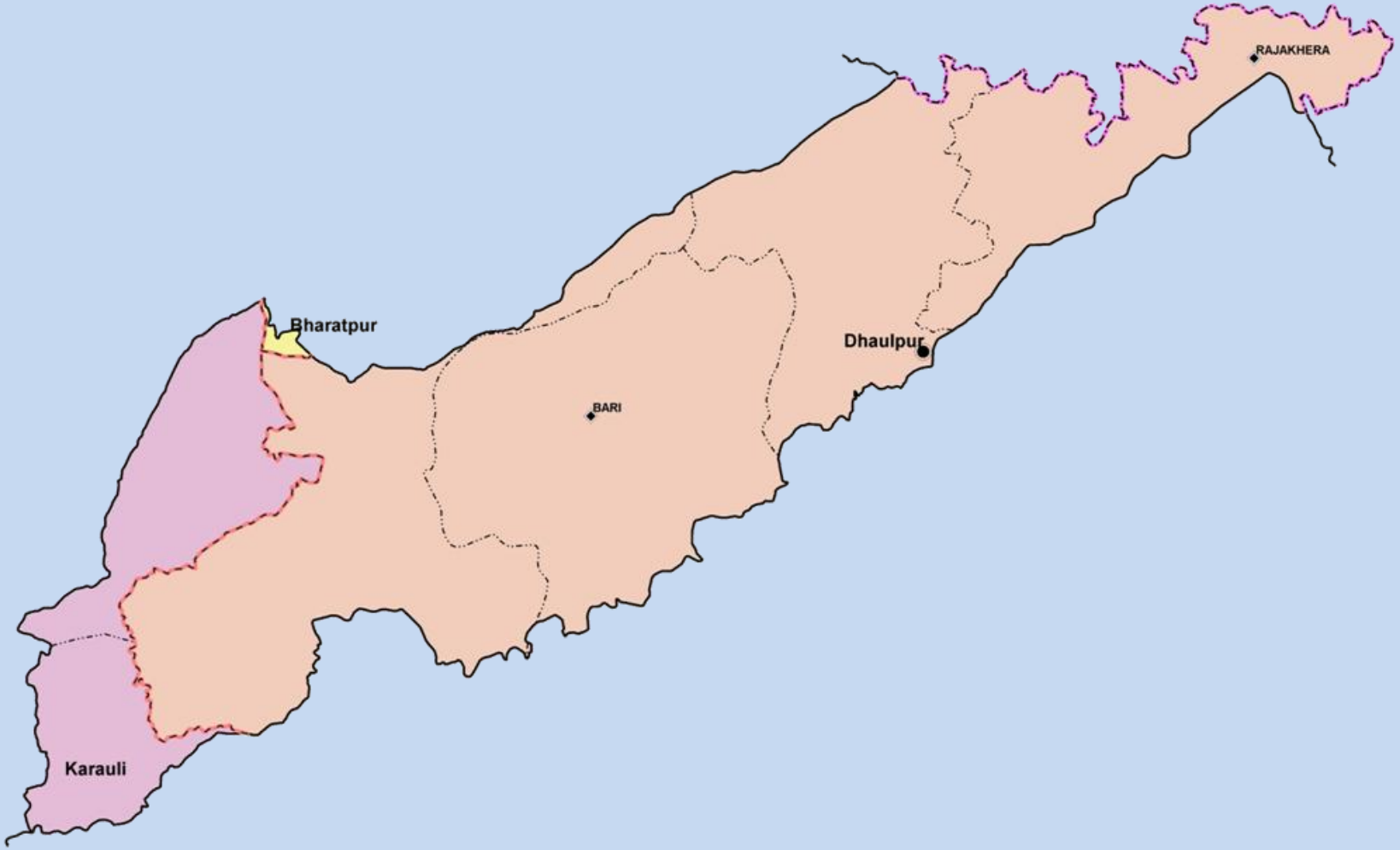
Ground Water Department,
Rajasthan

European Union
State Partnership Programme

Hydrogeological Atlas of Rajasthan

Parbati River Basin



2013

ROLTA
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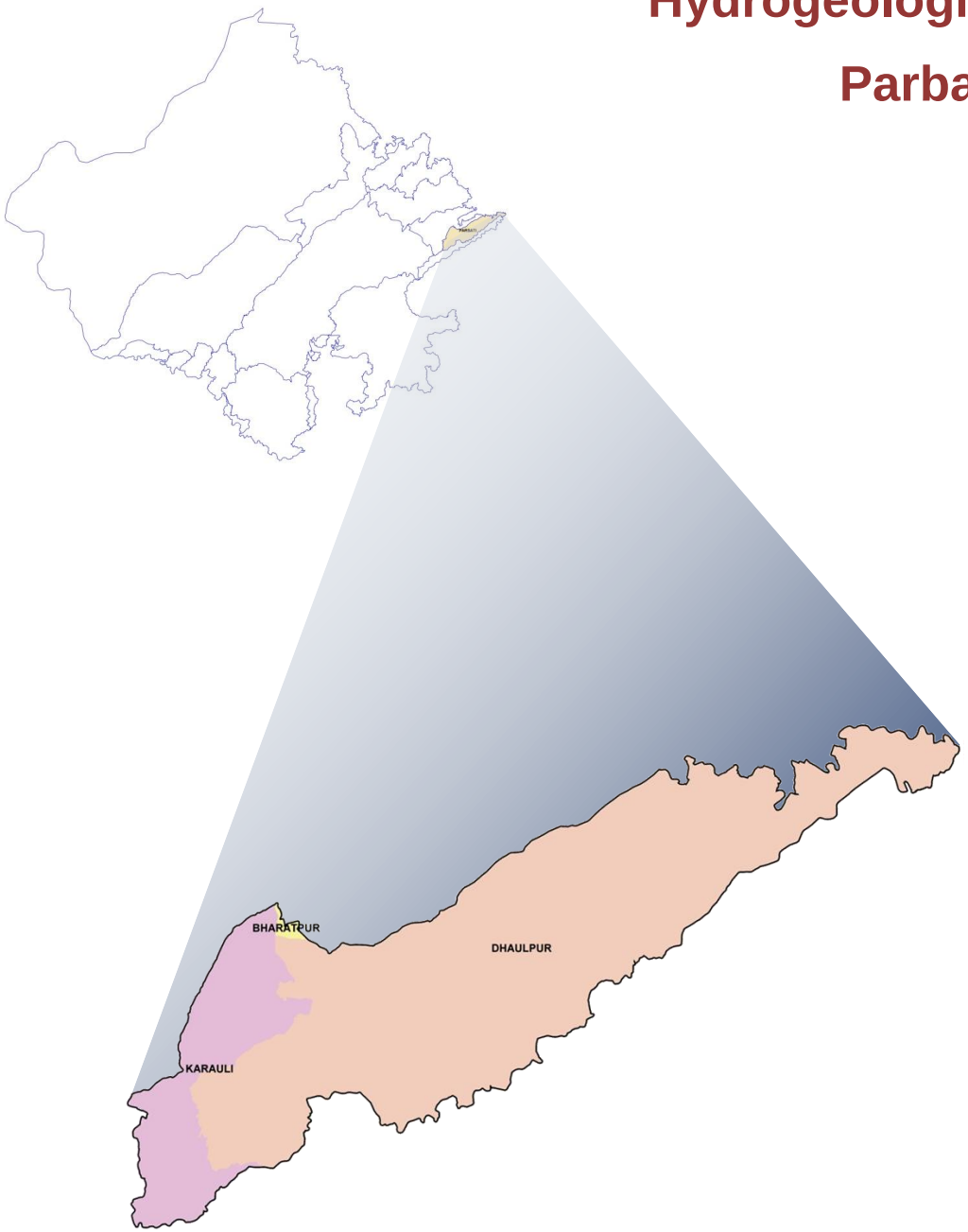
Hydrogeological Atlas of Rajasthan

Parbati River Basin



Contents:

2013

ADMINISTRATIVE SETUP

PARBATI RIVER BASIN

Location:

The Parbati River Basin is located in the eastern part of Rajasthan. It stretches between 26° 20' 29.76" to 26° 58' 05.87" North latitude and 77° 08' 33.59'' to 78° 16' 27.33'' East longitudes. The basin extends in NE-SW direction and is bounded by the Gambhir River Basins in the northwest side and the Chambal River Basin in the southeast. The basin extends over parts of Bharatpur, Dhaulpur and Karauli Districts. The total catchment area of the Basin is 2,266.2 km^2.

River Parbati originates in the hills in Karauli district close to Sawai Madhopur District border. It flows in a generally northeast direction for about 123 km before joining Gambhir River near Kharagpur village in Dhaulpur District. The main tributaries of the river are Sairni on the left side, and Bamni, Mendka on the right side.

Administrative Set-up:

Administratively, Parbati River Basin extends over parts of Bharatpur, Dhaulpur and Karauli districts encompassing 7 Blocks divided into 584 towns and villages. While the basin has very small contribution from Bharatpur district, the largest part of basin contributor is Dhaulpur district which contributes approximately 83% of its whole area.

S. No.	District Name	Area (sq km)	% of Basin Area	Total Number of Blocks	Total Number of Towns and Villages
1	Bharatpur	7.1	0.3	1	**1**
2	Dhaulpur	1,873.8	82.7	4	**549**
3	Karauli	385.3	17.0	2	**34**
	Total	**2,266.2**	**100.0**	**7**	**584**

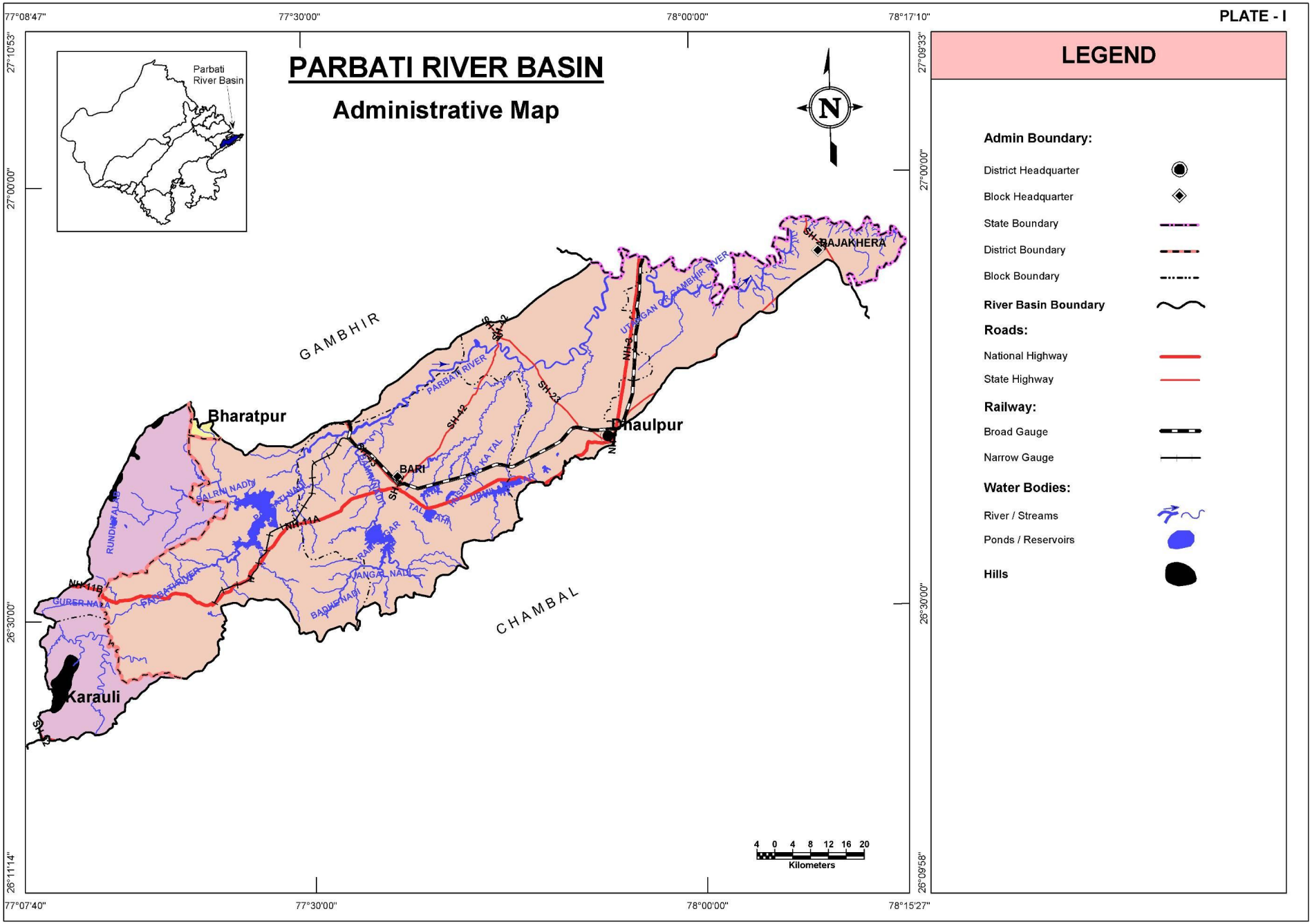
Climate:

The basin is located on the eastern fringe of Rajasthan in close proximity to Uttar Pradesh and Madhya Pradesh. It falls within the semi-arid to sub-humid regions but witnesses extreme temperatures during the hottest months which are May and June. Coldest months are December and January where temperatures sometimes reach near-zero and subzero levels. In some years, the winters and summers (recorded -4.3°C in Jan 1990 and 50°C in June 1995 respectively) cross the extremes and record such unusually high and low temperatures. The rain are mostly received during monsoon season i.e., from July through September, and mean annual rainfall over the Parbati Basin was computed as 638 mm.

Ground Water Department, Rajasthan

European Union
State Partnership Programme

PLATE - I



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TOPOGRAPHY

PARBATI RIVER BASIN

The western part is hilly which is the area where the Parbati river originates, and then the topography slopes towards northeast. The hills mostly belong to the Aravali ridges and have a southwest – northeast trend and the river flowing in the intervening valleys also follows the same trend till it drains out of the basin and enters Uttar Pradesh eventually to join the Yamuna river. The elevation ranges from a minimum of 135m in Dhaulpur district to a maximum of about 379m in Karauli district. The undulating plains between Bari and Rajkhera often show the development of ravines especially when closer to Uttar Pradesh border.

Table: District wise minimum and maximum elevation

S. No.	District Name	Min Elevation (m amsl)	Max. Elevation (m amsl)
1	Bharatpur	277.0	325.4
2	Dhaulpur	135.4	340.5
3	Karauli	221.1	378.7

RAINFALL

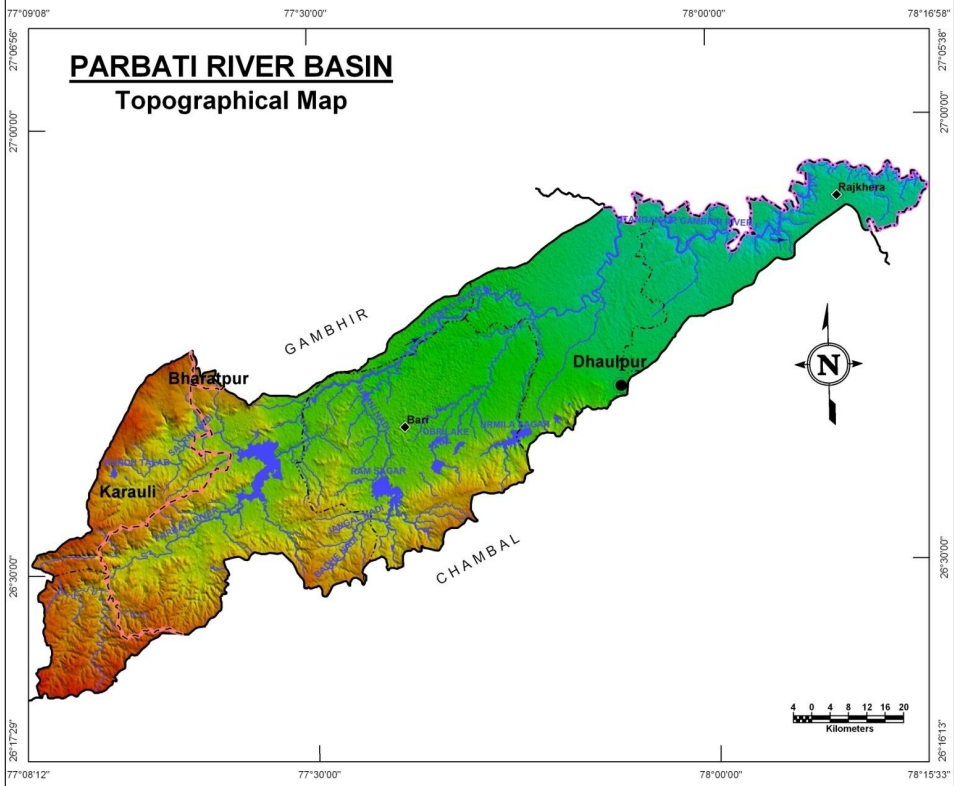
The general distribution of rainfall across the Parbati River Basin can be visualized from isohyets presented in the Plate III where the western part receives lesser rainfall (minimum total annual rainfall of 712mm) which seem to increase gradually towards east where it reaches a high of upto 975mm. The average annual rainfall computed based on available station data is about 829 mm. The rainfall data for available rain gauge stations is presented below.

Table: District wise total annual rainfall (based on year 2010 meteorological station recordings (http://waterresources.rajasthan.gov.in)

S. No.	Rain gauge Stations	Total Monsoon Rainfall (mm)	Total Non-Monsoon Rainfall (mm)	Total Annual Rainfall (mm)
1	Bari	600.0	112.0	712.0
2	Dholpur	895.0	80.5	975.5
3	Rajakhera	742.0	56.0	798.0

PLATE - II

PARBATI RIVER BASIN
Topographical Map



LEGEND

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

River Basin Boundary

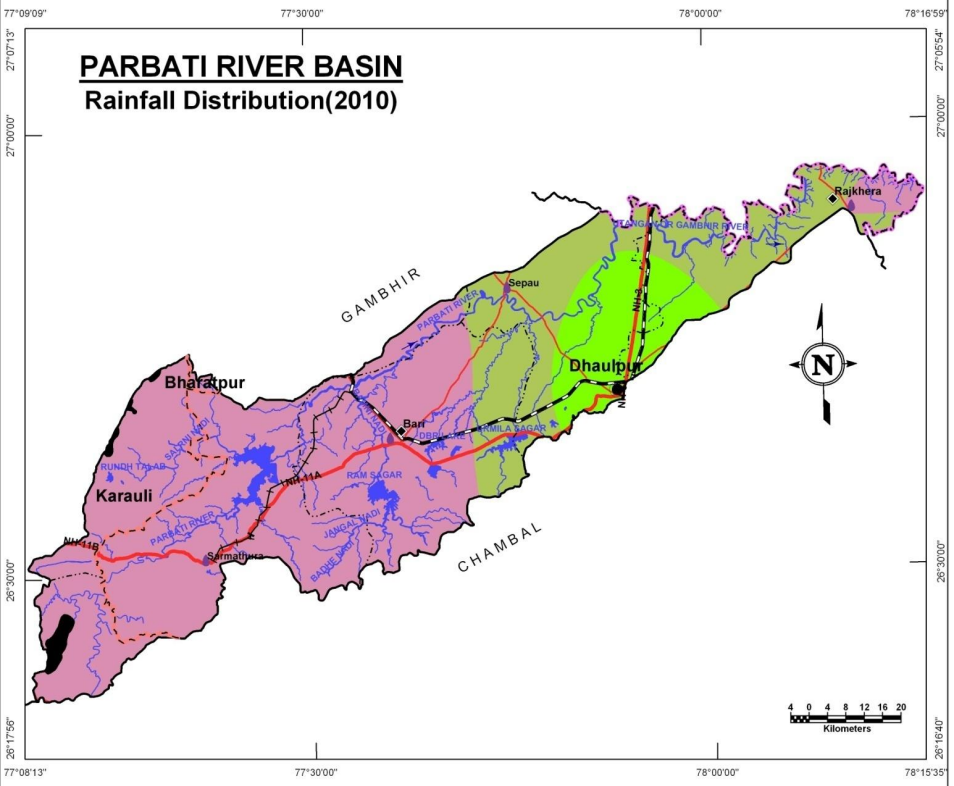
Water Bodies:
- River / Streams
- Ponds / Reservoirs

Elevation(m amsl):
380 m
350 m
300 m
250 m
200 m
150 m
137 m

Source : SRTM DEM

PLATE - III

PARBATI RIVER BASIN
Rainfall Distribution(2010)



LEGEND

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

River Basin Boundary

Railway:
- Broad Gauge
- Narrow Gauge

Roads:
- National Highway
- State Highway

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Hills

Isohyets(mm):
- 700-800
- 800-900
- > 900

GEOLOGY

PARBATI RIVER BASIN

The area covered by the basin is very small (<2300 sq km) so geologic variation in the basin is also very limited. The Vindhyans (Sandstones, Shales and Limestones) represent older rocks in the area whereas the older alluvium represents youngest geologic formations in the area consisting of clay, sand and gravel with kankar.

Age	Super-Group	Group/ Formation	Rock Types
Holocene Pleistocene	----	Older Alluvium	Wind-blown sand and fluvial deposits, alluvial clay, silt, with clay, sand and sand and gravel with kankars
----------x----------x ----------Unconformity----------x----------x----------			
Upper Proterozoic	Vindhyan	Bhander (Upper)	Sandstone, Shale and Limestone

GEOMORPHOLOGY

Origin	Landform Unit	Description
Denudational	Burried 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.
	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	Dissected Plateau	Plateau, criss-crossed by fractures forming deep valleys.
	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

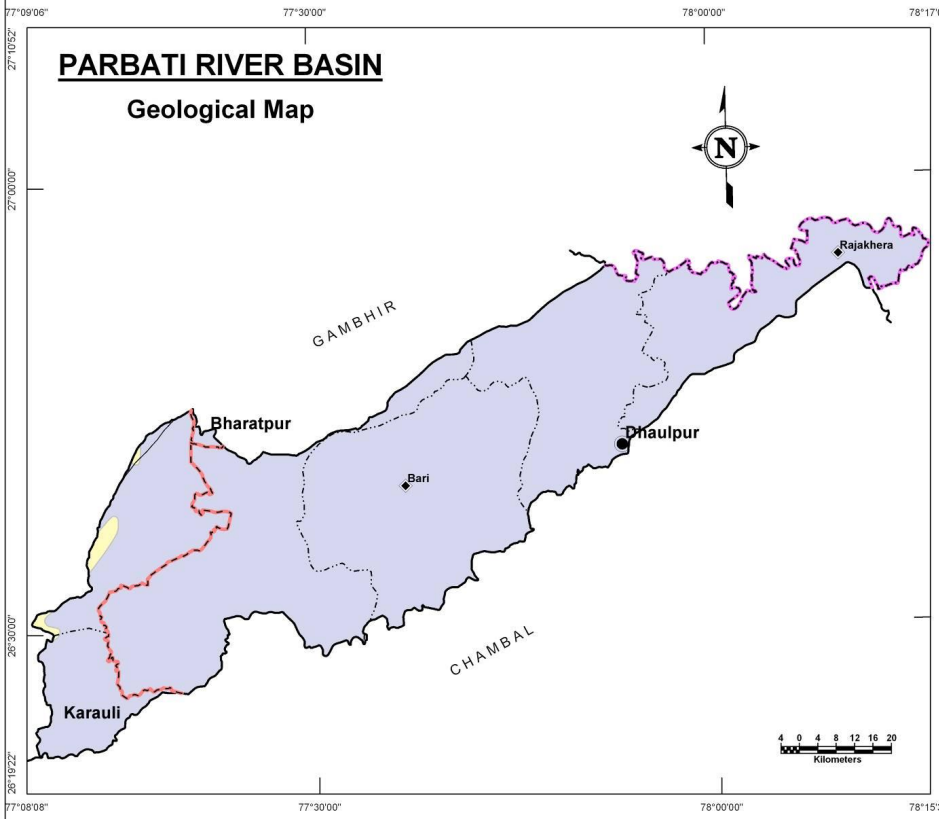
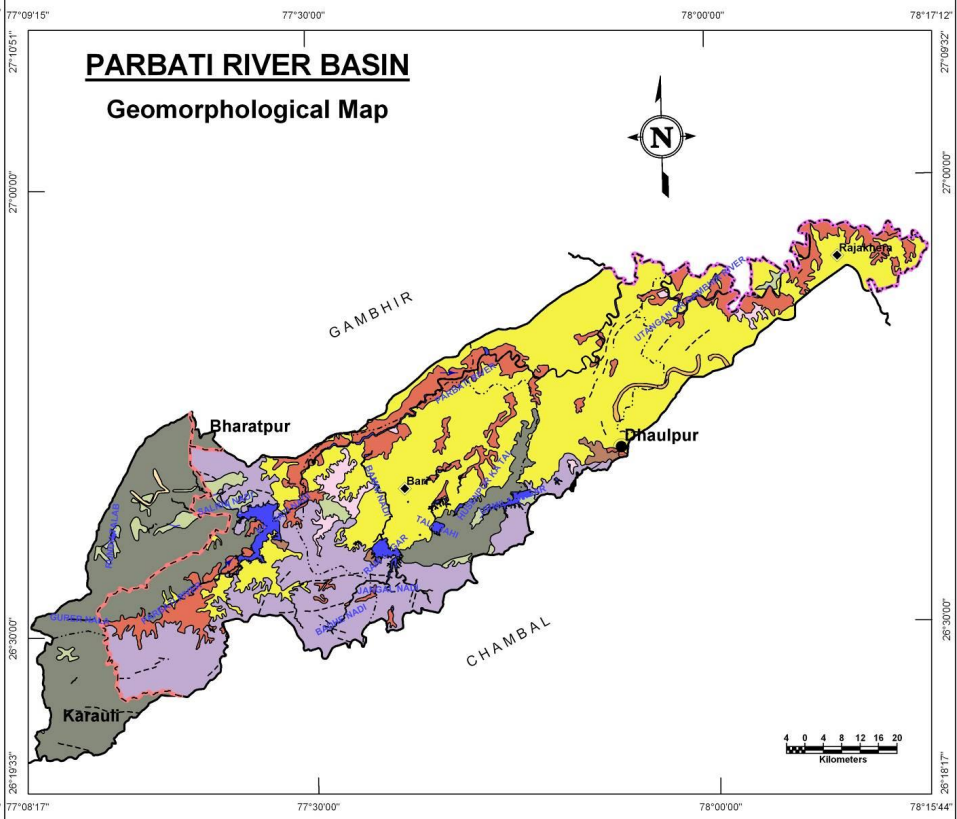


PLATE - V



LEGEND

Admin Boundary:

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

River Basin Boundary

Structural Features:

- Great Boundary Fault

Geology:

- Alluvium and Wind blown sand
- Bhander Group

Source : District Resource Map of Rajasthan - GSI

LEGEND

Admin Boundary:

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

River 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)
- Palaeochannel
- Ravine
- Valley Fill

Denudational Origin:

- Pediment
- Burried Pediment

Structural Origin:

- Dissected Plateau
- Plateau

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

AQUIFERS

PARBATI RIVER BASIN

Surface cover is mostly the alluvium but interestingly, when it comes to aquifers, it is the Vindhyan Sandstone which occupies about 63% of the aquifer area in the basin followed by Older Alluvium (37%).

Aquifer in Potential Zone	Area (sq km)	% of Basin Area	Description of the unit/Occurrence
Older Alluvium	829.0	36.6	This litho unit comprises of mixture of heterogeneous fine to medium grained sand, silt and kankar.
Vindhyan Sandstone	1,420.3	62.7	Fine to medium grained, red colour and compact and at places.
Non Potential Zone	16.9	0.7	(Hills
Total	**2,266.2**	**100.0**	

LOCATION OF GROUND WATER MONITORING WELLS

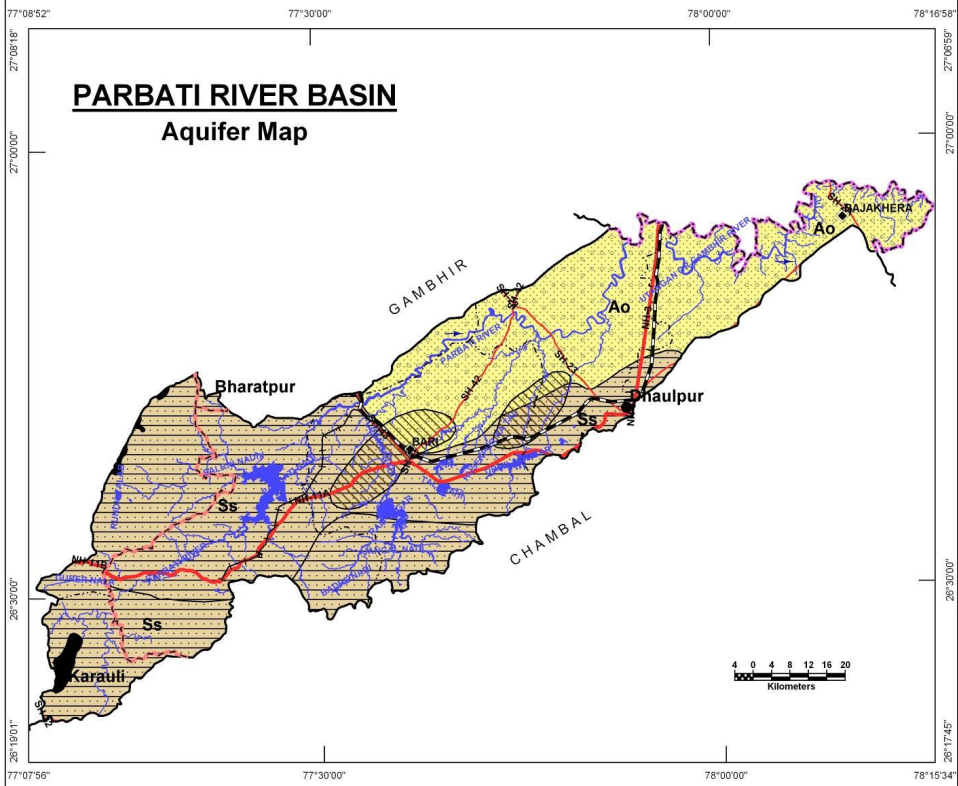
The basin has a well distributed network of large number of ground water monitoring stations (86) in the basin owned by RGWD (74) and CGWB (12); and an additional 38 wells have been recommended to be added to network to effectively monitor ground water quality (34 additional wells) and water level (4 additional wells) in the basin.

District Name	CGWB	RGWD	Total	Recommended additional wells for optimization of monitoring network	
				Water Level	Water Quality
Bharatpur	-	-	-	-	-
Dhaulpur	12	74	86	4	33
Karauli	-	-	-	-	1
Total	**12**	**74**	**86**	**4**	**34**

PLATE - VI

PARBATI RIVER BASIN

Aquifer Map



LEGEND

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

River Basin Boundary

Roads:
- National Highway
- State Highway

Railway:
- Broad Gauge
- Narrow Gauge

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Hills

Command Area

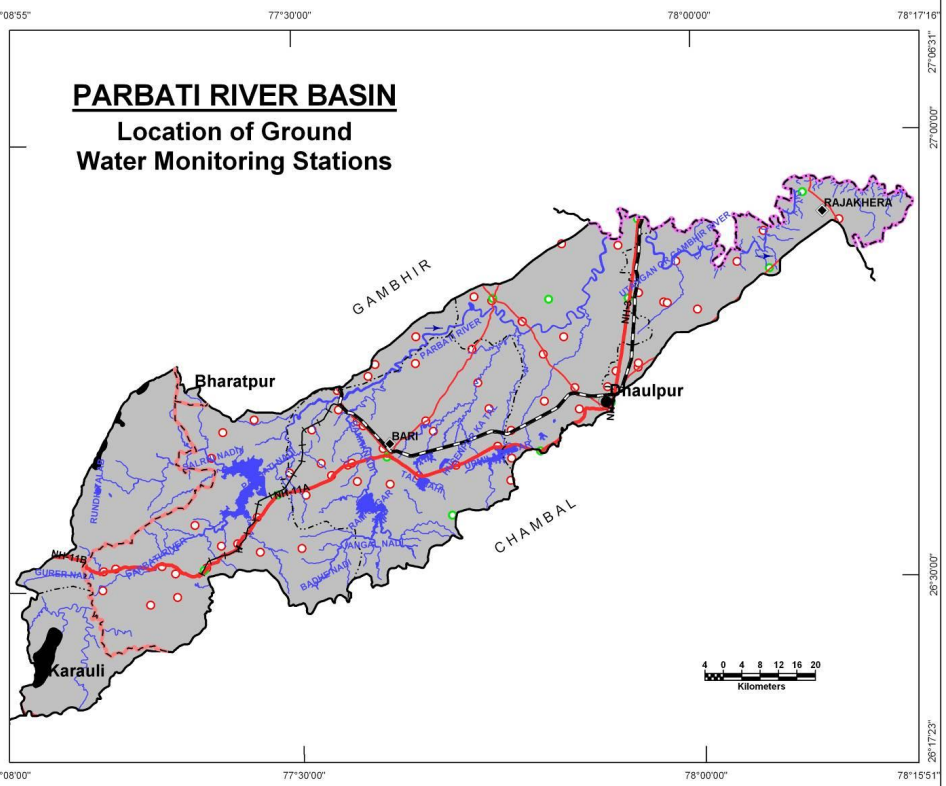
Aquifer:
- Older Alluvium
- Sandstone

Source: Ground Water Potential Zone Map - GWD,Rajasthan

PLATE - VII

PARBATI RIVER BASIN

Location of Ground Water Monitoring Stations



LEGEND

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

River Basin Boundary

Roads:
- National Highway
- State Highway

Railway:
- Broad Gauge
- Narrow Gauge

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Hills

Ground Water Monitoring Stations:
- CGWB
- RGWD

LOCATION OF EXPLORATORY WELLS

PARBATI RIVER BASIN

In all there are 41 exploratory wells present in the basin drilled in the past by RGWD (32) and CGWB (9) that form the basis for delineation of sub-surface aquifer system.

District Name	CGWB	RGWD	Total
Bharatpur	-	-	**-**
Dhaulpur	9	31	**40**
Karauli	-	1	**1**
Total	**9**	**32**	**41**

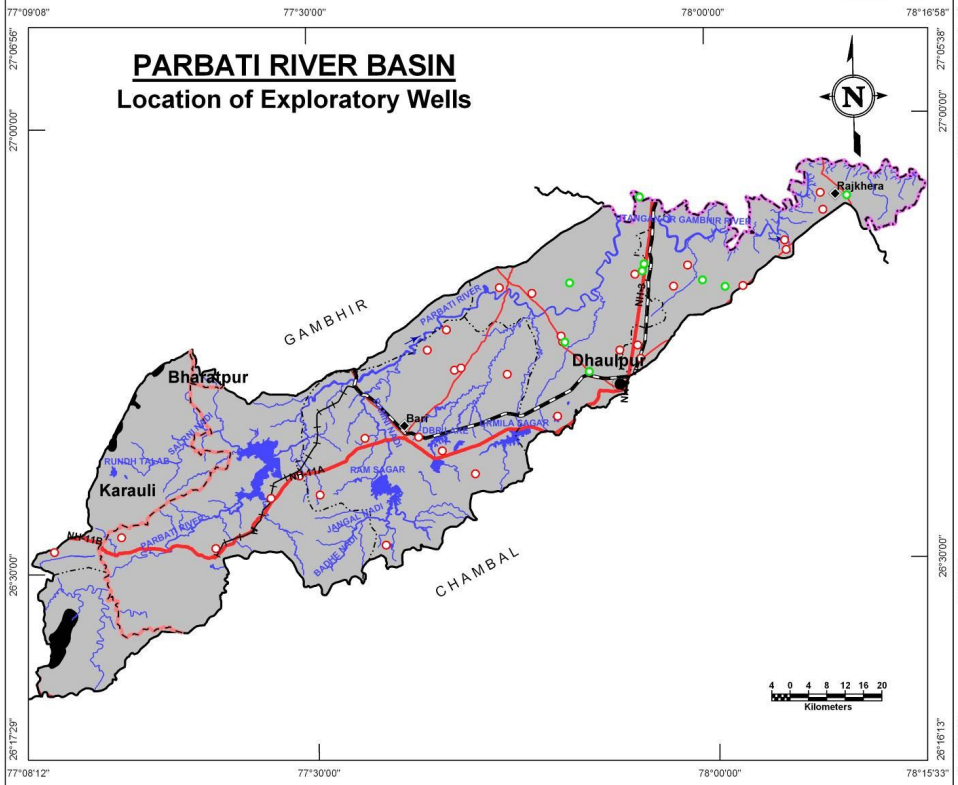
DEPTH TO WATER LEVEL (PRE MONSOON – 2010)

The general depth to water level in the basin is less than 20 meters below ground level, as seen in most of the central and western parts of the basin. In the eastern part of the basin, however, there are pockets wherein deeper water levels were encountered. The two areas, first one in the north and northeast of Dhaulpur city and the second one around Rajkhera, the depth to water level is highest i.e., reaching upto 30m bgl or more.

Depth to water level (m bgl) Pre Monsoon - 2010	District wise area coverage (sq km)*			Total Area (sq km)
	Bharatpur	Dhaulpur	Karauli	
< 10	4.7	398.6	4.2	**407.5**
10 - 20	2.4	1,063.8	319.8	**1,386.0**
20 - 30	-	283.4	44.4	**327.8**
> 30	-	128.0	-	**128.0**
Total	**7.1**	**1,873.8**	**368.4**	**2,249.3**

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

PLATE - VIII



LEGEND

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

River Basin Boundary

Railway:
- Broad Gauge
- Narrow Gauge

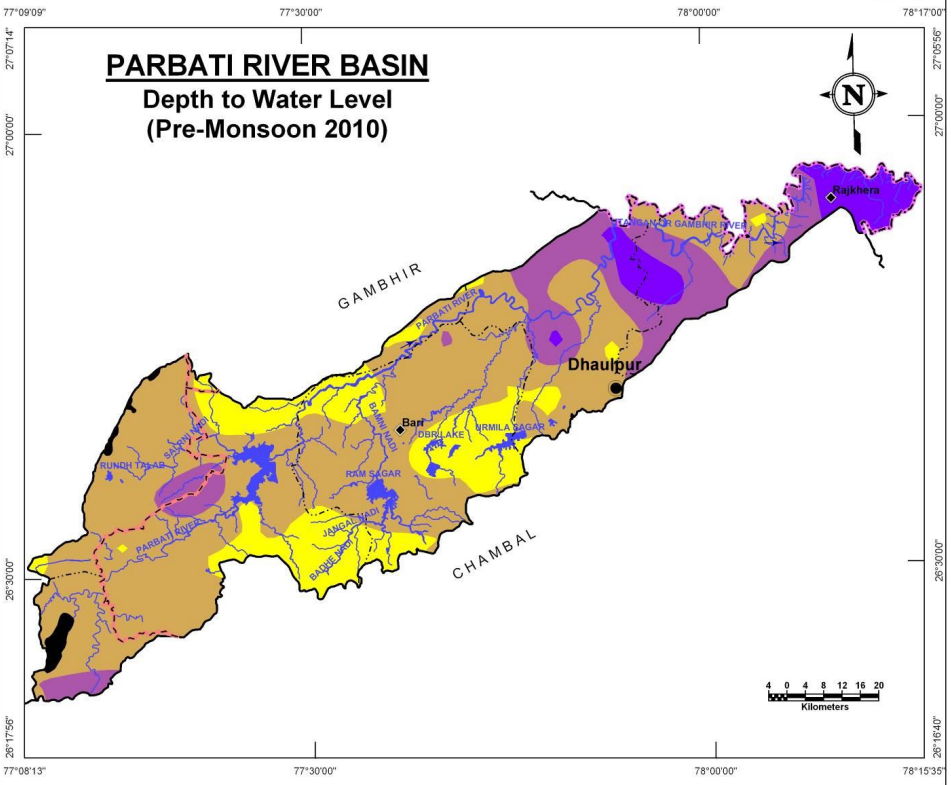
Roads:
- National Highway
- State Highway

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Hills

Exploratory Wells:
- CGWB
- RGWD

PLATE - IX



LEGEND

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

River 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) PARBATI RIVER BASIN

The flow directions marked on water table elevation contour map (Plate – X) indicate an initial west and southeast to northwards and northeastwards general flow of ground water within the Parbati river basin. The highest Water table elevation is seen in the western hilly area in Karauli district attaining >320m amsl, whereas the lowest elevation (about 140m amsl) is recorded at the end of river basin where the river leaves the basin in Dhaulpur district near Rajakhera. That shows a variation of more than 180m of water table elevation in the basin. The flow gradient is also steep in the hilly areas but becomes sluggish in plain areas of Dhaulpur district.

Water Table Elevation (m amsl) (Pre Monsoon – 2010)	District wise area coverage (sq km)			Total Area (sq km)
	Banswara	Chittaurgarh	Dungarpur	
>140	-	151.5	-	**151.5**
140 - 160	-	387.9	-	**387.9**
160 - 180	-	241.9	-	**241.9**
180 - 200	-	215.4	-	**215.4**
200 - 220	-	251.7	6.6	**258.3**
220 - 240	7.1	383.0	62.2	**452.3**
240 - 260	-	142.3	127.2	**269.5**
260 - 280	-	90.8	90.0	**180.8**
280 - 300	-	9.3	61.7	**71.0**
300 - 320	-	-	20.5	**20.5**
< 320	-	-	0.2	**0.2**
Total	**7.1**	**1,873.8**	**368.4**	**2,249.3**

WATER LEVEL FLUCTUATION (PRE TO POST MONSOON 2010)

Water level fluctuation map is presented in Plate – XI. The fluctuation range is high as seen from the values of about -8m to more than 10m which is about 18m. The predominantly blue colour in the map suggests that the water levels in the post monsoon season have shown, in general, rise with respect to pre-monsoon water levels in the year 2010. Barring the steep rise (as seen in the southern part of Dhaulpur district) or fall (north of Dhaulpur city) in water levels which however occupy limited areas in the basin, the fluctuation has largely remained in the range of -2m to 8m.

District Name	District wise area coverage (sq km) within fluctuation range (m)											Total Area (sq km)
	< -8	-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	
Bharatpur	-	-	-	-	-	7.1	-	-	-	-	-	**7.1**
Dhaulpur	0.2	1.9	5.8	17.1	167.7	613.6	404.6	384.8	221.6	52.0	4.5	**1,873.8**
Karauli	-	0.6	4.4	9.4	22.0	142.2	150.3	38.2	1.3	-	-	**368.4**
Total	**0.2**	**2.5**	**10.2**	**26.5**	**189.7**	**762.9**	**554.9**	**423.0**	**222.9**	**52.0**	**4.5**	**2,249.3**

PLATE - X

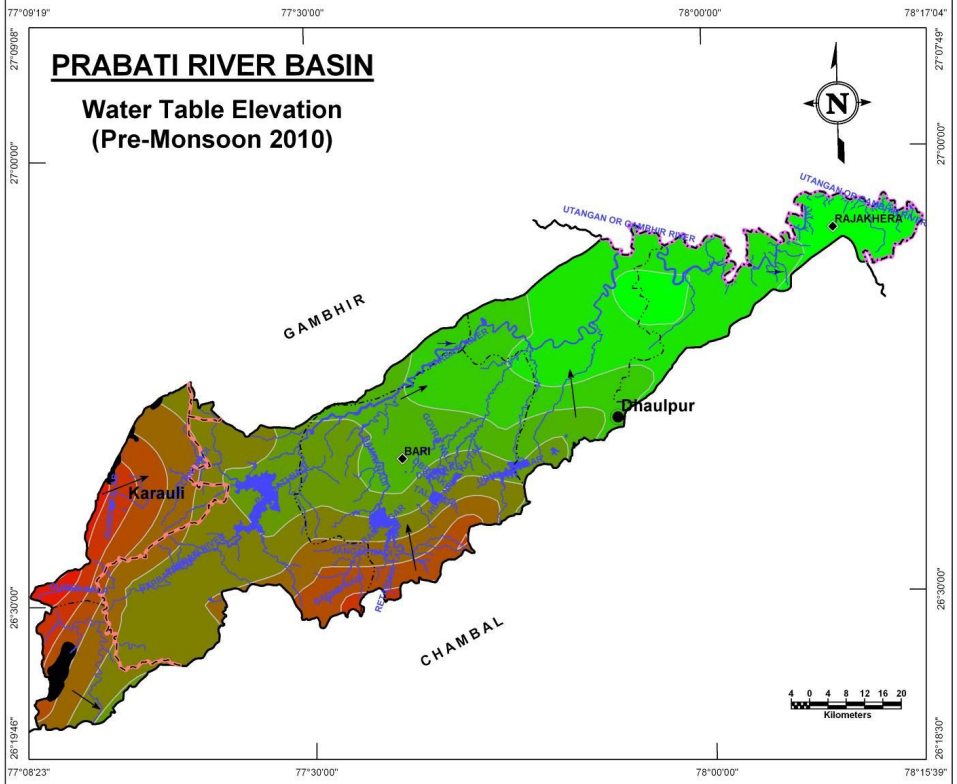
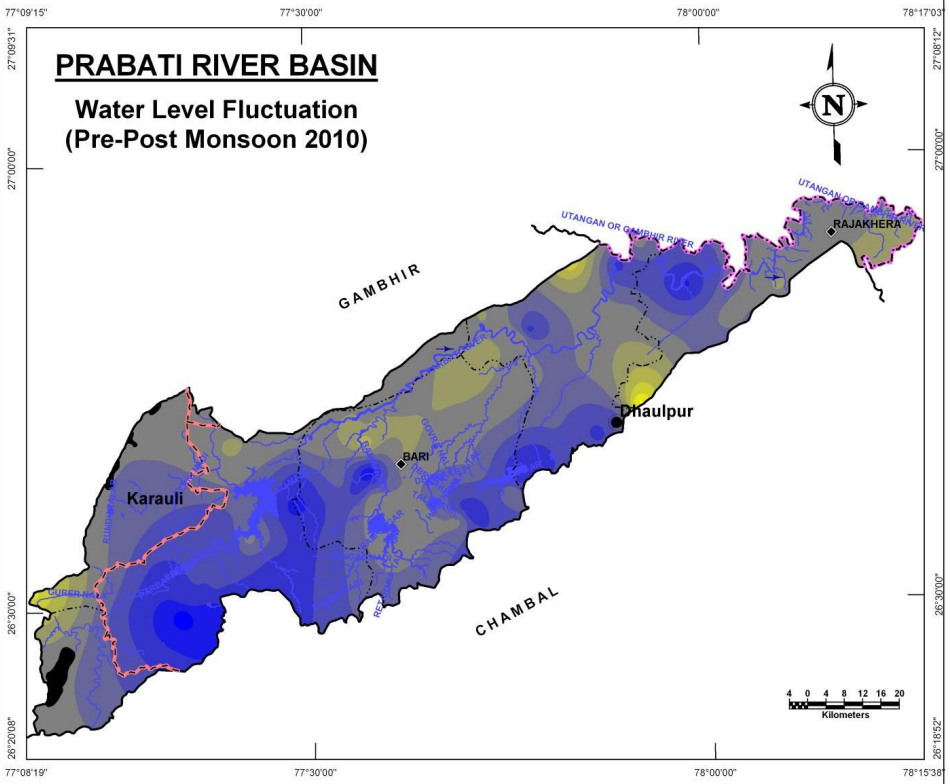


PLATE - XI



LEGEND

Admin Boundary:

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

River Basin Boundary

Water Bodies:

- River / Streams
- Ponds / Reservoirs

Hills

Water Table Elevation

Water Table Elevation(m amsl):

- >140
- 140 - 160
- 160 - 180
- 180 - 200
- 200 - 220
- 220 - 240
- 240 - 260
- 260 - 280
- 280 - 300
- 300 - 320
- <320

LEGEND

Admin Boundary:

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

River Basin Boundary

Water Bodies:

- River / Streams
- Ponds / Reservoirs

Hills

Water Level Fluctuation(m):

- < -8
- -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

ELECTRICAL CONDUCTIVITY DISTRIBUTION PARBATI RIVER BASIN

The Electrical Conductivity (at 25°C) distribution map is presented in Plate – XII reveals an in general low values in the basin which makes it suitable for domestic purposes. The only strip between Dhaulpur and Rajkhera in the northern part of the basin has shown the presence of moderate to high EC (>2000 µS/cm) in ground water which limits to some extent, its suitability for different purposes. Hardly 0.02% of the basin area falls within high EC (>4000 µS/cm) region.

Electrical Conductivity Ranges (µS/cm at 25°C) (Ave. of years 2005-09)	District wise area coverage (sq km)						Total Area (sq km)
	Bharatpur		Dhaulpur		Karauli		
	Area	% age	Area	% age	Area	% age	
< 2000	7.08	100.0	1576	84.1	362.6	98.4	**1,945.7**
2000-4000	-	-	281.1	15.0	5.8	1.6	**286.9**
> 4000	-	-	16.7	0.9	-	-	**16.7**
Total	**7.1**	**100.0**	**1,873.8**	**100.0**	**368.4**	**100.0**	**2,249.3**

CHLORIDE DISTRIBUTION

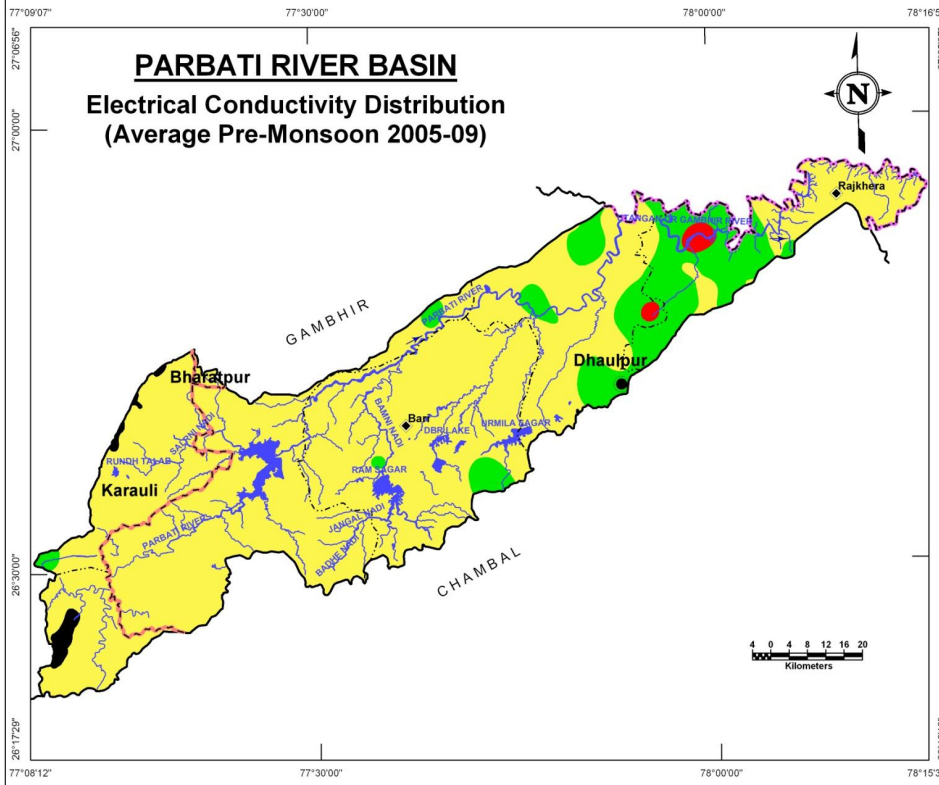
High chloride concentration in ground water also renders it unsuitable for domestic and other purposes. The chloride concentration map (Plate – XIII) exhibits a similar distribution pattern as to that of Electrical Conductivity. A predominantly yellow colour (<250 mg/l) in the map suggests that from chloride perspective, the ground water is suitable for all purposes and together with moderately high concentration (250 – 1000 mg/l), these areas occupy more than 99.3% of basin area and the rest of the area (0.7%) in the north has shown high chloride concentration in ground water.

Chloride Ranges (mg/l) (Ave. of years 2005-09)	District wise area coverage (sq km)						Total Area (sq km)
	Bharatpur		Dhaulpur		Karauli		
	Area	% age	Area	% age	Area	% age	
< 250	7.08	100.0	1576	84.1	362.6	98.4	**1,945.7**
250 - 1000	-	-	281.1	15.0	5.8	1.6	**286.9**
> 1000	-	-	16.7	0.9	-	-	**16.7**
Total	**7.1**	**100.0**	**1,873.8**	**100.0**	**368.4**	**100.0**	**2,249.3**

PLATE - XII

PARBATI RIVER BASIN

Electrical Conductivity Distribution (Average Pre-Monsoon 2005-09)



LEGEND

Admin Boundary:

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

Water Bodies:

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

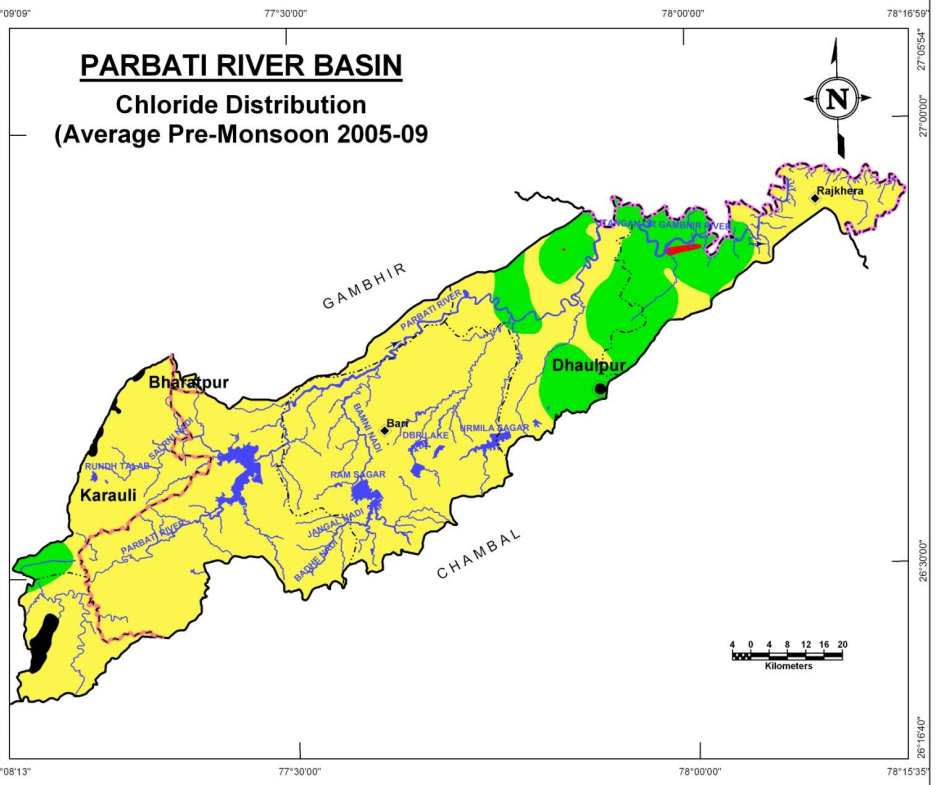
Electrical Conductivity (µS/cm at 25°C):

- < 2000
- 2000-4000
- > 4000

PLATE - XIII

PARBATI RIVER BASIN

Chloride Distribution (Average Pre-Monsoon 2005-09



LEGEND

Admin Boundary:

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

Water Bodies:

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

Chloride Concentration(mg/l):

- < 250
- 250 - 1000
- > 1000

FLUORIDE DISTRIBUTION

PARBATI RIVER BASIN

The Fluoride concentration map for Parbati River Basin (Plate – XIV) shows three small patches in the central part of the basin where very high Fluoride concentration (>3 mg/l) was recorded and these occupy an insignificant (less than 1%) part of basin area. Moderate Fluoride concentration (1.5 – 3.0 mg/l) occupies about 15% of basin area surrounding the high concentration areas. The rest of the area (approximately 85%) has shown very low concentration in ground water samples which makes it suitable for all purposes.

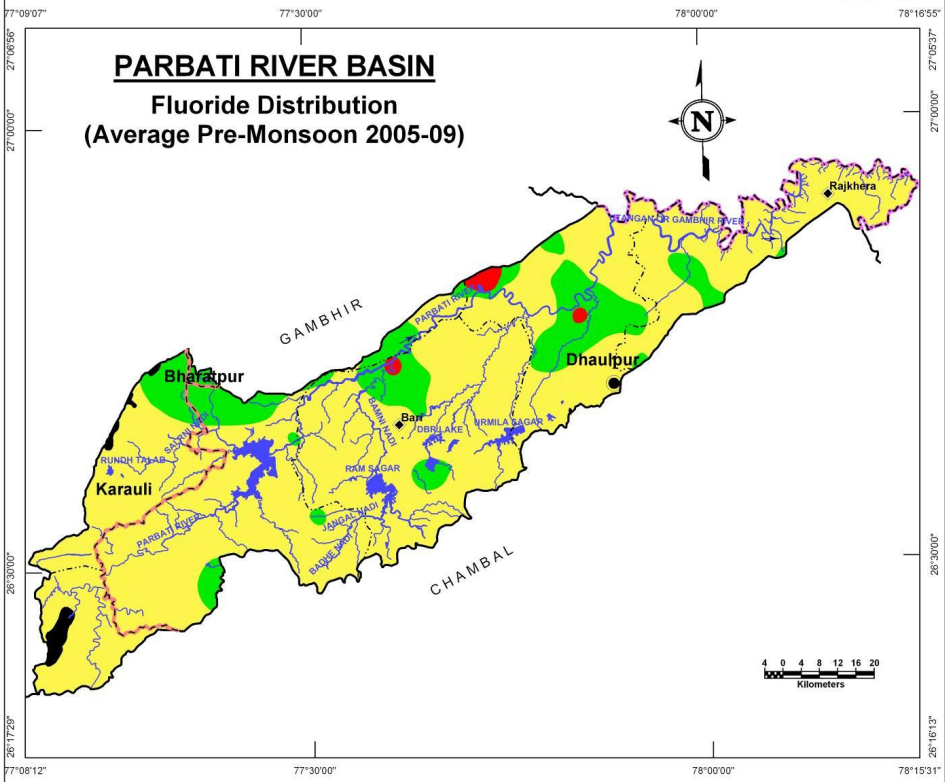
Fluoride Ranges (mg/l) (Ave. of years 2005-09)	District wise area coverage (sq km)						Total Area (sq km)
	Bharatpur		Dhaulpur		Karauli		
	Area	% age	Area	% age	Area	% age	
< 1.5	-	-	1,570.0	83.8	330.9	89.8	**1,900.9**
1.5-3.0	7.1	100.0	287.1	15.3	37.5	10.2	**331.7**
> 3.0	-	-	16.7	0.9	-	-	**16.7**
Total	**7.1**	**100.0**	**1,873.8**	**100.0**	**368.4**	**100.0**	**2,249.3**

NITRATE DISTRIBUTION

High nitrate concentration in ground water renders it unsuitable for agriculture purposes. Plate – XV shows distribution of Nitrate in ground water. The distribution pattern has a different trend from EC distribution and several isolated high Nitrate concentration (>100 mg/l) patches are seen distributed over the area located in the northern and central parts of the basin. Such areas of high Nitrate concentration in ground water constitute approximately 10% of the basin area only. Moderate concentration of Nitrate is found in approximately 24% of the basin area. Rest of the basin in southern and central parts, has low Nitrate concentration in ground water and thus rendering it suitable for agriculture.

Nitrate Ranges (mg/l) (Ave. of years 2005-09)	District wise area coverage (sq km)						Total Area (sq km)
	Bharatpur		Dhaulpur		Karauli		
	Area	% age	Area	% age	Area	% age	
< 50	7.1	100.0	1,279.6	68.3	223.1	60.6	**1,509.8**
50-100	-	-	384.4	20.5	145.3	39.4	**529.7**
> 100	-	-	209.8	11.2	-	-	**209.8**
Total	**7.1**	**100.0**	**1,873.8**	**100.0**	**368.4**	**100.0**	**2,249.3**

PLATE - XIV



LEGEND

Admin Boundary:

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

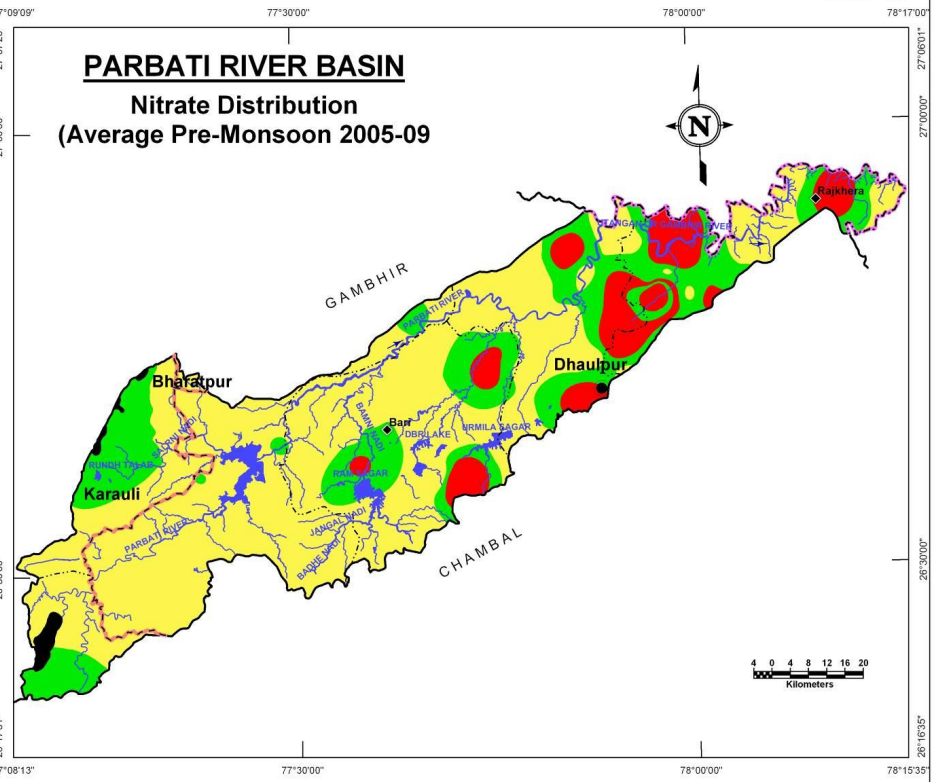
Water Bodies:

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

Water Bodies:

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

Nitrate Concentration(mg/l):

- < 50
- 50-100
- >100

DEPTH TO BEDROCK

PARBATI RIVER BASIN

Below soil cover and thick pile alluvial material at different depths, and weathered/fractured bedrock material which constitutes good aquifer material, the massive bedrock is found that is not very significant from ground water occurrence perspective. Plate – XVI represents depth to bedrock in meters below ground level. The bedrock is generally found at moderate depths ranging from about 20m bgl to about 80m bgl as seen by regions marked on map which together constitute about 95% of the basin area. The rest of the basin (approximately 5%) is either shallower than 20m or deeper than 80m.

Depth to Bedrock (m bgl)	District wise area coverage (sq km)			Total Area (sq km)
	Bharatpur	Dhaulpur	Karauli	
< 20	-	33.6	-	**33.6**
20-40	-	268.7	34.3	**303.0**
40-60	6.8	871.0	211.1	**1,088.9**
60-80	0.3	666.0	99.3	**765.6**
> 80	-	34.5	23.7	**58.2**
Total	**7.1**	**1,873.8**	**368.4**	**2,249.3**

UNCONFINED AQUIFER

Hydrogeological properties are different for alluvial and hard rock aquifers and therefore, this aquifer has been mapped as two separate regions viz, unconfined aquifers in alluvial and in hard rock areas.

The alluvial material is predominantly alluvial or fluvial origin sand, clay and gravel. The thickness of this aquifer varies from very thin layers to upto 30m in the northern parts of Dhaulpur district. The hardrock aquifers are formed in weathered and fractured part of the hardrock that can sustain water under unconfined conditions. Such aquifers are formed in Vindhyan sandstone rocks in southern parts of Dhaulpur district and in Karauli district. These aquifers significantly vary in thickness ranging from less than 10m to about 90m.

Alluvial areas

Unconfined aquifer Thickness (m)	District wise area coverage (sq km)			Total Area (sq km)
	Bharatpur	Dhaulpur	Karauli	
<10	-	595.5	-	**595.5**
10-20	-	229.5	-	**229.5**
>20	-	4.2	-	**4.2**
Total	**-**	**829.2**	**-**	**829.2**

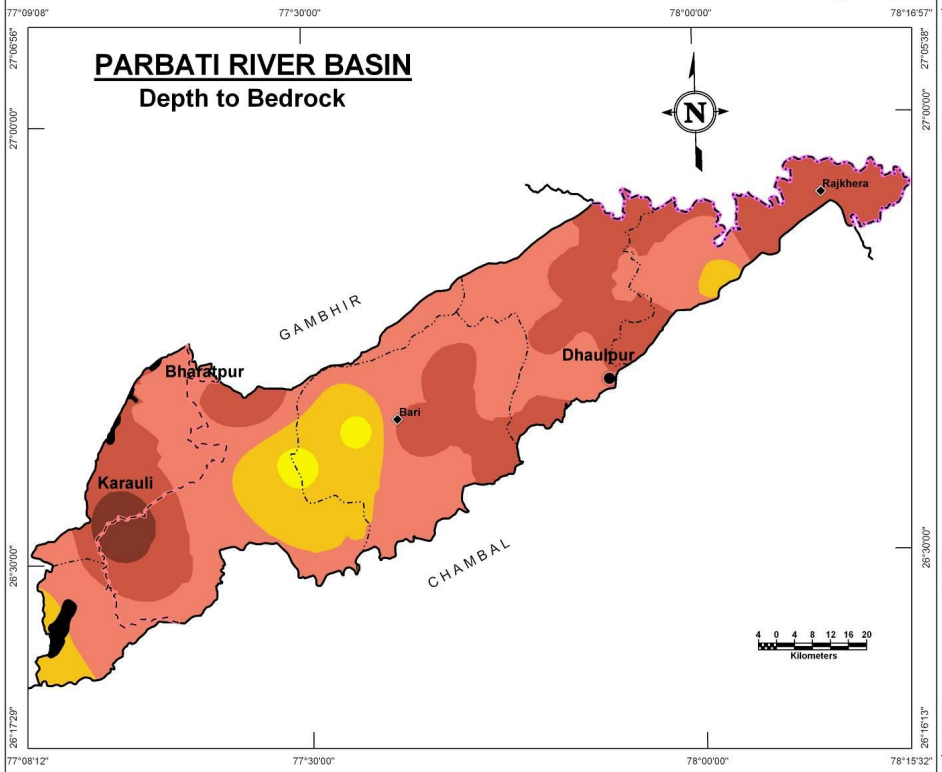
Hardrock areas:

Unconfined aquifer Thickness (m)	District wise area coverage (sq km)			Total Area (sq km)
	Bharatpur	Dhaulpur	Karauli	
< 10	-	129.2	-	**129.2**
10-20	7.1	148.1	10.2	**165.4**
20-30	-	173.2	57.2	**230.4**
30-40	-	220.3	83.5	**303.8**
40-50	-	152.0	79.7	**231.7**
50-60	-	95.2	58.2	**153.4**
60-70	-	60.5	41.0	**101.5**
70-80	-	38.0	26.8	**64.8**
80-90	-	21.0	11.5	**32.5**
> 90	-	7.1	0.3	**7.4**
Total	**7.1**	**1,044.6**	**368.4**	**1,420.1**

PLATE - XVI

PARBATI RIVER BASIN

Depth to Bedrock



LEGEND

Admin Boundary:

- District Headquarter
- Block Headquarter
- State Boundary
- District Boundary
- Block Boundary
- River Basin Boundary
- Hills

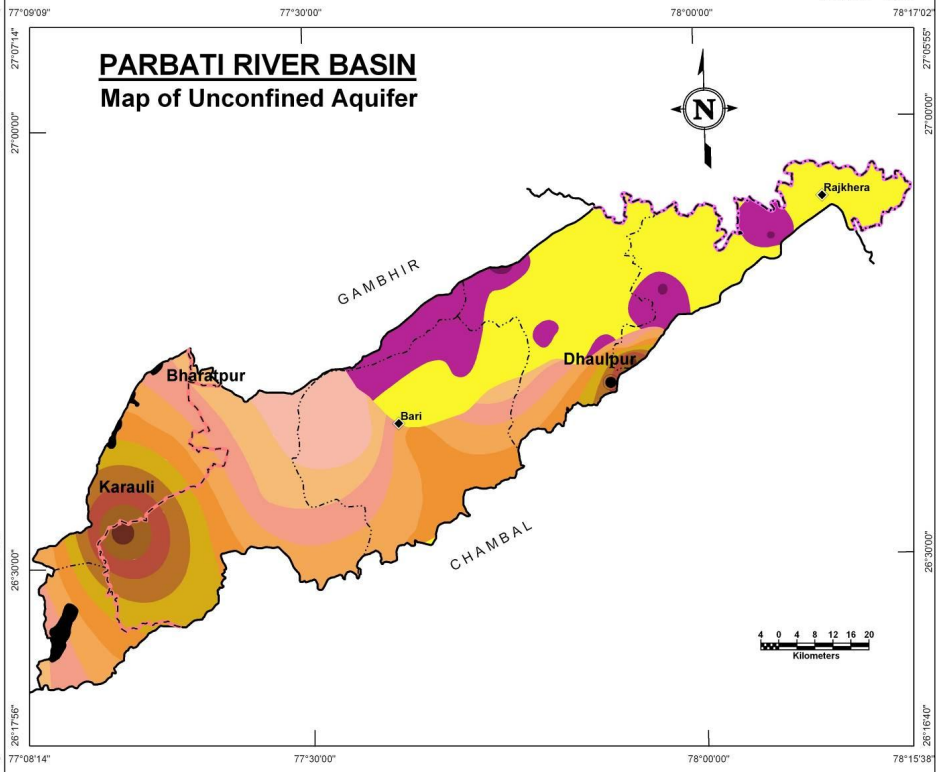
Depth to Bedrock (m bgl):

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

PLATE - XVII

PARBATI RIVER BASIN

Map of Unconfined Aquifer



LEGEND

Admin Boundary:

- District Headquarter
- Block Headquarter
- State Boundary
- District Boundary
- Block Boundary
- River Basin Boundary
- Hills

Aquifer Thickness (m):

Alluvial Area:

- < 10
- 10-20
- >20

Weathered & Fractured Zone in Hardrock Area :

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

CROSS SECTIONS

PARBATI RIVER BASIN

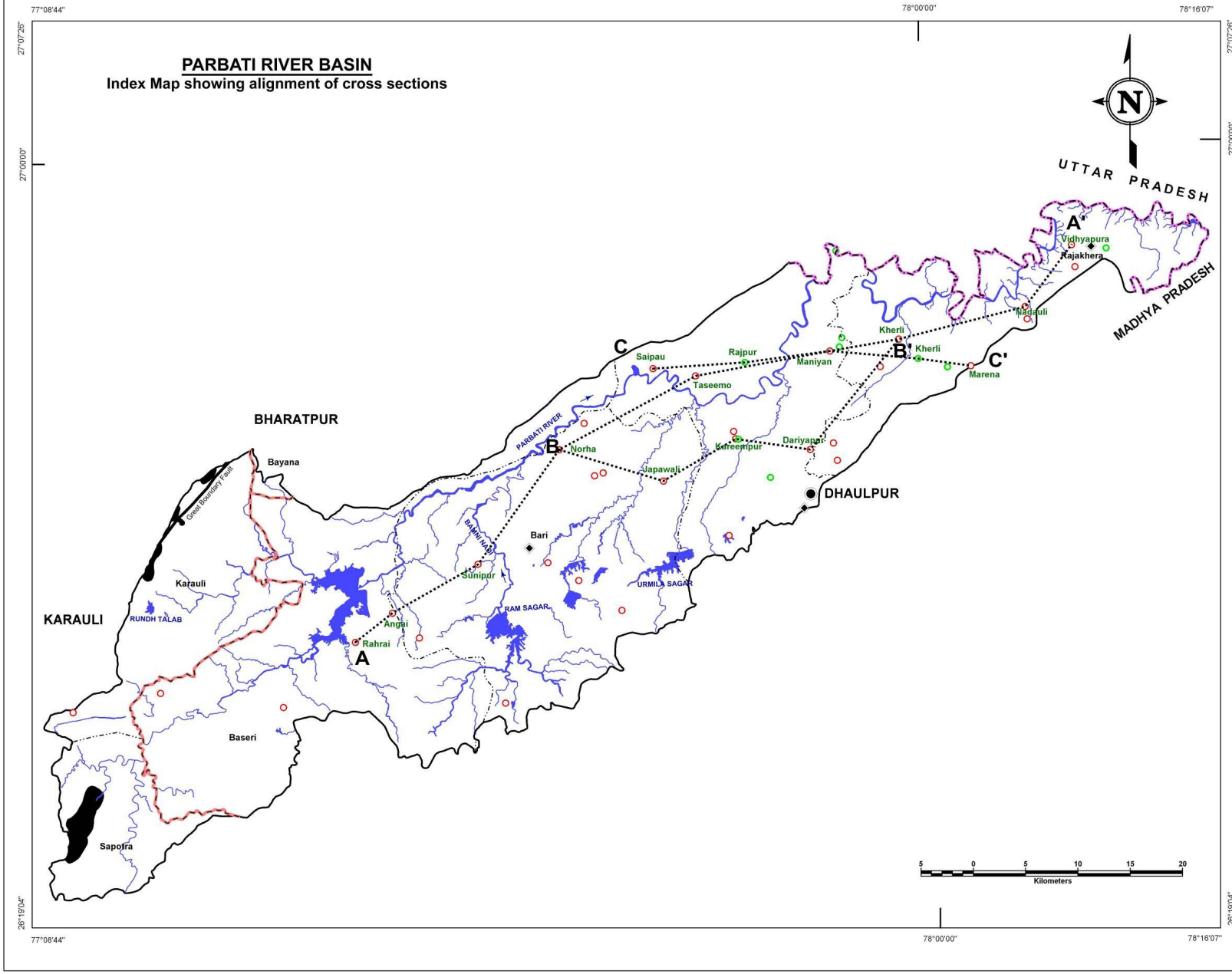
Several hydrogeologic cross sections have been drawn to better depict the sub-surface distribution of lithology. These sections have been overlaid with geological maps and structural faults if there are any have been transferred for verification of their impact on sub-surface material disposition. The alignment of the cross sections is shown in Plate – XVIII and corresponding sections are presented in Plates – XIX to XXI. The broad alignment of the sections is as given below:

Name of Section Line	Orientation
Section AA’	SW – NE
Section BB’	SW – NE
Section CC’	W – E

PLATE - XVIII

PARBATI RIVER BASIN

Index Map showing alignment of cross sections



Legend

- District Headquarter
- Block Headquarter
- State Boundary
- District Boundary
- Block Boundary
- River Basin Boundary
- Great Boundary Fault
- Section Lines
- Major Streams / River
- Pond / Reservoir
- Hills

Depth to Bed Rock (m bgl)

- Norha — Well location for Sections
- CGWB
- RGWD

CROSS SECTIONS

PARBATI RIVER BASIN

Section A-A':

The section AA' (Plate – XIX) is taken along SW-NE direction and is prepared based on the lithologs of 9 boreholes, which cover length of about 80 Km. In the southwestern part, sandstone formation underlying top soil occurs for about a length of 40Km along the profile and gradually goes deeper giving way to progressively increasing thicker pile of alluvium. While sand is predominant material in the alluvium, there are frequent intercalations with clay formation which gradually increase in thickness northeastwards.

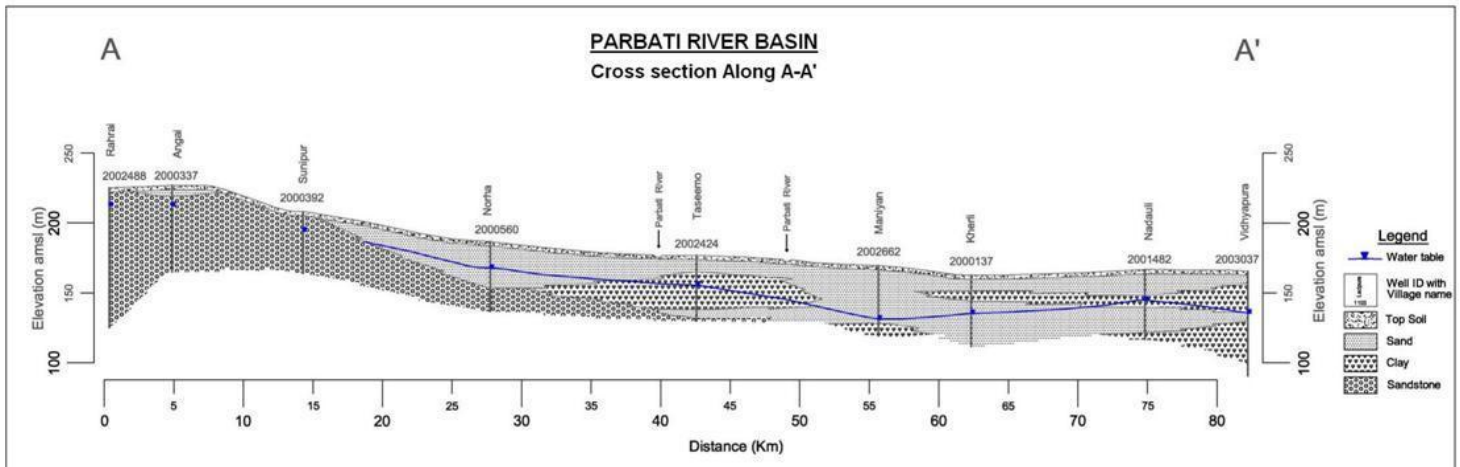
Water table varies from 140 m amsl to 215 m amsl in the section.

Section B-B':

The section BB' (Plate – XX) is also drawn in the SW-NE direction based on the lithologs of 5 boreholes and covering a distance of about 40Km. In the southwest, the section is dominated by 30-40m of sandy alluvial material underlain by sandstone. The sandstone terminates in the middle of the section till a length of 22 km and giving way to still thicker pile of alluvial material that is sandy in nature. In the alluvial cover, the sand is interbedded with clay and also there is a consistent soil cover above all these.

Water table varies in elevation from 140 m amsl to 165 m amsl in the section.

PLATE - XIX



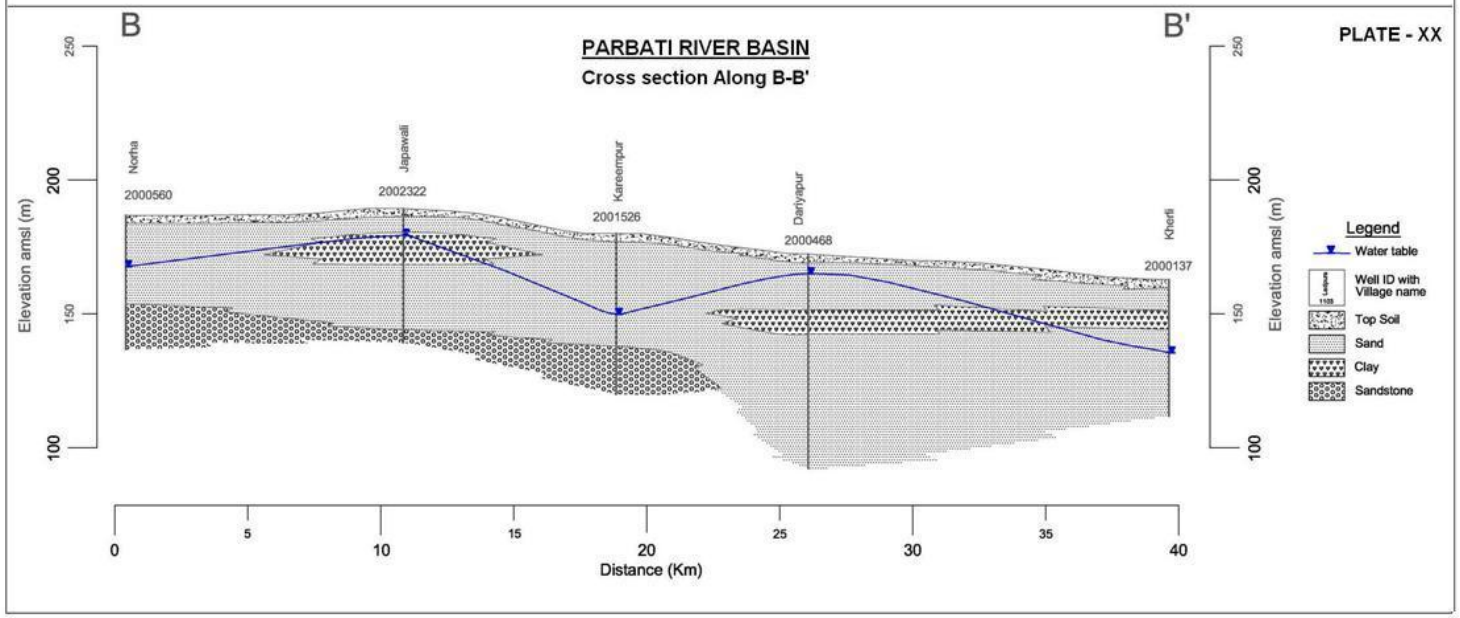


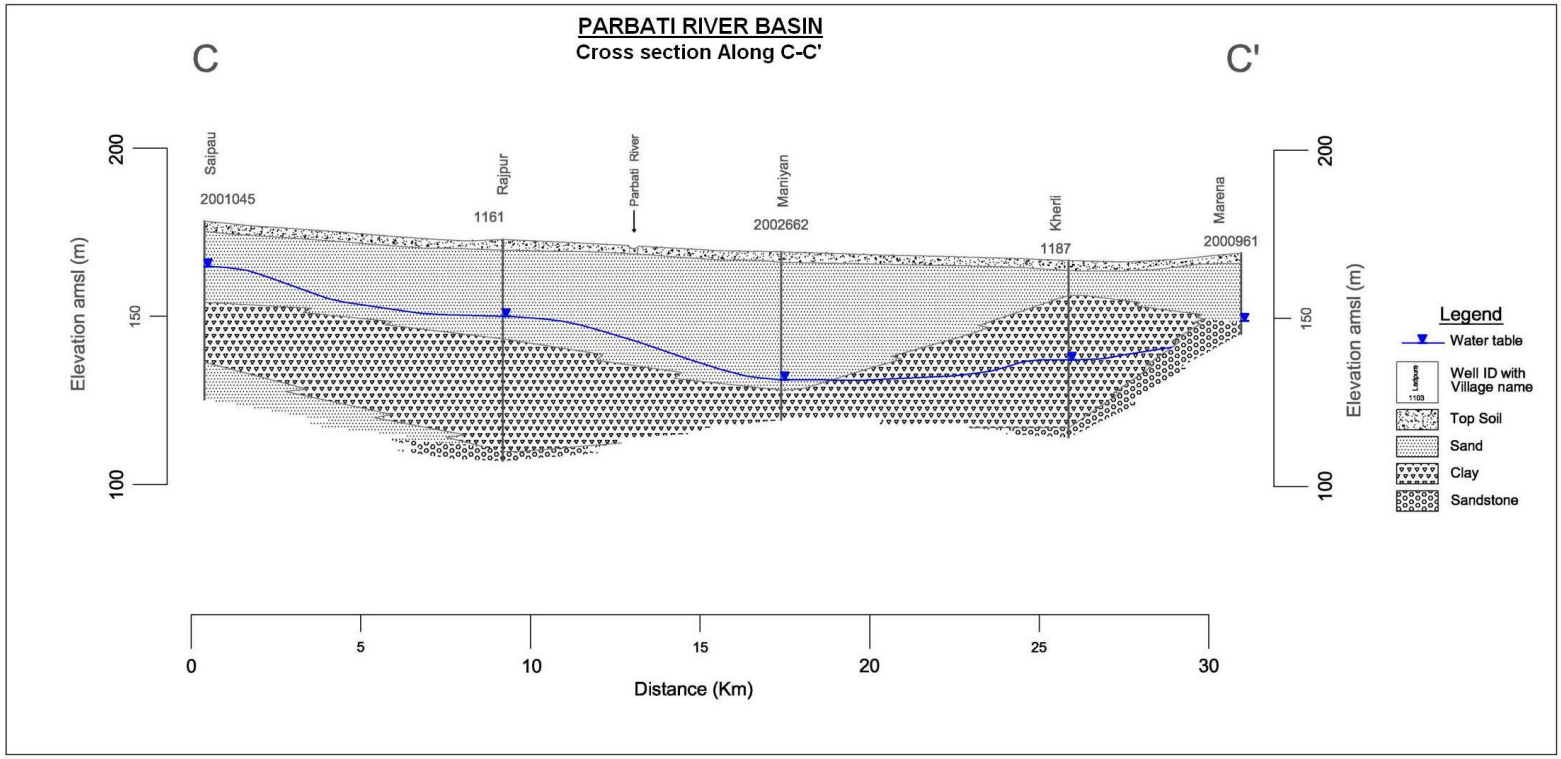
PLATE - XX

Section C-C':

The Section CC' (Plate – XXI) has been chosen in W-E direction, in the northern part of the river basin, broadly parallel to the Parbati River. This section is prepared based on the lithologs of 5 boreholes and extends over a length of 30Km. The section reveals the presence of sandstone forming the bedrock at shallower depths in the east which is deeper further west. The alluvium also increases in thickness westwards reaching to more than 50m in thickness. Thick layer of clay rests over sandstone and in turn overlain by variable but persistent sand below a thin layer of soil cover. Sandstone was encountered in the well of Kheril, Marena and Rajpur.

Water table is variable in elevation ranging from 150 m amsl to 170 m amsl in the section.

PLATE - XXI


PARBATI RIVER BASIN
Cross section Along C-C'
C
C'
Saipau
2001045
Rajpur
1161
Parbati River
Maniyan
2002662
Kherli
1187
Marena
2000961
200
150
100
Elevation amsl (m)
0
5
10
15
20
25
30
Distance (Km)
Legend
Water table
Well ID with Village name
Top Soil
Sand
Clay
Sandstone

3D MODEL OF AQUIFERS

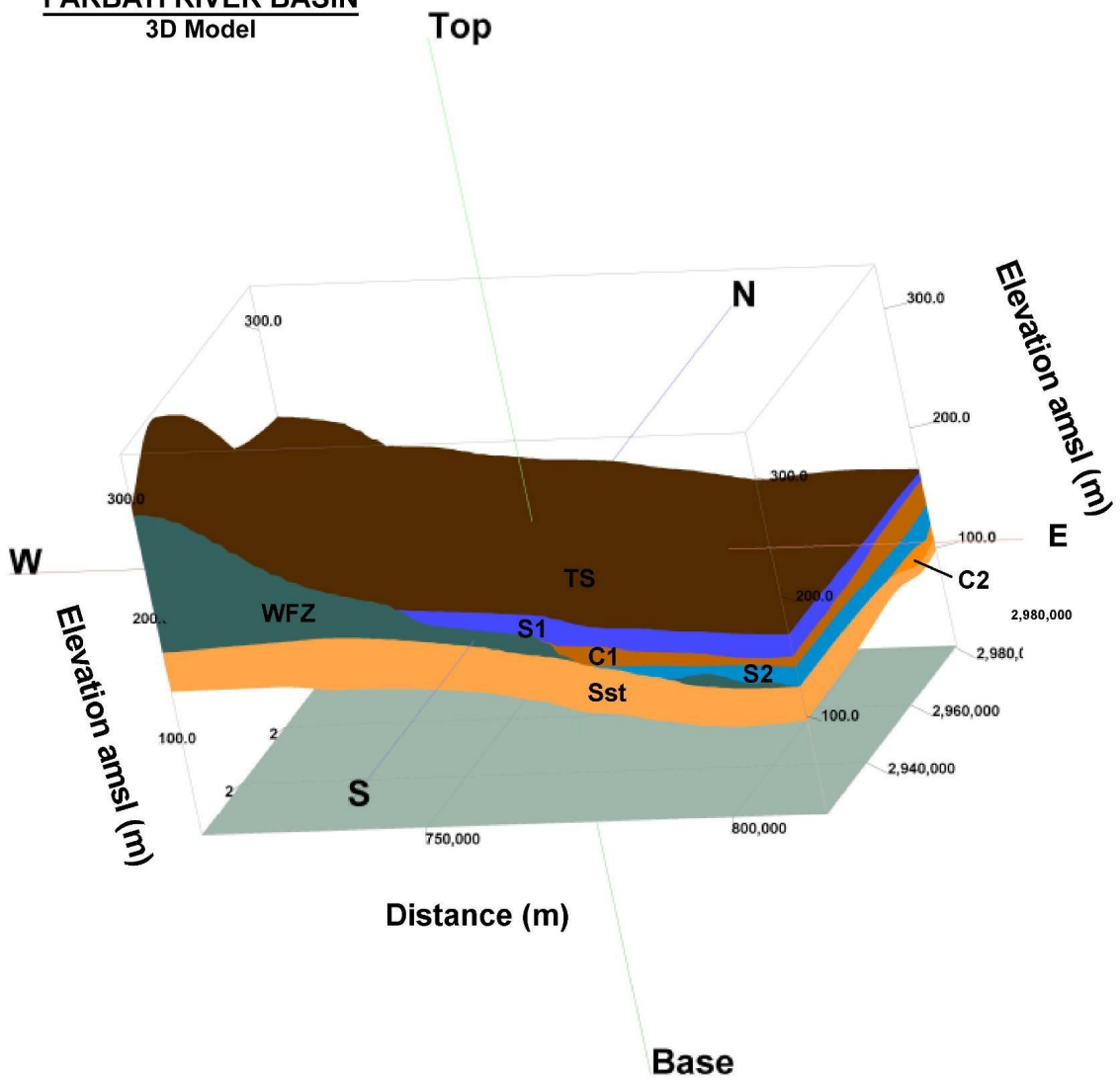
PARBATI RIVER BASIN

The continuous litho-stratigraphic model has been developed for the Parbati River Basin using the data of scattered wells as input. 3D model depicts the sub-surface aquifer disposition of litho-stratigraphic units forming aquifers, aquicludes and aquitards in the area.

Plate XXII presents 3D model depicting the various litho-stratigraphic units in the entire river basin. From this model it appears that beneath the soil cover, there are two persistent clay horizons in the region separating two sandy aquifers. The second sandy aquifer is found only in the eastern part of the basin within alluvium. The depth of bedrock is less in the eastern part as compared to the western part of the basin. Sandstone appears in entire basin overlain by weathered & fractured rock in western part and second sandy aquifer in eastern part of the basin.

PLATE - XXII

PARBATI RIVER BASIN
3D Model



Legend

TS	Top Soil
S1	Sand
C1	Clay
S2	Sand
C2	Clay
WFZ	Weathered & Fractured Zone
Sst	Sandstone
Q	Quartzite

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 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.

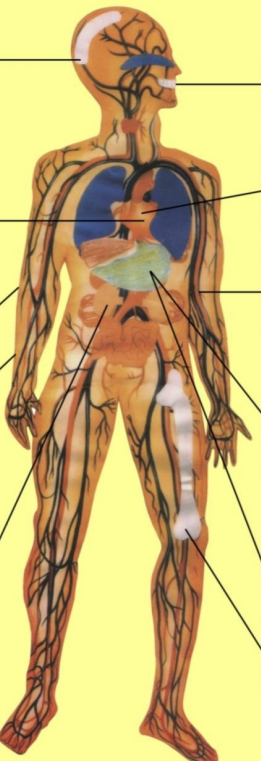
(Contd…)

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
- 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

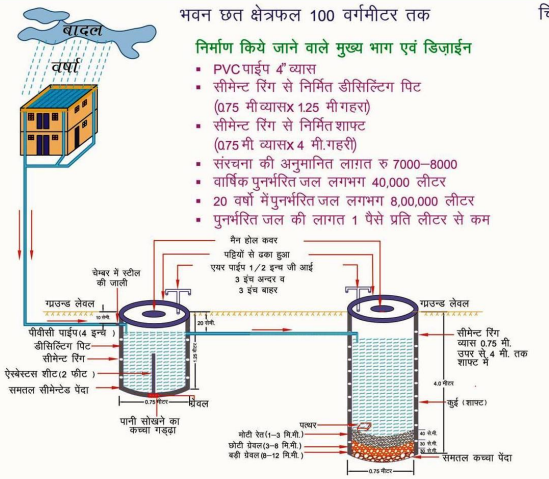
केन्द्रीय भूमि जल बोर्ड,
पश्चिमी क्षेत्र, जयपुर
जल संसाधन मंत्रालय
भारत सरकार
e-mail:cgwbwr@sancharnet.in

भूजल अमूल्य है इसे प्रदूषित न करें।

चित्र–1 भवन छत क्षेत्रफल 100 वर्गमीटर तक

निर्माण किये जाने वाले मुख्य भाग एवं डिज़ाईन

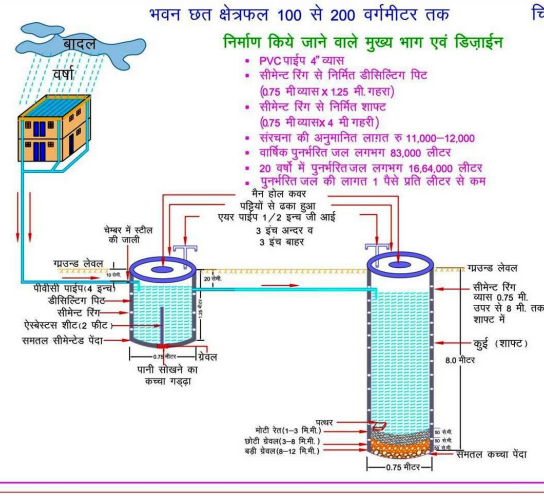
- PVC पाईप 4" व्यास
- सीमेन्ट रिंग से निर्मित डीसिल्टिंग पिट (0.75 मी व्यास x 1.25 मी गहरा)
- सीमेन्ट रिंग से निर्मित शाफ्ट (0.75 मी व्यास x 4 मी गहरी)
- संरचना की अनुमानित लागत रु 7000–8000
- वार्षिक पुनर्भरित जल लगभग 40,000 लीटर
- 20 वर्षों में पुनर्भरित जल लगभग 8,00,000 लीटर
- पुनर्भरित जल की लागत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



चित्र–2 भवन छत क्षेत्रफल 100 से 200 वर्गमीटर तक

निर्माण किये जाने वाले मुख्य भाग एवं डिज़ाईन

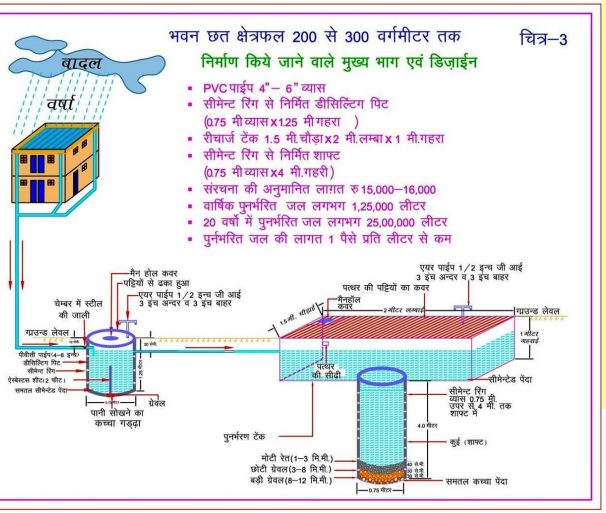
- PVC पाईप 4" व्यास
- सीमेन्ट रिंग से निर्मित डीसिल्टिंग पिट (0.75 मी व्यास x 1.25 मी. गहरा)
- सीमेन्ट रिंग से निर्मित शाफ्ट (0.75 मी व्यास x 4 मी गहरी)
- संरचना की अनुमानित लागत रु 11,000–12,000
- वार्षिक पुनर्भरित जल लगभग 83,000 लीटर
- 20 वर्षों में पुनर्भरित जल लगभग 16,64,000 लीटर
- पुनर्भरित जल की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

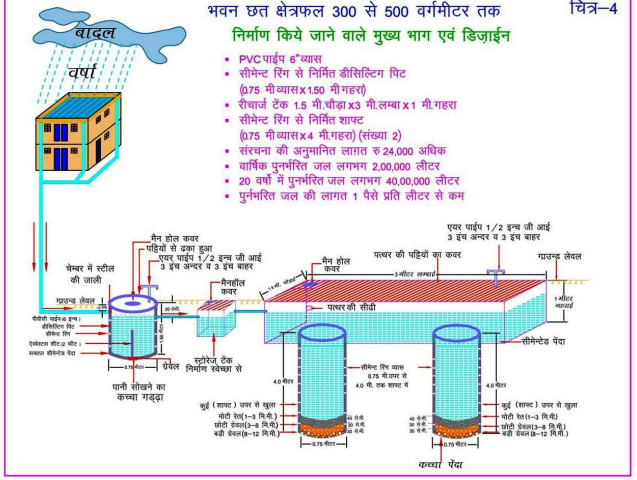
- PVC पाईप 4"– 6" व्यास
- सीमेन्ट रिंग से निर्मित डीसिल्टिंग पिट (0.75 मी व्यास x 1.25 मी गहरा)
- रीचार्ज टेंक 1.5 मी.चौड़ा x 2 मी.लम्बा x 1 मी.गहरा
- सीमेन्ट रिंग से निर्मित शाफ्ट (0.75 मी व्यास x 4 मी.गहरी)
- संरचना की अनुमानित लागत रु 15,000–16,000
- वार्षिक पुनर्भरित जल लगभग 1,25,000 लीटर
- 20 वर्षों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



चित्र–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 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



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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