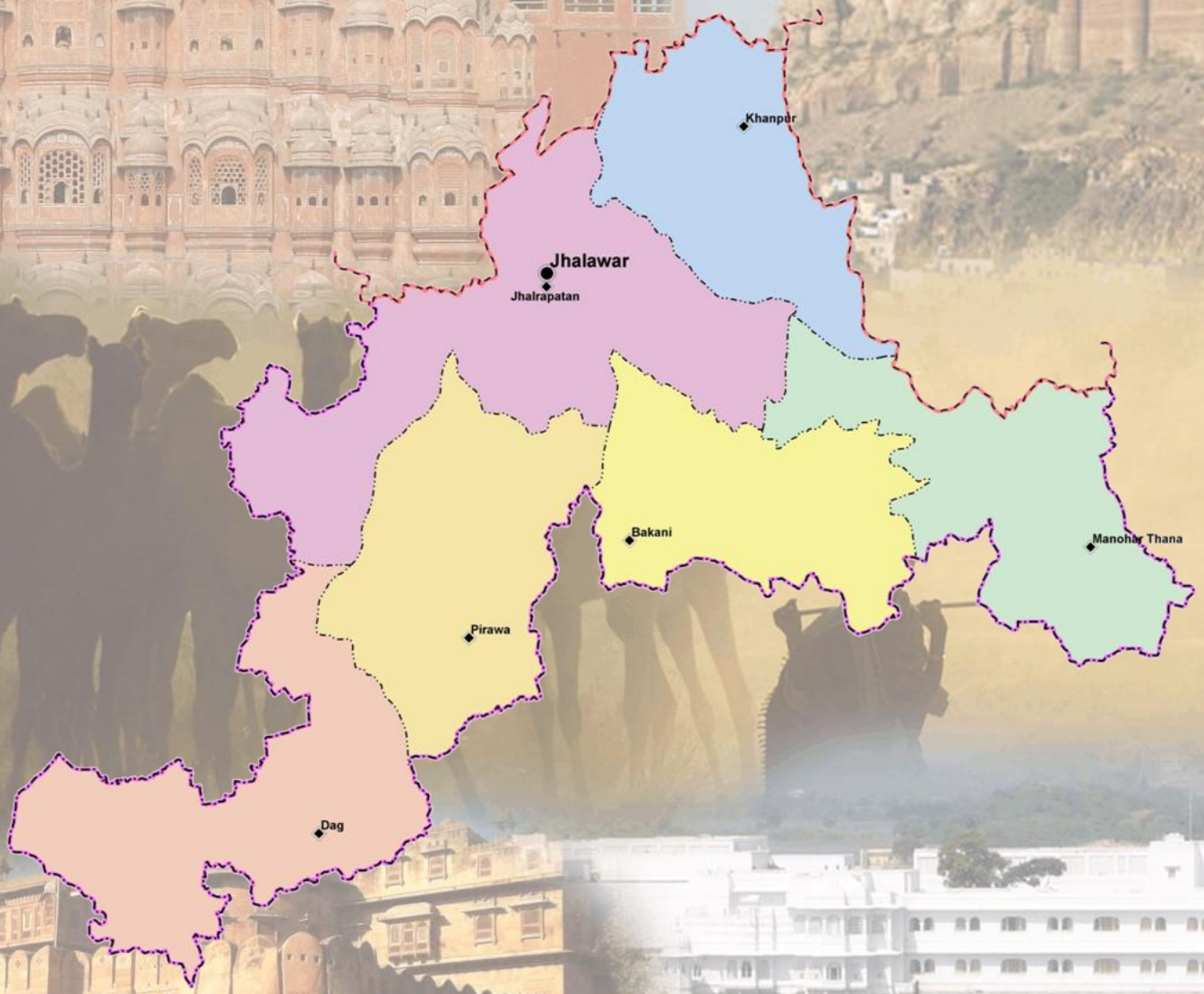
Ground Water Department,
Rajasthan

Hydrogeological Atlas of Rajasthan
Jhalawar District

European Union
State Partnership Programme



2013

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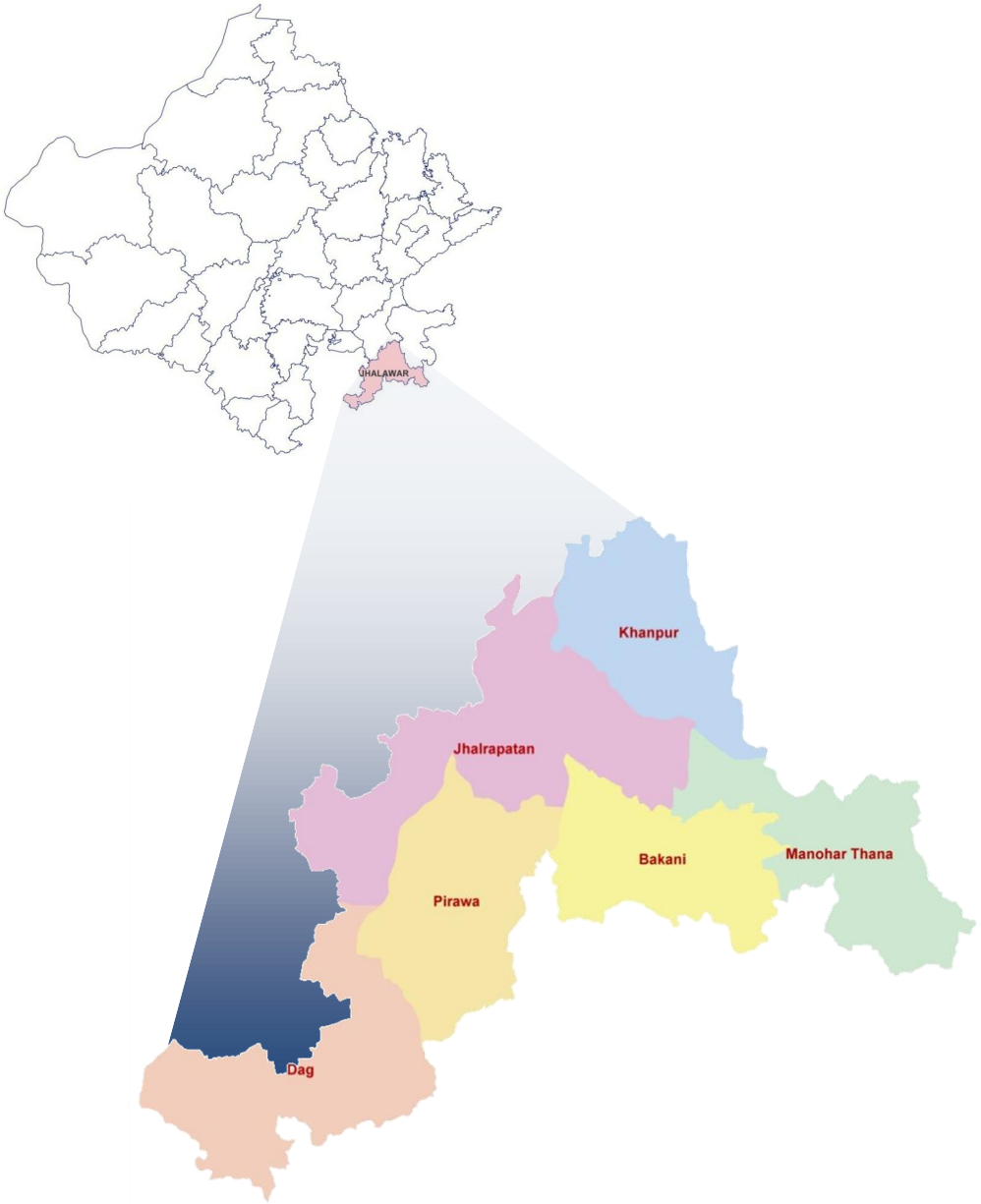
Hydrogeological Atlas of Rajasthan

Jhalawar District



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2013

ADMINISTRATIVE SETUP

DISTRICT – JHALAWAR

Location:

Jhalawar district is located in the southeastern part of Rajasthan. It is bounded in the north by Kota and Baran districts, in the south and southwest by state of Madhya Pradesh and in the northeast by Baran district. It stretches between 23° 44' 41.51" to 24° 52' 32.63" North latitude and 75° 27' 34.78'' to 76° 57' 30.55'' East longitude covering an area of 6,315.2 sq km. Major part of the district have a systematic drainage system, as the whole district is part of 'Chambal River' Basin.

Administrative Set-up:

Jhalawar district is administratively divided into six 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	Bakani	1,60,267	861.0	13.6	327
2	Dag	1,75,059	1,126.4	17.8	232
3	Jhalrapatan	3,19,720	1,501.7	23.8	319
4	Khanpur	1,53,370	844.1	13.4	207
5	Manohar Thana	1,88,825	966.7	15.3	304
6	Pirawa	1,83,082	1,015.3	16.1	219
Total		**11,80,323**	**6,315.2**	**100.0**	**1,608**

Jhalawar district has 1,608 towns and villages of which six are block headquarters as well.

Climate:

The climate of the area is more similar to that of the Indo-Gangetic Plains, with hot summer and delightfully cold winters than to the typical arid parts of Rajasthan. In summer maximum temperature is 47 °C and in winter minimum temperature is 9.5 °C. The monsoon season spread over months of July to September is however, quite unlike and very distinct from the oppressive humid climate of the North IndianPlains. Jhalawar district is known for the highest rainfall in the Rajasthan state. An average of 781.2 mm of rainfall keeps it cool, and gentle breezes ward off the high humidity.

Ground Water Department, Rajasthan

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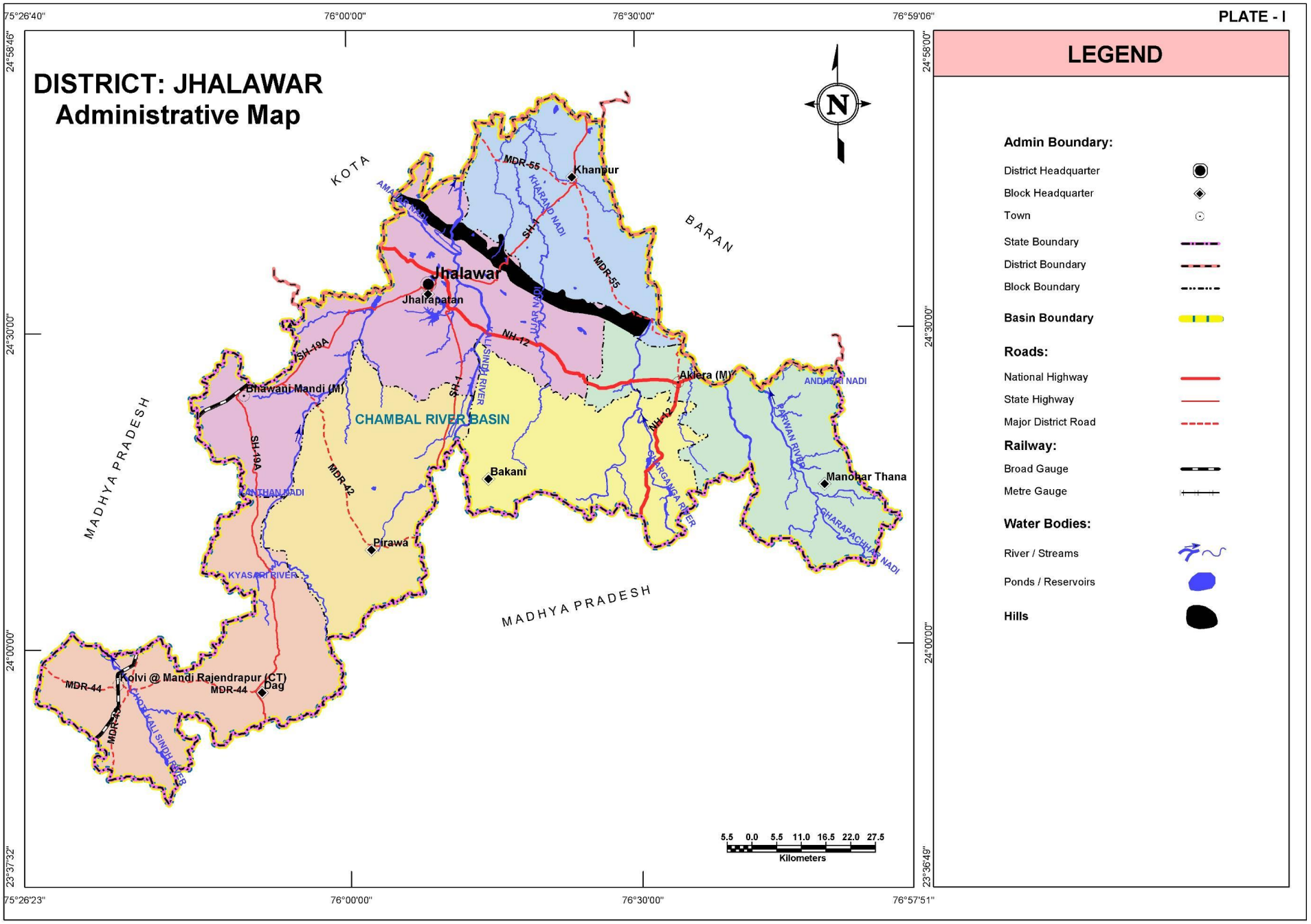
PLATE - I



LEGEND

Admin Boundary:

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

Roads:

- National Highway
- State Highway
- Major District Road

Railway:

- Broad Gauge
- Metre Gauge

Water Bodies:

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

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TOPOGRAPHY

DISTRICT – JHALAWAR

Topographically, the district is an area of rounded hills interspersed by plains in the South and undulating plains in the North. General elevation range is 300-350 m falls under most of the blocks in the district. The entire district belongs to the Chambal river basin. The main rivers of the district are Parwan, Charganga, Kalisindh and Kyasari which are north flowing. The general topographic elevation in the district is between 300-350 m above mean sea level in most of the blocks. Elevation ranges from a minimum of 250.0 m above mean sea level in Khanpur block in the North part of the district and maximum of 523.7 m above mean sea level In Dag in SW part of the district.

Table: Block wise minimum and maximum elevation

S. No.	Block Name	Minimum Elevation (m amsl)	Maximum Elevation (m amsl)
1	Bakani	303.2	466.2
2	Dag	360.3	523.7
3	Jhalrapatan	261.8	471.4
4	Khanpur	250.0	399.5
5	Manohar Thana	295.7	477.1
6	Pirawa	308.9	473.9

RAINFALL

The rainfall is fairly good in this district. The general distribution of rainfall across can be visualized from isohyets presented in the Plate III. Rainfall ranges from 600-700 mm received in most of the district and 700-800 mm in West and East of the district. The total annual average rainfall is 663.5 mm based on the data of available blocks. Maximum rainfall occurs in Jhalrapatan block (825.4 mm) whereas minimum also in Jhalrapatan block (528.4 mm). Maximum average annual rainfall is recorded in Pirawa block about 706.9mm.

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)
Bakani	599.5	720.6	670.7
Dag	559.9	747.1	645.3
Jhalrapatan	528.4	825.4	672.0
Khanpur	535.9	745.1	666.2
Manohar Thana	570.0	680.6	619.9
Pirawa	626.6	751.6	706.9

PLATE - II

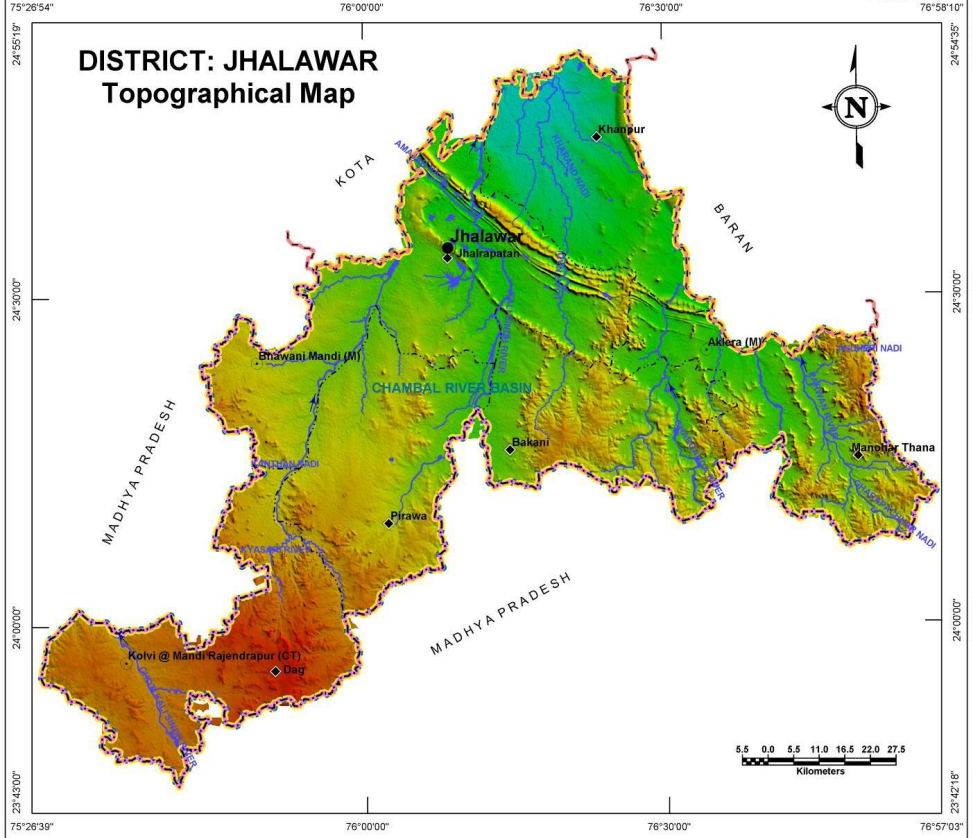
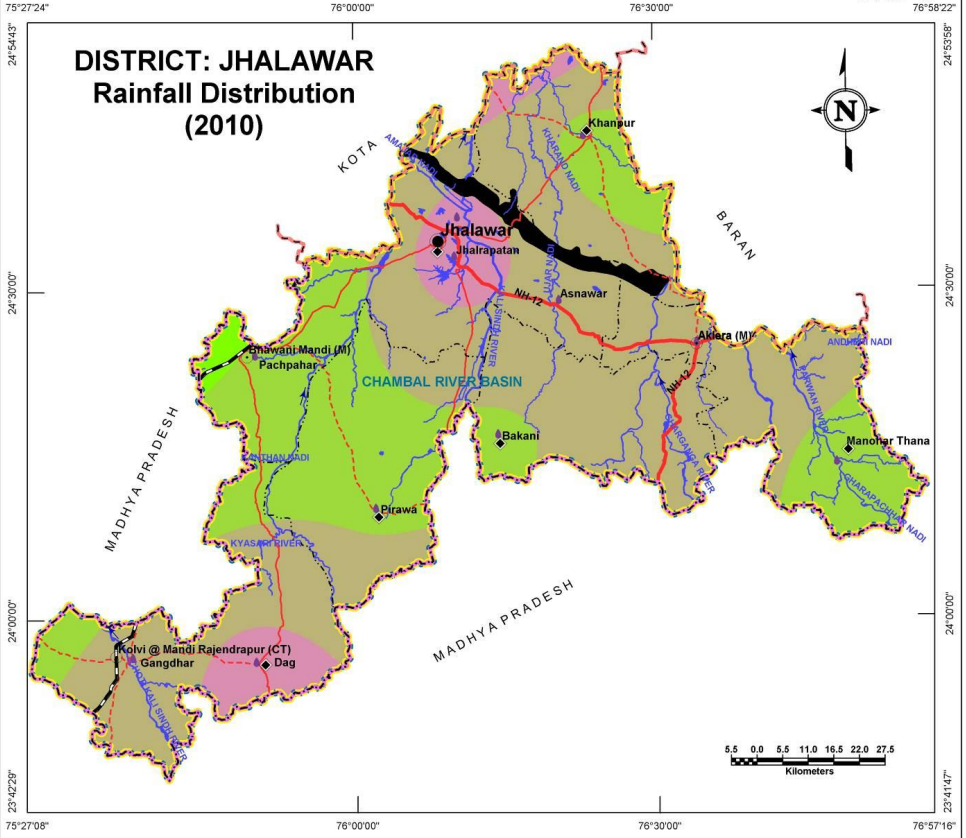


PLATE - III



LEGEND

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

Basin Boundary

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Elevation (m amsl):

524
500
450
400
350
300
250

Source : SRTM DEM

LEGEND

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

Basin Boundary

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

Railway:
- Broad Gauge
- Metre Gauge

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Hills

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

GEOLOGY

DISTRICT – JHALAWAR

Geologically, the district is occupied by Deccan traps which cover almost 70% area along with the rocks of Vindhyan Super Group. The Vindhyan Super Group represented by Semri, Kaimur, Rewa and Bhander Groups which consist of sandstone, shale and limestone. The Vidhyan sandstone and shales form linear hills trending northwest to southeast. They are exposed around Jhalawar and to its northeast and northwest.

Super Group	Group	Formation
	Recent to Sub-Recent	Alluvium and soil
	Deccan traps	Basaltic flows with interatrappean beds
------X--------X--------X--------X---Unconformity---X--------X--------X-------X-------		
Vindhyan	Bhander	Shales with siltstone limestone intercalation Sandstone with shale intercalations of Impure argillaceous stromatolitic limestone, variegated shale
	Rewa	Sandstone grit and conglomerate with shale Brown, purple, green color shales
	Kaimur	Sandstone, grit and conglomerate
	Semri	Brown, purple and grey color shale, Limestone and, Sandstone with intercalated shale

GEOMORPHOLOGY

Table: Geomorphologic units, their description and distribution

Origin	Landform Unit	Description
Aeolian	Eolian Plain	Formed by aeolian activity, with sand dunes of varying height, size, slope. Long stretches of sand sheet. Gently sloping flat to undulating plain, comprised of fine to medium grained sand and silt. Also scattered xerophytic vegetation.
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	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.
	Water logged/ Wetland	Area submerged in water or area having very shallow water table. So that it submerges in water during rainy season.
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

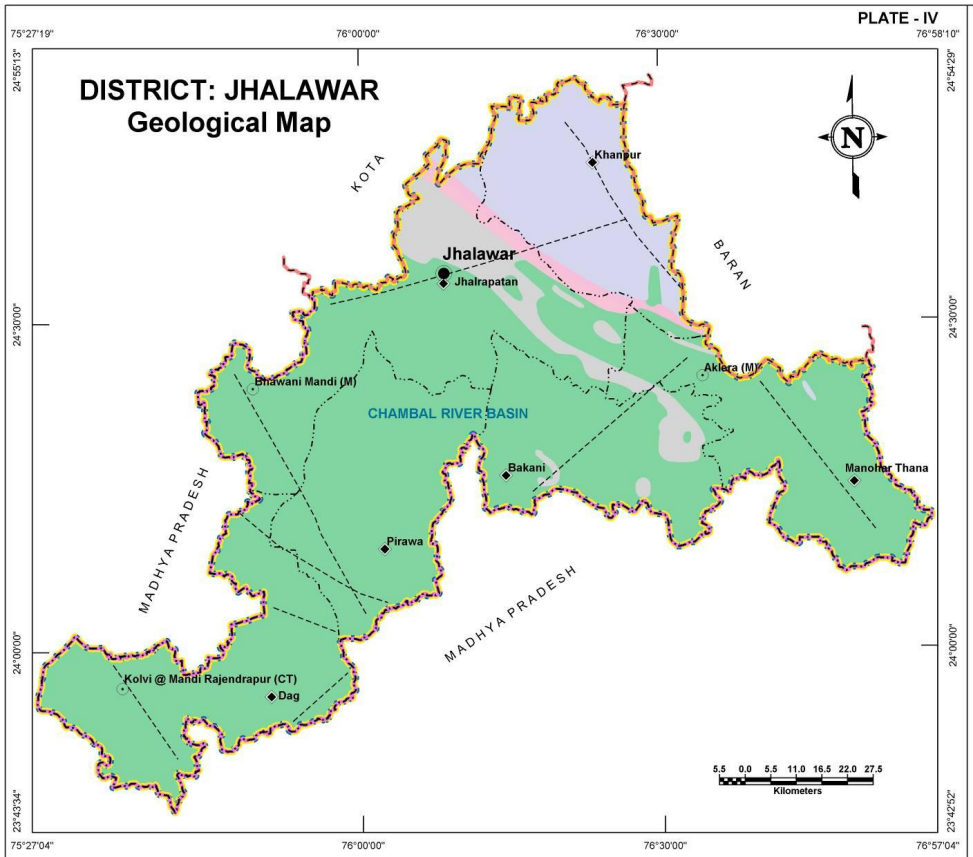
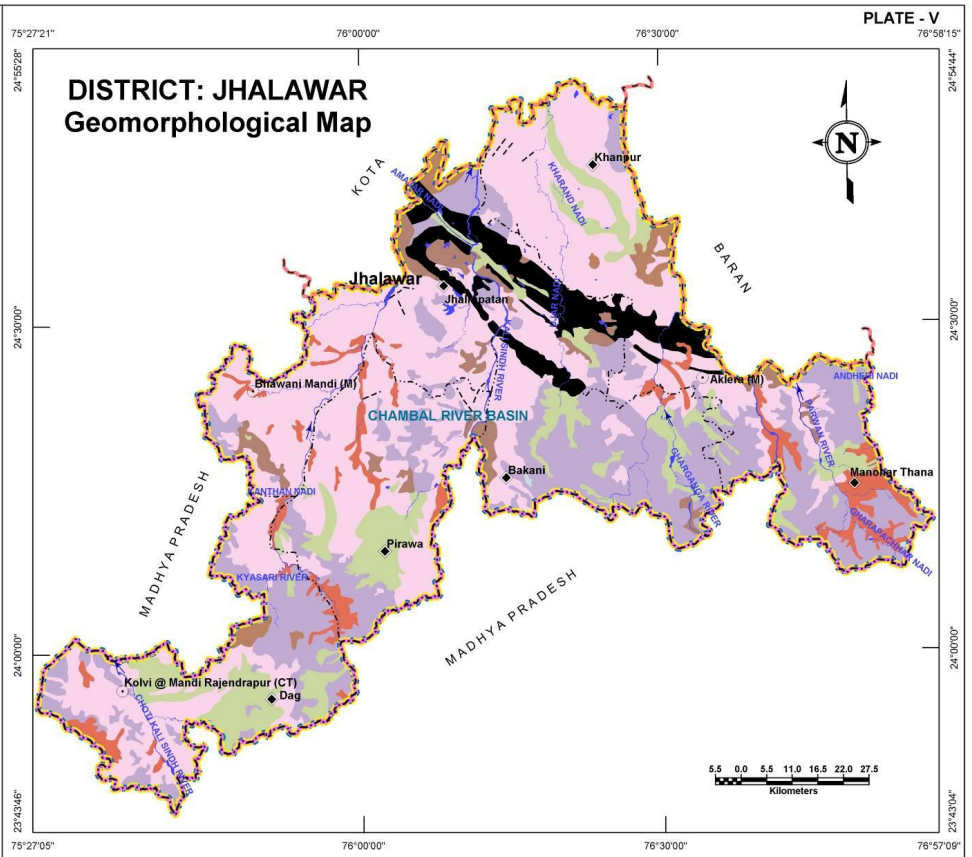


PLATE - V



LEGEND

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

Basin Boundary

Structural Features:
- Lineament

Geology:
- Bhander Group
- Rewa Group
- Kaimur Group
- Khorip Group
- Deccan Traps

Source: District Resource Map of Rajasthan - GSI

LEGEND

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

Basin Boundary

Water Bodies:
- River/Ponds/Reservoirs

Structural Features:
- Fault/Fractures/Lineament

Hills:
- Structural/Denudational/Linear Ridge

Landform Units:

Fluvial Origin:
- Valley Fill
- Ravine
- Waterlogged Area

Denudational Origin:
- Pediment
- Burried Pediment

Structural Origin:
- Dissected Plateau

Aeolian Origin:
- Eolian Plain

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

AQUIFERS

DISTRICT – JHALAWAR

Weathered, fractured and jointed openings in hardrocksconstitute good aquifer along with primary openings in sandstone. There are no aquifers formed in sandy or alluvial material in the district. Of the hardrocks, Basalts are most prominent aquifer forming material as more than 76% of district's aquifers are formed within basalt only. Next in prominence are sandstones of Vindhyan Super Group which occupy about 14% of district's aquifer area and a small part of aquifers is formed within shales accounting for just about 8%. About 110sq km area is covered by low hills.

Table: aquifer potential zones their area and their description

Aquifer in Potential Zone	Area (sq km)	% age of district	Description of the unit/Occurrence
Sandstone	867.9	13.7	Fine to medium grained, red colour and compact and at places.
Shale	516.7	8.2	Grey, light green and purple in colour and mostly splintery in nature.
Basalt	4,820.8	76.4	Dark grey, olive green and green colour, compact, vesicular, amygdaloidal and weathered.
Hills	109.8	1.7	
Total	**6,315.2**	**100.0**	

STAGE OF GROUND WATER DEVELOPMENT

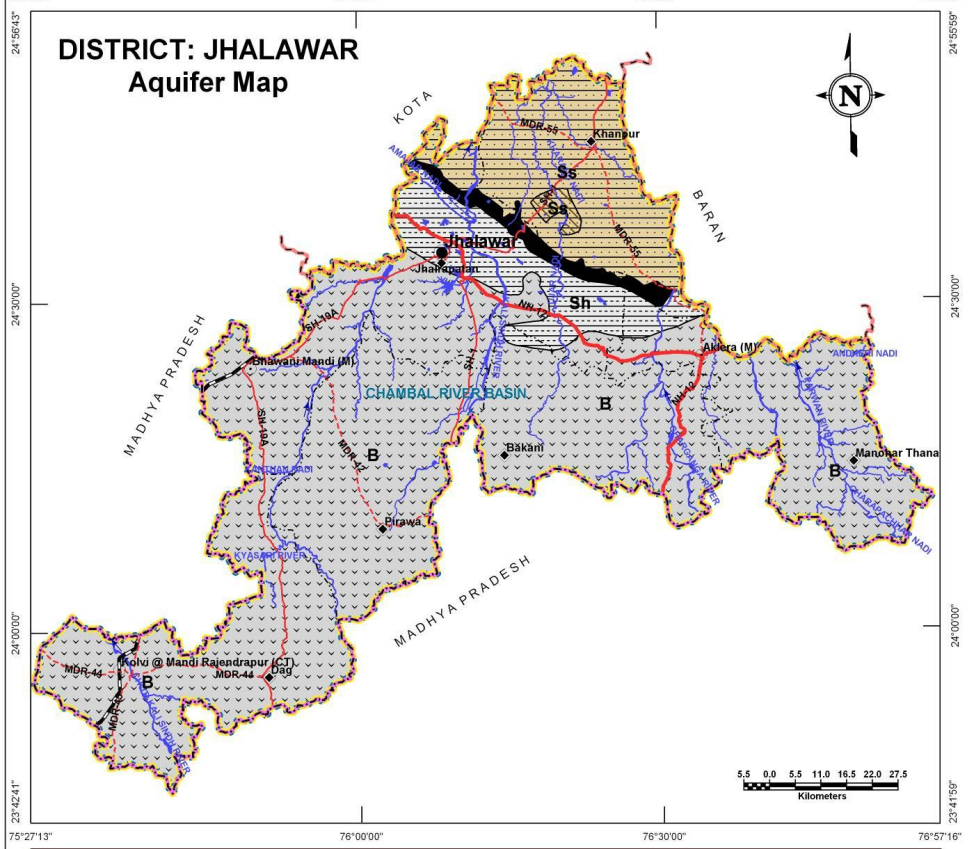
Ground water resource estimation studies reveal that the dynamic resource is under stress and in most part of the district the exploitation is being done from static resources. The Khanpur block falls under 'Critical' category on the basis of stage of development which is close to 100%. All the remaining 6 blocks fall within 'Over Exploited' category because the current stage of development of ground water resource exceeds 100% and it is recommended that the exploitation of ground water should not be resorted to anymore so as to prevent further depletion of dynamic resource.

Categorization on the basis of stage of development of ground water	Block Name
Critical	Khanpur
Over Exploited	Pirawa, Manohar, Thana, Bakani, Jhalrapatan, Dag

Basis for categorization: Ground water development <=100% - Critical and >100% - Over-Exploited.

PLATE - VI

DISTRICT: JHALAWAR
Aquifer Map



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Admin Boundary:
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- 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

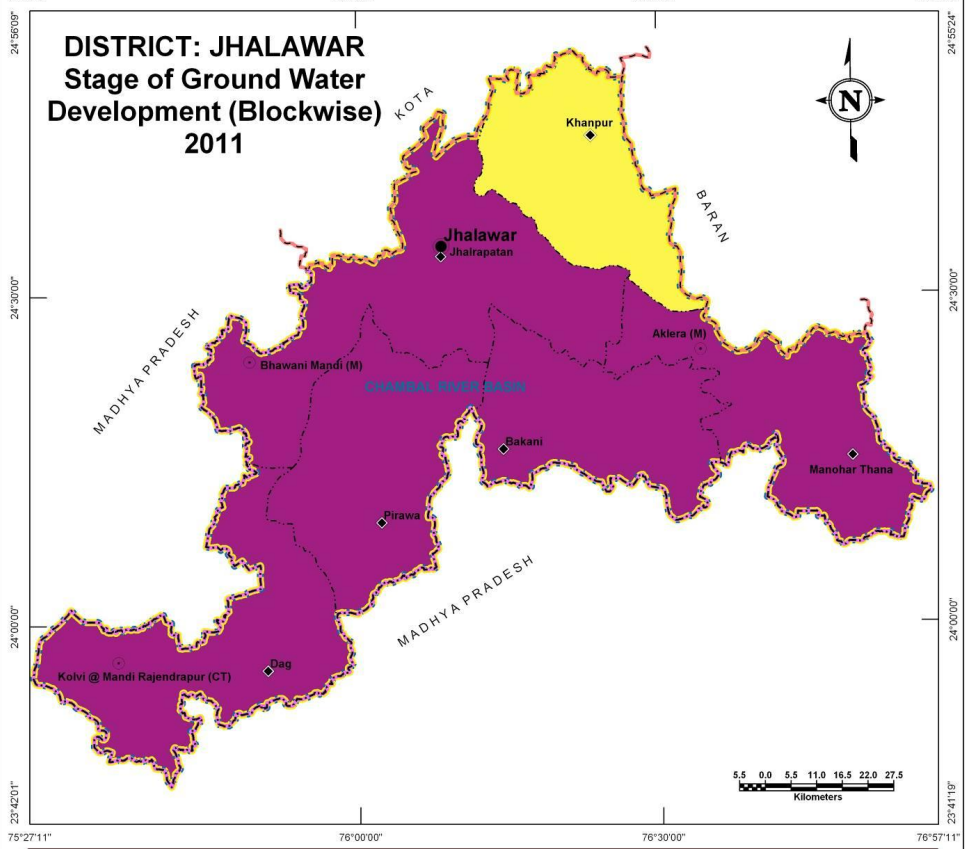
Command Area

Aquifer:
- Sandstone
- Shale
- Basalt

Source: Ground Water Potential Zone Map - GWD, Rajasthan

PLATE - VII

DISTRICT: JHALAWAR
Stage of Ground Water Development (Blockwise) 2011



LEGEND

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

Stage of Ground Water Development:
- Critical
- Over-Exploited

Source: Ground Water Department, Rajasthan

LOCATION OF EXPLORATORY AND GROUND WATER MONITORING WELLS DISTRICT – JHALAWAR

Jhalawar district has a well distributed network of exploratory wells (74) and ground water monitoring stations (247) in the district owned by RGWD (57 and 225 respectively) and CGWB (17 and 22 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 monitoring, 9 additional wells in Jhalrapatan block 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
Bakani	3	13	**16**	1	32	**33**	0	0
Dag	-	11	**11**	6	31	**37**	0	0
Jhalrapatan	12	12	**24**	10	49	**59**	0	9
Khanpur	-	8	**8**	1	33	**34**	0	0
Manohar Thana	1	5	**6**	3	49	**52**	0	0
Pirawa	1	8	**9**	1	31	**32**	0	0
Total	**17**	**57**	**74**	**22**	**225**	**247**	**0**	**9**

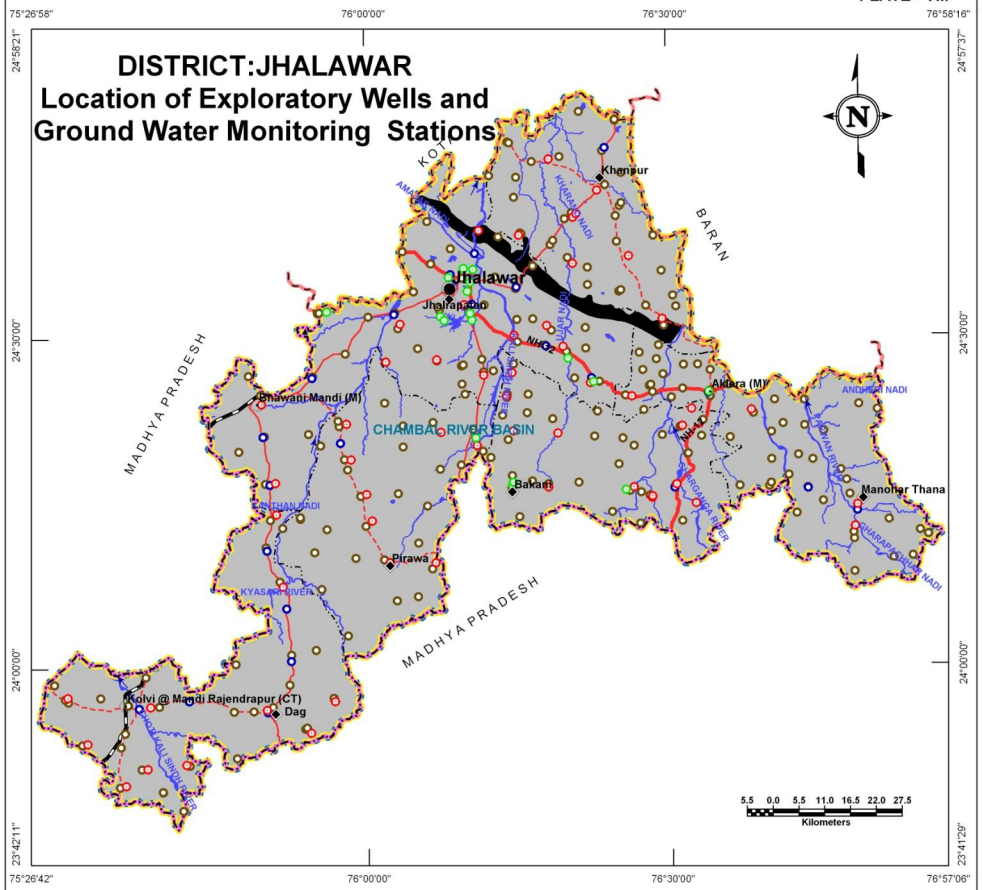
DEPTH TO WATER LEVEL (PRE MONSOON – 2010)

In spite of being a predominantly hard rock area, the district shows moderate variation in depth to ground water levels as most part of the district shows levels of less than 10m bgl to 20m bgl only and rarely reaching 40m at places. Shallow water levels of less than 10m bgl are seen in a narrow strip in the Manohar Thana-Khanpur-Bakani-Jhalrapatan region and also as isolated patches in Dag and Pirawa blocks. Deeper water levels of more than 30m bgl are found in southern part of Dag block, occasionally reaching more than 40m bgl.

Depth to water level (m bgl)	Block wise area coverage (sq km) *						Total Area (sq km)
	Bakani	Dag	Jhalrapatan	Khanpur	Manohar Thana	Pirawa	
< 10	164.3	35.3	271.5	28.7	266.2	292.3	**1,058.3**
10-20	693.6	921.8	1,133.0	723.5	698.5	690.3	**4,860.7**
20-30	3.1	144.7	21.8	59.4	-	32.7	**261.7**
30-40	-	24.5	-	-	-	-	**24.5**
> 40	-	0.2	-	-	-	-	**0.2**
Total	**861.0**	**1,126.5**	**1,426.3**	**811.6**	**964.7**	**1,015.3**	**6,205.4**

* 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

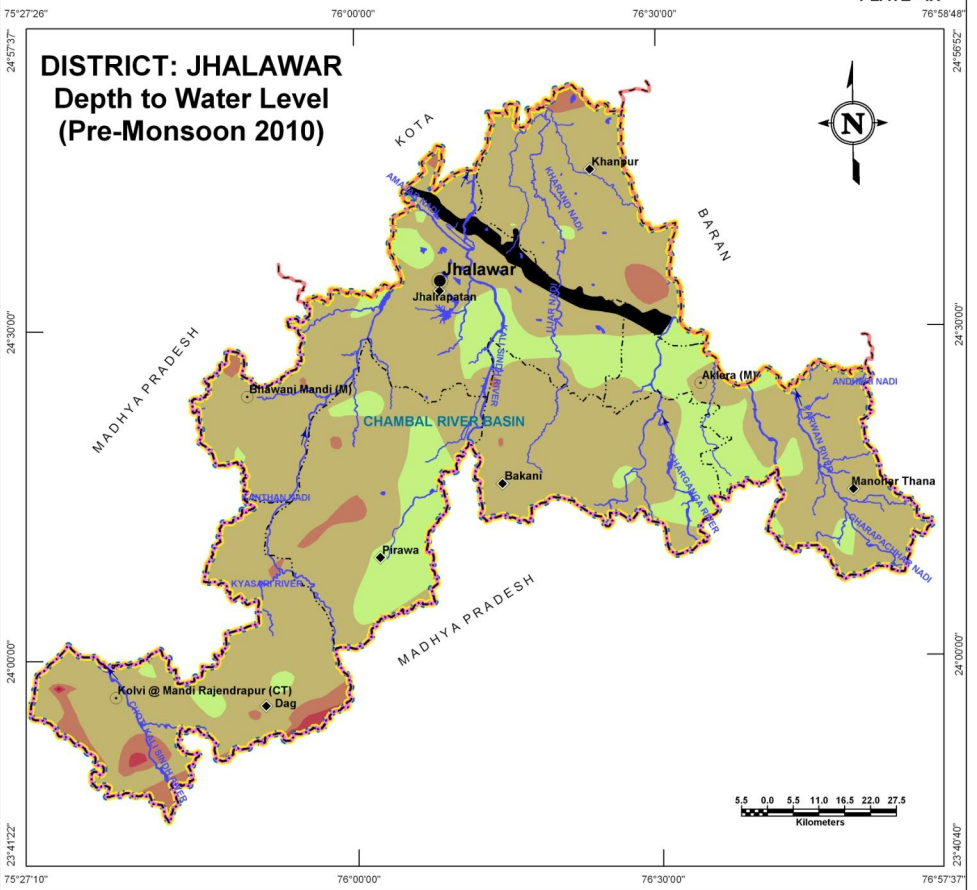
Railway:
- Broad Gauge
- Metre Gauge

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) DISTRICT – JHALAWAR

Plate – X shows water table contours between 260m above mean sea level to 400m amsl implying a generally high water table in the district with about 140m of variation. The South, Southeastern Western part of the district falls under the higher elevation ranges whereas North parts comes under the lower elevation ranges. Water table elevation highest reaching up to >400m amsl in Southwest part of Pirawa and Dag blocks of the district whereas minimum elevation (<260m amsl) in the Khanpur block.

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

Water table elevation range (amsl)	Block wise area coverage (sq km)						Total Area (sq km)
	Bakani	Dag	Jhalrapatan	Khanpur	Manohar Thana	Pirawa	
< 260	-	-	-	8.6	-	-	**8.6**
260 - 280	-	-	1.5	254.6	-	-	**256.1**
280 - 300	-	-	99.2	351.7	-	-	**450.9**
300 - 320	28.7	-	416.3	196.7	182.1	-	**823.8**
320 - 340	290.5	-	388.2	-	279.2	86.2	**1,044.1**
340 - 360	302.5	-	279	-	274.4	245.8	**1,101.7**
360 - 380	185.6	18	123.3	-	188.1	322.7	**837.7**
380 - 400	52.2	439.2	92.2	-	32.8	233.1	**849.5**
> 400	1.5	669.3	26.6	-	8.1	127.5	**833.0**
Total	**861.0**	**1,126.5**	**1,426.3**	**811.6**	**964.7**	**1,015.3**	**6,205.4**

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 by more than16m, as seen in Plate – XI. The negative fluctuation areas (indicated by pink and red regions) are the areas where water level in the post-monsoon season has actually gone down with respect to pre-monsoon levels. Such ground water depletion areas are located in the southern part of the Khanpur and eastern part of Bhawani Mandi city. Rest of the district has shown a general rise in ground water level in the post monsoon season between 0 to 6m. Maximum rise of more than 16m is noticed in the northern part of Jhalrapatan.

Table: Block wise area covered in each water fluctuation zone

Block Name	Block wise area coverage (sq km) per water level fluctuation range (m)													Total Area (sq km)
	< -6	-6 to -4	-4 to -2	-2 to 0	0 to 2	2 to 4	4 to 6	6 to 8	8 to 10	10 to 12	12 to 14	14 to 16	> 16	
Bakani	-	-	-	7.3	225.1	391.4	208.2	21.6	4.1	1.9	1.4	-	-	**861.0**
Dag	-	-	-	-	162.5	568.6	292.4	66.7	29.9	6.4	-	-	-	**1,126.5**
Jhalrapatan	-	-	-	9.3	304.3	642.3	274.7	130.3	46.1	15.1	2.7	1.3	0.2	**1,426.3**
Khanpur	4.1	14	40.5	79	242.4	247.3	112.8	49.5	20.8	1.2	-	-	-	**811.6**
Manohar Thana	-	-	-	-	284.5	580.5	90.9	8.8	-	-	-	-	-	**964.7**
Pirawa	-	-	4.7	69.3	315.9	316.4	278.2	30.8	-	-	-	-	-	**1,015.3**
Total	**4.1**	**14**	**45.2**	**164.9**	**1,534.7**	**2,746.5**	**1,257.2**	**307.7**	**100.9**	**24.6**	**4.1**	**1.3**	**0.2**	**6,205.4**

PLATE - X

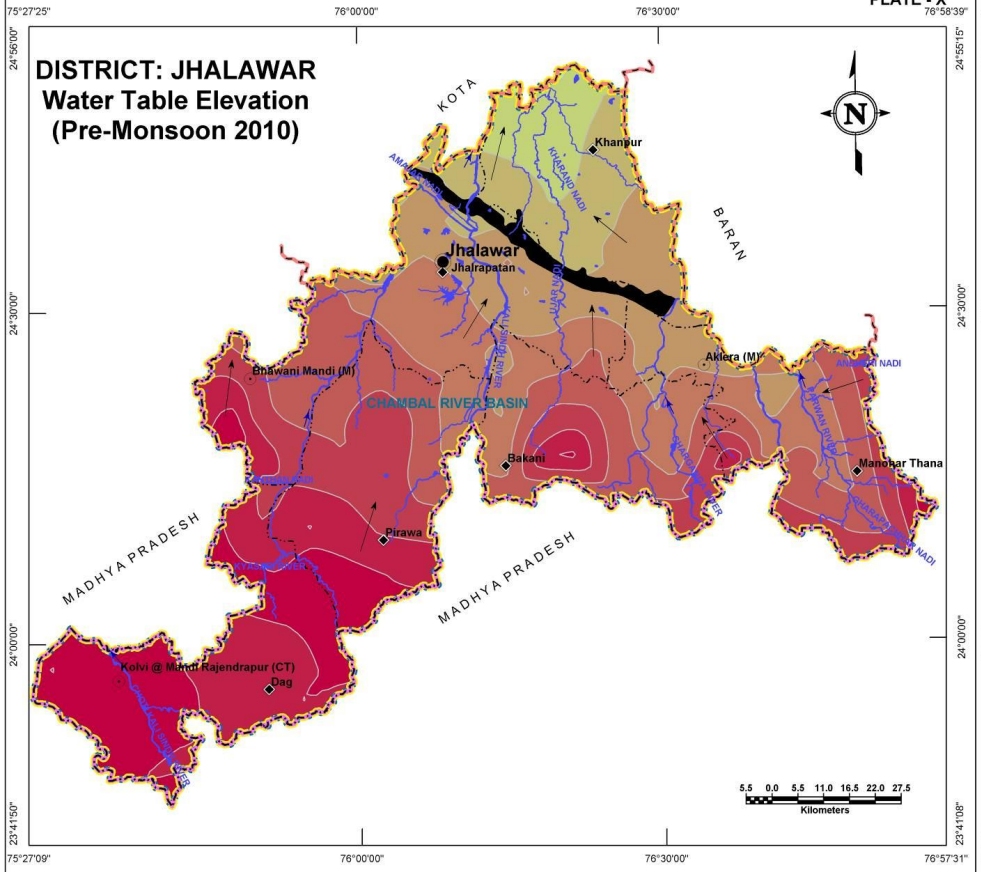
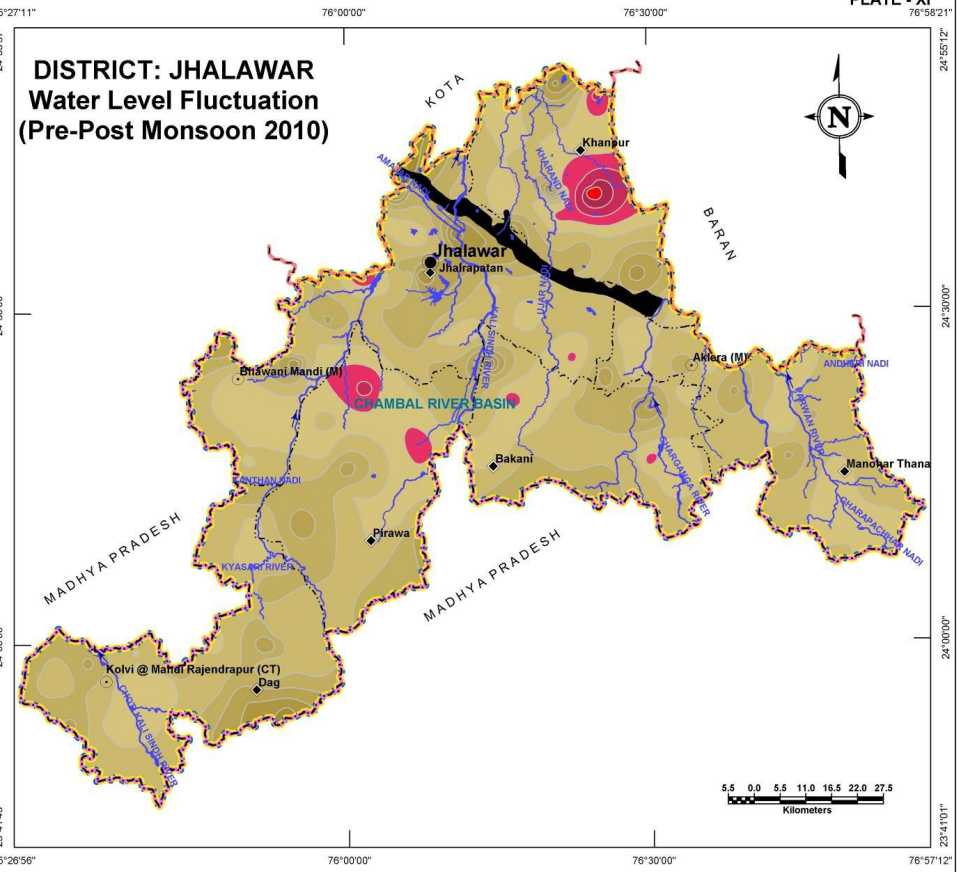


PLATE - XI



LEGEND

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

Basin Boundary

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Hills

Water Table Elevation

Water Table Elevation (m amsl):
- <260
- 260 - 280
- 280 - 300
- 300 - 320
- 320 - 340
- 340 - 360
- 360 - 380
- 380 - 400
- >400

LEGEND

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

Basin Boundary

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Hills

Water level Fluctuation(m):
- <-6
- -6 to -4
- -4 to -2
- -2 to 0
- 0 to 2
- 2 to 4
- 4 to 6
- 6 to 8
- 8 to 10
- 10 to 12
- 12 to 14
- 14 to 16
- >16

GROUND WATER ELECTRICAL CONDUCTIVITY DISTRIBUTION DISTRICT – JHALAWAR

The Electrical conductivity (at 25°C) distribution map is presented in Plate – XII. The areas with low EC values in ground water (<2000 µS/cm) are shown in yellow color which occupy almost 87% of the district area indicating that, by and large the ground water in this region is suitable for domestic purpose. The areas with moderately high EC values (2000 - 4000 µS/cm) are shown in green color and occupy 11% of the district area, largely western part of the district. Remaining small part of the district approximately 1% has high EC values in ground water (>4000 µS/cm) is shown in red color, largely southern part of Bhawani Mandi where 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)
	Bakani		Dag		Jhalrapatan		Khanpur		Manohar Thana		Pirawa		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
< 2000	861.0	100.0	1,123.9	99.8	940.2	65.9	806.7	99.4	935.3	97.0	744.1	73.3	**5,411.2**
2000-4000	-	-	2.6	0.2	406.2	28.5	4.9	0.6	29.4	3.0	269.2	26.5	**712.3**
>4000	-	-	-	-	79.9	5.6	-	-	-	-	2.0	0.2	**81.9**
Total	**861.0**	**100.0**	**1,126.5**	**100.0**	**1,426.3**	**100.0**	**811.6**	**100.0**	**964.7**	**100.0**	**1,015.3**	**100.0**	**6,205.4**

GROUND WATER CHLORIDE DISTRIBUTION

High chloride concentration in ground water also renders it unsuitable for domestic and other purposes. The yellow colored regions in Plate – XIII are such areas where chloride concentration is low (<250 mg/l) that occupy approximately 85% of the district area and is suitable for all purposes. The areas with moderately high chloride concentration (250-1000mg/l) are shown in green color,which occupy approximately 14% of the district area, largely in the western part of the district. Remaining small part of the district about 1%, falls under high chloride concentration (>1000 mg/l) area is shown in red color, largely in the southern part of Bhawani Mandi where the ground water is not 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)
	Bakani		Dag		Jhalrapatan		Khanpur		Manohar Thana		Pirawa		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
< 250	850.0	99.0	1,120.6	99.0	885.3	62.0	802.8	99.0	928.9	96.0	707.1	70.0	**5,294.7**
250-1000	11.0	1.0	5.9	1.0	488.5	34.0	8.8	1.0	35.8	4.0	306.1	30.0	**856.1**
> 1000	-	-	-	-	52.5	4.0	-	-	-	-	2.1	-	**54.6**
Total	**861.0**	**100.0**	**1,126.5**	**100.0**	**1,426.3**	**100.0**	**811.6**	**100.0**	**964.7**	**100.0**	**1,015.3**	**100.0**	**6,205.4**

PLATE - XII

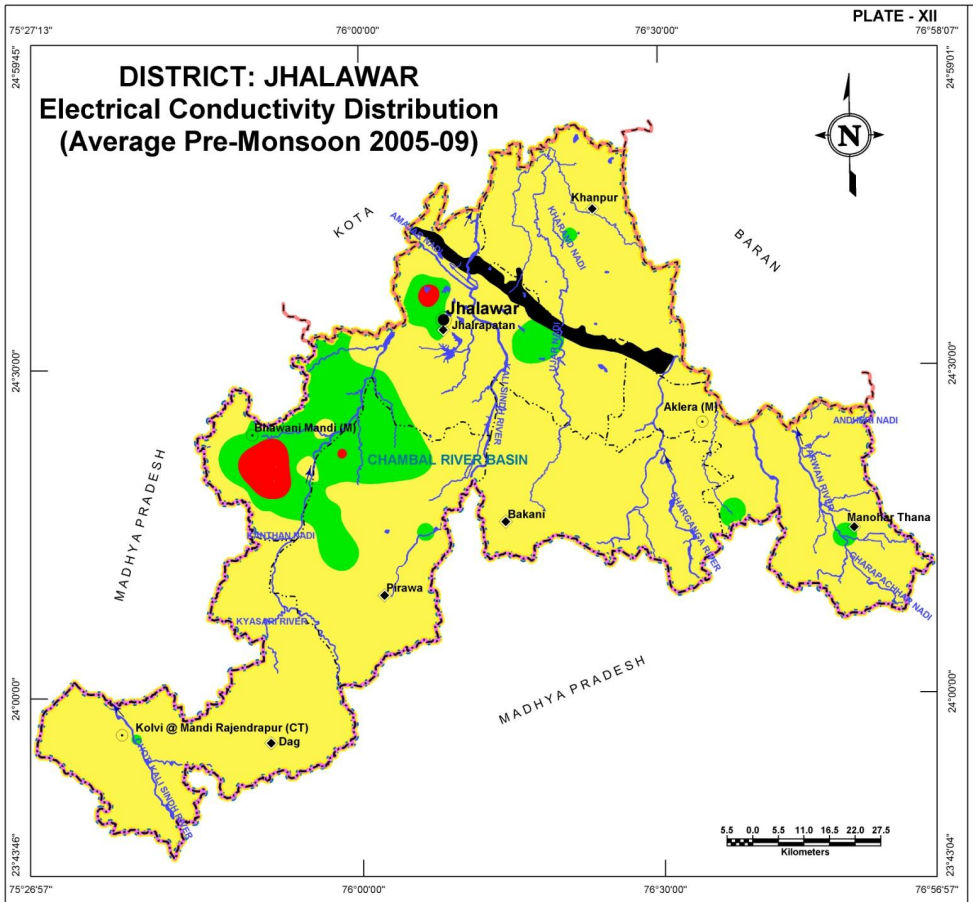
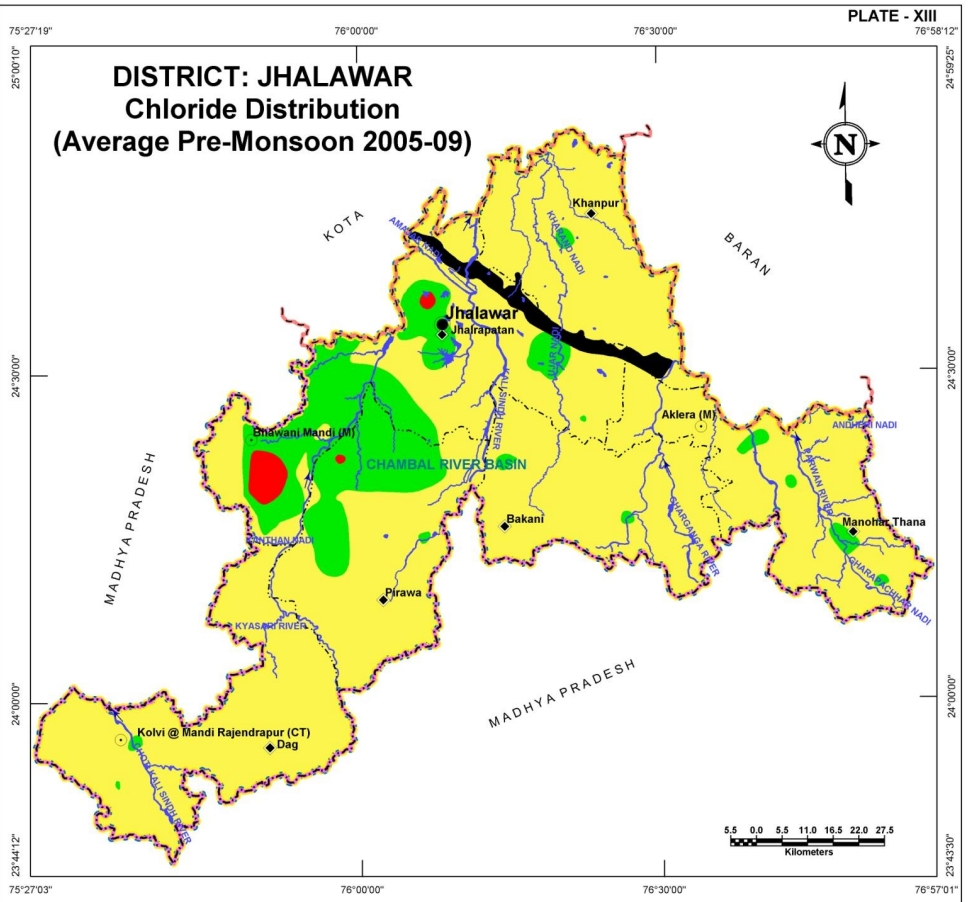


PLATE - XIII



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 (µS/cm at 25°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 – JHALAWAR

The Fluoride concentration map is presented in Plate – XIV.The areas with low concentration (i.e.,>1.5 mg/l) are shown in yellow color and occupies almost whole of the district (99% of the district area)hasground water that is suitable for domestic purpose. The areas with moderately high concentration (1.5-3.0 mg/l) in green color patches and high Fluoride concentration (>3.0 mg/l) in red color occupy negligibly small areas of the district (approximately 1%) where ground water is not suitable for domestic purpose.

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)
	Bakani		Dag		Jhalrapatan		Khanpur		Manohar Thana		Pirawa		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
< 1.5	860.1	99.9	1,122.7	99.7	1,365.1	95.7	811.6	100.0	964.7	100.0	998.0	98.3	**6,122.2**
1.5-3.0	0.9	0.1	3.8	0.3	27.9	2.0	-	-	-	-	17.3	1.7	**49.9**
> 3.0	-	-	-	-	33.3	2.3	-	-	-	-	-	-	**33.3**
Total	**861.0**	**100.0**	**1,126.5**	**100.0**	**1,426.3**	**100.0**	**811.6**	**100.0**	**964.7**	**100.0**	**1,015.3**	**100.0**	**6,205.4**

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 nitrate concentration (<50 mg/l) areas are shown in yellow color occupying approximately 49% 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 and occupy approximately 45% of the district area. Remaining part of the district area is covered has high nitrate concentration (>100 mg/l) which is shown in red color, largely in the southwestern and central part of the district 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)
	Bakani		Dag		Jhalrapatan		Khanpur		Manohar Thana		Pirawa		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
< 50	472.1	54.8	345.7	30.7	623.0	43.7	549.8	67.8	695.1	72.0	375.1	36.9	**3,060.8**
50-100	317.9	36.9	640.8	56.9	790.6	55.4	260.1	32.0	235.2	24.4	578.2	56.9	**2,822.8**
>100	71.0	8.3	140.0	12.4	12.7	0.9	1.7	0.2	34.4	3.6	62.0	6.2	**321.8**
Total	**861.0**	**100.0**	**1,126.5**	**100.0**	**1,426.3**	**100.0**	**811.6**	**100.0**	**964.7**	**100.0**	**1,015.3**	**100.0**	**6,205.4**

PLATE - XIV

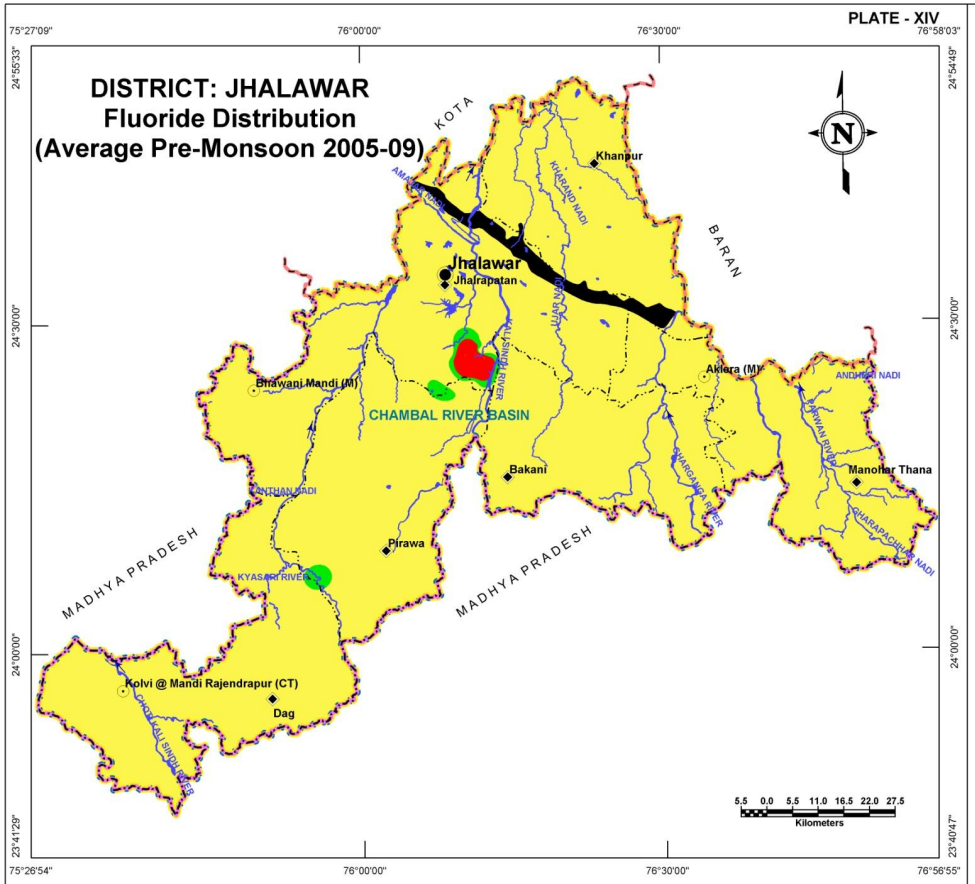
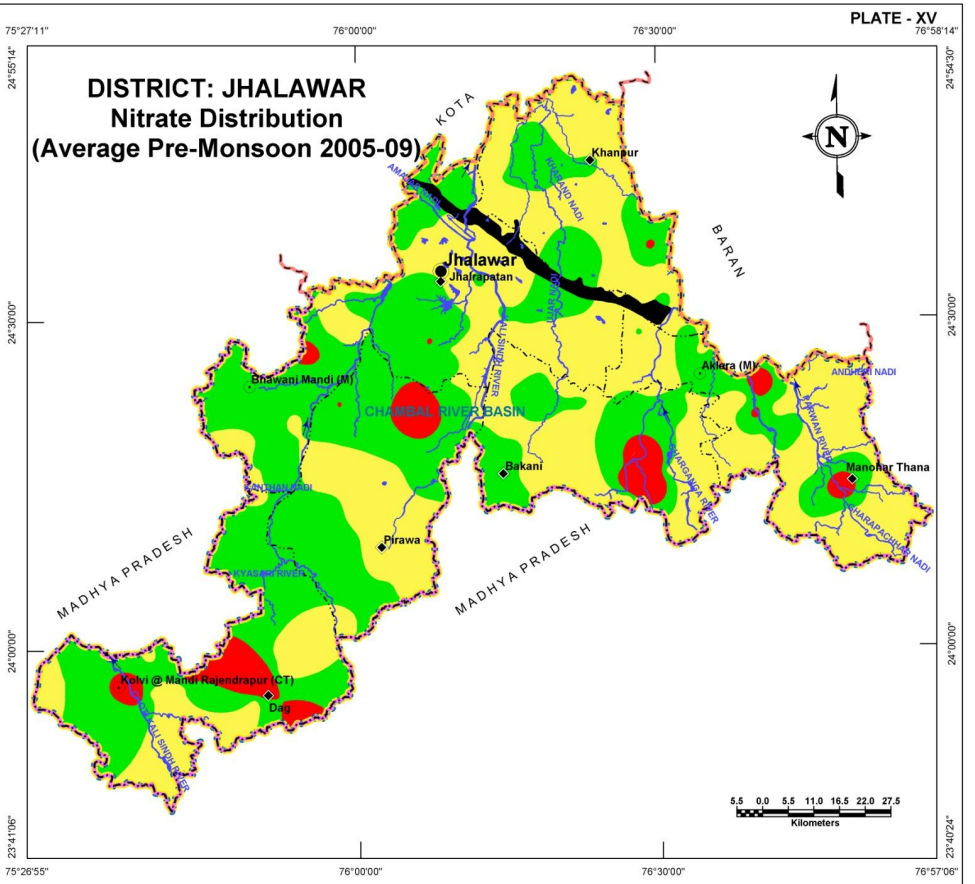


PLATE - XV



LEGEND

Admin Boundary:

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

Basin Boundary

Water Bodies:

- River / Streams
- Ponds / Reservoirs

Hills

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 – JHALAWAR

Plate – XVI depicts the bedrock depth from ground level in Jhalawar district. The beginning of massive bedrock has been considered for defining top of bedrock surface. The major rocks types constituting the bedrock are basalt, sandstones and shale. These rocks are overlain by alluvial deposits of sand, clay, silt and admixture of these in different proportions and thicknesses. The map of depth to bedrock in meters below ground level reveals that the bedrock surface varies from very shallow near hardrock exposures to more than 40m bgl. It is observed from the map that in the entire northern part of the district, the bedrock is closer to the surface (less than 20m bgl) where as we move towards northeastern parts viz. Manohar Thana, central part of Bakani and north and eastern parts of Pirawa block where the bedrock is encountered at depths of 40m bgl. Deeper bedrock occurrences have been reported in isolated patches at Bakani and Manohar Thana blocks.

Depth to bedrock (m bgl)	Block wise area coverage (sq km)												Total Area (sq km)
	Bakani		Dag		Jhalrapatan		Khanpur		Manohar Thana		Pirawa		
	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	Area	%age	
< 20	379.0	44.0	1,126.5	100.0	1,238.9	86.9	808.9	99.7	183.2	19.0	615.8	60.7	**4,352.3**
20-40	395.1	45.9	-	-	187.4	13.1	2.7	0.3	771.5	80.0	399.5	39.3	**1,756.2**
> 40	86.9	10.1	-	-	-	-	-	-	10.0	1.0	-	-	**96.9**
Total	**861.0**	**100.0**	**1,126.5**	**100.0**	**1,426.3**	**100.0**	**811.6**	**100.0**	**964.7**	**100.0**	**1,015.3**	**100.0**	**6,205.4**

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 about 60m. The southeastern part has very thick zones especially in Bakani and Manohar Thana blocks. Rest of the blocks have moderate to low thickness of aquifers in hardrock. Most of the district however, shows the distribution of bedrock of general thickness of upto 40m forming aquifers.

Unconfined aquifer Thickness (m)	Block wise area coverage (sq km)						Total Area (sq km)
	Bakani	Dag	Jhalrapatan	Khanpur	Manohar Thana	Pirawa	
<10	90.1	1,126.5	1,227.5	811.6	215.4	560.3	**4,031.4**
10-20	294.0	-	198.8	-	198.5	435.5	**1,126.8**
20-30	266.8	-	-	-	396.7	19.5	**683.0**
30-40	116.8	-	-	-	128.5	-	**245.3**
40-50	49.0	-	-	-	23.5	-	**72.5**
50-60	42.0	-	-	-	2.1	-	**44.1**
> 60	2.3	-	-	-	-	-	**2.3**
Total	**861.0**	**1,126.5**	**1,426.3**	**811.6**	**964.7**	**1,015.3**	**6,205.4**

PLATE - XVI

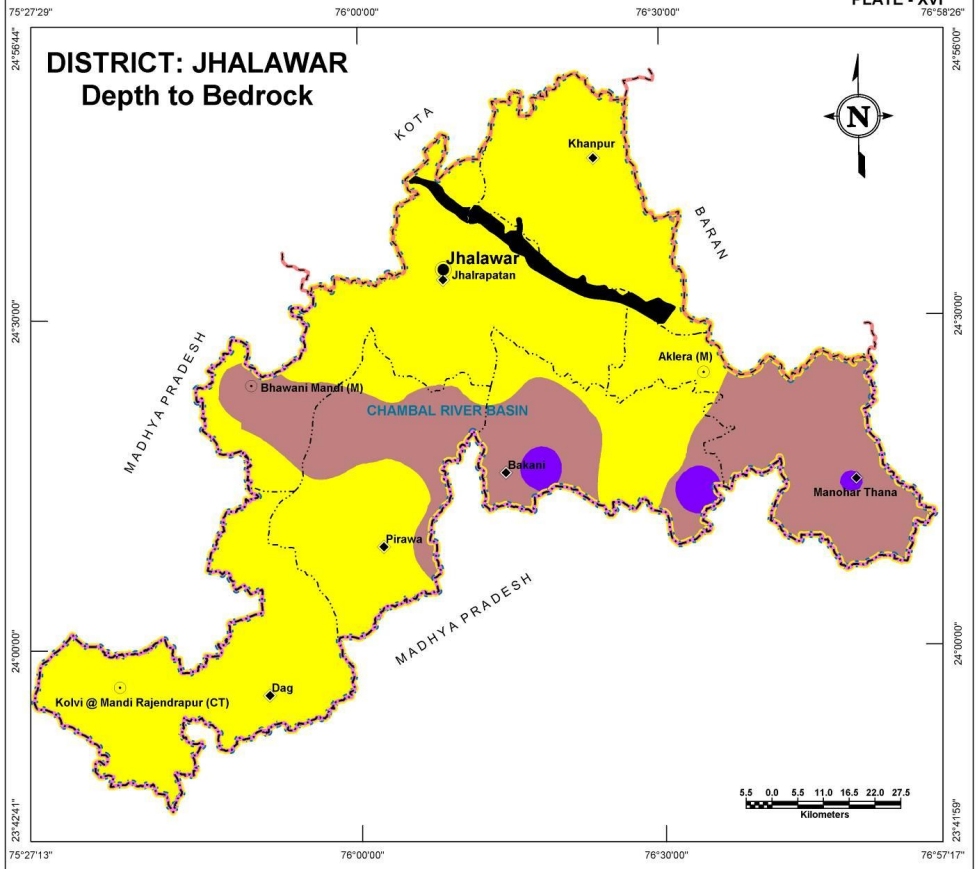
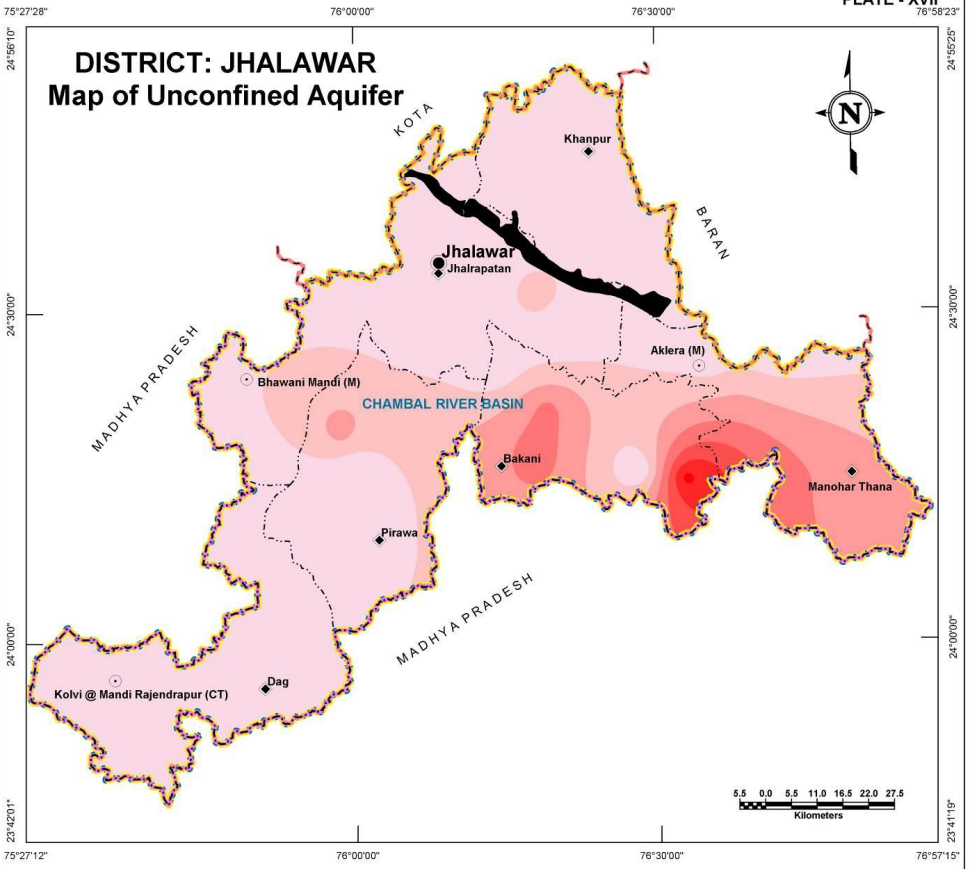


PLATE - XVII



LEGEND

Admin Boundary:

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

Depth to Bedrock (m bgl):

- < 20
- 20-40
- >40

LEGEND

Admin Boundary:

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

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.

(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

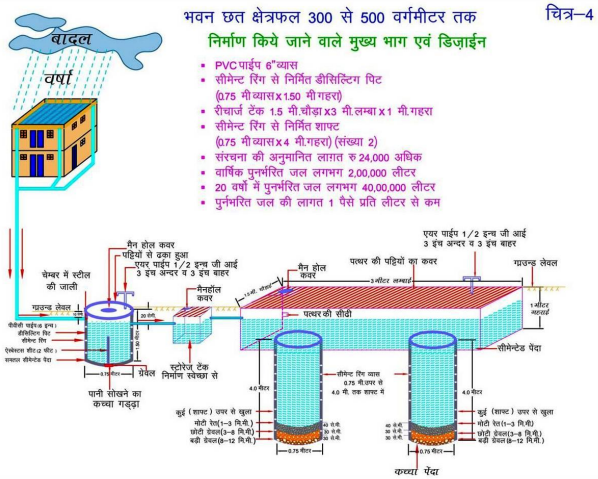
European Union
State Partnership Programme

चित्र–4

भवन छत क्षेत्रफल 300 से 500 वर्गमीटर तक

निर्माण किये जाने वाले मुख्य भाग एवं डिज़ाईन

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

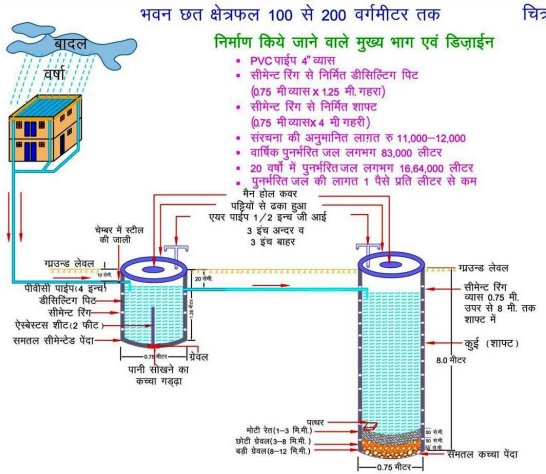


चित्र–2

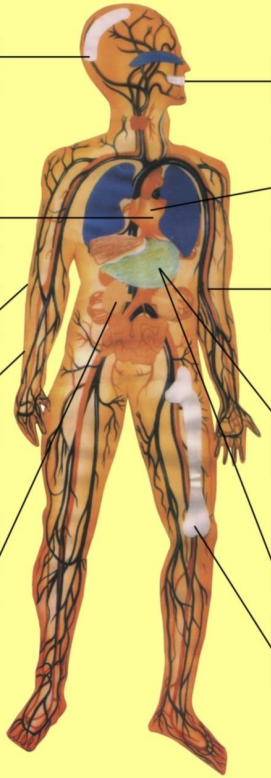
भवन छत क्षेत्रफल 100 से 200 वर्गमीटर तक

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 लाग़त 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



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

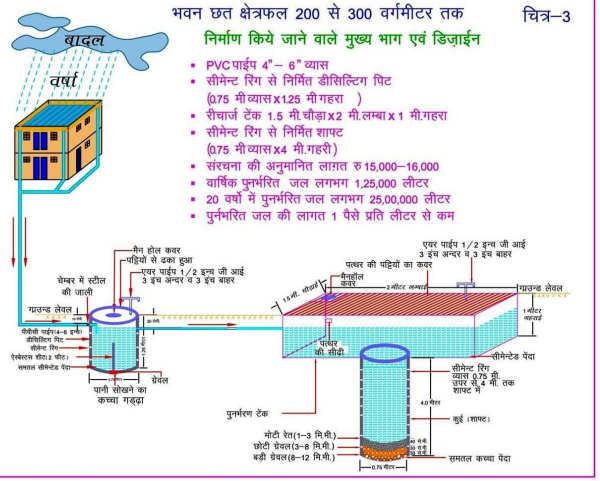
भूजल अमूल्य है इसे प्रदूषित न करें।

चित्र–3

भवन छत क्षेत्रफल 200 से 300 वर्गमीटर तक

निर्माण किये जाने वाले मुख्य भाग एवं डिज़ाईन

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

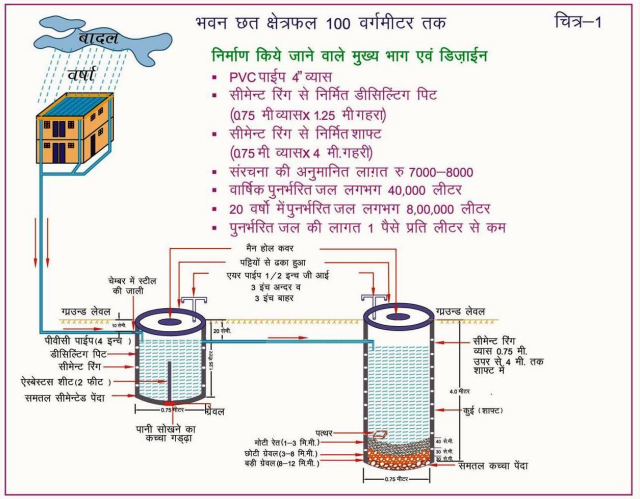


चित्र–1

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 लाग़त 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



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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