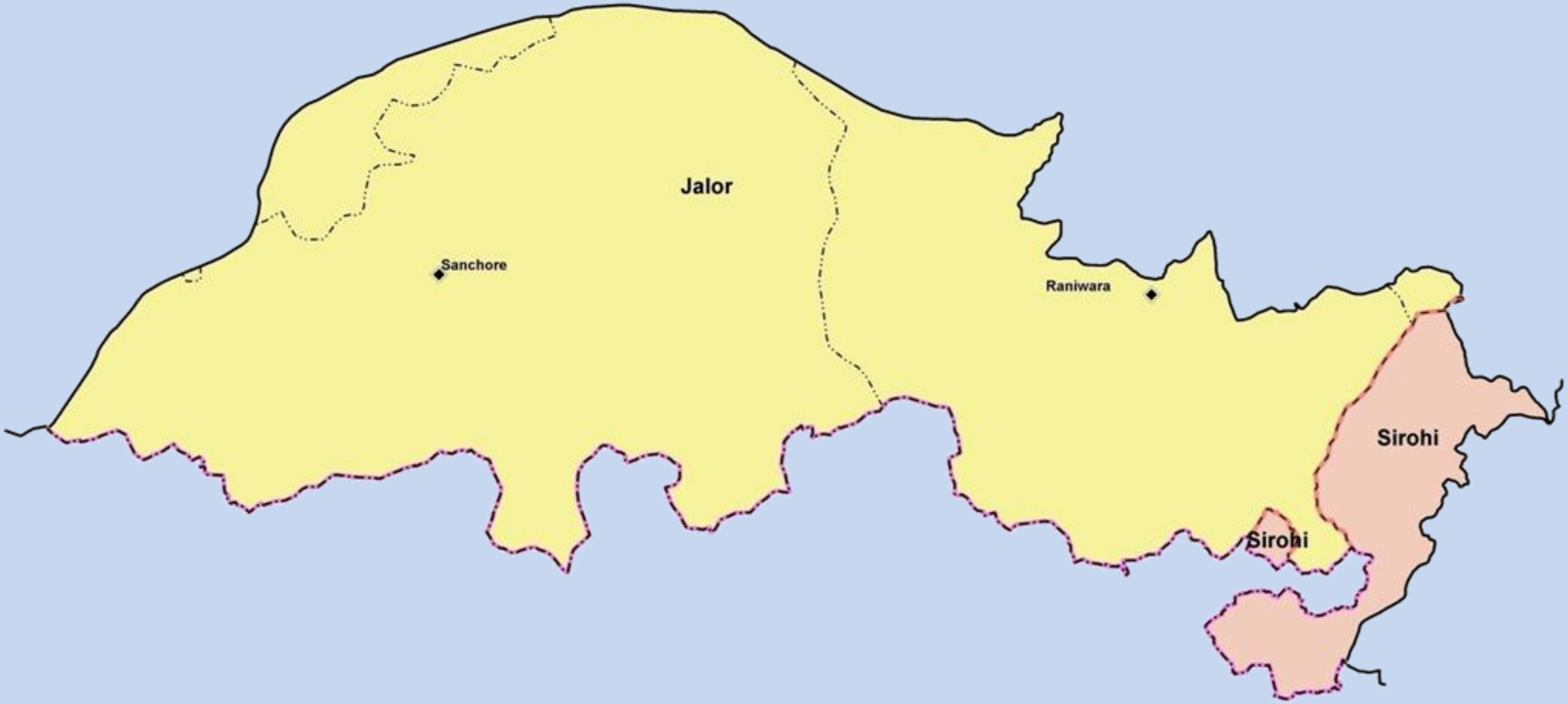
Ground Water Department, Rajasthan

European Union
State Partnership Programme

Hydrogeological Atlas of Rajasthan

Other Nallahs Basin

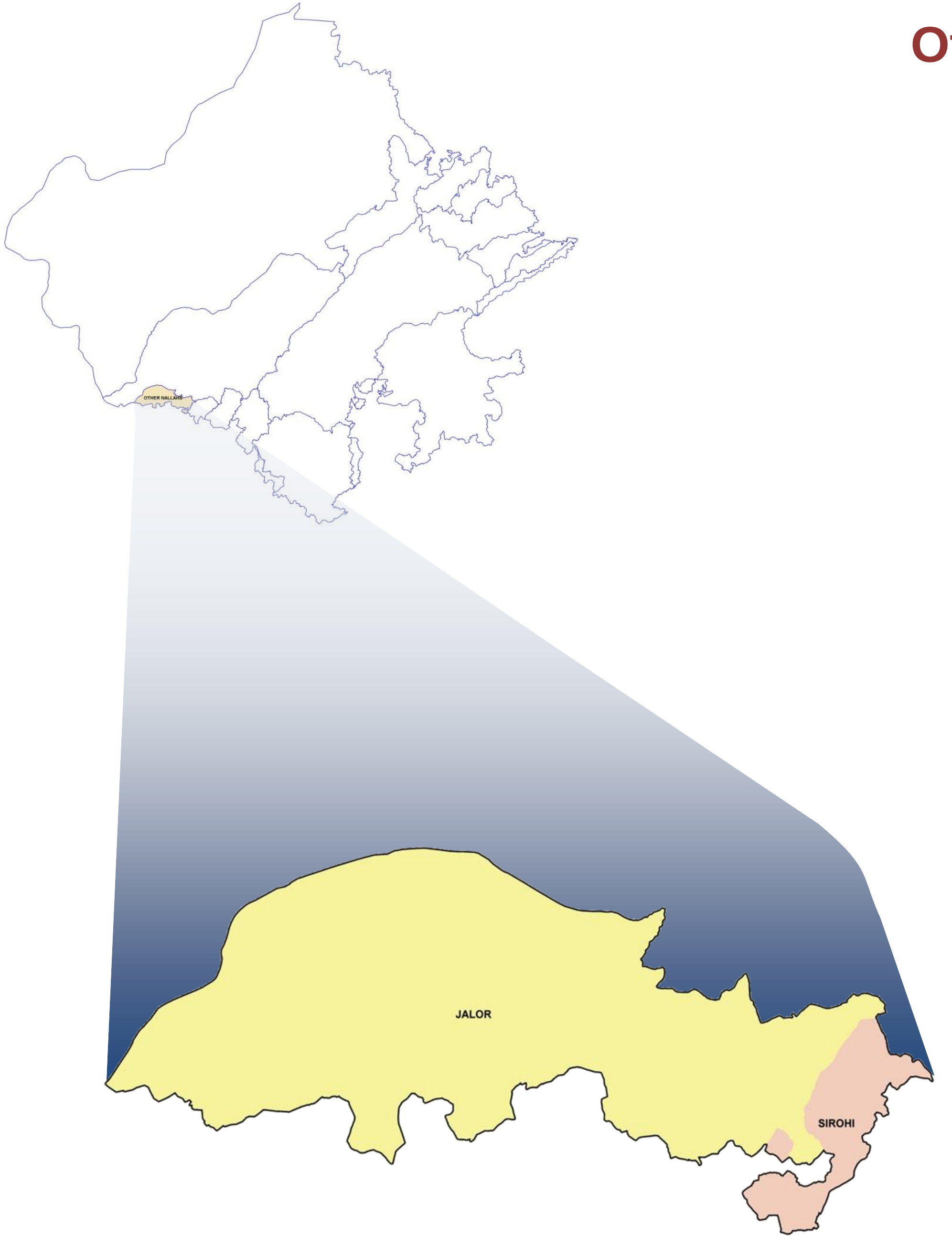


2013

ROLTA
Rolta India Limited

Hydrogeological Atlas of Rajasthan

Other Nallahs Basin



Contents:

2013

ADMINISTRATIVE SETUP

Location:

This is one of the very small basins in Rajasthan that measure less than 2,000 km^2 in area (approximately 1900 km^2). It is located in southwestern part of the state, bounded in the north and northwest by Luni river basin and in the east by Sukli river basin. The southern border is shared with administrative boundary of Gujarat state. It stretches between 24° 31' 50.08" to 24° 56' 27.96" North latitude and 71° 31' 26.59'' to 72° 27' 32.25'' East longitudes. Major part of the basin (>90%) falls within Jalor district whereas the remaining area falls in Sirohi district. The basin is a collection of small streams that drain the area but exit the border of Rajasthan State before contributing to any major river. Bandi river, Bargaon, Rip, and Sukal are some of the streams flowing in the area.

The general slope of the terrain is from east to south or west with hills appearing in the east which slowly roll into plains towards west in Sanchore.

Administrative Set-up:

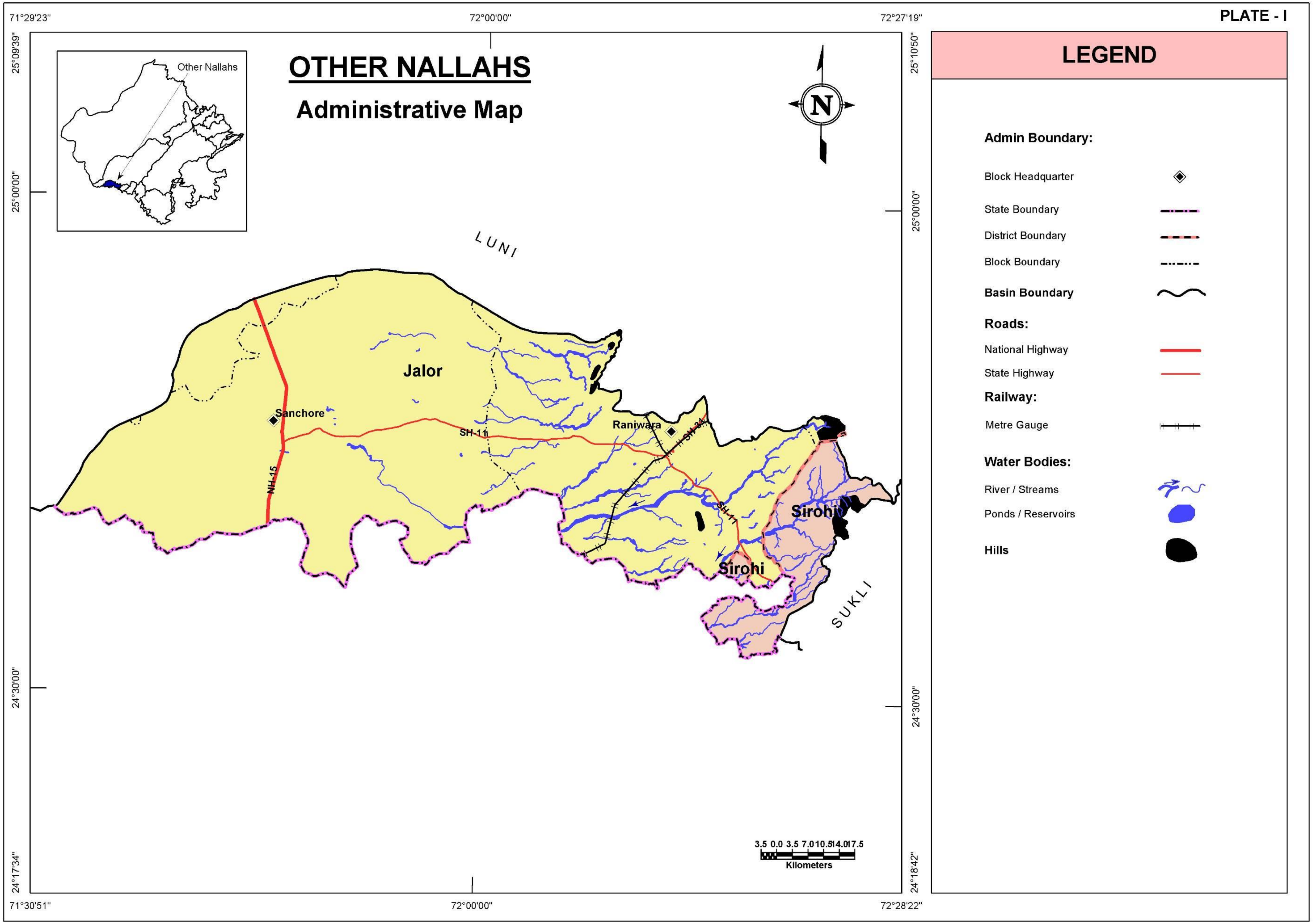
Administratively, Other Nallahs basin extends over parts of Ajmer, Jalor and Sirohi districts which are further divided into 5 blocks, encompassing 154 towns and villages.

S. No.	District Name	Area (sq. km)	% of Basin Area	Total Number of Blocks	Total Number of Towns and Villages
1	Jalor	1,731.2	91.1	4	138
2	Sirohi	168.6	8.9	1	16
	Total	**1899.8**	**100.0**	**5**	**154**

Climate:

The basin falls in Semi-arid to Arid region and experiences extreme temperatures in winter (down to 4^{o}C) and summer (reaches high of 50^{o}C). Rainfall is scanty, with mean annual rainfall of about 353 mm only. As a result the rainy days are very few spread over the months of July to September and for most part of the year it remains dry. Winter ensues rainy season and till February the low temperatures can be felt. Summer sets in from April and May – June months are really hot.

PLATE - I


71°29'23"
72°00'00"
72°27'19"
25°09'39"
25°00'00"
24°30'00"
24°17'34"
25°10'50"
25°00'00"
24°30'00"
24°18'42"
71°30'51"
72°00'00"
72°28'22"
Other Nallahs
OTHER NALLAHS
Administrative Map
N
LUNI
SUKLI
Jalor
Sanchore
Raniwara
Sirohi
Sirohi
NH 15
SH 11
SH 31
SH 11
3.5 0.0 3.5 7.0 10.5 14.0 17.5
Kilometers
LEGEND
Admin Boundary:
Block Headquarter
State Boundary
District Boundary
Block Boundary
Basin Boundary
Roads:
National Highway
State Highway
Railway:
Metre Gauge
Water Bodies:
River / Streams
Ponds / Reservoirs
Hills

TOPOGRAPHY

Though the area that forms part of the basin is not large but still the elevation variation is significant, ranging from minimum of 21 m above man sea level in Jalor district (in the westernmost part) to a maximum of 977m amsl in the eastern hilly parts falling in Sirohi district. The eastern part is hilly and the general slope of the topography is westwards. The hills in Sirohi district and partly in Jalor district are major sources of drainage in the basin which flow westwards.

Table: District wise minimum and maximum elevation

District Name	Min. Elevation (m amsl)	Max. Elevation (m amsl)
Jalor	21.0	850.9
Sirohi	203.7	976.8

RAINFALL

The general distribution of rainfall across the Other Nallah Basin can be visualized from isohyets presented in the Plate III. Total Annual rainfall for the rain gauge stations has been interpolated to understand the distribution across the basin. The year seems to have received a higher rainfall than the other years since it varies from a high of about 1225mm to a low of 938mm indicated by the coloured regions. Higher rainfall is received in the hilly region of eastern part of the basin and reducing gradually towards west.

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	Raniwara	1,064.0	161.0	1,225.0
2	Sanchore	820.0	118.0	938.0

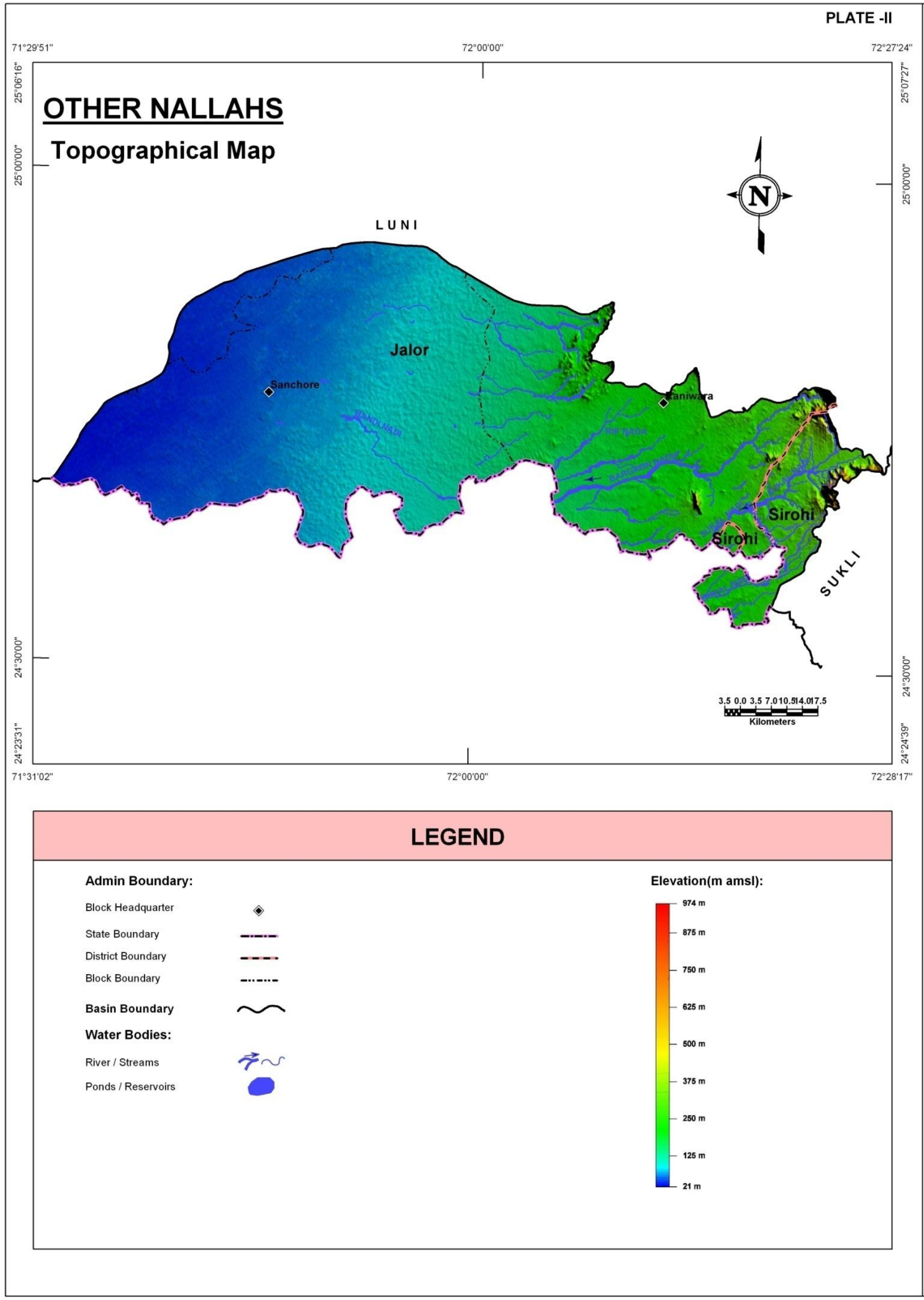


PLATE -II
OTHER NALLAHS
Topographical Map
LUNI
Jalor
Sanchore
Raniwara
Sirohi
Sirohi
SUKLI
Kilometers
LEGEND
Admin Boundary:
Block Headquarter
State Boundary
District Boundary
Block Boundary
Basin Boundary
Water Bodies:
River / Streams
Ponds / Reservoirs
Elevation(m amsl):
974 m
875 m
750 m
625 m
500 m
375 m
250 m
125 m
21 m

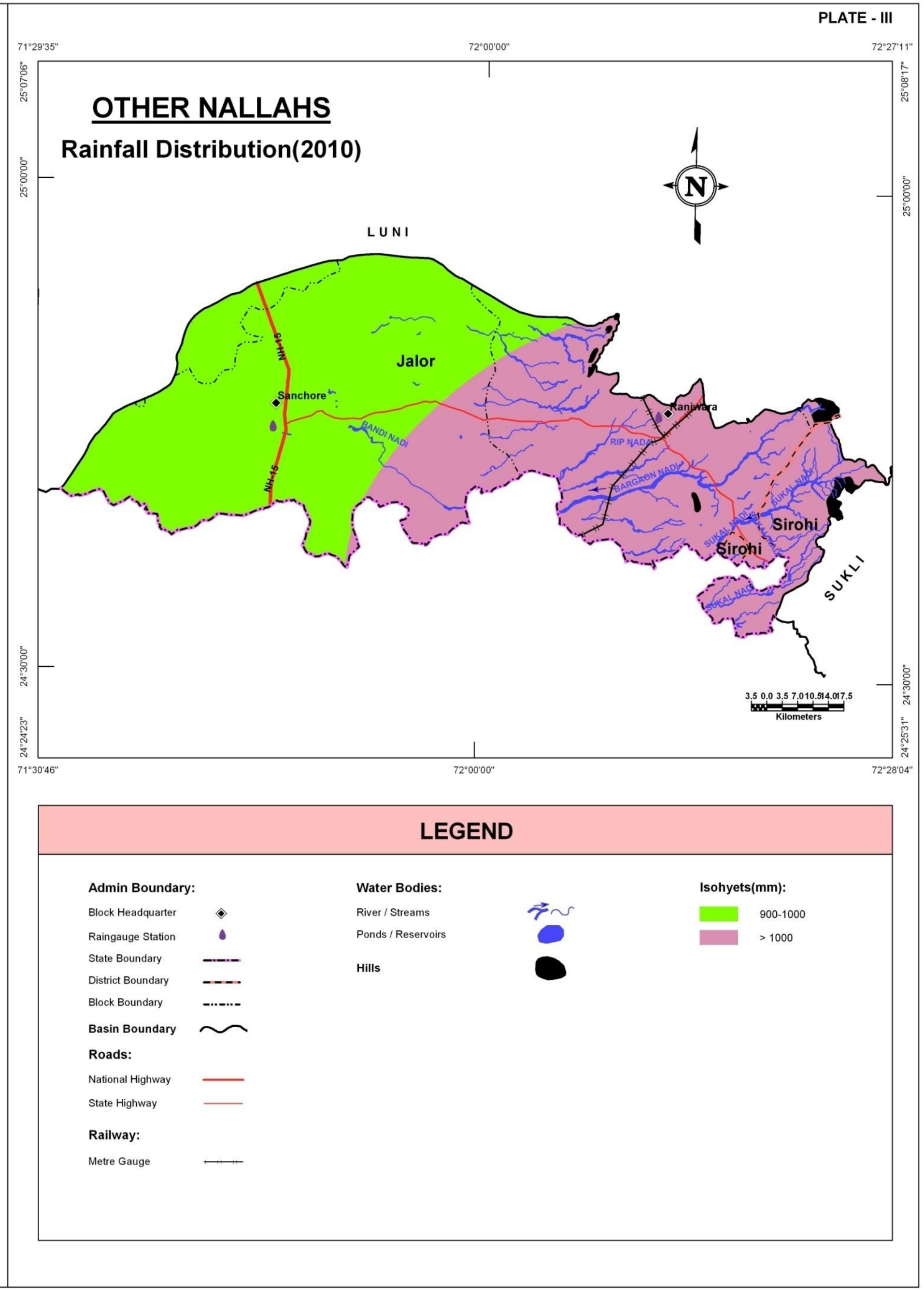


PLATE - III
OTHER NALLAHS
Rainfall Distribution(2010)
LUNI
Jalor
Sanchore
Raniwara
Sirohi
Sirohi
SUKLI
Kilometers
LEGEND
Admin Boundary:
Block Headquarter
Raingauge Station
State Boundary
District Boundary
Block Boundary
Basin Boundary
Roads:
National Highway
State Highway
Railway:
Metre Gauge
Water Bodies:
River / Streams
Ponds / Reservoirs
Hills
Isohyets(mm):
900-1000
> 1000

GEOLOGY

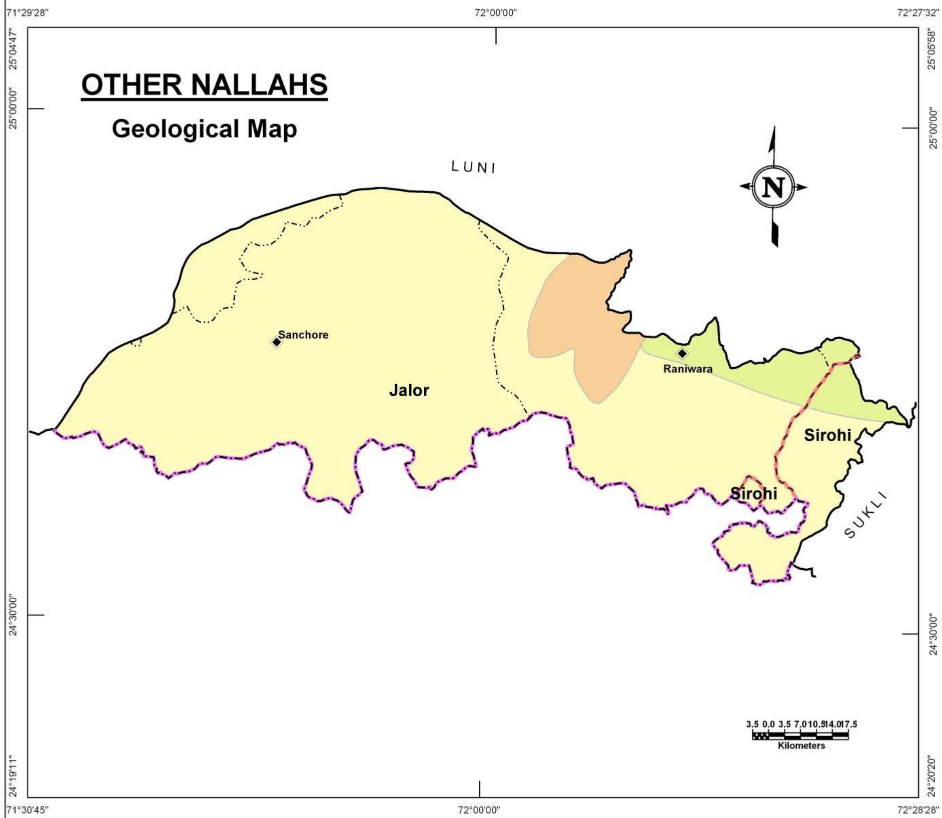
The hills are largely formed by Delhi Super Group rocks whereas the alluvial cover in the western part of the basin is very pronounced. The sand cover of Recent to Sub-Recent age is primarily windblown sand with minor contribution from alluvial sources.

Age	Super-Group	Group/ Formation	Rock Types
Sub-Recent to Recent	Aeolian Deposits (and Colluvium)	Alluvium	Windblown sand (sand dunes) cobble, pebble, gravel, sand, silt, clay and kankar
----------x----------x----------x----------Unconformity----------x----------x----------x----------			
Lower Precambrian to Upper Precambrian	Lower Vindhyan	Malani Rhyolite	Rhyolitic lavas with abundant pyroclastic material
	Post-Delhi (extrusives and intrusives)	Erinpura (Sandra Ambaji) granite and gneiss	Granites, gneisses, pegmatites, Amphilbolites, epidiorites
Middle Proterozoic	Delhi	Sirohi	Phyllites, mica schists, Dolomites, marbles and gneisses

GEOMORPHOLOGY

Origin	Landform Unit	Description
Aeolian	Dune Valley Complex	Cluster of dunes and interdunal spaces with undulating topography formed due to wind-blown activity, comprising of unconsolidated sand and silt.
	Obstacle Dune	Formed on windward/leeward sides of obstacle like isolated hills or continuous chain of hills, dune to obstruction in path of sand laden winds. Badly dissected well cemented and vegetated.
	Sandy Plain	Formed of aeolian activity, wind-blown sand with gentle sloping to undulating plain, comprising of coarse sand, fine sand, silt and clay.
Denudational	Buried Pediment	Pediment covers essentially with relatively thicker alluvial, colluvial or weathered materials.
	Pediment	Broad gently sloping rock flooring, erosional surface of low relief between hill and plain, comprised of varied lithology, criss-crossed by fractures and faults.
Fluvial	Alluvial Plain	Mainly undulating landscape formed due to fluvial activity, comprising of gravels, sand, silt and clay. Terrain mainly undulating, produced by extensive deposition of alluvium.
	Alluvial Plain (Sandy)	Flat to gentle undulating plain formed due to fluvial activity, mainly consists of gravels, sand, silt and clay with unconsolidated material of varying lithology, predominantly sand along river.
	Flood Plain	The surface or strip of relatively smooth land adjacent to a river channel formed by river and covered with water when river over flows its bank. Normally subject to periodic flooding.
	Ravine	Small, narrow, deep, depression, smaller than gorges, larger than gulley, usually carved by running water.
	Salt Encrustation/Playa	Topographical depression comprising of clay, silt, sand and soluble salts, usually undrained and devoid of vegetation.
Hills		Hills and intervening valleys in hilly areas

PLATE - IV



LEGEND

Admin Boundary:

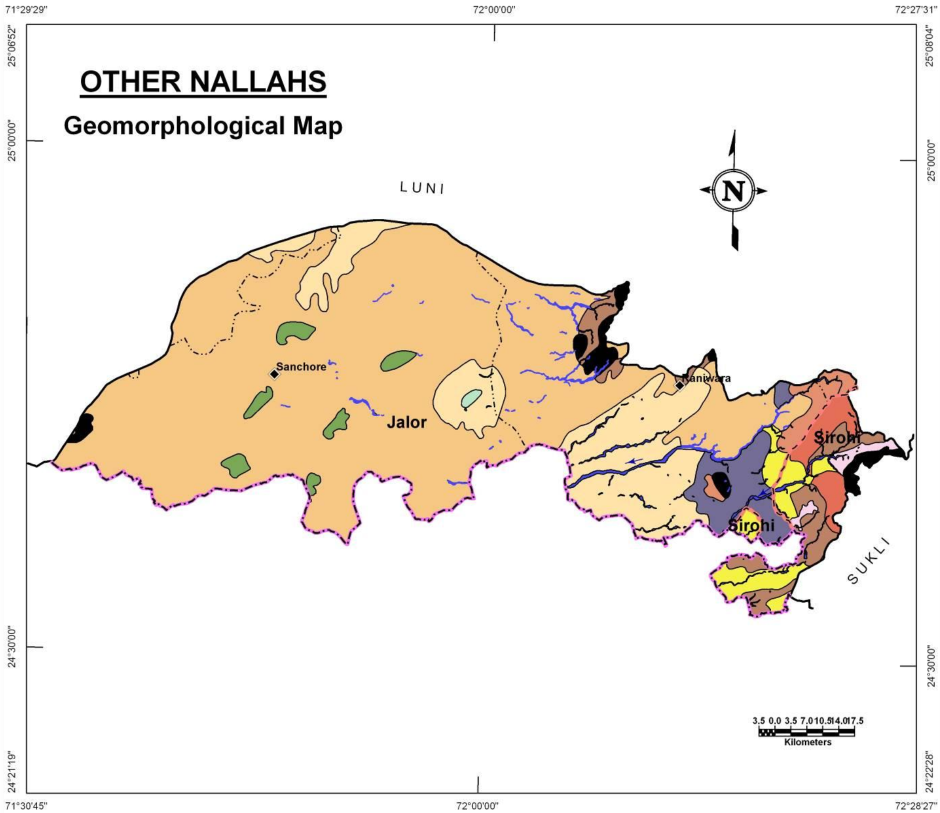
- Block Headquarter
- State Boundary
- District Boundary
- Block Boundary
- **River Basin Boundary**

Geology:

- Alluvium and Wind blown sand
- Volcanic Suite
- Erinpura Granite & Gneiss

Source : District Resource Map of Rajasthan - GSI

PLATE - V



LEGEND

Admin Boundary:

- 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

Landforms Units:

Fluvial Origin:

- Alluvial plain
- Alluvial Plain (Sandy)
- Ravine
- Flood Plain
- Salt Encrustation/Playa

Denudational Origin:

- Burried Pediment
- Pediment

Aeolian Origin:

- Sandy Plain
- Obstacle Dune
- Dune Valley Complex

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

AQUIFERS

While aquifers are formed in weathered and fractured hardrocks of Rhyolite and Granite, the alluvial aquifers formed in Older and younger alluviums are primary sources of groundwater in the basin. The alluvial aquifers together contribute to 96% of the sub surface distribution whereas the hardrock aquifers just make about 3%. The rhyolite aquifer is seen to the west of Raniwara in Jalor district around the hilly area, the granitic aquifers are seen in the easternmost part of the basin in Sirohi district adjacent to hills. The alluvial aquifers occupy the whole of rest of the basin.

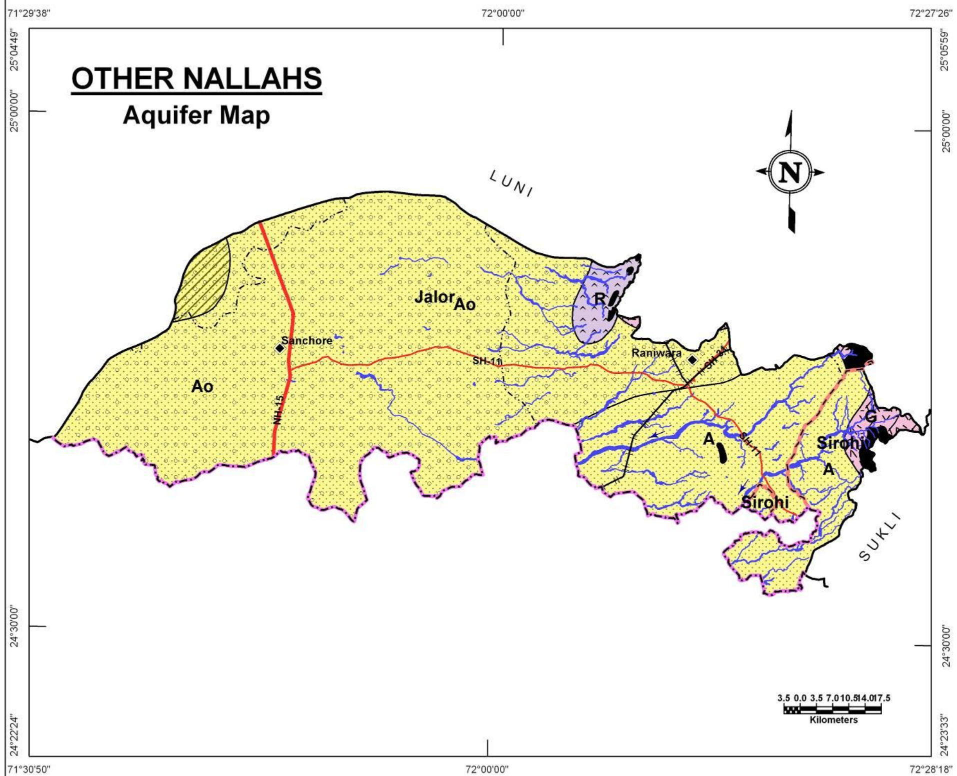
Aquifer in Potential Zone	Area (sq km)	% of Basin Area	Description of the unit/Occurrence
Younger Alluvium	454.9	23.9	It is largely constituted of aeolian and fluvial sand, silt, clay, gravel and pebbles in varying proportions.
Older Alluvium	1,363.3	71.8	This litho-unit comprises of mixture of heterogeneous fine to medium grained sand, silt and kankar
Rhyolite	37.2	2	Rhyolite is porphyritic and has phenocryst of quartz and feldspar.
Granite	28.3	1.5	Light grey to pink colour, medium to coarse grained, and characteristically have porphyritic texture
Non Potential Zone	16.1	0.8	Hills and reserve forests
TOTAL	**1,899.8**	**100.0**	

LOCATION OF GROUND WATER MONITORING WELLS

The basin has a network of 42 ground water monitoring stations (40) in the basin owned by RGWD and CGWB (2). To further strengthen the network in terms of water quality and water level monitoring, a total of 19 wells have been recommended for Jalor (18 wells) and Sirohi (1) districts.

District Name	Existing Ground Water Monitoring Stations			Recommended Additional Ground Water Monitoring Stations	
	CGWB	RGWD	Total	Water Level	Water quality
Jalor	2	34	**36**	0	18
Sirohi		6	**6**	0	1
Total	**2**	**40**	**42**	**0**	**19**

PLATE - VI



LEGEND

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

Basin Boundary

Roads:
- National Highway
- State Highway

Railway:
- Metre Gauge

Water Bodies:
- River / Streams
- Ponds / Reservoirs

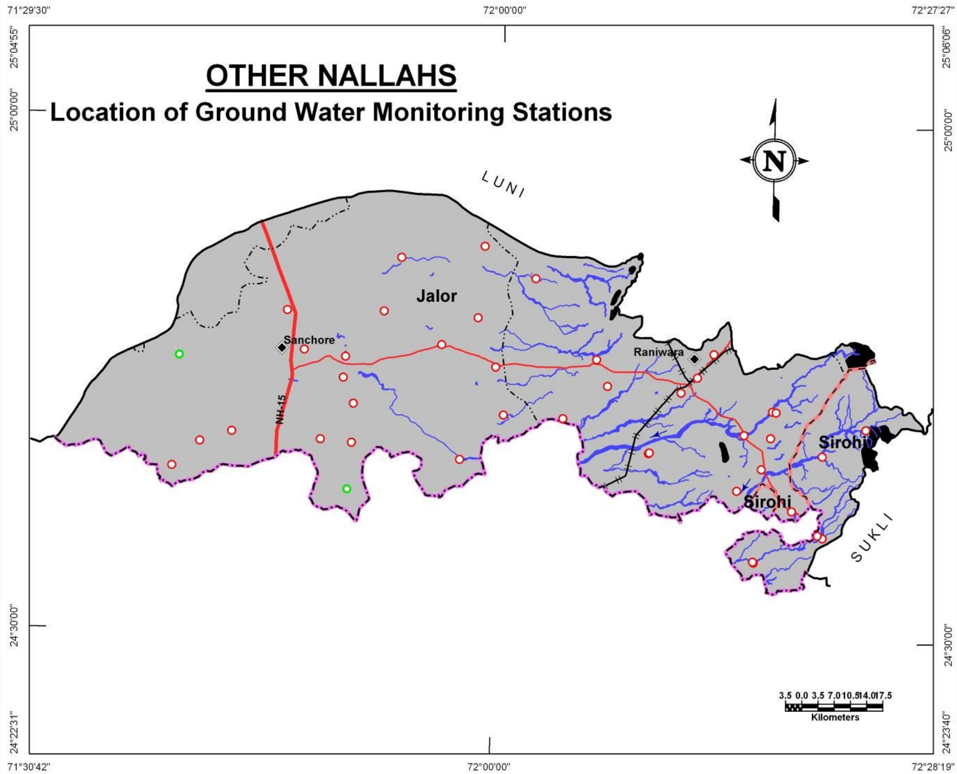
Hills

Saline Area

Aquifer:
- Younger Alluvium
- Older Alluvium
- Rhyolite
- Granite

Source: Ground Water Potential Zone Map - GWD,Rajasthan

PLATE - VII



LEGEND

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

Basin Boundary

Roads:
- National Highway
- State Highway

Railway:
- Metre Gauge

Water Bodies:
- River / Streams
- Ponds / Reservoirs

Hills

Ground Water Monitoring Stations:
- CGWB
- RGWD

LOCATION OF EXPLORATORY WELLS

In all there are 41 exploratory wells present in the basin drilled in the past by RGWD (37) and CGWB (4) that form basis for understanding of sub-surface and aquifer distribution.

District	Exploratory Wells		
	CGWB	RGWD	Total
Jalor	3	31	34
Sirohi	1	6	7
Total	**4**	**37**	**41**

DEPTH TO WATER LEVEL (PRE MONSOON – 2010)

The general depth to water level in the basin ranges from 10 to 40 meters below ground level, as seen in the eastern and western parts of the basin. The central part of the basin however, shows higher depth to water levels reaching upto 70m bgl.

Depth to water level (m bgl)	District wise area coverage (sq km)*		Total Area (sq km)
	Jalor	Sirohi	
< 10	247.1	0.7	**247.8**
10 - 20	364.2	72.5	**436.7**
20 - 30	408.1	81.9	**490.0**
30 - 40	332.2	6.5	**338.7**
40 - 50	233.7	-	**233.7**
50 - 60	114.4	-	**114.4**
60 - 70	22.3	-	**22.3**
> 70	0.1	-	**0.1**
Total	**1,722.1**	**161.6**	**1,883.7**

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

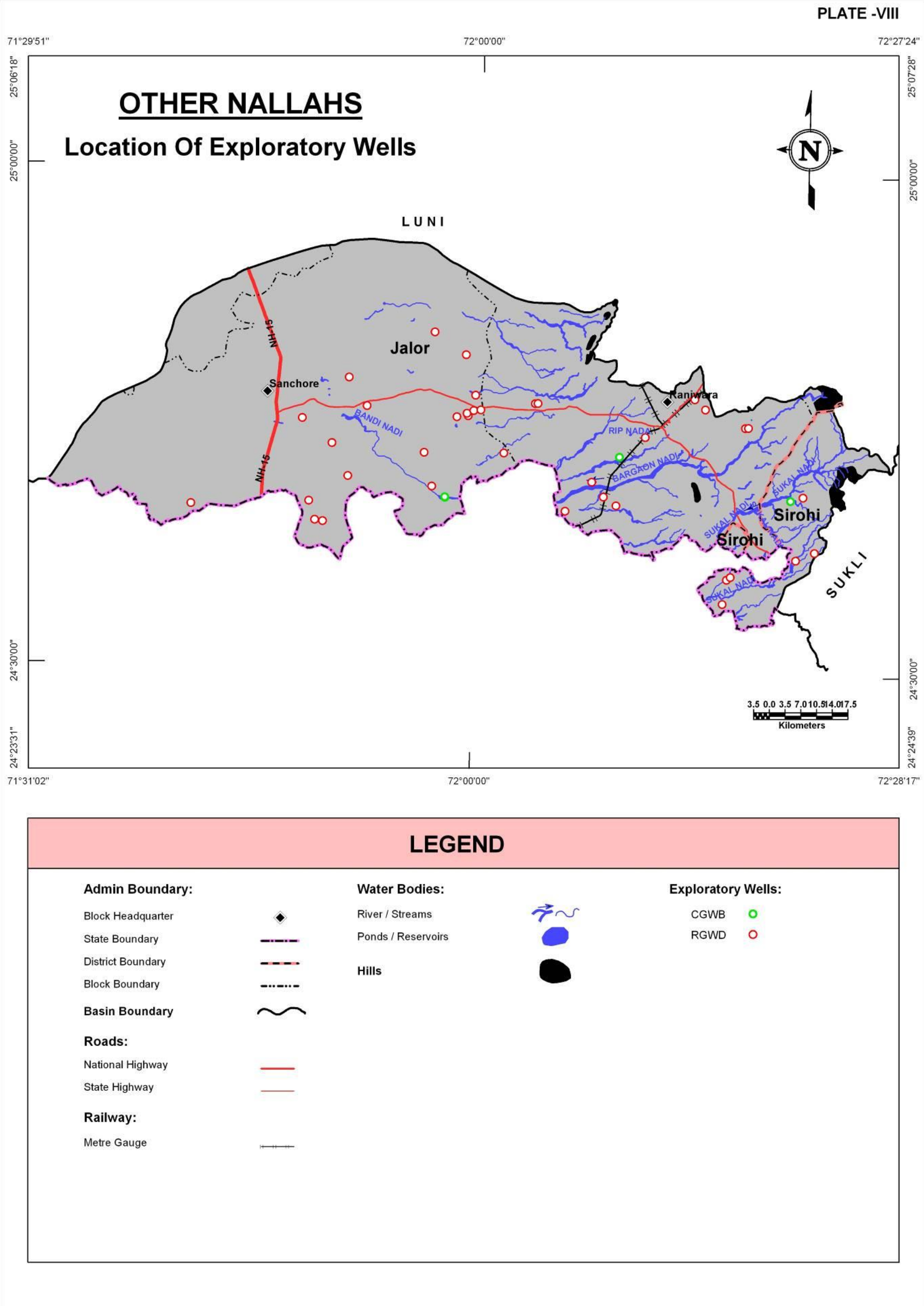


PLATE -VIII
OTHER NALLAHS
Location Of Exploratory Wells
LUNI
SUKLI
Jalor
Sanchore
Raniwara
Sirohi
NH-15
BANDI NADI
RIP NADA
BARGAON NADI
SUKAL NADI
N
Kilometers
LEGEND
Admin Boundary:
Block Headquarter
State Boundary
District Boundary
Block Boundary
Basin Boundary
Roads:
National Highway
State Highway
Railway:
Metre Gauge
Water Bodies:
River / Streams
Ponds / Reservoirs
Hills
Exploratory Wells:
CGWB
RGWD

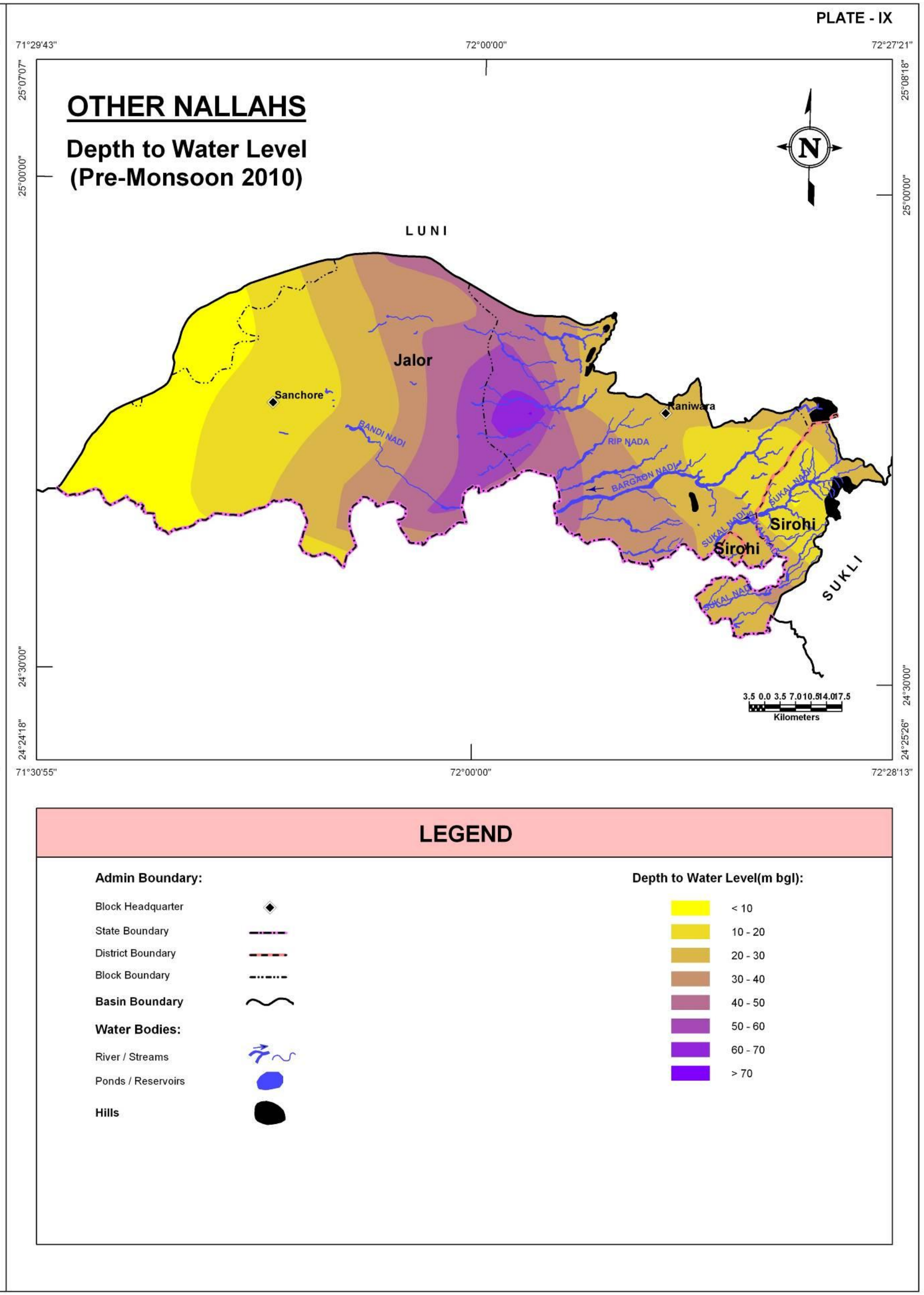


PLATE - IX
OTHER NALLAHS
Depth to Water Level
(Pre-Monsoon 2010)
LUNI
SUKLI
Jalor
Sanchore
Raniwara
Sirohi
BANDI NADI
RIP NADA
BARGAON NADI
SUKAL NADI
N
Kilometers
LEGEND
Admin Boundary:
Block Headquarter
State Boundary
District Boundary
Block Boundary
Basin Boundary
Water Bodies:
River / Streams
Ponds / Reservoirs
Hills
Depth to Water Level(m bgl):
< 10
10 - 20
20 - 30
30 - 40
40 - 50
50 - 60
60 - 70
> 70

WATER TABLE ELEVATION (PRE MONSOON 2010)

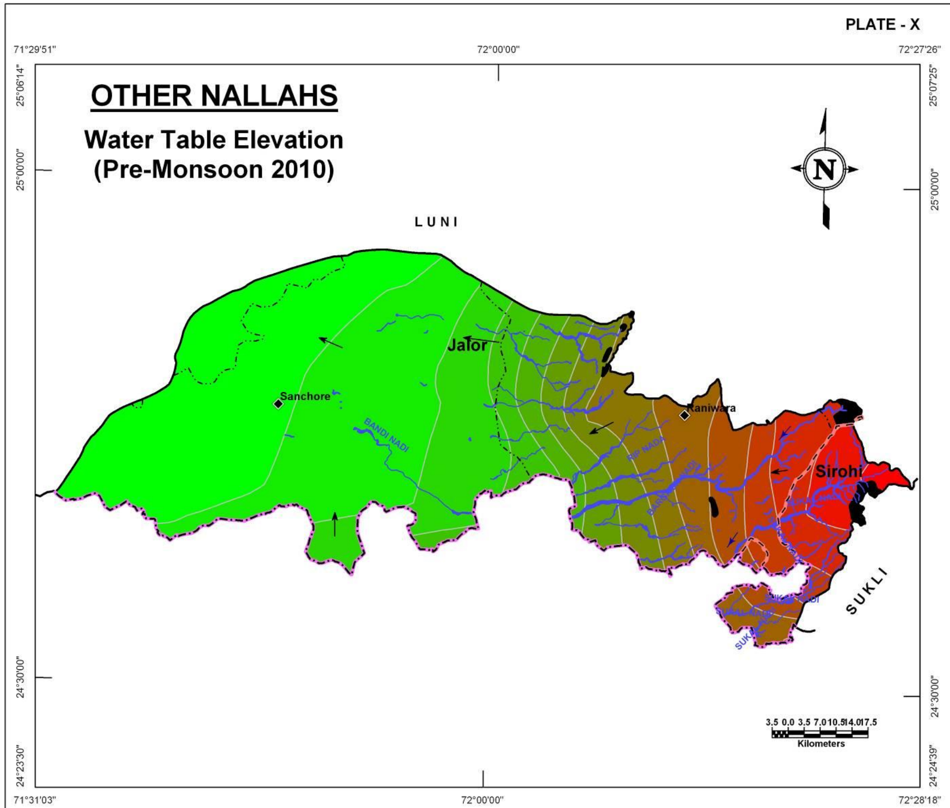
Water table elevation shows variation from less than 40m above mean sea level to about 280m amsl. On comparing this map with topography map it becomes evident that high water table corresponds to hilly areas in the east and has steeper gradients when moved to west. In the western parts of thick alluvial aquifers, the water table has lower elevations and also shows a flattening of the gradient with sluggish flows.

Depth to water table (m amsl)	District wise area coverage (sq km)		Total Area (sq km)
	Jalor	Sirohi	
< 40	502.5	-	**502.5**
40 - 60	395.2	-	**395.2**
60 - 80	201.3	-	**201.3**
80 - 100	74.4	-	**74.4**
100 - 120	58.6	-	**58.6**
120 - 140	76.8	-	**76.8**
140 - 160	89.5	-	**89.5**
160 - 180	93.0	-	**93.0**
180 - 200	74.7	26.8	**101.5**
200 - 220	59.4	17.5	**76.9**
220 - 240	49.0	13.8	**62.8**
240 - 260	47.7	42.8	**90.5**
260 - 280	-	50.9	**50.9**
> 280	-	9.8	**9.8**
Total	**1,722.1**	**161.6**	**1,883.7**

WATER LEVEL FLUCTUATION (PRE TO POST MONSOON 2010)

The hardrock aquifer/hilly areas show higher fluctuation in ground water levels indicating rise of 10m from pre monsoon water levels. In the alluvial aquifer/plain areas, which occupy most part of the basin, the water level fluctuation has been in the range of +2 to -2 m. There is an unusual fall of water level by around 4 meters in the central part of the area which appears to be due to some localized high ground water extraction.

District Name	District wise area coverage (sq km) within fluctuation range (m)									Total Area (sq km)
	< -4	-4 to -2	-2 to 0	0 to 2	2 to 4	4 to 6	6 to 8	8 to 10	> 10	
Jalor	3.4	25.6	202.9	1,172.7	188.2	77.5	37.8	12.7	1.3	**1,722.1**
Sirohi	-	-	8.0	102.5	33.8	10.6	2.8	3.0	0.9	**161.6**
Total	**3.4**	**25.6**	**210.9**	**1,275.2**	**222.0**	**88.1**	**40.6**	**15.7**	**2.2**	**1,883.7**



LEGEND

Admin Boundary:

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

Basin Boundary

Water Bodies:

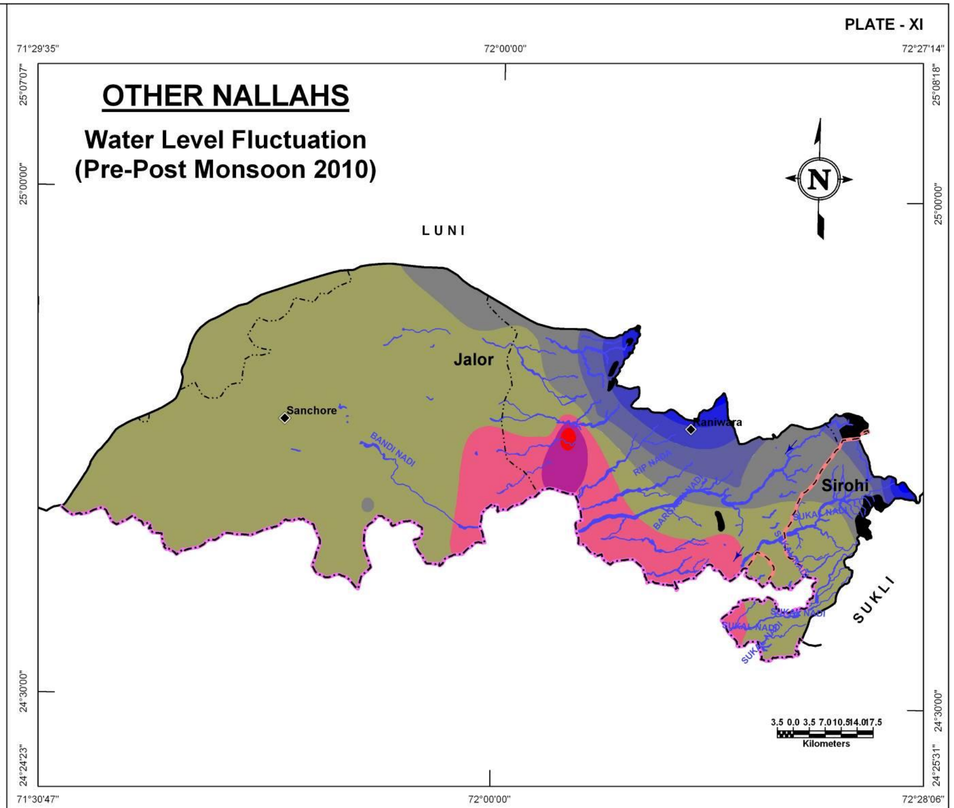
- River / Streams
- Ponds / Reservoirs

Hills

Water Table Elevation

Water Table Elevation(m amsl):

- < 40
- 40 - 60
- 60 - 80
- 80 - 100
- 100 - 120
- 120 - 140
- 140 - 160
- 160 - 180
- 180 - 200
- 200 - 220
- 220 - 240
- 240 - 260
- 260 - 280
- >280



LEGEND

Admin Boundary:

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

Basin Boundary

Water Bodies:

- River / Streams
- Ponds / Reservoirs

Hills

Water Level Fluctuation(m):

- < -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

The Electrical Conductivity (at 25ºC) distribution map is presented in Plate – XII shows a significantly large patch of red colour (EC >4000 µS/cm) in the western alluvial part of the basin occupying about 46% of the area. The areas in the eastern half of the basin however, show the presence of good ground water quality having EC < 2000 µS/cm (represented by Yellow coloured regions) which occupies approximately 33% of the basin area and is suitable for all purposes. The remaining area (about 20% of the basin) has moderate EC value (2000-4000 µS/cm).

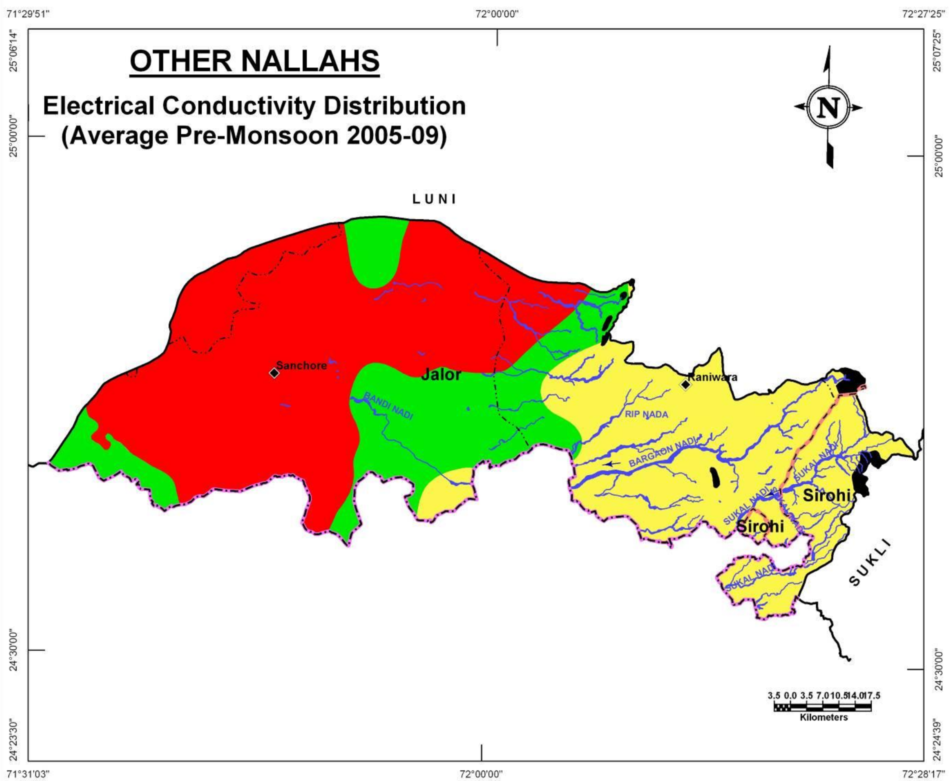
Electrical Conductivity Ranges (µS/cm at 25ºC) (Ave. of years 2005-09)	District wise area coverage (sq km)				Total Area (sq km)
	Jalor		Sirohi		
	Area	% age	Area	% age	
< 2000	470.6	27.3	161.6	100.0	**632.2**
2000-4000	385.0	22.4	-	-	**385.0**
> 4000	866.5	50.3	-	-	**866.5**
Total	**1,722.1**	**100.0**	**161.6**	**100.0**	**1,883.7**

CHLORIDE DISTRIBUTION

High chloride concentration in ground water may also render it unsuitable for domestic and other purposes. The red coloured regions in Plate – XIII are such areas where Chloride concentration is very high (> 1000 mg/l) which are largely found in alluvial aquifers in the western part of the basin. Good quality water with low Chloride concentration (<250 mg/l) are found in the close proximity of hilly areas as seen in the eastern part of the basin where the water table gradient has also been noticed to be higher than the western part. About 25% of the basin area located in central part of the basin between the high and low Chloride value areas, has moderate Chloride concentration in ground water that ranges in between 250-1000 mg/l.

Chloride Ranges (mg/l) (Ave. of years 2005-09)	District wise area coverage (sq km)				Total Area (sq km)
	Jalor		Sirohi		
	Area	% age	Area	% age	
< 250	425.9	24.7	150.7	93.2	**576.6**
250 - 1000	508.5	29.6	10.9	6.8	**519.4**
> 1000	787.7	45.7	-	-	**787.7**
Total	**1,722.1**	**100.0**	**161.6**	**100.0**	**1,883.7**

PLATE - XII



LEGEND

Admin Boundary:

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

Basin Boundary

Water Bodies:

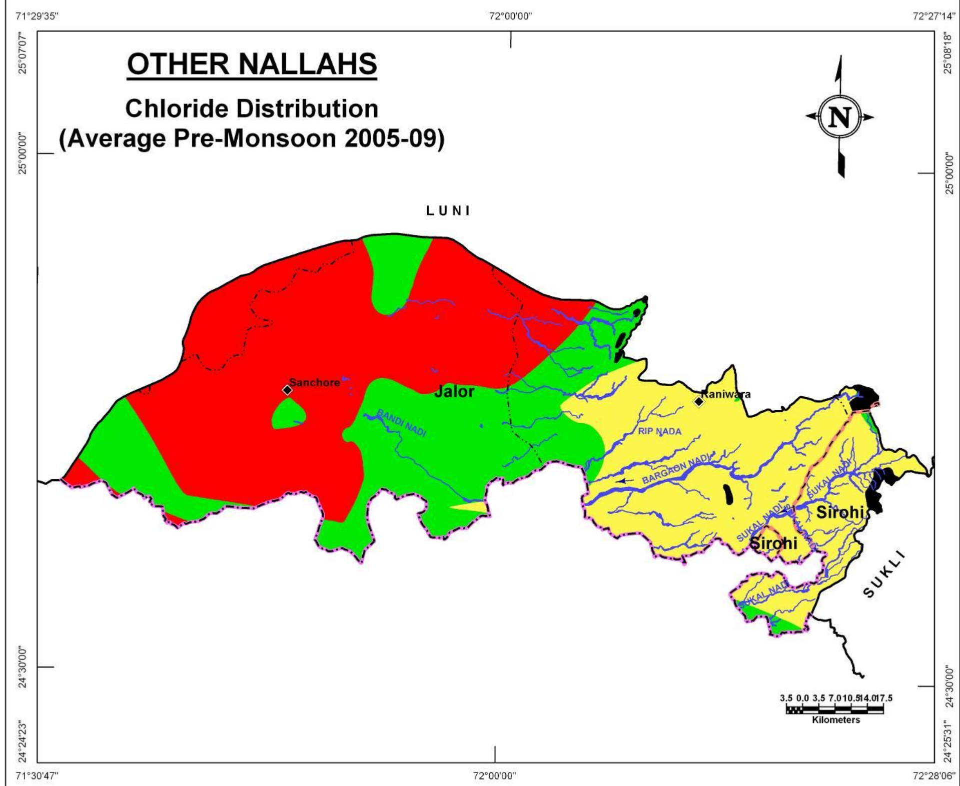
- River / Streams
- Ponds / Reservoirs

Hills

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

- < 2000
- 2000-4000
- > 4000

PLATE - XIII



LEGEND

Admin Boundary:

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

Basin Boundary

Water Bodies:

- River / Streams
- Ponds / Reservoirs

Hills

Chloride Concentration (mg/l):

- < 250
- 250 - 1000
- > 1000

FLUORIDE DISTRIBUTION

The Fluoride concentration map (Plate XIV) displays a number of scattered patches of high fluoride concentration (>3 mg/l) in the west, north and eastern parts of the basin of which the one around Sanchore is the largest one occupying nearly 4% of the area whereas the rest of four patches together constitute the rest 6% of the high fluoride concentration area. The rest of the area has moderate to low concentration of fluoride in ground water.

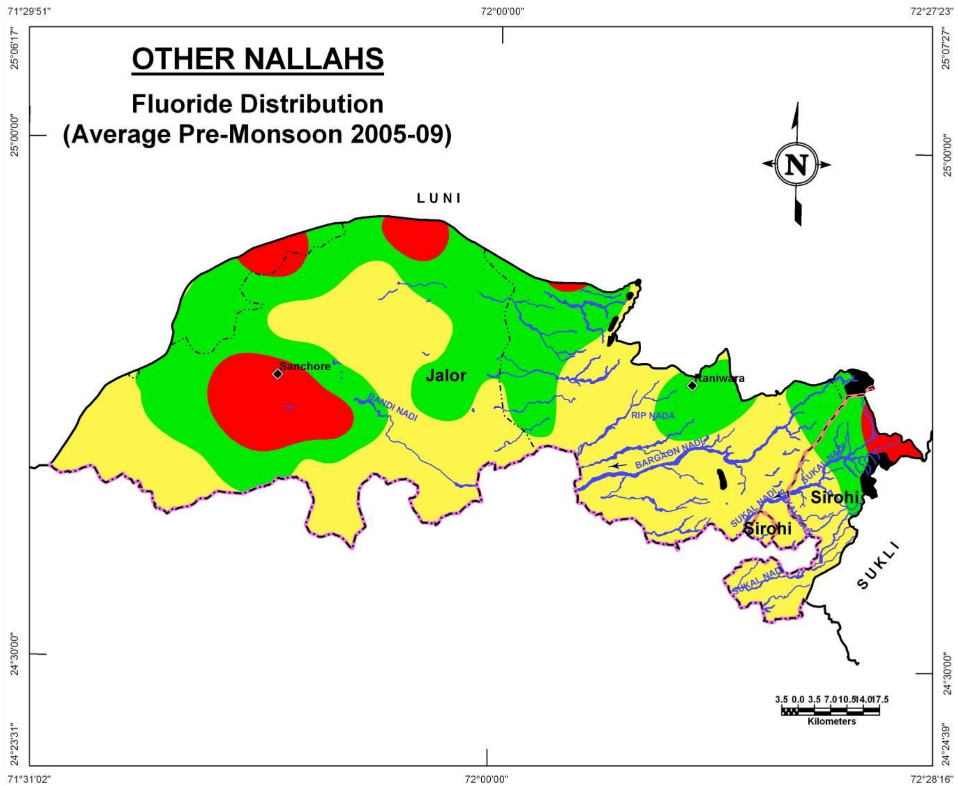
Fluoride Ranges (mg/l) (Ave. of years 2005-09)	District wise area coverage (sq km)				Total Area (sq km)
	Jalor		Sirohi		
	Area	% age	Area	% age	
< 1.5	857.6	49.8	103.3	63.9	**960.9**
1.5-3.0	694.3	40.3	42.3	26.2	**736.6**
> 3.0	170.2	9.9	16.0	9.9	**186.2**
Total	**1,722.1**	**100.0**	**161.6**	**100.0**	**1,883.7**

NITRATE DISTRIBUTION

Information of Nitrate concentration helps in understanding the suitability of ground water for agricultural purposes. A perusal of Plate – XV reveals a significantly large patch accounting for more than 65% of the basin area in the alluvial plains falls under high Nitrate category (>100 mg/l). Another 20% of the alluvial area shows presence of moderately high Nitrate concentration in ground water (i.e., 50 – 100 mg/l) which too is not very much suitable for agriculture but some crops may be grown. Hardly, 15% of the basin area (which also includes non-alluvial areas, contains low (<50 mg/l) Nitrate in the southeastern parts of the basin.

Nitrate Ranges (mg/l) (Ave. of years 2005-09)	District wise area coverage (sq km)				Total Area (sq km)
	Jalor		Sirohi		
	Area	% age	Area	% age	
< 50	172.1	10.0	119.0	73.6	**291.1**
50-100	325.6	18.9	42.6	26.4	**368.2**
> 100	1,224.4	71.1	-	-	**1,224.4**
Total	**1,722.1**	**100.0**	**161.6**	**100.0**	**1,883.7**

PLATE - XIV



LEGEND

Admin Boundary:

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

Basin Boundary

Water Bodies:

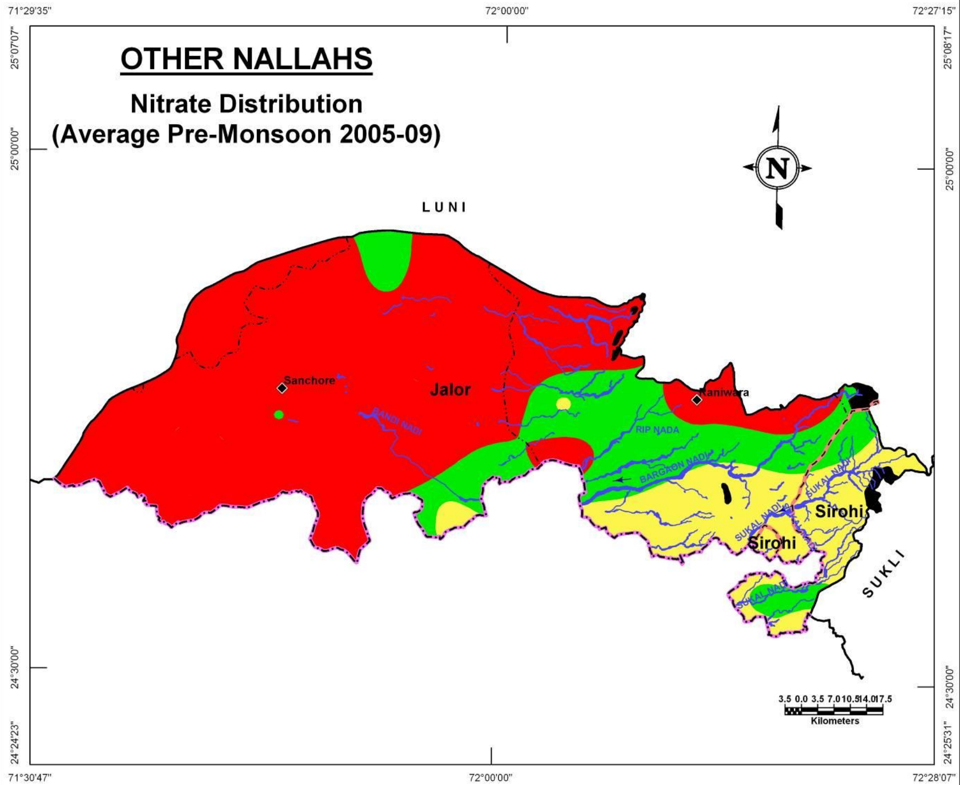
- River / Streams
- Ponds / Reservoirs

Hills

Fluoride Concentration(mg/l):

- < 1.5
- 1.5-3.0
- >3.0

PLATE - XV



LEGEND

Admin Boundary:

- Block Headquarter
- 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

Plate – XVI represents distribution of bedrock in terms of depth to bedrock map as meters below ground level. A perusal of map reveals that in general, the depth to bedrock in the basin is shallow in the east where depth ranges between negligible to 60m below ground level, moderately deep in the western part where the depth ranges between 60 to 100m bgl. In the central part of the basin the deepest depth is encountered which is about 120m bgl.

Depth to Bedrock (m bgl)	District wise area coverage (sq km)		Total Area (sq km)
	Jalor	Sirohi	
< 40	-	31.4	**31.4**
40-60	307.7	130.2	**437.9**
60-80	42.0	-	**42.0**
80-100	786.3	-	**786.3**
100-120	497.6	-	**497.6**
> 120	88.5	-	**88.5**
Total	**1,722.1**	**161.6**	**1,883.7**

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. Aquifers formed in weathered/fractured zone of hard rocks occupy very limited areas i.e., only about 65 sq km (less than 4% of basin area) whereas the rest of the basin has aquifers formed in alluvial material which attain high thicknesses of more than 40m reaching about 60m in western part of the basin. In the eastern part of the basin the thickness of alluvial aquifers is however low, estimated to be less than 20m.

Alluvial areas:

Unconfined aquifer Thickness (m)	District wise area coverage (sq km)		Total Area (sq km)
	Jalor	Sirohi	
< 10	403.4	104.3	**507.7**
10-20	217.6	29.6	**247.2**
20-30	283.4	3.1	**286.5**
30-40	218.9	-	**218.9**
40-50	260.0	-	**260.0**
50-60	227.0	-	**227.0**
> 60	71.0	-	**71.0**
Total	**1,681.3**	**137.0**	**1,818.3**

Hardrock areas:

Unconfined aquifer Thickness (m)	District wise area coverage (sq km)		Total Area (sq km)
	Jalor	Sirohi	
< 10	17.4	1.1	**18.5**
> 10	23.4	23.5	**46.9**
Total	**40.8**	**24.6**	**65.4**

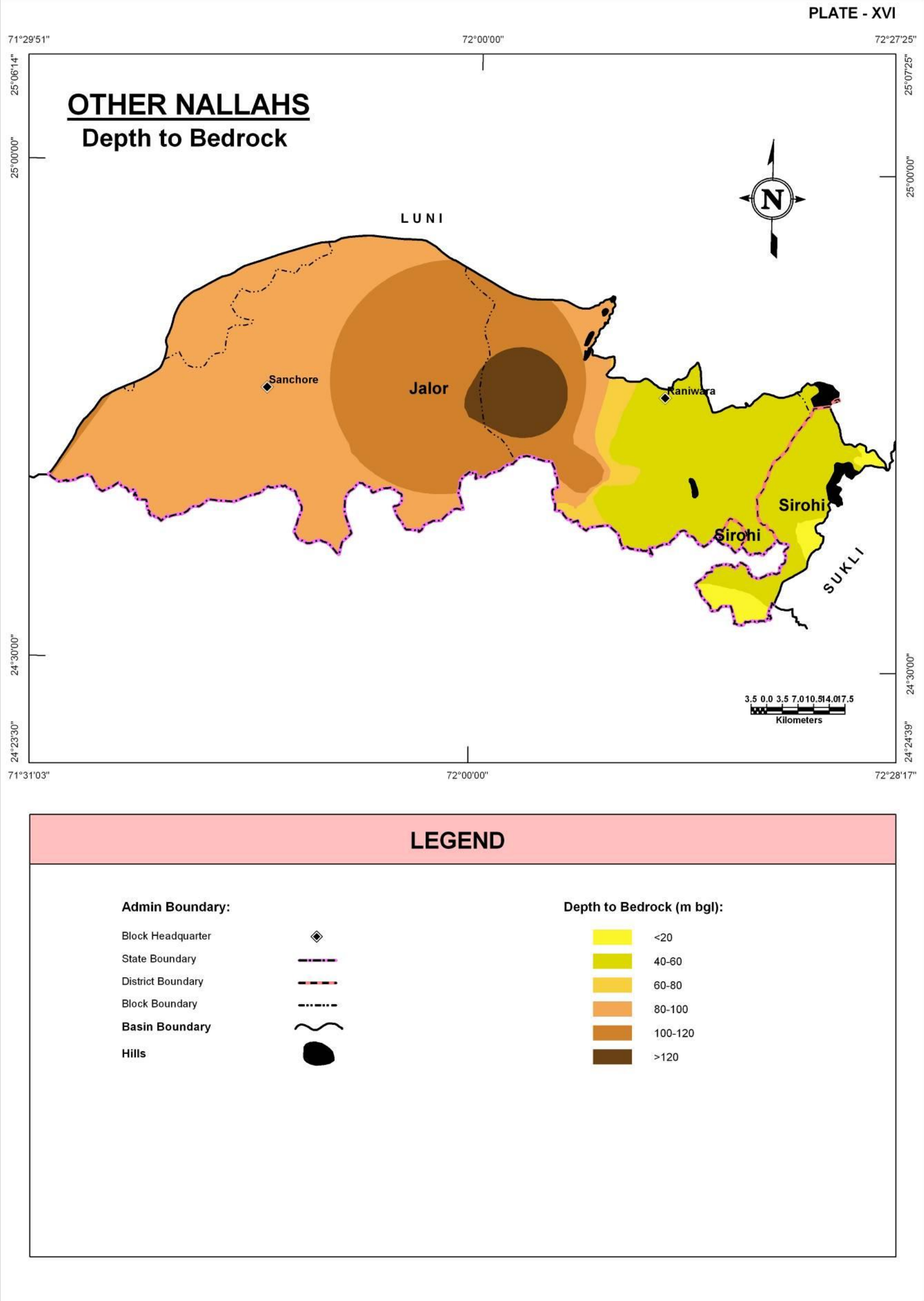


PLATE - XVI
OTHER NALLAHS
Depth to Bedrock
LUNI
Sanchore
Jalor
Raniwara
Sirohi
Sirohi
SUKLI
N
Kilometers
LEGEND
Admin Boundary:
Block Headquarter
State Boundary
District Boundary
Block Boundary
Basin Boundary
Hills
Depth to Bedrock (m bgl):
<20
40-60
60-80
80-100
100-120
>120

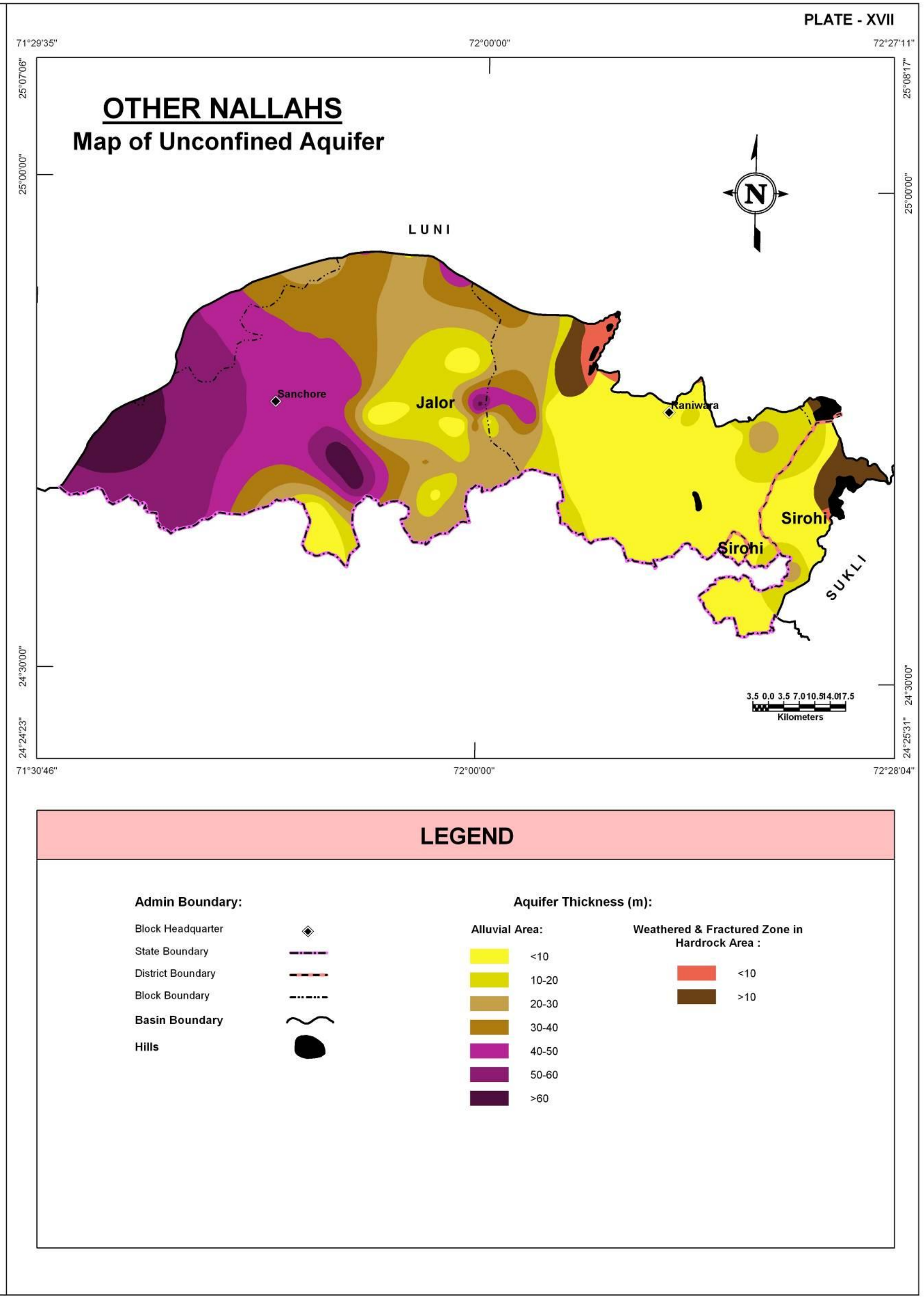
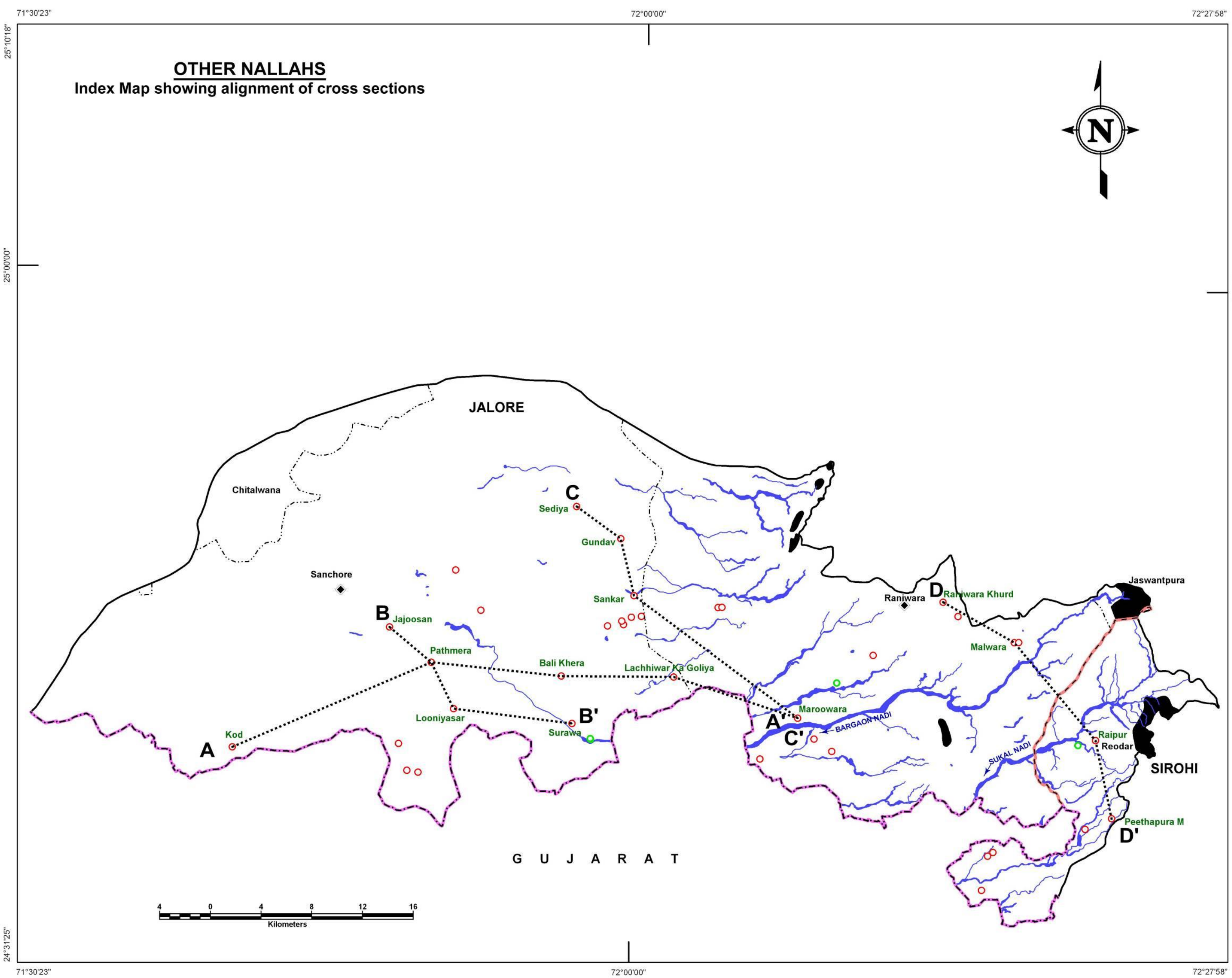


PLATE - XVII
OTHER NALLAHS
Map of Unconfined Aquifer
LUNI
Sanchore
Jalor
Raniwara
Sirohi
Sirohi
SUKLI
N
Kilometers
LEGEND
Admin Boundary:
Block Headquarter
State Boundary
District Boundary
Block Boundary
Basin Boundary
Hills
Aquifer Thickness (m):
Alluvial Area:
<10
10-20
20-30
30-40
40-50
50-60
>60
Weathered & Fractured Zone in Hardrock Area :
<10
>10

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 XXIII. The general alignment of the sections is as given below:

Name of Section Line	Orientation
Section AA’	W–E
Section BB’	NW–SE
Section CC’	NW–SE
Section DD’	NW–SE

PLATE - XVIII


OTHER NALLAHS
Index Map showing alignment of cross sections
71°30'23"
72°00'00"
72°27'58"
25°10'18"
25°00'00"
24°31'25"
JALORE
Chitalwana
Sanchore
C
Sediya
Gundav
Sankar
B
Jajoosan
Pathmera
Bali Khera
Lachhiwar Ka Goliya
Looniyasar
B'
Surawa
A
Kod
A'
C'
Maroowara
BARGAON NADI
SUKAL NADI
Raniwara
D
Raniwara Khurd
Malwara
Jaswantpura
Raipur
Reodar
SIROHI
Peethapura M
D'
G U J A R A T
4 0 4 8 12 16
Kilometers
N
Legend
Block Headquarter
State Boundary
District Boundary
Block Boundary
Basin Boundary
Section Lines
Major Streams / River
Pond / Reservoir
Hills
Exploratory Wells
Kod
Well location for Sections
CGWB
RGWD

Section A-A':

This section is the longest of the sections plotted in the area and trends in W-E direction, cutting across the basin and covering a distance of about 45 kms (Plate – XIX). Lithologs acquired from 5 boreholes was utilized in interpretation of sub-surface lithology in this section. The section depicts the disposition of different layers of sand and clay along with shale. On perusal of the cross section, it is apparent that the total area along the cross-section is occupied by sand. A narrow strip of clay is also is present. Hardrock is encountered in only easternmost well.

The water level varies from 50 m amsl to 140 m amsl in the section following the surface topography.

Section B-B':

The B-B' section trending from NW-SE and covers an area of 18 kms shown in (Plate – XX). The lithologs of 4 boreholes were taken in to account while preparing the section. The section depicts sand and clay layers of alluvial aquifers. The alternate sequence of sand and clay is forming the major aquifer system in these areas.

It is observed from pre monsoon 2010 data the ground water level varies from 50 m amsl to 70 m amsl from NW – SE of the section drawn in the Other Nallahs river basin.

PLATE - XIX

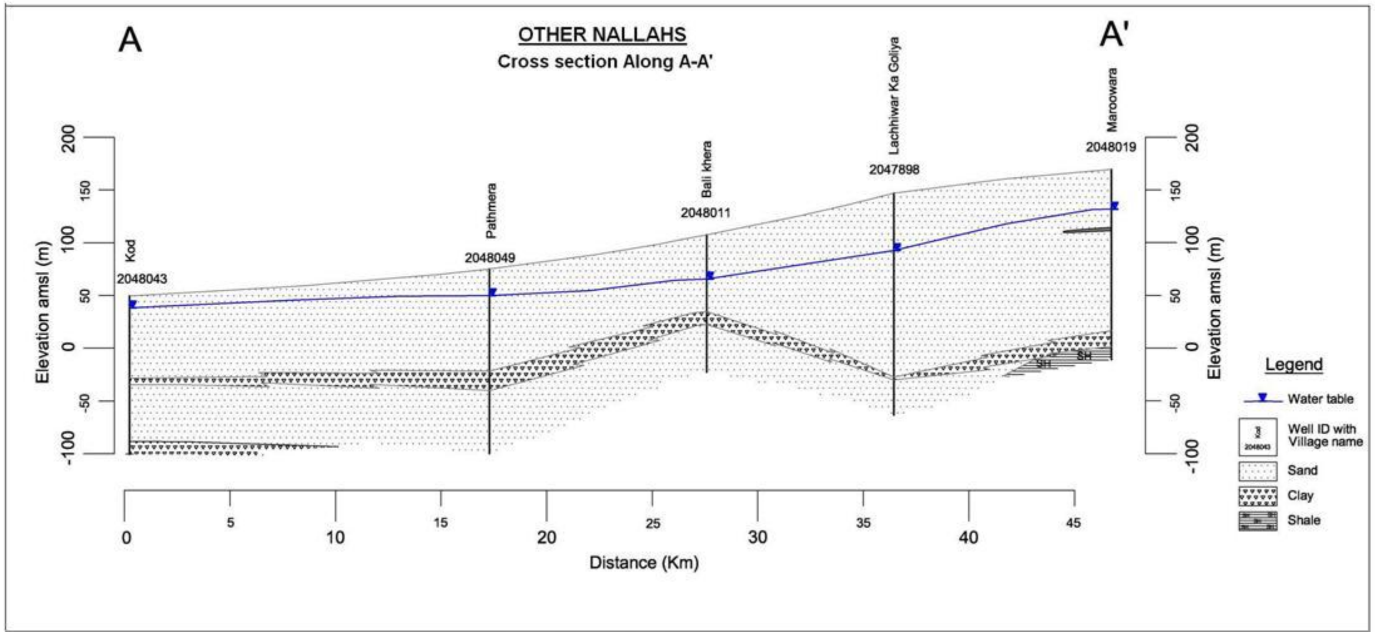
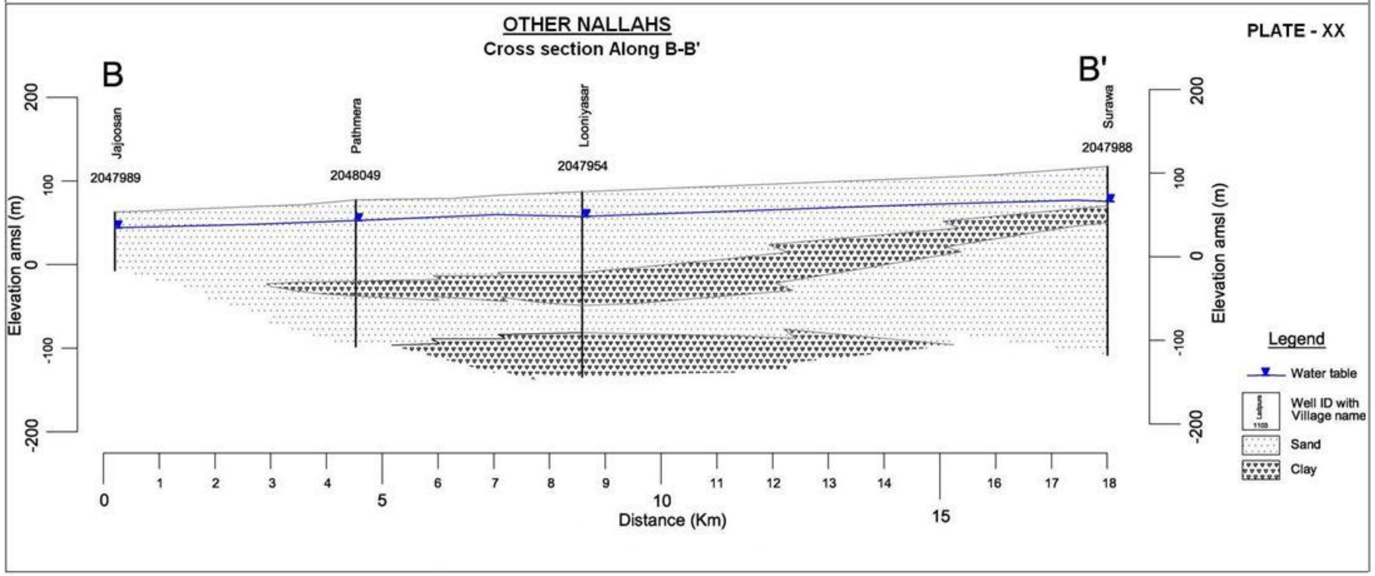


PLATE - XX



Section C-C’:

The C-C’ section has been prepared to visualize variation across the basin trending from NW-SE in the central part of the basin and covers a length of 25 kms (Plate – XXI). The lithologs of 4 boreholes are taken into account while preparing this cross-section. The section depicts the disposition of different layers of sand and clay along with shale. In the rest of the area, sand is predominating while there are some lenses of clay. Hardrock is encountered in easternmost well. The cross-section depicts that alluvium is forming the major aquifer system underlain by shale.

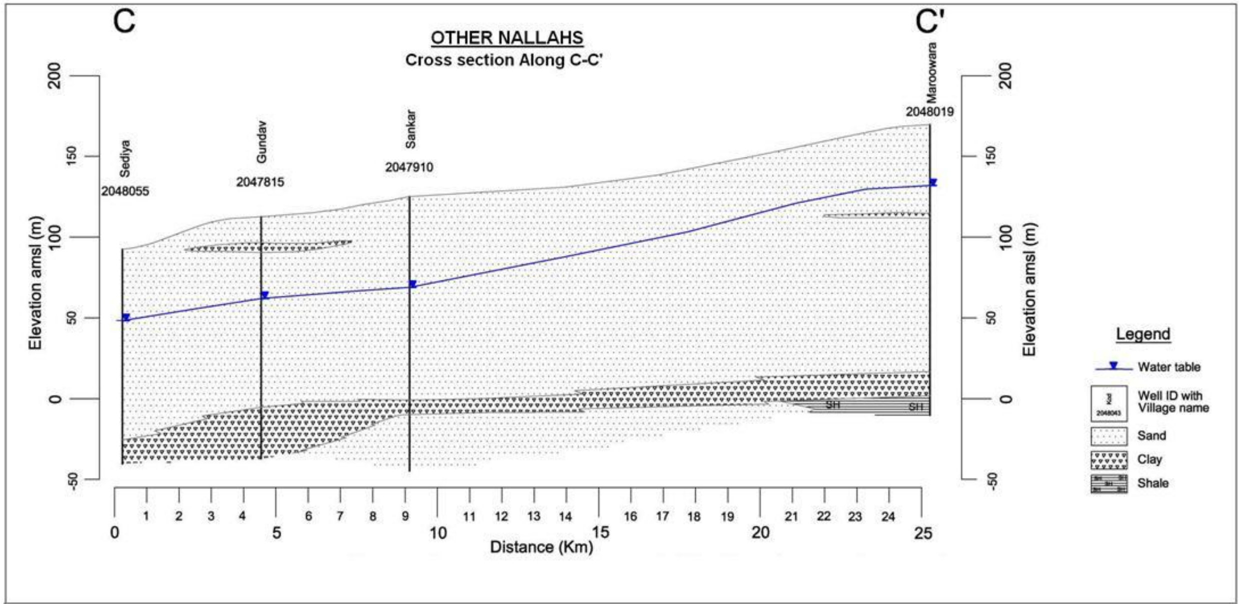
The water level varies from 48 m amsl to 130 m amsl based on the data of pre monsoon 2010.

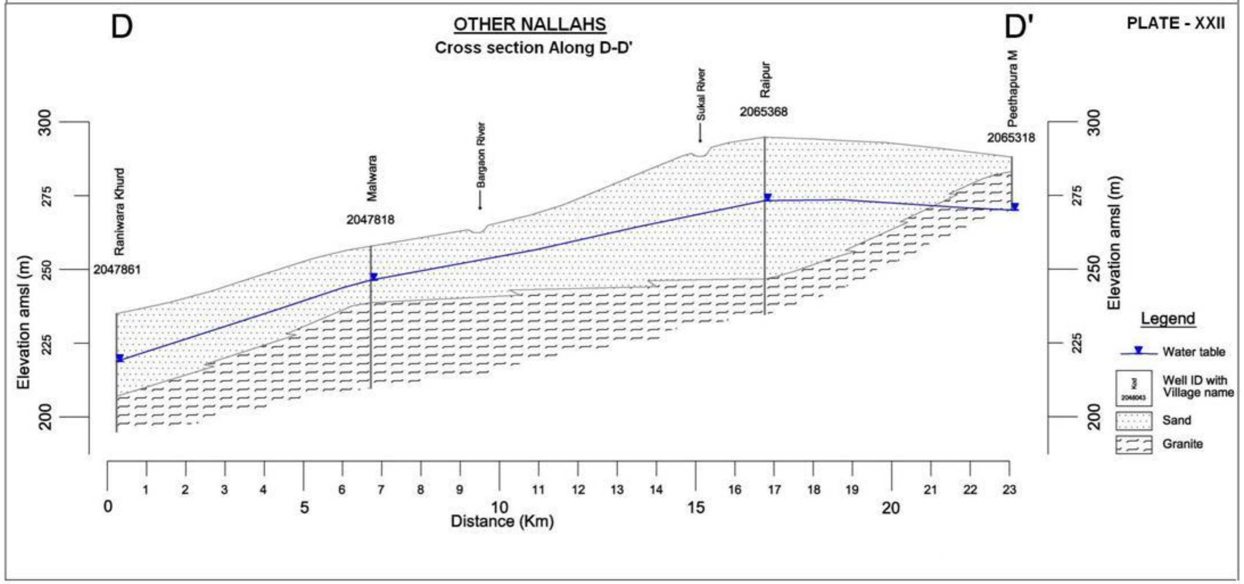
Section D-D’:

The section is trending from NW-SE covers a length of 23 kms (Plate – XXII). To depict the lithology of the cross-section, 4 boreholes along with surrounding well information are chosen. The cross section cuts across two streams namely Bargaon and Sukal. The section depicts the disposition of sand along with granite. Granite comprises the bedrock which is overlain by sand. The thickness of sand varies from 5m to 65m at various places in the section

It is observed from pre monsoon 2010 data the ground water level varies from 215 m amsl to 270 m amsl.

PLATE - XXI


C
C'
OTHER NALLAHS
Cross section Along C-C'
Sediya
2048055
Gundav
2047815
Sankar
2047910
Maroowara
2048019
SH
Elevation amsl (m)
Distance (Km)
Legend
Water table
Well ID with Village name
Sand
Clay
Shale

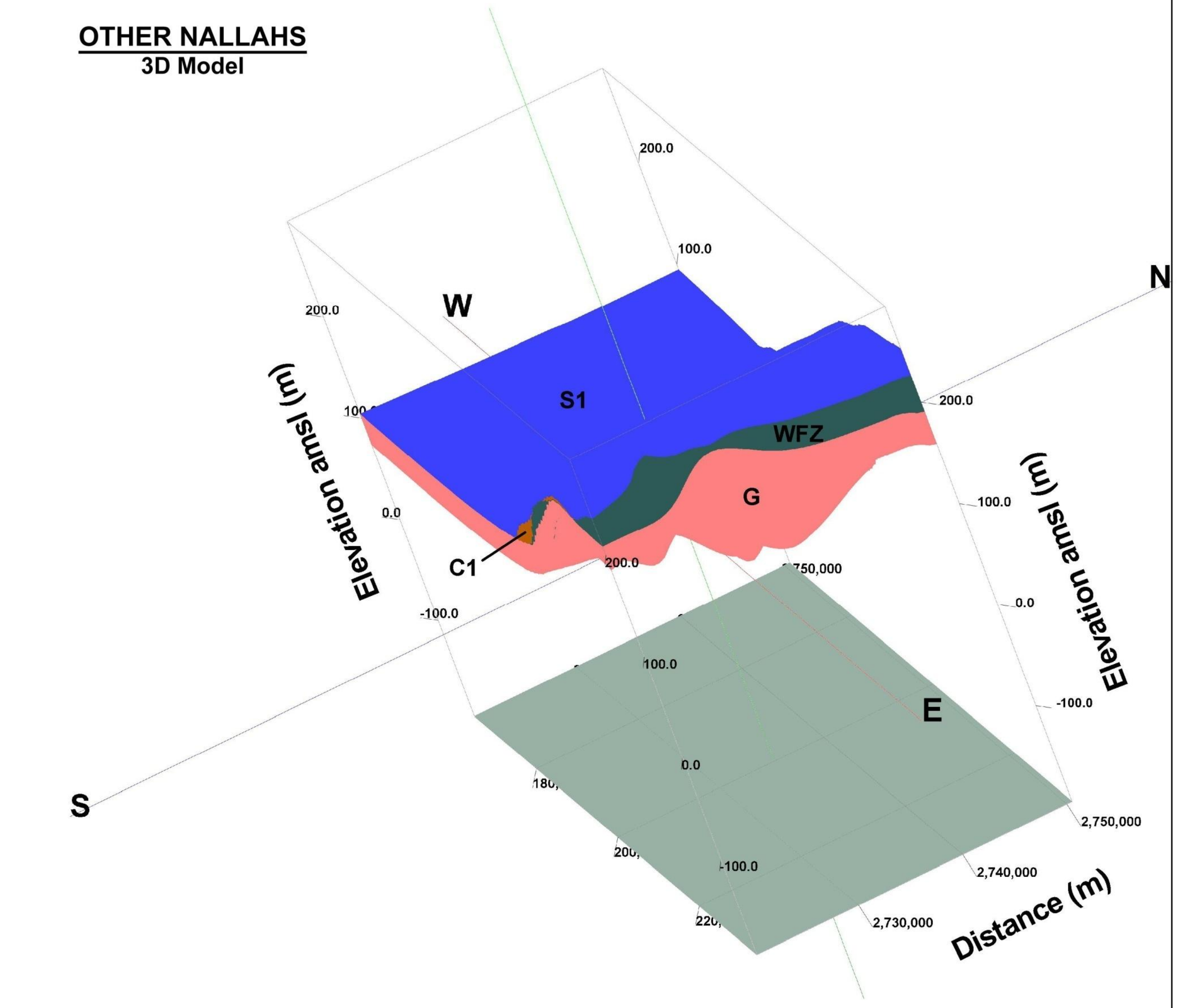

D
D'
PLATE - XXII
OTHER NALLAHS
Cross section Along D-D'
Raniwara Khurd
2047861
Malwara
2047818
Bargaon River
Sukal River
Raipur
2065368
Peethapura M
2065318
Elevation amsl (m)
Distance (Km)
Legend
Water table
Well ID with Village name
Sand
Granite

The three dimensional litho-stratigraphic model has been developed for the Other Nallahs basin using interpolation techniques on the data of scattered wells given as an input. Plate – XXII represents a 3D model depicting the various litho-stratigraphic units in the entire river basin. With this model it is apparent that beneath the thin cover of top soil, there are two persistent clay horizons in the region separating two sandy aquifers. The top sandy aquifer is present in the whole area. Beneath the sand layers there is indication of a persistent weathered and fractured bed rock acting as aquifer. From the model it has also been observed that a small patch of weathered and fractured rock acing as an unconfined aquifer in the southwestern part of the area.

The depth of hard rock is shallow in the southeastern part as compared to the northeastern part of the basin. Granite constitutes the basement.

PLATE - XXIII

OTHER NALLAHS
3D Model



Legend

S1	Sand
C1	Clay
S2	Sand
C2	Clay
WFZ	Weathered & Fractured Zone
G	Granite

Glossary of terms

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

(Contd…)

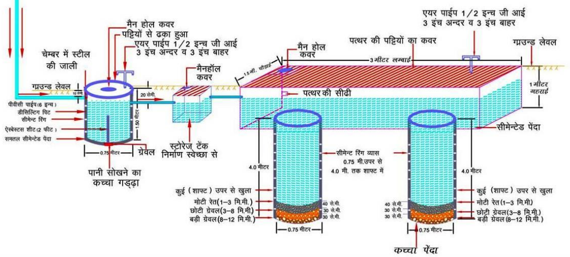
Ground Water Department,
Rajasthan

European Union
State Partnership Programme

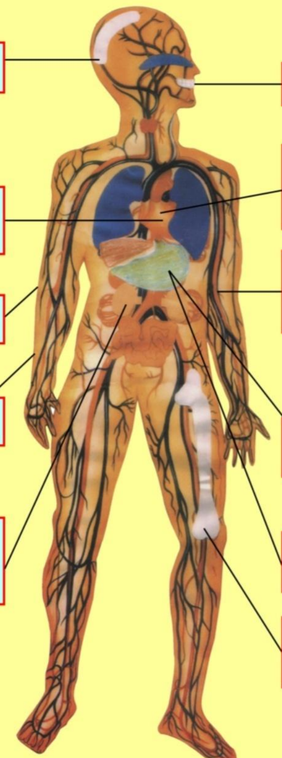
भवन छत क्षेत्रफल 300 से 500 वर्गमीटर तक   चित्र–4

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



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

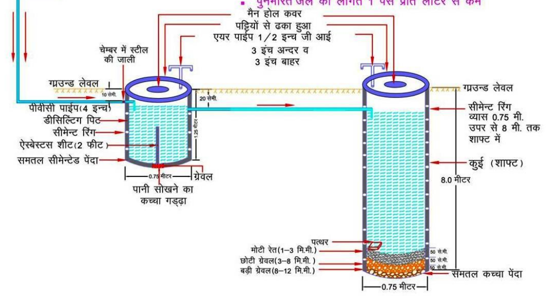
केन्द्रीय भूमि जल बोर्ड,
पश्चिमी क्षेत्र, जयपुर
जल संसाधन मंत्रालय
भारत सरकार
e-mail:cgwbwr@sancharnet.in

भूजल अमूल्य है इसे प्रदूषित न करें।

भवन छत क्षेत्रफल 100 से 200 वर्गमीटर तक   चित्र–2

निर्माण किये जाने वाले मुख्य भाग एवं डिज़ाईन

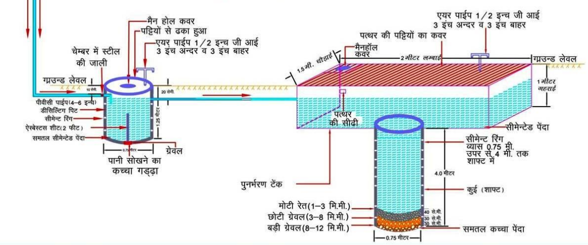
- PVC पाईप 4" व्यास
- सीमेन्ट रिंग से निर्मित डीसिल्टिंग पिट (0.75 मी.व्यास x 1.25 मी. गहरा)
- सीमेन्ट रिंग से निर्मित शाफ्ट (0.75 मी.व्यास x 4 मी गहरी)
- संरचना की अनुमानित लागत रु 11,000–12,000
- वार्षिक पुनर्भरित जल लगभग 83,000 लीटर
- 20 वर्षों में पुनर्भरित जल लगभग 16,64,000 लीटर
- पुनर्भरित जल की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



भवन छत क्षेत्रफल 200 से 300 वर्गमीटर तक   चित्र–3

निर्माण किये जाने वाले मुख्य भाग एवं डिज़ाईन

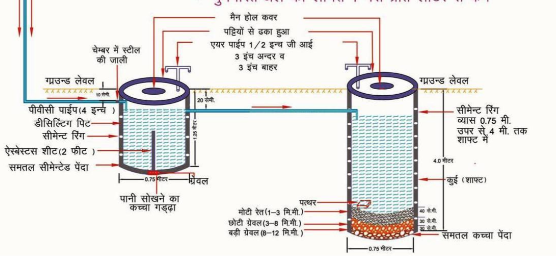
- PVC पाईप 4"– 6" व्यास
- सीमेन्ट रिंग से निर्मित डीसिल्टिंग पिट (0.75 मी.व्यास x 1.25 मी.गहरा)
- रीचार्ज टेंक 1.5 मी.चौड़ा x 2 मी.लम्बा x 1 मी.गहरा
- सीमेन्ट रिंग से निर्मित शाफ्ट (0.75 मी.व्यास x 4 मी.गहरी)
- संरचना की अनुमानित लागत रु 15,000–16,000
- वार्षिक पुनर्भरित जल लगभग 1,25,000 लीटर
- 20 वर्षों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



भवन छत क्षेत्रफल 100 वर्गमीटर तक   चित्र–1

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



ROLTA
Rolta India Limited

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