



स्वच्छ सुरक्षित जल – सुन्दर खुशहाल कल  
**CONSERVE WATER - SAVE LIFE**

**CENTRAL GROUND WATER BOARD**  
Ministry of Water Resources  
Government of India

## GROUNDWATER SCENARIO



## BIKANER DISTRICT, RAJASTHAN

Western Region  
Jaipur  
March, 2009

## DISTRICT AT A GLANCE – BIKANER DISTRICT, RAJASTHAN

S No	Item	Statistics	
<b>1</b>	<b>GENERAL INFORMATION</b>		
	(i) Geographical area (Sq. Km)	30247.90	
	(ii) Administrative Division (As on 31.3.2007)		
	Number of Tehsils	08	
	Number of Blocks	05	
	Number of Villages	889	
	(iii) Population (As per 2001 Census)	19,02,000	
(iv) Average Annual Rainfall (1986-2005) in mm	287.8		
<b>2</b>	<b>GEOMORPHOLOGY</b>		
	Major Physiographic Units	older alluvial plains, Sandy undulating aggraded Alluvial plains, Flat Interdunal Plains, Sandy undulating interdunal plains, Flood plane, Aeolian complex, Stabilized Sand dunes, Active Sand dunes, Gravelly aggraded alluvial plains, Eroded rocky surface, Saline depressions, Sandy Plain	
	Major Drainage	No Major Drainage	
<b>3</b>	<b>LAND USE (sq km)</b>		
	(a) Forest Area	812.62	
	(b) Net Sown Area	<b>13789.61</b>	
	(c) Cultivable Area	2283.55	
<b>4</b>	MAJOR SOIL TYPE	Loam, Clay loam, pebbly & stony and sandy loam	
<b>5</b>	<i>AREA UNDER PRINCIPAL CROPS</i> (As on 2004-05)	<b>Crops</b>	<b>Tonnes</b>
		Kidney bean	205831
		Oil Seeds	121348
		Wheat	73466
		Pulses	91288
		Jowar	226
		Barley	3416
		Spices	6228
		Bajra	35189
<b>6</b>	<b>IRRIGATION BY DIFFERENT SOURCES</b>		
	Source	No of structure	Gross Irrigated Area in ha
	Dug wells	-	-
	Tube wells/Bore wells	-	-

	Tanks/Ponds	-	-
	Canals	-	-
	Net Irrigated Area (ha)	144324	
	Gross Irrigated Area (ha)	228355	
<b>7</b>	<b>NUMBER OF GROUND WATER MONITORING WELLS OF CGWB</b> (As on May 2007)		
	Number of Dug wells	36	
	Number of Piezometers	30	
<b>8</b>	<b>PREDOMINANT GEOLOGICAL FORMATIONS</b>	Sandstone, Limestone - Evaporite sequence Sandstone -clay - Sandstone sequence, Aeolian sand, River flood Deposits.	
<b>9</b>	<b>HYDROGEOLOGY</b>		
	Major Water bearing formation	Tertiary sandstone, Alluvium, Sandstone, Limestone	
	Depth to water level (Pre-monsoon, 2006) (mbgl)	9.59 – 110.20	
	Depth to water level (Post-monsoon, 2006) (mbgl)	9.20– 110.10	
	Long term water level trend (1997-2006) in cm/yr	< 10 to > 40	
<b>10</b>	<b>GROUNDWATER EXPLORATION BY CGWB</b> (As on 31.3.2001)		
	Number of wells drilled (EW, OW, PZ, SH, Total)	EW – 32, OW-07, PZ- 22 & SH -2	
	Depth Range (m)	110 – 510	
	Discharge (liter per second)	60 – 750	
	Storativity	-	
	Transmissivity (m <sup>2</sup> /day)	36 to 720	
<b>11</b>	<b>GROUND WATER QUALITY</b>		
	Presence of chemical constituents more than permissible limit (EC>1500 mmhos/cm at 25 <sup>0</sup> C)	EC – 22500 sq km	
	Type of water	Alkaline	
<b>12</b>	<b>DYNAMIC GROUND WATER RESOURCES (March, 2004) in mcm</b>		
	Annual Replenishable Ground Water Resources	227.0832	
	Net Annual Ground Water Draft	214.928	
	Projected Demand for Domestic and Industrial Uses up to 2025	87.7435	
	Stage of Ground Water Development	94.65 %	
<b>13</b>	<b>GROUND WATER CONTROL AND REGULATION</b>		
	Number of Over-exploited blocks	02	
	Number of Critical Blocks	01	
	No of Blocks Notified	Nil	
<b>14</b>	<b>MAJOR GROUND WATER PROBLEMS AND ISSUES</b>	Scarcity of water	

# **DISTRICT GROUND WATER BROCHURE BIKANER DISTRICT**

## **1.0 INTRODUCTION**

Bikaner district is located in the north-western part of Rajasthan and encompassed between north latitudes 27°11' to 29°03' and east longitudes 71°52' to 74°15' covering geographical area of 30247.90 Sq. kms. It is bounded on the north by Ganganagar District, on the east by Churu and Nagaur Districts, on south by Jodhpur and Jaisalmer districts and on the west by International border with Pakistan. It is administratively divided into five blocks namely Bikaner, Nokha, Lunkaransar, Dungargarh and Kolayat. The district has one municipal council, 219 Gram panchayats and 889 Villages. As per 2001 Census, the total population of the district is 19.02 lac out of which 10.03 lac Male population and 8.99 lac is female population.

Auden (1950), Seth (1955), Kidwai (1961-63) and Doshi (1968) of Geological Survey of India carried out ground water studies for various purposes in the district. The entire district has been covered initially under systematic hydrogeological surveys, subsequently most of the areas of the district have Central Ground Water Board drilled over 100 wells/bore wells in the district under various programs, the maximum being under 200 production wells programme in Rajasthan (1964-67), under the programme of ground water exploration, wells have been drilled which includes 27 exploratory wells, 2 observation wells, 2 Slim holes and 19 Piezometers.

Under U.N.D.P. (Phase-II), ground water resources of the southern parts of Bikaner district were estimated (1971-74). In addition, Rajasthan Gound Water Department (RGWD) and Central Arid Zone Research Institute (CAZRI), Jodhpur have also carried out hydrogeological studies in the district.

Since 1973, monitoring of water level is being carried out four times a year from presently 66 National Hydrograph Network Stations.

## **2.0 RAINFALL & CLIMATE**

The district experiences arid type of climate. Mean annual rainfall (1971-2005) of the district is 297.7 mm whereas normal rainfall (1901-1971) is lower than average rainfall and placed at 257.8 mm. Almost 90% of the total annual rainfall is received during the southwest monsoon, which enters the district in the first week of July and withdraws in the mid of September. As the district lies in the desert area, extreme of heat in summer and cold in winter is the characteristic of the desert. Both day and night temperature increases gradually and reaches their maximum values in April, May and June. The temperature varies from 48 degree in summer to 1 degree in winter. Atmosphere is generally dry except during the monsoon period. The humidity is highest in August with mean daily relative humidity is 71% in the morning and 52% in the evening.

### 3.0 GEOMORPHOLOGY & DRAINAGE

The major part of the area under investigation is covered by sand dunes of different types and magnitudes, with flat to undulating interdunal plain. The west, central and eastern part of Bikaner tehsil area are constituted by flat and undulation alluvial plain. The regional slope of land surface in the district is from SE to NNW. The highest elevation in the eastern part of the district is 275 m above msl while in its western part it is 150 m above mean sea level.

The District has no major drainage except a few short intermittent and ephemeral channels near Kolayat and few natural lakes or depressions are observed near Gajner, Kolayat, Nal and Lunkaransar. In the year of drought there is no run off.

### 4.0 SOIL, LAND USE & IRRIGATION PRACTICES

The soils of Bikaner district are predominantly light textured, weak – structured but well – drained. The arid climate with low rainfall, high temperature and high evaporation losses have resulted in physical and mechanical disintegration of the parent material giving rise to predominance of coarse fraction in the soil. Very little chemical weathering has been taking place and the development of soil is mostly indistinct.

Soils are generally of desertic type with poor fertility status and very low water retention capacity. Soil profile studied during UNDP Project (1971-74) show that the hydraulic conductivity in the soil profiles reaches up to 10.9 cm/hr. while the maximum available moisture in the soil profile remains to the extent of 1.13 percent.

The mechanical analysis of the soil samples show that the constituents in general are light textured sand to sandy loam with the clay content ranging from 4.2% at Sutak to 11.2% at Palana and the silt content ranging from 28 to 13.3%. Maximum water holding capacity is 31.3% (Lunkaransar). In general the soils have good porosity (40%) and good to very good permeability.

The pH of the soil in its upper surface horizons ranges between 7.9 and 8.1 and show an increase with depth in general. This gradual downward increase in pH may be due to the increase in lime content with depth. Similar trend of increase with depth is also observed in respect of values of electrical conductivity of the soil profile.

Most of the soils are calcareous with a maximum lime content of 10.2% (at Lunkaransar). In general, the lime content in soil increases with depth whereas organic carbon decreases with depth and vary from 0.01 to 0.13%.

**Infiltration Rate:** The field infiltration tests had been conducted (FSP 1981-82) on different soils (using double ring infiltrometer) in parts of Kolayat and Nokha block of district Bikaner. The infiltration rate ranges from 2.05 to 39.54 Cm/hour.

**Land-use Pattern:** The meteorological parameters like low rainfall and high evaporation loss have significant influence over land use pattern in the district. Out of the total geographical area of 3024790 hectares, only 228355 hectares of land was cultivated during the year 2004-05. The uncultivable area comprises 81262 hectares

forest land, 10% uncultivable land, 1.90% Pasture land, 35.59% culturable waste and 9.89% fallow land. The cultivable land of 228355 hectares is spread over all the tehsils.

Net irrigated area of the district is 144324 hectares. Bikaner tehsil has the maximum irrigated area (54188 ha.) where as the Nokha the minimum irrigated area (382 ha.).

**Crops:** Agriculture in the district is by and large confined to traditional Kharif cultivation depending up on the monsoon rainfall. Rabi cultivation is restricted to localized areas where irrigation facilities are available. The major crops grown are:

Main crops	:	Bajra and wheat
Pulses	:	gram and Kharif Dals
Oily material	:	Mustard and Groundnut
Others	:	Cotton and Sugarcane.

The cultivators and agriculture labourers are 49.41% of the total workforce. Since the agriculture is the principal occupation of the population, so it is imperative that if the irrigation facilities are extended over large area, it will be possible to charge the agriculture scenario of the district to a great extent.

Principal crops of the District during 2005-06[in Tonnes]

Crops	in Tonnes
Bajra	35189
Moth	205831
Moong	243
R & M	40059
Wheat	73466
Jowar	226
Barley	3416
Gram	91045
Gwarseed	39844
Groundnuts	77203
Fenugreek seed	3301
Cumin seed	2382
Psyllium seed	545

**Irrigation and Water Resources:** The principal sources of irrigation in the districts are Canals, Canals account for 99.32% wells irrigation covered only 0.64% of the gross irrigated during 1992-93. Table indicated that the maximum irrigated through canals is in Bikaner tehsil whereas it is minimum in the Nokha tehsil.

There is a major irrigation project in the district which is called Indira Gandhi Nahar project whereas there are no minor and medium irrigation projects in the district.

As per the available statistics gross area irrigated by different sources in canals, wells etc. constitute only 12.96% of the gross cultivated area in the district. The irrigation potential created through ground water is almost negligible. Almost the entire irrigation in the district is through surface water imported from Punjab with a share of Rajasthan through Indira Gandhi Nahar.

**IGNP CANAL:** The main Indira Gandhi Canal enters the district of Bikaner north of village Bhansar and it passes through Khagabera, Lakharwara, Sisardesar Chattargarh, Sattasar, Siasar, Prithiraj Ka Bere, Karmisar and Modhyat. Its distributaries are the Naushera branch passing through Ranawar, Naushera and Sarangsar; the Dattor branch passing through Losasar, Jodagarh, Rawala and Musewala; the Birswlpur branch passing through Mankasar, Dhurkot and Birsilpur; and charanwala branch leading up to Charanwala and beyond in Jaisalmer district and Pugal Branch. The main Canal has commanded area westward towards international boundary with Pakistan.

Besides the Indira Gandhi Canal, there are other Command areas in Bikaner district. There are (a) The command area of tail end of Anupgarh Shakha north of Barwala (b) The command area of Lunkaransar high branch. The later has two commands called Lunkaransar lift area and Bikaner lift area. The Indira Gandhi Nahar Pariyojna receives water from barrage at Hari Ka pattan in Amritsar district of Punjab, through 204 kms. Indira Nahar feeder up to Masitanwali thereafter it is given to the 445 km. Indira Gandhi Main Canal. Out of 445 km. length, 189 kms. Falls in stage-I comprising 5.25 lakh hectares command area while remaining 256 km. is in Stage-II comprising 10.12 lakh hectares culturable Command Area (C.C.A.) of which 7 lakh hectares is in flow command and the rest in lift command. I.G.N.P. Canal.

The Indira Gandhi Nahar Project forms the major project in the district and there are no minor and medium irrigation projects in the district/ In I.G.N.P. Stage-I the Canal Command Area in Bikaner district is 1,79,000 hectares. In I.G.N.P. stage-II the Canal Command Area in Bikaner District is 4,12,000 hectares. Thus total Canal Command area in both the stage of I.G.N.P. up to March 1998 Comes out to 5,91,000 hectares.

The I.G.N.P. is known as "Life giving Current" in the dry Western Rajasthan of the Rajasthan State. It is in the north western part of the Thar Desert of Rajasthan which is a desolate unending sands cap. (Sandy landscape ) called land of death or Marubhumi. The IGNP is the largest Canal system in the world and construction of the Canal was started in 1958.

The groundwater is brackish to saline in most of the Western area with E.C. values from 3000 to over 20000 micromhos/cm, and is not suitable for domestic as well as irrigation purposes. The studies are required to make out strategies for optimum development of ground water resources in conjunction with surface water Command wise, and to improve present irrigation pattern by conjunctive in technique and to increase cropping intensity and bringing more area under irrigation with better and efficient management of water resources.

The area is underlain by hard pans at various depths at places. These hard pans etc. as hydrological barrier, the depth of which varies from less than 5m. to over 20m. The depth of barriers increases by and large towards west or northwest side away from the main canal. The occurrence of hydrological barrier has potential danger of creating water logging condition in the flow irrigation area, particularly where these occur at shallow depth. The rise of water table and accumulation of seepage water over hydrological barriers will make available ground water of suitable quality and this has to be used in conjunction with surface water so as to

control water logging conditions which may arise otherwise. Studies will also be required to be carried out for determining the possibilities of using ground water with reasonable salinity level in conjunction with canal water. This way there is every likely hood of getting the ground water quality in the canal command area gradually improved.

**Source wise irrigation facilities:**

Source	No. of structure	Gross Irrigated Area in hectare
Dug wells	-	228355
Tube wells/Bore wells	-	
Tanks/Ponds	-	
Canals	-	
Other Sources	-	

## 5.0 GROUND WATER SCENARIO

**5.1 Geological Framework:** Practically the whole of the surface geology in the greater part of the district is concealed under a thick cover of wind blown sand. However rocks belonging to Palana Series of Eocene age are exposed around Kolayat, Mar and Bikaner. Sporadic outcrops of sandstone belonging to Lathi (Jurassic) and Badhaura Series (Permo-carboniferous) occur in south-western corner of the district. Lathi and Badhaura sandstones are small area and these pinches out there itself. Palanas or the Quaternaries are directly underlain by rocks belonging to Marwar Super Group.

Apart from the exploratory drilling carried out by the Geological Survey of India for Mineral exploration the Central Ground Water Board (Erstwhile Exploratory Tube wells Organization) and the Rajasthan Ground Water Department have drilled number of boreholes (including 13 boreholes drilled under UNDP Phase-II Project). Based on the formations encountered during drilling a generalized geological succession for the district has been established.

Jodhpur sandstones and shales are encountered at very shallow depth just below the top Quaternaries in an elliptical area with its longer axis in East-west and shorter axis in north-south direction along Bamanwali-Dhirera and ulmera line.

Thickness of Quaternaries is less around Mahajan in the northern part of the district but increase both in the north towards Arjunsar and in south towards Lunkaransar. Again the Jodhpur sandstones are encountered at shallow depths just below the Quaternaries in the southern part of the district.

The subsurface regional geological correlation has revealed the presence of a major longitudinal fault (further east of Bikaner District Boundary). It separates the pre-Cambrian basement platform of the eastern up throw block with the lower Tertiary of the western down throw block falling in the Bikaner district. Some smaller parallel faults and a few cross faults are also noticed. One such fault passes in the east-west direction north of Nokha with its down throw in the north. Thus, practically whole of the Bikaner area forms a syncline separated from the southern Nagaur up lift.

**5.2 Hydrogeology:** The Palana sandstone member of the Palana series is the main aquifer in the district. Other aquifer formations are sandstone and limestone of Nagaur group of rocks. Jodhpur sandstone and Quaternary alluvium also form aquifer whenever they extend in the zone of saturation. The ground water conditions in different formations are described below:

### Geological Succession

Era	Period	Series	Lithologic description	Aquifer Properties
1	2	3	4	5
Quaternary	Recent to Sub Recent	Sand dune, Alluvium	Aeolian sand, River flood Deposits.	Productive in part but generally confirms brackish to saline water.
	Pleistocene	Pebble, Cobble and boulder beds	Pebble to boulder conglomerate etc.	Above water table
<b>Unconformity</b>				
Tertiary	Lower Eocene	Palana Series	Upper part: Sandstone, white to pink, fine to coarse grained to gravelly, locally consolidated.	The sandstone is a good aquifer in parts
			Lower part: Varied, pink to reddish brown clay widespread south of Bikaner. Nummulitic limestone at the top.	
Paleozoic	Marwar Super Group	Nagaur Group	Sandstone-clay-stone sequence: Sandstone, pink to reddish brown very fine to coarse, micaceous, generally	Aquifer with low water yielding capacity

			compact, intercalated and interbedded with red clay stone and shale.	
		Bilara Group	Limestone-evaporite sequence anhydrite and Gypsum, halite in Lakhasar, mainly in the upper part. Limestone partly dolomitic or siliceous associated with red clay and some sandstone, predominating in the lower part.	
		Jodhpur Group	Sandstone, purple Poor aquifer to reddish brown, fine to very coarse, micaceous, very compact, associated with red claystone.	

In the western Central and eastern part of the district, tertiary formation, attain considerable thickness particularly around Kolasar-Deabtra-Kolayat. The Quaternary sediments attain sufficient thickness for ground water in the northern part of the district, north of latitude 28°03' (except Dhiresara-Dhumera area).

**Hydrogeological Conditions:** The Palana sandstone member of the Palana series is the main aquifer in the district. Other aquifer formations are sandstone and limestone of Nagaur group of rocks. Jodhpur sandstone and Quaternary alluvium also form aquifer whenever they extend in the zone of saturation. The ground water conditions in different formations are described below:

**Quaternary Aquifer:** The unconsolidated Quaternary sediments attain the status of aquifer in the area north of latitude 28°03' except around Dhirera and Dhulmera, Mechanical analysis of the aquifer material collected during direct rotary drilling reveals the presence of 20% clay contents in the aquifer with sorting coefficient varying from 1.3 to 3.34, the average being in the range of 1.5 to 2.5. The ground water occurs under water table conditions and the yield varies from 75 lpm to less than 950 lpm. Thickness of alluvium in the exploratory well at Godwala-II is found to be 187 m in the yield of well 947 lpm (Godwala-II). The drilled depth of this borehole was 418.49 m. whereas constructed depth is of 187 m. The slim hole at Karmisar has been drilled to the depth of 510.27 m. The main potential area in the Central part, Quaternaries do become potential aquifers as and when they attain saturation, been found difficult.

**Palana Sandstone Aquifer:** Palana Sandstone is overlain by Quaternary deposits and is underlain by rocks belonging to Nagaur Group of Marwar Super group. Palana formations belong to lower Eocene to Palaeocene age comprises mainly sandstone fine to coarse grained, well sorted white to grey with some times pink tinge, poorly to moderately cemented, soft and friable. Locally it is more gravelly, poorly sorted and is intercalated with thin clay beds especially in their lower part, close to their contact with the thick lower members of the Palana series.

The saturated thickness of Palana sandstone aquifer attains its maximum thickness, more than 80 meters, north of Bikaner. In accordance with the regional structural pattern, the saturated thickness of Palana sandstone aquifer increases towards north, except in the axial part of the Bikaner syncline around Sital where it is greatly reduced to 15 meters only. In Gajner, Akasar and Soa, it is reduced to near negligible but it again attains thickness of about 100 m. at Kolayat and Baneri. The drilled depth in Palana sandstone varies from 105 m. bgl to 505 m bgl. The yield varies from less than 50 lpm to 1000 lpm.

Palana aquifer is found to be under phreatic conditions. Specific capacity of wells ranges from 3.6 to 28.1 m<sup>3</sup>/hr./m. and transmissivity ranges up to 720 m<sup>2</sup>/day, and permeability from 1.65 to 13.5 m/day. The values of transmissivity remains much below 100m<sup>2</sup>/day in the axial zone of the Bikaner syncline and relatively high values are expected in the north-eastern part around Bikaner-Sujandesar and around Raneri in the west. Average specific yield of the aquifer is estimated at 7%.

**Aquifer of Nagaur Group:** Only the upper part of Nagaur Group of rocks comprising mainly sandstones has been encountered just below Palana series in most of Kolayat-Bikaner-Sital-Surpura area. The ground water in Nagaur Sandstone occurs under confined conditions mostly. In the explored part its saturated thickness varies from 40 to 310 meters. However, Nagaur sandstone aquifer is under water table conditions in Nokha area. In this area its saturated thickness varies from a few meters to little over 50 meters at Nokha. Yield of wells vary from 200 to 750 lpm. Transmissivity is low and ranges from 2.5 to 50 m<sup>2</sup>/day. Permeability is correspondingly low. Specific capacity of wells varies from 0.17 to 1.20 m<sup>2</sup>/hr./m. The specific yield of Nagaur Sandstone is estimated at 1% only.

In the southern most part of the district the lower members of the Nagaur group comprising limestone evaporate sequence also form an aquifer in a localized patch of insignificant potential.

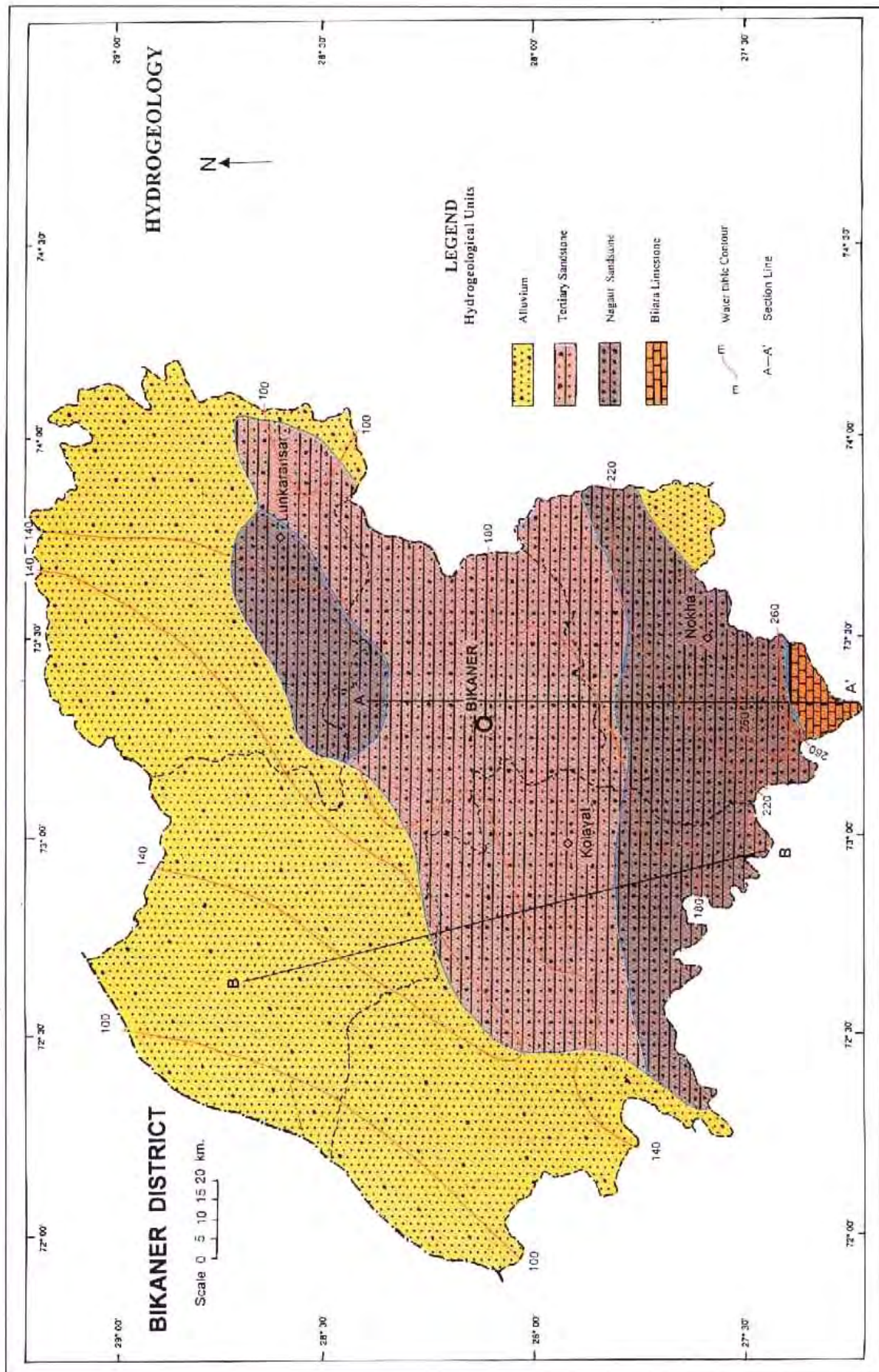
**Aquifers of Jodhpur Group:** Jodhpur sandstone is compact, fine to coarse grained, micaceous and purple to reddish brown in colour. In most of the Bikaner area it lies below the evaporate sequence and it contains saline ground water.

**Aquifer of Nagaur Group:** Only the upper part of Nagaur Group of rocks comprising mainly sandstones has been encountered just below Palana series in most of Kolayat-Bikaner-Sital, Surpura area. The ground water in Nagaur Sandstone occurs under confined conditions mostly. In the explored part its saturated thickness varies from 40 to 310 meters. However Nagaur sandstone aquifer is under water table conditions in Nokha area. In this area its saturated thickness varies from a few meters to little over 50 meters at Nokha. Yield of wells vary from 200 to 750 lpm. Transmissivity is low and ranges from 2.5 to 50 m<sup>2</sup>/day. Permeability is correspondingly low. Specific capacity of wells varies from 0.17 to 1.20 m<sup>2</sup>/hr. /m. The specific yield of Nagaur – Sandstone is estimated at 1% only.

In the southern most part of district the lower members of the Nagaur Group comprising limestone evaporate sequence also form an aquifer in a localized patch of insignificant potential.

**Aquifers of Jodhpur Group:** Jodhpur sandstone is compact, fine to coarse grained, micaceous and purple of reddish brown in colour. In most of the Bikaner area it lies below the evaporate sequence and it contains saline ground water.

# HYDROGEOLOGICAL MAP OF DISTRICT BIKANER



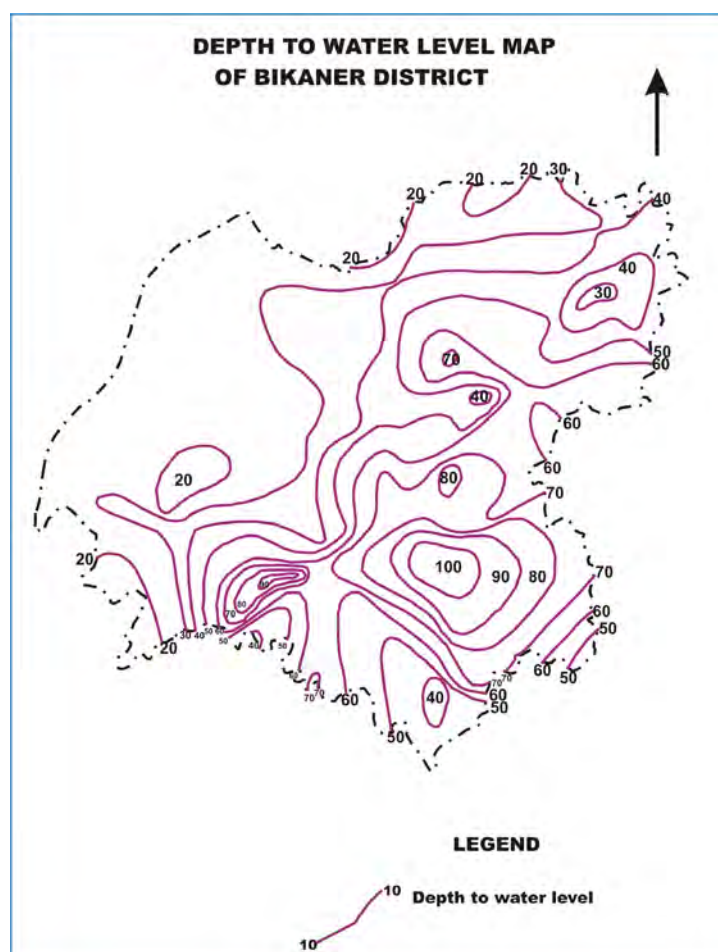
## Depth to Water Level

Depth to water level (2006) in the district, monitored on 66 stations, ranges from 9.59 to 110.20 m bgl and 9.20 to 110.10 m bgl during pre monsoon and post monsoon, 2006, respectively. Block-wise depth to water level is as follows:

Block	Pre-monsoon water level in m bgl		Post-monsoon water level in m bgl		Water level fluctuation in m (Pre- Post)			
	Min	Max	Min	Max	Rise		Fall	
					Min	Max	Min	Max
Bikaner	13.73	110.20	13.55	110.10	0.02	2.24	0.02	1.19
Kolayat	12.08	106.01	11.20	106.50	0.05	3.26	0.03	1.95
Lunkaransar	9.59	71.20	9.20	67.93	0.04	4.79	0.03	16.58
Nokha	38.92	100.93	65.90	100.96	0.40	0.67	0.03	0.13
Shri Dungargarh	-	-	16.88	68.35	-	-	-	-
<b>District</b>	<b>18.58</b>	<b>97.09</b>	<b>23.35</b>	<b>90.77</b>	<b>0.13</b>	<b>2.74</b>	<b>0.03</b>	<b>4.96</b>

During pre monsoon, shallow water level 9.59 to 38.92m bgl exists in Bikaner, Kolayat, Lunkaransar and Nokha blocks. Bikaner, Kolayat, Lunkaransar and Nokha blocks water level was 9.59 to 110.20 m bgl.

During post monsoon, shallow water level 9.20 to 65.90 m bgl exists in Bikaner, Kolayat, Lunkaransar and Nokha blocks. Bikaner, Kolayat, Lunkaransar and Nokha blocks water level was 9.20 to 110.10 m bgl.



### 5.3 Ground Water Quality

The chemical quality of ground water in the district has been studied from the available data of chemical analysis of water sample collected from the National hydrograph network stations located in various parts of the district. The analytical data of ground water sample indicate that the ground water in general alkaline in nature.

A perusal of the Ec map indicates that specific conductance varies from 670 micromhos/cm (Sathasar) to 30160 micromhos/Cm (Modayat) less than 750 micromhos/cm is found in small area at around Sattasar (northern part of the district). EC is within 2000 micromhos/cm in the Southeastern part of the district around Napasar Gusaisar, Udaira sar and Nokha, Bhamatsar etc. and in a small patch around Raner in the north western part and around Mahajan in the north-eastern part. Areas with Ec in between 2000 to 4000 micromhos/Cm are in a small part in the northern part of district and are in southern part of the district. Areas with Ec in between 4000 to 6000 micromhos/Cm are in southwest, western and north-eastern part of the district and cover around Bajju Bhikampur, jaggasar etc. In most part of western and eastern part the E.C. varies between 6000 to 18000 micromhos/Cm with a maximum of 30160 micromhos at Modayat.

A perusal of chloride map indicates the almost similar pattern. The chloride content varies from 28 to 9749 ppm. The areas having less than 250 ppm are in the eastern portion of the district and in a small patch is central northern & western part of the district, where as areas more than 1000 ppm are mainly in the Western, north eastern part of the district.

Fluoride is very important constituent in determining the suitability of water for drinking purposes. High concentration of fluoride causes matling of teeth enamel and regular in take of water with high concentration of fluoride may cause fluorosis. It varies from traces to 21.3 ppm (Malkisar). The fluoride content above 3 mg/lit. is found in western, Central and northeastern part of the district around charanwala (4.94 mg/l), Karnisar (6.9 mg/l), Jawala (7.8 mg/l), Arjansar (16.5 mg/l), Mahajan (9.8 mg/l), Malkisar (21.3 mg/l).

Thus the ground water of Bikaner district possesses relatively high mineral concentration which varies considerably laterally and vertically. This is due to combination of factors like physical environment, arid climate, dissolution, reduction, base exchange concentration etc. It has been observed that groundwater quality is saline at all levels in the western part of the district, and the fresh water is underlain by saline water in the northeastern part of the district. The ground water quality is good in south central and south eastern part of the district except in some patches.

**Long term change in the quality of ground water:** The perusal of specific conductance in shallow ground water for the water samples collected and in 1997 indicates that there has generally been an improvement in groundwater quality in the area. It has improved at Arjansar (6795 micromhos/Cm in 1986 for 3210 micromhos in 1997), Ballar (9470 micromhos in 1989 to 3290 micromhos in 1997), Dantor (7260 micromhos in 1986 to 6390 micromhos in 1997), Hansera (16630 micromhos in 1986 to 11980 micromhos in 1997), Jalwali (15160 micromhos in 1986 to 6470 micromhos in 1997), Kalu (4495 micromhos in 1991 to 2020 micromhos in 1997), Kasturia (3980

micromhos in 1986 to 2690 micromhos in 1997), Khakli (16330 in 1987 to 11950 micromhos in 1997), Lakhansar (10790 micromhos in 1988 to 6980 micromhos (in 1997), Sattasar (3590 micromhos in 1986 to 670 micromhos in 1997).

The quality of ground water has deteriorated at few places Bithnok (Sp. Conductance 7390 micromhos in 1987 to 9580 micromhos in 1997), vhattargarh (10100 micromhos in 1986 to 10270 micromhos in 1997), Godu (5360 micromhos in 1990 to 13400 micromhos in 1997), Kakku (3000 micromhos in 1990 to 3380 micromhos in 1997), Mahajan (1500 micromhos in 1993 to 1830 micromhos in 1997).

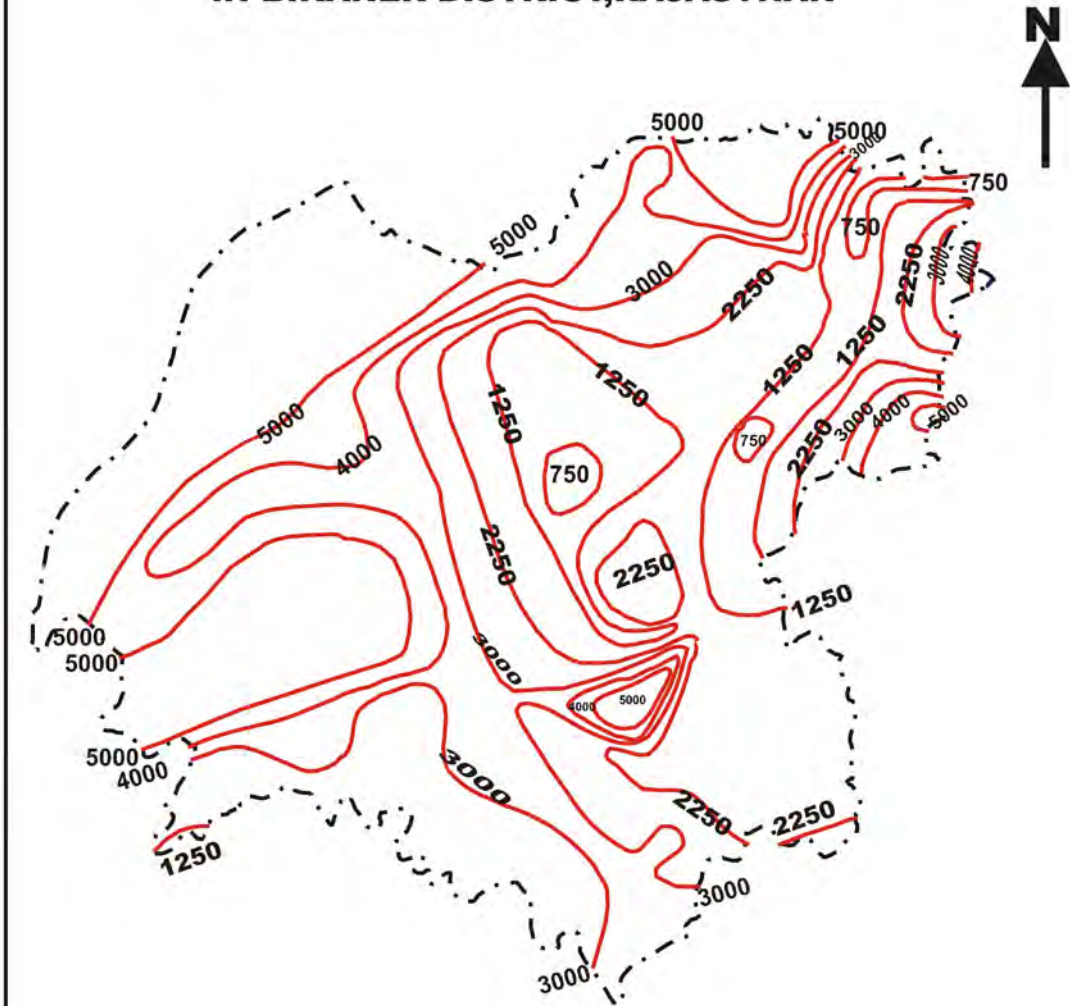
**Ground Water quality in deeper Aquifers:** The results of chemical analysis of water sample collected from the exploratory bore holes, Piezometers and deposit well etc. are given in Table No. The range of different constituents is furnished below:

S. No.	Constituents	Ranges
1.	Specific conductance In micromhos/cm at 25°C	650 to 80290 (Kaluansar) (Khajuwala)
2.	Chloride in ppm	26 to 27512 (Borabas) (Khajuwala)
3.	Nitrate in ppm	Traces to 480 (Govindsar) (Jesrasar)
4.	Fluoride in mg/l	0.26 to 3.35 (Badnu) (Sejrasar)


The data of the bore holes reveal that the specific conductance varies from 650 to 80290 micromhos/Cm at 25°C. the values more than 3000 micromhos/Cm. are found at Khujuwala (80290 micromhos/Cm.) in the Western part of the district; Motigarh (3485 micromhos/Cm), in the Central part of the district, Sajrasar (9515 micromhos/Cm.), Lunkaransar (11760 micromhos/Cm.), Badoniwali (12575 micromhos/Cm.), Malasar (35390 micromhos/Cm.), Sobhasar (5015 micromhos/Cm.), Banjarwali (19190 micromhos/Cm.), Goganpura (13800 micromhos/Cm.), Jesrasar (3100 micromhos/Cm.), Deshnok (5590 micromhos/Cm.), Palana (5270 micromhos/Cm.), Raisar (4095 micromhos/Cm.) in the northern Central eastern and south eastern parts of the district; Govindsr (18980 micromhos/Cm.), Kolayat (7985 micromhos/Cm.) in south western part of the district.

Similarly chloride content also indicates the similar trend. Nitrate values vary from Traces (Govindsar 1 to 4.80) (Jesrasar). The values of Nitrate more than 100 ppm have been found at Borabas (152 ppm), Raisar (384 ppm), Surpura (134 ppm), Hurlidhar Vyas colony, Bikaner (140 ppm), Civil lines Bikaner (210 ppm).

## DISTRIBUTION OF ELECTRIC CONDUCTIVITY IN BIKANER DISTRICT, RAJASTHAN



### LEGEND

1250  EC (micro mhos/cm at 25°C)

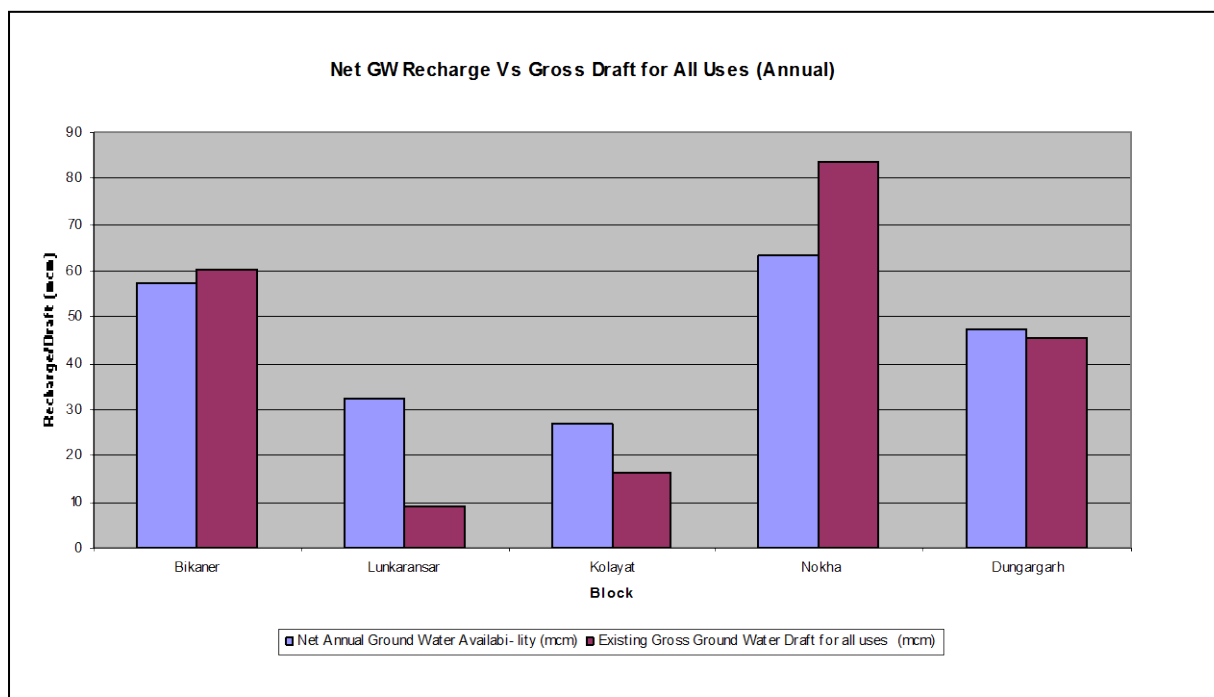
## 5.4 Ground Water Resources

Ground water resources have been reassessed as on 31.3.2004 based on Ground Water Estimation Committee (1997) are given below:

### Ground Water Potential of BIKANER District (As on 31.3.2004)

<b>GROUND WATER POTENTIAL OF BIKANER DISTRICT AS ON 31.3.2004</b>									
Block	Area of Block	Type of Area	Potential zone area	Net Annual Ground Water Availability	Existing Gross Ground Water Draft for Irrigation	Existing Gross G.W. Draft for Dom. & Ind. Use	Existing Gross Ground Water Draft for all uses.	State of G.W. Develop - ment	Category
	(Sq.m.)		(Sq.m)	(mcm)	(mcm)	(mcm)	(mcm)	(%)	
1	2	3	5	6	7	8	9	12	15
Bikaner	9278	NC & C	3191.00	57.2622	38.7768	21.7928	60.5696	105.78	O.E.
Lunkaransar	6328.02	NC & C	2071.00	32.3287	6.6535	2.3520	9.0055	27.86	Safe
Kolayat	7970.86	NC	1924.00	26.8388	8.8644	7.4712	16.3356	60.87	Safe
Nokha	3800.97	NC	3712.63	63.2686	68.5441	14.8282	83.3723	131.78	O.E.
Dungargarh	3003.9	NC	2703.88	47.3849	33.6012	12.044	45.6452	96.33	Critical
<b>Total of District (Excluding Saline Area)</b>			<b>13602.5</b>	<b>227.0832</b>	<b>156.44</b>	<b>58.4882</b>	<b>214.928</b>	<b>94.65</b>	
<b>Total of District (Saline Area)</b>			<b>16779.2</b>	<b>250.3576</b>					

O. E. – Over-exploited      NC – Non Command      C - Command



Category of blocks, Bikaner District (As on 31.3.2004)



### 5.5 Ground Water Development

Ground water is the only source of irrigation in the district. The ground water development in the district is being done by dug wells and tube wells. The present stage of ground water development in the district is 94.65 %, which indicate that the scope of ground water development is already exhausted. Out of 5 blocks, 2 falls under “Over-exploited” category, 1 blocks under “Critical” category, 2 blocks under safe category.

Quaternary alluvium, Tertiary sandstone, Nagaur sandstone and Limestone form the aquifer in different parts of the district. Ground water occurs under unconfined to semi-confined conditions. Confined conditions are also met sometimes at deeper levels in the north-western parts of the district. Depth and diameter of the dug well and bore well depends on formation and geomorphology. However, general depth of dug well and bore well ranges from 20 to 80 m and 200 m respectively. A detail of groundwater structures is as follows:

Formation	Yield of Dug well (m <sup>3</sup> /day)	Discharge of Bore well (lpm)	Depth (m)		Diameter		Type of pump/Water lifting devices
			Dug well	Bore well	Dug well (m)	Bore well (mm)	
Alluvium	20-100	200-400	40-100	200-300	2-3	200-250	Submersible/ Centrifugal pump
Tertiary sandstone	20-100	200-450	40-120	200-300	2-3	200-250	
Nagaur sandstone	15-80	100-250	40-100	150-250	2-3	200-250	

## **6.0 GROUND WATER DEVELOPMENT STRATEGY**

### **6.1 Ground Water Development**

The overall stage of ground water development of district as on 31.03.2004 is 94.65% (excluding saline). Out of total five blocks, 2 block (Lunkaransar and Kolayat) fall in safe, 1 block (Dungargarh) in critical and 2 blocks (Bikaner and Nokha) in over-exploited categories. 22 exploratory and 02 observation wells in consolidated formation and 50 exploratory and 13 observation wells in unconsolidated formation are yet to be drilled in geographical gaps and unexplored areas. Deep ground water exploration especially in saline hazardous areas may be taken up to find out the aquifer geometry and also quality hazards.

### **6.2 Water Conservation and Artificial Recharge**

Precious Groundwater resources have to be conserved for sustainable availability. Artificial recharge measure to be employed for augmenting ground water resources by roof top rain water harvesting, construction of sub surface barriers and anicuts at suitable locations. Inferior quality water can be blended with fresh water for irrigation use.

Watershed Development & Soil Conservation Department has constructed permanent (masonry) check dams under Irrigated Watershed Development Project to harvest rainwater, reduce soil erosion and check runoff velocity.

## **7.0 GROUND WATER RELATED ISSUES & PROBLEMS**

The environmental impact due to development of water resources encompasses the socio-cultural set up created by man to adapt to the demands, and Challenges of his naturally occurring circumstances. The ecological system, once disturbed, may not be reverted back in most of the cases especially the problems related to ground water pollution.

With the introduction of Canal system these have been perceptible changes in the ground water regime in its command area. There is a rise in water levels of the command area in his whole track of Indira Gandhi Nahar Project of which district Bikaner is a part of fit. In the Bikaner District there is a rise of water level along the canal and has been monitored in the National Hydrograph Stations at Amarapura, Charanwala Chattargarh, Khakhli, Kherbas, Lakhasar etc.

There are no water logged areas at present in the Bikaner District. However, the areas around Kharbara, Dantor, Manaksar, Modayat, Charanwala Bhikampur etc. are more prone towards water logging.

The main hazard in the development of ground water in the district is its salinity. The ground water of Bikaner district possesses relatively high mineral concentration which varies laterally and vertically.

Also such areas suffer from water quality problem and in some of the areas ground water is highly saline. Villages located in such areas have the basic problem of

drinking water requirement and the situation becomes very critical in summers and in drought years.

Another problem of concern in the district is that most of the potential zones have registered heavy ground water development causing lowering of water table and drying up of large number of shallow wells or reduction in their yields. Heavy decline of water level in the wells located in Tertiary formation and Quaternary alluvium observed during last 10 years.

## **8.0 RECOMMENDATIONS**

1. Heavy Ground water withdrawal from potential zones areas of Bikaner and Nokha block for agriculture and drinking use, where stage of ground water development has reached more than 100%, it has to be controlled by preventing further development and systematic ground water development is required in Dungargarh block.
2. Awareness program to educate about conservation of precious ground water resources and training on rainwater harvesting will be beneficial to check decline in water level and justified use.
3. Financial assistance for ground water development in over-exploited, critical and semi-critical area should not be encouraged.
4. Use of water serving devices like sprinklers, close field distribution channels etc. should be promoted.
5. Modern agricultural management techniques have to be adopted for effective and optimum utilization of the water resources. This can be achieved by maintaining irrigation through minimum pumping hours as per minimum requirement of water by the crop and also selecting most suitable cost effective crop pattern.
6. High water requirement crops to be discouraged. Proper agriculture extension services should be provided to the farmers so that they can go for alternate low water requirement economical crops.
7. Salt resistant crops can be sown in the area having brackish ground water.
8. Kolayat and Lunkaransar block, which falls under safe category further ground water development, is suggested in this area through financial institutions.
9. A close network of Piezometers should be established in over exploited and areas of heavy ground water development to precisely watch changes in ground water level for further planning.
10. In the Tertiary and Nagaur formation areas of the district deep ground water exploration is suggested by suitable rigs.

11. Over a large part of the district, ground water quality is saline. Systematic ground water exploration is needed in such areas to locate fresh water pockets if any and yielding zones to meet water supply demand.
12. Traditional rainwater harvesting structures like tankas, roof top rain water storage should be encouraged for day to day requirements which will reduce ground water draft.
13. Large-scale recharge potentials exist in depleted aquifers. Mega ground water recharge to such areas through outside surface water sources like lift canal from IGNP system or floodwater during excess rainy years be implemented.
14. Conjunctive use of ground water and surface water should be encouraged in canal command areas to prevent further water logging in the CCA. Anti water logging measures have to be adopted in the canal command areas.
15. Ground water Legislation should be implemented for regulation and control of Ground water in over-exploited areas with immediate effect.

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