केंद्रीय भूमि जल बोर्ड

जल संसाधन, नदी विकास और गंगा संरक्षण मंत्रालय

भारत सरकार

Central Ground Water Board

Ministry of Water Resources, River Development and Ganga Rejuvenation

Government of India

Report

on

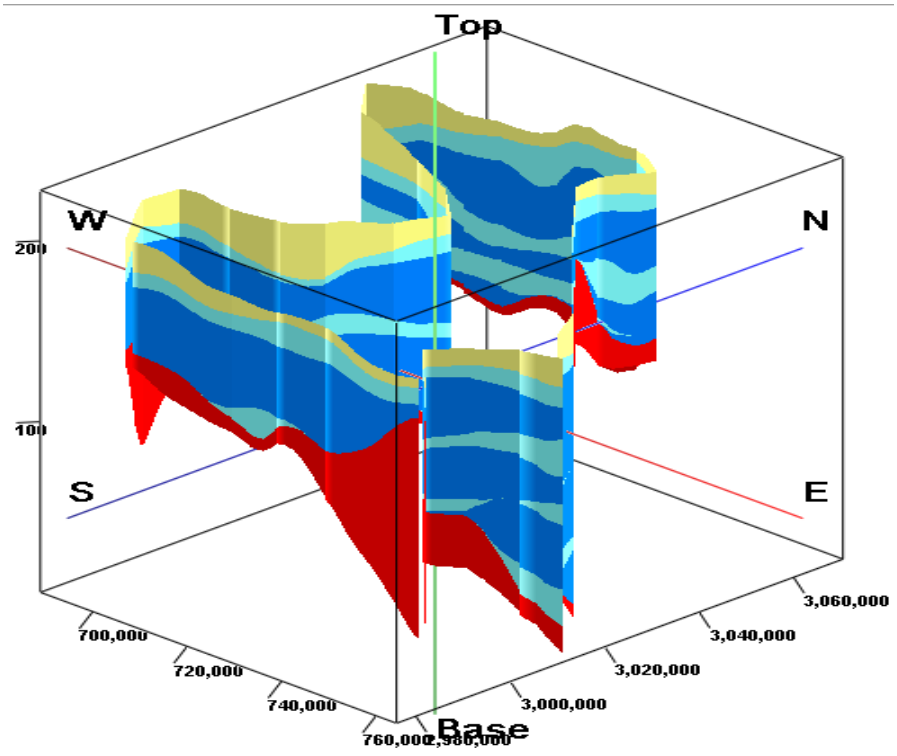
AQUIFER MAPPING AND GROUND WATER MANAGEMENT

Bharatpur District, Rajasthan

पश्चिमी क्षेत्र जयपुर

Western Region, Jaipur

Report on
AQUIFER MAPPING AND GROUND WATER MANAGEMENT
DISTRICT BHARATPUR, RAJASTHAN
(UNDER XII PLAN)



CENTRAL GROUND WATER BOARD
MINISTRY OF WATER RESOURCES, RIVER DEVELOPMENT & GANGA REJUVENATION
GOVERNMENT OF INDIA
WESTERN REGION, JAIPUR

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1. INTRODUCTION

1.1 Objectives

Various developmental activities over the years have adversely affected the groundwater regime in the state. There is a need for scientific planning in development of groundwater under different hydrogeological situation and to evolve effective management practices with involvement of community for better ground water governance. In view of sprouting challenges in the ground water sector in the state there is an urgent need for comprehensive and realistic information pertaining to various aspects of groundwater resource available in different hydrogeological setting through a process of systematic data collection, compilation, data generation, analysis and synthesis. Hence, aquifer mapping and management of the study area is the need of the hour.

1.2 Scope of the study

Aquifer mapping can be understood as a scientific process wherein a combination of geological, geophysical, hydrological & chemical fields and laboratory analyses are applied to characterize the quantity, quality, and sustainability of ground water in aquifers. Aquifer mapping is expected to improve our understanding of the geological framework of aquifer, their hydrologic characteristics, water level in aquifer and how they change over time & space and the occurrence of natural and anthropogenic contaminants that affect the portability of groundwater. Results of these studies will contribute significantly to resource management tools such as long term aquifer monitoring network and conceptual and quantitative regional groundwater flow models to be used by planners, policy makers and other stake holders. Aquifer mapping at appropriate scale can help to prepare, implement, and monitor the efficacy of various management interventions aimed at long term sustainability of our precious groundwater recourses, which in turn will help to achieve drinking water scarcity, improved irrigation facilities and sustainability of water resource in the state.

1.3 Approach & Methodology

Aquifer mapping is an attempt to integrate the geological, geophysical, hydrological & chemical field and laboratory analyses and are applied to characterize the quality, quantity and sustainability of groundwater in aquifer. Under the National Aquifer Prograrmme, it is proposed to generate Aquifer Maps on 1:50000 scale, which basically aims at characterizing the aquifer geometry, behavior of groundwater levels and status of groundwater development in various aquifer system to facilitate planning of their suitable management. The major activities involved in this process encompass compilation of existing data, identification of data gaps, generation of data for feeling data gaps and preparation of different aquifer layers.

1.4 Location, administrative set up and population

Bharatpur district is located between $26^{o}40'$ and $27^{o}50'$ latitude and $76^{o}53'$ and $77^{o}45'$ longitude covering an area of 5044.10 sq.km. The district is part of Bharatpur Division and is

divided into 9 sub-divisions. Administratively, the district is divided into 10 tehsils(Bharatpur, Bayana, Deeg, Kama, Kumher, Nadbai, Nagar, Rupwas, Sewar and Weir) and 9 development blocks(Bayana, Deeg, Kama, Kumher, Nadbai, Nagar, Rupwas, Sewar and Weir). The district has 1472 villages and 9 urban towns. As per Census 2011, total population of the district is 25,48,462 with urban and rural population at 4,95,099 and 20,53,363 respectively. Adminsistrative map of the district showing block boundaries is presented as Figure-1.

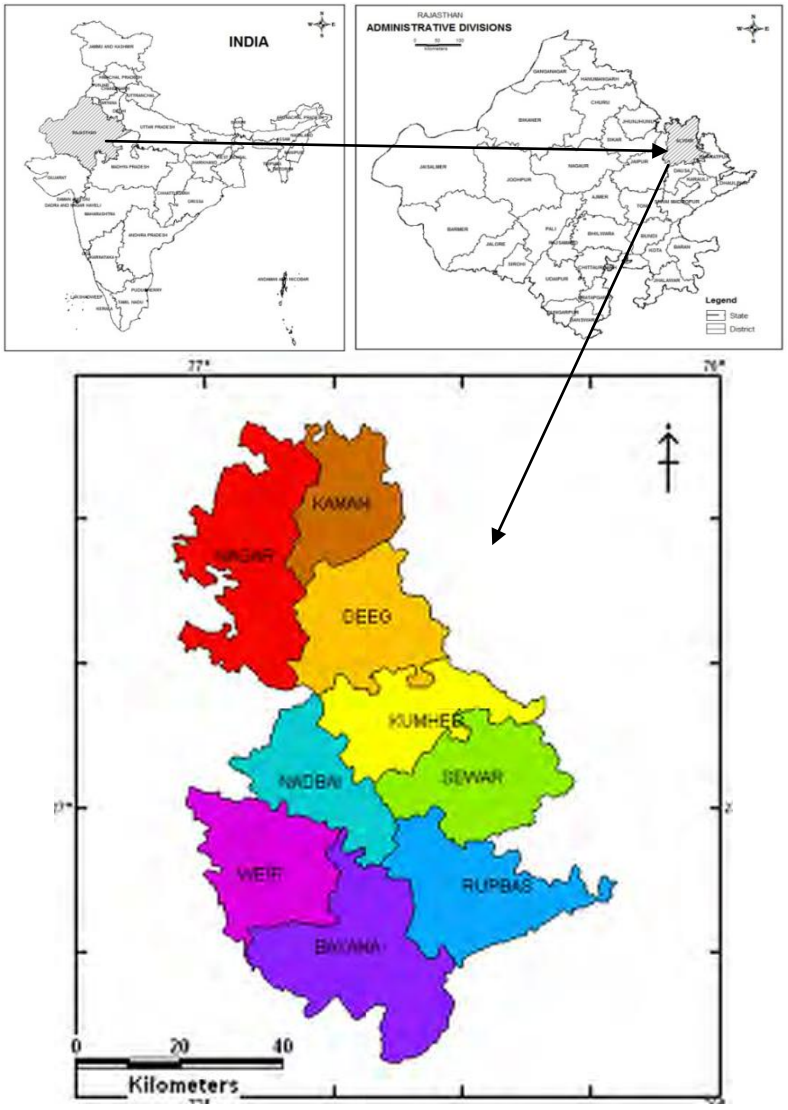


Figure 1: Administrative Map, Bharatpur District

1.5 Data availability, Data Adequacy, Data Gap Analysis & Data Generation

1.5.1 Data Availability

Various ground water related data viz. water level, exploration, aquifer parameters, quality, resources etc. generated so far by CGWB have been utilized for aquifer mapping programme in

the area and similar consistent data of Ground Water Department, Govt. of Rajasthan have been amalgamated for the purpose.

CGWB has explored aquifer geometry and aquifer parameters determination and deciphering of aquifer quality through construction of 56 exploratory wells,3 observation, 6 slim holes and 38 piezometers in the district as on March, 2016. 110 no. of vertical electrical sounding(VES) have been carried out to decipher sub-surface geology and vertical ground water quality variations if any in the area. Ground water regime monitoring is being done through 37 hydrograph stations representing /various hydrogeolgical settings to observe the changes in water level in time and space along with ground water quality.

To minimize the data gap, consistent available ground water data of GWD, Govt. of Rajasthan have been integrated and utilized for aquifer mapping. Data of 86 boreholes have been integrated. Estimation of ground water resources is carried out in collaboration with the GWD, Govt. of Rajasthan and approved by the State Level Coordination Committee under the chairmanship of Principal Secretary (PHED & GWD), Govt. of Rajasthan.

1.5.2 Data Adequacy

The available data of CGWB and consistent/validated data of State GWD, have been integrated and analysed the data gap if any in the area.Data gap analysis indicate that the existing/available various related ground water data are not adequate to represent the area in terms of data on aquifer parameters in alluvial aquifers, their quality and underlying hard rock aquifer beneath alluvium. It has been observed that available data are restricted in the areas of state highways and main roads in the study area and further alluvial aquifer has gone dried up due to excess draft of ground water in many parts of district thereby reaching water level into the underlying hard rock for which required various ground water are not adequate. Ground water regime monitoring data are not adequate for better understanding of its behaviors in terms of quantity and quality therefore, there is need to increase the density of hydrograph stations in the area.

1.5.3 Data Gap Analysis

Based on the available data of CGWB and relevant ground water related data collected from State agencies like , PHED, Water Resources, Agriculture, and their integration on 1:50,000 scale, data gaps have been identified in the district. Therefore, to attain a clear 3D hydrogeological geometry of the aquifer system, its potentiality, parameters and quality in the data gaps and in present changing ground water scenario, it is proposed to generate the required information/data through construction of 16 additional exploratory bore holes in the data gaps and increase the density of hydrograph stations & integration of key wells of State GWD for better representation of existing aquifers and understanding of behaviors of ground water regime in terms of quantity and quality.

1.5.4 Data Generation

Based on data gap analysis, 16 additional exploratory bore holes (including 1 in hard rock and 15 in soft & hard rocks) are to be drilled in the district and increase the density of hydrograph stations & integration of key wells of State GWD for better representation of existing aquifers and understanding of behaviors of ground water regime in terms of quantity and quality. Under

NAQUIM, 57 no. of geophysical soundings have been conducted in the area. Ground water sampling has been completed from 108 location representing existing various hydrogeological units.

1.6 Hydrometeorology

Climate of the district can be classified as semi-arid. It is characterized by very hot summer and very cold winters with fairly good rainfall during south west monsoon period. In May and June, the maximum temperature may go up to 47**0**C. Normal annual rainfall of the district is 645.6mm. Almost 95% of the total annual rainfall is received during the southwest monsoon, which enters the district in the last week of June and withdraws in the middle of September. The mean annual rainfall is highest at Nadbai(715.3mm), which is located in the central western part of the district. It is lowest at Pahari(483.5mm), which lies in north eastern part of the district. The potential evapotranspiration rates are quite high especially during May and June and annual total is 1780mm. Climate is generally dry except during the monsoon period. Humidity is the highest in August with mean daily relative humidity of 81%.

Various climatological parameters viz. normal rainfall, potential evapo-transpiration, maximum & minimum mean temperature, relative humidity and wind speed are presented in Table 1 and depicted in Figure 2.

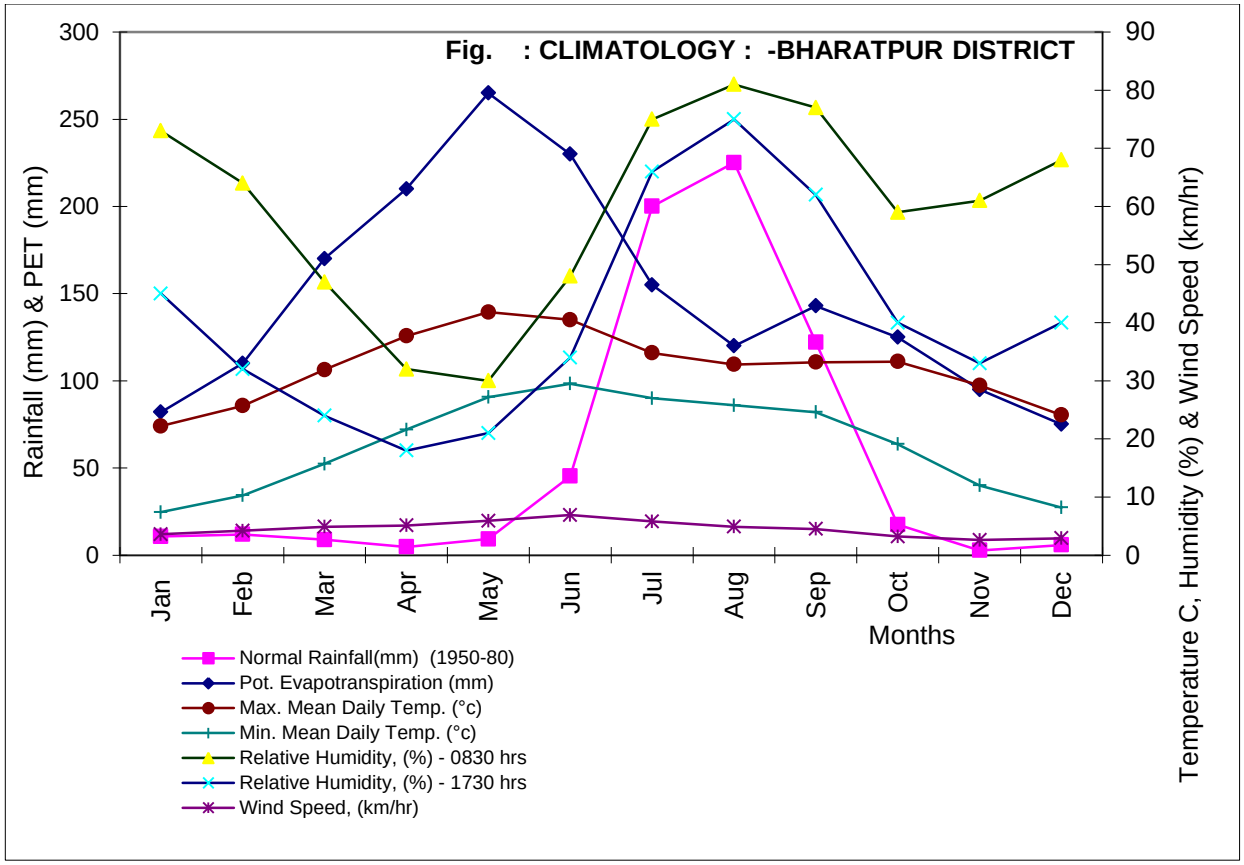


Figure 2: Climatology Data, Bharatpur District

Table 1: Climatological data, Bharatpur District

Description	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Normal Rainfall(mm) (1950-80)	10.7	11.9	8.9	4.7	9.2	45.3	200	225.1	122.1	17.5	2.7	5.8	663.9
Pot. Evapotranspiration (mm)	82	110	170	210	265	230	155	120	143	125	95	75	1780
Max. Mean Daily Temp. (°c)	22.2	25.7	31.9	37.7	41.8	40.5	34.8	32.8	33.2	33.3	29.2	24.1	32.3
Min. Mean Daily Temp. (°c)	7.4	10.3	15.7	21.6	27.2	29.5	27	25.8	24.6	19.1	12	8.2	19.0
Relative Humidity, (%) - 0830 hrs	73	64	47	32	30	48	75	81	77	59	61	68	59.6
Relative Humidity, (%) - 1730 hrs	45	32	24	18	21	34	66	75	62	40	33	40	40.8
Wind Speed, (km/hr)	3.6	4.2	4.9	5.1	5.9	6.9	5.8	4.9	4.5	3.2	2.6	2.9	4.5
Source;- IMD, Agra													

Long term rainfall data for the period 1971-14 given below in Table 2.

Table: 2 Tehsil-wise rainfall data (1971-14), Bharatpur district

YEAR	Bharatpur	Kumher	Nadbai	Deeg	Nagar	Kama	Pahari	Bayana	Weir	Roopbas	Mean (mm)
71	830.6	717.0	739.0	639.2	852.4	680.7	785.6	893.3	961.0	530.1	762.9
72	576.6	484.2	668.8	416.8	549.5	406.1	496.7	866.5	727.8	584.0	577.7
73	681.5	435.0	586.4	451.6	612.0	466.6	507.3	519.2	560.0	790.5	561.0
74	621.0	628.0	508.0	610.7	452.0	526.5	367.9	551.1	516.7	587.0	536.9
75	700.5	784.0	883.0	908.1	821.2	791.0	338.8	838.0	788.0	684.9	753.8
76	775.7	915.0	696.6	907.3	575.0	852.0	591.1	824.4	718.0	865.6	772.1
77	803.2	783.0	786.0	905.2	1022.0	1121.2	762.5	1027.1	577.0	934.9	872.2
78	590.2	470.5	610.7	690.1	543.4	840.2	368.5	659.5	635.0	683.8	609.2
79	218.5	152.4	144.9	330.1	281.4	294.0	201.7	249.0	197.0	359.7	242.9
80	638.3	529.0	862.5	390.5	460.0	678.4	430.1	514.6	651.0	479.0	563.3
81	356.7	293.0	623.5	338.6	556.0	560.9	397.4	513.0	364.0	466.6	447.0
82	781.5	570.2	1315.0	410.0	680.8	630.0	400.4	1018.2	443.3	622.2	687.2
83	886.4	755.8	1146.0	729.0	714.0	763.0	693.6	925.6	582.5	656.2	785.2
84	395.4	471.4	1299.0	405.0	530.0	774.0	613.7	595.8	306.0	513.0	590.3

YEAR	Bharatpur	Kumher	Nadbai	Deeg	Nagar	Kama	Pahari	Bayana	Weir	Roopbas	Mean (mm)
85	662.5	319.6	1081.0	391.0	518.0	418.0	476.4	712.0	358.2	493.0	543.0
86	378.8	303.3	659.0	118.5	307.0	397.0	232.8	425.0	183.0	361.0	336.5
87	363.6	362.5	470.0	245.0	458.0	400.2	197.4	224.0	207.0	331.0	325.9
88	573.0	640.2	675.0	359.0	465.0	638.0	405.4	587.0	446.0	340.6	512.9
89	547.8	596.6	648.0	356.0	413.5	420.4	284.4	511.0	337.0	230.8	434.6
90	671.3	586.0	1087.0	495.0	600.0	762.8	466.1	632.0	494.5	460.3	625.5
91	447.4	514.0	557.0	391.0	221.0	607.4	342.0	385.0	335.0	292.0	409.2
92	736.3	634.0	824.0	336.0	623.5	660.2	349.0	693.0	719.5	586.0	616.2
93	558.2	426.0	622.0	451.0	523.7	610.8	470.0	566.0	545.0	401.0	517.4
94	654.2	476.0	600.0	511.9	645.0	463.0	306.0	785.0	719.0	413.0	557.3
95	837.0	643.0	1000.6	777.0	942.0	739.6	619.0	1314.0	926.0	819.0	861.7
96	851.0	730.0	1014.0	1167.0	1277.0	1219.2	1174.0	1032.0	1150.0	892.0	1050.6
97	646.2	579.5	631.0	552.0	729.0	676.2	548.0	705.0	535.0	491.0	609.3
98	951.8	724.0	781.0	820.0	402.0	724.0	646.0	848.0	633.0	752.0	728.2
99	786.0	568.0	587.0	717.0	454.0	742.0	433.0	469.0	665.0	812.0	623.3
2k	405.0	382.0	325.0	355.0	371.0	467.0	293.0	333.0	498.0	401.0	383.0
1	646.0	578.0	661.0	799.0	448.0	578.0	528.0	449.0	777.0	498.0	596.2
2	465.0	355.0	358.0	583.0	216.0	483.0	391.0	304.0	369.0	422.0	394.6
3	801.0	555.0	685.0	898.0	706.0	995.0	791.0	649.0	759.0	680.0	751.9
4	608.0	516.0	651.0	395.0	571.0	528.0	525.0	448.0	582.0	640.0	546.4
5	1041.0	491.0	836.0	619.0	546.0	639.0	590.0	630.0	654.0	670.0	671.6
6	373.5	266.0	411.0	440.0	424.0	378.0	266.0	515.0	296.0	670.0	404.0
7	539.0	414.0	482.0	494.0	423.0	604.0	513.0	421.0	456.0	524.0	487.0
8	786.0	747.0	840.0	747.0	689.0	793.0	675.0	1059.0	848.0	735.0	791.9
9	642.0	825.0	574.0	627.0	648.0	590.0	387.0	633.0	626.0	459.0	601.1
10	754.0	770.0	761.0	927.0	744.0	1022.0	669.0	733.0	709.0	905.0	799.4
11	743.0	986.0	774.0	835.0	681.0	559.0	531.0	947.0	787.0	675.0	751.8
12	832.0	730.0	970.0	713.0	626.0	567.0	529.0	835.0	709.0	801.0	731.2
13	603.0	819.0	564.0	571.0	599.0	525.0	405.0	649.0	974.0	794.0	650.3
14	442.0	572.0	477.0	543.0	635.0	555.0	277.0	744.0	551.0	620.0	541.6
Mean	640.9	570.4	715.3	576.5	580.8	639.7	483.5	664.4	588.1	589.2	604.9
STDEV	179.4	183.4	245.0	224.1	202.3	198.7	187.5	238.3	218.0	180.6	164.6
CV(%)	28.0	32.2	34.3	38.9	34.8	31.1	38.8	35.9	37.1	30.6	27.2

1.7 Soil, Land Use, Agriculture, Irrigation, Cropping Pattern

1.7.1 Soil

There are mainly five types of soils in the district which are sandy, sandy loam, clay loam, clay and loam. In northern eastern part of the district clay loam is dominant soil. In central part, loam soils are more prevalent while in south western part , sandy loam soils prevail.

The problem of soil salinity and alkalinity is very common in Bharatpur and Kumbher tehsils. In Bayana and Rupbas tehsils , the problems of impended drainage and salinity exists under tank irrigation areas. Further the problem of soil salinity and alakalinity is more in irrigated areas(both well and canal irrigation). This can be attributed mainly to the high salinity in ground water and shallow water tables in certain areas.

1.7.2 Land Use

The socio-cultural and economic factors have significantly influenced over land use both in rural and urban areas in the district. Land forms, slope, soils and natural resources are some of the important which control the land use pattern of the district. Data are based on district statistics outline, 2012-13. The land use pattern of district is presented in Table 3.

Table 3: Land Use, Bharatpur District (2012-13)

Sl.No.	Land Use	Area in hectare	%
1	Total geographical area	506731	-
2	Forest	33645	
3	Uncultivable land	30001	5.92
4	Land not cultivated including pasture land; barren land; trees, grooves & orchards; padat land	21518	4.25
5	Uncultivable land apart from padat land	10446	2.06
6	Padat land	14767	2.91
7	Actual sown area (subtracting double)	396354	78.22
8	Gross sown area	587087	-
9	Area sown more than once	190733	-

1.7.3 Agriculture

Agriculture activity in the district is, by and large, confined to traditional kharif cultivation depending on monsoon rainfall and rabi cultivation is prevalent in areas where irrigation facilities are available. The major crops grown in the area are:

Food Grain	Wheat,Bajra, Jowar, Barley, Rice, Maize
Cereals	Gram, other Ravi cereals,other Kharif cereals, Tur
Oil seeds	Rai & Mustard,Til, Taramira, Arandi, Ground nut,
Non food grains	Gownwar,Potato, Sugercane, Red chilli, Jute
Other	Green fodder crop, Reshe,Vegetables, Fresh fruits,Spices, Medicinal and intoxicating liquids

1.7.4 Irrigation Practices

The principal means of irrigation in the district are through wells though very small areas irrigated by canals. Ground water plays an important role for irrigation contribute 98.86% and is utilized through dug wells, dug cum bore wells, tube wells and bore wells run almost by electricity in the area. Status of sources wise irrigation in the district is given below:

Particulars	**Irrigated area in sq.km.**
Dug wells/ tube wells	3472.27
Talab	0
Canals	30.19
Other sources	9.93
Total	3512.39

Out of gross sown area of 5870.87 sqkm, only 3512.39 sqkm(59.83%) area is irrigated. There are total 39319 wells including 14013 non-utilizable/abandoned wells and 25306 utilizable wells and total 91 Talabs including 46 non-utilizable and 45 utilizable.

1.7.5 Cropping Pattern

Gross sown area is 587087hec with net sown area is 396354 hec and area sown more than once is 190733hec. Crop wise irrigated area is given in Table 4.

Table 4 : Irrigated area wise crops, Bharatpur district

	Crops	**Irrigated area in hec.**
Food grain	Wheat	134777
	Barley	2100
	Rice	812
	Jowar	11
	Maize	1
Cereals	Gram	380
	Other Rabi cereals	74
	Other Kharif Cereals	29
Oil seeds	Rai and Mustard	203499
	Taramira	25
Non food grains	Potato	2835
	Cotton	1428
	Spices	236
	Sugercane	231
	Red chilli	185
	Onion	57
	Tobacco	2
Other crops	Green fodder	2171
	Vegetables	1349
	Fresh fruits	1046
	Other food garins	403
	Medicinal and other intoxicating materials	35

Major crops under irrigation are Rai and Mustard(203499 hec) and Wheat(134777 hec.), Potato(2835hec), Green fodder (2171 hec), Barley(2100 hec), Cotton(1428hec), Vegetable(1349 hec).

1.8 Physiography, Geomorphology

1.8.1 Physiography

The Bharatpur district forms part of eastern Rajasthan plain lying east of Aravalli after hill ranges. On the basis of the topography, the district can be classified into three units physiographic units viz. (a) isolated hillocks in the norther part, (b) large alluvium and wind blown sand sandy plains covering central and southern part, (c) low lying flat topped hills in the south western part of the district.

Most of the area of the distric t is occupied by alluvial plains which forms part of Banganga and Gambhir river basin. The isolated hillocks in the north belong to Delhi Super Group of formations. In the south (south and west of Bayana) , the flat topped hills belong to Achaean (Ranthambore Group) and Vindhyans(Bhander Group). The height of ground level generally varies from 180 to 220m amsl. Isolated blokcs are comparatively higher like Pahari(369m amsl) and Panhari(323m amsl) The general slope of the area in the district is easterly towards Yamuna River.

1.8.2 Geomorphology

The occurrence of various geomorphological units in the district are given in Table 5.

Table 5: Geomorphological units in Bharatpur district

Origin	Land Forms	Occurrence in the District
Fluvial Origin	Alluvial Plain	Formed due to fluvial activity, consisting of gravels, sand, silt and clay. Terrain mainly undulating.
	Valley Fills	Formed by fluvial activity at lower topographic level
	Ravines	Small, narrow, deep depression usually carved by running water.
	Flood Plain	Surface of relatively smooth land adjacent to a river channel. Subjected to periodic flooding.
Structural Origin	Plateau	Extensive flat landscape, bordered by escarpment on all sides. Formed over horizontally layered rock formation with steep slopes.
	Dissected plateau	Plateau, criss-crossed by fractures forming deep valleys.
Hills	Linear Ridges	Long narrow ridges having high run-off
	Structural Hills	Linear to arcuate hills associated with folding
	Denudational Hills	Steep sided comprising of varying lithology with joints, fractures and lineaments.

1.8.3 Drainage

Bharatpur district falls in parts of Ruparel, Banganga and Gambhiri river basins. Tehsil wise distribution of basin area is given in Table 6.

Table 6: Tehsil wise distribution of basin area in Bharatpur district

S. No.	Name of Tehsil	Area in river basin (sq.km.)		
		Banganga	Gambhiri	Ruparel
1	Pahari	3	-	483
2	Kaman	119	-	314
3	Nagar	162	-	308
4	Deeg	398	-	-
-5	Nadbai	439	0.4	-
6	Kumher	508	-	-
7	Bharatpur	468	-	-
8	Weir	508	274	-
9	Bayana	48	483	-
10	Roopwas	61	466	-

All the major rivers of the district originate from outside the district and ephemeral Banganga river originate in Jaipur district. It has easterly flow and disappears in the sandy track near Ghana before meeting any big river. River Gambhir originate in Sawai Madhopur district and its enters thye district in southern part and passes through the district to meet Yamuna river in Uttar Pradesh. River Ruparel originate from Thanagazi hills in Bharatpur district, it enters Bharatpur districtnear Gopalgarh and is hold by Sikri Bund. A small area of 5-00 sq.km. in the northern fringe of the district , falls in Bareh sub-basin.

Drainage density in the northern and central part varies between 0.2 and 0.3 km/km^2 whereas in the southern part, it varies from 0.3 to 0.5 km/km^2 in area around Rupbas.In Bayana and Weir blokcs, it varies from 0.5 to 0.7 km/km.

There are four important lakes in the district.

- Moti Jheel located 3 km west of Bharatpur city,
- Keola Deo Jheel about 5 km south east of Bharatpur which is famous for its Bird Sanctuary(Ghana Bird Sanctuary),
- Model Jheel riterated on the northern border and
- Jheel ka Bara located about 14 km north of Bayana town.

2. Data Integration, Interpretation, Aquifer Mapping and Ground Water Scenario

2.1 Geology

Different metasedimentary, sedimentary rocks and quaternary alluvium forms the geological framework of the district. These formation belong to Bhilwara Supergroup, Delhi Supergroup, Vindhyan Supergroup and Quaternary alluvium. About 85% area of the district is occupied by the alluvium and windblown sands. The geological sequence as met within the district is as under.

Age	Super Group	Group	Formation
Quaternary			Recent to sub recent dune sand, soil and alluvium
	---------- Unconformity ----------		
Proterozoic	Vindhyan S G	Bhander	Sandstone, shale and limestone
	---------- Unconformity ----------		
	Delhi S G	Ajabgarh	Argillaceous, metasediments, phyllites schist and marble
		Bharatpur	Archaeans metasediments consisting of quartzites, phyllites etc.
	---------- Unconformity ----------		
Archaean	Bhilwara S G	Ranthambor	Schist, gneisses and granites

Archeans:

Bhilwara Super Group of rocks occur near the south western margin of the district bordering with Sawai Madhopur district. These comprises mainly of schist and gneisses. These were encountered at a depth of 110 m at Hingota and at 50 m at Kalsade in Bayaya and Weir blocks respectively. The southern boundary of these formations is faulted against Vindhyans.

Delhi Supergroup:

Delhi Super Group of rocks lies mainly in the southern and northern parts of the district. Both Bharatpur and Ajabgarh group of rocks occur in the district but rocks of Bharatpur Group are more extensive.

The Bharatpur group metasediments overlies unconformably over Archaean schists and gneisses. These are predominantly arenaceous. Prominent exposure occur west of Bayana and north west of Deeg. Fine grained quartzites generally form the crest line of hills due to its high resistance to erosion. It directly overlies gritty quartzite and the contact of two is well observed due to sudden change in slope angle forming break in topography. The fine grained quartzite is light grey to white and light pink, fairly well jointed and thickly bedded. Current bedding structure is fairly common in quartzites. Fine grained quartzites are overlain by interbedded sequence of phyllites and quartzites.

The Ajabgarh group metasediments are exposed in the north western part of the district in limited area. These have predominance of argillaceous rocks as compared to Bharatpur. At the base generally calcareous horizon is present and carbonaceous litho units also occur sometimes. Ajabagarh group consists mainly of phyllites, slates, impure limestone and quartzites.

Vindhyan Supergroup:

The Vindhyan group sediments are exposed in a small pocket in the southern part of the district. Upper Bhander Sandstone occur in the form of a plateau overlying the Sirbu shale.

Bhandar sandstone is fine grained ad usually dark red with spots and splashes of fawn coloured. Thickness of sandstone beds ranges from few centimetre to about 2 metre. The beds are horizontal with very low dips. Primary sedimentary structure like ripple marks, current bedding and load casts are present. Vindhyans are separated from Archaeans by Great Boundary fault.

Quaternary Formation:

More than 85% of the area of the district is covered by Quaternary sediments mainly the alluvium of varying thickness and comprising of sand, silt, clay and kankars.

Over the greater part of the Banganga, Gambhir river and other river courses in the district, the alluvium consists of reworked aeolin sand. Gravel, pebbles and cobbles in the alluvium are confined to those sections of the river courses where the quartzite hills from a part of the catchment.

The wind blown sand in the area is represented by a few stable and few drifting sand dunes. The blown sand are mainly seen in northern part and in the eastern part around Halena and Bayana. Blown sand is fine to moderate in texture and mixed with silt and clay. Sand dunes are also common in areas along Banganga river courses. Sand dunes are arranged in a linear pattern trending in NW-SE direction.

Subsurface Geology:

Under its exploration programme Central Ground Water Board has drilled a total of 56 EW, 3 OW, 6 SH and 35 PZ(as on 31.03.2016 in parts of Banganag, Gambhiri basin/sub basin falling in the district. These bore holes reveal information about subsurface geology in the district. Apart from the PHED and other agencies have drilled a number of tubewells in the district. Exploratory data indicate that the alluvium attains a thickness of 60 to 80 m in the southern part of the district. In the ceneral part of the district, the thickness of alluvium is more and varies from 120 m to 185 m. The basement of the alluvium is formed by gneisses of Delhi Super Group /Bhilwara Super Group in south western part and sandstone/quartzites in central and south eastern part. Thick lenses of clays and silty clays separating fine to coarse grained aquifer do occur at depth which very often give rise to some confined and confined conditions.

In the northern part of the district, basement is encountered at shallow depth as compared to central part and is formed by gneisses and quartzites of Delhi Super Group. Thickness of alluvium is about 100 m around Kaman and Sau. There is predominance of clay which is found mixed with kankar and little amount of gravel thus forming poor aquifers separated by layers. In the central part of the district where the thickness of alluvium is more, thick gravel zone is found overlying the bedrock which this found mixed with sand. Intermittent clay layers and silty clay layers give rise to semi confined conditions.

Structure:

The rocks of Delhi Super Group and Bhilwara Super Group shows intensive folding. The quartzites of Bharatpur series displays various sets of joints and fractures. There are three

main inferred faults in the area, the most important is the NE-SW trending Great Boundary Fault (GBF) between Archaean and Vindhyans.

2.2 Hydrogeology

Ground water occurs both in Quaternary alluvium and consolidated formation belonging to Vindhyan Super Group and Bhilwara and Delhi Super Groups metasedimentary rocks. Quaternary alluvium and wind blown sand form most wide spread and important aquifer in the district occupying about 85% part of the district. The ground water conditions in hard and unconsolidated formation are as under (Figure3).

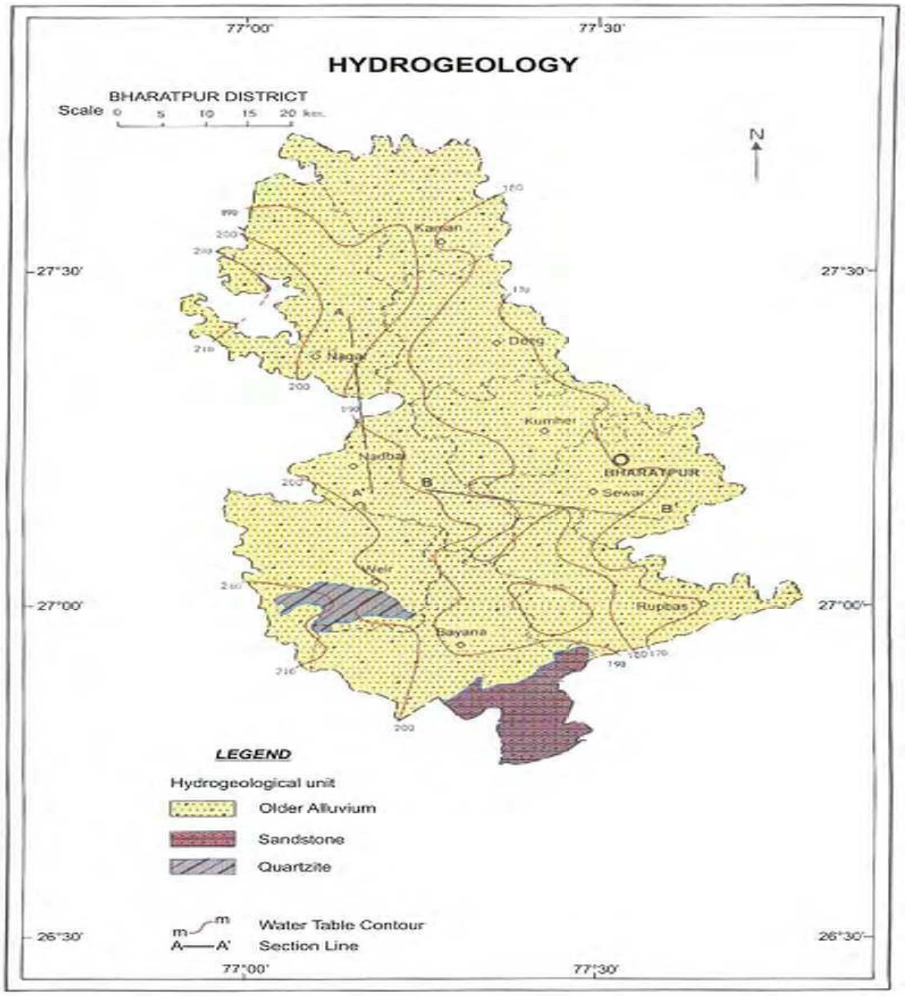


Figure 3: Hydrogeologiacal map, Bharatpur District

2.2.1 Aquifer systems, potentiality and parameters

Consolidated formation:

Both sedimentary and metasedimentary consolidated formation belonging to Vindhyan, Delhi and Bhilwara Super Groups form aquifer in the district. These cover only a small part mainly in southern and south western margin of the district forming parts of Rupwas,

Bayana and Weir block. Delhi Super Group of rocks also form aquifer in a small area lying in north western part of the district, lying mainly in Nagar block. The consolidated water bearing formations in the district are mainly sandstone, quartzites, schists, gneisses and phyllites. Ground water occurs under unconfined conditions in this formation along joints, fractures, structurally weak zones and in the weathered portions. These are generally tapped by open wells and dug cum bored wells. Yield of these wells varies widely depending on the extension of weathering, presence of weak zones & their continuation and recharge source etc. Yield of open wells in these formation varies from 25 to 600 m^3/day.

Unconsolidated formation:

Alluvium forms the principal aquifer in the district covering about 85% of the area of the district. It is consisting of gravel, sand, silt, clay and kankar. The most potential aquifer is formed of gravels and sand while clay and kankar form very poor aquifer. Silty clay and kankar are however, being tapped at many places by open dug wells.

Groundwater in shallow zones occurs under unconfined conditions and is generally tapped by open wells. Thick layers of clay and silt occur at depth in various horizons. This gives rise to seem confined to confined conditions to ground water at depth. At places, where the basement is at shallow depth only phreatic aquifer is present. The yield of open wells in alluvium range from 90 to 1050 m^3/day.

Exploratory drilling in the district has revealed that

- In the Banganga river basin, aquifers under confined and semi confined conditions have been encountered. In an area east of Ludhawai and Sinsini the tubewells tapping deeper aquifer were under free flowing conditions. The piezometric head generally lies above the phreatic surface. The free flow of 8 m^3/hr was recorded at Kumher. Analysis of pumping test data of seven exploratory tubewells in Banganga River basin indicates that transmissivity and storage coefficient ranges from 46.36 to 1696 m^2/day and 5.1 x 10^{-5} to to 6.45 x 10^{-3} respectively. Only at Kemalpura and Nadbai aquifer shows delayed yield conditions and its transmissivity ranges from 78.39 to 194.85 m^2/day and storage coefficient from 2.13x10 m^{-4}/ to 2.40x10^{-3}.
- In Gambhiri river basin area mainly one aquifer is present. In a limited are, two aquifers are also present. Thickness of the alluvium is limited to less than 100 m. Ten wells were drilled in this region which indicated presence of one aquifer varying in thickness from 4 to 20 m in the depth range of 36 to 105 metres. The transmissivity varies from 10.46 m^2/day at Vidhari to 414 m^2/day at Samogar. The storage coefficient varies from 1.07x10^{-4} to 1.6 x10^3. Yield of tubewells varies from 5 to 85 m^3/hr.
- In northern part of the district the thickness of alluvium is within 130 m. Yield of tube wells in this area is comparatively lower than other alluvial area of the district. It varies from 6 m to 25 m^3/hr.
- Transmissivity value is found to vary from 31 to 186 m^2/day. Storage coefficient was found to vary from 3.4x10^{-4} to 5.5x10^{-3}.

Salient features of exploratory data are summarized in Table 7.

Table 7: Summarized Results of Ground Water Exploration, Bharatpur District

Type of well	No.	Depth drilled (m)	SWL (m)	T (m^2/day)	Discharge (lpm)	EC (micromhos/cm) at 25°C
EW	56	30.09 – 207.28	– 1.79 – 83	6 - 787	3 - 2529	460 - 23300
OW	3	70 – 101	10.6 – 19	-	880	750 - 3400
PZ	38	32 – 184.6	0.95 – 84.7	27	10 – 3000	565 - 42260
SH	6	65.3 – 210.64	-2.00	-	95	5729 - 11690

Three dimension aquifer geometry and characterization model has been prepared using Rock Works Software (Figure 4). Model indicate the aquifer geometry and characterization desaturated/saturated alluvial/weathered part of underlying hydrogeological formation in the study area with saturated thickness ranging from 1 to 83 m with average of 13m. 3 D Fence diagram depicting aquifer disposal has been prepared using the said software given in Figure 5. Four aquifers have been demarcated based on the studies of lithologs and water level in the district. Aquifer I has saturated thickness ranging from 1 to 42 m with average of 11m, aquiferII from 1 to 48 with average of 13.47m, aquifer III from 3 to 83m with average of 16.54m and aquifer IV from 2 to 36m with average of 14.1m

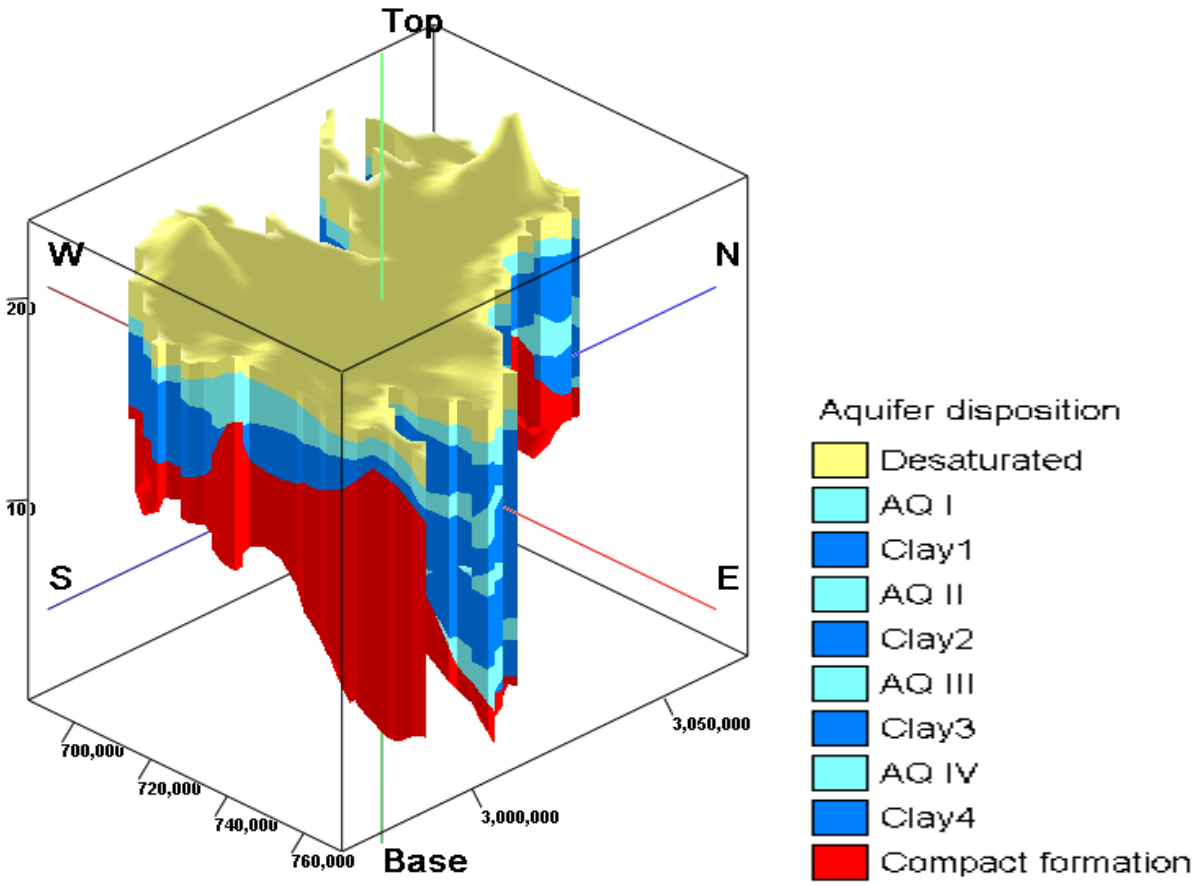


Figure 4: Aquifer Geometry and charatersization, Bharatpur District

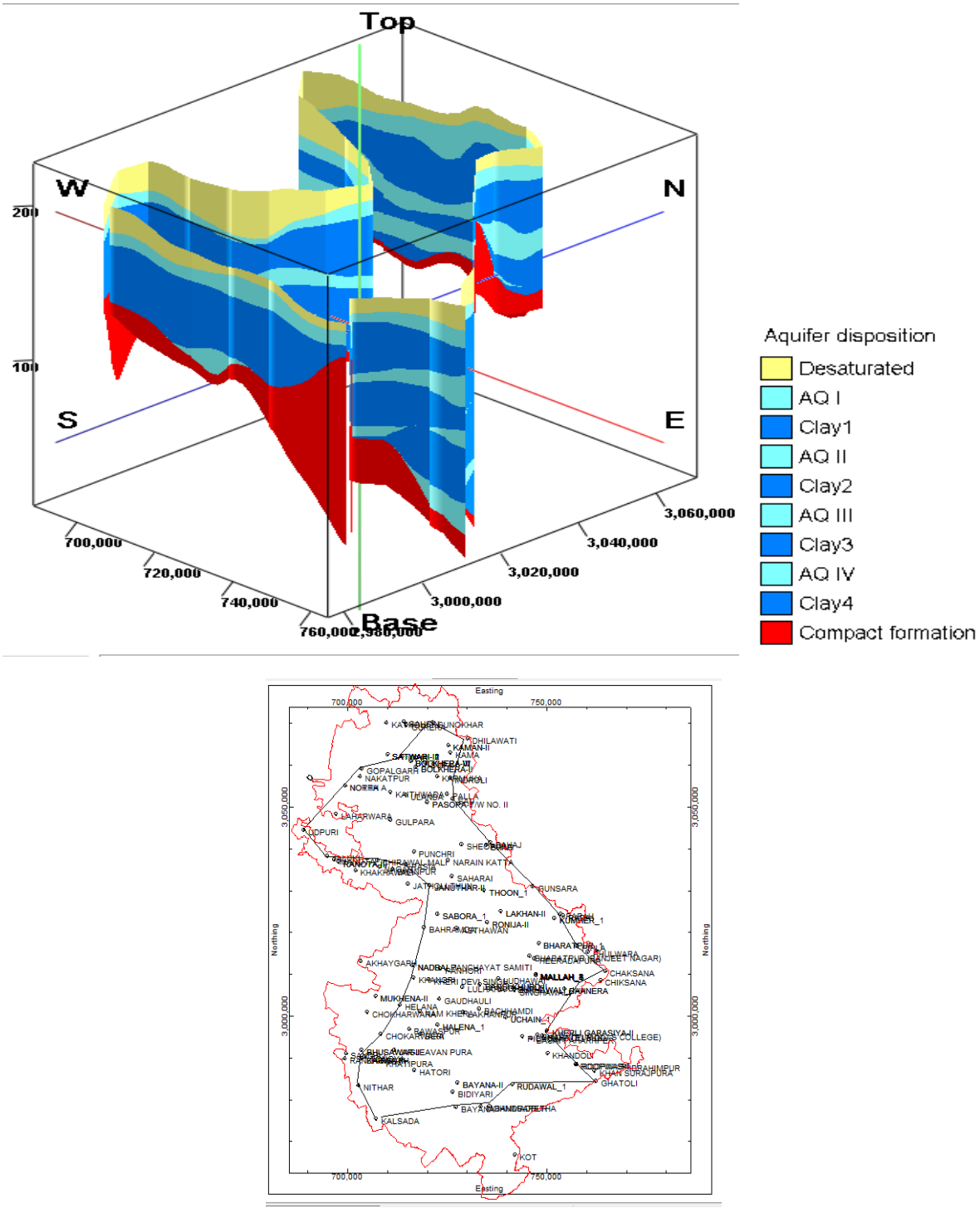


Figure 5: Aquifer Disposition, Bharatpur District

The following hydrogeological sections showing aquifer disposition, have been prepared (Figure 6 A to 6 G).

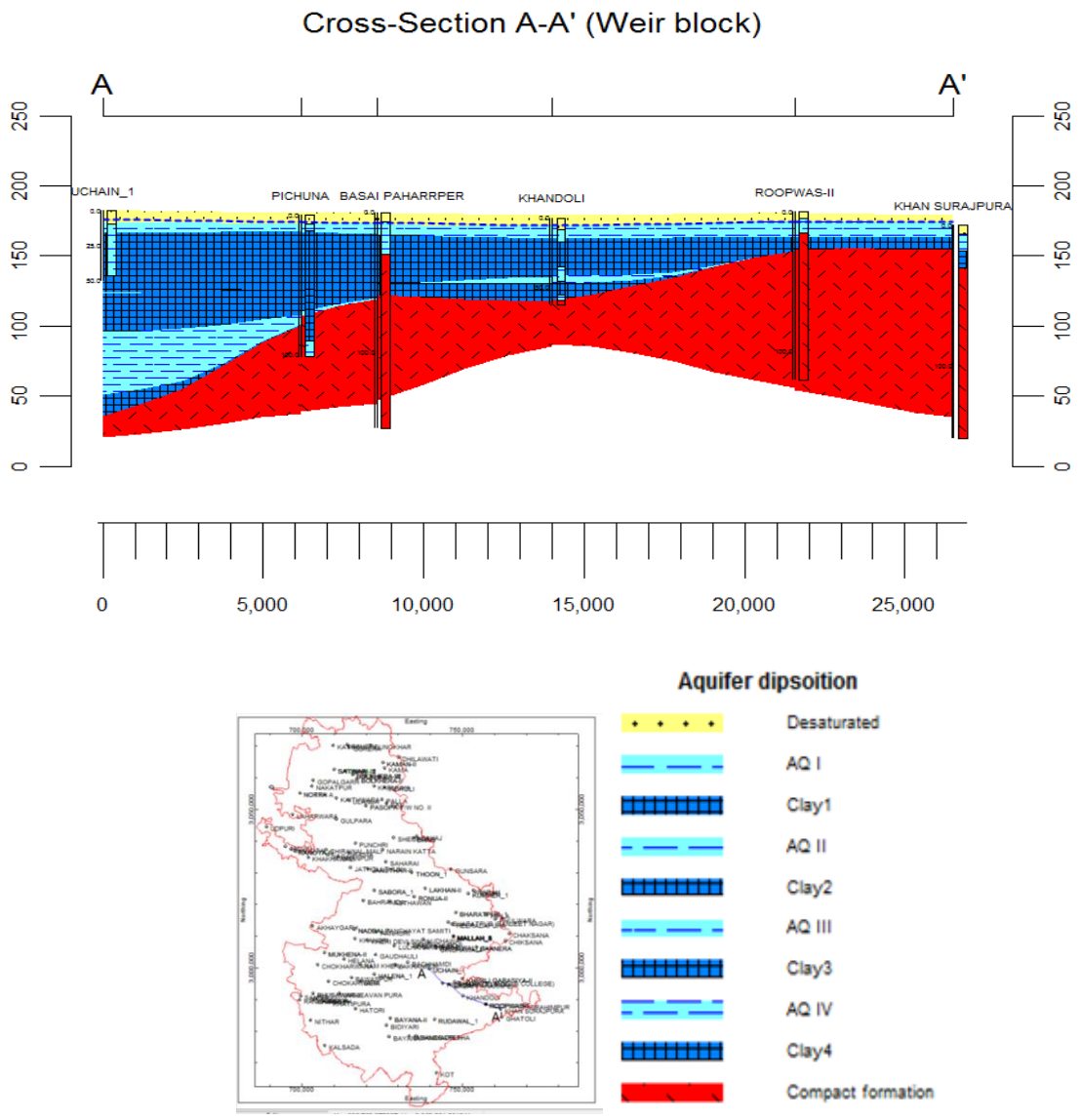


Figure 6A: Section A - A': Uchain-Pichuna-Khandoli-Roopwas-Khansurajpur, Block Weir

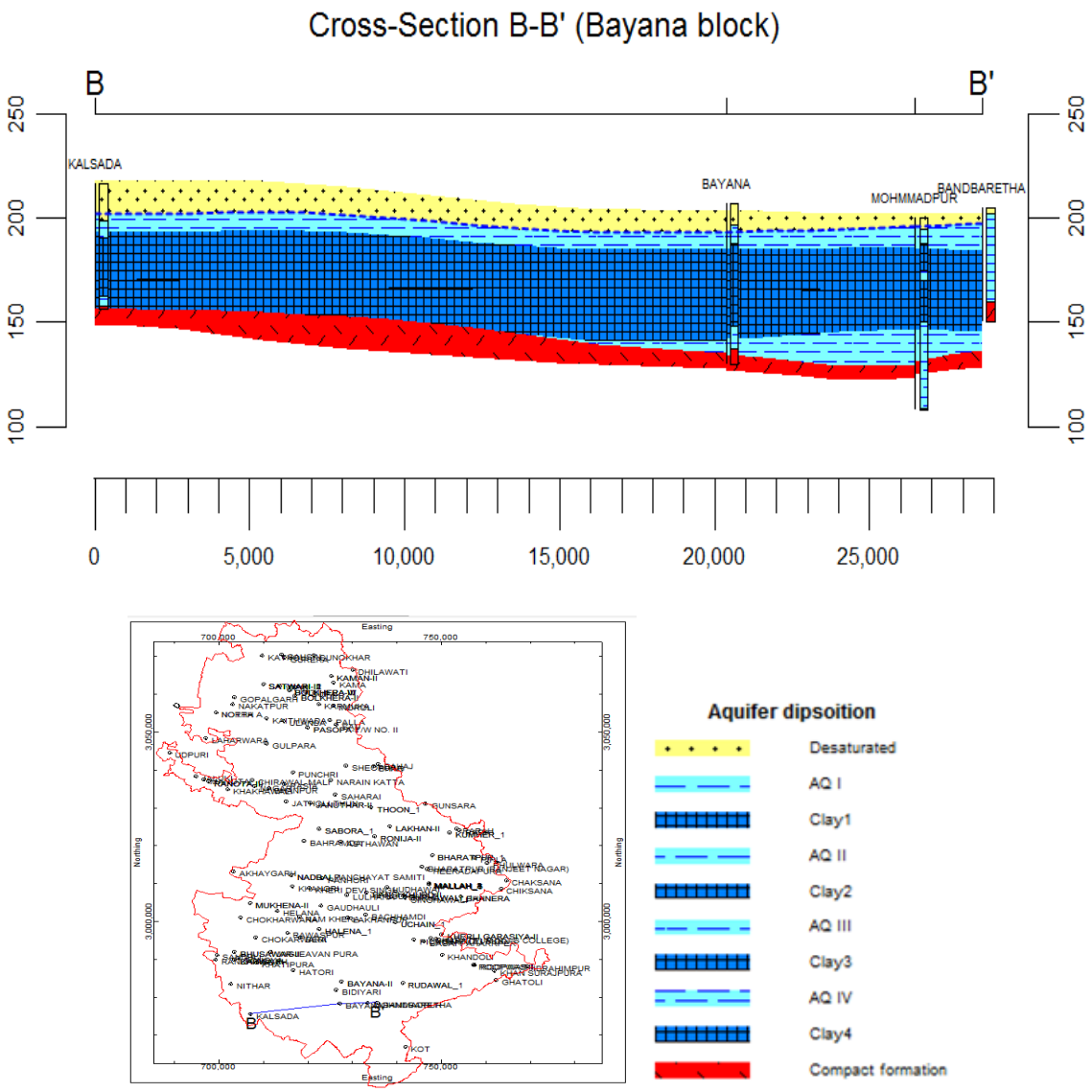


Figure 6B: Section B – B' : Kalsada-Bayana-Mohammadpur-Band Baretha, Block Bayana

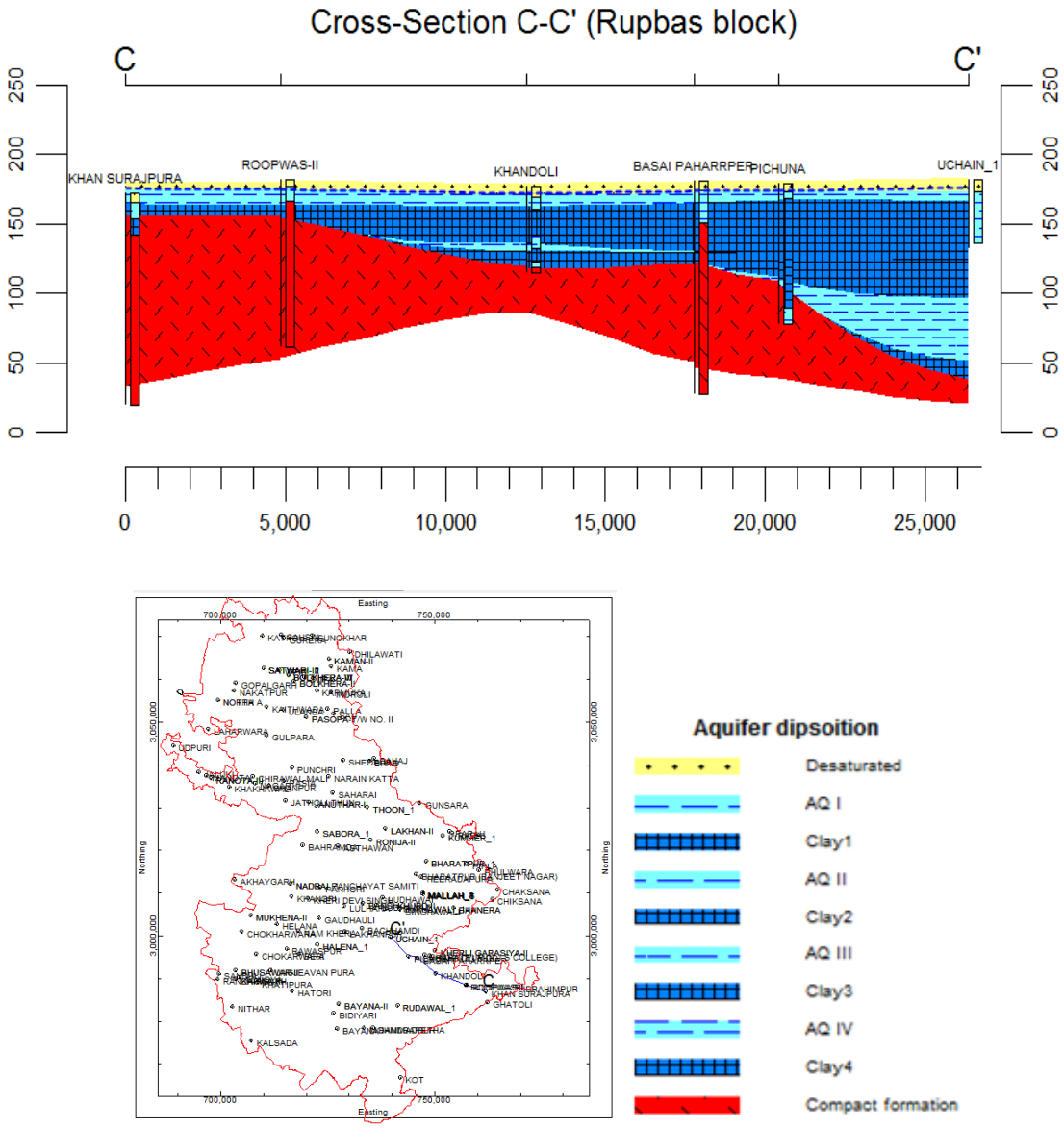


Figure 6C: Section C–C': Khansurajpur-Roopwas-Khandoli-Basai Paharrper –Uchain, Block Rupbas

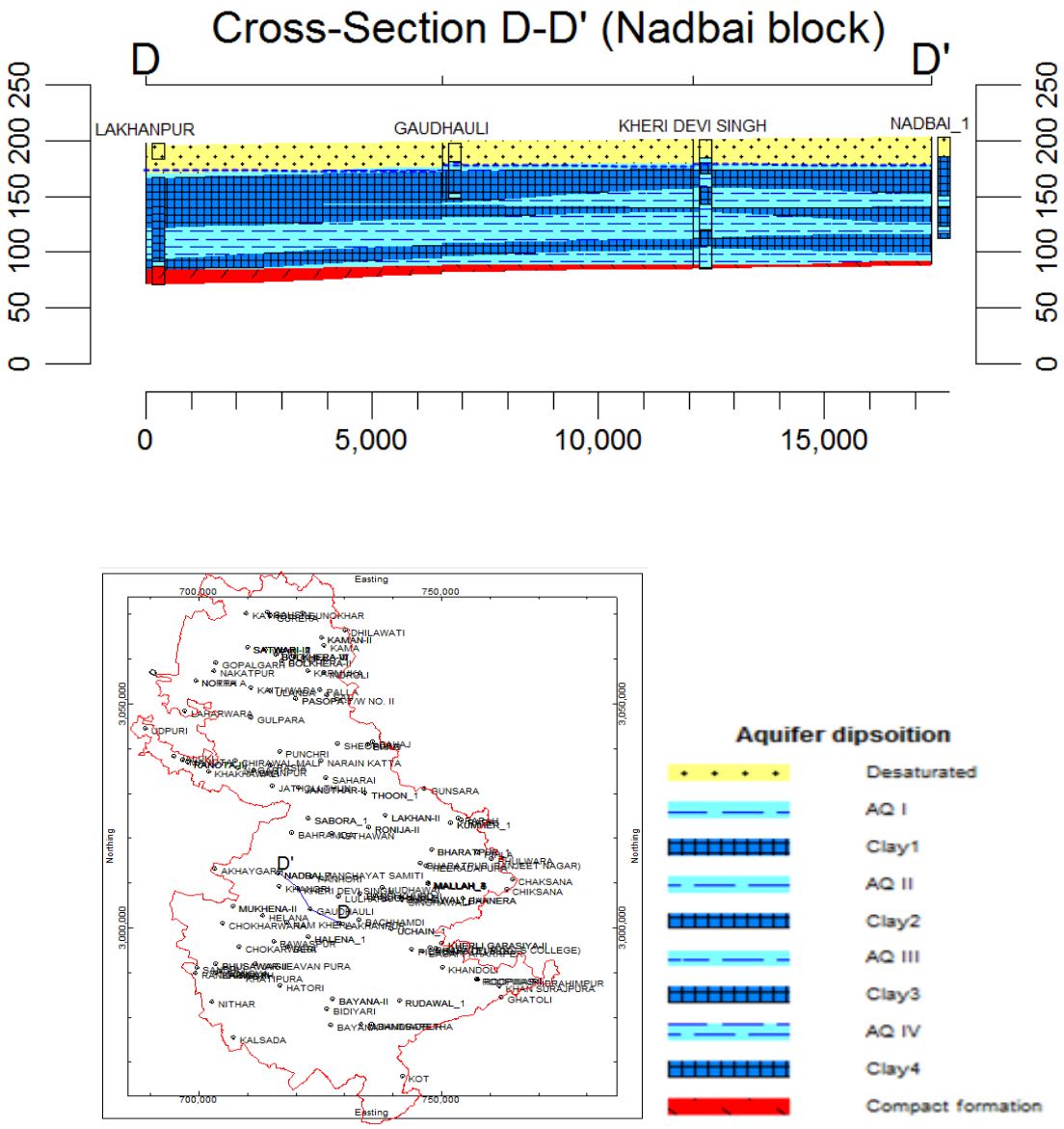


Figure 6D: Section D – D': Lakhanpur-Gaudhauli-Kheri Devi Singh-Nadbai, Block Nadbai

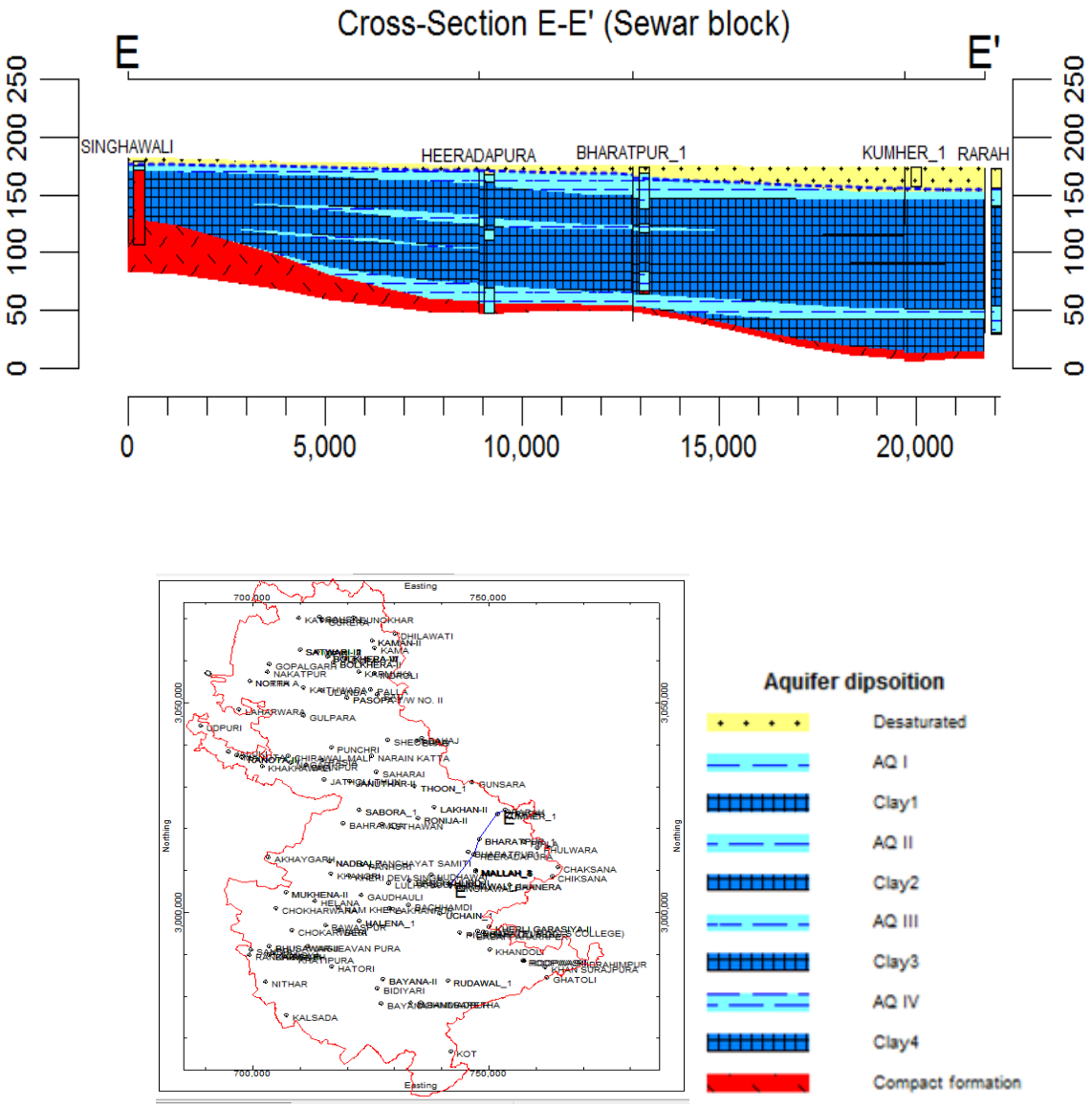


Figure 6E: Section E – E':Singhawali-Heeradapura-Bharatpur-Kumbher-Rarah, Blokc Sewar

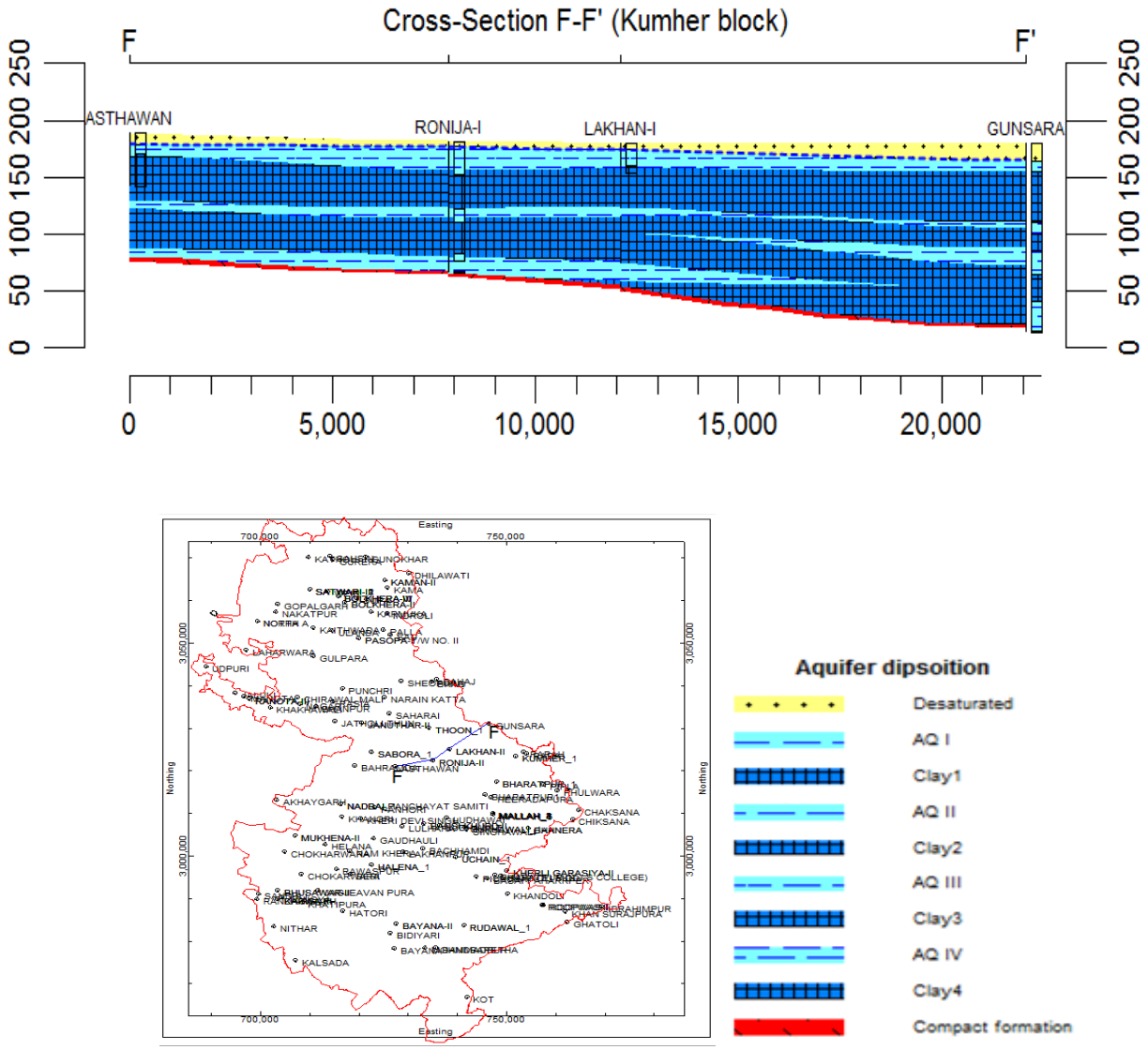


Figure 6F: Section F – F':Ashtawan-Ronija-Lakhan-Gunsara, Block Kumbher

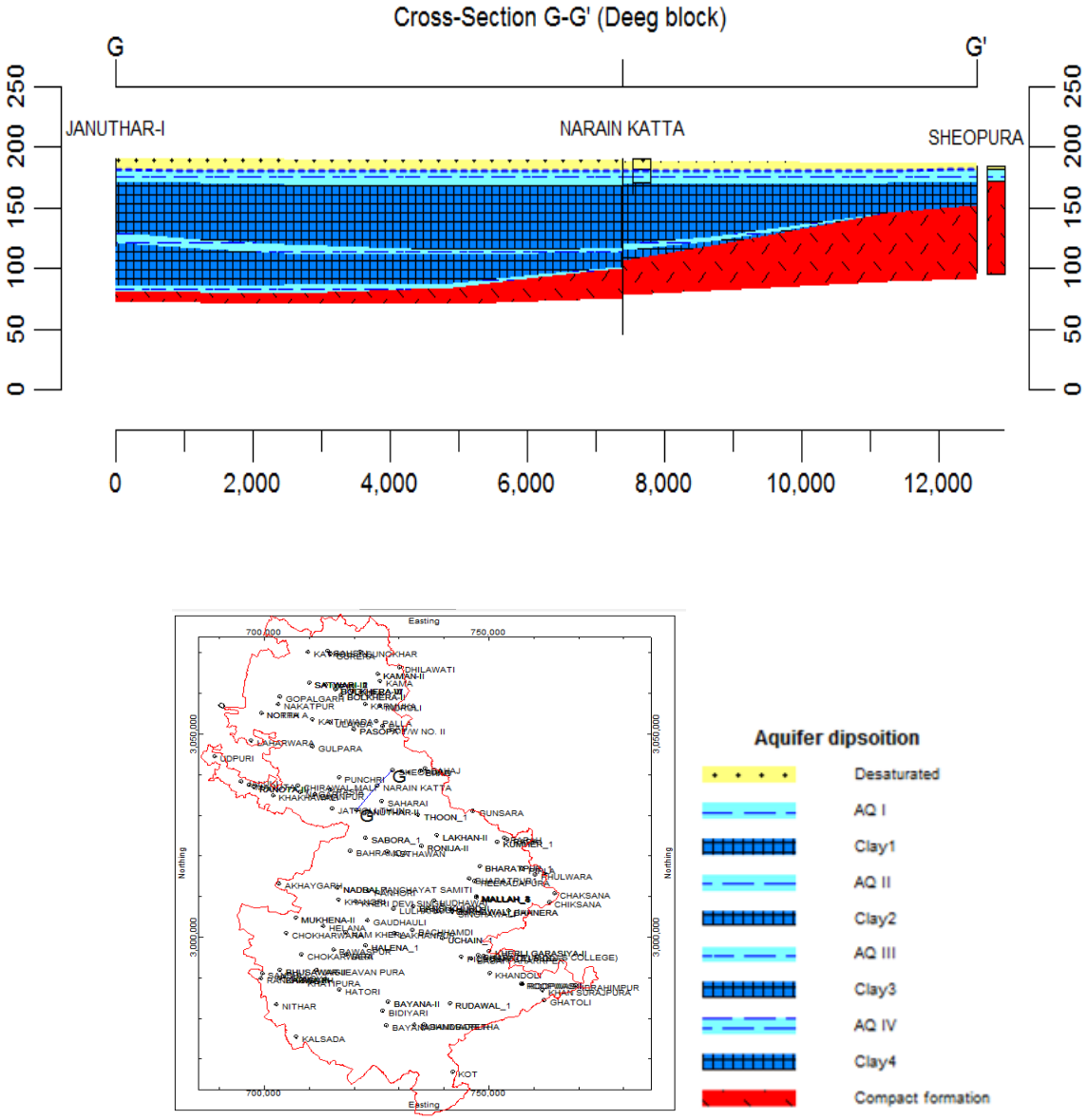


Figure 6G: Section G –G' :Januthar-Narain Katta-Sheopura, Block Deeg

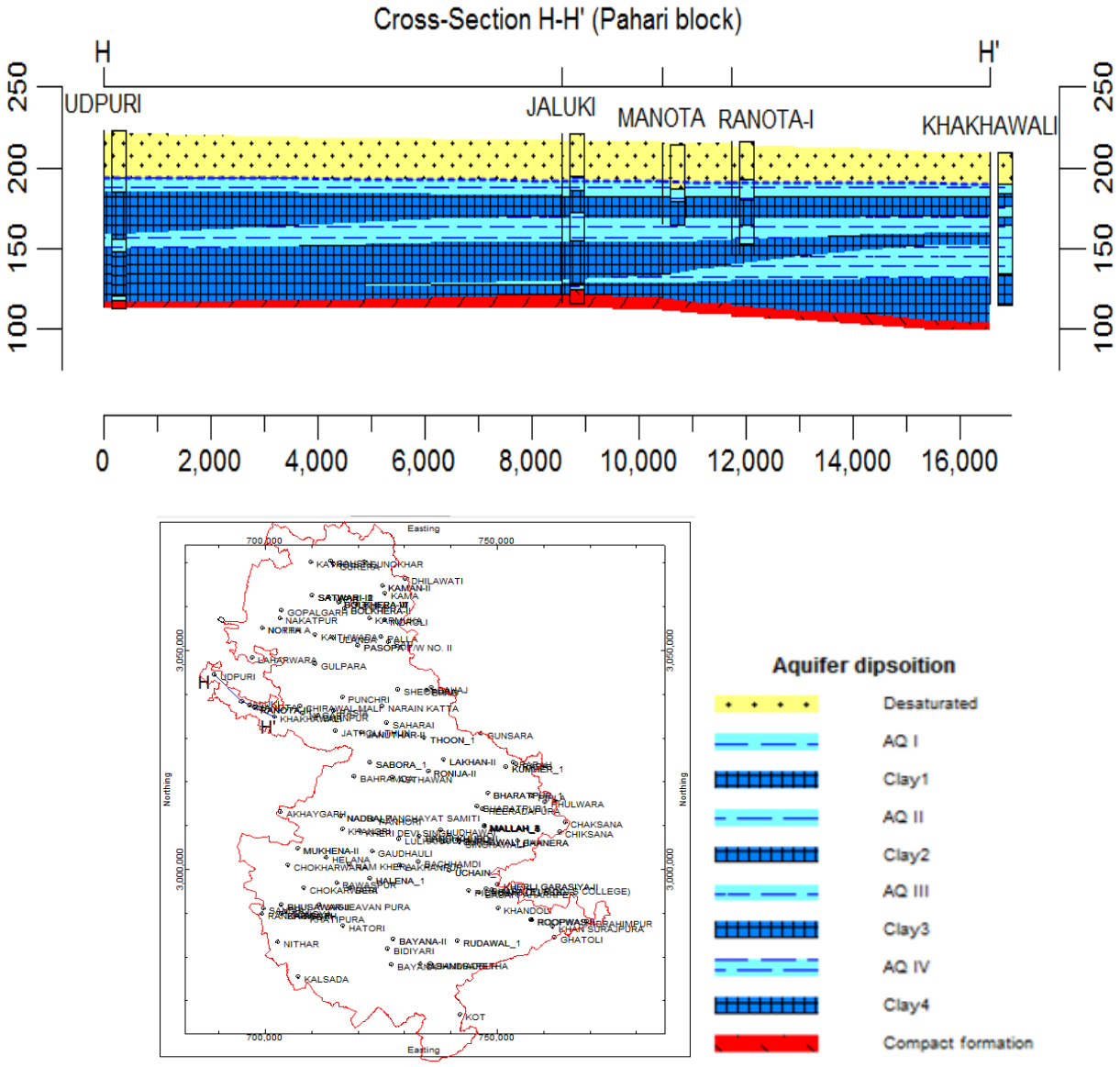


Figure 6H: Section G –G' : Udpuri-Jaluki-Manota-Ranota-Khakhawali, Block Pahari

Study of various said cross sections representing the area, reveals that thickness of saturated portion of alluvial aquifer has been reduced significantly owing to the over draft of ground water resources over the years for various uses.

2.2.2 Depth to Water Level

Central Ground Water Board periodically monitors the ground water regime through 43 active National Hydrograph Network Stations stations(including 27 dug wells and 16 piezometers) four times a year i.e. in January, May (Premonsoon), August and November (Postmonsoon) including one time ground water sampling during May measurement. Depth to water level varies widely depending upon topography, drainage, bed rock, geology etc.

Pre-monsoon (May-2016):

The depth to water level varies widely from 2.10 (lowest at Roopwas in Roopwas block) to 51.4 mbgl(deepest at Chokarwara in Weir Block). Block-wise water level ranges are given below in Table 8.

Table 8: Block-wise Range of Depth to Ground Water Level, Bharatpur District (May, 2016)

Sl.No.	Name of Block	Depth to Ground Water Level Range(mbgl)	
		From	To
1	Bayana	8.45	24.50
2	Deeg	4.10	14.13
3	Kaman	10.67	12.33
4	Kumher	5.98	18.40
5	Nadbai	16.99	32.16
6	Nagar Pahadi	6.98	11.80
7	Rupwas	2.10	9.22
8	Sewar	NA	NA
9	Weir	20.76	51.64

Depth to water level map has been prepared using May, 2016 data and depicted in Figure 7. The perusal of map indicate that deeper water level more than 20 metre lies in the western part of district covering parts of Bayana, Weir, Nadbai and Nagar blocks. Major part of the district has water level between 10 and 20mbgl. Shallow water level less than 10 m has been found in south eastern part of the district covering mainly parts of Roopwas, Bayana, Sewar and also Kumbher, Deeg, Kaman and Nagar blocks.

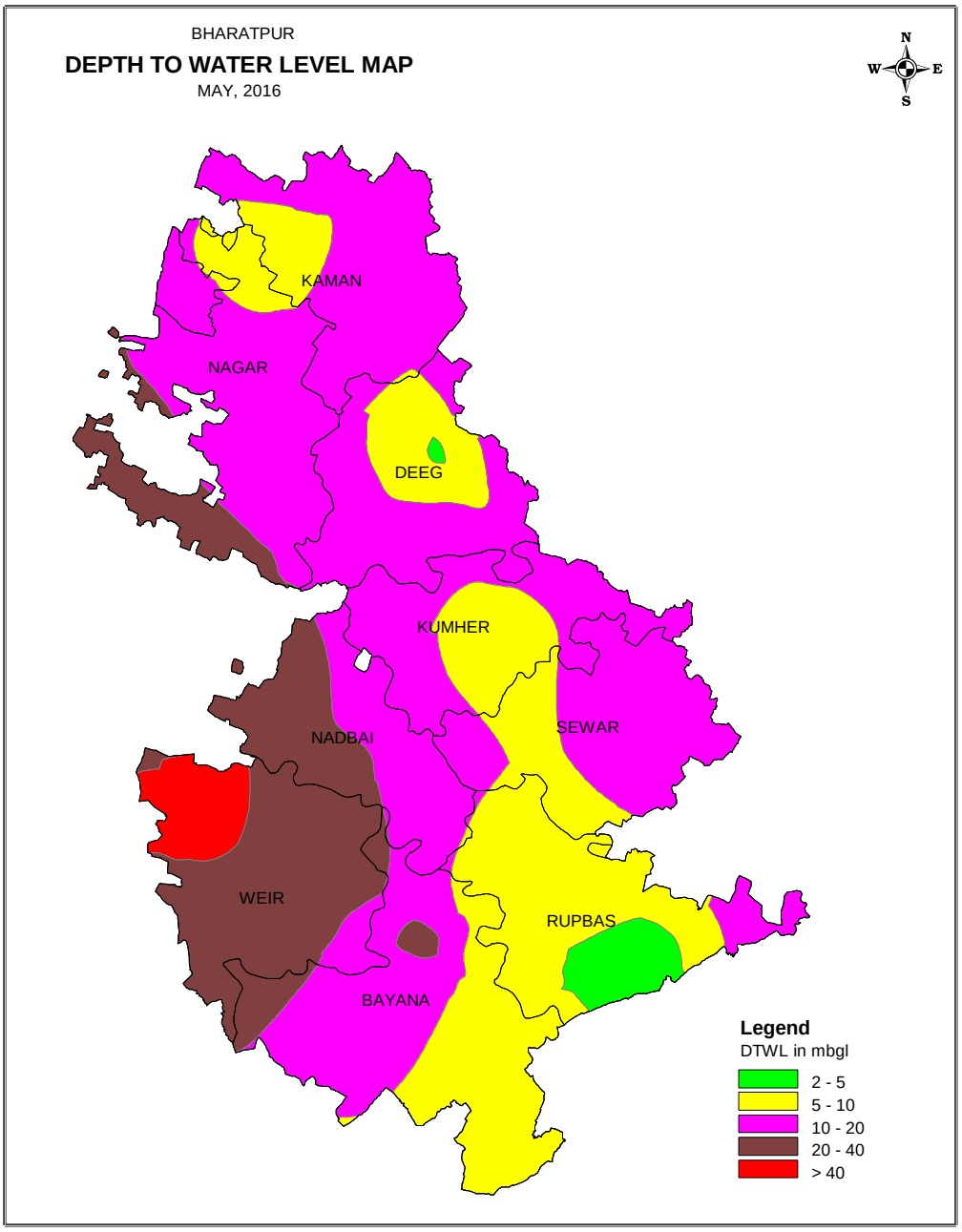


Figure 7: Depth to Ground Water Level (May, 2016), Bharatpur District

Post-monsoon (Nov, 2016):

The depth to water level varies from 2.10mbgl (lowest at Kumbher in Kumbher block and Roopwas in Roopwas block) to 52.10mbgl (deepest at Chokharwara in Weir block) (Figure 8). The perusal of map reveals that deeper water level more than 20 metre lies in the western part of district covering parts of Weir, Nadbai and and small part in Nagar blocks. Major part of the district has water level between 10 and 20mbgl covering aprts of all the nine blocks. Shallow water level less than 10 m lies in parts of Kama, Nagar, Deeg, Kumbher, Sewar, Roopwas and Bayana.

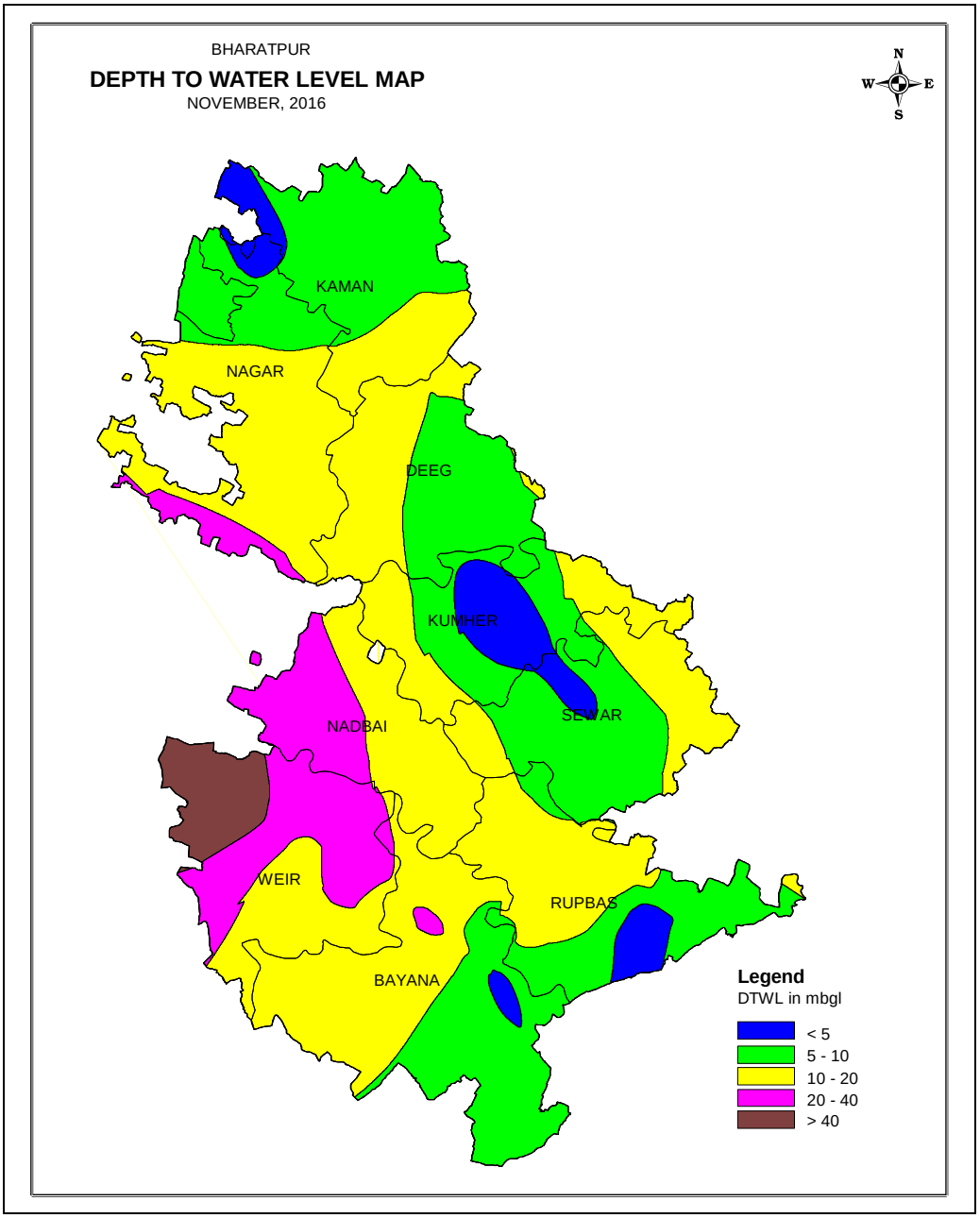


Figure 8: Depth to Ground Water Level (Nov, 2016), Bharatpur District

Seasonal Water level Fluctuation (Nov, 2016 versus May, 2016):

Seasonal water level fluctuation map (pre-monsoon versus post-monsoon, 2016) has been prepared (Figure9). Perusal of map indicate that rise in water level has been observed in norther, central and southern parts of district. Rise in water level of more than 2 metre is observed in ports of Kama, Kumbher and Bayana blocks. Fall in water level less than 4 metre has been noticed in parts of Deeg, Nagar, Sewar, Nadbai, Weir and Roopwas and more than 4 metre in isolated pockets falling parts of Roopwas, Nadbai and Weir.

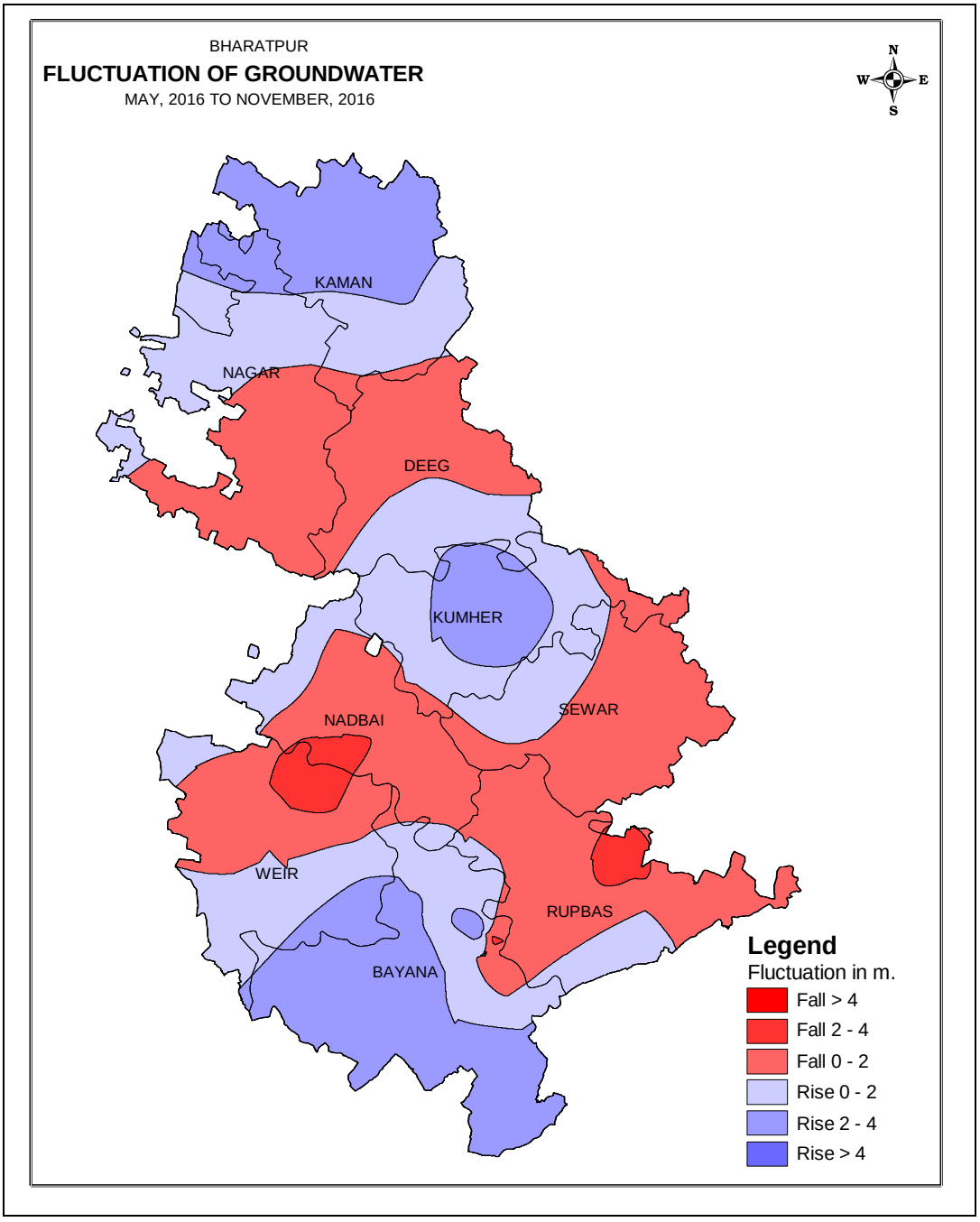


Figure 9: Seasonal Ground Water Level Fluctuation (pre versus post-monsoon, 2016)

Decadal Water level Fluctuation (2006-15 and May, 2016):

Decadal water level fluctuation map (2006-15 versus May, 2016) has been prepared (Figure10). Perusal of map indicate that decline in water level ranging from less than 2m to 4 has been noticed in major part of the district with more 4 metre decline in water level in south western part of district covering parts of Weir, Nadbai, Bayana and Nagar blocks. Rise in water level of

less than 2 metre has been observed in small eastern central area of district covering parts of Sewar, Kumbher and Bayana blocks.

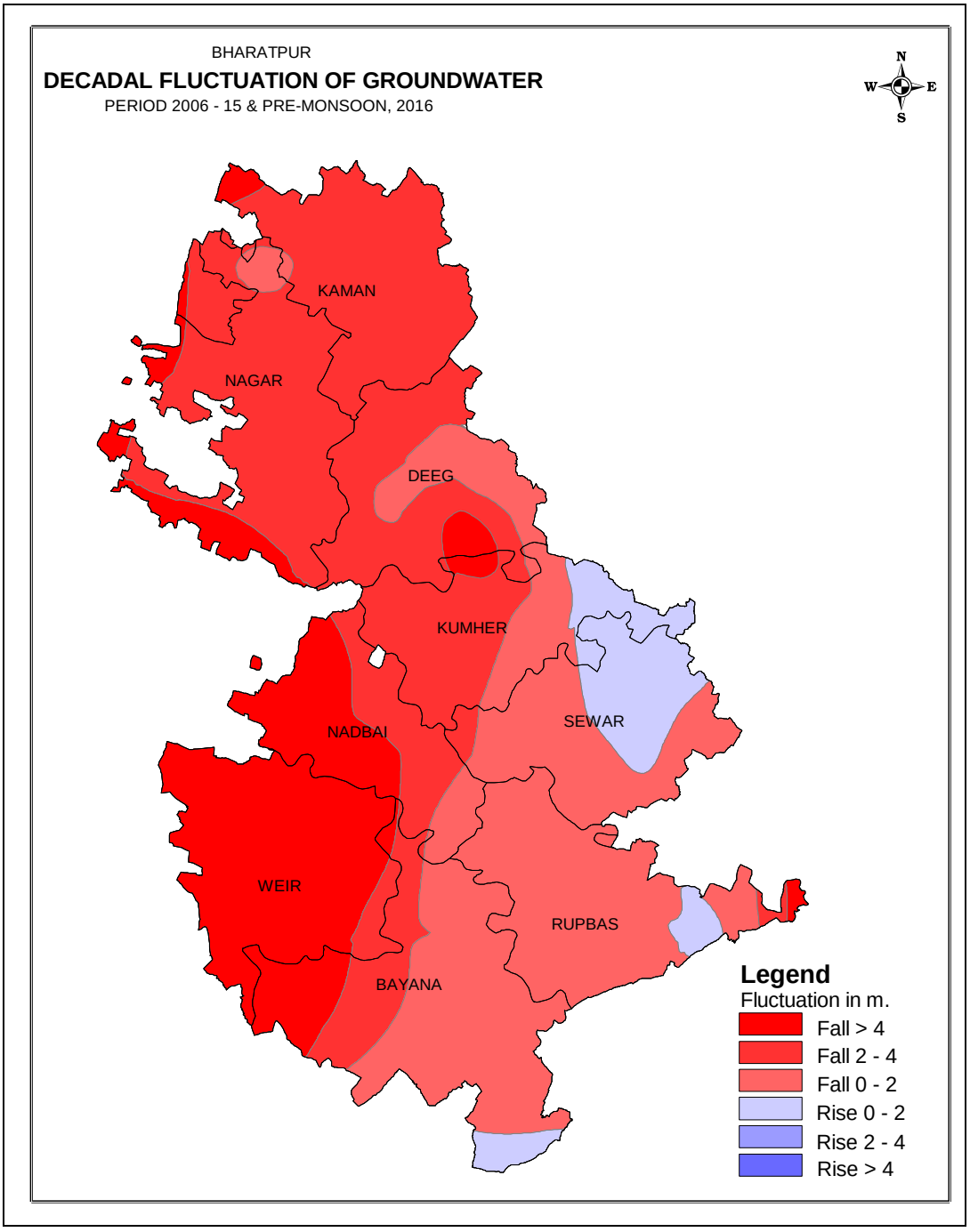


Figure 10: Decadal fluctuation Water Level (2006-15 and pre-monsoon, 2016)

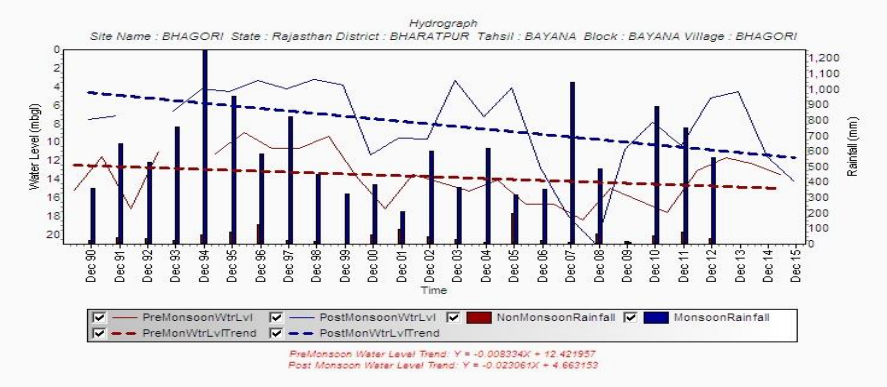
Long Term Water Level Trend (2001-2012):

Block-wise long term ground water level trend for the period 2001 to 2012 is given below in Table 9.

Table 9: Block-wise Ground Water Level Trend(2001-2012), Bharatpur District

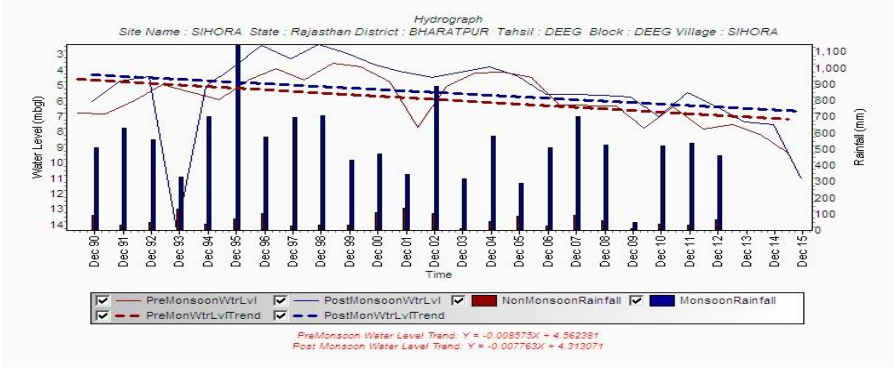
Sl.No.	Name of Block	Ground Water Level Trend (metre/year)	
		Pre-monsoon	Post-monsoon
1	Bayana	0.15	0.02
2	Deeg	0.27	0.20
3	Kaman	0.20	0.13
4	Kumher	0.11	0.04
5	Nadbai	0.72	0.54
6	Nagar, Pahadi	0.24	0.18
7	Rupwas	0.26	0.21
8	Sewar	0.30	0.22
9	Weir	0.41	0.24

Water level trend data indicate that declining trend ranging has been observed in all the blocks ranging from 0.11m/year in Kumbher block to 0.41m/year in Weir block during pre-monsoon period and from 0.02 m/year in Bayana block to 0.54m/year in Nadbai block during post-monsoon period. Declining trend has resulted due to the over draft of ground water resources than its natural replenishment. The long term hydrograph of select monitoring stations representing all the blocks are depicted in Figure 11A to 11I.



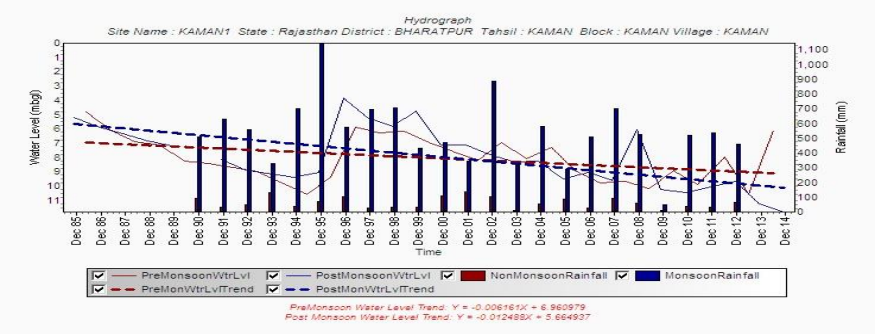
Water Level Decline by 3.5 m in 15 years

Figure 11A: Hydrograph of NHS at Bhagori, Block Bayana(Aquifer-Alluvium)



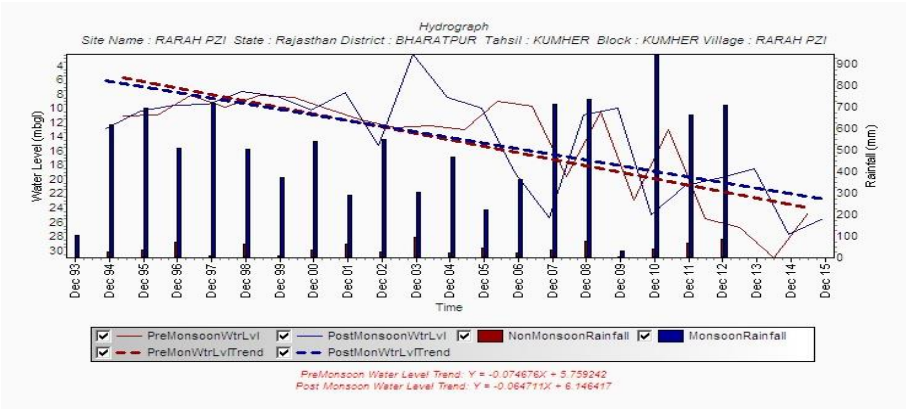
Water Level Decline by 3 m in 15 years

Figure 11B: Hydrograph of NHS at Siroha, Block Deeg (Aquifer-Alluvium)



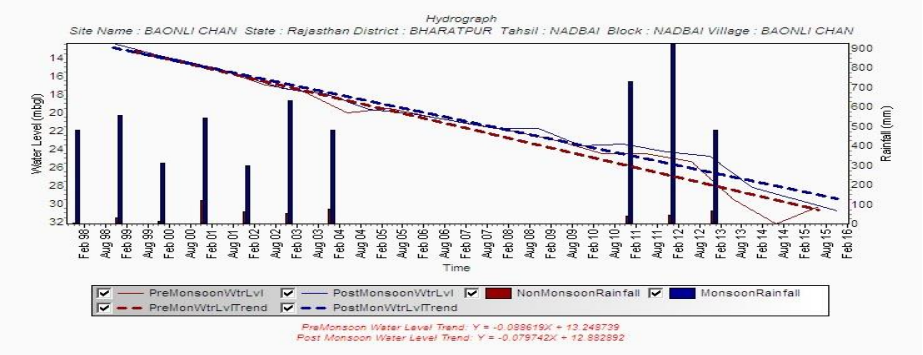
Water Level Decline by 4 m in 19 years

Figure 11C: Hydrograph of NHS at Kaman, Block Kaman(Aquifer-Alluvium)



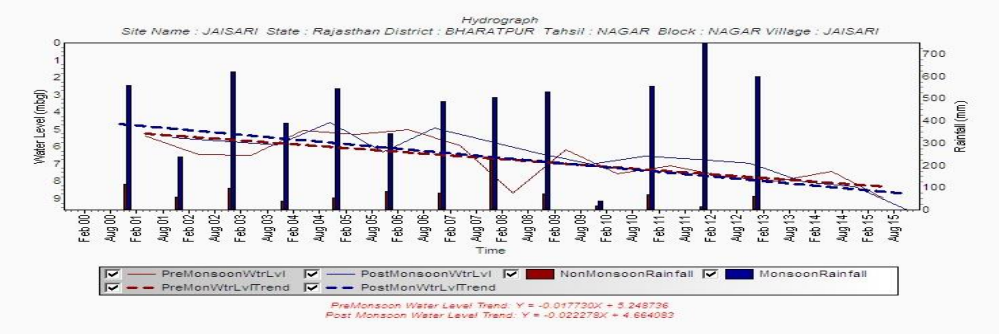
Water Level Decline by 16 m in 25 years

Figure 11D: Hydrograph of NHS at Rarah, Block Kumbher (Aquifer-Alluvium)



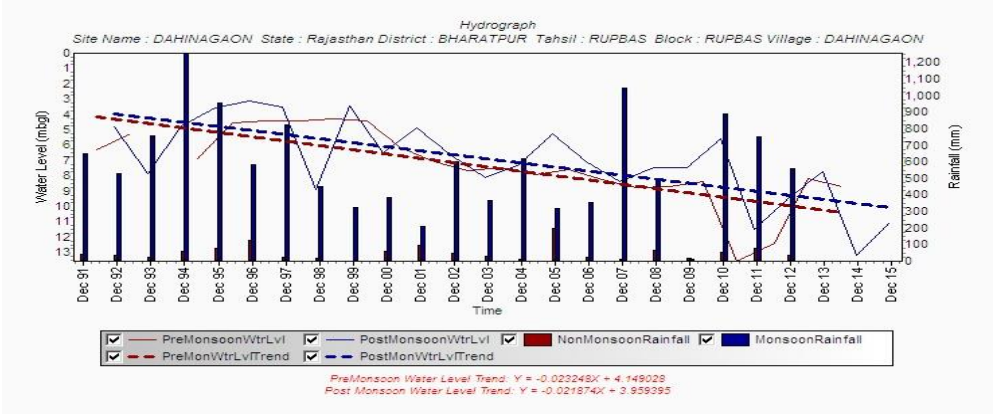
Water Level Decline by 18m in 26 years

Figure 11E: Hydrograph of NHS at Baloni Chan, Block Nadbai (Aquifer-Alluvium)



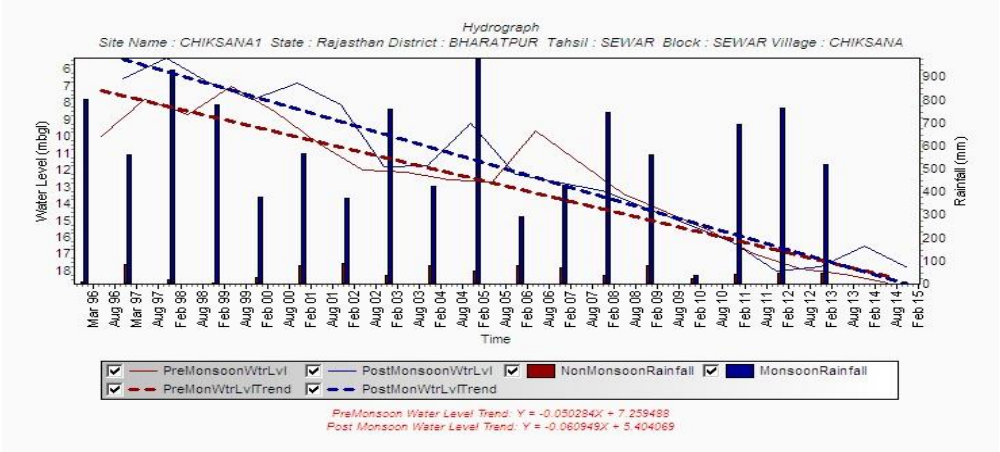
Water Level Decline by 3.5m in 16 years

Figure 11F: Hydrograph of NHS at Jaisari, Block Nagar (Aquifer-Alluvium)



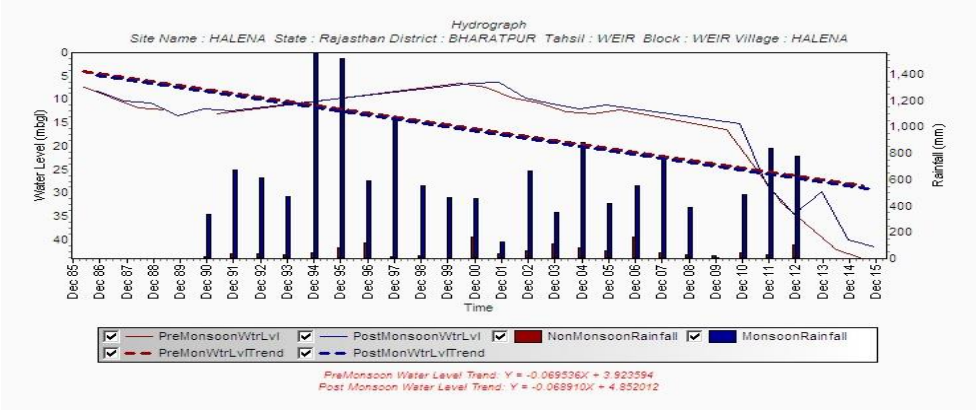
Water Level Decline by 6.5m in 25 years

Figure 11G: Hydrograph of NHS at Dahinagaon, Block Rupbas (Aquifer-Alluvium)



Water Level Decline by 12m in 19 years

Figure 11H: Hydrograph of NHS at Chiksana, Block Sewar (Aquifer-Alluvium)



Water Level Decline by 25m in 30 years

Figure 11I: Hydrograph of NHS at Halena, Block Weir (Aquifer-Alluvium)

Water Table:

The highest elevation of water table is about 217 m amsl in the western part of the district. The lower elevation of water table in 163 m.amsl in extreme eastern part of the district. In the extreme southern part of the district in Bayana block elevation of water table contour in more than 200 m and slope of water table in northerly which gradually turns easterly. Hydraulic gradient is steeper in the western part of the district (1.6 km/km) and is gentle in Central and eastern part (0.6 m/km).

3. Ground Water Quality

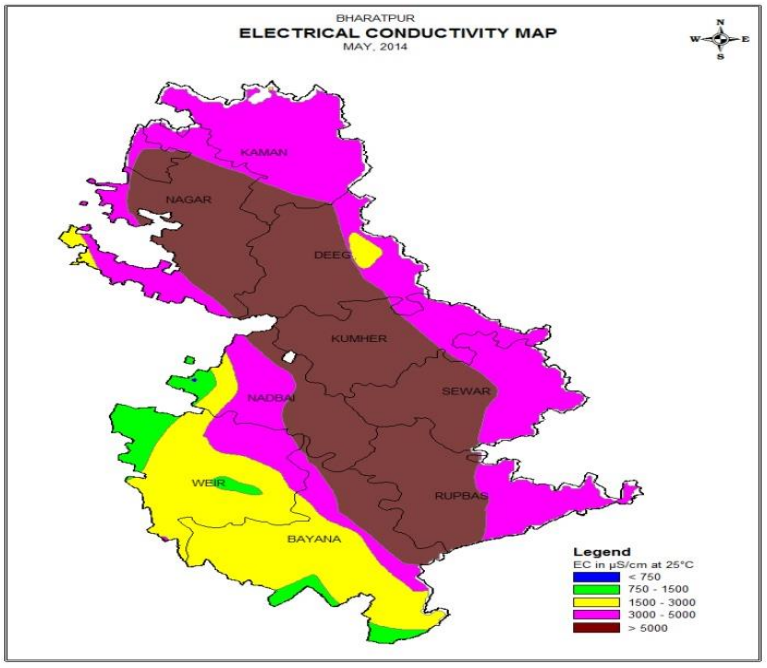
There is a large variation in the chemical quality of ground water in the district, both in aerially and depth wise. Both in shallow and deeper aquifers it varies from fresh to saline. About the shallow aquifer information is available from the studies conducted during earlier hydrogeological surveys and NHS analytical data in the district.

Ground water quality in phreatic aquifers:

The quality of shallow ground water varies from fresh to saline. In the south western part of the district, mainly in Bayana, Weir and Nadbai blocks, phreatic ground water is generally within electrical conductance less then 3000 micromhos/cm at 25°C (Figure12) and covers about 22% of district area. Marginal quality of ground water (electrical conductance varying from 3000 to 5000 micromhos/cm at 25°C and more exists in complete parts of Rupbas, Sewar, Kumbher, Kaman blocks and most parts of Deeg, Nagar, Nadbai blocks and small part of Bayana and Weir blocks(Forms 78% of area of the district.

The surface water in the river Banganga indicated electrical conductivity varying from 215 to 945 micromhos/cm at 25°C. The Ghana lake water indicated electrical conductivity varying form 378 to 990 micromhos/cm at 25°C. The shallow aquifers around Ghana lake yield fresh water due to influent seepage from the lake into aquifer. There is a gradual

change from mixed to chloride type in the direction of flow of ground water i.e. towards eastwards.



EC (ms/cm at 25°C)	Area insq.km.(%)
<750	0.71(<1%)
750 - 1500	164(3%)
1500 - 3000	944(19%)
3000- 5000	1766(35%)
>5000	2169(43%)

- EC – 540(Min) to 18460(Max) ms/cm at 25°C.
- >3000 EC in about 3935sq.km.(78%)

Figure 12: Distribution of Electrical Conductivity in shallow ground water, Bharatpur District

Salinity of water in deeper aquifer:

The salinity of ground water is revealed by the exploratory boreholes drilled in the district. An analytical data indicate potable ground water with electrical conductance less than 2000 micromhos/cm at 25°C is encountered in southern part of district in Bayana and Weir blocks. Area having electric conductance between 2000 to 4000 micromhos/cm at 25°C indicating marginal quality of water occurs in parts of weir, Bayana, Rupbas and Sewar block in southern part covering part of Nadbai block, in central part & part of Nagar and Kaman block in northern parts of the district. Highly saline water having electrical conductance more than 6000 micromhos/cm at 25°C occur in central part of the district in form of a big patch falling in Weir, Nadbai, Kumher, Sewar blocks. In northern parts of the district such patch occur northern part of Kumher and Nagar blocks. List of places where extremely high salinity has been recorded in exploratory wells is given below.

Locations of Exploratory wells having high salinity

Name	EC	Cl (ppm)
Gangrauli	15980	4325
Halena	23300	7516
Kamalpura	19115	6275
Kumher	13248	4325
Sahari	22240	6887
Bahai	22180	6133
Nadbai	8420	1828

Depth wise variation of quality:

A perusal of information regarding chemical quality indicates vertical variation in ground water quality as per details below:

- areas with fresh water at all levels exists in a belt extending from Weir and Hingota to Bayana and Samogar
- areas with fresh water overlie with saline water exists in Sewar and Rupwas blocks
- areas with saline waters at all levels exists around Gangrauli, Sinsine, Kumher and Kanjoli lines covering a large area
- very small areas where marginal to potable water overlying the saline water occur in very small pockets in Sewar and Kumher block
- areas with a thin fresh water zone in between saline water zone, occur at Rarah and Sinsine.

Brine resources:

Brine resources are also present in the district which were being used during the past, about hundred years back, for production of salt GSI has carried out geophysical survey to locate the saline tracks located around Bharatpur, Kumher and Deeg. The survey reveals a salt tract of about 10 sq.km around Bharatpur. Sodium chloride is predominant salt content varying between 60 to 80%.Thus it is seen that in a large part of Bharatpur district area, the ground water is not fit for drinking due to high salinity.

The principal reasons for the severe ground water quality problem are:

- The Banganga and Ruparel terminate in an internal drainage basin. It is estimated that flood waters of these rivers carry 100,000 tons of solute load annually (Water Resources Planning for Banganga River Basin-1998) which are concentrated by evaporation and seep into shallow ground water.
- Further, concentration is brought about by evaporation from the water table i.e. by capillary rise due to shallow water table and clayey lithology of formations.
- All solutes transported to this area by means of surface/subsurface flow remain in-situ as there seems to be no flushing out of salts from the closed basin.

Fluoride:

Fluoride concentration in groundwater in the district varies from 0.1 mg/litre at Bhagori in Bayana block and Jurahara in Kaman block to 9.42 mg/litre at Jhantli in Nagar block. Flouride content is generally within the permissible limit of 1.5 mg/litre. However, major parts of Nagar, Kaman, Nadbai, northwestern and northeastern parts of Deeg, western parts of Weir, Bayana, Kumher and Sewar and northwestern part of Roopwas have fluoride content above the permissible limit.

Nitrate:

Nitrate concentration in groundwater varies from 1.5 mg/litre at Bharatpur to 327 mg/litre at Nadbai. Higher concentration of Nitrate exceeding maximum permissible limit of 45 mg/litre has

been reported from parts of Bayana, Roopwas, Kumher, Nadbai and Nagar blocks.

Iron:

Iron content in ground water has been found to vary from negligible to 5.41 mg/litre Iron concentration in ground water has been observed within the permissible limit of 1 mg/litre in most parts of the district except isolated pockets in Umrain, Laxmangarh, Rajgarh and Reni blocks.

Ground water sampling from 174 locations representing various aquifers and in data gaps has been done to assess the ground water quality in more precise way. Ground water samples have been submitted in chemical laboratory of WR and analysis is under progress. Data/maps of same will be incorporated in the report on receipt of analytical results.

4. Ground Water Resources

Based on Ground Water Estimation Committee (1997), dynamic groundwater resources of Rajasthan as on 31.03.2013 have been reassessed jointly by Central Ground Water Board and Ground Water Department, Govt. of Rajasthan. Block and zone wise details of resources are given in Table 10.

Table: 10 Ground Water Potential Of Bharatpur District As On 31.03.2013

Block	Area of Block (Sq.Km.)	Potential zone	Potential zone area (Sq.kms)	Net Annual Ground Water Availability (mcm)	Existing Gross Ground Water Draft for Irrigation (mcm)	Existing Gross G.W. Draft for Dom. & Ind. Use (mcm)	Existing Gross Ground Water Draft for all uses (mcm)	Allocation for Dom. & Ind. Requirement (mcm)	Net G.W. Availability for future Irr. Dev. (mcm)	Stage of G.W. Develop-ment. (%)	Category
Bayana	808.69	Ao	509.11	72.8390	78.1860	6.8171	85.0031	10.0800	0.0000	116.70	
		Ss	167.20	10.4103	3.0564	1.1906	4.2470	1.0600	6.2939	40.80	
Total (Block)			676.31	83.2493	81.2424	8.0077	89.2501	11.1400	6.2939	107.21	OE
Deeg	492.85	Ao	338.91	41.9967	36.2772	4.8231	41.1003	10.9600	0.0000	97.87	CRIT
Kama	562.49	Ao	492.93	64.7251	59.8059	5.7002	65.5061	11.5300	0.0000	101.21	OE
Kumher	454.51	Ao	119.08	16.3747	13.1556	5.0574	18.2130	6.0800	0.0000	111.23	OE
Nadbai	446.7	Ao	281.34	39.4857	65.6820	5.1728	70.8548	6.6900	0.0000	179.44	OE
Nagar	623.8	Ao	291.36	47.9076	40.3920	6.4715	46.8635	5.0000	2.5156	97.82	CRIT
Roopwas	539.01	Ao	338.60	54.4862	53.1000	3.6865	56.7865	3.4230	0.0000	104.22	
		Ss	162.50	12.2094	15.0678	2.2137	17.2815	1.4670	0.0000	141.54	
Total (Block)			501.10	66.6956	68.1678	5.9002	74.0680	4.8900	0.0000	111.05	OE
Sewar	509.52	Ao	281.10	40.8469	40.0404	16.2750	56.3154	12.2900	0.0000	137.87	OE

Block	Area of Block (Sq.Km.)	Potential zone	Potential zone area (Sq.kms)	Net Annual Ground Water Availability (mcm)	Existing Gross Ground Water Draft for Irrigation (mcm)	Existing Gross G.W. Draft for Dom. & Ind. Use (mcm)	Existing Gross Ground Water Draft for all uses (mcm)	Allocation for Dom. & Ind. Requirement (mcm)	Net G.W. Availability for future Irr. Dev. (mcm)	Stage of G.W. Develop-ment. (%)	Category
Weir	606.53	Ao	344.07	48.9691	57.7632	9.8116	67.5748	8.9600	0.0000	137.99	
		Q	86.32	6.7544	11.7666	1.3286	13.0952	0.8400	0.0000	193.88	
Total (Block)			430.39	55.7235	69.5298	11.1402	80.6699	9.8000	0.0000	144.77	OE
Total of District Pot./zone			3412.52	457.0051	474.2930	68.5481	542.8411	78.3800	8.8095	118.78	OE
Deeg		Ao(S)	131.91	16.1022	14.9976	1.0501	16.0477	0.0000	1.1046	99.66	
Kumher		Ao(S)	335.12	34.4834	20.9856	1.4447	22.4303	0.0000	13.4978	65.05	
Nadbai		Ao(S)	165.36	19.9081	20.2368	1.1435	21.3803	0.0000	0.0000	107.40	
Nagar		Ao(S)	319.68	43.8110	11.4204	1.3344	12.7548	0.0000	32.3906	29.11	
Sewar		Ao(S)	228.27	26.0862	11.3472	2.0122	13.3594	0.0000	14.7390	51.21	
Weir		Ao(S)	158.66	23.3838	35.4911	0.0000	35.4911	0.0000	0.0000	151.78	
Total of saline zone			1339.00	163.7747	114.4787	6.9850	121.4637	0.0000	61.7320	74.17	

Data indicate that out of 9 blocks, 2 blocks (Deeg and Nagar) are critical and remaining 7 blocks (Bayana, Kama, Kumbher, Nadbai,Roopbas, Sewar and Weir) are over exploited. The stage of ground water development ranges from 97.82% (minimum in Nagar blokc) to 179.44% (maximum in Nadbai Block). It has resulted in decline in water level. The changing scenario of ground water development over the years since 1984 has been presented in Table 11 and depicted with the help of bar diagram in Figure 13.

Table 11: Status of Ground Water Development, Bharatpur District

Year	Net GW availability(mcm)	Gross draft (mcm)	Stage of GW development(%)
1984	514.0263	179.5381	35
1990	441.3076	323.9381	73.40
1995	493.1348	480.3368	97.40
1998	541.0596	472.4515	87.32
2001	514.2610	479.6573	93.27
2004	453.6358	453.1589	99.89
2009	453.51	508.56	112.14
2011	449.36	522.18	116.21
2013	457.0051	542.8411	118.78

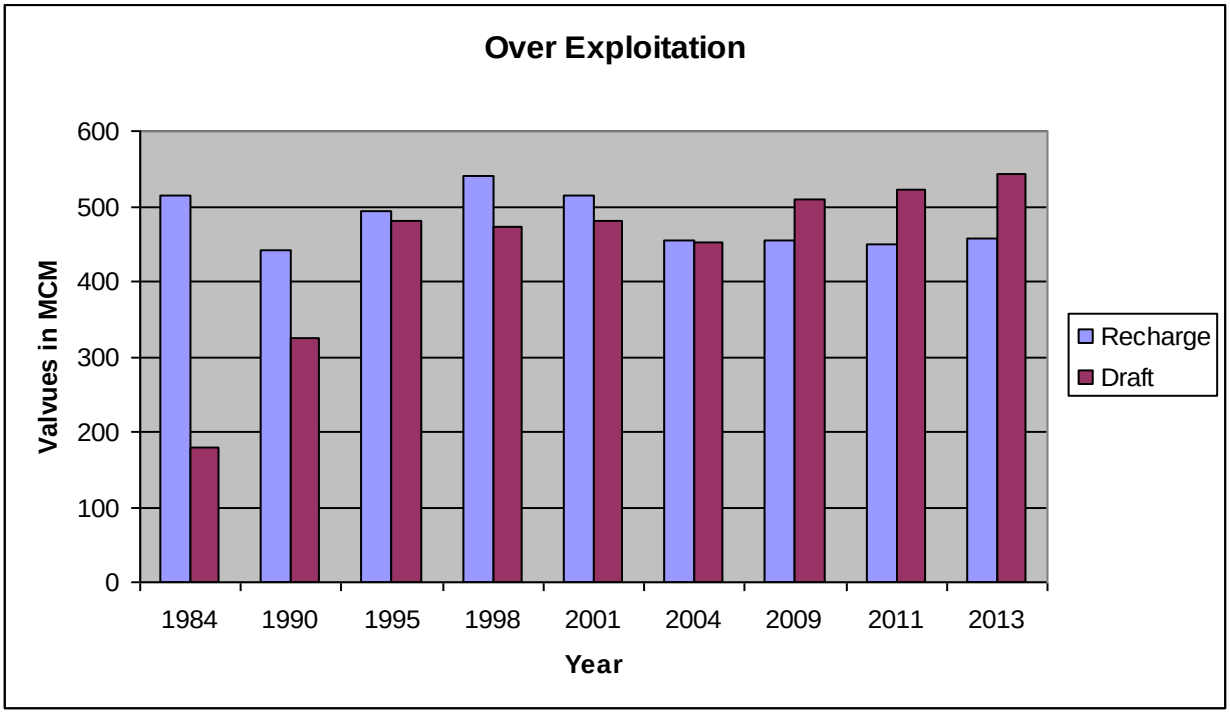


Figure 13: Ground Water Development Status, Bharatpur District

If the present development of ground water continues, resources very likely to be exhausted by 2041. Sustainability of resources of district is given in Table 12.

Table 12: Sustainability of Ground Water Resources, Bharatpur District

Year	Annual Recharge (mcm)	Gross Ground water demand (mcm)	Yearly storage depletion (mcm)	In-storage ground water resources (mcm)
2009	454	509	55	2694
2010	454	509	55	2639
2011	449	522	73	2566
2012	449	522	73	2493
2013	457	543	86	2407
2014	457	543	86	2321
2015	457	543	86	2235
2016	457	543	86	2149
2017	457	543	86	2063
2018	457	543	86	1977
2019	457	543	86	1891
2020	457	543	86	1805
2021	457	543	86	1719
2022	457	543	86	1633
2023	457	543	86	1547
2024	457	543	86	1461
2025	457	543	86	1375
2026	457	543	86	1289
2027	457	543	86	1203
2028	457	543	86	1117
2029	457	543	86	1031
2030	457	543	86	945
2031	457	543	86	859
2032	457	543	86	773
2033	457	543	86	687
2034	457	543	86	601
2035	457	543	86	515
2036	457	543	86	429
2037	457	543	86	343
2038	457	543	86	257
2039	457	543	86	171
2040	457	543	86	85
2041	457	543	86	-1

5. Groundwater Related Issues

The following ground water related issues have been emerged:

a) Decline in Water Level
Long term water level data (pre and post monsoon, 2001-12) indicate declining trend in all the blocks ranging from 0.11m/year in Kumbher block to 0.41m/year in Weir block during pre-monsoon period and from 0.02 m/year in Bayana block to 0.54m/year in Nadbai block during post-monsoon period. Declining trend has resulted due to the over

draft of ground water resources than its natural replenishment. Ground water resources data indicate that out of 9 blocks, only 2 blocks (Deeg and Nagar) are critical and remaining 7 blocks (Bayana, Kama, Kumbher, Nadbai,Roopbas, Sewar and Weir) are over exploited. The stage of ground water development ranges from 97.82% (minimum in Nagar block) to 179.44% (maximum in Nadbai Block). It has resulted in decline in water level. About 15% of district area has depth to water level more than 20m. Deeper water level causes more consumption of power to draw ground water and deterioration in ground water quality.

b) Ground Water Salinity
   Ground water salinity with EC more than 3000micromhos/cm at 25°C has been observed in complete parts of Rupbas, Sewar, Kumbher, Kaman blocks and most parts of Deeg, Nagar, Nadbai blocks and small part of Bayana and Weir blocks(Forms 78% of area of the district).
c) Fluoride
   Area faces high fluoride hazarad in ground water which has adverse effect on human health. Fluoride concentration in groundwater more than 1.50ml (acceptable limit) has been noticed mainly in parts of Neemrana, Ramgarh and Kathumar blocks and with sporadic occurrence in parts of Kotkasim, Mandawar, Behror, Bansur, Thanagazi, Rajgarh, Reni, Umrain, Laxmangarh and Kishangarh Bas blocks.

6. Management Strategies

All the blocks are over exploited, thereby, leaving no/limited scope of further ground water development for various consumptions and area is devoid of sustained surface water bodies. In order to manage the ground water resources and to control further decline in water levels, a management plan has been proposed. In order to manage the ground water resources and to control further decline in water levels, a management plan has been proposed. The management plan comprises two components- supply side management and demand side management. Since there is very little surplus surface water available in this district, very little intervention in the form of supply side management could be proposed.

6.1 Supply Side Management

The supply side management of ground water resources can be done through the artificial recharge of surplus runoff available within river sub basins and micro watersheds. Also it is necessary to understand the unsaturated aquifer volume available for recharge.

The supply side management of ground water resources can be done through the artificial recharge of surplus runoff available within river sub basins and micro watersheds. Also it is necessary to understand the unsaturated aquifer volume available for recharge. The unsaturated volume of aquifer for the Bharatpur district is computed based on following; the area feasible for recharge, unsaturated depth below 5 m bgl and the specific yield of the aquifer. The block-wise volume available for the recharge is given below in Table 13.

Table 13: Area Feasible and Volume Available for Artificial Recharge, Bharatpur District

Block	Area of Block (Sq.km.)	Potential area suitable for recharge (Sq.km.)	Type of Aquifer	Area feasible for artificial recharge (Sq km)	Sp Yield (%)	Average DTW (mbgl) NOV 2013	Thickness of unsaturated zone 3 m below ground level (m)	Volume of sub surface storage space available for artificial recharge (MCM)
Bayana	808.69	676.31	SR	509.11	0.12	12.54	9.54	582.83
			HR	167.2	0.02	8.54	5.54	18.53
Deeg	492.85	338.91	SR	338.91	0.1	8.18	5.18	175.56
Kaman	562.49	492.93	SR	492.93	0.1	8.14	5.14	253.37
Kumher	454.51	119.08	SR	119.08	0.08	5.87	2.87	27.34
Nadbai	446.7	281.34	SR	281.34	0.1	16.62	13.62	383.19
Nagar Pahadi	623.8	291.36	SR	291.36	0.1	9.13	6.13	178.6
Rupwas	539.01	501.1	SR	338.6	0.1	9.78	6.78	229.57
			HR	162.5	0.02	4.94	1.94	6.31
Sewar	509.52	281.1	SR	281.1	0.07	8.86	5.86	115.31
Weir	606.53	430.39	SR	344.07	0.12	16.67	13.67	564.41
			HR	86.32	0.02	14.5	11.5	19.85
Total	5044.1	3412.52		3412.52			87.7700	2554.87

It can be seen that huge volume is available for artificial recharge in this district. The total unsaturated volume available is 2554.87MCM and it ranges from 27.34 MCM in Kumbher block to 601.36 MCM in Bayana block.

However, adequate surplus surface water is not available to recharge this volume. The basin wise and watershed wise surplus surface water availability at 75% dependability level was obtained from the Water Resources Department of Govt. of Rajasthan for calculation of surplus surface water. The available surplus runoff can be utilised for artificial recharge through construction of recharge shafts in existing ponds and Percolation tanks at suitable location. The number of Recharge Shaft is decided based on the number of suitable ponds available within the zone. If still some surplus remaines unallocated, than few Percolation tanks are proposed at suitable locations. Thus, the entire surplus available cannot be utilised in some areas where suitable ponds for recharge shaft of suitable locations for percolation tanks are not available. Besides, the areas with shallow water levels (less than 5 m bgl) are also to be excluded.

After taking into consideration all the factors, the surplus of 26.129 MCM has been calculated for Bharatpur district which can be utilised for recharge. The usage of this surplus in various types of recharge structures is given in Table14. By taking surplus of 0.035 MCM for each recharge shaft, 297 no. of recharge shafts can be constructed in existing ponds and by taking 0.2 MCM for each percolation tank, 4 no. of percolation tanks can be constructed in the district after allocation of surplus water for recharge shafts. By considering 80% of the total recharge as

effective recharge, these structures would lead to about 9.452 MCM/year effective recharge. The tentative location of these structures along with map are given in Part B.

Table14: Recharge Structures Proposed, Bharatpur District

Block	Usable Surplus Water (MCM)	Recharge Shafts proposed	Percolation Tanks Proposed	Recharge from Recharge Shaft (MCM)	Recharge from Percolation Tanks (MCM)	Total Recharge (MCM)
Bayana	3.788	73	4	2.044	0.64	2.684
Deeg	4.648	41	0	1.148	0	1.148
Kaman	7.523	80	0	2.232	0	2.232
Kumher	1.087	23	0	0.644	0	0.644
Nadbai	1.779	30	0	0.84	0	0.84
Nagar Pahadi	4.199	15	0	0.42	0	0.42
Rupwas	1.575	25	0	0.70	0	0.70
Sewar	0.306	8	0	0.224	0	0.224
Weir	1.224	2	0	0.56	0	0.56
Total	26.129	297	4	8.812	0.64	9.452

6.2 Demand Side Management

Since there is least feasibility of supply side management through artificial recharge to ground water, applying the techniques of demand side management can save large amount of water. Demand side management has been proposed through two interventions – changing the more water intensive wheat crop to gram (chick pea) and use of sprinkler irrigation in the areas where rabi crop is being irrigated through ground water.

6.2.1 Change in cropping pattern

In view of the alarming decline of water level, drastic reduction in saturated thickness of aquifer and resulting of depletion of aquifer, there is need to bring paradigm change/shift in cropping pattern in the area. It is proposed to grow low water requirement crop like gram in the instead of wheat. Growing of gram will save the water to the tune of about 59.54 mcm per annum @ 0.1m (Table15) and will not affect the economy of farmer (Table 16).

Table 15: Block-wise water saving through change in cropping pattern and irrigation practice, Bharatpur district

Block	Irrigated Area (ha)	Irrigated Area (ha) proposed for irrigation through sprinkler	Total cost (Rs in cr)	Water Saving by sprinkler in mcm @0.08 m	Irrigated area(ha) under wheat proposed for gram cultivation	Water Saving by change in cropping pattern in mcm @0.1 m	Total water saving(mcm)
Kaman	32738	16369	81.84	13.10	9168	9.17	22.27
Nagar	40596	20298	101.49	16.24	8702	8.70	24.94

Block	Irrigated Area (ha)	Irrigated Area (ha) proposed for irrigation through sprinkler	Total cost (Rs in cr)	Water Saving by sprinkler in mcm @0.08 m	Irrigated area(ha) under wheat proposed for gram cultivation	Water Saving by change in cropping pattern in mcm @0.1 m	Total water saving(mcm)
Deeg	27598	13799	68.99	11.04	5231	5.23	16.27
Nadbai	38927	19464	97.32	15.57	5171	5.17	20.74
Kumher	27053	13527	67.63	10.82	5403	5.40	16.22
Sewar	36290	18145	90.72	14.52	7823	7.82	22.34
Weir	41200	20600	103	16.48	5526	5.53	22.01
Bayana	33109	16555	82.77	13.24	6145	6.15	19.39
Roopbas	34601	17301	86.50	13.84	6361	6.36	20.20
Total	312112	156056	780.26	124.84	59530	59.54	184.38

Source: District Statistics Outline, Department of Economics and Statistics, Bharatpur, Govt. of Rajasthan (2011-12)

Table16: Summary of Economic Statistics of Growing of Gram instead of Wheat

Irrigated Area (ha)	Irrigated Area (ha) under wheat proposed for Gram cultivation	Production of wheat (ton)/ha	Production of gram (ton)/ha	Unit cost (Rs) of wheat /ton	Unit cost (Rs) of gram /ton	Market value (Rs) of wheat (ton)/ha	Market value (Rs) of gram (ton)/ha
315446	59530	5	1.5	16000	53000	80000	79500

6.2.2 Adoption of modern practice of sprinkler irrigation/improved irrigation practices

Data indicate that flooding method of irrigation is still in practice in many parts of the district which causes wastage of ample quantity of water. In view of this, it is proposed to bring about 50% of total irrigated area under sprinkler irrigation which may save water to the tune of about 124.84mcm/annum @0.08m (Table 15). Total cost of sprinkler sets has been computed as Rs. 780 crore @50,000/hectare.

7. Expected Benefit of Management Strategies

Considerable saving of ground water can be achieved if the proposed supply side and demand side management plans are implemented. There is no supply side management in view of non feasibility.

With the proposed use of sprinkler irrigation in the areas where rabi crop is being irrigated through ground water it is expected that 124.84mcm/year can be saved due to reduction in pumping and with changing the wheat crop to gram (chick pea) and additional 59.54 mcm/year can be saved due to reduction of pumping. With implementation of these two interventions, a total of 184.38mcm/year can be saved. This may lead to a total reduction in ground water draft from 542.84 MCM/year to 358.46MCM/Year and with this, the stage of ground water

development may come down from 118.80% to 72.39%. These interventions may progressively lead to further improvement in ground water situation over the years.

Enhancement of ground water resources through artificial recharge, improved irrigation practices and change in cropping pattern is abridged below as under.

- **Sprinkler**
    - Area proposed under irrigation by sprinkler – 1560.56 sq km (50% of gross irrigated area)
    - Net Water saving - 124.84(20% of crop water requirement)
    - Total cost for sprinklers – Rs 780 crore @Rs 50,000 per hectare
    - Change in cropping pattern
    - From wheat to gram in 595.30 sq km irrigated area
    - Net water saving - 59.54 MCM
- **Total water saving : 184.38 MCM**
- **Total Cost / Outlay: Rs. 780 Crores**

Block wise details of ground water recharged and saved along with expected improvement in stage of ground water development is given in Table 17.

Table17: Summary of Expected Benefit of Management Strategies, Bharatpur district

Block	Net G.W. Availability (mcm)	Additional Recharge from RWH & conservation (mcm)	Total Net G.W. Availability after intervention (mcm)	Existing G.W Draft for all purpose (mcm)	Saving of Ground water through projects (mcm)	Net GW draft after interventions (mcm)	Present stage of G.W. development (%)	Projected stage of G.W. Dev. (in %)
Kaman	64.7251	2.684	67.4091	65.51	22.27	43.24	101.20	64.15
Nagar	47.9076	1.148	49.0556	46.86	24.94	21.92	97.82	44.68
Deeg	41.9967	2.232	44.2287	41.10	16.27	24.83	97.87	56.14
Nadbai	39.4857	0.644	40.1297	70.85	20.74	50.11	179.40	124.87
Kumher	16.3747	0.84	17.2147	18.21	16.22	1.99	111.20	11.56
Sewar	40.8469	0.42	41.2669	56.32	22.34	33.98	137.90	82.34
Weir	55.7235	0.70	56.4235	80.67	22.01	58.66	144.80	103.96
Bayana	83.2493	0.224	83.4733	89.25	19.39	69.86	107.20	83.69
Roopbas	66.6956	0.56	67.2556	74.07	20.20	53.87	111.10	80.10
Total	457.0051	9.452	466.4571	542.84	184.38	358.46	118.80	72.39

The perusal of data indicate that saving of ground water through projects may lead to decrease in the net ground water draft and may reduce the stage of ground water development from 118.80% to 72.39% after interventions.

PART B

Block Wise Aquifer Management Plans Of Bharatpur District

1. Aquifer Management Plan of Block -Bayana, District-Bharatpur

Salient Information	**Block**	**Bayana**
	Geographical Area (km2)	808.69
	Hilly Area (Sq.km)	132.38
	Saline Area (Sq.km)	0
	Potential Area (Sq.km)	676.31
Climate & Rainfall	Climate	Semi Arid
	Average Rainfall (1971-2014)	664.4
Ground Water Issues	Aquifer Characteristics	Adequate space for groundwater recharge
	Main Aquifers in the area	Occupied by Alluvium(75%) and Hard(25%) formations
Aquifer System	Aquifer Disposition	Alluvium followed by hard rocks and hard formation of Sandstone
	Geology	Quaternary alluvium and Vindhyan Sandstone
	Maximum Depth of Aquifer in meter	87.06(Soft Rock) 87.12(Hard Rock)
	Type of Aquifer	Unconfined and confined
	Thickness of Aquifer (Utilisable)	13.06(Soft Rock) 8.71(Hard Rock)
	Hydraulic Characters (sp.yield%)	12
Water Level Behaviour, DTW (m)	Depth to Water Level (m BGL)	8.45 – 24.50
	Trend (m/yr)	0.15(pre-monsoon) and 0.02 (post-monsoon)
Ground Water Quality	General	Potable in major part and brackish to saline in remaining north eastern part
	Electrical Conductivity in ms/cm (Min/Max)	540-7020

Salient Information	Block	Bayana
	Chloride in mg/ litre (Min/Max)	35.50-1562
	Nitrate in mg/litre (Min/Max)	3-140
	Fluoride in mg/litre (Min/Max)	0.25-0.68
Groundwater Resources	Total annual ground water recharge(mcm)	91.8904
	Natural discharge during non-monsoon season(mcm)	8.6411
	Net ground water availability(mcm)	83.2493
	Existing gross ground water draft for irrigation(mcm)	81.2424
	Existing gross ground water draft for domestic & industrial uses(mcm)	8.0077
	Existing gross ground water draft for all uses(mcm)	89.2501
	Allocation for domestic & industrial requirement(mcm)	11.1400
	Net ground water availability for future irrigation development(mcm)	6.2939
	State of ground water development	107.21
	Category	OE
Supply Side Management	Space Available for Recharge (mcm)	582.83
	Area of Block (Sq.km.)	808.69
	Potential area suitable for recharge (Sq.km.)	676.31
	Type of Aquifer	Alluvium and unconfined
	Area feasible for artificial recharge (Sq km)	509.11(Soft Rock) 167.2(Hard Rock)
	Sp Yield(%)	0.12(Soft Rock) 0.02(Hard Rock)
	Average DTW (m bgl)	12.54(Soft Rock) 8.54(Hard Rock)
	Thickness of unsaturated zone 3 m below ground level (m)	9.54(Soft Rock) 5.54(Hard Rock)
	Volume of sub surface storage space available for artificial recharge (MCM)	582.83(Soft Rock) 18.53(Hard Rock)
	Surplus Runoff Availability(MCM)	----------
	Surplus available (MCM)	3.788
	Surplus available in zone as per the water level (in Mm3)	---------
	Recharge Shafts Proposed in existing water bodies	73
	Percolation Tanks Proposed	4
Demand side Management	Use of Advanced Irrigation Practices to be promoted	
	(i)Use of Sprinklers	

Salient Information	**Block**	**Bayana**
	Total Irrigated Area (ha)	32738
	Irrigated Area (ha) proposed for irrigation through sprinkler	16369(50% of total irrigated area)
	Water Saving by Use of Sprinklers	13.10
	(ii)Change in Cropping pattern	
	Irrigated Area under wheat (ha)	12290
	Irrigated Area (ha) under wheat proposed for Gram cultivation	6145
	Water Saving by change in cropping pattern	6.15
Expected Benefits	Net G.W. Availability (MCM)	83.2493
	Additional Recharge from RWH & water conservation (MCM)	0.224
	Total Net G.W. Availability after intervention (MCM)	83.4733
	Existing G.W Draft for all purpose (MCM)	89.25
	Saving of Ground water through demand side interve ntion (MCM)	19.39
	Net GW draft after interventions (MCM)	69.86
	Present stage of G.W. development (in %)	107.20
	Expected stage of G.W. Development after intervention (%)	83.69
Other Interventions proposed, if any	Alternate water Sources available	Nil
	Regulation and Control measures to be implemented	To be notified

Tentative locations of village for village pond with recharge shaft, Block Bayana, District Bharatpur

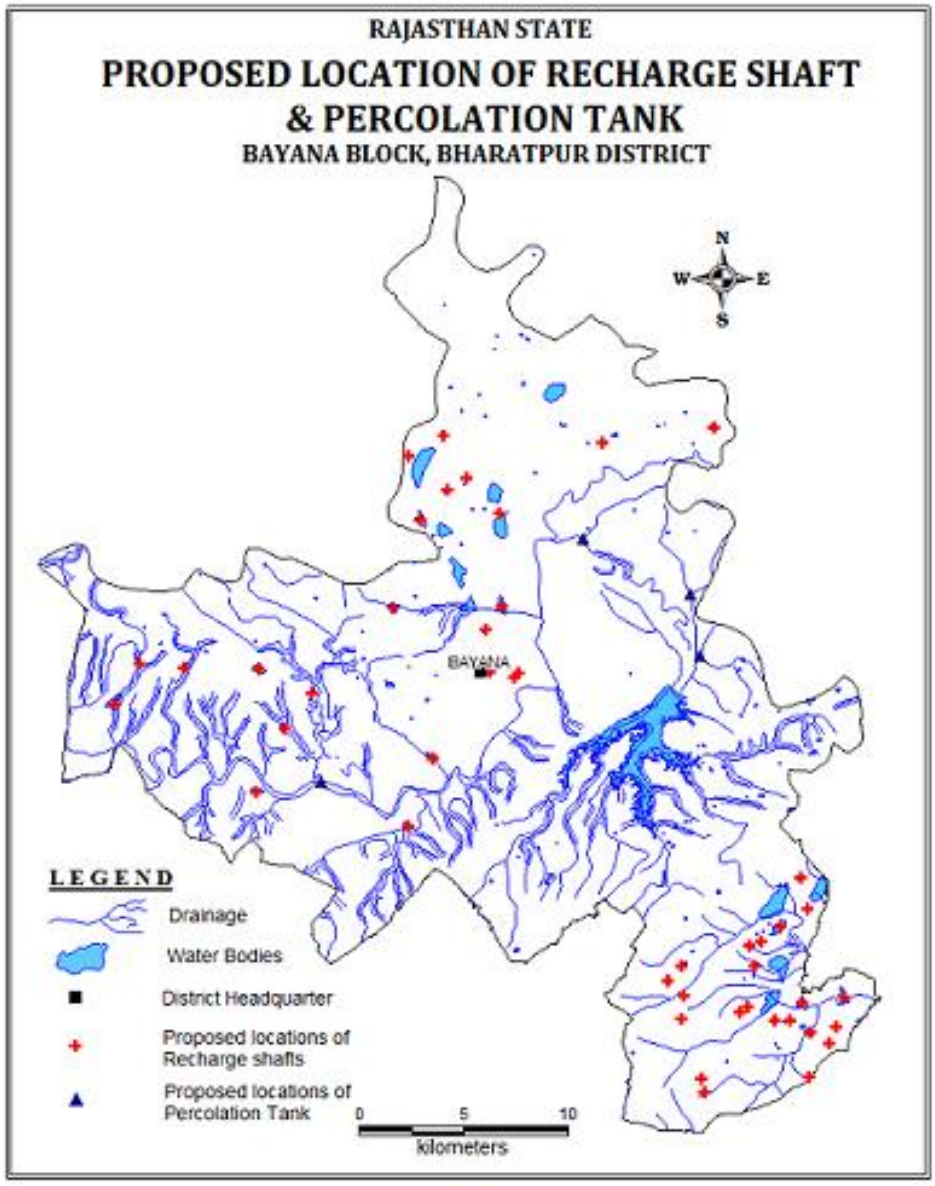
S.No.	Village	Long	Lat	Watershed	No of Shafts	Unit cost (Rs in lac)	Total cost (Rs in lac)
1	Khatnawali	77.261	27.007	Gambhir_Gambhir_004_RJ0601_AL	1	5.0	5.0
2	Nayagaon Kalan	77.244	26.999	Gambhir_Gambhir_004_RJ0601_AL	1	5.0	5.0
3	Dehgawan	77.272	26.989	Gambhir_Gambhir_004_RJ0601_AL	1	5.0	5.0
4	Agawali	77.337	27.004	Gambhir_Gambhir_004_RJ0601_AL	1	5.0	5.0
5	Milakpur	77.391	27.011	Gambhir_Gambhir_004_RJ0601_AL	1	5.0	5.0
6	Bayana (M)	77.281	26.924	Gambhir_Gambhir_006_RJ0601_AL	1	5.0	5.0
7	Bayana (M)	77.283	26.906	Gambhir_Gambhir_006_RJ0601_AL	1	5.0	5.0
8	Bayana (M)	77.297	26.905	Gambhir_Gambhir_006_RJ0601_AL	1	5.0	5.0
9	Bayana (M)	77.295	26.903	Gambhir_Gambhir_006_RJ0601_AL	1	5.0	5.0
10	Nagla Chheetariya	77.287	26.974	Gambhir_Gambhir_006_RJ0601_AL	1	5.0	5.0
11	Bhagori	77.263	26.984	Gambhir_Gambhir_006_RJ0601_AL	2	5.0	10.0
12	Sikandara	77.255	26.868	Gambhir_Gambhir_006_RJ0601_AL	2	5.0	10.0
13	Mahloni	77.236	26.933	Gambhir_Gambhir_006_RJ0601_AL	3	5.0	15.0
14	Dhurairi	77.243	26.839	Gambhir_Gambhir_006_RJ0601_AL	3	5.0	15.0
15	Bhagori	77.250	26.971	Gambhir_Gambhir_006_RJ0601_AL	4	5.0	20.0
16	Bayana (M)	77.289	26.934	Gambhir_Gambhir_006_RJ0601_AL	4	5.0	20.0
17	Kair	77.114	26.909	Gambhir_Gambhir_007_RJ0601_AL	1	5.0	5.0
18	Khan Khera	77.136	26.907	Gambhir_Gambhir_007_RJ0601_AL	1	5.0	5.0
19	Bagren	77.197	26.896	Gambhir_Gambhir_007_RJ0601_AL	1	5.0	5.0
20	Mahrawar	77.184	26.881	Gambhir_Gambhir_007_RJ0601_AL	1	5.0	5.0
21	Madanpur	77.170	26.854	Gambhir_Gambhir_007_RJ0601_AL	3	5.0	15.0
22	Bagren	77.172	26.907	Gambhir_Gambhir_007_RJ0601_AL	4	5.0	20.0
23	Bhaja Moroli	77.102	26.892	Gambhir_Gambhir_007_RJ0601_AL	4	5.0	20.0
24	Kot	77.376	26.779	Gambhir_Gambhir_011_RJ0601_SR	1	5.0	5.0
25	Kot	77.369	26.772	Gambhir_Gambhir_011_RJ0601_SR	1	5.0	5.0
26	Kot	77.377	26.766	Gambhir_Gambhir_011_RJ0601_SR	1	5.0	5.0
27	Kot	77.376	26.756	Gambhir_Gambhir_011_RJ0601_SR	1	5.0	5.0
28	Jaisora	77.404	26.758	Gambhir_Gambhir_011_RJ0601_SR	1	5.0	5.0
29	Jaisora	77.408	26.761	Gambhir_Gambhir_011_RJ0601_SR	1	5.0	5.0
30	Kani	77.411	26.779	Gambhir_Gambhir_011_RJ0601_SR	1	5.0	5.0
31	Baisora	77.421	26.755	Gambhir_Gambhir_011_RJ0601_SR	1	5.0	5.0
32	Baisora	77.428	26.755	Gambhir_Gambhir_011_RJ0601_SR	1	5.0	5.0
33	Samantgarh	77.450	26.752	Gambhir_Gambhir_011_RJ0601_SR	1	5.0	5.0
34	Chak Samantgarh	77.447	26.745	Gambhir_Gambhir_011_RJ0601_SR	1	5.0	5.0
35	Baisora	77.437	26.731	Gambhir_Gambhir_011_RJ0601_SR	1	5.0	5.0
36	Singhrawali	77.386	26.730	Gambhir_Gambhir_011_RJ0601_SR	1	5.0	5.0

37	Singhrawali	77.387	26.724	Gambhir_Gambhir_011_RJ0601_SR	1	5.0	5.0
38	Bajna	77.433	26.817	Gambhir_Gambhir_011_RJ0601_SR	1	5.0	5.0
39	Bajna	77.436	26.803	Gambhir_Gambhir_011_RJ0601_SR	1	5.0	5.0
40	Kani	77.415	26.789	Gambhir_Gambhir_011_RJ0601_SR	1	5.0	5.0
41	Kani	77.408	26.787	Gambhir_Gambhir_011_RJ0601_SR	1	5.0	5.0
42	Kani	77.423	26.795	Gambhir_Gambhir_011_RJ0601_SR	3	5.0	15.0
43	Samantgarh	77.434	26.763	Gambhir_Gambhir_011_RJ0601_SR	3	5.0	15.0
44	Baisora	77.438	26.750	Gambhir_Gambhir_011_RJ0601_SR	3	5.0	15.0
45	Samantgarh	77.454	26.765	Gambhir_Gambhir_011_RJ0601_SR	3	5.0	15.0
				Total	**73**		**365**

Tentative locations of village for Percolation Tanks, Block Bayana, District Bharatpur

S. No.	Village	Longitude	Latitude	Micro Watershed	Unit Cost (Rs. In lacs)
1	Soopa	77.380	26.939	Gambhir_Gambhir_004_RJ0601_AL	40
2	Purabai Khera	77.328	26.963	Gambhir_Gambhir_004_RJ0601_AL	40
3	Mahmadpura	77.385	26.912	Gambhir_Gambhir_004_RJ0601_AL	40
4	Peeloopura	77.202	26.858	Gambhir_Gambhir_007_RJ0601_AL	40
				Total	**160**

Tentative location of Recharge Shaft and Percolation Tank, Block Bayana, District Bharatpur



2. Aquifer Management Plan of Block -Deeg, District-Bharatpur

Salient Information	**Block**	**Deeg**
	Geographical Area (km2)	492.85
	Hilly Area (Sq.km)	153.94
	Saline Area (Sq.km)	131.91
	Potential Area (Sq.km)	338.91
Climate & Rainfall	Climate	Semi-arid
	Average Rainfall (mm) (1971-2014)	576.5
Ground Water Issues	Aquifer Characteristics	Adequate space for groundwater recharge
	Main Aquifers in the area	Occupied by Alluvial formations(100%)
Aquifer System	Aquifer Disposition	Alluvium
	Geology	Quaternary alluvium underlain by Vindhyan Sandstone
	Maximum Depth of Aquifer in meter	90.01
	Type of Aquifer	Unconfined and confined
	Thickness of Aquifer (Utilisable)	18
	Hydraulic Characters (Sp.Yield %)	0.10
Water Level Behaviour, DTW (m)	Depth to Water Level (m BGL)	4.10-14.13
	Trend (m/yr)(2001-12)	0.27(pre-monsoon) and 0.20 (post-monsoon)
Ground Water Quality	General	Saline to brackish in major part except isolated pocket around Deeg with EC 1500 to 3000ms/cm at 25^0C.
	Electrical Conductivity in microS/cm (Min/Max)	5350-12050
	Chloride in mg/ litre (Min/Max)	894.6-4020
	Nitrate in mg/litre (Min/Max)	3-26
	Fluoride in mg/litre (Min/Max)	0.05-2.65
Groundwater Resources	Total annual ground water recharge(mcm)	46.6630

Salient Information	Block	Deeg
	Natural discharge during non-monsoon season(mcm)	4.6663
	Net ground water availability(mcm)	41.9967
	Existing gross ground water draft for irrigation(mcm)	36.2772
	Existing gross ground water draft for domestic & industrial uses(mcm)	4.8231
	Existing gross ground water draft for all uses(mcm)	41.1003
	Allocation for domestic & industrial requirement(mcm)	10.9600
	Net ground water availability for future irrigation development(mcm)	0.0000
	State of ground water development	97.87
	Category	Critical
Supply Side Management	Space Available for Recharge (mcm)	175.56
	Area of Block (Sq.km.)	492.85
	Potential area suitable for recharge (Sq.km.)	338.91
	Type of Aquifer	Quaternary alluvium
	Area feasible for artificial recharge (Sq km)	338.91
	Sp. Yield(%)	0.10
	Average DTW (m bgl)	8.18
	Thickness of unsaturated zone 3 m below ground level (m)	5.54
	Volume of sub surface storage space available for artificial recharge (MCM)	175.56
	Surplus Runoff Availability	---
	Surplus available (MCM)	4.648
	Surplus available in zone as per the water level (in Mm3)	---
	Recharge Shafts Proposed in existing water bodies	41
	Percolation Tanks Proposed	0
Demand side Management	Use of Advanced Irrigation Practices to be promoted	
	(i)Use of Sprinklers	

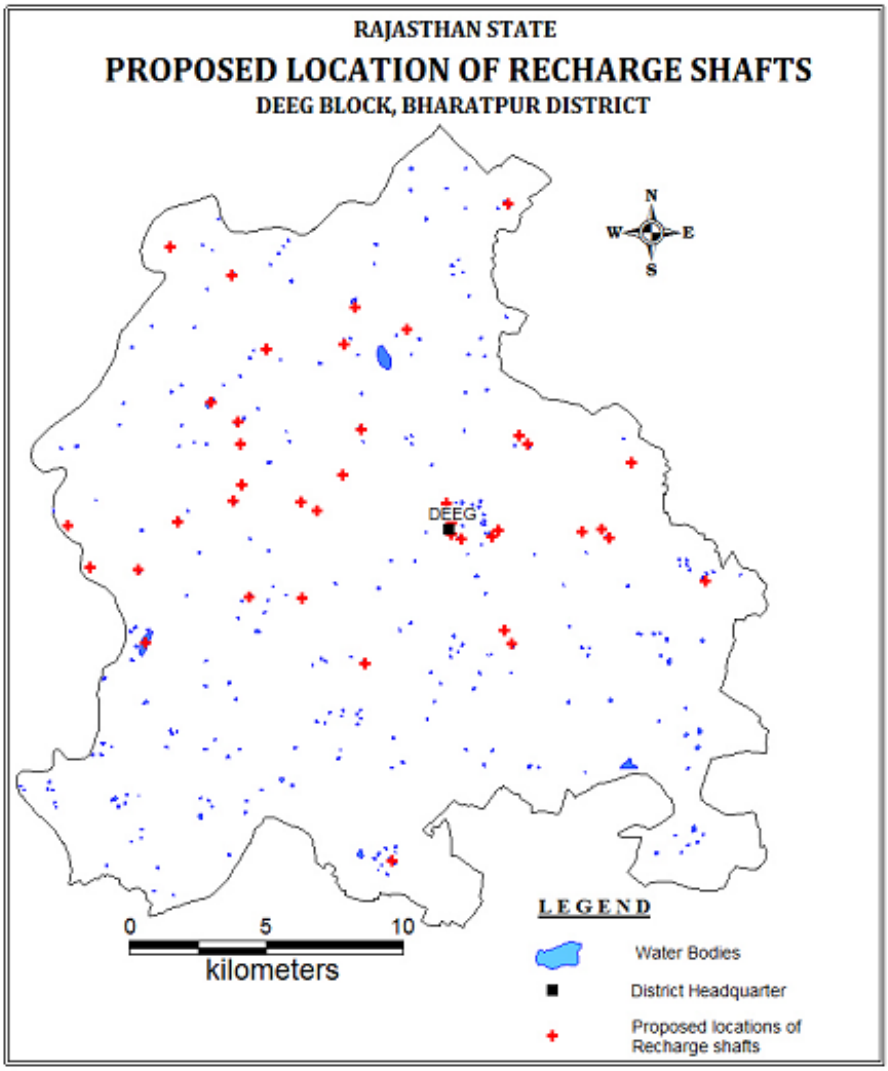
Salient Information	Block	Deeg
	Total Irrigated Area (ha)	27598
	Irrigated Area (ha) proposed for irrigation through sprinkler	13799
	Water Saving by Use of Sprinklers	
	(ii)Change in Cropping pattern	
	Irrigated Area under wheat (ha)	10462
	Irrigated Area (ha) under wheat proposed for Gram cultivation	5231
	Water Saving by change in cropping pattern	5.23
Expected Benefits	Net G.W. Availability (MCM)	41.9967
	Additional Recharge from RWH & water conservation (MCM)	2.232
	Total Net G.W. Availability after intervention (MCM)	44.2287
	Existing G.W Draft for all purpose (MCM)	41.10
	Saving of Ground water through demand side interven tion (MCM)	16.27
	Net GW draft after interventions (MCM)	24.83
	Present stage of G.W. development (in %)	97.87
	Expected stage of G.W. Dev.after intervention (%)	56.14
Other Interventions proposed, if any	Alternate water Sources available	Nil
	Regulation and Control measures to be implemented	To be notified

Tentative locations of village for village pond with recharge shaft, Block Deeg, District Bharatpur

S.No.	Village	Long	Lat	Watershed	No of Shafts	Unit cost (Rs in lac)	Total cost (Rs in lac)
1	Bedham	77.209	27.437	Banganga_Banganga_003_RJ0602_AL	1	5	5
2	Sinsini	77.300	27.365	Banganga_Banganga_008_RJ0602_AL	1	5	5
3	Chulera	77.241	27.558	Ruparail_Ruparail_006_RJ0602_AL	1	5	5
4	Khoh	77.254	27.533	Ruparail_Ruparail_006_RJ0602_AL	1	5	5
5	Guhana	77.283	27.535	Ruparail_Ruparail_006_RJ0602_AL	1	5	5
6	Nagla Khoh	77.243	27.509	Ruparail_Ruparail_006_RJ0602_AL	1	5	5
7	Nagla Khoh	77.245	27.502	Ruparail_Ruparail_006_RJ0602_AL	1	5	5
8	Nigohi	77.245	27.489	Ruparail_Ruparail_006_RJ0602_AL	1	5	5
9	Nigohi	77.242	27.483	Ruparail_Ruparail_006_RJ0602_AL	1	5	5
10	Barai	77.267	27.483	Ruparail_Ruparail_006_RJ0602_AL	1	5	5
11	Barai	77.273	27.480	Ruparail_Ruparail_006_RJ0602_AL	1	5	5
12	Barai	77.283	27.492	Ruparail_Ruparail_006_RJ0602_AL	1	5	5
13	Adhawali	77.221	27.477	Ruparail_Ruparail_006_RJ0602_AL	1	5	5
14	Kakra	77.207	27.461	Ruparail_Ruparail_006_RJ0602_AL	1	5	5
15	Kakra	77.189	27.462	Ruparail_Ruparail_006_RJ0602_AL	1	5	5
16	Hingota	77.181	27.475	Ruparail_Ruparail_006_RJ0602_AL	1	5	5
17	Panhori	77.248	27.452	Ruparail_Ruparail_006_RJ0602_AL	1	5	5
18	Panhori	77.267	27.451	Ruparail_Ruparail_006_RJ0602_AL	1	5	5
19	Kheriya Goojar	77.289	27.507	Ruparail_Ruparail_006_RJ0602_AL	1	5	5
20	Deeg (M)	77.321	27.482	Ruparail_Ruparail_006_RJ0602_AL	1	5	5
21	Deeg (M)	77.326	27.471	Ruparail_Ruparail_006_RJ0602_AL	1	5	5
22	Deeg (M)	77.322	27.472	Ruparail_Ruparail_006_RJ0602_AL	1	5	5
23	Deeg (M)	77.322	27.476	Ruparail_Ruparail_006_RJ0602_AL	1	5	5
24	Deeg (M)	77.338	27.472	Ruparail_Ruparail_006_RJ0602_AL	1	5	5
25	Deeg (M)	77.340	27.474	Ruparail_Ruparail_006_RJ0602_AL	1	5	5
26	Nagla Khoh	77.233	27.516	Ruparail_Ruparail_006_RJ0602_AL	2	5	10
27	Pasopa	77.219	27.567	Ruparail_Ruparail_009_RJ0602_AL	1	5	5
28	Narena Chauth	77.344	27.581	Ruparail_Ruparail_011_RJ0602_AL	1	5	5
29	Badri	77.287	27.547	Ruparail_Ruparail_011_RJ0602_AL	1	5	5
30	Paramdara	77.306	27.540	Ruparail_Ruparail_011_RJ0602_AL	1	5	5
31	Chomeda	77.351	27.502	Ruparail_Ruparail_011_RJ0602_AL	1	5	5
32	Iklahra	77.348	27.505	Ruparail_Ruparail_011_RJ0602_AL	1	5	5

33	Bahaj	77.371	27.473	Ruparail_Ruparail_011_RJ0602_AL	1	5	5
34	Bahaj	77.378	27.474	Ruparail_Ruparail_011_RJ0602_AL	1	5	5
35	Bahaj	77.381	27.471	Ruparail_Ruparail_011_RJ0602_AL	1	5	5
36	Au	77.342	27.441	Ruparail_Ruparail_011_RJ0602_AL	1	5	5
37	Au	77.345	27.436	Ruparail_Ruparail_011_RJ0602_AL	1	5	5
38	Khohri	77.291	27.430	Ruparail_Ruparail_011_RJ0602_AL	1	5	5
39	Nagla Khaman	77.389	27.496	Ruparail_Ruparail_011_RJ0602_AL	1	5	5
40	Shyamdhak	77.417	27.457	Ruparail_Ruparail_011_RJ0602_AL	1	5	5
				Total	**41**		**205**

Tentative location of Recharge Shaft, Block Deeg, District Bharatpur



3. Aquifer Management Plan of Block - Kaman, District-Bharatpur

Salient Information	**Block**	**Kaman**
	Geographical Area (km2)	562.49
	Hilly Area (Sq.km)	69.92
	Saline Area (Sq.km)	0
	Potential Area (Sq.km)	492.93
Climate & Rainfall	Climate	Sem-arid
	Average Rainfall (mm)1971-2014)	639.7
Ground Water Issues	Aquifer Characteristics	Adequate space for groundwater recharge
	Main Aquifers in the area	Occupied by Alluvial formations(100%)
Aquifer System	Aquifer Disposition	Alluvium
	Geology	Quaternary alluvium underlain by bed rock of Delhi Super Group
	Maximum Depth of Aquifer in meter	91.05
	Type of Aquifer	Unconfined and confined
	Thickness of Aquifer (Utilisable)	18.21
	Hydraulic Characters (Sp.Yield%)	0.10
Water Level Behaviour, DTW (m)	Depth to Water Level (m BGL)	10.67-12.33
	Trend (m/yr)	0.20 (pre-monsoon) and 0.13(post-monsoon)
Ground Water Quality	General	Brackish in major part with saline in south western part
	Electrical Conductivity in microS/cm (Min/Max)	1820-3180
	Chloride in mg/ litre (Min/Max)	210-660.3
	Nitrate in mg/litre (Min/Max)	13-32
	Fluoride in mg/litre (Min/Max)	0.75-5.8
Groundwater Resources	Total annual ground water recharge(mcm)	71.9168
	Natural discharge during non-monsoon season(mcm)	7.1917

Salient Information	Block	Kaman
	Net ground water availability(mcm)	64.7251
	Existing gross ground water draft for irrigation(mcm)	59.8059
	Existing gross ground water draft for domestic & industrial uses(mcm)	5.7002
	Existing gross ground water draft for all uses(mcm)	65.5061
	Allocation for domestic & industrial requirement(mcm)	11.5300
	Net ground water availability for future irrigation development(mcm)	0.0000
	State of ground water development	101.21
	Category	Over exploited
Supply Side Management	Space Available for Recharge (mcm)	253.37
	Area of Block (Sq.km.)	562.49
	Potential area suitable for recharge (Sq.km.)	492.93
	Type of Aquifer	Quaternary alluvium
	Area feasible for artificial recharge (Sq km)	492.93
	Sp Yield(%)	0.10
	Average DTW (m bgl)	8.14
	Thickness of unsaturated zone 3 m below ground level (m)	5.14
	Volume of sub surface storage space available for artificial recharge (MCM)	253.37
	Surplus Runoff Availability	--------
	Surplus available (MCM)	7.523
	Surplus available in zone as per the water level (in Mm3)	----------
	Recharge Shafts Proposed in existing water bodies	80
	Percolation Tanks Proposed	0
Demand side Management	Use of Advanced Irrigation Practices to be promoted	
	(i)Use of Sprinklers	
	Total Irrigated Area (ha)	32738

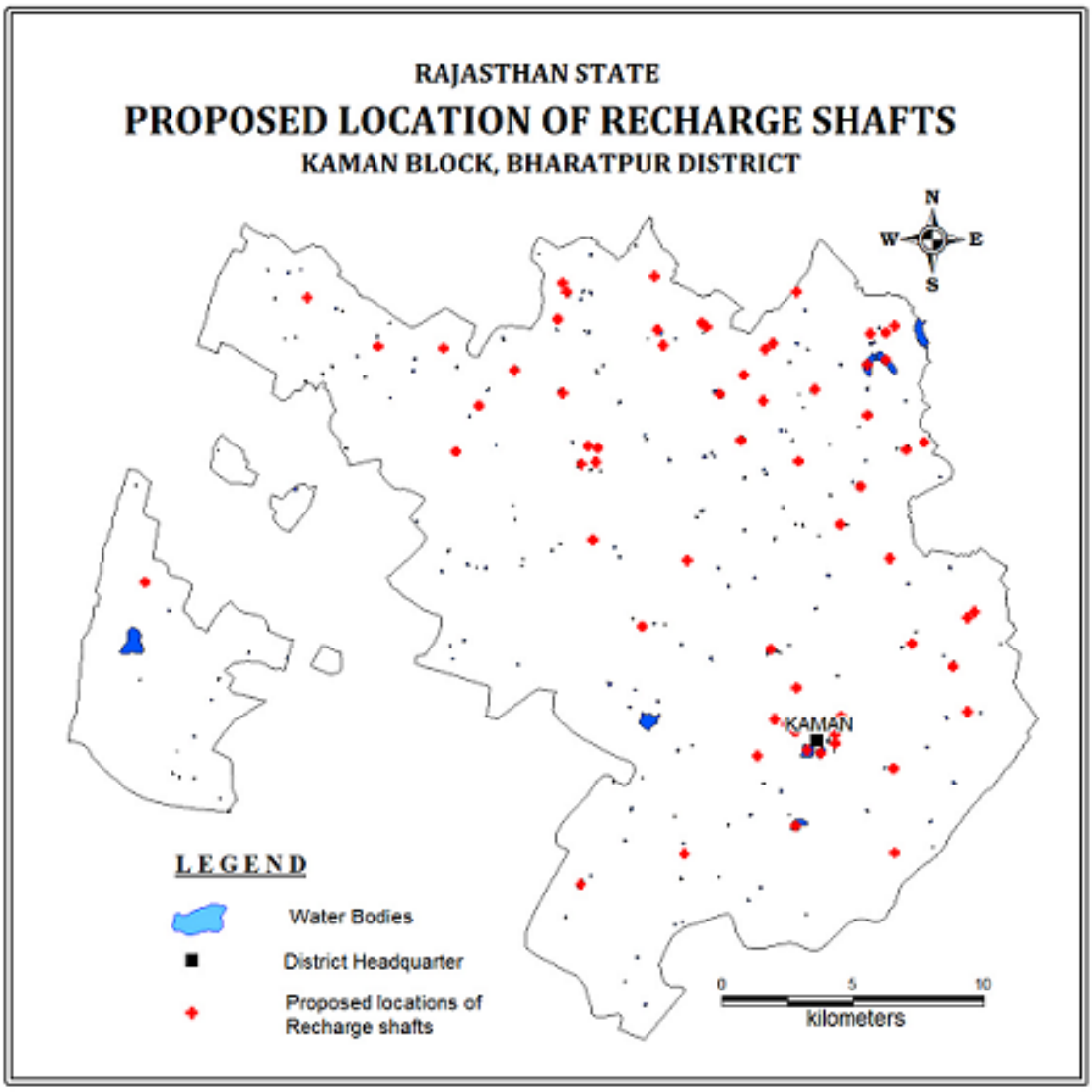
Salient Information	Block	Kaman
	Irrigated Area (ha) proposed for irrigation through sprinkler	16369
	Water Saving by Use of Sprinklers	
	(ii)Change in Cropping pattern	
	Irrigated Area under wheat (ha)	18336
	Irrigated Area (ha) under wheat proposed for Gram cultivation	9168
	Water Saving by change in cropping pattern	9.17
Expected Benefits	Net G.W. Availability (MCM)	64.7251
	Additional Recharge from RWH & water conservation (MCM)	2.684
	Total Net G.W. Availability after intervention (MCM)	67.4091
	Existing G.W Draft for all purpose (MCM)	65.51
	Saving of Ground water through demand side interven tion (MCM)	22.27
	Net GW draft after interventions (MCM)	43.24
	Present stage of G.W. development (in %)	101.20
	Expected stage of G.W. Dev.after intervention (%)	64.15
Other Interventions proposed, if any	Alternate water Sources available	Nil
	Regulation and Control measures to be implemented	To be notified

Tentative locations of village for village pond with recharge shaft, Block Kaman, District Bharatpur

S.No.	Village	Long	Lat	Watershed	No of Shafts	Unit cost (Rs in lac)	Total cost (Rs in lac)
1	Bas Laddooka	77.217	27.604	Ruparail_Ruparail_009_RJ0603_AL	1	5	5
2	Bas Karmooka	77.245	27.638	Ruparail_Ruparail_009_RJ0603_AL	1	5	5
3	Kaman (M)	77.260	27.646	Ruparail_Ruparail_009_RJ0603_AL	1	5	5
4	Kaman (M)	77.252	27.650	Ruparail_Ruparail_009_RJ0603_AL	1	5	5
5	Kaman (M)	77.261	27.661	Ruparail_Ruparail_009_RJ0603_AL	1	5	5
6	Kaman (M)	77.278	27.652	Ruparail_Ruparail_009_RJ0603_AL	1	5	5
7	Kaman (M)	77.276	27.645	Ruparail_Ruparail_009_RJ0603_AL	1	5	5
8	Kaman (M)	77.276	27.642	Ruparail_Ruparail_009_RJ0603_AL	1	5	5
9	Kanwara	77.298	27.634	Ruparail_Ruparail_009_RJ0603_AL	1	5	5
10	Dhana	77.327	27.653	Ruparail_Ruparail_009_RJ0603_AL	1	5	5
11	Ghata	77.299	27.605	Ruparail_Ruparail_009_RJ0603_AL	1	5	5
12	Udaka	77.305	27.677	Ruparail_Ruparail_009_RJ0603_AL	1	5	5
13	Dhilawati	77.327	27.686	Ruparail_Ruparail_009_RJ0603_AL	1	5	5
14	Dhilawati	77.329	27.688	Ruparail_Ruparail_009_RJ0603_AL	1	5	5
15	Akata	77.321	27.669	Ruparail_Ruparail_009_RJ0603_AL	1	5	5
16	Unchera	77.261	27.739	Ruparail_Ruparail_009_RJ0603_AL	1	5	5
17	Anchwara	77.286	27.731	Ruparail_Ruparail_009_RJ0603_AL	1	5	5
18	Satwas	77.277	27.717	Ruparail_Ruparail_009_RJ0603_AL	1	5	5
19	Palri	77.297	27.706	Ruparail_Ruparail_009_RJ0603_AL	1	5	5
20	Saumka	77.182	27.712	Ruparail_Ruparail_009_RJ0603_AL	1	5	5
21	Undhan	77.218	27.705	Ruparail_Ruparail_009_RJ0603_AL	1	5	5
22	Nagla Mukariv	77.201	27.683	Ruparail_Ruparail_009_RJ0603_AL	1	5	5
23	Thalchana	77.137	27.758	Ruparail_Ruparail_009_RJ0603_AL	1	5	5
24	Bamanwari	77.170	27.763	Ruparail_Ruparail_009_RJ0603_AL	1	5	5
25	Kathaul	77.128	27.743	Ruparail_Ruparail_009_RJ0603_AL	1	5	5
26	Sahsan	77.177	27.739	Ruparail_Ruparail_009_RJ0603_AL	1	5	5
27	Sahsan	77.180	27.745	Ruparail_Ruparail_009_RJ0603_AL	1	5	5
28	Sahsan	77.183	27.744	Ruparail_Ruparail_009_RJ0603_AL	1	5	5
29	Sahsan	77.183	27.739	Ruparail_Ruparail_009_RJ0603_AL	1	5	5
30	Ghoseenga	77.170	27.801	Ruparail_Ruparail_009_RJ0603_AL	1	5	5
31	Ghoseenga	77.171	27.798	Ruparail_Ruparail_009_RJ0603_AL	1	5	5
32	Kherli Nanoo	77.168	27.788	Ruparail_Ruparail_009_RJ0603_AL	1	5	5
33	Kanchanner	77.151	27.771	Ruparail_Ruparail_009_RJ0603_AL	1	5	5

34	Kalawata	77.251	27.675	Ruparail_Ruparail_009_RJ0603_AL	2	5	10
35	Kaman (M)	77.257	27.649	Ruparail_Ruparail_009_RJ0603_AL	2	5	10
36	Kaman (M)	77.270	27.639	Ruparail_Ruparail_009_RJ0603_AL	2	5	10
37	Kaman (M)	77.265	27.640	Ruparail_Ruparail_009_RJ0603_AL	4	5	20
38	Sablana	77.260	27.614	Ruparail_Ruparail_009_RJ0603_AL	4	5	20
39	Sonokhar	77.239	27.747	Ruparail_Ruparail_010_RJ0603_AL	1	5	5
40	Pathwari	77.288	27.755	Ruparail_Ruparail_010_RJ0603_AL	1	5	5
41	Sahera	77.303	27.743	Ruparail_Ruparail_010_RJ0603_AL	1	5	5
42	Nagla Bhongra	77.310	27.746	Ruparail_Ruparail_010_RJ0603_AL	1	5	5
43	Jurhara	77.205	27.803	Ruparail_Ruparail_010_RJ0603_AL	1	5	5
44	Jurhara	77.209	27.779	Ruparail_Ruparail_010_RJ0603_AL	1	5	5
45	Jurhari	77.224	27.787	Ruparail_Ruparail_010_RJ0603_AL	1	5	5
46	Jurhari	77.226	27.786	Ruparail_Ruparail_010_RJ0603_AL	1	5	5
47	Nagla Doobokhar	77.240	27.769	Ruparail_Ruparail_010_RJ0603_AL	1	5	5
48	Kherli Gumani	77.248	27.760	Ruparail_Ruparail_010_RJ0603_AL	1	5	5
49	Bamni	77.248	27.778	Ruparail_Ruparail_010_RJ0603_AL	1	5	5
50	Bamni	77.251	27.780	Ruparail_Ruparail_010_RJ0603_AL	1	5	5
51	Gaonri	77.268	27.764	Ruparail_Ruparail_010_RJ0603_AL	1	5	5
52	Nogawan	77.260	27.798	Ruparail_Ruparail_010_RJ0603_AL	1	5	5
53	Naunera	77.289	27.783	Ruparail_Ruparail_010_RJ0603_AL	1	5	5
54	Naunera	77.295	27.784	Ruparail_Ruparail_010_RJ0603_AL	1	5	5
55	Naunera	77.299	27.786	Ruparail_Ruparail_010_RJ0603_AL	1	5	5
56	Jurhara	77.207	27.785	Ruparail_Ruparail_010_RJ0603_AL	2	5	10
57	Pai	77.231	27.763	Ruparail_Ruparail_010_RJ0603_AL	2	5	10
58	Naunera	77.288	27.773	Ruparail_Ruparail_010_RJ0603_AL	3	5	15
59	Naunera	77.295	27.774	Ruparail_Ruparail_010_RJ0603_AL	4	5	20
60	Bijasana	77.007	27.698	Ruparail_Ruparail_012_RJ0603_AL	1	5	5
61	Manchi	77.177	27.594	Ruparail_Ruparail_012_RJ0603_AL	1	5	5
62	Gadhaner	77.070	27.796	Ruparail_Ruparail_012_RJ0603_AL	1	5	5
63	Kanwari	77.098	27.779	Ruparail_Ruparail_012_RJ0603_AL	1	5	5
64	Khallooka	77.124	27.778	Ruparail_Ruparail_012_RJ0603_AL	1	5	5
				Total	**80**		**400**

Tentative location of Recharge Shaft and Percolation Tank, Block Kaman, District Bharatpur



4. Aquifer Management Plan of Block -Kumher, District-Bharatpur

Salient Information	**Block**	**Kumher**
	Geographical Area (km2)	454.51
	Hilly Area (Sq.km)	0
	Saline Area (Sq.km)	335.12
	Potential Area (Sq.km)	119.08
Climate & Rainfall	Climate	Semi-arid
	Average Rainfall (mm)(1971-2014)	570.4
Ground Water Issues	Aquifer Characteristics	In adequate space for groundwater recharge
	Main Aquifers in the area	Alluvial formations(100%)
Aquifer System	Aquifer Disposition	Alluvium
	Geology	Quaternary alluvium underlain by Vindhyan sandstone
	Maximum Depth of Aquifer in meter	90.62
	Type of Aquifer	Unconfined and confined
	Thickness of Aquifer (Utilisable)	18.12
	Hydraulic Characters (sp.yield%)	0.08
Water Level Behaviour, DTW (m)	Depth to Water Level (m BGL)	5.98-18.40
	Trend (m/yr)	0.11(pre-monsoon) and 0.04(post-monsoon)
Ground Water Quality	General	Saline water in major part with brackish in eastern part
	Electrical Conductivity in microS/cm (Min/Max)	2480
	Chloride in mg/ litre (Min/Max)	480
	Nitrate in mg/litre (Min/Max)	21
	Fluoride in mg/litre (Min/Max)	1.5
Groundwater Resources	Total annual ground water recharge(mcm)	18.1941

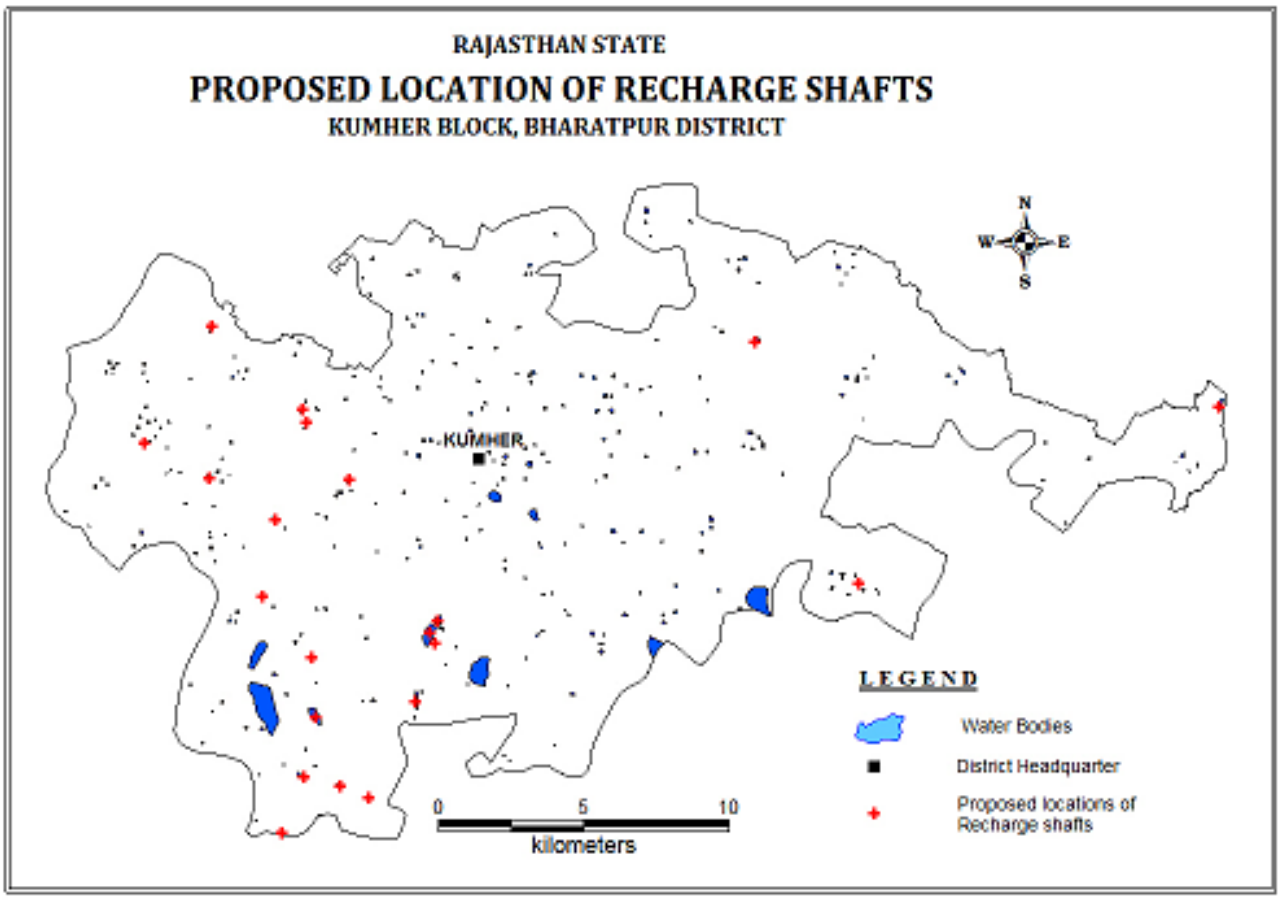
Salient Information	Block	Kumher
	Natural discharge during non-monsoon season(mcm)	1.8194
	Net ground water availability(mcm)	16.3747
	Existing gross ground water draft for irrigation(mcm)	13.1556
	Existing gross ground water draft for domestic & industrial uses(mcm)	5.0574
	Existing gross ground water draft for all uses(mcm)	18.2130
	Allocation for domestic & industrial requirement(mcm)	6.0800
	Net ground water availability for future irrigation development(mcm)	0.0000
	State of ground water development	111.23
	Category	Over-exploited
Supply Side Management	Space Available for Recharge (mcm)	27.34
	Area of Block (Sq.km.)	454.51
	Potential area suitable for recharge (Sq.km.)	119.08
	Type of Aquifer	Alluvium
	Area feasible for artificial recharge (Sq km)	119.08
	Sp Yield(%)	0.08
	Average DTW (m bgl)	5.87
	Thickness of unsaturated zone 3 m below ground level (m)	2.87
	Volume of sub surface storage space available for artificial recharge (MCM)	27.34
	Surplus Runoff Availability	---------
	Surplus available (MCM)	1.087
	Surplus available in zone as per the water level (in Mm3)	--------
	Recharge Shafts Proposed in existing water bodies	23
	Percolation Tanks Proposed	0
Demand side Management	Use of Advanced Irrigation Practices to be promoted	
	(i)Use of Sprinklers	

Salient Information	Block	Kumher
	Total Irrigated Area (ha)	27053
	Irrigated Area (ha) proposed for irrigation through sprinkler	13527
	Water Saving by Use of Sprinklers	10.82
	(ii)Change in Cropping pattern	
	Irrigated Area under wheat (ha)	10806
	Irrigated Area (ha) under wheat proposed for Gram cultivation	5403
	Water Saving by change in cropping pattern	5.40
Expected Benefits	Net G.W. Availability (MCM)	16.3747
	Additional Recharge from RWH & water conservation (MCM)	0.84
	Total Net G.W. Availability after intervention (MCM)	17.2147
	Existing G.W Draft for all purpose (MCM)	18.21
	Saving of Ground water through demand side interven tion (MCM)	16.22
	Net GW draft after interventions (MCM)	1.99
	Present stage of G.W. development (in %)	111.20
	Expected stage of G.W. Dev. after intervention (%)	11.56
Other Interventions proposed, if any	Alternate water Sources available	Nil
	Regulation and Control measures to be implemented	To be notified

Tentative locations of village for village pond with recharge shaft, Block Kumbher, District Bharatpur

S.No.	Village	Long	Lat	Watershed	No of Shafts	Unit cost (Rs in lac)	Total cost (Rs in lac)
1	Usrani	77.271	27.357	Banganga_Banganga_008_RJ0604_AL	1	5	5
2	Sabora	77.248	27.321	Banganga_Banganga_008_RJ0604_AL	1	5	5
3	Jahangeerpur	77.303	27.331	Banganga_Banganga_008_RJ0604_AL	1	5	5
4	Pichoomar	77.304	27.327	Banganga_Banganga_008_RJ0604_AL	1	5	5
5	Maharawar	77.271	27.310	Banganga_Banganga_008_RJ0604_AL	1	5	5
6	Astavan Jadid	77.293	27.297	Banganga_Banganga_008_RJ0604_AL	1	5	5
7	Peedhi	77.319	27.310	Banganga_Banganga_008_RJ0604_AL	1	5	5
8	Gudawali	77.289	27.274	Banganga_Banganga_008_RJ0604_AL	1	5	5
9	Chimni	77.306	27.255	Banganga_Banganga_008_RJ0604_AL	1	5	5
10	Ubar	77.496	27.278	Banganga_Banganga_013_RJ0604_AL	1	5	5
11	Chak Paprera	77.308	27.236	Banganga_Banganga_025_RJ0604_AL	2	5	10
12	Ajau	77.342	27.241	Banganga_Banganga_025_RJ0604_AL	1	5	5
13	Pahua	77.349	27.259	Banganga_Banganga_025_RJ0604_AL	1	5	5
14	Pahua	77.347	27.262	Banganga_Banganga_025_RJ0604_AL	2	5	10
15	Pahua	77.350	27.266	Banganga_Banganga_025_RJ0604_AL	1	5	5
16	Moroda	77.296	27.201	Banganga_Banganga_025_RJ0604_AL	1	5	5
17	Paprera	77.304	27.218	Banganga_Banganga_025_RJ0604_AL	1	5	5
18	Khanswara	77.316	27.215	Banganga_Banganga_025_RJ0604_AL	1	5	5
19	Sonera	77.326	27.212	Banganga_Banganga_025_RJ0604_AL	1	5	5
20	Abhaurra	77.460	27.352	Banganga_Banganga_026_RJ0604_AL	1	5	5
21	Santrook	77.622	27.332	Banganga_Banganga_026_RJ0604_AL	1	5	5
				Total	**23**		**115**

Tentative location of Recharge Shaft and Percolation Tank, Block Kumbher, District Bharatpur



5. Aquifer Management Plan of Block - Nadbai, District-Bharatpur

Salient Information	**Block**	**Nadbai**
	Geographical Area (km2)	446.7
	Hilly Area (Sq.km)	0
	Saline Area (Sq.km)	165.36
	Potential Area (Sq.km)	281.34
Climate & Rainfall	Climate	Semi-arid
	Average Rainfall (mm)(1971-2014)	715.3
Ground Water Issues	Aquifer Characteristics	Adequate space for groundwater recharge
	Main Aquifers in the area	Alluvial formations(100%)
Aquifer System	Aquifer Disposition	Alluvium
	Geology	Quaternary alluvium underlain by Bed rock of Delhi and Vindhyan Super Group of rocks
	Maximum Depth of Aquifer in meter	83.47
	Type of Aquifer	Unconfined and confined
	Thickness of Aquifer (Utilisable)	16.69
	Hydraulic Characters (sp.yield%)	0.10
Water Level Behaviour, DTW (m)	Depth to Water Level (m BGL)	16.99-32.16
	Trend (m/yr)	0.72(pre-monsoon) and 0.54(post-monsoon)
Ground Water Quality	General	Major part underlain by potable to brackish ground water
	Electrical Conductivity in microS/cm (Min/Max)	940
	Chloride in mg/ litre (Min/Max)	35.50
	Nitrate in mg/litre (Min/Max)	8
	Fluoride in mg/litre (Min/Max)	8.7
Groundwater Resources	Total annual ground water recharge(mcm)	43.8730

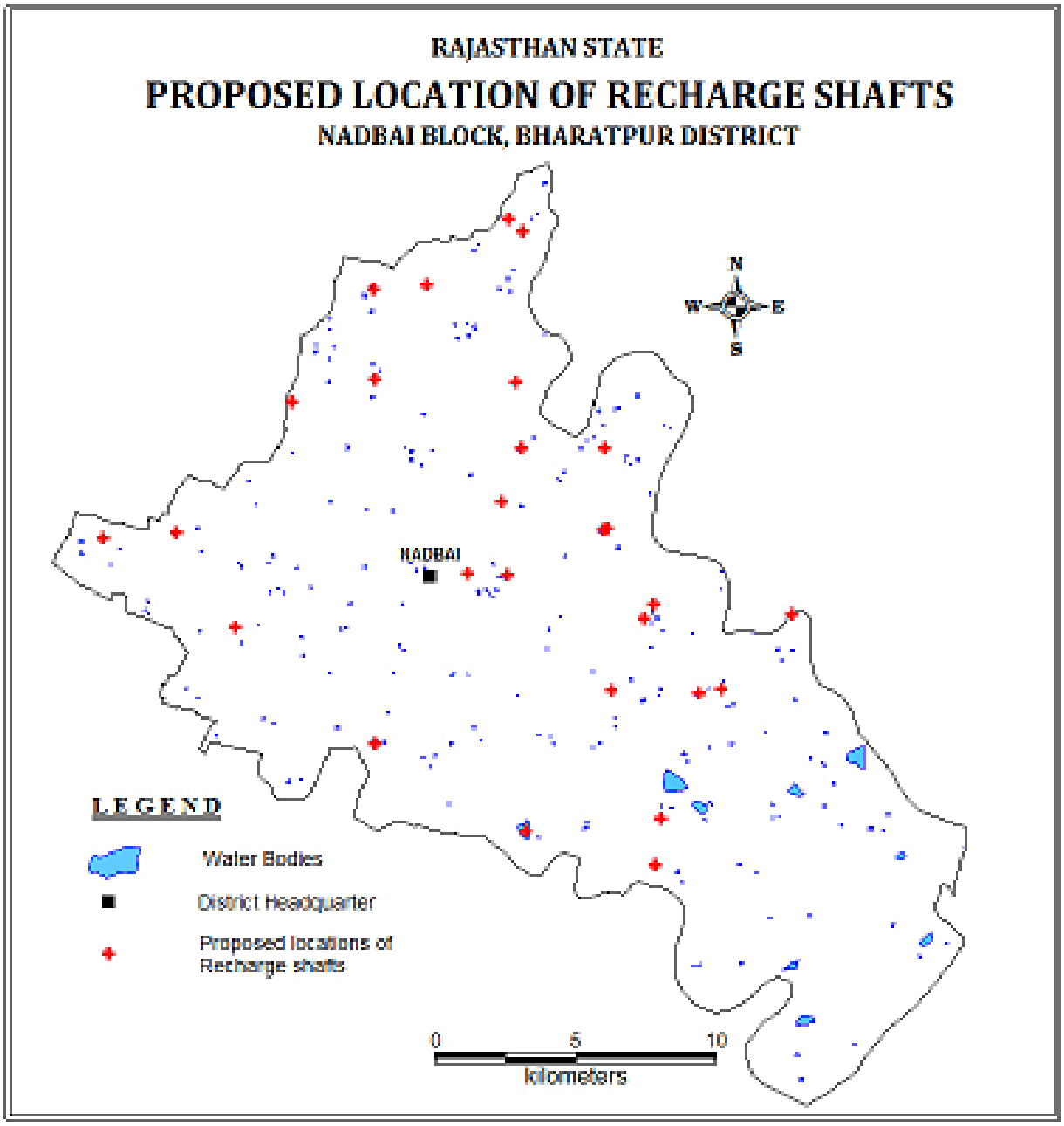
Salient Information	Block	Nadbai
	Natural discharge during non-monsoon season(mcm)	4.3873
	Net ground water availability(mcm)	39.4857
	Existing gross ground water draft for irrigation(mcm)	65.6820
	Existing gross ground water draft for domestic & industrial uses(mcm)	5.1728
	Existing gross ground water draft for all uses(mcm)	70.8548
	Allocation for domestic & industrial requirement(mcm)	6.6900
	Net ground water availability for future irrigation development(mcm)	0.0000
	State of ground water development	179.44
	Category	Over-exploited
Supply Side Management	Space Available for Recharge (mcm)	383.19
	Area of Block (Sq.km.)	446.70
	Potential area suitable for recharge (Sq.km.)	281.34
	Type of Aquifer	Alluvium
	Area feasible for artificial recharge (Sq km)	281.34
	Sp Yield(%)	0.10
	Average DTW (m bgl)	16.62
	Thickness of unsaturated zone 3 m below ground level (m)	13.62
	Volume of sub surface storage space available for artificial recharge (MCM)	383.19
	Surplus Runoff Availability	----------
	Surplus available (MCM)	1.779
	Surplus available in zone as per the water level (in Mm3)	----------
	Recharge Shafts Proposed in existing water bodies	30
	Percolation Tanks Proposed	0
Demand side Management	Use of Advanced Irrigation Practices to be promoted	
	(i)Use of Sprinklers	
	Total Irrigated Area (ha)	38927

Salient Information	Block	Nadbai
	Irrigated Area (ha) proposed for irrigation through sprinkler	19464
	Water Saving by Use of Sprinklers	15.57
	(ii)Change in Cropping pattern	
	Irrigated Area under wheat (ha)	10342
	Irrigated Area (ha) under wheat proposed for Gram cultivation	5171
	Water Saving by change in cropping pattern	5.17
Expected Benefits	Net G.W. Availability (MCM)	39.4857
	Additional Recharge from RWH & water conservation (MCM)	0.644
	Total Net G.W. Availability after intervention (MCM)	40.1297
	Existing G.W Draft for all purpose (MCM)	70.85
	Saving of Ground water through demand side interven tion (MCM)	20.74
	Net GW draft after interventions (MCM)	50.11
	Present stage of G.W. development (in %)	179.40
	Expected stage of G.W. Dev.after intervention (%)	124.87
Other Interventions proposed, if any	Alternate water Sources available	Nil
	Regulation and Control measures to be implemented	To be notified

Tentative locations of village for village pond with recharge shaft, Block Nadbai, District Bharatpur

S.No.	Village	Long	Lat	Watershed	No of Shafts	Unit cost (Rs in lac)	Total cost (Rs in lac)
1	Enchera	77.207	27.333	Banganga_Banganga_008_RJ0605_AL	1	5	5
2	Enchera	77.212	27.329	Banganga_Banganga_008_RJ0605_AL	1	5	5
3	Kailoori	77.178	27.312	Banganga_Banganga_008_RJ0605_AL	1	5	5
4	Roneeja	77.158	27.310	Banganga_Banganga_008_RJ0605_AL	1	5	5
5	Unch	77.159	27.281	Banganga_Banganga_008_RJ0605_AL	1	5	5
6	Lalpur	77.129	27.274	Banganga_Banganga_008_RJ0605_AL	1	5	5
7	Barauli Chhar	77.087	27.232	Banganga_Banganga_008_RJ0605_AL	1	5	5
8	Beekroo	77.061	27.230	Banganga_Banganga_008_RJ0605_AL	1	5	5
9	Bahramda	77.210	27.280	Banganga_Banganga_008_RJ0605_AL	1	5	5
10	Manjhi	77.211	27.259	Banganga_Banganga_008_RJ0605_AL	1	5	5
11	Luhasa	77.204	27.242	Banganga_Banganga_008_RJ0605_AL	1	5	5
12	Kheriya Jaga	77.242	27.259	Banganga_Banganga_008_RJ0605_AL	1	5	5
13	Talchhera	77.109	27.202	Banganga_Banganga_025_RJ0605_AL	1	5	5
14	Raisees	77.241	27.233	Banganga_Banganga_025_RJ0605_AL	1	5	5
15	Raisees	77.243	27.233	Banganga_Banganga_025_RJ0605_AL	1	5	5
16	Kawai	77.256	27.205	Banganga_Banganga_025_RJ0605_AL	1	5	5
17	Kawai	77.259	27.209	Banganga_Banganga_025_RJ0605_AL	1	5	5
18	Nadbai (M)	77.192	27.219	Banganga_Banganga_025_RJ0605_AL	1	5	5
19	Nadbai (M)	77.207	27.218	Banganga_Banganga_025_RJ0605_AL	1	5	5
20	Karhi	77.309	27.206	Banganga_Banganga_025_RJ0605_AL	1	5	5
21	Hasanpur	77.284	27.182	Banganga_Banganga_025_RJ0605_AL	1	5	5
22	Hasanpur	77.275	27.181	Banganga_Banganga_025_RJ0605_AL	1	5	5
23	Khatauti	77.244	27.182	Banganga_Banganga_025_RJ0605_AL	1	5	5
24	Nyotha	77.159	27.165	Banganga_Banganga_025_RJ0605_AL	1	5	5
25	Arauda	77.213	27.136	Banganga_Banganga_025_RJ0605_AL	4	5	20
26	Dahra	77.262	27.141	Banganga_Banganga_025_RJ0605_AL	1	5	5
27	Bharkau	77.260	27.126	Banganga_Banganga_025_RJ0605_AL	1	5	5
				Total	**30**		**150**

Tentative location of Recharge Shaft , Block Nadbai, District Bharatpur



6. Aquifer Management Plan of Block – Nagar, District- Bharatpur

Salient Information	**Block**	**Nagar**
	Geographical Area (km2)	623.80
	Hilly Area (Sq.km)	12.76
	Saline Area (Sq.km)	319.68
	Potential Area (Sq.km)	291.36
Climate & Rainfall	Climate	Semi-arid
	Average Rainfall(mm) (1971-2014)	580.8
Ground Water Issues	Aquifer Characteristics	Adequate space for groundwater recharge
	Main Aquifers in the area	Alluvial formations(100%)
Aquifer System	Aquifer Disposition	Alluvium
	Geology	Quaternary alluvium underlain by Bed rock of Delhi Super Group of rocks
	Maximum Depth of Aquifer in meter	91.29
	Type of Aquifer	Unconfined and confined
	Thickness of Aquifer (Utilisable)	18.26
	Hydraulic Characters (sp.yield%)	0.10
Water Level Behaviour, DTW (m)	Depth to Water Level (m BGL)	6.98-11.80
	Trend (m/yr)	0.24(pre-monsoon) and 0.18(post-monsoon)
Ground Water Quality	General	Major part has saline water followed by brackish water and potable ground water in small area falling in extreme western fringe of area
	Electrical Conductivity in microS/cm (Min/Max)	2410-6700
	Chloride in mg/ litre (Min/Max)	410-2485

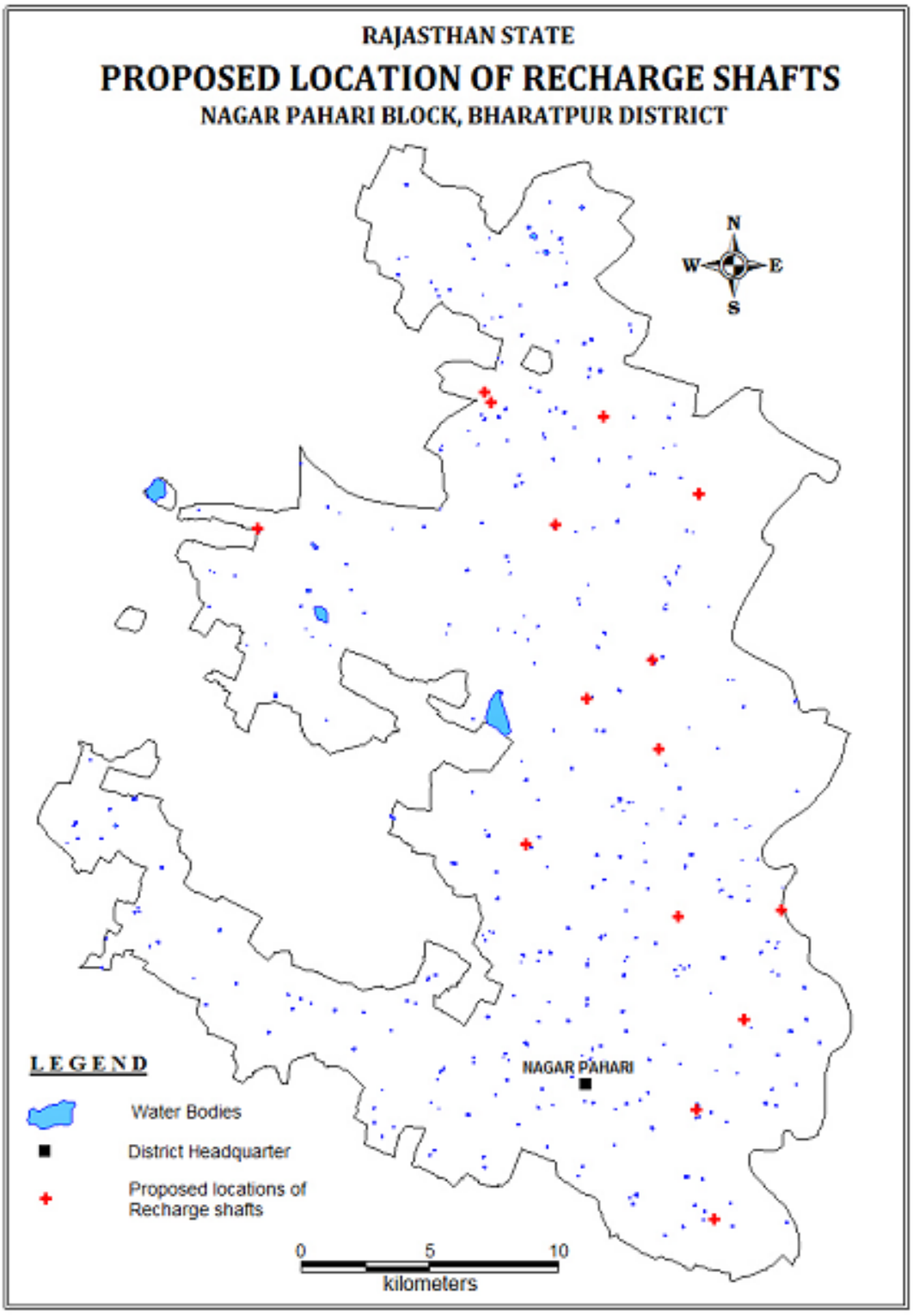
Salient Information	Block	Nagar
	Nitrate in mg/litre (Min/Max)	32-280
	Fluoride in mg/litre (Min/Max)	1.2-1.8
Groundwater Resources	Total annual ground water recharge(mcm)	53.2307
	Natural discharge during non-monsoon season(mcm)	5.3231
	Net ground water availability(mcm)	47.9076
	Existing gross ground water draft for irrigation(mcm)	40.3920
	Existing gross ground water draft for domestic & industrial uses(mcm)	6.4715
	Existing gross ground water draft for all uses(mcm)	46.8635
	Allocation for domestic & industrial requirement(mcm)	5.0000
	Net ground water availability for future irrigation development(mcm)	2.5156
	State of ground water development	97.82
	Category	Critical
Supply Side Management	Space Available for Recharge (mcm)	178.6
	Area of Block (Sq.km.)	623.8
	Potential area suitable for recharge (Sq.km.)	291.36
	Type of Aquifer	Alluvium
	Area feasible for artificial recharge (Sq km)	291.36
	Sp Yield(%)	0.10
	Average DTW (m bgl)	9.13
	Thickness of unsaturated zone 3 m below ground level (m)	6.13
	Volume of sub surface storage space available for artificial recharge (MCM)	178.6
	Surplus Runoff Availability	-------
	Surplus available (MCM)	4.199
	Surplus available in zone as per the water level (in Mm3)	----------
	Recharge Shafts Proposed in existing water bodies	15
	Percolation Tanks Proposed	0

Salient Information	Block	Nagar
Demand side Management	Use of Advanced Irrigation Practices to be promoted	
	(i)Use of Sprinklers	
	Total Irrigated Area (ha)	40596
	Irrigated Area (ha) proposed for irrigation through sprinkler	20298
	Water Saving by Use of Sprinklers	16.24
	(ii)Change in Cropping pattern	
	Irrigated Area under wheat (ha)	17404
	Irrigated Area (ha) under wheat proposed for Gram cultivation	8702
	Water Saving by change in cropping pattern	8.70
Expected Benefits	Net G.W. Availability (MCM)	47.9076
	Additional Recharge from RWH & water conservation (MCM)	1.148
	Total Net G.W. Availability after intervention (MCM)	49.0556
	Existing G.W Draft for all purpose (MCM)	46.86
	Saving of Ground water through demand side interven tion (MCM)	24.94
	Net GW draft after interventions (MCM)	21.92
	Present stage of G.W. development (in %)	97.82
	Expected stage of G.W. Dev.after intervention (%)	44.68
Other Interventions proposed, if any	Alternate water Sources available	Nil
	Regulation and Control measures to be implemented	To be notified

Tentative locations of village for village pond with recharge shaft, Block Nagar, District Bharatpur

S.No.	Village	Long	Lat	Watershed	No of Shafts	Unit cost (Rs in lac)	Total cost (Rs in lac)
1	Dunawal	77.160	27.441	Banganga_Banganga_003_RJ0606_AL	1	5	5
2	Sundrawali	77.141	27.409	Banganga_Banganga_003_RJ0606_AL	1	5	5
3	Pathroda	77.148	27.371	Banganga_Banganga_003_RJ0606_AL	1	5	5
4	Dhanota	76.968	27.612	Ruparail_Ruparail_002_RJ0606_AL	1	5	5
5	Berroo	77.074	27.502	Ruparail_Ruparail_006_RJ0606_AL	1	5	5
6	Padalwas	77.134	27.476	Ruparail_Ruparail_006_RJ0606_AL	1	5	5
7	Banaini Toda	77.175	27.478	Ruparail_Ruparail_006_RJ0606_AL	1	5	5
8	Gopalgarh	77.058	27.660	Ruparail_Ruparail_012_RJ0606_AL	1	5	5
9	Gopalgarh	77.060	27.656	Ruparail_Ruparail_012_RJ0606_AL	1	5	5
10	Pathrali	77.104	27.651	Ruparail_Ruparail_012_RJ0606_AL	1	5	5
11	Peepal Khera	77.085	27.613	Ruparail_Ruparail_012_RJ0606_AL	1	5	5
12	Ranph	77.142	27.624	Ruparail_Ruparail_012_RJ0606_AL	1	5	5
13	Dawak	77.124	27.566	Ruparail_Ruparail_012_RJ0606_AL	1	5	5
14	Punay	77.098	27.552	Ruparail_Ruparail_012_RJ0606_AL	1	5	5
15	Gulpara	77.126	27.535	Ruparail_Ruparail_012_RJ0606_AL	1	5	5
				Total	**15**		**75**

Tentative location of Recharge Shaft, Block Nagar, District Bharatpur



7. Aquifer Management Plan of Block - Roopwas, District- Bharatpur

Salient Information	**Block**	**Roopwas**
	Geographical Area (km2)	539.01
	Hilly Area (Sq.km)	37.91
	Saline Area (Sq.km)	0
	Potential Area (Sq.km)	501.10
Climate & Rainfall	Climate	Semi-arid
	Average Rainfall (mm)(1971-2014)	589.2
Ground Water Issues	Aquifer Characteristics	Adequate space for groundwater recharge
	Main Aquifers in the area	Alluvium(62.82%) Sandstone(37.18 %)
Aquifer System	Aquifer Disposition	Alluvium underlain by sandstone and sandstone
	Geology	Quaternary alluvium and Sandstone of Vindhyan Super Group
	Maximum Depth of Aquifer in meter	90.00
	Type of Aquifer	Unconfined and confined
	Thickness of Aquifer (Utilisable)	18.00
	Hydraulic Characters (sp.yield%)	0.10%(Alluvium) 0.02%(Sandstone)
Water Level Behaviour, DTW (m)	Depth to Water Level (m BGL)	2.10-9.22
	Trend (m/yr)	0.26(pre-monsoon) 0.21(post-monsoon)
Ground Water Quality	General	Major part underlain by brackish and potable in isolated pockets
	Electrical Conductivity in microS/cm (Min/Max)	2430-5400
	Chloride in mg/ litre (Min/Max)	497-1320
	Nitrate in mg/litre (Min/Max)	2-200
	Fluoride in mg/litre (Min/Max)	0.5-0.98
Groundwater Resources	Total annual ground water recharge(mcm)	73.3922

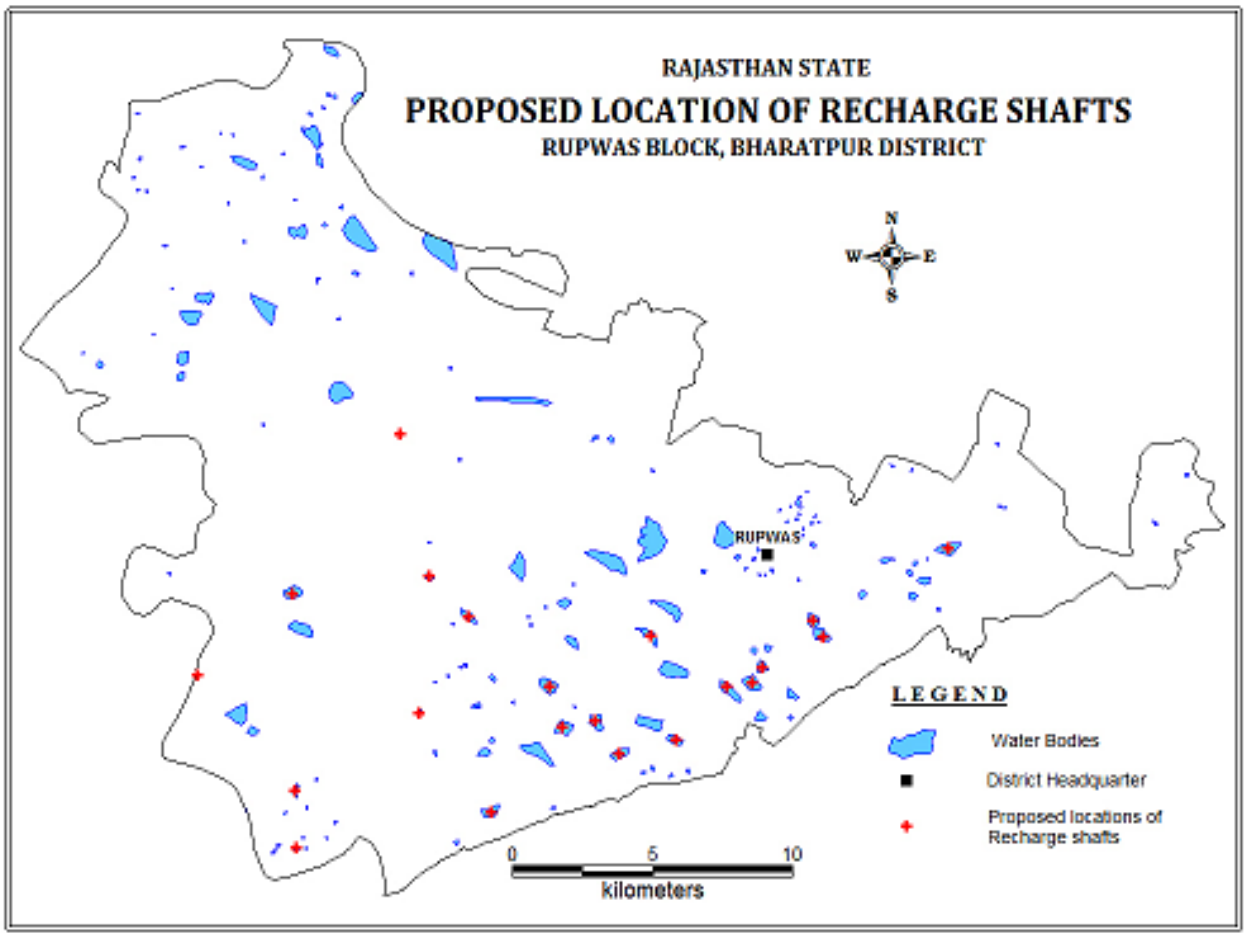
Salient Information	Block	Roopwas
	Natural discharge during non-monsoon season(mcm)	6.6966
	Net ground water availability(mcm)	66.6956
	Existing gross ground water draft for irrigation(mcm)	68.1678
	Existing gross ground water draft for domestic & industrial uses(mcm)	5.9002
	Existing gross ground water draft for all uses(mcm)	74.0680
	Allocation for domestic & industrial requirement(mcm)	4.8900
	Net ground water availability for future irrigation development(mcm)	0.0000
	State of ground water development(%)	111.05
	Category	Over-exploited
Supply Side Management	Space Available for Recharge (mcm)	229.57(Alluvium) 6.31(Sandstone)
	Area of Block (Sq.km.)	539.01
	Potential area suitable for recharge (Sq.km.)	338.60(alluvium) 162.50(sandstone)
	Type of Aquifer	Alluvium Sandstone
	Area feasible for artificial recharge (Sq km)	338.60(Alluvium) 162.50(Sandstone)
	Sp Yield(%)	0.1(Alluvium) 0.02(Sandstone)
	Average DTW (m bgl)	9.78(Alluvium) 4.94(Sandstone)
	Thickness of unsaturated zone 3 m below ground level (m)	6.78(Alluvium) 1.94(Sandstone)
	Volume of sub surface storage space available for artificial recharge (MCM)	229.57(Alluvium) 6.31(Sandstone)
	Surplus Runoff Availability	----------
	Surplus available (MCM)	1.575
	Surplus available in zone as per the water level (in Mm3)	----------
	Recharge Shafts Proposed in existing water bodies	25
	Percolation Tanks Proposed	0
Demand side	Use of Advanced Irrigation Practices to be promoted	

Salient Information	Block	Roopwas
Management		
	(i)Use of Sprinklers	
	Total Irrigated Area (ha)	34601
	Irrigated Area (ha) proposed for irrigation through sprinkler	17301
	Water Saving by Use of Sprinklers	13.84
	(ii)Change in Cropping pattern	
	Irrigated Area under wheat (ha)	12722
	Irrigated Area (ha) under wheat proposed for Gram cultivation	6361
	Water Saving by change in cropping pattern	6.36
Expected Benefits	Net G.W. Availability (MCM)	66.6956
	Additional Recharge from RWH & water conservation (MCM)	0.56
	Total Net G.W. Availability after intervention (MCM)	67.2556
	Existing G.W Draft for all purpose (MCM)	74.07
	Saving of Ground water through demand side interven tion (MCM)	20.20
	Net GW draft after interventions (MCM)	53.87
	Present stage of G.W. development (in %)	111.10
	Expected stage of G.W. Dev.after intervention (%)	80.10
Other Interventions proposed, if any	Alternate water Sources available	Nil
	Regulation and Control measures to be implemented	To be notified

Tentative locations of village for village pond with recharge shaft, Block Roopwas, District Bharatpur

S.No.	Village	Long	Lat	Watershed	No of Shafts	Unit cost (Rs in lac)	Total cost (Rs in lac)
1	Paharpur	77.522	26.951	Gambhir_Gambhir_003_RJ0607_SR	1	5	5
2	Dhana	77.527	26.939	Gambhir_Gambhir_003_RJ0607_SR	1	5	5
3	Basai	77.501	26.911	Gambhir_Gambhir_003_RJ0607_SR	1	5	5
4	Sajjanwas	77.539	26.941	Gambhir_Gambhir_003_RJ0607_SR	1	5	5
5	Tontpur	77.547	26.930	Gambhir_Gambhir_003_RJ0607_SR	1	5	5
6	Maloni	77.567	26.934	Gambhir_Gambhir_003_RJ0607_SR	1	5	5
7	Samahad	77.559	26.968	Gambhir_Gambhir_003_RJ0607_SR	1	5	5
8	Noharda	77.586	26.951	Gambhir_Gambhir_003_RJ0607_SR	1	5	5
9	Samri	77.595	26.953	Gambhir_Gambhir_003_RJ0607_SR	1	5	5
10	Samri	77.599	26.958	Gambhir_Gambhir_003_RJ0607_SR	1	5	5
11	Jotroli	77.493	26.974	Gambhir_Gambhir_003_RJ0607_SR	1	5	5
12	Rundh Rupbas	77.617	26.973	Gambhir_Gambhir_003_RJ0607_SR	1	5	5
13	Rundh Kheriya Jat	77.620	26.967	Gambhir_Gambhir_003_RJ0607_SR	1	5	5
14	Shakkarpur	77.665	26.996	Gambhir_Gambhir_003_RJ0607_SR	1	5	5
15	Jareela	77.395	26.955	Gambhir_Gambhir_004_RJ0607_AL	1	5	5
16	Khera Thakur	77.430	26.981	Gambhir_Gambhir_004_RJ0607_AL	4	5	20
17	Nagla Radhey	77.468	27.032	Gambhir_Gambhir_004_RJ0607_AL	1	5	5
18	Dumriya	77.431	26.918	Gambhir_Gambhir_004_RJ0607_SR	1	5	5
19	Dumriya	77.431	26.900	Gambhir_Gambhir_004_RJ0607_SR	1	5	5
20	Goojar Balai	77.479	26.987	Gambhir_Gambhir_004_RJ0607_SR	2	5	5
21	Mahalpur Choora	77.475	26.943	Gambhir_Gambhir_004_RJ0607_SR	1	5	5
				Total	**25**		**125**

Tentative location of Recharge Shaft , Block Roopwas, District Bharatpur



8. Aquifer Management Plan of Block -Sewar, District-Bharatpur

Salient Information	**Block**	**Sewar**
	Geographical Area (km2)	509.52
	Hilly Area (Sq.km)	0
	Saline Area (Sq.km)	228.27
	Potential Area (Sq.km)	281.10
Climate & Rainfall	Climate	Semi-arid
	Average Rainfall (mm)(1971-2014)	570.4
Ground Water Issues	Aquifer Characteristics	Adequate space for groundwater recharge
	Main Aquifers in the area	Alluvium
Aquifer System	Aquifer Disposition	Alluvium underlain by sandstone
	Geology	Quaternary alluvium underlain by bed rock of sandstone of Vindhyan Super Group
	Maximum Depth of Aquifer in meter	115.79
	Type of Aquifer	Unconfined and confined
	Thickness of Aquifer (Utilisable)	23.16
	Hydraulic Characters (sp.yield%)	0.07
Water Level Behaviour, DTW (m)	Depth to Water Level (m BGL)	
	Trend (m/yr)	0.30(pre-monsoon) 0.22(post-monsoon)
Ground Water Quality	General	Major part underlain by saline water(55%) and followed by brackish water with potable water at isolated pockets close to local pond/talabs
	Electrical Conductivity in microS/cm (Min/Max)	650-18460
	Chloride in mg/ litre (Min/Max)	35.5-6450
	Nitrate in mg/litre (Min/Max)	4-130
	Fluoride in mg/litre (Min/Max)	0.04-0.98
Groundwater Resources	Total annual ground water recharge(mcm)	45.3855

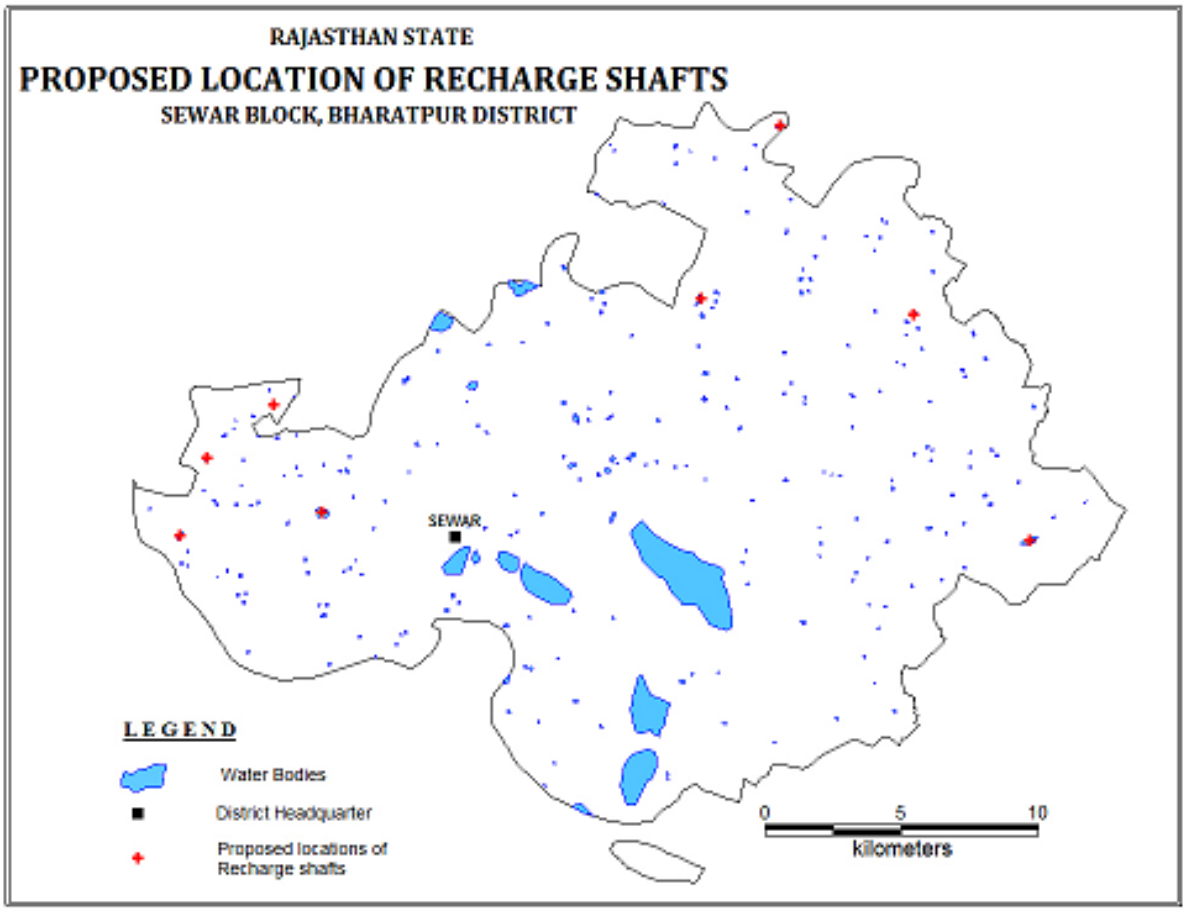
Salient Information	Block	Sewar
	Natural discharge during non-monsoon season(mcm)	4.5386
	Net ground water availability(mcm)	40.8469
	Existing gross ground water draft for irrigation(mcm)	40.0404
	Existing gross ground water draft for domestic & industrial uses(mcm)	16.2750
	Existing gross ground water draft for all uses(mcm)	56.3154
	Allocation for domestic & industrial requirement(mcm)	12.2900
	Net ground water availability for future irrigation development(mcm)	0.0000
	State of ground water development(%)	137.87
	Category	Over-exploited
Supply Side Management	Space Available for Recharge (mcm)	115.31
	Area of Block (Sq.km.)	509.52
	Potential area suitable for recharge (Sq.km.)	281.10
	Type of Aquifer	Alluvium
	Area feasible for artificial recharge (Sq km)	281.10
	Sp Yield(%)	0.07
	Average DTW (m bgl)	8.86
	Thickness of unsaturated zone 3 m below ground level (m)	5.86
	Volume of sub surface storage space available for artificial recharge (MCM)	115.31
	Surplus Runoff Availability	-------
	Surplus available (MCM)	0.306
	Surplus available in zone as per the water level (in Mm3)	-------
	Recharge Shafts Proposed in existing water bodies	8
	Percolation Tanks Proposed	0
Demand side Management	Use of Advanced Irrigation Practices to be promoted	
	(i)Use of Sprinklers	

Salient Information	Block	Sewar
	Total Irrigated Area (ha)	36290
	Irrigated Area (ha) proposed for irrigation through sprinkler	18145
	Water Saving by Use of Sprinklers	14.52
	(ii)Change in Cropping pattern	
	Irrigated Area under wheat (ha)	15646
	Irrigated Area (ha) under wheat proposed for Gram cultivation	7823
	Water Saving by change in cropping pattern	7.82
Expected Benefits	Net G.W. Availability (MCM)	40.8469
	Additional Recharge from RWH & water conservation (MCM)	0.42
	Total Net G.W. Availability after intervention (MCM)	41.2669
	Existing G.W Draft for all purpose (MCM)	56.32
	Saving of Ground water through demand side interven tion (MCM)	22.34
	Net GW draft after interventions (MCM)	33.98
	Present stage of G.W. development (in %)	137.90
	Expected stage of G.W. Dev.after intervention (%)	82.34
Other Interventions proposed, if any	Alternate water Sources available	
	Regulation and Control measures to be implemented	To be notified

Tentative locations of village for village pond with recharge shaft, Block Sewar, District Bharatpur

S.No.	Village	Long	Lat	Watershed	No of Shafts	Unit cost (Rs in lac)	Total cost (Rs in lac)
1	Sinpini	77.385	27.193	Banganga_Banganga_013_RJ0608_AL	1	5	5
2	Jagheena (Rural)	77.525	27.264	Banganga_Banganga_013_RJ0608_AL	1	5	5
3	Chiksana	77.646	27.184	Banganga_Banganga_013_RJ0608_AL	1	5	5
4	Bisda	77.343	27.211	Banganga_Banganga_025_RJ0608_AL	1	5	5
5	Nagla Hargovind	77.367	27.229	Banganga_Banganga_025_RJ0608_AL	1	5	5
6	Dhanota	77.333	27.186	Banganga_Banganga_025_RJ0608_AL	1	5	5
7	Rundh Rarah	77.554	27.321	Banganga_Banganga_026_RJ0608_AL	1	5	5
8	Peepla	77.604	27.258	Banganga_Banganga_026_RJ0608_AL	1	5	5
				Total	**8**		**40**

Tentative location of Recharge Shaft, Block Sewar, District Bharatpur



9. Aquifer Management Plan of Block - Weir, District-Bharatpur

Salient Information	**Block**	**Weir**
	Geographical Area (km2)	606.53
	Hilly Area (Sq.km)	17.48
	Saline Area (Sq.km)	158.66
	Potential Area (Sq.km)	430.39
Climate & Rainfall	Climate	Semi-arid
	Average Rainfall (mm)(1971-2014)	588.1
Ground Water Issues	Aquifer Characteristics	Adequate space for groundwater recharge
	Main Aquifers in the area	Alluvium and quartzite
Aquifer System	Aquifer Disposition	Alluvium underlain by quartzite and quartzite
	Geology	Quaternary alluvium underlain by bed rock (quartzite) of Delhi/ Bhilwara Super Groups
	Maximum Depth of Aquifer in meter	78.95(Alluvium) 77.90(Hard rock-quartzite)
	Type of Aquifer	Unconfined and confined
	Thickness of Aquifer (Utilisable)(m)	15.79(Alluvium) 3.90(Hard rock-quartzite)
	Hydraulic Characters (sp.yield%)	0.12(Alluvium) 0.02(Quartzite)
Water Level Behaviour, DTW (m)	Depth to Water Level (m BGL)	20.76-51.64
	Trend (m/yr)	0.41(pre-monsoon) 0.24(post-monsoon)
Ground Water Quality	General	Major part underlain by potable formation water (EC within 3000ms/cm at $25^{O}C$) and saline formation water (25%) in north eastern part
	Electrical Conductivity in microS/cm (Min/Max)	1340-3890

Salient Information	Block	Weir
	Chloride in mg/ litre (Min/Max)	482.8-1000
	Nitrate in mg/litre (Min/Max)	17-150
	Fluoride in mg/litre (Min/Max)	1.85-6.8
Groundwater Resources	Total annual ground water recharge(mcm)	61.5200
	Natural discharge during non-monsoon season(mcm)	5.7965
	Net ground water availability(mcm)	55.7235
	Existing gross ground water draft for irrigation(mcm)	69.5298
	Existing gross ground water draft for domestic & industrial uses(mcm)	11.1402
	Existing gross ground water draft for all uses(mcm)	80.6699
	Allocation for domestic & industrial requirement(mcm)	9.8000
	Net ground water availability for future irrigation development(mcm)	0.0000
	State of ground water development	144.77
	Category	Over-exploited
Supply Side Management	Space Available for Recharge (mcm)	564.41(Soft rock) 19.85(Hard rock)
	Area of Block (Sq.km.)	606.53
	Potential area suitable for recharge (Sq.km.)	430.39
	Type of Aquifer	Alluvium and quartzite
	Area feasible for artificial recharge (Sq km)	430.39
	Sp Yield(%)	0.12(Soft rock) 0.02(Hard rock)
	Average DTW (m bgl)	16.67(Soft rock) 14.50(Hard rock)
	Thickness of unsaturated zone 3 m below ground level (m)	13.67(Soft rock) 11.50(Hard rock)
	Volume of sub surface storage space available for artificial recharge (MCM)	564.41(Soft rock) 19.85(Hard rock)
	Surplus Runoff Availability	----------
	Surplus available (MCM)	1.224
	Surplus available in zone as per the water level (in Mm3)	----------

Salient Information	Block	Weir
	Recharge Shafts Proposed in existing water bodies	2
	Percolation Tanks Proposed	0
Demand side Management	Use of Advanced Irrigation Practices to be promoted	
	(i)Use of Sprinklers	
	Total Irrigated Area (ha)	41200
	Irrigated Area (ha) proposed for irrigation through sprinkler	20600
	Water Saving by Use of Sprinklers	16.48
	(ii)Change in Cropping pattern	
	Irrigated Area under wheat (ha)	11052
	Irrigated Area (ha) under wheat proposed for Gram cultivation	5526
	Water Saving by change in cropping pattern	5.53
Expected Benefits	Net G.W. Availability (MCM)	55.7235
	Additional Recharge from RWH & water conservation (MCM)	0.70
	Total Net G.W. Availability after intervention (MCM)	56.4235
	Existing G.W Draft for all purpose (MCM)	80.67
	Saving of Ground water through demand side interven tion (MCM)	22.01
	Net GW draft after interventions (MCM)	58.66
	Present stage of G.W. development (in %)	144.80
	Expected stage of G.W. Dev.after intervention (%)	103.96
Other Interventions proposed, if any	Alternate water Sources available	Nil
	Regulation and Control measures to be implemented	To be notified

Tentative locations of village for village pond with recharge shaft, Block Weir, District Bharatpur

S.No.	Village	Long	Lat	Watershed	No of Shafts	Unit cost (Rs in lac)	Total cost (Rs in lac)
1	Bhagora	77.197	26.973	Gambhir_Gambhir_004_RJ0609_AL	1	5	5
2	Nithar	77.043	26.965	Gambhir_Gambhir_007_RJ0609_AL	1	5	5
				Total	**2**		**10**

Tentative location of Recharge Shaft, Block Weir, District Bharatpur