
# 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**

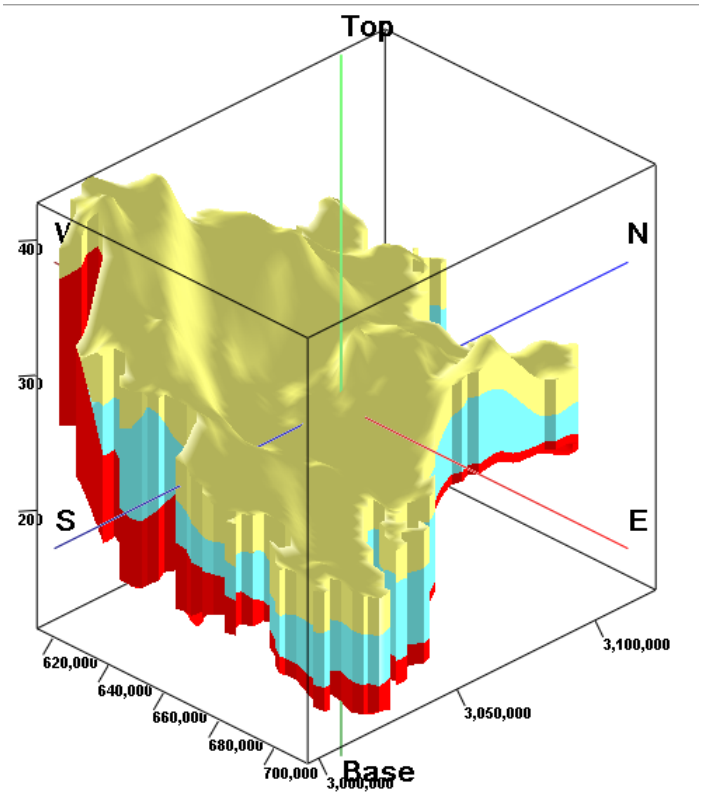
# AQUIFER MAPPING AND GROUND WATER MANAGEMENT

## Alwar District, Rajasthan

पश्चिमी क्षेत्र, जयपुर

Western Region, Jaipur

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




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

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# Alwar District, Rajasthan

## 1.0 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. The flow chart is as follow

### 1.4 Location, Administrative set up and Population

Alwar district is located in the north eastern part of Rajasthan and extends between north latitude 27° 03’ and 28° 14’ and east longitude 76° 07’ and 77° 13’. It covers 8720 sq. km of

geographical area. Its length from south to north is about 137 km and breadth from east to west is about 110 km. The district occupies about 2.45% of total area of the State.

Administratively, the district is divided into 12 sub-divisions and 12 tehsils (Alwar Bansur, Behror, Kathumar, Kishangarh Bas, Kotkasim, Laxmangarh, Mandawar, Rajgarh, Ramgarh, Thanagaz and Tijara)and 14 blocks(Bansur, Behror, Kathumar, Kishangarh Bas, Kotkasim, Laxmangarh, Mandawar, Neemrana, Rajgarh, Ramgarh, Reni, Thanagaz,Tijara and Umrain) (Fig.1). District has 2054 villages (including 2021 habited and 33 unhabited), 9 urban towns and 6 Municipalities.

As per census 2011, population of the district is 3674179 including 1939026(52.77%) male and 1735153 (47.23%) with population density as 438 persons/sq.km. The population in the rural area is 3019728 (82.19%) & 654451 (17.81%) in urban and sex ratio is 895 female per 1000 male. Population growth in rural and urban between census 2011 and 2001 has been registered as 15.30% and 33.54% respectively. A map of the district showing taluka boundaries, taluka headquarters, physical features and locations of monitoring wells is presented as Figure-1.

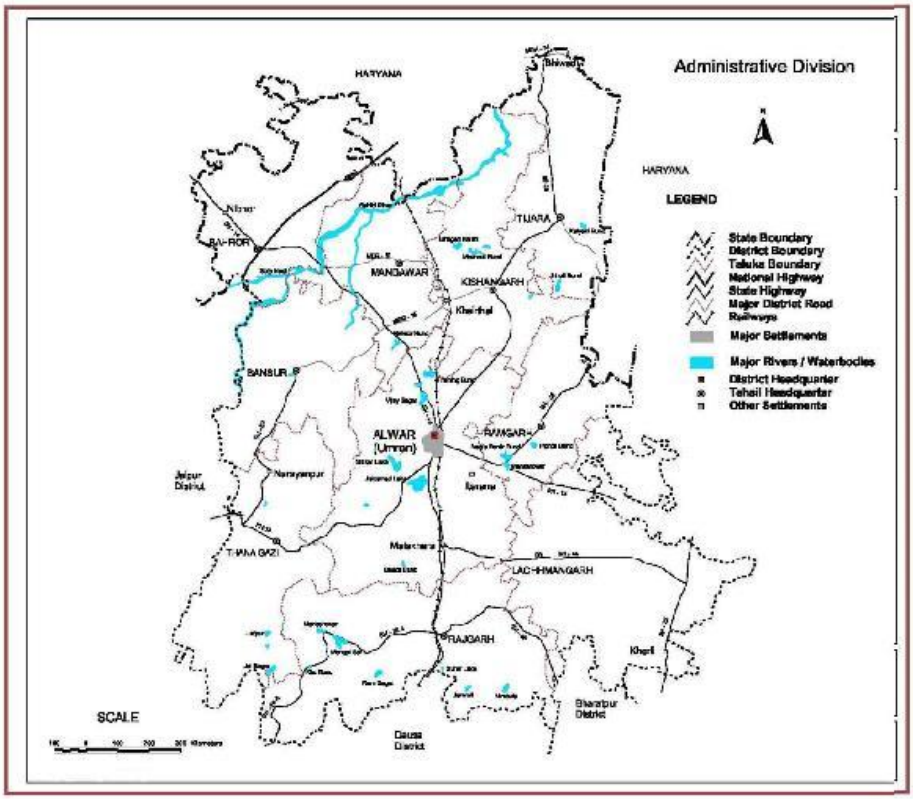



**Figure 1: Administrative Map, Alwar District**

## 1.5 Data availability and Data Adequacy

### 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 54 exploratory wells, 6 slim holes and 30 piezometers in the district as on March 2016. 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 29 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, 29 additional exploratory bore holes (including7 in hard rocks and 22 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. Four No. of exploratory well along with 3 observation wells have been constructed in the gaps indentified in the district. A total 182 number of wells have been inventoried including ground

water sampling in Alwar district from the data gap areas to have precise information on hydrogeology and ground water quality.

### 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°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 Thanagazi (733.8mm), which is located in the south western part of the district. It is lowest at Laxmangarh (549.3mm), which lies in south eastern part of the district. The potential evapo transpiration rates are quite high especially during May and June and annual total is 1706 mm. Climate is generally dry except during the monsoon period. Humidity is the highest in August with mean daily relative humidity of 75.15%.

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.

**Table 1: Climatological data, Alwar District**

| **Parameters** | **Month** | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Annual |
| Normal Rainfall(mm) (1950-80) | 12.7 | 11.8 | 9 | 4.7 | 15.3 | 58.1 | 180.4 | 199.4 | 137.1 | 19.3 | 2.7 | 6.8 | 657.3 |
| Pot. Evapo transpiration (mm) | 75 | 98 | 155 | 200 | 256 | 210 | 160 | 125 | 147 | 130 | 81 | 69 | 1706 |
| Max. Mean Daily Temp. (°c) | 21.8 | 24.9 | 31 | 36.8 | 41 | 39.9 | 34.7 | 32.8 | 33.5 | 33.2 | 29 | 24 | 31.9 |
| Min. Mean Daily Temp. (°c) | 7.7 | 10.4 | 15.4 | 21.2 | 26.5 | 28.5 | 26.6 | 25.4 | 24.1 | 18.7 | 11.9 | 8.4 | 18.7 |
| Relative Humidity, (%) - 0830 hrs | 68 | 57.3 | 44 | 31 | 31.3 | 47.7 | 74.3 | 80 | 73.7 | 54.7 | 52.3 | 62.3 | 56.4 |
| Relative Humidity, (%) - 01730hrs | 40 | 29.3 | 22.3 | 17.3 | 19.3 | 33 | 62.7 | 70.3 | 57.7 | 35.7 | 31.3 | 37.7 | 38.1 |
| Wind Speed, (km/hr) | 8.4 | 8.6 | 9.2 | 9.7 | 11.8 | 13.1 | 10.8 | 8.8 | 8.8 | 6.5 | 5.6 | 6.2 | 9.0 |

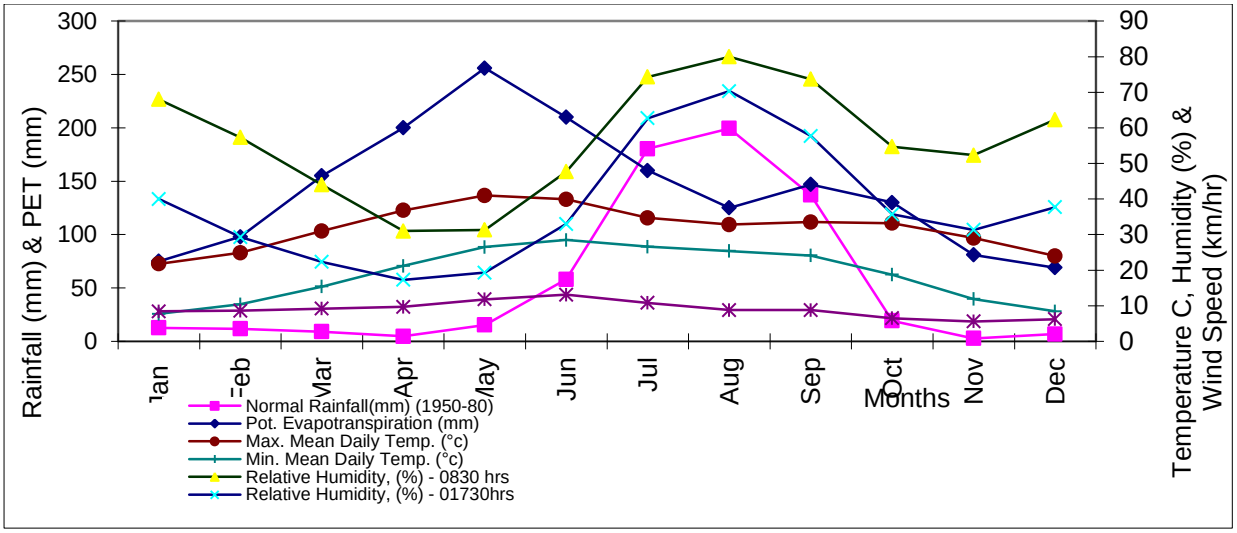



**Figure 2: Climatology Data, Alwar,District**

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

### 1.7.1 Soil

Mainly three major types of soils viz. lithosol & regosol of hills, older alluvium & recent alluvium are found in the area. Brief description of soils is given below and depicted in Figure 3.

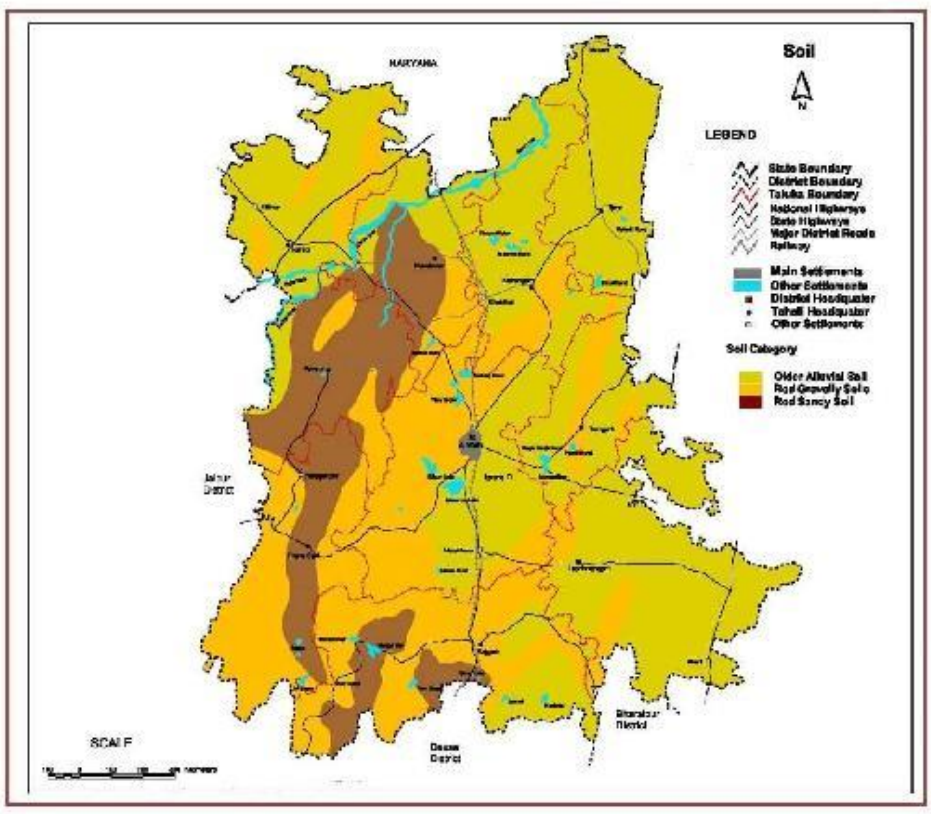



**Figure 3: Soil distribution, Alwar District**

a. Lithosol & regosol of hills (Red Grey valley Soil)

These are found in the Aravalli hills of south western part of the district. These soils are shallow with gravels found very near the surface, light textured, fairly drained, reddish brown to grayish brown in colour.

b. Older alluvium (Older Alluvial Soils)

These soils are derived from alluvium and found mainly in western parts of the district.
These soils are non calcareous, semi-consolidated to unconsolidated brown soils, loamy sand to sandy loam in texture. They are well drained and occupy gently sloping terrains.

c. Recent alluvium (Red Sandy Soils)

These soils are developed in alluvium and found mainly in the eastern part of the district. These soils are deep, well drained, sandy loam to loam in texture and non- calcareous.

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. The land use pattern of district is presented in Table 2.

**Table 2: Land Use, Alwar District**

| **Sl.No.** | **Land Use** | **Area in hectare** | **%** |
|---|---|---|---|
| 1 | Total geographical area | 783281 | - |
| 2 | Forest | 84886 | 10.84 |
| 3 | Uncultivable land | 126280 | 16.11 |
| 4 | Land not cultivated including pasture land; barren land; trees, grooves & orchards; padat land | 70702 | 8.91 |
| 5 | Actual sown area (subtracting double) | 502413 | 64.14 |
| 6 | Gross sown area | 866860 | |
| 7 | Area sown more than once | 364447 | |

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 prevailing tin areas where irrigation facilities are available. The major crops grown in the area are:

| | |
|---|---|
| Food Grain | Jowar, Bajra,Wheat, Barley, Maize, Rice |
| Cereals | Gram, other kharif cereals,Tur, other rabi cereals |
| Oil seeds | Rai & Mustard,Til, Ground Nut,Arandi/Taramira |
| Non food grains | Cotton,Onion,Red chilli,Tobacco,Potato,Jute |

### 1.7.4 Irrigation Practices

The principal means of irrigation in the district are through wells though very small areas irrigated by canals (0.075sq.km.). Ground water plays an important role for irrigation contribute almost 100% and is utilized through dug wells, dug cum bore wells, tube wells and bore wells run almost by electricity in the area. Out of gross sown area of 8573.18 sq.km, only 4815.20 sq.km. (56%) area is irrigated. There are total 90614 wells including 40529 non-utilizable/abandoned wells and 28 utilizable ponds.

### 1.7.5 Cropping Pattern

Gross sown area is 857318 hec with net sown area is 503527 hec. and area sown more than once is 349366hec. Area wise crops grown in the district are food grains (492417 hec), Tilhan/oil seeds (242673hec), Cereals (19581hec), Cotton (12711hec) and Sugercane (44hec).

## 1.8 Physiography & Geomorphology

### 1.8.1 Physiography

The district is quadrilateral in shape. The Aravalli ranges form ridges of rocky hills in most parts and are generally parallel. These make their appearance in the district from north east in Tijara subdivision and run southwards forming boundary of the district in the north east for about 24 km, terminating near Naugaon. Another prominent hill range is at Mandawar, which passes through Jindoli and Alwar towards the extreme south west corner of the district adjacent to Jaipur district. The low hills cover almost entire Thanagaji and Rajgarh tehsils & about one third of the Alwar tehsil and form prominent feature in Bansur, Kishangarh and Tijara tehsils. Mandawar, Behror, eastern part of Alwar, Rajgarh tehsils and western part of Bansur tehsils are gentle plains with scattered peaks of small hills. The highest peak in the district is at Bilahi, which is 775 mamsl.

### 1.8.2 Geomorphology

Various geomorphological units in the district are given in Table 3 below and depicted in Figure 4.

**Table 3. Geomorphological units, Alwar district**

| S. No. | Origin | Landforms | Description & Occurrence |
|---|---|---|---|
| 1 | Fluvial | Alluvial plains | Mainly undulating landscape formed due to fluvial activities scattered in entire district |
| | | Valley fill | Formed by fluvial activities usually at low topographic locations mainly south west of Thanagaji and north west of Alwar town |

| S. No. | Origin | Landforms | Description & Occurrence |
|---|---|---|---|
| | | Ravine | Small narrow deep depressions occur along river Sabi |
| | | Flood plain | Surface of relatively smooth land adjacent to a river channel as found along river Sabi and Sota. |
| 2 | Denudational | Pediment and Buried Pediment | Broad gently sloping rock forming erosion surface of low relict between hills and plains. Occurs along forest hills & east of Kherthaltown around Gola Ka Bas. |
| 3 | Aeolian | Sandy plains | Formed by the wind activities. Occurs in west & north eastern parts. |
| 4 | Hills | Linear ridge | Long narrow low lying ridge usually barren. Occurs in south eastern parts. |
| | | Denudational hill | Steep sided relict hills. Occur north of Hamirpur and east of Khara village. |
| | | Structural hills | Linear to arcuate hills associated with folding & faulting etc. Occurs in western boundary of the district. |

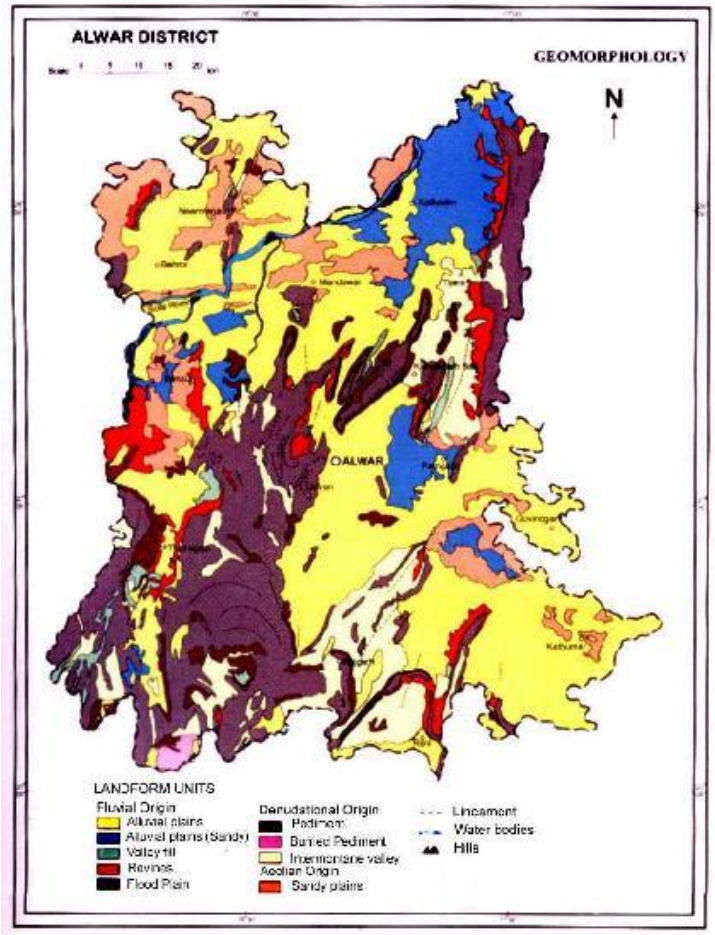



**Figure 4. Geomorphology, Alwar District**

1.8.3 Drainage

There is no perennial river in the district. The seasonal rivers, which flow through the district and carry the runoff from the hills are Sabi (Sahibi), Ruparail (Barah), Chuhar Sidh and Landoha. Several of these rivers and their tributaries have been impounded at suitable sites and the water is used for irrigation if remains available. The natural drainage is from south west to north east. Tehsil wise river basin area of district is given in Table 4.

**Table 4: Tehsil-wise distribution of River Basin area, Alwar District**

| S. No. | Name of Tehsil | River Basin (sq. km) | | |
|---|---|---|---|---|
| | | **Sabi** | **Ruparail** | **Banganga** |
| 1 | Alwar | 87.7 | 1077.8 | 0.3 |
| 2 | Bansur | 551.4 | 98.9 | - |
| 3 | Behror | 242.6 | - | - |
| 4 | Kathumar | - | - | - |
| 5 | Kishangarh | 564.9 | 138 | - |
| 6 | Kot kasim | - | - | - |
| 7 | Laxmangarh | - | - | 967.1 |
| 8 | Mandawar | 607.4 | - | - |
| 9 | Rajgarh | - | 254.6 | 725.6 |
| 10 | Ramgarh | - | 659.3 | - |
| 11 | Thanagazi | 68.1 | 114.8 | 554.6 |
| 12 | Tijara | 625.3 | 193.6 | - |
| **TOTAL** | | **2747.4** | **2537.0** | **2247.6** |

## 1.9 Hydrology

There is no natural lake in the district. However, there are 24 talab/bunds in the district used for irrigation if water is available. The tehsil wise status of bunds existing the district is presented in Table 5.

**Table 5: Status of Irrigation Bunds,Alwar District**

| Sl.No. | Tehsil | No.of Talab/ Bunds | Gross Water Capacity (million feet) | Normal Water Capacity (million feet) | Command Area(hec) | Water Catchment | Length of canals(km) |
|---|---|---|---|---|---|---|---|
| 1 | Rajgarh | 4 | 1432.52 | 1294.60 | 4419.00 | 114.50 | 39.25 |
| 2 | Laxmangarh | 1 | 106.00 | 212.40 | 3419.78 | 70.70 | 21.80 |
| 3 | Kathumar | 1 | 106.40 | 106.40 | 691.00 | 21.20 | 0.00 |
| 4 | Tijara | 3 | 152.38 | 151.45 | 1366.00 | 19.20 | 9.02 |
| 5 | Kishangarh | 3 | 454.00 | 311.00 | 1657.00 | 151.70 | 13.16 |
| 6 | Mundawar | 2 | 34.43 | 33.52 | 334.00 | 7.68 | 9.02 |
| 7 | Behror | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 8 | Bansur | 2 | 333.00 | 418.00 | 3472.00 | 136.00 | 22.15 |
| 9 | Alwar | 3 | 1643.00 | 1301.25 | 6129.00 | 152.20 | 53.95 |
| 10 | Thanagazi | 4 | 644.71 | 330.31 | 2436.00 | 130.31 | 14.30 |
| 11 | Ramgarh | 1 | 0.00 | 0.00 | 2284.00 | 133.00 | 0.00 |
| 12 | Kotkasim | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **Total** | | **24** | **4936.44** | **4158.93** | **26207.78** | **936.49** | |

Bunds/talabs dried up during summer period and water are not available for irrigation during kharif cultivation. Irrigated area by bund/talab is only 17 hectare *(Source:Department of Economics & Statistics, Govt. of Rajasthan 2013-14).*

## 1.10 Prevailing Water Conservation Practices

The water conservation practices in the district are ponds and baories, however the baoaries are non functional in the present times owing to sharp decline in water levels in the district. There are 24 bunds/talabs which acts as recharge body and contribute recharge to ground water. Gross water capacity and normal water capacity of talabs/ponds 4936.44 million feet and 5158.93

million feet respectively. Water in the said talab/bund do lasts long and gets dried up on the inception of summer and not available for irrigation during kharif crop cultivation.Hardly runoff is generated during monsoon in the alluvial part of district due to scanty and scattered rainfall.Some of the bunds are very old and need repair, renovation and restoration and such two bunds are Silised and Jaisagar with its canal are in progress under Jayaka scheme by Govt. of Rajasthan.

# 2.0 Data Integration, Interpretation, Aquifer Mapping And Ground Water Scenario.

## 2.1 Geology

The district is underlain by rocks of Delhi Super Group with minor out crops of Bhilwara Super Group and Post Delhi intrusive covered by Quaternary alluvium. The stratigraphic succession after Geological Survey of India is given below:

**Geological Succession, Alwar District**

| Age | Super Group | Group | Litho- Formation | Description |
|---|---|---|---|---|
| Quaternary | - | Recent to sub-recent | Wind blown sand | Aeolian sand deposit composed of very fine to fine grained, yellowish brown & unconsolidated and covers the greater part of the overlying recent alluvium, along the river courses. |
| | | | Alluvium | Composed of silt, clay, with kankar, sand, gravel and pebble bed. Occupies about 5400 sqkm area and covers mostly northern,central western, eastern part and areas south of Alwar . Alluvium is occupied in valley floor of major river basins and tributaries inter-mountain valleys. Thickness of alluvium varies from 40 to 137mbgl in Sabi basin, from 49 to 98 m in Banganga basin, from 60 to 70 m in Alwar valley. |
| U N C O N F O R M I T Y | | | | |
| | | Post Delhi intrusives | Quartz veins, pegmatite, granite, amphibolite | Number of acid and basic intrusive occur in Delhi Group. |
| | | Ajabgarh | Quartzite, phyllite, | Occurs in the south-eastern, central |

| | | | | |
|---|---|---|---|---|
| Pre-cambrian | Delhi Super Group (exposed over major parts of the district and dominating) | Group | mica schist, calc-schist, and gneiss, marble and basic flows | and northern parts of the district. |
| | | Alwar Group | Quartzite, conglomerate and conglomerate and quartz sericite schist | Covers wide tract from south-western to central part of district and to the east of Alwar town. Dominance of arenaceous material. |
| | | Raialo Group | Marble, dolomite, conglomerate and felspathic quartzite | Occurs as discontinuous exposures in the southern and south western part of district within the Alwar Group of rocks |
| U N C O N F O R M I T Y | | | | |
| Archaean | - | Bhilwara Super Group (Pre-Aravalli) | Granite, granitic gneiss, migmatite, phyllite, slate and schist | Occurs in the southern most part of the district as isolated out crops in the Delhi Super Group of rocks. |

Based on the consistent data 176 boreholes (including of CGWB and GWD) using Rock Works software, borehole lithology and a three dimension picture of the regional lithology of the district has also been generated which are shown in Figure 5 and 6. Study of 3 D picture of lithological model indicate extensive deposit of Quaternary sediments both in lateral and vertical directions. Thickness of alluvium reaches to a maximum of 137m in Sabi basin. The bore hole depth varies from 41 to 174 m. The depth range of alluvium varies from 1 to 156 m, weathered part from 6 to 15 m and hard rocks from 0.1 to 170 m below ground level.

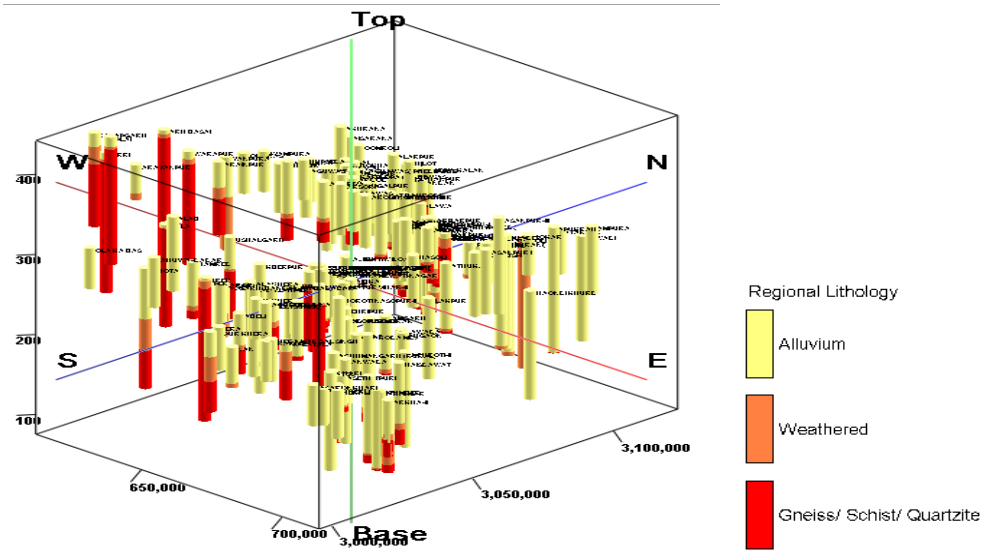



**Figure 5: Borehole Lithology, Alwar District**

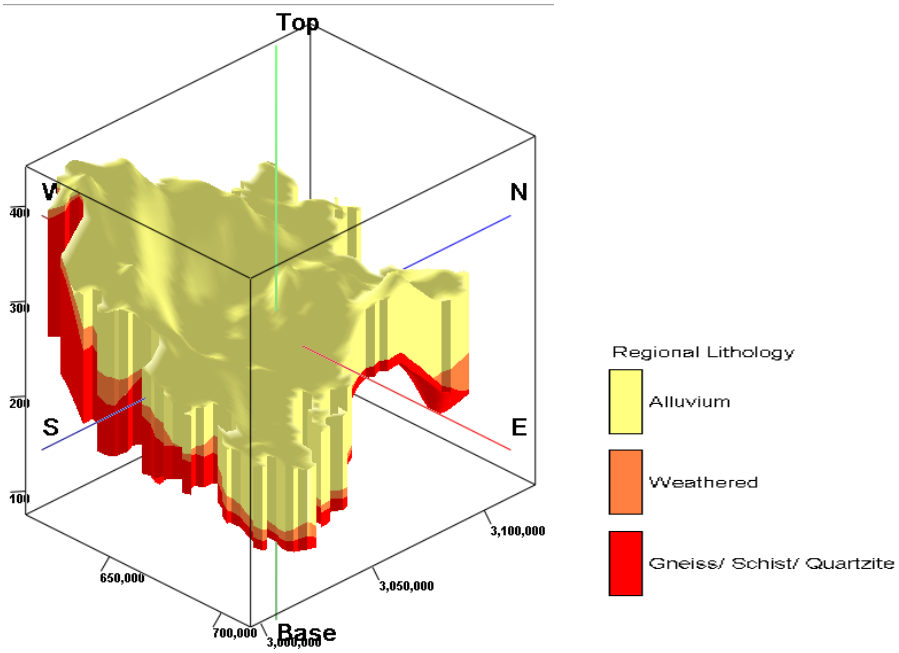



**Figure 7: Regional Lithological Model of Alwar District**

Tectonically, the rocks are much disturbed as evidenced by numerous major and minor faults, fold, joints and fractures.The major structures encompassregional faults, major folds extending from a kilometer to several kilometers. The major folds are generally parallel to Great Boundary Fault of Rajaputana (Heron 1922-35).

## 2.2 Hydrogeology

Alwar district is mostly underlain by the rocks of Delhi Super Group with minor outcrops belonging to Bhilwara Super Group and Post Delhi Intrusives at places overlain by Quaternary alluvium.The occurrence of ground water in the area is mainly controlled by the topographic

features, physical characteristics and structural features present in the geological formations. Ground water occurs under unconfined conditions in phreatic zones, semi-confined conditions in deeper zones and weathered & fractured portions of the hard rocks.A two dimentional map depicting hydrogeology of district is presented in Figure 7.

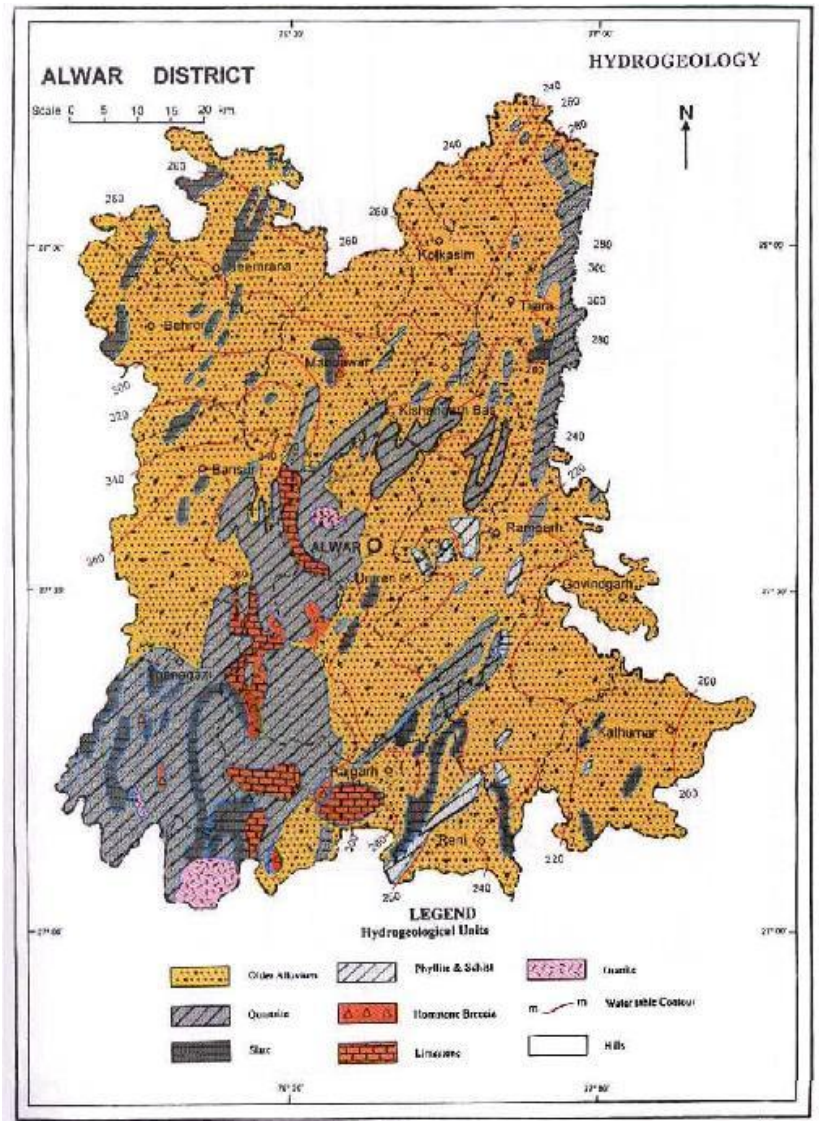



**Figure 7: Hydrogeologiacal map, Alwar District**

2.2.1 Aquifer system

a. Alluvial Aquifer

Quaternary sediments overlying the hard rock formations constitute principal aquifer and constitutes 5784.68 sq.km. (80%). Ground water occurs in the pore spaces and interstitial openings and occurs under phreatic conditions. Alluvial aquifer covers major parts of all the blocks except Thanagazi and Rajgarh blocks. Exploratory drilling done in the district by CGWB has revealed the extension of aquifer both in lateral and vertical directions. However, different

water bearing lithological units of the Quaternary deposits are inter-connected and behave like a single hydrogeological unit. However a three dimension picture of the aquifers in the district has also been generated and is depicted in Figure 6.

Exploratory drilling in the district has revealed that:

- The alluvial deposit consists of silt, clay with kankar, sand, gravel and pebble beds. These sediments are generally unconsolidated, unsorted, angular to sub-angular, fragments of parent's rocks mixed with coarse sand and a little kankar. The major river courses and their tributaries, intermountain valleys are occupied by Quaternary alluvium. The coarse sediment are encountered in the small intermountain valleys located in the hilly terrain of the district such as areas around Kushalgarh-Bairawas; Sirawas; Rogra; Hazipur, Chandoli & Perisal;Seriska-Bhartholi and its joining areas.
- The valley floor of the major river basins and tributaries are have alluvium comprising stream laid deposits of clay, sand of various size, kankar, gravel, cobbles and boulders. Sabi river basin falls in northern part of district. In the upper reaches of Sabi basin, the alluvium is devoid of cementing material except with in the capillary fringe where, grains are cemented with secondary calcium carbonate. The thickness of alluvium is highly variable and encountered maximum with depth of 137 mbgl at Hina Ka Lan otherwise in general ranges from 40 to 107 mbgl.
- In the Banganga river basin, thickness of alluvium ranges from 49 to 98mbgl. In the Berah river basin, lies between 30m at Rajgarh and 114 m at Tulsera. However, it is 125 m north of Tulsera. In the plain areas around Laxmangarh, alluvial thickness varies from 6 to 19mbgl. Thickness of sediments varies from 90 to 124 m in the areas north east of Ramgarh.
- Talus and scree material derived from hills form the sediments which are composed of angular to sub-angular fragments of quartzite with fine to coarse sand and are covered by thin blanket of clay and kankar in the areas close to the hill ranges.
- The Alwar valley of about 480 sq.km. is underlain by sediments comprising clay and kankar, sand, gravel and boulders.

Exploratory data indicate that thickness of sediments in the piedmont area, varies generally between 60 and 70mbgl, however ranges from 90 to 110 mbgl in the central part of the valley.The proportion of fine sediments increases significantly in the central part. Alluvial aquifer has been reduced/squeezed due to the drastic decline in water level over the years and reached into the underlying hard formation mainly in parts of Behror, Umrain, Govindgarh, Reni, Neemrana, Mandawar blocks of district.

Depth of exploratory drilling in alluvium varies from 44.80 to 160.07 m having depth of wells from 44.60 to 158m. Discharge of tube wells from 35 to 1003 lpm. However, discharge of tubewells drilled in the area has been analyzed in terms of their potentiality and their discharge ranges is given below:

| **Discharge range(lpm)** | | **Tubewell/Borewell** | |
|---|---|---|---|
| **From** | **To** | **Number** | **Precentage(%)** |
| 0 | 100 | 12 | 17 |
| 100 | 200 | 5 | 7 |
| 200 | 400 | 20 | 28 |

| Discharge range(lpm) | | Tubewell/Borewell | |
|---|---|---|---|
| 400 | 600 | 20 | 28 |
| > 600 | | 14 | 20 |
| Total | | 71 | 100 |

Transmissivity of alluvial aquifer varies from 27 to 662 $m^2$/day and storativity value from $5.0x10^{-5}$ to $2.6x10^{-2}$.

b. Hard Rocks Aquifer

Hard rocks including quartzite, slate etc. forms second major aquifer in the district and covers an area of 1416.93sqkm(20%). Hard rock aquifer mostly occurs in parts of Thanagazi(624.21sqkm), Rajgarh(402.83sqkm),Ramgarh(143.54sqkm),Tijara(106.77sqkm), Kishangarh(83.33sqkm) and Behror(56.25sqkm).The occurrence and movement of ground water is controlled by secondary porosity i.e. through the bedding planes, fissures, joints, fractures, solution cavities and other structurally weaker planes. Ground water occurs under phreatic condition in weathered zone of shallow aquifer and under semi-confined condition in deeper aquifer of hard formation. They do not form important water bearing formation except in the fractured and brecciated quartzite at places. A three dimension picture of the aquifers in the district is portrayed in Figure 6.

Depth of exploratory drilling in hard rock varies from 92 to 202.70m. Discharge of tube wells from 32 to 850 lpm. However, discharge of borewells drilled in the area have been analyzed in terms of their potentiality and their discharge ranges is given below:

| **Discharge range(lpm)** | | **Tubewell/Borewell** | |
|---|---|---|---|
| **From** | **To** | **Number** | **Precentage(%)** |
| 0 | 100 | 6 | 38 |
| 100 | 200 | 3 | 19 |
| 200 | 400 | 4 | 25 |
| 400 | 600 | 1 | 6 |
| > 600 | | 2 | 12 |
| **Total** | | **16** | **100** |

Three dimension aquifer disposition model has been prepared using Rock Works Software (Figure 8). Model indicate the disposition of desaturated/saturated alluvial/weathered part of underlying hydrogeological formation in the study area with saturated thickness ranging from 0.60 to 131m with average of 34m.

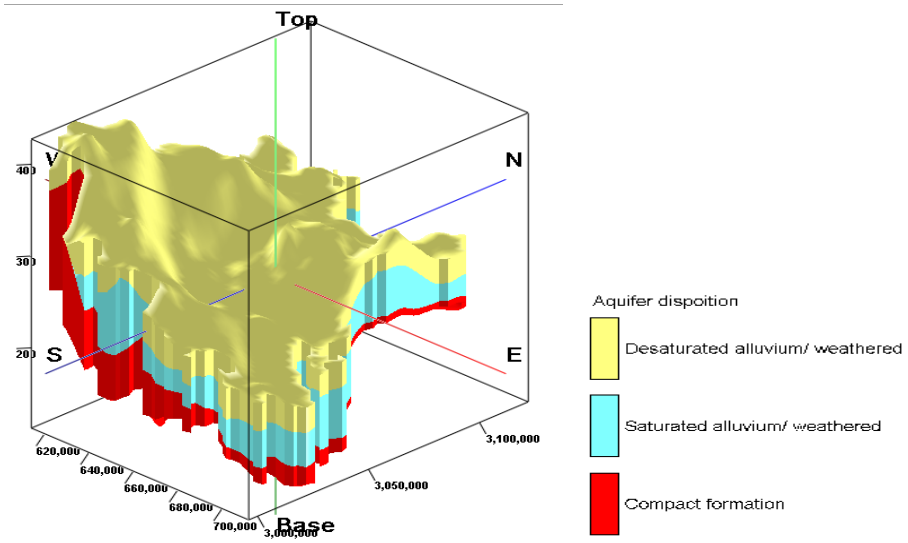



**Figure 8: Aquifer Disposition, Alwar District**

The 3-D Fence diagram has been prepared using the said software given in Figure 9.

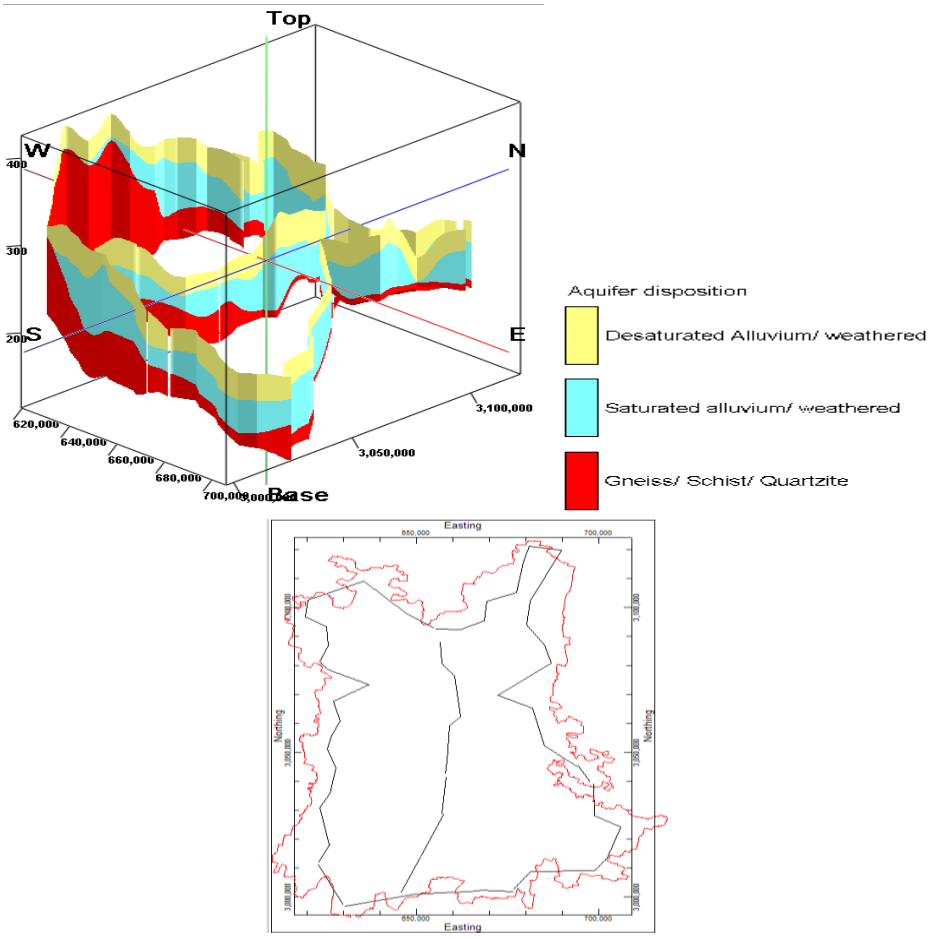



**Figure 9: Aquifer Disposition, Alwar District**

The following hydrogeological sections showing aquifer disposition, have been prepared (Figure 11 A to 11 H) and their alignment is depicted in Figure 12.

- Section A - A' : Piplai-Narayanpur-Garh Basi-Narainpur (Figure 11A)
- Section B – B' :Gyanpura-Holawas-Shyampura-Bansur-Bararіya(Figure 11B)
- Section C – C' :Kanhawas-Fauladpur-Palawa-Darbarpur(Figure 11C)
- Section D – D' :Pur- Bhokar-Tatarpur-Shyampura(Figure 11D)
- Section E – E' :Khairthal-Bhindusi-Luhadera(Figure 11E)
- Section F – F' :Shahpur-Alwar-Gajura- Kaochikani(Figure 11F)
- Section G –G' :Tehla- Dhamred-Khera Mangal Singh(Figure 11G)
- Section H – H' :Baroda Mev- Sonar (Figure 11H)

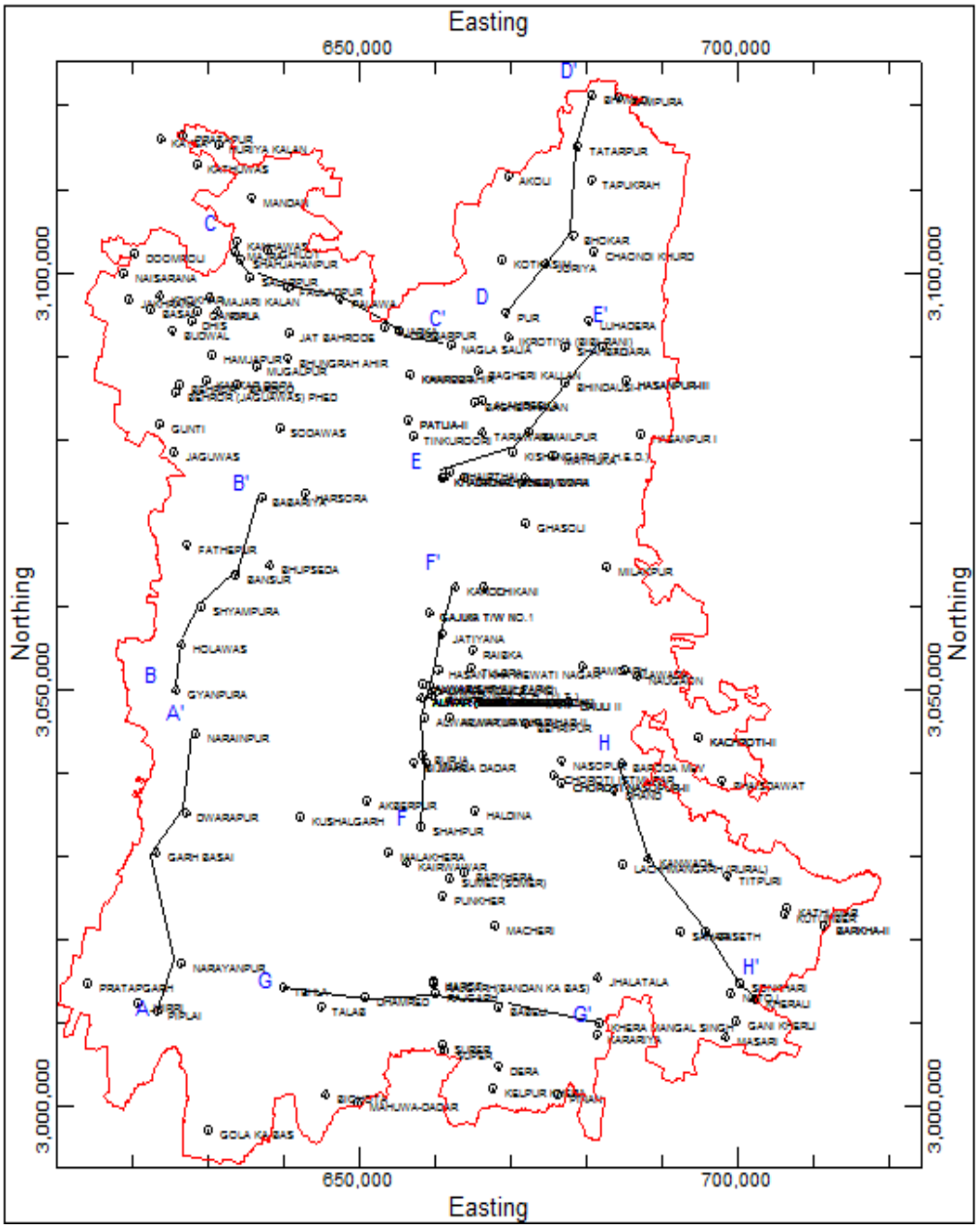



**Figure 10: Alignments of hydrogeological cross sections, Alwar District**

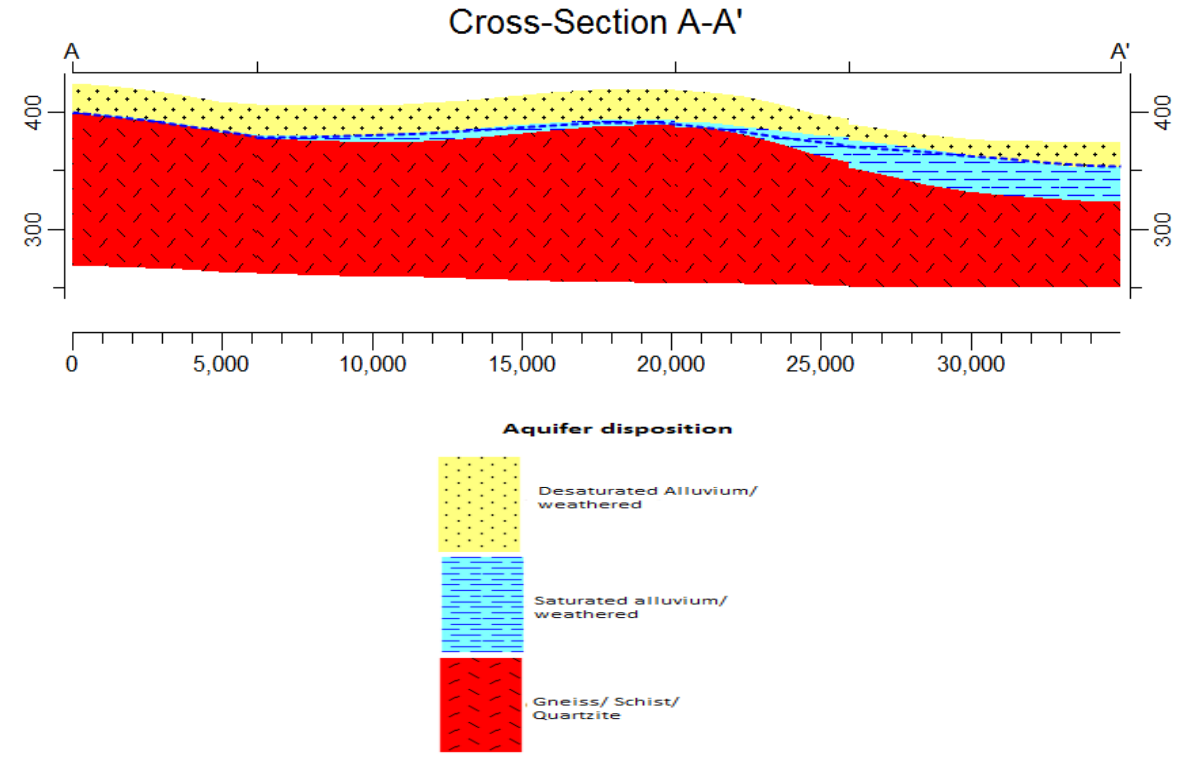



**Figure 11A: Section A - A': Piplai-Narayanpur-Garh Basi-Narainpur**

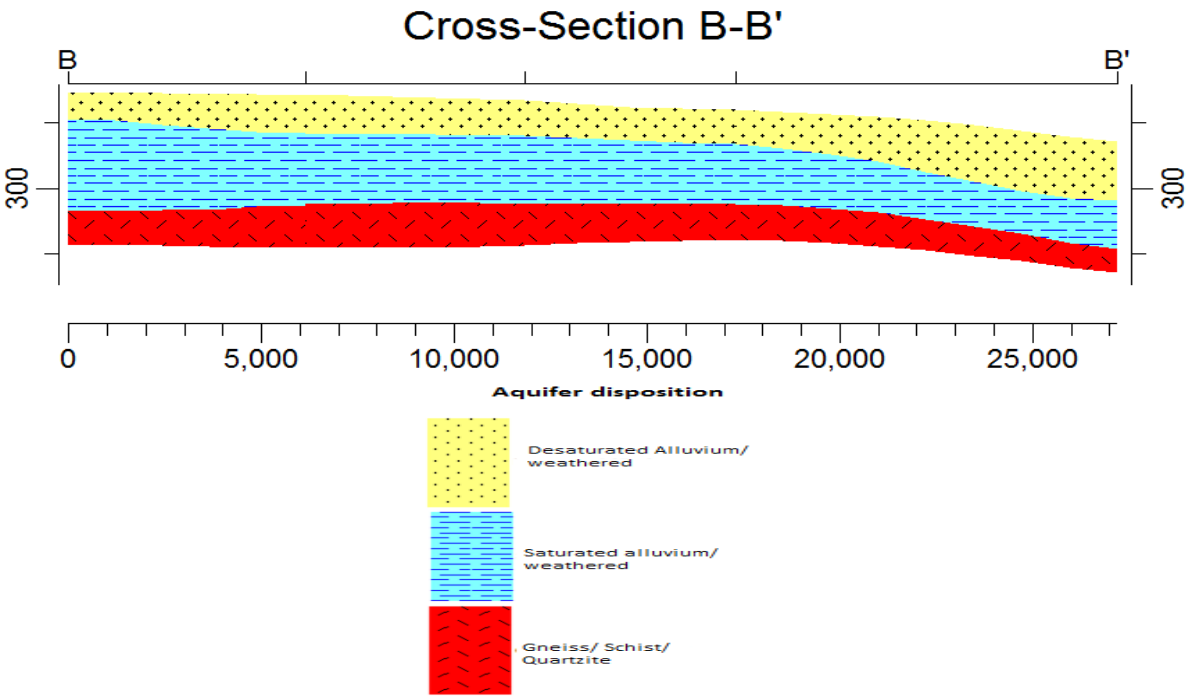



**Figure 11B: Section B – B': Gyanpura-Holawas-Shyampura-Bansur-Barariya**

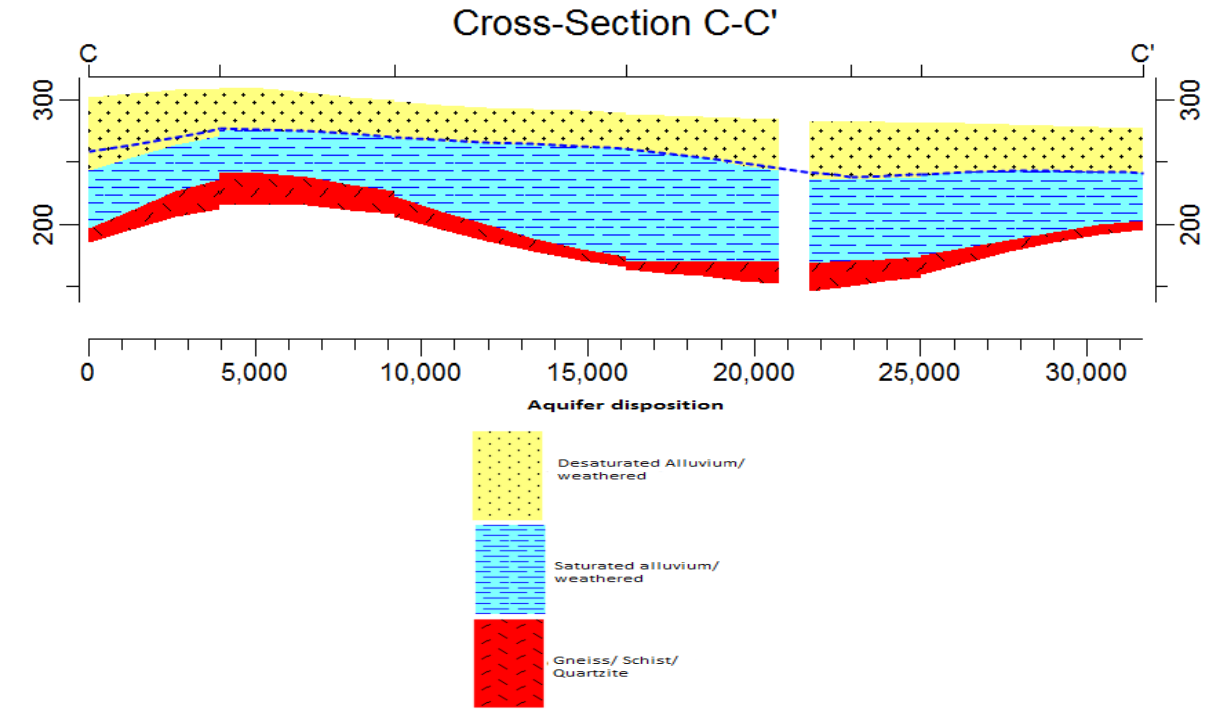



**Figure 11C: Section C – C': Kanhawas-Fauladpur-Palawa-Darbarpur**

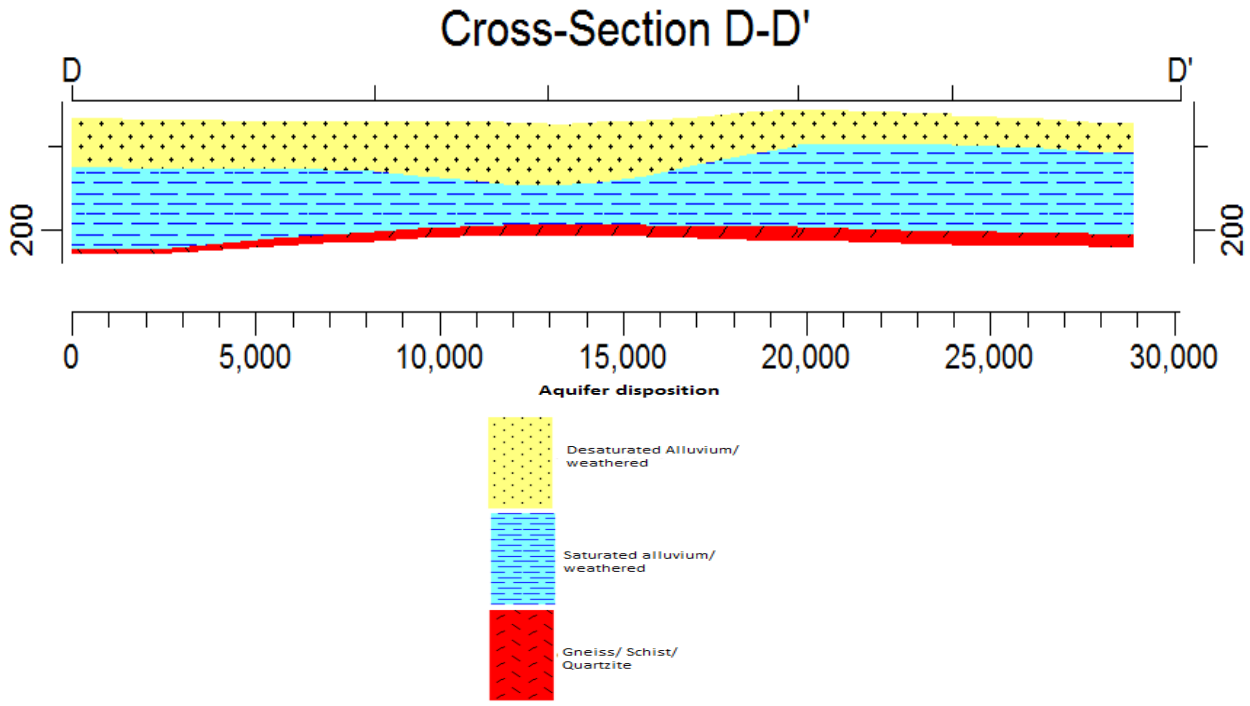



**Figure 11D: Section D – D': Pur- Bhokar-Tatarpur-Shyampura**

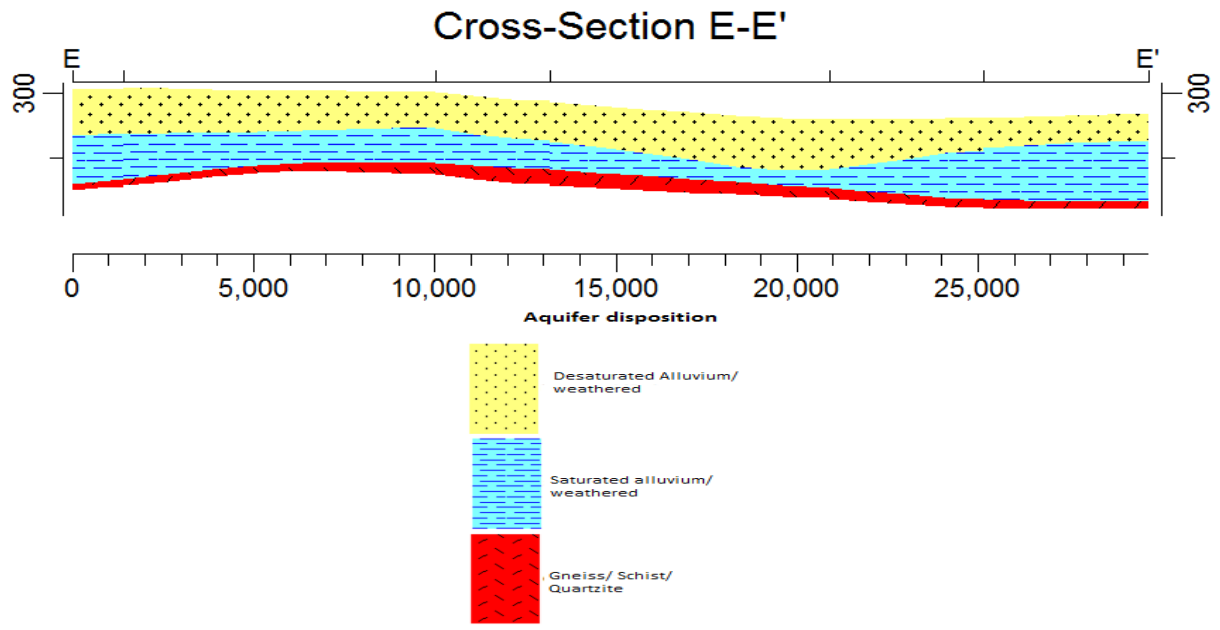



**Figure 11E: Section E – E' :Khairthal-Bhindusi-Luhadera**

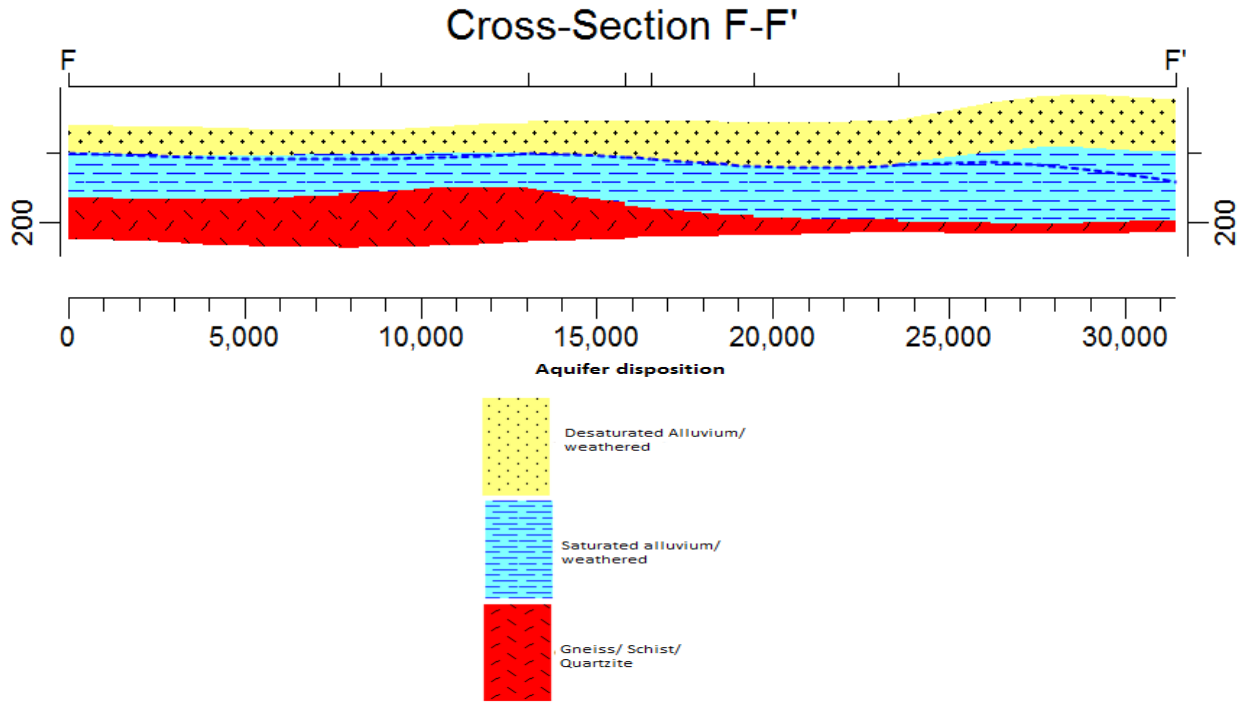



**Figure 11F: Section F – F': Shahpur-Alwar-Gajura- Kaochikani**

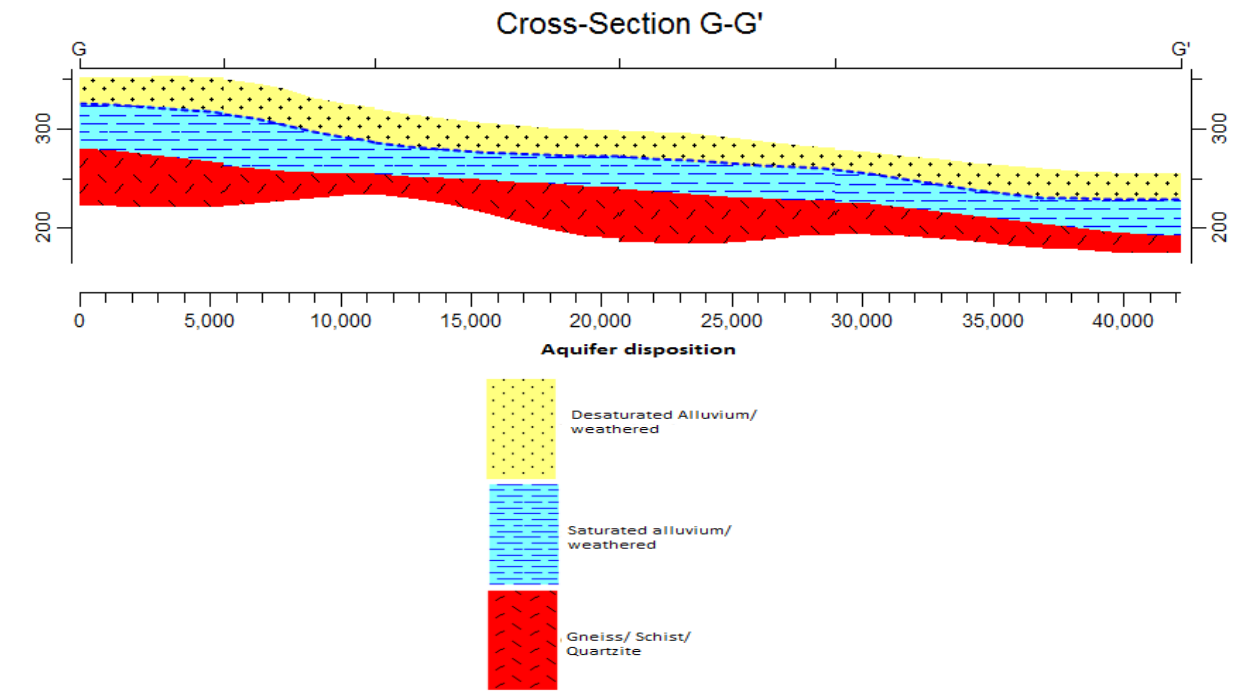



**Figure 11G: Section G –G': Tehla- Dhamred-Khera Mangal Singh**

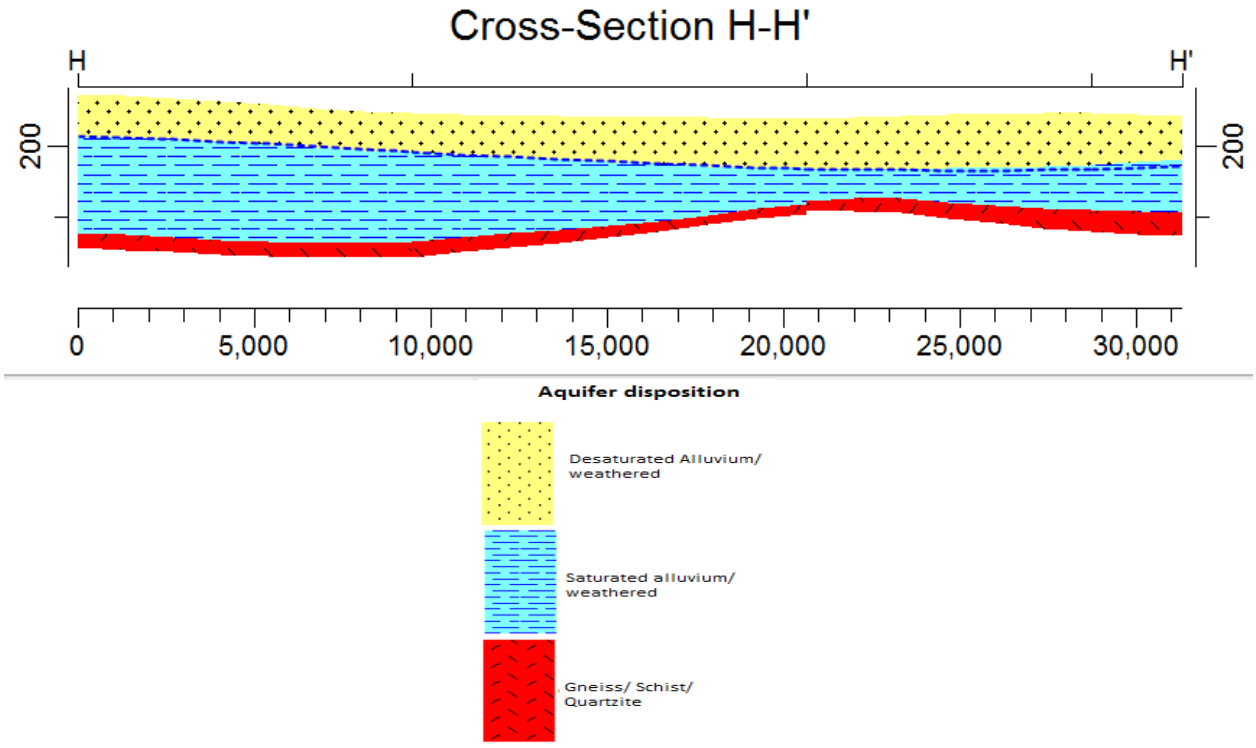



**Figure 11H: Section H – H': Baroda Mev- Sonar**

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 36 active National Hydrograph Network Stations (NHNS) stations 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-2015):

The depth to water level varies widely from about 4.70 (lowest at Tehla in Rajgath block) to about 75mbgl (deepest at Behror in Behror block). Water level is comparatively shallow in the south western, eastern parts and in Sabi river basin and Barah river basin, especially along river (Figure 12).Whereas, it is deeper in the north west and western parts of the district. Block-wise water level ranges are given below:

**Block-wise Range of Depth to ground Water Level, Alwar District(May, 2015)**

| Sl.No. | Name of Block | Depth to Ground Water Level Range (mbgl) | |
|---|---|---|---|
| | | From | To |
| 1 | Bansur | 26.59 | 36.50 |
| 2 | Behror | 75.00 | 75.00 |
| 3 | Kathumar | 18.90 | 33.15 |
| 4 | Kishangarh Bas | 38.72 | 38.72 |
| 5 | Kotkasim | 19.00 | 26.15 |
| 6 | Laxmangarh | 7.68 | 36.70 |
| 7 | Mandawar | 34.10 | 49.60 |
| 8 | Neemrana | 58.21 | 59.15 |
| 9 | Rajgarh | 4.70 | 13.26 |
| 10 | Ramgarh | 21.30 | 23.25 |
| 11 | Reni | 23.35 | 23.35 |
| 12 | Thanagazi | 27.00 | 27.00 |
| 13 | Tijara | 7.25 | 24.06 |

| | | | |
|---|---|---|---|
| 14 | Umrain | 13.45 | 41.80 |

| **DTWL (May, 2015)** | |
|---|---|
| Water Level(mbgl) | Area in sq.km. |
| 2-5 | 0.72 (0.01%) |
| 5-10 | 203 (2.83%) |
| 10-20 | 1856 (25.77%) |
| 20-40 | 4223 (58.63%) |
| >40 | 920 (12.76) |
| ➢ DTWL: 5 - 77mbgl<br>71% of area has > 20m Water Level | |

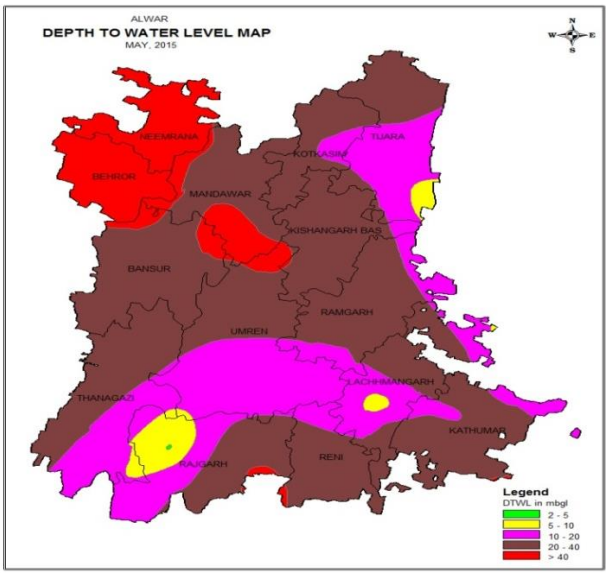



**Figure 12: Depth to Ground Water Level Map (May, 2015) Alwar District**

The perusal of map indicates that approximately 71% of area has water level more than 20m and maximum area of district i.e. 4223sqkm (8.63%)has water level between 20 and 40 m.

Post-monsoon (Nov, 2015):

The depth to water level varies widely from about 5.72 (lowest at Tehla in Rajgath block) to about 76.10mbgl (deepest at Behror in Behror block). Water level is comparatively shallow in the south western, eastern parts and in Sabi river basin and Barah river basin, especially along river (Figure 13).Whereas, it is deeper in the north west and western parts of the district. Block-wise water level ranges are given in below:

**Block-wise Range of Depth to ground Water Level, Alwar District) Nov, 2015)**

| **Sl.No.** | **Name of Block** | **Depth to Ground Water Level Range(mbgl)** | |
|---|---|---|---|
| | | **From** | **To** |
| 1 | Bansur | 27.10 | 37.10 |
| 2 | Behror | 28.48 | 76.10 |
| 3 | Kathumar | 17.92 | 33.15 |
| 4 | Kishangarh Bas | 38.47 | 38.47 |
| 5 | Kotkasim | 19.00 | 26.30 |

| Sl.No. | Name of Block | Depth to Ground Water Level Range(mbgl) | |
|---|---|---|---|
| 6 | Laxmangarh | 7.93 | 22.30 |
| 7 | Mandawar | 34.95 | 49.55 |
| 8 | Neemrana | 60.65 | 61.53 |
| 9 | Rajgarh | 5.72 | 17.36 |
| 10 | Ramgarh | 16.36 | 23.15 |
| 11 | Reni | 20.45 | 50.52 |
| 12 | Thanagazi | 27.00 | 27.00 |
| 13 | Tijara | 8.10 | 24.30 |
| 14 | Umrain | 13.20 | 43.52 |

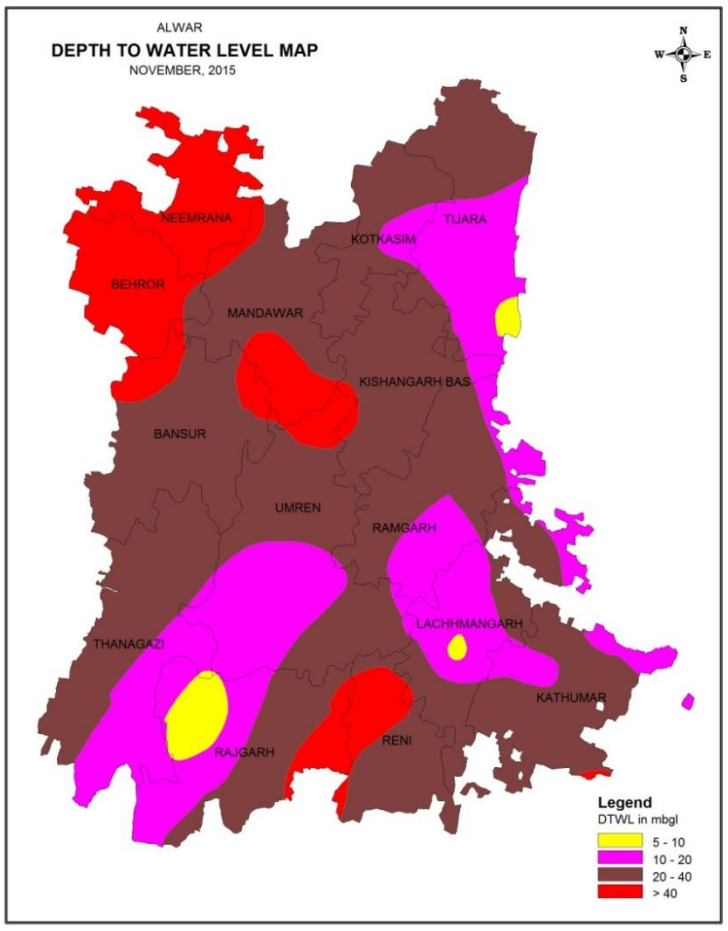



**Figure 13: Depth to Ground Water Level (Nov, 2015), Alwar District**

Seasonal Water level Fluctuation (Nov, 2015 versus May, 2015):

Seasonal water level fluctuation map (pre-monsoon versus post-monsoon, 2015) has been prepared (Figure 14). Perusal of map indicate that negative fluctuation has been observed in major part of area except area lying in south-eastern part, and isolated pockets in north eastern part of district. Positive fluctuation has been found in areas of shallow water level along rivers courses and in hard rock terrain.

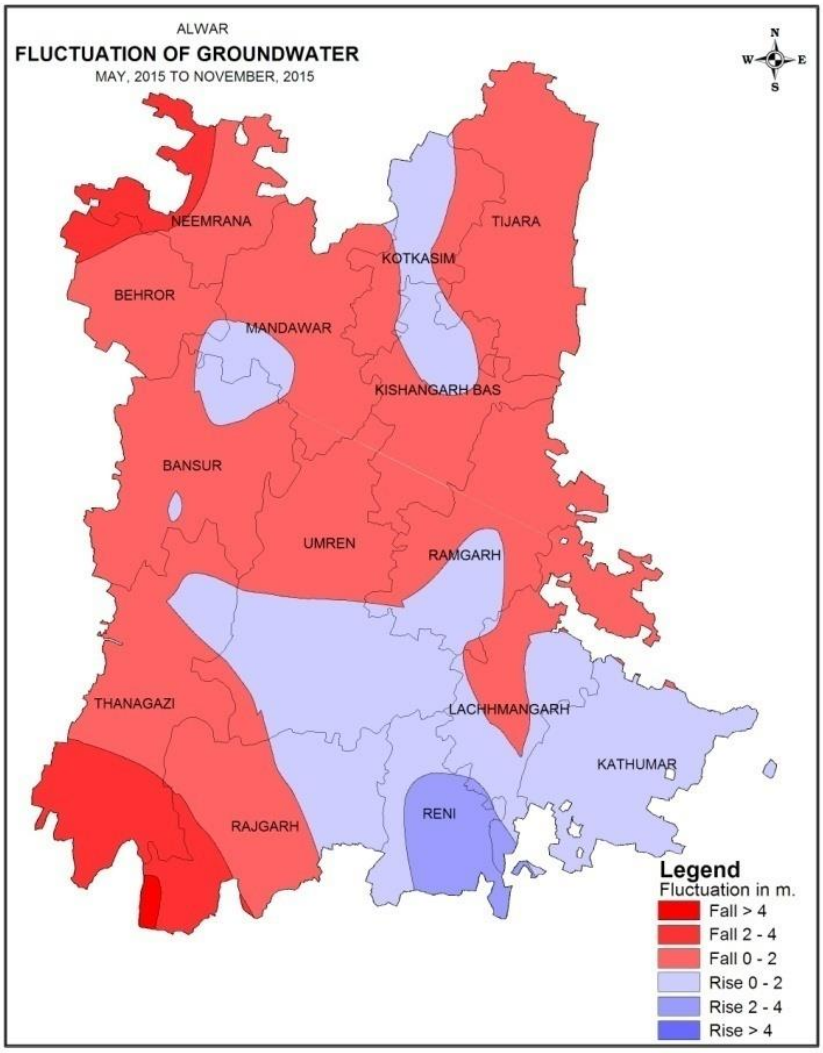



**Figure 14: Seasonal Ground Water Level Fluctuation (pre versus post monsoon, 2015)**

Decadal Water level Fluctuation (2005-14 versus May, 2015):

Decadal water level fluctuation map (2005-14 versus May, 2015) has been prepared (Figure 15). Perusal of map indicate decline in water level ranging from less than 2m to more than 4m in major part of the district except isolated pocket falling in extreme south-western part of district where marginal rise in water level has been observed. Marginal rise in water level may be due to less withdrawal of ground water in the area being hilly and less availability of cultivable area.

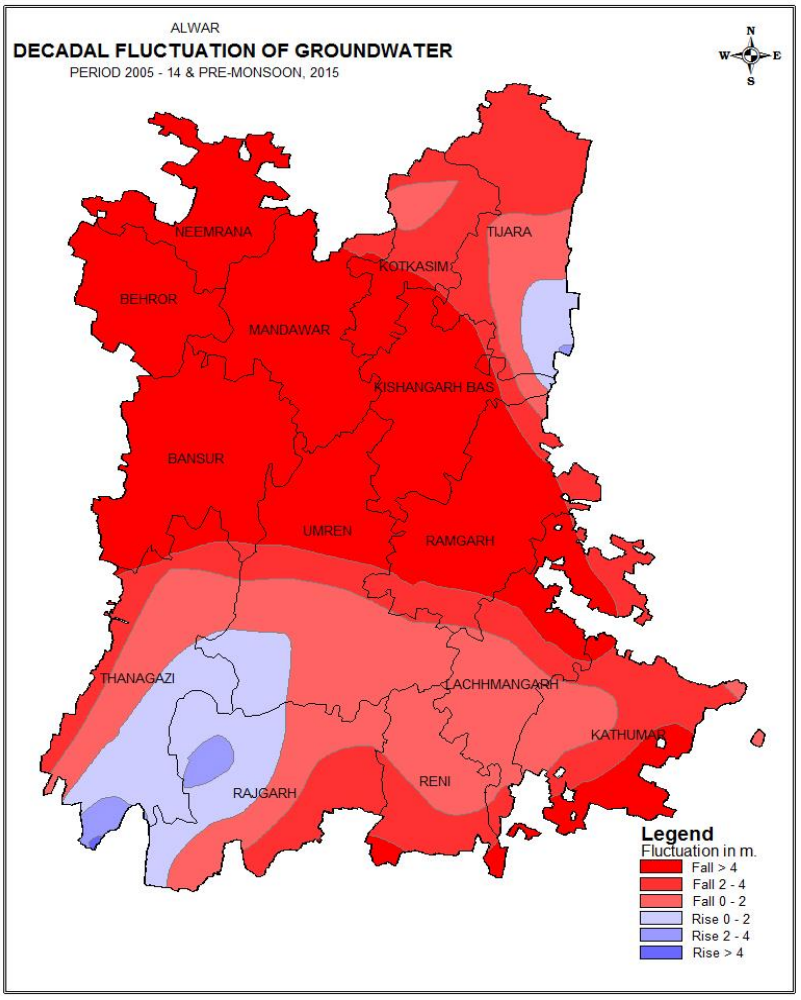



**Figure 15: Depth to Ground Water Level (Nov., 2015), Alwar District**

Long Term Water Level Trend (2001-2012):

Block-wise long term ground water level trend for the period 2001 to 2012 are given below:

**Block-wise Ground Water Level Trend(2001-2012), Alwar District**

| Sl.No. | Name of Block | Ground Water Level Trend (metre/year) | Remarks |
|---|---|---|---|
| 1 | Bansur | 1.24 | Declining |
| 2 | Behror | 2.55 | Declining |
| 3 | Kathumar | 1.33 | Declining |
| 4 | Kishangarh Bas | 1.11 | Declining |
| 5 | Kotkasim | 1.02 | Declining |

| Sl.No. | Name of Block | Ground Water Level Trend (metre/year) | Remarks |
|---|---|---|---|
| 6 | Laxmangarh | 0.97 | Declining |
| 7 | Mandawar | 1.09 | Declining |
| 8 | Neemrana | 1.08 | Declining |
| 9 | Rajgarh | (-) 0.014 | Marginal Rising |
| 10 | Ramgarh | 0.60 | Declining |
| 11 | Reni | 0.45 | Declining |
| 12 | Thanagazi | 0.0183 | Declining |
| 13 | Tijara | 0.35 | Declining |
| 14 | Umrain | 0.94 | Declining |

The trend data indicates that declining trend ranging from has been observed in all the blocks except in Rajgarh block where marginal rising trend of 0.014 m/year has been found. Declining ternd ranges from 0.0183 m/year (Thanagazi Block) to 2.55 m/year ( Behror Block). Declining trend has been resulted due to the over draft of ground water resources than its natural replenishment. Marginal rising trend may be due to the less withdrawal of ground water in the area being hilly and less availability of cultivable area. The long term hydrograph of selected monitoring stations are depicted in Figure 16A to 16F.

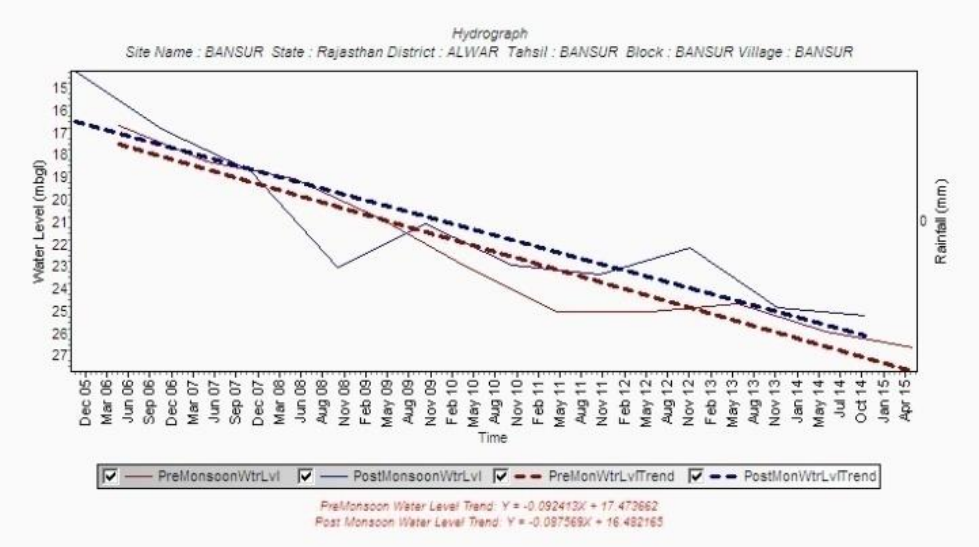



**Figure 16A:Bansur, Bansur Block(Aquifer-Alluvium)**

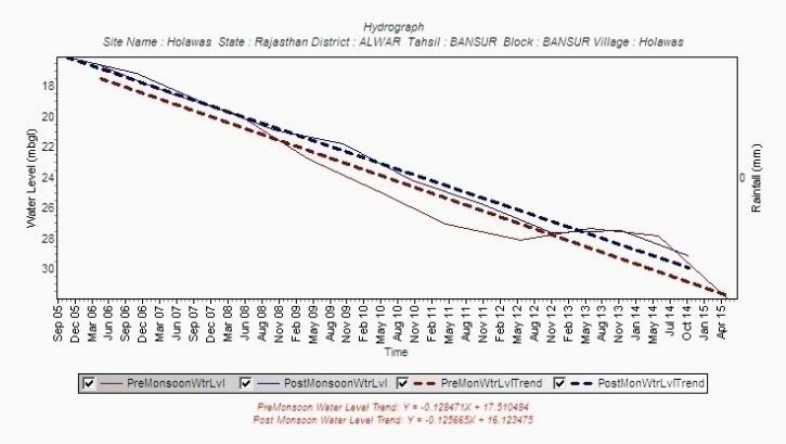



**Figure 16B:Holawas, Bansur Block(Aquifer-Alluvium)**

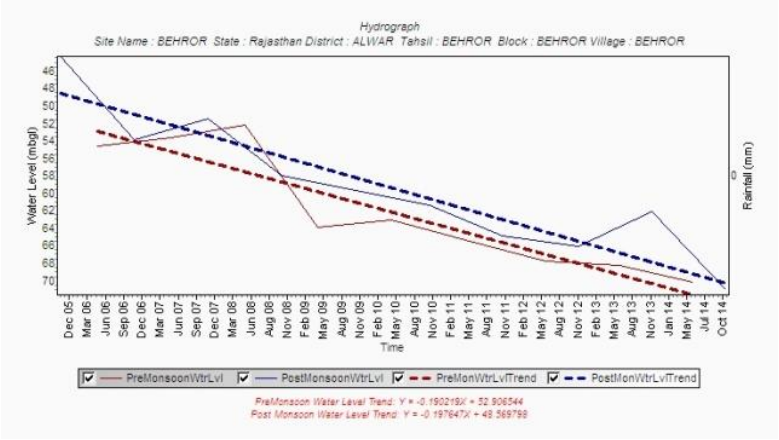



**Figure 16C:Behror, Behror Block(Aquifer-Alluvium)**

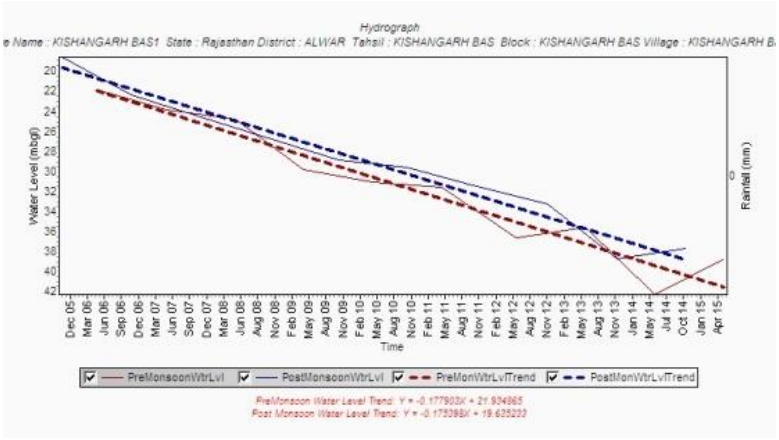



**Figure 16D:Kishangarh Bas, Kishangarh Bas Block(Aquifer-Alluvium)**

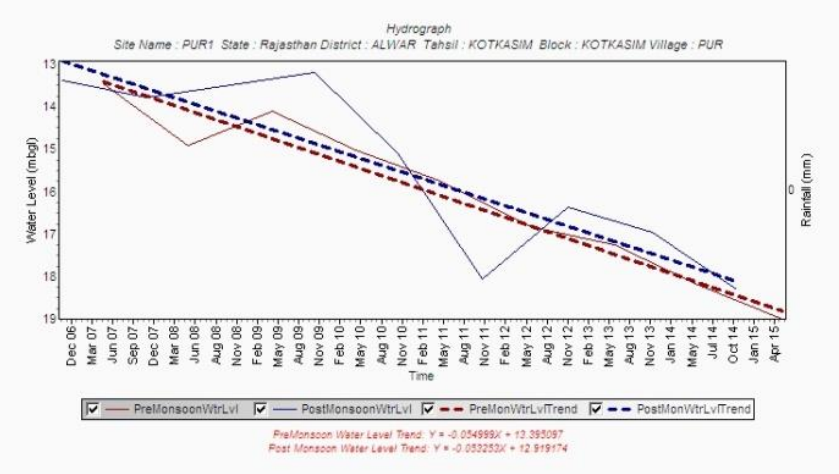



**Figure 16E:Pur, Kotkasim Block(Aquifer-Alluvium)**

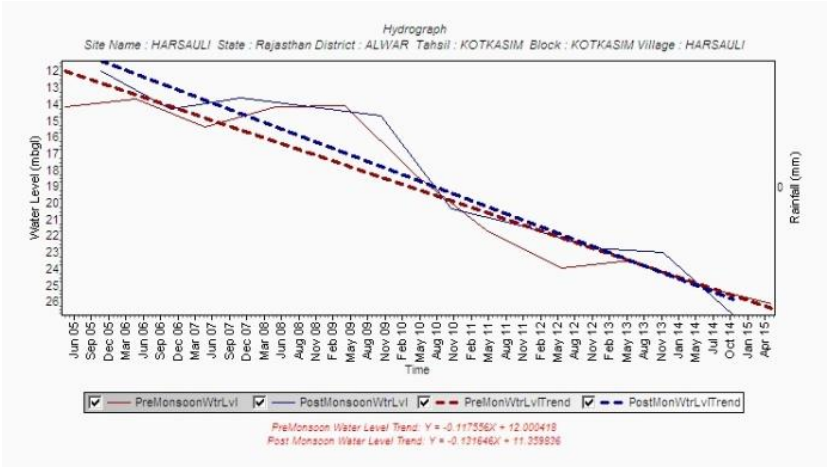



**Figure 16F:Harsauli, Kotkasim Block(Aquifer-Alluvium)**

Water Table:

The general slope of water table in the area is towards east. In Barah basin, it has a south easterly slope in the north-eastern part of the district; easterly slope in the major part of the area between Alwar and Nagar and north-westerly and south easterly slope in the southern part of the area between Rajgarh and Malakhera. However, near Dhakpuri, water table slopes towards north - easterly direction. In the northern part of the district, the general slope of water table in the area is broadly towards north-easterly direction. Water table maps on plane and 3D of area have been prepared using Rock Works Software and portrayed in Figure 17 and 18.The highest water table lies at an elevation of more than 400 mamsl in in Thanagazi block and minimum elevation at less than 190 mamsl in Kathumar block. Water table slope gently in the eastern direction averaging about 1.02 m/km.The hydraulic gradientin Berah sub-basin is not very steep ranging from 0.60 to 2 m/km.

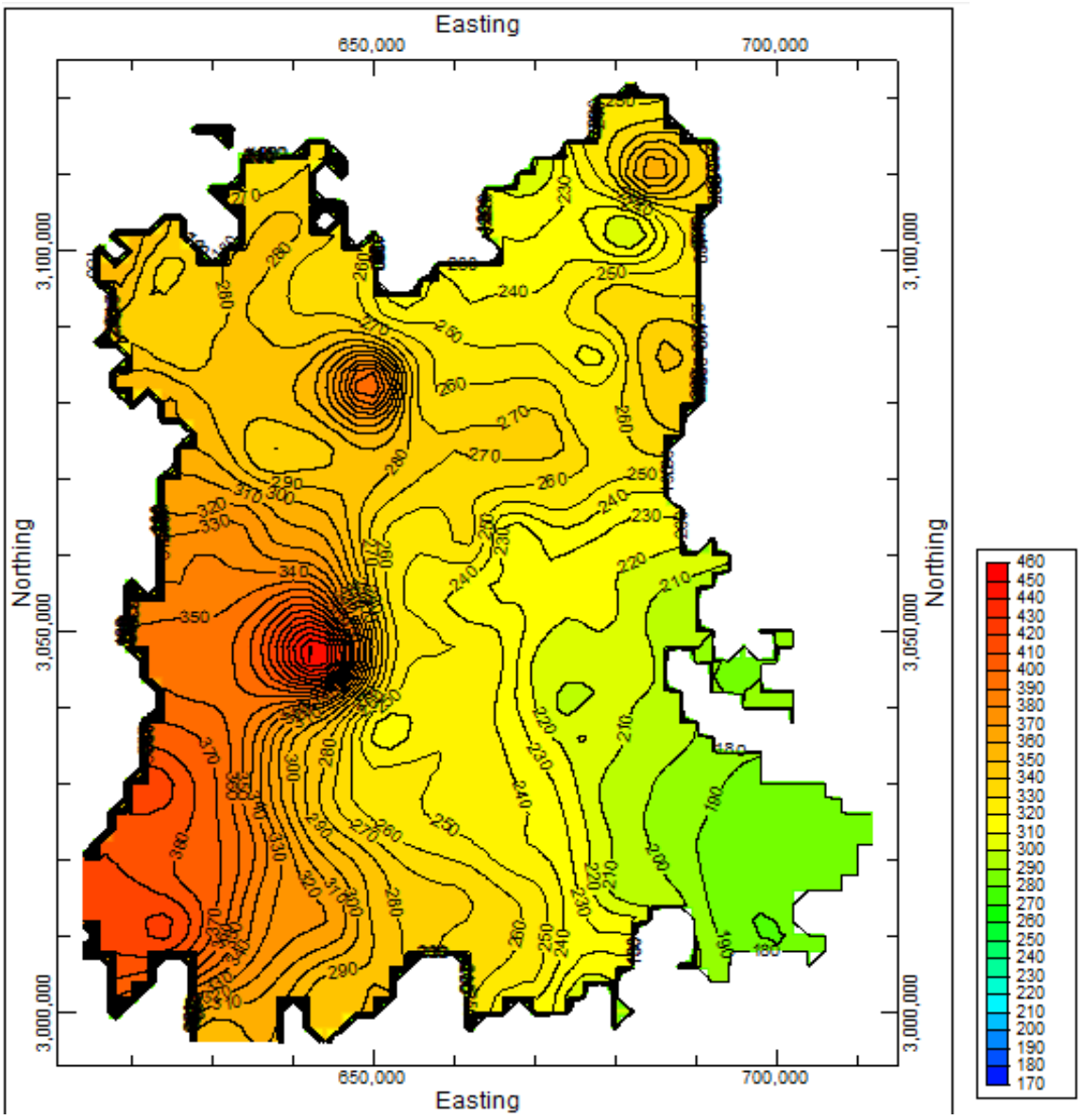



**Figure 17: Water Table Map, Alwar District**

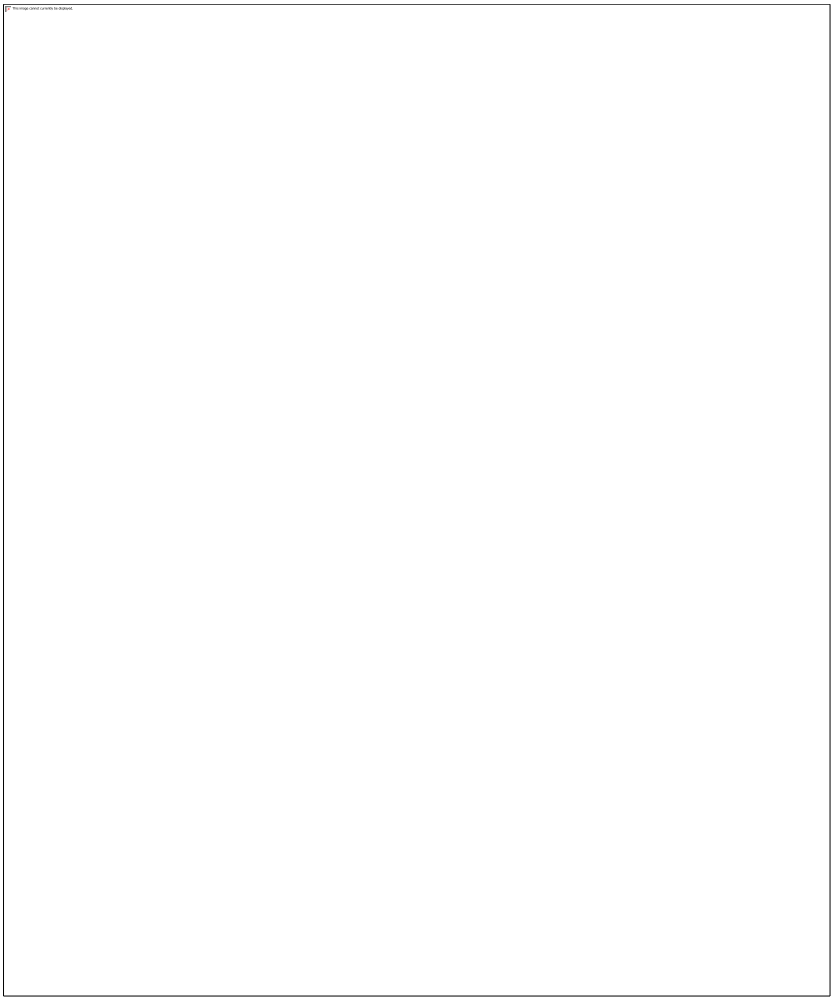


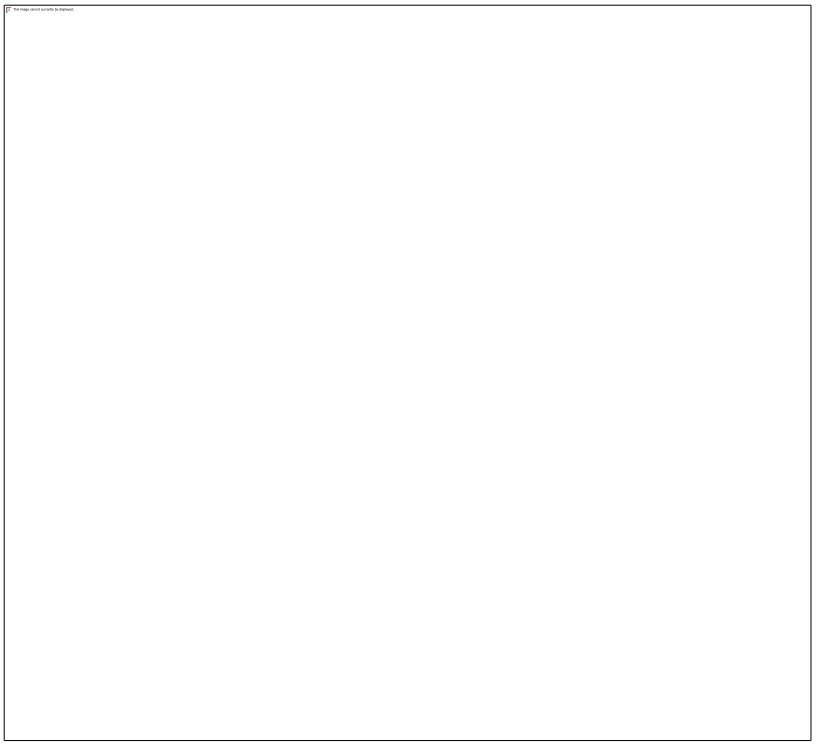
**Figure 18: 3-D Water Table Map, Alwar District**

## 3. Ground Water Quality

Ground water in the area is alkaline in nature with pH varying from 7.02 to 8.26. In general, quality of ground water is suitable for irrigation and domestic uses.

### 3.1 Electrical Conductivity (EC)

EC varies from 500 µs/cm at 25$^{o}$C at Chatarpura, Bansur Block to 12000 µS/cm at 25$^{o}$C at Sundana, Laxmangarh Block. Electrical conductivity in major part of the district is below 3000µs/cm at 25$^{o}$C (Figure 19). EC value of 2000 to 3000 µS / cm at 25$^{o}$C has been observed in parts of Neemrana, Behror, Tijara, Mandawar, Kishangarh Bas, Reni, Umrain and Kathumar blocks. Higher EC values varying from 3000 to 10000 µS/cm at 25$^{o}$C have been reported from Ramgarh, Laxmangarh and Kathumar blocks and EC more than 10000 µS / cm at 25$^{o}$C has been reported from localized pockets in Kathumar block.



- EC – 500(Min) to 12000(Max) ms/cm at 25°C.
- In general, mostly with in 3000ms/cm at 25°C.
- > 3000 EC in about 400sq.km.(6%) in parts of Laxmangarh & Kathumar Blocks

**Figure 19: Distribution of Electrical Conductivity in Ground Water, Alwar District**

### 3.2 Fluoride

Fluoride concentration in ground water has been found to vary from 0.672 mg/l at Tapukara, Tijar block to 3.42 mg/l at Ramgarh. It is found to be within the permissible limit of 1.5 mg/l in major part of the district. However, Neemrana, Ramgarh and Kathumar blocks have excess fluoride. Fluoride contamination in ground water has also been reported from parts of Kotkasim, Mandawar, Behror, Bansur, Thanagazi, Rajgarh, Reni, Umrain, Laxmangarh and Kishangarh Bas blocks.

### 3.3 Nitrate

Nitrate concentration in ground water has been found to be within the maximum permissible limit of 45 mg/litre in major part of the district. However, higher values of nitrate in excess of 45 mg/l have been reported from parts of Umrain, Tijara, Thanagazi, Neemrana, Kishangarh Bas, Laxmangarh and Ramgarh blocks.

### 3.4 Iron

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 (Fig. 14). Iron content varies from 0 in Neemrana and Kanhawas in Neemrana block and Holawas in Behror block to 1.395 mg/l at Govindgarh, Laxmangarh block.

## 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 is given in Table 6. Data indicate that all the blocks are over exploited having stage of ground water development ranging from 102.04% (minimum in Thanagazi Block) to 293.81% (maximum in Behror Block).It has resulted in decline in water level and drying of alluvial aquifer particularly in parts of Behror and Umrain blocks. The changing scenario of ground water development over the years since 1984 has been presented in Table7 and depicted with the help of bar diagram in Figure 20.

| Table 6: GROUND WATER RESOURCES OF ALWAR DISTRICT(AS ON 31.03.2013) | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **GROUND WATER RECHARGE,EXTRACTION & STAGE OF GROUND WATER DEVELOPMENT** | | | | | | | | | | | | | | | | |
| **Block** | **Area of Block (Sq. Km.)** | **Type of Area** | **Potential zone** | **Potential zone area (Sq. Km.)** | **Total Annual ground water Recharge (mcm)** | **Natural Discharge during non-monsoon season (mcm)** | **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 Irrigation Development (mcm)** | **Stage of G.W. Development (%)** | **Whether significant decline in Premonsoon W.L. (Yes/No)** | **Whether significant decline in post monsoon W.L. (Yes/No)** | **Category** |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 |
| Behror | 351.69 | NC | Ao | 278.35 | 31.1151 | 1.5558 | 29.5593 | 76.3938 | 7.8683 | 84.2621 | 7.2240 | 0.0000 | 285.06 | | | |
| | | | SI | 56.25 | 2.6276 | 0.1314 | 2.4962 | 8.4240 | 1.4954 | 9.9194 | 1.8060 | 0.0000 | 397.38 | | | |
| **Total (Block)** | | | | **334.60** | **33.7427** | **1.6872** | **32.0555** | **84.8178** | **9.3637** | **94.1815** | **9.0300** | **0.0000** | **293.81** | **YES** | **YES** | **OE** |
| Bansur | 664.43 | NC | Ao | **604.12** | **117.5048** | **11.7505** | **105.7543** | **164.7300** | **6.8255** | **171.5555** | **5.5800** | **0.0000** | **162.22** | **YES** | **YES** | **OE** |
| Kathumar | 569.99 | NC | Ao | **362.35** | **42.9883** | **4.2988** | **38.6895** | **78.3180** | **5.1772** | **83.4952** | **8.0500** | **0.0000** | **215.81** | **YES** | **YES** | **OE** |
| Kishangarh | 526.46 | NC | Ao | 329.89 | 59.5525 | 5.9553 | 53.5972 | 73.9650 | 7.6621 | 81.6271 | 8.2718 | 0.0000 | 152.30 | | | |
| | | NC | Q | 83.33 | 4.7400 | 0.2370 | 4.5030 | 11.7270 | 1.4710 | 13.1980 | 0.6558 | 0.0000 | 293.09 | | | |
| **Total (Block)** | | | | **413.22** | **64.2925** | **6.1923** | **58.1002** | **85.6920** | **9.1330** | **94.8250** | **8.9276** | **0.0000** | **163.21** | **YES** | **YES** | **OE** |
| Kotkasim | 344.43 | NC | Ao | 306.59 | **62.9430** | 6.2943 | 56.6487 | 95.2140 | 6.1342 | 101.3482 | **3.3200** | **0.0000** | **178.91** | YES | YES | OE |
| Laxmangarh | 623.95 | NC | Ao | 415.01 | **55.0071** | 5.5007 | 49.5064 | 90.3121 | 3.1514 | 93.4636 | **7.9000** | **0.0000** | **188.79** | YES | YES | OE |
| Mandawar | 577.26 | NC | Ao | 545.78 | **94.6857** | 9.4686 | 85.2171 | 151.5960 | 7.5821 | 159.1781 | **5.3800** | **0.0000** | **186.79** | YES | YES | OE |
| Neemrana | 378.82 | NC | Ao | 327.43 | **48.4244** | 4.8424 | 43.5820 | 67.9830 | 6.9974 | 74.9804 | **4.4500** | **0.0000** | **172.04** | YES | YES | OE |
| Rajgarh | 1034.21 | NC | Ao | 53.12 | 9.7117 | 0.9712 | 8.7405 | 13.3881 | 2.0356 | 15.4237 | 6.0427 | 0.0000 | 176.46 | | | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | NC | Q | 402.83 | 26.9767 | 1.3488 | 25.6279 | 40.9320 | 3.1302 | 44.0622 | 3.5076 | 0.0000 | 171.93 | | | |
| **Total (Block)** | | | | **455.95** | **36.6884** | **2.3200** | **34.3684** | **54.3201** | **5.1658** | **59.4859** | **9.5503** | **0.0000** | **173.08** | **YES** | **NO** | **OE** |
| Ramgarh | 616.97 | NC | Ao | **568.46** | **57.7706** | **2.8885** | **54.8821** | **92.6220** | **6.9547** | **99.5767** | **6.2400** | **0.0000** | **181.44** | **YES** | **YES** | **OE** |
| Reni | 392.05 | NC | Ao | 187.50 | 13.1377 | 1.3138 | 11.8239 | 20.6100 | 2.0867 | 22.6967 | 2.3000 | 0.0000 | 191.96 | | | |
| | | NC | Q/Sl | 143.54 | 8.5353 | 0.4268 | 8.1085 | 21.4101 | 1.4432 | 22.8533 | 0.7700 | 0.0000 | 281.84 | | | |
| **Total (Block)** | | | | **331.04** | **21.6730** | **1.7406** | **19.9324** | **42.0201** | **3.5299** | **45.5500** | **3.0700** | **0.0000** | **228.52** | **YES** | **YES** | **OE** |
| Thanagazi | 1060.33 | NC | Ao | 128.12 | 19.7624 | 1.9762 | 17.7862 | 16.1513 | 3.5332 | 19.6845 | 1.1314 | 0.5035 | 110.67 | | | |
| | | NC | Q/Sl | 624.21 | 49.8852 | 2.4943 | 47.3909 | 43.8907 | 2.9310 | 46.8217 | 3.9286 | 0.0000 | 98.80 | | | |
| **Total (Block)** | | | | **752.33** | **69.6476** | **4.4705** | **65.1771** | **60.0420** | **6.4642** | **66.5062** | **5.0600** | **0.5035** | **102.04** | **YES** | **NO** | **OE** |
| Tijara | 673.48 | NC | Ao | **611.52** | **106.4401** | **10.6440** | **95.7961** | **136.0350** | **9.4820** | **145.5170** | **14.4800** | **0.0000** | **151.90** | **YES** | **YES** | **OE** |
| Umrain | 906.39 | NC | Ao | 690.04 | 117.5164 | 11.7516 | 105.7648 | 143.7408 | 33.8713 | 177.6121 | 25.8268 | 0.0000 | 167.93 | | | |
| | | NC | Q | 106.77 | 10.0674 | 0.5034 | 9.5640 | 14.6112 | 6.8135 | 21.4247 | 3.9579 | 0.0000 | 224.01 | | | |
| **Total (Block)** | | | | **796.81** | **127.5838** | **12.2550** | **115.3288** | **158.3520** | **40.6847** | **199.0367** | **29.7847** | **0.0000** | **172.58** | **YES** | **YES** | **OE** |
| **Total of Distt. (Excluding Saline Zones)** | | | | **6825.21** | **939.3920** | **84.3534** | **855.0386** | **1362.0542** | **126.6459** | **1488.7001** | **120.8226** | **0.5035** | **174.11** | | | **OE** |
| Kathumar | | NC (S) | Ao(S) | 200.89 | 28.2807 | 2.8281 | 25.4526 | 15.5525 | 0.9198 | 16.4723 | 0.0000 | 9.9001 | 64.72 | | | SAFE |
| Laxmangarh | | NC (S) | Ao(S) | 175.51 | 19.5593 | 1.9559 | 17.6034 | 7.6860 | 0.1896 | 7.8756 | 0.0000 | 9.9174 | 44.74 | | | SAFE |
| Total of saline zones | | | | **376.40** | **47.8400** | **4.7840** | **43.0560** | **23.2385** | **1.1094** | **24.3479** | **0.0000** | **19.8175** | **56.55** | | | **SAFE** |

**Table 7: Status of Ground Water Development, Alwar District**

| Year | Net GW availability | Gross Draft | Stage of Ground Water Development(%) |
|---|---|---|---|
| 1984 | 674.86 | 446.85 | 66.22 |
| 1990 | 612.44 | 657.63 | 107.38 |
| 1995 | 518.85 | 615.87 | 118.70 |
| 1998 | 968.77 | 1064.61 | 109.89 |
| 2001 | 912.30 | 1112.07 | 121.90 |
| 2004 | 790.37 | 1143.91 | 144.73 |
| 2009 | 794.82 | 1323.87 | 166.56 |
| 2011 | 731.70 | 1311.18 | 179.20 |
| 2013 | 855.04 | 1488.70 | 174.11 |

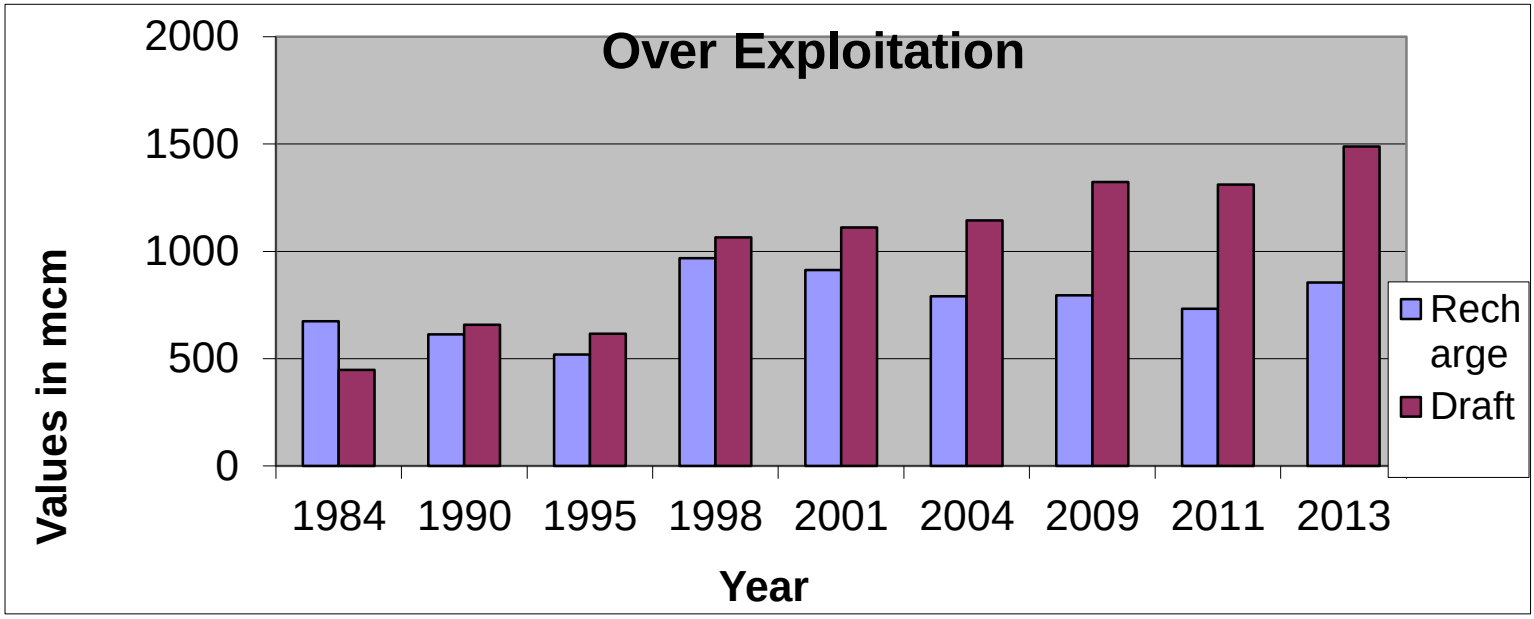



**Figure 20: Ground Water Development Status, Alwar District**

If the present development of ground water continues, resources very likely to be exhausted by 2020. Sustainability of resources of district is given in Table 8.

**Table 8: Sustainability of Ground Water Resources, Alwar District**

| Year | Annual Recharge (mcm) | Gross Ground Water Demand (mcm) | Yearly Storage Depletion (mcm) | In-storage Ground Water Resources (mcm) |
|---|---|---|---|---|
| 2013 | 855 | 1488 | 0 | 4319 |
| 2014 | 855 | 1488 | 633 | 3686 |
| 2015 | 855 | 1488 | 633 | 3053 |
| 2016 | 855 | 1488 | 633 | 2420 |
| 2017 | 855 | 1488 | 633 | 1787 |
| 2018 | 855 | 1488 | 633 | 1154 |
| 2019 | 855 | 1488 | 633 | 521 |
| 2020 | 855 | 1488 | 633 | -112 |

## 5.0 Groundwater Related Issues

The following ground water related issues have been emerged:

### 5.1 Decline in Water Level

Long term water level data (pre-monsoon, 2001-2012) have indicated declining water level trend ranging from 0.0183 to 2.55m/year. It has resulted due to the over draft of ground water resources for various uses than its annual recharge. All the blocks are over exploited having stage of ground water development ranging from 102.04% (minimum in Thanagazi Block) to 293.81% (maximum in Behror Block). Deep water level has caused more consumption of power to draw ground water and deterioration in ground water quality.71% area has water level more than 20m in the district.

### 5.2 Depletion of Aquifer

Decline in water level has resulted in drying of alluvial aquifer particularly in parts of Behror and Umrain blocks where water level has entered into the underlying hard rock.

### 5.3 Ground Water Salinity

Ground water salinity with EC more than 3000µs/cm at 25$^{o}$C has been found in south eastern part of district covering parts of Ramgarh, Laxmangarh & Kathumar blocks and EC more than 10000 µs/cm at 25$^{o}$C has been reported from localized pockets in Kathumar block.

### 5.4 Ground Water Pollution

Industrial clusters have been developed at Bhiwadi, Alsar, Neemrana and Behror in Alwar district. Untreated disposal of effluents into the open nallah/open depression have casued the contamination of ground water rendering water unsuitable for human consuimption. Pollution study carried out by CGWB at Bhiwadi industrial cluster, has clearly indicated the contamination of ground water with presence of high concentration of toxic substances viz. cadmium, lead and nickel more than the acceptable limit of Drinking Water Specification(2012) and rendering ground water unhealthy/unfit for drinking use. Bhiwadi industrial Cluster has been ranked 6$^{th}$ in the country and 1$^{st}$ in Rajasthan state with CEPI score 82.91 indicating critically polluted cluster (MOEF,J-11013/5/2010-IA.II(I), New Delhi dated 13.1.2010). Similar pollution studies are to under taken in other industrial clusters in the district to assess the gamut of ground water contamination, if any.

### 5.5 Notification of Block

Behror block has been notified on 2nd December 2005 by the Central Ground Water Authority for ground water regulation and management making it mandatory to seek permission for any structure proposed to be drilled for groundwater abstraction. District Collector has been authorized to take necessary measures for implementation of regulatory measures. An Advisory Committee under the Chairmanship of District Collector has been constituted to take up all the issues related to Notified areas.

# 6.0 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 unsaturated volume of aquifer for the Alwar district is computed based on following; the area feasible for recharge, unsaturated depth below 5 m bgl and the specific yield of the aquifer.

6.1.1 Artificial recharge to ground water through interventions of various structures

The following parameters are inevitable for planning of artificial recharge to ground water.

- Availability of sufficient storage space to accommodate recharged water
- Availability of surplus water to recharge
- Feasibility of sub-surface geological formations

In case of Alwar district, sufficient sub-surface storage space is available to accommodate the recharged water. Volume of sub-surface storage space calculated for artificial recharge is 16529 mcm, details of the same given in Table 9.

**Table 9: Computation of sub-surface storage for artificial recharge, Alwar District**

| Sr.No. | Block | Block code | 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 (7*8*10) (MCM) |
|---|---|---|---|---|---|---|---|---|---|---|
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| 1 | Behror | RJ0202 | 351.690 | 334.600 | Alluvium | 278.350 | 0.120 | 49.700 | 46.700 | 1559.873 |
| 2 | Behror | | | | Hard rock | 56.250 | 0.020 | 81.000 | 78.000 | 87.750 |
| 3 | Bansur | RJ0201 | 664.430 | 604.120 | Alluvium | 604.120 | 0.120 | 26.960 | 23.960 | 1736.966 |
| 4 | Kathumar | RJ0203 | 569.990 | 362.350 | Alluvium | 362.350 | 0.120 | 25.000 | 22.000 | 956.604 |
| 5 | Kishangarh | RJ0204 | 526.460 | 413.220 | Alluvium | 329.890 | 0.120 | 31.080 | 28.080 | 1111.597 |
| 6 | Kishangarh | | | | Hard rock | 83.330 | 0.020 | 30.000 | 27.000 | 44.998 |
| 7 | Kotkasim | RJ0205 | 344.430 | 306.590 | Alluvium | 306.590 | 0.150 | 18.240 | 15.240 | 700.865 |
| 8 | Laxmangarh | RJ0210 | 623.950 | 415.010 | Alluvium | 415.010 | 0.100 | 24.080 | 21.080 | 874.841 |
| 9 | Mandawar | RJ0211 | 577.260 | 545.780 | Alluvium | 545.780 | 0.100 | 33.250 | 30.250 | 1650.985 |
| 10 | Neemrana | RJ0212 | 378.820 | 327.430 | Alluvium | 327.430 | 0.120 | 43.020 | 40.020 | 1572.450 |
| 11 | Rajgarh | RJ0206 | 1034.210 | 455.950 | Alluvium | 53.120 | 0.100 | 25.000 | 22.000 | 116.864 |
| 12 | Rajgarh | RJ0213 | | | Hard rock | 402.830 | 0.020 | 13.780 | 10.780 | 86.850 |
| 13 | Ramgarh | | 616.970 | 568.460 | Alluvium | 568.460 | 0.120 | 16.930 | 13.930 | 950.238 |
| 14 | Reni | RJ0207 | 392.050 | 331.040 | Alluvium | 187.500 | 0.080 | 30.550 | 27.550 | 413.250 |
| 15 | Reni | | | | Hard rock | 143.540 | 0.080 | 12.400 | 9.400 | 107.942 |
| 16 | Thanagazi | RJ0214 | 1060.330 | 752.330 | Alluvium | 128.120 | 0.100 | 47.150 | 44.150 | 565.650 |
| 17 | Thanagazi | | | | Hard rock | 624.210 | 0.020 | 7.470 | 4.470 | 55.804 |
| 18 | Tijara | RJ0208 | 673.480 | 611.520 | Alluvium | 611.520 | 0.150 | 19.090 | 16.090 | 1475.904 |
| 19 | Umrain | RJ0209 | 906.390 | 796.810 | Alluvium | 690.040 | 0.100 | 38.560 | 35.560 | 2453.782 |
| 20 | Umrain | | | | Hard rock | 106.770 | 0.020 | 5.930 | 2.930 | 6.257 |
| | **Total** | | **8720.46** | **6825.21** | | **6825.21** | | | **519.19** | **16529.5** |

Total amount of water required to recharge the available sub-surface storage of 16529.5mcm is 21983mcm. Total surplus water has been computed to the tune of 3.83mcm only including 1.3204mcm for Behror block, 0.2106mcm for Mandawar block and 2.2997mcm for Neemrana block only. Details of feasible recharge structures to recharge the surplus water in respective block is given in Table10.

**Table 10: Block-wise details of feasible recharge structures, Alwar District**

| **Block** | **Sub-basin** | **Aquifer** | **Formation** | **Zone Area (sq. km.)** | **Surplus Available in the Zone (in $mm^3$)** | **Surplus Available in Zone as per the Water Level** | **No. of R.S. 0.03 mcm/RS** | **No of RS Possible in Block (as per Water Bodies in the Zone** | **Remaining Surplus Water for Recharge and Conservation** | **No. of PT (rounded off to nearest integer)** | **No. of PT Possible in Block** | **Surplus for Farm Pond** | **No of Farm Pond** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Behror | | AO | SR | 184.86 | 1.3204 | 1.3204 | 44 | 18 | 0.78 | 4 | 4 | 0 | 0 |
| Mandawar | Dohan | AO | SR | 29.49 | 0.2106 | 0.2106 | 7 | 7 | 0 | 0 | 0 | 0 | 0 |
| Neemrana | Dohan | AO | SR | 321.97 | 2.2997 | 2.2997 | 77 | 47 | 0.9 | 5 | 5 | 0 | 0 |
| | | | | **536.32** | **3.8308** | **3.8308** | **128** | **72** | **1.68** | **9** | **9** | **0** | **0** |

Out of total computed 128 no. of feasible recharge structures, only 72 are possible as per the availability of water bodies in the zones of Behror, Mandawar and Neemrana blocks. Remaining surplus water for recharge of 1.68mcm after intervention of 72 recharge structures, may be recharged through 9 no. of possible percolation tanks. The additional net ground water recharge is 2.68mcm. Summary of recharge structures and percolation tanks and their cost component is as below:

| **Information** | **Figure** |
|---|---|
| Surplus available | 3.83 MCM |
| Number of recharge shafts (in existing village ponds) | 72 |
| No. of percolation tanks | 9 |
| Net ground water recharge | 2.68 MCM |
| Total cost of proposed interventions | Rs 7.81 crore |

**6.2 Demand Side Management**

Though not much augmentation can be done through supply side management due to less availability of surplus 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 and

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 95.72mcm per annum @ 0.1m (Table11).

**Table 11: Block-wise water saving through change in cropping pattern and irrigation practice**

| **Block** | **Irrigated Area (ha) proposed for irrigation through sprinkler(50% of gross irrigated area)** | **Total cost sprinkler (Rs in cr)** | **Water Saving by sprinkler in mcm @0.08 m** | **Irrigated Area (ha) under wheat proposed for Gram cultivation** (50% of wheat irrigated area considered for gram) | **Water Saving by change in cropping pattern in mcm @0.1 m** | **Total water saving (mcm)** |
|---|---|---|---|---|---|---|
| Behror | 13358 | 66.79 | 10.69 | 3708 | 3.71 | 14.39 |
| Neemrana | 14472 | 72.36 | 11.58 | 4018 | 4.02 | 15.60 |
| Mandawar | 22283 | 111.42 | 17.83 | 6242 | 6.24 | 24.07 |
| Kotkasim | 14743 | 73.72 | 11.79 | 6450 | 6.45 | 18.24 |
| Tijara | 20897 | 104.49 | 16.72 | 9727 | 9.73 | 26.44 |
| Kishangarh | 12515 | 62.57 | 10.01 | 4422 | 4.42 | 14.43 |
| Ramgarh | 20550 | 102.75 | 16.44 | 9509 | 9.51 | 25.95 |
| Umrain | 28002 | 140.01 | 22.40 | 13339 | 13.34 | 35.74 |
| Bansur | 24590 | 122.95 | 19.67 | 7952 | 7.95 | 27.62 |
| Thana Ghazi | 9008 | 45.04 | 7.21 | 3721 | 3.72 | 10.93 |
| Reini | 3927 | 19.63 | 3.14 | 1958 | 1.96 | 5.10 |
| Rajgarh | 10617 | 53.08 | 8.49 | 5293 | 5.29 | 13.79 |
| Laxmangarh | 24002 | 120.01 | 19.20 | 10002 | 10.00 | 29.20 |
| Kathaumar | 21327 | 106.64 | 17.06 | 9379 | 9.38 | 26.44 |
| **Total** | **240291** | **1201.44** | **192.23** | **95720** | **95.72** | **287.95** |

Growing of gram in place of wheat will not affect the economy of farmer and is explicit from the table below.

**Summary of Economic Statistics of Growing of Gram instead of Wheat, Alwar District**

| 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 |
|---|---|---|---|---|---|---|---|
| 480576 | 95720 | 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 192.23mcm/annum @0.08m (Table 11). Total cost of sprinkler sets has been computed as Rs. 1201 crore @50,000/hectar

## 7.0 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. With the implementation of supply side management, additional 2.6815 MCM/year can be recharged. This would increase the replenish able recharge to ground water from 855.0386 MCM/year to 857.7201 MCM/year.
It can be seen that not much augmentation in ground water resources can be achieved through artificial recharge due to constraints of availability of surplus/non-committed surface water. However, considerable improvement in ground water situation can be achieved with implementation of demand side management plans.

With the proposed use of sprinkler irrigation in the areas where rabi crop is being irrigated through ground water it is expected that 192 MCM/year can be saved due to reduction in pumping and with changing the wheat crop to gram (chick pea) and additional 96 MCM/year can be saved due to reduction of pumping. With implementation of these two interventions, a total of 287.9504MCM/year can be saved. This may lead to a total reduction in ground water draft from 1488.6999 MCM/year to 1274.95 MCM/Year and with this, the stage of ground water development may come down from 293.81 to 241.93%. 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.

- The additional net ground water recharge - 2.68mcm
- **Sprinkler**
    - Area proposed under irrigation by sprinkler – 2406 sq km (50% of gross irrigated area)
    - Net Water saving - 192 MCM (20% of crop water requirement)
    - Total cost for sprinklers – Rs 1201 crore @Rs 50,000 per hectare
- **Change in cropping pattern**
    - From wheat to gram in 957 sq km irrigated area
    - Net water saving - 96 MCM
    - **Total water saving : 288 MCM**
    - **Total Cost / Outlay: Rs. 1201 Crores**

The overall expected benefit through the additional net ground water recharge is 2.68mcm. Block wise details of ground water recharged and saved along with expected improvement in stage of ground water development is given in Table 12. 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 174.11% to 146.52% after interventions.

**Table12: Summary of expected benefit of management strategies, Alwar district**

| **Block** | **Net GW availability (mcm)** | **Additional recharge from RWH & conservation (mcm)** | **Total net GW availability after intervention (mcm)** | **Existing GW draft for all purpose (mcm)** | **Saving of GW through projects (mcm)** | **Net GW draft after interventions (mcm)** | **Present stage of GW development (%)** | **Projected stage of GW development (%)** |
|---|---|---|---|---|---|---|---|---|
| Behror | 32.0555 | 0.92 | 32.98 | 94.1815 | 14.39 | 79.79 | 293.81 | 241.93 |
| Neemrana | 43.582 | 1.61 | 45.19 | 74.9804 | 15.60 | 59.39 | 172.024 | 131.41 |
| Mandawar | 85.2171 | 0.15 | 85.36 | 159.1781 | 24.07 | 135.11 | 186.79 | 158.27 |
| Kotkasim | 56.6487 | 0.00 | 56.65 | 101.3481 | 18.24 | 83.10 | 178.91 | 146.70 |
| Tijara | 95.7961 | 0.00 | 95.80 | 145.517 | 26.44 | 119.07 | 151.9 | 124.30 |
| Kishangarh | 58.1002 | 0.00 | 58.10 | 94.825 | 14.43 | 80.39 | 163.21 | 138.37 |
| Ramgarh | 54.8821 | 0.00 | 54.88 | 99.5767 | 25.95 | 73.63 | 181.44 | 134.16 |
| Umrain | 115.3288 | 0.00 | 115.33 | 199.0367 | 35.74 | 163.30 | 172.58 | 141.59 |
| Bansur | 105.7543 | 0.00 | 105.75 | 171.5555 | 27.62 | 143.93 | 162.22 | 136.10 |
| Thanaghazi | 65.1771 | 0.00 | 65.18 | 66.5062 | 10.93 | 55.58 | 102.04 | 85.27 |
| Reni | 19.9324 | 0.00 | 19.93 | 45.55 | 5.10 | 40.45 | 228.52 | 202.94 |
| Rajgarh | 34.3684 | 0.00 | 34.37 | 59.4859 | 13.79 | 45.70 | 173.08 | 132.97 |
| Laxmangarh | 49.5064 | 0.00 | 49.51 | 93.4636 | 29.20 | 64.26 | 188.79 | 129.80 |
| Kathaumar | 38.6895 | 0.00 | 38.69 | 83.4952 | 26.44 | 57.05 | 215.81 | 147.47 |
| **Total** | **855.0386** | **2.6815** | **857.7201** | **1488.6999** | **287.9504** | **1200.7495** | **174.11** | **146.52** |

# PART B

# BLOCKWISE MANAGEMENT PLANS OF ALWAR DISTRICT

| **Name of the Block** | **Behror** | **Bansur** | **Kathumar** | **Kishangarh** | **Kotkasim** | **Laxmangarh** | **Mandawar** | **Neemrana** | **Rajgarh** | **Ramgarh** | **Reni** | **Thanagazi** | **Tijara** | **Umrain** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Geographical Area (km2 ) | 352 | 664.43 | 569.99 | 526.46 | 344.43 | 624 | 577.26 | 378.82 | 1034.21 | 616.97 | 392.05 | 1060.33 | 673.48 | 906.39 |
| Rainfall (1971-2014) | 599.3 | 693.5 | 600.7 | 658.8 | 702.2 | 549.3 | 650.75 | 599.3 | 618.9 | 636 | 618.9 | 733.8 | 600.1 | 663.6 |
| **Groundwater Resource Availability and Extraction** | | | | | | | | | | | | | | |
| Net G.W. Availability (mcm),2013 | 32.0555 | 105.7543 | 38.6895 | 58.1002 | 56.6487 | 49.5064 | 85.2171 | 43.582 | 34.3684 | 54.8821 | 19.9324 | 65.1771 | 95.7961 | 115.3288 |
| Irrigation Draft(2013) | 84.8178 | 164.73 | 78.318 | 85.692 | 95.214 | 90.3121 | 151.596 | 67.983 | 54.3201 | 92.622 | 42.0201 | 60.042 | 136.035 | 158.352 |
| Existing Water Demand(2013) | 94.18 | 171.56 | 83.50 | 94.83 | 101.35 | 93.46 | 159.18 | 74.98 | 59.4859 | 99.5767 | 45.55 | 66.5062 | 145.517 | 199.0367 |
| Future water demand for domestic & industries(2013 ) | 9.03 | 5.58 | 8.05 | 8.9276 | 3.32 | 7.9 | 5.38 | 4.45 | 9.5503 | 6.24 | 3.07 | 5.06 | 14.48 | 29.7847 |
| Water Level Behaviour, DTW (m) | 75 | 26-37 | 19-33 | 39 | 19-27 | 7.7-37 | 34-50 | 58-60 | 4.7-14 | 21-24 | 24 | 27 | 7.25-25 | 13.45-42 |
| Trend (m/yr)(2001-12) | 2.55 | 1.24 | 1.33 | 1.11 | 1.02 | 0.97 | 1.09 | 1.08 | -0.014 | 0.6 | 0.45 | 0.02 | 0.35 | 0.94 |
| **Aquifer Disposition** | | | | | | | | | | | | | | |
| Geology | All/Slate | All | All | All/Qtz | All | All | All | All | All/Qtz | All | All/Qtz/Sl | All/Qtz/Sl | All | All/Qtz |
| Depth of Occurrence | | | | | | | | | | | | | | |
| Type of Aquifer | Unconf | Unconf | Unconf | Unconf | Unconf | Unconf | Unconf | Unconf | Unconf | Unconf | Unconf | Unconf | Unconf | Unconf |

| Name of the Block | Behror | Bansur | Kathumar | Kishangarh | Kotkasim | Laxmangarh | Mandawar | Neemrana | Rajgarh | Ramgarh | Reni | Thanagazi | Tijara | Umrain |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Thickness of Aquifer (Utilisable) | | | | | | | | | | | | | | |
| Hydraulic Characters (sp.yield%) | 12/2. | 12 | 12 | 12/2. | 15 | 10 | 10 | 12 | 10/2. | 12 | 8/2. | 10/2. | 15 | 10/2. |
| **Groundwater Resource Extraction, Contamination and Other Issues** | | | | | | | | | | | | | | |
| Aquifer wise resource Availability | 32.0555 | 105.7543 | 38.6895 | 58.1002 | 56.6487 | 49.5064 | 85.2171 | 43.582 | 34.3684 | 54.8821 | 19.9324 | 65.1771 | 95.7961 | 115.3288 |
| Stage of development | 293.81 | 162.22 | 215.81 | 163.21 | 178.91 | 188.79 | 186.79 | 172.04 | 173.08 | 181.44 | 228.52 | 102.04 | 151.9 | 172.58 |
| Whether significant decline pre monsoon/ post monsoon | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Categorisation | OE | OE | OE | OE | OE | OE | OE | OE | OE | OE | OE | OE | OE | OE |
| Chemical Quality of Groundwater in General | Saline / Fresh | Fresh | Fresh/saline | Fresh | Fresh | Fresh/Saline | Fresh | Fresh | Fresh | Fresh/saline | Fresh | Fresh | Fresh | Fresh |
| Other issues | 1. Over exploitation 2. Deeper water level 3. Declining trend | 1. Over exploitation 2. Deeper water level 3. Declining trend | 1. Over exploitation 2. Deeper water level 3. Declining trend4. Salinity | 1. Over exploitation 2. Deeper water level 3. Declining trend | 1. Over exploitation 2. Deeper water level 3. Declining trend | 1. Over exploitation 2. Deeper water level 3. Declining trend4. Salinity | 1. Over exploitation 2. Deeper water level 3. Declining trend | 1. Over exploitation 2. Deeper water level 3. Declining trend | 1. Over exploitation 2. Deeper water level 3. Declining trend | 1. Over exploitation 2. Deeper water level 3. Declining trend4. Salinity | 1. Over exploitation 2. Deeper water level 3. Declining trend | 1. Over exploitation 2. Deeper water level 3. Declining trend | 1. Over exploitation 2. Deeper water level 3. Declining trend | 1. Over exploitation 2. Deeper water level 3. Declining trend |
| **Groundwater Resource Enhancements** | | | | | | | | | | | | | | |

| Name of the Block | Behror | Bansur | Kathumar | Kishangarh | Kotkasim | Laxmangarh | Mandawar | Neemrana | Rajgarh | Ramgarh | Reni | Thanagazi | Tijara | Umrain |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aquifer wise Space Available for Recharge | | | | | | | | | | | | | | |
| surplus available in the Zone (in Mm3) | 1647.62 | 1736.97 | 956.6 0 | 1156.6 | 700.87 | 874.84 | 1650.99 | 1572.45 | 203.71 | 50.24 | 521.19 | 621.45 | 1475.9 | 2460.04 |
| Surplus available ins zone as per the water level (in Mm3) | 1.3204 | 0 | 0 | 0 | 0 | 0 | 0.2106 | 2.2997 | 0 | 0 | 0 | 0 | 0 | 0 |
| No of RS 0.03 MCM/RS (as per water bodies)/Percolation Tanks | 18/4 | 0 | 0 | 0 | 0 | 0 | 7/- | 47/5 | 0 | 0 | 0 | 0 | 0 | 0 |
| Water saving by through recharge from RWH & conservation (mcm) (70% of surplus water available) | 0.92 | | 0.00 | 0.00 | 0.00 | 0.00 | 0.15 | 1.61 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Demand side Interventions - Advanced Irrigation Practices** | | | | | | | | | | | | | | |
| Irrigated Area (ha) proposed for irrigation through sprinkler | 13358 | 24590 | 21327 | 12515 | 14743 | 24002 | 22283 | 14472 | 10617 | 20550 | 3927 | 9008 | 20897 | 28002 |
| Water Saving by sprinkler in mcm @0.08 m | 10.69 | 19.67 | 17.06 | 10.01 | 11.79 | 19.20 | 17.83 | 11.58 | 8.49 | 16.44 | 3.14 | 7.21 | 16.72 | 22.4 |
| Change in Cropping pattern | | | | | | | | | | | | | | |

| Name of the Block | Behror | Bansur | Kathumar | Kishangarh | Kotkasim | Laxmangarh | Mandawar | Neemrana | Rajgarh | Ramgarh | Reni | Thanagazi | Tijara | Umrain |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Irrigated Area under wheat (ha) | 7417 | 15903 | 18758 | 8843 | 12900 | 20005 | 12484 | 8035 | 10586 | 19018 | 3916 | 7442 | 19453 | 26678 |
| Irrigated Area (ha) under wheat proposed for Gram cultivation | 7417 | 15903 | 18758 | 8843 | 12900 | 20005 | 12484 | 8035 | 10586 | 19018 | 3916 | 7442 | 19453 | 26678 |
| Water Saving by change in cropping pattern in mcm @0.1 m | 7.42 | 15.90 | 18.76 | 8.84 | 12.90 | 20.01 | 12.48 | 8.04 | 10.59 | 19.02 | 3.92 | 7.44 | 19.45 | 26.68 |
| Alternate water Sources | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil | Nil |
| Regulation and Control | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| **Other Interventions proposed, if any** | | | | | | | | | | | | | | |
| Irrigated Area (ha) proposed for land levelling (10% of irrigated area) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Water Saving by land levelling in mcm @0.02 m | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| **Expected Outcome** | | | | | | | | | | | | | | |
| Net G.W. Availability (mcm) | 32.0555 | 105.7543 | 38.6895 | 58.1002 | 56.6487 | 49.5064 | 85.2171 | 43.582 | 34.3684 | 54.8821 | 19.9324 | 65.1771 | 95.7961 | 115.3288 |
| Additional Recharge from RWH & conservation (mcm) | 0.92 | 0 | 0 | 0.00 | 0.00 | 0.00 | 0.15 | 1.61 | 0 | 0 | 0 | 0 | 0 | 0 |

| **Name of the Block** | **Behror** | **Bansur** | **Kathumar** | **Kishangarh** | **Kotkasim** | **Laxmangarh** | **Mandawar** | **Neemrana** | **Rajgarh** | **Ramgarh** | **Reni** | **Thanagazi** | **Tijara** | **Umrain** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Total Net G.W. Availability after intervention (mcm) | 32.98 | 105.7543 | 38.6895 | 58.1002 | 56.6487 | 49.5064 | 85.36 | 45.19 | 34.3684 | 54.8821 | 19.9324 | 65.1771 | 95.7961 | 115.3288 |
| Existing G.W Draft for all purpose (mcm) | 94.1815 | 171.5555 | 83.4952 | 94.825 | 101.348 | 93.4636 | 159.1781 | 74.9804 | 59.4859 | 99.5767 | 45.55 | 66.5062 | 145.517 | 199.0367 |
| Saving of Ground water through projects (mcm) | 18.11 | 35.57 | 35.82 | 18.85 | 24.69 | 39.21 | 30.31 | 19.62 | 19.08 | 35.46 | 7.06 | 14.65 | 36.17 | 49.08 |
| Net GW draft after interventions (mcm) | 79.79 | 143.93 | 57.05 | 80.39 | 83.10 | 64.26 | 135.11 | 59.39 | 45.7 | 73.63 | 40.45 | 55.58 | 119.07 | 163.3 |
| **Present stage of G.W. development (%)** | 293.81 | 162.22 | 215.81 | 163.21 | 178.91 | 188.79 | 186.79 | 172.04 | 173.08 | 181.44 | 228.52 | 102.04 | 151.9 | 172.58 |
| **Projected stage of G.W. Dev. (in %)** | **241.93** | **136.10** | **147.47** | **138.37** | **146.70** | **129.80** | **158.27** | **131.41** | **132.97** | **134.16** | **202.94** | **85.27** | **124.3** | **141.59** |