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

Jaipur District, Rajasthan

पश्चिमी क्षेत्र जयपुर

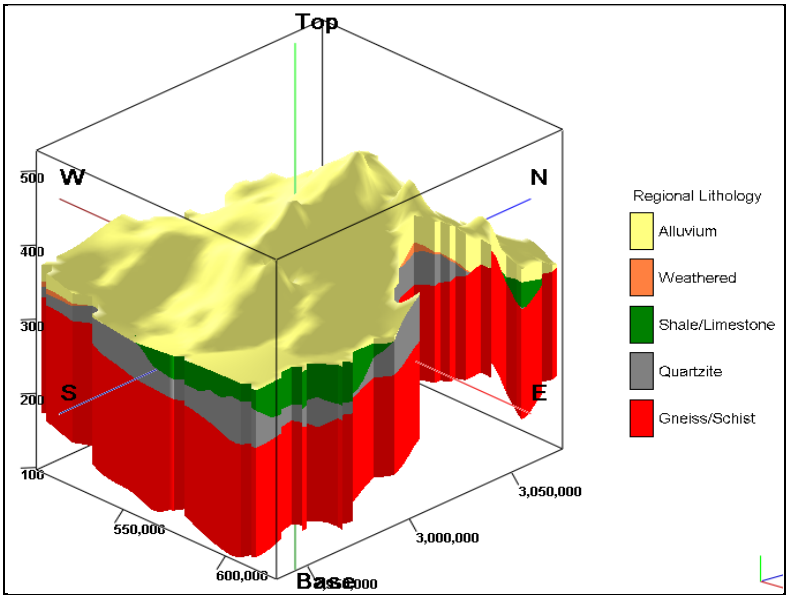
Western Region, Jaipur

Government Of India

Ministry of Water Resources, River Development & Ganga Rejuvenation,

Central Ground Water Board (WR)

Western Region Jaipur



Report on National Aquifer Mapping & Management Plan

(Based on Selected Available Data)

Jaipur District, Rajasthan.

By

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JAIPUR

2017

Contents

List of Tables

List of Figures

Report On National Aquifer Mapping And Management Jaipur 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 emergent 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 of the study area is the need of the hour.

1.2 Scope of the study

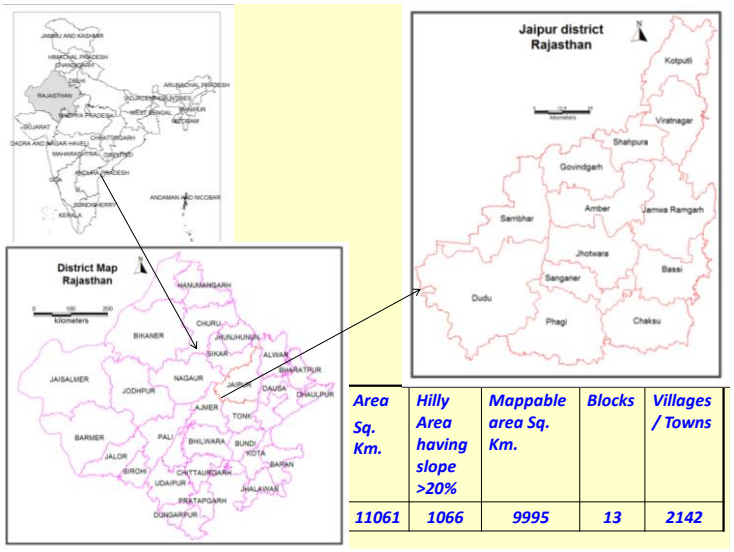
Aquifer mapping can be understood as a scientific process wherein a combination of geological, Geophysical, hydrological and chemical fields and laboratory analyses are applied to characterized the quantity, quality, and sustainability of ground water in aquifers. Aquifer mapping is expected to improve our understanding of the geological framework of aquifer, their hydrologic characteristics, water level in aquifer and how they changes over time and 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

As mentioned above, aquifer mapping is an attempt to integrate the geological, Geophysical, hydrological and chemical field and laboratory analyses are applied to characterize the quality, quantity and sustainability of groundwater in aquifer. Under the National aquifer Programme, 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 include 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 Area details

Jaipur district, covering geographical area of 11,061.44 sq. km and extending between north latitudes 26° 25' and 27° 51' and east longitudes 74° 55' and 76° 15' forms east-central part of the Rajasthan State. For administrative convenience, the district is divided into 16 tehsils and 15 blocks. Two blocks namely Pawta and Jalsu are formed in 2014. Since the ground water resources estimation and notification is as per 13 blocks formation, so 13 blocks as status prior to 2014 are taken in this report. The index map of Jaipur district is given in Figure 1.



Area Sq. Km.	Hilly Area having slope >20%	Mappable area Sq. Km.	Blocks	Villages / Towns
11061	1066	9995	13	2142

Figure 1: Index Map

1.5 Data availability and Adequacy

Exercise on Groundwater availability, groundwater monitoring (water level and chemical quality) and exploration had been carried out by CGWB and state Ground water Department. 57 No. of NHS have been monitored by CGWB, WR. 1009No. of EW have been constructed and 147 VES have been conducted by CGWB in this area.

1.6 Data Adequacy

The data collected from State GWD and CGWB WR Jaipur have been compiled and analysed. It has been observed that validation and georeferncing of the location coordinates, lithologs and hydrogeological data is needed and State GWD data lacks in aquifer parameters. Geophysical data collected needs georeferncing of the hydrogeological interpretations. It has been observed that available data are limited largely to State highways and main roads only. Hence, to get a clear 3D hydrogeological geometry of the aquifer system and its behaviour, there is need to generate data by Groundwater Exploration and to establish more numbers of monitoring stations for better understanding of the groundwater regime behavior in terms of both quantity and quality.

1.7 Data Gap Analysis

Based on the data collected from State GW agencies like GWD, PHED, Water Resources and CGWB regarding groundwater monitoring, exploration, surface water and agriculture, the gaps were identified after plotting on 1:50000 map. Based on this map the gaps were identified for data to be generated like bed rock configuration, Saline/ Fresh water interface, aquifer continuity and quality of groundwater in an area. Jaipur District further needs data to be generated in the gaps.

1.8 Rainfall & Climate

The semi-arid district receives normal annual rainfall of 527mm (1901-71) while average annual rainfall for the last 34 years (1971-2014) is 575.7mm. Annual average rainfall during the period 2005 to 2014 has been 600.9mm (Table 3). Over 90% of total annual rainfall is received during monsoon.

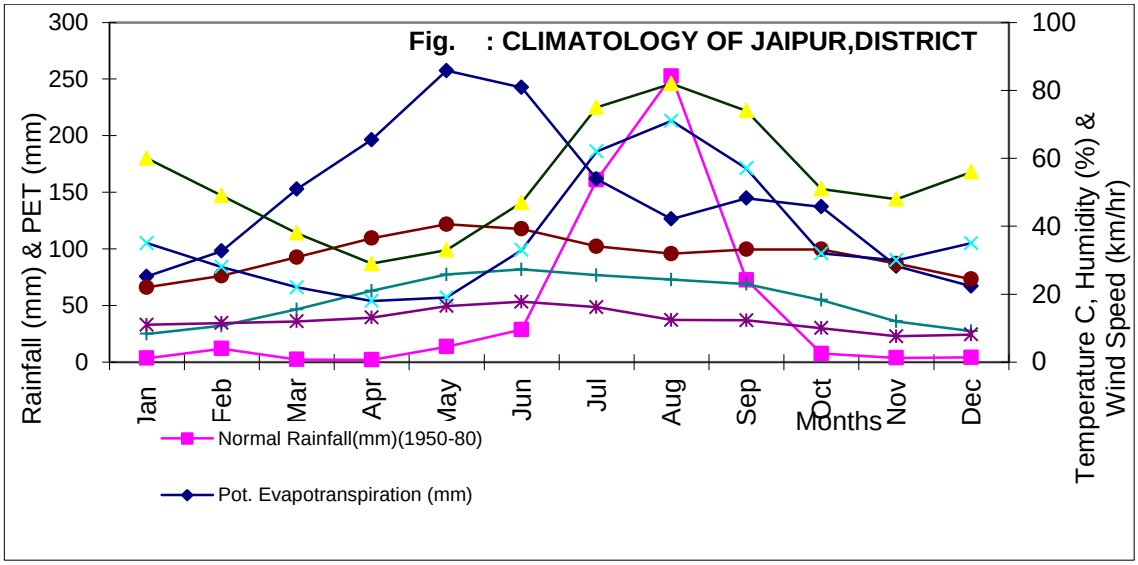


Figure 2: Climatology Data, Jaipur district

Total annual potential evapotranspiration is 1744.7mm. The coefficient of variation is moderate at 25.6% indicating slightly unreliable pattern of rainfall. Though, Jaipur city has experienced floods in 1981, the district is prone to drought spells as witnessed during 1984 to 1989 and 1999 to 2002. 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: Annual Rainfall, Standard Deviation & Coeff. of Variation of annual rainfall, Jaipur district (2005-2014)

YEAR	Jaipur	Bassi	Chaksu	Sanganer	Amber	J.Ramgarh	Sambher	Dudu	Phagi	Kotputli	Viratnagar	MEAN mm
2005	408.6	634.0	513.4	392.0	470.0	980.0	457.6	344.0	535.4	777.0	976.0	589.8
2006	338.0	294.0	342.0	407.0	357.0	460.0	292.0	287.0	360.0	517.0	476.5	375.5
2007	521.0	487.0	577.4	553.3	529.0	673.5	385.0	291.0	408.0	719.0	454.0	508.9
2008	572.0	578.0	735.4	572.0	552.0	1160.0	677.4	617.0	534.0	904.0	969.5	715.6
2009	306.0	348.0	424.0	377.0	280.0	521.0	216.6	276.0	345.0	307.0	344.0	340.4

YEAR	Jaipur	Bassi	Chaksu	Sanganer	Amber	J.Ramgarh	Sambher	Dudu	Phagi	Kotputli	Viratnagar	MEAN mm
2010	659.0	945.0	928.0	750.0	731.0	1039.0	729.5	823.0	810.0	816.0	923.0	832.1
2011	660.0	621.0	685.0	646.0	589.0	577.0	715.0	793.0	608.0	659.0	895.0	677.1
2012	1083.0	497.0	614.0	984.0	781.0	599.0	602.0	349.0	600.0	649.0	647.0	673.2
2013	812.1	782.0	598.3	757.0	854.0	684.0	500.5	269.0	654.0	721.0	931.0	687.5
2014	646.0	750.0	699.0	609.7	635.0	791.0	514.0	440.0	509.0	589.0	514.0	608.8
Mean (mm)	600.6	593.6	611.7	604.8	577.8	748.5	509.0	448.9	536.3	665.8	713.0	600.9
STD (mm)	232.4	199.1	165.8	191.4	730.4	237.0	176.0	216.3	142.5	168.2	250.1	153.6
CV(%)	38.7	33.5	27.1	31.7	752.3	31.7	34.6	48.2	26.6	25.3	35.1	25.6

(Source: Revenue Department, Ajmer)

1.9 Geomorphology, Drainage, Soil, Land Use & Irrigation Practices

Jaipur district is characterized by wide spectrum of landscapes including hillocks, pediments, undulating fluvial plains, aeolian dune fields, ravines, palaeo-channels etc. Structural hills (mainly in northern and northeastern parts) trending NNE-SSW are generally composed of Delhi quartzite. Main peaks include Jaigarh (648m amsl), Nahargarh (599m amsl), Manoharpura (747mamsl) and Bichun (656mamsl). Pediments with thin to thick soil cover can be seen around Dudu, Phagi and Chaksu forming flat gneissic outcrops. Undulating plains of fluvial/ fluvial-aeolian origin forming landforms of river terraces, floodplains and buried channels of various drainage systems dominate in the district. Aeolian sand dunes are found mainly in western parts (Sambhar, Jobner, Renwal area) which are a few metres to 10m high.Obstacle and shadow dunes can also be seen in parts of the district in addition to ravine and badland topography at places.

The district area is drained by ephemeral rivers Banganga, Bandi, Dhund, Mendha, Mashi, Sota and Sabi and their tributaries. Sota and Sabi rivers in the northern part of district flow northeasterly while southwesterly flowing Banganga river passes through Shahpura, Bairath andJamwa Ramgarh blocks and contribute water to the famous Ramgarh lake from where it flows easterly to enter Dausa district. Mendha River in northwest portion of the district merges with famous Sambhar lake whereas Mashi river in the southwestern part flows easterly. Soils in the district may be classified as:

- Loamy sand to sandy loam
- Sandy clay loam
- Sandy clay
- Wind blown sand
- River sand

2. Aquifer System

2.1 Hydrogeology

Gneisses and schists of Bhilwara Super Group are the oldest rock types overlain by quartzites, schists, conglomerates, dolomitic limestone etc. belonging to Alwar and Ajabgarh Groups of Delhi Super Group along with granite, pegmatite and amphibolite intrusives of Post Delhi age. Hard rocks in major parts of the district are covered by Quaternary fluvial and aeolian deposits mainly composed of sand, silt, clay, gravel and kankar. Alluvial thickness is less in southern and southwestern parts of the district i.e. in Naraina, Sakhun, Dudu, Mozamabad, Phagi, Chaksu areas etc. Alluvial thickness between 90 and 100m has been observed at Chomu, Jairampura, Nangal Bharra, Dhaunauta areas whereas its thickness over 100m has been found at Risani village (104m).

In the northern part of the district, altitude of bedrock ranges from 426.72mamsl at Mairh to 276.82 mamsl at Kotputli indicating northerly sloping bed rock. In the northwestern and western parts, altitude of bedrock varies from 446 mamsl at Kariri

(Shahpura) to 337 mamsl at Dhani Boraj (Sambhar block) showing southwesterly sloping bed rocks. Around Jaipur urban area, altitude is higher at Harmada area (417.11 mamsl) with southerly and southeasterly sloping bedrock and low altitudes of bedrock have been observed as 310.79 mamsl at Chandlai and 273.47 mamsl at Kotkaoda in Chaksu block. Groundwater in the district occurs both in unconsolidated Quaternary formations and consolidated formations of Bhilwara and Delhi Super Groups and also Post Delhi Granites. In greater part of the district, alluvial deposits comprising of mainly fine sand and silt serve as potential aquifers in addition to gravel zones as encountered at Sanganer, Ambabari, Bajaj Nagar (Jaipur city) and Shahpura, Dhanauta, Nayan,Kalyanpur, Mohana and Chandalai. Groundwater at shallow depth occurs under water table condition and under semi-confined conditions at depth. Talus and scree deposits at foothills form potential aquifer at places including Banskho in Bassi block and parts of Amber, Jamwa Ramgarh and Govindgarh blocks. Yield of wells in these formations ranges from 100 to 500 m^3/day. Hard rocks of Bhilwara Super Group, comprising of granulitic gneisses, quartz mica schist, phyllite along with granite and pegmatite intrusives, form main aquifers in southern and south western parts of the district in Dudu, Phagi and Chaksu blocks. Similarly, quartzite, schist and phyllite of Delhi Super Group form aquifers in Jamwa Ramgarh, Bairath, Kotputli, Shahpura, Amer and Bassi blocks. Movement of groundwater in these hard rocks is controlled by size, continuity and interconnectivity of weathered and fractured parts and other secondary porosities. Depth of wells in the district generally varies from 50 to 100m in alluvium and 50 to 200m in combination/consolidated formation areas. Specific capacity of wells varies from 58 to 500 lpm/m. Transmissivity value and storage coefficient varies from 10 to 850m^2/d and 4.70 x 10^{-5} to 1.05x 10^{-3} respectively. A map depicting hydrogeological features is presented as Figure 3.

Central Ground Water Board periodically monitors the National Hydrograph Network Stations (NHNS) in the Jaipur district, four times a year i.e. in January, May (Premonsoon), August and November (Postmonsoon).

During premonsoon period (May, 2015), depth to water levels varied from 4.47mbgl at Mozmabad to 69.93 mbgl at Chaump (Figure 4). Deeper water levels of more than 40 mbgl were recorded in the central part of district covering most parts of Govindgarh, Shahpura, Amer,

and Jhotwara Sanganer blocks. Shallow water level less than 10 mbgl has been recorded in the

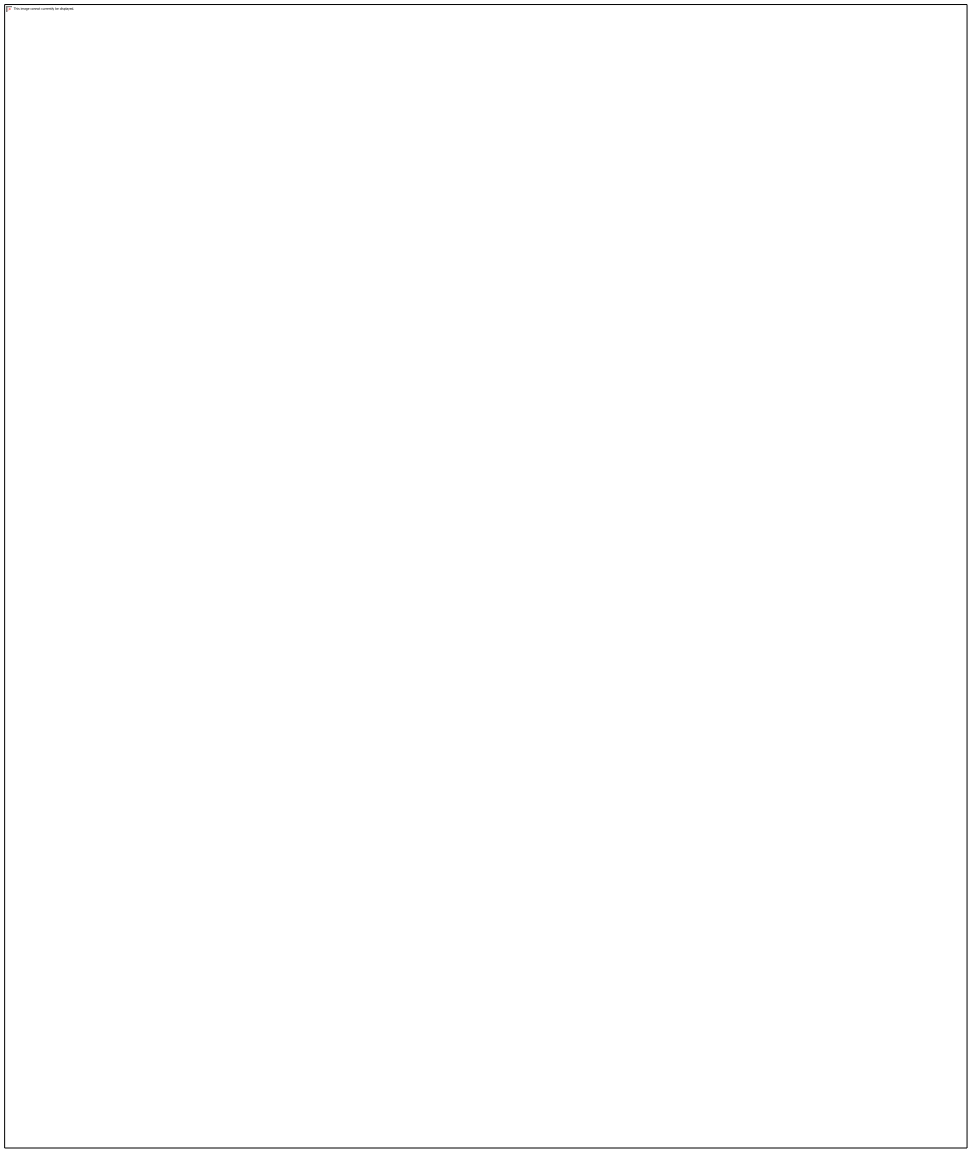


Figure 3: Hydrogeological map of Jaipur district

southwestern part of the district mostly in the blocks of Dudu and Phagi. During postmonsoon

period (November 2015), depth to water level varied from 1.28 mbgl at Mangarwara to 71.70 mbgl at Chaump. Water levels more than 40 mbgl were observed in the central parts of the district covering blocks of Govindgarh, Amer, Jhotwara, Sanagner, Sambhar, Jamwa Ramgarh and Bassi (Figure 5).

Shallow water level less than10 mbgl is observed in the south-western parts of the district in Dudu and Phagi blocks.

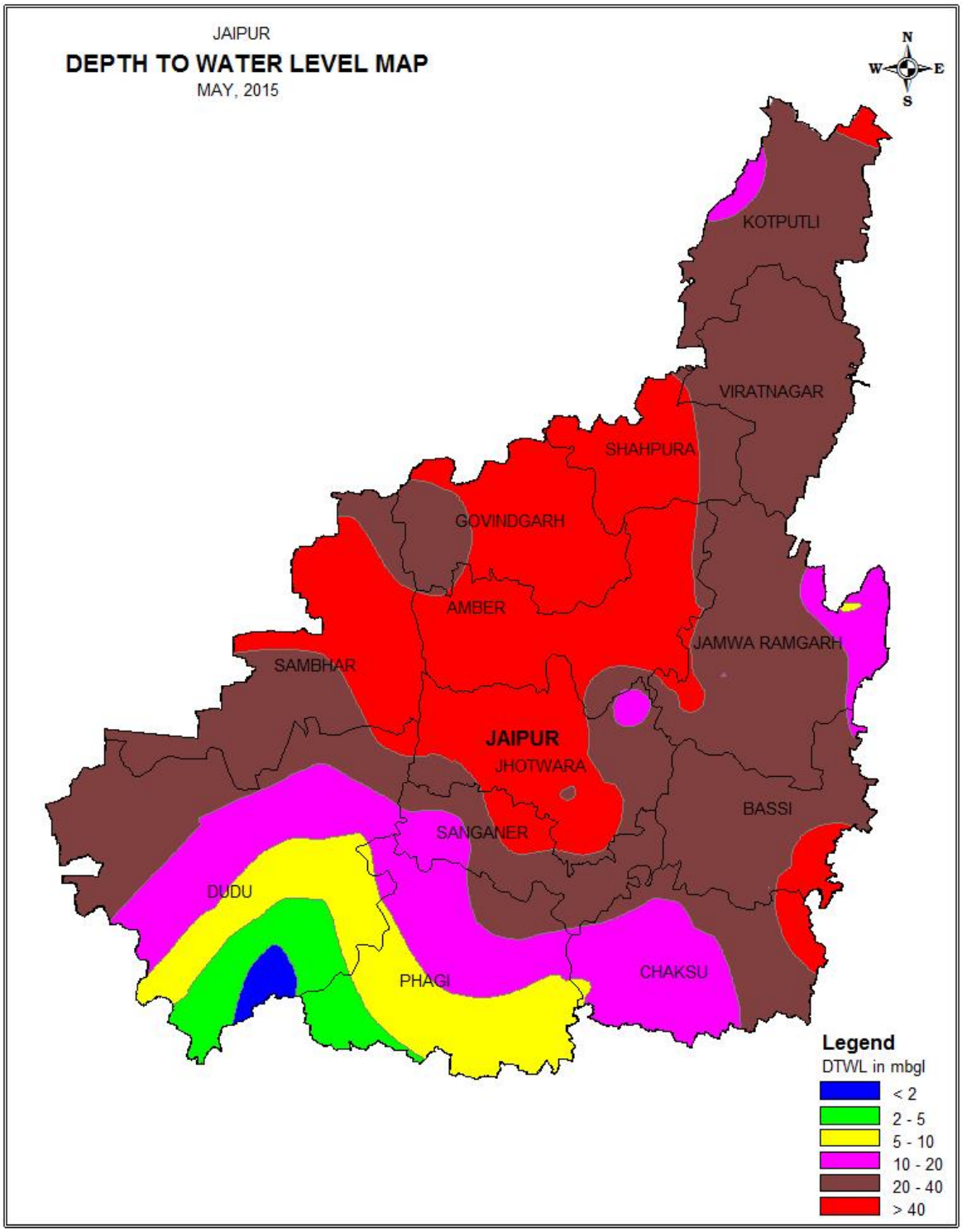


Figure 4: Depth to Water Level (May 2015)

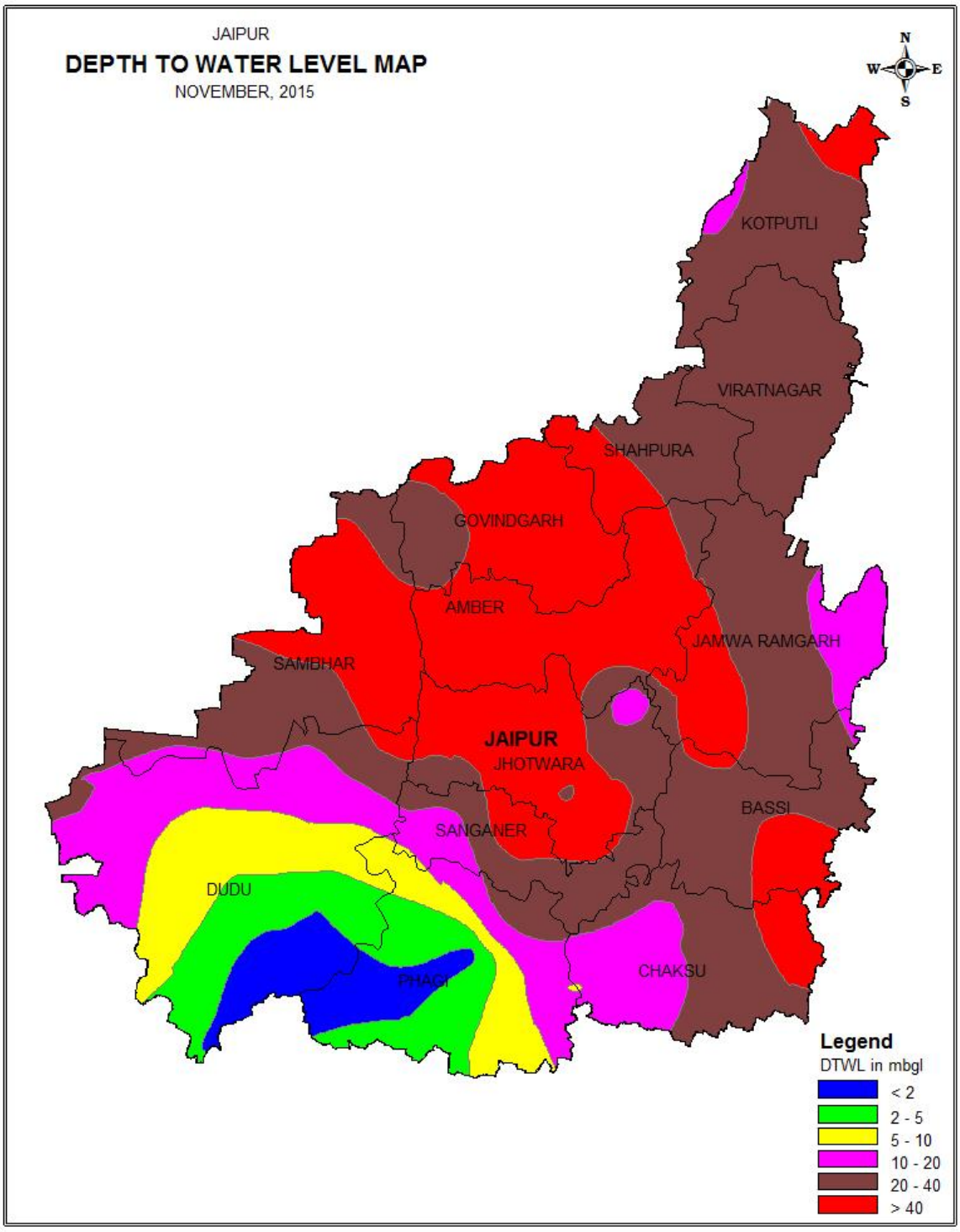


Figure 5: Depth to Water Level (November 2015)

Analysis of decadal premonsoon water level data (May, 2005-2014)- May 2015 shows that almost the entire district has experienced falling trends of water level except a few isolated patches of rising trend mostly in the blocks of Dudu, Phagi and Chaksu (Figure 6). The decadal water level fluctuation in the district range from 1.36 m to 7.39 m (Rise) and 0.31 m to 23.09 m (fall).

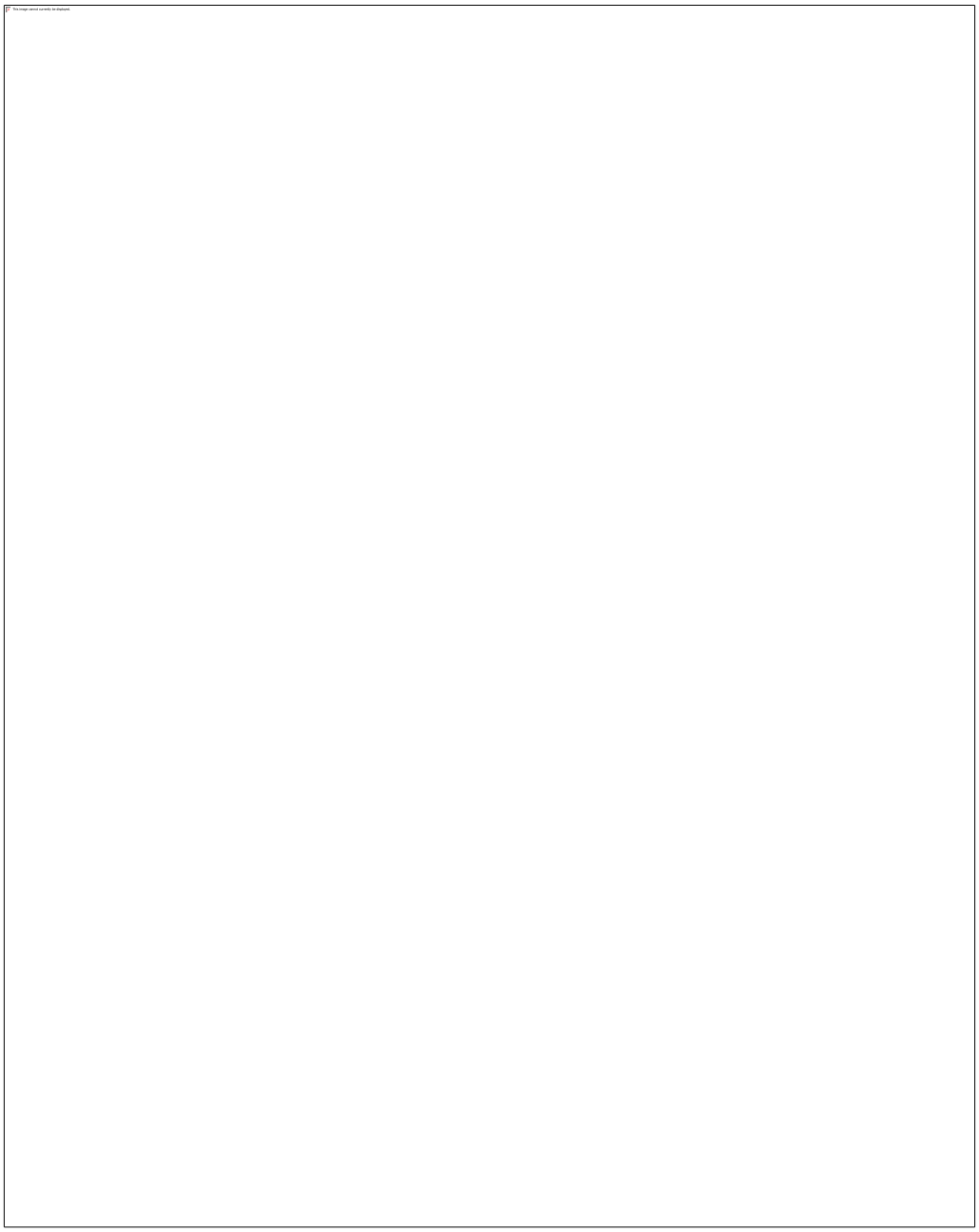


Figure 6: Decadal Fluctuation Map

The hydrographs of selected monitoring station is shown in Figure 7.

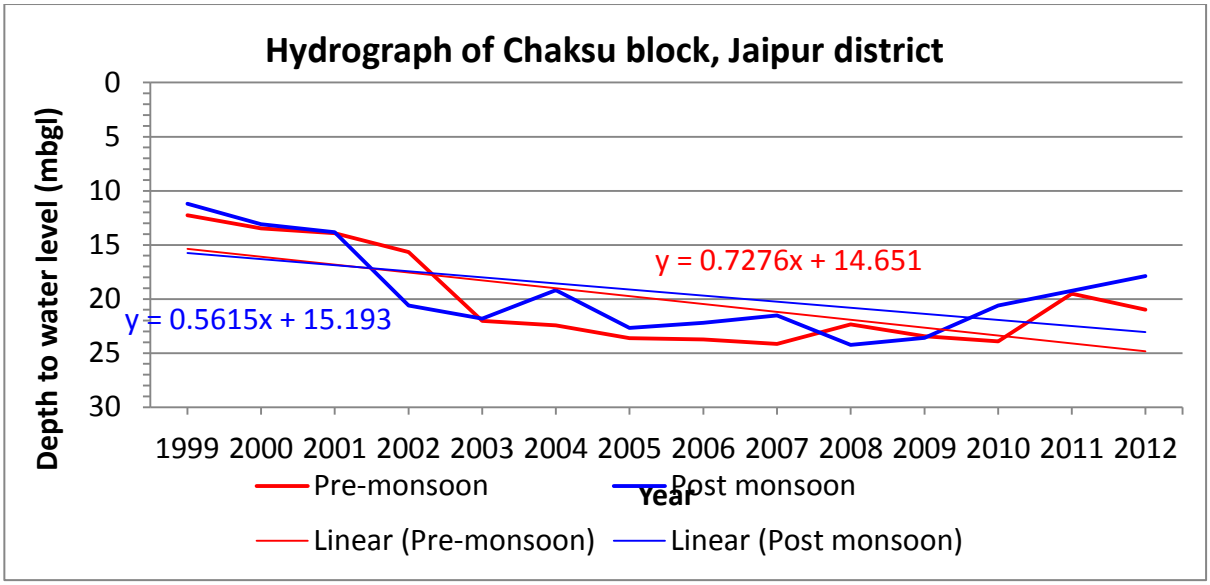


Figure: 7. Hydrograph of Chaksu & Jhotwara blocks, dist. Jaipur.

The map showing aquifer geometry & characterization Jaipur district is presented in Figure 8. The bore hole depth varies from 20 to 250 m and total no. of bore holes is 138.

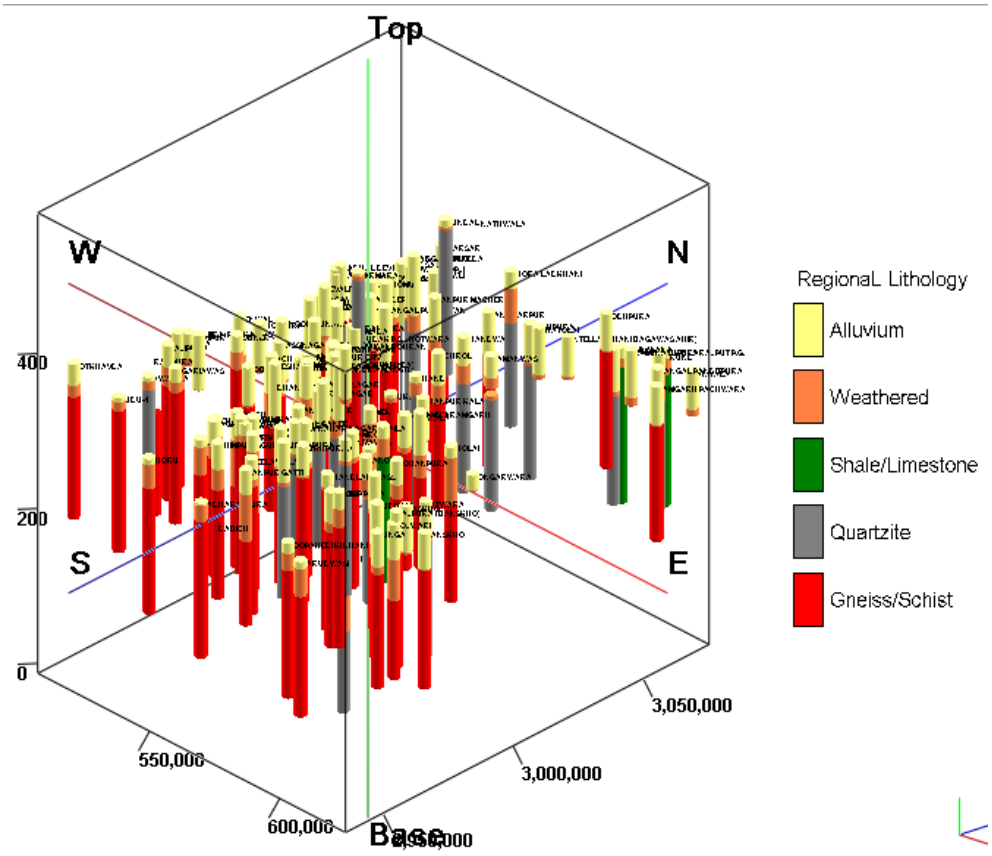


Figure 8: Map showing aquifer geometry & characterization Jaipur district

The map showing the Regional lithology of Jaipur district has been shown in Figure 9. The formation depth range is as follows: Alluvium: 0.0 – 100m, Weathered: 0.4 – 135m, Hard rock: 8.8 m and below.

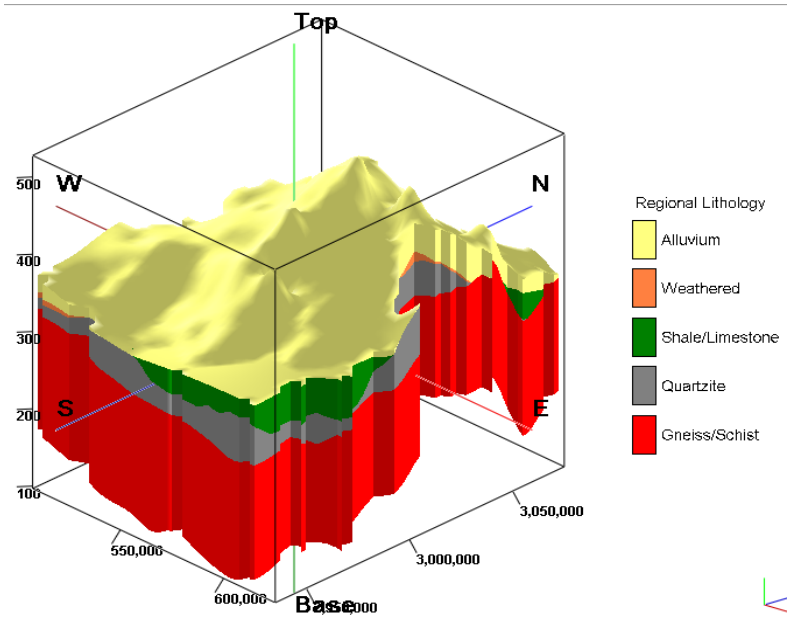


Figure 9: Map showing regional lithology, Jaipur district

Based on the data, the 3 D aquifer disposition modal has been prepared in presented in Figure 10.

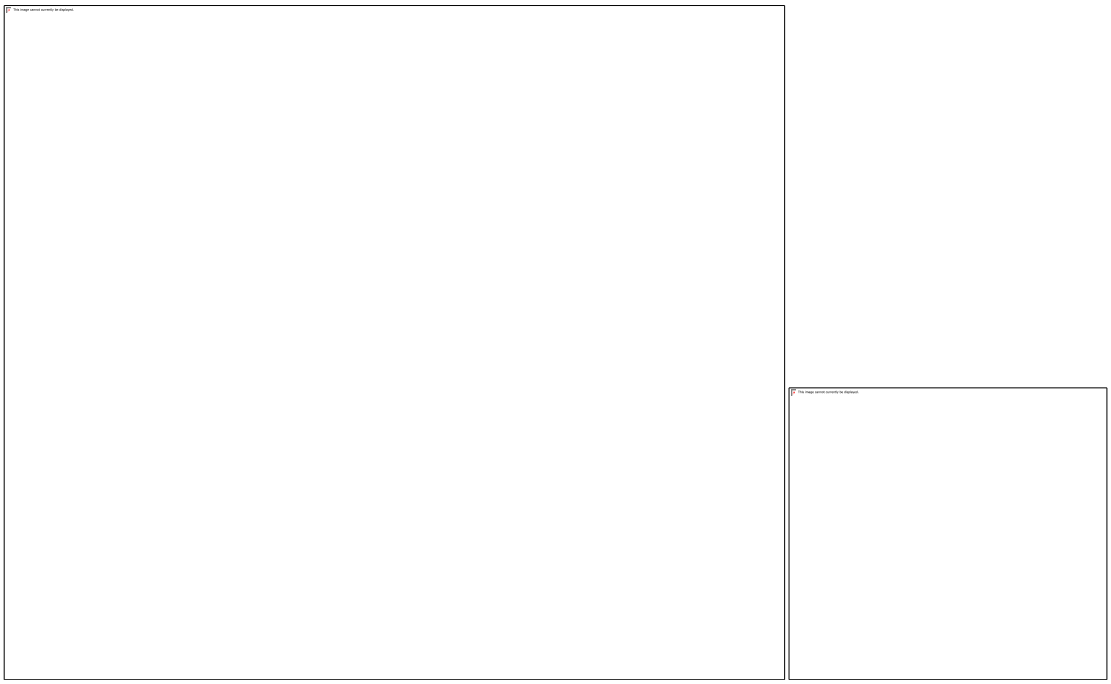
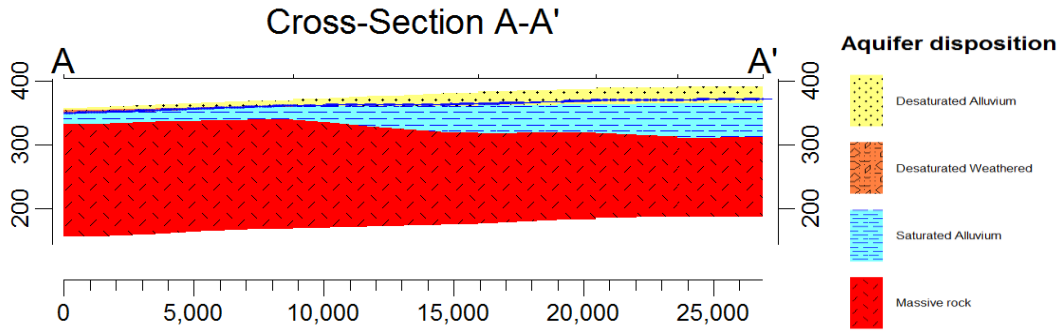
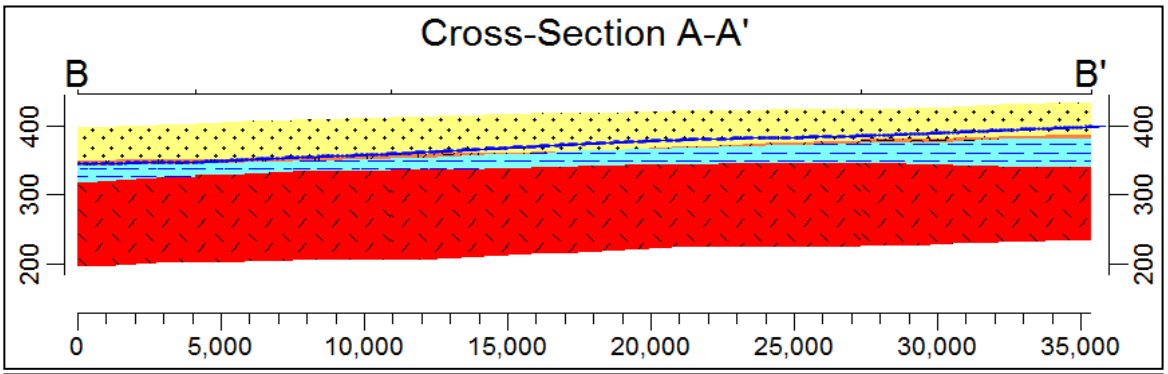


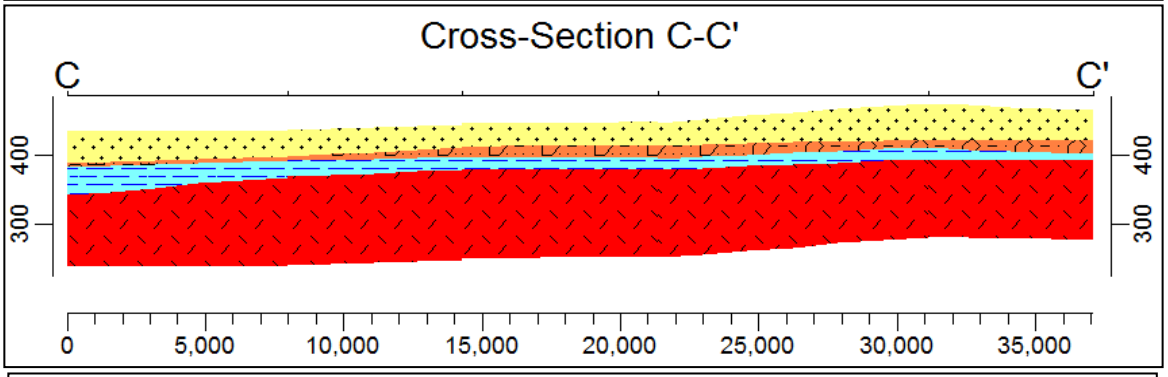
Figure 10: Map showing aquifer disposition, Jaipur district

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

Figure 11: Map showing different cross sections line aquifer disposition, Jaipur district


Cross-Section A-A'
A
A'
400
300
200
0
5,000
10,000
15,000
20,000
25,000
Aquifer disposition
Desaturated Alluvium
Desaturated Weathered
Saturated Alluvium
Massive rock


Cross-Section A-A'
B
B'
400
300
200
0
5,000
10,000
15,000
20,000
25,000
30,000
35,000


Cross-Section C-C'
C
C'
400
300
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5,000
10,000
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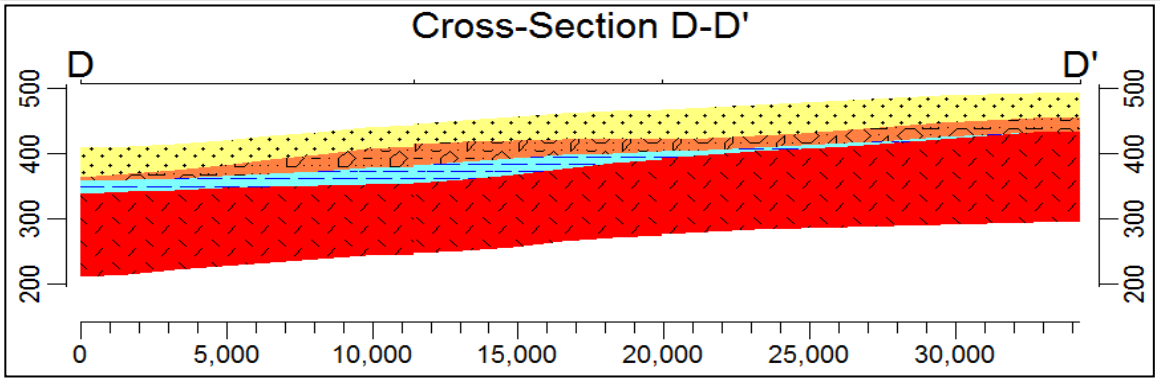
20,000
25,000
30,000
35,000


Cross-Section D-D'
D
D'
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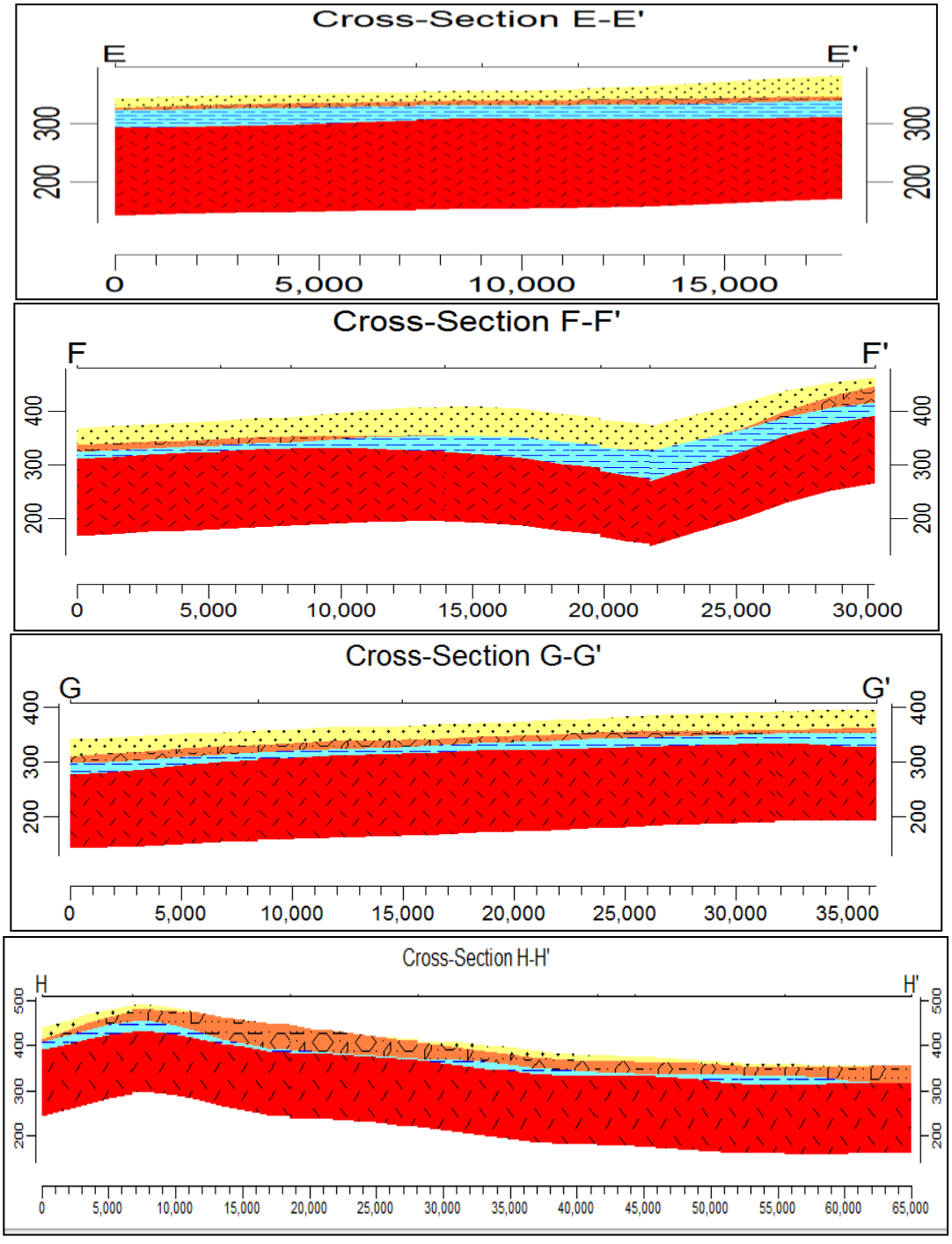

Figure 12: Mapshowing different cross sections, Jaipur district

The water table elevation map of Jaipur district as per pre monsoon 2015 data is shown in Figure 13.

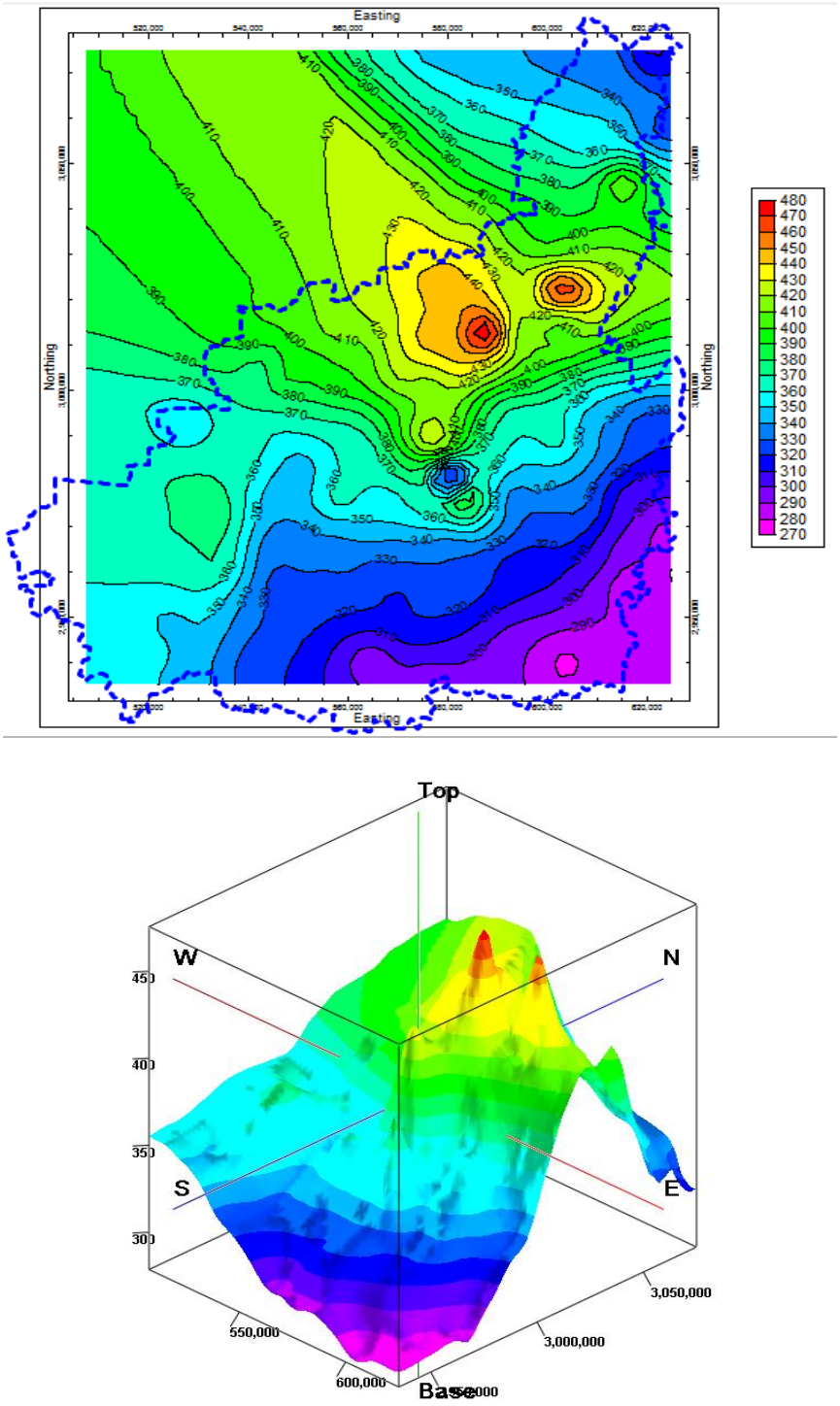

Figure 13: Water table elevation Map (May 2015)

2.2 Ground Water Quality

For the evaluation of hydrochemical status and distribution of various chemical constituents in ground water, a total of 10 water samples were collected from various observation wells located throughout the district during May 2014.

Electrical Conductivity (EC)

Electrical conductivity in general varies from 440 µS/cm at 25°C to 3805 µS/cm at 25°C. Electrical conductivity more than 3000 µS/cm at 25°C has been observed in parts of Dudu, Sambhar, Chaksu, Jamwa Ramgarh and Kotputli blocks (Fig. 7). Electrical conductivity more than 10000 µS/cm at 25°C has been observed only from isolated pocket in Dudu and Bassi block (Figure 14).

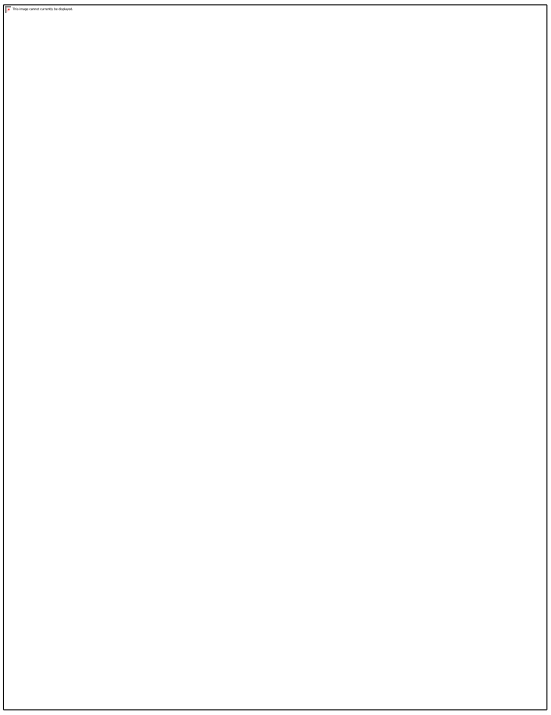

Figure 14: EC Map of Jaipur District

Occurrence of high fluoride in ground water in the district is a great concern. Fluoride concentration in the district ranges from 0.29 mg/ litre to 4.8 mg/litre at. About 29% of ground water samples collected for chemical analysis have shown fluoride value beyond maximum permissible limit of 1.5 mg/litre (Figure 15). Around 64% and 7% of samples have Fluoride content within the desirable (1 mg/litre) and maximum permissible limits respectively. Dudu, Sambhar, Phagi, Chaksu, Sanganer, Jothwara and Jamwa Ramgarh blocks are the worst affected blocks with Fluoride contamination.

Nitrate (NO_3)

Nitrate concentration in ground water has been found to vary from 8mg/litre at Gonera, Kotputli block to 153 mg/litre at Kukas, Amer block. Nitrate concentration beyond maximum permissible limit of 45 mg/litre has been reported from parts of Amer,Govindgarh , Chaksu, Dudu, Phagi, Sambhar, Sanganer, part of Jamwa Ramgarh and Kotputli blocks (Figure 16). Around 91% of samples have nitrate values within the maximum permissible limit and rest 9% samples have nitrate beyond permissible limit.

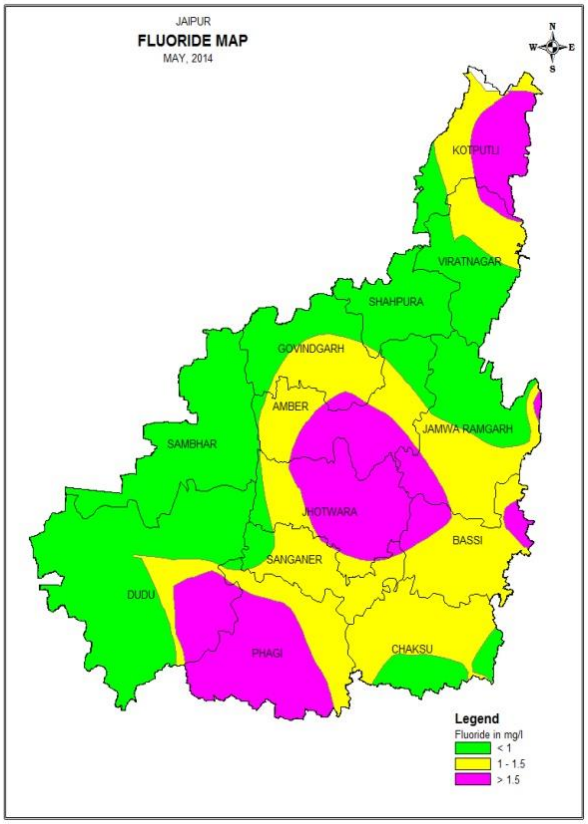

Figure 15: Fluoride map of Jaipur district

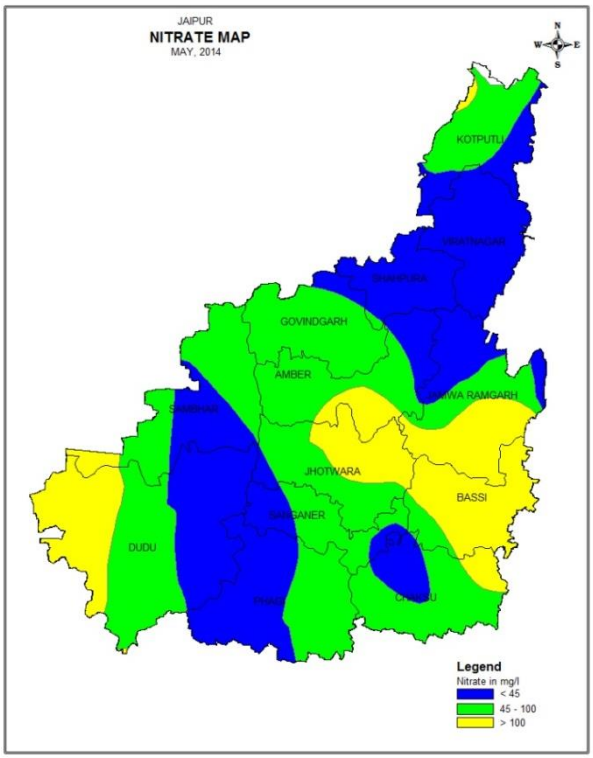

Figure 16: Nitrate map of Jaipur district

Iron (Fe)

Iron concentration in ground water in the district varies from 0.08 mg/litre at Datal Gurjaran, Jamwa Ramgarh block to 4.81 mg/litre at Mozmabad, Dudu block. In major part of the district, iron content in ground water is within the maximum permissible limit of 1.0 mg/litre (Figure 17). Out of 55 water samples analysed, only 16% of samples have iron concentration beyond the permissible limit of 1.0 mg/litre, 58% samples have iron content within the desirable limit of 0.3 mg/litre and the rest 26% samples have iron content within maximum permissible limit (0.31 to 1.0 g/litre). Higher concentration of iron has been reported from Dudu, Phagi, Sanganer, Chaksu, Bassi, Amer and Jamwa Ramgarh blocks.

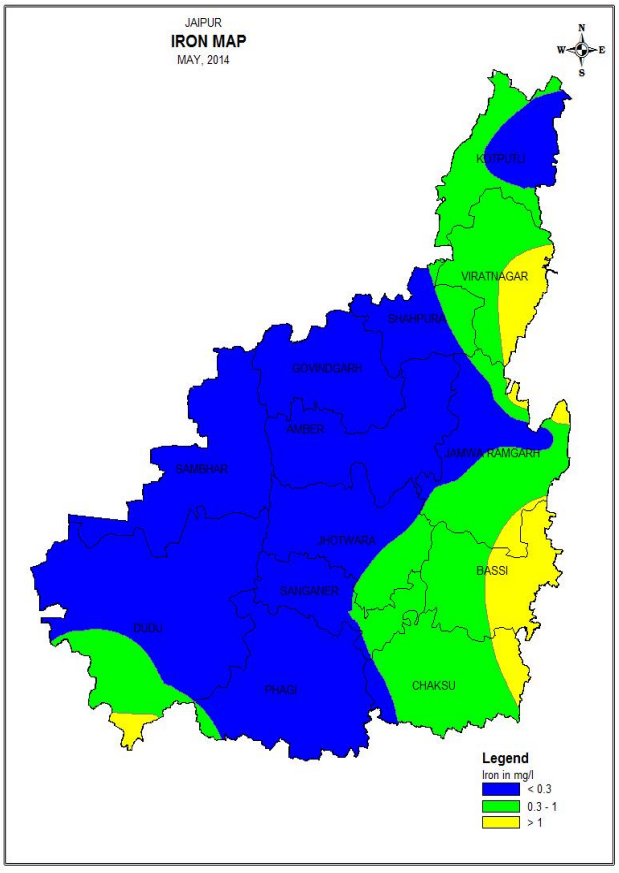

Figure 17: Iso Iron map Jaipur district

Classification of ground water samples was carried out based on the desirable and maximum permissible limits for the parameters viz., TDS, TH, Ca, Mg, Cl, SO_4 and NO_3 prescribed in the Drinking Water Standards by BIS and is given in Table 2.

Table 2: Classification of Ground Water Samples based on BIS Drinking Water Standards (IS-10500-91, Revised 2012)

Parameters	DL	MPL	Samples with conc. < DL		Samples with conc. in DL-MPL	Samples with conc. >MPL
TDS	0 to 500	501 to 2000		8	34	13
TH	0 to 300	301 to 600		38	8	9
Cl	0 to 250	251 to 400		37	17	7
SO4	0 to 200	201 to 400		46	5	4
NO3	0 to 45	46 to 100		43	7	5
Ca	0 to 75	76 to 200		38	11	6
Mg	0 to 30	31 to 100		35	15	5
F	0 to 1	1.01 to 1.5		35	4	16
Fe	0 to 0.30	0.31 to 1.0		32	14	9

(Here, DL- Desirable Limit, MPL- Maximum Permissible Limit)

Overall, the ground water quality in the wells monitored is good for irrigation purpose and there is a less possibility of developing sodium hazard.

3. Ground Water Resources

Central Ground Water Board and Rajasthan Ground Water Department (RGWD) have jointly estimated the ground water resources of Jaipur district (as on 31.3.2013) based on GEC-97 methodology. Ground Water Resource estimation was carried out for 9994.67 sq. km. area in non-command area and 340.06 sq. km area falling in Phagi block is saline. The total annually replenishable resource of the district has been assessed to be 720.9993 mcm and net annual ground water availability has been estimated to be 650.7882 mcm. Gross annual ground water draft for all uses has been estimated to be 1494.8793 mcm with stage of ground water development at 229.7 %. In addition, net annual availability of saline ground water resource in Phagi block has been assessed to be 26.1098mcm against which net annual withdrawal has been estimated as 23.96 mcm with stage of ground water development at 102%. Blockwise details of ground water resources are given in Table 3. Out of 13 blocks in the district 12 are categorized as overexploited and one block i.e. Phagi block as Critical. The figure showing Showing net GW availability Vs ground water draft, dist. Dausa is shown in Figure 18.

Table 3: Status of Ground Water resources as on 31.03.2017

Block	Total Annual Ground Water Recharge	Net Annual Ground Water Availability	Existing Gross Ground Water Draft for Irrigation	Existing Gross G.W. Draft for Dom. & Ind. Use	Existing Gross Ground Water Draft for all uses	Stage of G.W. Development	Category of Block
	(mcm)	(mcm)	(mcm)	(mcm)	(mcm)	(%)	
Amer	82.9115	74.6204	144.3445	50.2145	194.5590	260.73	OVER EXPLOITED

Block	Total Annual Ground Water Recharge	Net Annual Ground Water Availability	Existing Gross Ground Water Draft for Irrigation	Existing Gross G.W. Draft for Dom. & Ind. Use	Existing Gross Ground Water Draft for all uses	Stage of G.W. Development	Category of Block
Bairath	50.1552	45.1397	66.0531	11.3615	77.4146	171.50	OVER EXPLOITED
Bassi	45.4434	41.0252	88.7314	11.5608	100.2921	244.46	OVER EXPLOITED
Chaksu	58.2865	52.4579	82.0861	6.2981	88.3843	168.49	OVER EXPLOITED
Dudu	91.2754	82.1479	75.4026	20.6268	96.0294	116.90	OVER EXPLOITED
Govindgarh	55.9691	50.3722	121.4873	14.0433	135.5306	269.06	OVER EXPLOITED
J.Ramgarh	56.3321	50.6988	97.5829	5.7023	103.2851	203.72	OVER EXPLOITED
Jhotwara	55.4027	49.8624	66.5881	138.1206	204.7087	410.55	OVER EXPLOITED
Kotputli	39.4585	35.5126	74.0710	9.9145	83.9854	236.49	OVER EXPLOITED
Phagi	49.7472	46.5351	39.9105	3.8330	43.7435	94.00	CRITICAL
Sambher	49.7373	44.7636	159.6166	11.8276	171.4442	383.00	OVER EXPLOITED
Sanganer	54.1203	48.7083	96.3934	23.3144	119.7078	245.76	OVER EXPLOITED
Shahpura	32.1602	28.9442	66.6488	9.1457	75.7945	261.86	OVER EXPLOITED
TOTAL	720.9993	650.7882	1178.9163	315.9630	1494.8793	229.7	

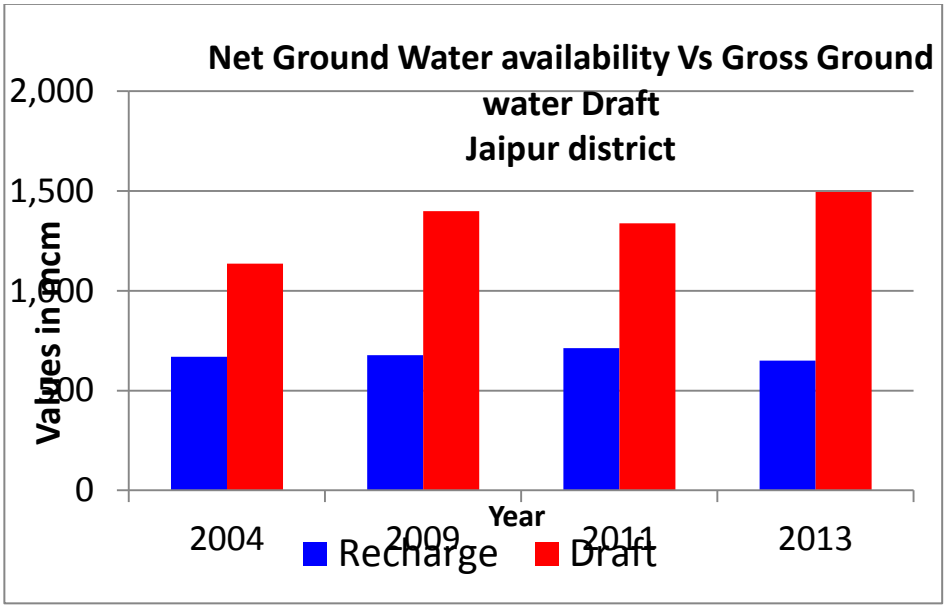

Figure 18: Showing net GW availability Vs ground water draft, dist. Jaipur.

4. Major ground water related issues

- Over exploitation
- Decline in ground water level
- Deep water levels
- Ground water quality - Salinity

5. Management Options

All the blocks except one block 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.

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

5.1.1 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

The details of feasible recharge structures to recharge the surplus water in respective blocks of Jaipur district are given in Table 4.

Table 4: Block-wise details of feasible recharge structures, Jaipur District

Block	**Zone AREA (sq. km.)**	**surplus available in the Zone (in Mm3)**	**Surplus available ins zone as per the water level**	**No. of RS 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**
Amber	653.55	1.4436	1.4436	48	33	0.4599	3	0	0.4599	9
Bassi	646.96	3.6017	3.6017	120	116	0.1203	1	0	0.1203	2
Chaksu	817.63	3.7299	3.7299	124	119	0.1462	1	0	0.1462	3

Block	Zone AREA (sq. km.)	surplus available in the Zone (in Mm3)	Surplus available ins zone as per the water level	No. of RS 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
Dudu	1928.37	2.4292	2.4292	81	81	0	0	0	0	0
Govindgarh	702.11	0.4402	0.4402	15	14	0.0193	1	0	0.0193	1
Jamwa Ramgarh	266.79	1.4853	1.4853	50	37	0.3856	2	0	0.3856	8
Jhotwara	827.75	2.6477	2.6477	88	31	1.7177	9	7	0.4394	9
Kotputli	25.36	0.1812	0.1812	6	0	0.1812	1	0	0.1812	4
Sambhar	972.47	0.6075	0.6075	20	16	0.1142	1	0	0.1142	2
Sanganer	487.33	1.0198	1.0198	34	32	0.0641	1	0	0.0641	1
Shahpura	102.48	0.0552	0.0552	2	2	0	0	0	0	0
Total	7430.8	17.6411	17.641137	588	481	3.2085	20	7	1.9302	39

Summary of recharge structures and percolation tanks and their cost component is as below:

- Surplus available -18 MCM
- Number of recharge shafts (in existing village ponds) - 481
- No. of percolation tanks-7
- Net ground water recharge - 11.08 MCM
- Farm ponds - 39 (Nos)
- Net ground water saving- 1.37 MCM
- Total Cost of proposed interventions- Rs 27.41 crore

5.2 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

5.2.1 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 51 mcm per annum @ 0.1m (Table 5).

Table 5: Block-wise water saving through change in cropping pattern and irrigation practice

Block	Irrigated Area (ha) proposed for irrigation through sprinkler	Total cost sprinkler (Rs in cr)	Water Saving by sprinkler in mcm @0.08 m	Water Saving by change in cropping pattern in mcm @0.1 m	Total water saving (mcm)
Amer	33585	13.43	25	9.83	34.83
Bairath	30570	12.23	12.23	5.46	17.69
Bassi	32541	13.02	13.02	8.31	21.33
Chaksu	53989	21.60	21.60	3.61	25.20
Dudu	202503	81.00	81.00	7.24	88.24
Govindgarh	34095	13.64	13.64	9.12	22.76
J.Ramgarh	36377	14.55	14.55	9.78	24.33
Jhotwara	17022	6.81	6.81	4.10	10.91
Kotputli	37843	15.14	15.14	6.70	21.83
Phagi	102828	41.13	41.13	3.92	45.05
Sambher	88001	35.20	35.20	3.73	38.93
Sanganer	25043	10.02	10.02	2.87	12.89
Shahpura	25366	10.15	10.15	3.81	13.95
Total	719763	288	299.47	78.47	378

Change in crop from wheat to gram will not affect farmers economy and sustainable ground water supply will be maintained.

Change in cropping pattern (Wheat to Gram)							
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**
719763	74872	5	1.5	16000	53000	80000	79500

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

- Irrigated area to be brought under irrigation by sprinkler - 3599 sq km
- Net Water saving - 299 MCM (20% of crop water requirement)
- Total cost for sprinklers – Rs 288 crore @Rs 50,000 per hectare
- From wheat to gram in 785 sq km irrigated area
- Net water saving - 78.47 MCM
- Total water saving : 378 MCM

- Total Cost / Outlay: Rs. 288 Crores

Block wise details of ground water recharged and saved along with expected improvement in stage of ground water development is given in Table 6. 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 229.70 % to 179.54% after interventions.

Table 6: Summary of expected benefit of management strategies, Jaipur 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 %)
Amer	74.6204	0.00	74.62	194.559	34.83	159.73	260.73	214.06
Bairath	45.1397	0.00	45.14	77.4146	17.69	59.73	171.5	132.32
Bassi	41.0252	0.07	41.10	100.2921	21.33	78.97	244.46	192.13
Chaksu	52.4579	0.87	53.33	88.3843	25.20	63.18	168.49	118.48
Dudu	82.1479	0.00	82.15	96.0294	88.24	7.79	116.9	9.48
Govindgarh	50.3722	0.03	50.40	135.5306	22.76	112.77	269.06	223.74
J.Ramgarh	50.6988	0.24	50.94	103.2851	24.33	78.95	203.72	155.01
Jhotwara	49.8624	0.14	50.00	204.7087	10.91	193.80	410.55	387.59
Kotputli	35.5126	0.00	35.51	83.9854	21.83	62.15	236.49	175.01
Phagi	46.5351	0.00	46.54	43.7435	45.05	-1.31	94	-2.82
Sambher	44.7636	0.00	44.76	171.4442	38.93	132.51	383	296.02
Sanganer	48.7083	0.00	48.71	119.7078	12.89	106.82	245.76	219.31
Shahpura	28.9442	0.00	28.94	75.7945	13.95	61.84	261.86	213.66
Total	650.7883	1.3532	652.1415	1494.8792	377.9432	1116.9360	229.70	179.54

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