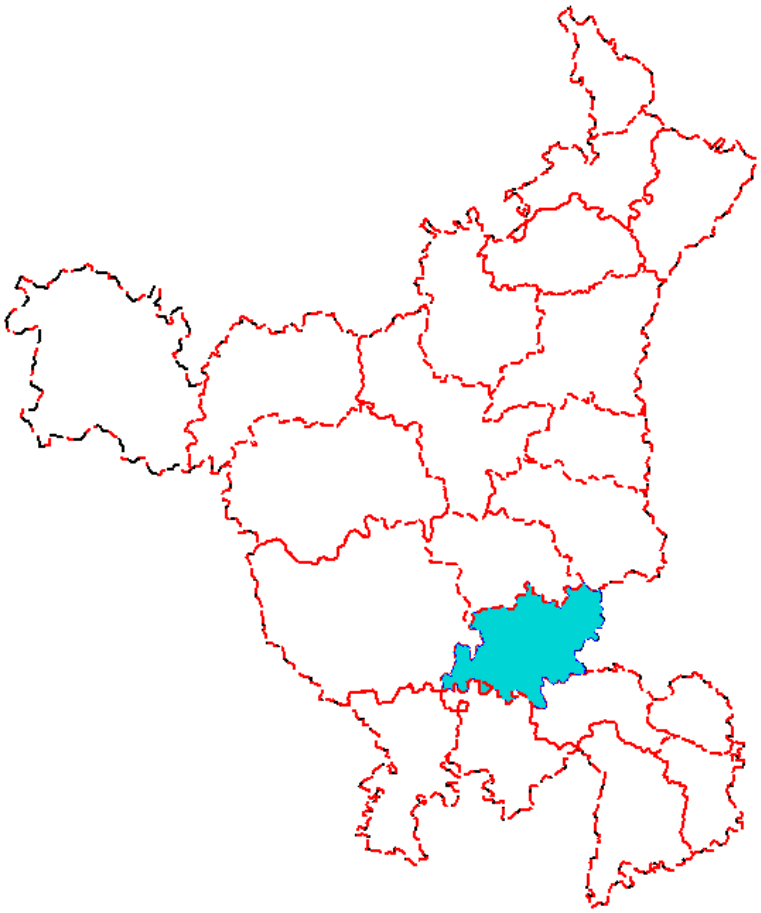
JHAJJAR DISTRICT, HARYANA



Government of India
Ministry of Water Resources
CENTRAL GROUND WATER BOARD
North Western Region
Chandigarh
2013

Contributors

Roopesh G.Krishnan

Scientist- 'B'

Prepared under supervision of

A.K Bhatia

Regional Director

Our Vision

"Water Security through Ground water Management"

GROUND WATER INFORMATION BOOKLET

JHAJJAR DISTRICT, HARYANA

C O N T E N T S

JHAJJAR DISTRICT AT A GLANCE

Sl.No	Contents	Statistics
1.	**GENERAL INFORMATION**	
	i. Geographical Area (Sq.Km)	1834
	Administrative Divisions	(As on17-01-2013)
	ii. Sub Divisions	03 (Jhajjar, Bahadurgarh, & Beri)
	iii. Number of Tehsils	04 Jhajjar, Bahadurgarh, Matanhail & Beri)
	iv. Number of Blocks	05 Jhajjar, Bahadurgarh, Matanhail, Sahlawas & Beri)
	v. Number of Villages	260
	vi. Population (As per Census 2011)	9,56,907
	vii. Average Annual Rainfall (mm)	532
2.	**GEOMORPHOLOGY**	
	i. Major Physiographic Units	Alluvium
	ii. Major Drainage	Artificial Drains (No.8)
3.	**LANDUSE (Sq.Km)**	
	i. Forest Area	41
	ii. Net area sown	1670
	iii. Cultivable Area	1760
4.	**MAJOR SOIL TYPES**	Sierozem& Arid Brown solonized
5.	**AREA UNDER PRINCIPAL CROPS**	166000 ha
	(Wheat- 99000, Rice- 31000, Bajra- 23000, Jowar - 13000 ha)	
6.	**IRRIGATION BY DIFFERENT SOURCES (Area and Number of Structures)**	
	i. Dugwells	--
	ii. Tubewells/ Borewells	64000 ha, 29008 nos.
	iii. Tanks/Ponds	-- 1045 ha
	iv. Canals	60000 ha
	v. Other sources	--
	vi. Net Irrigated Area	124000ha
	vii. Gross Irrigated Area	197000ha
7.	**NUMBERS OF GROUNDWATER MONITORING**	

	STRUCTURES / WELLS OF CGWB	
	i. Number of Dugwells	15
	ii. Number of Piezometers	04
8.	**PREDOMINANT GEOLOGICAL FORMATIONS**	Alluvium
9.	**HYDROGEOLOGY**	
	i. Major Water Bearing Formation	Sand and gravel
	ii. Pre-monsoon depth to water level	1.53 m to 19.25 m bgl
	iii. Post-monsoon depth to water level	0.43 m to 18.3 m bgl
	iv. Long-term water level trend in 10 yrs in m/yr (2002 – 2011)	Fall : -0.01 to -0.46 m/yr Rise: 0.02 to 0.41 m/yr
10.	**GROUNDWATER EXPLORATION BY CGWB**	
	i. Number of wells drilled	14
	Exploratory Well Observation Well Piezometer Slim Holes	10 -- 04 --
	ii. Depth Range (m)	74 m to 116 m
	iii. Discharge (lpm)	270 – 1796
	iv. Storativity (S)	1.21×10^{-3}
	v. Transmissivity (m^2/day)	124
11.	**GROUNDWATER QUALITY**	
	i. Presence of chemical constituents more than the permissible limit	
	EC, in micro mhos/cm	621 – 15500
	F, in mg/l	0.12 – 2.89
	As, in mg/l	--
	Fe, in mg/l	0.00 – 2.90
	No_3 in mg/l	5.1 – 1755
	ii. Type of water	$NaHCO_3$
12.	**DYNAMIC GROUNDWATER RESOURCES (MCM)**	As on 31.03.2011
	i. Annual Replenishable Groundwater Resources	427.18
	ii. Net Annual Groundwater Draft	409.43
	iii. Projected Demand for Domestic and Industrial uses upto 2025	2.30
	iv. Stage of Groundwater Development	96%
13.	**AWARENESS AND TRAINING ACTIVITY**	Nil
14.	**EFFORTS OF ARTIFICIAL RECHARGE & RAINWATER HARVESTING**	Nil

15.	**GROUNDWATER CONTROL AND REGULATION**	
	i. Number of Over Exploited blocks	2
	ii. Number of Critical blocks	1
	iii. Number of Semi Critical blocks	2
	iv. Number of blocks notified	-
16.	**MAJOR GROUNDWATER PROBLEMS AND ISSUES**	Twin problem of water logging and salinity, high fluoride.

GROUND WATER INFORMATION BOOKLET

JHAJJAR DISTRICT, HARYANA

1.0 INTRODUCTION

Jhajjar district of Haryana lies between 28^{o} 22': 28^{o} 49' North latitudes, and 76^{o} 18': 76^{o} 59' East longitudes. The district lies in the south east of Haryana state. The district is having a geographical area of 1834 sq.km, which is 3.77 % of total area of the state. The total population of the District is 956,907, (514,303 Males and 442,604 Females) as per the Census 2011. Rural population is 74.60% of the total population. Population density is 522 person per sq. km. . Administratively, the district is controlled by Rohtak division. It is divided into three tehsils namely Jhajjar and Bahadurgarh & Beri, and sub-divided into five development blocks namely Jhajjar, Beri, Bahadurgarh, Matenhail and Salhawas. The district headquarter is situated in Jhajjar town at a distance of about 65 km from Delhi. On its north lies the Rohtak Subdivision of Rohtak District and in the South lies the Subdivision Rewari of Rewari District. In the East lies Tikri border of Delhi and in the West lies Charkhi Dadri Sub Division of Bhiwani District. In the eastern part of district, the area is considerably even. Some area is uneven and also suffers from inundation and water logging during Monsoon season. The overall topography of the area is marked by alluvial plain and at some places by undulating dunes. The average plain elevation of the district is about 222 meters above mean sea level. There is a gentle slope from North South.

The Hydraulic gradient of ground water is very gentle. Ground water movement in the North Western part is from SE to NW in the South Western part is from SW to NE .The district falls within the classified arid and semi-arid zones. Broadly four types of soil are available in the District viz. clay, loamy clay, loamy sand and sand. It is alluvial in nature and fertile. However, the soil is deficient in Nitrogen. Hot summer, cold winter and meager rain fall are the main climatic characteristics of Jhajjar District. The district area falls in Yamuna sub-basin of Ganga basin, and is mainly drained by the artificial drain NO.8 flows from north to south. Jawahar Lal Nehru feeder and Bhalaut sub Branch are main canals of the district. Area under Canal irrigation is about 600 sq. km. in the district. The CGWB has carried out ground water exploration besides other hydro geological and geophysical studies in the district.

2.0 RAINFALL & CLIMATE

The climate of the district can be classified as tropical steppe, semi-arid and hot which is mainly characterized by the extreme dryness of the air except during monsoon months, intensely hot summers and cold winters. During three months of south west

monsoon from last week of June to September, the moist air of oceanic origin penetrate into the district and causes high humidity, cloudiness and monsoon rainfall. The period from October to December constitutes post monsoon season. The cold weather season prevails from January to the beginning of March and followed by the hot weather or summer season which prevails upto the last week of June.

RAINFALL: The normal annual rainfall in Jhajjar district is about 532 mm and rainy days spread over 23 days. The south west monsoon sets in the last week of June and withdraws towards the end of September and contributes about 85% of the annual rainfall. July and August are the wettest months. 15% of the annual rainfall occurs during the non-monsoon months in the wake of thunder storms and western disturbances. The maximum temperature reaches up to 45^{o}C while in winter season minimum temperate fall up to 4^{o}C in the month of January. Sandy dust cyclones are common in summer season.

Normal Annual Rainfall	:	532 mm
Normal monsoon Rainfall	:	379.3 mm
Temperature		
Mean Maximum	:	45^{0}C (May&June)
Mean Minimum	:	4 ^{0}C(January)
Normal Rainy days	:	23

3.0 GEOMORPHOLOGY AND SOILTYPES

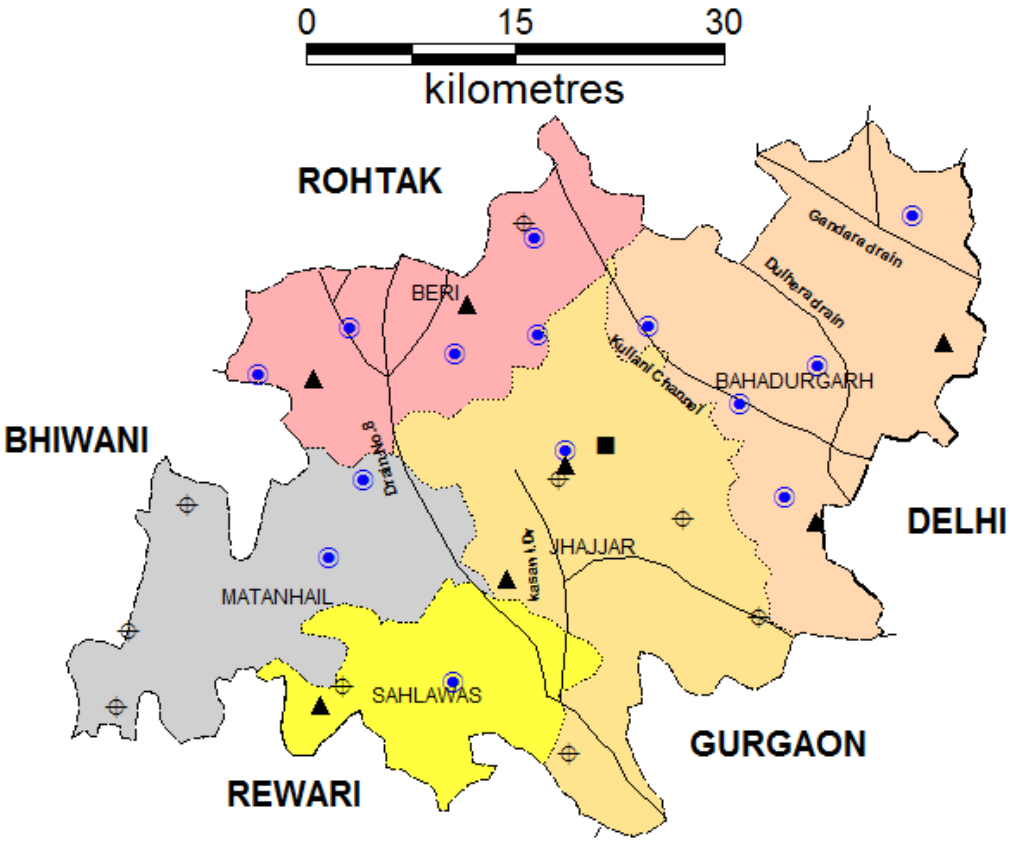
The area forms a part of Indo- Gangetic alluvial plain ranging from Pleistocene to recent in age Aeolian deposits of Sub- recent age cap the plains. The sediments comprise of clay, sand and Kankar mixed in different proportions. No exposure of hard rock farming the basement is seen in the area. Physiographically, the district area is dotted with sand dunes and very small isolated hill in south western part and rest is alluvial plain. Alluvial plains are by and large flat. And elevation in the district ranges from 212 to 222m above MSL. However, the elevation ranges upto 276m above MSL at places in the SW part of the district. The general slope is north east to south west, and is of the order of 0.48m/ km. from north to south and increases towards south west. In absence of natural drainage the area is drained by main drain No.8 of the district. The canal system of the district, if required, is also utilized to drain rain water during rainy season.

The soils of the district are fine to medium textured. It comprises sand to sandy loam in north eastern part covering Bahadurgarh, and Jhajjar blocks. The soil contains massive beds of pale reddish brown coloured clay in the southern eastern parts of the area. The nitrogen contents are low in the soils of the area. Potassium and phosphorous is medium in

PLATE - I

INDEX MAP

JHAJJAR DISTRICT, HARYANA



INDEX

- DUG WELL
- PIEZOMETER
- EXPLORATORY WELL
- DISTRICT HEAD QUARTER
- STATE BOUNDARY
- DISTRICT BOUNDARY
- BLOCK BOUNDARY

Salhawas block whereas high potassium, medium phosphorus occur in the soils of the district. The soils of the district are classified as arid brown (Solonized) and sierozem.

4.0 GROUND WATER SCENARIO

4.1 HYDROGEOLOGY

The ground water in the area occurs in the alluvium of Quaternary age. The permeable granular zones comprising fine to medium sand and occasionally coarse grained sand and gravel. Their lateral as well as vertical extent is limited. The study of borehole data generated by the CGWB indicates that clay group of formations dominate over the sand group in the district. The lithological correlation clearly indicates the presence of clay layer at the top of the surface. In general, source of ground water in the area is rainfall, sub-surface inflow, seepage from canal and return seepage from irrigation. The natural discharge includes sub-surface out flow and evapo-transpiration. The artificial discharge includes utilization of groundwater for irrigation, domestic and industrial purposes. Granular zones that occur are inter bedded with clays in alluvial formations, form the principal ground water reservoir. The upper surface of zone of saturation is represented by water levels in dug wells. Groundwater in the area occurs under water table and semi-confined or confined conditions. The basement also encountered at a depth of 315.50 m. near Jhajjar. Two to four permeable granular zones with an aggregate thickness varying between 23m and 50m have been encountered down to the depth of bed rock. The boreholes drilled at 9 sites, 8 were abandoned due to bad quality of water or inadequate discharge. And one was proved to be successful. At Bahu site in depth range of 74m to 116m Transmissivity value 124m^2 /day and lateral Hydraulic Conductivity 731m/day were determined.

Water level behavior

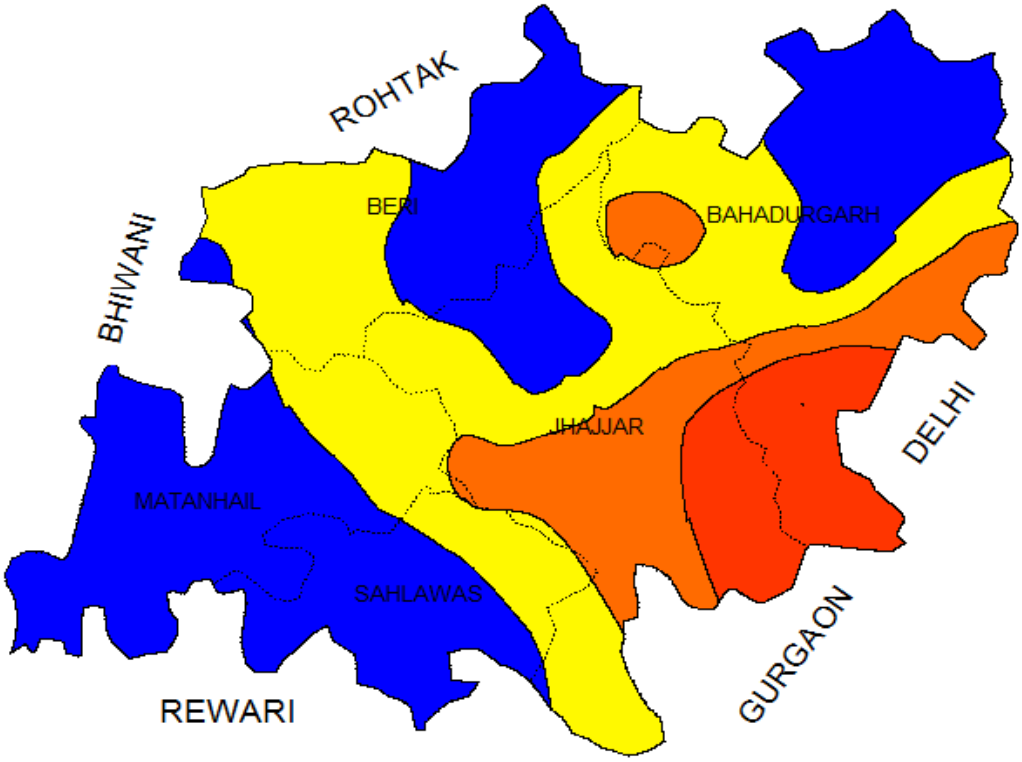
There are 16 national hydrograph net work stations in the district. The depth to water level varies from 0.84 m to 12.27 m bgl during pre monsoon period, and 0.21 m to 11.90m bgl during post monsoon period. The long term (10years) trend of the water level suggest that water level is rising at the rate of about 0.004 to 0.49 m per year. There is however a fall in parts of the district which is in the order of 0.005m per year. In the extreme southwest area of the district where the water level are deep ranges > 9.00 m bgl, high fluctuation, 2m to 3m, was observed due to excess rainfall - in1994 (709mm), 1995 (905mm) and 1996 (697mm) . There is a good correlation between rainfall and water level fluctuation which is worked out to be 0.86. About 75% of the variation in water level is accounted by rainfall. The net work of canals is causing water logging condition in the area.

PLATE - II

DEPTH TO WATER LEVEL

(PRE MONSOON , MAY- 2011)

JHAJJAR DISTRICT, HARYANA



LEGEND

MAP SYMBOL	DTWL Range (m.bgl)
	< 3.00
	3.00 -- 6.00
	6.00 -- 9.00
	> 9.00

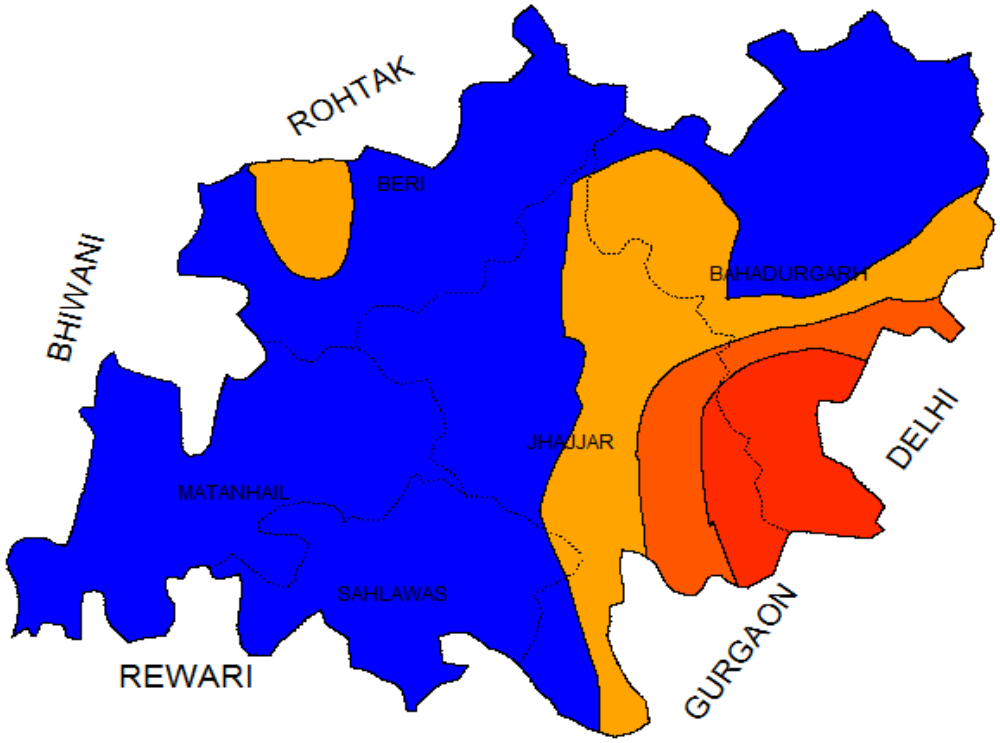
0 10 20
kilometers

PLATE - III

DEPTH TO WATER LEVEL

(POST MONSOON, NOVEMBER - 2011)

JHAJJAR DISTRICT, HARYANA



LEGEND

MAP SYMBOL	DTWL Range (m.bgl)
	< 3.00
	3.00 -- 6.00
	6.00 -- 9.00
	> 9.00

Ground water flow

The elevation of the water table in the district varies from 206 m to 250 m above mean sea level. The average gradient of the water table is of the order of 0.48 m/km. The general slope of water table in the area is converging towards the center of the district or more precisely around Jhajjar. It is also observed that the flow of water in the western part of the district is towards south- west to north- east and south-east to northwest.

4.2 GROUND WATER RESOURCES

The block wise ground water resource potential in the district has been assessed as per GEC-97 as on 31.03.2011. The stage of ground water development ranges between 77% (block-Beri) to 113% (block-Jhajjar). The total replenishable ground water resource in the district is 427.18 MCM, while the existing ground water draft is 409.43 MCM. Ground water availability for future irrigation development is 17.37 MCM. The stage of ground water development in the district is 96%.

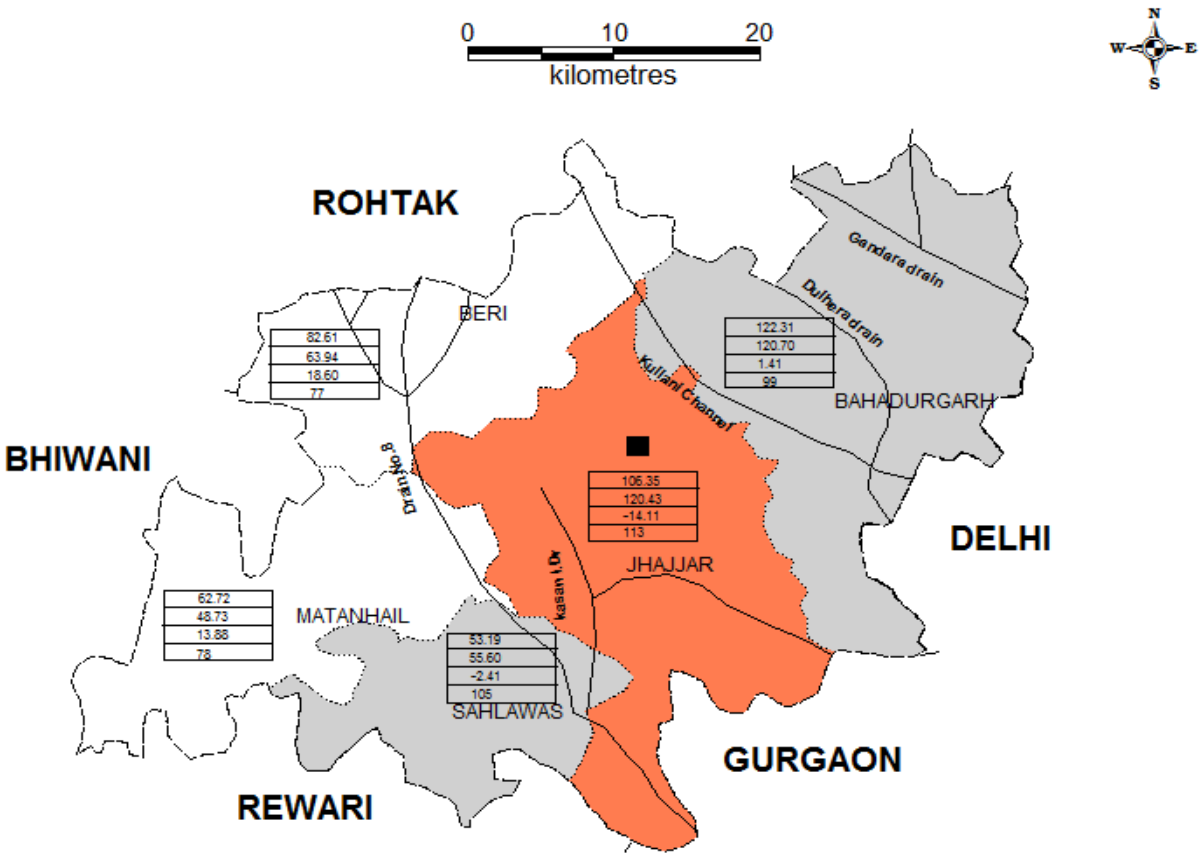
GROUND WATER RESOURCE AND DEVELOPMENT POTENTIAL OF JHAJJAR DISTRICT, HARYANAAS ON 31ST MARCH, 2011
in ha m

Block Name	Net Annual Ground Water Availability (Ham)	Existing Gross Ground Water Draft for irrigation (Ham)	Existing Gross Ground Water Draft for all uses (Ham)	Allocation domestic industrial up to next 25 years (Ham)	Net Ground Water Availability for future irrigation development (Ham)	Stage of Ground Water Develop-ment (%)	Category of Block
Bhadurgarh	12231	12016	12070	74	141	99	CRITICAL
Beri	8261	6376	6394	25	1860	77	SEMI-CRITICAL
Jhajjar	10635	11995	12046	51	-1411	113	OVER EXPLOITED
Matanhail	6272	4840	4873	44	1388	78	SEMI-CRITICAL
Salhawas	5319	5524	5560	36	-241	105	OVER EXPLOITED
TOTAL	**42718**	**40751**	**40943**	**230**	**1737**	**96**	

PLATE - IV

GROUND WATER DEVELOPMENT POTENTIAL AND CATEGORISATION OF BLOCKS

JHAJJAR DISTRICT, HARYANA



INDEX

SAFE | SEMI CRITICAL | CRITICAL

427.18	NET GROUND WATER AVAILABILITY (MCM /YR)
409.43	GROSS GROUNDWATER DRAFT FOR ALL USES (MCM /YR)
17.37	NET GROUND WATER AVAILABILITY FOR FUTURE USES (MCM /YR)
96	STAGE OF GROUND WATER DEVELOPMENT (%)

■ DISTRICT HEAD QUARTER

— . — . STATE BOUNDARY

---------- DISTRICT BOUNDARY

..... BLOCK BOUNDARY

4.3 GROUND WATER QUALITY

The ground water of the district is alkaline in nature. The pH values ranges from7.44 to 8.60 indicating that the ground water is neutral to alkaline (weak base type in nature). The development of highly productive agricultural practices , industries and changing life style of people have been taken place which has indicate the quality of surface and groundwater and which has become more dominant to deterioration. The impassive behavior of pH and electrical conductivity(EC) confirms that there is not a remarkable change in the water quality in the district area .In parts of the district below a relatively thin layer of fresh ground water in dug well zone, the quality deteriorates with depth and as such areas may not always be suitable for installation of shallow tube wells. The over estimation of suitable areas on the basis of chemical analysis of shallow ground water leads to over estimation of the resources. It is therefore essential to recommend in the method that suitability of ground water should be determined on the basis of the samples from normal depth of shallow tube wells rather than open wells. This also indicates that there is not a remarkable change in the salt concentration in the soil. The soil texture has also remained unchanged.

Suitability of groundwater for drinking purposes:

The ground water in the district is alkaline in nature. The pH values ranges from7.44 to 8.60 indicating that the ground water is neutral to alkaline (weak base type in nature). The electrical conductivity is a measure of total dissolved solids present in water and it ranges from 621 (Sankal) to 15500 micro/mhos at 25^0C was observed in Dighal. The nitrate values within the permissible limit are at few places such as Kaulasi, Dubahdhan, Mudsa, Bigoa, Chhuchakwas, Wazirpur, Chhara, Dulhera and Salhawas. Highest value of nitrate was recorded at Dighal (1755 mg/l). The fluoride (F) values ranges from 0.12 mg/ l to 2.89 mgl but in general it is within the permissible limit except at Mundsa ,Subana, Guhana and chamanpura in the district. Highest value of fluoride was observed at Chhuchakwas (2.89 mg/l). Ground water occurring in the shallow aquifer is by and large saline, But where the EC, NO3, and F value are within the permissible limits set by the BIS: 10500: 1991, it is suitable in the district for drinking purposes, however potable water at places along canals and surface water bodies like ponds, where salinity has decreased, is collected for drinking purposes.

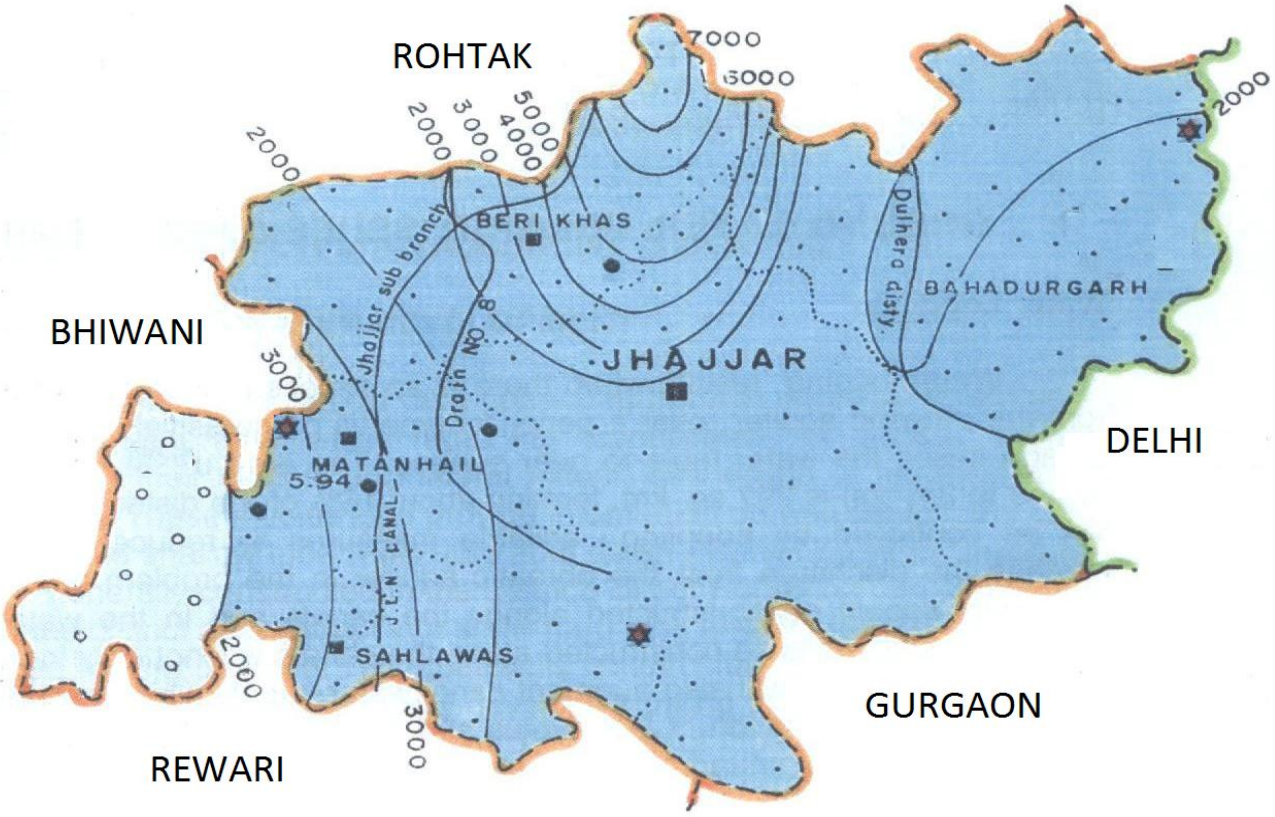
Suitability of groundwater for Irrigation purposes:

The suitability of ground water for irrigation as per the available chemical data (2010) reveals that the ground water is for irrigation except in Mudsa, Chuchakkwas, and Hasanipur. The suitability of ground water for irrigation purposes is generally ascertained by considering salinity, SAR and RSC values. As per USSL diagram ground water fall under C, S, C_2S_1, C_3S_1, C S_2, C_4S_1, C_4S_2, C_2S_3, and C_4S_4. The deep ground water is saline, salinity increases with depth and that

PLATE - V

HYDROGEOLOGY

JHAJJAR DISTRICT, HARYANA



INDEX

	WELLS FEASIBLE	RIGS SUITABLE	DEPTH OF WELL (m)	DISCHARGE (lpm)
SOFT ROCK AQUIFER	TUBEWELLS	REVERSE / DIRECT ROTARY	20 — 80	480 — 600
SOFT ROCK AQUIFER	TUBEWELLS	REVERSE / DIRECT ROTARY	12 — 20	150 — 300

ELECTRICAL CONDUCTIVITY (MICROMHOS/CM. AT 25° C) 4000

IRON < PERMISSIBLE LIMIT (1.0ppm)

FLUORIDE > PERMISSIBLE LIMIT (1.5ppm)

water is not fit for irrigation. In a very small patch in the extreme southwest of Jhajjar approximately 50 to 60m thickness of granular zones (with in 80m depth) bearing fresh water has been identified.

TYPE OF WATER

The shallow ground water is of $NaHCO_3$ type, and mixed facies type of water also occurs in the district.

4.4 STATUS OF GROUND WATER DEVELOPMENT

The ground water is saline at the shallow as well as at depths in the area. The water supply, rural or urban in the district area is based only on canal water. The canal water is cleaned through "SLOW SAND PROCESS'' and supplied to the villages and towns at the rate of 150 litres per head per day. Out of 260 villages of the district, 170 villages are covered by the PUBLIC HEALTH DEPARTMENT at Jhajjar ,79 at Bahadurgarh and rest of the villages are either lamp less or covered by the Public Health Department at Rohtak and Rewari. There are about 86 tube wells of PHE, Deptt., used for augmentation to water supply in the district. The additional demand of water both in rural and urban areas are met with the hand pumps generally located near the canals or other surface water bodies, as the quality of shallow ground water is fresh. Beside canal irrigation, there are 33795 minor irrigation units to meet out the irrigation demand of the district. These shallow tube wells, mostly cavity type, are either run by diesel engines or electric motors. The exploratory drilling carried out in the district has revealed the presence of the granular zones at depth .The ground water being saline at depth; the shallow ground water can be developed for moderate supplies for irrigation purposes.

4.5 SURFACE GEOPHYSICAL SURVEYS

The surface geophysical studies in Jhajjar district show that ground water is saline at all levels in major part of the area which is almost 42% of the total area studied. Only 58% area is available in few patches where fresh to marginally saline ground water within 10 m depth is expected. This has resulted in scarcity of drinking water in many areas. Large lateral variation has been noticed in respect of ground water quality in the entire study area, however, ground water quality improves slightly at shallow depth in the vicinity of canals. The areas where granular zones with fresh water have been inferred at shallow depth within 35 m depth are Rankhanda, Beed Chhuchhakwas, Silani-jan around central part and Kasni in southern part. The thickness of the granular zones bearing fresh water is approximately 18 to 30m. Approximately 50 to 60m thickness of granular zone (within 80m depth) bearing fresh water is expected in extreme southwest at Dalan-was and Jhamri where water level are declining beyond 25m. No fresh water occurs below 80m in the district.

5.0 GROUND WATER MANAGEMENT STRATEGY

5.1 GROUND WATER DEVELOPMENT

The hydrogeological data generated through exploratory test drilling has provided vital information regarding identification of aquifer systems, demarcation of their vertical and lateral extent, and delineation of potential aquifer characteristics. These studies also provide information on well design and drilling techniques. The shallow tube wells upto 20 m depths (CAVITY TYPE), using PVC pipes are generally constructed in the District. Direct Rotary rig can carry out the drilling in the district area except in a small hard rock terrain where DTH rig would be required for the purpose. .The tubewells constructed with in a depth range from 12m to 20m are drilled using locally developed drilling techniques in fresh water areas would yield about 150 to 300 lpm. The depth of tubewells may however be more upto 80 m in the southwest area of the district. The "V" wire galvanized Johnson Screen having 1.0 mm slot width can be used against granular zones, as it has more open area for the entrance of water, where the tube wells have considerable depth. In a very small patch in the extreme southwest of Jhajjar approximately 50 to 60m thickness of granular zones (with in 80m depth) bearing fresh water has been identified through geophysical surveys, and is suitable for ground water development. The expected discharge of the tube well constructed in this area is 360 to 480 lpm.

5.2 WATER CONSERVATION STRUCTURES

There are about 375 tank/ponds in the district. Their block wise distribution and recharging contribution are shown in the following tables.

Block	No. of Tanks/ Ponds	Average water spread area (ha)		No of days water is available		Recharge in Ha.m. during	
		Monsoon	Non-Monsoon	Monsoon	Non-Monsoon	Monsoon	Non-Monsoon
Bahadurgarh	80	150	80	85	200	18.36	23.04
Beri	70	120	70	85	205	14.688	20.664
Jhajjar	105	200	105	90	180	25.92	27.216
Matanheil	60	100	60	80	150	11.52	12.96
Salhawas	60	100	60	80	150	11.52	12.96
Total	**375**	**670**	**375**	**420**	**885**	**82.008**	**96.84**

Table: Number of Groundwater Abstraction structures and its season wise unit draft

Block	Type of structures	No. of structures		Seasonal wise unit Draft (ham)			
		Domestic	Irrigation	Domestic		Irrigation	
				Monsoon	Non-Monsoon	Monsoon	Non-Monsoon
Bahadurgarh	STW	11126	30	0.486	0.594	0.5973	1.2127
	DTW			-	-	-	-
Beri	STW	6642	10	0.432	0.528	0.5973	1.2127
	DTW			-	-	-	-
Jhajjar	STW	7497	28	0.72	0.88	0.5973	1.2127
	DTW			-	-	-	-
Matanheil	STW	7334	18	0.297	0.363	0.5973	1.2127
	DTW			-	-	-	-
Salhawas	STW	5261	20	0.4725	0.5775	0.5973	1.2127
	DTW			-	-	-	-

6.0 GROUND WATER RELATED ISSUES & PROBLEMS

Water Logging

Water logging results when there is an excess recharge over discharge from the phreatic aquifer over a period of time till progressively the increase in storage raises the water table to near surface. The area under water logging (DTW 0 to 2m bgl) is 297 sq. km. forming about 16% of the district. Water logging can be controlled by adopting suitable measures to reduce recharge and increase the discharge from the phreatic aquifer in the problem area. Shallow tube wells should be constructed along the canals and in the water logged areas. The tube wells so constructed along the canals will not only increase the draft in the area but will also augment canal water supply which can be utilized at the tail ends. Plantation of Eucalyptus and other similar type of plants along the minors in the command area and strengthening of present drainage system would also be beneficial in arresting the water logging in the area.

Salinity

The twin problem of water logging and salinity is associated with clay formation at shallow depth, thereby the increased evaporation and evapo-transpiration from shallow water table takes place. The improper management of ground water by users in the area has also contributed to ground water salinity. This has also damaged surface soils in the area and aggravated the problem of ground water salinity. In absence of natural drainage the rain water accumulates in the natural depressions and artificial drains. This undrained flood water creates

ponds and marshes. However, a good net work of artificial drains keep proper balance between soil moisture and air to a considerable extent, and has been very helpful in removing excess water and salt from the soils.

Fluoride

High fluoride (F) content, more than the permissible limit of 1.5mg/l, is present at places in the shallow ground water in the district. The high fluoride values ranges from 0.12mg/l to 2.89 mg/l, thus making the water harmful (unfit) for human consumption.

7.0 RECOMMENDATIONS:

1. Water logging can be checked by adopting suitable measures to reduce the recharge and increase discharge from the phreatic aquifer in the problem area construction of surface drains, lining of canals, and water courses, village ponds, optimum use of irrigation water, aforestation along canals, drains rails, and roads, and pumpage of ground water to drains and canals are some of the remedial measures suggested.

2. Change in cropping pattern (Crop Diversification) from high water intensive crops to low water intensive crops such as maize, wheat, and pulses may reduce water logging.

3. The permanent water logged areas especially by the side of canals, roads drains, and ponds can be utilized for developing fisheries.

4. In the extreme southwest part of the district shallow to deep tubewells upto 80 m depth are feasible.

5. PVC pipe assembly may be used in case of shallow tubewells.

6. It is necessary to notify the Jhajjar (stage of development 113%) and Salahwas (stage of development 105%) blocks of the district for registration of all ground water abstraction structures and the construction of any tubewell , prior permission should be sought from the Central Ground Water Authority. Local people are to be educated regarding consequences of mining of ground water and need for its economic use.