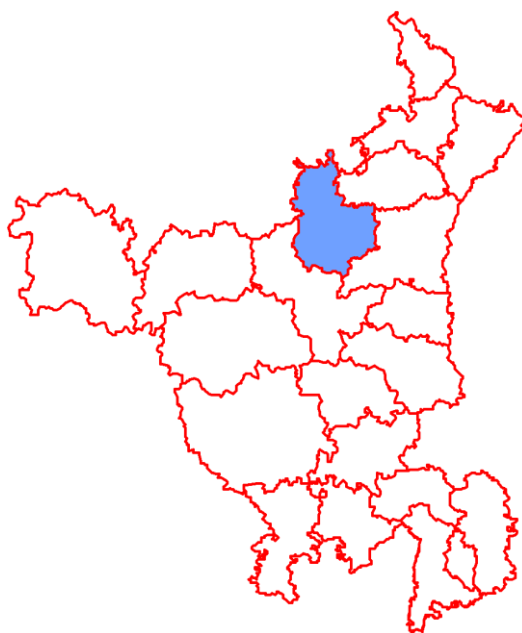




**GROUND WATER INFORMATION BOOKLET
KAITHAL DISTRICT HARYANA**



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

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**GROUND WATER INFORMATION BOOKLET
KAITHAL DISTRICT, HARYANA**

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KAITHAL DISTRICT AT A GLANCE

Sl. No	ITEMS	Statistics
1	GENERAL INFORMATION	
	i) Geographical area (sq.km)	2317
	ii)Administrative Divisions Number of Sub-division Number of Tahsils Number of Sub-tehsil Number of Blocks	02 04 03 06
	iii) Population (as on 2011 Census)	10,72,861
	iv) Normal Annual Rainfall (mm)	511 mm
2.	GEOMORPHOLOGY	
	Major Physiographic units	Alluvial Plain
	Major Drainages	Ghaggar and Markanda River
3.	LANDUSE (Sq.Km)	
	a) Forest area	20
	b) Net area shown	2010
	c) Area sown more than once	1840
	d) Total cropped area	3850
4.	MAJOR SOIL TYPES	Sandy, Kallar or Rehi and Sierozem soil
5.	AREA UNDER PRINCIPAL CROPS	Paddy 1587 Sq. Km Wheat 1776 Sq. Km
6.	IRRIGATION BY DIFFERENT SOURCES (Areas and Numbers of	
	Dugwells	Nil
	Tube Wells/Boreholes	1910 Sq. Km/ 56,599 Nos
	Tanks/Ponds	NIL
	Canals	90 Sq. Km
	Net Irrigated area	2000 Sq. Km
	Gross irrigated area	3840 Sq. Km

7.	NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB No. of Dug Wells No. of Piezometers	06 13
8	PREDOMINANT GEOLOGICAL FORMATIONS	Quaternary Alluvium
9	HYDROGEOLOGY	
	Major Water bearing formations Pre-monsoon depth to Water Level Post-monsoon depth to water level Long term water level trend in 10 yrs	Fine to medium grained Sand layers 3.92 mbgl to 35.39 mbgl 1.67 mbgl to 36.68 mbgl Declining trend; 0.18 m/yr to 1.16 m/yr Rising trend; 0.05 m/yr
10	GROUND WATER EXPLORATION	
	No of wells drilled by CGWB EW PZ SH	07 06 01
	Depth Range (m)	200.00 – 610.00 m
	Discharge (litres per min.)	1200 to 4656
	Storativity (S)	2.35×10^{-2}
	Transmissivity (m^2/day)	400 – 1400
	No of PZ drilled through outsourcing by M/s WACOS Ltd.	09
11	GROUND WATER QUALITY	
	Presence of chemical constituents more than permissible limit (eg. EC, F, Fe, As)	EC-5990 $\mu S/cm$ F- 2.55 mg/l Fe-NIL As-NIL
	Type of Water	Sodium mixed anion type.

12	DYNAMIC GROUND WATER RESOURCES (As on 31 st March 2009)	
	Annual Replenishable Ground Water Resources	507.83 MCM
	Net Annual Ground water Draft for all uses	1077.46 MCM
	Net Ground Water Availability for future irrigation development	(-) 56963 MCM
	Stage of ground Water Development	212%
13	AWARENESS AND TRAINING ACTIVITY	NIL
14	EFFORTS OF ARTIFICIAL RECHARGE & RAINWATER HARVESTING	NIL
15	GROUND WATER CONTROL AND REGULATION	
	Number of Over-exploited Blocks	05
	Number of Critical Blocks	NIL
	No. of Blocks notified	01
16	MAJOR GROUND WATER PROBLEMS AND ISSUES.	Declining Water Table, Salinity & Fluoride problem

GROUND WATER INFORMATION BOOKLET, KAITHAL DISTRICT, HARYANA

1.0 INTRODUCTION

Kaithal, the north eastern district of Haryana State with a total geographical area of 2317 sq. km is located between 29°31': 30°12' north latitudes and 76°10': 76°42' east longitudes. It is bordered by Patiala district of Punjab in the north, Kurukshetra, Karnal and Jind district of Haryana in north east, eastern, western & southern respectively.

Administratively, the district is under control of Ambala division and it has four tehsils and divided into six development blocks namely Gulha at Cheeka, Kaithal, Pundari, Kalayat, Rajound and Siwan. The district headquarter is at Kaithal. It has four towns namely Kaithal, Cheeka, Kalayat and Pundri. Towns are well connected by roads.

As per 2011 census the total population of the district is 10,72,861. The population density is 630 persons per sq.km against the state average of 573 persons per sq.km. The decennial growth rate of population of the district for the decade 2001-2011 was + 13.39 per cent. The rural and urban population is 8,37,171 and 2,35,690 with an average density of 463 person/sq km against the state average of 573 persons per sq.km. Out of total population 5,70,595 are males and 5,02,666 are females. The male & female ratio of the district as a whole was 880. In Kaithal district rural population is settled in 269 villages and the rest of population is concentrated in 4 towns.

The Ghaggar and Markanda rivers are important seasonal rivers in the district and flows through the northern part of the district covering Gulha block in westerly direction and enters Patiala district of Punjab. River Ghaggar sometimes gets flooded during monsoon and causes extensive damage to crops and property. Besides Sirsa branch which is part of Western Yamuna canal system, is the most important canal passing through the Pundri, Kaithal and Kalayat blocks area. Depletion in ground water resources are the major concern of the district.

2.0 RAINFALL AND CLIMATE

Rainfall: The normal annual rainfall of the district is 511 mm which is unevenly distributed over the area 30 days. The south west monsoon, sets in from last week of June and withdraws in end of September, contributed about 85% of annual rainfall. July and August are the wettest months. Rest 15% rainfall is received during non-monsoon period in the wake of western disturbances and thunder storms. Generally rainfall in the district increases from southwest to northeast and varies from 400 mm at Rajound to more than 563 mm at Kaithal and Gulha.

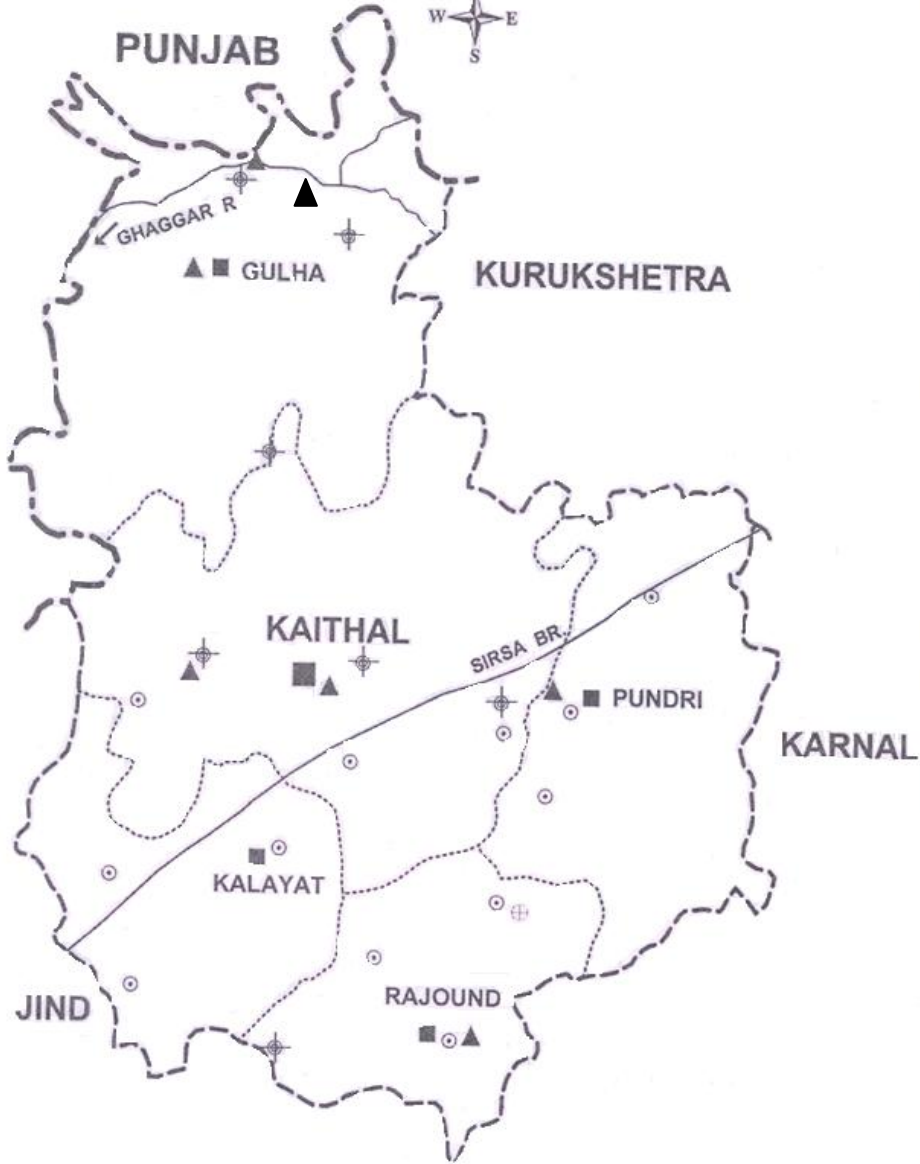
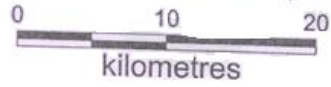
Normal Annual Rainfall (average of 2006-10): 511 mm
Normal monsoon Rainfall: 480 mm
Annual average rainfall (2010): 567.5 mm
Temperature Mean Maximum : 40°C (May & June) Mean Minimum : 7 °C (January)
Normal Rain days : 30

Climate: The climate of Kaithal district can be classified as tropical steppe, semi- arid and hot which is mainly dry with very hot summer and cold winter except during monsoon season when moist air of oceanic origin penetrate into the district. There are four seasons in a year. The hot weather season starts from mid March to last week of the June followed by the south west monsoon which lasts up to September. The transition period from September to October forms the post-monsoon season. The winter season starts late in November and remains up to first week of March.

3.0 GEOMORPHOLOGY AND SOILS

Physiographically, the district is characterised by distinct features i.e. upland plain, alluvial bed (flood plain) of river Ghaggar and Markanda. The area as a whole is almost flat with a gentle slope towards south west direction. The district is mainly drained by the river Ghaggar and Markanada. The district has two types of soils viz Sierozem and Desert soils. The sierozem soils are found in major parts of the district and desert soils are comparatively found in smaller part of the district especially in northern part of the district. Sierozem Soil are found in the areas where the normal annual rainfall varies from 300 to 500 mm. These soils vary from sandy loam to loamy sands in texture and are marginally fertile. Degree of salinity and alkali hazards is highly variable, though salinity is major hazard.

INDEX MAP KAITHAL DISTRICT, HARYANA



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|---|---|
| <ul style="list-style-type: none"> ○ GROUND WATER MONITORING STATION ⊕ EXPLORATORY WELL ▲ PIEZOMETER ⊕ SLIM HOLE ■ DISTRICT HEAD QUARTER | <ul style="list-style-type: none"> ■ BLOCK HEAD QUARTER — STATE BOUNDARY - - - DISTRICT BOUNDARY ⋯ BLOCK BOUNDARY |
|---|---|

4.0 IRRIGATION AND AGRICULTURE

IRRIGATION: The Sirsa branch is the major source of canal irrigation. The canal passes through the Pundri, Kaithal and Kalayat blocks of the district. Out of 2,00,000 ha net irrigated area, 9,000 ha is irrigated by canal and 1,91,000 ha is irrigated by ground water. About 95.5% of the irrigation is based on ground water resources, which indicates the heavy stress on the ground water resources for irrigation sectors. The gross irrigated area has been worked out as 3,84,000 ha, which is 6.9% to the State total. Percentage of Gross Area Irrigated to Total Cropped Area has been worked out as 99.7% with the irrigation intensity of 192.

AGRICULTURE: Net area sown in the district is 2,01,000 ha which constitutes about 87 % of the total area. Area sown more than once is 1,84,000 ha bringing the total cropped area to 3,85,000 ha. Paddy constitutes main kharif crop whereas the wheat is the main Rabi crop. The details of area under cultivation, production and average yield of important crops of the district during the year 2011-12 is given in table below:

.Crops	Area under cultivation (ha)	Production (Tonnes)	Average yield (Kgs/ha)
Rice	1,58,700	4,36,000	2743
Bajra	9,200	14,000	1561
Wheat	1,77,600	8,35,000	4720
Sugarcane	2,000	15,000	7689

5.0 GROUND WATER SCENARIO

5.1 HYDROGEOLOGY

The geological formations met within the district comprised unconsolidated alluvial deposits of Quaternary age. The alluvial deposits comprises of sand, silt, clay associated with kankar. Fine to medium grained sand horizon forms the potential aquifer in the area.

The area has both unconfined and confined aquifers. In general the unconfined aquifers occurs down to 60 m depth below ground level in the district and abstracted through hand pumps and shallow tubewells. The alluvium forms the principal ground water reservoir and the principal aquifer material comprises fine to medium sand and sand mixed with kankar. This aquifer is either in the form of isolated lenses of sand embedded in clay beds or well connected granular zones that have a pinching and swelling disposition and are quite extensive in nature.

The ground water in confined condition is abstracted through medium and deep tubewells. In alluvium potential aquifer zone exists down to explored depth of 600 m. In

the district, thickness of alluvial formation increases towards Southwest. Perusal of the data of the exploratory tubewell constructed in Ghaggar Basin indicate that tubewells tapping water bearing zone within 100 to 200 m depth yield 1500 lpm to 3000 lpm for draw down of 5 to 17 m.

The quality of water has not been found fresh in shallow as well as deep aquifer in some parts of the district. Shallow aquifer zones contain fresh water in northern and eastern parts of the district covering Gulha, Kaithal, Pundari, Kalayat and Rajaound. Marginal to saline ground water occur in shallow zones in part of Kalayat and Rajaound blocks. In general deeper zone in Kalayat and Rajaound block contains brackish to saline ground water. A large number of shallow tubewells exists in all parts of the district having fresh water, however their number is significantly large in blocks of Gulha, Pundari, Kaithal Kalayat followed by Rajaound. Depth of these shallow tubewells ranges from 20 to 50 m and yield varies between 500 lpm to 1200 lpm for moderate drawdown. Deeper tubewells tap water bearing zones down to 120 m depth and yields 1500 to 3000 lpm for 4 to 7 m of draw down. In some parts of district i.e. surrounding Padla in Kaithal block a tubewell tapping unconfined aquifer group in the depth range 26 to 91 m yields a discharge of 1500 lpm for drawdown of 7.0m

Central Ground Water Board has drilled 07 exploratory wells, 01 Slim Holes and 06 piezometers to delineate and determine the potential aquifer zones, evaluation of aquifer characteristics etc. Besides, 09 piezometers have been constructed through outsourcing by M/s WAPCOS Ltd. The drilling has been done to a maximum depth of about 610 m and revealed the presence of 6 to 22 prominent permeable granular zones. Aquifer parameters as determined from exploratory activity of the Central Ground Water Board reveals that in the central part of the district transmissivity value $686 \text{ m}^2/\text{day}$, Lateral hydraulic conductivity of 11.45 m/day and specific yield value 2.35×10^{-2} have been observed. In the north central part of the district covering part of Gulha block transmissivity value $1400 \text{ m}^2/\text{day}$, Lateral hydraulic conductivity of 25 m/day and in the northern extreme part of the district transmissivity value $400 \text{ m}^2/\text{day}$, Lateral hydraulic conductivity of 22.2 m/day and specific yield value 18.00×10^{-2} have been reported.

5.2 Water level behavior

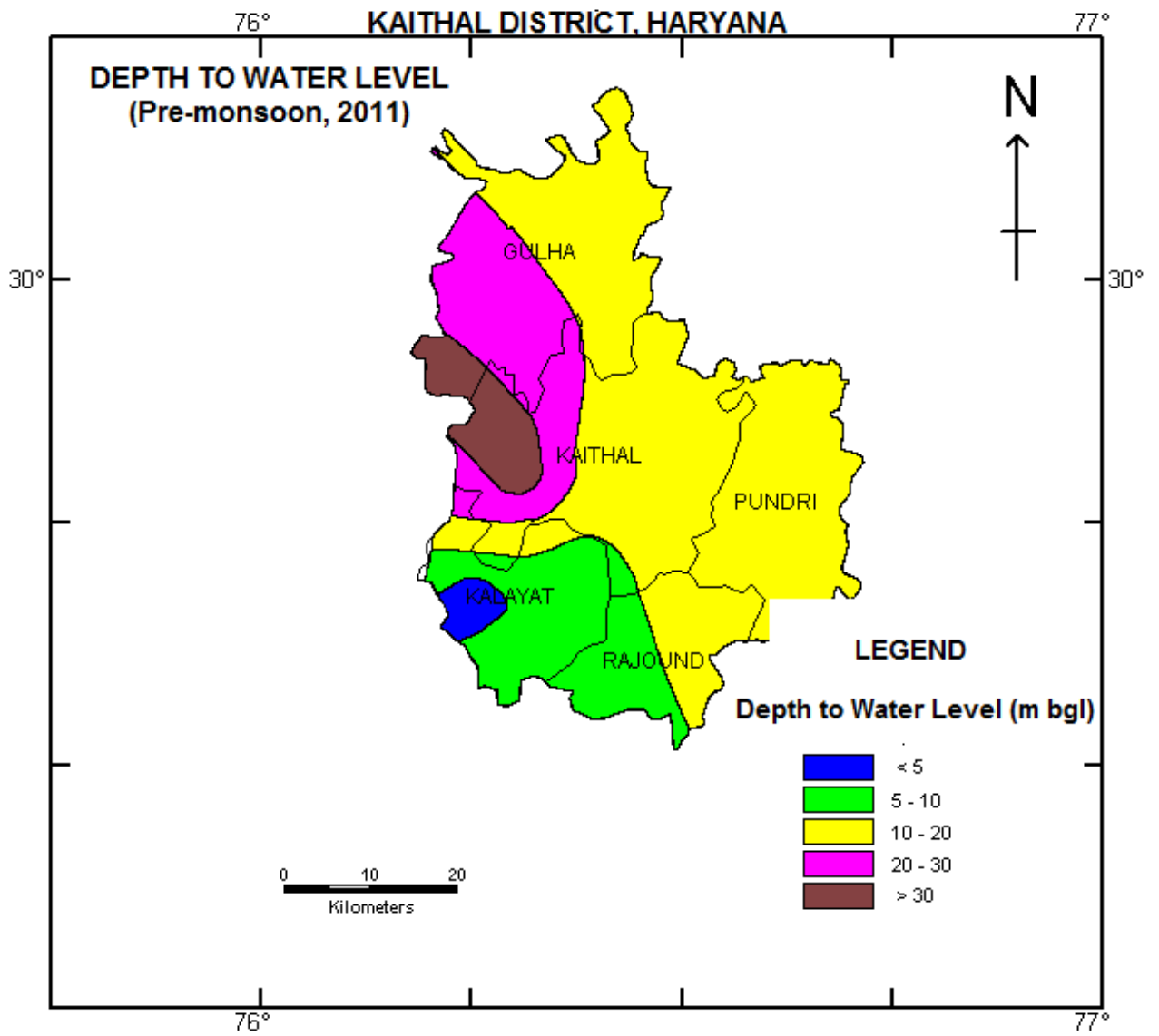
Depth to water level in the district ranges from 3.92 to 35.39 m bgl during pre-monsoon period and 1.67 mbgl to 36.68 mbgl during post-monsoon period 2011. In

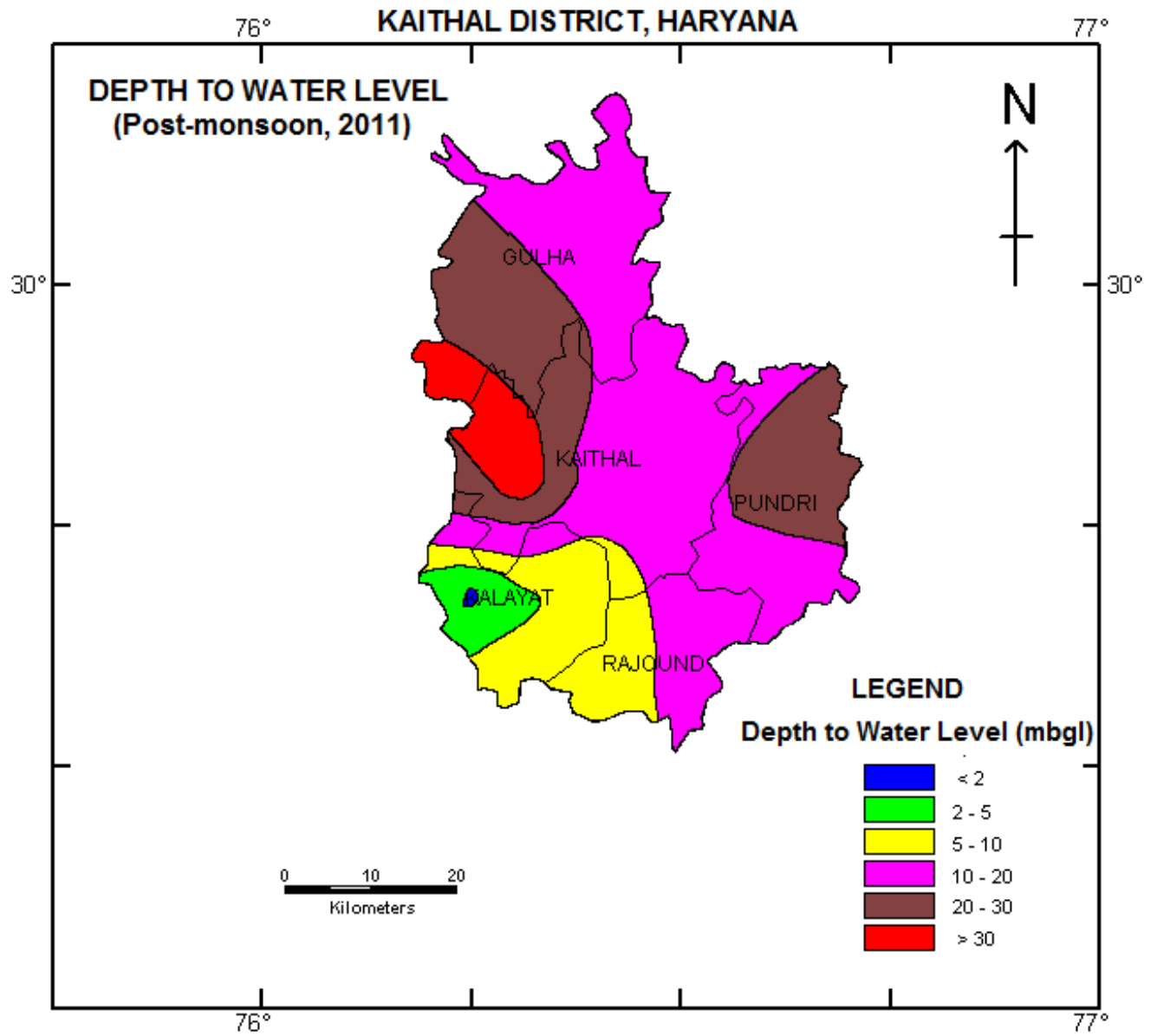
major part of the district water level ranges between 10 m to 20 m bgl and spreads in part of Gulha, Kaithal, Pundri, Rajound and Kalayat Blocks. The ground water levels more than 30m bgl has been recorded in part of Goula and Kaithal Blocks. The shallow water level in the depth range of 3 m to 5 m bgl spreads in part of Kalayat Block. During post monsoon period the area under ground water table of depth range from 20to 30 m bgl gets spreads covering parts of Gulha, Kaithal and Pundri Blocks. Besides, the water logging condition is also gets existed in parts of Kalayat block.

Long-term net change of water levels during the period 2000-2011 reflected by ground water hydrograph are indicative of the change in groundwater storage in phreatic zone with time. The hydrograph indicates declining water level trend which may be due to over-exploitation of ground water. The rate of decline varies from 0.18 m/yr to 1.16 m/yr. The maximum rate of decline has been observed in piezometer at Gulha. In piezometer at Kalayat rising trend in ground water levels in the order of 0.05 m/yr has also observed. The district area require careful management of ground water and surface water through the practice of Conjunctive use of surface water and ground water. In general the ground water elevation varies from 209 to 219 a.m.s.l. and the regional ground water flow direction is from northeast to southwest.

5.3 GROUND WATER RESOURCES

Block-wise ground water resource potential of the district has been assessed as per GEC-97 as on 31st March 2009. The ground water development in all the blocks has exceeded the available recharge, thus all the blocks have been categorized as over exploited. Stage of ground water development, ranges from 161% (block-Kalayath) to 255% (block-Kaithal). Net annual replenishable ground water availability in the district have been assessed as 507.83 MCM. The total ground water draft for all uses in the district is 1077.46 MCM, thus leaving shot-fall (over draft) of 569.63 M C M . Stage of ground water development in the Kaithal district has been assessed to be 212%.



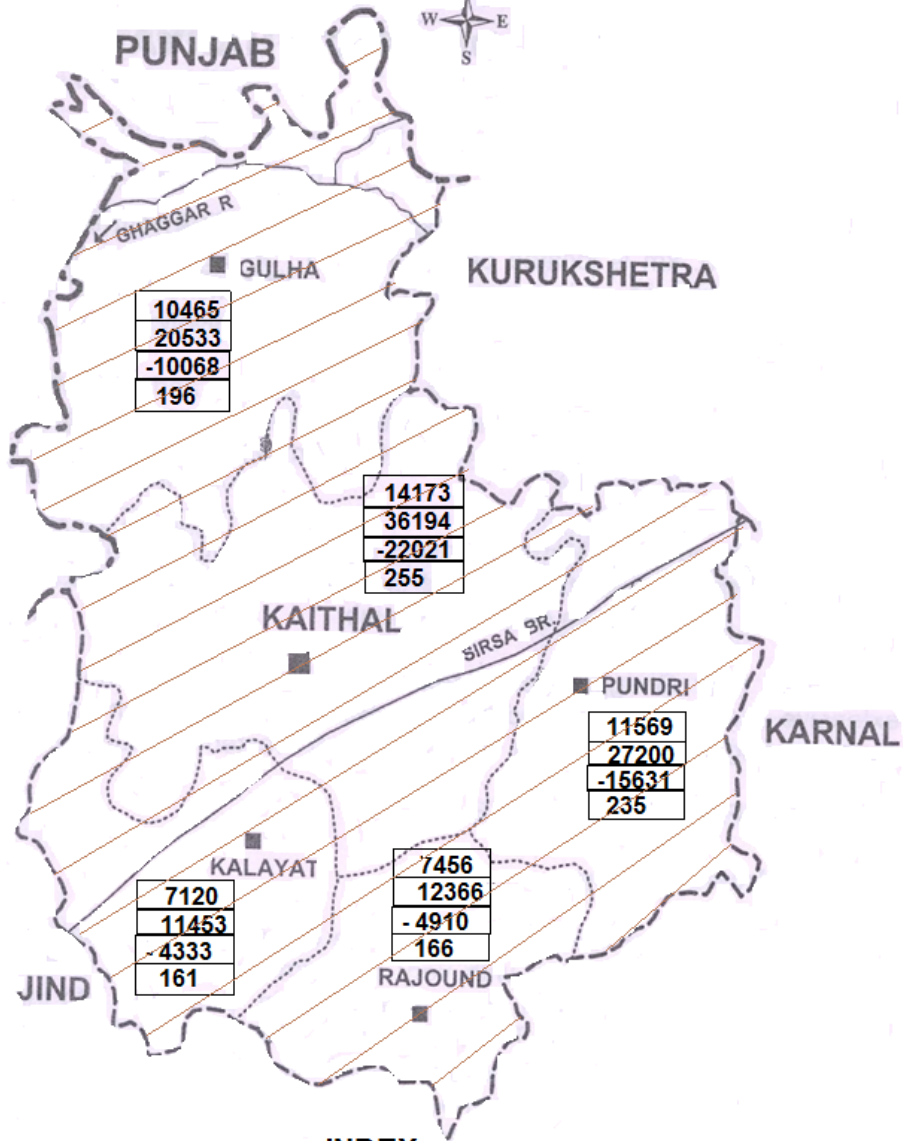
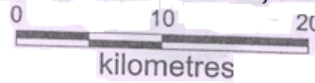


Block wise Ground water Resources of Kaithal District as on 31.03.2009 (in Ham)

Assessment Unit/ District	Net Annual Ground Water Availability (ham)	Existing Gross Ground Water Draft for irrigation (ham)	Existing Gross Ground Water Draft for domestic and industrial water supply (ham)	Existing Gross Ground Water Draft for All uses (ham)	Provision for domestic, and industrial requirement supply to 2025 (ham)	Net Ground Water Availability for future irrigation development (ham)	Stage of Ground Water Development (%)	Categorization
Gulha	10465	18762	1771	20533	1771	-10068	196	Over exploited
Kaithal	14173	33733	2461	36194	2461	-22021	255	Over exploited
Kalayath	7120	11303	150	11453	150	-4333	161	Over exploited
Pundri	11569	25445	1755	27200	1755	-15631	235	Over exploited
Rajound	7456	12261	105	12366	105	-4910	166	Over exploited
Total	50783	101504	6242	107746	6242	-56963	212	

GROUND WATER DEVELOPMENT POTENTIALS AND CATEGORISATION OF BLOCKS

KAITHAL DISTRICT, HARYANA



14173	Net Annual Ground Water Availability (ham)
36194	Existing Annual Ground Water Draft for all uses (ham)
-20021	Net Ground Water Availability For Future Irrigation Development (ham)
255	Stage of Ground Water Development (%)
	Over-exploited Block

5.4 Ground Water Quality (Irrigation and Drinking point of view)

Chemical data of ground water from shallow aquifer indicates that ground water is alkaline in nature and is fresh to moderately saline. The electrical conductivity (EC) values are generally less than 3000 $\mu\text{S}/\text{cm}$ at 25°C, except at Kalayat and Mataur where these values are 3310 $\mu\text{S}/\text{cm}$ and 5990 $\mu\text{S}/\text{cm}$ respectively. Generally it is suitable for drinking purposes as chemical parameters are well within the permissible limits for safe drinking water set by Bureau of Indian standard (BIS) except at Kalayat and Mataur due to high salinity and nitrate and at Mundri and Rajound due to high fluoride. The fluoride concentration is found to be higher than the permissible limit at Rajound (1.85 mg/l), Mundri (1.89 mg/l) and Mataur (2.55 mg/l). Among Cations, sodium dominates in more than 73% wells where as among Anions, no single anion dominates and ground water is of mixed anion type in most wells.

Plot of USSL diagram used for classification of irrigation water indicates that ground water falls under C_3S_1 , C_3S_2 , C_4S_2 and C_4S_3 classes. As 73% ground water sample falls under C_3S_1 and C_3S_2 classes and thus are suitable for customary irrigation without any fear of salinity or sodium hazards. The remaining water, nevertheless, can be used on well drained soils on which semi-salt tolerant crops such as wheat, gram and rice etc are grown without any fear of sodium hazards.

Type of water: Na-Mixed Anion type.

5.5 GEOPHYSICAL STUDIES

Surface Geophysical studies have been conducted in southern part of Kaithal district covering parts of Kaithal, Pundari, Kalayat and Rajaound blocks of the district. Results indicate that water is mostly saline beyond the depth of 100 m. Most of the area covered under geophysical study seems to have saline water levels at all depth except thin film marginally saline water floating over saline water. In some parts of this area there are evidences of relatively fresh water in the depth range of 50 to 100 m. In some parts of the Rajaound blocks and few patches in Kaithal blocks fresh water have been expected to be between 200 to 300m.

5.6 STATUS OF THE GROUND WATER DEVELOPMENT

Net area sown in the district is 2010 Sq. km, which is 100% of the total cultivable area of the district. Area sown more than once is 1840 sq. km bringing the total cropped area to 3850 sq km. The entire net area sown is irrigated through tubewells and canals. There are 56080 tubewells in the district which irrigates an area of 1910 sq.km. Canals of the area are irrigating approximately 90 sq. km area. Tubewells support 95.5% irrigation in the district. The block-wise detail of MIUs and draft is given below:

Sl. No	Block	Shallow T/W with	Ground Water Draft (Ham)		
			Monsoon	Non-Monsoon	Annual
1	Gulha	10366	8443	10319	18762
2	Kithal	18637	15180	18553	33733
3	Kalayat	6245	5087	6217	11303
4	Pundri	14058	11450	13995	25445
5	Rajound	6774	5517	6744	12261

The entire drinking water supply to all rural as well as urban parts of the district is based on ground water or by canal (where water quality of ground water is saline or poor) The tubewell for water supply constructed by Public Health Department, Haryana for drinking water supply are generally between 40 to 100 m deep or on the basis of local hydrogeological conditions and availability of fresh water bearing zone. The area where drinking water supply is not present through PHED Haryana, the supply is dependent on hand pumps /dug wells shallow jet pumps which are constructed by Panchayat or by user. The depth of hand pumps varies from 10 to 25 m on the basis of prevailing local conditions. The block-wise details of numbers of tubewells and draft are given below:

Sl. No	Block	T/W (PHED)	Ground WaterDraft (Ham)
			Annual
1	Gulha	106	1590
2	Kithal	162	2430
3	Kalayat	10	150
4	Pundri	117	1755
5	Rajound	7	105

6.0 GROUND WATER MANAGEMENT STRATEGY

6.1 Ground Water Development

The stage of ground water development for the district as a whole is 212% and all the five blocks have shown high development of ground water resources and making the blocks overexploited. It indicates that the ground water is under stress and ground water level is declining. Blocks located in northern half of the district namely Gulha Kaithal and Pundari have comparatively high ground water development owing to fresh ground water quality. Blocks with high ground water development status and lesser rate of decline is indicative of prolific aquifer in these areas. There is need to take up the measures to enhance water use efficiency by adopting practices of water conservation techniques. Besides, there is need to arrest the depleting ground water resources by

implementing the projects of rain water harvesting and artificial recharge to ground water. Whole of the district is suitable for artificial recharge to ground water. Excess rain water in agricultural field, surplus canal water and rooftop rain water can be injected to ground water system. Since the whole area of the district is alluvium and neither basement nor any cobble, pebble bed has been encountered, hence appropriate method of drilling in the area would be rotary or reverse rotary. The ground water at shallow depth up to 40 to 100 m is fresh to marginal saline. Tubewells can be constructed upto the depth of 40-100 m for drinking as well as for irrigation purpose depending on the local hydrogeological conditions.

6.2 Water Conservation & Artificial Recharge

There are 292 tanks /ponds in the Kaithal district which act both as water conservation and recharge structures. There is need to revive the tradition water bodies of the villages. The block-wise details on tanks/ponds and recharge through them is given in table below:

Block	No of Tank/Pond	Average water spread area(ha)		No of days water available		Recharge (Ham)	
		monsoon	non-monsoon	monsoon	non-monsoon	monsoon	non-monsoon
Gulha	54	27.54	12	120	200	4.758912	3.456
Kithal	81	102.15	35	120	200	17.65152	10.08
Kalayath	42	106.25	38	120	200	18.36	10.944
Pundri	69	199.65	73	120	200	34.49952	21.024
Rajaund	46	73.3	23	120	200	12.66624	6.624

The major source of recharge to ground water in the area is inflow of ground water from north eastern and northern parts, rainfall, seepage from canals, return seepage through irrigation and percolation from surface water bodies. Central Ground Water Board has not taken up any recharging scheme in the district. As per assessment of the Central Ground Water Board for preparation of Master Plan on Artificial Recharge, a large part of district is suitable for Artificial Recharge. But, the northern half of the district covering parts of Gulha, Kaithal and Pundari Blocks have been found most suitable and feasible for artificial recharge on the basis of annual decline in water level and annual mean water level for last ten years. Most suitable structure for artificial recharge is recharge trench with or without injection wells and recharge shaft of variable size to accommodate available run-off or surplus available water for recharge. As per 'Master

Plan on Artificial recharge 2013' an area of 2317sq.km has been identified for artificial recharge in the district which has a subsurface storage potential of 3550 MCM. A volume of 4722 MCM of water would be required to attain this recharge. A total of 5696 Nos of recharge structure have been proposed. Besides this roof top rain water harvesting should also be taken up in the district.

7.0 GROUND WATER RELATED ISSUES AND PROBLEMS

The ground water related problems in the district can be identified as depletion of ground water resources and poor quality of ground water at specifically in deeper aquifer along with contamination of ground water with fluoride. Declining of water levels has been observed in the entire district except at Kalayat where rising in water level has noticed due to shallow water table condition exist in the block Kalayat. The analysis of long term water levels in the district shows the rate of decline of water level is in the range of 0.18 m/yr to 1.16 m/yr. From portability point of view, the ground water in some parts of the district is having poor ground water quality due to salinity. Some sporadic occurrence of high fluoride concentration has also noticed. By and large the ground water in shallow aquifers is fresh and potable.

8.0 AREAS NOTIFIED BY CGWA

The Central Ground Water Authority (CGWA) has notified Rajound Block on 27th November, 2012. The block area has been notified with a view to protect the ground water resources and other development activities in consonance with protection & preservation of ground water resources.

9.0 RECOMMENDATIONS

The following remedial measures are recommended to minimize the declining ground water trend in parts of the Kaithal district as safeguard against environmental degradation.

1. The directives of CGWA notification for the notified block Rajound should be implemented.
2. Artificial recharge to ground water should be taken up in the urban and rural area to avert the further lowering of ground water level since natural recharge to the aquifer system is not adequate to support such ground water withdrawal especially in the northern half of the district area.
3. Geophysical study is required for the delineation of fresh water zones in the remaining part of the district.

4. Revival of water bodies like pond in the village could be recommended under scheme of drinking water mission for the sustainability of shallow tube wells and the crop of the area.
5. Water use efficiency should be enhanced by practicing modern methods of irrigation like Laser levelling, zero tillage, mulching, Sprinkler irrigation, drip Irrigation etc.
6. For effective water management techniques most suitable cost effective cropping pattern should be selected so that even high TDS ground water could be utilised for irrigating salt tolerant crops.
7. The ground water exploration along with micro level study should be taken up for mapping of flood plains of river Ghaggar and Markanda, which can have more prolific fresh water aquifers at deeper levels.
8. Subsurface drainage system may be laid down in Kalayat block to combat water logging.
9. Local populace to be educated regarding consequences of mining of ground water and need for its effective/economic use.
10. In the areas where water is saline and canal network is dense intensive study may be carried out to know the feasibility of conjunctive use of surface and ground water.
11. Micro level mapping of the ground water for fluoride concentration may be taken up and people may be educated about its harmful effect on human health and its remedial measures.