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Central Ground Water Board

GROUND WATER BROCHURE, DISTRICT DEHRADUN, UTTARAKHAND

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Uttaranchal Region

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GROUND WATER BROCHURE, DISTRICT DEHRADUN

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DISTRICT DEHRADUN AT A GLANCE

S.No.	ITEMS	STATISTICS	
1.	**GENERAL INFORMATION**		
	Geographical area (km^2)	3088.0 km^2	
	Tehsils	6, Dehradun, Chakrata, Vikas Nagar, Kalsi, Tiuni and Rishikesh	
	Developmental Blocks	6, Chakrata, Kalsi, Vikas Nagar, Sahaspur, Raipur and Doiwala	
	Number of Towns/Villages	17 towns and 764 villages	
	Population	1025680	
	Average Annual Rainfall (mm)	2187	
2.	**GEOMORPHOLOGY**		
	Major physiographic units	Intermundane Doon Valley, piedmont fan deposits and denudational and residual hills	
	Major drainages	Ganga and Yamuna	
3.	**LAND USE (km^2)**		
	Forest area	2200.56	
	Net sown area	550.57	
	Net irrigated area	217.53	
4.	**MAJOR SOIL TYPES**		
		Udifluventic, Ustochrepts Udic Ustochrepts, Udic Haplustolls and Typic Ustipsamments	
	Forest soils	Inceptisol and Mollisol	
5.	**AREA UNDER PRINCIPAL CROPS (ha)**		
		Crops	Area in ha
		Paddy	16398.27
		Wheat	24987.0
		Sugarcane	7808.70
		Maize	14055.66
		Mandua	3123.48
		Pulses	2342.61
		Sawan	1561.74
		Edible oils	2342.61
		Potato	1561.74
		Others	3904.35
6.	**IRRIGATION BY DIFFERENT SOURCES (area and number of structures)**		
	Source	No of structure	Area in ha
	Canals	786	11459
	Government Tube wells	75	2899
	Private Tube wells	266	378
	Dug wells	30	37
	Other Sources		7432 ha
7.	**NUMBER OF GROUND WATER MONITORING WELLS OF CGWB (as on 31.1.08)**		

	Number of Dug Wells	19
	Number of Piezometers	Nil
	Number of Hand Pumps	Nil
	Number of observation wells	Nil
8.	**PREDOMINANT GEOLOGICAL FORMATIONS**	
	Outer or Sub Himalaya	Siwalik Group, Doon Gravels
	Lesser Himalaya	Deoban Group, Jaunsar Group, Baliana Group, Krol, Tal and Dag shai / Kasauli
9.	**HYDROGEOLOGY**	
	Major water bearing formations	Dun Gravels, Upper Siwalik formation
	Pre-monsoon Depth to Water	2.29 to 71.00 m bgl
	Post-monsoon DTW range	2.52 to >100 m bgl
	Long term water level trend in ten years	The water levels are by and large sustained
10.	**GROUND WATER EXPLORATION BY CGWB (As on 31.1.2008)**	
	No. of wells drilled (EW, OW, PZ, SH, Total)	15 Exploratory wells (all are Exploratory wells)
	Depth Range (m)	50.0 to 200.0m
	Discharge (lpm)	252 to 3198 lpm
	Hydraulic conductivity (m/day)	21.65 to 299.15
	Transmissivity (m^2/day)	184 to 8242
11.	**GROUND WATER QUALITY**	
	Presence of chemical constituents more than Permissible limits (EC, F, As, Fe)	NIL
	Type of water	Mainly Bicarbonate Type
12.	**DYNAMIC GROUND WATER RESOURCES (2007) in ha m**	
	Annual replenish able Groundwater resources	115541.30
	Projected demand for Domestic and industrial Uses up to 2025	17565.98
	Stage of groundwater Development	Doiwala block: 25.34% Sahaspur block: 22.08% Vikas Nagar block: 51.44%
13.	**EFFORTS OF ARTIFICIAL RECHARGE AND RAIN WATER HARVESTING**	
	Project completed by CGWB (No. and amount spent)	One, Rupees 1.90 Lakhs (Gabion structures)
14.	**GROUND WATER CONTROL AND REGULATION**	
	Number of Critical blocks Number of Notified blocks	NIL NIL NIL
	Major Ground Water Problems and Issues	Heavy exportations of ground water from deeper aquifer in Doon Valley and its management

1. Introduction

District Dehradun is situated in NW corner of Uttarakhand state and extends from N Latitude 29^0 58' to 31^0 02' 30" and E Longitude 77^0 34' 45" to 78^0 18' 30". It falls in Survey of India Toposheets Nos. 53E, F, G, J and K. The district is bounded by Uttarkashi district on the north, Tehri Garhwal and Pauri Garhwal districts on the east and Saharnpur district (UP) on the south. Its western boundary adjoins Sirmour district of Himachal Pradesh separated by Rivers Tons and Yamuna.

The total area of Dehradun district is 3088 km^2 with an average altitude of 640 m above MSL. The district comprises of six tehsils, namely Dehradun, Chakrata, Vikasnagar, Kalsi, Tiuni and Rishikesh. Further, it is divided into six developmental blocks, viz: Chakrata, Kalsi, Vikasnagar, Sahaspur, Raipur and Doiwala. There are seventeen towns and 764 villages in this district. The administrative map of the district is shown in **Fig. 1.**

1.1 Drainage

District Dehradun is drained by Ganga, Yamuna and their tributaries. The two basins are separated by a ridge starting from Mussoorie and passing through Dehradun. The easterly flowing rivers join River Ganga and the westerly flowing rivers join River Yamuna. Ganga River enters the district near Rishikesh where Chandrabhaga River joins it. Song and Suswa are two main tributaries of the Ganges. Suswa flows SE, draining the eastern Doon along with its ephemeral tributaries like Bindal Rao, Rispana Rao etc. and joins River Song SE of Doiwala. Song River has its origin from the adjoining Tehri district. Initially it runs parallel to the Mussoorie Mountain chain in NW direction for few kilometers and then takes a sudden turn in SE direction and joins Suswa River south of Doiwala.

Yamuna River emerges from Yamnotri, which falls in district Uttarkashi. It enters Dehradun district at the point called Khat Bhondar which is about 20km east of Deoban. Tons is the main tributary of Yamuna which has its emerging point in the north of Yamnotri and receives water from Supin and Rupin (tributaries of Tons). River Tons separates Uttarakhand from Himachal Pradesh. The western part of Doon Valley is drained by Asan and its tributaries; it joins Yamuna near Rampur Mandi. Yamuna River roughly divides the district in two halves, the hilly region in the north and Doon valley in the south.

1.2 Irrigation practices

Both surface and subsurface sources are being developed for irrigation purpose. The perennial rivers/ springs/ gadheras are being developed by constructing canals and guls. Canals in District Dehradun run for a length of 786 km. There are four main canal systems namely Bijapur, Rajpur, Kalanga and Jakhan. These canal systems were developed during the British period and now being maintained by the state irrigation department. The Rajpur

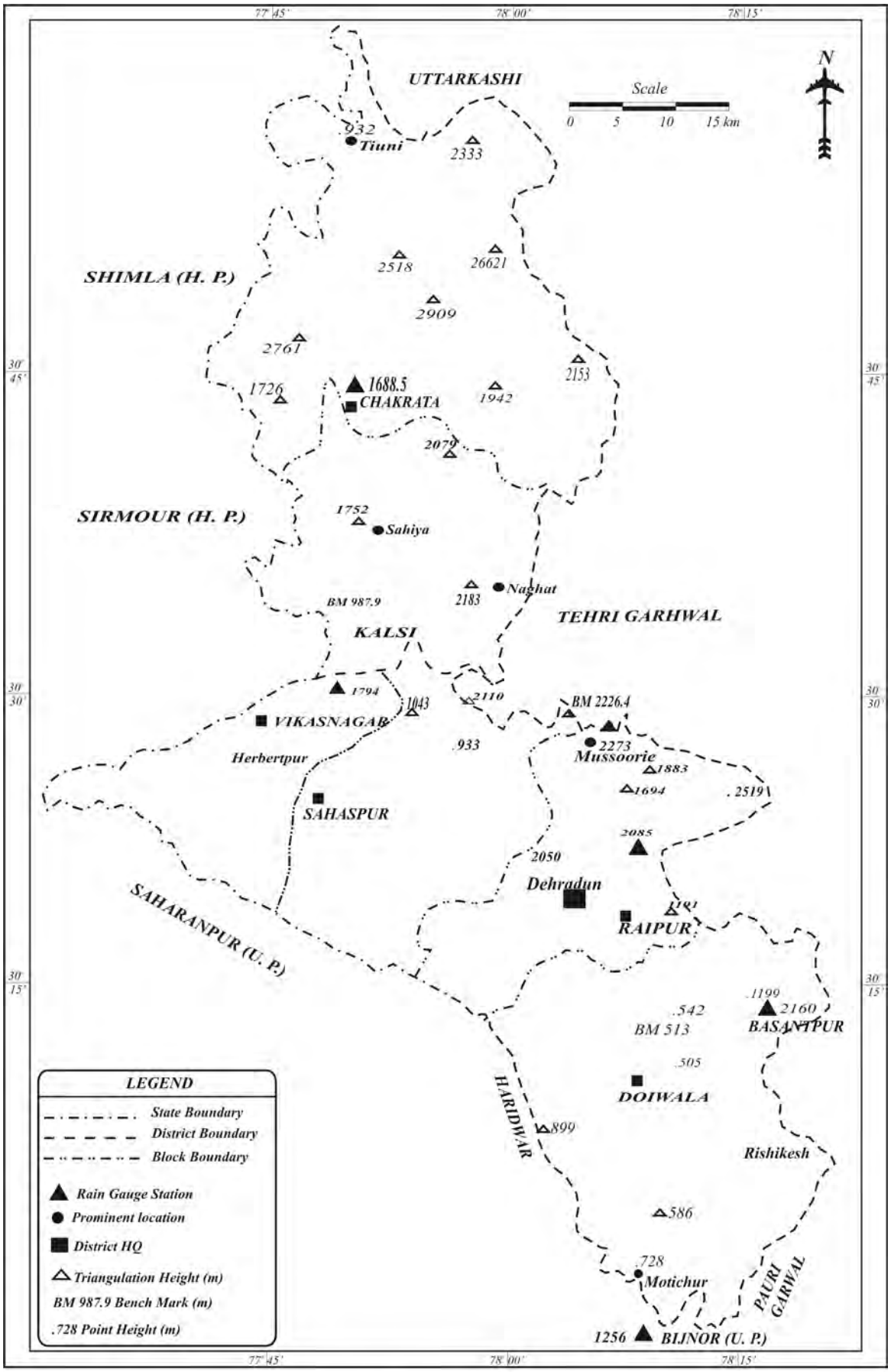

Fig 1.1 Administrative Map, District Dehradun

canal system, Jakhan canal system, Kalanga canal system, and Bijapur canal system have 7,5,7 and 10 number of canals, respectively.

Sub surface water is developed through tubewells. There are 118 functional Irrigation tubewells in District Dehradun (as on 31.3.2009). Most of these tubewells are located in the Intermentane Doon Valley tapping the Doon Gravels. Besides the canals and tubewells, there are other irrigation practices like pump sets, hydrum, hauz, tanks etc. The area irrigated through different practices is given in **Table 1.**

Table1. Area irrigated through different sources/practices, District Dehradun (hectares)

Block	Reported Area	Canals	Tubewells		Dug wells	Other sources	Total
			Govt.	Private			
Chakrata	67324	87	-----	-----	-----	878	965
Kalsi	29468	442	-----	-----	-----	379	821
Vikas Nagar	44606	3744	483	184	-----	926	5337
Sahaspur	61693	2329	1068	54	-----	1214	4665
Raipur	53396	2235	290	15	37	1303	3880
Doiwala	59648	2622	1058	125	-----	2732	6537
Total	**316165**	**11459**	**2899**	**378**	**37**	**7432**	**22205**

1.3 Activities of CGWB:

Studies to assess the groundwater potential in Doon valley and Bhabar-Tarai belt through exploratory drilling and collection of scientific data were taken up by Shri T. S. Raju, Shri M. P. Pandey and K.V. Raghava Rao of Exploratory Tubewells Organization (ETO) during 1959-1962 and the report was released in the form of Bulletins of E T O in 1963. Exploratory drilling was carried out at fifteen locations (as on 31.3.2009). Ground Water Management Studies were carried by Shri G.D. Barthwal in 2001-2002 and Dr. Konga Gopi Krishna in 2007-2008.So far Five Mass Awareness Programmes have been organized at various important location of the district.

2.0 Climate and Rainfall

The district has within its limits lofty peaks of the Outer Himalayas as well as the Dun Valley with climatic conditions nearly similar to those in the plains. The temperature depends on the elevation. The climate of the district, in general, is temperate. In the hilly regions, the summer is pleasant but in the Doon Valley, the heat is often intense. The temperature drops below freezing point not only at high altitudes but also even at places like Dehradun during the winters, when the higher peaks are under snow.

The summer starts by March and lasts up to mid of June when the monsoon sets in. Generally, the month of May and early part of June is hottest with mean temperatures shooting upto 36.2^0c at Dehradun and 24.8^0C at Mussoorie. The maximum temperature rises to over 42^0C at Dehradun while at Mussoorie it doesn't exceed 32^0C. Winter starts from November and continue upto February. The highest maximum temperature recorded at Dehradun was 43.9^0C on June 4, 1902 and that at Mussoorie was 34.4^0C, on May 24th 1949. The mean daily maximum temperature during winter is 19.1^0C at Dehradun and 10.2^0C at Mussoorie. The mean daily minimum temperature in January is 6.1^0C at Dehradun and 2.5^0C at Mussoorie. In Mussoorie the temperature drops to about -6^0C to -7^0C when snow fall occurs. The lowest minimum temperature at Dehradun during winter was - 1.1^0C, on February 1st, 1905 and January 1945 while at Mussoorie it was -6.7^0C, on February 10th, 1950. Monsoon starts by the mid of June and lasts upto September.

The district receives an average annual rainfall of 2073.3 mm. Most of the rainfall is received during the period from June to September, July and August being the wettest months. The region around Raipur gets the maximum rainfall, while the southern part receives the least rainfall in the district. About 87% of the annual rainfall is received during the period June to September. The climatic data of Doon Valley is summarized in **Table 2.**

Table 2. Doon Valley Climate data

Month	**Normal Rainfall(mm)**	**Relative Humidity %**	**Temperature (^{0}C)***		
			Maximum	**Minimum**	**Average**
January	57.9	91	19.3	3.6	10.9
February	66.8	83	22.4	5.6	13.3
March	37.9	69	26.2	91.	17.5
April	19.6	53	32	13.3	22.7
May	35.8	49	35.3	16.8	25.4
June	184.4	65	34.4	29.4	27.1
July	655.6	86	30.5	22.6	25.1
August	713.0	89	29.7	22.3	25.3
September	304.5	83	29.8	19.7	24.2
October	41.9	74	28.5	13.3	20.5
November	7.6	82	24.8	7.6	15.7
December	24.9	89	21.9	4.0	12.0
Annual	**2149.9**	**76**	**27.8**	**13.3**	**20.0**
	Normal	**Average**			

* Average for last 25 years

3.0 Geomorphology

3.1 Geomorphic Divisions

Dehradun district may be divided into four geomorphological units namely alluvium, piedmont fan deposits, structural and denudational hills and residual hills.

3.1.1 **Alluvium:** This unit is represented by unconsolidated and loose admixture of sand, gravel, pebbles, silt and clay of varied grades deposited in the form of terraces along Asan, Song, Tons, Yamuna, Ganges etc. and in the intermontane valley as well. These are represented by unconsolidated material like sand, gravel, silt and clay. The terraces are formed by river cuttings followed by deposition of eroded and transported material in step like features along the river.

3.1.2 **Piedmont Fan Deposits:** The area comprising of Dun gravels formed of numerous coalesced fans constitute this unit. The older Dun gravels belong to the upper realm of principal Doon fans whereas the younger and youngest duns belong to lower realm of principal Doon fans and dip controlled pedimont fans respectively.

3.1.3 **Denudational and Structural Hills:** The denudational and structural hills comprise Siwalik and Lesser Himalayan Ranges. The Siwaliks are exposed as a narrow band all along the southern boundary of Doon Valley and also in isolated patches. These hills have undergone severe denudation, weathering and erosion, making steep to moderate slopes.

3.1.4 **Residual Hills:** The residual hills are mostly formed by erosion and are the remnants of post Upper Siwalik deposits. These are called Older Doon Gravels or Langha Boulder Beds. Boulder beds, shales and red clay represent this unit. The residual hills are present in Doiwala and Vikas Nagar blocks.

3.2 Soil Types

The nature and soil type play an important role in agriculture and have direct relation with groundwater recharge. Physiography, climate, drainage and geology of the area are the factors responsible for the nature and type of soil and soil cover. The soil type also depends upon the slope and rate of erosion. The soil types of district Dehradun are given in Table 3.

Table 3. Soil Types, District Dehradun

Physiography	Characteristics	Taxonomic Classification
Mountains	Moderately deep, well-drained, thermic coarse loamy soils on steep slopes, strong, stoniness, associated with shallow excessively drained, loamy skeletal soil.	Loamy skeletal, Dystric Eutrochrepts, Fine loamy lithic and typic Hapludolls- Loamy skeletal typic Udrothants
Soils on Upper piedmont plains	Deep, well-drained, coarse loamy cover, fragmental soils on heavy gentle slope with loamy surface and	Udifluventic Ustochrepts

	slight erosion.	
	Associated with excessively drained soils with loamy surface and slight to moderate erosion	Typic Ustipsamments
	Deep, well- drained, fine to coarse loamy surface and slight to moderate erosion	Udic Ustorchrepts
Soil on Lower piedmont plains	Deep, well- drained, coarse loamy cover over fragmental soils on nearly level plains with loamy surface.	Udifluventic Ustochrepts
	Associated with deep, well drained, fine loamy soil with loamy surface.	Udic Ustochrepts
	Deep, well drained, fine silty soil on very gentle slopes with loamy surface and slight erosion	Udic Haplustolls
	Deep, well drained, fine to coarse loamy surface and slight to moderate erosion, silty soil with loamy surface	Udic Ustochrepts

4.0 Ground Water Scenario

4.1 Hydrogeology:

4.1.1 Water Bearing Formations

The hydrogeology of the district is mainly controlled by the geology and geomorphology. A wide variation in the geology and land forms, in the area, gives rise to different hydrogeological conditions. Broadly Dehradun district is divided into three hydrogeological units, viz. (1) Himalayan Mountain Belt (2) Siwalik zone and (3) Doon Gravels

4.1.1.1 Himalayan Mountain Belt

Groundwater, in this unit, occurs as disconnected local bodies both under confined and unconfined conditions. Quartzite, schist, shale, slate, phyllite, compact sandstone, limestone and dolomite of Jaunsar, Baliana, Krol and Tal Groups are the main rock types. The rock formations are characterized by fissures, fractures, veins and joints which provide the secondary porosity. The secondary porosity and permeability help forming the local bodies of groundwater. The weathered veneers found on hill tops, ridges, spurs etc. give rise to large groundwater repositories, under perched conditions. The alluvial deposits of fluvial and colluvial origin in the lower reaches of streams/ rivers in the form of fans and terraces are highly porous

and permeable and hold promising areas for groundwater exploration. The springs and seepages are the main source for hilly areas. The springs show wide variation in discharge ranging from 1400 to 1507000 liters/ day (Bartarya, 1995)

4.1.1.2 Siwalik Zone

Groundwater occurs under confined and unconfined conditions in this unit. The water levels are comparatively deep. In spite of the boulder- conglomerate bed of Upper Siwalik Formation being highly porous and permeable most of the water goes as run off due to steep slopes and the sediments forming piedmont fans dipping into the Intermontane valley. About 70 gravitational type springs have been reported which have a varying discharge from less than a liter per second to 113 liters/second (0.002 m^3/min). The fresh water bearing zones are present in the Upper Siwaliks due to the presence of pebble–gravel–conglomerate–boulder beds and act as good groundwater reservoirs when underlain by the Bhabar or Dun gravels. Exploration has revealed that the pebble - boulder and gravel - sand beds of Siwalik are capable of yielding copious quantities of water.

4.1.1.3 Doon Gravels

The intermontane valley portion, of district Dehradun, is underlain by alluvial fan deposits. The sediments descend from the Lesser Himalayan front as well as well as the North facing Siwalik hill slopes. These fan deposits are called as 'Doon Gravels' and characterized by boulders and pebbles embedded in sandy and silty matrix. The clasts are mainly composed of quartzite, sandstone and phyllite, which are mainly derived from the Krol belt of the Himalayas Pebbles from Siwalik conglomerates are also present in the Doon Gravels.

Doon Gravels are highly porous and they have a significant permeability. Groundwater occurs under unconfined and semi confined conditions. The saturated granular zones occur in a depth range between 35.50 and 138.68 m bgl. The piezometric head ranges from 20.0 to 125.0 mbgl. Transmissivity varies from 1648.0 to 3500.0 m^2/day while the field permeability ranges from 5.86 to 104.0 m/day. The discharge from the tubewell varies from 600 to 3000 lpm for a tapped thickness of 30 to 50 m with a drawdown of 2 to 7 m. The hydraulic conductivity, in the district, varies from 13 to 583 m/day. The hydrogeological map of the district is given in **Fig 4.1.**

4.1.2 Depth to Water Level

There are 19 hydrograph stations located in the southern half of the district. The northern part is hilly where continuous water table is lacking and hence no hydrograph stations in this part. Using the data of these hydrograph stations Depth to Water maps for pre-monsoon, 2006 **(Fig.4.2)** and Post monsoon, 2006 **(Fig.4.3)** are prepared. Depth to Water, in the southernmost part of the district, ranges between 5 and 10 m. The area close

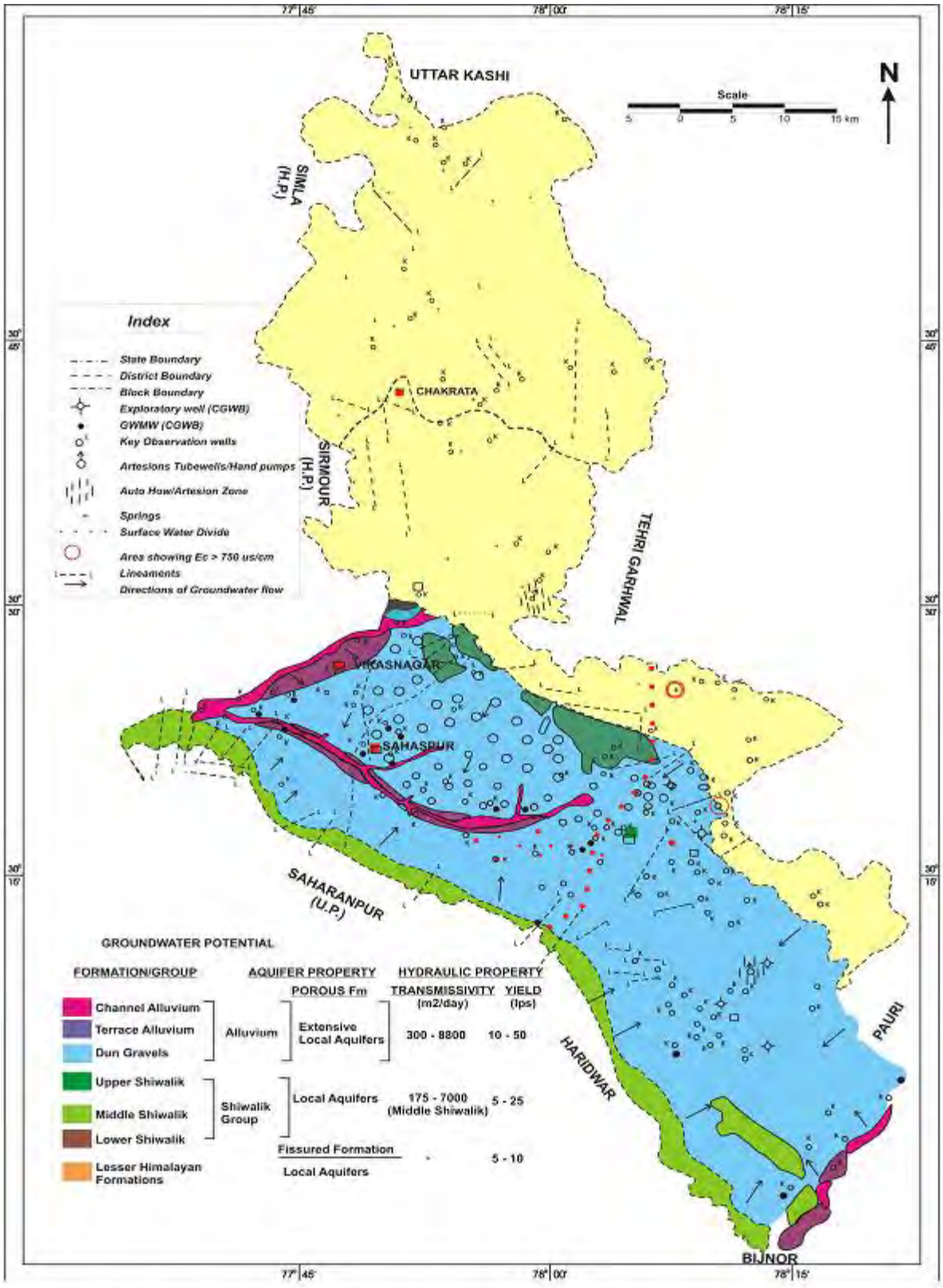

Fig. 4.1 Hydrogeological Map, District Dehradun

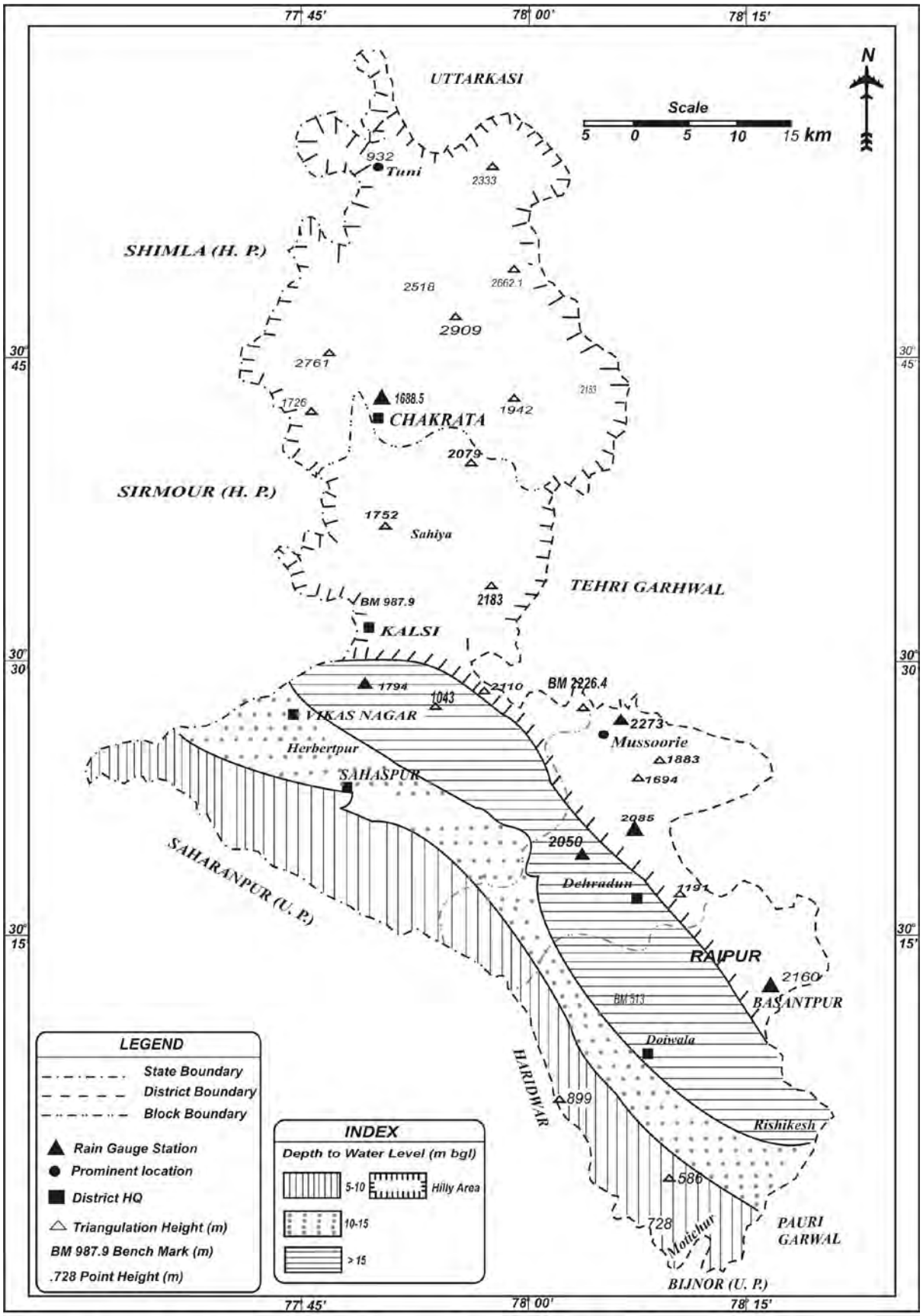

Fig. 4.2. Depth to Water Level Map (May, 2006)

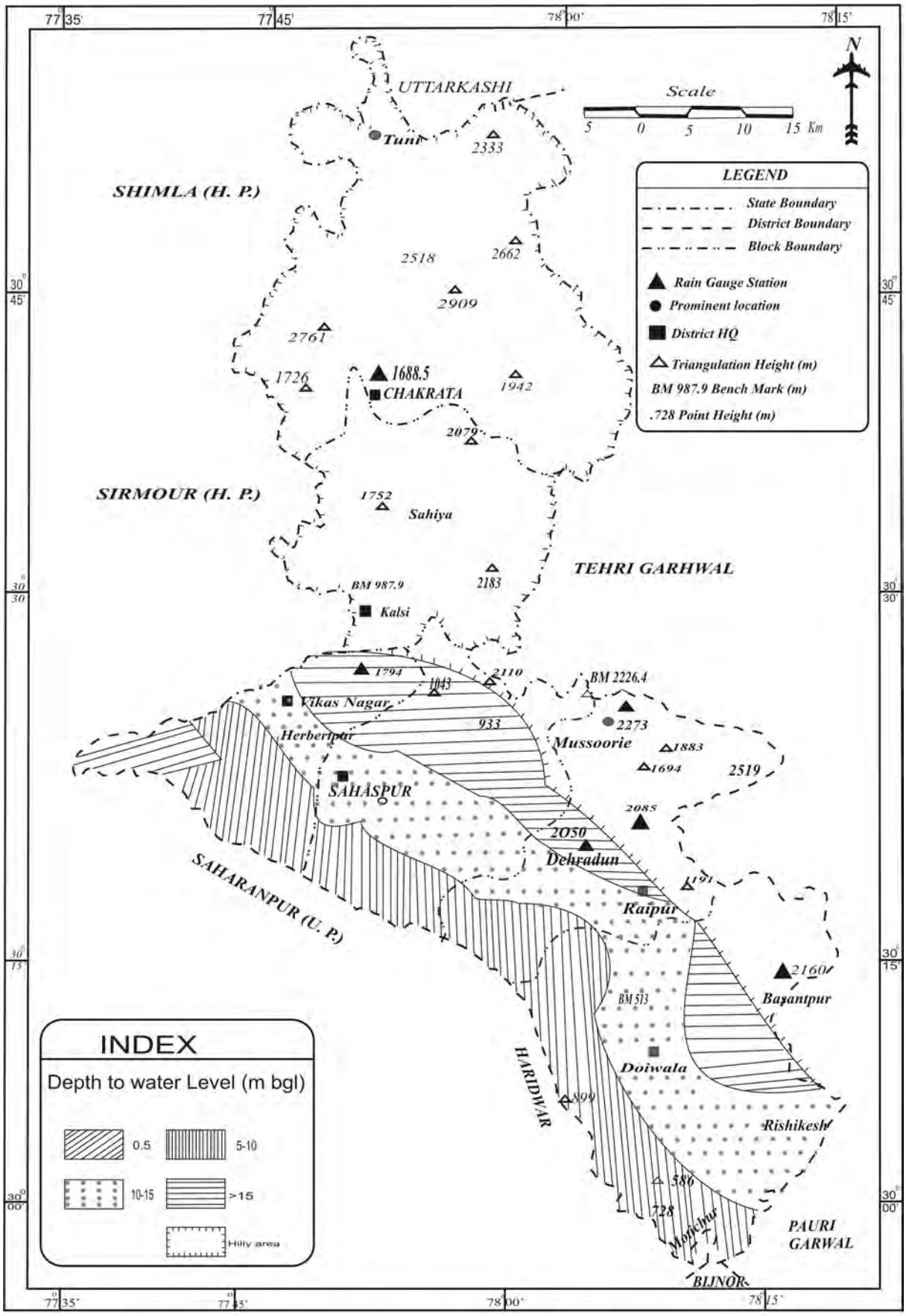

Fig. 4.3. Depth to Water Level Map (November, 2006)

to the hills is represented by water table >15 m bgl. The intermediate part has DTW in the range between 10 and 15 mbgl. During the post monsoon period the 5-10 m and 10-15 m ranges of DTW increased and the >15 m group is reduced.

4.1.3 Long Term Water Level Fluctuation

A comparison of the shallow water levels of May, 2006 with the decadal average of May have been made **(Fig.4.4)**. This comparison reveals that larger part of the Doon Valley shows a rise in water levels between 0 and 2 m. A small area in the SE part of the Valley close to the foot hills shows water level decline between 0 and 2 m. The decadal fluctuation map shows that by and large the area has groundwater potential with low development of shallow aquifers

4.2 Ground Water Resources

There are six developmental blocks in District Dehradun. Two blocks (Chakrata and Kalsi) fall in mountainous terrain where the slopes are high and water resources are not estimated for these blocks. Water Resources are estimated, using GEC 1997 methodology, for Raipur, Doiwala, Sahaspur and Vikas Nagar blocks as the topography is by and large plain, in these blocks. The block areas are divided into command and non-command. Draft for all uses and recharge from all sources are calculated for command and non-command areas. The Stage of Ground Water Development has been worked out by using the formula given below:

Stage of Ground Water Development

= Existing Gross Ground Water Draft for all uses/Net Annual Ground Water Availability *100

The block-wise gross groundwater draft, net annual groundwater availability, stage of groundwater development and category are summarized in Table below**.** The stage of groundwater development, for command area, ranges from 53.78 to 78.34% while it ranges from 19.23 to 51.23% for non-command areas. All the four blocks are categorized as Safe.

Table. 4. Block wise net available groundwater, stage of groundwater development and category (as on 2007)

Block	Type Area	Net available ground water reserve (ham)	Current draft for all uses (ham)	Stage Groundwater Development (%)	Category
Raipur	Command	2037.62	1257.46	61.71	Safe
	Non-command*	25586.85	7882.13	30.80	Safe

Doiwala	Command	2626.92	2058.0	78.34	Safe
	Non-command	31828.65	6675.26	20.97	Safe
Sahaspur	Command	1573.01	1573.01	75.85	Safe
	Non-command	30283.30	30283.30	19.23	Safe
Vikas Nagar	Command	1780.61	1780.61	53.78	Safe
	Non-command	19824.35	19824.35	51.23	Safe

**** After Gopikrishana, K. 2009***

4.3 Ground Water Quality

Seventy four water samples were collected from different groundwater structures located in District Dehradun, during Pre-monsoon, 2007. The samples were got analyzed for their electrical conductivity (EC), pH, calcium, magnesium, carbonate and bicarbonate. The groundwater is suitable for domestic and irrigation purposes, in respect of these parameters.

The EC, in District Dehradun, ranges between 80 and 659 micro mhos/cm at 25^0C. An Iso-conductivity map has been prepared for the district **(Fig. 4.5)**. This map shows that for most part of the district the EC is around 200 micro mhos/cm. The higher values are there around the Dehradun and Doiwala townships.

4.4 Status of Ground Water Development

Groundwater is developed mainly through tubewells and India mark-II hand pumps. Jal Sansthan, Jal Nigam and Irrigation departments have constructed a number of tubewells in Raipur, Doiwala, Sahaspur and Vikas Nagar blocks to meet the domestic and irrigational requirements. In hilly areas, springs and gadheras form the main sources of drinking water. The springs are developed for irrigation purpose also. India mark-II hand pump is common in hilly areas also. The depth of the tubewells, constructed in Doon Valley, range in depth from 50 to 150 m bgl whereas the discharge ranges from 500 to 1500 lpm. In Chakrata and Kalsi blocks, only hand pumps are successful. These blocks haven't yet been explored for their groundwater potential either by CGWB or state government agencies.

4.4.1 Urban Water Supply Schemes

Urban water supply is mainly through tubewells. Eighty four tubewells based water supply schemes are in operation in urban area.

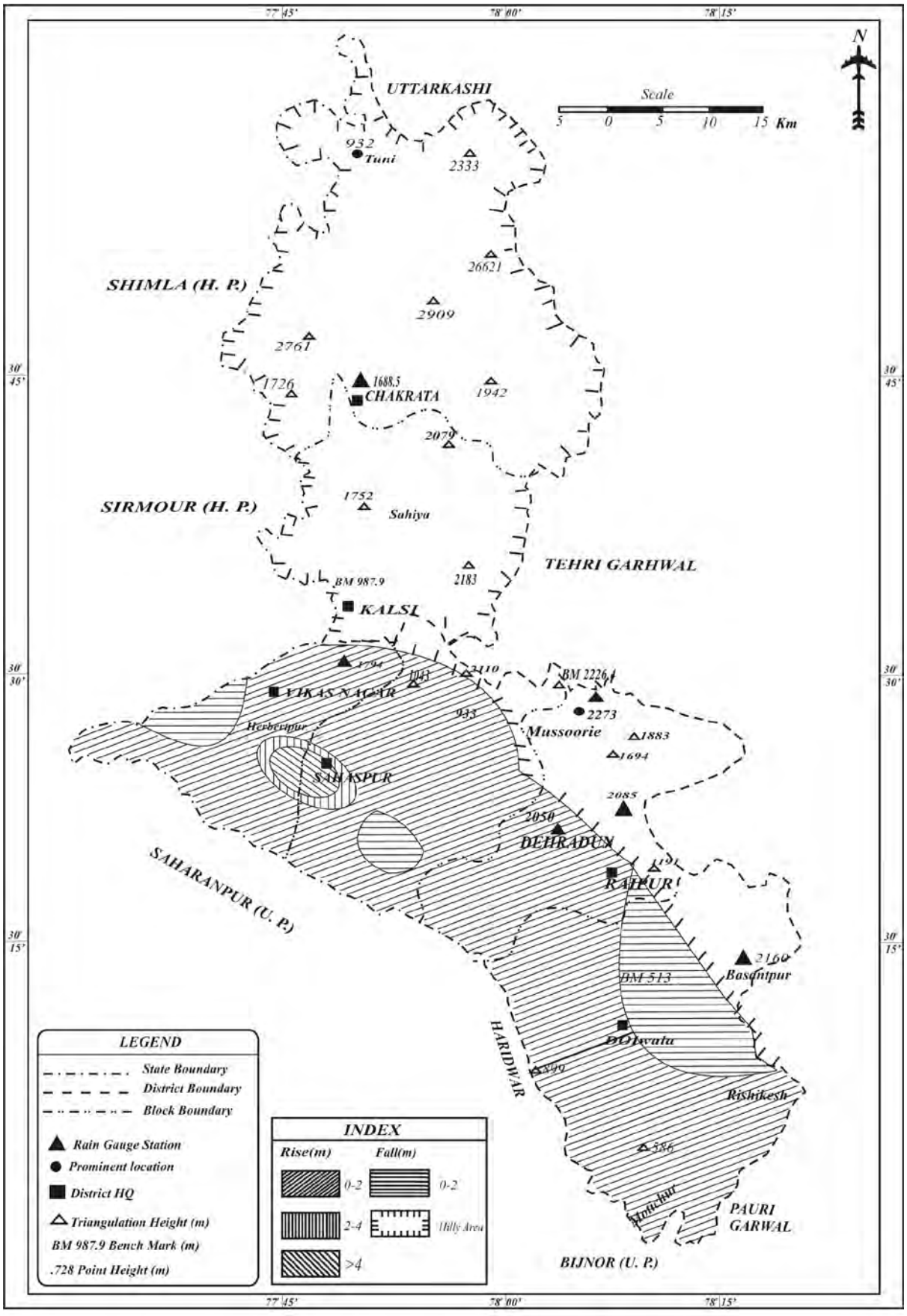

Fig. 4.4 Decadal Water Level Fluctuation Map
(Decadal Average May - May 2006)

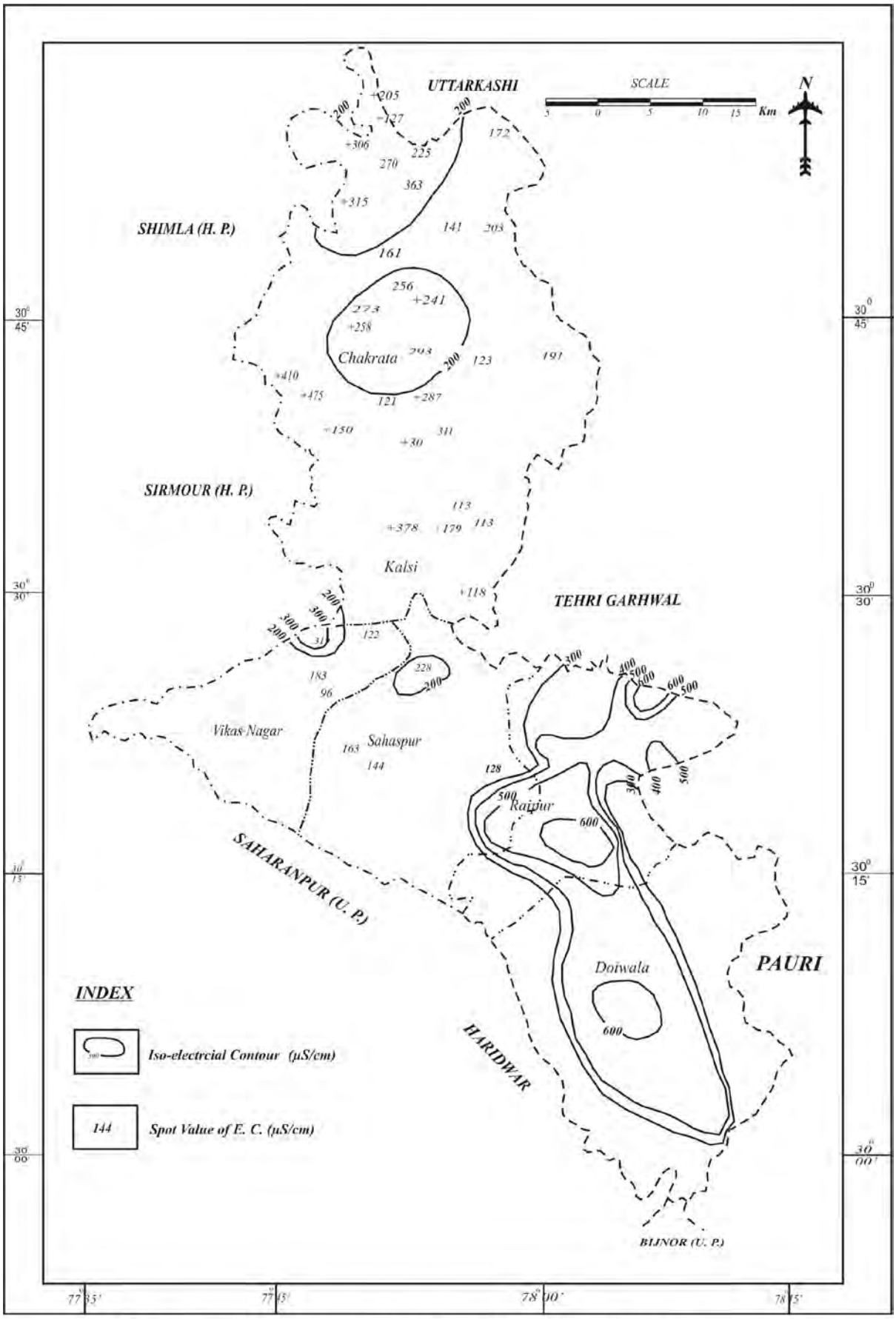

Fig.4.5 Iso-electrical Conductivity Map, Dehradun District

4.4.2 Rural Water Supply Schemes

The rural domestic water supply is through India Mark-II hand pumps, guls, springs and tubewells. Springs form the main source of drinking water in Chakrata and Kalsi blocks. There are 13 scarcity villages, in the district, out of which 3 are in Chakrata block and 10 are in Kalsi block.

The annual replenishable groundwater resources, current draft for domestic and industrial uses and the groundwater resources allocated up to 2025 for Raipur, Doiwala, Sahaspur and Vikas Nagar block for command and non-command areas are given in Table below**.**

Table 5. Net annual groundwater resources availability for various uses in Dehradun district.

S.No.	Block	Command/Non. Command/ Total	Net Ground water Availability (ham)	Existing Ground water Draft for domestic and industrial supply (ham)	Allocation for domestic and industrial water supply up to 2025 (ham)
1	Raipur	Command	2037.62	59.88	216.41
		Non-command	25586.85	375.34	2776.27
		Total	27624.47	435.22	2992.68
2	Doiwala	Command	2626.92	98.0	372.63
		Non-command	31828.65	317.86	5176.86
		Total	34455.57	415.86	5549.49
3	Sahaspur	Command	1573.01	56.82	263.05
		Non-command	30283.30	278.25	5570.37
		Total	31856.31	335.07	5833.42
4	Vikas Nagar	Command	1780.61	45.60	312.12
		Non-command	19824.35	483.62	2878.27
		Total	21604.96	529.22	3190.39

**** After Gopikrishana, K. 2009***

4.4.3 Irrigation Potential

Irrigation facilities have been developed by tapping the water from perennial rivers/springs/gadheras by constructing canals. The means of irrigation are canal, tubewells and

other sources such as hauz, guls and hydrums. The details of irrigation potential are given in Table below.

Table. 6. Details of irrigation potential, District Dehradun

Block	Number of Existing Groundwater Structures	Annual Groundwater draft through tube wells for all uses (ham)	Net annual Groundwater availability (ham)	Existing Groundwater draft for irrigation (ham)	Net annual Groundwater available for future use (ham)	Total Cropped area (ha)	Area Irrigated through tubewells (ha)
Raipur	331	9139.59	27624.47	8704.37	18485.49	12168.0	305.0
Doiwala	382	8733.26	34455.57	8317.4	20172.82	6506.00	1183.0
Sahaspur	217	7036.46	31856.31	6701.39	18986.43	6852.0	1122.0
Vikas Nagar	381	11113.76	21604.96	10584.54	7300.81	3785.0	667.0
	1311	**36023.07**	**115541.3**	**34307.7**	**64945.55**	**29311.00**	**3277.0**

5.0 Ground Water Management Strategy

5.1 Ground Water Development

Groundwater in the upper aquifer has been developed through dug wells. After the success of tubewells the groundwater withdrawal from dug wells is generally discontinued and most of the dug wells are abandoned. Owing to this reason there is no significant decline in the first aquifer. About 200 tubewells are operational in the intermontane valley. The total stress for all kind of needs is on the deeper aquifer. According to the stage of groundwater development the district as a whole is categorized as ‘safe’. Groundwater at shallow depth may be developed in Raipur, Sahaspur, Doiwala and Vikas Nagar blocks. As the geological formation is bouldery and percussion and DTH with ODEX attachment are the suitable methods of drilling.

5.2 Water Conservation and Artificial Recharge

The groundwater development is going on at a faster rate and management practices are required for the sustainability of this resource. The Central Ground Water Board, Dehradun constructed four gabion structures on Medawala Khala in Thano Forest Range. It is observed that the Doon Gravels are highly receptive to the artificially recharged water.

The structures suitable in high reaches and foot hill zones are gabion, check dam, gully plug and brushwood check dam. In the valley portion rain water may be harvested for the use other than drinking. Roof top rainwater harvesting and recharge well are suitable in the plain

areas of the valley. Technical guidance has been provided to the state government departments for designing artificial recharge structures.

6.0 Ground Water Related Issues and Problems

The groundwater resources estimation study reveals that all the four blocks (Raipur, Doiwala, Sahaspur and Vikas Nagar) fall in safe category. But the problem may crop out in future. There are no water quality and water logging problems in the area. The formation is bouldery in most parts of the district the drilling is slow and expensive and requires special techniques for the drilling of tubewells.

7.0 Awareness and Training Activity

7.1.1 Mass Awareness Programme

So far five Mass Awareness Programme (MAP) have been organized by the CGWB, UR, in district Dehradun. The venues of these programmes were

1. Village Gujrara, Sahastradhara Road, Dehradun.
2. Doon Global School, Sahaspur Block, Chakrata Road
3. Village Singhniwala, Shimla Road, Dehradun
4. Village Bhogpur, Doiwala Block, Rishikesh Road.
5. Village Chhorba, Sahaspur Block

The programmes were focused on the following aspects/messages

1.The local problems related to groundwater solution.
2. To aware public about diminishing water sources.
3.Water is every one's subject and to make the public aware about joint responsibility to manage the resource.
4.Role of public participation in water management.
5.The tubewells should be used on sharing basis to avoid over development of groundwater.

7.1.2 Water Management Training Programme

Four training programmes were conducted by CGWB in District Dehradun. The venues of these programmes were Forest Research Institute, Wadia Institute, Vikas Bhawan and Hotel Viceroy Inn. The target groups were MES Engineers, Uttarakhand Jal Sansthan, Jalagam, Uttarakhand Pey Jal Nigam, Degree college professors and students, NGOs, Irrigation, Mirror irrigation, Block Development Officers etc.

7.2 Presentation and Lectures

1) More crops per drop.
2) Ground Water Management.

3) Groundwater Management in Hilly Terrain.
4) Rain water harvesting and artificial recharge.

8.0 Areas Notified by CGWA/SGWA

As the whole district falls in safe category, no area, so far, has been notified in District Dehradun by CGWA/SGWA.

9.0 Recommendations

The recommendations are as given below:

i At present the total stress is on the deeper aquifer. There are no piezometers to monitor the change in water levels. A net of well distributed piezometers is essentially required.

ii Groundwater management practice should be implemented for deeper aquifers sustainable development

iii The Upper Siwalik Formation should be deciphered with the help of planned groundwater exploration since they form a potential groundwater repository owing to their pebble-boulder-conglomerate bed.

iv The forest should be safe guarded in the recharge area

v Construction activities should be avoided in the recharge area.

vi Roof top rain water harvesting and artificial recharge techniques may be adopted in urban areas.

vii Abandoned dug wells may be used to recharge shallow aquifer

viii Public should be made aware of water conservation practices.

ix Sewage should be treated and the need for irrigation purpose in adjoining areas.

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