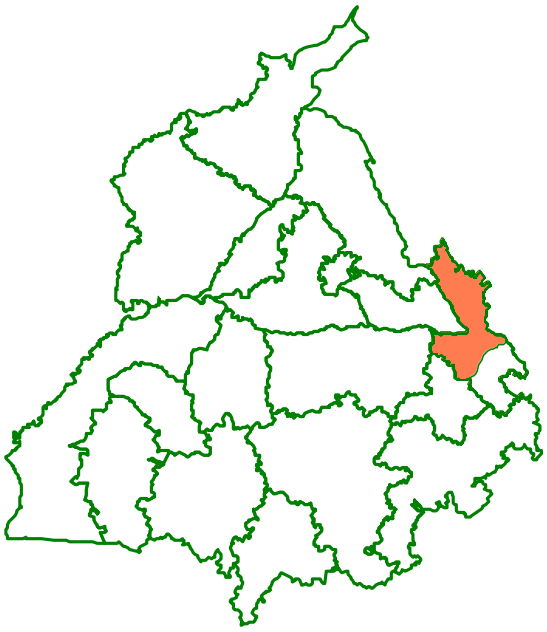
ROPAR DISTRICT PUNJAB



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

Contributors

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STA (Hg)

Prepared under supervision of

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Regional Director

GROUND WATER INFORMATION BOOKLET

ROPAR DISTRICT, PUNJAB

C O N T E N T S

ROPAR DISTRICT AT A GLANCE

Sl.NO	ITEMS	Statistics
1.	GENERAL INFORMATION	
	i. Geographical Area (sq. km.)	1369
	ii. Administrative Divisions	
	Number of Tehsils	4
	Number of Blocks	5
	Number of Towns	6
	Number of Villages	617
	iii. Population (As per 2011Census)	684627
	iv. Normal Annual Rainfall (mm)	775.6 mm
2.	GEOMORPHOLOGY	
	Major physiographic Units	Alluvial Plain & Intermontane Valley
	Major Drainage	Sutlej
3.	LAND USE (hectare.)	
	a. Forest Area:	26403
	b. Net area sown:	780
	Net Cultivated Area	76555
	c. Total Cultivated area:	141969
4.	MAJOR SOIL TYPES	Reddish Chestnut, Tropical Arid Brown (Weakly Solonized)
5.	AREA UNDER PRINCIPAL CROPS (Thousand hectare	Kharif-74 Rabi-72
6.	IRRIGATION BY DIFFERENT	(thousand hectare)

	SOURCES	
	Dugwells	-
	Tubewells/Borewells	710/21873((66)- 18345/
	Tanks/ponds	-
	Canals	4
	Other sources	-
	Net Irrigated area	70
	Gross irrigated area	124.8
7.	NUMBER OF GROUNDWATER MONITORING WELLS OF CGWB	
	No of Dug wells	14
	No of Piezometers	2
8.	PREDOMINANT GEOLOGICAL FORMATIONS	Alluvium
9.	HYDROGEOLOGY	
	*Major Water bearing formation *(Pre-monsoon depth to water level *(Post-monsoon depth to water level *Long term water level trend in 10 yrs	Sand 2.7-10.3 2.1-11.6 Fall -0.015-1.05 m/yr
10.	GROUND WATER EXPLORATION BY CGWB	
	No. of wells drilled EW OW PZ SH	 12 - 2 -
	Depth range (m)	50-459
	Discharge (liters per minutes)	731-1500
	Storativity (S)	$7.8*10^{-4}$ -$1.7*10^{-3}$
	Transmissivity (m^2/day)	123-1180

11.	GROUNDWATER QUALITY	
	Presence of Chemical constituents more than the permissible limit EC (micro mhos at 25^{o}C) F (mg/l) As (mg/l) Fe (mg/l)	
	Type of water	Alkalini,Ca-Mg-HCO_3
12	DYNAMIC GROUNDWATER RESOURCES (2009) MCM	
	Net annual ground water availability	415.18
	Annual Ground Water Draft	458.18
	Projected Demand for Domestic and industrial Uses upto 2025	31.07
	Stage of Ground Water Development	110
13	AWARENESS AND TRAINING ACTIVITY	NIL
14.	EFFORTS OF ARTIFICIAL RECHARGE& RAIN WATER HARVESTING	
	Projects completed by CGWB (No.& Amount spent)	1, Rs. 40,29,000/-
	Projects under technical guidance of CGWB (Numbers)	-
15.	GROUND WATER CONTROL AND REGULATION	
	Number of OE Blocks.	3 – Chamkaur Sahib, Nurpur Bedi & Morinda

	Number of Critical Blocks	-
	Number of blocks notified	NIL
16	MAJOR GROUND WATER PROBLEMS AND ISSUES.	Over-exploitation

GROUND WATER INFORMATION BOOKLET

ROPAR DISTRICT, PUNJAB

1.0 INTRODUCTION

Ropar district is located in the eastern part of the Punjab State and geographically lies between North latitudes of 76°19′00″ and 76°45′00″ and East longitudes of 30°44′00″ and 31°25′00″. The geographical extent of the area is 1440 sq.km. The area is bounded by Himachal Pradesh in the north and north east, Hoshiarpur, Nawanshahr and Ludhiana district in the west, Fatehgarh Sahib district in the South and Mohali district in the south east. Administratively the new Ropar district is divided into four tehsils – Rupnagar, Chamkaur Sahib, Anandpur Sahib and Nangal comprise of five development blocks.

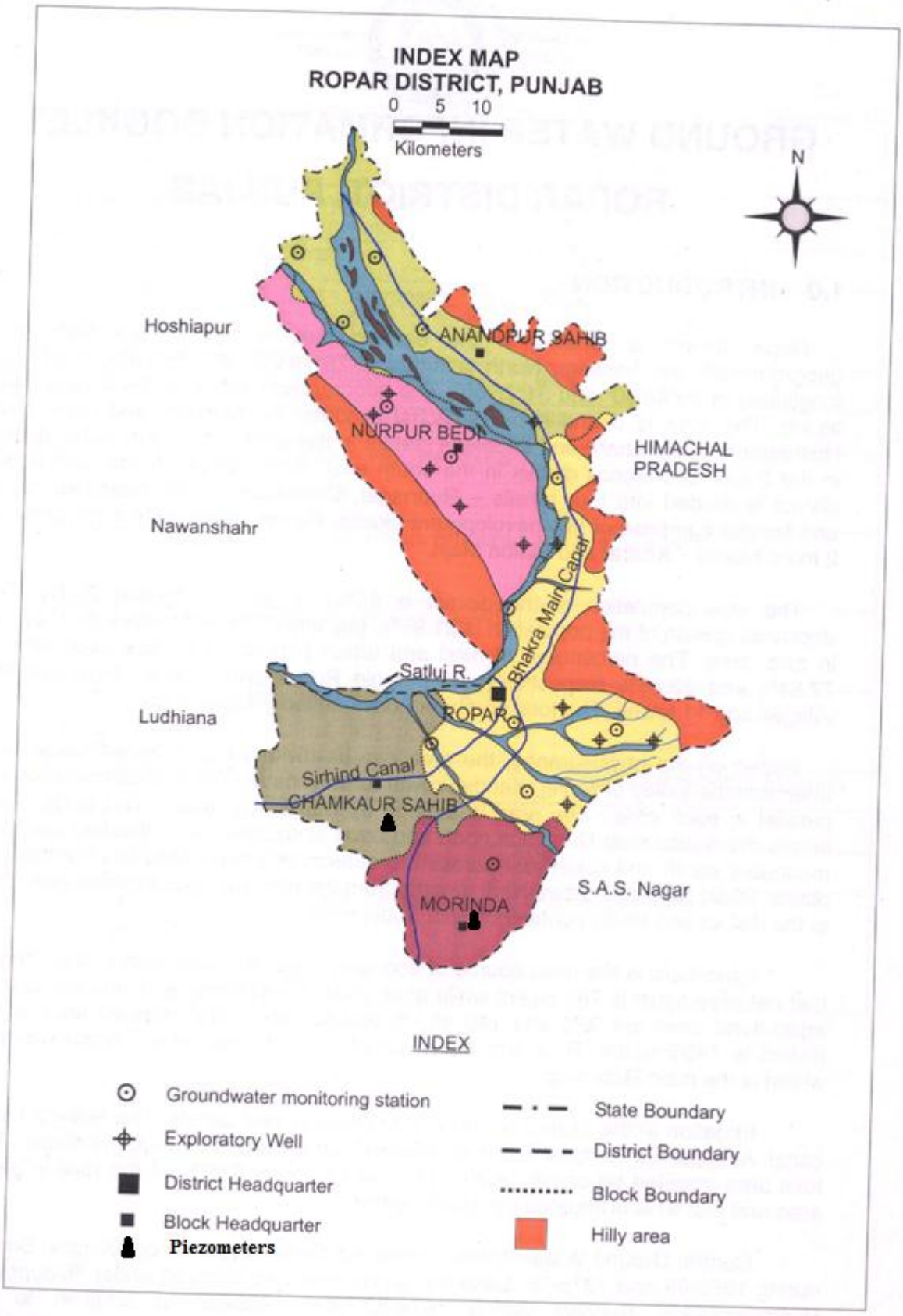
The total population of the district is 684627 (as per census 2011). The decennial growth of the population is 00.00%. Majority of the total population resides in rural area. The percentage of rural and urban population to total population is 72.71% and 27.29 % respectively. As per Ropar district data, there are 617 villages and 11 towns. The total number of uninhabited villages is 19.

Based on the physiography, the area can be divided into 4 units-Siwalik Hills, Intermontane valley of Sutlej, Kandi/Sirowal formations and alluvial plains-which run parallel to each other. The area is drained by Sutlej river basin. The Sutlej River enters the district near Nangal in north and flows in southeasterly direction and then meanders south and southwest across the outermost Siwalik Hills to debouch into plains. Budki Nadi and Siswa Nadi emerge from the hills drain the southeastern part of the district and finally confluence with Sutlej River.

Agriculture is the main source of economy. The land utilization pattern shows that net area sown is 780 sq.km while area under forest cover and land put to non-agricultural uses are 370 and 140 sq.km respectively. Total cropped area of the district is 1400 sq.km. Rice and maize constitute the main Kharif crops whereas wheat is the main Rabi crop.

Irrigation in the district is mainly by tubewells and canals. The Nangal Hydel canal. Anadpur Sahib hydel Canal and Sirhind canal passes through the district. The total area irrigated by canals is 66 sq.km, which forms 8.57% of the total irrigated area and rest 91% is irrigated by ground water.

Central Ground Water Board carried out Systematic Hydrogeological Survey during 1968-69 and 1975-76. Later the same area was covered under Reappraisal


INDEX MAP
ROPAR DISTRICT, PUNJAB
0 5 10
Kilometers
N
Hoshiapur
ANANDPUR SAHIB
NURPUR BEDI
HIMACHAL PRADESH
Nawanshahr
Bhakra Main Canal
Satluj R.
ROPAR
Ludhiana
Sirhind Canal
CHAMKAUR SAHIB
S.A.S. Nagar
MORINDA
INDEX
Groundwater monitoring station
Exploratory Well
District Headquarter
Block Headquarter
Piezometers
State Boundary
District Boundary
Block Boundary
Hilly area

Hydrogeological Surveys during 1979-80 and 1985-86. In addition to the conventional hydrogeological survey, surface resistivity surveys were carried out along the Kandi tract and Intermontane valley for groundwater exploration. In 1978, resisitivity soundings were done along Kandi tract for groundwater exploration. Resisitivity surveys were also carried out in Intermontane valley of Nupur Bedi/Anandpur Sahib block for the delineation of upper boulder beds.

2.0 RAINFALL AND CLIMATE

The district receives normal annual rainfall of 776 mm, which was spread over 41 days. 78% of the annual rainfall is contributed by southwest monsoon. Generally, rainfall increases from southwest to northeastern part of the district. The climate of the district can be classified as tropical steppe hot and semi-arid type.

3.0 GEOMORPHOLOGY AND SOIL TYPES

Based on geomorphology the entire district can be grouped into 4 units such as Siwalik Hills, Intermontane valley, alluvial fan and alluvial plain. The Siwalik Hills separates the main Himalayan ranges from the Indo-Gangetic alluvial plain. The area is highly dissected and has an uneven topography. Adjacent to the hills is a long narrow intermontane valley, which extends from Nangal to Ropar trending northwest to southeast. Anandpur Sahib tehsil of the district lies in the intermontane valley and occupies a length of 40 km. The average width of the valley in the district is 5 km. Sutlej River and its tributaries drain this valley. Adjacent to this is the alluvial fan which forms the transitional area between the alluvial plains and hilly area of Himalayan foot hills. The coarse sediments brought down by hill torrents forms the alluvial fan deposits. These alluvial fans coalesced to form Kandi and Sirowal formation. The southern part of the district is mainly alluvial plain, which forms a part of vast Indo-Gangetic alluvail plain.

Two types of soils are found in the district-(1) Reddish chestnut soils which is seen in the northeastern part of the district, particularly in the Ropar and Anandpur Sahib blocks. These soils are loam to clay-loam in nature and decalcified and (2) Tropical Arid Brown soils (Weakly Solonized) are mainly found in rest of the area which are mainly calcareous sandy loam.

The soils of the District vary in texture generally from loam to silty clay loam except along the Sutlej River and chos (seasonal canals) where some sandy patches may be found. Chamkaur Sahib and Morinda blocks have sodic soils. The soils of Anandpur Sahib and Rupnagar blocks are undulating.

4.0 GROUND WATER SCENARIO

4.1 Hydrogeology

The Quaternary alluvial deposits belonging to the vast Indo-Gangetic Alluvium occurring in the southern blocks of the district forms the main aquifer system. The aquifers in the northern part are mainly Siwalik formation, Intermontane Valleys and Kandi/Sirowal formation.

The Central Ground Water Board has drilled 12 Exploratory wells in the district in the depth range of 50-459 m to determine various aquifer systems and its properties. Exploratory drilling has revealed the presence of 5 to 27 saturated granular zones comprising fine to coarse sand, silt, gravel and kankar upto the depth of 460 m. Shallow aquifers up to the depth of 75 m are either in the form of isolated lenses of sand embedded in clay beds or well connected granular zones that have pinching and swelling disposition and are quite extensive in nature. These aquifers comprising fine to coarse sand are often intercepted with kankar horizons. Deeper aquifers in the range of 50-460 m are composed of fine to coarse sand, silt, gravel and kankar. From west to east the granular zones thin out and clay horizons with gravel or kankar become predominant.

Two Piezometers were drilled at Rurkee Heeran, Chamkaur Sahib block and Chutamali, Morinda block. At Rurkee Heeran Pz is drilled upto the depth of 100 meters with SWL 17.77 m bgl and at Chutamli, Pz is drilled upto the depth of 88.34 meters with SWL 41.34 m. The Pz were drilled in the phreatic aquifer occurring in the depth range of 60 – 100 m.

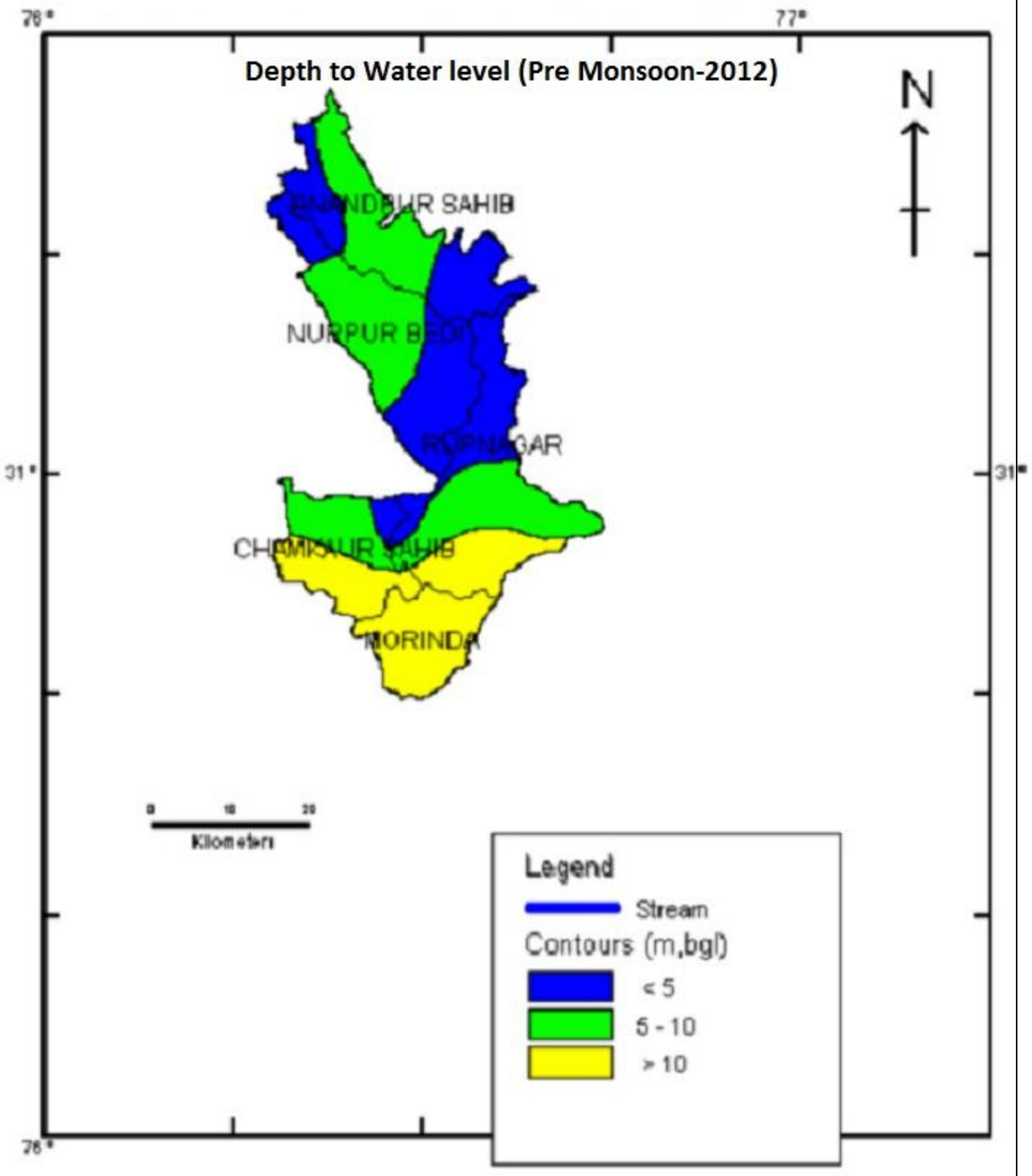
Groundwater occurs under phreatic condition in the shallow aquifers of Quaternary alluvium deposits, Intermontane valley and Kandi formation while groundwater occurs under leaky confined to confined conditions in the deeper aquifers of alluvium.

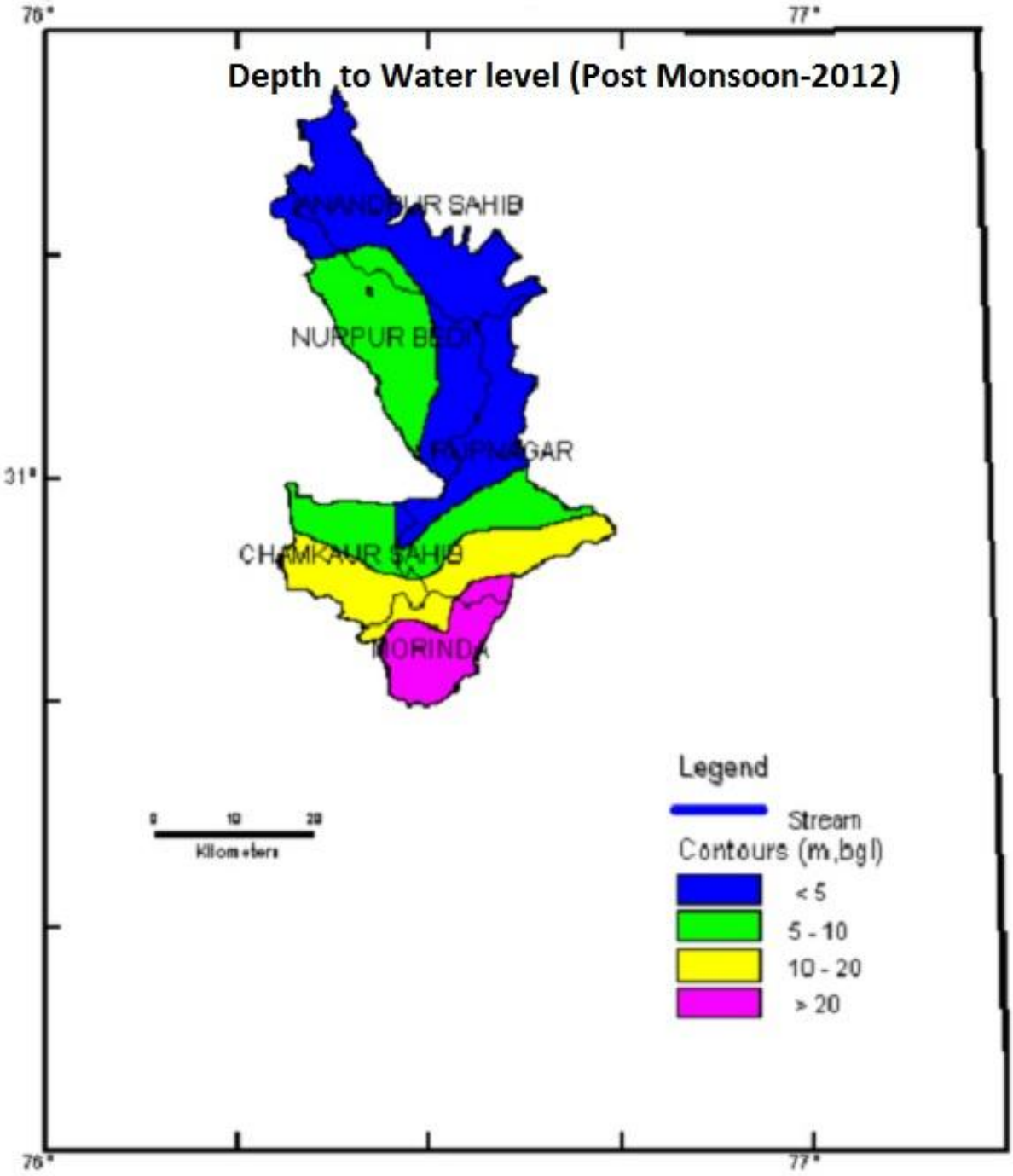
In the case of unconfined aquifers, the depth to water level varies from 3.55 to 9.08 meters during pre-monsoon and 3.61 to 10.14 meters during post-monsoon. Seasonal fluctuation shows that in general there is an overall fall in water level except few isolated patches. The long-term trend of water level (10 years) shows a general decline in the entire district. The maximum fall is observed along the intermontane valley and the decline is at the rate of 1.05 m/year. Near the Siwalik hill, groundwater occurs at greater depth when compared to alluvial plains where it occurs at shallow depth. Generally, the water level is deep in intermontane valley and slope towards central part of the valley. North Western Region, Chandigarh have 12 Ground water monitoring stations (10 Dug well & 2 Pz) at Ropar district.

In the northern part, especially in the intermontane valley, groundwater flow is towards south and southeastern direction whereas in the southeastern part of the district, the groundwater flow is in the south and southwestern direction. The water table elevation is highest near the hills and lowest in the southeastern part, which in turns reflects the topographic gradient. The hydraulic gradient is steeper near the hills and gentles near the plains.

The aquifer parameters show marked difference depending upon the subsurface lithology. The wells drilled in the intermontane valley shows more yield in the range of 1098-1500 lpm for 6.2 to 13.3 m drawdown. While the yield of wells tapping alluvial aquifers are in the range of 731 to 946 lpm for 4.4 to 8.2 m drawdown. This high discharge may be attributed to induced recharge from antecedent Sutlej River passing through the valley. The transmissivity value ranges from 123 to 1180 m^2/day in Nupur Bedi and Ropar Block respectively. Similarly, the lateral hydraulic conductivity ranges from 3 to 21.6 m/day. The storativity value is between 7.8 *10^{-4} and 1.7* 10^{-3} indicating semi-confined to confined conditions.

Out of 12 exploratory wells, 2 exploratory wells have been constructed in Kandi area. In these locations - Harnampur and Bhagwati- Aquifer performance test were conducted for more than 10,000 min. The specific capacity is 49.76 lpm/m at Harnampur and 115.09 lpm/m at Bhagwati.


Depth to Water level (Pre Monsoon-2012)
76°
77°
31°
N
NURPUR BEDI
MORINDA
Kilometers
Legend
Stream
Contours (m,bgl)
< 5
5 - 10
> 10


Depth to Water level (Post Monsoon-2012)
76°
77°
31°
NUPPUR BEDI
CHAMKAUR SAHIB
MORINDA
0 10 20
Kilometers
Legend
Stream
Contours (m,bgl)
< 5
5 - 10
10 - 20
> 20

4.2 Ground Water Resources

The block-wise groundwater resource potential of Ropar district was calculated based on GEC-97 by excluding hilly areas. The net groundwater availability of district is 415.18 MCM, while the gross groundwater draft is 458.18 MCM only. This leaves a balance of -50.76 MCM for future development purpose, that is the district is deficit in water balance for future development. The stage of groundwater development for the district as a whole is 110%, which puts it in Over Exploited Category. While considering the development block wise, 3 out of 5 blocks namely Chamkaur Sahib, Nurpur Bedi and Morinda, stage of groundwater development has exceeded the available recharge (>100%), thus categorized as over- exploited.

Block-wise Groundwater Resource of Ropar district as on 31.03.2009

Block Name	Net Annual Ground Water Availability (MCM)	Existing Gross Ground Water Draft for irrigation (MCM)	Existing Gross Ground Water Draft for all uses (MCM)	Allocation for domestic and industrial requirement supply upto next 25 years (MCM)	Net Ground Water Availability for future irrigation development (MCM)	Stage Ground Water Development (%)	Category
ANANDPUR SAHIB	76.85	53.95	58.43	6.92	15.98	76	SAFE
CHAMKAUR SAHIB	90.30	189.04	190.68	2.52	-101.25	211	OVER-EXPLOITED
MORINDA	56.56	103.03	106.62	4.74	-51.20	188	OVER-EXPLOITED
NURPURBEDI	47.62	46.11	48.35	3.43	-1.92	102	OVER-EXPLOITED
ROPAR	143.85	42.75	54.10	13.46	87.64	38	SAFE
TOTAL	**415.18**	**434.87**	**458.18**	**31.07**	**-50.76**	**110**	OVER-EXPLOITED

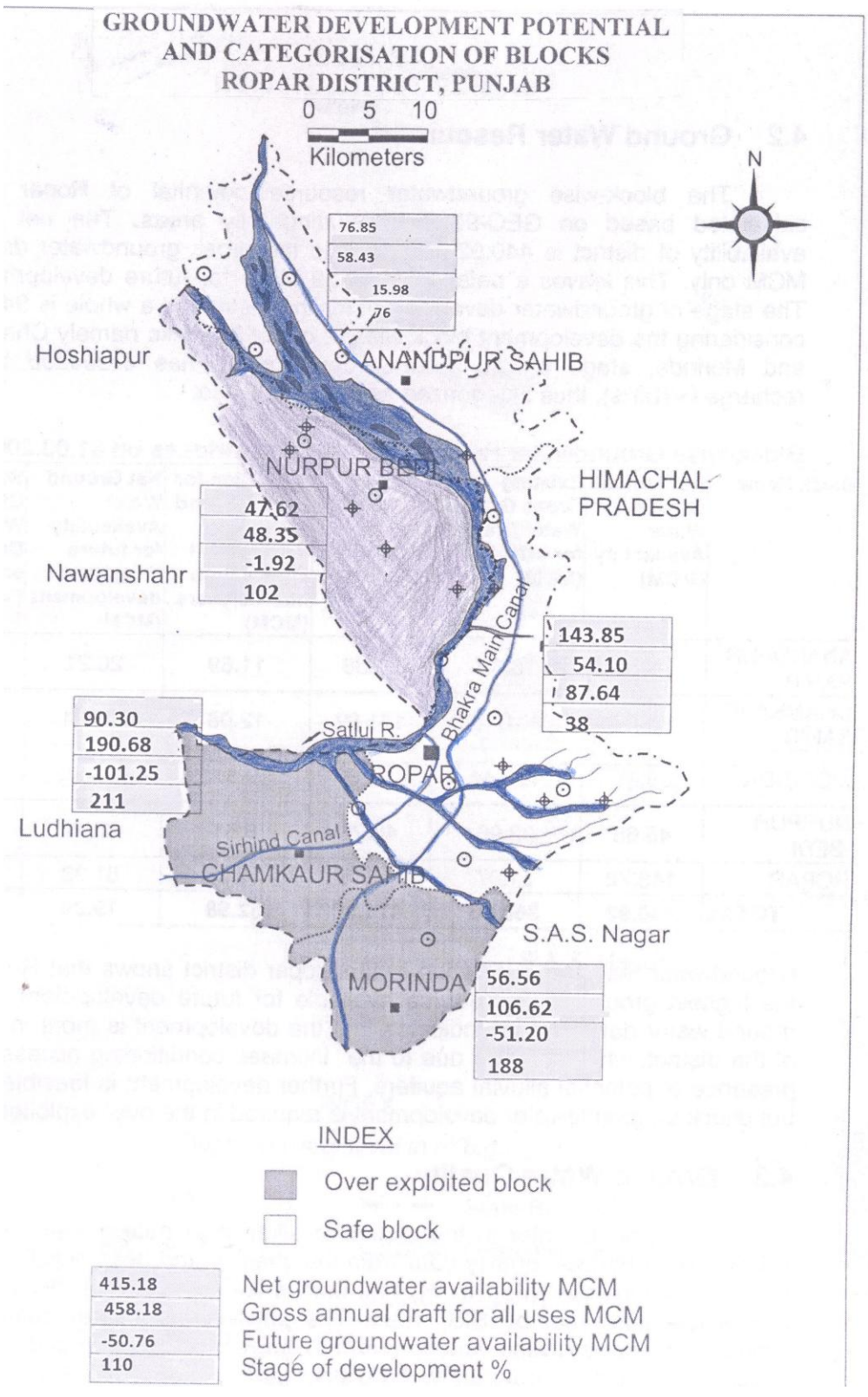
Groundwater resource evaluation in the Ropar district shows that Ropar block is deficit in available ground water resources for future development. The stage of ground water development indicates that the development is more in southern part of the district, which may be due to the increase conditioning accessibility and the presence of potential alluvial aquifers. Further development is feasible in the Ropar, Anandpur Sahib blocks of the district and check on groundwater development is required in the over-exploited blocks.

4.3 Ground Water Quality

The ground water in the district is alkaline in nature with medium to high salinity. The chemical quality data from the shallow and deep aquifers indicate that all major cations (Ca, Mg, Na, K) and anions (CO_3, HCO_3, Cl, SO_4) are within the permissible limits set by BIS, 2012. The physical parameter such as electrical conductivity shows a wide variation from 470µS/cm in southern and northern part to 1225µS/cm in the central part of the district particularly, in Ropar block. Nitrate and fluoride concentration is below the prescribed permissible limit in entire district

66.7% of the groundwater samples collected from the district show Ca-Mg-HCO_3 type of water, which imparts temporary hardness. Rest 33.3% shows a mixed type of chemical character. Since all the physical and chemical parameters are below the permissible limit prescribed by BIS the ground water in the area is suitable for drinking purposes. The suitability of groundwater for irrigation purpose is calculated by SAR and RSC values. The SAR value is below the permissible limit of 10.0 in entire district while the RSC value is slightly above the prescribed limit of 2.0 in two locations, viz., Chakdera and Kakrali. As per USSL diagram, ground water of the district falls in medium to high salinity hazard and low sodium hazard and hence it is suitable for irrigation in all types of soil.

In the entire district Iron, which is an essential plant and animal nutrient, is found to be below the permissible limit with an exception in Ropar block. Majority of the samples in Ropar block show slightly higher values than the permissible limit of 1.0 mg/l. Arsenic above the prescribed BIS permissible limit of 0.05 mg/L is found in well waters located at Bara Chaunta (0.096 mg/l).


GROUNDWATER DEVELOPMENT POTENTIAL
AND CATEGORISATION OF BLOCKS
ROPAR DISTRICT, PUNJAB
0 5 10
Kilometers
N
76.85
58.43
15.98
76
Hoshiapur
ANANDPUR SAHIB
NURPUR BEDI
HIMACHAL PRADESH
47.62
48.35
-1.92
102
Nawanshahr
143.85
54.10
87.64
38
Bhakra Main Canal
90.30
190.68
-101.25
211
Satluj R.
ROPAR
Ludhiana
Sirhind Canal
CHAMKAUR SAHIB
S.A.S. Nagar
MORINDA
56.56
106.62
-51.20
188
INDEX
Over exploited block
Safe block
415.18
458.18
-50.76
110
Net groundwater availability MCM
Gross annual draft for all uses MCM
Future groundwater availability MCM
Stage of development %

4.4 Status of Groundwater development

The groundwater development for domestic and irrigation is mainly through tubewells, hand pumps and cavity wells. Large quantities of water are abstracted through shallow and deep tubewells. The State tubewells are in the depth range of 44 to 183 m bgl tapping both shallow and deep aquifers. The discharge ranges from 206 to 2873 lpm with moderate drawdown. Depending upon the water level, submersible or centrifugal pumps can be used to harness the water.

In rural as wells as in urban areas drinking water supply is based on groundwater. Tubewells tapping shallow and deep aquifers are constructed by Tube Wells Corporation and Public Health Department.

Out of the net irrigated area of 780 sq.km in Ropar district, only as 70 sq.km of land is irrigated by canals and rest by groundwater. Thus 91% of the total irrigated area is irrigated by groundwater by means of shallow and deep tubewells. The total number of shallow private tubewells in the district is 21,873. Majority of the private tubewells used for irrigation purpose tap the shallow aquifer. During the past few years, density of shallow tubewells has increased tremendously. Tubewells tapping shallow aquifers up to the depth of 75 m yield in the range from 150 to 1800 lpm. Rice, maize and wheat are the main crops grown in the district.

5.0 GROUNDWATER MANAGEMENT STRATEGY

5.1 Groundwater Development

Further groundwater development can be done in two blocks of the district – Anandpur Sahib and Ropar where the stage of development is low. In the Siwalik hills and in Intermontane valley, the presence of consolidated formation and boulders restrict the development. By installing deep tube wells with the help of percussion DTH rigs further groundwater development can be done in this area. If the boulders occur at shallow depth and are small in size, rotary method finds to be more suitable but be used with caution. However, the groundwater development in over-exploited areas such as Morinda, Nurpur Bedi and Chamkaur Sahib must be linked with water conservation schemes since these blocks are under over-exploited category.

Based on the type of formation, well design will be different for boulder formation and alluvial areas. A tube well design involves utilizing the aquifers with appropriate materials for long life and low operation and maintenance cost.

On the basis of exploration data, it has been found that a well assembly of 305/203 mm diameter with housing length 40-60 m and 1.6 mm slot size and shrouded with pea gravel of 3-5 mm size would be suitable for deep tube well in the district. The shallow tube wells up to 75 m depth can be constructed with a single assembly of 100-200 mm diameter with 10-20 m slotted pipes having 1.6 mm slot size and annular space to be shrouded with gravel of 1.5-4.7 mm.

Direct rotary rigs would be suitable for drilling in alluvial areas while percussion rigs are suitable for drilling in bouldary formation. If the boulders are at shallow depth and small in size, reverse rotary can also be deployed.

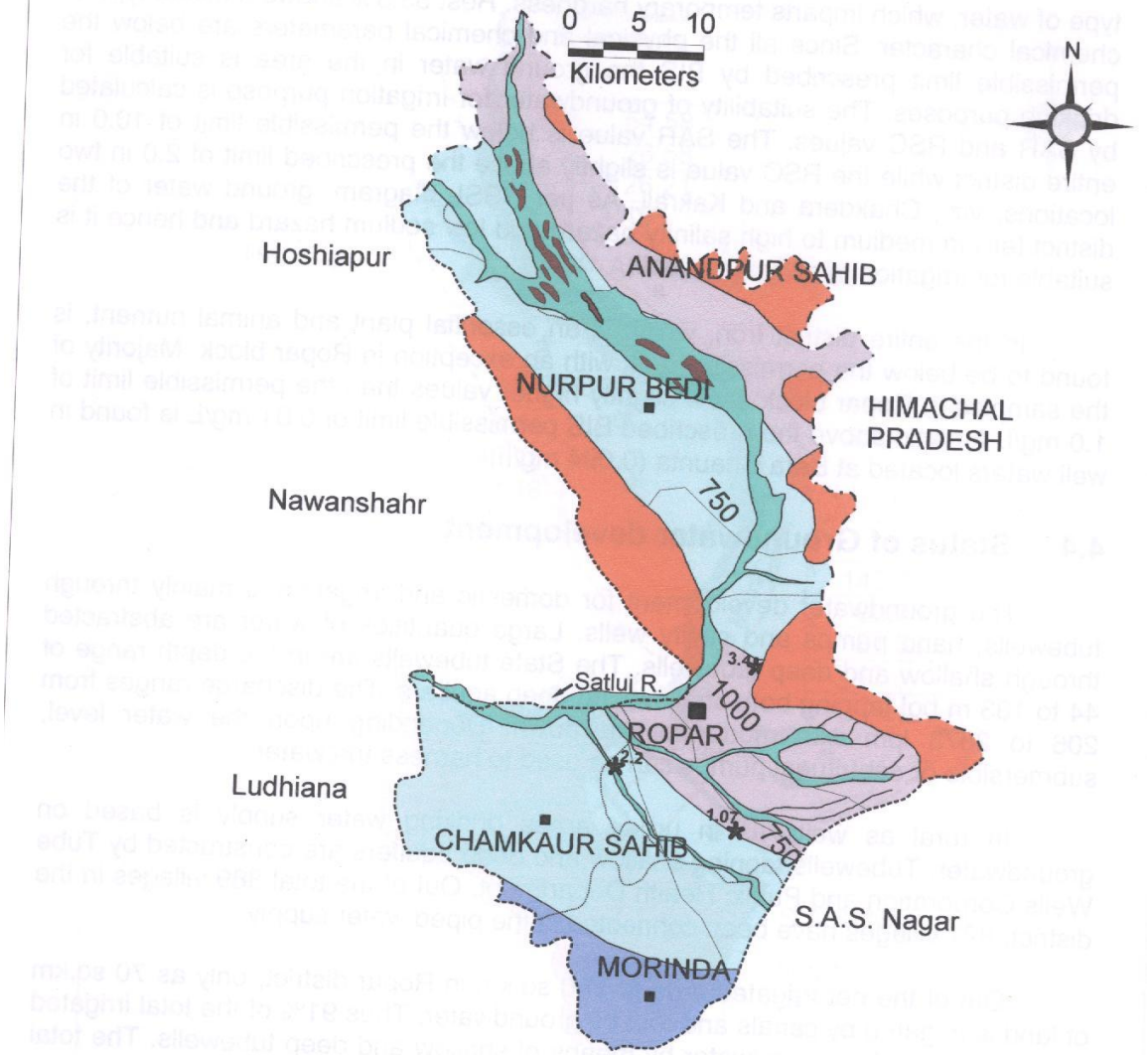
For proper management of groundwater resource, abstraction structures should be placed at specific intervals. The spacing between shallow tubewells is to be kept 225 m and for deep tube wells the spacing between the well should be kept 800 m.

5.2 Water Conservation and Artificial Recharge

CGWB has taken up artificial recharge scheme by harvesting rainwater at Bardar village, Ropar block. The artificial structures constructed at this site are one lateral trench and two injection wells of 250 mm diameter and 75 m deep each.

Since there was an ample supply of surface water in the district, there is an urgent need to take up artificial recharge schemes on over-exploited blocks such as Chamkaur Sahib, Nurpur Bedi and Morinda. The non-committed monsoon run-off can be utilized as a source for artificial recharge. The area suitable for artificial recharge in the district is 100 km^2, which has a sub-surface storage potential of 77 MCM. A volume of 102 MCM of water would be required to reach this recharge, The artificial recharge structures feasible in hilly areas are check dams, gabion structures and nala bunds
where as in alluvial areas recharge shafts, lateral trench with injection wells are suitable.

HYDROGEOLOGY
ROPAR DISTRICT, PUNJAB



INDEX

	Wells Feasible	Rigs Suitable	Depth of Wells (m)	Discharge (lpm)	Suitable Artificial Recharge Structures
Soft Rock Aquifer	Tube wells	Direct and reverse rotary	35-185	>1280	Recharge trench with injection well
Soft Rock Aquifer	Tube wells	Direct and reverse rotary	50-220	960-1280	Recharge trench with injection well
Soft Rock Aquifer	Tube wells	Direct and reverse rotary	25-180	480-960	Recharge trench with injection well

ELECTRICAL CONDUCTIVITY (MICRO MHOS/CM AT 25 C) 500

IRON>PERMISSIBLE LIMIT (1.0 ppm) 2.2*

Hilly area

6.0 GROUNDWATER RELATED ISSUES AND PROBLEMS

The major problem in respect to groundwater in the district is the overall decline in the water level particularly in over-exploited blocks such as Chamkaur Sahib, Nurpur Bedi and Morinda. These blocks need macro analysis as well as urgent attention to conserve groundwater.

7.0 RECOMMENDATIONS

1. Groundwater resource in Anandpur Sahib and Ropar blocks are recommended for further development.
2. In order to avert the declining trend of water levels, groundwater management structures such as roof top rainwater harvesting system and recharge structures should be constructed which in turn augment the groundwater reservoir.
3. Mass Awareness Programme should be conducted in the district by giving emphasis to over-exploitation and its consequences and need for its effective/economic use.