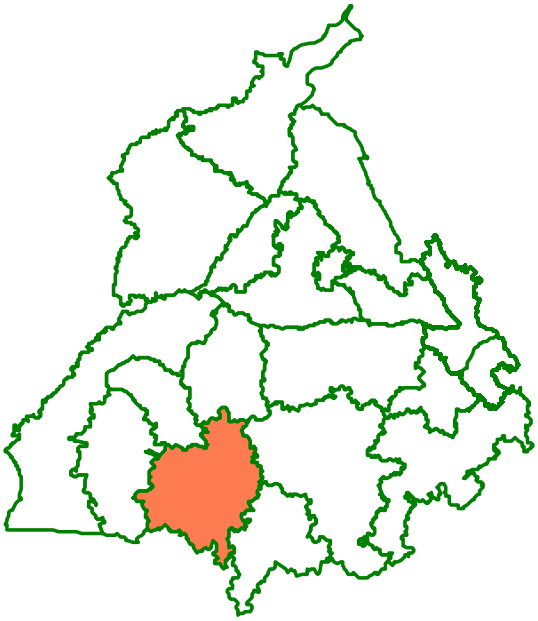
GROUND WATER INFORMATION BOOKLET

BATHINDA DISTRICT, PUNJAB



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

2013

Contributor

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Scientist "C"

Prepared under supervision of

A. K. BHATIA
Regional Director

OUR VISION

"FRESH AND ADEQUATE WATER - FOR ALL"

GROUND WATER INFORMATION BOOKLET
BATHINDA DISTRICT, PUNJAB

C O N T E N T S

BATHINDA DISTRICT AT A GLANCE

Sl. NO.	ITEMS	Statistics
1.	GENERAL INFORMATION	
	i. Geographical Area (sq. km.)	3367
	ii. Administrative Divisions (As on 31-03-2012)	
	Number of Tehsils	3-Bathinda, Rampura phul & Talwandi Sabo
	Number Of Blocks	7-Bathinda, Nathana, Rampura, Phool, Talwandi Sabo, Sangat and Maur
	Number Of Panchayats	-
	Number Of Villages	285
	iii. Population (As per 2011Census)	1388859
	Urban	499916
	Rural	888943
	Males	744875
	Females	643984
	Persons per sq. km	414
	% increase over 2001 to 2011	17.37
	Literacy rate	69.6 %
	iv. Average Annual Rainfall (mm)	408
2.	GEOMORPHOLOGY	
	Major physiographic Units	Flat alluvial plain
	Major Drainage	Bathinda branch , Kotla branch & Abohar Branch
3.	LAND USE (Thousand Hectare)	
	a. Forest Area	8
	b. Net area sown	296
	c. Total cropped area	556
	d. Area under non agriculture use	31

4.	MAJOR SOIL TYPES	Arid brown & Siezoram soils
5.	AREA UNDER PRINCIPAL CROPS	556000 ha.
6.	IRRIGATION BY DIFFERENT SOURCES (Areas and Number Of Structures)	
	Dugwells	-
	Tubewells/Borewells	63000 (76000 ha .)
	Tanks/ponds	-
	Canals	219000 ha.
	Other sources	-
	Net Irrigated area	295000 ha. .
	Gross irrigated area	555100 ha.
7.	NUMBERS OF GROUND WATER MONITORING WELLS OF CGWB (As on 31-3-2012)	
	No. of dug wells	19
	No of Piezometers	12
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 in m /yr	Sand, 3.43 - 20.39 m bgl 2.24 -20.76 m bgl Fall : –0.77 to –0.03 Rise : 0.05 to 0.13
10.	GROUND WATER EXPLORATION BY CGWB	
	No. of wells drilled EW OW PZ SH	 5 - 9 -
	Depth range(m)	250 - 545

	Discharge(liters per minutes)	1000-1736
	Storativity (S)	$2.6*10^{-2}$
	Transmissivity (m^2/day)	2724
11.	GROUND WATER QUALITY	
	EC (micro mhos at 25^oC) F (mg/l) Fe (mg/l) As (mg/l)	288 to 3490 0.19 to 7.25 Nd to 2.165 0.0001 to 0.0061
	Type of water	Na-HCO_3
12	DYNAMIC GROUND WATER RESOURCES (2011) – in ham	
	Net Ground water Availability	101681
	Net Annual Ground water Draft	121452
	Projected Demand for Domestic and industrial Uses upto 2025	4500
	Stage of Ground Water Development	119%
13	AWARENESS AND TRAINING ACTIVITY	-
14.	EFFORTS OF ARTIFICIAL RECHARGE& RAIN WATER HARVESTING	-
15.	GROUND WATER CONTROL AND REGULATION	
	Number of OE Blocks.	- 4 – Phul, Rampura, Maur, Nathana
	No. Critical Blocks	-
	No.of blocks notified	-
16	MAJOR GROUND WATER PROBLEMS AND ISSUES.	Water quality and Water level rise in Southwestern part of the district.

GROUND WATER INFORMATION BOOKLET BATHINDA DISTRICT, PUNJAB

1.0 INTRODUCTION

Bathinda district is situated in the southern part of Punjab State. It lies between 29^{o} $33^{'}$ and 30^{o} $36^{'}$ North latitude and 74^{o} $38^{'}$ and 75^{o} $46^{'}$ East longitude. . It falls in Survey of India Topo sheets No. 44J, 44K, 44N, and 44O It covers an area of 3367 Sq. Km. The district is surrounded by Sirsa and Fatehabad district of Haryana State in the south, Sangrur and Mansa districts in the East, Moga in the North-East and Faridkot and Muktsar districts in North-West. The Bathinda district has 3 Sub-Divisions, Bathinda, Rampura phool, Talwandi sabo. It has Seven blocks named Bathinda, Nathana, Rampura, Phool, Talwandi sabo, Sangat, Maur. The district has a good network of canals for irrigation and domestic purposes. The main canals in the area which feed the various distributaries and minor canals are the Bathinda branch and Kotla branch canal originated from Sirhind canal. The CGWB has carried out ground water exploration and hydrogeological studies in the district.

2.0 RAINFALL & CLIMATE

The district lies in the South-western region of the State and in far away from the Shivalik ranges in the North of the state. It is the nearest to the Thar Desert of Rajasthan and also far away from the Major rivers lines that run through the state. Therefore, climatically, the district has a very hot in summer and frequently scorching heat is in full swing. The climate of Bathinda district can be classified as tropical steppee, semi arid and hot which is mainly dry except in rainy months and characterised by intensely hot summer and cold winter. During three months of monsoon season from July to September, the moist air of oceanic origin penetrate into the district and causes high humidity, cloudiness and good monsoon rainfall. The period from October to November constitutes post monsoon season. The cold weather season prevails from December to February followed by the hot weather season or Pre-monsoon season which ends upto the last week of June.

Rain fall : The normal annual rainfall of Bhatinda District is 408 mm in 20 days which is unevenly distributed over the district. The southwest monsoon sets in last week of June and withdrawn towards end of September and contributes about 82% of annual rainfall. July and August are the rainest months. Rest 18% of the annual rainfall occurs during non of the year in the form of thunder storm and western disturbances. Rainfall in the district increases from southwest to northeast.

Rainfall

Normal Annual Rainfall : 408 mm
Normal monsoon Rainfall : 335 mm
Normal Rain days : 20

Temperature

Mean Maximum : 42°C (May & June)
Mean Minimum : 3.9 °C (January)

The rainfall data of the last 5 years of Bhatinda is given below:

	2008	2009	2010	2011	2013
Rainfall in mm	**527.0**	**252.7**	**357.3**	**4943**	**215.9**
			Source: IMD		

3.0 GEOMORPHOLOGY AND SOIL TYPES

The district area is occupied by Indo-Gangetic alluvim. There is no surface features worth to mention. The maximum elevation of the area is 220.6 m. amsl. and the minimum elevation is 197.5 m.amsl. The master slope of the area is towards Southwest. The Southern part contains isolated sand dunes of various dimensions. The soil in the district is mostly sandy. Being sandy Plain region is dotted with scattered sand dunes which have a tendency to shift towards eastern side. But with the development of latest Technology and machinery the topography is under vast change with respect to various aspects connected with green revolution. The district has two types of soils, the arid brown soils and siezoram soils. The arid brown soils are calcareous in nature, these soils are imperfectly to moderately drained. Salinity and alkalinity are the principal problems of this soil. In siezoram soils the accumulation of calcium carbonate is in amorphous or concretionary form (kankar). Presence of high amount of calcium carbonate and poor fertility is the main problem of this soil. The arid brown soils are found in mostly eastern parts of the district and siezoram soils are found in the western part of the district.

4.0 GROUND WATER SCENARIO

4.1 Hydrogeology

The district is occupied by Indo-Gangetic alluvial plain of Quaternary age. The Central Ground Water Board has drilled 5 exploratory borehole to delineate and determine potential aquifer zones, evaluation of aquifer characteristics etc. The area has both unconfined and confined aquifers. In alluvium thin granular zones exist down to a depth of 450m. The top aquifer ranges from 40 to 56 m. The depth of the top aquifer in the North is upto 56 m, in the south it is upto 58

m, in the East it is 38 m. and in the west it is 40 m. The top granular zone is interspersed by 2 to 3 thin clay lenses. A thick clay bed of thickness from 15 to 35 m. present beneath the granular zone. The granular zones are more in comparision to the clay beds in the Central and Northern parts of the district. And clay beds are more dominant than the granular zones in the South and western parts of the district. The fresh water granular zones exist upto 300 m in the North, upto 200 m in the Central and upto 50 m. in the Southwestern parts of the district. The exploratory wells at Khaliwale and Gulabgarh were tested at discharge of 1006 and 1500 lpm. The transmissivity values were low in the order of 1300 and 2724 m2/day respectively. The hydraulic conductivity value varies from 1.6 to 19.17m/day. The value of storage coefficient was computed as 2.6×10^{-2}.

Water level behavior

During the Premonsoon the depth to water level in the district varies from 20.39 m bgl (western and southern part) to 16.50 m.bgl (Northern part). It is shallow and around 4 m in the west and southern parts and water level are deep above 12 m in Northern parts of the district. In the south and western part of the district, the water levels range from 6 to 12 m. and gradually increase towards North where the water level ranges from 14 to 1 m. The shallowest water level recorded was 3.43 m.bgl at Raike Kalan in Bathinda block and the deepest water level recorded was 20.39 at Dialpural in Bagtha Baika block. During the Post-monsoon, the depth to water level is in the same pattern as in pre-monsoon. The water level varies from 2.24 to 20.76 m.bgl. Seasonal fluctuation of the water level varies from –0.03 to 2.5 m. Water level rise of above 1 m. occurs in a small area. Remaining area shows either constant or decline in water level. Maximum water level decline is seen at Phulla, Dialpura and Dialpur mirza sites located in the North central part of the district.

The long-term (10 years) water level trend during premonsoon period indicates that maximum decline is seen in the northern part of the district, at Dialpur mirza and Dhapali the decline is of around 0.30 to 0.77 m/yr. In the southern part of the district Jajjal and Bagi bander are showing a maximum rise in water level around 0.05 to 0.13 m/yr. In the western part of the district. Kalla Bander and Rai ke kalan are showing the maximum rise in the range of 0.0.87 to 4.30m. In general, a rise in water level is seen in the southern part of the district and decline in water level is seen in the Northern part of the district

Ground water flow

The elevation of the water table in the district ranges between 189.14 to 209.25 m amsl. The general slope of the water table is towards SW from North, NE, East and SE. The hydraulic Gradient is gentle being of the order of 0.18 m/km in the NE – SW direction with the slope towards SW. In the SE – NW

direction the hydraulic Gradient is 0.22 m/km with the slope towards NW. In the E – W direction the hydraulic Gradient of 0.23 m/km has been observed with the slope towards East. This gives a clear picture that the water table has a gentle slope towards SW forming a conical shaped depression.

4.2 Ground Water Resources

The blockwise ground water resource potential in the district has been assessed as per GEC-97. The stage of ground water development ranges between 67% (block-Sangat) to 255% (block- Phul). The net annual ground water availability in Bathinda district is 101681 Ham out of this 4500 Ham has been kept reserved for domestic and industrial purposes upto 2025 years. The present net ground water draft in the district is 121452 Ham. The average level of ground water development in the district is 119% and falls in Over Exploited category.

GROUND WATER RESOURCE AND DEVELOPMENT POTENTIAL OF BATHINDA DISTRICT, PUNJAB AS ON 31ST MARCH, 2011 in ham

Assessment Unit/Block	Net Ground Water Availability	Existing Gross Ground Water Draft for irrigation	Existing gross Ground Water Draft for domestic and industrial water supply	Existing Gross Ground Water Draft for all uses	Allocation for domestic and industrial requirement supply upto next 25 years	Net Ground Water Availa-bility for future irrigation develop-ment	Stage of ground Water develop - ment (%)	CATEGORY Of Block
PHUL	12656	31759	503	32263	753	-19857	255	OVER-EXPLOITED
NATHANA	18521	15137	370	15507	555	2829	84	CRITICAL
MAUR	8481	17188	251	17438	376	-9083	206	OVER-EXPLOITED
BATHINDA	21242	21524	1044	22568	1565	-1847	106	OVER-EXPLOITED
TALWANDI SABO	10786	8239	326	8565	488	2059	79	SAFE
SANGAT	12949	8419	267	8686	400	4129	67	SAFE
RAMPURA	17047	16180	244	16424	363	503	96	CRITICAL
Total	**101681**	**118446**	**3005**	**121452**	**4500**	**-21266**	**119**	

4.3 Ground Water Quality

The ground water of the district is alkaline in nature with pH values ranging from 7.54 (Dhapoli) to 8.0 (Dera Tappa). Well waters in the area are generally medium to highly saline. However, pockets of fresh water are also

found. EC of waters show wide variations, it ranges from 288 μS/cm at Dhapoli Tappa to 3490 μS/cm at 25°C at Ghuda . The ground water is moderately hard in nature with total hardness expressed as $CaCO_3$ ranging from 40 to 1451 mg/l. Among cations, the concentration of calcium ranges from 11 mg/l at Rampur Phulla to 216 mg/l at Raike Kalan whereas magnesium concentration ranges between 3.8 mg/l at Rampur Phulla and 228 mg/l at Ghuda. Calcium content is within the permissible limit of 200 mg/l (BIS). Likewise, magnesium, in most of the waters, is below 100mg/l. Sodium concentration varies widely from 12 mg/l at Dera Tappa to 570 mg/l at Bhagi Bhandar, whereas potassium concentration ranges from 3.2 mg/l at Dhapali to 325 mg/l at Dial purmirza. In majority of the samples, the potassium content is less than 100 mg/l.

Among anions, bicarbonate is the dominant anion. Carbonate is found to be absent whereas bicarbonate concentration is found to be ranging between 120 mg/l at Dhapoli and 918 mg/l at Bhagi Bhander. The chloride content varies between 5.3 mg/l to 471 at Kaila Bhandar. In most ground waters chloride concentration is less than 250 mg/l. The nitrate levels in the district ranges from traces at Derra Tappa to 380 mg/l at Ghuda. The nitrate concentration in one-third well waters is more than 100mg/l. High concentration of nitrate in ground water indicates its contamination due to anthropogenic activities such as indiscriminate use of nitrogenous fertilizers in agriculture and/or sewage disposal. The fluoride content in ground water of the district ranges from 0.19 mg/l at Ablu to 7.25 mg/l at Rampur Phullarza. Fluoride in ground water is less than 1.0mg/l in 74% samples. However, significant numbers of well waters (26%) show fluoride > 1.5mg/l. .

Among cations, sodium is the predominant cation in 62% of waters; Ca+Mg in 28% and no single cation is dominant in 10% of ground waters in the area. Among anions, HCO_3 is the predominant anion in 76% of water samples and in the remaining 24% samples mixed anionic character is observed. Occurrence of Na - HCO_3 type in 48% wells show that at some places, the ground waters have under gone cation exchange phenomenon while wells having Na-HCO_3 + Cl type water indicates that the process of base exchange is still going on.

Plot in the USSL staff diagram which is based on EC and SAR indicates that waters fall under C_2S_1, C_3S_1, C_3S_2, C_3S_4, C_4S_1, C_4S_2, C_4S_3, C_4S_4 classes of irrigation rating. Such waters when used for irrigation may cause medium salinity - low sodium, high salinity - low sodium and high salinity - high sodium hazards. Such water can be used on well-drained soils with adequate permeability and for salt tolerant crops and in conjunctive use with canal water. Classification based on RSC indicates that 33% of the waters are safe, and the remaining 67 % are unsafe for irrigation use. The range of concentration of chemical constituents is tabulated below:

Range of concentration of Chemical constituents

pH	7.54	8.00
Specific conductivity	288	3490 micromhos/cm at $25^{o}C$
CO_3	Nil	
HCO_3	120	918 mg/l
Cl	5.3	471 mg/l
NO_3	2.9	380 mg/l
F	0.19	7.25 mg/l
Ca	11	216 mg/l
Mg	3.8	228 mg/l
Na	12	570 mg/l
K	3.2	325 mg/l
Total hardness as $CaCO_3$	40	1451 mg/l

Suitability of Water

Domestic

The ground water quality of Bathinda district shows that Ground water in more than half of the district area is suitable for drinking as well as for domestic purposes. Some parts in Southern, Northwestern, Central and Western parts are having higher concentration of Fluoride and EC. As most of the district is dependant on canal water for drinking purpose, the conjunctive use of canal and ground water will help to improve the ground water quality in those areas.

Irrigation

Ground water in shallow aquifer fall in C2S1, C3S1, C3S2, C4S1 categories of USSL classification depicting medium salinity – low sodium, high salinity - low sodium and high salinity – high sodium hazard characteristics. Small area fall under high sodium hazards class. Such water can be used on well-drained soils and for salt tolerant crops and in conjunctive use with canal water.

4.4 Status of Ground Water Development

The Bathinda district as a whole is completely dependant on canal water for drinking purpose. Out of 279 of villages which are covered under safe drinking water scheme only 14 villages are dependant on tubewells and 15

villages are dependant on both tubewell and canal water for drinking purpose. The villages located on the Northwest part of the district are dependant on Ground Water for drinking purpose .The distribution of the main source of Drinking water households wise in the district is tabulated below:

Households by main source of Drinking Water		
Total number of Households		266035
Tap Water	From Treated Source	40.0%
	From Un-treated Source	16.6%
Dug-Well	Covered Well	0.3%
	Un-covered Well	0.1%
Handpump		23.2%
Tubewell		16.4%
Spring		
River, Canal		0.6%
Tank, Pond, Lake		0.5%
Any other source		1.9
Availability of Drinking Water source		
Within the premises		79.5%
Near the premises		14.8%
Away		5.6%

The fresh water granular zones exist upto 300 m. in the North, upto 200 m. in the Central and upto 50 m. in the Southwestern parts of the district. This condition of poor quality ground water and subsequently its low use and over dependance on canal water in the Southwestern part of the district is making the water level to rise. At the same time the existence of fresh water zones upto 300 m in the Northern parts has resulted in large scale ground water development causing the water level to decline.

The district has net work of canal system throughout the area, all of which are originated from Satluj River. The major canal in the area is Bathinda branch canal, it traverses whole of the district except the southern and extreme north part of the district. The Southern and south-eastern part of the district is traversed by Kotla branch canal and the extreme north part of the district is covered by Abohar Branch canal. 80% of the area is irrigated by canals. In the district a total of 44366 shallow tubewells are present. The general depth of these shallow tubewells ranges between 40 m and 60 m.

A look at the ground water level hydrographs of the district clearly shows that almost entire northern segment is having a declining water level trend due to heavy withdrawal of ground water for drinking as well as irrigational purposes, while the southern and western segments shows rise in water level

trends, because of negligible withdrawal of ground water and recharge through canal irrigation water.

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, delineation of potential aquifer characteristics. These studies also provide information on well design and drilling techniques. A well assembly of 305/203 mm dia. combination, using about 20 m to 30 m housing pipe and slot size of 0.51 to 1.2 mm would be ideal for construction of production wells in the district . The MS slotted pipe or “V” wire galvanized Screen having 0.5 to 1.20 mm slot opening may be used against granular zones, these provide more open area as compared to conventional slotted pipe. The shallow tube wells upto 40 m depth should have 203 mm single dia. pipe assembly with a suitable screen length. The depth of tube well construction vary from north to south in the district, in the north the tubewells may be constructed between 100 to 150 m. and in the south it may be between 40 to 60 m. Direct Rotary rig can carry out the drilling in the district.

5.2 Water Conservation and Artificial Recharge

The Northern part of the district where water level decline exits, Artificial recharge structures may help in arresting this water level decline. Generally Recharge Trench with injection well structure is the suitable for artificial recharge. Water conservation methods like change in cropping pattern, change in Irrigation policy, timely plantation of paddy, promotion of sprinkler and drip irrigation etc. may be adopted to over come the ground water decline in the area.

6.0 GROUND WATER RELATED ISSUES & PROBLEMS

6.1 Ground Water Depletion

Significant water table decline has been observed in Northern parts of Bathinda. The main cause of ground water depletion is its over-exploitation to meet the increasing demand of various sectors including Agriculture, Industry and Domestic. This declining water table trend, if not checked, would assume an alarming situation in the near future affecting agricultural production and thus economy. Ground Water Recharge and Ground Water Conservation may be done in these areas to over come the Water level decline.

6.2 Rising Water Table and Water Logging

In southwestern parts of the district the water table is rising due to limited/non-extraction of ground water because of its brackish / saline quality and more availability of canal water for domestic and irrigation purposes. The fresh water thickness in this area is less. These areas are likely to get water logged in near future. There is an urgent need to arrest the rising water trend in southwestern part of the district and implement anti-water logging schemes.

7.0 AWARENESS AND TRAINING ACTIVITY

7.1 Training Program

One Water Management Training Programme was organized on 25-26th February 2009 at PAU Regional Centre, Bathinda, Punjab. The training programme focused on the theme of water conservation, ground water management, rain water harvesting and artificial recharge to ground water. The target group consists of progressive farmers, NGOs and officers/officials from water related department and 50 trainees participated in above training. During the training programme lectures were delivered by the scientists from Central Ground Water Board, North Western Region, Chandigarh and officer from PAU Regional Centre, Bathinda.

7.0 RECOMMENDATIONS

- In order to arrest the declining trend of water levels in Northern part of the district, the rooftop rainwater harvesting technology should be adopted and recharge structures may also be constructed in depression areas where water gets accumulated during rainy season. This will help in enhancing the recharge to ground water reservoir.

- The canal water which is used in excess in the Southern part of the district should be diverted to the Northern part of the district so that the over dependence on ground water can be reduced.

- Planned use of surface and ground water (conjunctive use) has to be done to over come both over exploitation and Ground water quality problems. In the southern part of the district where excess surface water is used and where ground water quality problem is there the usage of ground water is to be encouraged to overcome the water logging problem in future.

- The construction of roof top rainwater harvesting structures should be made mandatory in building bye-laws, which will help in checking the falling water level trend in the towns of water level depleting areas.

- The surplus canal water may be utilized for recharging the ground water through construction of injection wells in over-exploited areas.

- The abandoned dug wells may be cleaned and should be used for recharging the ground water by utilising the surface monsoon runoff.

- The crops consuming less quantity of water may be grown in place of crops requiring more water in the over exploited blocks.

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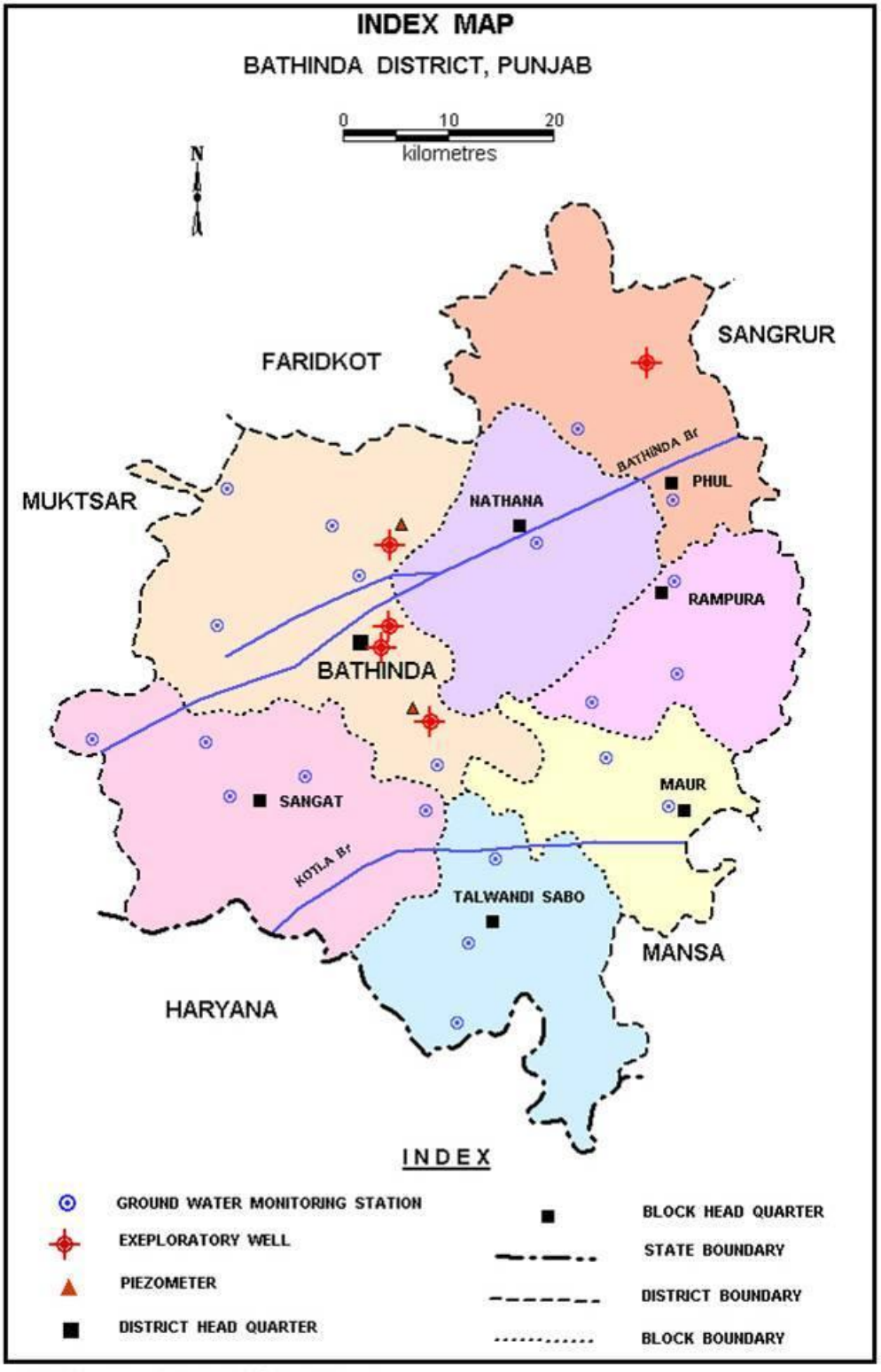
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FARIDKOT
SANGRUR
MUKTSAR
BATHINDA Br
PHUL
NATHANA
RAMPURA
BATHINDA
MAUR
SANGAT
KOTLA Br
TALWANDI SABO
MANSA
HARYANA
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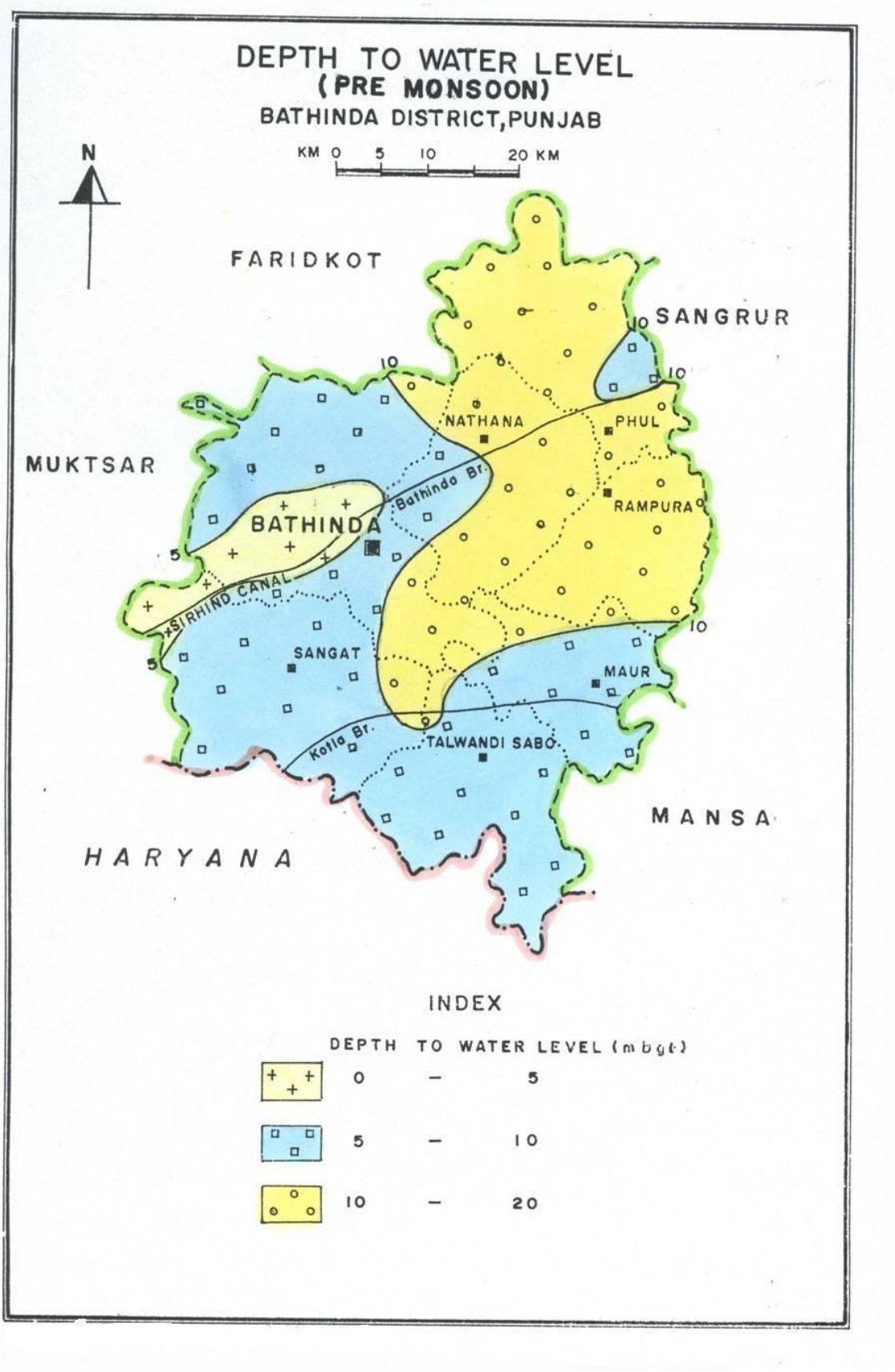
GROUND WATER MONITORING STATION
EXEPLORATORY WELL
PIEZOMETER
DISTRICT HEAD QUARTER
BLOCK HEAD QUARTER
STATE BOUNDARY
DISTRICT BOUNDARY
BLOCK BOUNDARY


DEPTH TO WATER LEVEL
(PRE MONSOON)
BATHINDA DISTRICT, PUNJAB
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KM 0 5 10 20 KM
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SIRHIND CANAL
SANGAT
MAUR
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TALWANDI SABO
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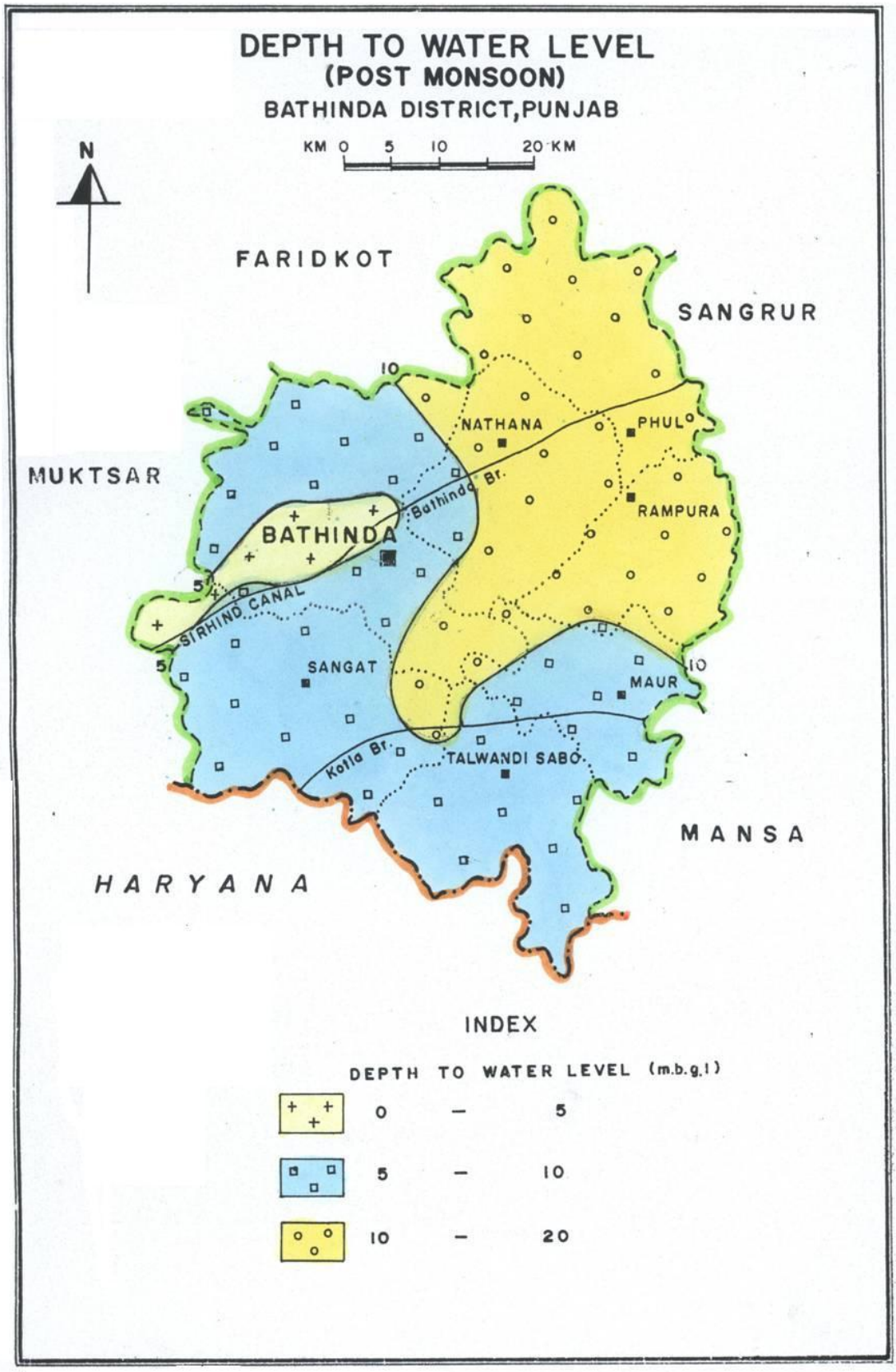
DEPTH TO WATER LEVEL (m bgt)
0 – 5
5 – 10
10 – 20


DEPTH TO WATER LEVEL
(POST MONSOON)
BATHINDA DISTRICT, PUNJAB
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PHUL
RAMPURA
BATHINDA
Bathinda Br.
SIRHIND CANAL
SANGAT
MAUR
Kotla Br.
TALWANDI SABO
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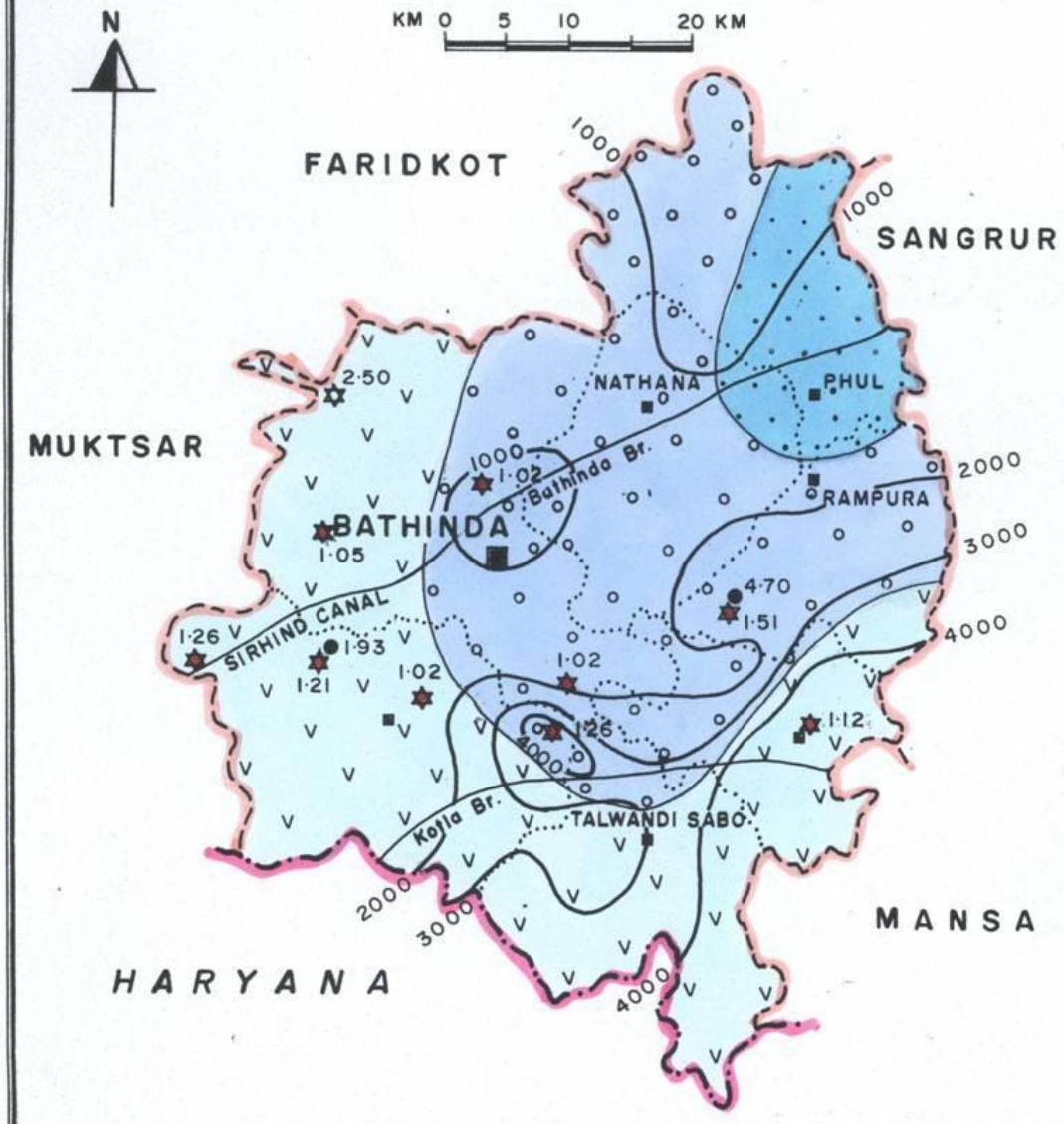
DEPTH TO WATER LEVEL (m.b.g.l)
0 – 5
5 – 10
10 – 20

HYDROGEOLOGY

BATHINDA DISTRICT, PUNJAB



INDEX

	WELLS FEASIBLE	RIGS SUITABLE	DEPTH OF WELL (m)	DISCHARGE (lpm)	SUITABLE ARTIFICIAL RECHARGE STRUCTURES
SOFT ROCK AQUIFER	TUBE WELLS	REVERSE / DIRECT ROTARY	40 – 100	> 1280	RECHARGE TRENCH WITH INJECTION WELL
SOFT ROCK AQUIFER	TUBE WELLS	REVERSE / DIRECT ROTARY	40 – 250	960 – 1280	RECHARGE TRENCH WITH INJECTION WELL
SOFT ROCK AQUIFER	TUBE WELLS	REVERSE / DIRECT ROTARY	20 – 50	< 960	RECHARGE TRENCH

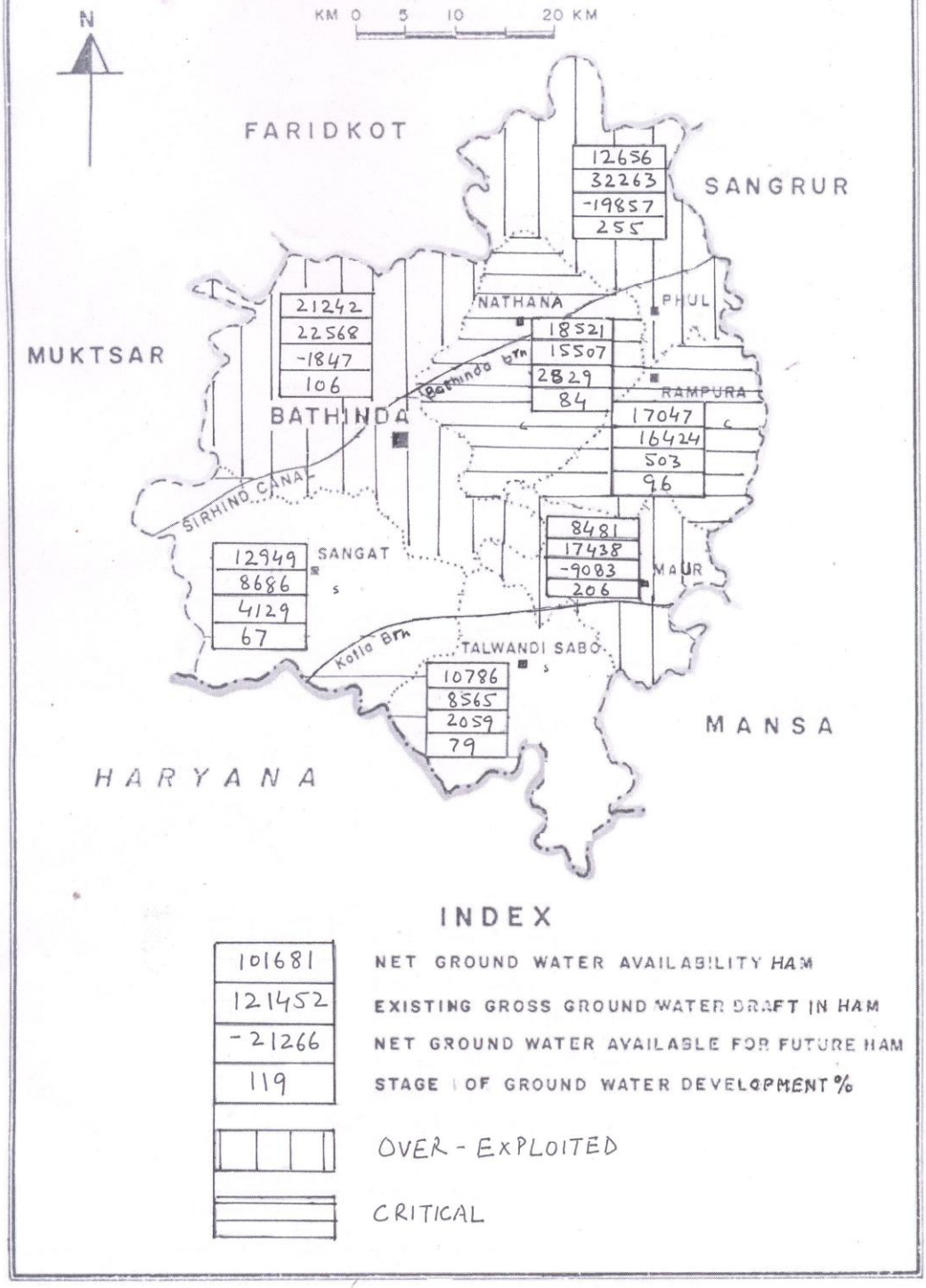
ELECTRICAL CONDUCTIVITY (MICROMHOS/CM AT 25°C) — 1000

IRON 1·21 > PERMISSIBLE LIMIT (1·0 ppm)

FLUORIDE 1·93 > PERMISSIBLE LIMIT (1·5 ppm)

GROUND WATER DEVELOPMENT POTENTIAL AND CATEGORISATION OF BLOCKS

BATHINDA DISTRICT, PUNJAB



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101681	NET GROUND WATER AVAILABILITY HAM
121452	EXISTING GROSS GROUND WATER DRAFT IN HAM
-21266	NET GROUND WATER AVAILABLE FOR FUTURE HAM
119	STAGE OF GROUND WATER DEVELOPMENT %
	OVER-EXPLOITED
	CRITICAL