

GROUND WATER BROCHURE OF VARANASI DISTRICT, U.P.

(A.A.P.: 2012-13)

By

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CONTENTS

Chapter	Title	Page No.
	VARANASI DISTRICT AT A GLANCE3
1.0	INTRODUCTION5
2.0	PHYSIOGRAPHY5
3.0	GEOLOGY5
	3.1 Sub-Surface Geology	
4.0	HYDROMETROLOGY6
5.0	HYDROGEOLOGY7
	5.1 Hydrogeological Setup	
	5.2 Ground Water Condition	
	5.3 Long Term Water Level Trend	
	5.4 Ground Water Resources	
	5.5 Ground Water Exploration	
6.0	GROUND WATER QUALITY13
	6.1 Quality of Shallow Ground Water	
	6.2 Quality of Deeper Aquifer	
7.0	GROUND WATER PROBLEMS ENCOUNTERED13
	7.1 Water Table Depletion	
8.0	AWARENESS & TRAINING ACTIVITY13
9.0	CONCLUSIONS14
10.0	RECOMMENDATIONS14

PLATES:

- 1.0 INDEX MAP OF VARANASI DISTRICT, U.P.
- 2.0 DEPTH TO WATER LEVEL PREMONSOON 2012, VARANASI DISTRICT, U.P.
- 3.0 DEPTH TO WATER LEVEL POSTMONSOON 2012 VARANASI DISTRICT, U.P.
- 4.0 GROUND WATER RESOURCE AND DRAFT OF VARANASI DISTRICT, U.P.
- 5.0 GROUND WATER EXPLORATION MAP OF VARANASI DISTRICT, U.P.

VARANASI DISTRICT AT GLANCE

1. GENERAL INFORMATION

District	: Varanasi
Geographical Area (Sq. Km.)	: 1578
Sub Division	
a) Number of Tehsil	: 02 Varanasi Sadar & Pindra
b) Number of Block	: 08
Population (as on 2011 census)	: 3682194
Male	: 1928641
Female	: 1753553
Decadal Growth of Population	: 23.84%

2. CLIMATOLOGICAL DATA

Normal Rainfall (mm)	: 997.40
Mean Maximum Temperature	: 44.00 ⁰ C
Mean Minimum Temperature	: 5.20 ⁰ C
Average R. Humidity	: 56%
Number of Rainy Days	: 58
Wind Speed Maximum	: 4.5 Km./Hr.

3. LAND USE (Ha.)

Total Area	: 361595
Total Forest Area	: 569
Barren Land	: 7661
Present Fallow Land	: 55023
Pasture	: 682
Garden	: 15900

4. IRRIGATION (Ha.)

Net Cultivated Area	: 94605
Net Irrigated Area	: 80349
By Canal	: 8486
By Ground Water	: 71862
Others	: 4

5. HYDRAULIC STRUCTURES

Dugwells	:	4867
Shallow Tubewells	:	2488
Deep Tubewells	:	434
Exploratory Tubewells of C.G.W.B.	:	14

6. GROUND WATER RESOURCE POTENTIAL (as on 31.03.09)

Net Ground Water Availability (Ham)	:	47972.08
Gross Ground Water Draft (Ham)	:	38569.60
Balance Ground Water Availability (Ham)	:	4785.87
Stage of Ground Water Development	:	80.40%
Number of Critical Blocks	:	02
Number of Semi Critical Blocks	:	05
Number of Safe Block	:	01

GROUND WATER BROCHURE OF VARANASI DISTRICT, U.P.

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1.0 INTRODUCTION

Varanasi district covers an area of 1578 sq.km. and administratively the district comprise 02 tehsils and 08 blocks. It has population of 3682194 persons. It is bounded by Jaunpur district in north and northwest, by Mirzapur and Sant Ravidas Nagar in south and southwest and in the east by Chandauli and Gazipur district. Historically, Varanasi is also very famous as 'Kashi'. Varanasi district is characterized by alluvial formations consisting of older and younger alluvium.

2.0 PHYSIOGRAPHY

The district is characterized with alluvial formations and plain topographic features. The district area in general is more or less flat. River Ganga is most important stream apart from river Varuna. There is significant meandering in the area of the district where river Ganga has taken its course. The average elevation of the land surface is about 85 to 105 mamsl. The general slope of the tract is from west to east. The topography is influenced or modified by the existing rivers and streams.

3.0 GEOLOGY

Geologically the district is characterized by quaternary alluvium consisting of older and younger alluvium. The geological succession is given below on Table-1.

Table-1

STRATIGRAPHIC SEQUENCE IN VARANASI DISTRICT, U.P.

Age	Formation	Lithology
Upper Pleistocene to Recent	Newer Alluvium	Clay, Sand and Kankar
Middle to Upper Pleistocene	Older Alluvium	Fairly consolidated clay with kankar, sand, fine to medium with some gravel.
----- Un conformity -----		
Upper Vindhyan	Kaimur Sandstone	Sandstones, grey to white, buff, arkosic with capping of laterites and Bauxite

3.1 Sub-Surface Geology:

Sub-surface geology of the district has been inferred on the basis of exploratory boreholes drilled by C.G.W.B. Thickness of quaternary alluvium increases from East to West. It ranges from 06 to 44 m. On a regional scale, on single aquifer system is seen extending down to the drilled depth of 149 m. The thickness varies between 40.25 and 90.00 mbgl. The aquifer system behaves as semiconfined to unconfined depending upon the presence of clay beds and also the duration of pumping. The sediments forming the aquifer are fine to coarse grained.

4.0 HYDROMETROLOGY

The average annual rainfall is 1036.00 mm. Climate is sub humid and is characterized by hot summer and pleasant monsoon and cold season. About 90% of rainfall takes place from June to September. During monsoon surplus water flows into rivers and streams un-arrested due to hilly topographic features in northern part of the district.

In February there is increase in temperature, May is the hottest month with the mean daily maximum temperature is 41.5⁰C and mean daily minimum temperature is 9.5⁰C. The average temperature ranges from 14.15⁰C to 39.80⁰C. The average temperature from March to June do not fluctuate much.

The average relative humidity is 82%. The average monthly relative humidity of the district is 42%. Winds are generally high with some increase in force during summer and southwest monsoon season. The mean wind velocity is 2 knots and potential evapotranspiration rate is 1406.7 mm.

5.0 HYDROGEOLOGY

5.1 Hydrogeological Setup:

Exploratory drilling data of C.G.W.B. and state tubewells department show that the ground water occurs in two distinct formations:

- a) A shallow ground water body which occurs principally in clay and kankar beds of back swamp deposits and
- b) Deep or main ground water body which occurs in thick sands of the meander belt deposits.

These two water bodies are hydraulically distinct. The back swamp deposits are thick but are likely to be interconnected when they are comparatively thin. The shallow ground water in back swamp deposits is generally unconfined and its static water level is only few meters bgl.

5.2 Ground Water Condition:

Central Ground Water Board has established number of ground water monitoring stations in Varanasi district to monitor the water level behaviour in space and time. The data compiled on the basis of 14 NHS of Varanasi district.

Ground water is mainly controlled by drainage, topography and lithological behaviour, it occurs under phreatic condition at shallow depths and fractures & granular zones under at deeper depths. The depth to water levels recorded during the year 2012 are given in Table-II. Depth to water in premonsoon ranges between 5.33 to 20.55 mbgl and the postmonsoon water level varies between 2.30 to 17.06 mbgl. The depth to water level map for both premonsoon & postmonsoon periods of 2012 were prepared (Plate-II & III). The water level fluctuation ranges from 0.65 to 4.11 m Table-III. Water level fluctuation is maximum in Arazi Line block. The average

magnitude of falling trend over last 5 years is 50-65 cm/year. The yield of the wells vary from 700 lpm to 3550 lpm.

5.3 Long Term Water Level Trend:

It provides a more realistic scenario in the water level of any particular period depending upon occurrence of rainfall & ground water utilisation Table-III. The Table-III indicates decline trend during premonsoon period (2008-2012) the falling of water level ranges from 0.33 to 1.10 m/year entire the district. The post monsoon water level trend also indicates falling trend except Cholapur and Varanasi NHS which are showing rising trend (0.017 to 0.027 m/year). The falling of water level ranges from (0.02 to 1.03 m/year).

Table-II

WATER LEVEL FLUCTUATION (PRE AND POST) FOR 2012

Sl. No.	Well Name	Premonsoon (mbgl)	Postmonsoon (mbgl)	Fluctuation (m)
1.	Anal	5.33	2.30	3.03
2.	Babatpur	10.15	8.63	1.52
3.	Babatpur Chaura	-	12.65	-
4.	Barwaon	14.36	12.49	1.87
5.	Chobepur	10.30	8.47	1.83
6.	Cholapur 1	8.89	7.80	1.09
7.	Jikhan (Narsara)	11.75	8.78	2.97
8.	Kakrahwan	20.05	17.06	2.99
9.	Raja Talab 1	15.90	15.25	0.65
10.	Rustampur	14.86	12.95	1.91
11.	Tahipur	5.60	2.37	3.23
12.	Thatra	20.55	16.44	4.11
13.	Varanasi	13.72	10.03	3.69

Table-III

LONG TERM WATER LEVEL TRENDS VARANASI DISTRICT, U.P.

State : Uttar Pradesh

District : Varanasi

S. No.	Location	Pre-Monsoon			Post-Monsoon			Annual		
		Data points	Rise (m/year)	Fall (m/year)	Data points	Rise (m/year)	Fall (m/year)	Data points	Rise (m/year)	Fall (m/year)
1	2	3	4	5	6	7	8	9	10	11
1.	Siswa	1			0			2		
2.	Cholapur 1	9		0.2537	10	0.0169		39		0.0933
3.	Chobepur	10		0.3812	10		0.4378	40		0.4750
4.	Phulpur 1	7		0.7037	7		1.0060	26		0.9275
5.	Sindhaura	7		0.5418	8		0.9382	29		0.8132
6.	Babatpur Chaura	9		0.4171	8		0.8527	39		0.6030
7.	Varanasi	10		0.1830	10	0.0270		40		0.0938
8.	Thatra	7		0.7336	9		0.2338	36		0.5911
9.	Babatpur	7		0.5550	10		0.5098	34		0.4797
10.	Tahipur	10		0.0333	10		0.0201	40	0.0129	
11.	Barwaon	9		0.9913	9		1.0018	36		1.0290
12.	Kakrahwan	9		1.1018	10		0.8774	38		0.8872
13.	Raja Talab 1	5			6		1.0263	22		
14.	Anai	10		0.2862	10		0.0408	37		0.1161
15.	Jikhan (Narsara)	9		0.1011	10		0.0939	36		0.1120
16.	Rustampur	9		0.6280	10		0.1725	39		0.4565

5.4 Ground Water Resources:

To facilitate the ground water development the ground water resources of the district have been worked out and are as follows (Table-IV).

Table-IV

BLOCKWISE GROUND WATER RESOURCES OF VARANASI DISTRICT, U.P.

Sl. No.	Assessment Unit (Blocks)	Ground Water Availability (Ham)	Ground Water Draft (Ham)	Category as on 31.03.2009	Level of Development (%)
1.	Arazi Line	6411.20	6180.01	Critical	96.39
2.	Baragaon	6321.45	4511.15	Semi Critical	71.36
3.	Chariagaon	5932.91	5319.41	Semi Critical	89.66
4.	Cholapur	6298.92	4906.60	Semi Critical	77.90
5.	Harhua	4632.70	4356.83	Critical	94.05
6.	Kashi	4546.49	3210.45	Semi Critical	70.61
7.	Pindra	8101.22	6222.85	Semi Critical	76.81
8.	Sewapuri	5727.20	3862.30	Safe	67.44
	Total	47972.08	38569.60		

A perusal of above table shows that blockwise ground water resource (2009) shows that out of 8 blocks, two blocks (Arazi Line & Harahaua) are critical, one block (Sewapuri) is safe and rest five blocks are under semi critical category. The ground water development of the district is 80.40%.

5.5 Ground Water Exploration:

Under ground water exploration of Varanasi district 5 exploratory wells constructed by (Departmental) rotary rig between 229.20 and 402.00 mbgl, water bearing zone tapped from 61 m to 324 mbgl. The yield of wells ranges 2520 to 3450 lpm with drawdown 3.15 to 12.93 m. The transmissivity varies from 3884 to 8604m²/day and Storativity ranges from 4.29×10E-4 to 8.0×10E-2 (Table-V & Plate-V).

Table-V

GROUND WATER QUALITY OF VARANASI DISTRICT, U.P.

Sl. No.	District	Block	pH	EC in $\mu\text{s}/\text{cm}$ at 25°C	-----mg/l-----										
					CO_3	HCO_3	Cl	F	NO_3	SO_4	TH	Ca	Mg	Na	K
1.	Varanasi	Harahna	8.12	786	nd	183	124	0.58	28.00	13	345	16	73	5.5	2.8
2.	Varanasi	Sewapuri	7.48	600	nd	250	82	0.14	9.79	3	325	24	64	1.4	2.0
3.	Varanasi	Narhua	7.46	1050	nd	390	53	1.34	9.36	14	395	22	82	8.3	3.0
4.	Varanasi	Cholapur	7.88	706	nd	384	138	0.69	3.75	5	505	18	110	5.1	1.1
5.	Varanasi	K.V. Peeth	8.15	886	nd	470	40	0.42	3.62	9	430	8	98	7.9	2.3
6.	Varanasi	Chirraigaon	8.12	646	nd	183	106	0.46	1.17	25	300	6	68	3.8	1.8

Table-VI

HYDROGEOLOGICAL DATA OF EXISTING TUBEWELLS, VARANASI DISTRICT, U.P.

S. No.	Location latitude longitude	Type of well	Drilled depth/ Bedrock (mbgl)	Zones tapped (mbgl)	Water level (mbgl)	Yield (lpm)	Drawdown (m)	Transmissivity (m ² /day)	Storativity (S)	Geology	Electrical conductivity (micromhos/cm. at 25 ^o C)	Chloride (mg/l)	Remarks
1.	Adampur	EW	236.80	132-150 156-168	18.94	2520	6.16	4770	-	Alluvium	380	7	
2.	Biraon Kot	EW	356.05 356.00 SST	116-122 131-137 149-155 167-173 242-248 272-278 318-324	14.68	3410	12.93	8604	4.29×10E-4	Alluvium	-	-	
3.	Natimli	EW	293.50 291.50 SH	84-96 110-122 129-135 144-147 156-162 186-192 196-202 207-213	14.87	3450	5.37	8285	-	Alluvium	-	-	
4.	Rajapur	EW	402.00 N.EN	172-178 201-207 214-226 250-256 295-307	-	-	-	-	-	Alluvium	-	-	Not Tested
5.	Town Hall 25 ^o 19'50" 83 ^o 00'55"	EW	229.20	61-67 70-76 88-94 100-112 127-133 145-157 160-166	16.3	3245	3.62	3884	8.0×10E-2	Alluvium	1023	115	

6.0 GROUND WATER QUALITY

6.1 Quality of Shallow Ground Water:

The chemical analysis of shallow ground water consists of pH, E.C., Na, K, Ca, Mg, HCO₃, Cl, SO₄, NO₃, F and TH as CaCO₃. The result reflects that the ground water is safe and potable in the entire district. The details of table (blockwise) is enclosed (Table-VI).

6.2 Quality of Deeper Aquifers:

Data of water samples collected from deeper aquifers reveals that the water is safe and potable from deeper fractures/aquifers and better than shallow aquifer.

7.0 GROUND WATER PROBLEMS ENCOUNTERED

After study, it is inferred that the following ground water problems have been encountered in the district.

7.1 Water Table Depletion:

In Varanasi district, there is depletion of water level over last ten years. In all 8 (eight) blocks there is decline in water level over the years (2003-2012). Even the area which were experiencing water logging during year 2001 are showing water level depletion since 2007. It is fact that the ground water level has declined significantly over the years except canal command area due to canal seepage. Long term water level trend reveals that it is declining in entire district. The average decline in water level is 0.19 m to 1.03 m/year.

8.0 AWARENESS & TRAINING ACTIVITY

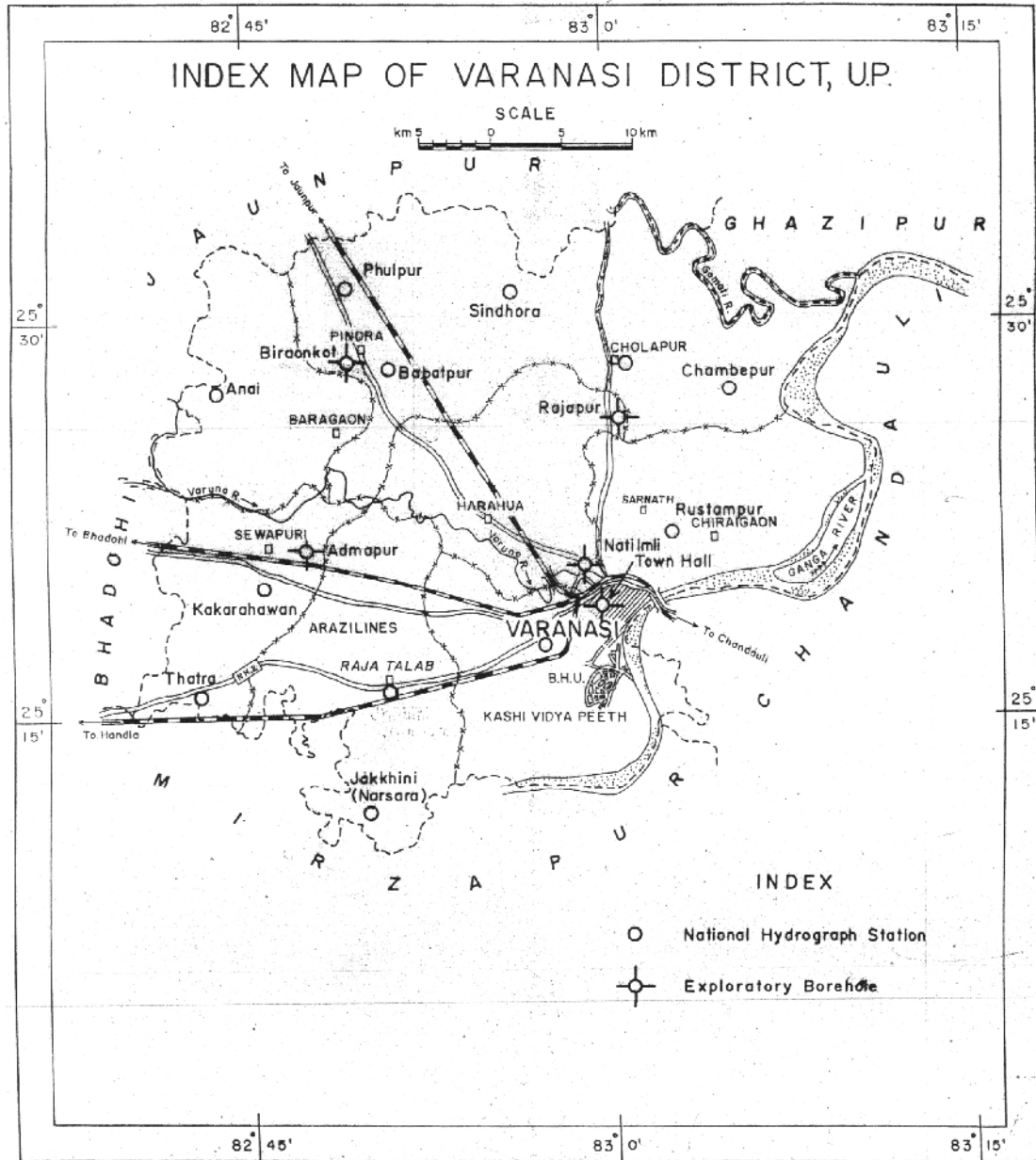
Water management training conducted in 2005-06 in Banaras Hindu University, Varanasi. In this training 47 trainees participated from IT B.H.U. and State Government Offices (Jal Nigam & Minor Irrigation) etc.

9.0 CONCLUSIONS

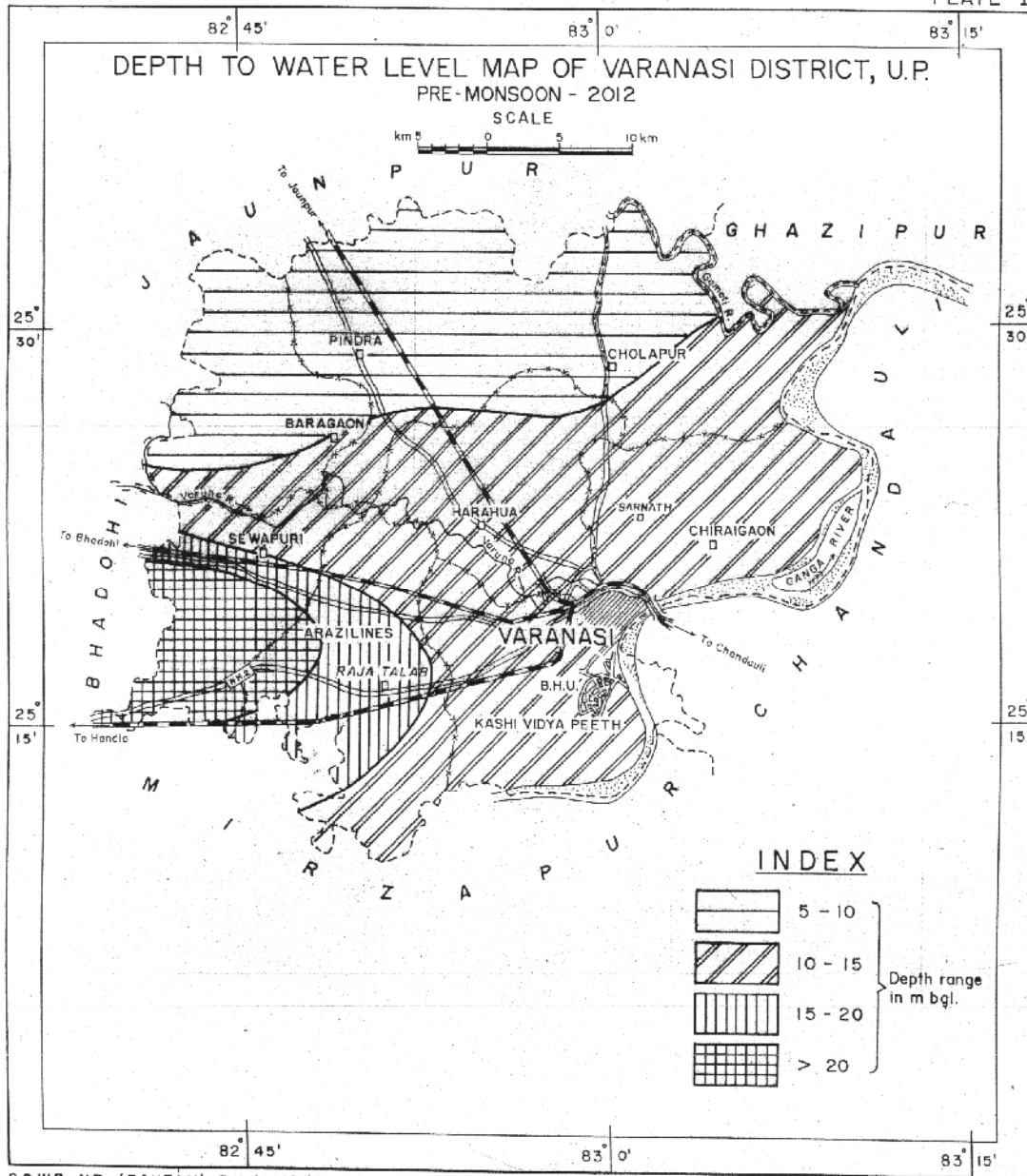
Varanasi district covers an area of 1578 sq.km. and falls in the Vindhyan super group rocks. The district is characterized with plains made by alluvium. The district contains two tehsil and eight blocks. River Ganga and Varuna are main drainage apart from smaller streams in the district. The data of exploratory drilling conducted by C.G.W.B. in the district that ground water occurs in porous as wells as weathered zones. Yield of well varies from 30 to 3100 lpm with 30 m drawdown in the district. Depth to water level in pre-monsoon ranges from 5.33 to 20.55 mbgl. Post-monsoon water level varies between 2.30 and 17.06 mbgl. Water level data of all NHS falling in the district were analyzed from 2003 to 2012 which clearly shows that the water level fluctuation ranges from 0.65 to 4.11 m corroborating insignificant base flow of ground water in the area. Long term water level trend has shown the decline in ground water level from 0.11 to 1.03 m/year in entire district. The blockwise ground water resource (2009) shows that out of eight blocks, two blocks (Arazi Line & Harahau) are critical, one block (Sewapuri) is safe and rest five blocks are under semi critical category. The ground water development of the district is 80.40%. The net area irrigated by ground water is 89.44% of net irrigated area of the district. The chemical analysis of ground water samples of the district shows that the water quality is fresh and potable.

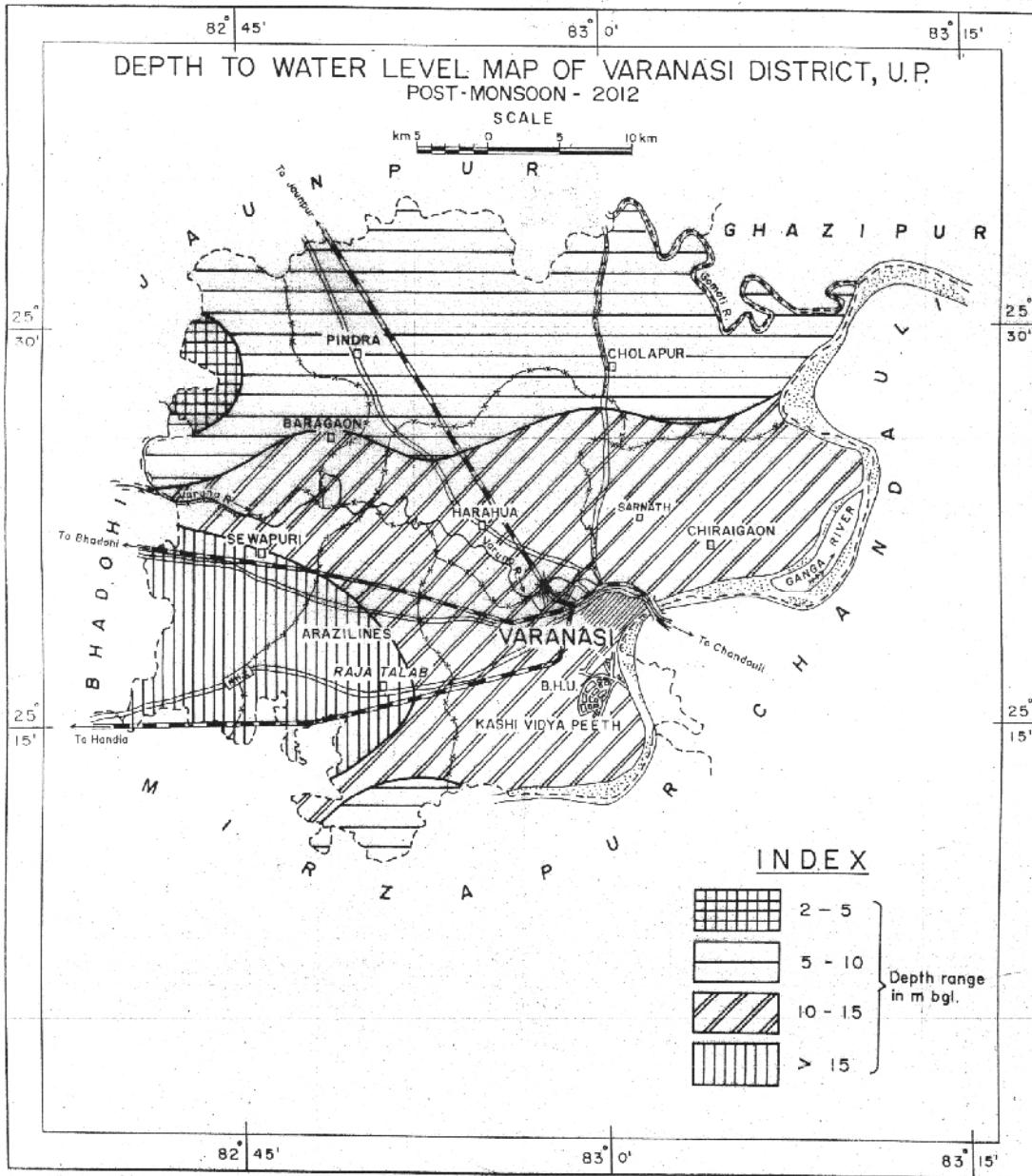
10.0 RECOMMENDATIONS

- (i) Delineation of buried and paleo-channels for potable ground water may be searched out.
- (ii) To counter the declining water level trend in the district the artificial recharge practices and water-shed management should be adopted at large scale.
- (iii) There is urgent need of quality assessment of shallow and deeper ground water and its relationship with the lithological behavior.
- (iv) Exploratory of potential sites for ground water withdrawal should be carried out through the help of remote sensing, study of satellite imageries and resistivity surveys.

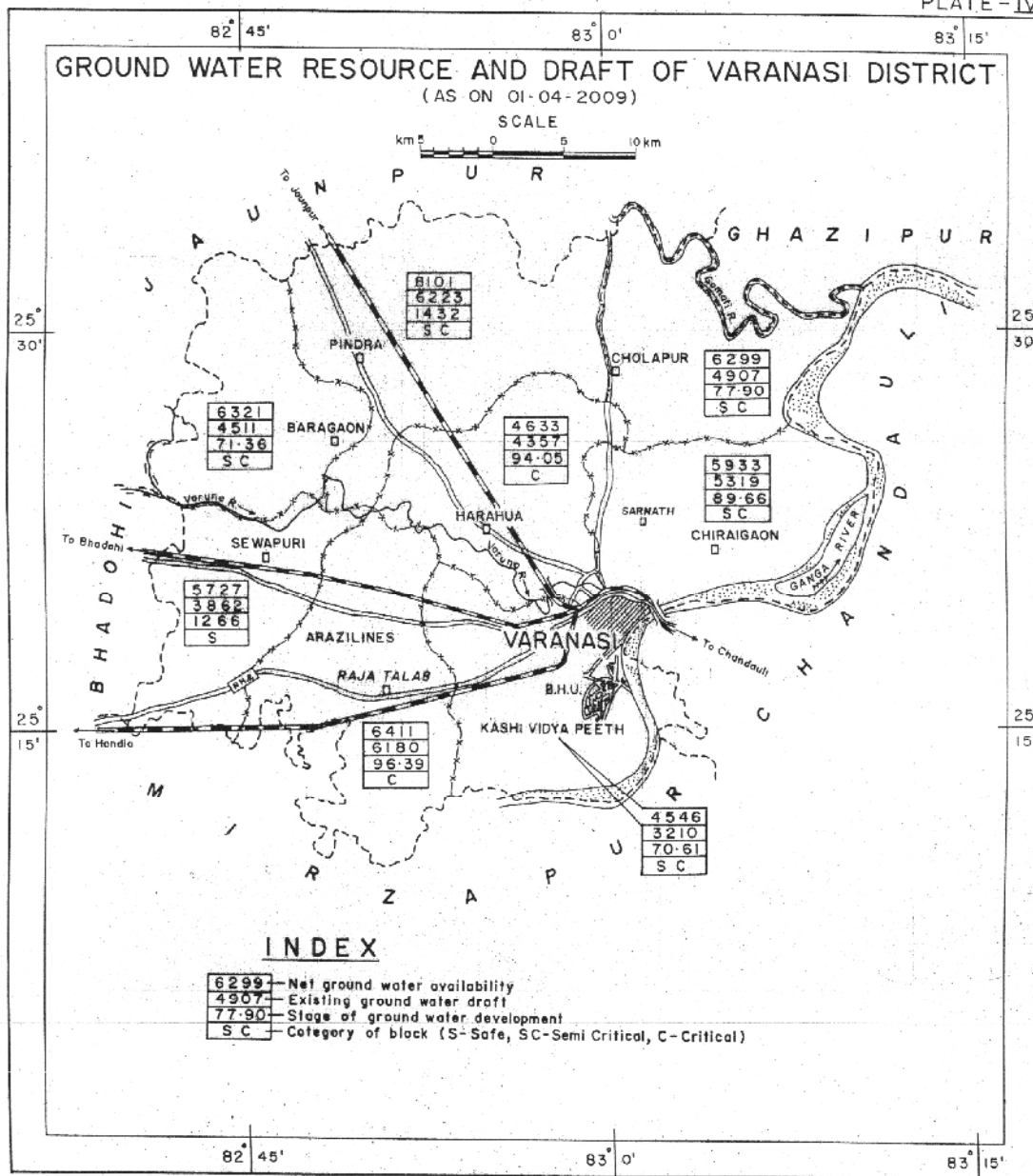


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