GROUND WATER SCENARIO OF SHRAVASTI DISTRICT, UTTAR PRADESH

By

S. MARWAHA

Superintending. Hydrogeologist

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DISTRICT AT A GLANCE

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	i. Geographical Area (Sq. Km.)	:	1858
	ii. Administrative Divisions Number of Block	:	5 nos (Jamunha, Ikauna, Hariharpur Rani, Sirsiya & Gilaula)
	Number of Villages	:	536 (incl. 25 uninhabited)
	Density of Population per Sq. Km.	:	523
	Literacy Percentage	:	49.13
2.	**CLIMATE**		
	Normal Annual Rainfall (mm)	:	1143.20
	Mean Maximum Temperature ^{0}C	:	39.8^{0}C
	Mean Minimum Temperature ^{0}C	:	9.4^{0}C
	Relative Humidity Percentage	: :	43 to 83 Evening 24 to 77 Morning
	Wind Speed Km/hr	:	2.7 to 8.4
3.	**LAND USE (2008-09)**		
	a) Forest area (ha)	:	34353
	b) Net cultivated (ha)	:	134594
	c) Area sown more than once (ha)	:	14076
	d) Net area irrigated (ha)	:	61943
4.	**AREA UNDER PRINCIPAL CROPS (2008-09)**	: :	Dhaan- 141326 ha Pulses- 25400 ha Oil seeds-2327 ha Sugar cane – 7749 ha
5.	**IRRIGATION BY DIFFERENT SOURCES (2008-09)**		
	Dugwells	:	2638 ha
	Tubewells/Borewells	:	54122 ha
	Tanks / Ponds	:	4068 ha
	Canal	:	1115 ha
	Other Sources	:	-
6.	**NUMBERS OF GROUND WATER MONITORING WELLS OF**		

CGWB (As on 31-3-2012)

	No. of Dugwells	:	14
	No. of Piezometers	:	Nil
7.	**PREDOMINANT GEOLOGICAL FORMATIONS**	:	Quaternary Alluvium
8.	**HYDROGEOLOGY**		
	Major water bearing formation	:	Alluvium
	Pre-monsoon Depth to water May 2012	:	3.32 -7.47 mbgl
	Post-monsoon Depth to water Nov 2012	:	1.42- 4.87 mbgl
	Long Term Water Level Trend		
	Pre-monsoon	:	Rise:0.013- 0.16m/yr (13 wells) Fall: 0.003- 0.13m/yr (2 wells)
	Post-monsoon	:	Rise:0.017- 0.20m/yr (12 wells) Fall: 0.004- 0.19m/yr (3 wells)
9.	**GROUND WATER EXPLORATION BY CGWB**		
	No of wells drilled	:	4
	Depth range	:	283.42 m. to 299.95 m.
	Discharge (litre per second)	:	40.16 to 4916 lps
	Storativity (S)	:	6.5 * E-4 to 7.6* OE-4
	Transmissivity (m^2/day)	:	1013 to 1530
10.	**GROUND WATER QUALITY**	:	The ground water is of alkaline type. It is good both for domestic & irrigation purpose.
11.	**DYNAMIC GROUND WATER RESOURCES (2009)-in MCM**		
	Annual Replenishable Ground Water Resources	:	393.86 mcm
	Gross Annual Ground Water Draft	:	195.35 mcm
	Projected Demand for Domestic & Industrial Uses	:	35.79 mcm
	Stage of Ground Water Development	:	49.60 %
12.	**AWARENESS AND TRAINING ACTIVITY**		
	Mass Awareness Programmes organized	:	NIL
	Water Management Training Programme organized	:	NIL
13.	**EFFORTS OF ARTIFICIAL RECHARGE & RAINWATER HARVESTING**		
	Projects completed by CGWB	:	NIL
	Projects under technical guidance of CGWB (Numbers)	:	NIL

14.	**GROUND WATER CONTROL AND REGULATION**	:	-
	Number of OE/Critical Blocks	:	NIL
	No of blocks notified	:	NIL
15.	**MAJOR GROUND WATER PROBLEMS AND ISSUES**	:	Shallow water levels with arising trend

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I. INTRODUCTION

Shravasti district is in the north western part of Uttar Pradesh covering an area of 1858.20 Sq. Km. It is a created district carved out from Bahraich district. Shravasti, which is closely associated with the life of Lord Buddha, shares border with Balrampur, Gonda & Bahraich districts. Bhinga is the district headquarter of Shravasti and is approximately 175 kilometers away from the state capital. The district is drained by river Rapti & its tributaries. Total population of the district as per 2011 census is 1,114,615 persons out of which 594,318 are males and 520,297 are females. Land utilization pattern of the district is presented in table-1 which indicates that all the area of district is rural.

Table 1- Land Utilisation of Shravasti district (2008-09) in Hectare

	Area	Forest	Barren / Cultivable waste land	Present fallow land	Other fallow land	Barren / Un Cultivable waste land	Land put to non-agricultural use	Pastures	Area under bush/ garden
Jamunaha	35447	933	110	25	168	111	4174	4	142
Gilaula	30288	0	80	35	173	61	4443	2	262
Ikauna	27262	70	66	30	178	58	4525	8	236
Hariharpur Rani	42312	14741	84	20	158	108	2050	7	227
Sirsia	57578	18609	110	40	183	118	5634	8	302
Total Rural	192887	34353	450	150	860	456	20826	29	1169
Total District	192887	34353	450	150	860	456	20826	29	1169

The net area irrigated by ground water structures is 56760 ha (91.63% of total irrigated area) and net area irrigated by canals & other sources is 5183 ha. The net area sown is 69.7% of the total area of district and cropping intensity is 139.5 %. Area under irrigation as per various sources is given in table-2 .

Table-2:- Source-wise area under irrigation (Ha), Shravasti, UP

	Canals	Tubewell		Wells	Ponds	Others	Total
		Public	Private				
Jamunaha	233	173	10643	527	814	0	12390
Gilaula	213	160	10663	532	810	0	12378
Ikauna	220	182	10653	534	803	0	12392
Hariharpur Rani	226	176	10640	520	823	0	12385
Sirsia	223	166	10666	525	818	0	12398
Total District	1115	857	53265	2638	4068	0	61943

The land under any source of irrigation is only 46% of the net sown area of the district. In the district all the villages have been provided with India mark-2 hand pumps for meeting drinking water needs and table – 3 presents the population benefited from this source.

Table-3:- Block-wise population covered by hand pumps, Shravasti, UP

	Villages fully covered	No. of villages using India Mark - 2 Hand pump	Population benefited
Jamunaha	101	101	179414
Gilaula	123	123	158714
Ikauna	104	104	165444
Hariharpur Rani	79	79	150203
Sirsia	106	106	168854
Total District	513	513	822629

II. CLIMATE AND RAINFALL

The climate of the district is characterised as sub-humid with hot summer and cold winter. The well distributed rainfall occur during south west monsoon. There is no meteorological observatory in Shravasti. Nearest observatory is Bahraich. The climatic data of this observatory has been considered for the evaluation of climate type. The annual rainfall based on 1931 to 1960 data is 1143.20 mm more than 85% rainfall occur during the monsoon period from June to September.

Winds are generally light and increase in speed from the beginning of summer and continues to have higher speedup to September. The annual potential evapotranspiration in the district in the district is of the order of 1428.9 mm. The maximum PET occurs in the month of May & June with 212.6 mm and 183.2 mm respectively.

III. GEOMORPHOLOGY & SOILS

Broadly the Shravasti district can be classified into the following four geomorphological units.

1. **Upper Piedmont Plain:**

It is a gently sloping plain in the district and is formed at the foot hill zones by the coalescence of several alluvial forms consisting of unconsolidated rock debris and alluvium brought by the streams from hills. The area comprises thick vegetation.

2. Lower Piedmont Plain:

This zone is relatively have a very gently sloping plain and below the upper piedmont plain.

3. Older Alluvial Plain:

A flat to gentle sloping undulating terrain formed by extensive deposition of alluvium at early slope of depositional regimen. Comprising older unconsolidated alluvium. It also includes back swamp & water bodies known as Talao.

4. Younger Alluvial Plain:

A flat to gently sloping slightly undulating terrain. It is produced by extensive deposition of alluvium usually on & adjacent to flood plain. It consists various fluvial land forms such as back swamp, oxbow lakes, old meander and meander scars etc.

SOILS:

The land surface of the district is covered by moderately deep soil cover. These are well drained clayey soils on very gently sloping land with moderate erosion associated with very shallow somewhat excessively drained loamy soils with severe erosion.The soil cover is very thin to subsequent at places along river beds where sands are predominated.

IV. HYDROGEOLOGY

The ground water occurrence and availability generally depends upon the water bearing properties of water bearing formation which is alluvium. The alluvium comprises of alternating layers of sand, silt, clay and its admixture. Kankar is occasionally associated with clay. The ground water occurs under water table condition in shallow aquifer whereas the ground water in deeper aquifer occurs under semi confined to confined condition.

The shallow aquifer, which is being tapped by dug wells/ tubewells, occur upto the depth of 80 meter. The aquifer material is fine to medium sand. In addition the gravel, pebbles & boulder occur in the northern part of the district. The kankar associated with clay also occurs occasionally

DEPTH TO WATER LEVEL:

Based on premonsoon water level data of May 2012 of hydrograph station, a depth to water level map for premonsoon period 2012 has been prepared. The depth to water level in the district ranges from 3.32 to 7.47 mbgl mbgl. In major area depth to water ranges between 4 & 6 mbgl. In northeastern part the depth to water level is screening where as shallowest water level occurs in the form of a strip along in direction of river Rapti & east of Rapti river.

During monsoon period the ground water recharge takes place and depth to water level becomes shallower. To study the distribution of water level during post-monsoon period the depth to water map of November 2012 has been prepared. The depth to water during post-monsoon period ranges from 1.42 to 4.87 mbgl (Table-2). In major part of the area the depth to water in post-monsoon ranges between 2.00 & 4.00 mbgl.

WATER LEVEL FLUCTUATION:

The water level fluctuations in shallow aquifer based on data of national hydrograph monitoring stations is summerised in Table-4.

Table 4 - Depth to water levels (CGWB NHS wells)– Shravasti district

Sl. No.	Name of Station	Depth to water level Pre-monsoon (mbgl) May 2012	Depth to water level Post-monsoon (mbgl) Nov 2012	Fluctuation (m)
1.	Bhagwantpur	3.32	1.42	1.90
2.	Madora Chowki	3.27	1.70	1.57
3.	Lachmanpur	8.41	-	-
4.	Laxman Nagar	7.47	4.87	2.60
5.	Badla	6.57	4.35	2.22
6.	Pakaria	3.66	2.09	1.57
7.	Parpatganj	5.87	-	-
8.	Pratapur	3.60	2.07	1.53
9.	Shravasti	-	1.46	-
10.	Bhujanga	5.81	2.71	3.10
11.	Ratanpur	4.22	2.42	1.80
12.	Sirsia	4.52	4.22	0.30
13.	Dikauli	3.19	1.58	1.61
14.	Tulsipur 2	4.24	2.92	1.32

As it is evident from table -4 the seasonal water level fluctuations range from 0.30m to 3.10m during 2012. This indicates that aquifers get recharged during monsoon period and water levels during post-monsoon are at shallowest levels.

Long Term Water Level Trend:

Ground water level indicates the elevation of atmospheric pressure, changes in storage resulting from differences between recharge withdrawal census levels to vary in time. Based on water level data of several years a long term water level trend

for pre post monsoon period has been worked out and summarised as follows (Table-5):

Table-5 :-Water Level Trend Of Hydrograph Stations Of Shravasti District, U.P.

Sl. No.	Location	Period	Pre-monsoon		Post-monsoon	
			Rise (m/yr.)	Fall (m/yr.)	Rise (m/yr.)	Fall (m/yr.)
1.	Bhagwanpur	2002-2011	0.099	-	0.122	-
2.	Madora Chowk	2002-2011	0.073	-	0.111	
3.	Dikauli	2002-2011	0.070	-	0.057	-
4.	Tulsipur	2002-2011	0.048	-	0.069	-
5.	Bhinga 2	2002-2011	0.159	-	0.205	-
6.	Laxman Nagar	2002-2011	0.105	-	-	0.061
7.	Badla	2002-2011	0.115	-	0.155	-
8.	Pakaria	2002-2011	0.020	-	0.022	-
9.	Parpatganj	2002-2011	-	0.31	0.154	-
10.	Pratapur	2002-2011	0.078	-	0.039	-
11.	Shravasti	2002-2011	0.013		-	0.004
12.	Bhujanga	2002-2011	-	0.128	-	0.192
13.	Ratanpur	2002-2011	0.076	-	0.017	-
14.	Sirsia	2002-2011	0.130	-	0.137	-
15.	Lachmanpur	2002-2011	0.091	-	0.370	-

On perusal of table it is observed that in general there is a rise in water level in major part of the district both in premonsoon and postmonsoon period. Marginal Fall in water level in postmonsoon period is observed at Laxman nagar, Shravasti and Bhujanga. Fall in premonsoon period is observed at Bhujanga & Parpatganj.

Ground Water Movement:

The elevation of water table ranges from 162 m like north to 110m above mean sea level in the southern part of the district. Then there is a drop in water level elevation from north to south of around 52 m.

In general ground water movement direction is from north to south, except some localised variation. The steepness of water table contours in the trans Rapti region in the north eastern, northern and western part indicate the low permeability of aquifers showing the finer sediments. Whereas in southern portion of the district gradient is very low thus indicating that the formation occurring are highly permeable. The hydraulic gradient of water table ranges between 0.13 m/km to 4 m/km.

Ground Water Exploration:

Four exploratory wells and one piezometer have been drilled in past by Central Ground Water Board. Out of these one well at site Chandgarhi was not constructed due to lack of granular zones. The depth drilled of these wells range from 290.50 to 299.95 mbgl. The storativity ranges from 6.5×10E-4 to 7.6×10E-4. The transmissivity ranges from 1013 to 1536 m^2/day. In addition to these wells number of tubewells have been drilled by State Irrigation Department. These wells are constructed to meet the irrigation requirement.

V. GROUND WATER RESOURCES ESTIMATION

The estimation of ground water resource is a basic pre requisite for sustainable development with out causing adverse effect on the ground water regime. The ground water resource of Shravasti district is as follows:

Net Ground Water Availability	=	39386.54 ham.
Gross Irrigation Draft	=	27191.62 ham.
Gross Domestic & Industrial Draft	=	17381.70 ham.
TOTAL DRAFT	=	29136.47 ham.
Domestic & Industrial Requirement Upto next 25 years	=	3579.26 ham.
Net Ground Water Availability for Irrigation	=	18425.58 ham
Steppers Ground Water Development	=	49.60 %

Block wise detailed ground water resources are presented in Table-6

Table-6:- Block Wise Ground Water Resources As On 31.3.2009, Shravasti

	Net annual ground water availability (ham)	Existing ground water draft for irrigation (ham)	Draft for industrial & domestic use (ham)	Existing gross ground water draft for all uses (ham)	Allocation for domestic and industrial requirement supply upto 2025	Net ground water availability for future irrigation (ham)	Stage of ground water development	Category
GILAULA	9949.59	5260.50	423.13	5683.63	703.34	3985.75	57.12	Safe
HARIHAR PUR RANI	7757.04	2847.75	385.28	3233.03	640.43	4268.86	41.68	Safe
IKAUNA	7981.79	4190.25	434.33	4624.58	721.97	3069.57	57.94	Safe
JAMUNHA	8280.90	3771.00	468.01	4239.01	777.94	3731.96	51.19	Safe
SIRSIYA	5417.22	1312.20	442.52	1754.72	735.58	3369.44	32.39	Safe
TOTAL	**39386.54**	**17381.70**	**2153.27**	**19534.97**	**3579.26**	**18425.58**	**49.60**	Safe

As evident form the table 6, all the five blocks of the Shravasti district are falling under 'Safe' category of ground water resource estimation leaving ample scope for development of the resource.

VI. GROUND WATER QUALITY

In general the quality of ground water is good both for drinking and irrigation purposes. The quality of water is described as follows:

Ground Water Suitability for Drinking Purposes:

14 water samples were collected during ground water management survey from handpumps being used for drinking purposes. These samples were analysed in the chemical laboratory of CGWB, Northern Region. The summerised result falling in permissible level and undesirable effect one side permissible limits are showing Table-7 & the analytical results are shown in Table-8.

Table-7:- Constituent, Desirable Limit, Permissible Limit Number of Samples Beyond Permissible Limit & Undesirable Effect Beyond Permissible Limit

S. No.	Constituent	Desirable limit	Permissible limit	No. of samples beyond permissible limit	Undesirable effect beyond permissible limit
Essential Characteristics					
1.	pH	6.5-8.5	No relaxation	Nil	Beyond this range the water will affect the mucus membrane and water supply system
2.	Total hardness as $CaCO_3$	300	600	Nil	Encrustation in water supply structure, an adverse effect on domestic use
3.	Iron	0.3	1.00	Nd	Precipitation after exposure to air causes turbidity stains plumbing fixtures laundry & cooking utensils
4.	Chloride	250	1000	Nil	May cause physiological damage
5.	Fluoride	1.00	1.5	Nil	Fluoride may be kept low as far as resource. High fluoride leads to fluorosis, pronounced mottling and disfiguration of teeth.
Desirable Characteristics					
6.	Total Dissolved aocel	500	2000	Nil	May cause gastro intestinal irritation
7.	Calcium	75	200	Nil	Encrustation in water supply structure and adverse effect on domestic use
8.	Magnesium	30	100	Nil	-Do-
9.	Sulphate	200	400	Nd	Beyond this causes gastro intestinal irritation when Mg & Na are present
10.	Nitrate	45	No relaxation	Nil	Beyond this limit may cause methano-globo-enemia

Table-8: Chemical Analysis Results of Water Samples,2011, Shravasti District

S. No.	Location	Type of sample	Date of collection	E.C. micro siemens/ cm at 25^0C	pH	Constituents in mg/l									
						CO_3	HCO_3	Cl	NO_3	F	Ca	Mg	TH as $CaCO_3$	Na	K
1.	Jamunaha	H.P.	May 2011	352	8.00	Nd	220	14	1.16	nd	12	22	120	36	2.5
2.	Gilaula	H.P.	May 2011	339	8.10	Nd	232	7	Nd	0.36	16	30	165	15	2.3
3.	Sirsiya	H.P.	May 2011	541	8.07	Nd	342	7	Nd	0.24	4	35	155	63	0.9
4.	Hariharpur Rani	H.P.	May 2011	424	8.04	Nd	244	14	2.3	0.17	12	32	165	25	2.3
5.	Ikauna	H.P.	May 2011	359	8.02	Nd	232	14	Nd	0.1	12	34	170	15	5.3

HP* Water sample from Hand pump

Suitability of Ground Water for Irrigation Purposes:

As per Wilcox classification based on E.C. of ground water, the water can be grouped with 5 categories and as follows (Table-9)

Table-9: Irrigation Water Class & Number of Samples, Shravasti District, U.P.

S. No.	Water class	E.C. in micromhos/cm at 25^0C	No. of samples	Remark
1.	Excellent	<250	-	
2.	Good	250-750	5/5	
3.	Permissible	750-2000	-	
4.	Doubtful	2000-3000	-	
5.	Unsuitable	>3000	-	

The ground water of the district is of good quality from irrigation point of view. Thus the quality of water both for drinking & irrigation purpose is good.

VII. GROUND WATER DEVELOPMENT

The ground water in the area is being developed by borewells & dugwells. The district has 131 tubewells, 48 masonry wells and 42396 borewells for irrigation purposes. There are 513 wells fitted with handpumps and are in use for drinking purposes. The details are as follows:

Table-10:- Block wise Ground water Extraction structures, 2009, Shravasti, U.P

	Canal Length (km)	Govern-ment tube well	Perma-nent wells	Pump sets				Total
				Rahat	Electricity	Diesel	Other	
Jamunaha	25	37	0	13	1	11019	37	11057
Gilaula	254	51	48	0	51	10619	51	10721
Ikauna	141	30	0	0	125	10501	30	10656
Hariharpur Rani	0	4	0	0	9	7087	4	7100
Sirsia	39	9	0	0	1	5907	9	5917
Total	**459**	**131**	**48**	**13**	**187**	**45133**	**131**	**45451**

VIII. GROUND WATER MANAGEMENT STRATEGY

The Shravasti district comprises of alluvial areas. The cultivators of the area are having small land holding & poor. The fragmented nature of land holding is creating hardship to an individual farmer to develop the ground water resource economically. Following strategy may be taken up to enhance the irrigation for future development.

i) Mass awareness programme should be taken up to educate the user regarding rising trend of water level and use of ground water in conjunction with surface water to serve the land from becoming water logging in future.

ii) The net area irrigated by ground water structures is 56760 ha (91.63% of total irrigated area) and net area irrigated by canals & other sources is 5183 ha. The net area sown is 69.7% of the total area of district and more area can be brought under agriculture.

ii) Efforts should be made to increase cropping intensity which is just 139.5% at present. Ground water which is the mainstay for irrigation in the area should be developed for supporting additional crops.

iii) Most of the tubewells are fitted with diesel pumpsets and their pumping cost is higher for marginal/small farmers. Power availability should be enhanced for agriculture sector.

iv) The Kharif crops still remain dependent on rainfall only. Thus the efforts should be made for maximisation of rainwater use, through water harvesting system.

IX. AWARENESS & TRAINING ACTIVITY

Mass awareness programme & water management training programme by CGWB has not taken place in the district so far.

X. AREAS NOTIFIED BY CGWB/SGWA

None of the area has been notified in the district so far.

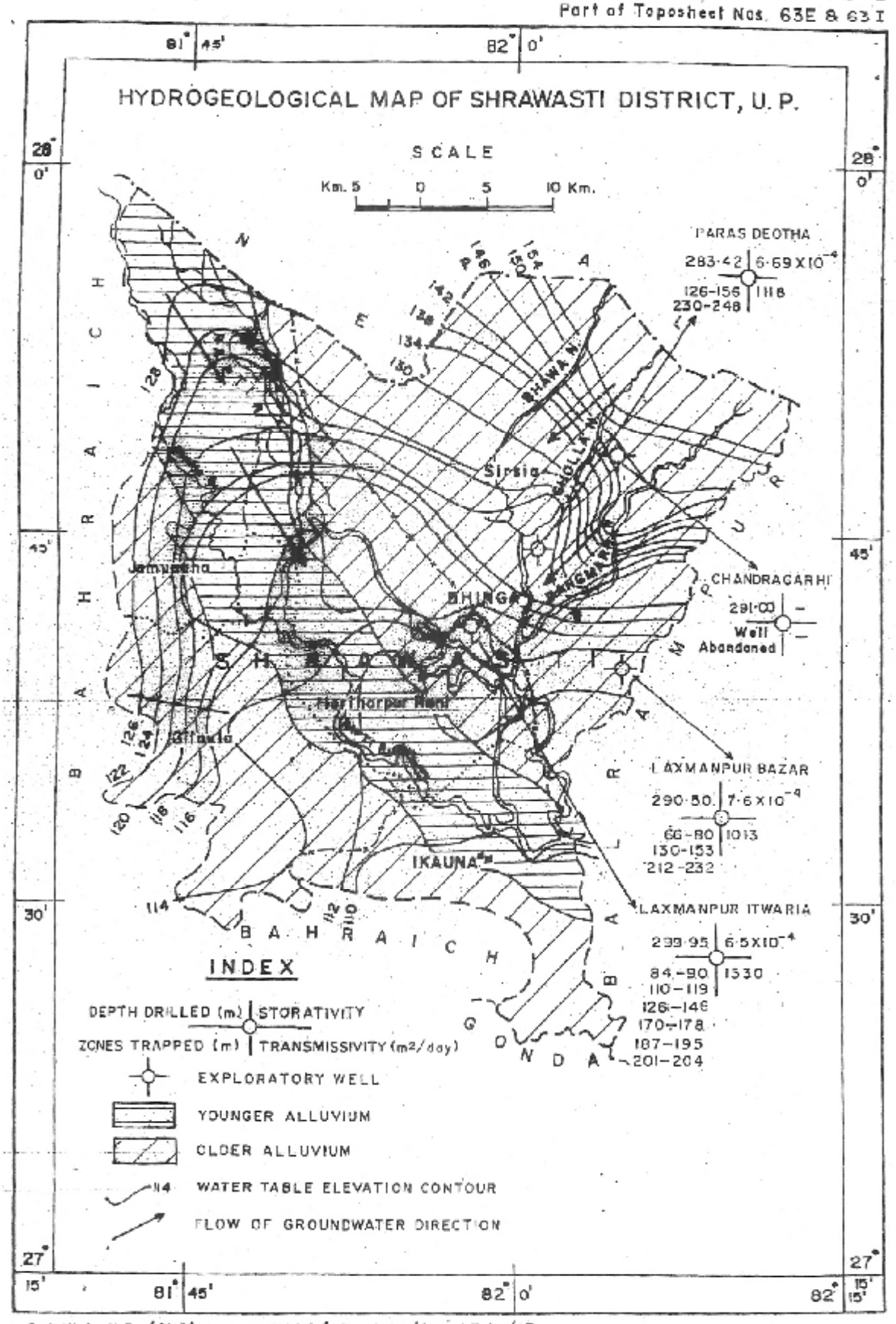
X. RECOMMENDATIONS

Shravasti district has balance of 18426 ham of ground water availability for future irrigation. Ground water should be developed in a planned and scientific manner in order to increase the agricultural productivity. The recommendations are as follows:

1. The actual utilization of ground water available for irrigation is much less than the potential available. Multiple cropping pattern be adopted to utilise the potential available increasing the cropping intensity.
2. Marginal & small farmers should be given subsidised loans for constructing ground water abstraction structures with a view to draw water for irrigation.
3. Ground water should be developed more in all blocks since stage of ground water development as on 31.3. 2009 is less than 60%..
4. Mass awareness programme should be arranged to educate the availability of resources. Marginal farmers should be given loans at subsidized rate through financial institution for developing the ground water abstraction structure.
5. It is suggested that state government should take up supply of irrigation water on co-operative basis.

PLATE - I

Part of Toposheet Nos. 63E & 63I



C. G. W. B., N. R., (AKS), Drg. no. 2604/09., 4171/10, 4741/13

PLATE - II

Part of Toposheet Nos. 63E & 63I

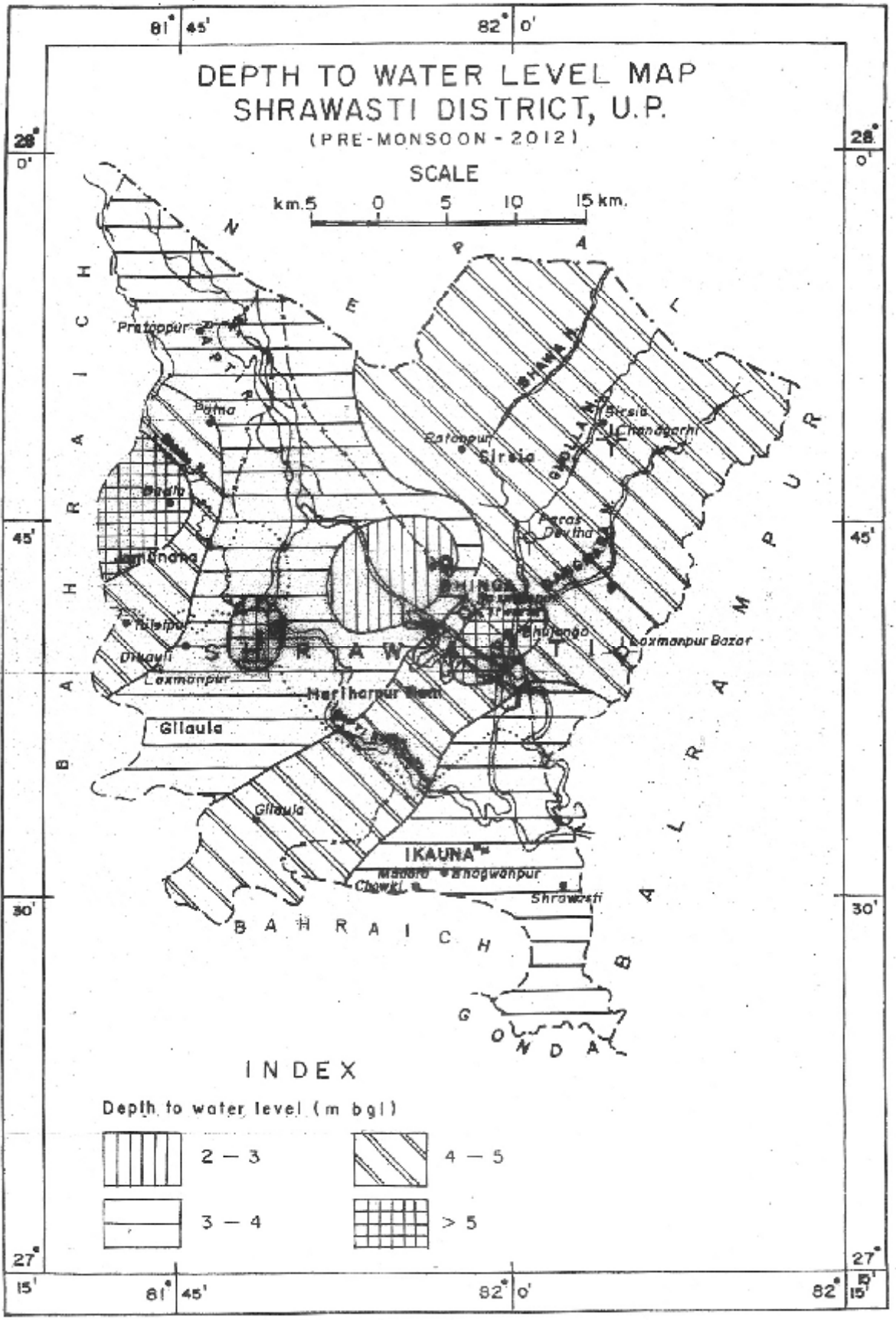


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PLATE - III

Part of Toposheet Nos. 63E & 63I

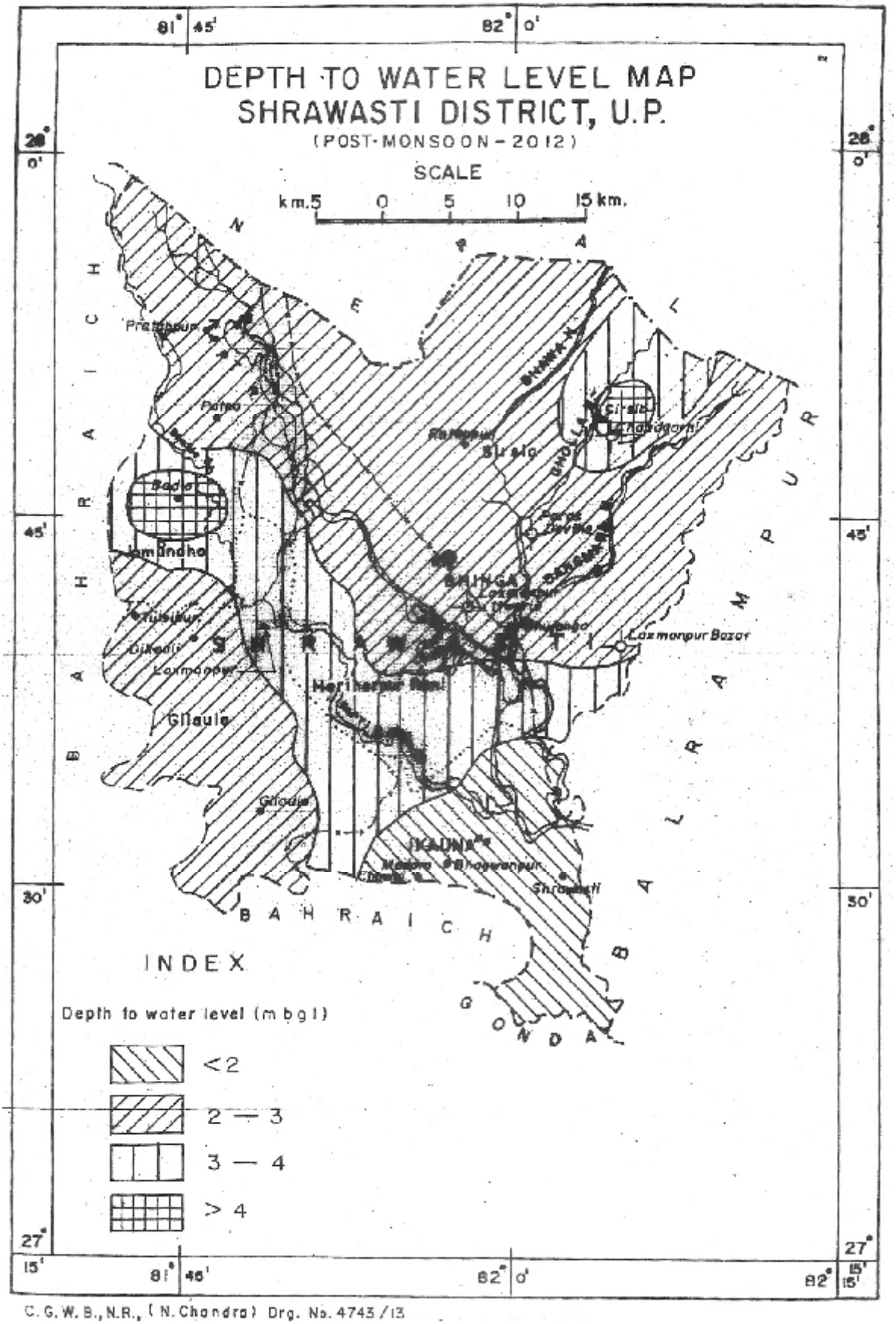

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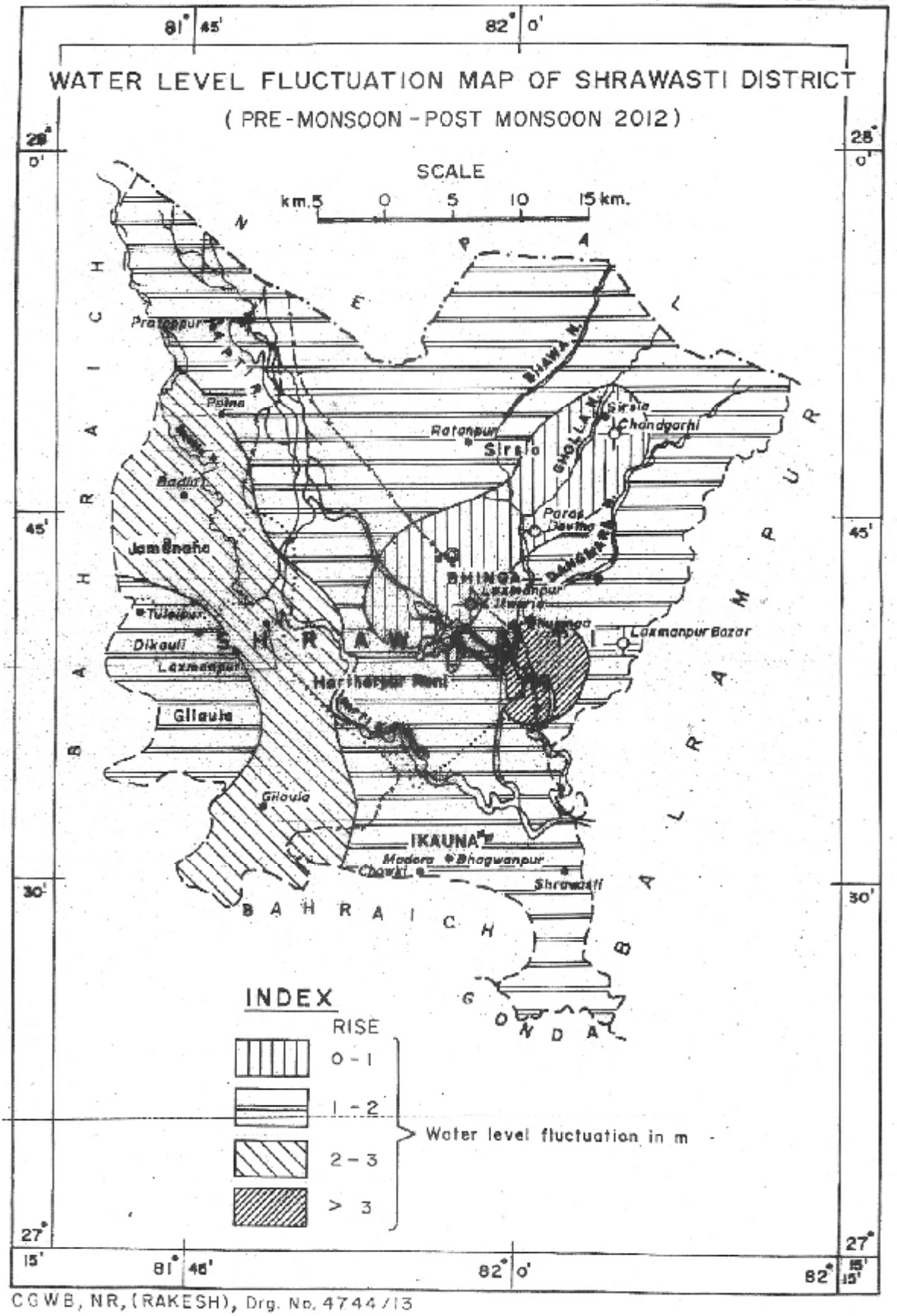
PLATE IV

Part of Toposheet Nos. 63E & 63I



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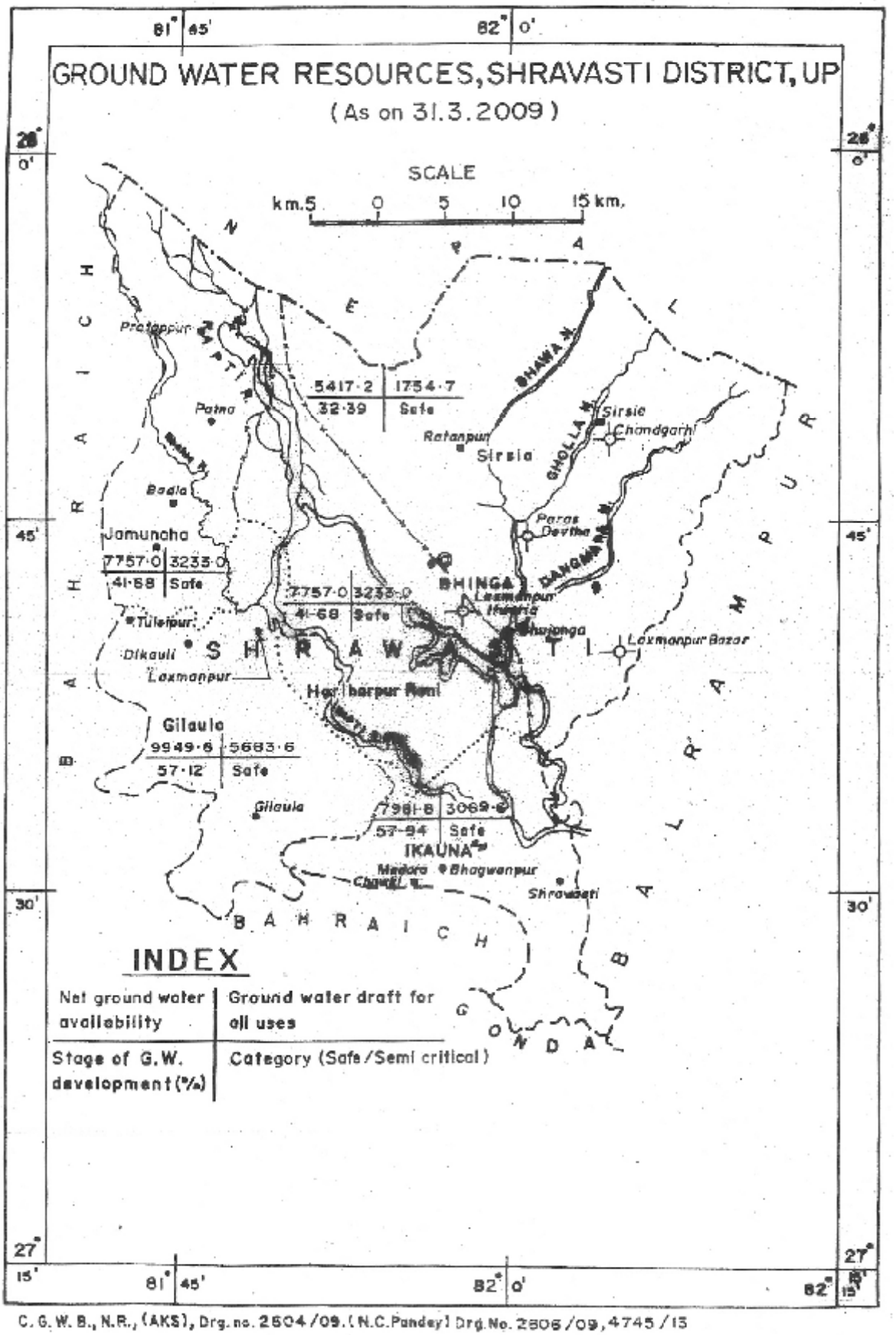
Part of Toposheet Nos. 63E & 63I



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