केंद्रीय भूमि जल बोर्ड

जल संसाधन, नदी विकास और गंगा संरक्षण

विभाग, जल शक्ति मंत्रालय

भारत सरकार

Central Ground Water Board

Department of Water Resources, River Development and Ganga Rejuvenation,

Ministry of Jal Shakti

Government of India

AQUIFER MAPPING AND MANAGEMENT OF GROUND WATER RESOURCES

SHRAVASTI DISTRICT, UTTAR PRADESH

उत्तरी क्षेत्र, लखनऊ

Northern Region, Lucknow

CENTRAL GROUND WATER BOARD
Ministry of Jal Shakti
Govt. of India

Interim Report

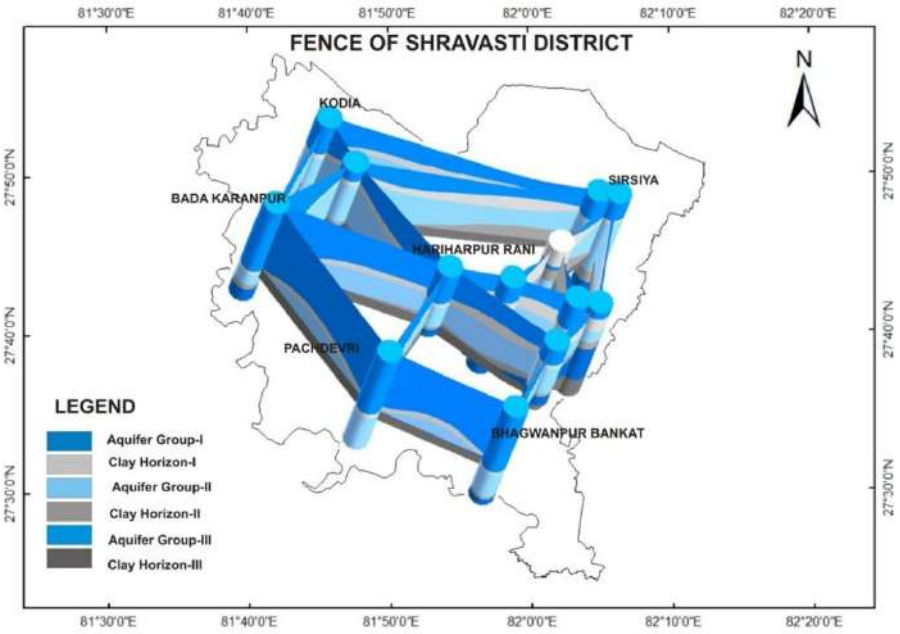
AQUIFER MAPPING AND GROUND WATER MANAGEMENT PLAN

SHRAVASTI DISTRICT, UTTAR PRADESH

By

Dr. Shaista Khan

Jr. Hydrogeologist, Scientist-B



Northern Region
Lucknow, Uttar Pradesh

REPORT ON AQUIFER MAPPING AND MANAGEMENT PLAN OF SHRAVASTI DISTRICT, UTTAR PRADESH
(AAP 2019-2020)

By
Dr. Shaista Khan

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ANNEXURES

LIST OF PLATES

SHRAVASTI DISTRICT AT A GLANCE

1. General Information

i. Geographical Area (sq km.)	: 2016
ii. Administrative Divisions	
Number of Block	: 05
Number of Town	: 02
Number of Villages	: 532
	500 (inhabited villages)
	32 (uninhabited villages)
iii. Population (2011 census)	: 1116000
	Male-593000, Female-523000
iv. Average Annual Rainfall (mm)	: 1020

2. Geomorphology	: Alluvium
Major Physiographic Units	: Older and younger Alluvium, Palaeochannel, Flood Plains, ox-bow lakes, Piedmont slope, Channel bar
Major Drainages	: Rapti river

3. Land Use (Sq. Km.)

Forest area	: 343.54
Net area sown	: 1224.22
Gross area sown	: 1912.86

4. Major Soil Types	: Fine silt with varying grades of loam
5. Area under Principal crops (Sq. Km)	: 1045.76 (rice, wheat, corn, maize, sugarcane)

6. Irrigation by different sources (sq km)

Tubewells / Borewells	: 681.22
Dugwells	: 2.78
Canals	: 0.0
Other sources	: 0.02
Net Irrigated Area	: 684.02
Gross Irrigated Area	: 909.28

7. Number of Ground Water Monitoring Wells of CGWB (as on 31-3-2021)

No. of Dugwells	: 11
No. of Piezometers	: 01

8. Predominant Geological Formations : Quaternary Alluvium

9. Hydrogeology

Major water bearing formation : Alluvium

Aquifer Group

Ist aquifer between 150 m depth
IInd aquifer 160-250 m depth
IIIrd aquifer below 250 m

10. Depth to Water level

Pre-monsoon Depth to water level during May' 2019	: 2.35 to 6.60 m bgl
Post-monsoon Depth to water level during Nov' 2019	: 1.10 to 4.27 m bgl

11. Ground Water Exploration by CGWB (as on 31-03-2021)

No. of wells drilled	: EW- 14 (1 abandoned due to lack of granular zone); OW- 12
Depth range (m)	: 200-305

Discharge (lpm)	: 1903 to 2950
Storativity (S)	: 1.21×10^{-04} to 6.78×10^{-05}
Transmissivity (m^2/day)	: 318 to 3083

12. Ground Water Quality

Presence of chemical constituents more than permissible	: Arsenic and Fe concentration in 1st aquifer reported more than the permissible limit of BIS. Fe reported more than the permissible limit of BIS in deeper Aquifers.
Type of water	: Alkaline type

13. Dynamic Ground Water Resources (Ham) as on 31 March, 2020

Annual Extractable GW Resources	: 46628.26
Net Ground Water availability for future use	: 19151.01
Total Draft	: 27476.49
Stage of Ground Water Development	: 58.90%

14. Ground Water Control and Regulation

Number of Over Exploited Blocks	: 0
Number of Semi Critical Blocks	: 0
Number of Critical Blocks	: 0
Number of Safe Blocks	: All 5 Blocks
Number of blocks notified	: Nil

15. Major Ground Water Problems and Issues : Sporadic presence of Arsenic in shallow Aquifer.

Aquifer Mapping and Management Plan of Shravasti District

1.0 Introduction

Aquifer mapping can be defined as a scientific process, wherein a combination of geologic, geophysical, hydrologic, chemical field and laboratory analyses are applied to characterize the quantity, quality and sustainability of ground water in aquifers. The National Project on Aquifer Management (NAQUIM) is an initiative of the Ministry of Jal Shakti, Government of India, for mapping and managing the entire aquifer systems in the country. The study integrates multiple disciplines and scientific approaches, including remote sensing, hydrogeology, geophysics, hydrochemistry, drilling, groundwater modelling and management approaches.

Systematic aquifer mapping is expected to improve our understanding of the geologic framework of aquifers, their hydrologic characteristics, water levels in the aquifers and how they change over time, and the occurrence of natural and anthropogenic contaminants that affect the potability of ground water.

1.1. Objectives

The major objectives of Aquifer Mapping are-

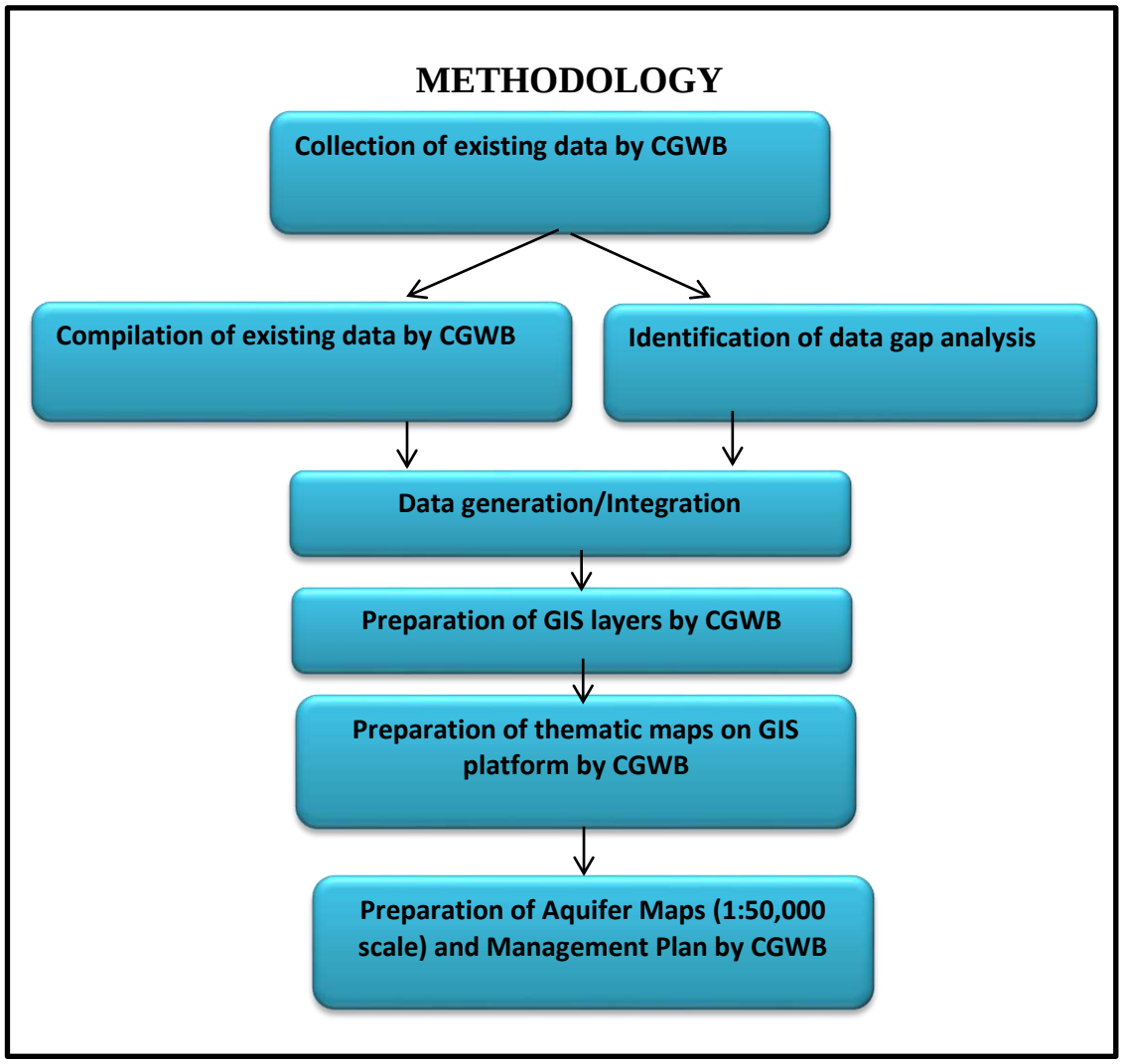
i. To identify and map subsurface aquifer geometry at the micro level.
ii. To evaluate aquifer parameters, type of aquifers, ground water regime behaviours, hydraulic characteristics and geochemistry of multi-layered aquifer systems on 1:50,000 scale.
iii. To quantify the available groundwater resources and to propose plans appropriate to the scale of demand and aquifer characteristics.
iv. Finalizing the approach and methodology on which National Aquifer mapping programme of the entire country can be implemented.

1.2. Scope of the Study

Systematic mapping of an aquifer encompasses a host of activities such as collection and compilation of available information on aquifer systems, demarcation of their extents and their characterization, analysis of data gaps, generation of additional data for filling the identified data gaps and finally preparation of aquifer maps at the desired scale. Results of these studies will contribute significantly to resource management tools such as long-term aquifer monitoring networks and conceptual and quantitative regional ground-water-flow models used planners, policy makers and other stakeholders. Aquifer mapping at the appropriate scale can help prepare, implement and monitor the efficacy of various management interventions aimed at long-term sustainability of our precious ground water resources, which, in turn, will help achieve drinking water security, improved irrigation facilities and sustainability in water resources development in the country as a whole.

1.3. Approach and Methodology

The work plan for the aquifer mapping envisaged compilation, integration, validation and analysis of the existing database at one platform with a view to generate various thematic maps like land use/ land cover map, geomorphology map, geology, hydrogeology etc. using various GIS and geo-scientific computer software.
The major activities involved in this process include i) collection of data from various sources like CGWB records, State Government agencies and available literature/data on internet; ii) compilation of existing data; iii) identification of data gaps; iv) generation of data for filling data gaps and finally v) preparation of aquifer maps and Management Plan. The overall methodology for aquifer mapping is shown in the flow chart given below-



1.4. Location of the study area

Shravasti district is in the north-western part of Uttar Pradesh covering an area of 2016 Sq. Km. It is a created district carved out from Bahraich district in 1997. Shravasti shares border with Balrampur, Gonda & Bahraich districts and international border with Nepal in the north. Bhinga is the district headquarters of Shravasti and is approximately 175 kilometers away from the state capital. Shravasti has five Blocks, viz., Hariharpur Rani, Jamunaha, Gilaula, Sirsiya and Ikauna. The area lies between North Latitude 27°04' and 28°24' and East Longitude 81°35' and 82°15" (figure 1) and falls in Survey of India Toposheet No. 63E & 63I.

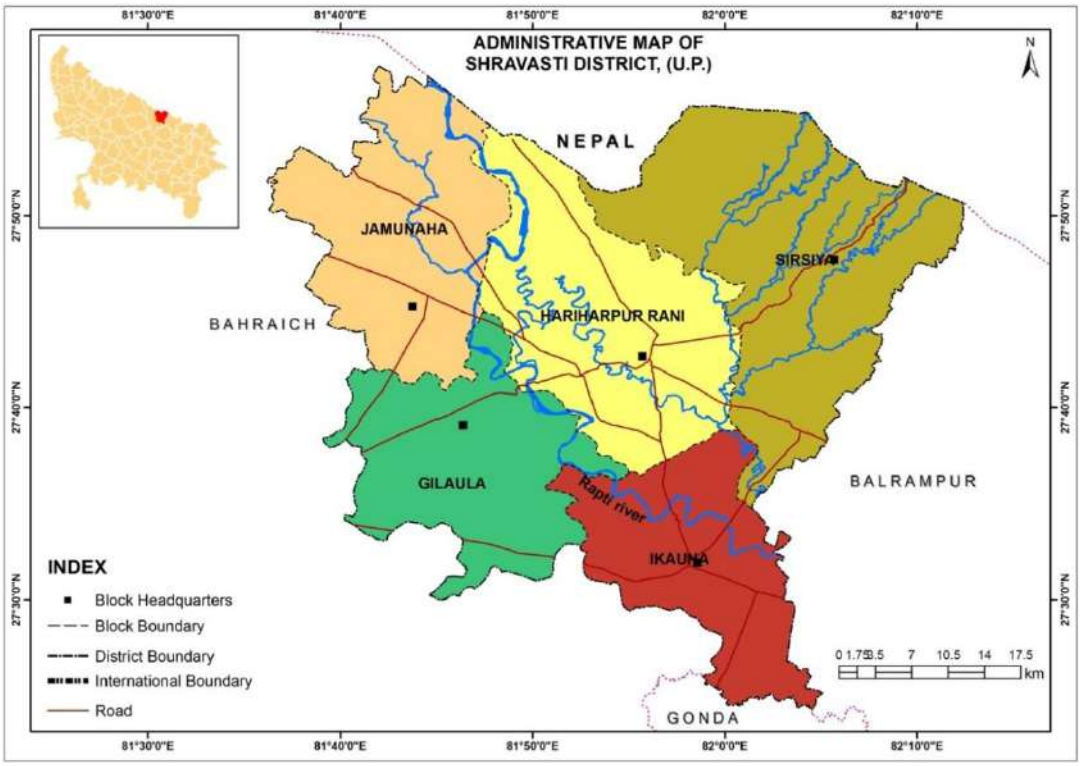


Figure1: Administrative Map of Shravasti district

1.5. Climate

Shravasti has a relatively subtropical climate with high variation between summer and winter temperatures. The average temperature is 30°C-43°C in summer and 6°C-18°C in winter. The well distributed rainfall occurs during south west monsoon. The average Annual Rainfall is 1020 mm. 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. Winds are generally light and increase in speed from the beginning of summer and continue to have higher speedup to September.

1.6. Geology

The Shravasti district constitutes a part of Rapti alluvial plains which is underlain by sands of various grades with clay and kankar and at places boulders and pebbles of Quaternary age (figure-2). The unconsolidated sediment deposited over the surface of the Siwalik group series deposition. The alluvium is broadly divided into:

I. Older Alluvium of Pleistocene age occupying generally by high levels is not effected by floods during monsoon.
II. Newer Alluvium occupying lower levels and is mainly confined to the flood plains along the river channel belonging to upper Pleistocene to recent in age.

The geological succession is as follow:

AGE	**FORMATION**	**LITHOLOGY**
Recent	Newer Alluvium	Fine Sand silt, Clay admixed with gravel
	Older Alluvium	Clay with kankar and Sand of different grades
Classification of Siwalik Group (Based on Pilgrim, 1913, Colbert,1934,1942)		
---------- Gradational ----------		
Upper (Upper Pliocene to Lower Pleistocene)	Upper Conglomerate	Coarse boulder conglomerate, Clay Sands grits
	Pinjor Formation	Conglomerate, Sandstone, Clays

	Taiort Formation	Sandstones, Clays, Conglomerates
Middle (Upper Miocene to Lower Pliocene)	Dhokapathan Formation	Sandstones, Shales, Clays pebbly at the top
	Nagri Formation	Massive Sandstones, Shales, Red Clays
Lower (Middle Miocene)	Chinji Formation	Nodular Shales,Clays,Sandstones
	Kamlial Formation	Dark hard Sandstones, red and purple Shales

The elevation difference between older and newer alluvium is between 2-3 m. In north eastern part of the district after the Siwaliks lies the Bhabhar tract which in followed by the Tarai belt and extends along NNW-SSE direction parallel to the trend of Siwalik hills which are exposed in Nepal. South of Bhabhar-Tarai tract lies the central alluvial plain.

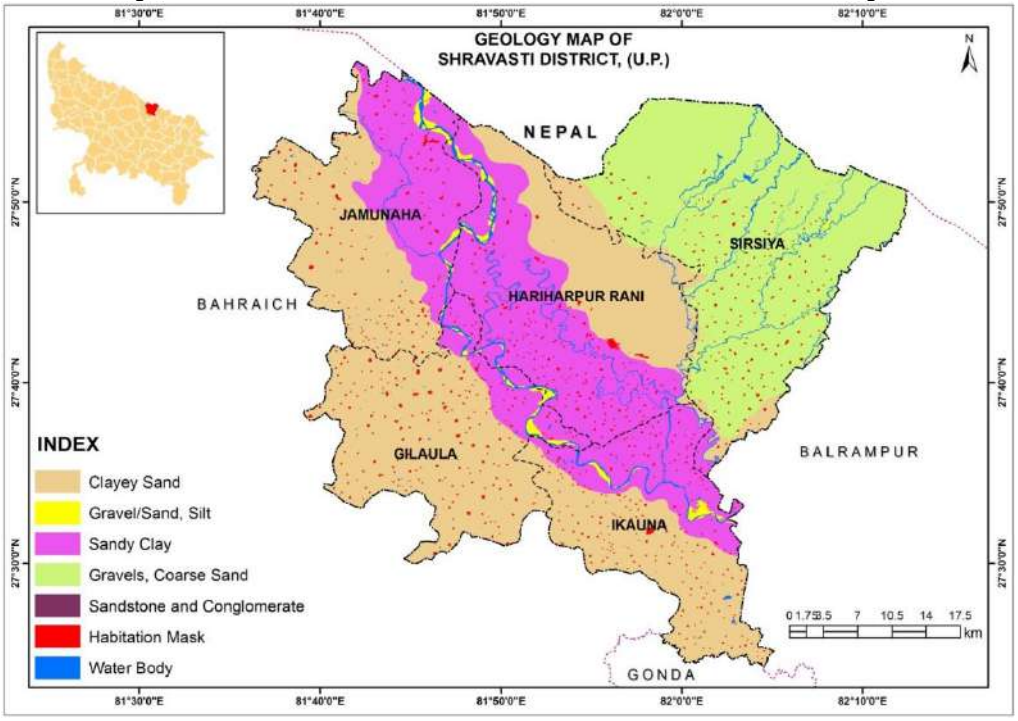


Figure 2: Geology Map of Shravasti district

1.7. Physiography

Shravasti district is a part of Indo-Gangetic plains. The ground level elevations of the area ranges from around 200 m above mean sea level. The general master slope of the area is from north to south. Bad land ravinous topography is seen developed at places along the Rapti river draining the southern part of the area. Small hillocks of the Siwaliks stand out at the northern most part of the district. The north-eastern corner of the area comprises boulders cobble sandstone, quartzite, shale, silicious limestone and sands of various grades mix and clays, rest of the area lies under central alluvial plain comprising mainly clay, silt, sandy clays with sands and occasional gravel of various grades. On the whole the area is plain land. A major part of the area is underlain by alluvial deposits of Quaternary age, excepting for disconnected small patches of upper Siwalik of tertiary age seen in the northern most parts. These Siwalik patches are disconnected because of the position of the international border between Nepal and India, which runs almost at foothills of Siwalik Mountains, except at few places.

1.8. Geomorphology

Broadly Shravasti district can be classified into following four geomorphological units (figure-3).

i. 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.

ii. Lower Piedmont Plain:

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

iii. 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 and water bodies known as Talao. Several palaeochannels can be seen in plain throughout the district which are the results of meandering river.

iv. Younger Alluvial Plain:

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

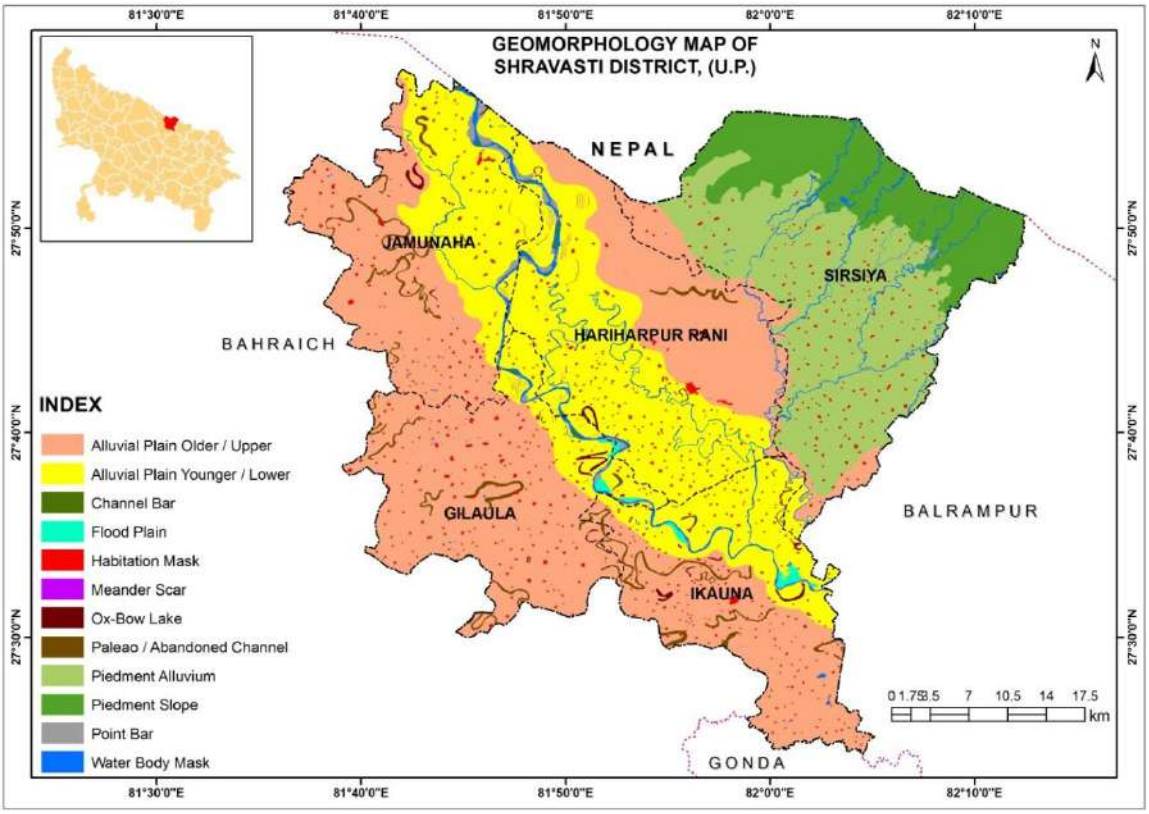


Figure 3: Geomorphology Map of Shravasti district

1.9. Drainage

The main drainage feature in the area is the river Rapti which originates in Nepal from where it flows towards west and near about Nepalganj (Nepal) it takes a sudden southerly or south easterly turn and follows a meandering course (figure-4). Rapti enters the district at Indo-Nepal Border near east of village Bilari. For some distance it flows in NW-SE direction and then takes southward turn at north of village Dayal and flows almost N-S direction upto village Tilakpur. South of Tilakpur, Rapti takes a turn eastward and flows in NW-SE direction further. It meanders almost throughout its course and is perennial in nature. The sand bar deposits are common throughout its course. The river is well known for its bank

erosion and channel shifting. The study further reveals that the river is more dynamic in its entire-course and shifted towards east in response to neotectonic activity.

The river channel slope of the upstream area is about 12 %, due to high slope of river and topography, this basin is more prone to flood as a result one river adopts the path of another river and encroaches on another river. In some parts of the district, especially in the north eastern parts, streams are of parallel in nature but near the International borders, dendritic drainage pattern can be seen (figure-4). Major streams originating from Nepal and merging Rapti river are Bhakla Nala, Baisakhi Nala, Suraj Kund Nala, Hathia Kund Nala, Bhawa Nala etc.

Bhakla:

It is the tributary of river Rapti. It rises in the north eastern part in Nepal country and enters the district near village Guiriha. It flows almost in NW-SE direction. It meanders along its course and meet the river Rapti near village Bardhera. It is a perennial river and drops its discharge into river Rapti at the confluence point.

Bhawa:

It is a tributary of river Rapti. It rises in the hilly area of Nepal and enters the district near Bhawa Naka. Initially travels in NE-SW direction and then flows in N-S direction. It meets the river Rapti near Bans Kund. It is a non perennial stream.

Bhalsahi:

It also originates in the hills of Nepal and enters the district near Bhalsahi Naka at International Post and after traveling in NE-SW direction it drops its discharge into river Rapti.

Dangmara:

It also originates in the hills of Nepal and enters the district near Dangrnara Naka. It meets the river Bhaisahi Nadi near Bans Kundi.

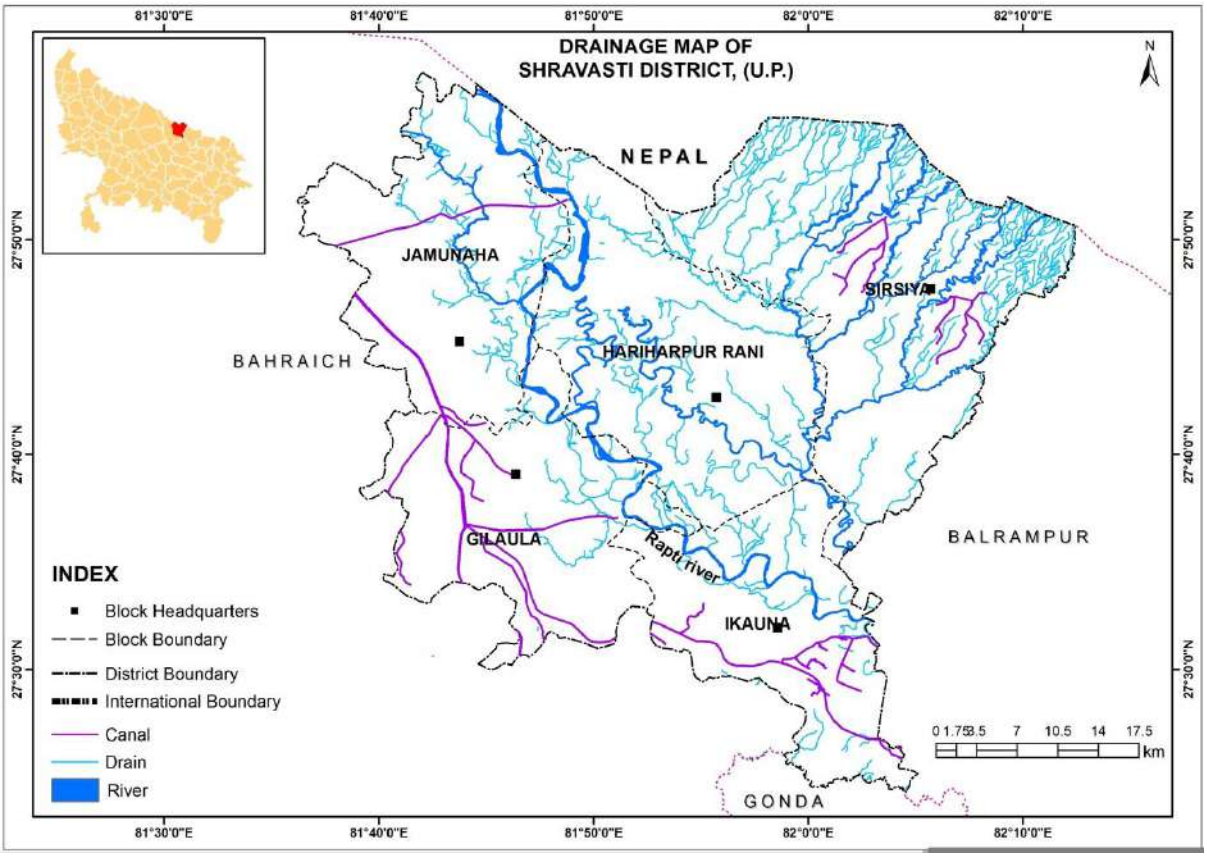


Figure 4: Drainage Map of Shravasti district

1.10. Data Availability

The data pertaining to various attributes of ground water were collected from available literatures of Central Ground Water Board, State Departments and other agencies. The compiled data were plotted on 1:50,000 scale map and data gap analysis was carried out for ascertaining additional requirement of Hydrogeological, Hydrological, Hydrochemical and Geophysical Studies. The summarized details presenting the data availability, data requirement, data adequacy, data gap analysis and data generation is shown in table 1 and 2 given below.

Table:1 Data Availability in Aquifer Mapping Area

S. No.	Type of structure	Agency	Nos.	Depth Range (m)				Remarks
				<100	100-200	200-300	>300	
1	Tube Wells	CGWB	14	0	5	9	0	1 well abandoned due to lack of granular zone.

Table:2 Data Requirement, Data Adequacy, Data Gap Analysis & Data Generation

S. No.	Parameters	Data Requirement	Data Availability	Data Gap	Data Generation
1	Rainfall data	IMD Meteorological stations spread over the project area	Data available	No	Nil
2	Soil	Soil Map and soil infiltration rate	Soil Map available	Soil Infiltration test	Soil infiltration rate across study area
3	Land Use/Land cover	Land Use/Land cover pattern	Land Use/ Land cover Map available	Nil	Generated on GIS platform
4	Geomorphology	Digitized geomorphological map	Geomorphological Map available	Nil	Generated on GIS platform
5	Geophysics	Geophysical data in each quadrant	Insufficient data	Data Gap in whole area	Data to be generated
6	Exploration Data	EW in each quadrant	Only 13 Exploratory wells data available which is not sufficient.	Data Gap in whole area	Data to be generated
7	Aquifer Parameters	Aquifer parameters in all the quadrants	Not available	Data Gap in whole area	Data to be generated
8	Recharge parameters	Recharge parameters for different types of soil and aquifer types based on field studies	Available in Ground water Resources Estimation	Nil	Nil
9	Discharge Parameters (Draft data)	Discharge Parameters of different Ground Water abstraction structures	Available in Resources Estimation	Nil	Nil
10	Geology	All the data/maps on 1:50,000 scale. Hard and soft copy	Geological Map available	Nil	Generated on GIS platform

1.11. Soil

The district is covered mostly by moderately deep fine silt soil (figure-5). Generally the soil is fertile in nature. Soil may be divided into following types depending on the physiography of the region.

Piedmont Plains (1-3% slope)
Deep, loamy soils associated with moderately erosion
Alluvial plain (0-1% slope)
Deep, fine soils, loamy soils and slightly eroded.
Old Alluvial plain with river left out channels/Oxbows/point bars (1-3% slope)
Deep, loamy soils and slightly eroded associated with stratified loamy soils.
Recent Alluvial Plain (1-3% slope)
Deep, loamy soils with moderate water logging and slight salinity associated with fine soils, slightly water logging.
Active Flood Plain (1-3% slope)
Deep, sandy soils with moderate flooding associated with stratified loamy soils.

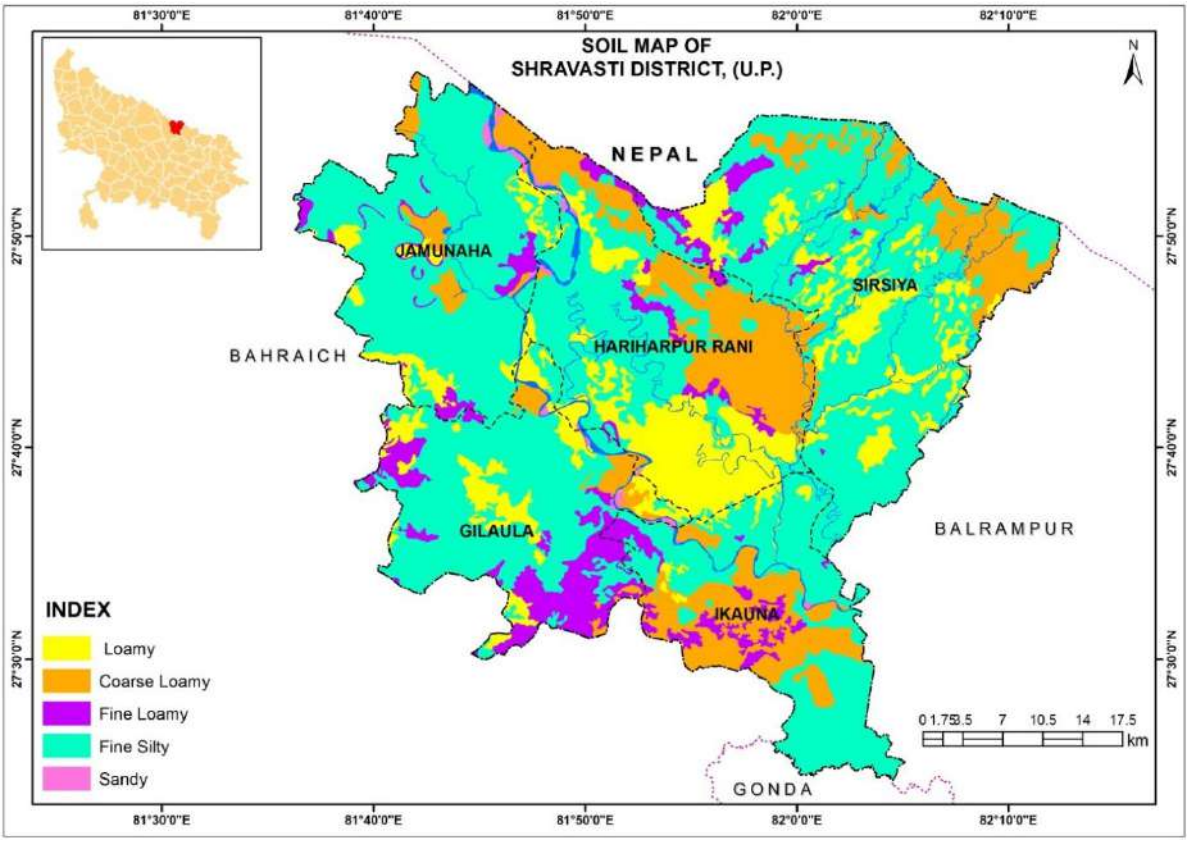


Figure 5: Soil Map of Shravasti district

1.12. Landuse/ Landcover

Landuse is based on the nature of topography, its structure and geometry, availability of resources, historical importance, people lifestyle, flora and fauna. Forest cover is in the north and north-eastern part while agricultural land and settlements can be seen in the central part of the district as shown in figure-6. Blockwise data of land utilization under the standard heads of land uses are given in table-3 and 4 and figure-6 and 7.

Table: 3 Blockwise land use/ land cover (in hectare) in the district

Block	Total Reported Area	Forest	Cultivable Waste Land	Current Fallow	Other Fallow	Unseasonal Land	Land other than Agriculture	Grassland / Trees, Shrubs
Jamunaha	35155	933	31	1677	371	30	5199	18
Gilaula	30398	0	22	1720	389	29	5434	34
Ikauna	27428	70	16	1592	361	18	5318	37
Hariharpur Rani	42155	14741	22	1290	481	28	3759	30
Sirsiya	57751	18609	34	2454	567	35	5070	46
Total	192887	34353	125	8733	2169	140	24780	165

Source- Statistical diary- 2018

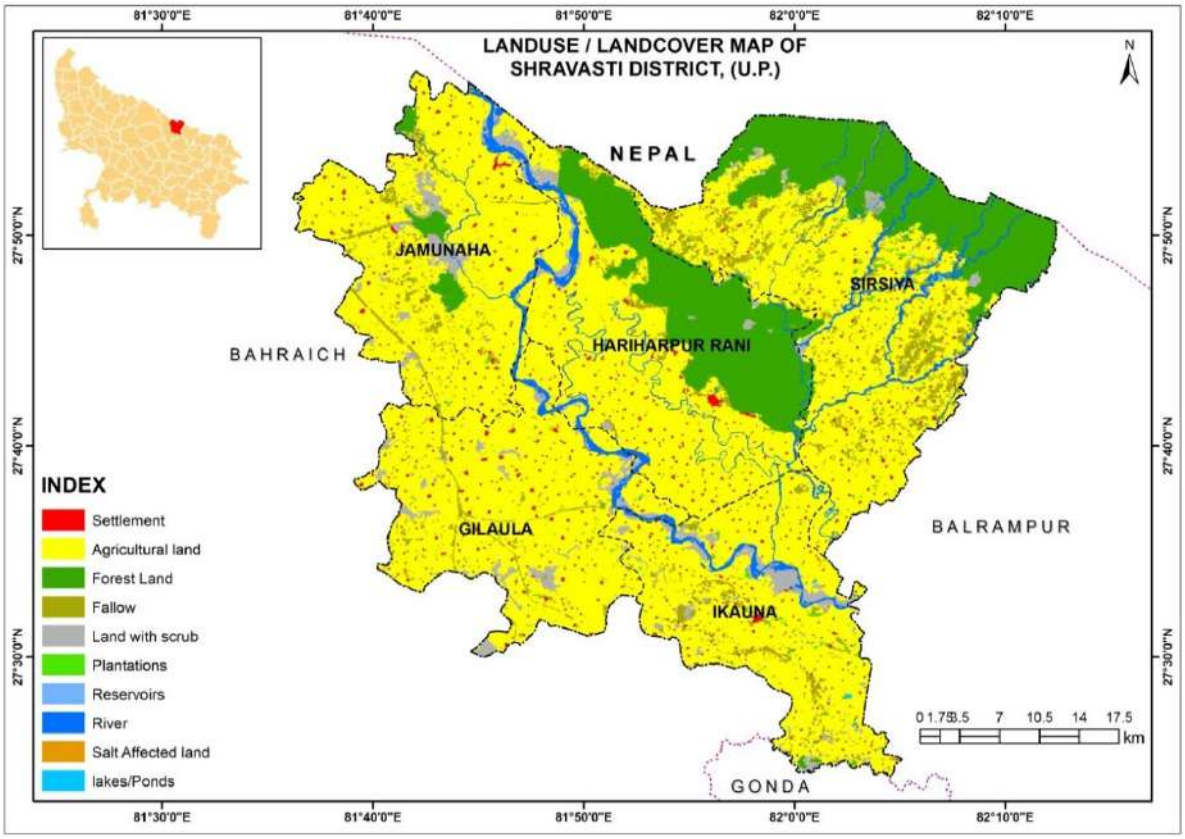


Figure 6: Landuse/ Landcover map of Shravasti district

Table: 4 Blockwise land use (in hectare) in the district					
Block	**Net Area Sown**	**Area sown more than once**	**Gross Area Sown**	**Net Irrigated area**	**Gross Irrigated area**
Jamunaha	26896	17792	44688	16643	21417
Gilaula	22770	12072	34842	12941	17434
Ikauna	20016	11462	31478	13844	18216
Hariharpur Rani	21804	11851	33655	12917	17425
Sirsiya	30936	15687	46623	12057	16436
Total	122422	68864	191286	68402	90928
Source- Statistical diary- 2018					

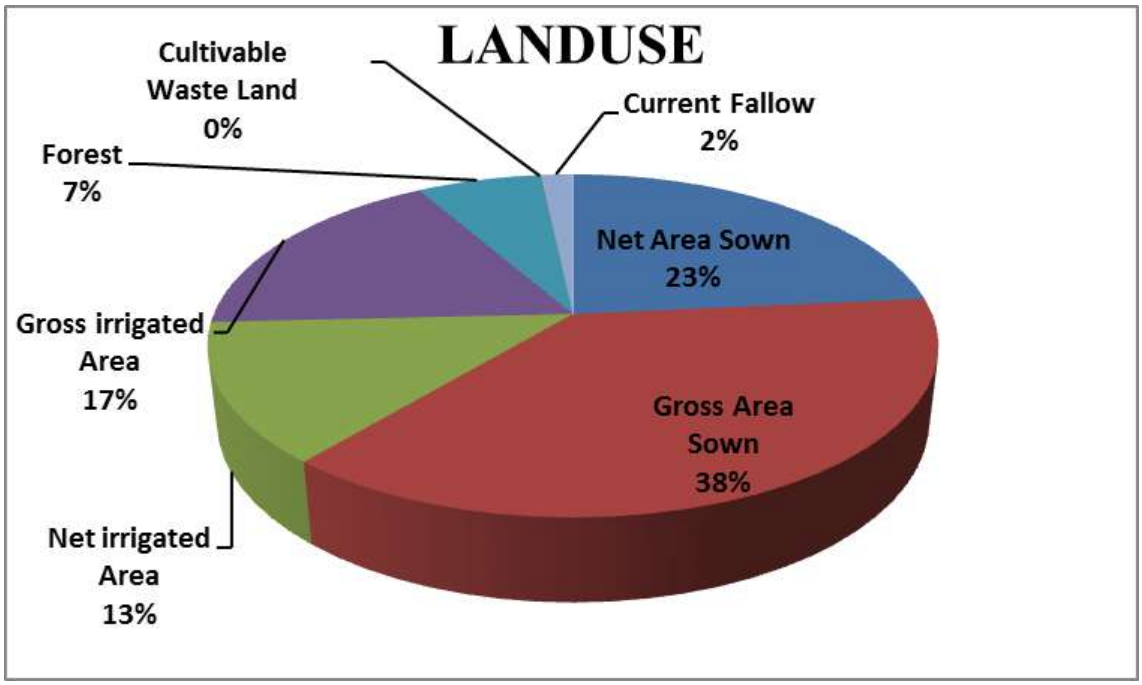


Figure 7: Landuse Pattern of Shravasti district

1.13. Agriculture and Cropping Pattern

The economy of the district is predominantly agricultural. Topography, climate and soil are the main factors affecting agriculture. Land under agriculture is 75% of total area of the district. The harvests of the district are Kharif, Rabi and Zaid. The Kharif is more important harvest owing chiefly to the large area under paddy, maize, corn and sugarcane. The Rabi crop mainly comprised of wheat, barley. The small area under Zaid or hot weather harvest of miscellaneous crops is of little importance. Paddy occupies the predominant place followed by wheat, corn and maize. Block-wise area under main crops in the district is given in table-5.

Table: 5 Block-wise area under main crops (in hectare) in the district							
Block	**Rice**	**Wheat**	**Barley**	**Maize**	**Corn**	**Sugarcane**	**Potato**
Jamunaha	15349	14359	18	1395	1433	1128	74
Gilaula	15618	14431	16	1409	1451	1470	80
Ikauna	15628	14434	16	1413	1454	1461	81
Hariharpur Rani	15377	14247	17	1404	1443	1128	77
Sirsiya	15341	13919	19	1393	1431	460	74
Total	77313	7390	86	7014	7212	5647	386
Source- Statistical diary- 2018							

1.14. Irrigation

Irrigation is a crucial input for the development of agriculture in the district. At district level 75 percent of total cultivable area has got the irrigation facility. The main source of irrigation in the district is tube wells (table-6).

Table: 6 Block-wise actual irrigated area (in hectare) by various means in the district						
Block	**Canal**	**Tubewell**		**Well**	**Pond**	**Other**
		State	**Private**			
Jamunaha	0	225	16362	56	0	0
Gilaula	0	203	12681	57	0	0
Ikauna	0	218	13573	53	0	0
Hariharpur Rani	0	210	12654	52	1	0
Sirsiya	0	207	11789	60	1	0
Total	**0**	**1063**	**67059**	**278**	**2**	**0**
Source- Statistical diary- 2018						

The net area irrigated by ground water structures is 99.90 % of the total irrigated area in district and the net area irrigated by canals, ponds and other sources is only .10 %. Ikauna and Hariharpur Rani blocks are totally devoid of canal network (table-7).

The block wise contribution of ground water for irrigation is maximum of 24 % in Jamunaha block and minimum of 17 % in Sirsiya block. Looking into the source of irrigation tube wells are the main source of irrigation accounted 94 % in district that is much higher in comparison of State level (72%).

Table: 7 Block-wise details of the Irrigation sources in the district

Block	Length of canal (km)	State Tubewell (No.)	Pucca Well (No.)	Geostationary Pumpset (No.)	Shallow Tube well (No.)			Deep Tubewell (No.)
					Electrically operated	Diesel powered	other	
Jamunaha	15	38	8	43	1	12023	37	0
Gilaula	226	62	12	0	51	11617	51	0
Ikauna	0	44	10	0	125	11110	30	0
Hariharpur Rani	0	20	9	22	9	7682	4	0
Sirsiya	39	30	9	20	1	5402	9	0
Total	280	194	48	85	187	47834	131	0

Source- Statistical diary- 2018-19

1.15. Prevailing Water Conservation and Recharge Practices

Rapti Canal Project is under construction in the district for providing irrigation facility; by completion of this project thrust on ground water will be reduced (Plate-I). Details of the project are as follows:

S.No.	Source		Ghaghra, Saryu and Rapti River
1	**Reservoir area**	**a.** Ghaghra River	455550 sq km
		b. Saryu River	4500 sq km
		c. Rapti River	6000 sq km
2	**Barrage Details**	A. Saryu Barrage	
		1 Length	243.50 metre
		2 maximum flood discharge	4600.00 cumec
		3 Gateway	12 rate of 18 meters
		B. Rapti Barrage	
		1. Length	294.5 metre
		2. Maximum Flood Discharge	6117 cumec
		3. Gateway	14 rate of 18 meters
3	**Length of Canals**	**1.** Main Feeder Canal	257.285 Km
		2. Branches	680.00 Km
		3. Rajwaha and Alpika	8266.00 Km
4	**Proposed Annual Irrigation**	**1** Cultivable Area	12.00 lac hectares
		2 Irrigation Capacity	
		Kharif 75%	9.00 lac hectares
		Rabi 40%	4.80 lac hectares
		Sugarcane 2%	0.24 lac hectares
		Total 117%	14.04 lac hectares

Source: Irrigation and Water Resources Department, U.P

Plate-I: Rapti Canal Project in Shravasti District

2.0 DATA COLLECTION AND GENERATION

2.1. Hydrogeology

Major part of the area is underlain by alluvial deposits of Quaternary age, excepting for disconnected small patches of upper Siwalik of tertiary age seen in the northern most parts. These Siwalik patches are disconnected because of the position of the international border between Nepal and India, which runs almost at foothills of Siwalik Mountains, except at few Places.

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. 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/ handpumps, occurs upto the depth of 80 meter. The aquifer material is fine to medium sand. In addition the gravel, pebbles and boulder occur in the northern part of the district. Kankar associated with clay also occurs occasionally. Clay beds are found at different depths in different parts of the district acting as aquiclude. Changes in its thickness and depth and horizontal direction affect the water level and water flow in the aquifer.

2.2. Depth to Water Level

Based on premonsoon water level data of May 2019 of hydrograph stations, a depth to water level map for premonsoon period 2019 has been prepared. The depth to water level in the district ranges from 2.35 to 6.6 mbgl (Annexure-I). In major area depth to water ranges between 3-5 mbgl (figure-8). Shallowest water level occurs in patches in Jamunaha, Gilaula and Sirsiya block. Deep water level can be seen near the south-western part of the district.

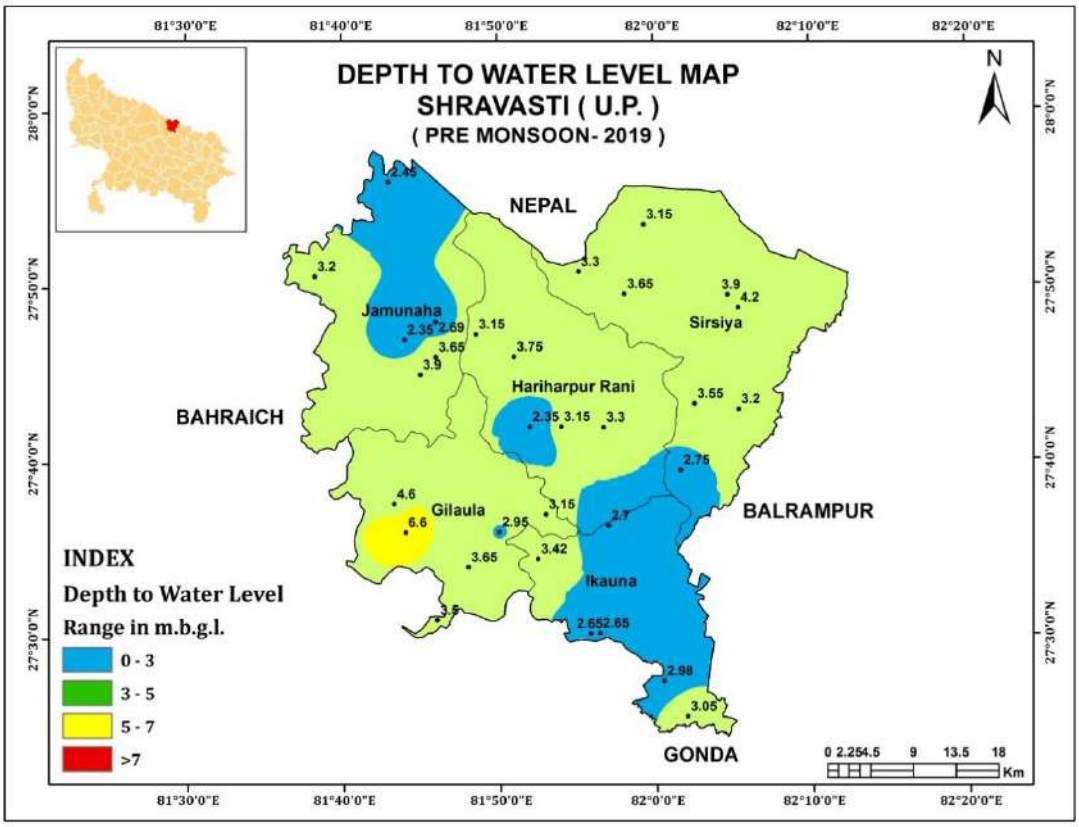


Figure 8: Depth to Water Level Map of Shravasti district- Pre Monsoon

During monsoon period the ground water recharge takes place and depth to water level becomes shallower. To study the distribution of water level during postmonsoon period the depth to water map of November 2019 has been prepared. The depth to water during post-monsoon period ranges from 1.1 to 4.27 mbgl (figure-9). In major part of the area the depth to water in post-monsoon is shallow ranging in between 0.0-2.0 and 2.0-4.0 mbgl.

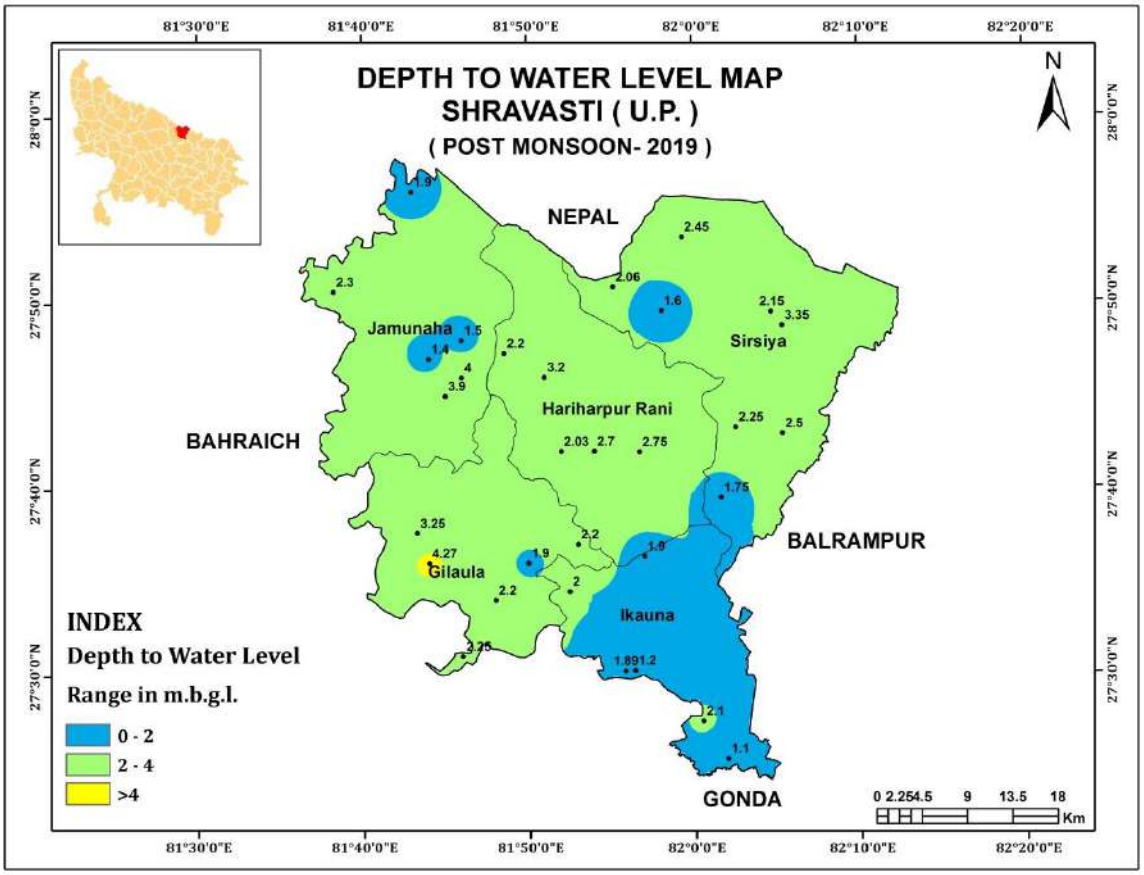


Figure 9: Depth to Water Level Map of Shravasti district- Post Monsoon

2.2.1. Water Level Fluctuation:

Based on water level data of 32 wells for the year 2019 it is observed that there is rise in water level in the district. Water level fluctuation in most part of the district ranges in between 0.0 -1.0 m bgl and show rising trend. Fluctuation in water level is shown in figure-10.

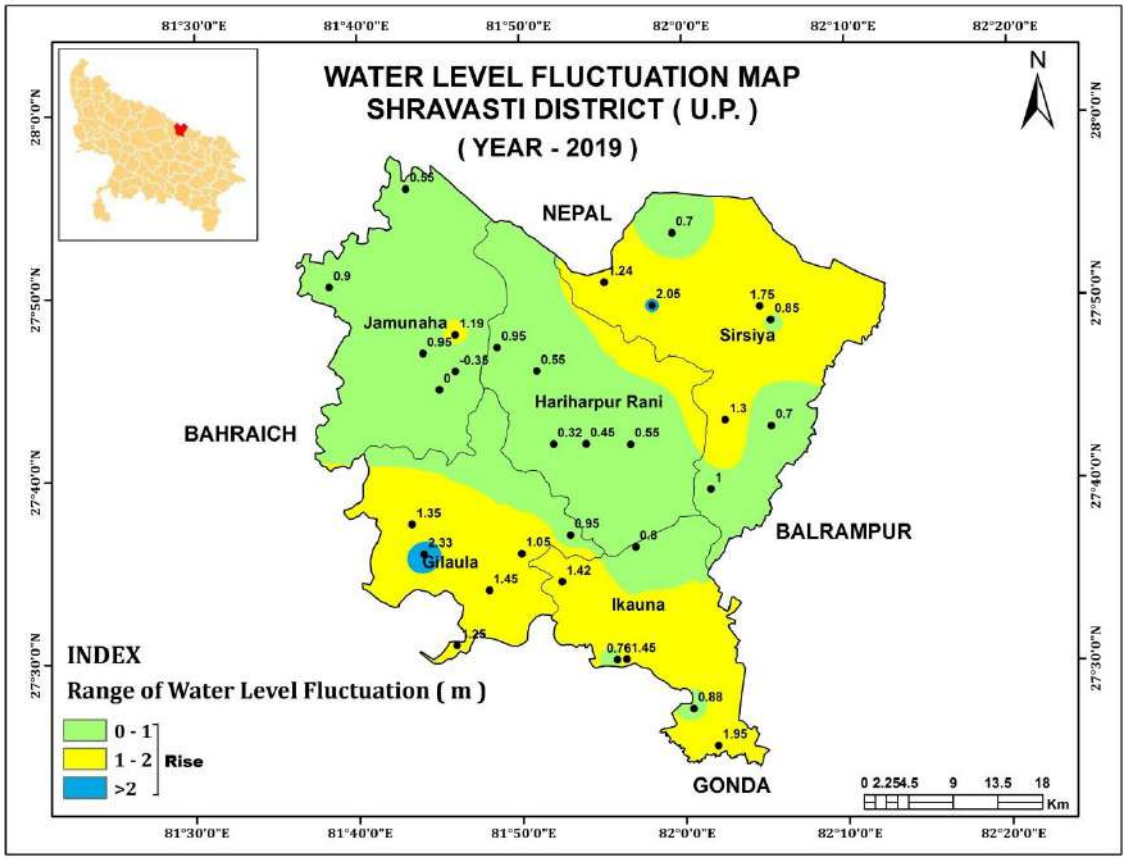


Figure 10: Water Level Fluctuation Map of Shravasti district

2.2.2. Water Table:

Water table contour map prepared for the pre-monsoon period in order to determine the flow direction (figure-11). The elevation of the water table ranges from 174 m in the north to 111 m above mean sea level in the south of the area. There is a fall of water level elevation from north to south of an order of 63 m. A perusal of the water table contour map shows that the general ground water movement direction is from north to south except for some localised variations which correspondence with the general topography of the area.

The steepness of the water table contours in the trans Rapti region in the north-east corner of the district indicated low permeability of the aquifers showing the finer sediments where as in the southern portion of the district gradient is very low which indicates that the formations are highly permeable. The hydraulic gradient of water table ranges between 0.13 m/km and 4m/km.

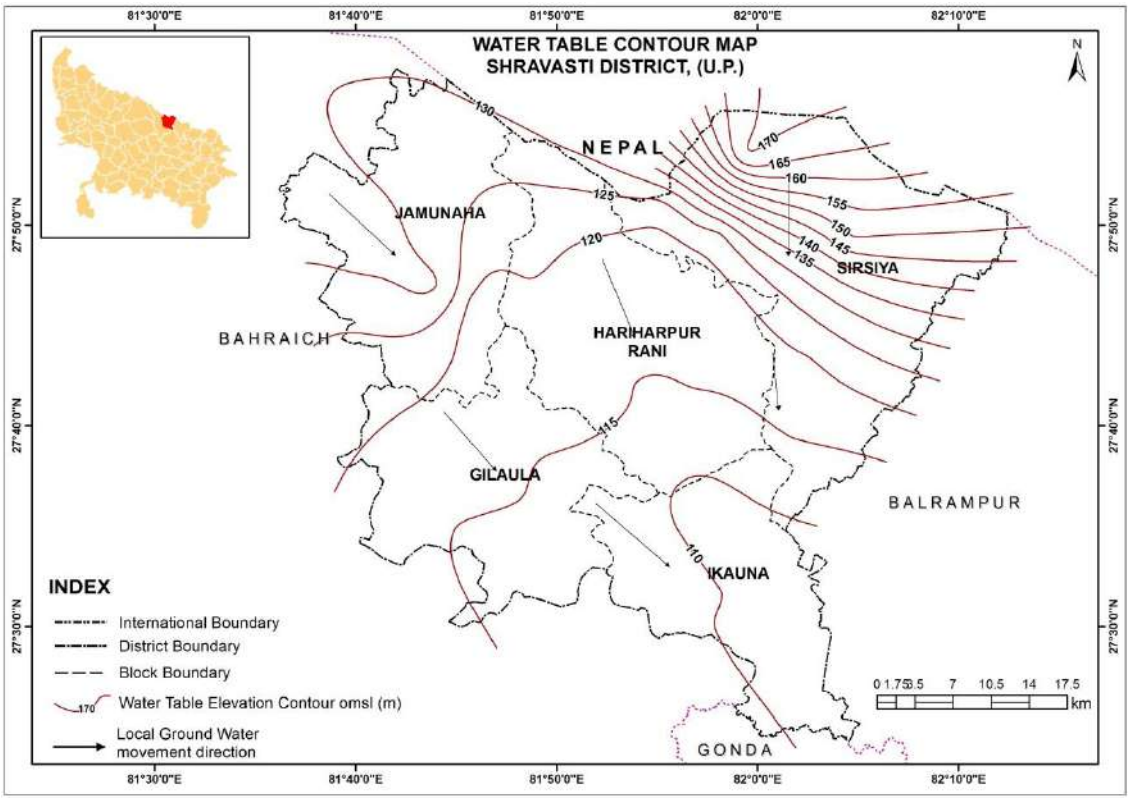


Figure 11: Water Table Contour Map of Shravasti district

2.2.3. Water Level Trend:

Long term water level trend reflected by water level hydrographs which indicates change in groundwater storage in phreatic zone with time. Changes in storage results from atmospheric pressure, differences in recharge and withdrawal with time. Based on water level data of 10 years a long term water level trend for pre and post monsoon period has been worked out and summarised as follows (Table-8):

Table 8: Long Term Water Level Trend (2010 – 2019) , Shravasti District, U.P

		Pre Monsoon		Post Monsoon	
Sl No.	**Location**	**Rise (m/year)**	**Fall (m/year)**	**Rise (m/year)**	**Fall (m/year)**
1	Sirsia1		0.0278	0.0498	
2	Shravasti		0.0291		0.0085
3	Laxman nagar		0.0333	0.0212	
4	Badla village		0.0011		0.1605
5	Pratapur	0.0545			0.0594
6	Ratanpur	0.0087			0.0142
7	Bhujanga	0.1668		0.1380	
8	Bhagwanpur		0.0231		0.0240
9	Madora chowki	0.0019			0.0115
10	Dikauli		0.0293		0.0648

On perusal of hydrograph trend (2010-2019) for 10 years it is observed that in general there is a minor fall in water level in major part of the district both in premonsoon and postmonsoon period which may be due to over exploitation of ground water and less recharge (figures 12-18). Rise in water level is observed at Pratapur, Ratanpur, Madora chowki and Bhujanga during premonsoon period while during postmonsoon period rising trend is observed at Sirsia1, Laxman nagar and Bhujanga. Rise in water level may be due to greater precipitation and recharge in the area.

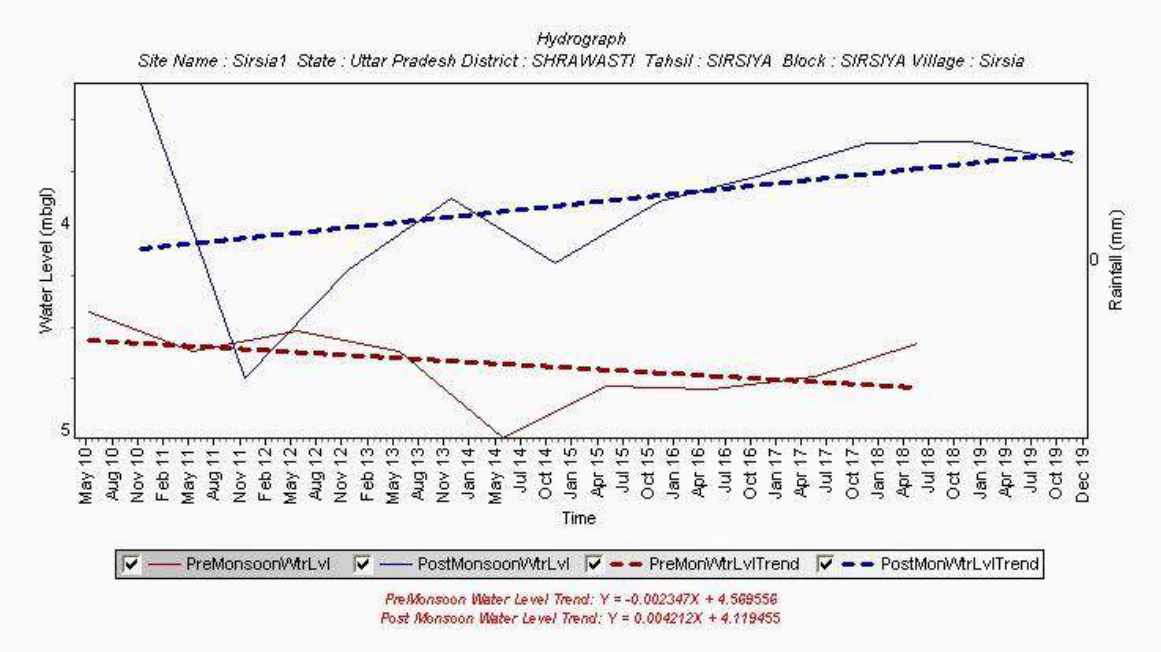


Figure 12: Long Term Water Level Trend of Sirsia1 (2010 – 2019) , Shravasti District

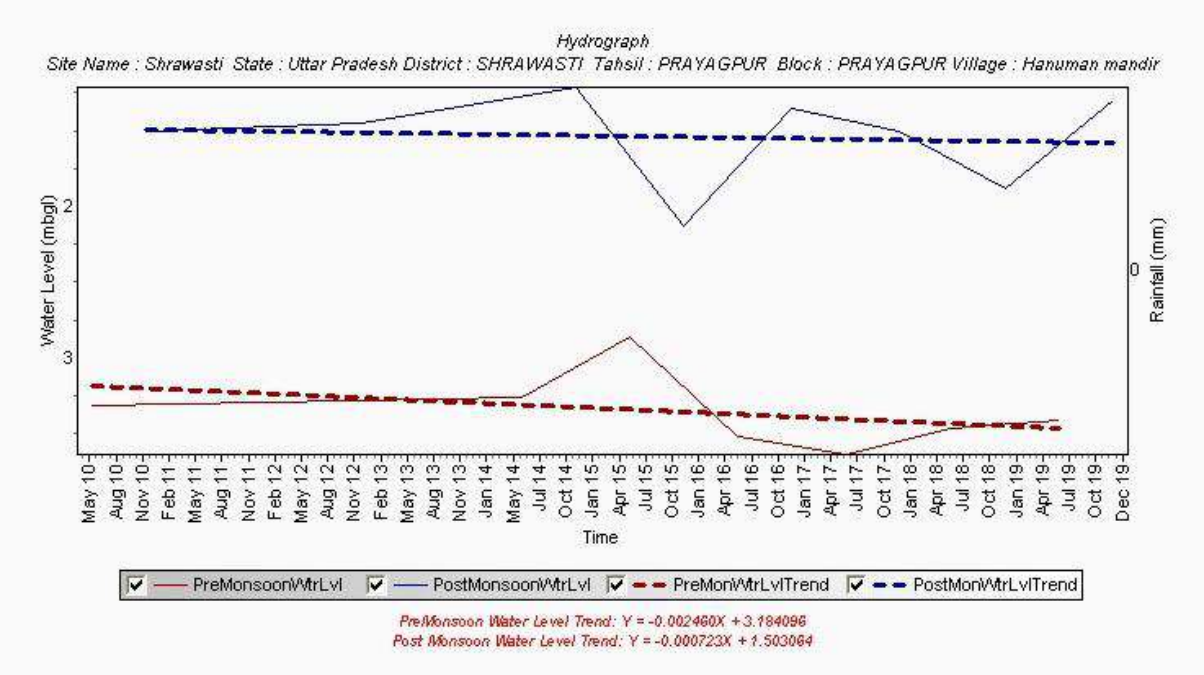


Figure 13 : Long Term Water Level Trend of Shravasti (2010 – 2019) , Shravasti District

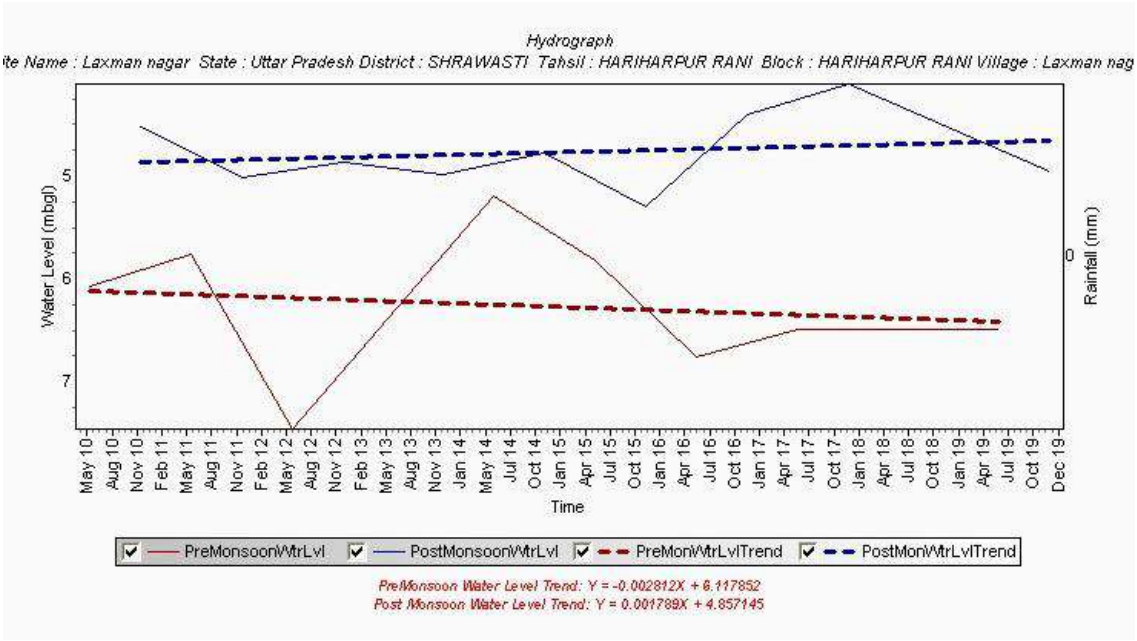


Figure 14: Long Term Water Level Trend of Laxman nagar (2010 – 2019) , Shravasti District

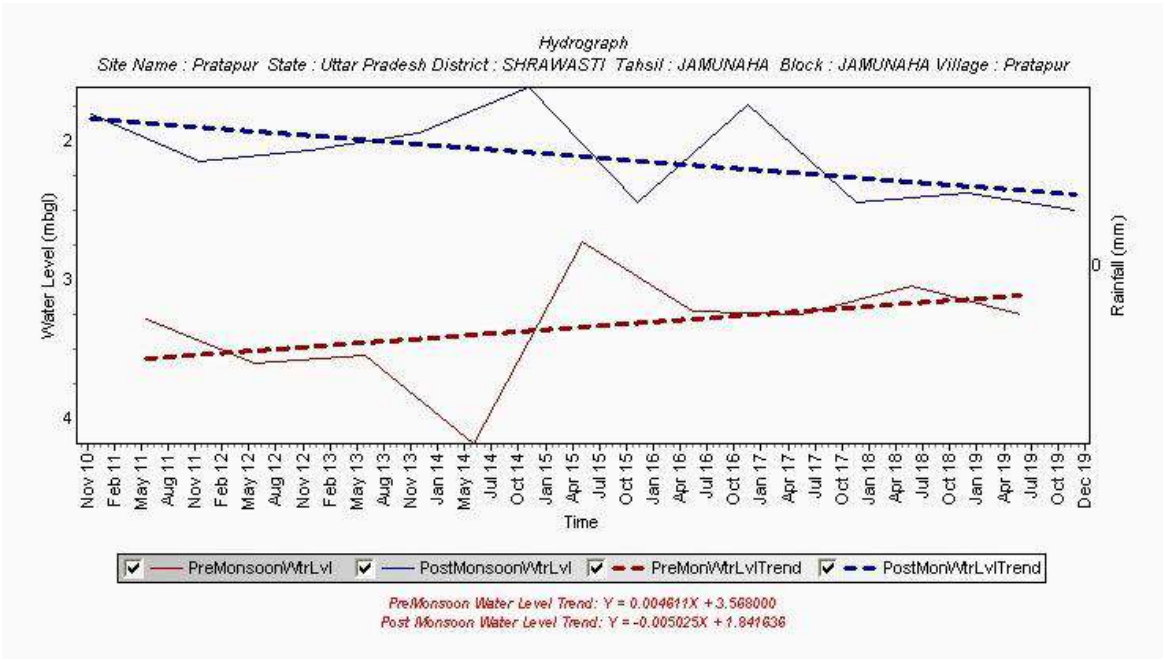


Figure 15: Long Term Water Level Trend of Pratapur (2010 – 2019) , Shravasti District

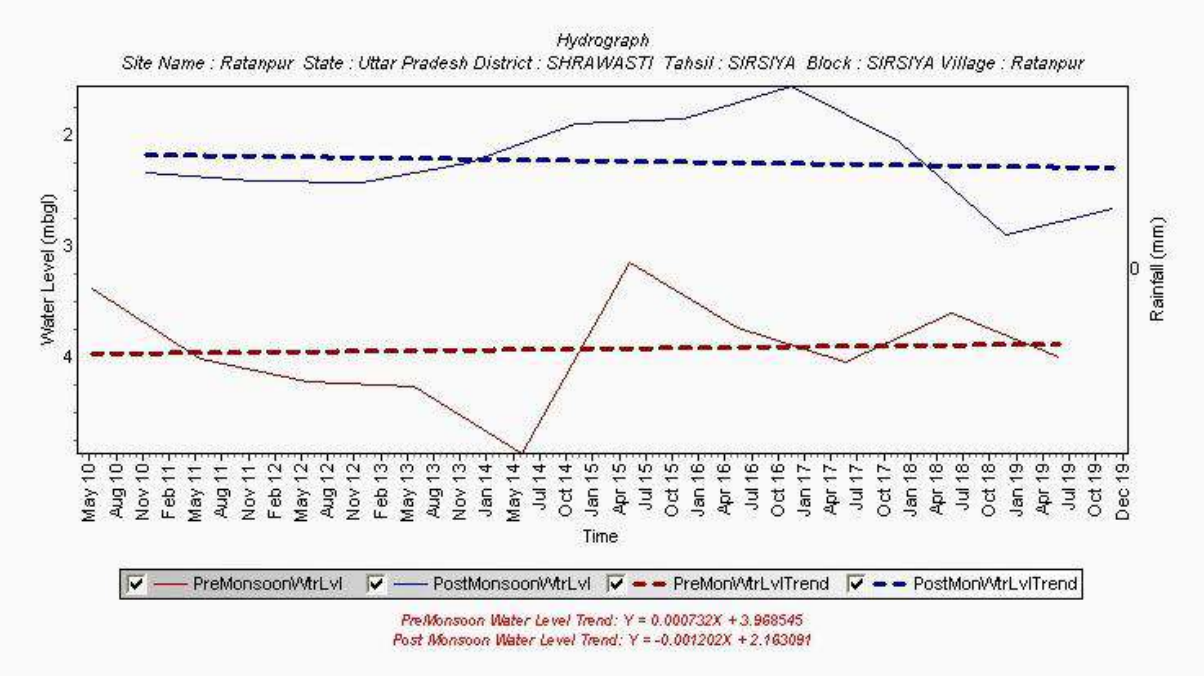


Figure 16: Long Term Water Level Trend of Ratanpur (2010 – 2019) , Shravasti District

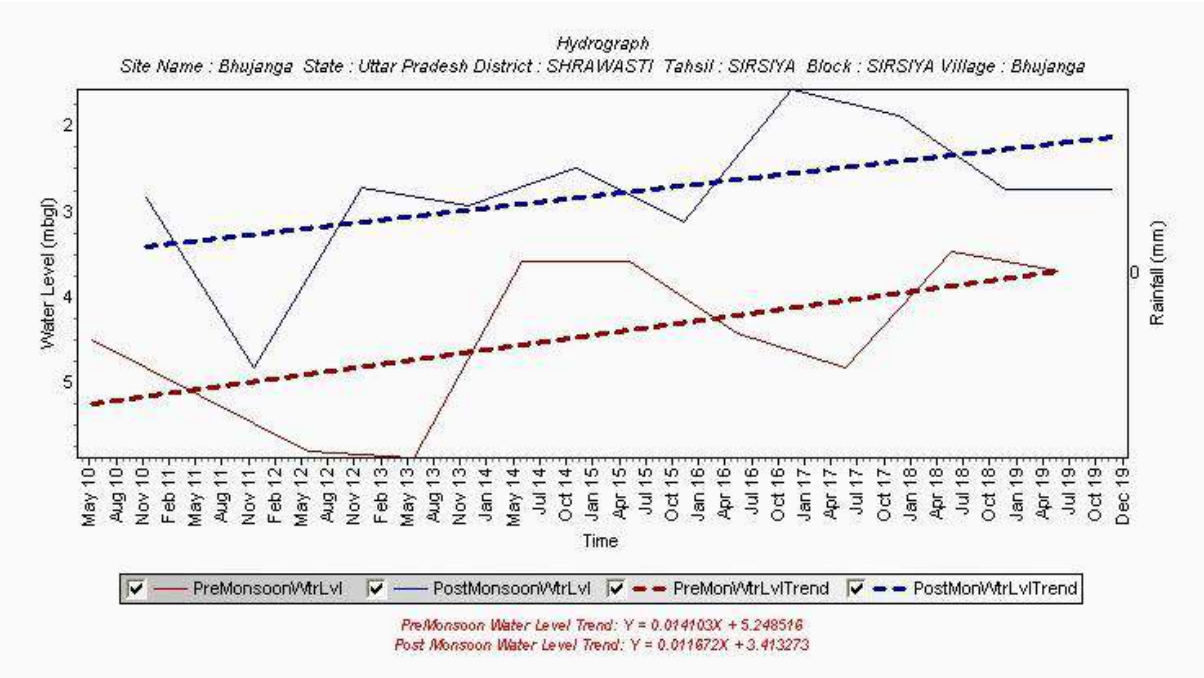


Figure 17 : Long Term Water Level Trend of Bhujanga (2010 – 2019) , Shravasti District

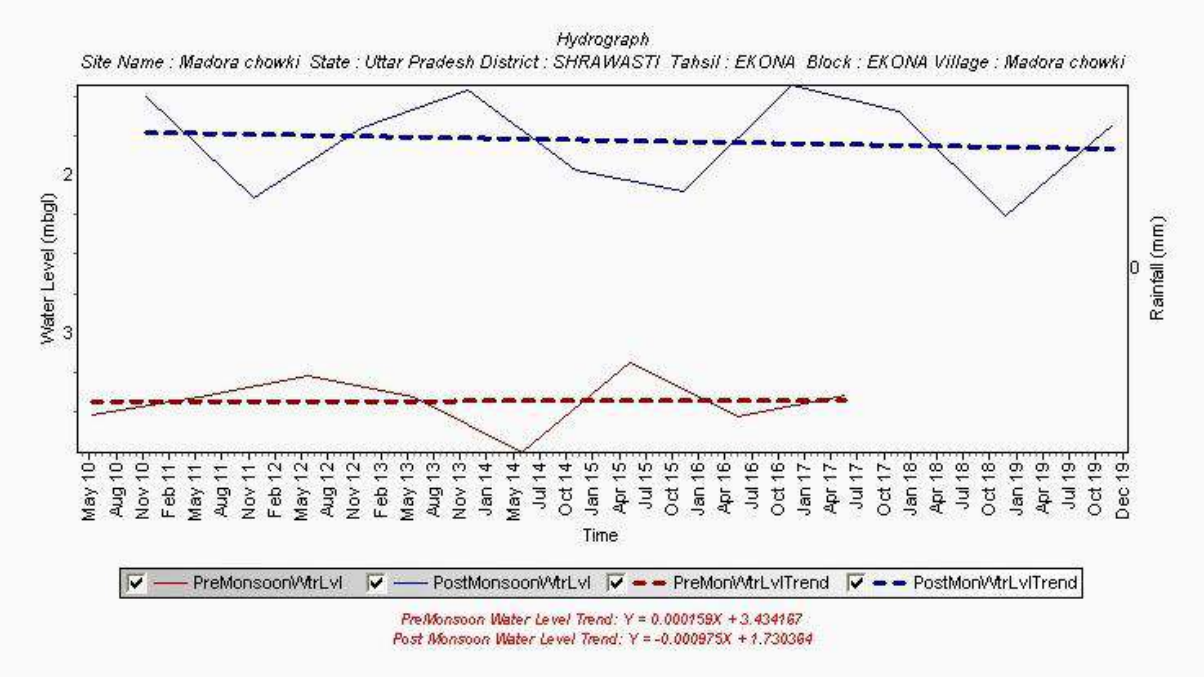


Figure 18: Long Term Water Level Trend of Madora chowki (2010 – 2019) , Shravasti District

2.3. Hydrochemistry

Groundwater is the most important and essential natural resource for domestic, industrial and agricultural needs. Quality of ground water is as much demanding as its quantity. To study the chemical quality of ground water for domestic, irrigation and industrial uses total of 20 samples (4 samples from each block) of shallow aquifers were collected. All the collected samples were analysed in chemical laboratory of CGWB NR, Lucknow by adopting standard methods of analysis (APHA). The results reveals that the chemical quality of ground water is good and is suitable for irrigation as well as for domestic purpose except for a few localized pockets where concentration of Fe and As are more than the permissible limits (figure-19). Results of chemical analysis data of ground water samples is given in Annexure–II and III. Brief description of the chemical results is as follows.

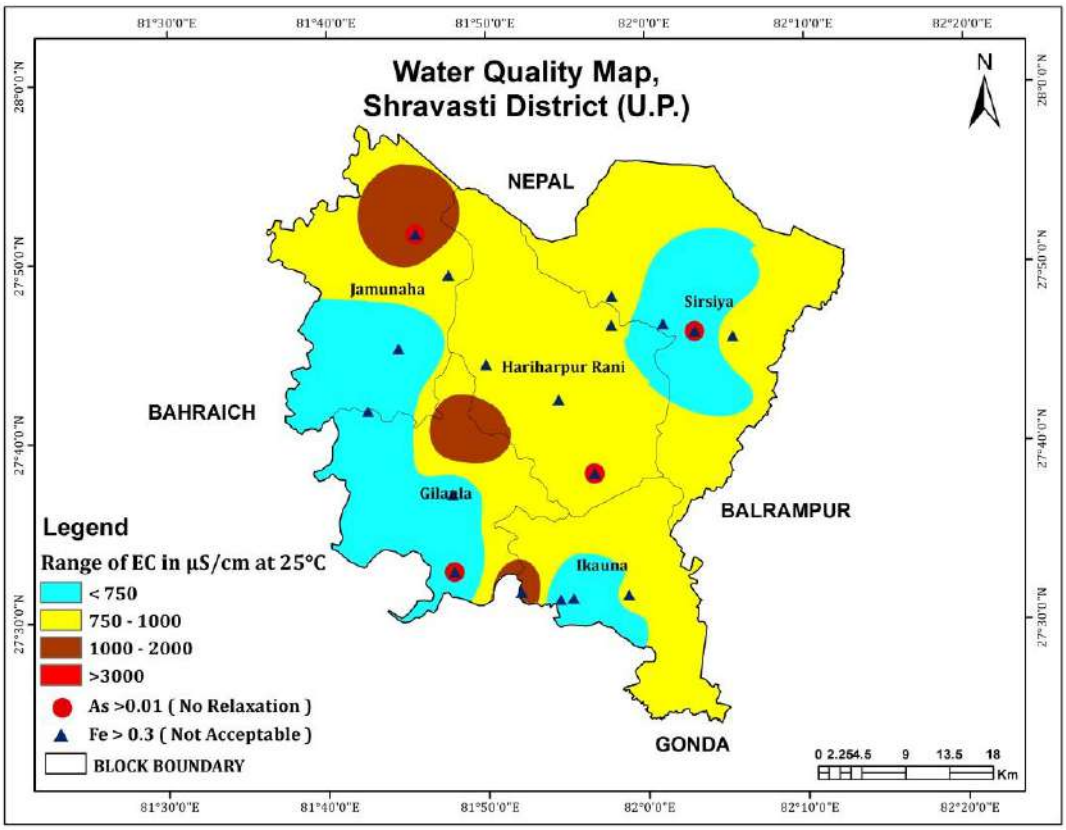


Figure-19: Water Quality Map of Shravasti district

2.3.1. Results of Basic constituents

i. pH Value:

pH is a measure of the hydrogen ion concentration of a solution. It shows how acidic or basic water is. pH in most part of the study area is within the acceptable/desirable limit of BIS (6.5-8.5 mg/l) and is neutral to moderately alkaline in nature.

ii. Electrical Conductivity

Electrical conductivity (EC) for groundwater is the ability of 1 cm^3 water to conduct an electric current at 25˚C. It's a measure of total mineralization in water, indicating salinity of groundwater. EC of ground water in area is generally within the permissible limits of BIS i.e. < 3000 µS/cm at 25^{o}C shown in (Figure-20).

iii. Total Hardness as $CaCO_3$:

High concentration of carbonates, bicarbonates of calcium and magnesium, in ground water causes hardness. Hardness concentration in most part of the study area is within the permissible limit of BIS (200-600 mg/l), except for one sample which shows slightly higher value i.e. 640 mg/l (Gilaula) shown in the figure-21.

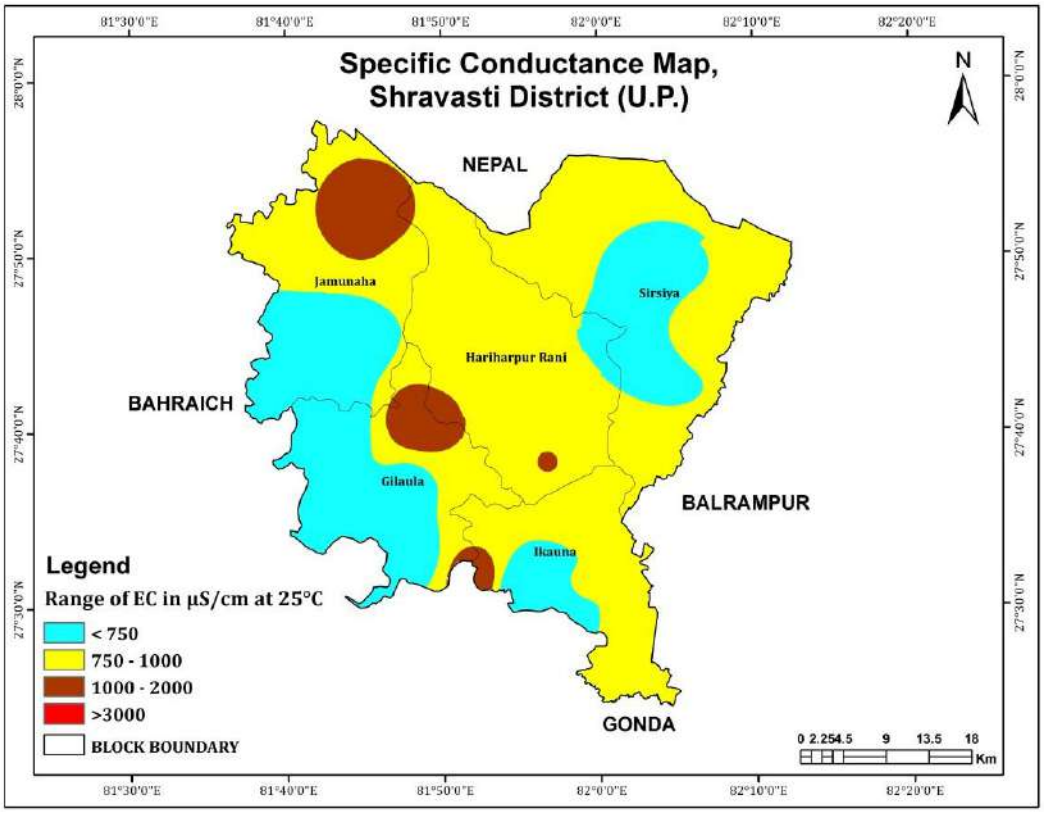


Figure-20: Specific Conductance Map of Shravasti district

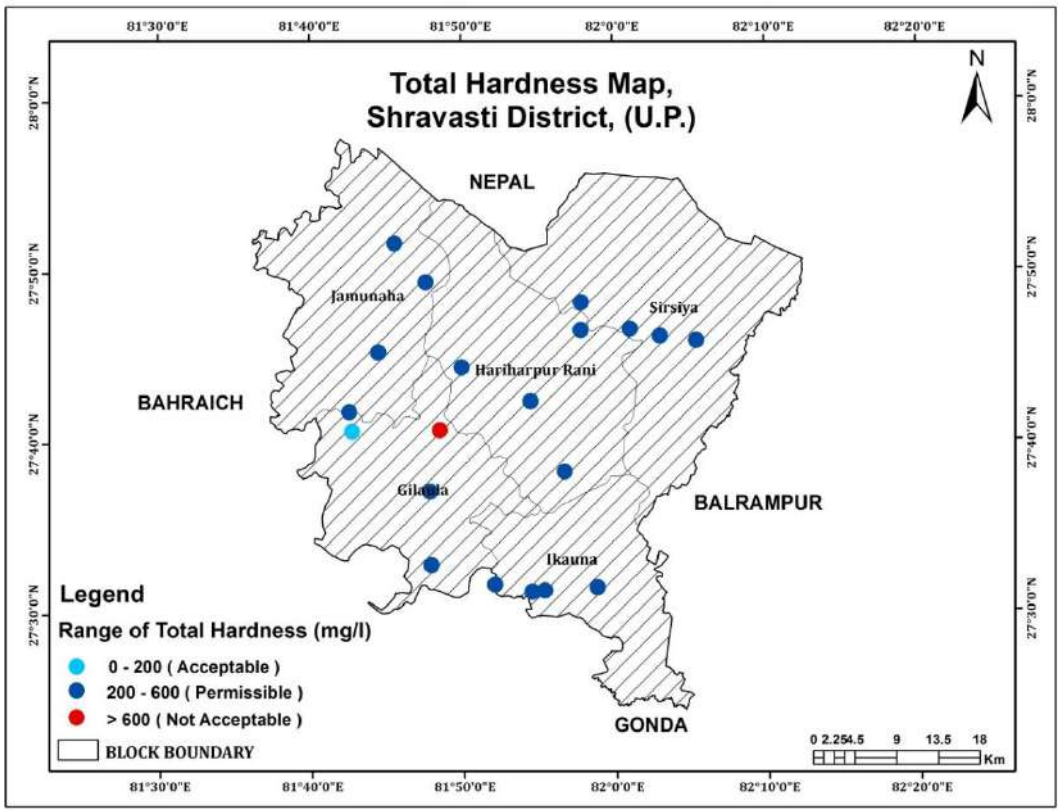


Figure-21: Total Hardness Map of Shravasti district

iv. Carbonates (CO_3) and Bicarbonates (HCO_3):

Bicarbonates associated with carbonates effect the alkalinity of groundwater. The concentration of carbonates (CO3) in all the water samples is nil while the concentration of Bicarbonates (HCO_3) in all the samples is below 600 mg/l which is considered to be safe (BIS-2012) for domestic and irrigation purpose except for one sample with higher concentration of HCO3 (Ikauna, 622 mg/l).

v. Calcium (Ca):

Presence of calcium contributes to the hardness of water. Calcium concentration is within the acceptable/permissible limit of BIS (0-200 mg/l) in all the parts of the study area (Figure-22).

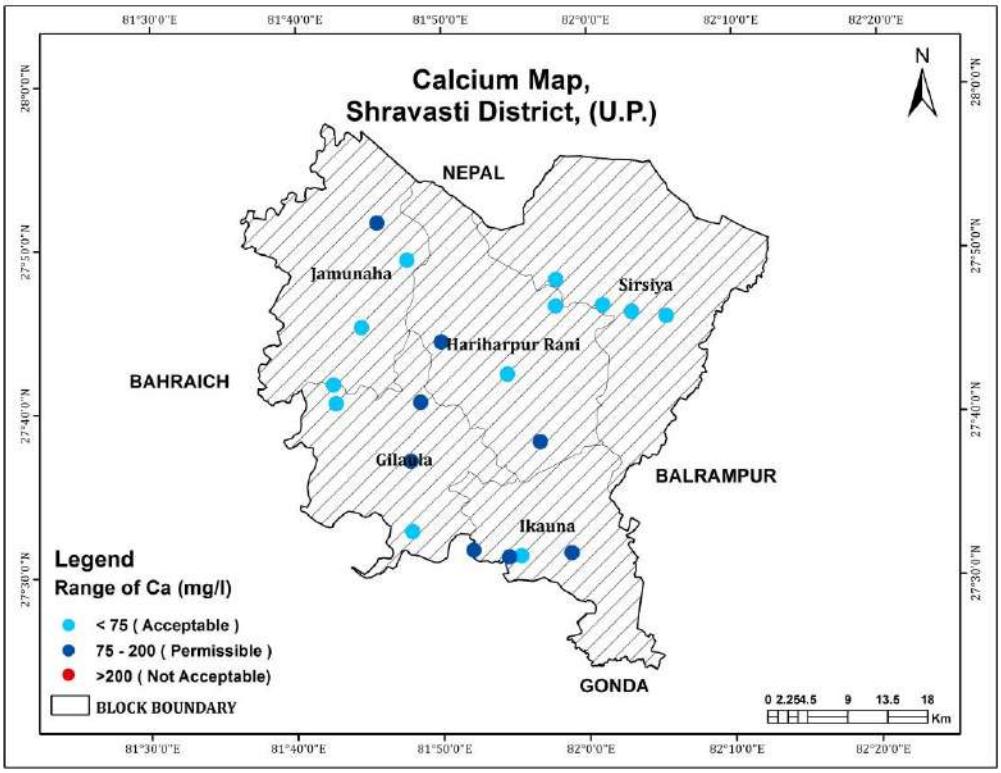


Figure-22: Calcium distribution Map of Shravasti district

vi. Magnesium (Mg):

Excess of magnesium contributes to the hardness of water. Magnesium concentration in the study area is within the acceptable/permissible limit of BIS (0-100 mg/l) as shown in the figure-23.

vii. Sodium (Na) and Potassium (K):

No standard desirable limits for Sodium and Potassium concentration in the drinking water have been given. However, in the study area the values of Na ranges in between 7- 110 mg/l and K values ranges in between 1-6.6 mg/l.

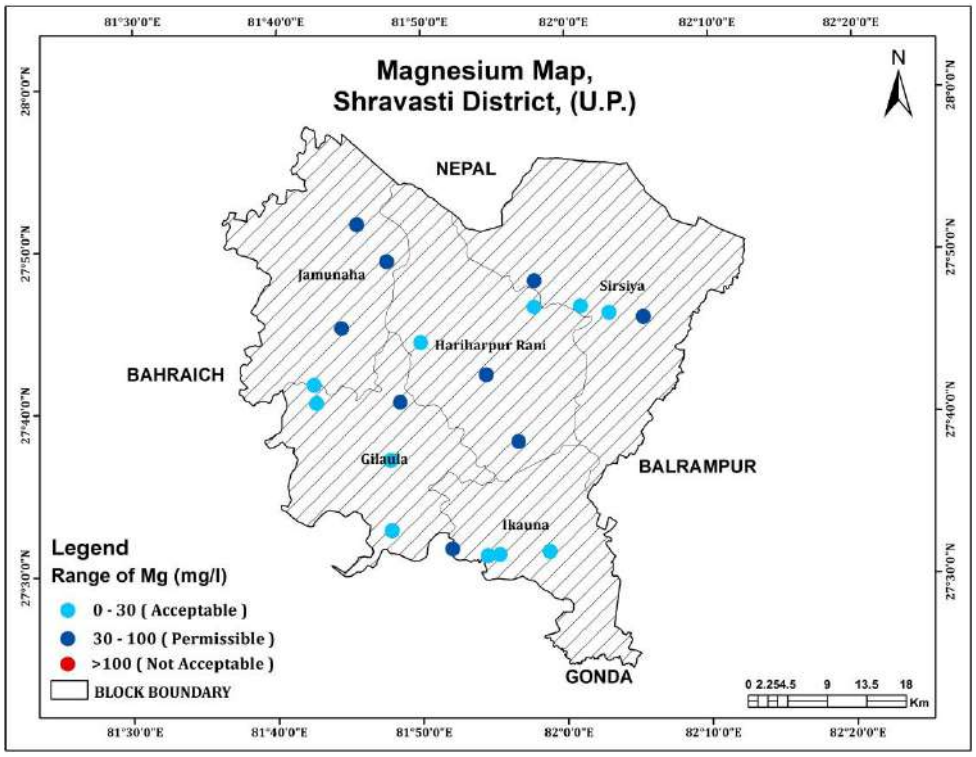


Figure-23: Magnesium distribution Map of Shravasti district

viii. Fluoride (F):

Higher concentration fluoride intake causes different types of diseases like fluorosis, primarily dental and skeletal fluorosis. Fluoride concentration in most part of the study area is below detection limit (BDL) and rest of the samples show concentration within the acceptable limit of BIS (0-10 mg/l) as shown in the figure-24.

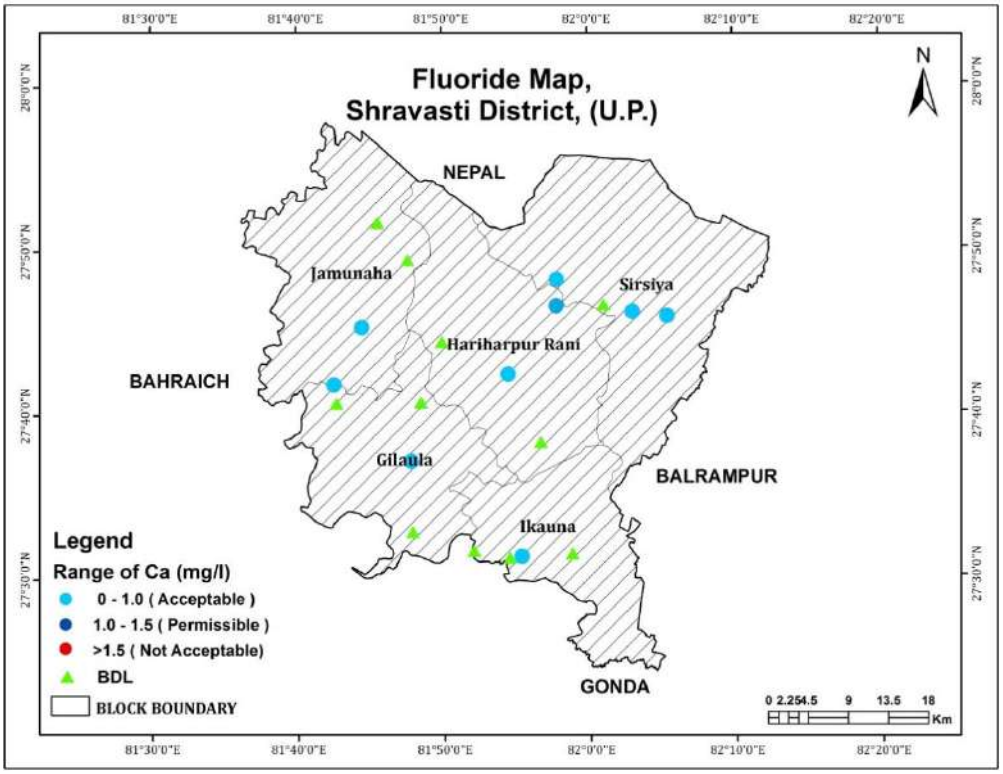


Figure-24: Fluoride distribution Map of Shravasti district

ix. Nitrate (NO_3) and Sulphate (SO_4):

Nitrate and Sulphate concentration in most part of the district is below detection limit (BDL) and rest of the samples show concentration within the acceptable limit of BIS (45 mg/l) for nitrate and (0-200 mg/l) for sulphate respectively. High sulphate levels in drinking water results in gastro-intestinal disorders.

x. Chloride

Chloride concentration is within the acceptable/desirable limit of BIS (0-250 mg/l) in all part of the study area (Figure-25).

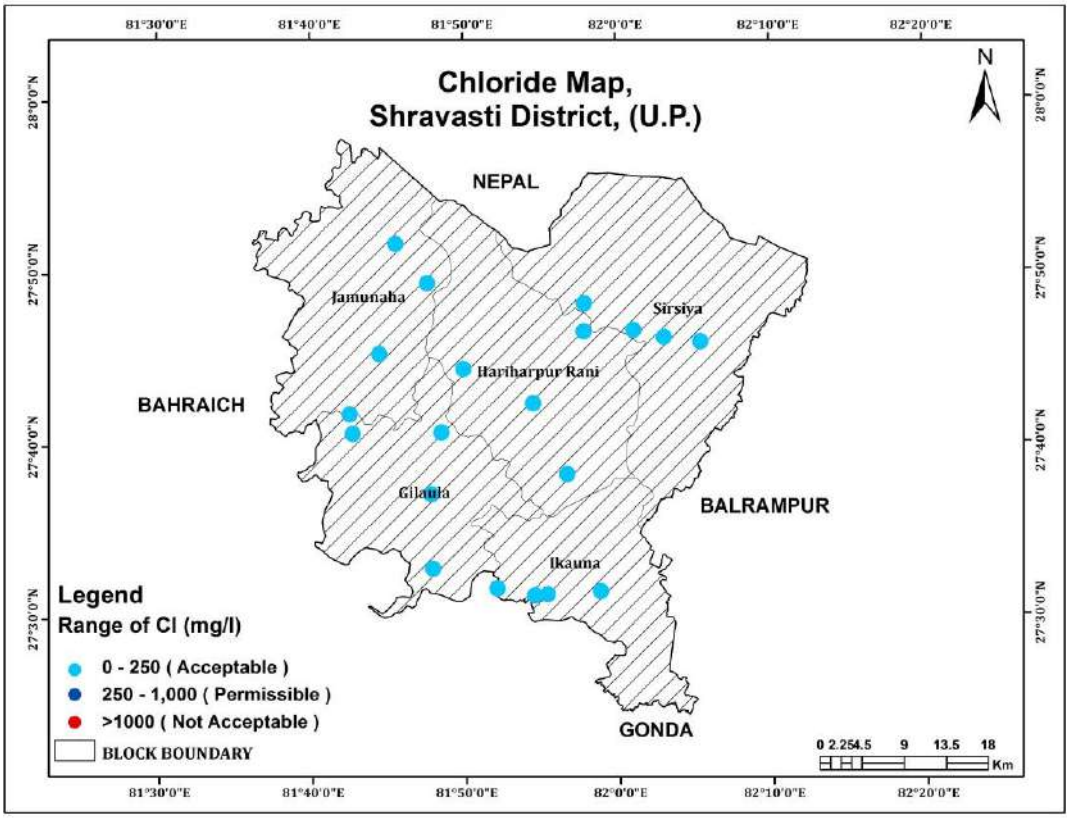


Figure-25: Chloride distribution Map of Shravasti district

Piper Diagram

To interpret the hydrochemical facies of shallow/ phreatic aquifer Piper diagram has been plotted (figure-26) which shows the ground water samples are Calcium and Bicarbonate type in cation and anion triangle. The Ca–HCO3 water is primarily a result of dissolution of carbonate minerals in groundwater. From the diamond plot we can interpret that weak acids exceeds strong acids and alkaline earth exceeds alkalies in the samples.

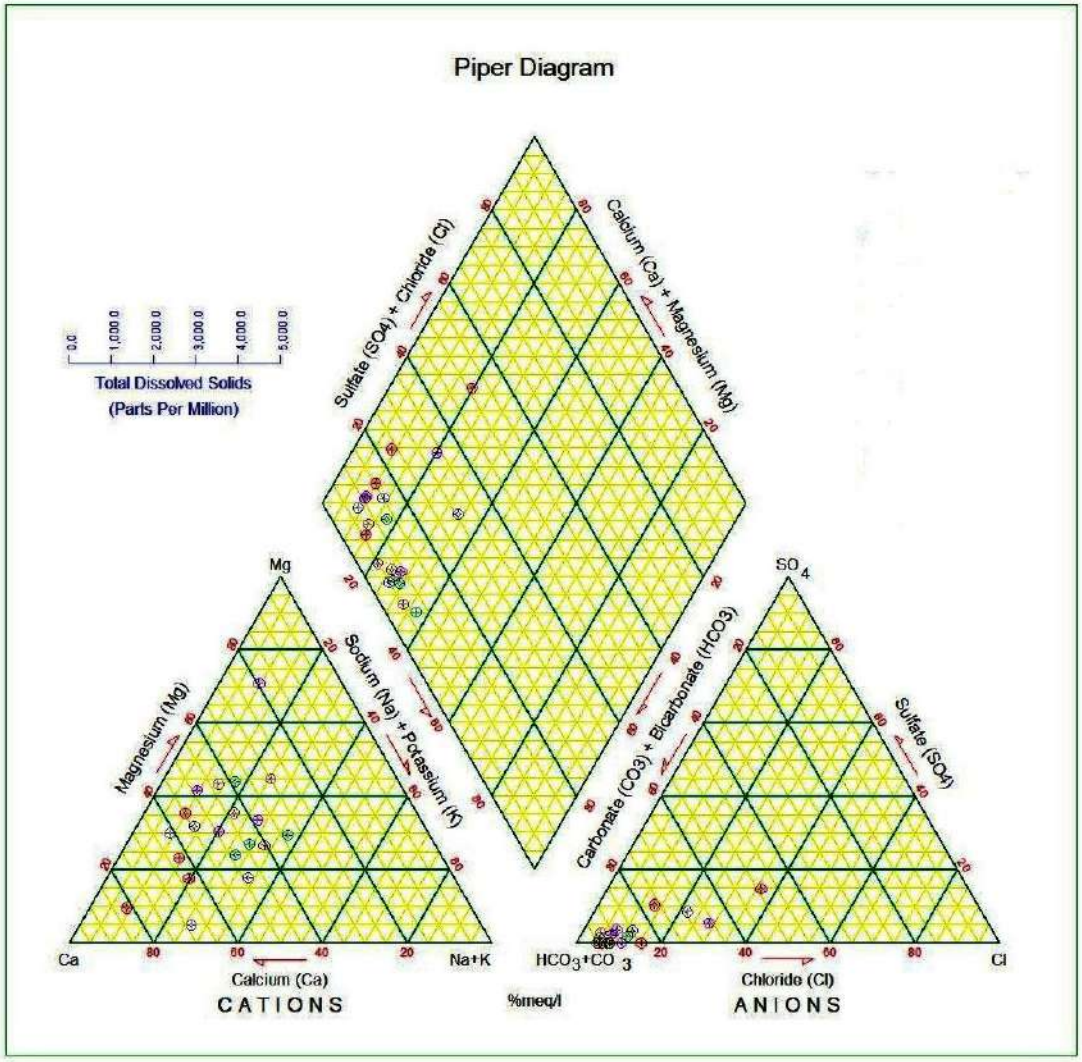


Figure-26: Piper diagram for Hydrochemical facies

2.3.2. Results of Heavy Metal

Presence of heavy metals in ground water has significant influence on human being due to their toxic nature and absorption behaviour as these are non- biodegradable. The toxicity of heavy metal depends on their concentration level. The major sources of heavy metals in ground water include weathering of rock minerals, discharge of sewage and other waste effluents on land and runoff water. The results of heavy metal in water samples are given in Annexure-II.

i. Copper (Cu) and Chromium (Cr)

The Bureau of Indian Standards (BIS, 2012), has recommended 1.5 mg/l as the permissible limit for Cu and 0.05 mg/l as the permissible limit for Cr. The concentration of Copper and Chromium in groundwater samples of the study area is below detection limit (BDL), hence the ground water is safe for drinking and domestic purposes.

ii. Manganese (Mn) and Zinc (Zn)

Manganese and Zinc concentration in groundwater samples in most part of the study area is below detection limit (BDL). Only few samples show concentration that too within the acceptable limit of BIS (0.3 mg/l) for Mn and (15 mg/l) for Zn.

iii. Lead (Pb)

Lead is a hazardous component; it is injurious even in minor quantities. Lead concentration in groundwater samples in most part of the study area is below detection limit (BDL). Only few samples show concentration that too within the acceptable limit of BIS (0.01 mg/l) (figure-27).

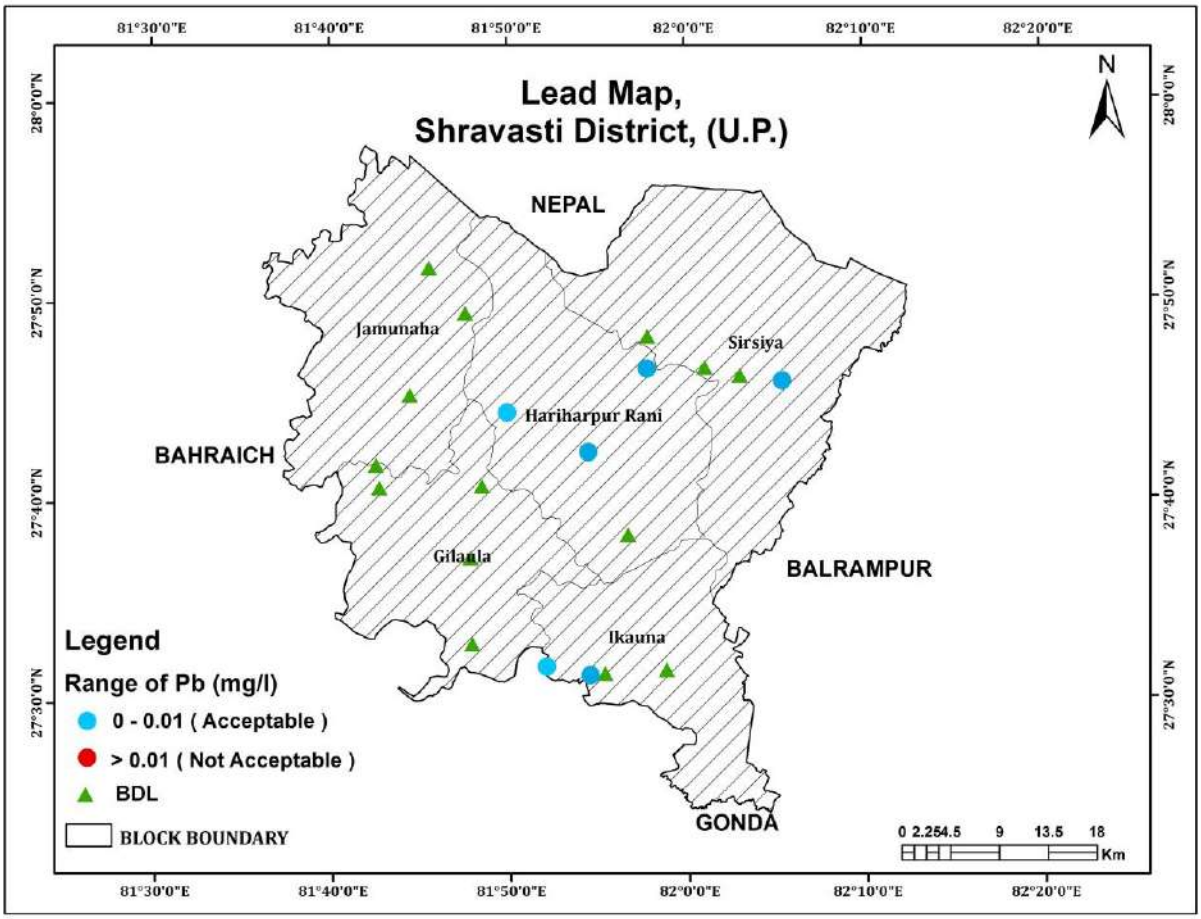


Figure-27: Lead distribution Map of Shravasti district

iv. Zinc (Zn)

Zinc is an important mineral apparent by the human today as being excellent biologic and human health significance, mainly concerning prenatal and perinatal growth. Zinc concentration in groundwater samples of the study area is below detection limit (BDL). Only few samples show concentration that too within the acceptable limit of BIS (15 mg/l).

v. Iron (Fe)

Concentration of iron in ground water samples of the study area ranges from 0.256 to 11.595 mg/l. Bureau of Indian Standards (BIS, 2012) has recommended 0.3 mg/l as the maximum permissible limit for iron in drinking water. Except for 2 samples all the groundwater samples show higher Fe concentration i.e. >0.3 mg/l (figure-28). High concentrations of iron may cause metallic taste to the water and staining of plumbing fixtures. The objection to iron in the distribution system is not due to health reason but to staining of laundry and plumbing fixtures and appearance.

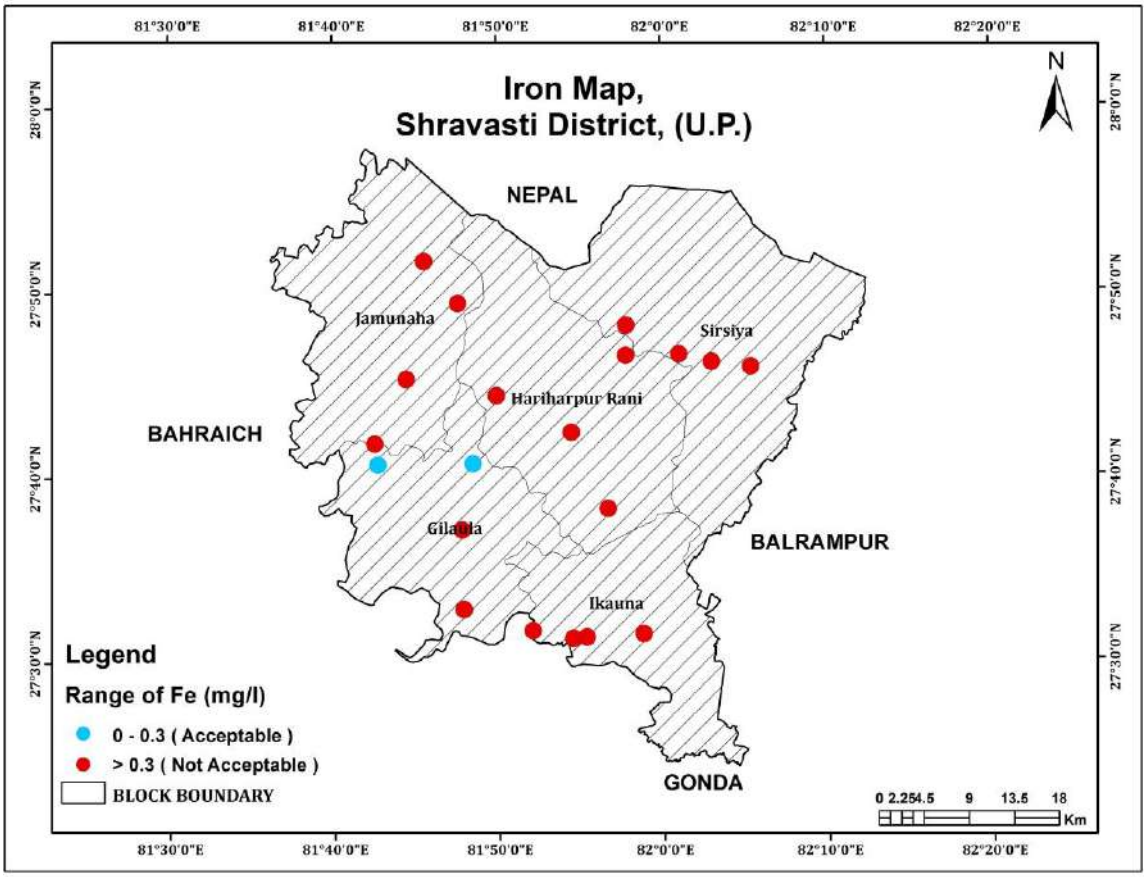


Figure-28: Iron distribution Map of Shravasti district

vi. Arsenic (As)

Source of arsenic in groundwater may be natural during weathering of rocks or from anthropogenic activities like intense exploitation of groundwater, application of fertilizers, burning of coal and leaching of metals from coal-ash tailings. Arsenic is highly toxic element. Arsenic concentration in groundwater samples of the study area is below detection limit (BDL) and within acceptable limit (0-0.01 mg/l). Only four samples show higher concentration with no relaxation limit of BIS (>0.01 mg/l) (figure-29). Sample collected from Bhujanga, Sirsiya Block shows alarming situation with concentration of arsenic (0.225 mg/l).

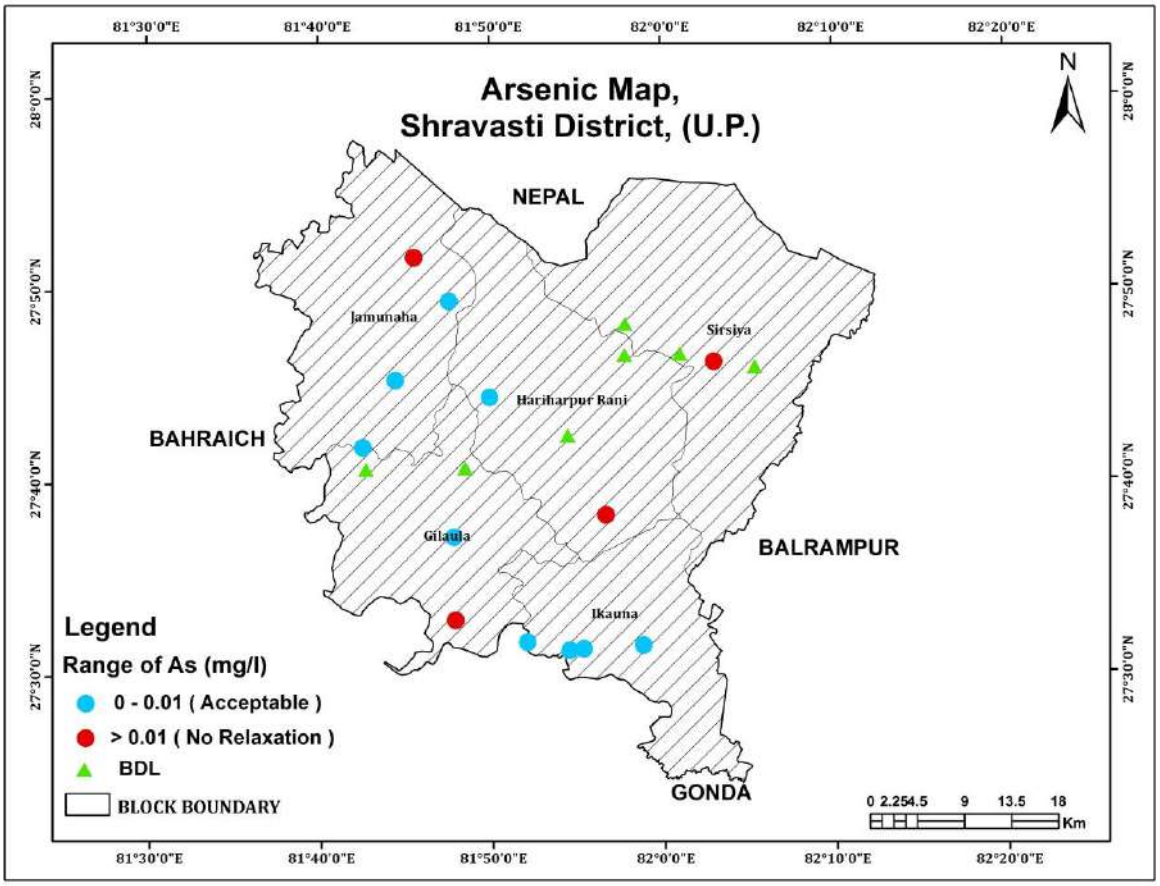


Figure-29: Arsenic distribution Map of Shravasti district

2.3.3. Ground Water Quality of Comparatively Deeper Aquifers:

Chemical analysis results of the ground water collected from the comparatively deeper Aquifers (semi-confined / confined) through departmental Exploratory wells shows that the basic constituents and heavy metals concentration are all within the permissible limit of Bureau of Indian Standards (BIS, 2012) recommendation except for iron with higher concentration values ranging from 0.39 mg/l to 0.576 mg/l (BIS acceptable range is 0.0-0.3). Analytical results of ground water samples are given in Annexure- IV and V.

2.4. Geophysical

Geophysical studies carried out in the Aquifer Mapping area comprises of VES with Schlumberger array, Resistivity Profiling with Wenner configuration and Borehole Electrical Loggings. The self–potential, short and long normal resistivity logs thus obtained were utilized for precise delineation of granular zones with quality of formation water therein and also to demarcate the exact contacts of permeable and impermeable horizons. Geophysical log graph (Resistivity and Natural Gamma log) are shown in Plate-II. A total of 25 VES (soft rock) were conducted in Shravasti district through outsourcing (WAPCOS) (Plate III).

It is observed from correlation study that different range of resistivity for a particular column depicts a combined effect of a good nos. of thin layers (5 to 10 meter thick approx.). Hence at deeper level the less resistivities such as 20 to 30 ohm m or nearing to that refers combined resistivity of a good nos. layers i.e., fine sand, fine to medium sand or medium sand layer with the alternating clay or sandy clay layers. Hence these resistivities cannot be neglected. If sand medium or fine to medium sand layers can be detected and tapped through bore hole

assembly these zones may be productive aquifers. Hence the specific depths of the aquifer layers identified by geophysical logging as well as geological litholog study. If the resistivity is found to be little higher then it may be due to presence of coarse sand or gravels. Sometimes the higher value infers the presence of silty sand or ferruginous nodule/kankar. E-log results of boreholes are given as follows-

i. E-Log 1: Bara Karanpur, Block-Jamunaha

S.No	Depth Range (m)		Thickness (m)	SP (mv)	LON-64" N Resistivity (ohm.m)	SHN-16" N Resistivity (ohm.m)	NGAM-Natural Gamma (cps)	Inferred Lithology	Quality of aquifer water
	From	To							
1	5	20	15	-25	-	-	-	Surface alluvium	
2	20	32	12	-7	75	50	65-75	Sand	Good
3	32	37	5	0	40	20	95	Clay	
4	37	55	18	-10	60	50	75	Sand	Good
5	55	65	10	0	25	15	100	Clay	
6	65	110	45	-12	60	45	75	Sand	Good
7	110	118	8	+5	25	20	90	Clay	
8	118	155	37	-12	60	45	70	Sand	Good
9	155	205	50	-16	45	40	65-95	Mixed zone	
10	205	215	10	+5	15	10	100	Clay	
11	215	250	35	-15	45	40	70	Sand	Good
12	250	265	15	+4	20	20	100	Clay	
13	265	290	25	-16	50	45	50-70	Sand	Good
14	290	295	5	+5	20	15	100	Clay	
15	295	300	5	-15	30	30	60	Sand	Good

ii. E-Log 2: Bhagwanpur Bankat, Block-Ikauna

S.No	Depth Range (m)		Thickness (m)	SP (mv)	LON-64" N Resistivity (ohm.m)	SHN-16" N Resistivity (ohm.m)	NGAM-Natural Gamma (cps)	Inferred Lithology	Quality of aquifer water
	From	To							
1	5	20	15	-25	-	-	-	Surface alluvium	
2	20	32	12	-7	75	50	65-75	Sand	Good
3	32	37	5	0	40	20	95	Clay	
4	37	55	18	-10	60	50	75	Sand	Good
5	55	65	10	0	25	15	100	Clay	
6	65	110	45	-12	60	45	75	Sand	Good
7	110	118	8	+5	25	20	90	Clay	
8	118	155	37	-12	60	45	70	Sand	Good
9	155	205	50	-16	45	40	65-95	Mixed zone	
10	205	215	10	+5	15	10	100	Clay	

11	215	250	35	-15	45	40	70	Sand	Good
12	250	265	15	+4	20	20	100	Clay	
13	265	290	25	-16	50	45	50-70	Sand	Good
14	290	295	5	+5	20	15	100	Clay	
15	295	300	5	-15	30	30	60	Sand	Good

iii. E-Log 3: Charghariya, Block-Sirsiya

S. No	Depth Range (m)		Thickness (m)	SP (mv)	LON-64" N Resistivity (ohm.m)	SHN-16" N Resistivity (ohm.m)	NGAM-Natural Gamma (cps)	Inferred Lithology	Quality of aquifer water
	From	To							
1	05	20	15	-	High	High	60-80	Surface Sand (Dry)	
2	20	34	14	-	High	High	60-80	Mix Zone	Good
3	34	40	06	-	50	30	80	Clay	Good
4	40	47	07	10	65	45	65	Sand	Good
5	47	57	10	5	43-50	27-40	70	Sandy Clay	Good
6	57	63	06	10	58	47	60	Sand	Good
7	63	67	04	10	54	45	70	Sandy Clay	Good
8	67	78	11	20	45-55	40-50	50-60	Sand	Good
9	78	119	41	5-15	25-30	20-35	60-75	Mix Zone	Good
10	119	123	04	5	40	43	50	Sand	Good
11	123	128	05	-	30	20	75	Clay	Good
12	128	150	22	5	50	45	55	Sand	Good
13	150	154	04	-	25	20	70	Clay	Good
14	154	161	07	5	44	40	55	Sand	Good
15	161	185	24	-	20-30	15-35	70-85	Sandy Clay & Kankar	Good
16	185	191	06	5	45	45	55	Sand	Good
17	191	200	09	10	25	25	75	Clay	Good
18	200	203	03	20	35	35	70	Fine Sand	Good

iv. E-Log 4: Hariharpur Rani, Block- Hariharpur Rani

S. No	Depth Range (m)		Thickness (m)	SP (mv)	LON-64" N Resistivity (ohm.m)	SHN-16" N Resistivity (ohm.m)	NGAM-Natural Gamma (cps)	Inferred Lithology	Quality of aquifer water
	From	To							
1	05	20	15	-	-	-	40-65	Surface Sand (Dry)	
2	20	36	16	-	High	50	40-55	Sand	Good
3	36	45	09	-	50-65	30-40	60-75	Sandy Clay	Good
4	45	51	06	+10	43	25	80	Clay	Good
5	51	56	05	-	60	45	40	Sand	Good
6	56	65	09	+10	38	25	75	Clay	Good

7	65	73	08	-	65	50	50	Sand	Good
8	73	87	14	-	25	15	85	Sandy Clay	Good
9	87	95	08	5	48	30	65	Sand	Good
10	95	106	11	5	20	15	80	Clay	Good
11	106	114	08	-	57	45	40	Sand	Good
12	114	117	03	-	35	25	60	Clay	Good
13	117	120	03	5	58	50	40	Sand	Good
14	120	125	05	5	35	22	65	Clay	Good
15	125	147	22	5	50-55	40-45	55	Sand with minor Clay	Good
16	147	152	05	-	30	20	65	Clay	Good
17	152	160	08	-	55	45	40	Sand	Good
18	160	165	05	-	20	15	85	Clay	
19	165	174	09	-	40	35	50	Sand	Good
20	174	182	08	-	20	20	60	Sandy Clay	Good
21	182	190	08	-	45	40	40	Sand	Good

v. E-Log 5: Kodia, Block- Jamunaha

S. No	Depth Range (m)		Thickness (m)	SP (mv)	LON-64" N Resistivity (ohm.m)	SHN-16" N Resistivity (ohm.m)	NGAM-Natural Gamma (cps)	Inferred Lithology	Quality of aquifer water
	From	To							
1	12	28	16	Shale line is shifting with depth. Negative development of SP is observed with varying magnitude.	30-40	17-30	42	Sandy clay	
2	28	42	14		35	25	24	Sand	Good
3	42	47	5		28	19	43	Clay	
4	47	75	28		62-70	40-75	30	Sand with Kankar	Good
5	75	86	11		20	15	56	Clay	
6	86	91	5		45	38	35	Sand	Good
7	91	110	19		30	25	59	Clayey sand with kankar	
8	110	127	17		47	36	32	Sand	Good
9	127	133	6		24	18	50	Clay	
10	133	148	15		42	34	34	Sand	Good
11	148	152	4		27	20	70	Clay	
12	152	190	38		40-46	32-40	35	Sand with Kankar	Good
13	190	196	6		21	16	52	Clayey sand with kankar	
14	196	218	22		38	32	35	Sand	Good
15	218	235	17		16	14	70	Clay with kankar	
16	235	252	17		35	30	40	Sand	Good
17	252	260	8		14	12	68	Clay	
18	260	270	10		40	40	36	Sand	Good
19	270	274	4		25	17	54	Clay	
20	274	290	16		39	35	36	Sand with Kankar	Good
21	290	295	5		18	15	65	Clay	
22	295	305	10		35	31	35	Sand with Kankar	Good

vi. E-Log 6: Malhipur Kalan, Block- Jamunaha

S. No	Depth Range (m)		Thickness (m)	SP (mv)	LON-64" N Resistivity (ohm.m)	SHN-16" N Resistivity (ohm.m)	NGAM-Natural Gamma (cps)	Inferred Lithology	Quality of aquifer water
	From	To							
1	5	15	10	-	-	-	35	Surface alluvium	
2	15	20	5	-	12	20	75	Clay	
3	20	32	12	10	30-45	40	40	Sand	Good
4	32	45	13	-	15	15	85	Clay	
5	45	51	6	8	20-32	20-40	40	Sand	Good
6	51	60	9	5	15-25	20-35	50-75	Intercalated Sand and Clay layers	
7	60	66	6	10	20-75	20-45	40-50	Sand	Good
8	66	72	6	-	20	20	85	Clay	
9	72	83	11	12	20-65	20-40	40-50	Sand	Good
10	83	100	17	5	15-45	15-20	85	Intercalated Sand and Clay layers	
11	100	109	9	10	20-60	20-40	50	Sand	Good
12	109	115	6	-	15	15	85	Clay	
13	115	130	15	7	20-45	20-35	55	Sand	Good
14	130	141	11	-	15-45	15-30	85	Intercalated Sand and Clay layers	
15	141	149	8	12	20-65	20-50	40-50	Sand	Good
16	149	152	3	-	15	15	85	Clay	
17	152	170	18	12	20-55	20-40	50	Sand	Good
18	170	184	14	-	15-40	15-20	85	Clay	
19	184	205	21	15	45	35	40-50	Sand	Good

vii. E-Log 7: Pachdevri, Block- Gilaula

S. No	Depth Range (m)		Thickness (m)	SP (mv)	LON-64" N Resistivity (ohm.m)	SHN-16" N Resistivity (ohm.m)	NGAM-Natural Gamma (cps)	Inferred Lithology	Quality of aquifer water
	From	To							
1	10	46	36	22	145	72	55	Sand	Good
2	46	50	4	36	42	22	70	Clayey Sand	
3	50	66	16	22	82	53	60	Sand	Good
4	66	74	8	26	60	40	60	Sandy Clay	
5	74	144	70	22-36	70	50	60	Sand with Kankar	Good
6	144	148	4	55	40	25	80	Clay with Kankar	
7	148	155	7	30	68	50	50	Sand	Good
8	155	158	3	50	62	43	65	Clayey Sand	

9	158	167	9	36	85	60	50	Sand	Good
10	167	173	6	22	70	50	60	Sandy Clay	
11	173	182	9	30	80	57	60	Sand	Good
12	182	202	20	78	25	20	85	Clay with Kankar	
13	202	208	6	36	60	50	60	Sand	Good
14	208	212	4	50	55	40	60	Sandy Clay	
15	212	236	24	45	90	65	60	Sand	Good
16	236	242	6	78	38	20	75	Clay	
17	242	246	4	52	70	60	55	Sand	Good
18	246	249	3	80	42	20	70	Clay	
19	249	268	19	26	70	55	60	Sand with kankar	Good
20	268	272	4	90	35	20	75	Clay	
21	272	278	6	36	57	48	60	Sand	Good
22	278	286	8	78	30	23	75	Clay with Kankar	
23	286	300	14	26	42	36	70	Sand with clay & kankar	

viii. E-Log 8: Semri Tarhar, Block- Ikauna

S.No	Depth Range (m)		Thickness (m)	SP (mv)	LON-64" N Resistivity (ohm.m)	SHN-16" N Resistivity (ohm.m)	NGAM-Natural Gamma (cps)	Inferred Lithology	Quality of aquifer water
	From	To							
1	05	20	15	-	>85	>85	50-65	Surface Soil (Dry)	
2	20	25	05	-	>85	30 - >85	70	Sand	Good
3	25	28	03	-	>85	40	80	Sandy Clay	Good
4	28	42	14	20	55 - >85	48-55	65	Sand	Good
5	42	45	03	15	50	25	85	Clay	Good
6	45	50	05	20	60	50	60	Sand	Good
7	50	61	11	-	30	25	95	Clay	Good
8	61	81	20	10	63	50	55-65	Sand	Good
9	81	86	05	-	30	20	95	Clay	Good
10	86	97	11	20	50	40-47	65-80	Sand	Good
11	97	103	06	-	35	30	90	Clay	Good
12	103	112	09	5-20	45-55	40-55	60-85	Sand with minor clay	Good
13	112	118	06	-	27	20	90	Clay	Good
14	118	149	31	3-15	50-55	40-50	60-75	Sand	Good
15	149	157	08	-	22	22	90	Sandyclay	Good
16	157	165	08	20	45	43	65	Sand	Good
17	165	171	06	-	17	20	90	Clay	Good
18	171	180	09	20	35	35	75	Sand	Good
19	180	185	05	-	25	22	90	Clay	Good
20	185	190	05	20	38	35	70	Sand	Good
21	190	195	05	-	20-28	20-30	80-95	Clay	Good
22	195	200	05	20	35	35	70	Sand	Good

ix. E-Log 9: Sirsiya, Block- Sirsiya

S. No	Depth Range (m)		Thickness (m)	SP (mv)	LON-64" N Resistivity (ohm.m)	SHN-16" N Resistivity (ohm.m)	NGAM-Natural Gamma (cps)	Inferred Lithology	Quality of aquifer water
	From	To							
1	5	27	22	-	HIGH	HIGH	70	Surface alluvium	
2	27	49	22	7	30-40	20-30	75	Mixed Zone	
3	49	54	5	5	45	38	60	Sand	Good
4	54	59	5	-	30	25	70	Clay	
5	59	65	6	5	40	40	60	Sand	Good
6	65	73	8	-	18	10	85	Clay	
7	73	78	5	5	40	38	65	Sand	Good
8	78	115	37	7	17-30	15-30	70-90	Interbedded Sand & Clay	
9	115	122	7	4	38	38	60	Sand	Good
10	122	128	6	-	20	15	80	Clay	
11	128	133	5	5	38	38	55	Sand	Good
12	133	143	10	-	20	15	75	Sand Clay	
13	143	150	7	10	20-28	20-33	65	Sand with minor Clay	
14	150	156	6	12	15	15	85	Clay	
15	156	164	8	10	18	18	70	Mixed Zone	
16	164	169	5	15	25	30	65	Sand	Good
17	169	175	6	-	12	10	85	Clay	
18	175	181	6	7	33	38	55	Sand	Good
19	181	185	4	-	15	15	75	Clay	
20	185	191	6	10	37	40	55	Sand	Good
21	191	200	9	5	15	15	75	Clay	

2.5.Exploration

Fourteen exploratory wells, twelve observation wells and three piezometers have been drilled by Central Ground Water Board, Lucknow as on 31-03.2021. Out of 14, one EW at Chandgarhi site was abandoned due to lack of granular zone. The drilled depth of these wells ranges from 200.0 m bgl to 305.40 mbgl. The tubewells yield fresh water for drawdown ranging from 6.13 to 29.03 m. The storativity ranges from 1.21×10^{-04} to 6.78×10^{-05} and transmissivity ranges from 318 to 3083 m^2/day. Discharge varies from 1903 to 2950 lpm. The location map of exploratory wells used in preparation of aquifer maps, models, fence diagram and cross sections shown in figure-30 and the details of each well is given in Annexure-VI.

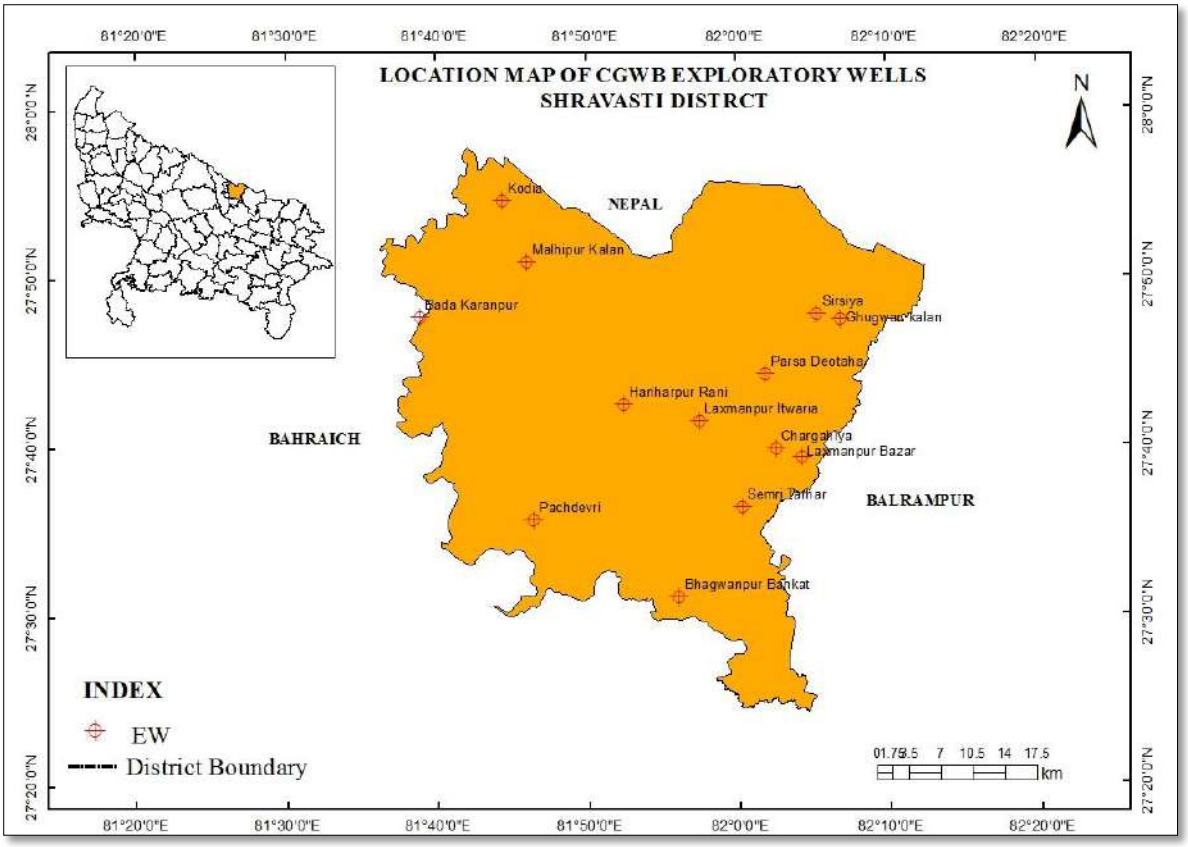


Figure 30: Location Map of Exploratory wells in Shravasti district

3.0 DATA INTERPRETATION, INTEGRATION AND AQUIFER MAPPING

3.1 Lithological Disposition and Aquifer Disposition

To understand the lithological and aquifer disposition in the study area, 3-D model, sections and fence diagrams have been prepared based on the lithological information obtained through exploratory drilling (Annexure-VII) and geophysical investigations undertaken by CGWB and private drillers in the district (Plate-II). The lithological layers are generated using borehole data. The uniform colour codes are used for preparation of Aquifer/Lithological sections, Fence diagram and 3D Aquifer/ Lithological dispositions diagrams. In the study area lithologs and the geophysical logs reveal the presence of a thick pile of various grades of sand with kankar with alternating sequence of clay.

The lithological and aquifer disposition interpreted through the models, fence and cross sections prepared using Rockworks software. The sections drawn for sub-surface formations and aquifers have vertical and horizontal scales in meters.

3.2. Principal Aquifer System in the study area

The principal aquifers in the study area have been delineated by grouping the sand, kankar, gravelly sand and pebbly sand as aquifers separated by confining clay layers as aquiclude. The granular zones (the aquifers) with varied resistivity were picked up from the combined interpretations of electrical resistivity (64 inches Normal) and gamma radioactivity logs of the boreholes drilled in the area. Demarcation of different aquifer groups has been done on the basis of lithological character, hydraulic properties and quality ascertained though exploratory drilling, geophysical logging. There are three aquifer systems in the study area grouped as Aquifer group-I, Aquifer group-II and Aquifer group-III.

i) **Aquifer Group- I**

Below the top soil is the Aquifer group-I and occurs generally between the depth of 150.00 mbgl. This aquifer group is unconfined/phreatic in nature and ground water occurs under water table condition. This aquifer is mostly tapped by shallow tube wells, dug wells and hand pumps. Generally the water level in the district is shallow and depth to water level varies between 3 to 6 metres below ground level in the first aquifer. This aquifer group comprises of sand, kankar, gravel and pebble. The thickness of granular zone varies between 11-180 m with an average of 90 m. Most of the state tubewells and public wells tapped this aquifer. The major issue in ground water quality of 1st Aquifer is sporadic occurrence of arsenic (>0.01 mg/l) and Fe (>0.3 mg/l).

ii) **Aquifer Group- II**

This aquifer group lies below the first Aquifer unit and is separated with the confining clay layer. It occurs generally between the depths of 160.00- 240.00 mbgl. The aquifer material is generally sand and kankar except for one Borehole at Kodia where gravel and pebbles are also encountered. The thickness of granular zone varies between 36-168 m with an average of 83 m. The storativity ranges from 1.37×10^{-04} to 6.78×10^{-05} and transmissivity ranges from 837 to 3083 m^2/day. Most of the departmental exploratory wells are tapped in this aquifer with precaution of cement sealing at the bottom of 1st aquifer. The quality of this aquifer group is fresh and good.

iii) **Aquifer Group- III**

This aquifer group is separated from the overlying aquifer group by thick clay and occurs between the depth range of 250 m bgl and below. The thickness of granular zone varies between 19-105 m with an average of 40 m. The storativity ranges from 1.98×10^{-04} to 6.18×10^{-04} and transmissivity ranges from 318 to 1766 m^2/day. . The quality of this aquifer group is fresh and good.

3.3. 3-D lithological and Aquifer Model

The 3-D lithological and aquifer model of the complete aquifer mapping area depicts the presence of a thick pile of alluvial sediments like clay, gravel and pebble with alternation of various grades of sand and kankar. The lithological variation in the district is fine to medium sand, kankar, gravel and pebble variably associated with clay formation. The thickness of clay increases in the east and north eastern part of the district with maximum clay thickness of 54 m encountered at Parsa Deotaha in Sirsiya block whereas thickness of sand beds is increasing in the west and north-west of Shravasti district. The maximum depth of exploration in the study area of 305.40 m at Bada Karanpur in Jamunaha block. 3-D lithological and aquifer model of the district is shown in figure-31 and 32.

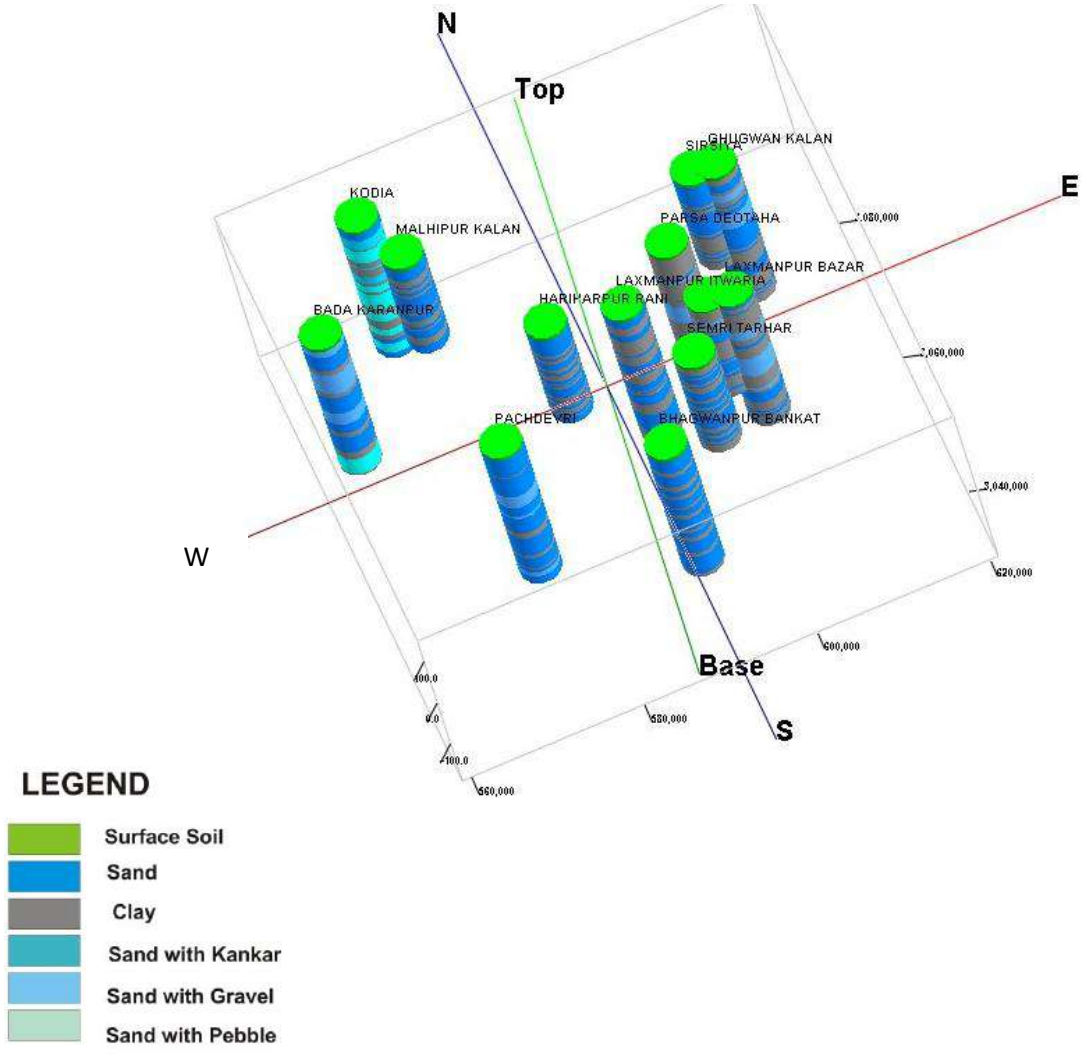


Figure 31: 3-D Strip log of Shravasti district

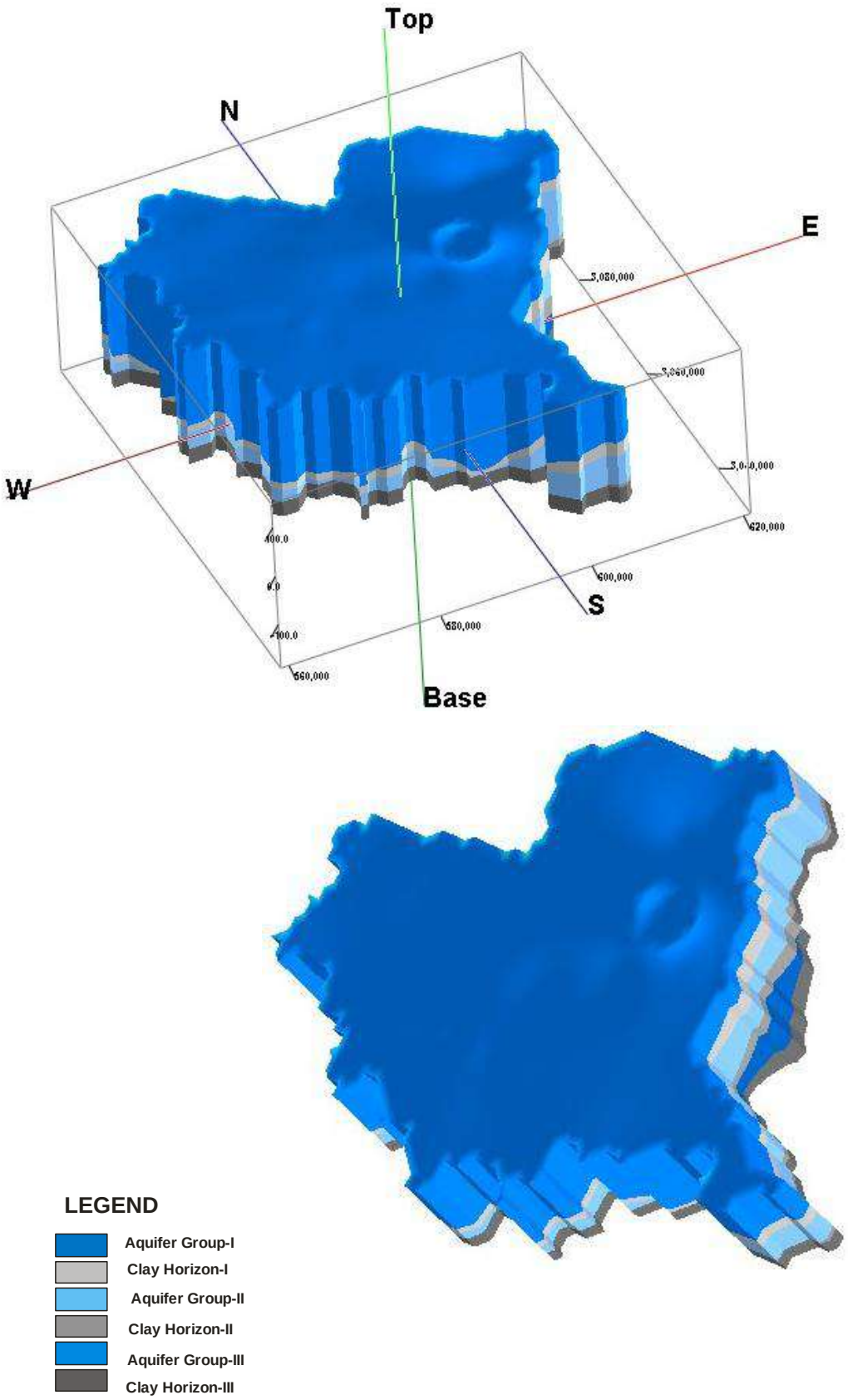


Figure 32: 3-D model of Shravasti district

3.4. Fence diagram

Fence diagrams delineating the lithology and aquifer disposition on regional scale established in the study area shown in figure-33 and 34.

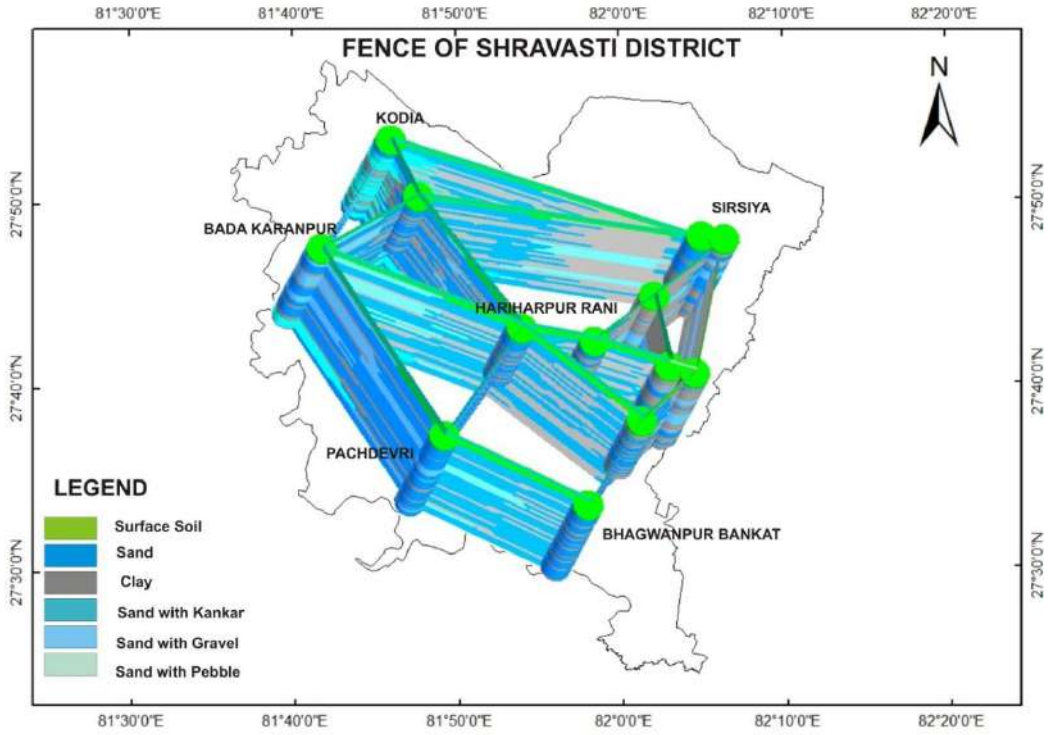


Figure 33: Fence diagram showing lithological variation in Shravasti district

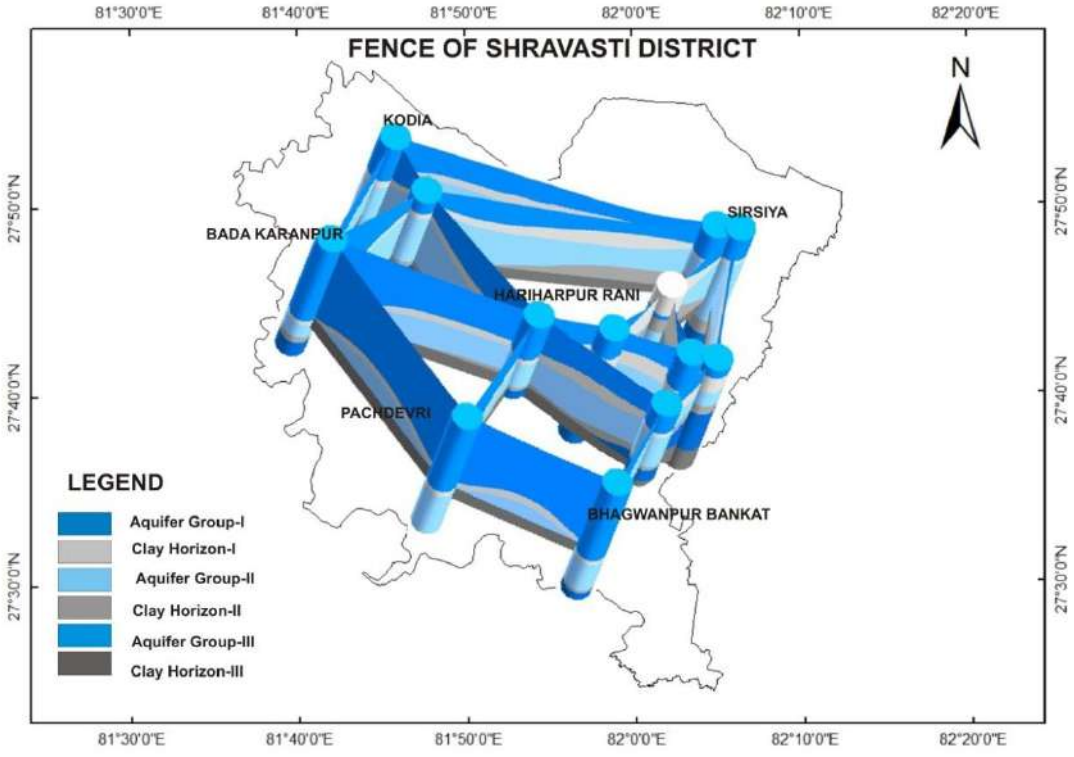


Figure 34: Fence diagram showing Aquifer groups in Shravasti district

3.5 Cross-sections (in 2-D)

To obtain a two-dimensional generalized view of the lithological and aquifer dispositions, block-wise cross-sections have been prepared on the basis of integrated lithologs using Rockworks software. As per the data available four cross-sections of the district are prepared viz. A-A', B-B', C-C', D-D' for each block (figure-35). Cross-sections along various wells are shown in figure- 36 to 39.

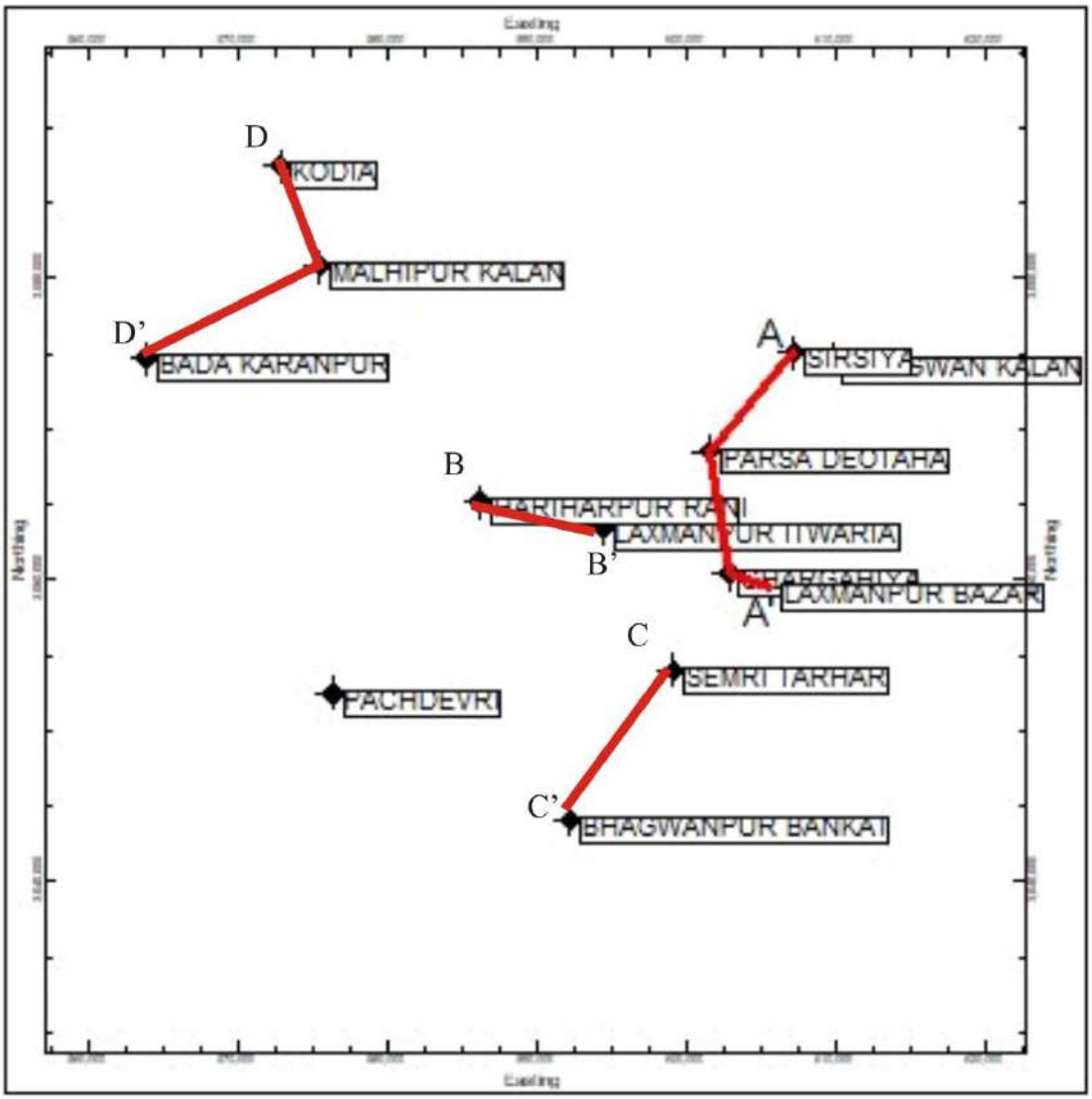


Figure 35: Map showing Cross-Section along A-A', B-B', C-C' and D-D' in Shravasti district

Cross-section A-A' drawn along Sirsiya to Laxmanpur Bazar (figure-36) of Sirsiya block. The cross-section depicts the occurrence of sand and kankar as aquifers separated by confining layers of clay as aquiclude. Water level varies from 4.22 mbgl at Chargahiya to 10.23 mbgl at Sirsiya.

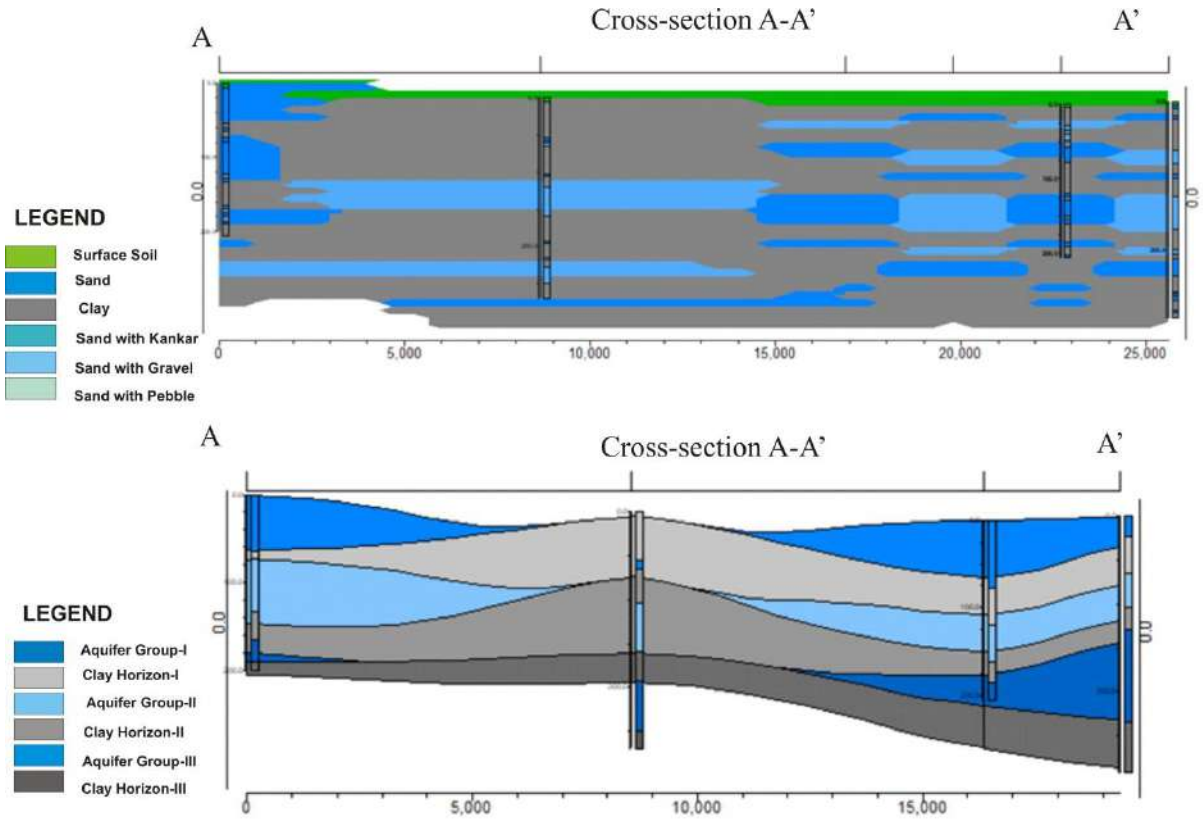


Figure 36: Cross-section depicting Lithological and Aquifer disposition along A-A'

Cross-section B-B' drawn along Hariharpur Rani to Laxmanpur Itwaria (figure-37) of Hariharpur Rani. The cross-section depicts the occurrence of sand as aquifers separated by confining layers of clay as aquiclude. Water level at Hariharpur Rani is 3.2 mbgl and at Laxmanpur Itwaria water level is quite shallow 1.92 mbgl.

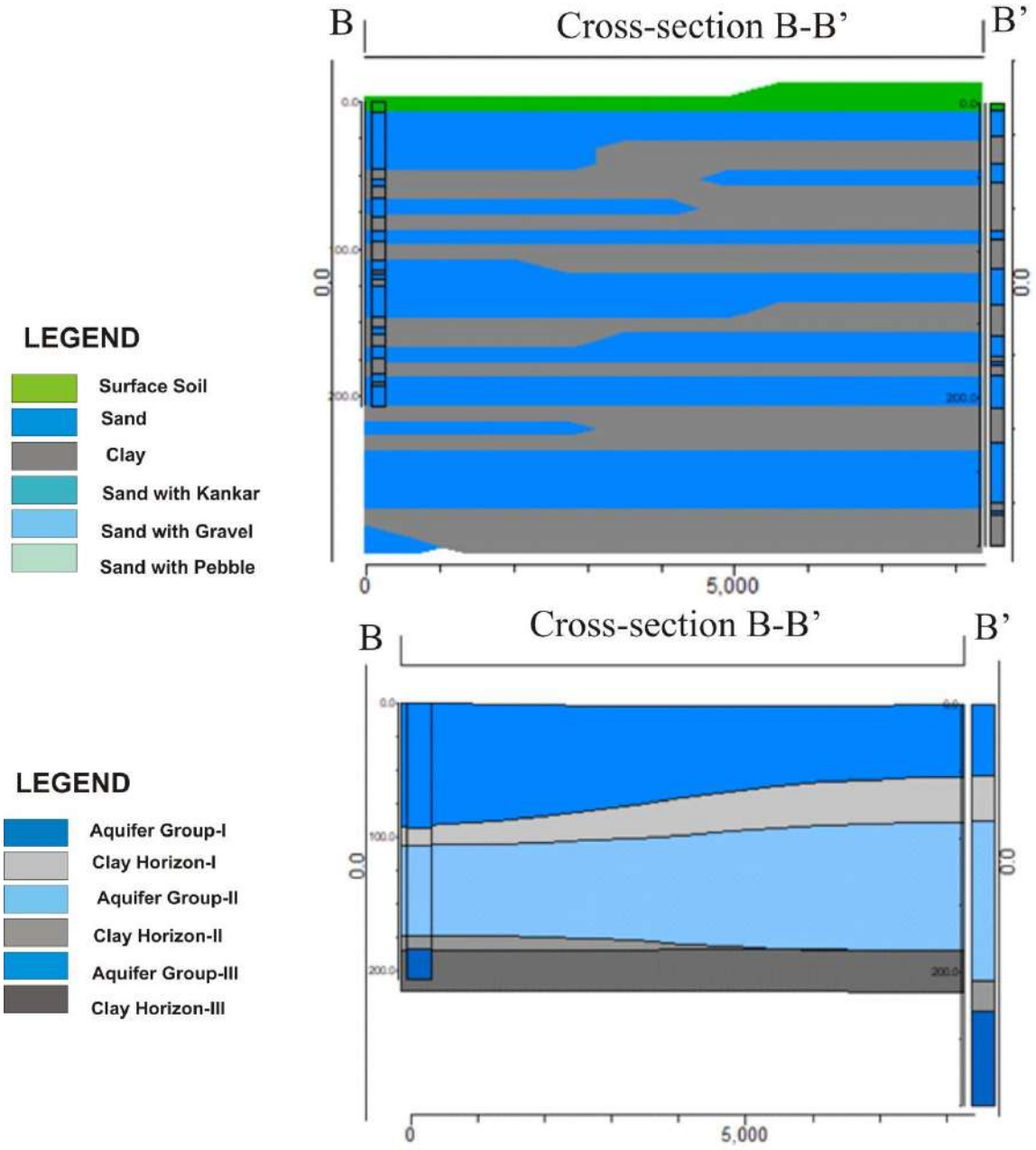


Figure 37: Cross-section depicting Lithological and Aquifer disposition along B-B'

Cross section C-C' drawn along Semri Tarhar to Bhagwanpur Bankat (figure-38) of Ikauna block. The cross-section depicts the occurrence of sand as aquifers separated by confining layers of clay as aquiclude. Water level at Semri Tarhar is shallow 2.98 mbgl and at Bhagwanpur Bankat water level is deep 10.53 mbgl.

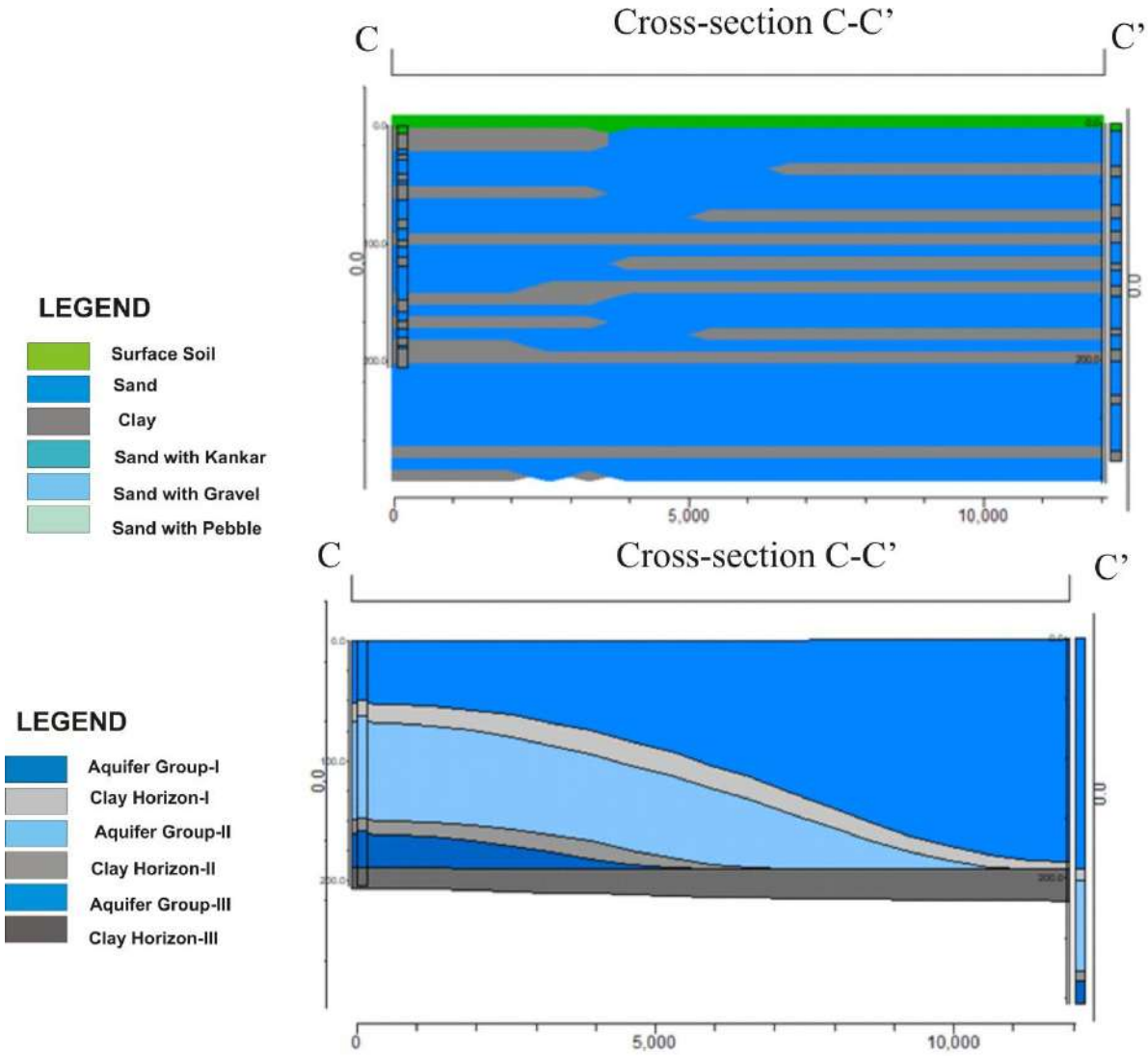


Figure 38: Cross-section depicting Lithological and Aquifer disposition along C-C'

Cross section D-D' drawn along Kodia to Bada Karanpur (figure-39) of Jamunaha block. The cross-section depicts the occurrence of sand, gravel, pebble and kankar as aquifers separated by confining layers of clay as aquiclude. Water level varies from 2.91 mbgl at Malhi Kalan which is shallow to 10.53 mbgl at Bada Karanpur.

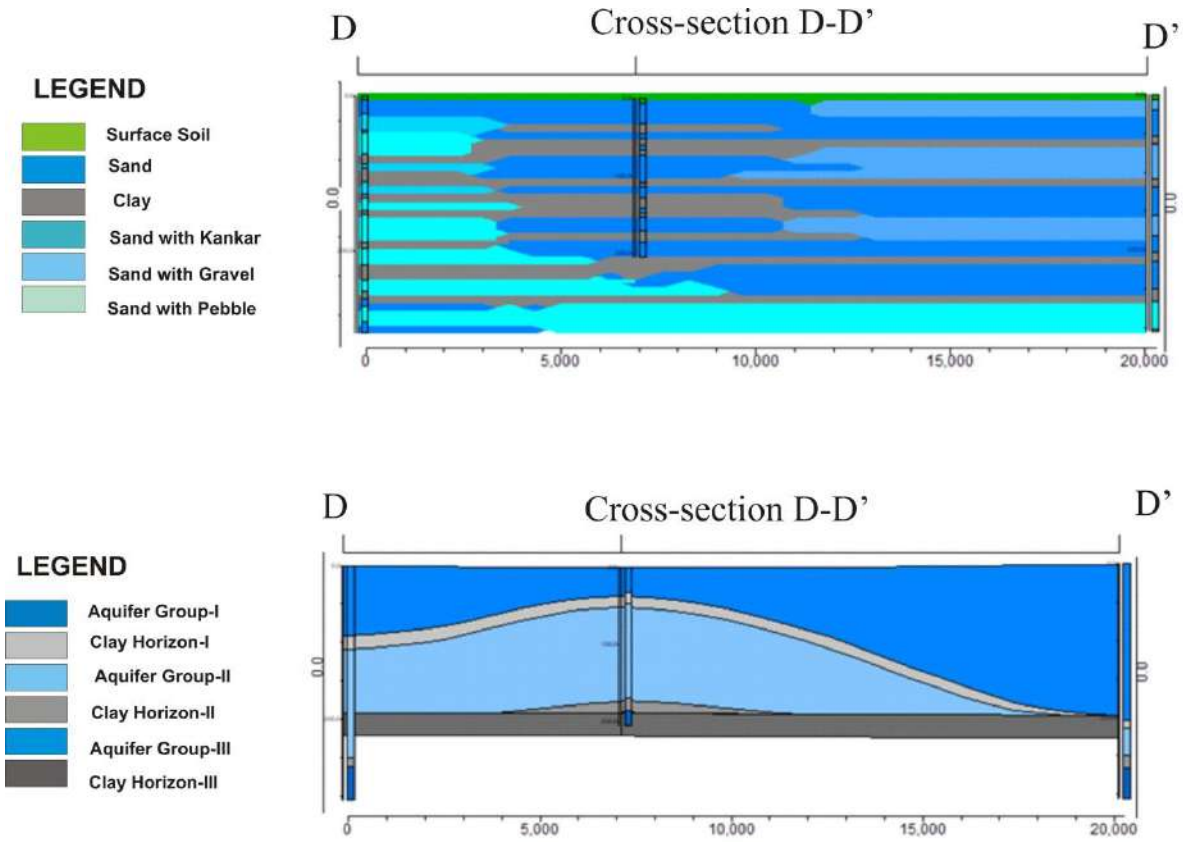


Figure 39: Cross-section depicting Lithological and Aquifer disposition along D-D'

4.0 GROUND WATER RESOURCES

The assessment of total availability of ground water resources encompasses two component namely Dynamic and In-storage resources. The in-storage resources include In-storage unconfined and In-storage confined resources. For unconfined aquifer in-storage resources are computed based on specific yield of the aquifer and for confined aquifer based on the storativity of the confined aquifer.

On the basis of Ground Water Estimation Committee (2015) methodology, Central Ground Water Board and Ground Water Department, Government of U.P. has jointly estimated Dynamic Ground Water Resources of Uttar Pradesh in 830 assessment units (820 blocks and 10 Urban area) for the base year 2020 (As on March-2020).

4.1. Dynamic Ground water resources

Dynamic Ground water resources of the district have been estimated on block/urban area wise basis. There are 5 number of assessment units (5 blocks) in the district which fall under non-command category. The annual extractable ground water resources in the district is 46628.26 ham and ground water extraction for all uses is 27476.49 ham, making stage of ground water extraction 58.90 % as a whole for district. The highest stage of ground water extraction is 67.84 % in Jamunaha block. After making allocation for future domestic and industrial supply upto 2025 years, balance available ground water for future irrigation would be 19151.01 ham in the district. All blocks of the district are categorized as *Safe blocks.* The details are given in the table-9 and shown in figure-40.

Table 9 : Dynamic Ground water Resources of Shravasti district (as on 31.03.2020)

S.No.	Assessment Unit Name	Total Area of Assessment Unit (Ha)	Recharge Worthy Area(Ha)	Recharge from Rainfall - Monsoon Season	Recharge from Other Sources - Monsoon Season	Recharge from Rainfall -Non Monsoon Season	Recharge from Other Sources - Non Monsoon Season	Total Annual Ground Water (Ham) Recharge	Total Natural Discharges (Ham)
1	Gilaula	31676	31676	5893.97	1071.63	593.17	1508.49	9067.26	453.36
2	Hariharpur Rani	36377	36377	6697	734.85	681.2	1313.37	9426.42	471.32
3	Ikauna	28731	28731	5282.1	1139.06	538.02	1871.81	8830.99	441.55
4	Jamunaha	36241	36241	6751.72	918.78	678.66	1620.28	9969.44	498.48
5	Sirsiya	52757	52757	9089.23	614.77	987.94	1096.33	11788.27	589.41
	Total	185782	185782	33714.02	4479.09	3478.99	7410.28	49082.38	2454.12

S.No.	Assessment Unit Name	Annual Extractable Ground Water Resource (Ham)	Ground Water Extraction for Irrigation Use (Ham)	Ground Water Extraction for Domestic Use (Ham)	Total Extraction (Ham)	Annual GW Allocation for Domestic Use as on 2025 (Ham)	Net Ground Water Availability for future use (Ham)	Stage of Ground Water Extraction (%)
1	Gilaula	8613.9	5384.44	0.79497	5385.235	0.89	3228.57	62.52
2	Hariharpur Rani	8955.1	5584.56	0.90009	5585.46	1.05	3369.49	62.37
3	Ikauna	8389.44	5482.8	0.955935	5483.756	1.14	2905.51	65.36
4	Jamunaha	9470.96	6424.16	0.962505	6425.123	1.12	3045.67	67.84
5	Sirsiya	11198.86	4596	0.91323	4596.913	1.09	6601.77	41.05
	Total	46628.26	27471.96	4.52673	27476.49	5.29	19151.01	58.90

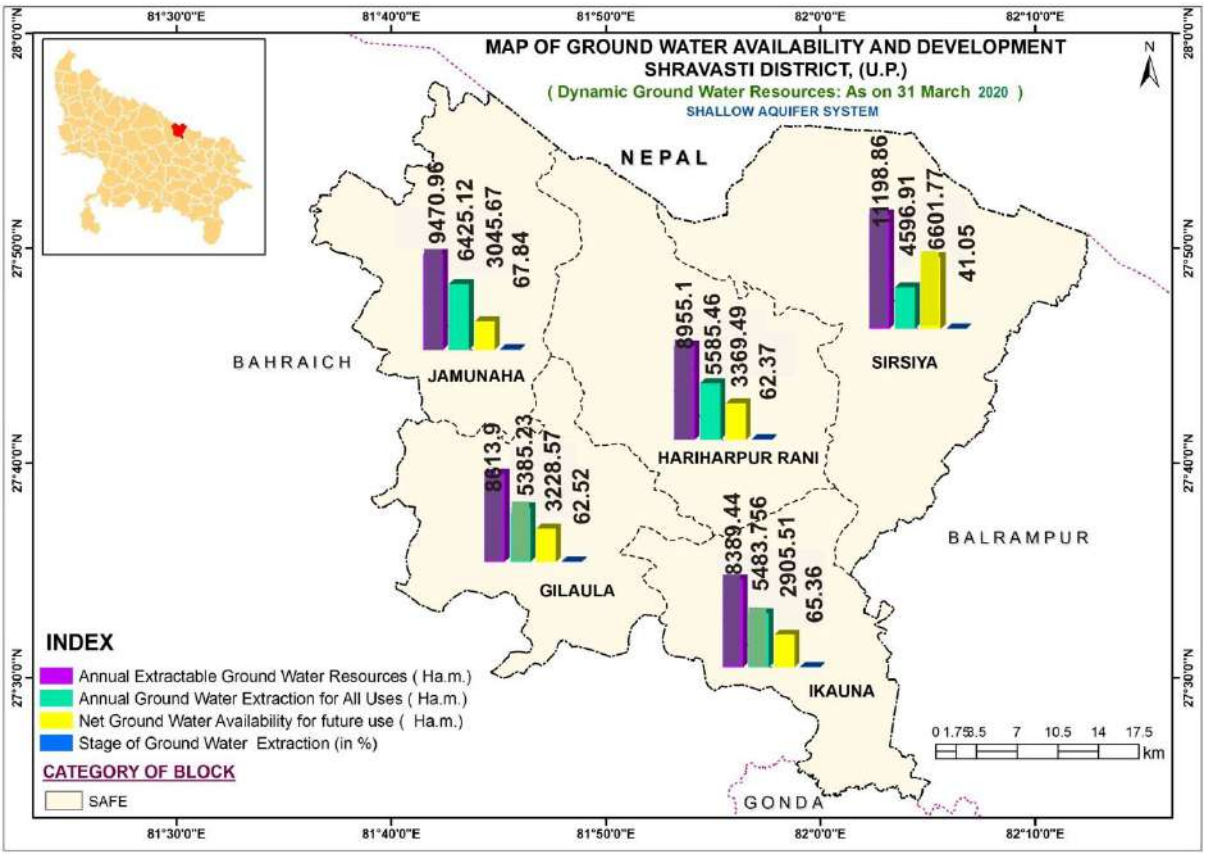


Figure 40: Dynamic Ground Water Resources Map of Shravasti district

4.2 In-storage Ground Water Resources

In case of alluvial area, the in-storage resources of unconfined aquifer computed based on specific yield of the aquifer as detailed below:

In-storage Ground Water Resources = **Thickness of the granular zone** (in the aquifer below the zone of water level fluctuation of the aquifer down to exploitable limit) **X Areal extent of the aquifer X Specific Yield**

An attempt has been made to carry out the estimation of In-storage resources for unconfined aquifer of the district based on the available aquifer information but due to data gap in the study area results were erroneous. Out of 13 wells 10 wells are being constructed during the year 2020-21 and no monitoring data available. Due to lack of data, piezometric head is not available thus the In-storage resources for confined and unconfined aquifer could not be estimated.

5.0 GROUND WATER RELATED ISSUES AND PROBLEMS

- Ground water in the district is being developed by bore wells and dug wells. The development of ground water is generally high as the major source of irrigation in the district is ground water, irrigating 68400 ham area contributing about 99.9% to the total irrigation potentials of the district.
- Arsenic has been sporadically reported in groundwater samples of 1st aquifer with no relaxation limit of BIS (>0.01 mg/l) in 4 blocks namely-Jamunaha, Hariharpur Rani, Gilaula and Sirsiya (one sample from each block). The arsenic concentration here ranges in between 0.015-0.225 mg/l (Annexure-III).
- Water levels in the district are shallow and in the Terai region comes very close to the surface, causing water logging problem in the area (Reported by SWaRA)

Water Logging

- District is prone to floods during monsoon periods due to which there is continuous erosion of river banks. As a result, the river changes its path frequently. Details of badly affected area are given in table-10

Rapti river during flood

Fourlane cut during flood

Table:10 Details of flood affected nearby settlements along Rapti river in Shravasti District (U.P.) during 16 August to 1st September 2018						
S.No.	**District**	**Block**	**Village**	**Settlement Name**	**Latitude**	**Longitude**
1.	Shravasti	Jamunaha	Hariharpur Maharaj Nag	Gurdat Purwa	27° 47' 50.471" N	81° 45' 26.162" E
Source: Remote Sensing Application Centre, U.P						

- The sediment flow of river destructs the agricultural lands downstream. Due to bed aggradation and bank erosion the river channel changes into braided and at the same time enhances lateral shifting. The basin morphology is marked by meandering channels, relict fluvial features like abandoned channels and oxbow lakes (Plate-IV). Such channel changes are the main problems and features of the river Rapti.

Plate-IV: Satellite Imagery showing meandering channels and ox-bow lake along Rapti river

- Agriculture is the major consumer of ground water. Ground water Draft for irrigation (27471.96 Ham) is in excess of Net Annual GW Availability for future use (19151.01 Ham). Although there is fairly strong canal network in the district, irrigation is mainly ground water dependent throughout the district indicating that sufficient water does not reach tail-ends of the canal.
- In Shravasti, about 99.9% irrigation is dependent on ground water. Even in the canal command areas, ground water is being used for irrigation. This is due to easy access to ground water as water levels are not deep and ground water is directly under the control of individual farmer/ user. Block wise irrigated area through different sources given in figure-41.

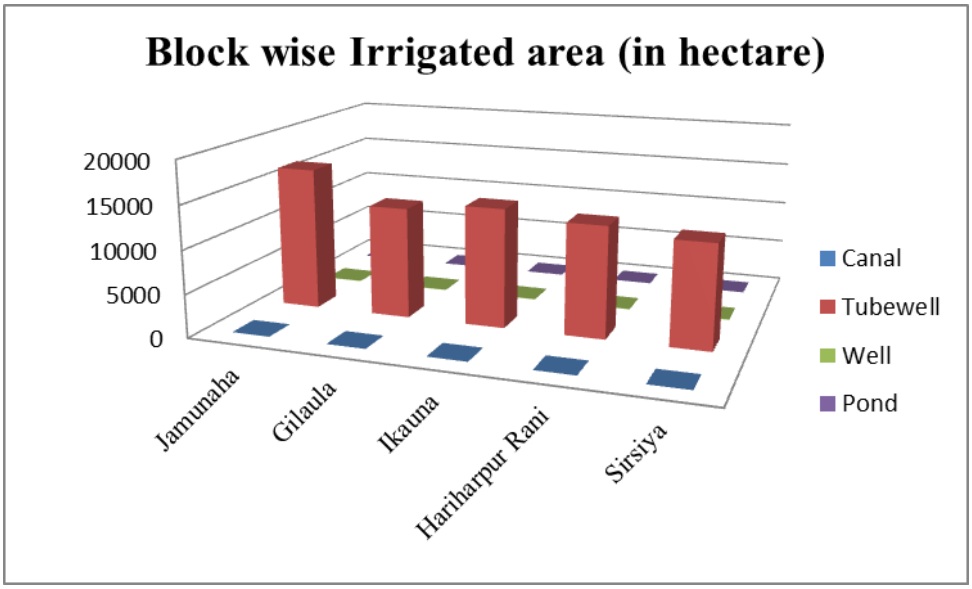


Figure 41: Blockwise irrigated area through different sources in Shravasti district

- Absence of canal network in Ikauna and Hariharpur Rani block put stress on groundwater resources.
- Bouldery formations in Bhabhar region pose difficulty in drilling of tubewells/borewells.
- At places clayey formation is sometimes encountered continuously during drilling without any granular zone particularly in Terai region.
- NITI Aayog has identified Shravasti as one of the Aspirational districts. Farmers are poor and the fragmented nature of land holding creates hardship to an individual farmer to develop the ground water resource economically. The numbers of land holding with respective area held by individual farmer are given in table-11 and shown in figure-41. The majority of farmers are small or marginal. Total number of holdings in the district is 190329, which cover an area of 133658 hectares. The distribution given in Figure-42 shows that marginal and small farmers account for 92 % of total area.

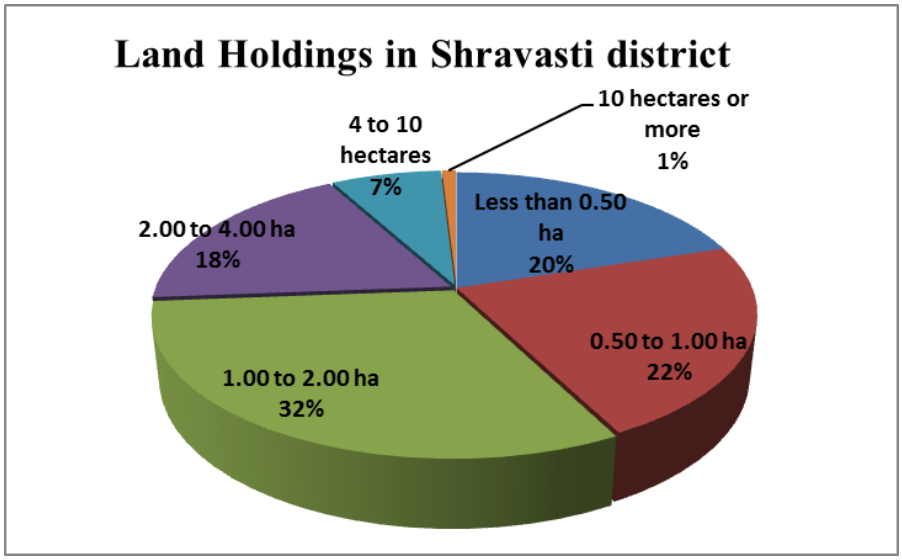


Figure 42: Distribution of Land Holding in Shravasti district, 2015-16

Table:11 Number of Land Holding and Area in Shravasti District														
Blocks	**Size square hectare**													
	Less than 0.50 ha		**0.50 to 1.00 ha**		**1.00 to 2.00 ha**		**2.00 to 4.00 ha**		**4 to 10 hectares**		**10 hectares or more**		**Number of total holdings**	
	No.	**Area**	**No.**	**Area**	**No.**	**Area**	**No.**	**Area**	**No.**	**Area**	**No.**	**Area**	**No.**	**Area**
Jamunha	21144	5143	7838	5708	5521	8038	1853	4664	361	1813	16	234	36733	25600
Guillaula	19814	5838	8117	5859	5297	8307	2651	6071	399	1981	9	114	36287	28170
single	23278	4748	7740	5269	5206	8001	1995	5158	473	2651	11	136	38703	25963
Hariharpur Rani	20472	5578	10870	6265	4450	6916	1021	2501	146	745	2	65	36961	22070
Sirsia	24363	7393	8729	6119	6119	9005	1916	6366	506	2835	12	137	41645	31855
Total	109071	28700	43294	29220	26593	40267	9436	24760	1885	10025	50	686	190329	133658
Source- Statistical diary- 2018-19														

6.0 MANAGEMENT STRATEGIES

Shravasti district comprises of alluvial areas. The water level in the district is shallow causing water logging problems and Rapti river basin is prone to floods during monsoon period. The cultivators of the area are having small land holding and poor. Though all the blocks of the district are in safe category, proper management is required for sustainable development of ground water. Following Supply side and Demand side management strategies may be implemented for the issues and future development of the district.

6.1 Demand Side Management:

i. Management of Surface water resources

- Surface water resources like canal and ponds should be used to meet the specified demand in a given area especially for irrigation purposes.
- The net area irrigated by ground water structures is 68400 ham which is 100 % of the net irrigated area (68402 ham) in the district while irrigation through canal is zero. There is urgent need to increase the surface water irrigation to reduce the stressed on ground water along with intervention practices.
- Conjunctive use of surface and ground water is the need of the hour in order to maintain the right balance between surface and ground water and also to bring about parity in ground water development across the district.

ii. Change in irrigation practices

- The net area sown is 61% of the total area of district and more area can be brought under agriculture through judicious use of ground water and advance irrigation techniques under Pradhan Mantri Krishi Sinchayi Yojna (PMKSY).
- Lowering of full supply level of irrigation channels. If the full supply level of irrigation channel is reduced, there will be lesser seepage loss from embankment. The effective head between full supply level and field will also reduce and therefore chances of wastage of water are avoided.
- Quality production and increase in productivity by adopting drip and sprinkler irrigation system in horticulture and agricultural crops.

iii. Diversification of cropping pattern

- Area with high water table may be allowed only for Kharif irrigation and during Rabi the cultivators may irrigate from dugwells and tubewells.
- Cultivation of new crops in nontraditional seasons and regions.
- Encouraging horticulture crops on uneven field.

iv. *Mass awareness*

- Mass awareness programme should be taken up to educate the people regarding sustainable development of ground water.
- The net area under irrigation is less than 50% of net area cultivated. Mass awareness programmes can be arranged to educate the availability of resources so that more area can be brought under agriculture.

6.2 Supply Side Management:

i. Lining/ efficient use of canals

- Canals main branch/distributaries/minors should be lined to minimize the seepage in canal command areas as the seepage from canal augments the water table and causes water logging.
- Even in the canal command areas the existing canals are losing their utility and storage capacity for agriculture purposes due to siltation as well as improper management. Through desiltation and proper canal network reach to the fields, canals can be efficiently used for irrigation purposes. Thus stress on ground water can be minimize.
- Establishing canal network in Ikauna and Hariharpur Rani block as these two blocks are totally devoid of canal network.

ii. Construction of embankments/dams

As the district is prone to floods, construction of embankments along the Rapti river in flood affected areas would be beneficial. The following projects are being taken up by the Irrigation and Water Resources Department in the district (Table-12).

Table:12 Embankment/Dam constructed along Rapti river in flood prone areas

S.No.	Name of District	Name of Embankment/Dam	River/Bank	Total Length (in km)	Benefited area (Hectare)
1	Shravasti	Parsa-Dehariya Tilakpur Marginal Embankment	Rapti River/Left	21.900	14865.000
2	Shravasti	Kalkalwa Marginal Dam	Rapti River/Right	7.850	3850.000
	Total			29.750	18715.00

Source: Irrigation and Water Resources Department, U.P

iii. On Farm Water Management Scheme

On-farm Water Management Scheme is being implemented in Shravasti district. The Scheme is being implemented through NABARD, GoI. Under this scheme additional irrigation facilities through construction of minor irrigation structures at the command of the farmers is created, which will result in sustained growth of agricultural productivity. The farmers will be able to grow more remunerative crops including horticultural crops, cash crops, pulses and oil seeds. They will meet the objective of crop diversification also.

iv. Participatory Management

- The majority of farmers are poor or marginal and 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.
- Marginal farmers should be given loans at subsidized rates through financial institution for developing groundwater abstraction structures.
- Step taken by CGWB, NR, Lucknow towards participatory management in association

with WaterAid and other organizations working at local levels, organized *Jal chaupals* in Shravasti district during December 2019 to collect village level data pertaining to usage of water for different purposes and to prepare Water Budget (Plate-V). The '*Jal Chaupals*' also created awareness among the local people about overuse of water while preparing Water Budget.

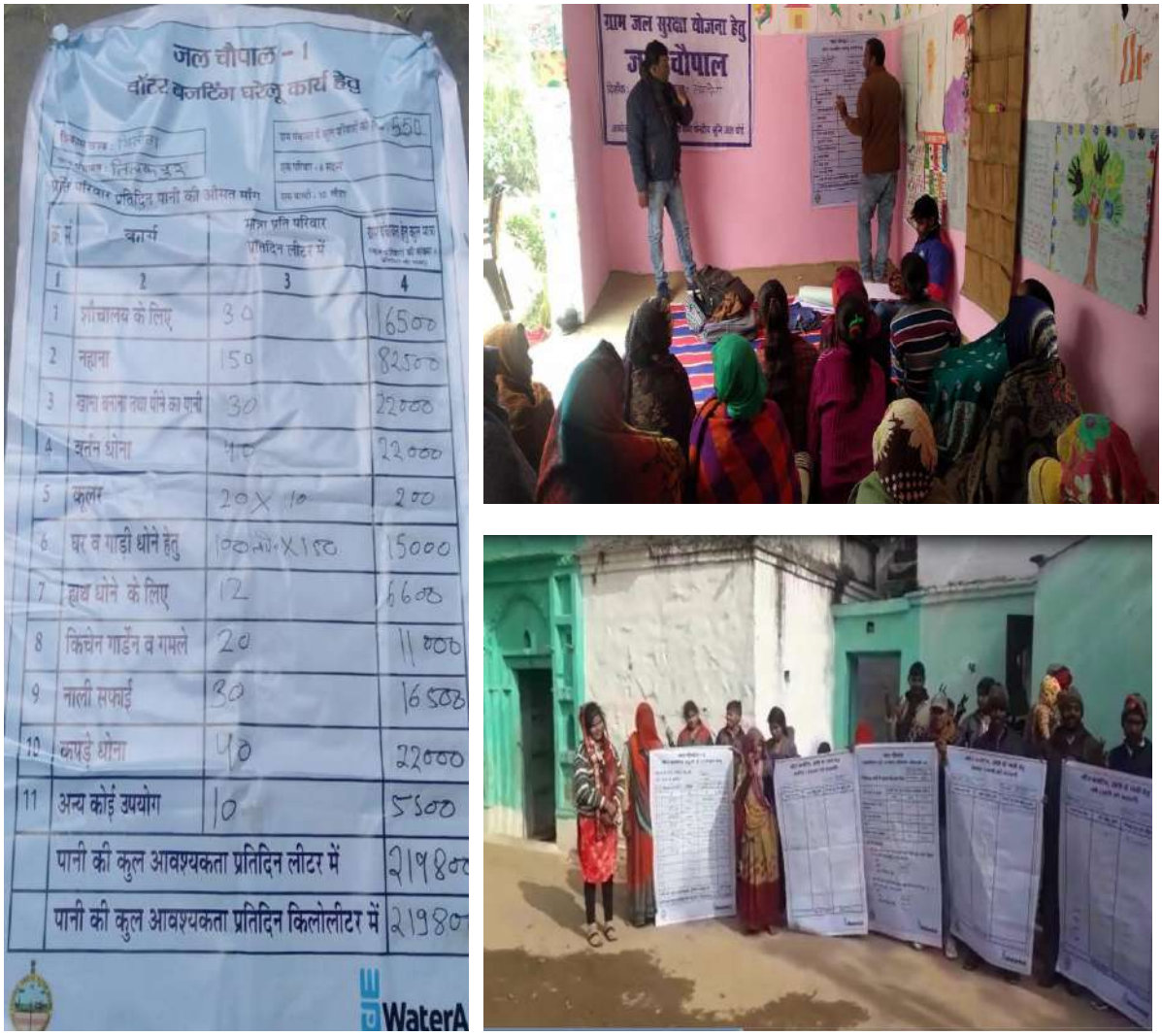


Plate V: Jal Chaupal at village level in Gilaula Block, Shravasti district

v. Water Conservation Projects taken up by State Government

Under Mahatma Gandhi Rural Employment Guarantee Act (MNREGA) Scheme various water conservation structures are under progress in each block. The details are given as under-

Scheme / Central Sector or State Sector	Block	Department	Number of structures / activities completed / proposed	Beneficiaries / Number	Status of project (whether Completed / Ongoing / Sanctioned for implementation	Financial outlay / Convergence (Lac Rs)
MNREGA	Ikauna	Rural Development	21	Community	21 Sanctioned	47.26
	Gilaula		16		16 Sanctioned	39.52
	Hariharpur Rani		12		12 Sanctioned	29.64
	Jamunaha		21		2 Ongoing 19 Sanctioned	51.87
	Sirsiya		17		01 Ongoing 16 Sanctioned	41.99
	Total		87		03 Ongoing 84 Sanctioned	210.28
Source: Chief Development Officer, Shravasti						

vi. NITI Aayog

As Shravasti is Aspirational district, under NITI Aayog the Government is committed in raising the living standards and expeditiously improve the socio-economic status of its citizens and ensuring inclusive growth for all – "Sabka Saath Sabka Vikas". The focus is on outputs (yield, price realisation etc.), inputs (quality seed distribution, soil health cards), and institutional support (crop insurance, electronic markets, animal vaccination etc.).

Summary of GW Management Interventions	
Demand side Interventions ➢ Management of Surface water resources**.** ➢ Change in irrigation practices under Pradhan Mantri Krishi Sinchayi Yojna (PMKSY). ➢ Cultivation of new crops in non-traditional seasons and regions. ➢ Diversification of cropping pattern. ➢ Encouraging horticulture crops on uneven field.	**Supply side Interventions** ➢ On farm Water Management Scheme. ➢ Lining of canals. ➢ Revival and renovation of ponds ➢ Construction of embankments along the course of Rapti river. ➢ Loans to marginal farmers at subsidized rates through financial institution. ➢ Participatory management.

Thus the measures adopted for demand side and supply side management in Shravasti district will substantially bring down stage of ground water development for future use.

7.0 RECOMMENDATIONS

- ***Management of Ground Water***
  - Canal network should be established in Ikauna and Hariharpur Rani block as these two blocks are totally devoid of canals.
  - Availability of water at the tail end should be ensured in canal command areas.
  - Deep exploratory drilling should be undertaken in the district to ascertain characteristics of deeper aquifers.
  - All the blocks are in safe category and water level fluctuation map shows rising trend of water level hence no intervention is required. However, on farm activities and Water Use Efficiency practices are recommended.
  - As the water levels are shallow in the district, practice of conjunctive use of surface and ground water is the need of the hour in order to maintain the right balance between surface and ground water and also to bring about parity in ground water development across the district.
  - There is data gap in the study area. Aquifer wise ground water exploration is recommended in all blocks.

- ***Arsenic in ground water***
  - Extent of the problem of arsenic in ground water should be demarcated and its magnitude be ascertained.
  - *Use of surface water source as an alternative to the contaminated groundwater source*

    Although the use of surface water sources as an alternative to the supply of treated contaminated groundwater seems to be a logical proposition, it would require availability and supply of surface water flow and organized water supply system for ensuring supply of both drinking and irrigation water.
  - *Tapping alternate safe aquifers for supply of arsenic free groundwater*

    Tapping deeper aquifers, for supply of arsenic free groundwater could be better option as arsenic has been sporadically reported in shallow aquifers.

BLOCK WISE AQUIFER MAPS
AND
MANAGEMENT PLAN
OF
SHRAVASTI DISTRICT

I. Aquifer Map and Management plan of *Jamunaha Block*

1. Salient Information

Coordinates :	Lat- 27˚ 53' 11.4" N; Long- 81˚ 45' 54" E
Geographical Area:	411.86 sq km
Population (2011):	Total :238857 male-125899, female-112958
Normal Annual Rainfall 2018 (Shravasti District):	1020 mm
Agriculture and Irrigation(2018):	Major Crops- Rice and Wheat Other crops- Corn, Maize, Sugarcane, Potatoes and Barley Net Area Sown-268.96 sq. km Net Irrigated Area-166.43 sq. km Tube well irrigated area- 165.87 sq km Well irrigated area- 0.56 sq km Surface water bodies irrigated area- Nil
Ground water resource (as on 31-03-2020)	*Dynamic* Net GW Availability- 2905.51 Ham/ 29.05 MCM Stage of GW Extraction- 67.84%

2. Location : Lat- 27˚ 53' 11.4" N; Long- 81˚ 45' 54" E

Jamunaha block lies in NW of Shravasti district, shares border with Bahraich district in west, Gilaula block in south and Hariharpur Rani block in east and International border with the Nepal country in north (figure-43).

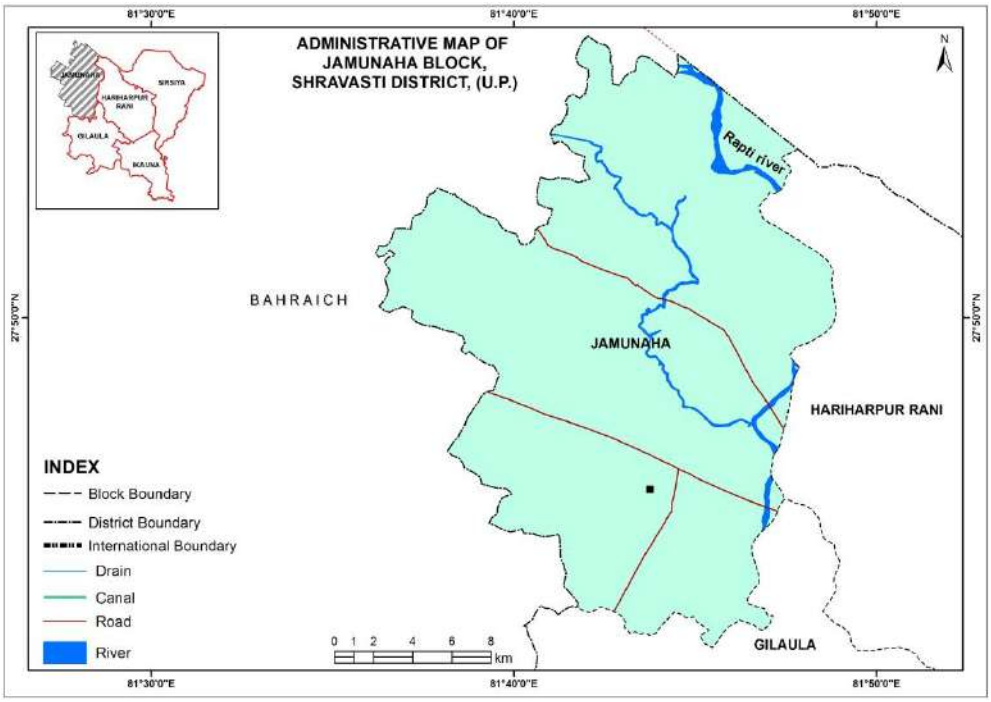


Figure 43: Administrative Map of Jamunaha block, Shravasti district

3. Geology

The Jamunaha block constitutes a part of Rapti alluvial plains which is underlain by sands of various grades with clay and kankar and at places boulders and pebbles of Quaternary age (figure-44).

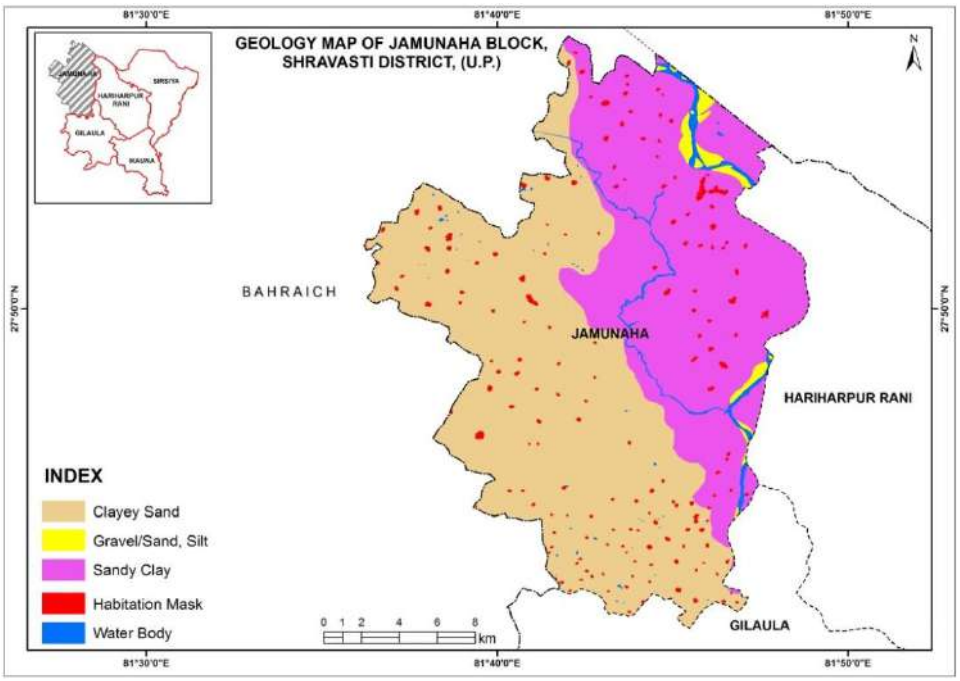


Figure 44: Geology Map of Jamunaha block, Shravasti district

4. Drainage

Jamunaha Block mainly drained by tributaries of Rapti like Bhakwa nala which meets the Rapti river (figure-45).

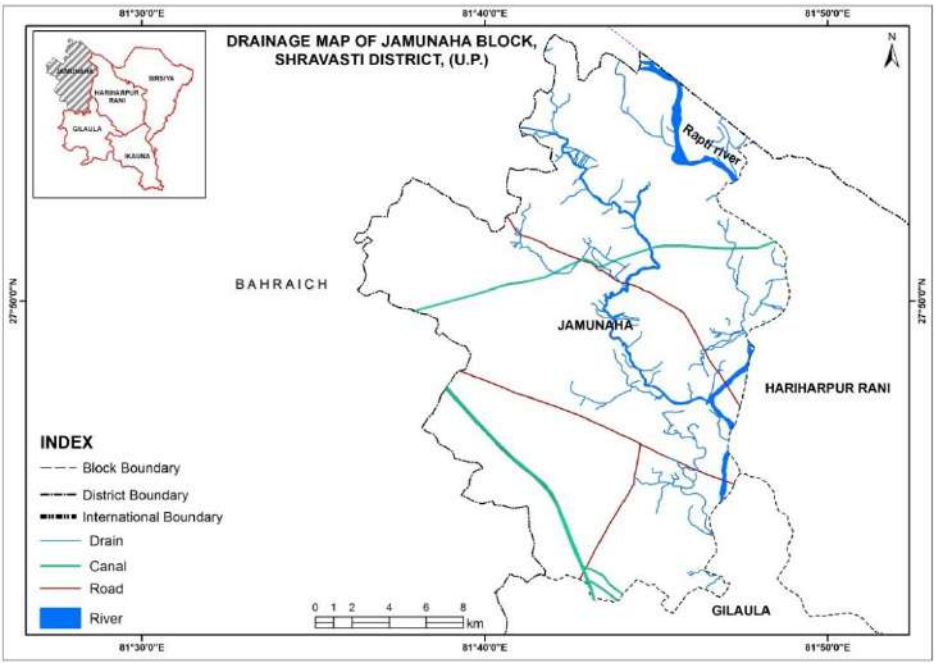


Figure 45: Drainage Map of Jamunaha block, Shravasti district

5. Soil

The block is mainly covered with fine silt with varying grades of loamy soil (figure-46).

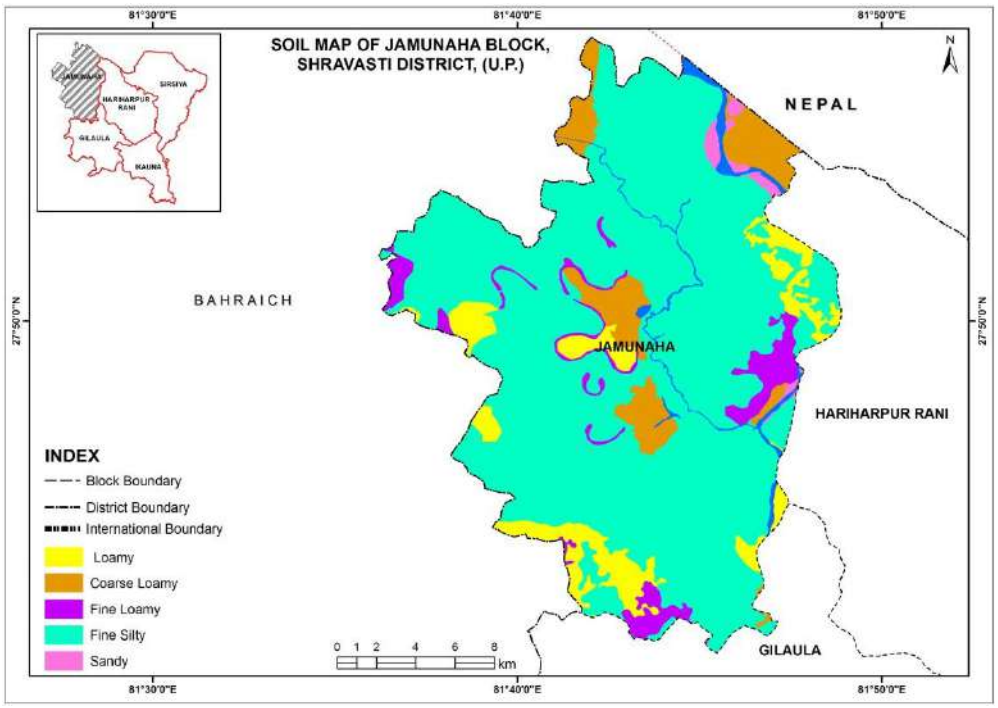


Figure 46: Soil Map of Jamunaha block, Shravasti district

6. Geomorphology

The block is mainly covered with older/upper alluvial plain and younger/lower alluvial plain. There are several oxbow lakes which are the results of meandering rivers and

which contain water except in the summer. Palaeo Channels can be seen in older/upper alluvial plain (figure-47).

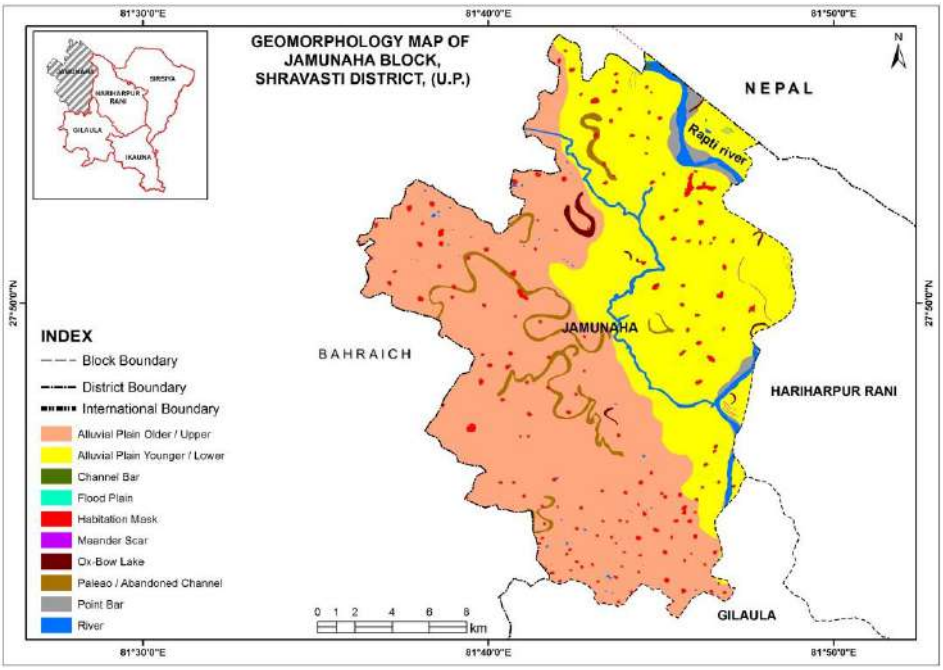


Figure 47: Geomorphology Map of Jamunaha block, Shravasti district

7. Landuse/ Land cover

Block is well covered with agricultural land with scattered settlement throughout. Forest area mainly covered central part of the block (figure-48).

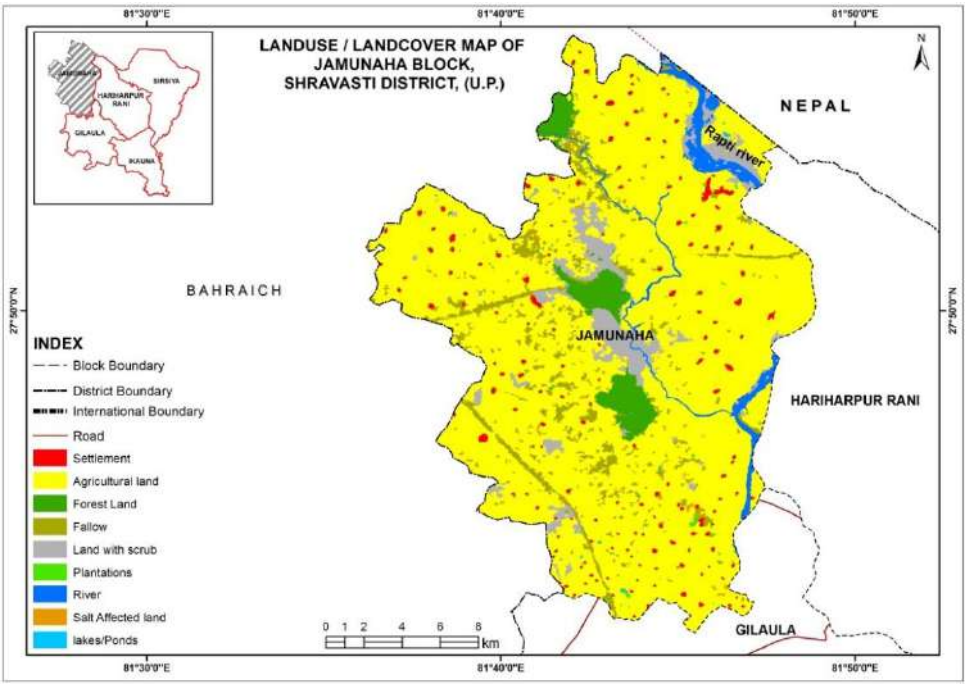


Figure 48: Landuse/Landcover Map of Jamunaha block, Shravasti district

8. Ground water Resources

The block is categorized as Safe as per Ground water Resource Assessment 2020 with 67.84% of stage of ground water extraction which is highest amongst the blocks of Shravasti district (figure-49).

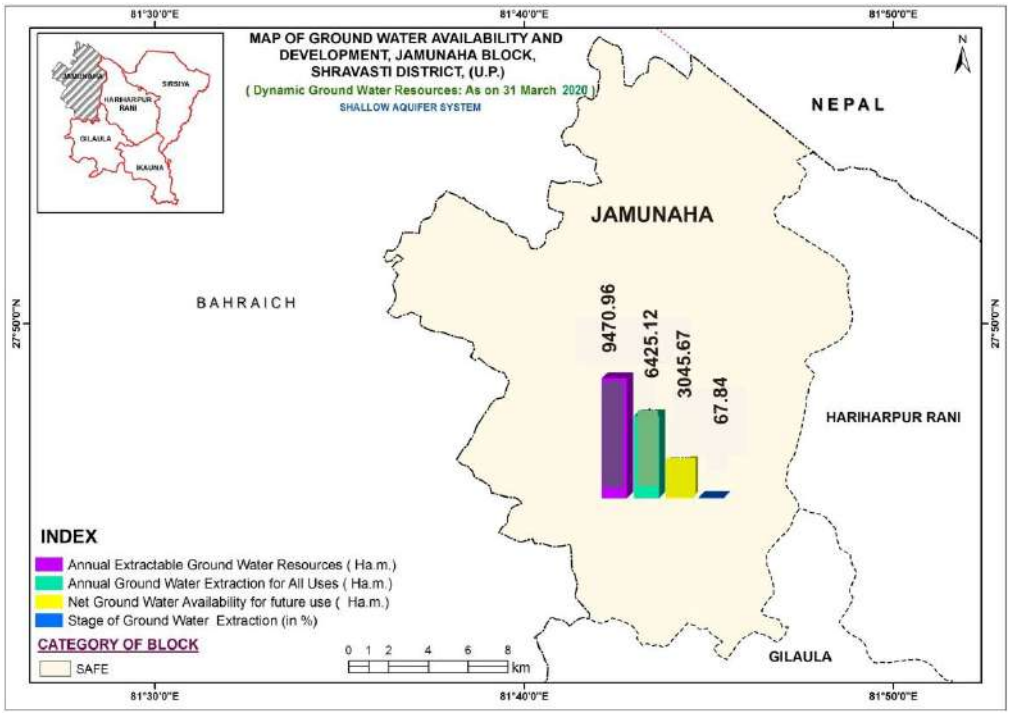


Figure 49: Ground water Resources Map of Jamunaha block, Shravasti district

9. Depth to Water Level (Pre-monsoon)

Depth to water level during Pre-monsoon is generally shallow throughout the block ranging in between 0.0-5.0 m bgl (figure-50).

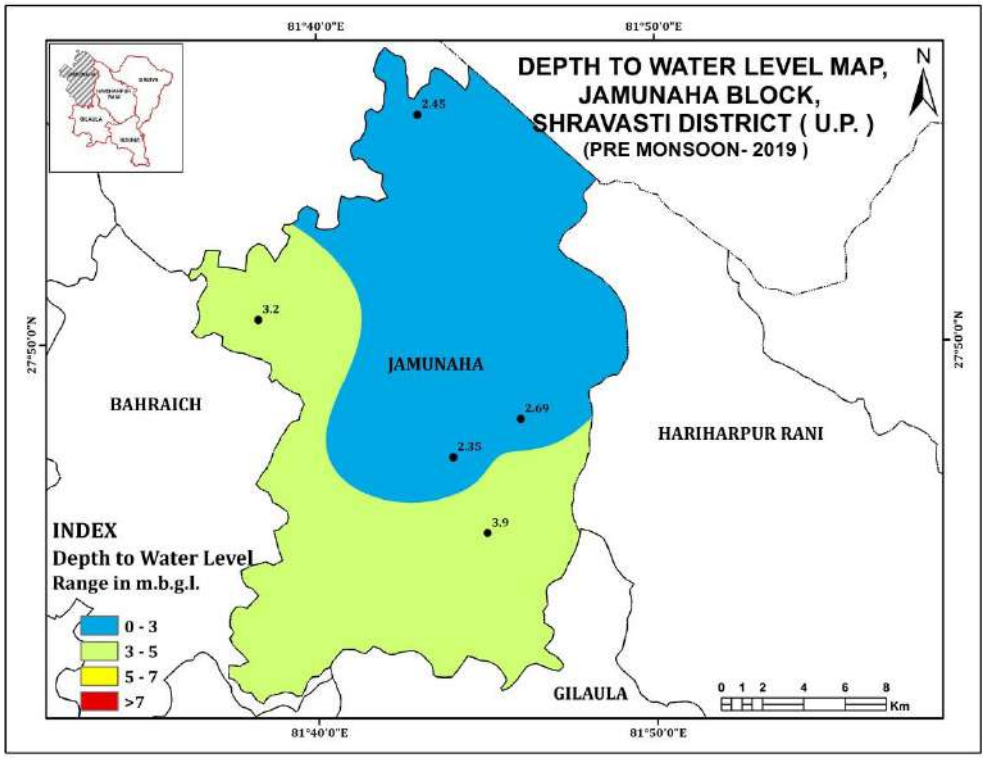


Figure 50: Depth to Water level Map (Pre-Monsoon) of Jamunaha block, Shravasti district

10. Depth to Water Level (Post-monsoon)

Depth to water level during Post-monsoon is generally shallow throughout the block ranging in between 0.0-5.0 m bgl (figure-51).

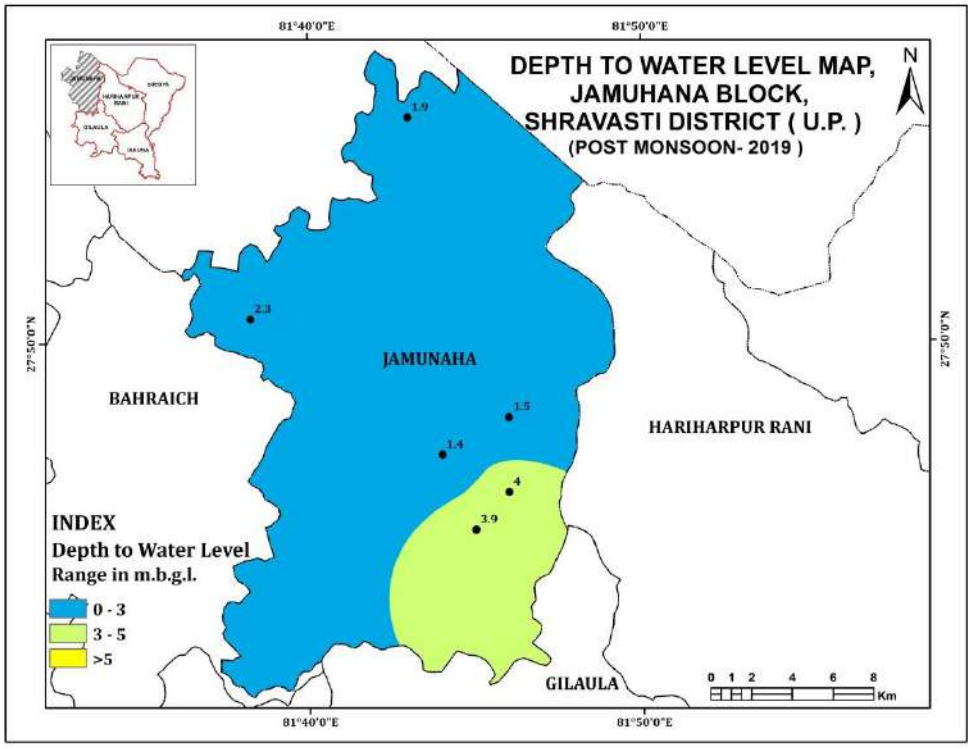


Figure 51: Depth to Water level Map (Post-Monsoon) of Jamunaha block, Shravasti district

11. Water level Fluctuation

Water level fluctuation map shows rise in water level in the block (figure-52).

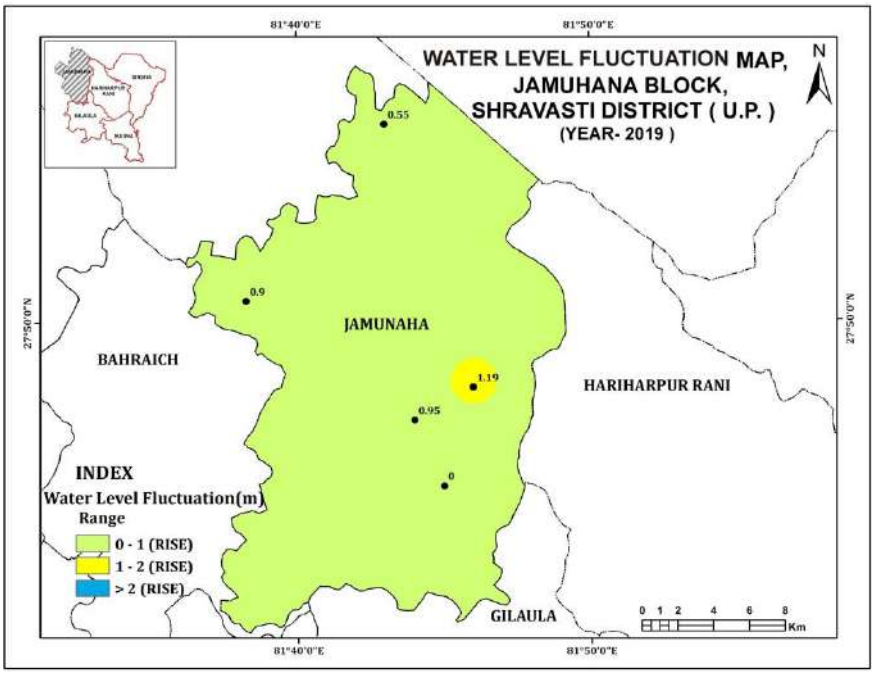


Figure 52: Water level Fluctuation Map of Jamunaha block, Shravasti district

12. Chemical Quality

All the chemical constituents are within the permissible limit of BIS-2012 except for sporadic occurrence of arsenic in shallow aquifer. Arsenic reported concentration is 0.027 mg/l.

13. 3-Dimensional Aquifer Disposition

Ground water occurs under water table condition at shallow depths while the deeper aquifer is under confined state of disposition. Sand, kankar, gravelly sand and pebbly sand forms the principal aquifers in the study area separated by confining clay layers acting as aquiclude (figure-53).

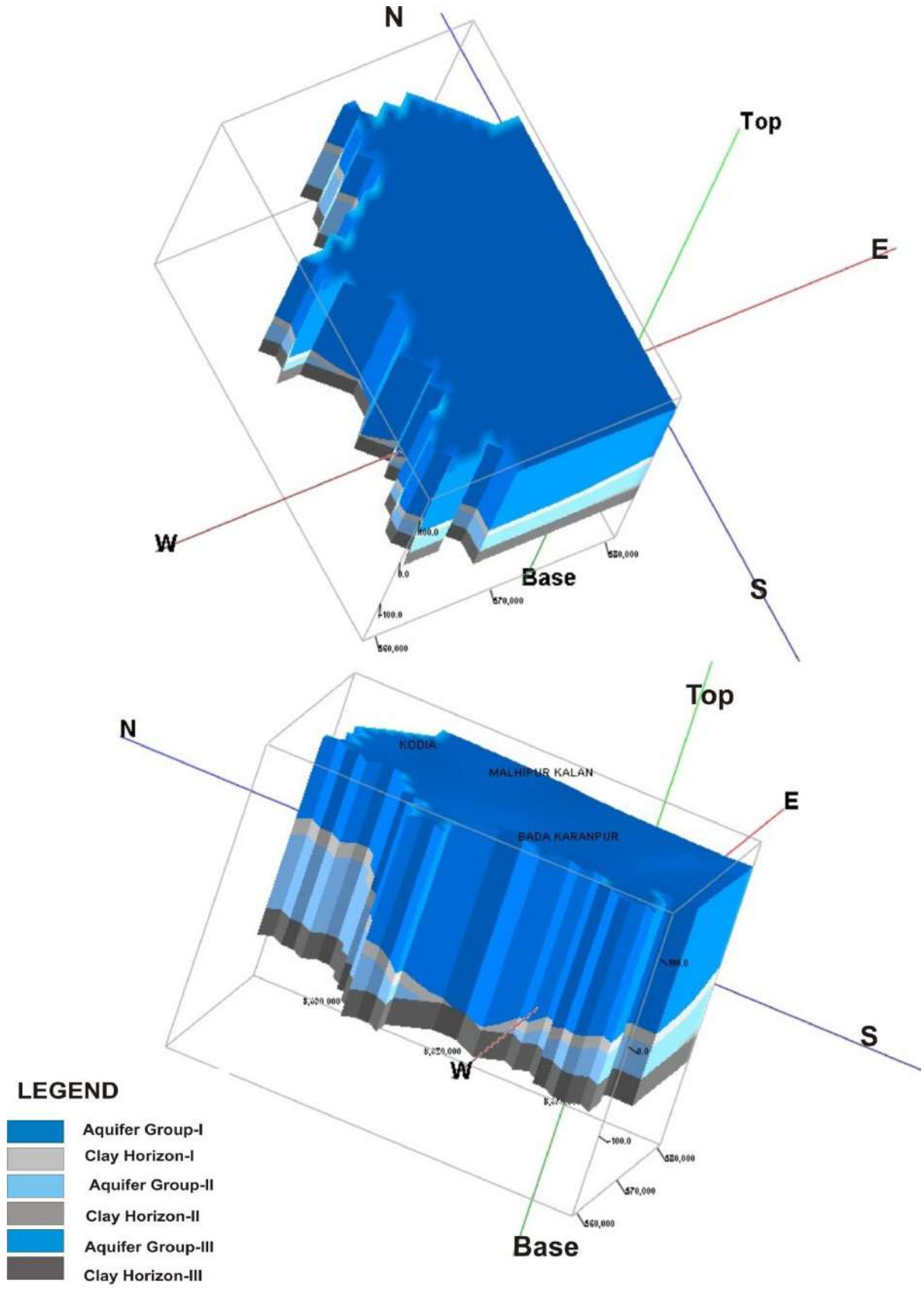


Figure 53: 3-D Model depicting Aquifer geometry of Jamunaha block, Shravasti district

14. Management Plan

Block is safe with 68.87% of stage of ground water extraction. Water level fluctuation map shows rising trend of water level hence no intervention is required. However, on farm activities and Water Use Efficiency practices are recommended. The in situ farm activities such as contour bunding, land leveling, bench terracing, water harvesting structures, afforestation and diversification of cropping pattern are other measures to increase recharge in the block.

Proposed Interventions in Jamunaha Block		**Benefits**	
On-farm activities (ha)	2690	Recharge from On-farm MCM	2.69
Water Use Efficiency practices WUE (ha)	2690	Saving from On-farm & WUE MCM	7.14

The contribution of ground water for irrigation in this block is 100 % and the block is prone to floods/water logging conditions with shallow water levels thus the conjunctive use of surface and ground water is the need of the hour in order to maintain the right balance between surface and ground water and also to bring about parity in ground water development across the block.

II. Aquifer Map and Management plan of *Gilaula Block*

1. Salient Information

Coordinates :	Lat- 27˚32' 45.24" N; Long- 81˚48' 9.36" E
Geographical Area:	334.64 sq km
Population (2011):	Total :204268 Male-108717, Female-95551
Normal Annual Rainfall 2018 (Shravasti District):	1020 mm
Agriculture and Irrigation(2018):	Major Crops- Rice and Wheat Other crops- Sugarcane, Corn, Maize, Potatoes and Barley Net Area Sown-227.70 sq km Net Irrigated Area-129.41 sq km Tube well irrigated area- 128.84 sq km Well irrigated area- 0.57 sq km Surface water bodies irrigated area- Nil
Ground water resource (as on 31-03-2020)	*Dynamic* Net GW Availability- 3228.57 Ham/ 32.28 MCM Stage of GW Extraction- 62.52%

2. Location

Gilaula block lies in SW of Shravasti district, shares border with Bahraich district in West, Ikauna block in South East, Jamunaha in North and Hariharpur Rani Block in East (figure-54).

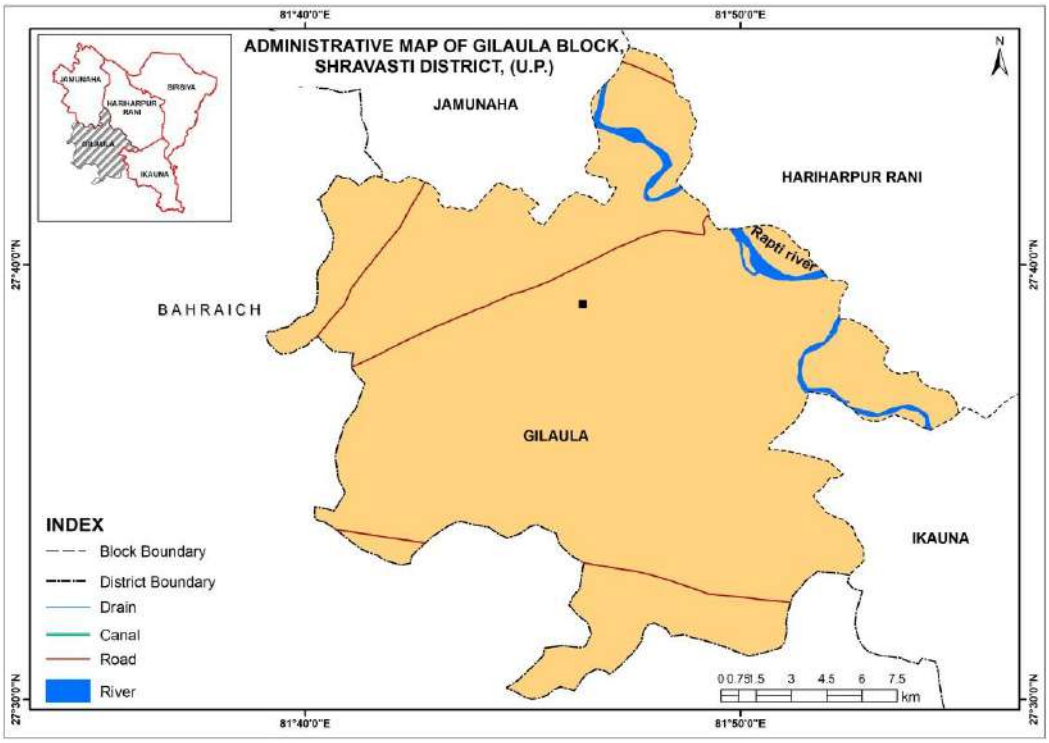


Figure 54: Administrative Map of Gilaula block, Shravasti district

3. Geology

The Gilaula block constitutes a part of Rapti alluvial plains mostly underlain by clayey sand followed by sandy clay and gravel/silt of Quaternary age (figure-55).

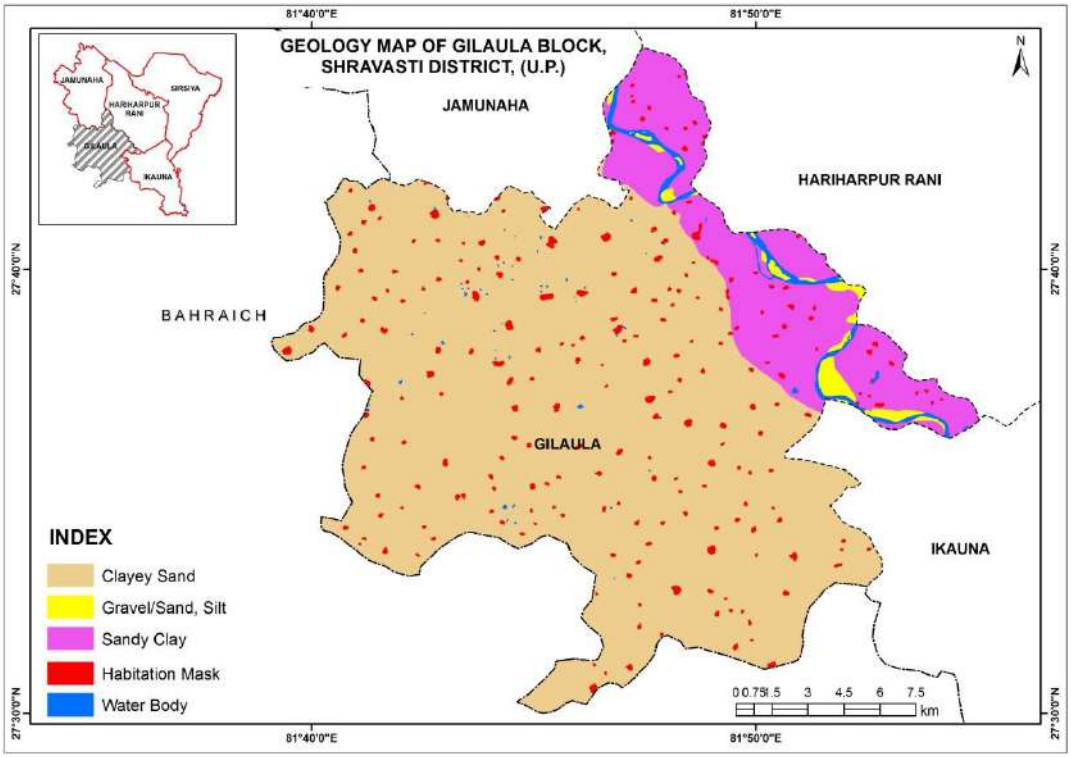


Figure 55: Geology Map of Gilaula block, Shravasti district

4. Drainage

Gilaula block mainly drained by Perinnial nala which joins the Rapti river (figure-56).

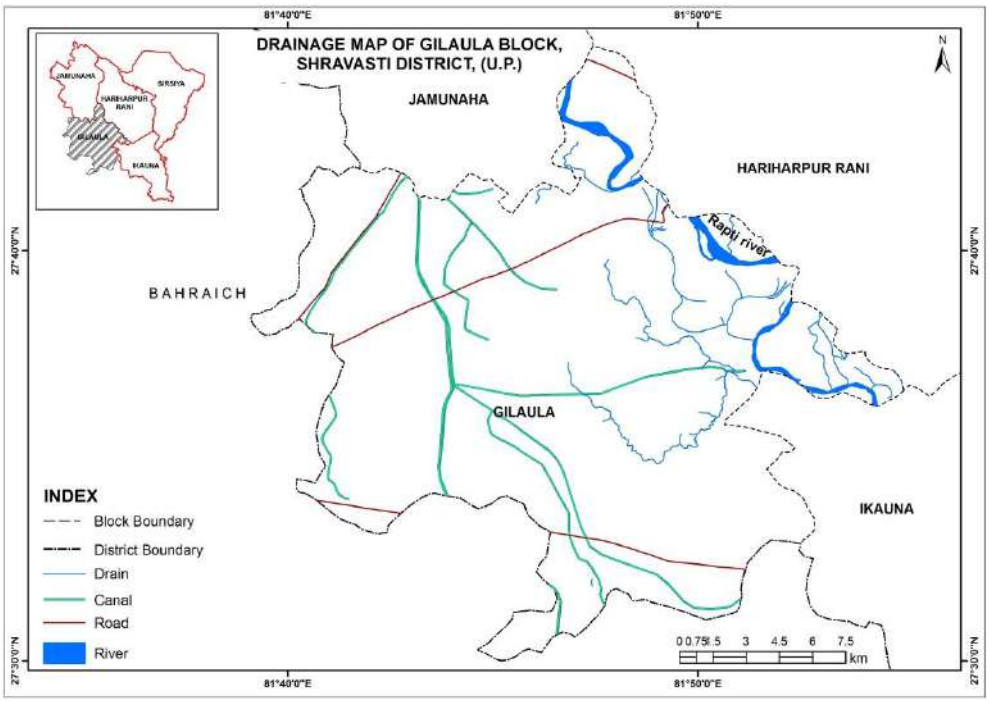


Figure 56: Drainage Map of Gilaula block, Shravasti district

5. Soil

The block is mainly covered with fine silt with varying grades of loamy soil (figure-57).

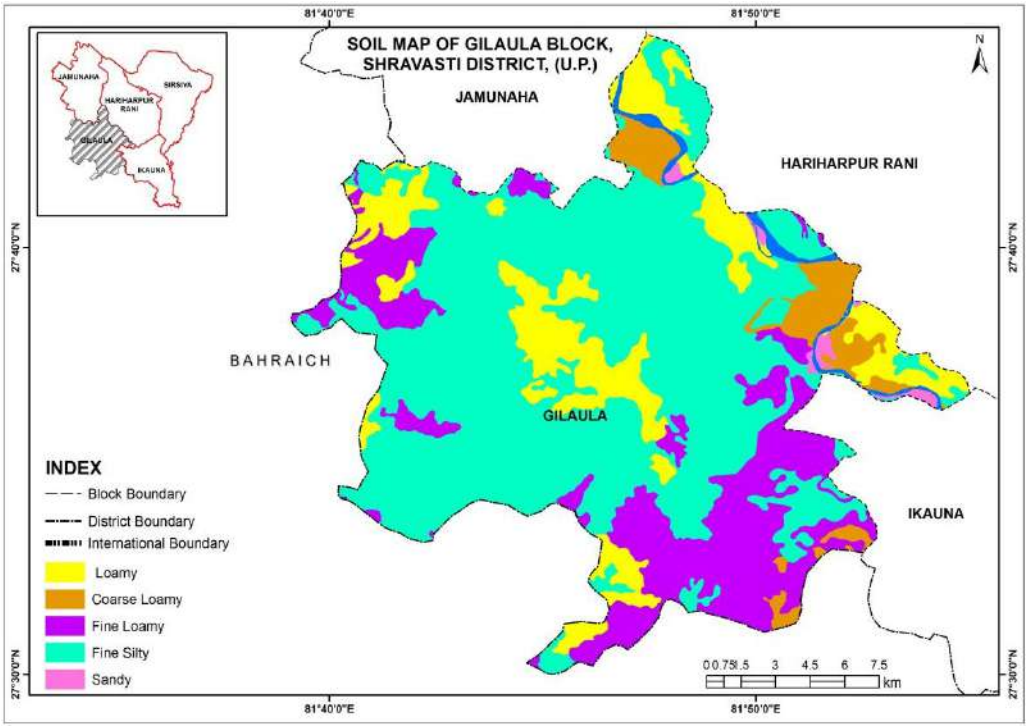


Figure 57: Soil Map of Gilaula block, Shravasti district

6. Geomorphology

The block is mainly covered with older/upper alluvial plain with some part of younger/lower alluvial plain. Oxbow lakes csan be seen along the course of Rapti river in north eastern part of the block. Palaeo Channels can be seen in older/upper alluvial plain (figure-58).

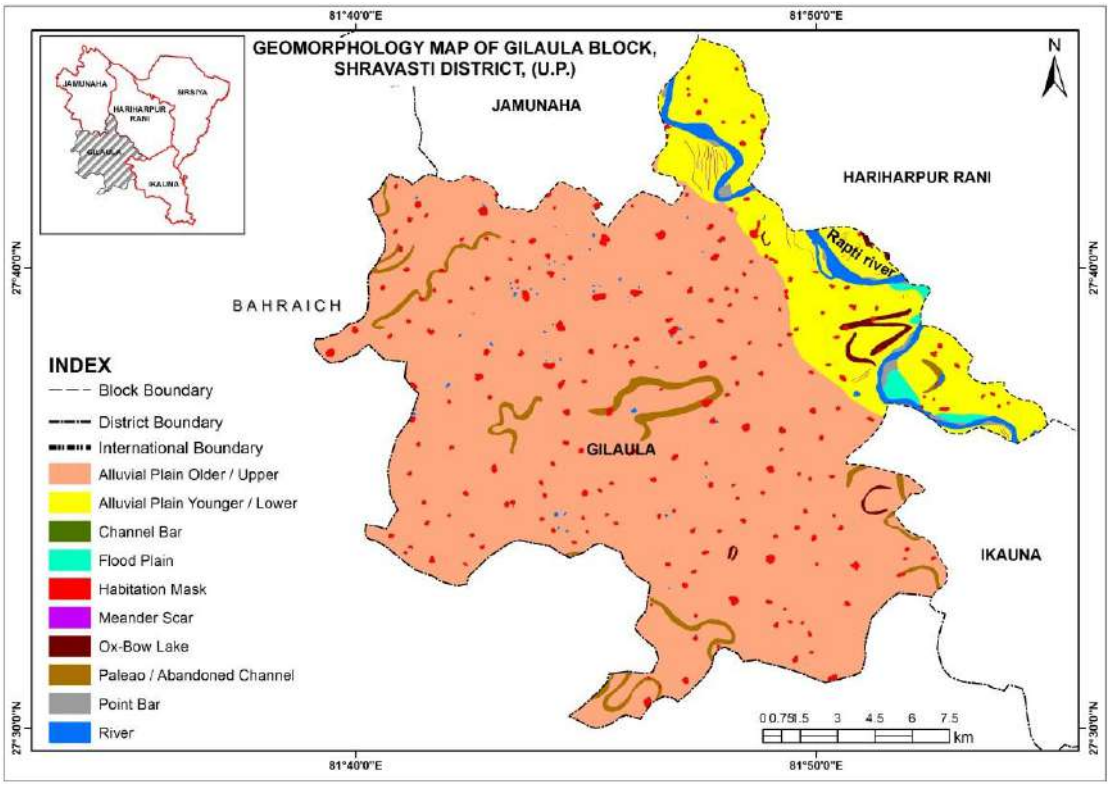


Figure 58: Geomorphology Map of Gilaula block, Shravasti district

7. Landuse/ Land cover

Block is well covered with agricultural land with scattered settlement throughout (figure-59).

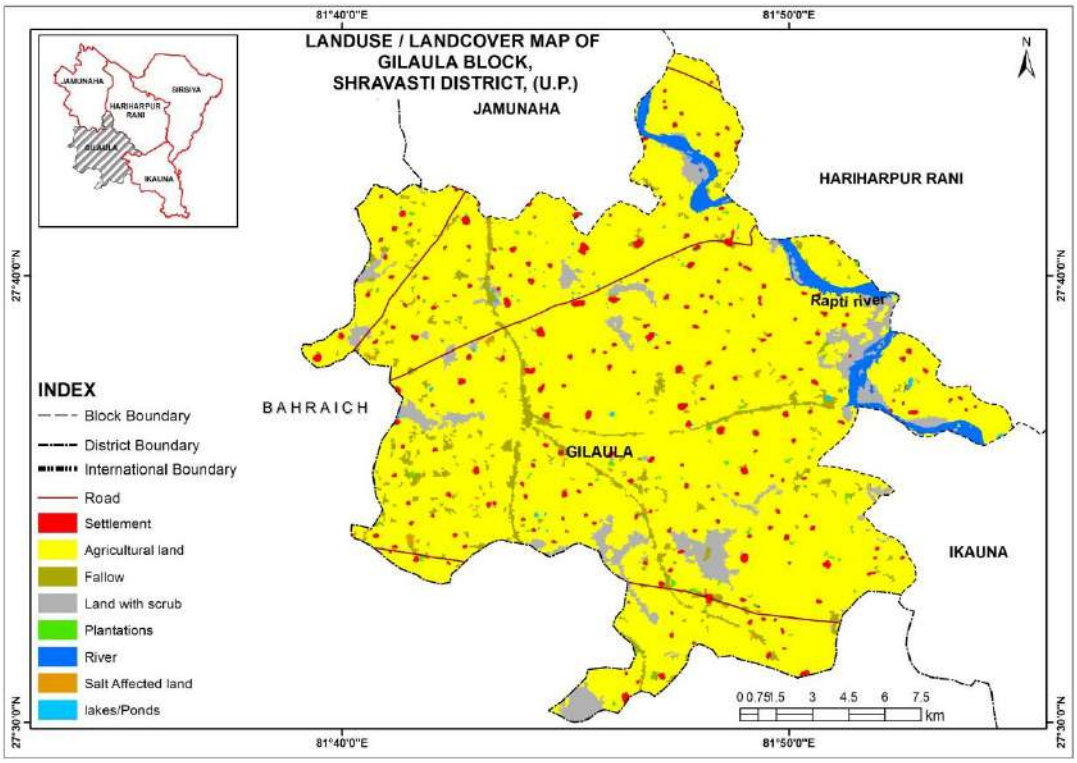


Figure 59: Landuse/Landcover Map of Gilaula block, Shravasti district

8. Ground water Resources

The block is categorized as Safe as per Ground water Resource Assessment 2020 with 62.52% of stage of ground water extraction (figure-60).

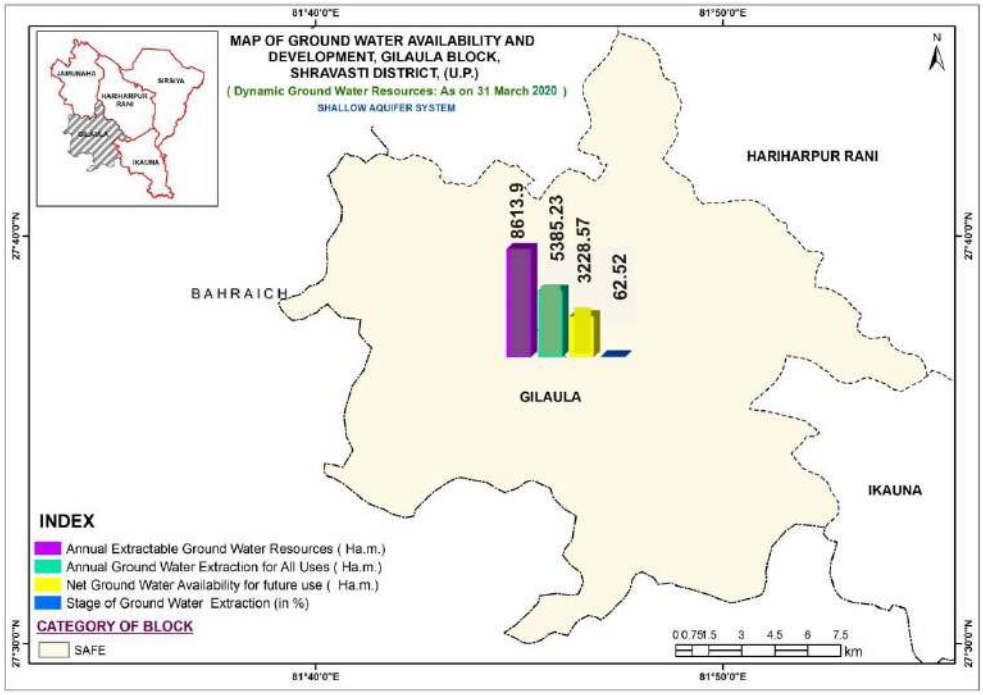


Figure 60: Ground water Resources Map of Gilaula block, Shravasti district

9. Depth to Water Level (Pre-monsoon)

Depth to water level during Pre-monsoon is generally in the range of 0.0-7.0 m bgl (figure-61).

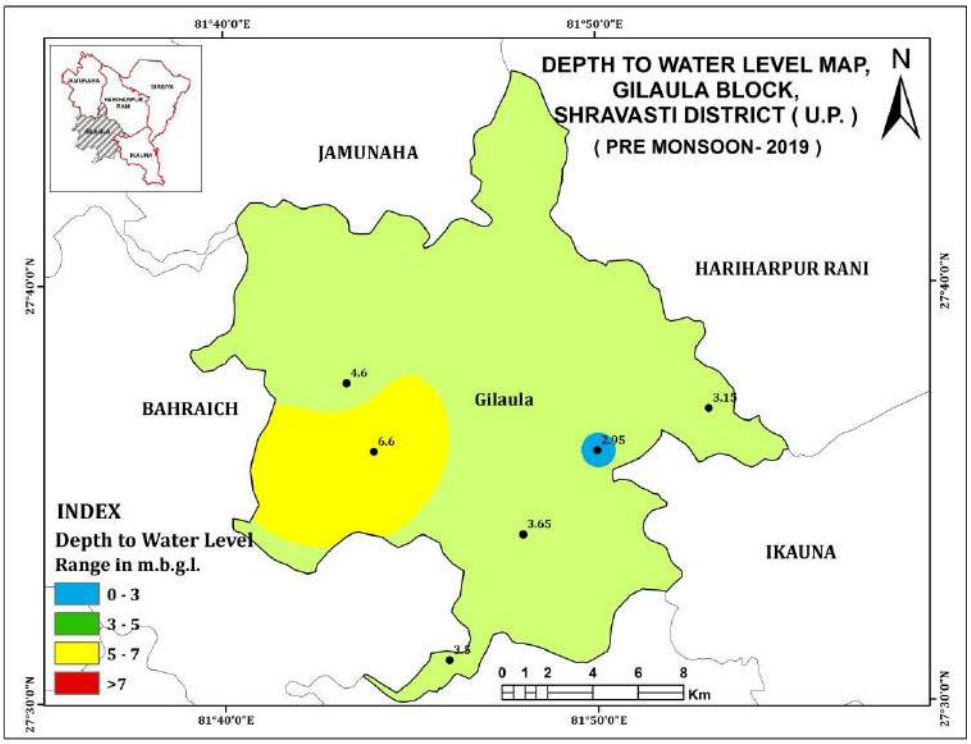


Figure 61: Depth to Water level Map (Pre-Monsoon) of Gilaula block, Shravasti district

10. Depth to Water Level (Post-monsoon)

Depth to water level during Post-monsoon is generally shallow throughout the block ranging in between 0.0-5.0 m bgl (figure-62).

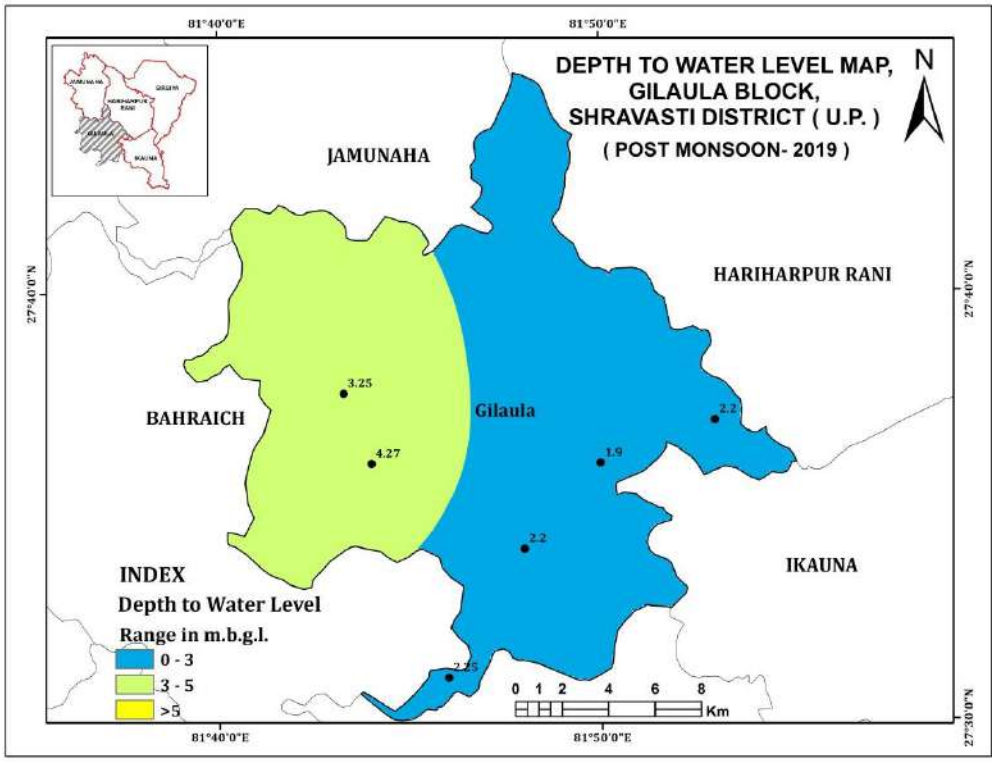


Figure 62: Depth to Water level Map (Post-Monsoon) of Gilaula block, Shravasti district

11. Water level Fluctuation

Water level fluctuation map shows rise in water level in the block (figure-63).

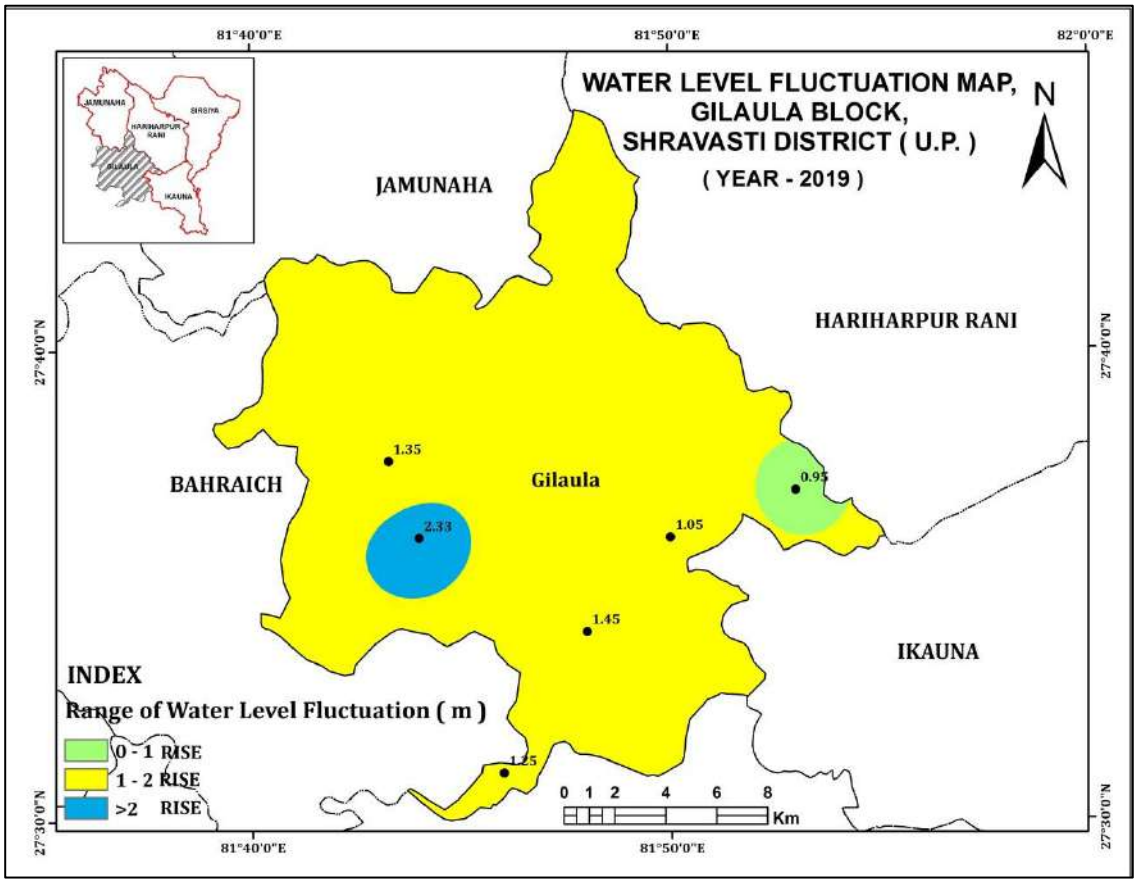


Figure 63: Water level Fluctuation Map of Gilaula block, Shravasti district

12. Chemical Quality

All the chemical constituents are within the permissible limit of BIS-2012 except for sporadic occurrence of arsenic in shallow aquifer. Arsenic reported concentration is 0.015 mg/l.

13. 3-Dimensional Aquifer Disposition

Ground water occurs under water table condition at shallow depths while the deeper aquifer is under confined state of disposition. Sand, kankar, gravelly sand and pebbly sand forms the principal aquifers in the study area separated by confining clay layers acting as aquiclude (figure-64).

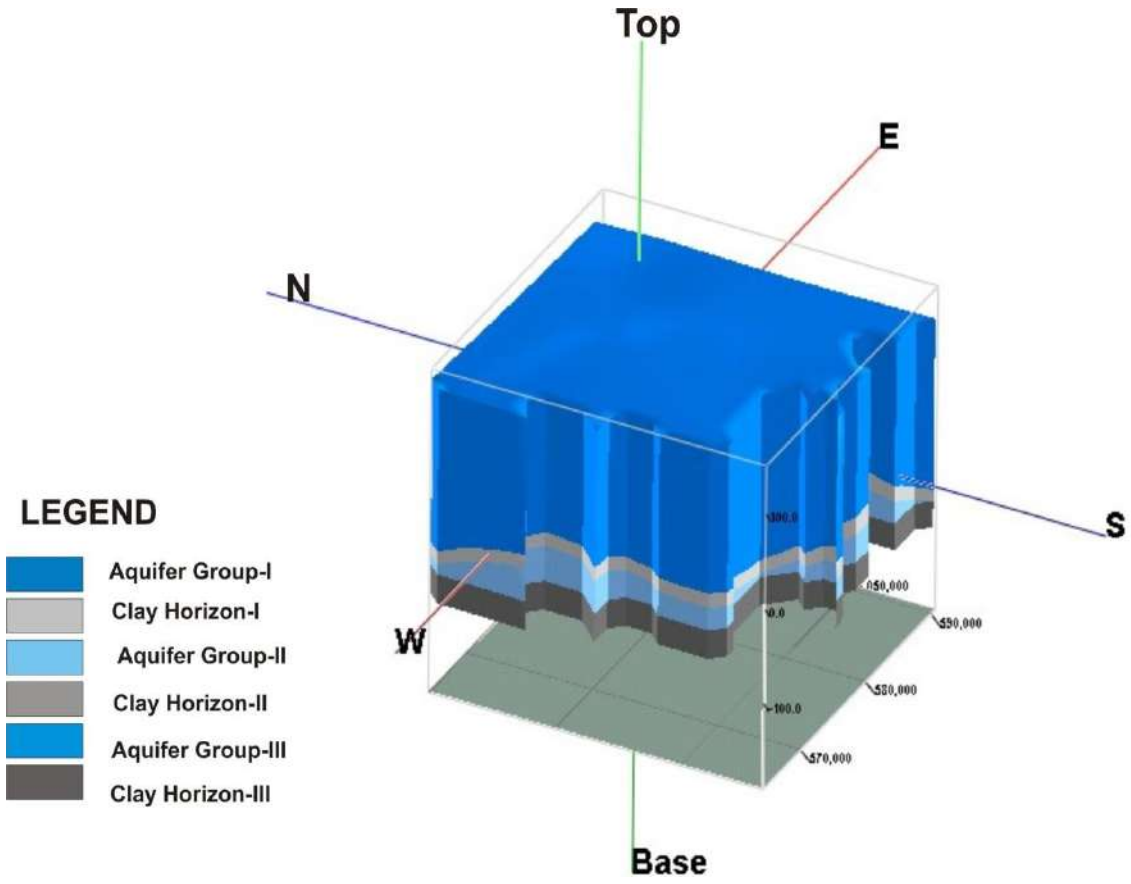


Figure 64: 3-D Model depicting Aquifer geometry of Gilaula block, Shravasti district

14. Management Plan

Block is safe with 61.37% of stage of ground water extraction. Water level fluctuation map shows rising trend of water level hence no intervention is required. However, on farm activities and Water Use Efficiency practices are recommended. The in situ farm activities such as contour bunding, land leveling, bench terracing, water harvesting structures, afforestation and diversification of cropping pattern are other measures to increase recharge in the block.

Proposed Interventions in Gilaula Block		Benefits	
On-farm activities (ha)	2277	Recharge from On-farm MCM	2.28
Water Use Efficiency practices WUE (ha)	2277	Saving from On-farm & WUE MCM	5.89

The contribution of ground water for irrigation in this block is 100 % and have shallow water levels thus the conjunctive use of surface and ground water is the need of the hour in order to maintain the right balance between surface and ground water and also to bring about parity in ground water development across the block.

III. Aquifer Map and Management plan of *Hariharpur Rani Block*

1. Salient Information

Coordinates :	Lat- 27˚ 41' 43.44" N; Long- 81˚ 52' 47.28" E
Geographical Area:	443.63 sq km
Population (2011):	Total :187331, Male-100626, Female-86705
Normal Annual Rainfall 2018 (Shravasti District):	1020 mm
Agriculture and Irrigation(2018):	Major Crops- Rice and Wheat Other crops- Corn, Maize, Sugarcane, Potatoes and Barley Net Area Sown-218.04 sq km Net Irrigated Area-129.17 sq km Tube well irrigated area- 128.64 sq km Well irrigated area- 0.52 sq km Surface water bodies irrigated area- 0.01 sq km
Ground water resource (as on 31-03-2020)	*Dynamic* Net GW Availability- 3369.49 Ham/ 33.69 MCM Stage of GW Extraction- 62.37%

2. Location

Hariharpur Rani block lies at centre of Shravasti district, shares border with all the four Blocks and International border with Nepal country in north (figure-65).

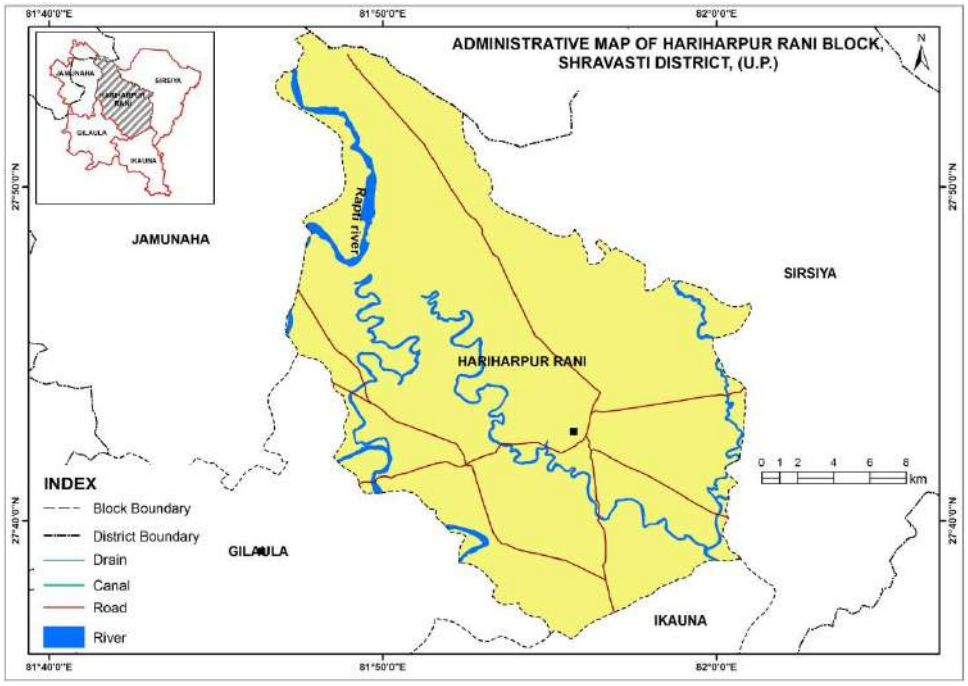


Figure 65: Administrative Map of Hariharpur Rani block, Shravasti district

3. Geology

The Hariharpur Rani block mostly underlain by sandy clay of upper Pliestocene to Recent in age followed by clayey sand of Pliestocene age (figure-66).

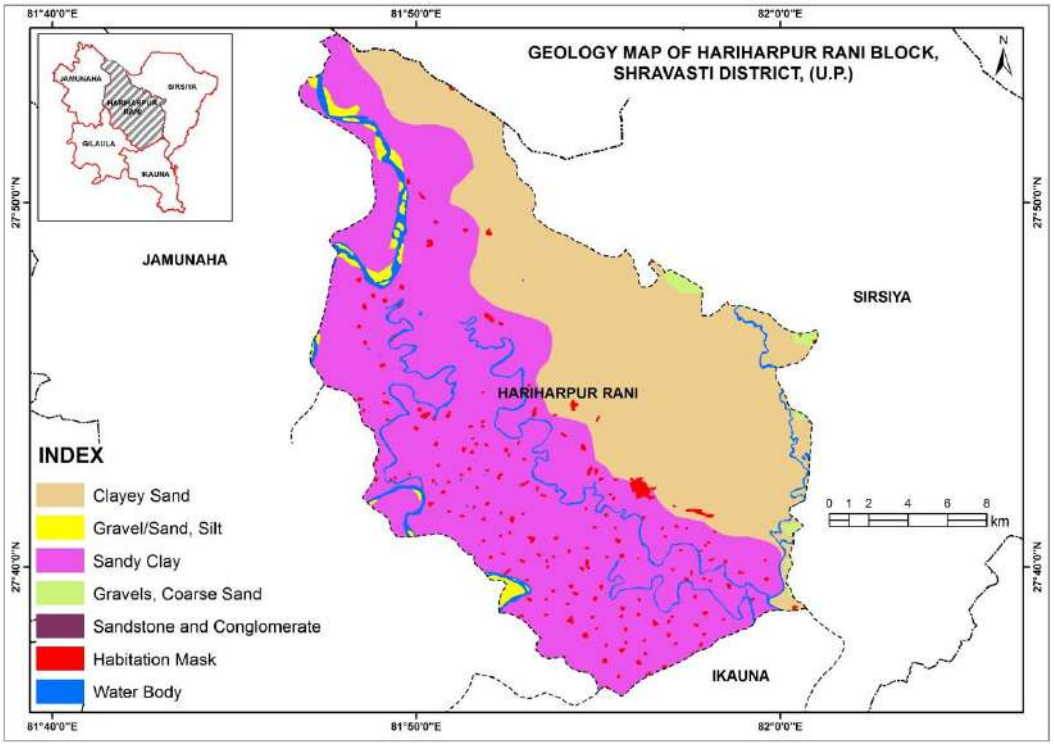


Figure 66: Geology Map of Hariharpur Rani block, Shravasti district

4. Drainage

Hariharpur Rani block is well drained by the Rapti river in north and its tributaries throughout the block (figure-67).

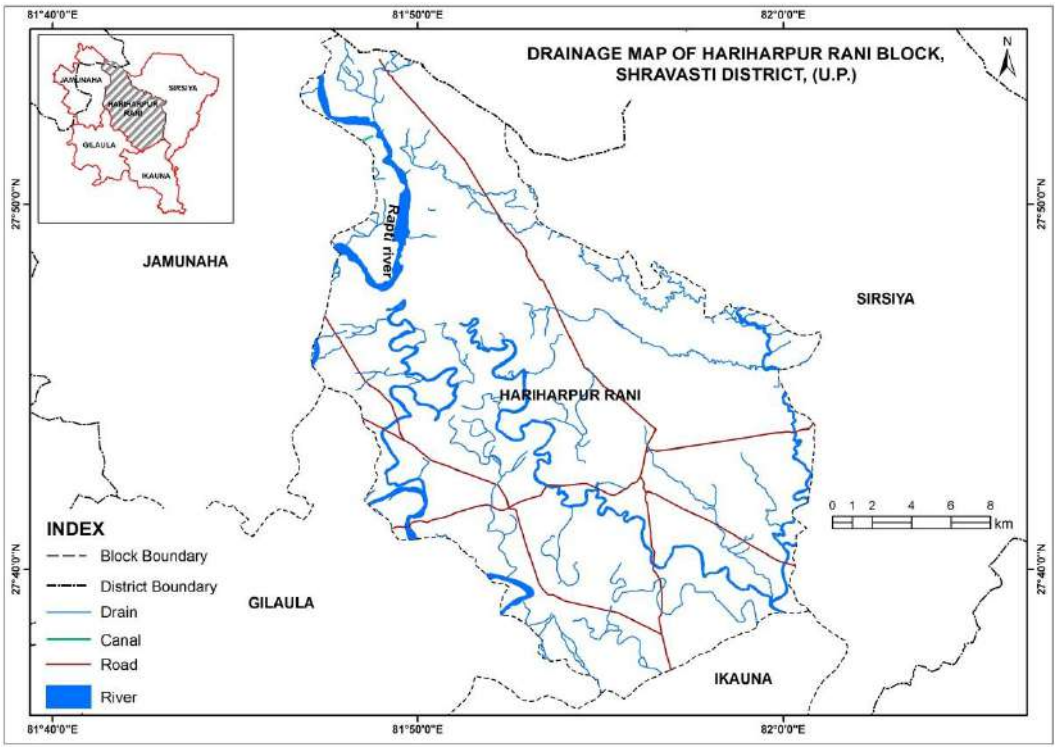


Figure 67: Drainage Map of Hariharpur Rani block, Shravasti district

5. Soil

The block is mainly covered with varying grades of loamy soil followed by fine silt (figure-68).

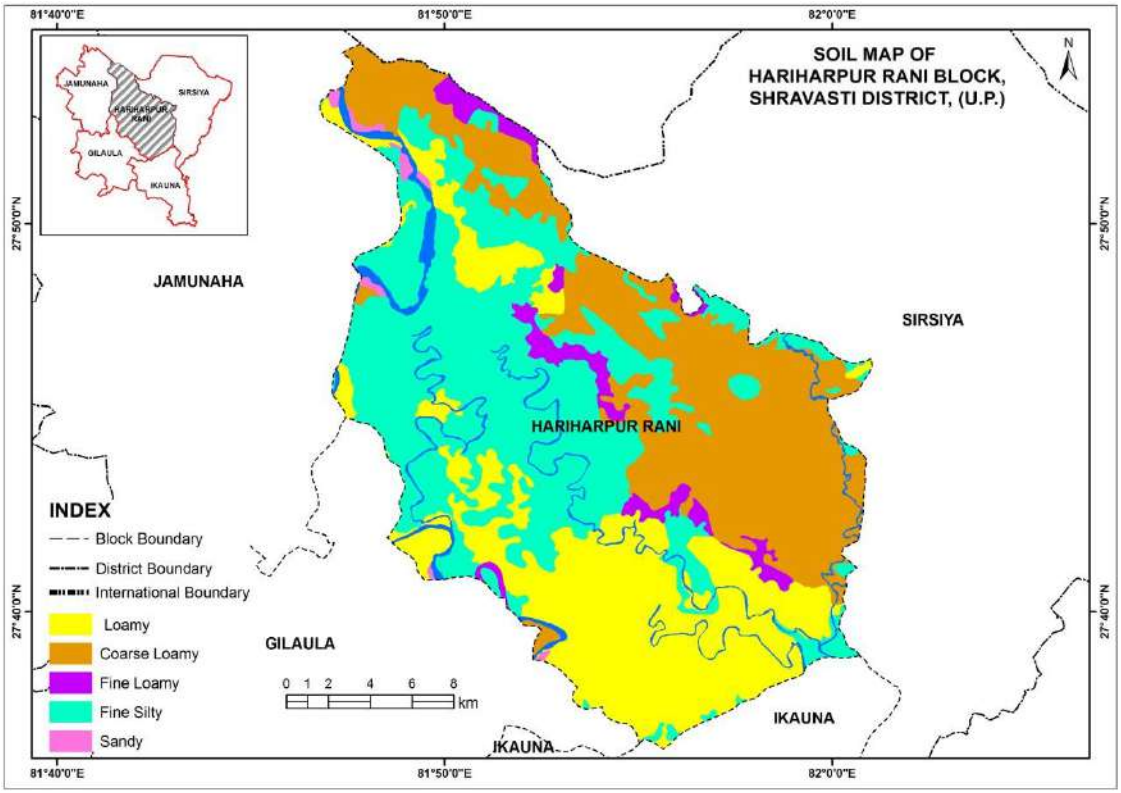


Figure 68: Soil Map of Hariharpur Rani block, Shravasti district

6. Geomorphology

The block is mainly covered with younger/lower alluvial plain with part of older/upper alluvial plain. Oxbow lakes csan be seen along the course of Rapti river in north west. Palaeo Channels can be seen in older/upper alluvial plain (figure-69).

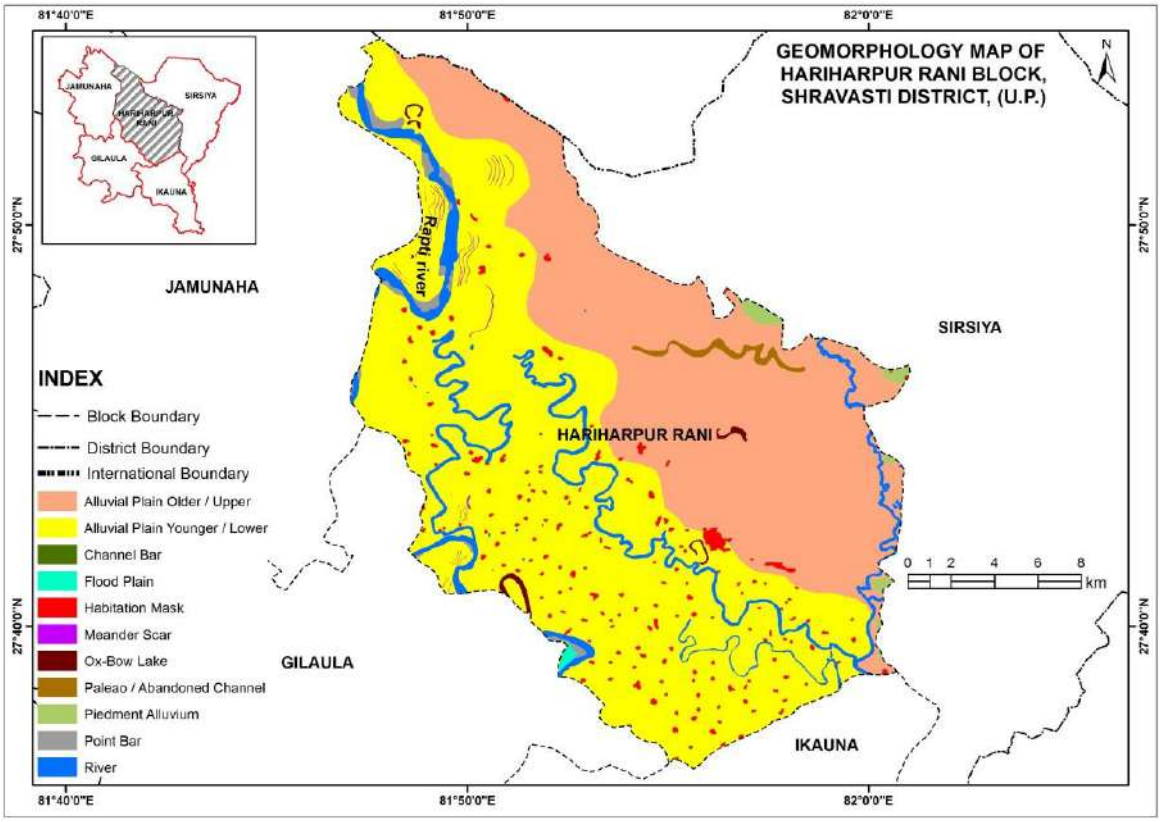


Figure 69: Geomorphology Map of Hariharpur Rani block, Shravasti district

7. Landuse/ Land cover

The south and SW part of the block is well covered with agricultural land with scattered settlement. However the north and NE part of the block is totally covered with dense forest (figure-70).

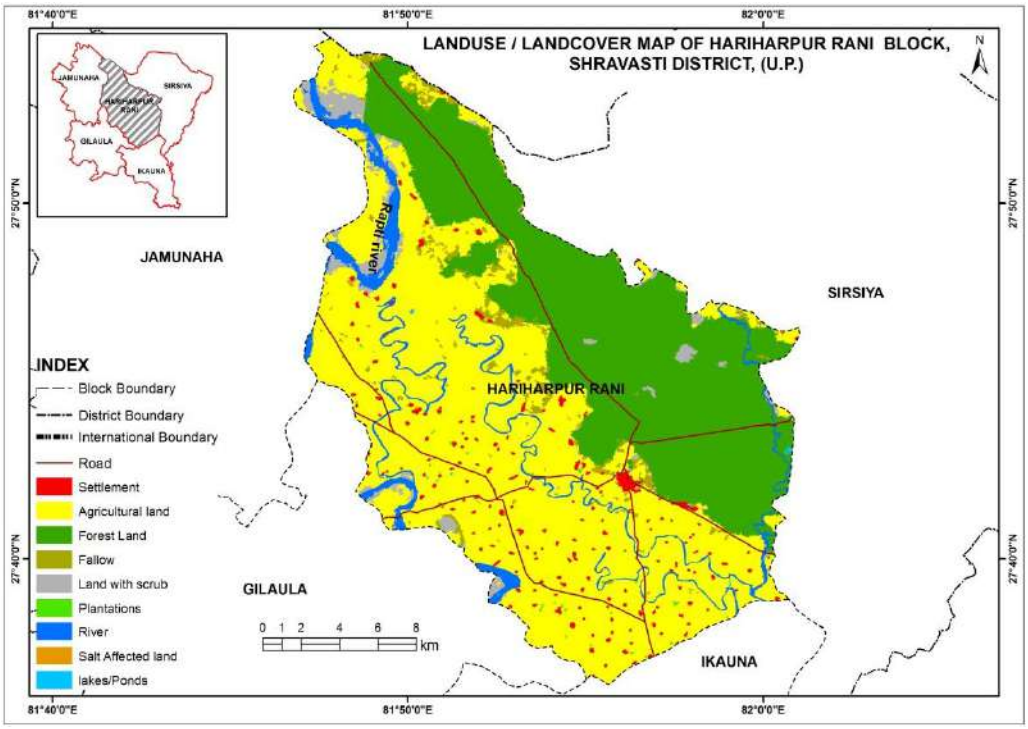


Figure 70: Landuse/Landcover Map of Hariharpur Rani block, Shravasti district

8. Ground water Resources

The block is categorized as Safe as per Ground water Resource Assessment 2020 with 62.37% of stage of ground water extraction (figure-71).

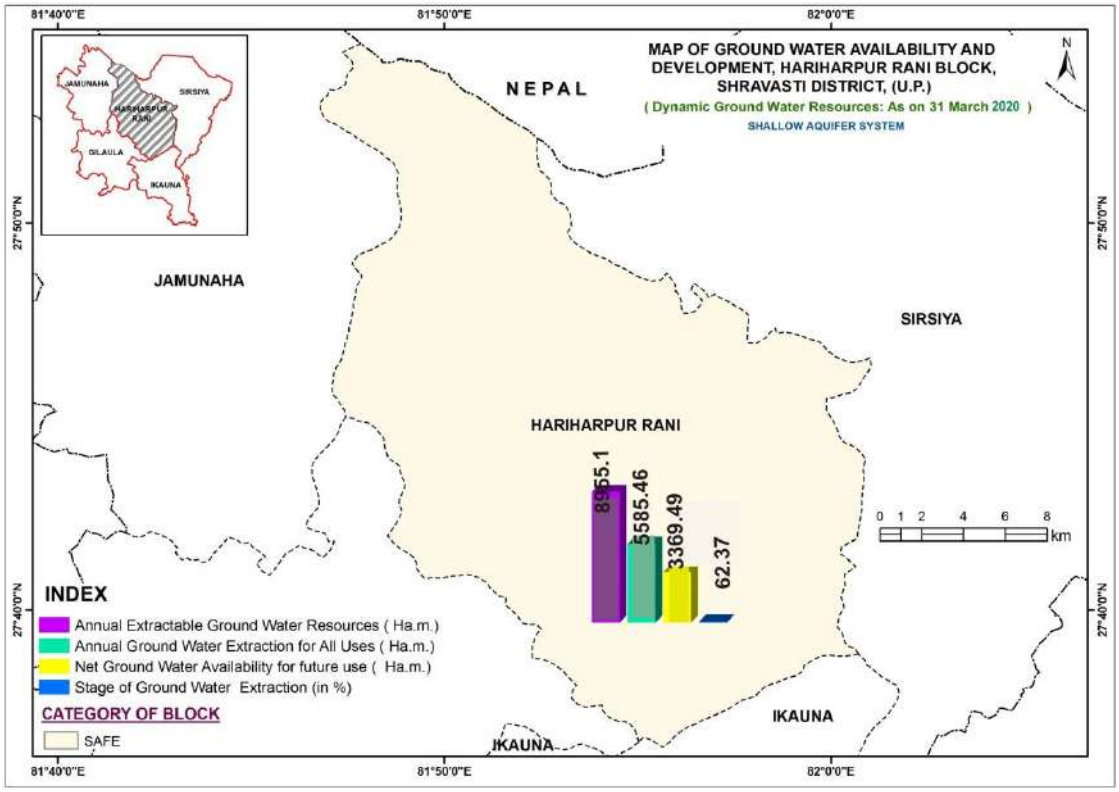


Figure 71: Ground water Resources Map of Hariharpur Rani block, Shravasti district

9. Depth to Water Level (Pre-monsoon)

Depth to water level during Pre-monsoon is generally shallow in the range of 0.0-5.0 m bgl throughout block (figure-72).

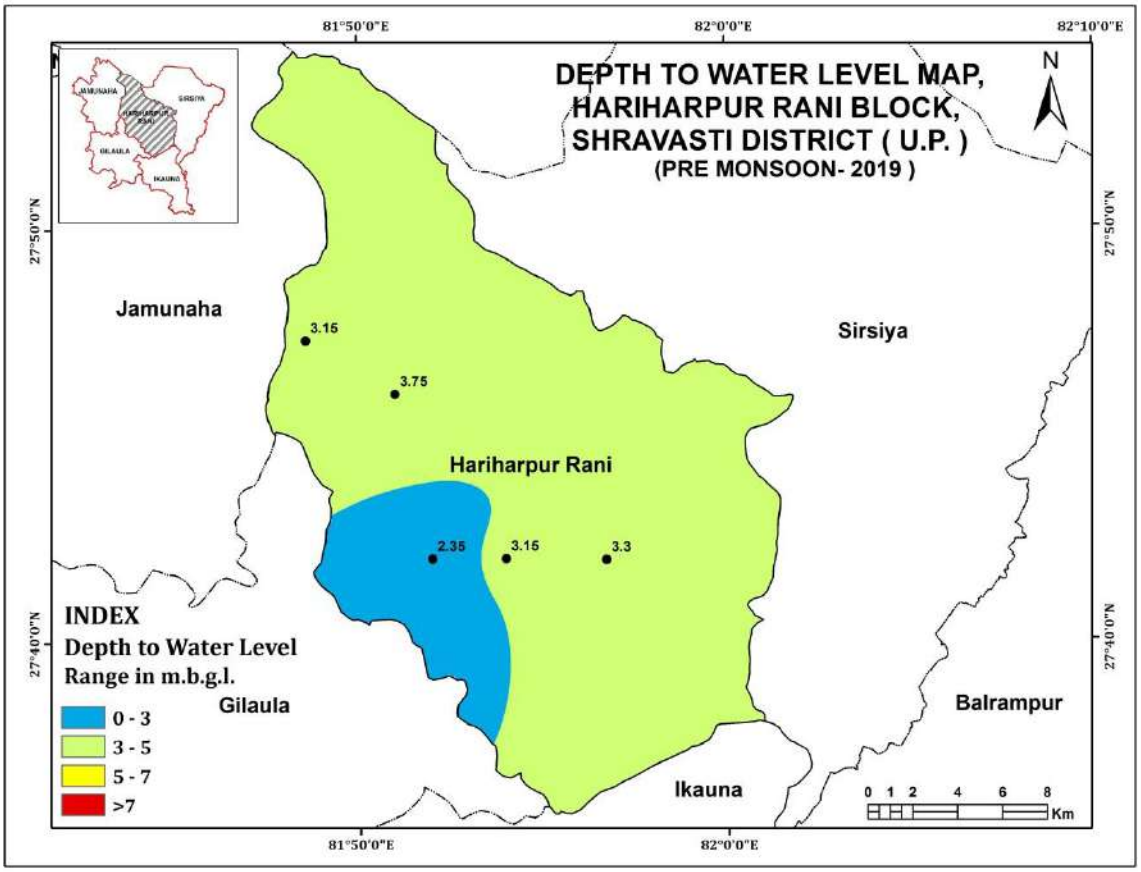


Figure 72: Depth to Water level Map (Pre-Monsoon) of Hariharpur Rani block, Shravasti district

10. Depth to Water Level (Post-monsoon)

Depth to water level during Post-monsoon is generally shallow throughout the block ranging in between 0.0-3.0 m bgl except for one location showing 3.2 m bgl water level (figure-73).

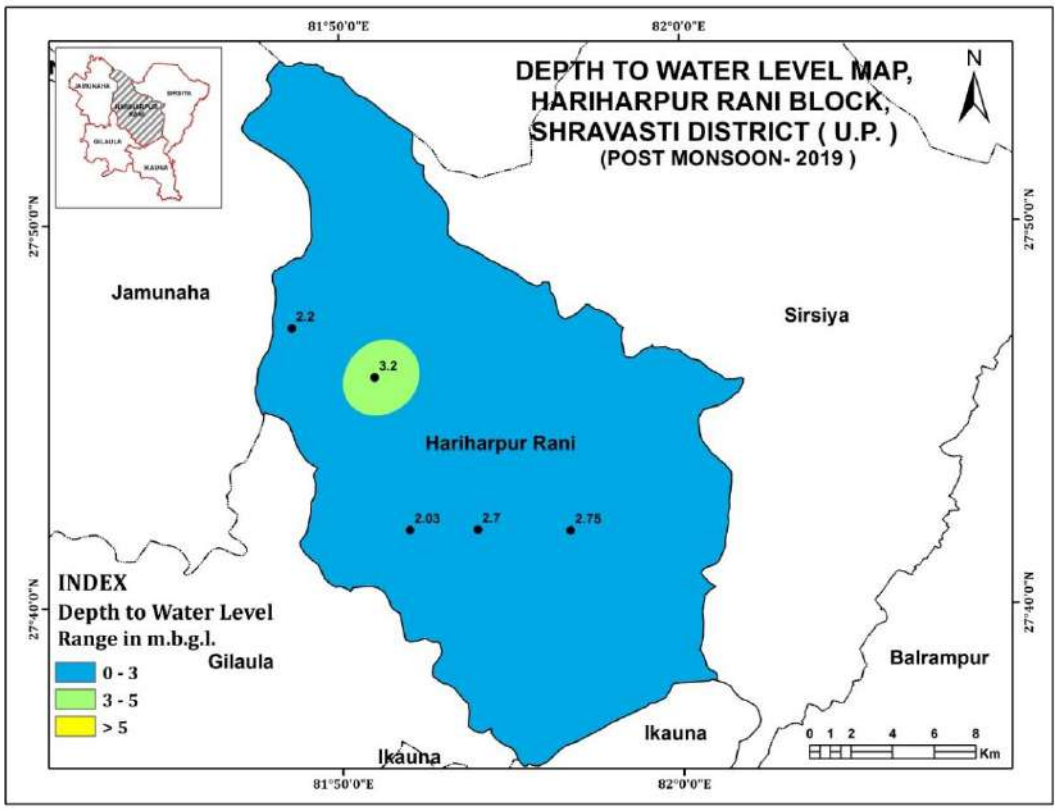


Figure 73: Depth to Water level Map (Post-Monsoon) of Hariharpur Rani block, Shravasti district

11. Water level Fluctuation

Water level fluctuation map shows rise in water level throughout the block (figure-74).

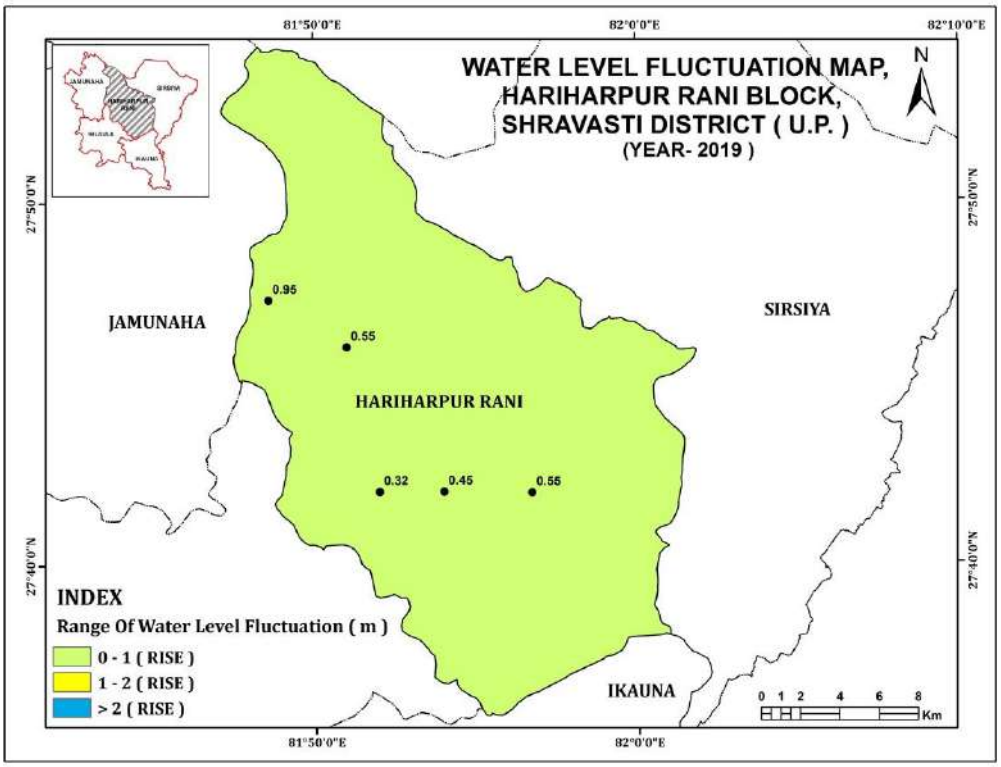


Figure 74: Water level Fluctuation Map of Hariharpur Rani block, Shravasti district

12. Chemical Quality

All the chemical constituents are within the permissible limit of BIS-2012 except for sporadic occurrence of arsenic in shallow aquifer. Arsenic reported concentration is 0.024 mg/l.

13. 3-Dimensional Aquifer Disposition

Ground water occurs under water table condition at shallow depths while the deeper aquifer is under confined state of disposition. Sand, kankar, gravelly sand and pebbly sand forms the principal aquifers in the study area separated by confining clay layers acting as aquiclude (figure-75).

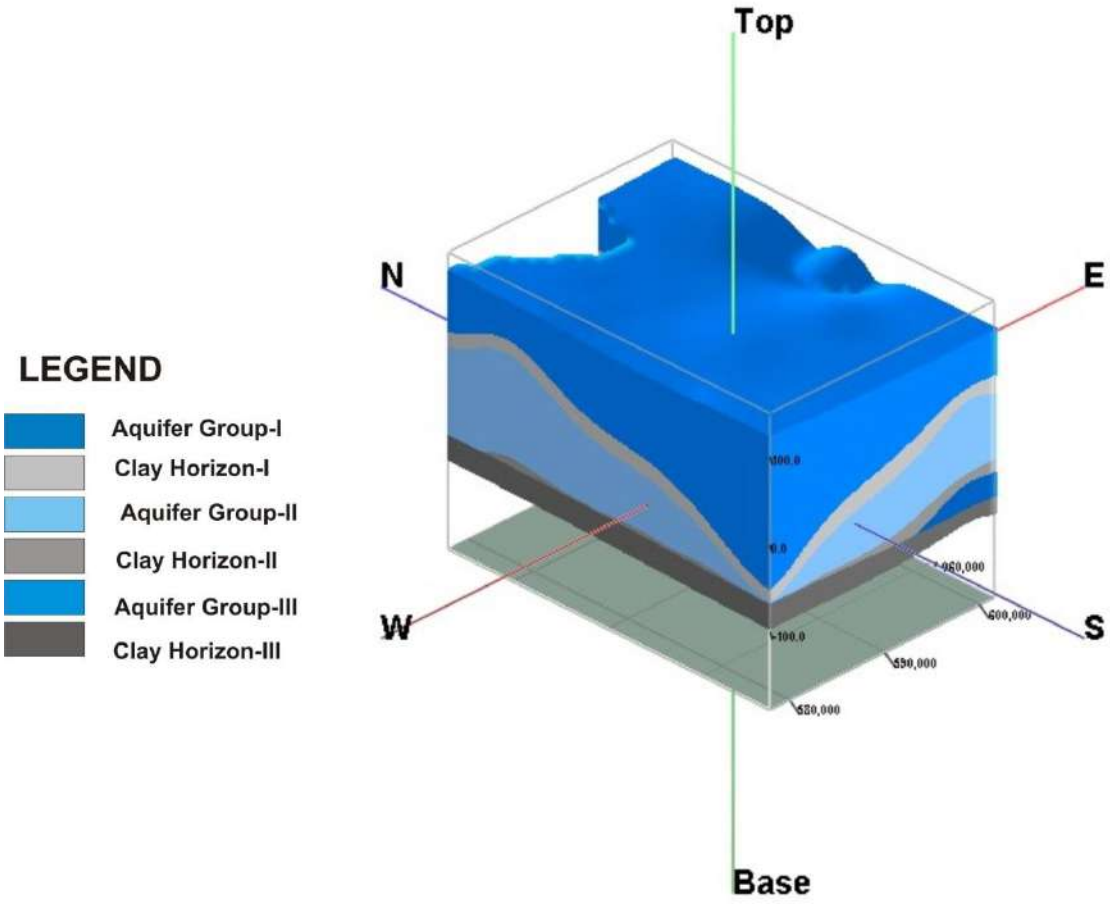


Figure 75: 3-D Model depicting Aquifer geometry of Hariharpur Rani block, Shravasti district

14. Management Plan

Block is safe with 60.20% of stage of ground water extraction. Water level fluctuation map shows rising trend of water level hence no intervention is required. However, on farm activities and Water Use Efficiency practices are recommended. The in situ farm activities such as contour bunding, land leveling, bench terracing, water harvesting structures, afforestation and diversification of cropping pattern are other measures to increase recharge in the block.

Proposed Interventions in Hariharpur Rani Block		**Benefits**	
On-farm activities (ha)	2180	Recharge from On-farm MCM	2.18
Water Use Efficiency practices WUE (ha)	2180	Saving from On-farm & WUE MCM	6.07

Establishing the canal network in the block as the canal network is totally absent in this block and ground water contribution for irrigation is 100%. Thus the conjunctive use of surface and ground water is the need of the hour in order to maintain the right balance between surface and ground water and also to bring about parity in ground water development across the block.

IV. Aquifer Map and Management plan of *Ikauna Block*

1. Salient Information

Coordinates :	Lat- 27˚ 31' 53.4" N; Long- 81˚ 58' 4" 1.56" E
Geographical Area:	286.05 sq km
Population (2011):	Total :216759 Male-114561, Female-102198
Normal Annual Rainfall 2018 (Shravasti District):	1020 mm
Agriculture and Irrigation(2018):	Major Crops- Rice and Wheat Other crops- Sugarcane, Corn, Maize, Potatoes and Barley Net Area Sown-200.16 sq km Net Irrigated Area-138.44 sq km Tube well irrigated area- 137.91 sq km Well irrigated area- 0.53 sq km Surface water bodies irrigated area- Nil
Ground water resource (as on 31-03-2020)	*Dynamic* Net GW Availability- 2905.51 Ham/ 29.05 MCM Stage of GW Extraction- 65.36%

2. Location

Ikauna block lies at south most of Shravasti district, shares border with Balrampur, Gonda and Bahraich districts in south and Gilaula, Sirsiya and Hariharpur Rani Blocks in north (figure-76).

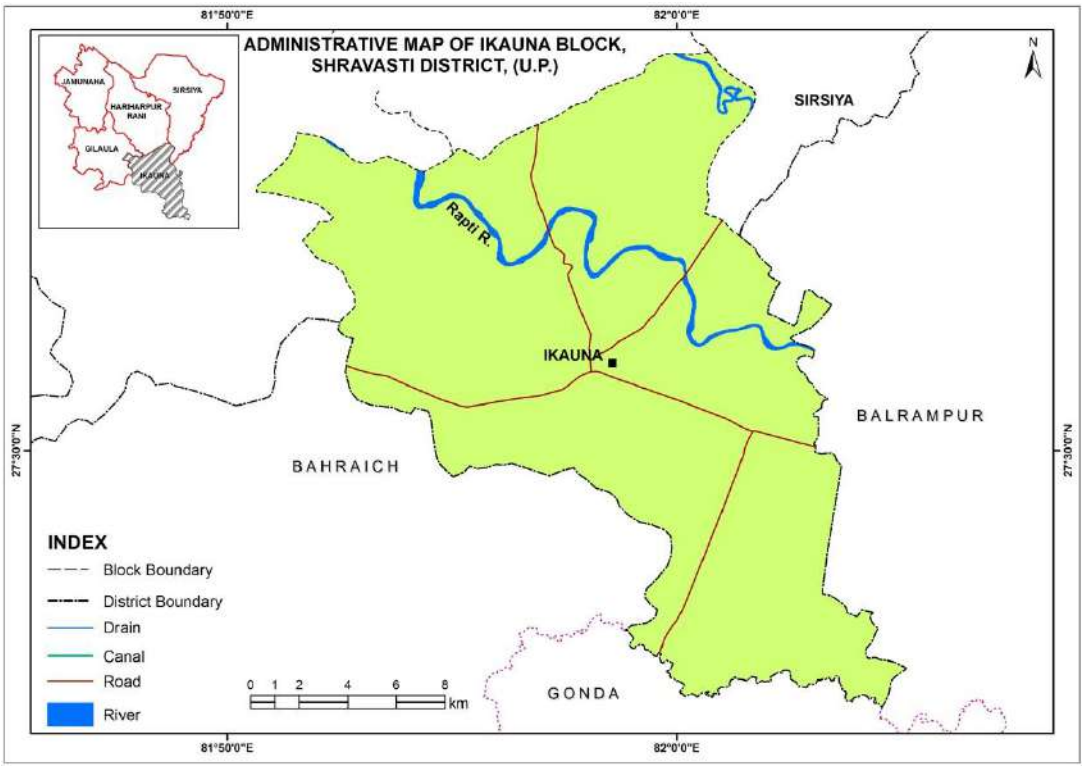


Figure 76: Administrative Map of Ikauna block, Shravasti district

3. Geology

The Ikauna block mostly underlain by clayey sand of Pliestocene age followed by sandy clay of upper Pliestocene to Recent in age (figure-77).

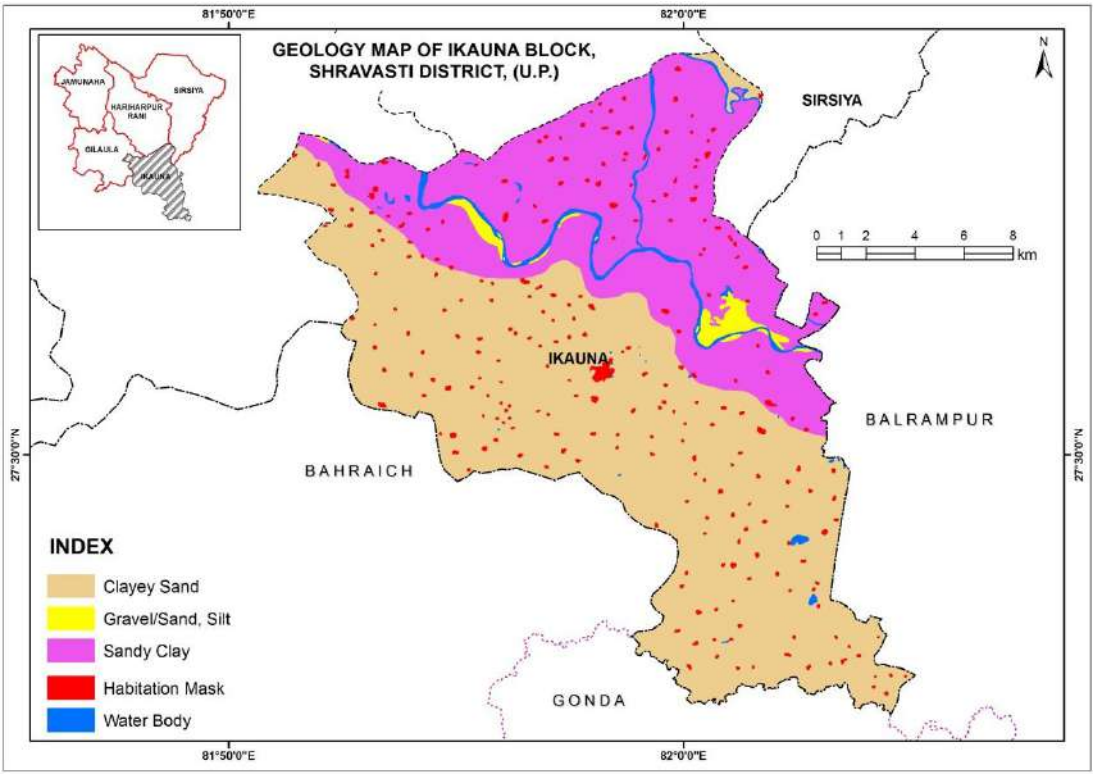


Figure 77: Geology Map of Ikauna block, Shravasti district

4. Drainage

Ikauna block is well drained by the Rapti river in north and perennial nalas throughout the block (figure-78).

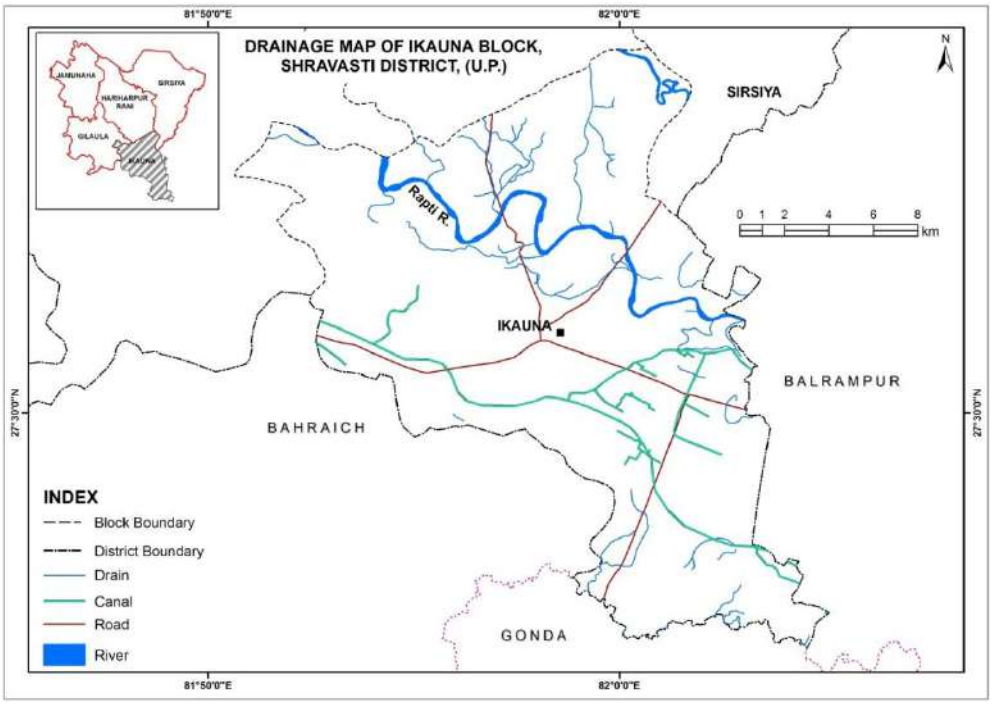


Figure 78: Drainage Map of Ikauna block, Shravasti district

5. Soil

The block is mainly covered with fine silt and varying grades of loamy soil (figure-79).

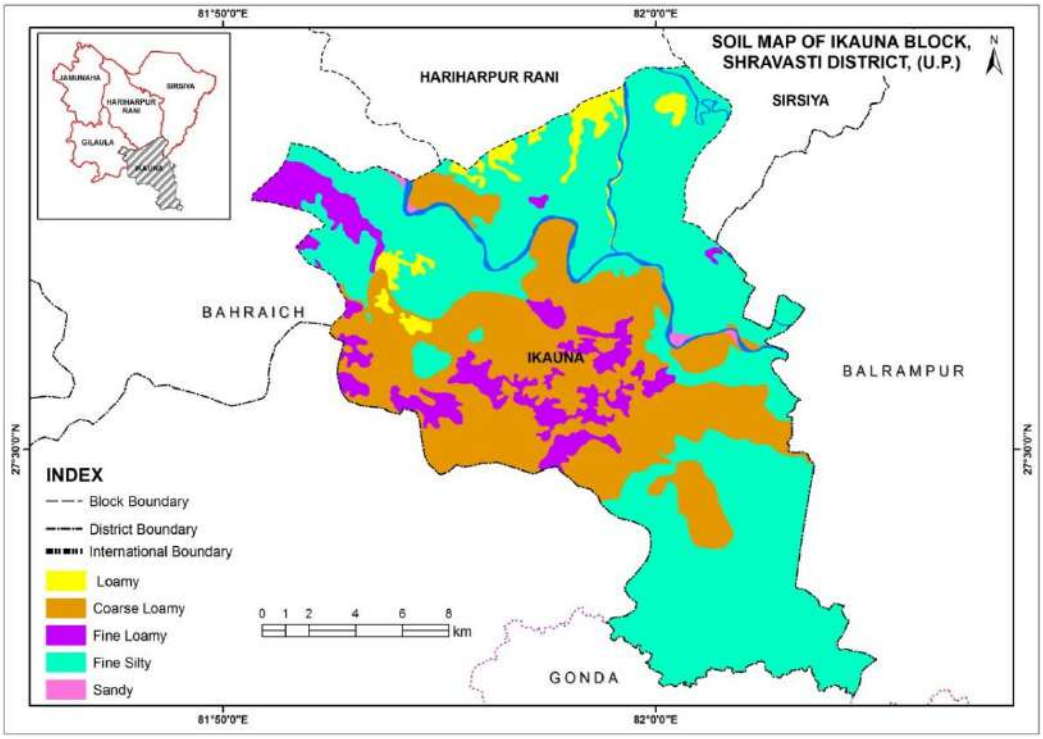


Figure 79: Soil Map of Ikauna block, Shravasti district

6. Geomorphology

The block is mainly covered with older/upper alluvial plain with few part of younger/lower alluvial plain. Oxbow lakes can be seen along the course of Rapti. Palaeo Channels can be well seen in older/upper alluvial plain (figure-80).

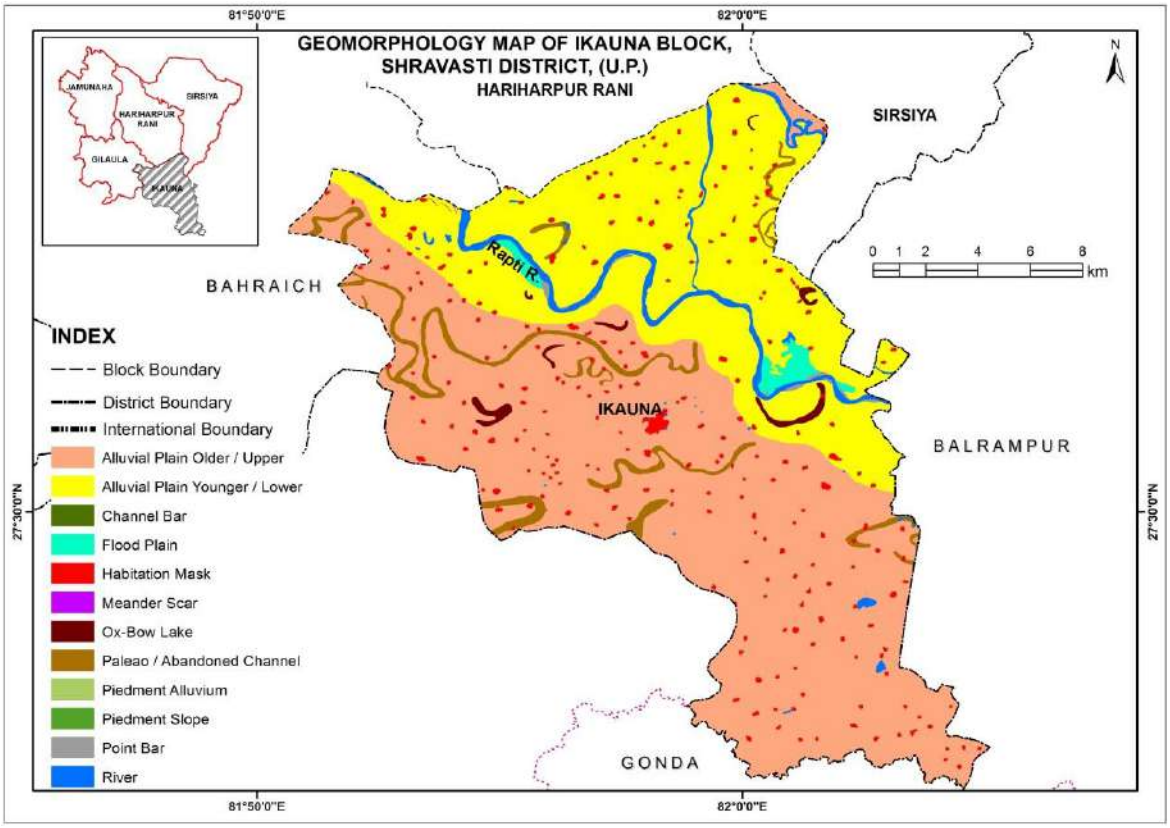


Figure 80: Geomorphology Map of Ikauna block, Shravasti district

7. Landuse/ Land cover

The block is well covered with agricultural land with scattered settlement. Patches of land with scrub and fallow land can be seen throughout the block (figure-81).

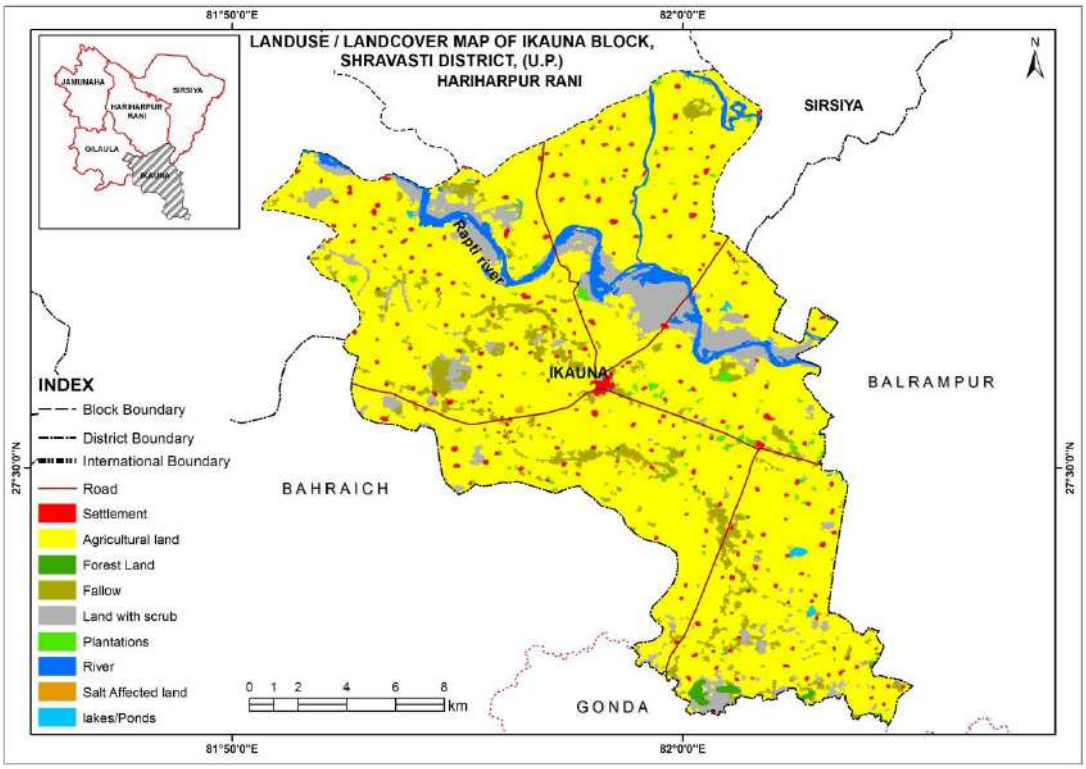


Figure 81: Landuse/Landcover Map of Ikauna block, Shravasti district

8. Ground water Resources

The block is categorized as Safe as per Ground water Resource Assessment 2020 with 65.36% of stage of ground water extraction (figure-82).

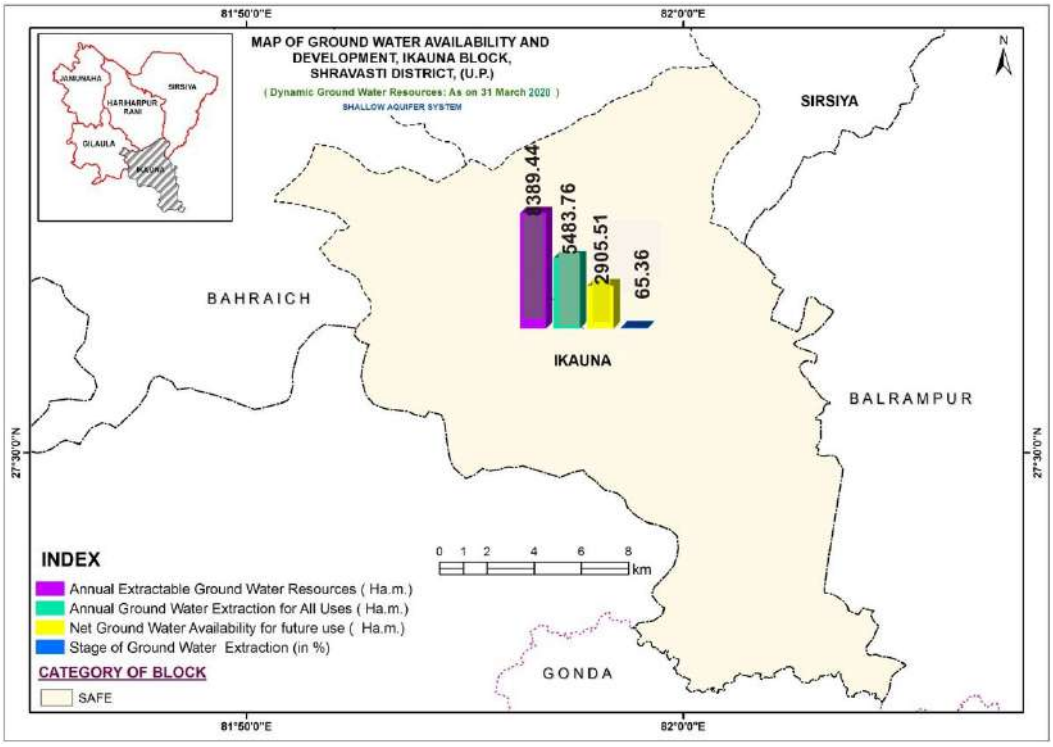


Figure 82: Ground water Resources Map of Ikauna block, Shravasti district

9. Depth to Water Level (Pre-monsoon)

Depth to water level during Pre-monsoon is generally shallow in the range of 0.0-5.0 m bgl throughout block (figure-83).

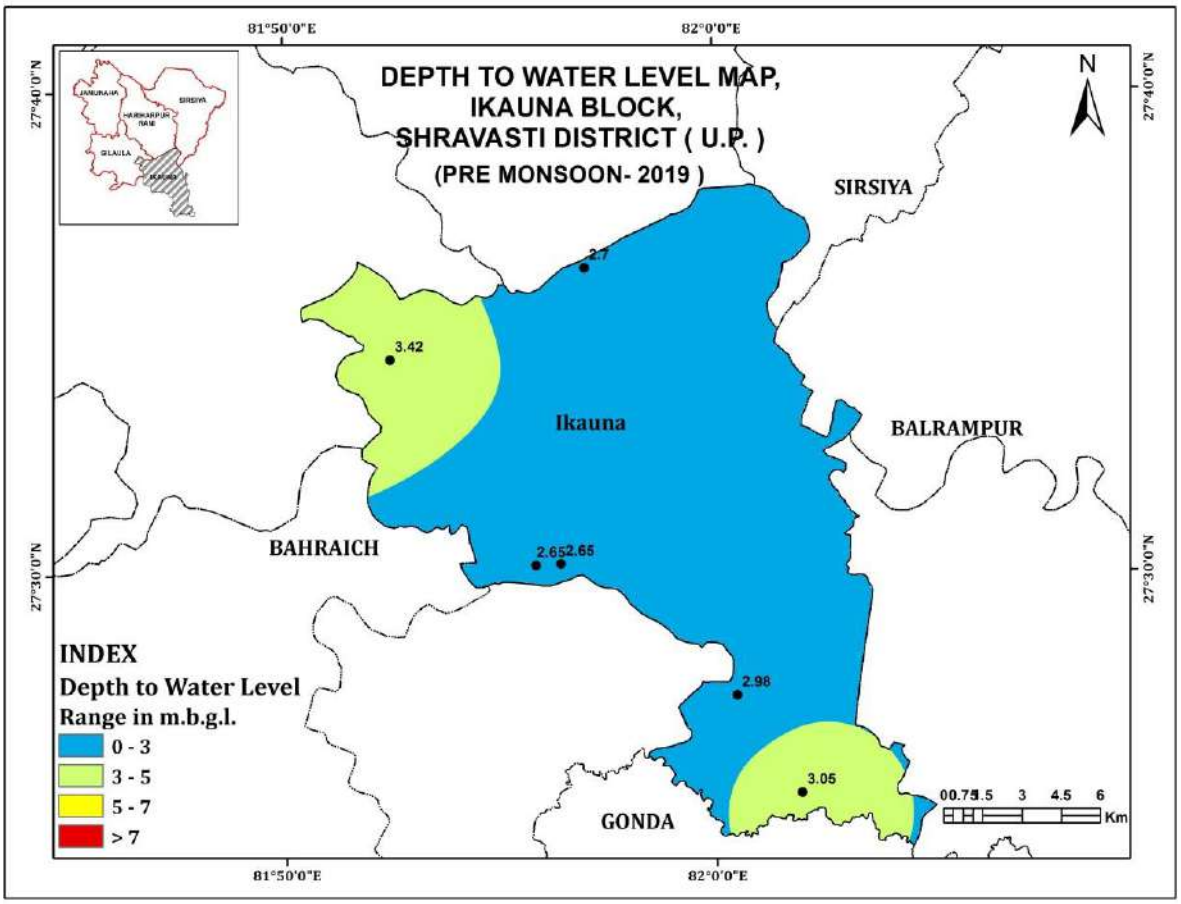


Figure 83: Depth to Water level Map (Pre-Monsoon) of Ikauna block, Shravasti district

10. Depth to Water Level (Post-monsoon)

Depth to water level during Post-monsoon is generally shallow throughout the block ranging in between 0.0-3.0 m bgl (figure-84).

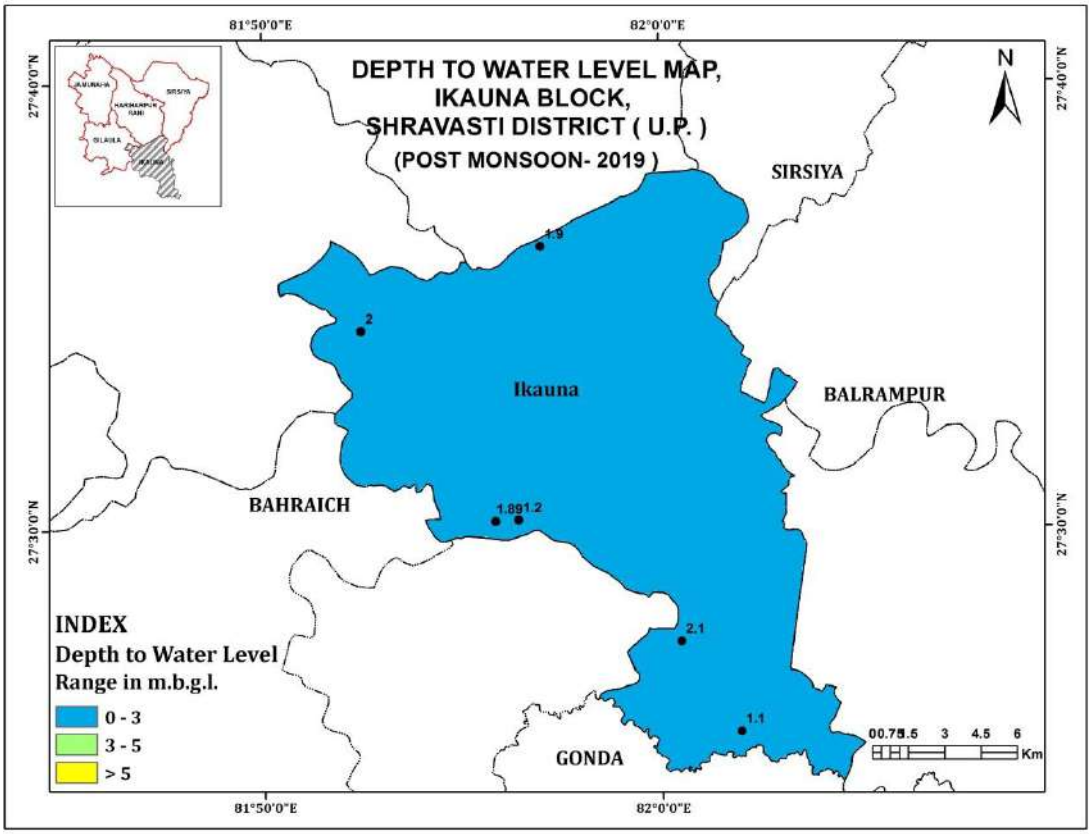


Figure 84: Depth to Water level Map (Post-Monsoon) of Ikauna block, Shravasti district

11. Water level Fluctuation

Water level fluctuation map shows rising trend throughout the block (figure-85).

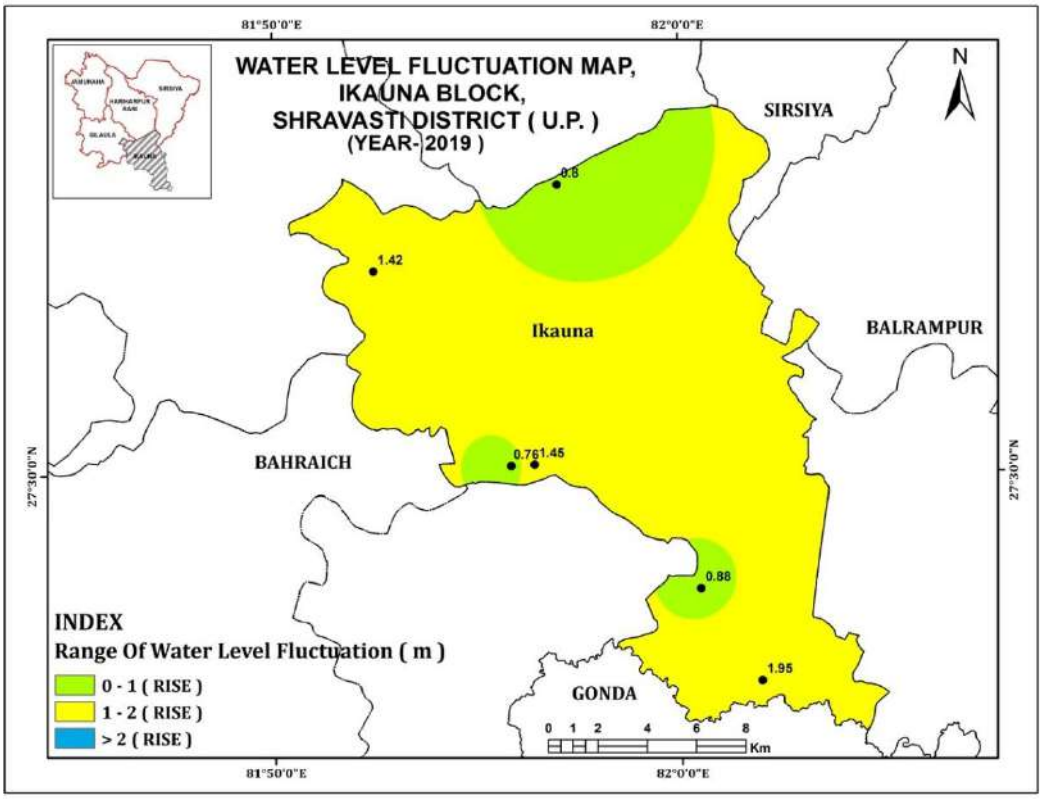


Figure 85: Water level Fluctuation Map of Ikauna block, Shravasti district

12. Chemical Quality

All the chemical constituents in groundwater samples reported within the permissible limit of BIS-2012.

13. 3-Dimensional Aquifer Disposition

Ground water occurs under water table condition at shallow depths while the deeper aquifer is under confined state of disposition.Sand, kankar, gravelly sand and pebbly sand forms the principal aquifers in the study area separated by confining clay layers acting as aquiclude (figure-86).

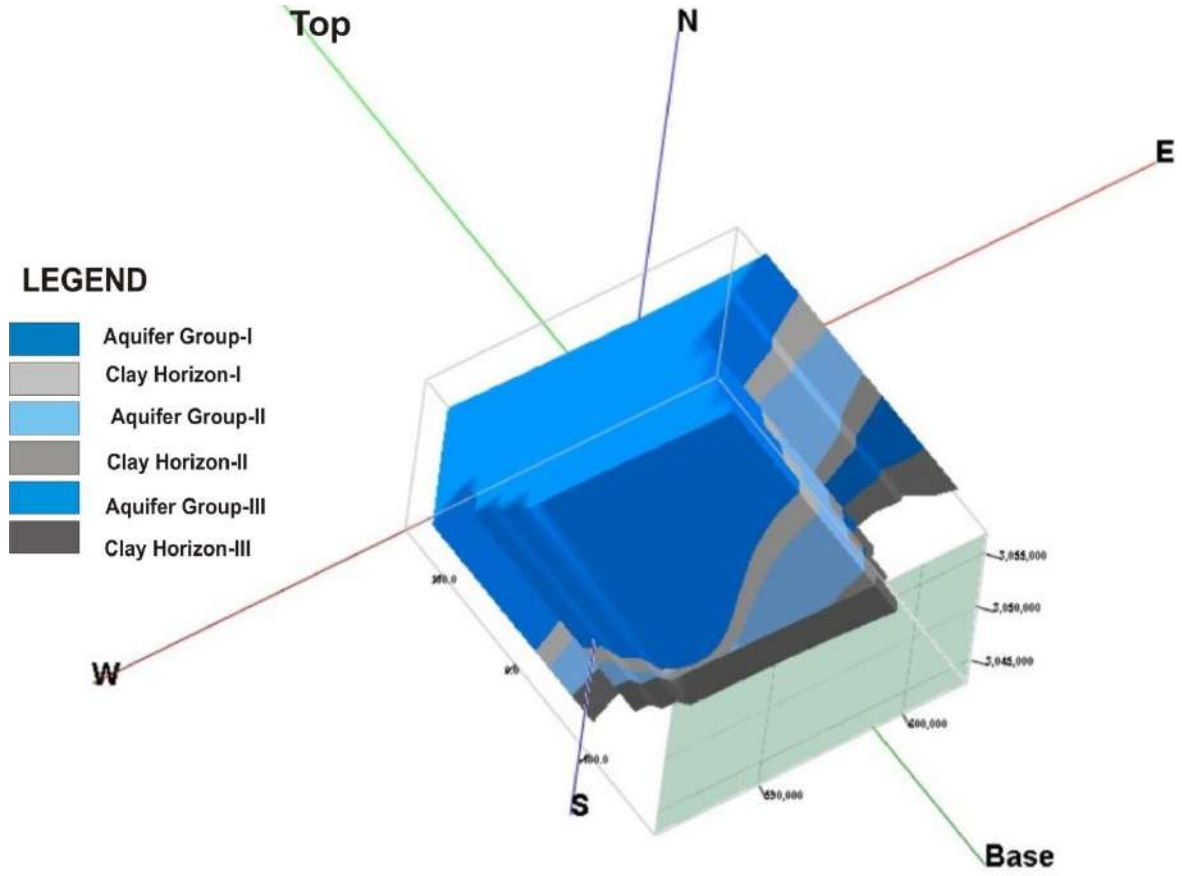


Figure 86: 3-D Model depicting Aquifer geometry of Ikauna block, Shravasti district

14. Management Plan

Block is safe with 61.37% of stage of ground water extraction. Water level fluctuation map shows rising trend of water level hence no intervention is required. However, on farm activities and Water Use Efficiency practices are recommended. The in situ farm activities such as contour bunding, land leveling, bench terracing, water harvesting structures, afforestation and diversification of cropping pattern are other measures to increase recharge in the block.

Proposed Interventions in Ikauna Block		**Benefits**	
On-farm activities (ha)	2002	Recharge from On-farm MCM	2.00
Water Use Efficiency practices WUE (ha)	2002	Saving from On-farm & WUE MCM	5.74

Establishing the canal network in the block as the canal network is totally absent in this block and ground water contribution for irrigation is 100%. Thus the conjunctive use of surface and ground water is the need of the hour in order to maintain the right balance between surface and ground water and also to bring about parity in ground water development across the block.

V. Aquifer Map and Management plan of *Sirsiya Block*

1. Salient Information

Coordinates :	Lat- 27˚ 47' 57.2" N; Long- 82˚ 05' 27.5" E
Geographical Area:	540.09 sq km
Population (2011):	Total :220348 Male-118028, Female-102320
Normal Annual Rainfall 2018 (Shravasti District):	1020 mm
Agriculture and Irrigation(2018):	Major Crops- Rice and Wheat Other crops- Corn, Maize, Sugarcane, Potatoe and Barley Net Area Sown-309.36 sq km Net Irrigated Area-120.57 sq km Tube well irrigated area- 119.96 sq km Well irrigated area- 0.60 sq km Surface water bodies irrigated area- 0.01 sq km
Ground water resource (as on 31-03-2020)	*Dynamic* Net GW Availability- 6601.77 Ham/66.01MCM Stage of GW Extraction- 41.05%

2. Location

Sirsiya block lies in SE of Shravasti district, shares border with Balrampur district in south-east, Ikauna and Hariharpur Rani Blocks in south and south-west and International border with Nepal country in the north (figure-87).

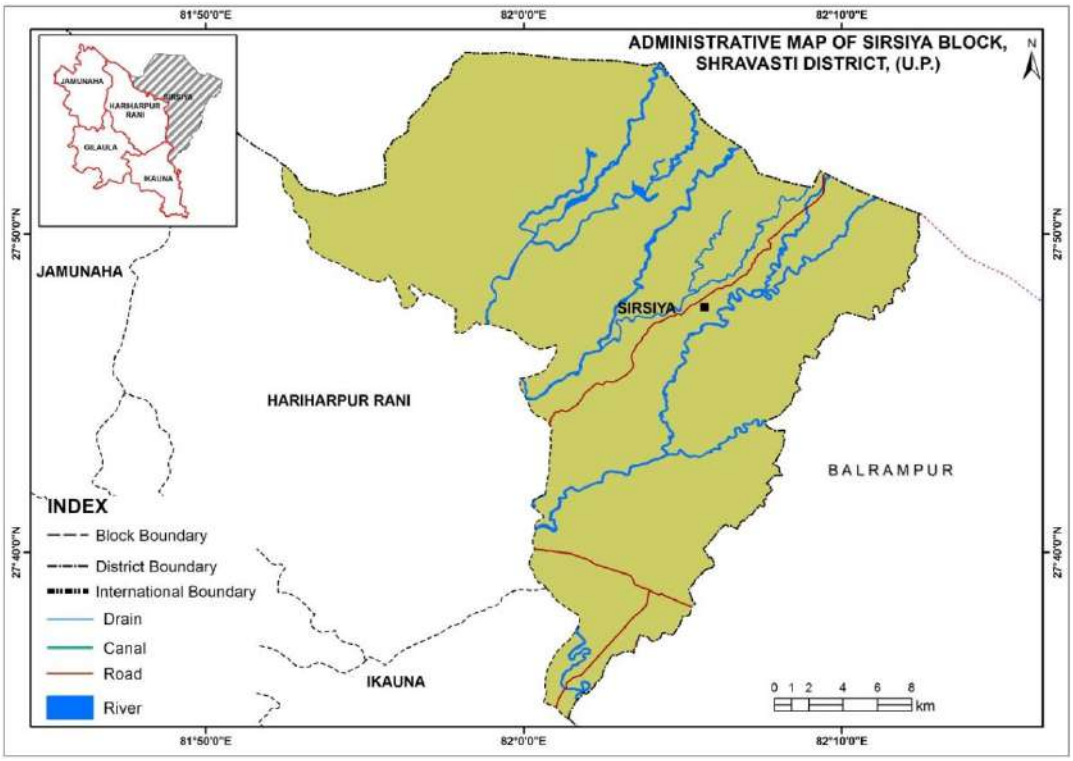


Figure 87: Administrative Map of Sirsiya block, Shravasti district

3. Geology

In the northern part of the block lies the Siwaliks after which lies the Bhabhar tract which in followed by the Tarai belt and extends along NNW-SSE direction parallel to the trend of Siwalik hills which are exposed in Nepal. The block mainly comprises of boulders cobble and sands of various grades mix (figure-88).

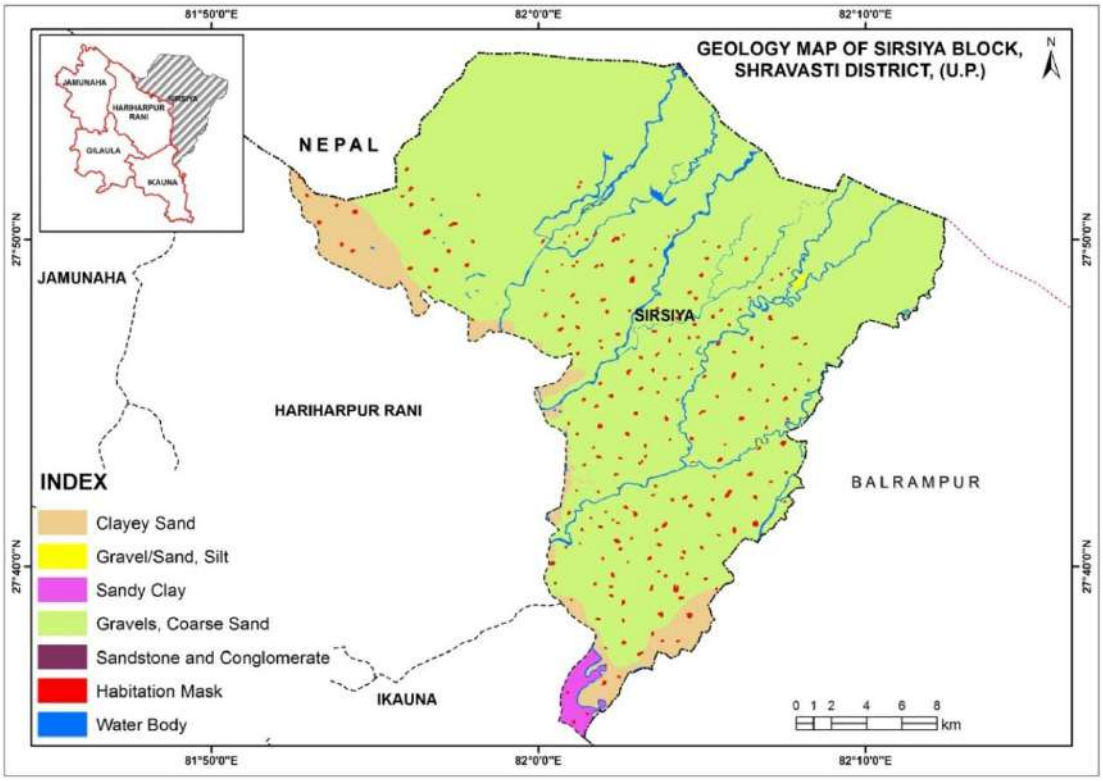


Figure 88: Geology Map of Sirsiya block, Shravasti district

4. Drainage

Sirsiya block is well drained by the number of drains and tributaries of Rapti river rising from the Indo-Nepal international boundary in north which later meets Rapti river in south (figure-89).

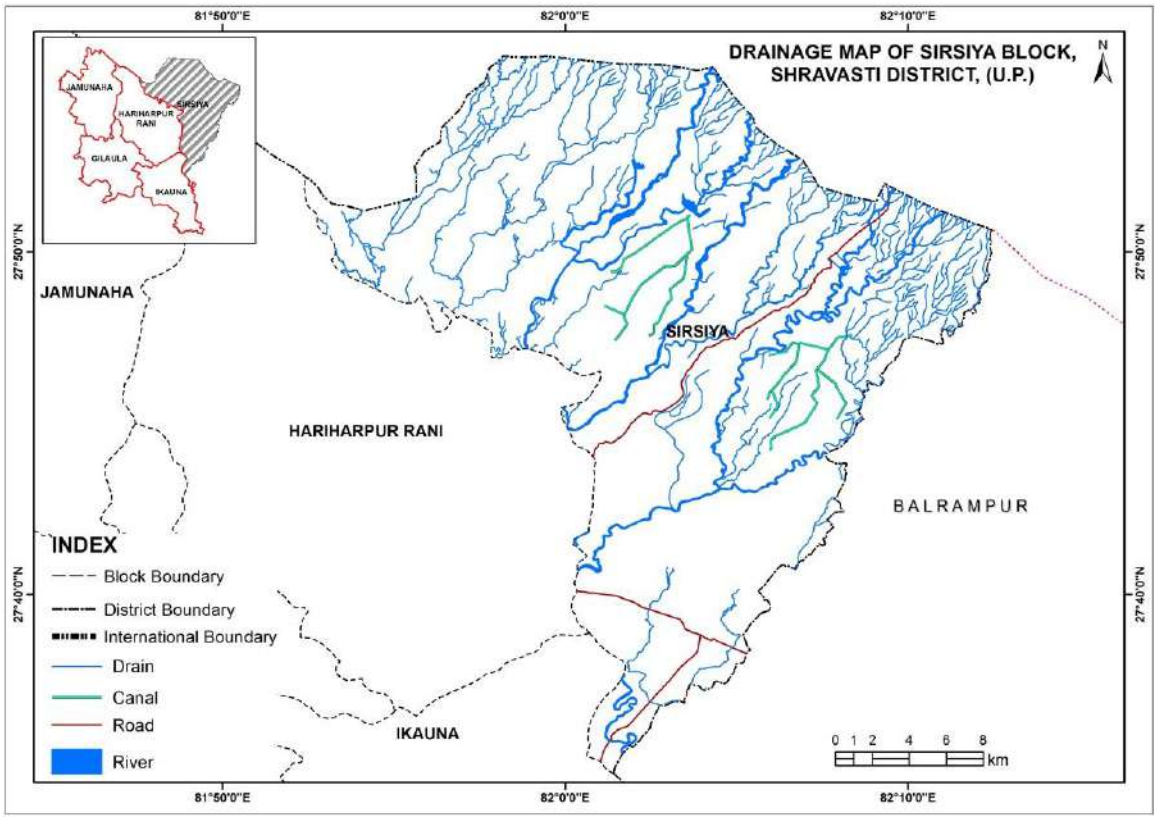


Figure 89: Drainage Map of Sirsiya block, Shravasti district

5. Soil

The block is mainly covered with fine silt and varying grades of loamy soil (figure-90).

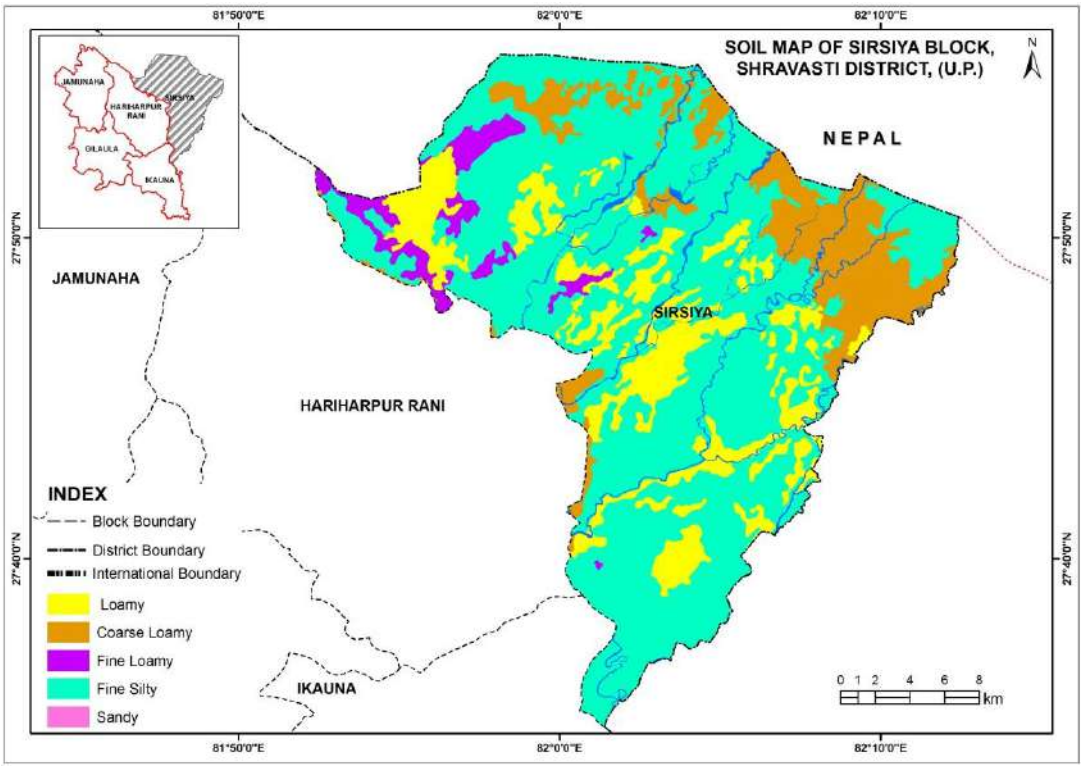


Figure 90: Soil Map of Sirsiya block, Shravasti district

6. Geomorphology

The block is mainly covered with piedmont alluvium and piedmont slope formed at foothill zones consisting of rock debris. The area comprises thick forest cover (figure-91).

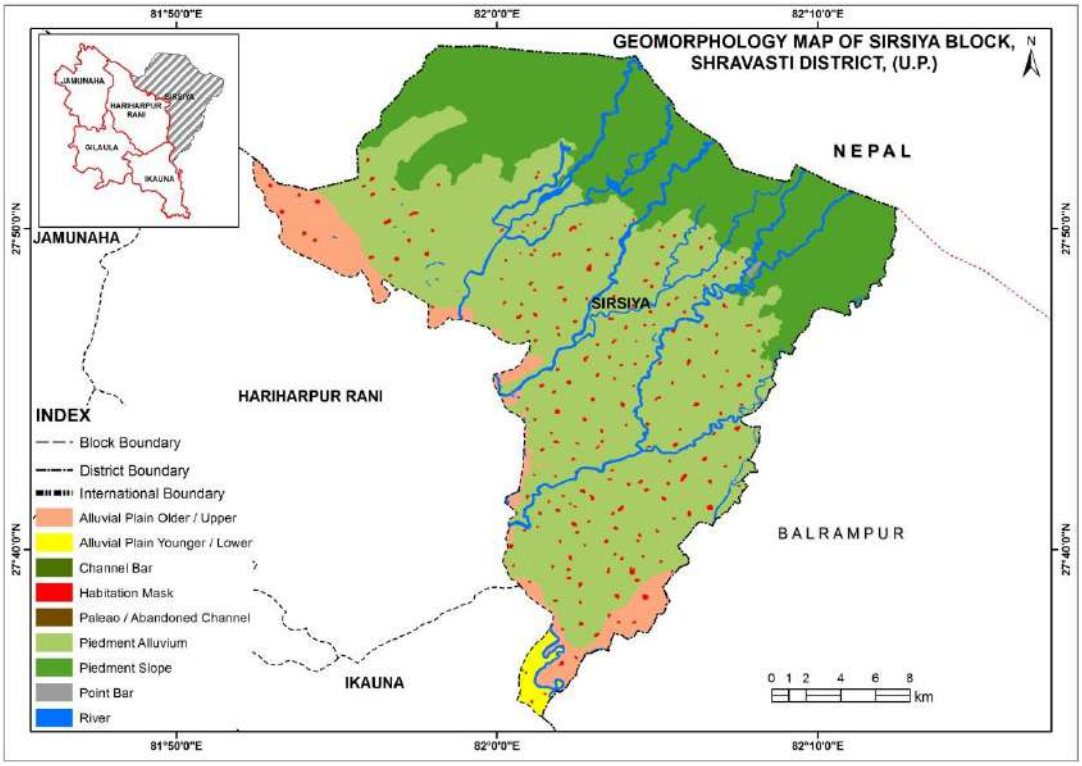


Figure 91: Geomorphology Map of Sirsiya block, Shravasti district

7. Landuse/ Land cover

The block is well covered with agricultural land with scattered settlement in centre. However north and north eastern part of the block is covered with dense forest (figure-92).

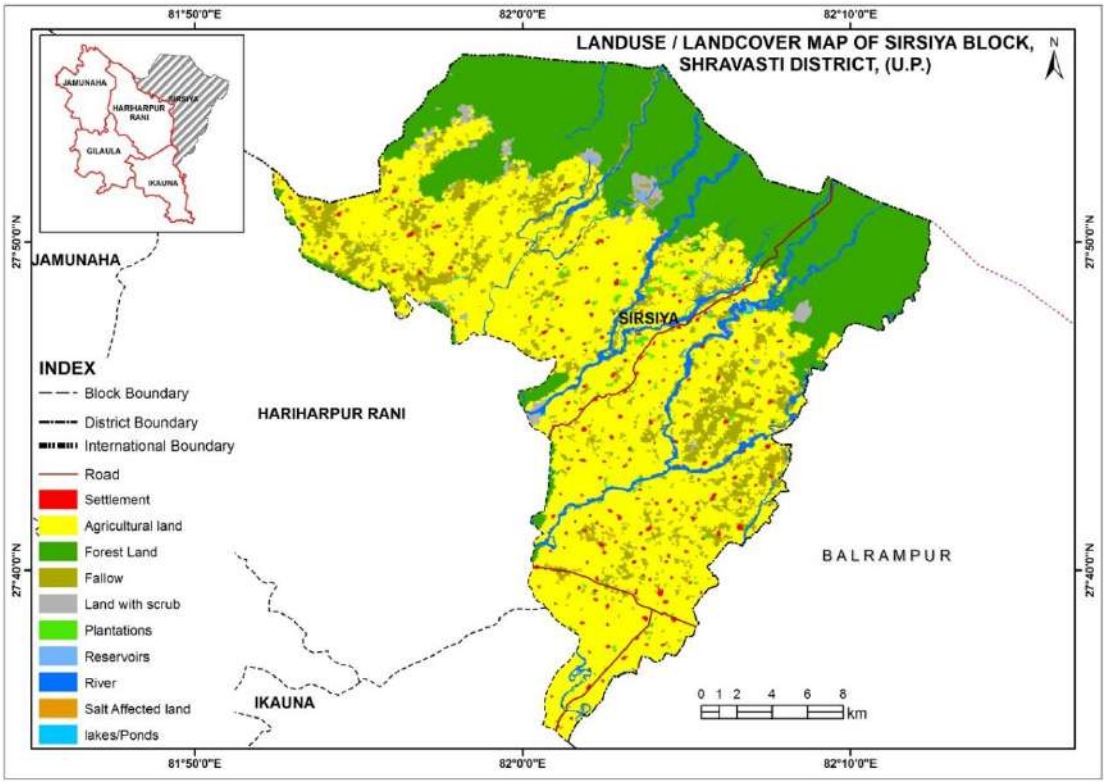


Figure 92: Landuse/Landcover Map of Sirsiya block, Shravasti district

8. Ground water Resources

The block is categorized as Safe as per Ground water Resource Assessment 2020 with 41.05% of stage of ground water extraction which is least amongst the blocks of district (figure-93).

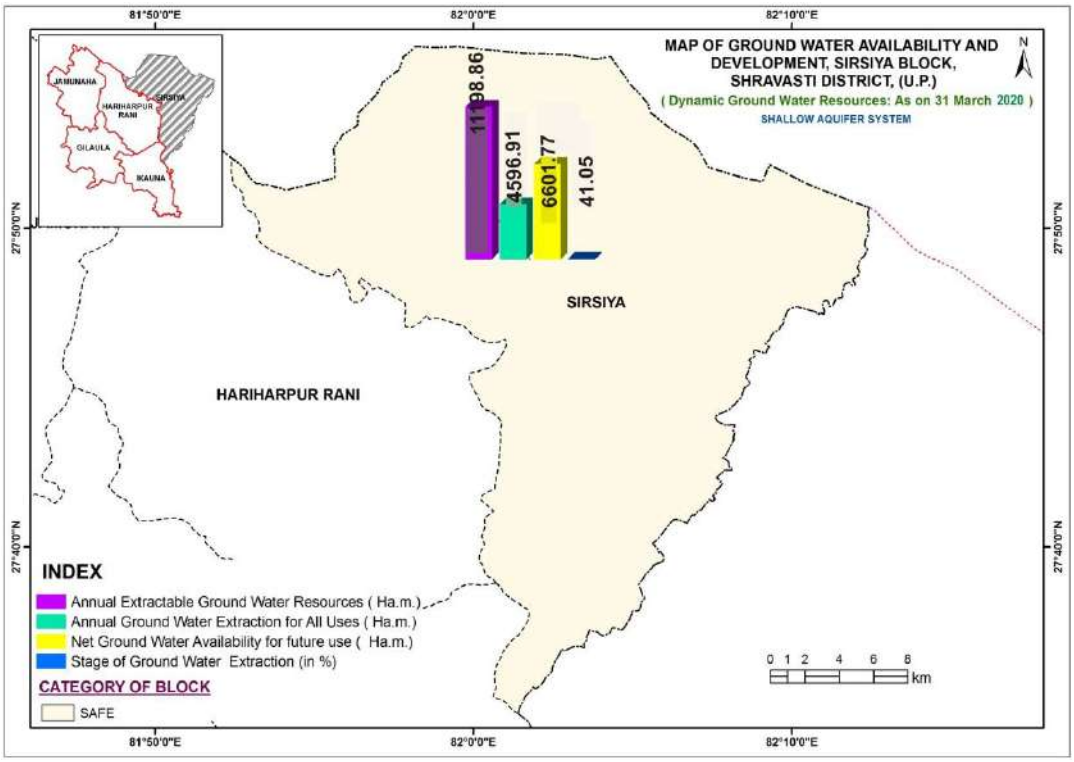


Figure 93: Ground water Resources Map of Sirsiya block, Shravasti district

9. Depth to Water Level (Pre-monsoon)

Depth to water level during Pre-monsoon is generally shallow in the range of 0.0-5.0 m bgl throughout block (figure-94).

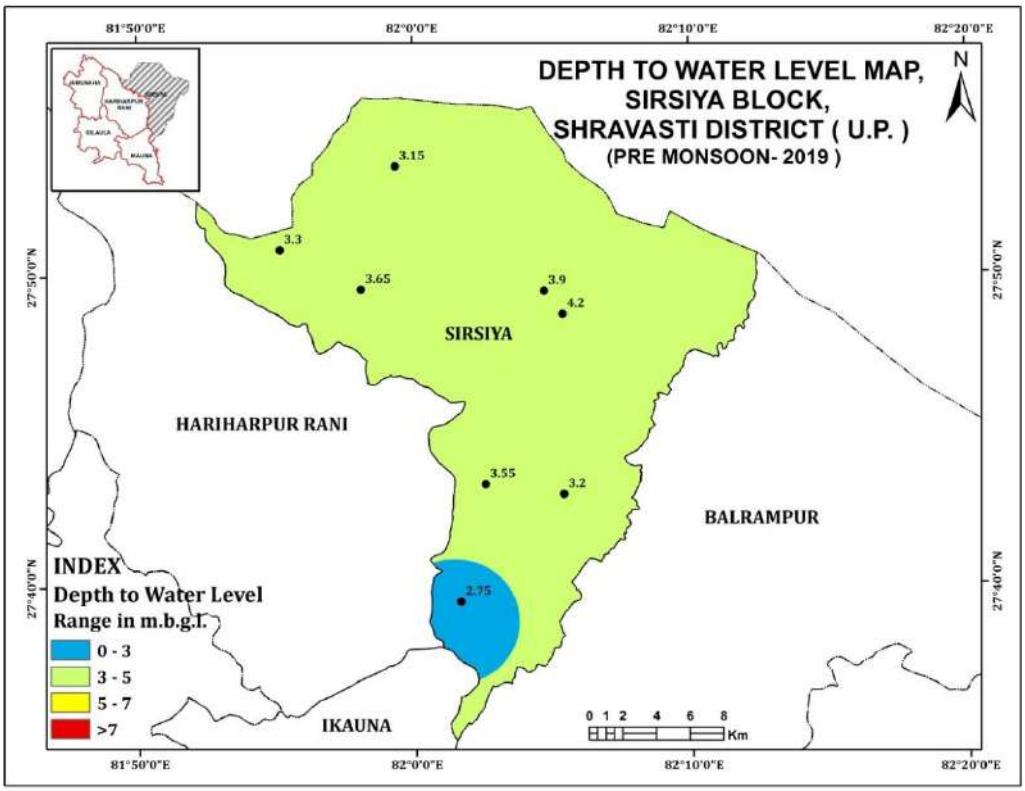


Figure 94: Depth to Water level Map (Pre-Monsoon) of Sirsiya block, Shravasti district

10. Depth to Water Level (Post-monsoon)

Depth to water level during Post-monsoon is generally shallow throughout the block ranging in between 0.0-3.0 m bgl except for one location with value 3.5 m bgl (figure-95).

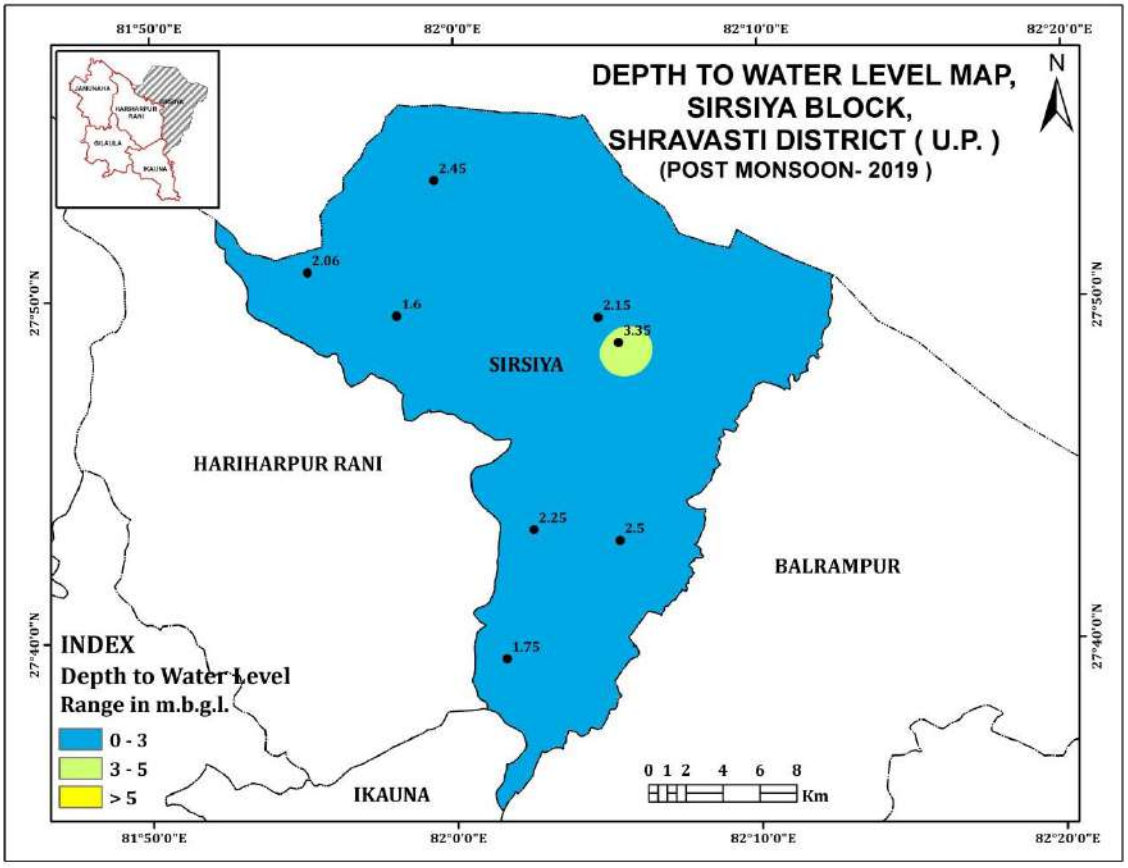


Figure 95: Depth to Water level Map (Post-Monsoon) of Sirsiya block, Shravasti district

11. Water level Fluctuation

Water level fluctuation map shows rising trend throughout the block (figure-96).

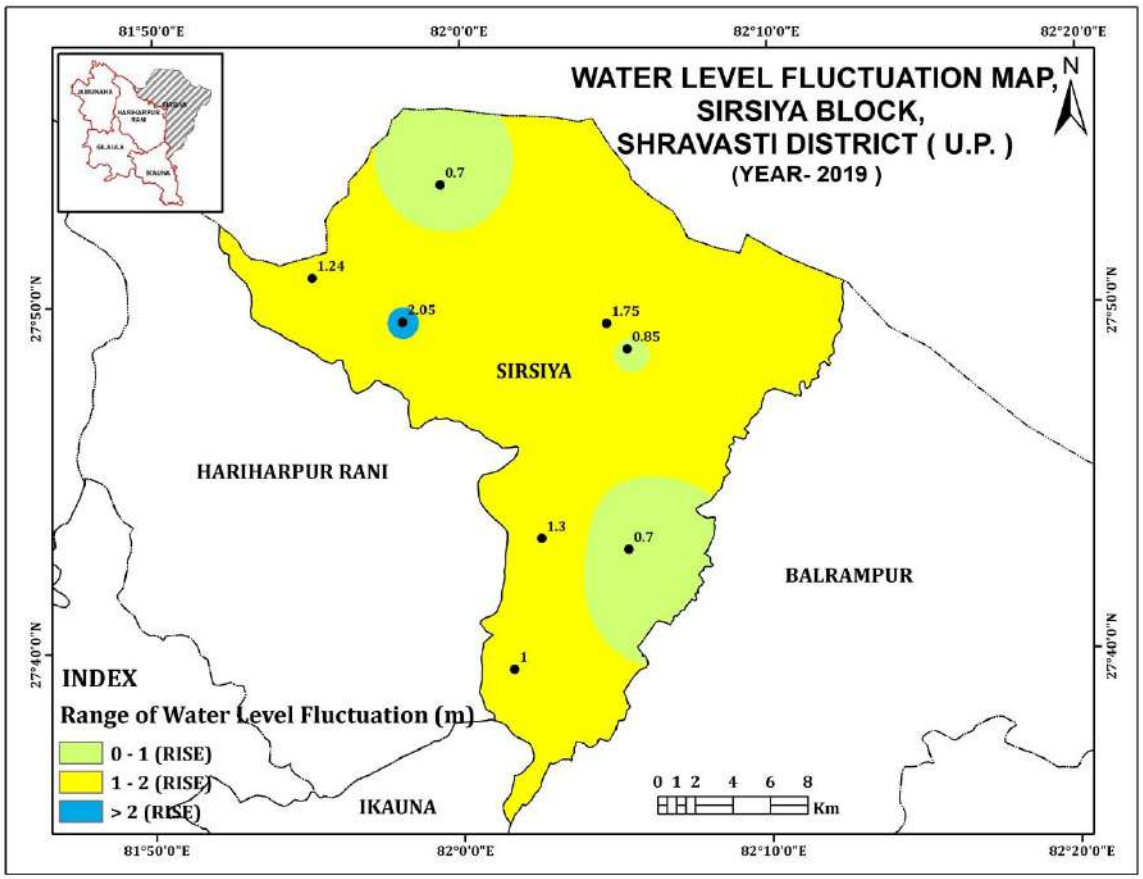


Figure 96: Water level Fluctuation Map of Sirsiya block, Shravasti district

12. Chemical Quality

All the chemical constituents are within the permissible limit of BIS-2012 except for arsenic in shallow aquifer. Arsenic reported concentration is 0.225 mg/l.

13. 3-Dimensional Aquifer Disposition

Ground water occurs under water table condition at shallow depths while the deeper aquifer is under confined state of disposition. Sand, kankar, gravelly sand and pebbly sand forms the principal aquifers in the study area separated by confining clay layers acting as aquiclude (figure-97).

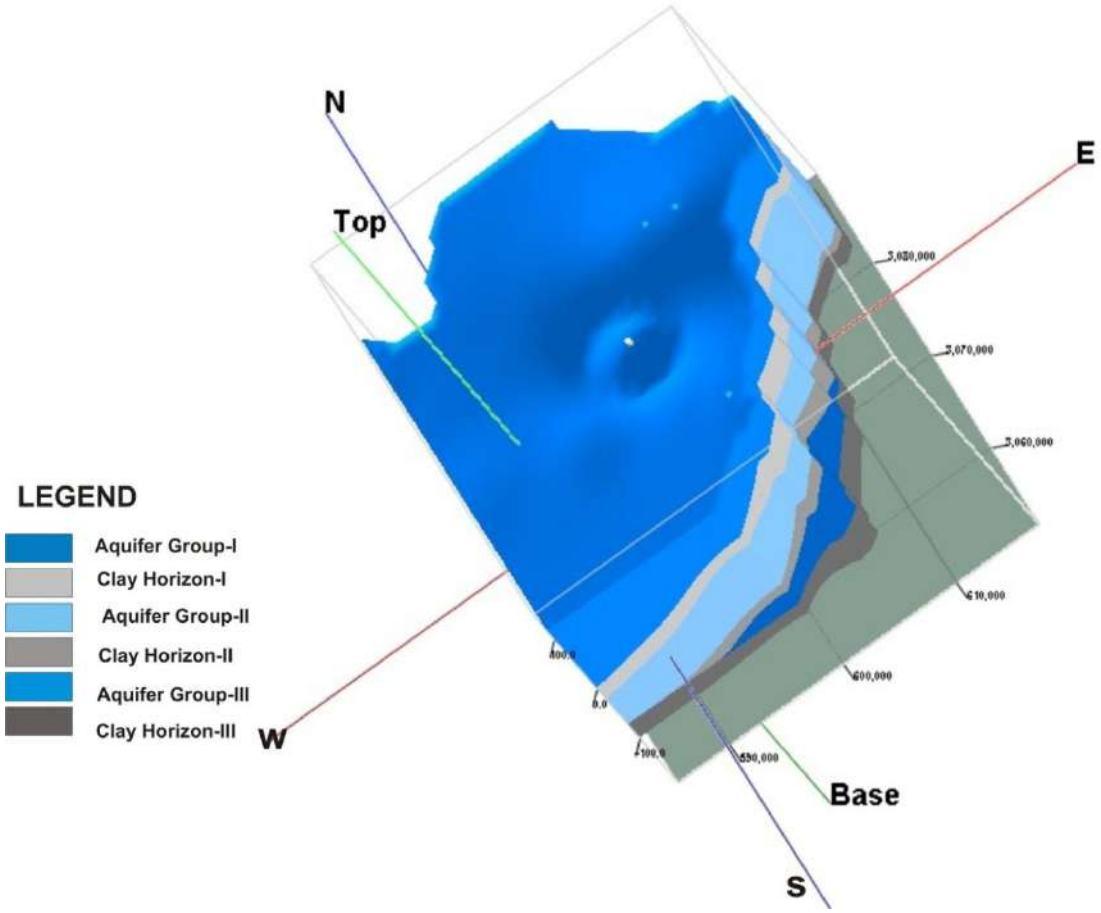


Figure 97: 3-D Model depicting Aquifer geometry of Sirsiya block, Shravasti district

14. Management Plan

Block is safe with 36.28% of stage of ground water extraction which is lowest amongst the blocks of district. Water level fluctuation map shows rising trend of water level hence no intervention is required. However, on farm activities and Water Use Efficiency practices are recommended. The in situ farm activities such as contour bunding, land leveling, bench terracing, water harvesting structures, afforestation and diversification of cropping pattern are other measures to increase recharge in the block.

Proposed Interventions in Sirsiya Block		**Benefits**	
On-farm activities (ha)	3094	Recharge from On-farm MCM	3.09
Water Use Efficiency practices WUE (ha)	3094	Saving from On-farm & WUE MCM	4.27

The contribution of ground water for irrigation in this block is 100 % and the block is prone to water logging conditions with shallow water levels thus the conjunctive use of surface and ground water is the need of the hour in order to maintain the right balance between surface and ground water and also to bring about parity in ground water development across the block.

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- Remote Sensing Application Centre, U.P website *www.rsacup.org.in*
- UP Jal Nigam website *www.upjn.org*
- Census India website *www.censusindia.gov.in*
- Irrigation and Water Resources Department, U.P website *www.idup.gov.in*

Annexure-I

Depth to Water Level-2019, Shravasti District, U.P							
S. No.	**Block**	**Hydrograph Station**	**Longitude**	**Latitude**	**Pre-Monsoon**	**Post Monsoon**	**Fluctuation**
					(mbgl)	**(mbgl)**	**(m)**
1	Gilaula	Prm.Vid. Akara Pz	81.73	27.60	6.60	4.27	2.33
2	Gilaula	Prm.Vidh. Auraiya Tikahi	81.72	27.63	4.60	3.25	1.35
3	Gilaula	Prm.Vid. Didauli Pz	81.77	27.52	3.50	2.25	1.25
4	Gilaula	Prm.Vidh. Suvikha Pz	81.80	27.57	3.65	2.20	1.45
5	Gilaula	Raipur Vilela Pz	81.83	27.60	2.95	1.90	1.05
6	Gilaula	Ramgari PZ	81.88	27.62	3.15	2.20	0.95
7	Hariharpur Rani	Prm.Path. Asharaphpur Pz	81.81	27.79	3.15	2.20	0.95
8	Hariharpur Rani	Prm.Path. Awdhoot Nagar	81.95	27.70	3.30	2.75	0.55
9	Hariharpur Rani	Prm.Path. Hariharpur Rani	81.87	27.70	2.35	2.03	0.32
10	Hariharpur Rani	Prm.Path. Machhrawan Pz	81.85	27.77	3.75	3.20	0.55
11	Hariharpur Rani	Prm.Path. Siswa Kevalpur	81.90	27.70	3.15	2.70	0.45
12	Ikauna	Madara	81.93	27.50	2.65	1.89	0.76
13	Ikauna	Prm.Vidh. Janaki Nagar Pz	81.87	27.57	3.42	2.00	1.42
14	Ikauna	Prm.Vidh. Madara Pz	81.94	27.50	2.65	1.20	1.45
15	Ikauna	Prm.Vidh. Semri Tarahar	81.95	27.61	2.70	1.90	0.80
16	Ikauna	Shivpur PZ	82.03	27.42	3.05	1.10	1.95
17	Ikauna	Veerpur PZ	82.01	27.46	2.98	2.10	0.88
18	Jamunaha	Chauri Kutiya	81.64	27.84	3.20	2.30	0.90
19	Jamunaha	Prm. Path. Lal Bojhi Pz	81.72	27.93	2.45	1.90	0.55
20	Jamunaha	Prm.Vidh. Rampur Pz	81.77	27.77	3.65	4.00	-0.35
21	Jamunaha	Prm.Vidh. Vardhani Pz	81.73	27.78	2.35	1.40	0.95
22	Jamunaha	Prm.Vidh.Ranisher Chiraiy	81.75	27.75	3.90	3.90	0.00
23	Jamunaha	Shikari-1	81.77	27.80	2.69	1.50	1.19
24	Sirsiya	Prm. Path. Kolhawa Pz	82.08	27.82	3.90	2.15	1.75
25	Sirsiya	Prm. Path. Parsauna Pz	81.92	27.85	3.30	2.06	1.24
26	Sirsiya	Prm. Path. Pure Prasad Pz	82.04	27.72	3.55	2.25	1.30
27	Sirsiya	Prm. Path.Jaogan Bharia	82.09	27.72	3.20	2.50	0.70
28	Sirsiya	Prm. Vih.. Bhaisahi Pz	81.97	27.83	3.65	1.60	2.05
29	Sirsiya	Prm. Vid.. Sonbarsa Pz	81.03	27.81	4.32	2.90	1.42
30	Sirsiya	Sambhar Purwa Pz	82.03	27.66	2.75	1.75	1.00
31	Sirsiya	Sirsiya Block Campus Pz	82.09	27.81	4.20	3.35	0.85
32	Sirsiya	Vilaspur Pz	81.99	27.89	3.15	2.45	0.70

Annexure-II

Chemical Analysis Results of Basic Constituents in Ground Water Samples of Shallow Aquifer

S.No.	Block	Location	Latitude	Longitude	pH	EC µS/cm at 25°C	CO_3 mg/l	HCO_3 mg/l	Cl mg/l	F mg/l	NO_3 mg/l	SO_4 mg/l	TH mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	SiO_2 mg/l
1	Ikauna	Jateran Inter College (India Mark) NHS-5	27°30'18"	82°02'20"	7.65	480	nil	293	14	0.24	BDL	BDL	240	64	19	9	3.0	28
2	Ikauna	Block HQ	27°31'40"	81°51'04"	7.46	1450	nil	622	114	BDL	BDL	60	490	144	32	110	6.0	27
3	Ikauna	Sita Dvar , India Mark Pump	27°31'14"	81°54'31"	7.63	616	nil	354	28	BDL	BDL	11	300	76	27	18	6.6	28
4	Gilaula	Block HQ	27°32'49"	81°47'53"	7.78	480	nil	268	28	BDL	BDL	BDL	230	56	22	10	2.6	28
5	Gilaula	Ghorma Parsiya Colony	27°37'08"	81°47'49"	7.67	625	nil	390	14	0.36	BDL	BDL	290	84	19	20	4.0	29
6	Gilaula	Lakshman Nagar, NHS-6	27°40'44"	81°48'29"	7.21	1580	nil	464	199	BDL	44	110	640	200	34	70	2.4	31
7	Hariharpur Rani	Block HQ	27°44'24"	81°49'56"	7.58	755	nil	476	14	BDL	BDL	5	300	80	24	50	2.5	24
8	Jamunaha	Block HQ	27°49'24"	81°46'96"	7.61	795	nil	476	21	BDL	BDL	9	320	68	36	55	2.6	25
9	Jamunaha	Pratapur	27°51'41"	81°45'33"	7.33	1300	nil	537	135	BDL	BDL	35	550	136	51	60	6.6	18
10	Jamunaha	Lalpur Chouraha , India Mark Pump	27°45'18"	81°44'27"	7.67	500	nil	281	14	0.31	BDL	9	230	20	44	10	2.0	27
11	Jamunaha	Pakdiya Village, India Mark Pump	27°41'49"	81°42'31"	7.76	550	nil	305	21	0.31	BDL	BDL	260	56	29	11	2.3	29
12	Gilaula	Pipri Village, India Mark Pump	27°40'41"	81°42'42"	7.84	330	nil	140	14	BDL	28	15	155	56	4	7	BDL	22
13	Hariharpur Rani	Bhinga DM Office	27°42'24"	81°54'28"	7.79	820	nil	512	14	0.52	BDL	12	280	60	32	75	1.8	26
14	Sirsiya	Ratanpur , India Mark Pump	27°48'10"	81°57'50"	7.61	780	nil	476	14	0.22	BDL	BDL	330	72	36	40	1.4	27
15	Hariharpur Rani	Ramnagar Police Chouki	27°46'33"	81°57'48"	7.58	752	nil	464	21	0.45	BDL	BDL	290	72	27	54	1.8	24
16	Sirsiya	Bhujanga	27°40'11"	82°00'01"	7.87	470	nil	281	14	0.33	5	BDL	220	44	27	15	1.8	16
17	Ikauna	Dharmpur Chouraha,India Mark Pump	27°37'28"	81°58'48"	7.52	760	nil	476	14	BDL	BDL	BDL	310	116	5	50	2.4	28
18	Hariharpur Rani	Semri Chouraha, Bhinga Road	27°38'16"	81°56'41"	7.38	1012	nil	586	43	BDL	BDL	10	450	84	58	42	1.7	21
19	Sirsiya	Aryavart Bank , India Mark Pump	27°46'36"	82°01'02"	7.61	730	nil	439	14	BDL	BDL	BDL	250	60	24	55	1.5	31
20	Sirsiya	Block HQ	27°45'55"	82°05'24"	7.82	840	nil	512	14	0.21	BDL	12	350	56	51	54	1.0	27

Annexure-III

Chemical Analysis Results of Heavy Metals in Ground Water Samples of Shallow Aquifer												
S.No.	**Block**	**Location**	**Latitude**	**Longitude**	**Cr**	**Fe**	**Mn**	**Cu**	**Zn**	**As**	**Pb**	**U**
					mg/l	mg/l	mg/l	mg/l	mg/	mg/l	mg/l	mg/l
1	Ikauna	Jateran Inter College Campus (India Mark) NHS-5	$27^0$30'18"	$82^0$02'20"	BDL	2.731	BDL	BDL	BDL	0.003	BDL	BDL
2	Ikauna	Block HQ	$27^0$31'40"	$81^0$51'04"	BDL	8.630	BDL	BDL	1.802	0.002	0.006	BDL
3	Ikauna	Sita Dvar , India Mark Pump	$27^0$31'14"	$81^0$54'31"	BDL	2.491	BDL	BDL	BDL	0.002	0.003	BDL
4	Gilaula	Block HQ	$27^0$32'49"	$81^0$47'53"	BDL	0.592	BDL	BDL	BDL	0.015	BDL	BDL
5	Gilaula	Ghorma Parsiya Colony	$27^0$37'08"	$81^0$47'49"	BDL	1.310	BDL	BDL	BDL	0.009	BDL	BDL
6	Gilaula	Lakshman Nagar, NHS-6	$27^0$40'44"	$81^0$48'29"	BDL	0.256	BDL	BDL	BDL	BDL	BDL	0.002
7	Hariharpur Rani	Block HQ	$27^0$44'24"	$81^0$49'56"	BDL	1.614	BDL	BDL	1.569	0.004	0.002	BDL
8	Jamunaha	Block HQ	$27^0$49'24"	$81^0$46'96"	BDL	0.605	0.305	BDL	BDL	0.006	BDL	BDL
9	Jamunaha	Pratapur	$27^0$51'41"	$81^0$45'33"	BDL	4.537	BDL	BDL	0.858	0.027	BDL	BDL
10	Jamunaha	Lalpur Chouraha ,India Mark Pump	$27^0$45'18"	$81^0$44'27"	BDL	1.981	BDL	BDL	BDL	0.005	BDL	BDL
11	Jamunaha	Pakdiya Village ,India Mark Pump	$27^0$41'49"	$81^0$42'31"	BDL	0.674	BDL	BDL	BDL	0.004	BDL	BDL
12	Gilaula	Pipri Village, India Mark Pump	$27^0$40'41"	$81^0$42'42"	BDL	0.282	BDL	BDL	BDL	BDL	BDL	0.003
13	Hariharpur Rani	Bhinga DM Office	$27^0$42'24"	$81^0$54'28"	BDL	1.326	0.253	BDL	1.180	BDL	0.003	0.003
14	Sirsiya	Ratanpur , India Mark Pump	$27^0$48'10"	$81^0$57'50"	BDL	1.208	BDL	BDL	BDL	BDL	BDL	0.006
15	Hariharpur Rani	Ramnagar Police Chouki	$27^0$46'33"	$81^0$57'48"	BDL	1.513	0.322	BDL	BDL	BDL	0.003	0.003
16	Sirsiya	Bhujanga	$27^0$40'11"	$82^0$00'01"	BDL	4.226	0.378	BDL	BDL	0.225	BDL	BDL
17	Ikauna	Dharmpur Chouraha,India Mark Pump	$27^0$37'28"	$81^0$58'48"	BDL	2.589	BDL	BDL	BDL	0.010	BDL	BDL
18	Hariharpur Rani	Semri Chouraha,Bhinga Road	$27^0$38'16"	$81^0$56'41"	BDL	5.242	0.543	BDL	BDL	0.024	BDL	BDL
19	Sirsiya	Aryavart Bank , India Mark Pump	$27^0$46'36"	$82^0$01'02"	BDL	1.941	0.354	BDL	BDL	BDL	BDL	0.007
20	Sirsiya	Block HQ	$27^0$45'55"	$82^0$05'24"	BDL	11.595	BDL	BDL	1.049	BDL	0.003	0.006

Annexure-IV

Chemical Analysis Results of Basic Constituents in Ground Water Samples of Deeper Aquifer																		
S.No.	Block	Location	Lati tude	Longi] tude	pH	TDS	EC µS/cm at 25°C	Ca CO_3	HCO_3	Cl	NO_3	SO_4	F	Ca	Mg	Na	K	TH
								mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
1	Jamunaha	Bada Karanpur	27.80	81.65	7.32	451	680	Nil	495.3	8.7	3.67	5.9	0.65	94.5	8.26	40.7	2.5	272
2	Ikauna	Bhagwanpur Bankat	27.52	81.93	7.3	451	680	Nil	495.3	8.7	3.67	5.9	0.65	94.5	8.26	40.7	2.5	273
3	Sirsiya	Chargahiya	27.66	82.04	7.49	360	541	Nil	276.93	10.9	2.59	18.5	0.29	63.2	20.7	37.8	2.8	276
4	Sirsiya	Ghungwa Kalan	27.79	82.11														
5	Hariharpur Rani	Hariharpur Rani	27.71	81.87	7.36	412	634	Nil	356.24	9.78	3.74	19.4	0.28	57.7	23.3	56.2	3.7	240
6	Jamunaha	Kodia	27.91	81.74	7.56	349	583	Nil	308.6	8.62	4.38	2.34	0.28	97.8	12.6	30.5	2.4	278
7	Jamunaha	Malhipur Kalan	27.85	81.77	7.38	395	614	Nil	388.6	9.26	3.58	8.1	0.18	93.2	9.14	37.3	2.87	298
8	Gilaula	Pachdevri	27.59	81.77	7.29	489	698	Nil	390.3	15.4	3.29	20.7	0.36	69.6	29.7	49.5	2.6	298
9	Ikauna	Semri Tarhar	27.61	82.00	7.37	345	531	Nil	345.8	9.18	3.85	12.4	0.36	60.3	25.7	25.6	3.78	256
10	Sirsiya	Sirsiya	27.80	82.09	7.29	489	698	Nil	390.3	15.4	3.29	20.7	0.36	69.6	29.7	49.5	2.6	298

Annexure-V

Chemical Analysis Results of Heavy Metals in Ground Water Samples of Deeper Aquifer														
S.No.	**Block**	**Location**	**Latitude**	**Longitude**	**Pb**	**Cd**	**Zn**	**Cu**	**Fe**	**Cr^{+6}**	**Ni**	**Co**	**Mn**	**As**
					mg/l	**mg/l**	**mg/l**	**mg/l**	**mg/l**	**mg/l**	**mg/l**	**mg/l**	**mg/l**	**mg/l**
1	Jamunaha	Bada Karanpur	27.80	81.65	<0.01	<0.01	0.031	<0.05	0.409	<0.05	<0.01	<0.025	0.046	<0.01
2	Ikauna	Bhagwanpur Bankat	27.52	81.93	<0.01	<0.01	0.031	<0.05	0.409	<0.05	<0.01	<0.025	0.046	<0.01
3	Sirsiya	Chargahiya	27.66	82.04	<0.01	<0.01	0.051	<0.05	0.576	<0.05	<0.01	<0.025	0.059	<0.01
4	Sirsiya	Ghungwa Kalan	27.79	82.11										
5	Hariharpur Rani	Hariharpur Rani	27.71	81.87	<0.01	<0.01	0.036	<0.05	0.462	<0.05	<0.01	<0.025	0.131	<0.01
6	Jamunaha	Kodia	27.91	81.74	<0.01	<0.01	0.038	<0.05	0.505	<0.05	<0.01	<0.025	0.043	<0.01
7	Jamunaha	Malhipur Kalan	27.85	81.77	<0.01	<0.01	0.018	<0.05	0.262	<0.05	<0.01	<0.025	0.03	<0.01
8	Gilaula	Pachdevri	27.59	81.77	<0.01	<0.01	0.032	<0.05	0.421	<0.05	<0.01	<0.025	0.203	<0.01
9	Ikauna	Semri Tarhar	27.61	82.00	<0.01	<0.01	0.021	<0.05	0.39	<0.05	<0.01	<0.025	0.036	<0.01
10	Sirsiya	Sirsiya	27.80	82.09	<0.01	<0.01	0.032	<0.05	0.421	<0.05	<0.01	<0.025	0.203	<0.01

Annexure-VI

Details of Tube Wells drilled by CGWB & Outsourced in Shravasti District														
S. No.	**Location**	**Latitude**	**Longitude**	**Drilled depth**	**Lithology**	**Aquifer Zones Tapped (mbgl)**		**Cement Sealing**	**Static Water Level**	**Discharge**	**Drawdown**	**Specific Capacity**	**Transmissivity**	**Storativity**
				(mbgl)		**from**	**to**	**(mbgl)**	**(mbgl)**	**(lpm)**	**(m)**	**(lpm/m)of DD**	**T (m2/day)**	**S**
Exploratory Wells (EW)														
1	Bada Karanpur	27.80	81.65	305.40	Sand	227	239	205-210	10.53	2074	14.62	141.86	1766	
					Kankar	243	249							
					Clay	268	274							
					Gravel	281	290							
2	Bhagwanpur Bankat	27.52	81.93	305.11	Sand	202	211	184-190	11.54	2188	17.02	128.55	1497	
					Kankar	222	231							
					Clay	249	255							
						274	280							
3	Chandgarhi	27.81	82.08	291.00	Clay	Abandoned due to lack of granular zone								
4	Chargahiya	27.66	82.04	206.00	Sand	132	138	_	4.22	2301	12.27	187.53	862	
					kankar	141	147							
					Clay	155	161							
						185	189							
5	Ghungwa Kalan	27.79	82.11	305.00	Sand	169	175	125-130	13.62	1903	29.03	65.55	1316	
					Kankar	179	183							
					Clay	193	195							
						217	229							
6	Hariharpur Rani	27.71	81.87	207.00	Sand	134	144	_	3.20	2210	11.23	196.79	1131	
					Clay	154	158							
						166	174							

Details of Tube Wells drilled by CGWB & Outsourced in Shravasti District														
S. No.	**Location**	**Latitude**	**Longitude**	**Drilled depth**	**Lithology**	**Aquifer Zones Tapped (mbgl)**		**Cement Sealing**	**Static Water Level**	**Discharge**	**Drawdown**	**Specific Capacity**	**Transmissivity**	**Storativity**
				(mbgl)		**from**	**to**	**(mbgl)**	**(mbgl)**	**(lpm)**	**(m)**	**(lpm/m)of DD**	**T (m2/day)**	**S**
						185	189							
7	Kodia	27.91	81.74	305.00	Sand	204	216	190-195	4.23	2210	18.82	117.43	1444	
					Pebble	238	250							
					Gravel	276	288							
					Clay									
8	Laxmanpur Bazar	27.66	82.07	291.00	Sand	66	80	_	4.32	2936	6.79	432.40	1013	
					Clay	130	153							
					Kankar	212	232							
9	Laxmanpur Itwaria	27.69	81.96	300.00	Sand	84	90	_	1.92	2950	6.55	450.38	1530	
					Clay	110	119							
						126	146							
						170	178							
						187	195							
						201	204							
10	Malhipur Kalan	27.85	81.77	205.00	Sand	118	127	_	2.91	2528	9.07	278.72	1409	
					Clay	143	149							
						160	169							
						185	194							
11	Pachdevri	27.59	81.77	305.00	Sand	216	222	_	10.23	2192	14.66	149.52	318	
					Clay	226	235							
					Kankar	253	265							
						272	278							
12	Parsa Deotaha	27.74	82.03	270.00	Sand	126	156		4.48	2410	9.32	258.58	1116	

Details of Tube Wells drilled by CGWB & Outsourced in Shravasti District														
S. No.	**Location**	**Latitude**	**Longitude**	**Drilled depth**	**Lithology**	**Aquifer Zones Tapped (mbgl)**		**Cement Sealing**	**Static Water Level**	**Discharge**	**Drawdown**	**Specific Capacity**	**Transmissivity**	**Storativity**
				(mbgl)		**from**	**to**	**(mbgl)**	**(mbgl)**	**(lpm)**	**(m)**	**(lpm/m)of DD**	**T (m2/day)**	**S**
					Clay	230	248							
					Kankar									
13	Semri Tarhar	27.61	82.00	205.00	Sand	89	98	_	2.98	2074	6.13	338.34	3083	
					Clay	121	130							
						138	147							
14	Sirsiya	27.80	82.09	200.00	Sand	73	78	_	10.23	2347	13.37	175.54	837	
					Clay	118	122							
						129	132							
						144	148							
						176	180							
						187	191							
Observation Wells (OW)														
1	Bada Karanpur	27.80	81.65	301.00	Sand	229	238	205-210	10.39		1.26		1461	1.982×10^{-04}
					kankar	243	249							
					Clay	268	274							
					Gravel	282	288							
2	Bhagwanpur Bankat	27.52	81.93	290.11	Sand	204	210	184-190	11.05		1.63		1409	1.21×10^{-04}
					Kankar	223	229							
					Clay	249	255							
						274	280							
3	Chargahiya	27.66	82.04	171.52	Sand	132	138	_	4.07		5.96		972	6.78×10^{-05}
					kankar	141	147							
					Clay	155	161							

Details of Tube Wells drilled by CGWB & Outsourced in Shravasti District														
S. No.	**Location**	**Latitude**	**Longitude**	**Drilled depth**	**Lithology**	**Aquifer Zones Tapped (mbgl)**		**Cement Sealing**	**Static Water Level**	**Discharge**	**Drawdown**	**Specific Capacity**	**Transmissivity**	**Storativity**
				(mbgl)		**from**	**to**	**(mbgl)**	**(mbgl)**	**(lpm)**	**(m)**	**(lpm/m)of DD**	**T (m2/day)**	**S**
4	Ghungwa Kalan	27.79	82.11	241.00	Sand	169	175	125-130	15.70		3.23		1316	6.184×10^{-04}
					kankar	179	183							
					Clay	193	195							
						219	228							
5	Hariharpur Rani	27.71	81.87	200.35	Sand	136	142	_	3.21		2.8		1062	1.37×10^{-04}
					Clay	154	158							
						167	173							
						185	189							
6	Kodia	27.91	81.74	298.58	Sand	207	213	190-195	3.89		2.21		1375	2.18×10^{-04}
					Pebble	240	249							
					Gravel	278	287							
					Clay									
7	Laxmanpur Itwaria-I	27.69	81.96	210.34	Sand	81	87	_						6.5×10^{-04}
					Clay	110	118							
						126	146							
						171	176							
						187	193							
						201	204							
8	Laxmanpur Itwaria-II	27.69	81.96	206.45	Sand	82	85	_						
					Clay	107	115							
						126	148							
						172	176							
						186	193							

Details of Tube Wells drilled by CGWB & Outsourced in Shravasti District														
S. No.	**Location**	**Latitude**	**Longitude**	**Drilled depth**	**Lithology**	**Aquifer Zones Tapped (mbgl)**		**Cement Sealing**	**Static Water Level**	**Discharge**	**Drawdown**	**Specific Capacity**	**Transmissivity**	**Storativity**
				(mbgl)		**from**	**to**	**(mbgl)**	**(mbgl)**	**(lpm)**	**(m)**	**(lpm/m)of DD**	**T (m2/day)**	**S**
						202	205							
9	Malhipur Kalan	27.85	81.77	202.70	Sand	120	126	_	2.74		2.11		4448	5.36×10^{-05}
					Clay	143	149							
						162	168							
						186	192							
10	Pachdevri	27.59	81.77	288.00	Sand	216	222	_	10.36		6.76		297	3.43×10^{-04}
					Clay	227	233							
					Kankar	254	263							
						272	278							
11	Semri Tarhar	27.61	82.00	157.00	Sand	91	97		2.65		1.68		3436	3.14×10^{-04}
					Clay	123	120							
						140	146							
12	Sirsiya	27.80	82.09	200.29	Sand	73	78	_	10.36		3.44		837	5.298×10^{-05}
					Clay	118	122							
						129	132							
						144	148							
						176	180							
						187	191							
Piezometer (Pz)														
1	Payagpur-1	27.26	81.76	131	Sand	24	30	_	5.2	772	2.22		1357	
					Clay	48	54							
						66	75							
						90	102							

Details of Tube Wells drilled by CGWB & Outsourced in Shravasti District														
S. No.	**Location**	**Latitude**	**Longitude**	**Drilled depth**	**Lithology**	**Aquifer Zones Tapped (mbgl)**		**Cement Sealing**	**Static Water Level**	**Discharge**	**Drawdown**	**Specific Capacity**	**Transmissivity**	**Storativity**
				(mbgl)		**from**	**to**	**(mbgl)**	**(mbgl)**	**(lpm)**	**(m)**	**(lpm/m)of DD**	**T (m2/day)**	**S**
						114	125							
2	Payagpur-2	27.26	81.76	207.56	Sand	160	172		5.45	625	6.38		589	
					Clay	184	202							
3	Bhinga	27.13	81.85	23.00	Sand	16	22							
					Clay									

Annexure-VII

Details of Exploratory Wells considered for Aquifer Mapping in Shravasti District									
S. No.	**Bore hole**	**Block**	**Longitude**	**Latitude**	**Total Depth**	**Elevation**	**Drilled Depth**		**Lithology**
					(mbgl)		**from**	**to**	
1	Bada Karanpur	Jamunaha	81.65	27.79	305.40	134.00	0.00	6.00	Surface Soil
							6.00	20.00	Kankar
							20.00	53.00	Sand
							53.00	64.00	Clay
							64.00	109.00	Kankar
							109.00	118.00	Clay
							118.00	156.00	Sand
							156.00	182.00	Kankar
							182.00	203.00	Sand
							203.00	214.00	Clay
							214.00	250.00	Sand
							250.00	266.00	Clay
							266.00	301.68	Gravel
							301.68	305.40	Clay
2	Bhagwanpur Bankat	Ikauana	81.93	27.52	305.11	119.00	0.00	7.00	Surface Soil
							7.00	36.00	Sand
							36.00	45.00	Clay
							45.00	70.00	Sand
							70.00	81.00	Clay
							81.00	92.00	Sand
							92.00	101.00	Clay
							101.00	119.00	Sand

Details of Exploratory Wells considered for Aquifer Mapping in Shravasti District									
S. No.	**Bore hole**	**Block**	**Longitude**	**Latitude**	**Total Depth**	**Elevation**	**Drilled Depth**		**Lithology**
					(mbgl)		**from**	**to**	
							119.00	124.00	Clay
							124.00	138.00	Sand
							138.00	147.00	Clay
							147.00	174.00	Sand
							174.00	180.00	Clay
							180.00	192.00	Sand
							192.00	202.00	Clay
							202.00	230.00	Sand
							230.00	238.00	Clay
							238.00	278.00	Sand
							278.00	286.00	Clay
							286.00	305.11	Kankar
3	Chargahiya	Sirsiya	82.04	27.66	206.00	117.00	0.00	4.00	Surface Soil
							4.00	28.00	Clay
							28.00	34.00	Kankar
							34.00	40.00	Clay
							40.00	48.00	Kankar
							48.00	58.00	Clay
							58.00	78.00	Sand
							78.00	120.00	Clay
							120.00	124.00	Sand
							124.00	128.00	Clay
							128.00	150.00	Sand
							150.00	154.00	Clay
							154.00	161.00	Sand

Details of Exploratory Wells considered for Aquifer Mapping in Shravasti District									
S. No.	**Bore hole**	**Block**	**Longitude**	**Latitude**	**Total Depth**	**Elevation**	**Drilled Depth**		**Lithology**
					(mbgl)		**from**	**to**	
							161.00	185.00	Clay
							185.00	191.00	Sand
							191.00	202.65	Clay
							202.65	206.00	Sand
4	Ghugwan Kalan	Sirsiya	82.11	27.79	305.00	149.00	0.00	7.00	Surface Soil
							7.00	20.00	Clay
							20.00	38.00	Sand
							38.00	45.00	Clay
							45.00	60.00	Kankar
							60.00	71.00	Clay
							71.00	76.00	Sand
							76.00	80.00	Clay
							80.00	91.00	Sand
							91.00	125.00	Kankar
							125.00	174.00	Sand
							174.00	179.00	Clay
							179.00	183.00	Sand
							183.00	215.00	Clay
							215.00	239.00	Sand
							239.00	274.00	Clay
							274.00	279.00	Sand
							279.00	283.00	Clay
							283.00	286.00	Sand
							286.00	305.00	Clay

Details of Exploratory Wells considered for Aquifer Mapping in Shravasti District									
S. No.	**Bore hole**	**Block**	**Longitude**	**Latitude**	**Total Depth**	**Elevation**	**Drilled Depth**		**Lithology**
					(mbgl)		**from**	**to**	
5	Hariharpur Rani	Hariharpur Rani	81.87	27.71	207.00	122.00	0.00	7.00	Surface Soil
							7.00	46.00	Sand
							46.00	52.00	Clay
							52.00	57.00	Sand
							57.00	65.00	Clay
							65.00	78.00	Sand
							78.00	87.00	Clay
							87.00	94.00	Sand
							94.00	107.00	Clay
							107.00	114.00	Sand
							114.00	117.00	Clay
							117.00	120.00	Sand
							120.00	125.00	Clay
							125.00	146.00	Sand
							146.00	153.00	Clay
							153.00	158.00	Sand
							158.00	166.00	Clay
							166.00	174.00	Sand
							174.00	184.00	Clay
							184.00	190.00	Sand
							190.00	193.00	Clay
							193.00	207.00	Sand

Details of Exploratory Wells considered for Aquifer Mapping in Shravasti District									
S. No.	**Bore hole**	**Block**	**Longitude**	**Latitude**	**Total Depth**	**Elevation**	**Drilled Depth**		**Lithology**
					(mbgl)		**from**	**to**	
6	Kodia	Jamunaha	81.74	27.91	305.00	132.00	0.00	5.00	Surface Soil
							5.00	22.00	Sand
							22.00	43.00	Pebble
							43.00	47.00	Clay
							47.00	75.00	Gravel
							75.00	87.00	Clay
							87.00	92.00	Pebble
							92.00	110.00	Clay
							110.00	126.00	Pebble
							126.00	132.00	Clay
							132.00	147.00	Gravel
							147.00	152.00	Clay
							152.00	188.00	Gravel
							188.00	196.00	Clay
							196.00	217.00	Gravel
							217.00	236.00	Clay
							236.00	251.00	Gravel
							251.00	261.00	Clay
							261.00	271.00	Sand
							271.00	291.00	Gravel
							291.00	305.00	Sand
7	Laxmanpur Bazar	Sirsiya	82.07	27.65	291.00	121.00	0.00	5.00	Surface Soil
							5.00	9.00	Sand
							9.00	19.00	Clay
							19.00	23.00	Sand

Details of Exploratory Wells considered for Aquifer Mapping in Shravasti District									
S. No.	**Bore hole**	**Block**	**Longitude**	**Latitude**	**Total Depth**	**Elevation**	**Drilled Depth**		**Lithology**
					(mbgl)		**from**	**to**	
							23.00	65.58	Clay
							65.58	83.83	Kankar
							83.83	97.09	Clay
							97.09	104.12	Sand
							104.12	128.29	Clay
							128.29	171.40	Kankar
							171.40	199.35	Clay
							199.35	205.45	Kankar
							205.45	211.60	Clay
							211.60	234.00	Sand
							234.00	255.62	Clay
							255.62	258.77	Sand
							258.77	261.77	Clay
							261.77	267.92	Sand
							267.92	280.36	Clay
							280.36	283.50	Sand
							283.50	291.00	Clay
8	Laxmanpur Itwaria	Hariharpur Rani	81.95	27.69	300.00	121.00	0.00	5.00	Surface Soil
							5.00	22.00	Sand
							22.00	40.50	Clay
							40.50	54.00	Sand
							54.00	87.00	Clay
							87.00	92.55	Sand
							92.55	112.14	Clay

Details of Exploratory Wells considered for Aquifer Mapping in Shravasti District									
S. No.	**Bore hole**	**Block**	**Longitude**	**Latitude**	**Total Depth**	**Elevation**	**Drilled Depth**		**Lithology**
					(mbgl)		**from**	**to**	
							112.14	136.35	Sand
							136.35	157.64	Clay
							157.64	171.63	Sand
							171.63	175.06	Clay
							175.06	178.06	Sand
							178.06	184.16	Clay
							184.16	207.00	Sand
							207.00	230.00	Clay
							230.00	270.52	Sand
							270.52	276.70	Clay
							276.70	279.70	Sand
							279.70	300.00	Clay
9	Malhipur Kalan	Jamunaha	81.76	27.85	205.00	129.00	0.00	7.00	Surface Soil
							7.00	32.00	Sand
							32.00	46.00	Clay
							46.00	52.00	Sand
							52.00	60.00	Clay
							60.00	67.00	Sand
							67.00	73.00	Clay
							73.00	108.00	Sand
							108.00	114.00	Clay
							114.00	128.00	Sand
							128.00	141.00	Clay
							141.00	148.00	Sand
							148.00	152.00	Clay

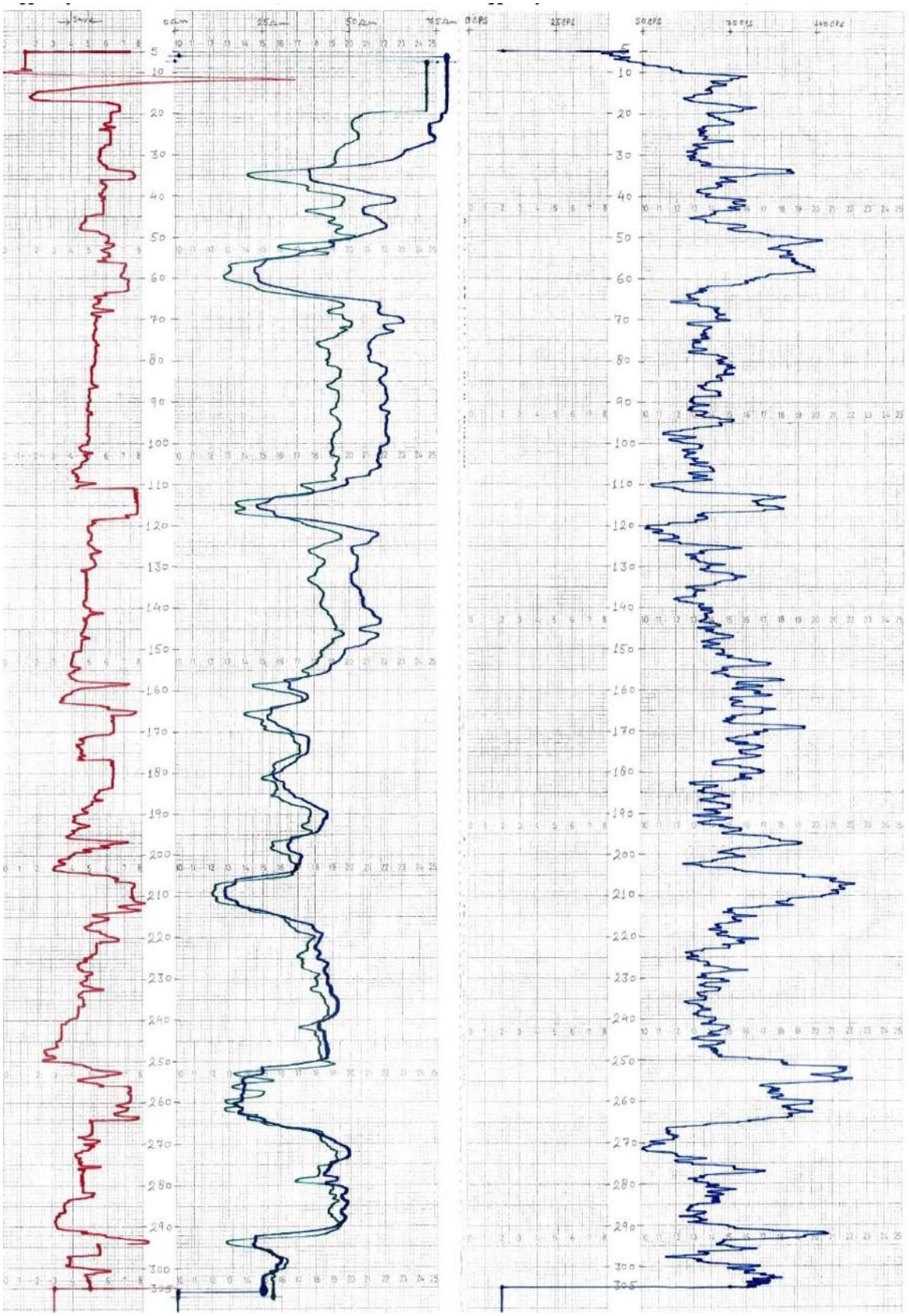
Details of Exploratory Wells considered for Aquifer Mapping in Shravasti District									
S. No.	**Bore hole**	**Block**	**Longitude**	**Latitude**	**Total Depth**	**Elevation**	**Drilled Depth**		**Lithology**
					(mbgl)		**from**	**to**	
							152.00	170.00	Sand
							170.00	185.00	Clay
							185.00	205.00	Sand
10	Pachdevri	Gilaula	81.77	27.59	305.00	124.00	0.00	6.00	Surface Soil
							6.00	48.00	Sand
							48.00	51.00	Clay
							51.00	96.00	Sand
							96.00	122.00	Kankar
							122.00	142.00	Sand
							142.00	148.00	Kankar
							148.00	183.00	Sand
							183.00	196.00	Clay
							196.00	237.00	Sand
							237.00	244.00	Clay
							244.00	268.00	Sand
							268.00	272.00	Clay
							272.00	278.00	Sand
							278.00	288.00	Kankar
							288.00	305.00	Sand
11	Parsa Deotaha	Sirsiya	82.03	27.74	270.00	126.00	0.00	5.00	Surface Soil
							5.00	54.00	Clay
							54.00	57.91	Sand
							57.91	60.81	Clay
							60.81	65.00	Kankar
							65.00	103.00	Clay

Details of Exploratory Wells considered for Aquifer Mapping in Shravasti District									
S. No.	**Bore hole**	**Block**	**Longitude**	**Latitude**	**Total Depth**	**Elevation**	**Drilled Depth**		**Lithology**
					(mbgl)		**from**	**to**	
							103.00	105.68	Sand
							105.68	119.47	Clay
							119.47	159.00	Kankar
							159.00	193.00	Clay
							193.00	196.38	Sand
							196.38	214.31	Clay
							214.31	217.31	Kankar
							217.31	228.14	Clay
							228.14	249.00	Kankar
							249.00	270.00	Clay
12	Semri Tarhar	Ikauana	82.00	27.61	205.00	117.00	0.00	7.00	Surface Soil
							7.00	20.00	Clay
							20.00	25.00	Sand
							25.00	29.00	Clay
							29.00	41.00	Sand
							41.00	46.00	Clay
							46.00	50.00	Sand
							50.00	63.00	Clay
							63.00	80.00	Sand
							80.00	87.00	Clay
							87.00	97.00	Sand
							97.00	103.00	Clay
							103.00	112.00	Sand
							112.00	119.00	Clay
							119.00	148.00	Sand

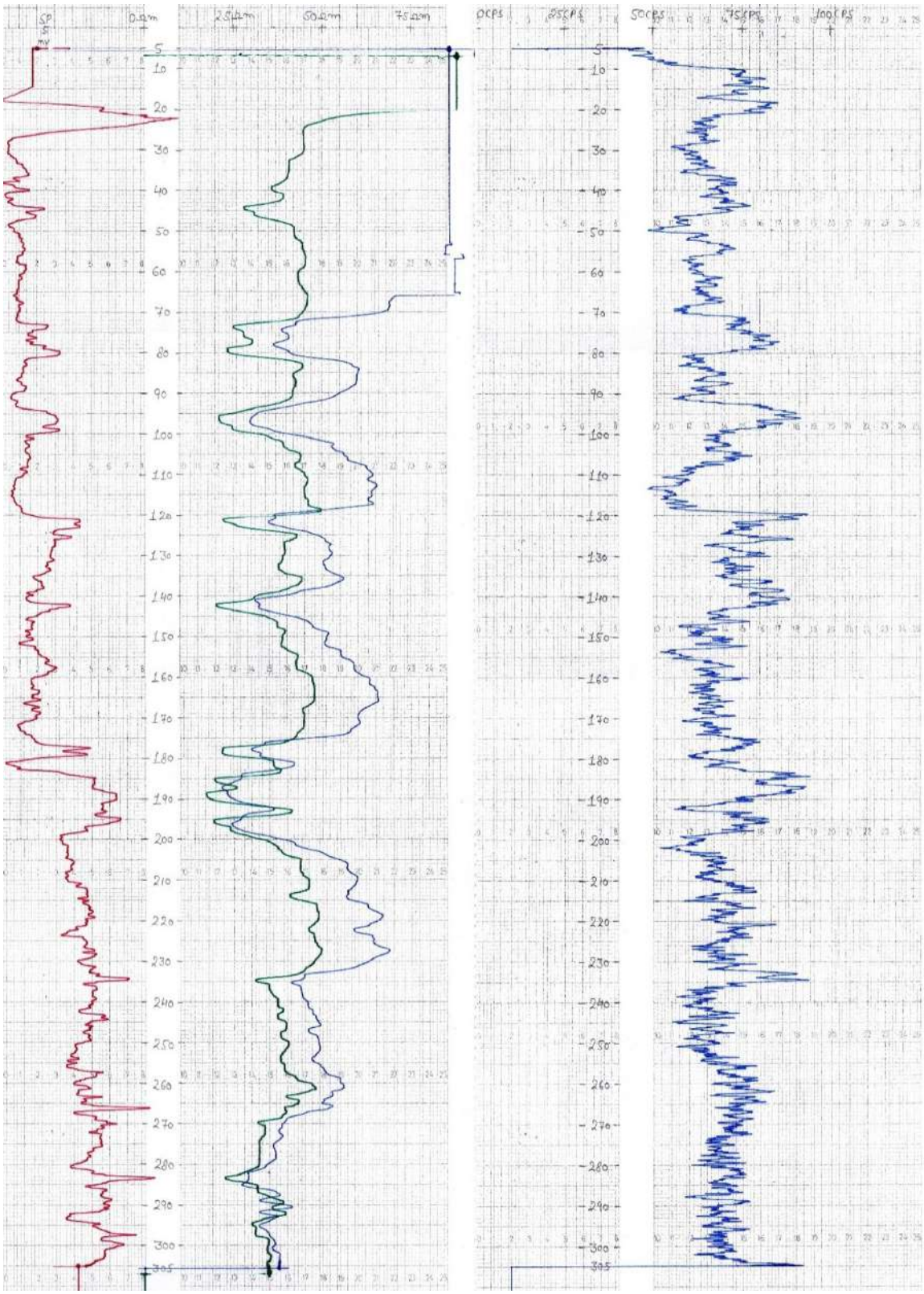
Details of Exploratory Wells considered for Aquifer Mapping in Shravasti District									
S. No.	**Bore hole**	**Block**	**Longitude**	**Latitude**	**Total Depth**	**Elevation**	**Drilled Depth**		**Lithology**
					(mbgl)		**from**	**to**	
							148.00	158.00	Clay
							158.00	165.00	Sand
							165.00	172.00	Clay
							172.00	180.00	Sand
							180.00	186.00	Clay
							186.00	189.00	Sand
							189.00	205.00	Clay
13	Sirsiya	Sirsiya	82.09	27.79	200.00	146.00	0.00	7.00	Surface Soil
							7.00	54.00	Sand
							54.00	60.00	Clay
							60.00	65.00	Sand
							65.00	73.00	Clay
							73.00	79.00	Sand
							79.00	122.00	Sand
							122.00	128.00	Clay
							128.00	133.00	Sand
							133.00	165.00	Clay
							165.00	169.00	Sand
							169.00	175.00	Clay
							175.00	180.00	Sand
							180.00	186.00	Clay
							186.00	190.00	Sand
							190.00	205.00	Clay

Plate-II

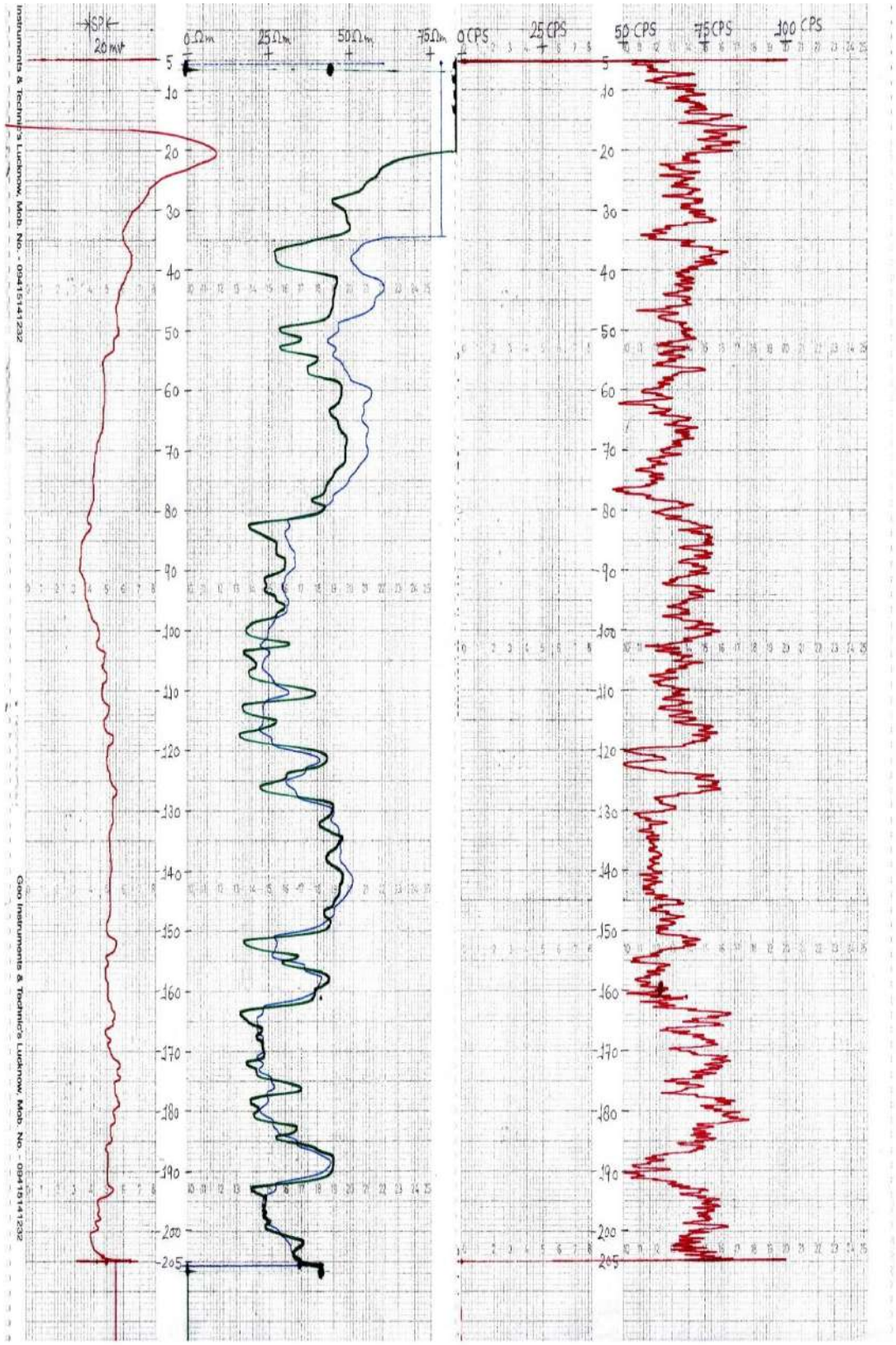
Geophysical log 1: Bara Karanpur, Block-Jamunaha



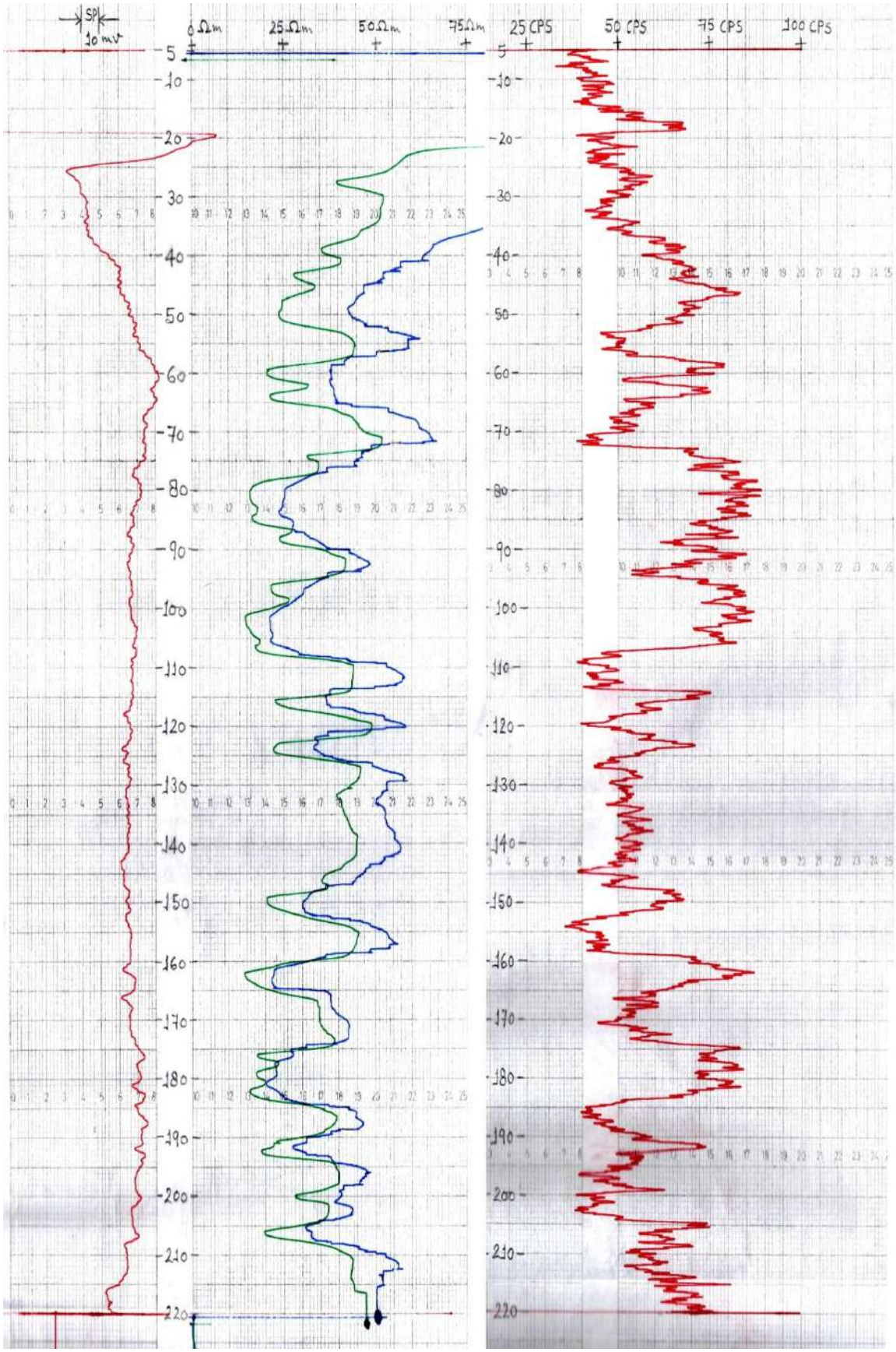
Geophysical log 2: Bhagwanpur Bankat, Block-Ikauna



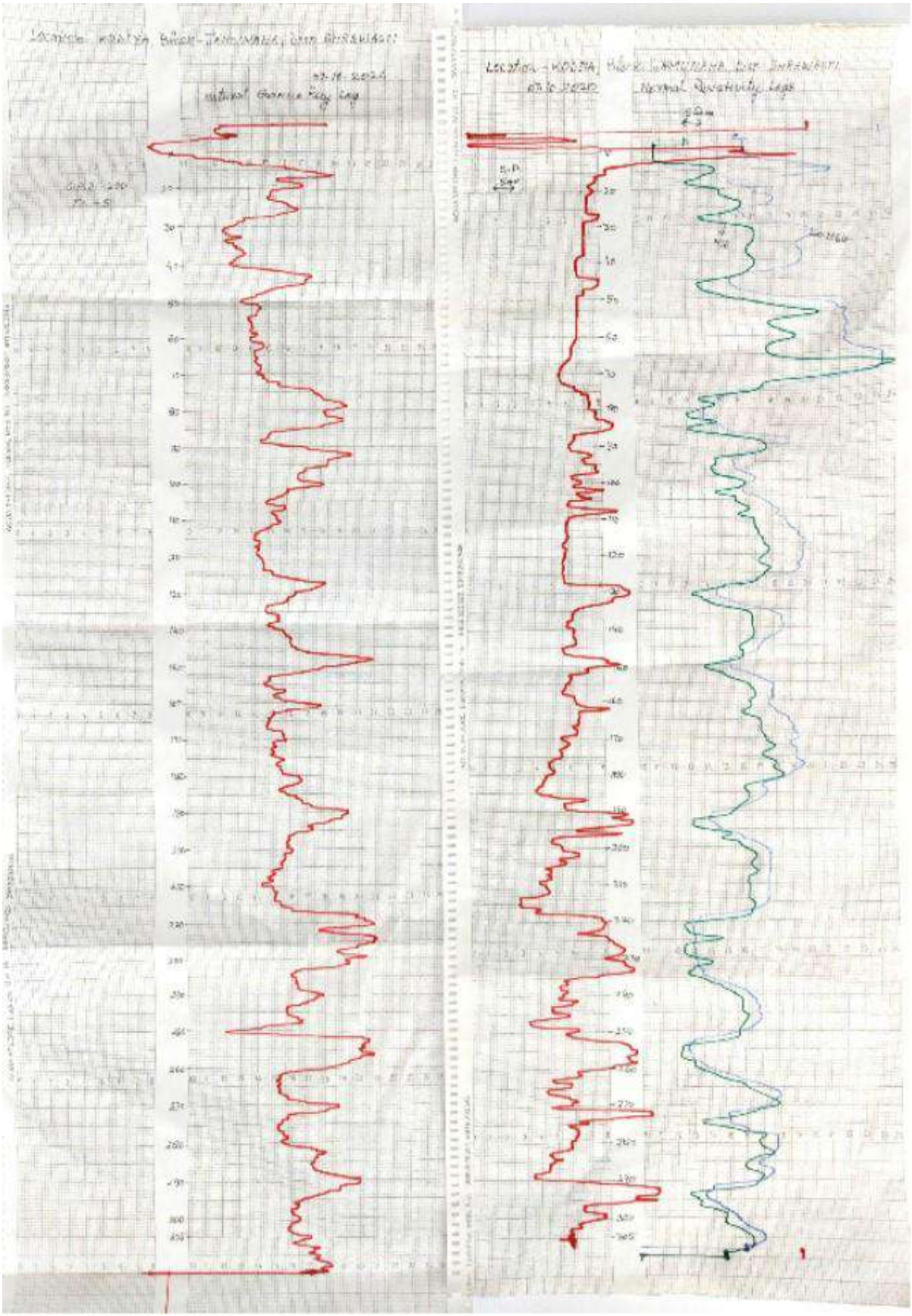
Geophysical log 3: Charghariya, Block-Sirsiya



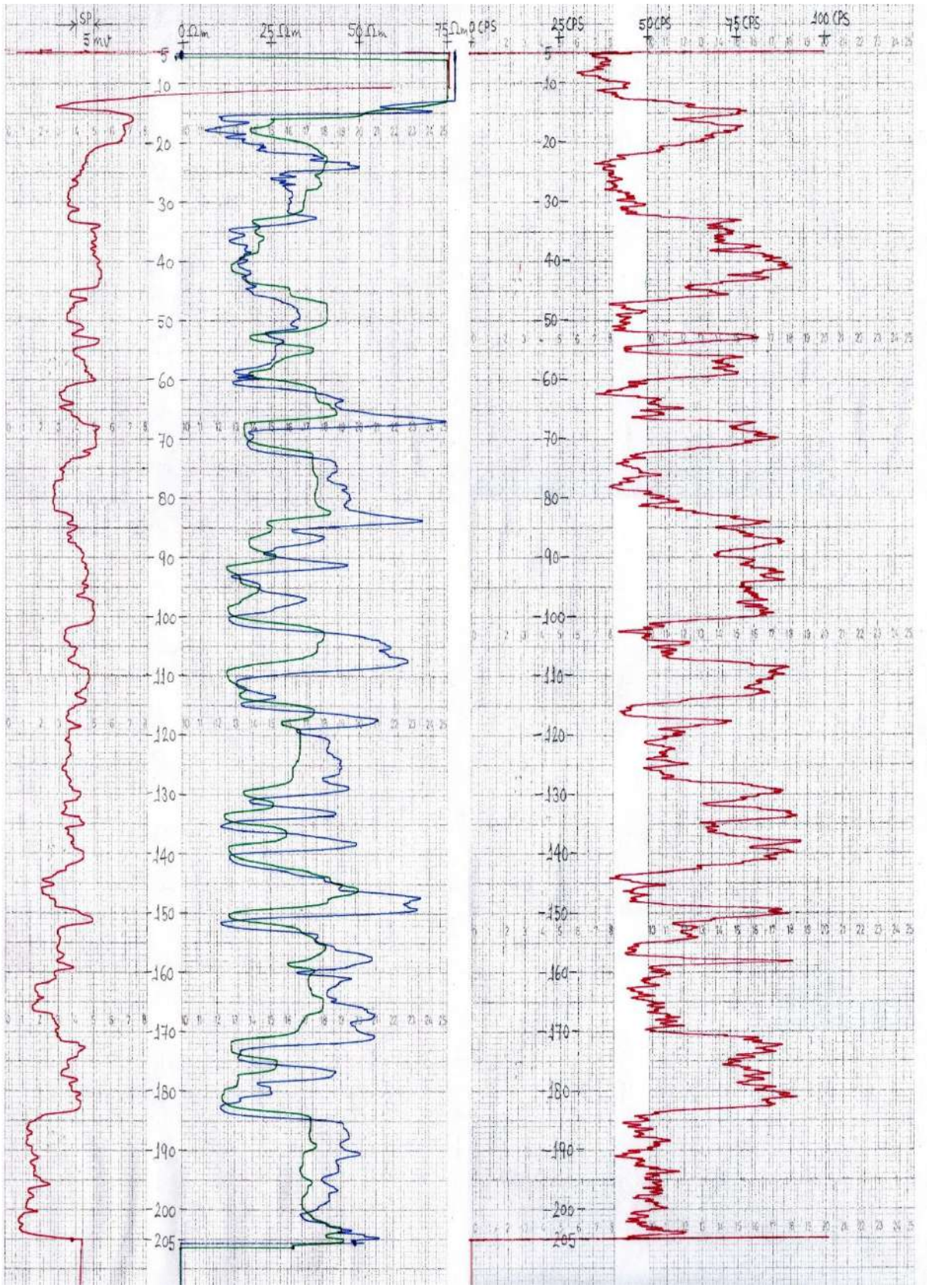
Geophysical log 4: Hariharpur Rani, Block- Hariharpur Rani



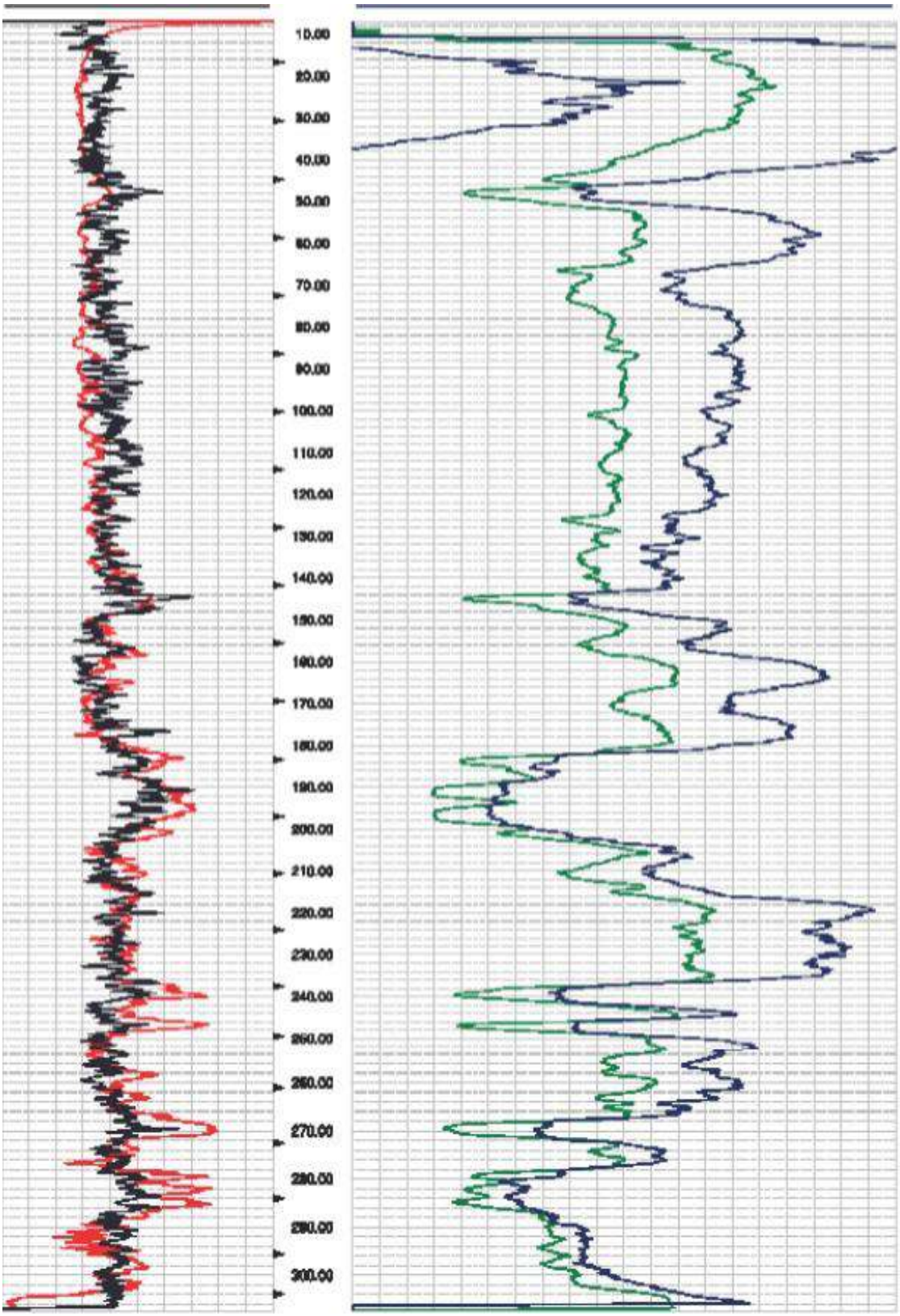
Geophysical log 5: Kodia, Block- Jamunaha



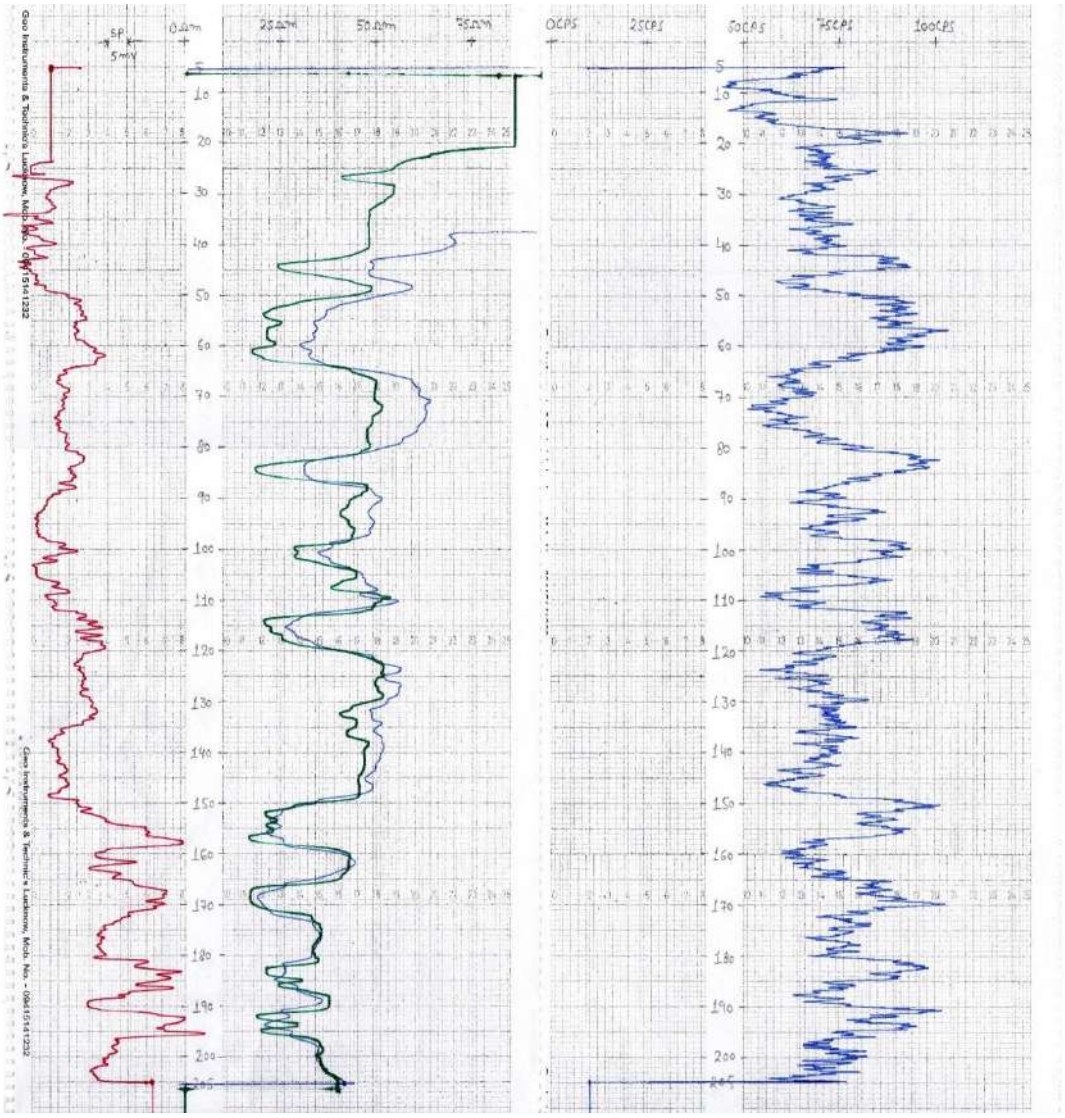
Geophysical log 6: Malhipur Kalan, Block- Jamunaha



Geophysical log 7: Pachdevri, Block- Gilaula



Geophysical log 8: Semri Tarhar, Block- Ikauna



Geophysical log 9: Sirsiya, Block- Sirsiya

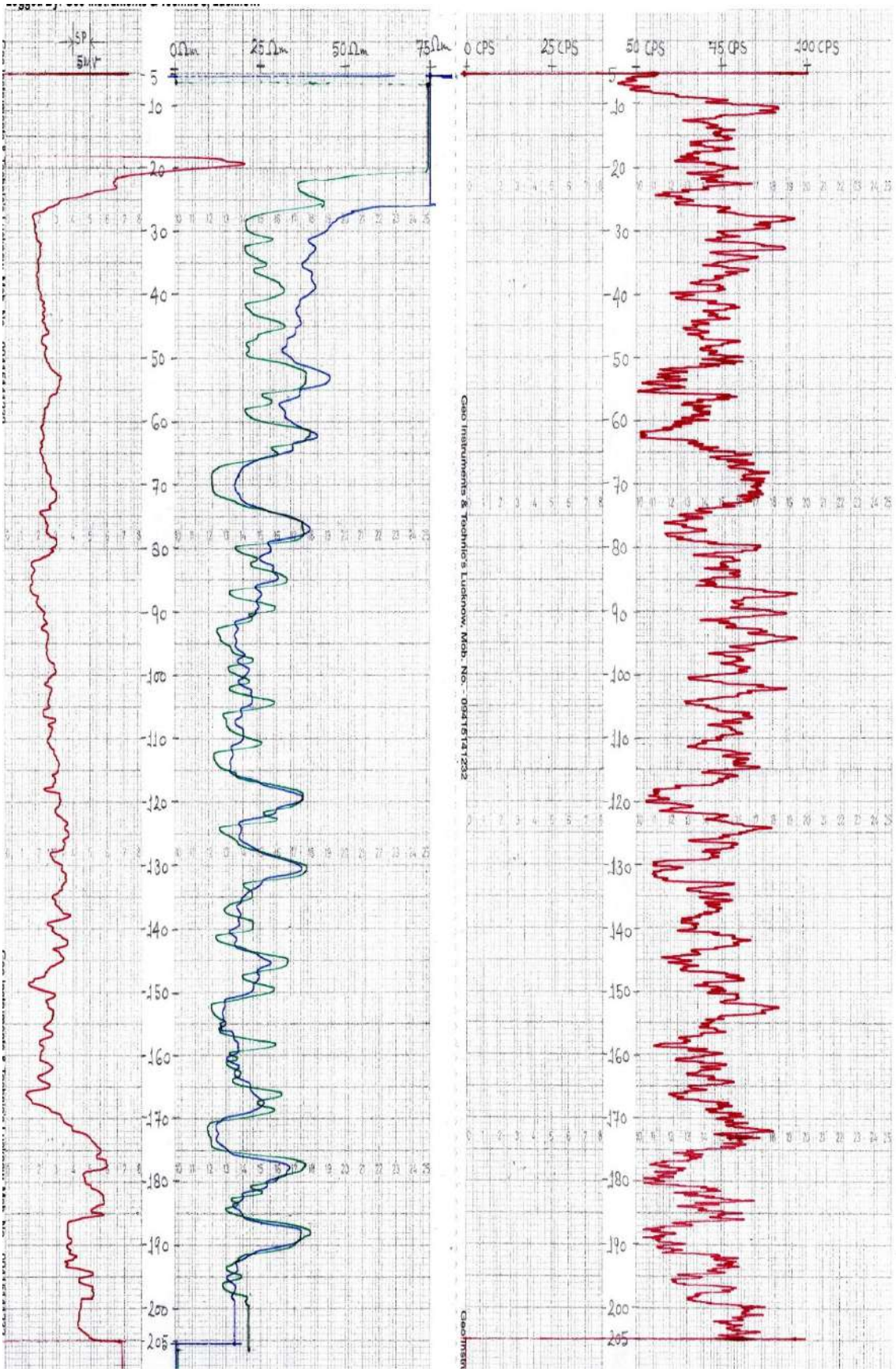


PLATE-III

Map of Shravasti district showing VES locations