



केंद्रीय भूमि जल बोर्ड

जल संसाधन, नदी विकास और गंगा संरक्षण मंत्रालय

भारत सरकार

Central Ground Water Board

Ministry of Water Resources, River Development and Ganga

Rejuvenation

Government of India

Report

on

AQUIFER MAPPING AND GROUND WATER

MANAGEMENT PLAN

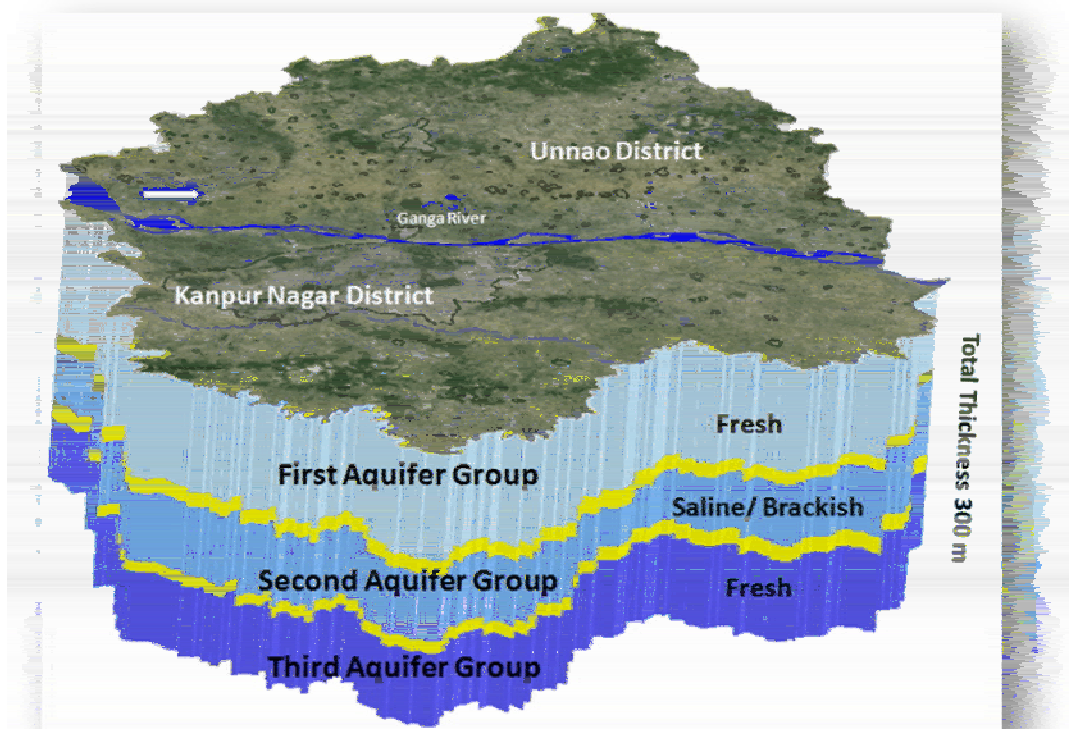
**In Parts of Kanpur Nagar and Unnao District,
Uttar Pradesh**

उत्तरी क्षेत्र, लखनऊ

Northern Region, Lucknow



Aquifer Mapping and Ground Water Management Plan in Parts of Kanpur Nagar and Unnao District of Uttar Pradesh



Central Ground Water Board
Northern Region
Lucknow

Content

1. Introduction
2. Area and Population
3. Scope of Study
4. Climate and Rainfall
5. Soil types
6. Landuse and Cropping Pattern
7. Agriculture and Irrigation
8. Geology
9. Physiography and Geomorphology
10. Hydrogeology
11. Hydrochemistry
12. Resources/ Storage
13. General Management Plan
14. Blockwise Management Plan

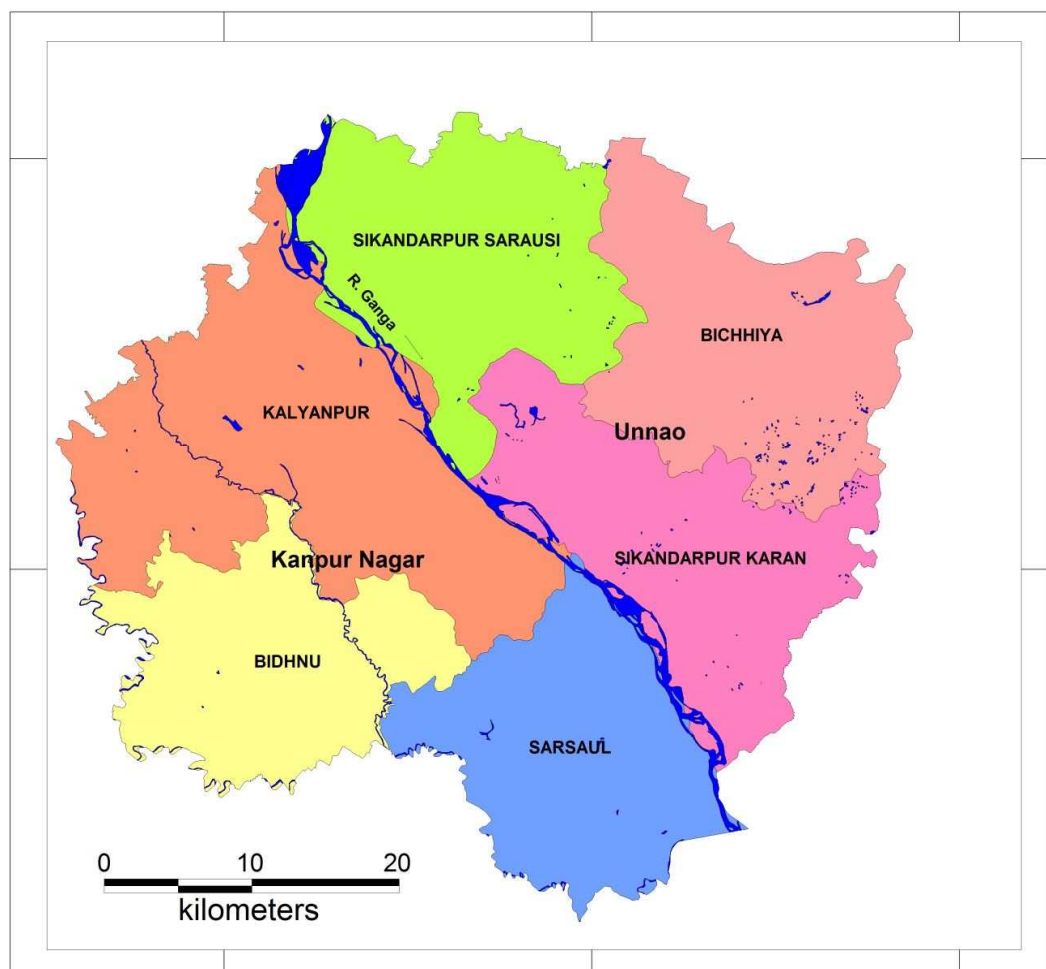
INTRODUCTION

Historical annals of Industrialisation in Uttar Pradesh are filled with references of Kanpur and Unnao districts of Uttar Pradesh. Kanpur Nagar and Unnao districts are two major towns/ districts of Uttar Pradesh, situated on the northern and southern bank of river Ganga have an area of 3155 and 4558 sq km respectively. Owing to its good national connectivity by means of rail and road, Kanpur has grown into largest urban area in the state of Uttar Pradesh supporting largest population in the state. Whereas Kanpur Nagar district has a distinction of being known for its high industrial activity, Unnao is known for its Leather factories. In order to support Leather factories of Unnao and Kanpur large number of tanneries are operating on the both banks of river Ganga.

Kanpur Nagar has 10 developmental blocks in total, whereas Unnao district has 16 blocks. Out of 16 developmental blocks of Kanpur Nagar, Kalyanpur block covers Kanpur Nagar Urban area and has witnessed highest Industrial activity in the district. Unnao urban area is situated almost equidistant from three blocks i.e. Sikanderpur Sirosi, Sikanderpur Karn and Bichiya Blocks. Whereas larger part of the Unnao urban area falls in Sikanderpur Sirosi

Administrative Map

Parts of Kanpur Nagar & Unnao District of Uttar Pradesh



block. For the purpose of Aquifer Mapping three blocks each of Kanpur Nagar and Unnao districts were selected namely Kalyanpur, Bidhano and Sarsol blocks of Kanpur Nagar and Sikanderpur sirosi, Sikanderpur Karn and Bichiya block of Unnao districts being contagious and falling on both the banks of river Ganges.

Area

Total geographical area of Kanpur Nagar is 3155 Sq. Km and Unnao district is 4558 sq km. For the purpose of present study six blocks selected have geographical area as shown in table below. Total area of 1790.24 sq. Km including 782.57 sq km of Kanpur Nagar and 1007.67 sq km of Unnao district was taken up to prepare aquifer map and propose ground water management plan depending on the prevailing hydro-geological conditions.

District	Blocks	Area in Sq. km
Kanpur Nagar	Kalyanpur	182.95
Kanpur Nagar	Bidhano	295.52
Kanpur Nagar	Sarsol	304.10
	Sub Total	782.57
Unnao	Sikanderpur Sirosi	325.32
Unnao	Sikanderpur Karan	345.01
Unnao	Bichiya	337.34
	Sub Total	1007.67

Population:

Kanpur Nagar and Unnao has population of 45, 08,127 lacs and 31,00,837 lacs person respectively for whole district. Details of the block wise population of the area selected for aquifer mapping are given below. Out of the blocks taken up for aquifer mapping Sikanderpur Sirosi of Unnao has largest population and Kalyanpur lowest. Because Kalyanpur, Kanpur Municipal corporation area has not been included in the developmental area of the Kalyanpur block. As per JNNRUM report for the Kanpur Municipal area for inner city area was 15,31,331 and outer city area was 10,20,004. Part of this population depends on natural resources of geographical area of Kalyanpur, Sarsol and Bidhano blocks of Kanpur Nagar.

Blocks	Total	Male	Female	Density Per sq km
<i>Kalyanpur</i>	171240	91366	79874	786
Bidhano	179997	96114	83883	646
Sarsol	187301	99386	87915	610
Sik. Sirosi	189935	100790	89145	583
Sik. Karan	181696	95596	86100	523
Bichiya	184024	96887	87137	547

Scope of the Study:

Scope of the present work was to prepare aquifer map on the basis of available data from the previous work done by Central Ground Water Board. The purpose of the present work was to decipher the aquifer geometry in terms of spatial extension in all three dimensions and propose a feasible ground water management plan. For the purpose of study previous work had to be established and data was to be compiled from all the agencies involved in ground water Exploration as well as having repository of the ground water data, irrespective of belonging to state or Central Government.

In order to create data base, data was collected from different state departments as well as data repository of Central Ground Water Board. Data was also collected from exploratory work done with specific purpose, besides samples were collected to assess the water quality in the area. Data perused was validated for its usefulness to meet the goal of aquifer mapping. After considering huge data pertaining to exploration, monitoring stations and sample collection station and VES stations suitable and useful data was derived and analysed.

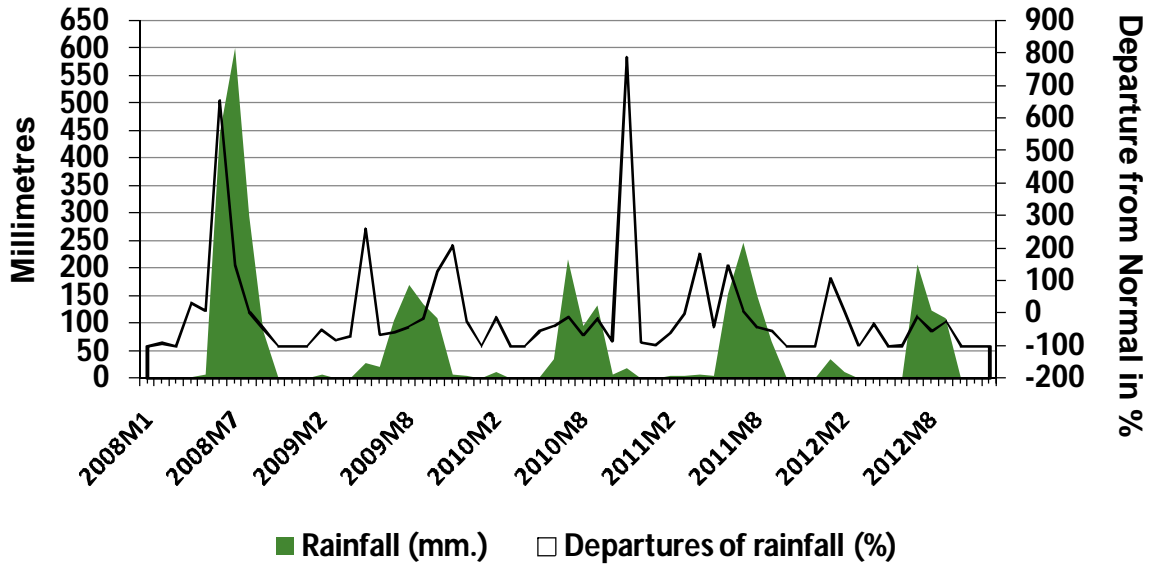
CLIMATE & RAINFALL

The average annual rainfall in the district is 821.9 mm. The climate is sub humid and it is characterized by hot summer and general dryness except in the south west monsoon. About 90% of rainfall takes place from third week of June to September. The mean daily maximum temperature in May and early part of June is 41.7°C. The mean daily minimum temperature is 27.2°C and maximum temperature rises up to 45°C or over. The January is the coldest month with mean daily maximum temperature at 22.8°C and mean daily minimum temperature at 8.6°C. The mean monthly maximum temperature is 32.2°C and mean monthly minimum temperature is 19.5°C. During monsoon season the relative humidity is high and in summer season, humidity is less. The mean monthly morning relative humidity is 69% and mean monthly relative humidity is 50%. The winds are generally light with some strength in force during summer and early monsoon season. The mean wind velocity is 9.6 k.m.p.h. The potential Evapotranspiration is 1660.9 m

As the study area comprises blocks of two districts located on the opposite banks of river Ganga, rainfall of two stations were used to assess the variability of the rainfall in the area in spatial and temporal terms.

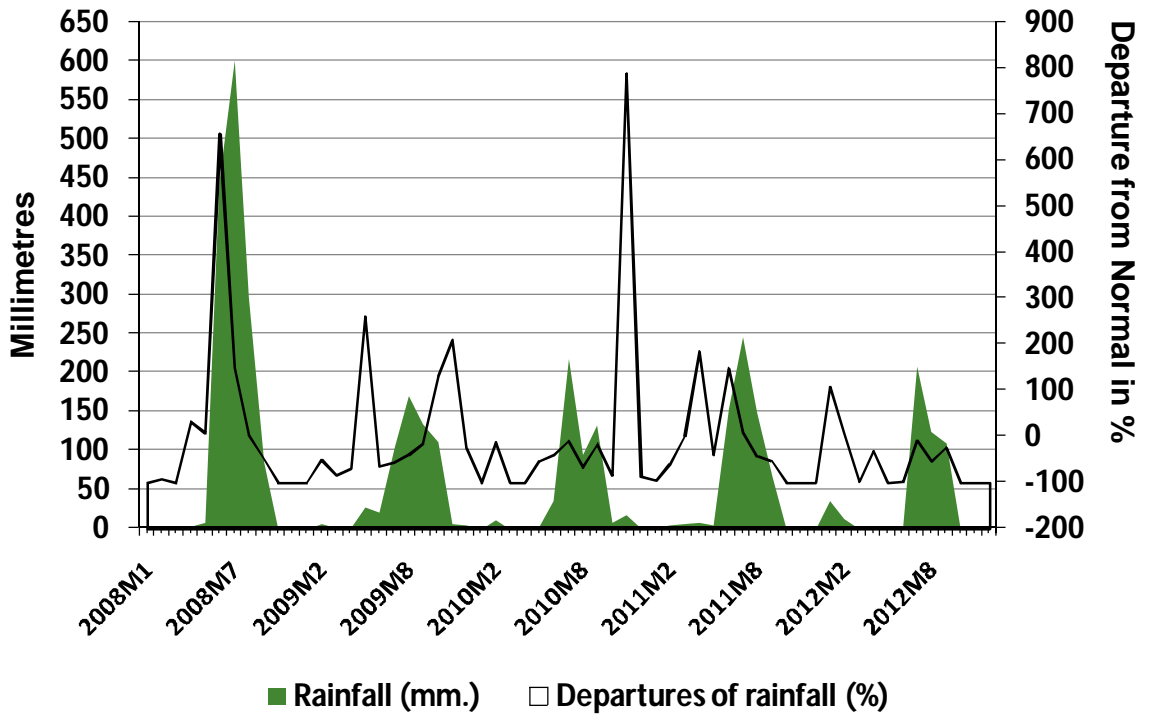
Rainfall Pattern

Kanpur Nagar District - Uttar Pradesh



Rainfall Pattern

Unnao District - Uttar Pradesh



Rainfall Pattern of Districts of Unnao and Kanpur

Units	Unnao		Kanpur City	
	Rainfall (mm.)	Departures of rainfall	Millimetres	Departures of rainfall
	Millimetres	%		%
2008M1	435.100	64.000	0.000	-100.000
2008M2	270.100	-7.000	1.200	-91.000
2008M3	103.700	-41.000	0.000	-100.000
2008M4	.400	-99.000	3.600	33.000
2008M5	0.000	-100.000	8.100	8.000
2008M6			445.600	658.000
2008M7			601.600	150.000
2008M8			297.000	5.000
2008M9			85.700	-46.000
2008M10			0.000	-100.000
2008M11			0.000	-100.000
2009M1	0.000	-100.000	0.000	-100.000
2009M2	96.200	-64.000	6.400	-50.000
2009M3	196.800	-32.000	1.200	-83.000
2009M4	267.800	51.000	.800	-70.000
2009M5	84.900	66.000	27.100	261.000
2009M6	0.000	-100.000	21.300	-64.000
2009M7	3.300	-54.000	104.100	-57.000
2009M8			170.700	-40.000
2009M9			134.400	-15.000
2009M10			110.900	131.000
2009M11			6.200	210.000
2009M12			4.800	-25.000
2010M1	.600	-96.000	0.000	-100.000
2010M2	14.900	-3.000	11.300	-12.000
2010M3	0.000	-100.000	0.000	-100.000

	Unnao		Kanpur City	
	Rainfall (mm.)	Departures of rainfall	Millimetres	Departures of rainfall
Units	Millimetres	%		%
2010M4	0.000	-100.000	0.000	-100.000
2010M5	10.900	3.000	3.500	-53.000
2010M6	6.800	-91.000	36.000	-39.000
2010M7	313.500	19.000	218.100	-10.000
2010M8	185.000	-36.000	94.800	-67.000
2010M9	180.600	2.000	133.500	-15.000
2010M10	4.500	-91.000	7.200	-85.000
2010M11	17.700	941.000	17.800	790.000
2010M12	.700	-90.000	.800	-88.000
2011M1	.700	-95.000	.600	-96.000
2011M2	7.700	-49.000	4.900	-59.000
2011M3	6.700	-9.000	6.000	0.000
2011M4	5.100	50.000	7.400	185.000
2011M5	13.000	24.000	4.600	-40.000
2011M6	188.100	127.000	154.900	149.000
2011M7	244.000	-2.000	246.700	9.000
2011M8	160.800	-44.000	150.000	-43.000
2011M9	82.300	-52.000	67.300	-53.000
2011M10	0.000	-100.000	0.000	-100.000
2011M11	0.000	-100.000	0.000	-100.000
2011M12	0.000	-100.000	0.000	-100.000
2012M1	43.300	191.000	35.100	109.000

Perusal of the Rainfall data clearly indicate though there is no variation in terms of total rainfall in the both the districts but there is reasonable temporal variation in rainfall.

Perusal of the graph of rainfall for both the district shows peak of the curves for departure of the rainfall does not coincides with the rainfall received by these districts, but there is slight shift. This shift observed from the graph is indicative of the fact that rainfall pattern has witnessed some change in respect of time districts have received rainfall.

Usually peaks and lows of the departure curve from the normal should have coincided with the total rainfall received in the months which usually witness rainfall. Shifting of peaks for departure in the months which usually do have very little or no rainfall is indicative of the fact that area is receiving rainfall in months in which usually there were little rainfall witnessed in the area.

Area received more rains in months, which usually had witnessed no or little rains. Whereas, trough of the curves are coinciding in the months which usually witnessed high to moderate rainfall.

In total it can be concluded, pattern observed in that area is in coherence with the regional change in the pattern of the rainfall. There is in general variation in temporal terms but there is little or no change in terms of the total rainfall received during the whole of the year.

Second important trend observed is there is decrease in the total rainy days as observed otherwise in the area. Indicating there is variability of rainfall in terms of intensity. Intensity has observed large variation in terms of rainfall.

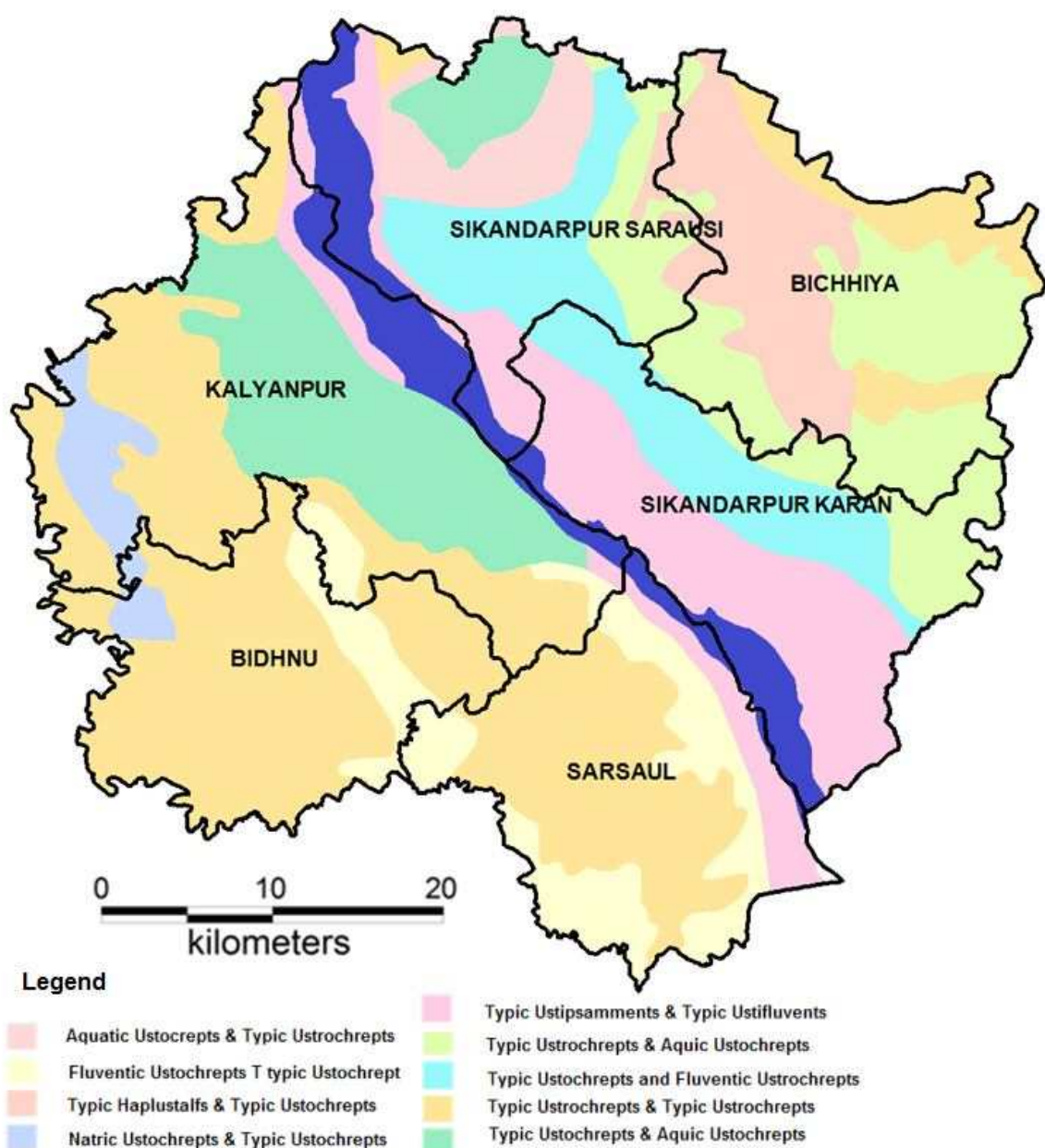
Since rainfall is an important part of the hydrological cycle of the area, it affects percolation and recharge in the area. Higher or increased intensity of the rainfall affects runoff and percolation. Whereas high intensity of rainfall causes more surface runoff, gives little time for rainwater to recharge aquifers in the area.

SOIL TYPES

On the basis of texture following type of soils have been encountered in the study area.

- 1) Loamy
- 2) Coarse Loamy,
- 3) Fine
- 4) Fine clay
- 5) Fine Loamy
- 6) Fine Silt

Loamy Soils are confined to north Eastern part of the study area and fine textured soils are observed in patches all along the toposheet except urban area. The major part of the district consists of ordinary soils known locally as Bhur and Sand on ridges, Matiyar or clay in depressions and Domat or Loam in the Plains. The 'Reh' prevails in the clay dominant areas. A detailed classification of the occurrence of soils has been depicted in the soil map below.



LANDUSE AND CROPPING PATTERN

In general landuse type of the area can clearly be classified in term of its uses. A large part of the area is urbanised and under the category Urban Landuse and other is rural or agricultural area.

Among all the blocks Bichiya of Unnao is having a large area covered under the forest or green cover. Sirosi block of Unnao owe its less area covered under forest is due to its geographical location in the geological trough. Reason for Kalyanpur to have less forest area is different as this is highly urbanised area and a large part of it is under municipal boundary of the area.

A large part of the area falling in the three blocks of the Kanpur Nagar are under the category bad lands because of its surface and sub-surface geology. Since large part of the area is underlain by argillaceous material, which has ultimately cause the formation of immature undeveloped ravines.

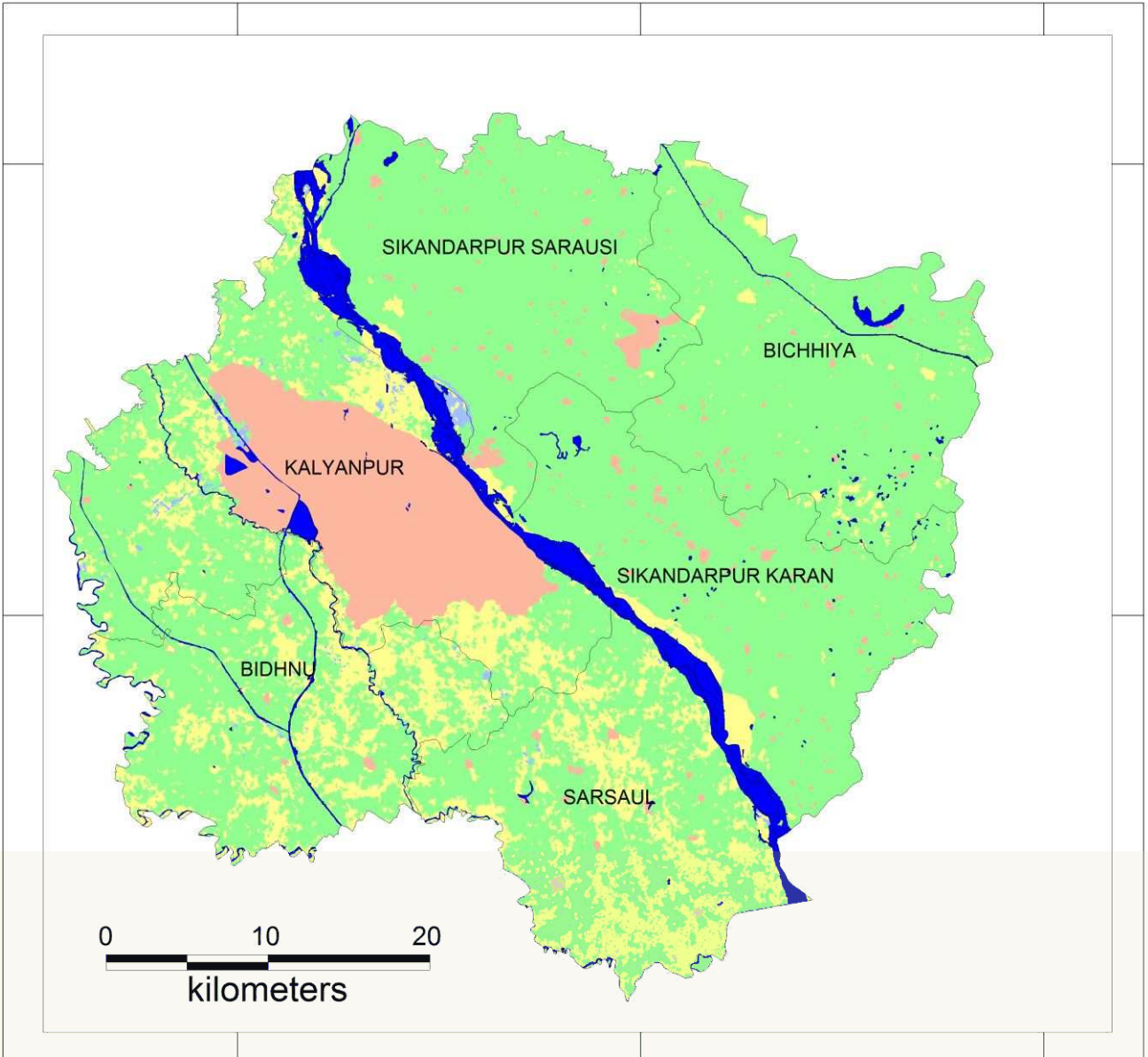
	Total Area	Forest	Barren Cult. Waste	Present Fallow Land	Other Fallow Land	Barren and Uncult. Land	Land Put to non-Agri. Use	Pasture	Area under bush and forest
Kalyanpur	18295	364	504	2345	1091	1782	3908	562	362
Bidhano	29552	190	612	1988	1056	774	3852	674	224
Sarsol	30410	852	1294	2014	817	601	4585	1369	212
Sik. Sirosi	32532	481	783	1751	1809	677	4945	139	109
Sik. Karan	34501	1255	1115	1931	2243	1281	3843	137	151
Bichiya	33734	1314	920	1925	2107	1067	3861	599	112

(All the Figures are in Hectare)

Agricultural & Irrigation

Area being the well irrigated area good amount of net sown area. Out of total area 11243 sq km area is net sown area, out of this 5039 sq km area is sown more than once. Total of 14444 sq km area is gross irrigated area and 8402 sq km is net irrigated area. A large part of the area falls under the under the flood plain area of district Unnao, which has not been covered under irrigational schemes but has good potential of ground water and is being sown with the help of diesel pumps. Blockwise details of the landuse has been shown in table below.

Landuse Map of the Area

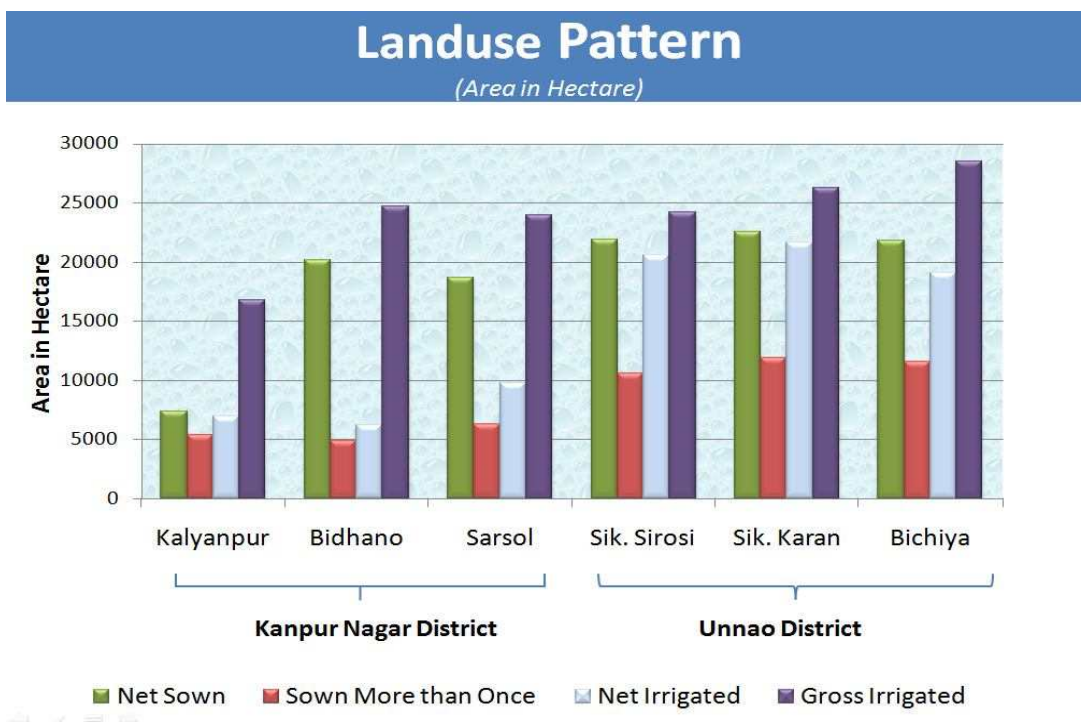


- Legend
- Urban Area/ Habitation
 - Agricultural Area
 - Wet Land
 - Water Bodies

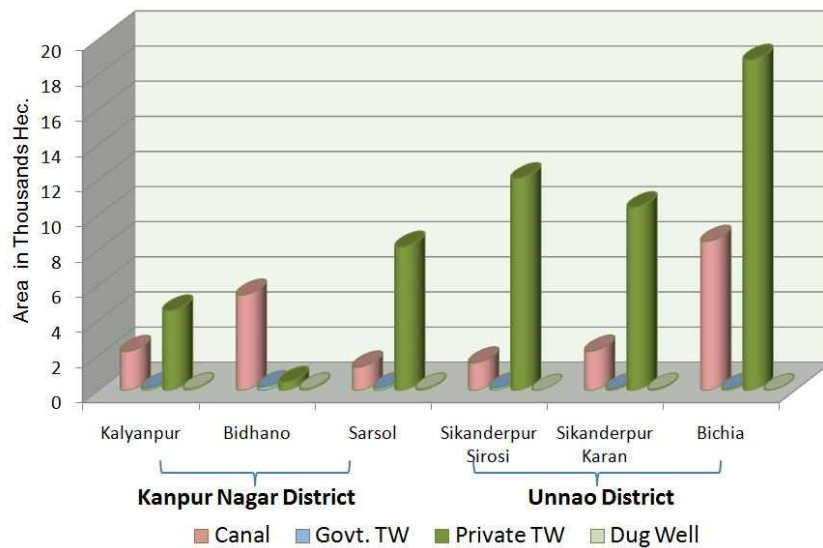
	Net Sown	Sown More than Once	Net Irrigated	Gross Irrigated
Kalyanpur	7377	5327	6947	16765
Bidhano	20182	4852	6164	24714
Sarsol	18666	6243	9702	23968
Sik. Sirosi	21838	10536	20543	24227
Sik. Karan	22545	11887	21626	26239
Bichiya	21829	11549	19043	28527
Total	112437	50394	84025	144440

Perusal of the graph below indicates Gross irrigated area in all the blocks is almost same in magnitude except in Kalyanpur block of Kanpur District owing to its skewed landuse pattern towards urban area. As already mentioned urban area of Kanpur municipal area falls in the geographical limits of Kalyanpur block.

Net irrigated area of blocks of unnao districts are more than blocks of Kanpur Nagar, this is because of better canal network and easy availability of ground water. Besides Bidhano and Sarsol blocks have witnessed lot of urban activity, there is no development of irrigation systems in these blocks. Area sown more than once is definitely indicative of poor irrigational infrastructure in the area and availability of ground water in the area. To understand this further it will be prudent to understand the irrigational facilities in the area along with type of irrigation method being used.



Source of Irrigation and Area Irrigated (Area in Hectare)



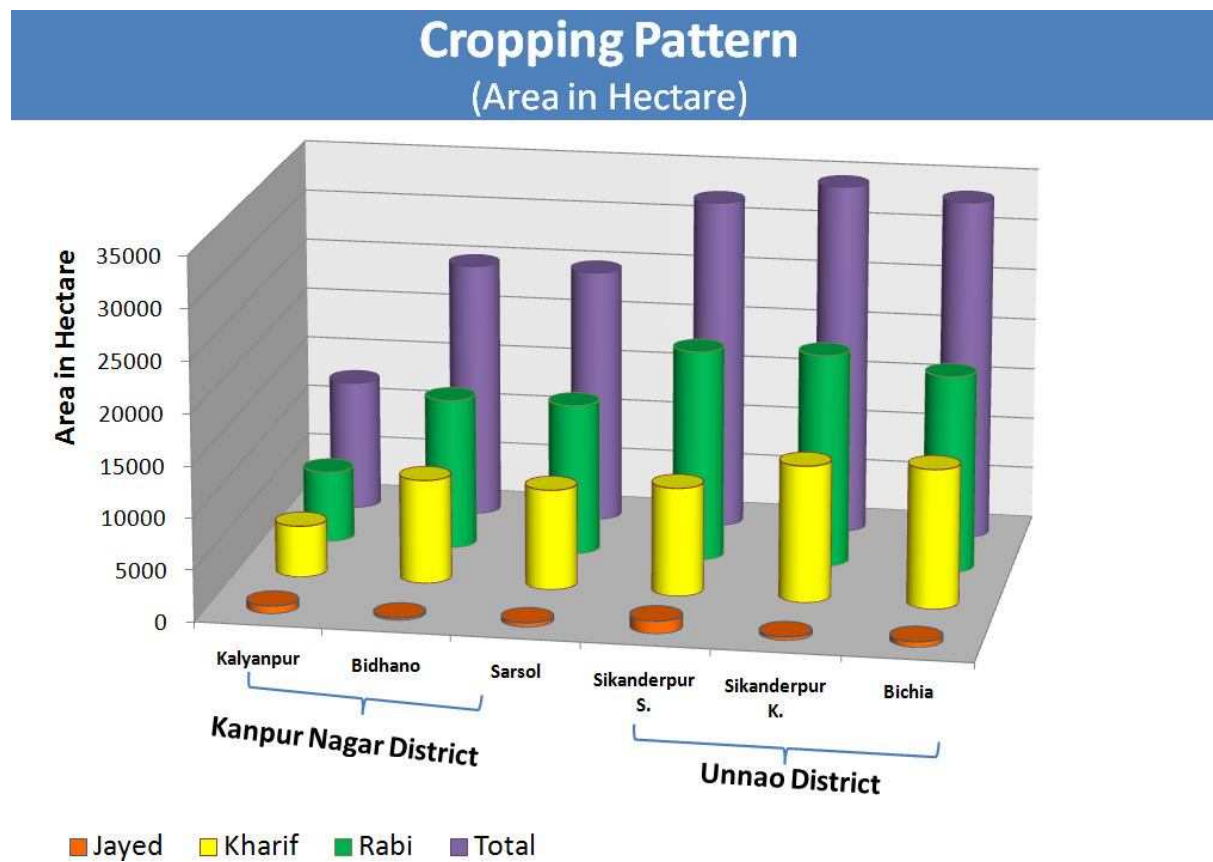
Perusal of the Figure above and Table below it is easy to understand the variation in the net irrigated and gross sown area. All three blocks of the Kanpur Nagar i.e. Kalyanpur, Bidhano and Sarsol show less area irrigated through surface and ground water sources in comparison to blocks of Unnao Districts. Large area in blocks of Kanpur Nagar is being irrigated through canal and private tubewells, but canal has reasonable share not the largest. Whereas, scenario of blocks of Unnao changes drastically and ground water become a major contributor towards irrigated land. Although blocks of Unnao districts are also dependent on both type of irrigation, surface and ground water but share of ground water is more than surface water.

Same conclusion can be supported by the following table:

	Canal	Govt. TW	Private TW	Dug Well
Kalyanpur	2211	121	4521	91
Bidhano	5425	201	453	84
Sarsol	1326	146	8151	79
Sikanderpur Sirosi	1561	139	12048	0
Sikanderpur Karan	2227	77	10398	66
Bichia	8481	87	18793	28

Cropping Pattern

Perusal of the data of the landuse pattern of the area indicate there are two distinct type of Pattern in terms of productivity and type of agricultural crops in the area. Blocks of the Unnao districts are more productive in term of crop sown in comparison to blocks of Kanpur Nagar district. More area has been sown in blocks having more irrigation potential and availability of cropping land. Kalyanpur blocks of Kanpur Districts



GEOLOGY

The Kanpur Nagar district is part of Indo Gangetic Plain. The generalized geological succession is as follows:

Geological Succession in Study Area:

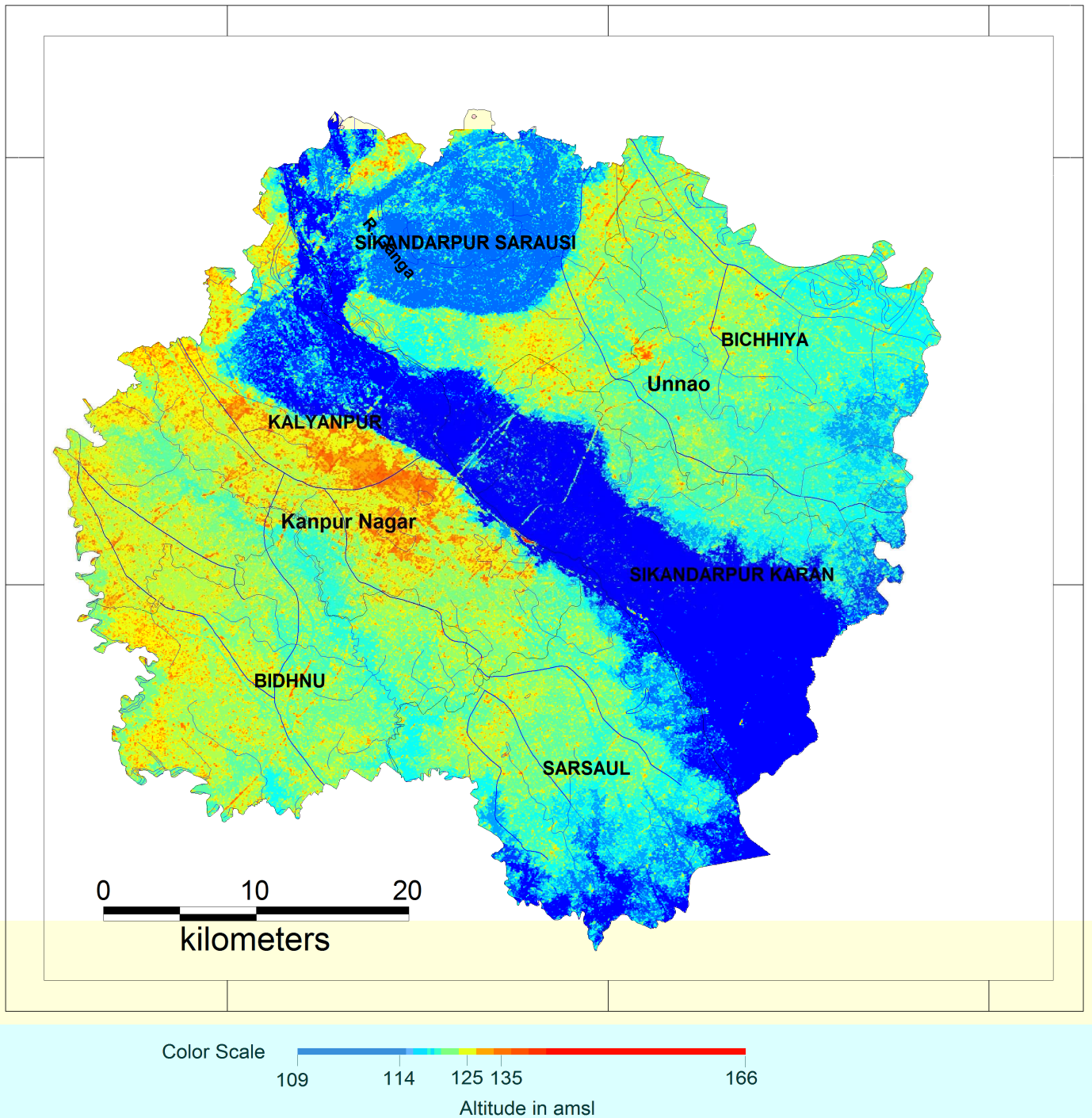
Period	Age	Land Form (Geomorphology)	Rock Type
QUATERNARY	Upper Pleistocene to Recent	Newer Alluvium	Fine Sand and Clays
	Lower Pleistocene to Upper Pleistocene	Older Alluvium	Sand of different grades and clay mixed with Kankar
-----UNCONFORMITY-----			
Bundelkhand Granite (Archean), Vindhyan Sandstone (Proterozoic)			

The older alluvium, is alluvial deposit mostly occurring in the central part were deposited during lower to Upper Pleistocene period. The newer alluvium were deposited during Upper Pleistocene to Recent period mostly occurring along the course of rivers. The soil of the district exhibits a great variety of composition and appearance. The major part of the district consists of ordinary soils known locally as Bhur and Sand on ridges, Matiyar or clay in depressions and Domat or Loam in the Plains. The 'Reh' prevails in the clay dominant areas.

PHYSIOGRAPHY AND GEOMORPHOLOGY

The study area forms a part of Ganga sub -basin in the Central Indo-Gangatic Plain. It exhibits more or less a flat topography with the master slope from north-west to south-east. The average elevation of land surface is 125 m.a.m.s.l. The area is drained by the river Gange and its tributary Pandu. The area of city has been geomorphologically divided into two units. (i) Low lands or Younger Alluvial Plain & (ii) Up lands or Older Alluvial Plain. The Low land or Younger Alluvial Plain has been identified as flat to gently sloping and slightly undulating terrain of large areal extent, formed by river deposition, and is limited along river Ganga with the breadth not exceeding 5 km. The sediments comprise of Recent unconsolidated alluvial material of varying lithology. The fluvial land-forms such as palaeochannel, meander scar and oxbow lakes are common features. Further west of Younger Alluvial Plain is the area of stable upland which has been produced by extensive

Topographical Variation and Geomorphic Features



deposition of older alluvium comprising of coarse to fine sand, silt and clay. The patches of salt encrustations have been reported in the area around Panki and Chakeri.

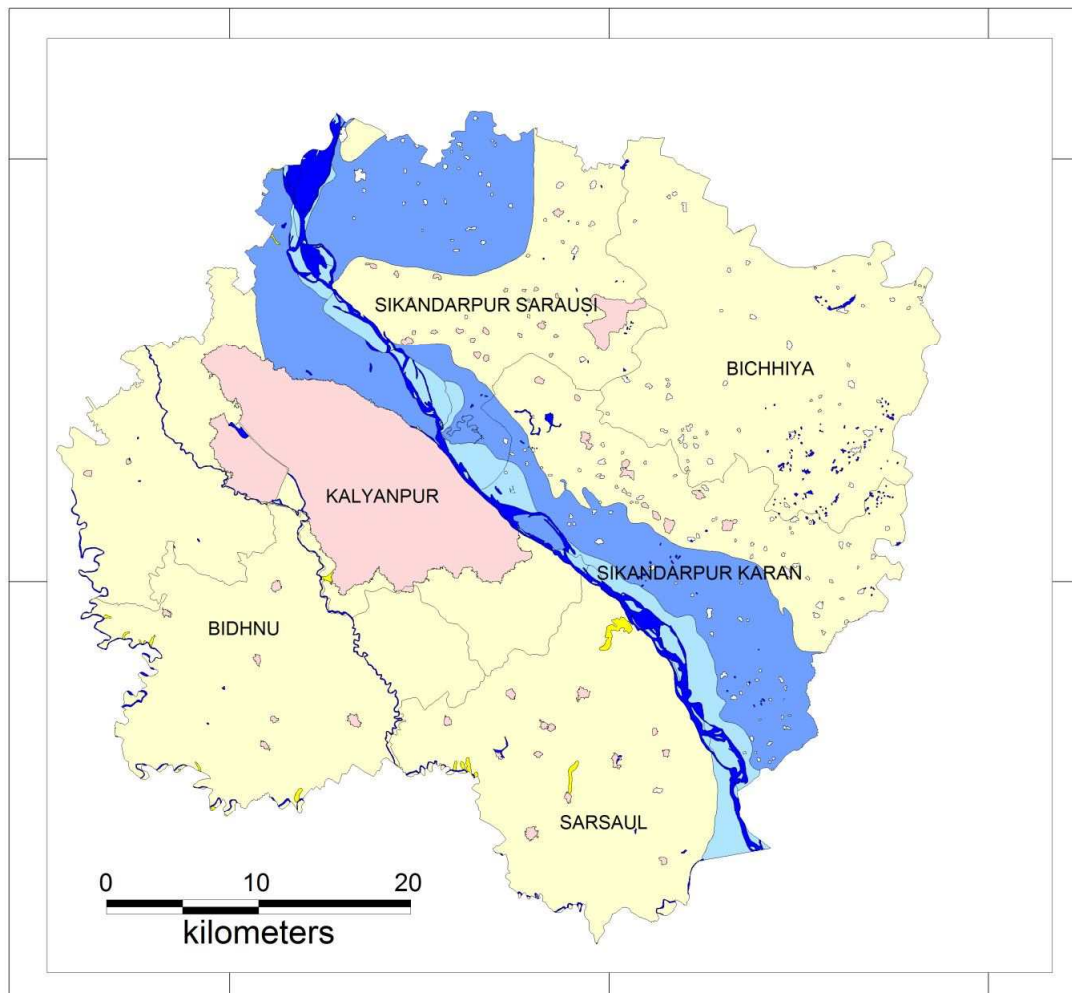
HYDROGEOLOGY

Study area forms a part of Central Ganga Alluvial Plain, underlined by unconsolidated sediments of Quaternary age comprising silt, clay, sand of various grades, gravel and kankar in varying proportion.

The Central Ground Water Board (CGWB) has undertaken exploratory drilling Study of the boreholes drilled by C.G.W.B. under its exploratory/deposit well programme and a subsequent perusal of sub -surface geological cross-sections.

Lithological Variation in the Area

Parts of Kanpur Nagar & Unnao District of Uttar Pradesh



Legend

- Urban Area/ Habitation
- Clayey Sand
- Clay with Sand Silt Parting
- Gravel Sand and Silt
- Sandy Clay
- Water Bodies

Location of Exploratory Wells:

Details of a large number of wells drilled in Toposheet area were collected from state as well as Central agencies including CGWB. Whereas CGWB is only agency which is involved in Exploration activity, State agencies were drilling wells with the purpose of providing drinking water to the residents. Wells drilled by CGWB were deeper and having more systematic information than other agencies. Agencies involved in providing drinking water to the local population were engaged in drilling only upto 100 m. After validation of data and availability of the electrical logs, 21 wells have been considered to be useful. Only constraints of the wells drilled by Central Ground Water board is that they are located in the urban area and their distribution is not even in space, hence more wells are required to be drilled in grid pattern for deciphering aquifer geometry of the area covered in the toposheet. List of the wells considered with available lithologs and drilling details have been annexed in the table.

In total 2 EW are required to be drilled in first aquifer and 6 in second aquifer for not only delineating aquifer geometry and aquifer parameters but also their utility in the later phase as water level monitoring and sample collecting stations for second aquifer.

Details of the Location of Exploratory wells :-

S. No.	Longitude	Latitude	Location
1.	80.42667	26.39000	Harjendranagar
2.	80.32222	26.42778	Juhi
3.	80.29640	26.48740	Chandra Sekhar
4.	80.42520	26.43610	Motinagar (Jajmau)
5.	80.39290	26.41040	Chakeri (N-4 Area)
6.	80.39270	26.40896	Chakeri (N-6 Area)
7.	80.27293	26.48682	Awas Vikas Kalyanpur
8.	80.26825	26.48450	Awas Vikas Vinayakpur
9.	80.26250	26.46900	Armapur Estate (OHT, Deposit Well)
10.	80.30769	26.48108	GSVM Medical College
11.	80.31150	26.47732	Lala Lajpat Rai Hospital
12.	80.36125	26.46840	Phoolbagh
13.	80.34050	26.45530	Rly. Colony, Cooperganj
14.	80.33170	26.45070	COD, C Road
15.	80.33520	26.40130	Y-1 Block, KDA Yashoda nagar
16.	80.28890	26.46500	J-2 Park, Vijay Nagar

17.	80.30490	26.43310	Tubewell No. 5, Barra, KDA
18.	80.27400	26.32146	Bidhnu
19.	80.39360	26.43130	Jajmau, Ganga Vihar
20.	80.33930	26.47480	Suterkhana
21.	80.48889	26.46111	Badarka

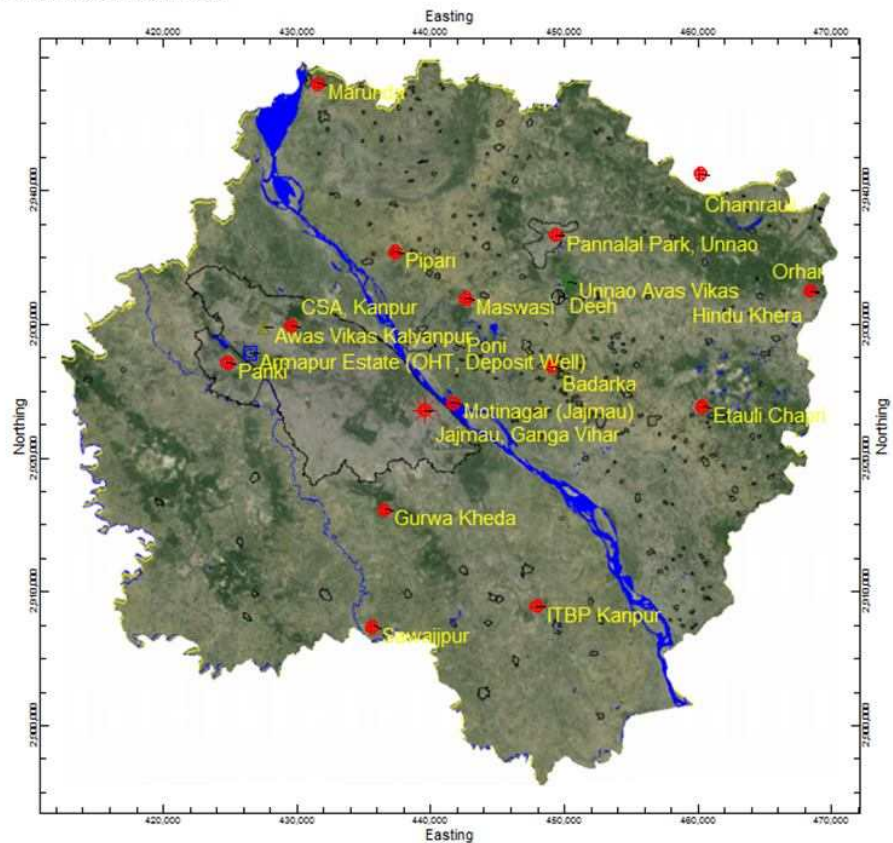
Aquifer Geometry

Information collected from wells drilled by CGWA has been compiled and schematic representation prepared to represent the subsurface lithology. For the purpose of delineating of aquifer groups wells with all necessary information has been considered and has been shown on the map below:

Parts of Kanpur Nagar and Unnao Districts

Location Map of EW


Location of EW
Considered for
Aquifer Mapping



The unconsolidated alluvial sediments deposited over the undulatory surface of the basement rock, (encountered in borehole at Panki at the depth of 505 mbgl) show alternative clay and granular beds. The sandy horizons at different depths form the main repository of ground water.

The thick pile of sediments down to depth of 300m broadly, consists of 3 tier aquifer system as below:-

1st Group of Shallow Aquifers (upto 150 m) depth bgl):

Ground Water occurs under unconfined to semi confined conditions. The aquifers of this group do not appear to hold good promise for ground water development due to their lensoidal nature. Shallow tubewells ranging upto 100m depth tapping 7 to 20 metres of saturated granular zones, yield 7 to 20 lps at drawdown ranging between 4 to 7 metres. The tubewells, 101 to 175 meter deep and tapping 10.5 to 49.0 m of saturated granular zones, yield 12 to 27 lps at drawdown ranging between 5.85 and 10.45 m. Static water level in these wells varies from 6 to 14 meters. Generally, the tubewells tapping the 1st Group of aquifers are moderately yielding but do not give sustained water supply during the peak summer period.

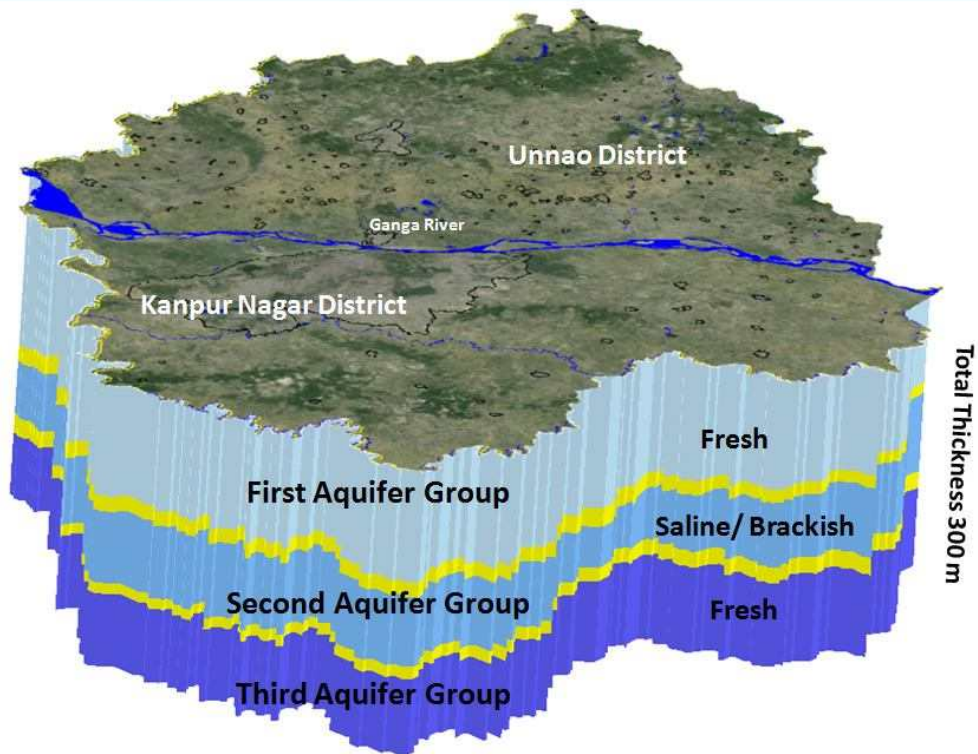
2nd Group of Moderately Deep Aquifer (Existing between 150-250m depth):

Ground water occurs under confined conditions. This particular aquifer group has not been exclusively tapped in any tubewell due to its poor quality of formation water. However, it has been observed that whenever even partly this aquifer group has been tapped in any tubewell along with overlying aquifer group, the yield of the well has remarkably increase, which confirms its potentialities. It appears that the confineness of this aquifer group due to overlying and underlying clay beds has restricted its flushing, resulting in the occurrence of poor quality of water in the aquifer.

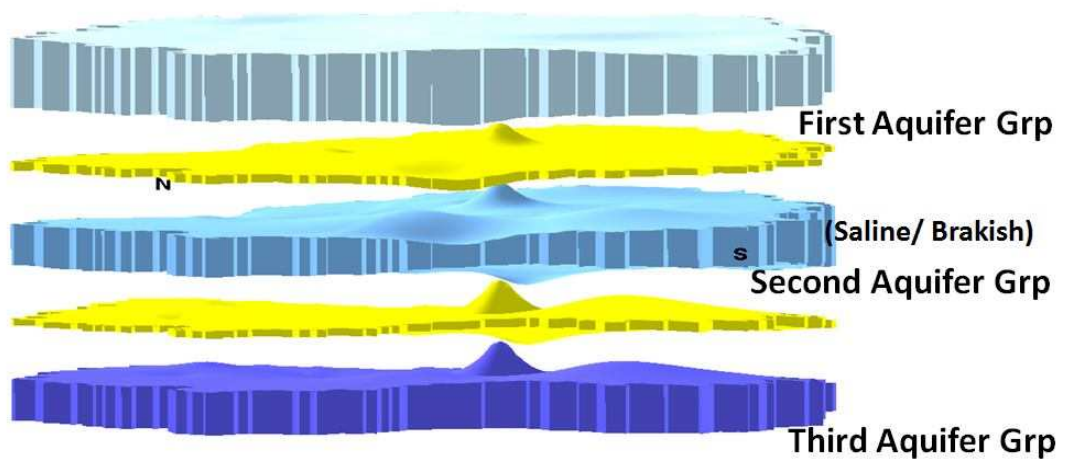
3rd Group of Deep Aquifers (below 250 m depth):

Ground water occurs under confined conditions. The piezometric level of the deep aquifers ranges between 12.00 an 19.00 mbgl. The aquifers of this group are holding good promise for ground water development. Deep tubewells, 338 to 400m deep, tapping 34 to 89m of saturated granular zones, yield 31 to 60 lps at drawdown ranging between 4 and 17m. Ranges of different parameters of these aquifers are given below.

Aquifer Disposition in 3 Dimension



Delineated Aquifer Group



Sections have been prepared for different direction for aquifer disposition and Lithological variation in the area and has been shown below; general thickness of aquifer material and layer separating it from upper and lower aquifer group is almost constant through out the area except at one place near pannalal park, where local mound of aquitard has been observed. This could be because of local depositional environment or effect of the local mechanical stresses.

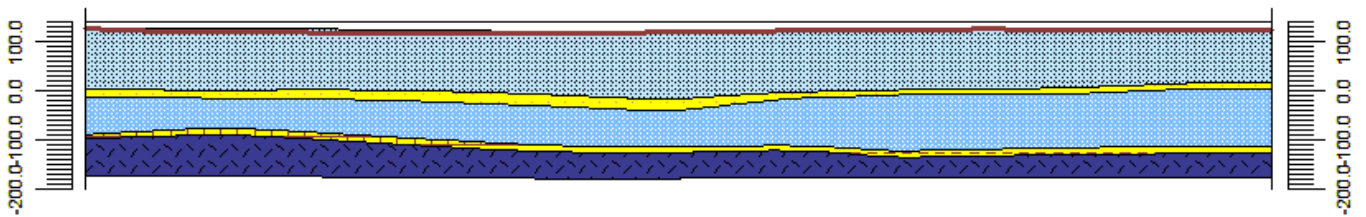


Fig : Sawaijpur to Ghurwakheda

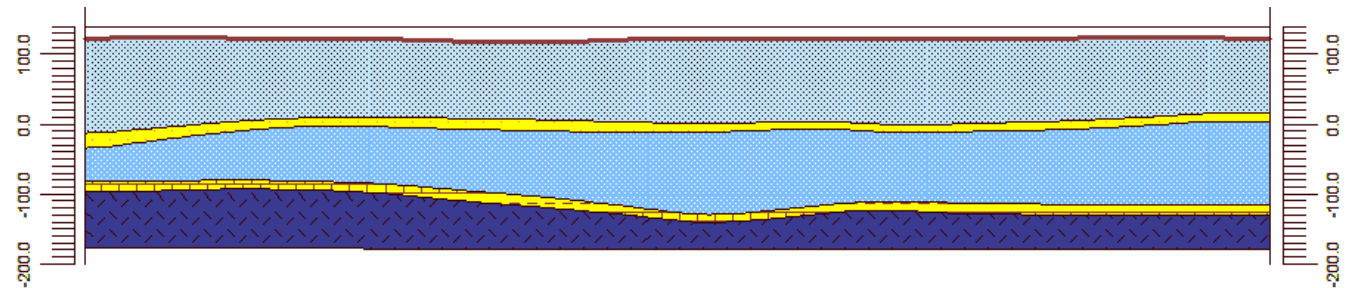


Fig Sawaijpur to Chamrauli

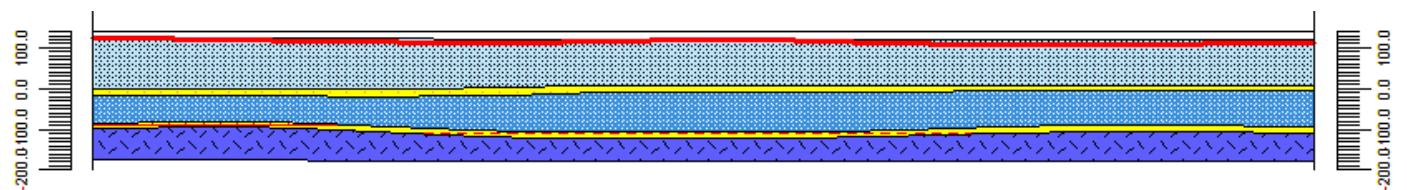


Fig : Along the River Ganga

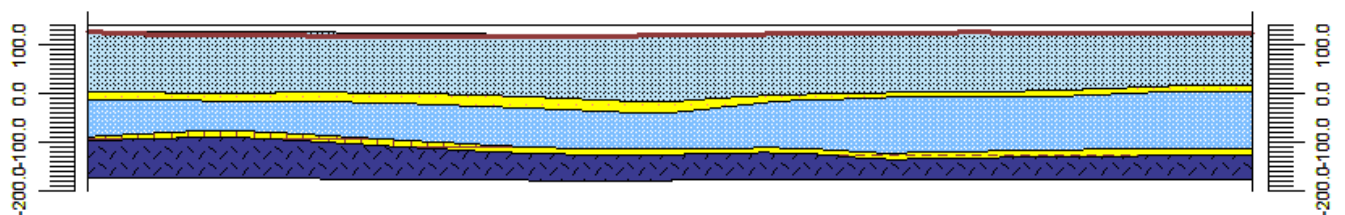
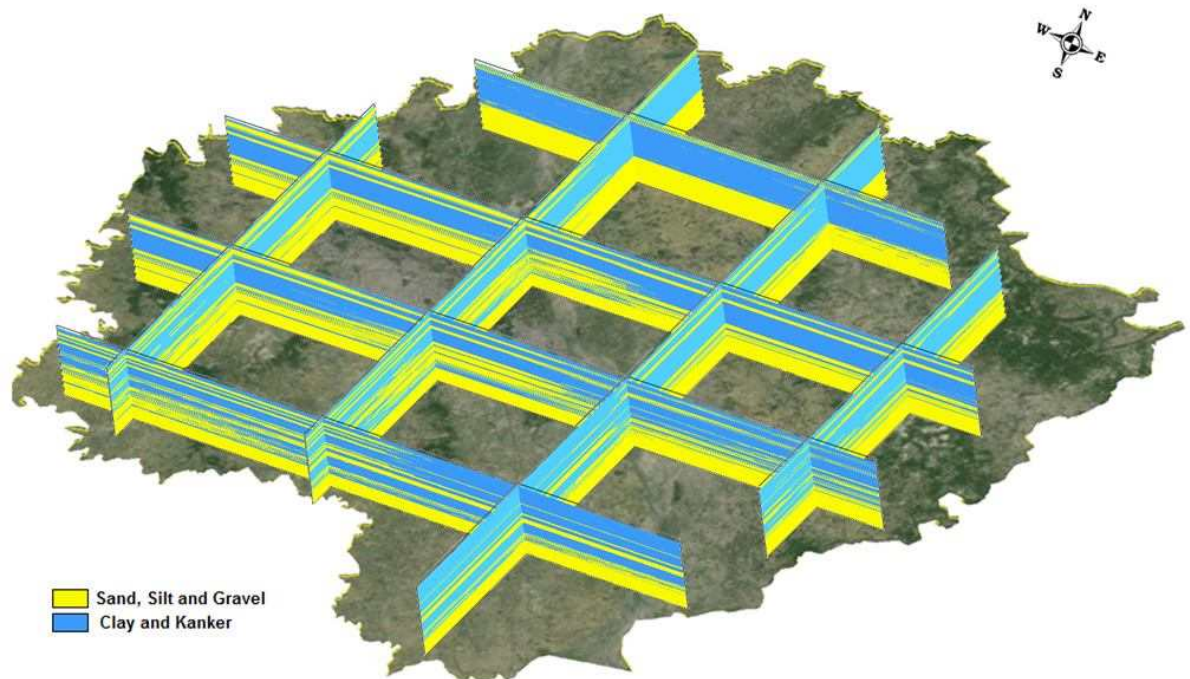


Fig: Across the River Ganga

Lithological Variation:

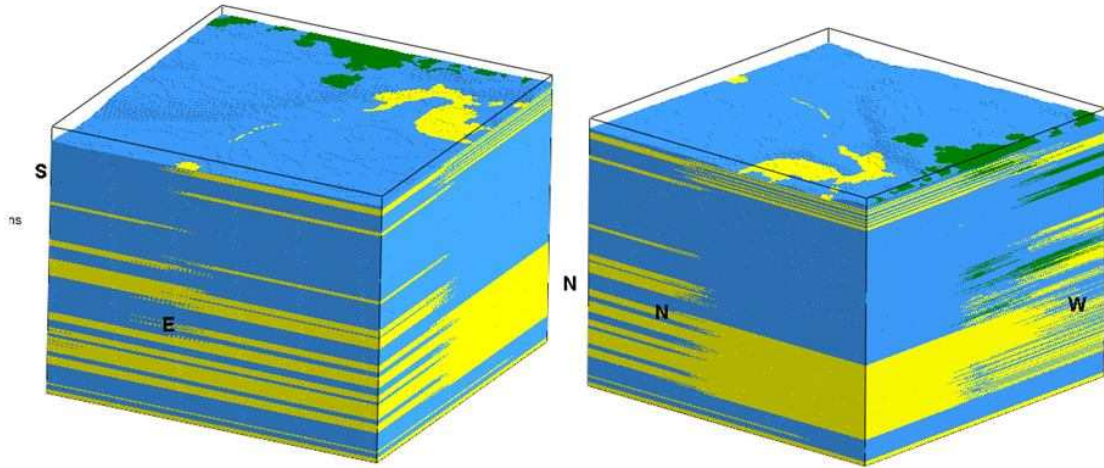
Lithological variation as depicted by the schematic representation of the area indicate there is large variation in lithological content of the area especially, when it comes to comparison of lithology across river. Blocks on the North eastern side of the river have more clay dominance in comparison to blocks of the Kanpur Nagar. Although there has been a

Lithological Variation in 3 Dimension





constant aquitard between the two aquifer groups i.e. First and Second, but within the same aquifer group there is large variation in the clay content and sand content of the aquifer material. This variation of clay content has been depicted in the form of sand percentage in the figure. More of aquifer material has been observed in area south west of river Ganga in comparison to eastern side. On the Unnao side of the aquifer, aquifers are more argillaceous in comparison to aquifers on the Kanpur side. Whereas, aquifer on the Kanpur side of river Ganga has more of arenaceous material in the first aquifer group. Second aquifer group exhibits complimentary style of sand percentage to first aquifer group. Third aquifer group is most productive and fresh in nature and has highest sand percentage upto 300 mbgl. Larger sequances of sand has been encountered in third aquifer group and the same has been depicted in lithological box diagram of the extent area. Same can also be seen in section drawn along different section line in the area.

Lithological Box for Extent of Area

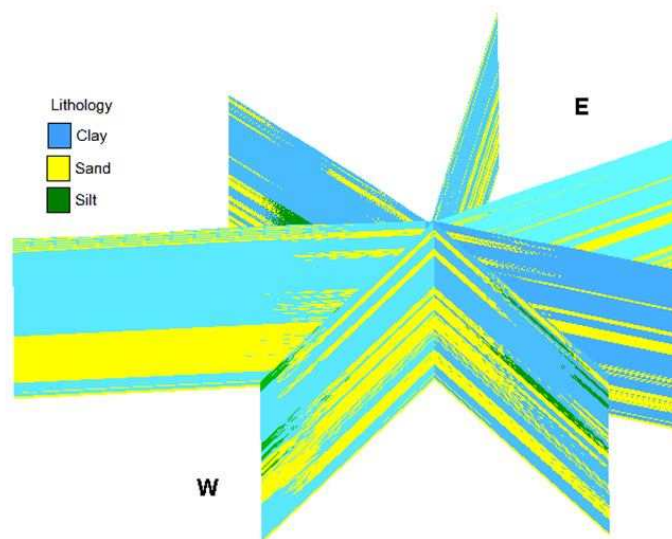


SE - NW Section

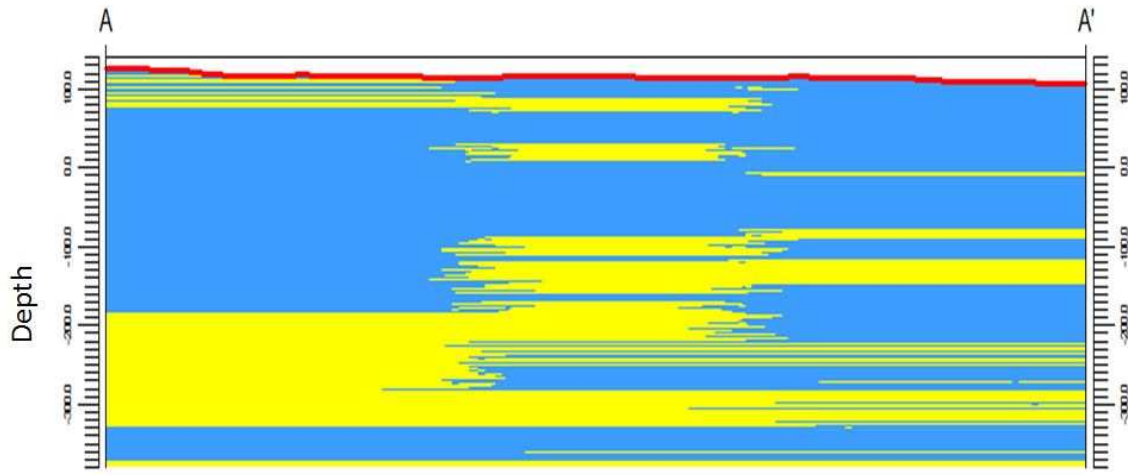
NE - SW Section

-  Sand, Silt and Gravel
-  Clay and Kanker

Radial Section From Centre of the Area



Section Along the River from North to South



■ Sand, Silt and Gravel
■ Clay and Kanker

Fig: Section along North to South of River

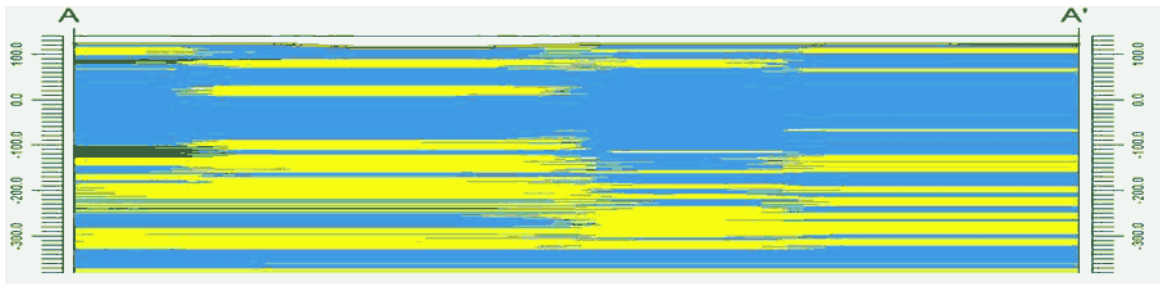


Fig: Section along Northern Part of the Area

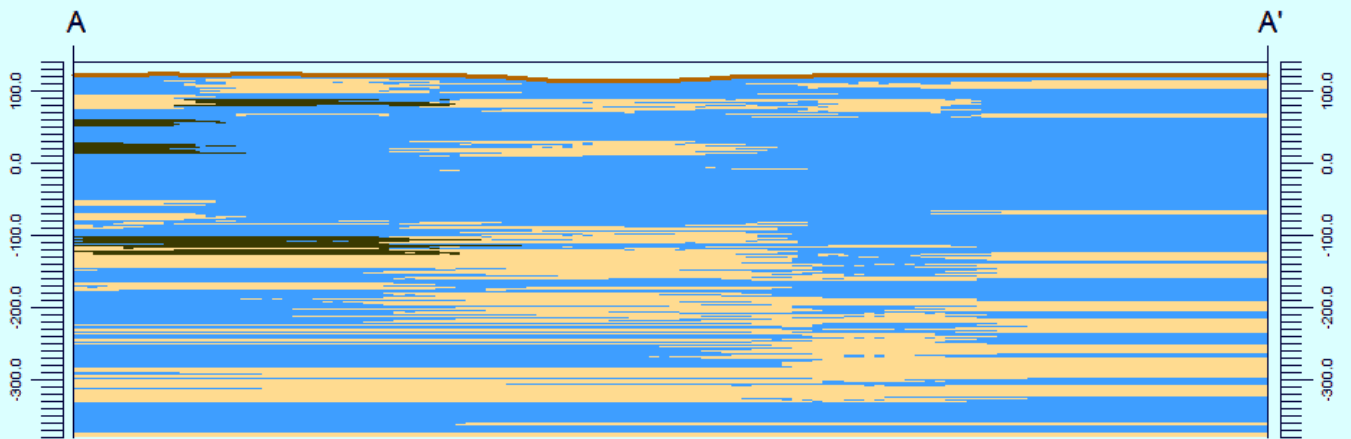


Fig: Section along Gurwakheda to Chamrauli

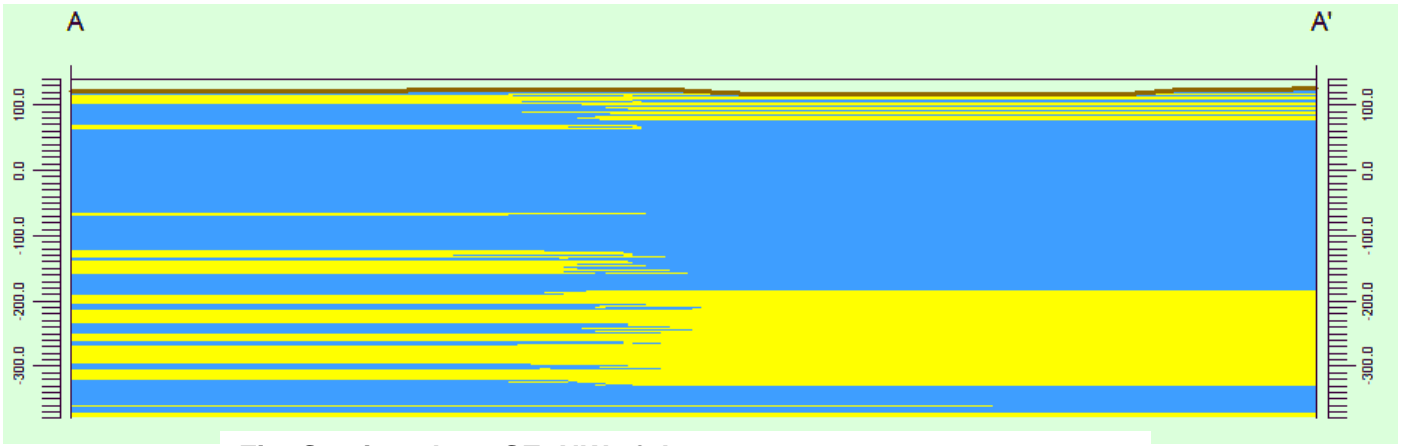


Fig: Section along SE- NW of the area

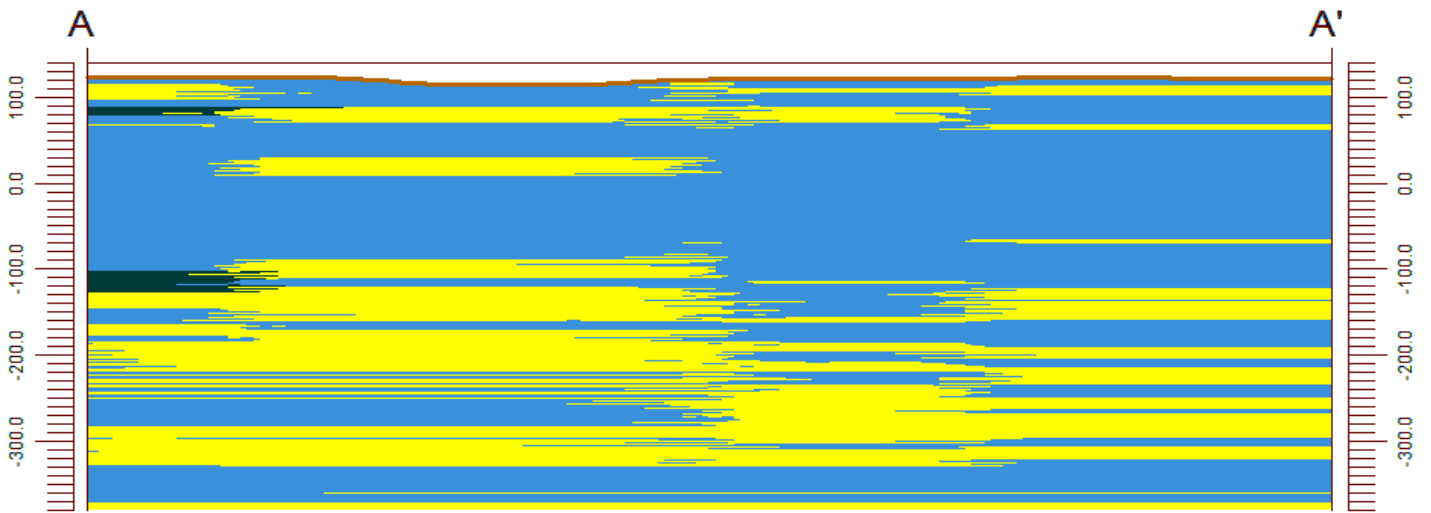
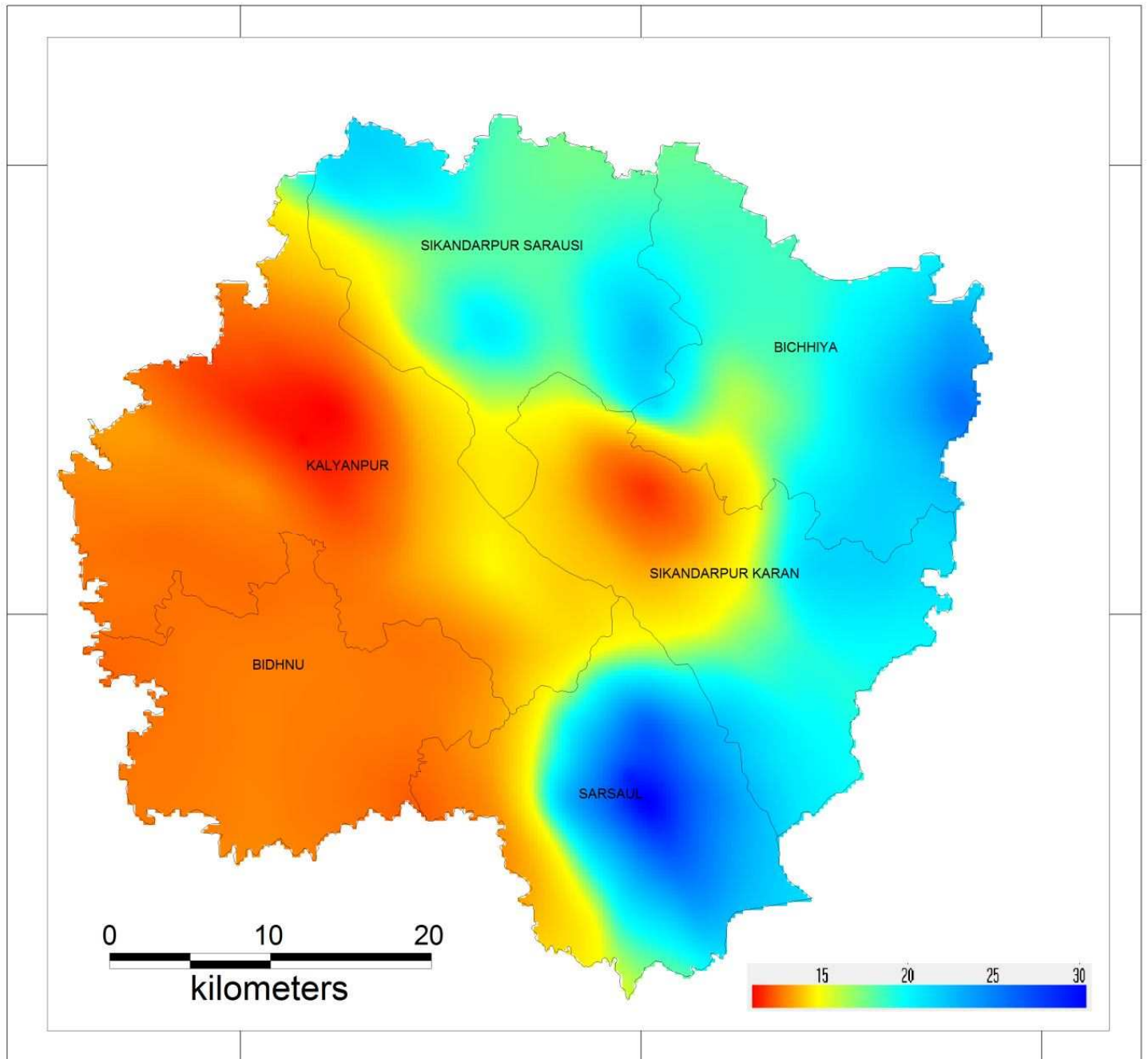
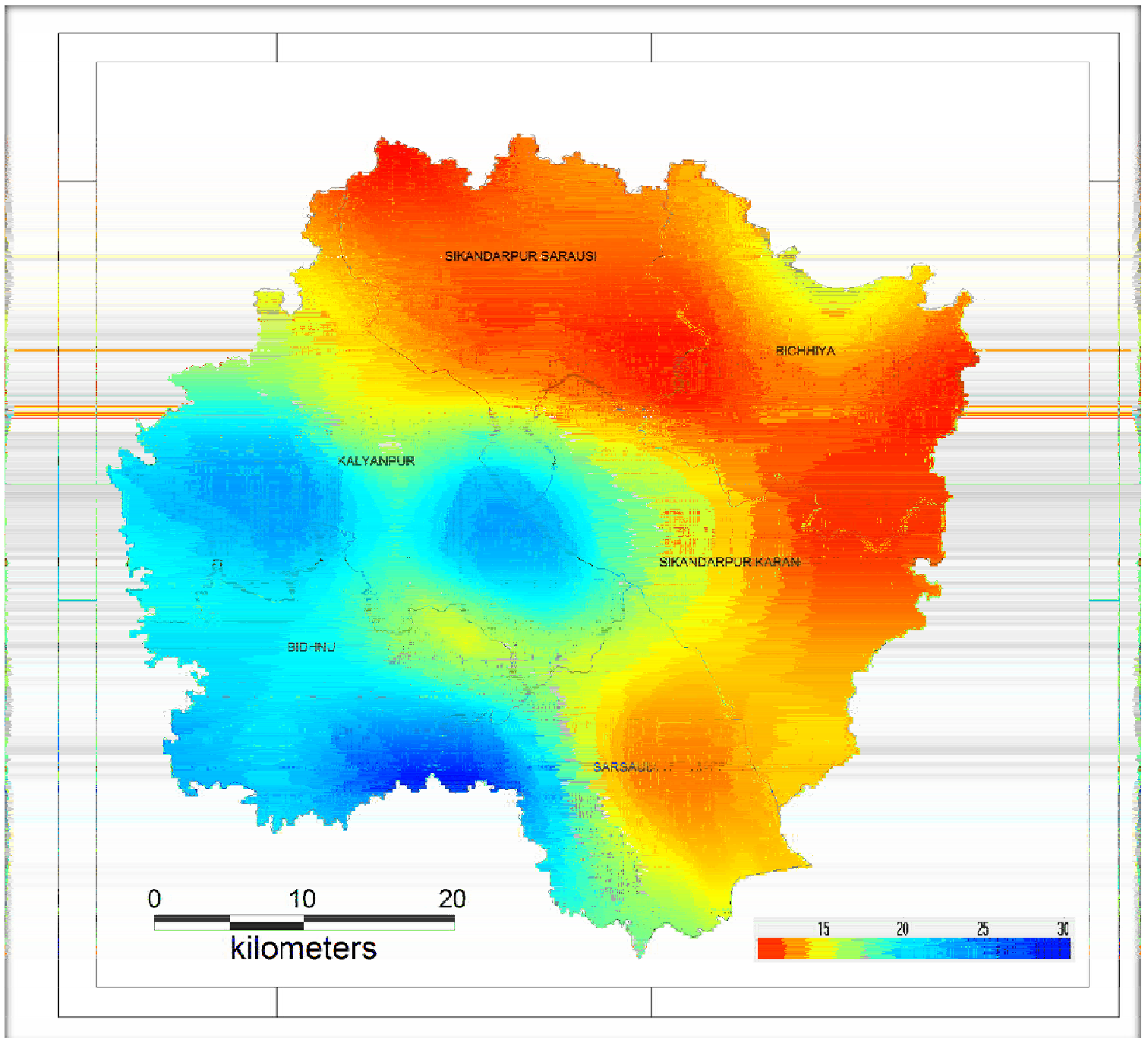


Fig: Section along Sawaijpur to Chamrauli

Variation in Aquifer Material in First Aquifer Group (Sand Percentage)



Variation in Aquifer Material in Second Aquifer Group (Sand Percentage)

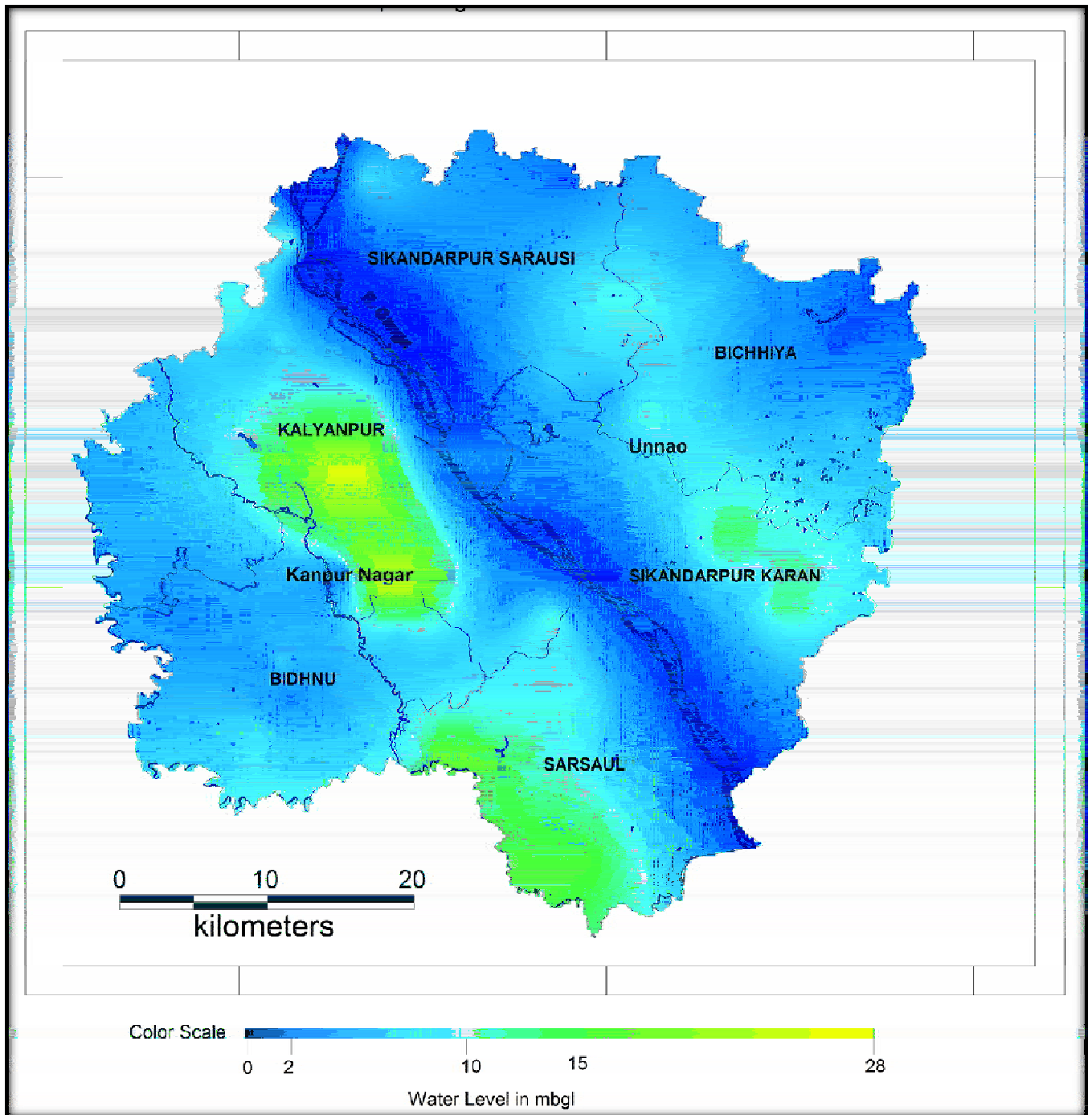


Details of the Monitoring Wells:

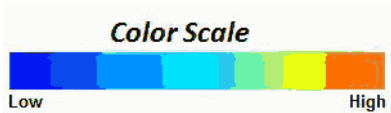
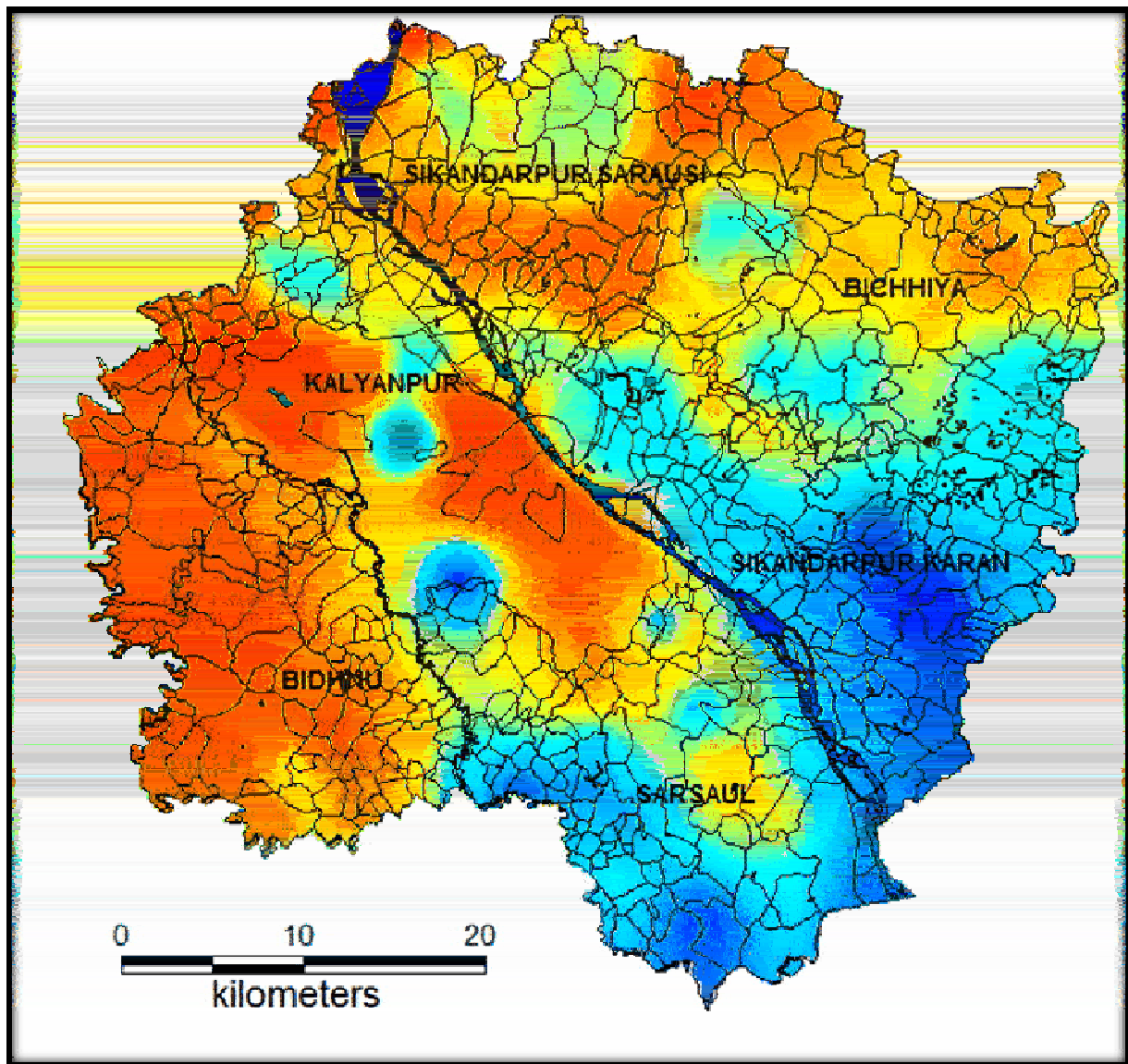
S. No.	Latitute	Longitute	Location Details
1.	26.416	80.301	C S Inter College, Jarauli
2.	26.418	80.292	S G Inter College, Jagraul
3.	26.445	80.289	S G Inter College, Jagraul
4.	26.462	80.312	Police Station Fazalganj
5.	26.397	80.324	Awas Vikas Sector 4&7, Hanspuram
6.	26.406	80.359	P D Inter College, Gopal Nagar
7.	26.440	80.342	Police Station Babupurwa
8.	26.462	80.377	EE Office Campus, IRR I Div-2, Cant.
9.	26.428	80.353	Dr. V. S. Education Centre, Shyam Nagar
10.	26.396	80.345	Govt. Primary School Gaganpur Naveen
11.	26.391	80.408	Bhartiya Vidya Mandir, Ahirwan
12.	26.384	80.379	H N Inter College, Harjindernagar
13.	26.424	80.398	Saraswati Inter College, Defence Colony
14.	26.374	80.413	Hatha Gajraj Singh Chakeri
15.	26.390	80.439	M L Junior High School, Allaulabad
16.	26.379	80.458	SJH School, Khalar
17.	26.362	80.408	B S Primary School, Tikra Paigambarpur
18.		80.311	Chitra Degree College, Hamirpur Road
19.	26.457	80.393	N N Int. College, Heeraman
20.	26.458	80.375	N N M Inter College, Civil Lines
21.	26.453	80.411	A N D Degree College, Harsh Nagar
22.	26.423	80.377	G N Inter College, Lajpat Nagar
23.	26.431	80.356	K D V Inter College, Kidwai Nagar
24.	26.325	80.469	Khojapur
25.	26.278	80.313	Palhapur
26.	26.285	80.371	Sarsaul
27.	26.300	80.411	Behta Sankat
28.	26.313	80.258	Bidhnu
29.	26.318	80.319	Majhawan
30.	26.342	80.283	Ramaipur
31.	26.322	80.269	Bidhanu
32.	26.342	80.254	Jamu
33.	26.360	80.344	Kathogar
34.	26.347	80.378	Kuihar
35.	26.400	80.339	Pipuri
36.	26.343	80.263	Ramaipur
37.	26.498	80.260	Awas Vikas Sector-17, Kalyanpur
38.	26.490	80.308	C S A Agriculture University

S. No.	Latitute	Longitute	Location Details
39.	26.484	80.276	Dalhan Anusandhan, Kalyanpur
40.	26.416	80.306	HBTI Kanpur
41.	26.462	80.306	Heart Institute, Rawatpur
42.	26.499	80.292	J S D Vidyalaya, Deendayal Nagar
43.	26.490	80.344	National Leather Institute, Suterganj
44.	26.462	80.305	UPSIDC, Udyagnagar Rawatpur
45.	26.444	80.330	Forest Department, Kidwainagar
46.	26.436	80.275	T V P Intercollege, Gujaini
47.	26.459	80.345	Chacha Nehru, Bansmandi
48.	26.414	80.372	37 P A C Campus, Shyam Nagar
49.	26.384	80.379	G W Hanuman Mandir, Sanigawan
50.	26.344	80.407	B D D Sewa Asharam, Pali Road
51.	26.384	80.311	Primary School Hanspur Paharpur
52.	26.286	80.361	Sawaiipur
53.	26.288	80.403	Akbarpur Jhabua
54.	26.497	80.317	Kalyanpur
55.	26.497	80.317	Kalyanpur
56.	26.492	80.308	Rooppur

Variation in Ground Water Level in First Aquifer Group (All values are in mbgl)



Variation in Water Table Elevation (Relative Variation in water Table Elevation)



Hydrochemistry:

Around 208 sample were collected from the study area to establish requirement of monitoring in term of spatial and temporal variation the in the water quality. Samples were collected for detailed analysis, heavy metal analysis and iron and Arsenic.

For each observation point three samples were collected each sample was collected in 1 liter bottle except for Iron and Arsenic for which 125 ml water was collected.:-

- a) Detailed analysis:.
- b) Heavy metal
- c) Arsenic and Iron

Details of the List of the Sample Collected (125 ml) for Arsenic and Iron analysis from the area

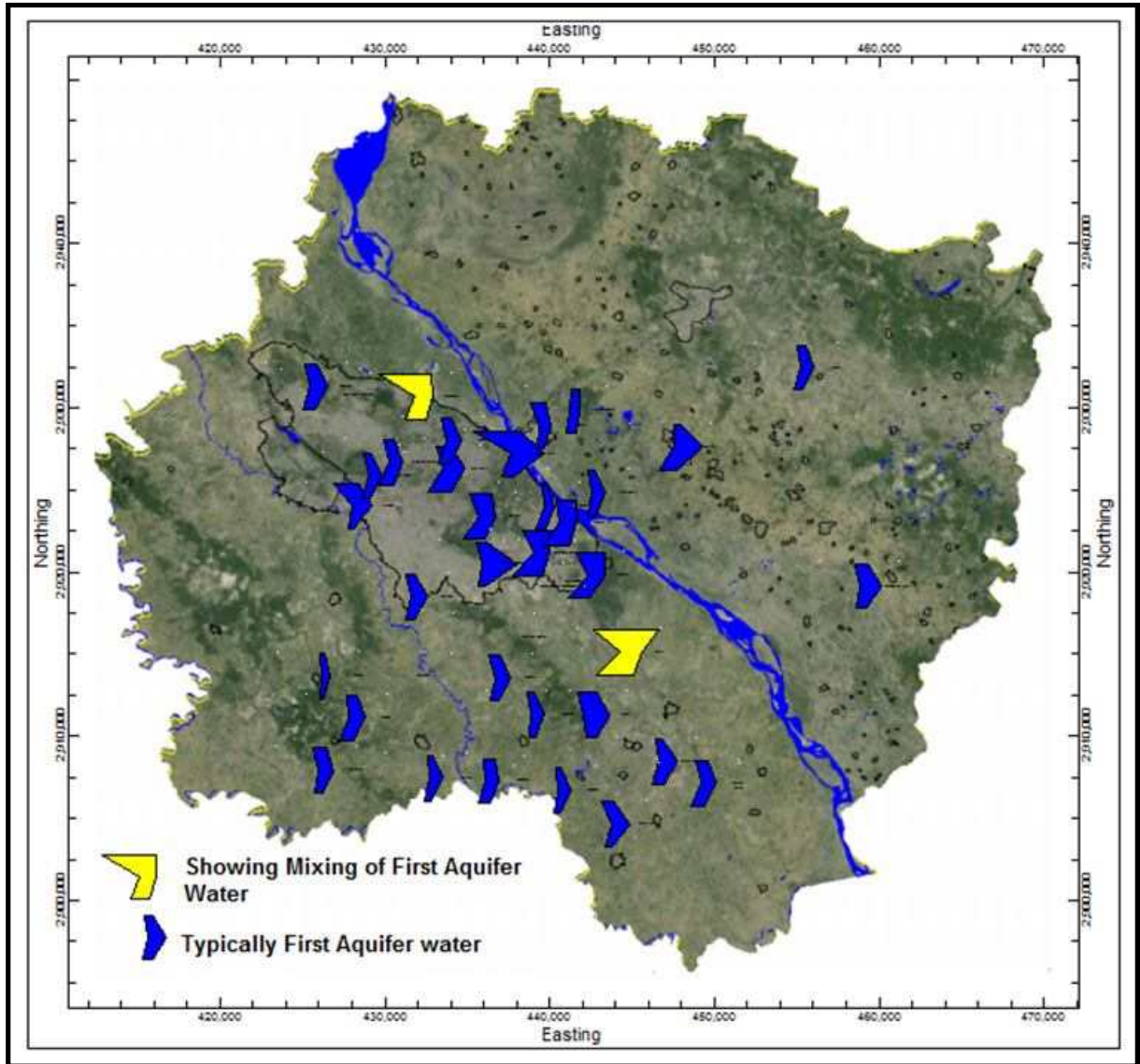
Sample No.	Location Name	Source	Detailed Location
KNP-1 T	Patel Nagar	H/P	Under the Flyover on Allahabad Road.
KNP-2 T	Maharajpur	H/P	Under the Fly Over just on the Chauraha.
KNP-3 T	Sarsaul	H/P	Located in front of BDO Office.
KNP-4 T	Hathigaon	H/P	Opposite Adarsh Jan – Kalyan Public School.
KNP-5 T	Sarsaul Rly. Station	H/P	Near Raly. Station on the tri junction of Rd. going to Hanthigaon.
KNP-6 T	Bausar	H/P	On the RHS of the road from Sarsaul R. s to Nasara.
KNP-7 T	Semar Jhal	H/P	Opposite Primary School where pz of GWC is located.
KNP-8 T	Palhepur	H/P	Located in front of Dr. A. N. Chaturvedi's Clinic on Sarh Rd.
KNP-9 T	Kwagjipur	H/P	Located 100 m from the primary School Kwagjipur on rd to Kwagjipur village on the RHS.
KNP-10 T	Pali Kalan	H/P	RHS of the Rd to Sawaizpur
KNP-11 T	Sawaizpur	H/P	Located in front of the temple at the entry of the Village.
KNP-12 T	Timron	H/P	Located in front of house of Sri Ram bharose.
KNP-13 T	Kudagaon	H/P	Located ob Pali Chakeri Rd. on turn.
KNP-14 T	Tajpur	H/P	Located in the village in front of house of Sri Ghasete s/o/ Late Rajaram on Pali and Garhi Road.
KNP-15 T	Tilsahri	H/P	Located on the chakeri Rd. on curve / turning of Road in front of neem tree.

Sample No.	Location Name	Source	Detailed Location
KNP-16 T	Salempur	H/P	Located in front of house of Waqeel Babu or Chuttu Babu.
KNP-17 T	Ruma	H/P	Located under the flyover from sarsaul to Kanpur in front of Atta Chakki and Hatri Om General Store.
KNP-18 T	Chakeri Mod	H/P	Located under the flyover from Allahabda to Kanpur Road in front of Ratan ITI.
KNP-19 T	Maweya	H/P	In the village on nthe turning and road bifurcation Kharanja near small Shop.
KNP-20 T	Naubasta	H/P	Located 50 m from transformer opposite SBI, Naubasta Branch. On LHS of the Road from Kanpur to Hamirpur.
KNP-21 T	Binarwan	H/P	Located in front Near Bajrang Bhojanalaya and Hanuman Temple near Pan Shop.
KNP-22 T	Nagwan	H/P	On RHS of the Road to Village from Kanpur to Hamirpur.
KNP-23 T	Ramaipur	H/P	Near Ramaipur chauraha in front of Vimal Telecom and Shree Radhe Uniform Shop.
KNP-24 T	Sen Paschimpura	H/P	Located at the entrance of the village from Ramaipur on RHS in front of ACC Cement Store
KNP-25 T	Jamon	H/P	Located in front of Parihar Khad bhandar and small grocesory Shop.
KNP-26 T	Bidhanu	H/P	Located at the entrance of the gate for Acharya Kautilya Inter college, Bidhanu. LHS of the Road from Kanpur.
KNP-27 T	Katharua	H/P	Located on the LHS of Rd from Kanpur to Ghatampur in front of Shivam ACC Cement store.
KNP-28 T	Majgaon	H/P	Located on the LHS of the road in front of small temple at the RHS. Maszid at 100 from the H/P.
KNP-29 T	Hardauli	H/P	Located on the LHS 190 m from the road. In front of Rajesh Pali's shop just at the entrance of the village.
KNP-30 T	Pipargaon	H/P	Located on the Pipargaon Chauraha on LHS of Rd. coming from Majhgawan.
KNP-31 T	Baghara	H/P	Located in the Primary School of the Village.
KNP-32 T	Jhar Kalan	H/P	Located in the house of Sri Kanhaiya Lal S/O Gaindalal.
KNP-33 T	Ghurwan Khera	H/P	Located in the house of Sri Jiyala a small Gumti

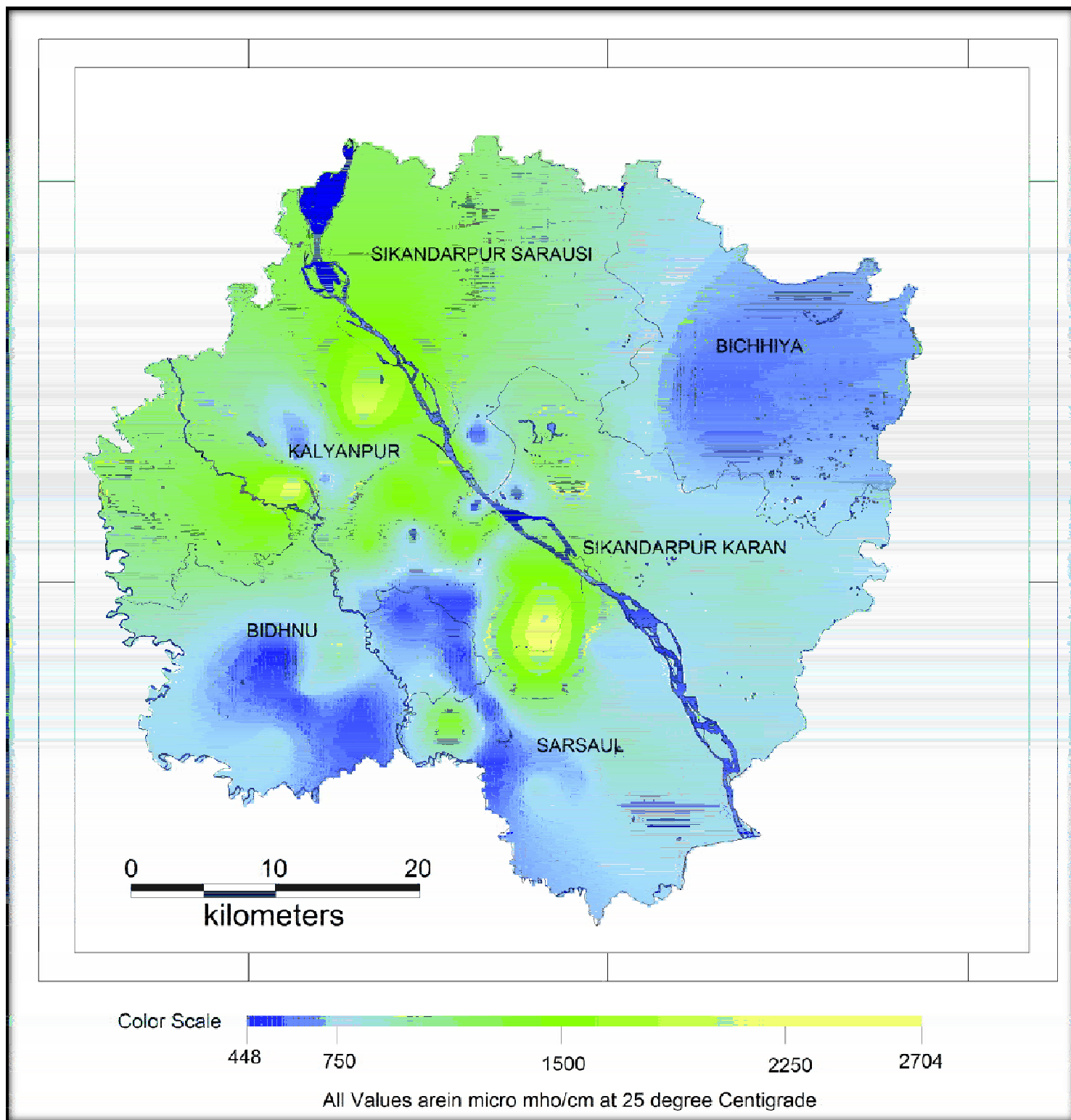
Sample No.	Location Name	Source	Detailed Location
			Owner in the Village.
KNP-34 T	Sajari	H/P	Located on the RHS on the Tiraha at the entrance of the village in front of Soni Lal's Shop.
KNP-35 T	Daheli Sujapur Sanigawan Road	H/P	Located on LHS of Rd. Sanigawan to NH. In front of ACC Cement Store named Pandey Traders.
KNP-36 T	Mangala Vihar- Ph-II	H/P	Located in front of Sarkari Galle ki Dukan. H. N. 172, Mangala Vihar Phase-II.
KNP-37 T	Shayam Nagar Chowki	H/P	Located on LHS in front of Balaji Hanuman Mandir under Fluover, Shayam Nagar chowk.
KNP-38 T	Nihura	H/P	Located at the entrance of the village.
KNP-39 T	Sujatganj	H/P	Located on RHS of the Road from Nihura near Power supply station in the compound.
KNP-40 T	DMSRDE, MES (Kakori Gaon)	H/P	Located on the LHS of the rd to Ramdevi. In front of Maa Durga Temple on Baradevi Road. Baradevi 3 km.
KNP-41 T	Ramadevi Chauraha	H/P	100 m from Ramadevi Chauraha on road to Kanpur 50 m from Barat Petrol Pump.
KNP-42 T	Gumti No. 5	H/P	Located out side the Bhai Banno Sahib Gurdwara in Gumti No. 5. Opposite Pariwar Lodge.
KNP-43 T	Afim Kothi	H/P	Located in front of Furniture Hub 87/155 G. T. Road.
KNP-44 T	Bakarganj Chauraha	H/P	Located at the Chauraha.
KNP-45 T	Gujheni	H/P	Located on turn from main road to Gujheni.
KNP-46 T	Nauraiya Khera	H/P	Located opposite Dainik Jagran Office. Near Gur Nanak road lines.
KNP-47 T	Dada Nagar	H/P	Located opposite Allahabad Bank Dada Nagar Branch
KNP-48 T	Armapur Estate	H/P	Located in front of Arms Factory Karmchari Sangh office in a residential building.
KNP-49 T	Gadarian Purwa	H/P	Located on Kalpi road from Fazalganj in front of Shani Dev Temple.
KNP-50 T	Rawatpur	H/P	Near Chauraha Sai Baba Mandir
KNP-51 T	Awass Vikas, Kalyanpur	H/P	Located opposite office of U. P. Awass Vikas Parishad, Kanpur in Kalyanpur.
KNP-52 T	Lakhanpur	H/P	Opposite Level Crossing 11B/ 2E. 50 from the crossing on the other side of the road.

Sample No.	Location Name	Source	Detailed Location
KNP-53 T	Nawabganj	H/P	Located outside Punjab National Bank Azad Nagar Branch.
KNP-54 T	Civil Lines	H/P	Located outside Batra Agarwal Associates 15/79(2) Civil Lines.
KNP-55 T	Ganga Ghat	H/P	Located 150 m before Ganga Bridge in Juggi Jhopri's.
KNP-56 T	Bhajja Purwa	H/P	Located in the village on Road from Circuit House to Jajmau in Cantt area.
KNP-57 T	Jajmau	H/P	Located below the Fly over under construction at the turning of the road for Jajmau area from NH.
KNP-58 T	Tiwaripur Tarbadia	H/P	Located at the tri Junction in the village.
KNP-59 T	Purwa Chabila	H/P	Located 100 m from turning & road cut to Chabile Purwa.
KNP-60 T	Jaipuria Rly. Crossing	H/P	Near SBI training Institute in Kanpur Cant.
KNP-61 T	Bajaria	H/P	Near Bajaria Thana at Tiraha, in front of Md. Gulshan's Mitti Tel ki Dukan.
KNP-62 T	Shuklaganj	H/P	Located at the gate of Daya shankar Memorial School on Unnao Kanpur Road.
KNP-63 T	Gazia Khera	H/P	Located on the Village Churaha Public Handpump.
KNP-64 T	Poni	H/P	Located in Purwa Madhaymik Vidhyalaya of the Village.
KNP-65 T	Banthal	H/P	Located in front of Thakurji Kisan Sewa Kendra on Rd. from Lko- Kanpur Highway to Achalganj on the entrance of the village.
KNP-66 T	Badarkha Harbaspur	H/P	Located on the village Chauraha opposite Dileep trunk and Furniture.
KNP-67 T	Turkiha Badarkha-1	H/P	Located in front of Riyasat S/O Sri Barkat Ali.
KNP-68 T	Turkiha Badarkha-2	H/P	Located 100 m from KNP-67 Location.

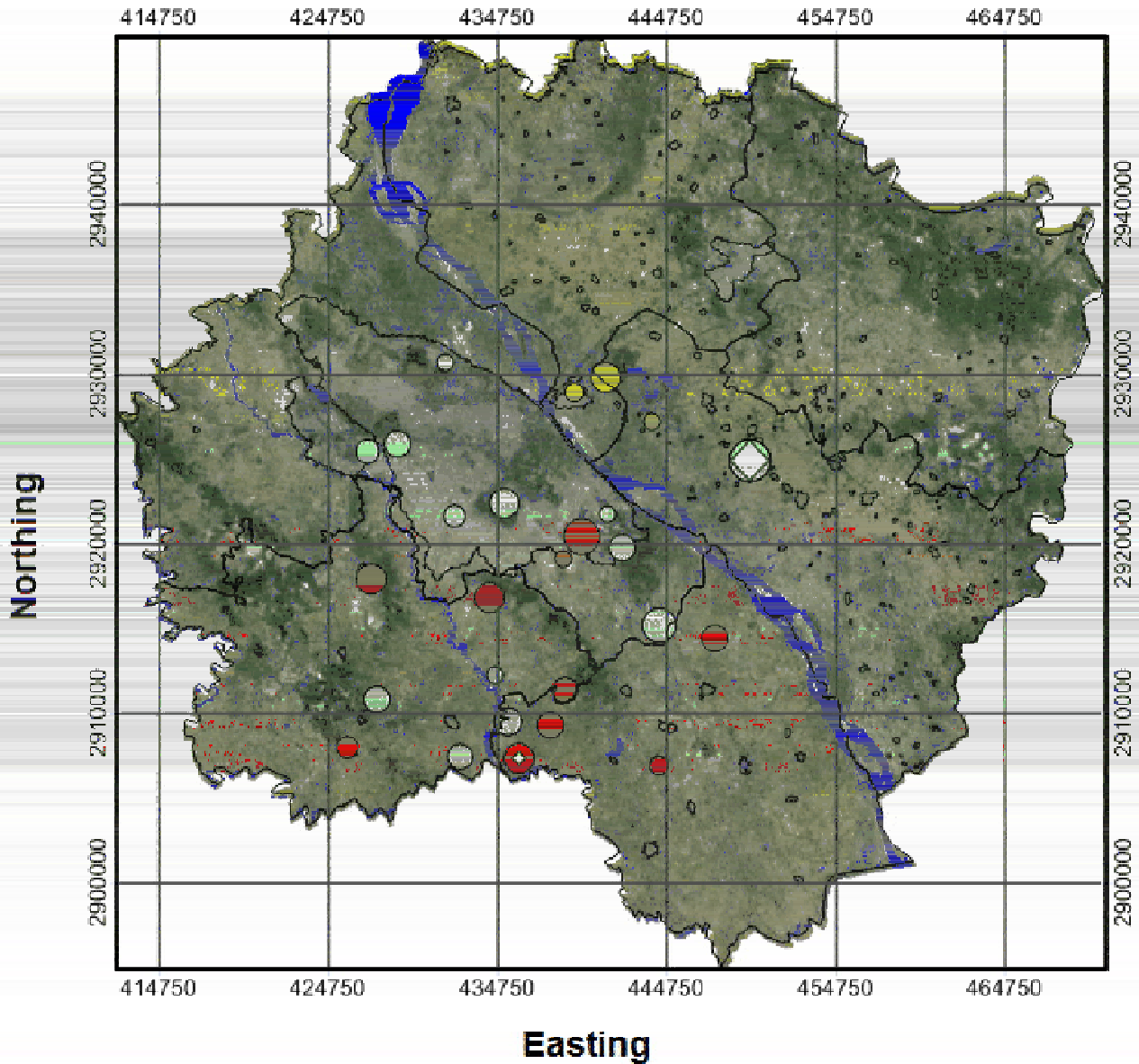
Stiff's Diagram to show Variation in Type of Water



Variation in Salinity in First Aquifer Group (All Values are in micro-mho/cm at 25⁰ C)



Heavy Metal Concentration (above Permissible Limits)



Legend

Size are in proportion to Values

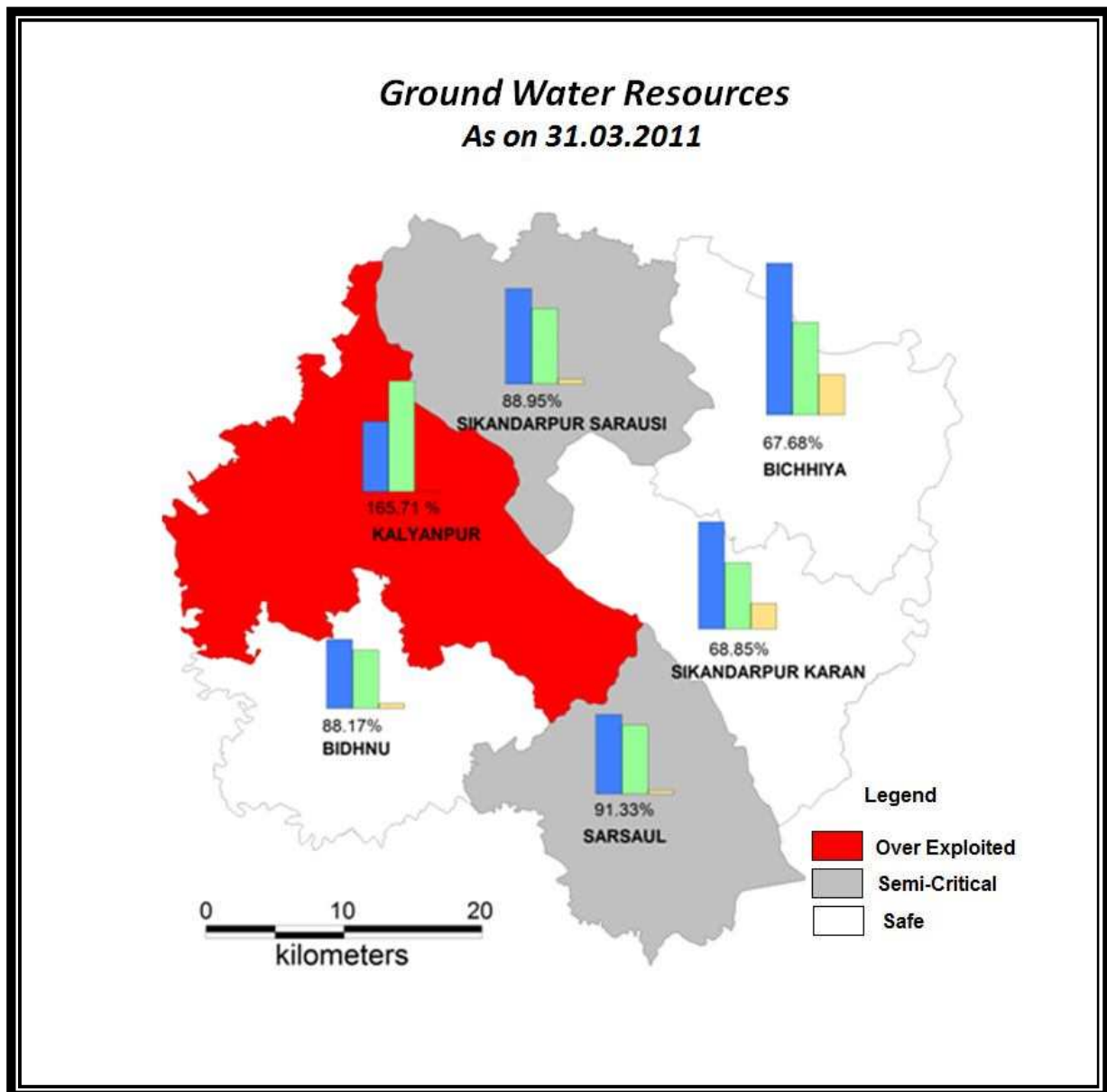
Range of Data

	Chromium	(66 - 108)		Manganese	(398 - 1144)
	Lead	(52 - 144)		Iron	(305 - 1801)

Resources

Ground Water Resources Estimates has been done by CGWB and State ground water department of UP for 2011. Resources estimated are for dynamic zone or water level fluctuation zone. On the basis of estimates Kalyanpur block (164.70%) of Kanpur is only block with Over-Exploited Category in Kanpur Nagar, Sarsol is in Semi-critical and Bidhanoo is in safe category. Kalyanpur block of Kanpur Nagar owes its high stage of ground water development because of rampant urbanisation in the area due to growing population pressure. Increasing population pressure has also affected Sarsol and is responsible for its semi-critical category.

Among the three blocks of the Unnao district only Sikanderpur Sirosi is semi-critical and rest other blocks are in safe category.



However in present study an attempt has also been made to calculate the total storage of water in different aquifer groups. Total volume of aquifer group and water level along with specific yield has been taken as function of volume of water available in different aquifer groups. Details thus obtained has been shown in the table below;

Storage:

Water Storage

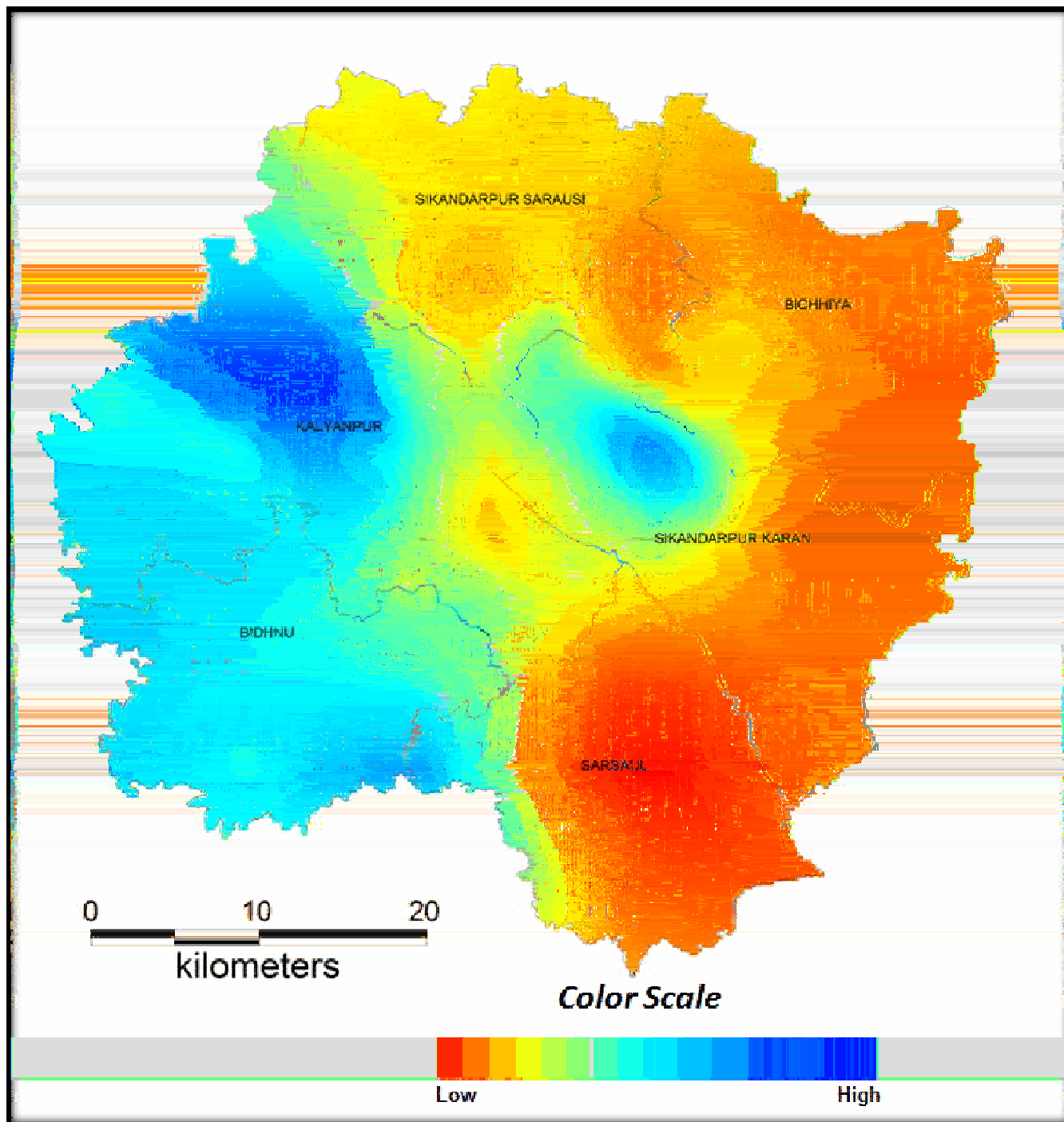
Block Name	Area	Volume First Aquifer Grp. (MCM)	Volume Piezometric (MCM)	Second Aquifer Grp.	Total Second (MCM)	Total Third (MCM)	Total (MCM)
SIKANDARPUR SARAUSI	331	945	2.53	327	330	418	1693
BICHHIYA	326	791	0.71	443	444	303	1538
SIKANDARPUR KARAN	333	912	0.96	450	451	487	1850
KALYANPUR	484	1878	2.07	682	684	1183	3745
BIDHNU	279	1086	1.09	417	418	727	2231
SARSAUL	295	668	0.56	317	318	590	1576

Water storage in first aquifer groups has been calculated using the precepts of basic calculation of ground water in storage as mentioned above. However for the second aquifer group for the purpose of calculation of storage water two components were calculated separately. One component deals with the water available in the aquifer group due to pressure head and other which deals with availability of water due to specific yield of the aquifer material. Total of these two has been taken as total storage in confined aquifer groups. Storage potential of different aquifer groups has been shown on the map separately for different aquifer groups.

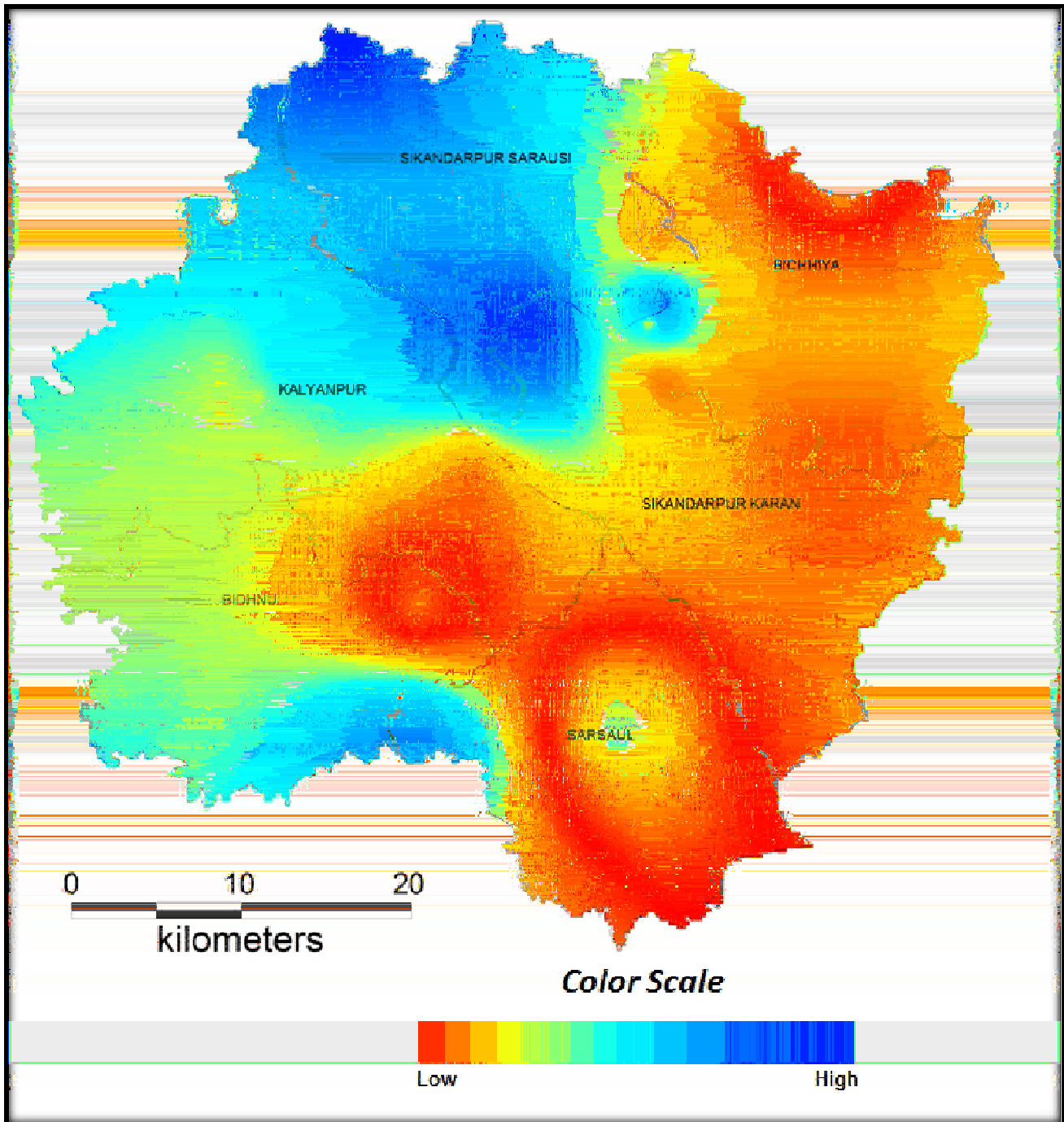
Storage potential of the aquifer groups when compared with the dynamic ground water resources show some contradictions and interesting facts of the ground water potential of the area.

Interestingly with less ground water resources has more ground water storage in comparison to areas with more ground water dynamic resources. Areas with

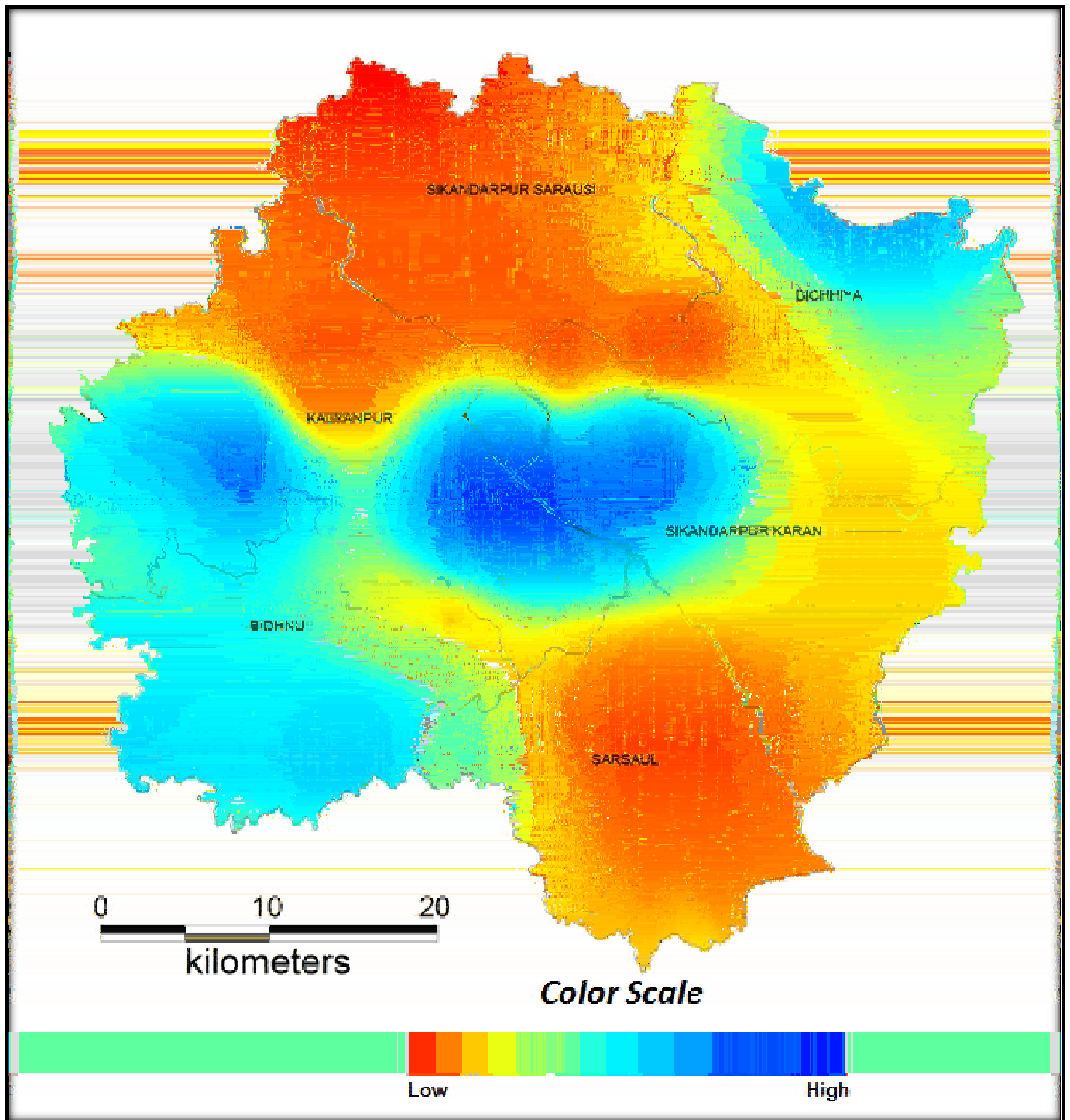
Relative Variation in Ground Water Storage in First Aquifer Group



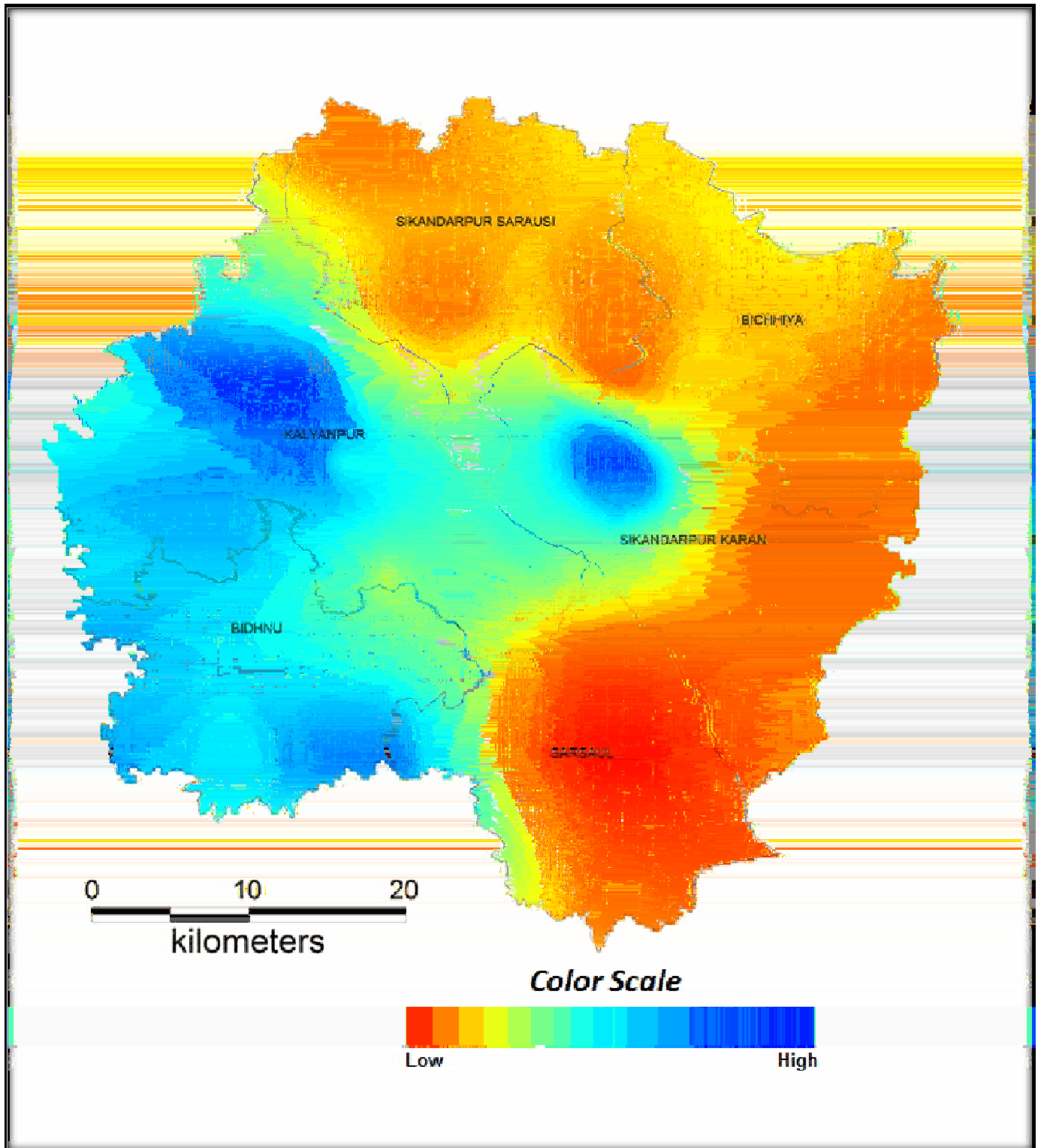
Relative Variation in Ground Water Storage Due to Piezometric Head



Relative Variation in Ground Water Storage Second Aquifer Group



Relative Variation in Cumulative Ground Water Storage (Total Depth Upto 300m)



General Management Plan for Study Area

Management Plan of an area is plan of the strategies to be adopted in the area for efficient use of the resources in such a way the practices/ methods are make resources sustainable as well as economically viable in long term. Study area being situated in the most fertile and productive part of the Ganga basin in term of ground water.

Dynamic ground water resource estimated by Central ground water board and State ground Water Department of UP (as on 31.03.2011) shows out of six blocks in study area, only Kalyanpur Block of Kanpur Nagar is Over-Exploited, Sarsol block of Kanpur Nagar and Sikanderpur Sirosi block of Unnao district has been categorised semi-Critical and rest are safe.

Kalyanpur block being the most urbanised block of the study area show high level of development because of pressure to sustain large urban population. Draft of ground water is mainly for the purpose of drinking and Industries. However, most of the state run tubewells in the block are tapping third aquifer. But local submersible and mechanised pumping is still main cause of its category as over-Exploited.

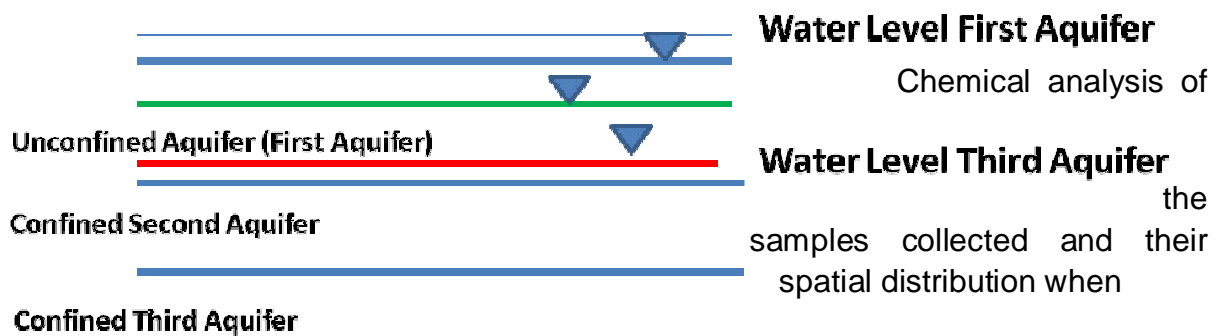
Same is true for Sarsol block of Kanpur Nagar, where pressure of urban population is also high due to rapid peripheral growth of urbanisation in the area. Sikanderpur Sirosi owes it semi-critical stage of ground water development to subsurface hydrogeology, lithologically most of the surface and subsurface formations are fine grained which do not allow percolation of water for accounted recharge.

In totality, major issues observed in study area are depleting water resources and salinity of the second aquifer. This combined with occurrence of fluoride in Unnao is one of the issues to be handled with management practise advised for the area.

Water Level Management and their Impact on Aquifer System

Managing water level in the area

It is one of the established precepts of the hydrogeology that, if water level in the second aquifer is higher than the water level in the first aquifer, second aquifer will start contributing to ground water in the first aquifer. Similarly, if the water level in the third aquifer is less than the water level of the second aquifer, second will start contributing to second aquifer. Occurrence of the second saline aquifer in the area has posed threat to first and third aquifer groups which has been reported to be fresh in comparison to second aquifer group.



plotted clearly indicate wherever water level in the shallow aquifer are deeper and water levels or piezometric head of the second aquifers are higher salinity in the first aquifer has also encountered. In order to avoid any contamination of fresh first aquifer group it becomes imperative to maintain water level of the second aquifer and first aquifer in coherence so that second saline aquifer group does not contaminate first aquifer group. For this purpose water abstraction from the first aquifer has to be reduced and also abstraction from the second aquifer group should be made to the extent water level of second aquifer remains below water level of first aquifer.

Water in second aquifer group is of inferior quality, in order to use this it should be used by blending with fresh water of the either fresh water of first aquifer group of third aquifer group.

Blending can be seen as possibility of solutions to many problem of the area, including reduced water availability in canal to be supplied in command area or availability of water in tail end of the canal command area. There is possibility of two methods which can enhance water resources of the area.

- 1) By taking some amount of water from canal and adding equal amount of saline water into the canal, this way by blending canal water will increase so it can be distributed in far end area of the canal command.
- 2) By adding saline water in canal water in a control manner to the extent it does not reach beyond the permissible limit for agricultural uses.

Limited and controlled quantity of Saline Water is put in canal to enhance supply in canal so water can reach upto tail ends. Will just cause blending without affecting EC of water beyond usable limit. (This will enhance Water Resources of other area, where water will be supplied

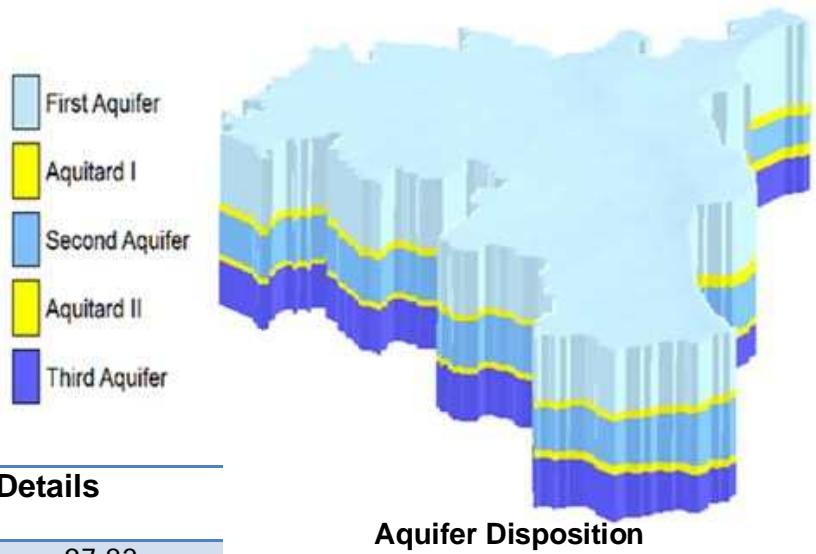
Limited and controlled quantity of Saline Water is mixed in canal and equal amount of water is taken out from canal to blend and use in field, hence increasing the water resources of the area.

Blockwise Hydrological Details of Aquifer Group

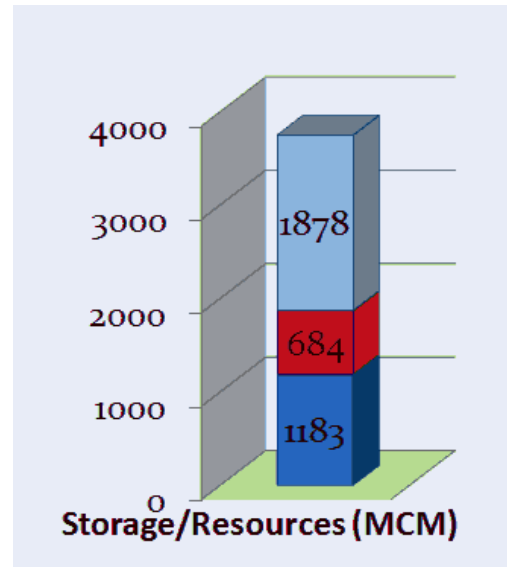
B_NAME	SIKANDARPUR SARAUSI	BICHHIYA	SIKANDARPUR KARAN	KALYANPUR	BIDHNU	SARSAUL
Aq I Thickness (Min.)	82.87	67.46	88.11	97.82	103.25	94.06
Aq I Thickness Max	157.52	154.17	159.03	150.76	139.29	139.91
Aq I Thickness Mean	130.74	112.81	109.27	122.11	126.66	106.39
Aq I Thickness Range	74.65	86.71	70.92	52.94	36.04	45.85
Aq II Thickness Min	42.10	75.53	62.03	41.32	62.62	61.08
Aq II Thickness Max_Value	127.86	126.81	139.64	112.35	89.42	111.00
Aq II Thickness Mean	72.54	120.80	106.47	67.88	73.13	71.66
Aq II Thickness Range	85.77	51.28	77.61	71.03	26.80	49.92
Water_level Min	0.90	1.57	0.42	0.50	3.30	0.21
Water_level Max	9.75	11.19	12.97	28.56	22.25	20.22
Water_level Mean	3.74	5.89	5.41	8.81	6.78	8.95
Water_level_Range	9.84	9.62	12.75	28.62	18.95	20.01
EC Min	543.60	584.26	640.68	519.19	448.24	519.47
EC1 Max	1706.56	979.01	1278.20	2704.27	1564.17	2306.49
EC1 Mean	1126.57	705.53	874.67	1201.26	756.67	861.17
EC1 Range	1162.96	394.76	637.52	2185.08	1115.93	1787.02

Block Wise Aquifer Details and Management Plan

Kalyanpur Block, District Kanpur Nagar



Parameters	Details
Aq I Thickness (Min.)	97.82
Aq I Thickness Max	150.76
Aq I Thickness Mean	122.11
Aq I Thickness Range	52.94
Aq II Thickness Min	41.32
Aq II Thickness Max_Value	112.35
Aq II Thickness Mean	67.88
Aq II Thickness Range	71.03
Water_level Min	0.50
Water_level Max	28.56
Water_level Mean	8.81
Water_level_Range	28.62
EC Min	519.19
EC1 Max	2704.27
EC1 Mean	1201.26
EC1 Range	2185.08



Issues

- Declining Water Level in Urban Parts of the City.*
- Salinity in the Second Aquifer. Withdrawal from the Third Aquifer.*

Management Plan

- Drinking Water Supply can be from surface water.*
- Blending with second aquifer water is proposed for Irrigation.*
- Effective management of water losses during conveyance a must.*
- Industries may be allowed and encouraged to withdraw saline water from second aquifer group.*

Aquifer Group Information

Aquifer Group	WL (mbgl)	Mean WL	EC	Thickness (m)
First	0.50 – 28.56	8.81	519 - 2704	97 - 150
Second	15 - 20		Approx 2500	41 - 112

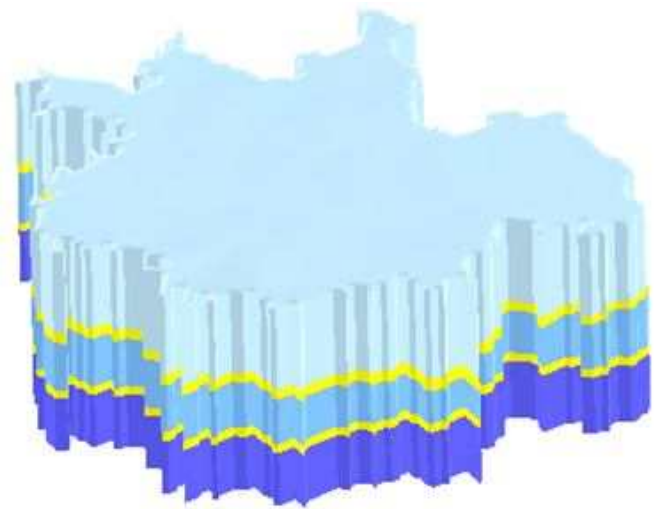
Ground Water Resources of Block

2013 (Dynamic)	First Aq. (MCM)	Second Aquifer(MCM)	Third Aquifer (MCM)	Total
87.89	1878	684	1183	3745

Resources Enhancement from Water Use Efficiency

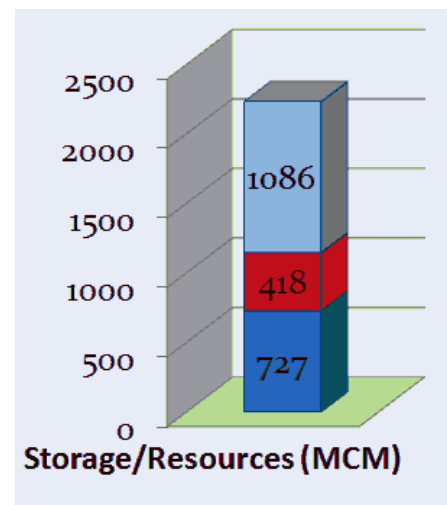
GW DEVELOPMENT BEFORE WUE					GW DEVELOPMENT AFTER WUE		
Net GW Availability	Draft Irrigation	Draft Domestic	Draft Total	Stage of GW	Draft Irrigation	Draft Total	Stage of GW
87.89	5575.10	444.90	6020.00	68.49	5017.59	5462.49	62.15

Bidhnoo Block, District Kanpur Nagar



Aquifer Disposition

Parameters	Details
Aq I Thickness (Min.)	103.25
Aq I Thickness Max	139.29
Aq I Thickness Mean	126.66
Aq I Thickness Range	36.04
Aq II Thickness Min	62.62
Aq II Thickness Max_Value	89.42
Aq II Thickness Mean	73.13
Aq II Thickness Range	26.80
Water_level Min	3.30
Water_level Max	22.25
Water_level Mean	6.78
Water_level_Range	18.95
EC Min	448.24
EC1 Max	1564.17
EC1 Mean	756.67
EC1 Range	1115.93



Issues

- Salinity in the Second Aquifer.*
- At places Fluoride and iron has been reported locally.*

Management Plan

- No intervention is required.*
- Second aquifer may be used for irrigation along with first by blending to keep a balance of quality and quantity.*

Aquifer Group Information

Aquifer Group	WL (mbgl)	Mean WL	EC	Thickness (m)
First	3.30 – 22.25	6.78	448 - 1564	103 - 139
Second	10 -15	15 - 20	2500	62 - 89

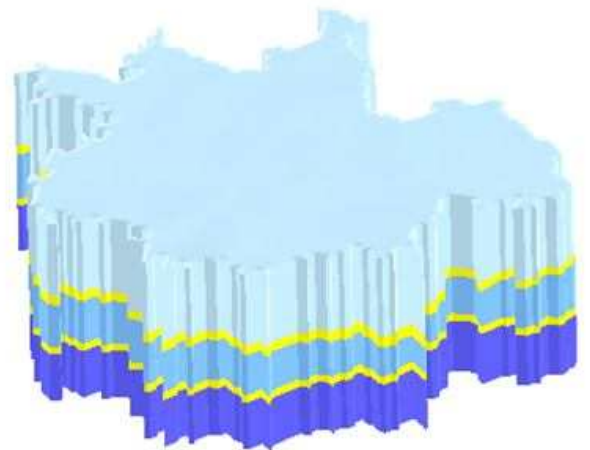
Ground Water Resources of Block

2013 (Dynamic)	First Aq. (MCM)	Second Aquifer(MCM)	Third Aquifer (MCM)	Total
87.89	1878	684	1183	3745

Resources Enhancement from Water Use Efficiency

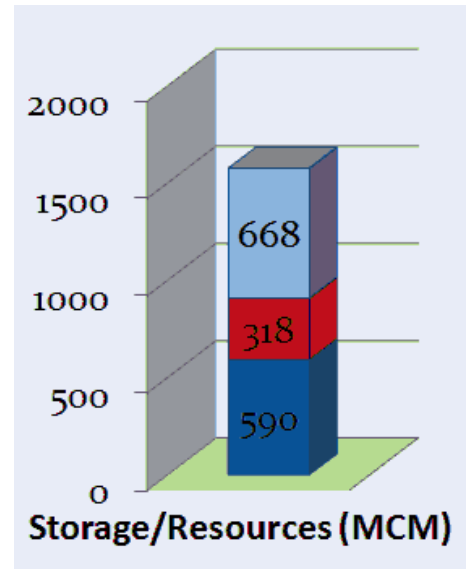
GW DEVELOPMENT BEFORE WUE					GW DEVELOPMENT AFTER WUE		
Net GW Availability	Draft Irrigation	Draft Domestic	Draft Total	Stage of GW	Draft Irrigation	Draft Total	Stage of GW
87.89	5575.10	444.90	6020.00	68.49	5017.59	5462.49	62.15

Sarsol Block, District Kanpur Nagar



Aquifer Disposition

Parameters	Details
Aq I Thickness (Min.)	94.06
Aq I Thickness Max	139.91
Aq I Thickness Mean	106.39
Aq I Thickness Range	45.85
Aq II Thickness Min	61.08
Aq II Thickness Max_Value	111.00
Aq II Thickness Mean	71.66
Aq II Thickness Range	49.92
Water_level Min	0.21
Water_level Max	20.22
Water_level Mean	8.95
Water_level_Range	20.01
EC Min	519.47
EC1 Max	2306.49
EC1 Mean	861.17
EC1 Range	1787.02



Issues

- Salinity in the Second Aquifer.*
- At places Fluoride and iron has been reported locally.*

Management Plan

- No intervention is required.*
- Second aquifer may be used for irrigation along with first by blending to keep a balance of quality and quantity.*

Aquifer Group Information

Aquifer Group	WL (mbgl)	Mean WL	EC	Thickness (m)
First	0.50 – 20.22	8.95	519 - 2300	94 – 139
Second	10 -15	15 - 20	2500	61 - 111

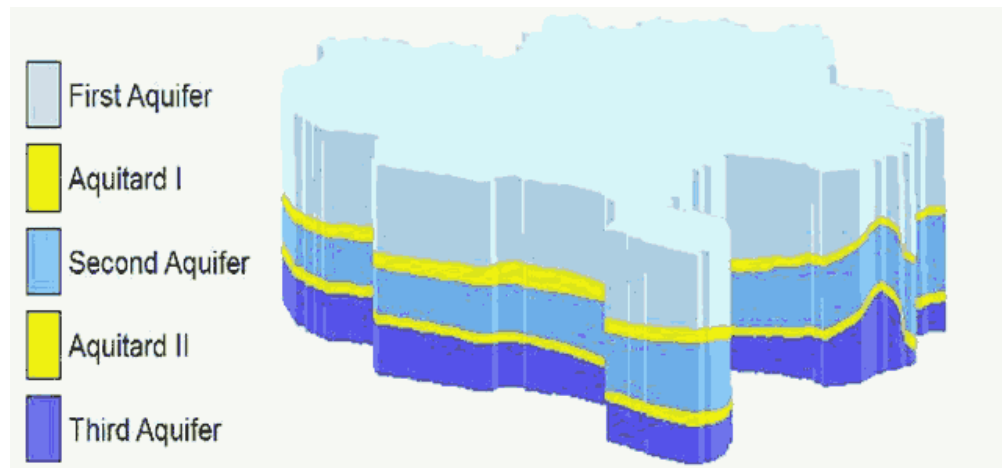
Ground Water Resources of Block

2013 (Dynamic)	First Aq. (MCM)	Second Aquifer(MCM)	Third Aquifer (MCM)	Total
74.81	1878	684	1183	3745

Resources Enhancement from Water Use Efficiency

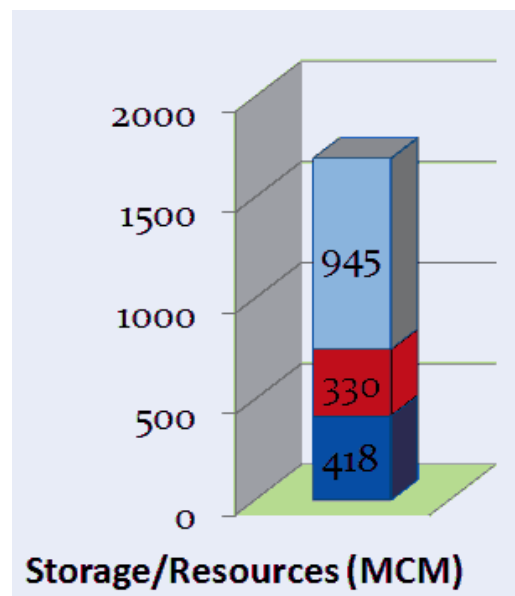
GW DEVELOPMENT BEFORE WUE					GW DEVELOPMENT AFTER WUE		
Net GW Availability	Draft Irrigation	Draft Domestic	Draft Total	Stage of GW	Draft Irrigation	Draft Total	Stage of GW
74.81	6114.20	438.09	6552.29	87.58	5502.78	5940.87	79.41

Sikanderpur Sirosi Block



Aquifer Disposition

Parameters	Details
Aq I Thickness (Min.)	82.87
Aq I Thickness Max	157.52
Aq I Thickness Mean	130.74
Aq I Thickness Range	74.65
Aq II Thickness Min	42.10
Aq II Thickness Max_Value	127.86
Aq II Thickness Mean	72.54
Aq II Thickness Range	85.77
Water_level Min	0.90
Water_level Max	9.75
Water_level Mean	3.74
Water_level_Range	9.84
EC Min	543.60
EC1 Max	1706.56
EC1 Mean	1126.57
EC1 Range	1162.96



Issues

- Salinity in the Second Aquifer.*
- Less productive second aquifer.*
- At places Fluoride and iron has been reported.*

Management Plan

- No immediate need of intervention.*
- However, Industries requiring water can be allowed to use the second aquifer from the area.*

Aquifer Group Information

Aquifer Group	WL (mbgl)	Mean WL	EC	Thickness (m)
First	0.90 – 9.75	3.74	543 - 1760	82 – 157
Second	12 - 18	Approx 15	2500	42 – 127

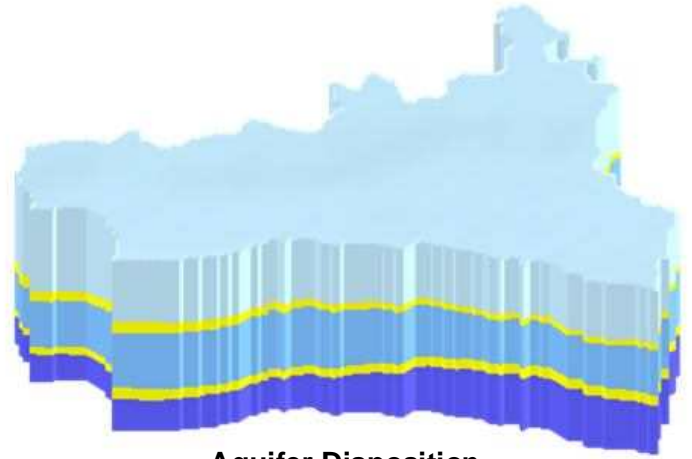
Ground Water Resources of Block

2013 (Dynamic)	First Aq. (MCM)	Second Aquifer(MCM)	Third Aquifer (MCM)	Total
105.34	1878	684	1183	3745

Resources Enhancement from Water Use Efficiency

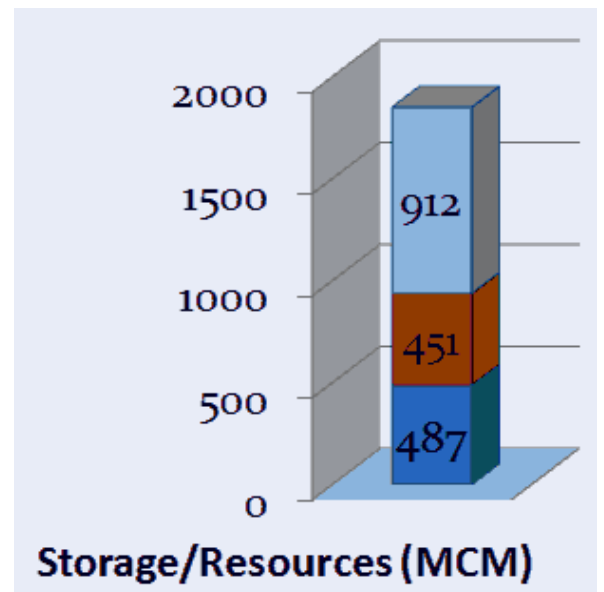
GW DEVELOPMENT BEFORE WUE					GW DEVELOPMENT AFTER WUE		
Net GW Availability	Draft Irrigation	Draft Domestic	Draft Total	Stage of GW	Draft Irrigation	Draft Total	Stage of GW
105.34	7060.95	498.72	7559.67	71.76	6354.86	6853.58	65.06

Sikanderpur Karan



Aquifer Disposition

Parameters	Details
Aq I Thickness (Min.)	88.11
Aq I Thickness Max	159.03
Aq I Thickness Mean	109.27
Aq I Thickness Range	70.92
Aq II Thickness Min	62.03
Aq II Thickness Max_Value	139.64
Aq II Thickness Mean	106.47
Aq II Thickness Range	77.61
Water_level Min	0.42
Water_level Max	12.97
Water_level Mean	5.41
Water_level_Range	12.75
EC Min	640.68
EC1 Max	1278.20
EC1 Mean	874.67
EC1 Range	637.52



Issues

- Salinity in the Second Aquifer.*
- Less productive second aquifer.*
- At places Fluoride has been reported.*

Management Plan

- Drinking Water Supply can be from surface water or third Aquifer which are free from fluoride contamination/ Pollution.*
- No immediate need of area specific intervention.*
- General conservation methods and water use efficiency methods are sufficient, Industry may be allowed to withdraw water from saline aquifer.*

Aquifer Group Information

Aquifer Group	WL (mbgl)	Mean WL	EC	Thickness (m)
First	0.50 – 12.97	5.41	640 - 1278	88 – 159
Second	15 - 20		2500	62 – 139

Ground Water Resources of Block

2013 (Dynamic)	First Aq. (MCM)	Second Aquifer(MCM)	Third Aquifer (MCM)	Total
88.32	1878	684	1183	3745

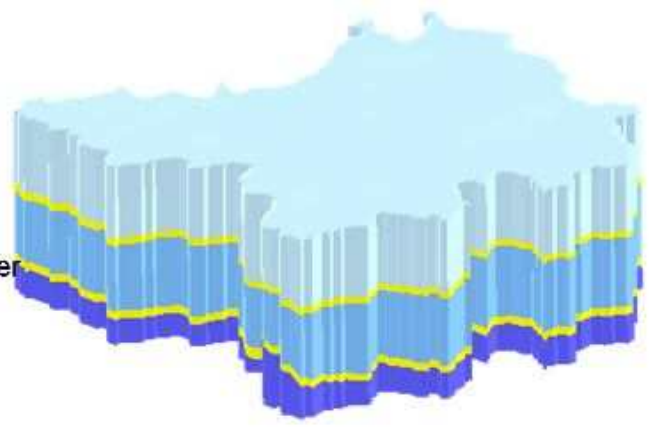
Resources Enhancement from Water Use Efficiency

GW DEVELOPMENT BEFORE WUE					GW DEVELOPMENT AFTER WUE		
Net GW Availability	Draft Irrigation	Draft Domestic	Draft Total	Stage of GW	Draft Irrigation	Draft Total	Stage of GW
88.32	6265.01	552.72	6817.73	77.19	5638.51	6191.23	70.10

Bichiya Block, District Unnao

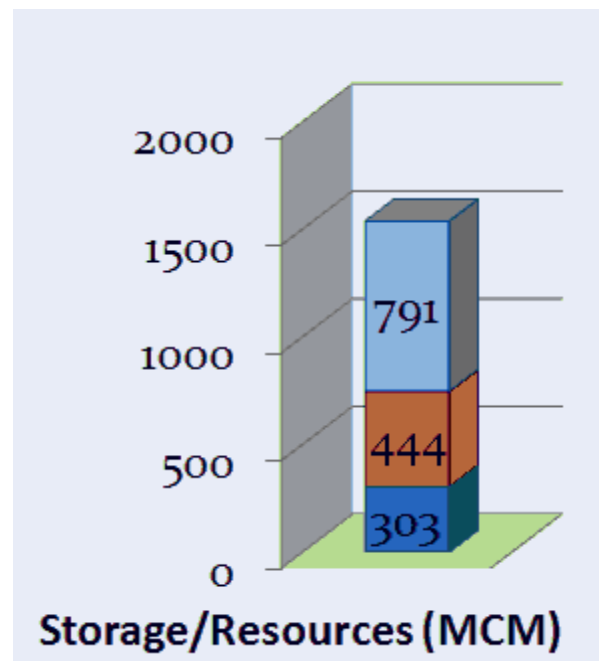
Stratigraphy

- First Aquifer
- Aquitard I
- Second Aquifer
- Aquitard II
- Third Aquifer



Aquifer Disposition

Parameters	Details
Aq I Thickness (Min.)	67.46
Aq I Thickness Max	154.17
Aq I Thickness Mean	112.81
Aq I Thickness Range	86.71
Aq II Thickness Min	75.53
Aq II Thickness Max_Value	126.81
Aq II Thickness Mean	120.80
Aq II Thickness Range	51.28
Water_level Min	1.57
Water_level Max	11.19
Water_level Mean	5.89
Water_level_Range	9.62
EC Min	584.26
EC1 Max	979.01
EC1 Mean	705.53
EC1 Range	394.76



Issues

- Salinity in the Second Aquifer.*
- Less productive second aquifer.*
- At places Fluoride and iron has been reported.*

Management Plan

- No immediate need of intervention.*
- However, Industries requiring water can be allowed to use the second aquifer from the area.*
- Drinking Water Supply can be from surface water or third Aquifer which are free from fluoride contamination/ Pollution.*

Aquifer Group Information

Aquifer Group	WL (mbgl)	Mean WL	EC	Thickness (m)
First	3.30 – 22.25	6.78	448 - 1564	103 - 139
Second	10 -15	15 - 20	2500	62 - 89

Ground Water Resources of Block

2013 (Dynamic)	First Aq. (MCM)	Second Aquifer(MCM)	Third Aquifer (MCM)	Total
154.29	1878	684	1183	3745

Resources Enhancement from Water Use Efficiency

GW DEVELOPMENT BEFORE WUE					GW DEVELOPMENT AFTER WUE		
Net GW Availability	Draft Irrigation	Draft Domestic	Draft Total	Stage of GW	Draft Irrigation	Draft Total	Stage of GW
154.29	8721.73	597.94	9319.67	60.40	7849.56	8447.50	54.75

