

DISTRICT GROUND WATER BROCHURE OF SHAHJAHANPUR DISTRICT, UP

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(AAP 2012-13)

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DISTRICT SHAHJAHANPUR AT A GLANCE

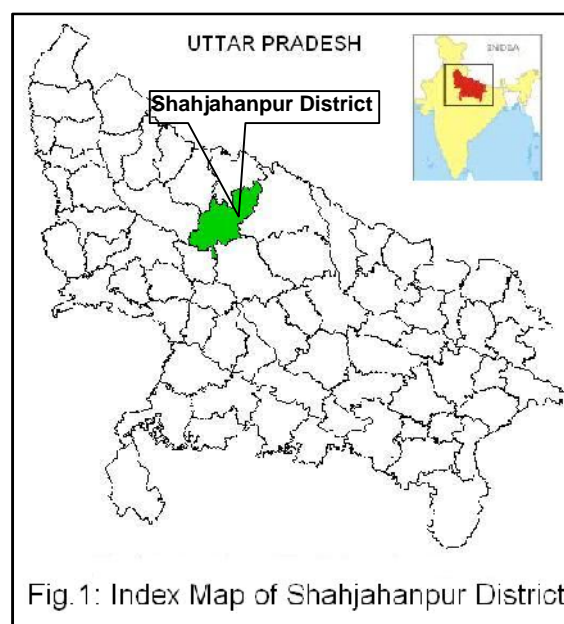
1. GENERAL INFORMATION			
i. Geographical Area (Sq.Km.)	:	4575	
ii. Administrative Divisions			
Number of Tehsil/Block	:	4/ 15	
Number of Panchayat/ Villages	:	124/ 2331	
iii. Population (provisional figures-2011)	:	3002376	
Rural	:	2410968	
Urban	:	591408	
iv. Average Annual Normal Rainfall (1901-70)	:	1046.70mm	
2. GEOMORPHOLOGY	:	Central Ganga Plain (upper Ganga Basin)	
i. Major Physiographic Units	:	Older Flood Plains; Younger Flood Plains (Older or Terrace Flood Plains & Active Flood Plains)	
ii. Major Drainages	:	Ramganga and Gomti and their tributaries; – Garra, Khannaut, Bahgul, Jokhaland; Ganga form the southwestern boundary; Garra divides the district in equal halves	
3. LAND USE			
Area other than Agriculture Use	:	87286 ha	
Net Sown Area (2010-11)	:	350183 ha	
4. MAJOR SOIL TYPES	:	Deep and well drained. Fine silty to loamy in northeastern part; fine to coarse loamy and calcareous in southwest part	
5. AREA UNDER PRINCIPAL CROPS (2010-11)			
2. Wheat	3.	4.	252136 ha
Rice	:	5.	201465 ha
Pulses	:		32658 ha
Oil seeds	:		28877 ha
6. IRRIGATION BY DIFFERENT SOURCES			
(Number of Structures; Area in ha) (Figures for 2010-11)	:		
Dugwells Tubewells/ Borewells	:		451; 312225 ha (Net Irrigated)
Tanks/ponds	:		--
Canals	:		892 km; 9987 ha (Net Irrigated)
Others	:		--
Net Irrigated Area	:		322212 ha
Gross Irrigated Area	:		536968 ha
7. NUMBER OF GROUND WATER MONITORING WELLS OF CGWB (As on 31-3-2013)	:	12	
Dug wells	:	3	
Piezometers	:		
8. PREDOMINANT GEOLOGICAL FORMATIONS			
		a)	Major part (upland areas) covered with Older Alluvium (~600m thickness) deposited over Upper Siwalik
		b)	Younger (Newer) Alluvium occurs in low land tracts along rivers.

- 9. HYDROGEOLOGY**
- Major water bearing formation : 3 Aquifer Groups up to the explored depth of 456m; ground water occurs in fine to medium and coarse sand zones and gravel in these aquifers
- Pre-monsoon Depth to water level during 2011 : 2.60 – 9.17 mbgl
- Post-monsoon Depth to water level during 2011 : 0.82 – 8.95 mbgl
- Long term water level trend (2002-2011)
- a) Pre-monsoon (6 wells analysed) : Fall 0.06 to 0.69 m/yr (5 wells)
Rise 0.06 m/yr (1 well)
- b) Post-monsoon (6 wells analysed) : Fall 0.06 to 0.49 m/yr (4 wells)
Rise 0.04 - 0.10 m/yr (2 wells)
- 10. GROUND WATER EXPLORATION BY CGWB (As on 31-3-2013)**
- a) Normal Programme**
- No of wells drilled (EW/ SH/ Deposit Well) : 11
- Depth range : 240 – 456m
- Discharge (litres per second) (m) : 904 – 2074 (up to 250m)
- Storativity (S) : 10^{-3}
- Transmissivity (m^2/day) : 164 – 2010
- 11. GROUND WATER QUALITY**
- Presence of Chemical constituents more than permissible limit (e.g. EC, F, As, Fe) : Quality fresh; Fluoride and Nitrate within permissible limits
- 12. DYNAMIC GROUND WATER RESOURCES (2009)**
- Annual Replenishible Ground Water Resources : 148634.50 ham
- Net Annual Ground Water Draft : 111883.26 ham
- Projected Demand for Domestic & Industrial Uses upto 2025 : 13418.71 ham
- Stage of Ground Water Development : 75.27%
- 13. AWARENESS AND TRAINING ACTIVITY** : No Mass Awareness and Water Management Training Programme organized by CGWB in Shahjahanpur district
- 14. EFFORTS OF ARTIFICIAL RECHARGE & RAINWATER HARVESTING**
- Projects completed by CGWB (No & Amount spent) : Nil
- Projects under technical guidance of CGWB (Numbers) : Nil
- 15. GROUND WATER CONTROL AND REGULATION**
- Number of OE/ Critical/ Semi-critical/ Safe Blocks : All the 15 blocks have been categorized as 'Safe'
- No of blocks notified : Nil
- 16. MAJOR GROUND WATER PROBLEMS AND ISSUES** :
- WL decline in urban area (Shahjahanpur City)
 - Arsenic in ground water; survey by UP Jal Nigam in 8 blocks; arsenic more than 10ppb found in 7 blocks – Dadrol, Jaitipur, Jalalabad, Katra, Khutar, Sindhauli and Tilhar; Arsenic >50ppb only in 3 samples out of 1193.

1. INTRODUCTION

1.1 Location, Extent and Population

Situated in the west-central part of Uttar Pradesh (**Fig. 1**), lying between latitude 27°27'N and 28°28'N, and longitude 79°19'E and 80°23'E, Shahjahanpur district covers 4575 Sq.Km. geographical area. It was carved out as separate district from Bareilly district in 1813 and is bounded in the northwest by Pilibhit district and in the east and southeast by Kheri and Hardoi districts respectively. To the south lies Farrukhabad district, separated by river Ganga, and to the west, Bareilly and Budaun districts.



As per **provisional figures of 2011 census** (source: *Census of India web site**), total Population of the district is 3002376, with density of population 684 souls/per SqKm and rural population constitutes 80.30% (2410968 nos.) of the total population. The decadal population growth from 2001 is 21.80% (12.54% in urban areas and 24.31% in rural areas).

1.2 Administrative Setup

The district is administratively divided into 4 tehsils and 15 development blocks (**Plate-I; Table 1**), with 124 Nyay Panchayats and 922 Gram Panchayats. The urban sector has 3 Nagar Palika Parishads (Shahjahanpur, Tilhar and Jalalabad) and 7 town areas with Nagar Panchayats (Katra, Powayan, Kanth, Khutar, Allahganj, Khudaganj and Railway Settlement Roza). Total number of villages is 2331 out of which 2080 are inhabited and 251, uninhabited.

Table 1: Administrative Set-up, Shahjahanpur District, UP

Tehsil	Block	Number of Nyay Panchayat	Number of Gram Panchayat	Number of villages
Shahjahanpur (Sadar)	Kanth	7	54	117
	Dadraul	7	62	126
	Bhawal Khera	9	77	162
	Madnapur (part)	8*	64**	150 (part)#

Contd..

*[http://www.censusindia.gov.in/2011-prov results/paper2/data_files/UP/7-pop-12-22.pdf](http://www.censusindia.gov.in/2011-prov%20results/paper2/data_files/UP/7-pop-12-22.pdf)

	Block	Number of Nyay Panchayat	Number of Gram Panchayat	Number of villages
Tilhar	Tilhar	7	61	140
	Nigohi	8	63	130
	Khudaganj Katra	9	60	128
	Jaitipur	7	57	130
	Madnapur (part)	*	**	#
Jalalabad	Jalalabad	10	68	142
	Mirzapur	8	50	86
	Kalan	9	52	100
	Madnapur (part)	*	**	#
Powayan	Powayan	8	63	179
	Banda	9	72	171
	Khutar	8	47	147
	Sindhauri	10	72	172

Source: website updes.up.nic.in (Statistical Diary-2012, Table-55; Figures for 2011-12)

1.3 Agriculture, Irrigation and Crops

1.3.1 Agriculture

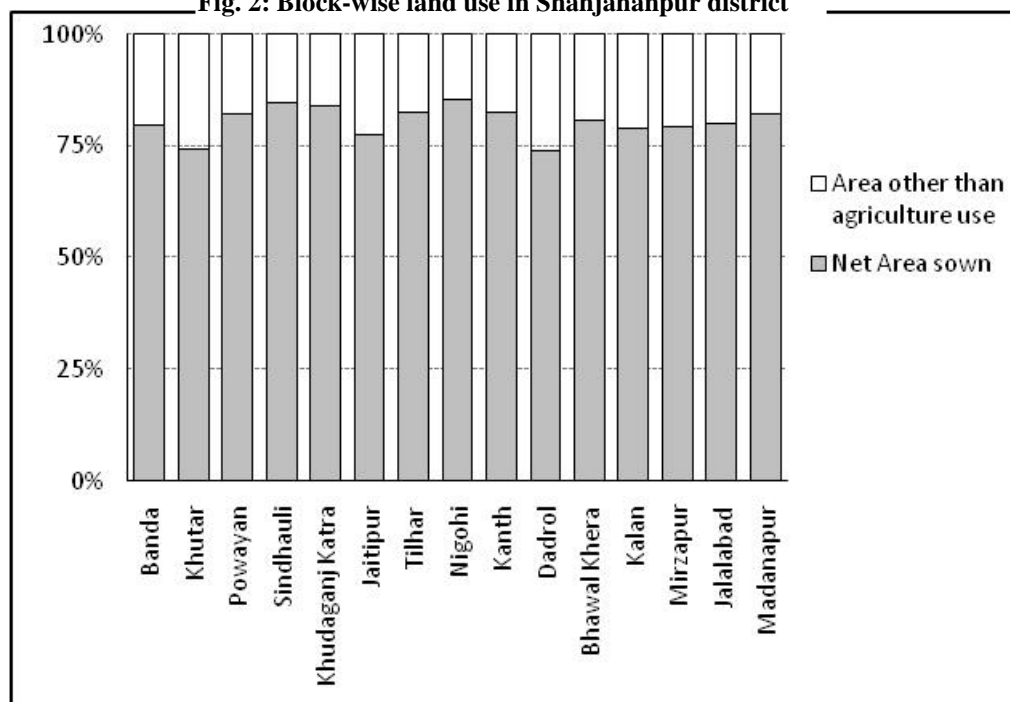
Bestowed with fertile soil and having good irrigation facilities, about 80% area of the district is under agricultural use. Net sown area ranges from 73.96% in Dadrol to 85.13% in Nigohi block (**Table-2; Fig. 2**). Net irrigated area is 322212 ha, which forms about 92% of the net sown area (350183 ha). Gross irrigated area is 536968 ha.

Table-2: Block-wise Land Use in Shahjahanpur District, UP (All Areas in ha)

Block	Total area	Area other than agriculture use*	Net Area sown	% Net Area Sown	Net Area Irrigated	% Net Irrigated to net sown
Banda	44125	8985	35140	79.64	32375	92.13
Khutar	40653	10534	30119	74.09	28647	95.11
Powayan	28369	5102	23267	82.02	21940	94.30
Sindhauri	29366	4537	24829	84.55	22848	92.02
Khudaganj Katra	26464	4259	22205	83.91	20731	93.36
Jaitipur	24498	5497	19001	77.56	17983	94.64
Tilhar	21985	3866	18119	82.42	17133	94.56
Nigohi	25036	3723	21313	85.13	18164	85.22
Kanth	26089	4545	21544	82.58	19068	88.51
Dadrol	26314	6851	19463	73.96	17922	92.08
Bhawal Khera	29016	5628	23388	80.60	19535	83.53
Kalan	29158	6151	23007	78.90	20609	89.58
Mirzapur	24179	5006	19173	79.30	18009	93.93
Jalalabad	32633	6554	26079	79.92	25161	96.48
Madanapur	28117	5018	23099	82.15	21953	95.04
Total Rural	436002	86256	349746	80.22	322078	92.09
Total Urban	1467	1030	437	29.79	134	30.66
Total District	437469	87286	350183	80.05	322212	92.01

*includes area of forest, barren cultivable waste, present fallow land, other fallow land, barren uncultivable land, land put to non-agriculture use, pastures and area under bush, forest & garden

Fig. 2: Block-wise land use in Shahjahanpur district



1.3.2 Irrigation

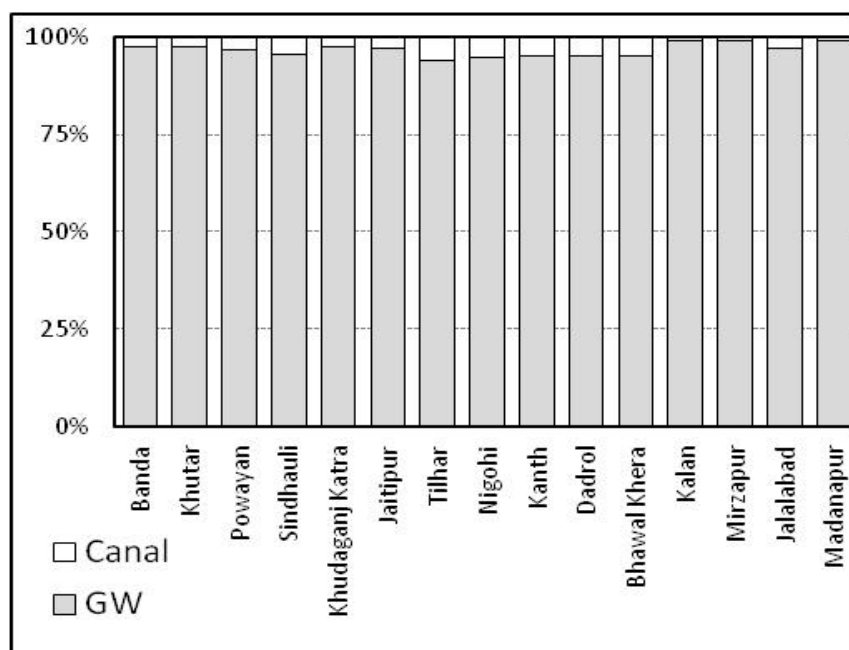
Contributing about 97% of the net irrigated area, ground water is the major source of irrigation in the district, ranging from 94.14% in Tilhar block to 99.40% in Madanapur block (Table-3; Fig. 3). The canal network runs through 892 km in the district.

Table 3: Block-wise Net Area Irrigated by different sources in Shahjahanpur District, UP

Block	Net irrigated area (Ha)	Different Irrigation Source (Net Irrigated Area in Ha)					% Area irrigated by GW	% Area irrigated by Canal
		Canal	Tubewell		Wells	Total GW		
			Public TW	Private TW				
Banda	32375	823	7	21775	9770	31552	97.46	2.54
Khutar	28647	721	6	18308	9612	27926	97.48	2.52
Powayan	21940	650	6	11430	9854	21290	97.04	2.96
Sindhauli	22848	1000	6	12030	9812	21848	95.62	4.38
Khudaganj Katra	20731	502	7	10591	9631	20229	97.58	2.42
Jaitipur	17983	500	6	7805	9672	17483	97.22	2.78
Tilhar	17133	1004	7	6490	9632	16129	94.14	5.86
Nigohi	18164	951	4	7593	9616	17213	94.76	5.24
Kanth	19068	900	6	8554	9608	18168	95.28	4.72
Dadrol	17922	865	8	7405	9644	17057	95.17	4.83
Bhawal Khera	19535	904	9	8812	9810	18631	95.37	4.63
Kalan	20609	170	4	10826	9609	20439	99.18	0.82
Mirzapur	18009	165	11	8114	9719	17844	99.08	0.92
Jalalabad	25161	701	5	14807	9648	24460	97.21	2.79
Madanapur	21953	131	7	12148	9667	21822	99.40	0.60
Total Rural	322078	9987	99	166688	145304	312091	96.90	3.10
Total Urban	134	0	0	134	0	134	100.00	0.00
Total District	322212	9987	99	166822	145304	312225	96.90	3.10

Source: website updes.up.nic.in (Statistical Diary-2012, Table-18; Figures for 2010-11)

Fig. 3: Block-wise Net Area Irrigated by Different Sources, Shahjahanpur District, UP



There are two main canal branches passing through the district – Shahjahanpur Branch and Nigohi Branch. Salient features about these are given in **Table-4**.

Table 4: Salient Features of Canal; Branches in Shahjahanpur District, UP

Canal	Distribution	Length	Designed Discharge	CCA
Shahjahanpur Branch	Starts from right bank of Apsara river (Kolaria Head) in Bhadpura block of Bareilly district; enters into Shahajahnpur district from Katra block and passes through Jaitipur, Tihar, Dadraul, Jalalabad and Kanth blocks before entering into Hardoi district	110.32 km	1219 cusec	136988ha
Nigohi Branch	Originates from left bank of Sharda Main Canal in Barkhera block of Pilibhit district and passes through Nigohi and Bhawal Khera blocks of Shahjahanpur district.	95.660 Km	600 cusec	73925ha

Source: Executive Engineer, Irrigation Department, Shahjahanpur

1.3.3 Crops

Wheat is grown in the maximum area of the district, followed by rice. Principal Kharif crops are paddy, millet, maize and jwar and Rabi crops - wheat, gram, barley, pulses and oil seeds. Other crops of minor importance are sugarcane, potato, cotton etc. Cropping pattern is given in Table-5.

Table 5: Cropping Pattern in District Shahjahanpur, UP (2010-11)

Crop	Area (Ha)	% of Gross Sown Area	Irrigated (% of sown Area)
Wheat	252136	42.05%	100%
Rice	201465	33.60%	100%
Pulses	32658	5.44%	4.65%
Sugarcane	37712	6.29%	100%
Barley (Jau)	421	0.07%	>99%
Potato	9519	1.58%	100%
Bajra (Millet)	4905	0.81%	0.93%
Jwar	1360	0.22%	0.66%
Maize	1723	0.28%	7%
Oil Seeds	28877	4.81%	~50%
Other Vegetables	17763	2.96%	~94%

Source: website updes.up.nic.in (Statistical Diary-2012, Table-19; Figures for 2010-11)

1.4 Industries

There are 3 major Industrial Estates/ Areas in the district, namely – Roza, Tilhar and Powayan. A few large-scale industries/ Public Sector Undertakings and Medium Scale Enterprise exist in the district (Table-6). Major exportable items produced in the district are carpet and durries.

Table-6: Main Industries in Shahjahanpur District

Scale of Industry	Industry
Large Scale Industries/ Public Sector Undertakings	<ul style="list-style-type: none"> • Ordinance Clothing Factory, Shahjahanpur • K R Pulp & Paper Ltd., Jamaur, Shahjahnpur • Bajaj Hindustan Ltd. Maksudpur, Powyana, Shahjahnpur • Dalmia Chini Mills, Nigohi • Kribhco Shyam Fertilizers Ltd., Pipraula, Shahjahanpur • Roza Power Plant, Roza, Shahjahanpur
Medium Scale Enterprises	<ul style="list-style-type: none"> • Roza Sugar Works, Roza • United Spirit Ltd (Distillery), Roza, Shahjahnpur • Formula tent Mardorcel & Co. Ltd.

Source: Brief Industrial Profile of Shahjahanpur District, UP by MSME Development Institute, Kanpur, Ministry of Micro, Small & Medium Enterprise, Government of India

In addition, there are number of micro and small enterprises, most of which are agro based. Some other such units are ready-made garments and embroidery; wood/ wooden based furnitures; paper & paper products; leather based; chemical/chemical based; rubber, plastic & petro based; metal based (Steel Fabrication); Soda water; cotton textile etc.

2. CLIMATE AND RAINFALL

With hot and dry summers, humid monsoon season and dry winters, the district comes under sub-tropical sub-humid climate zone. There are 5 meterological stations of IMD in the district. The temperature varies from 8.5 to 28.6⁰C in winters and 21.4⁰C to 40.5⁰C in summers. However, during cold-waves the temperature may go down to freezing point, whereas extreme heat wave at times can cause the temperature to go up to as high as 46⁰C. May is the hottest month of the year and January, the

coldest, with mean daily maximum temperature during the former being 40.5°C and that in latter, 21.9°C. The mean daily minimum temperatures during these months are 25.3°C and 8.5°C respectively. The normal annual rainfall (1901-70) averaged over 5 rain gauge stations existing in the district is 1046.7mm. The southwest monsoon is active from mid or mid June to September, with maximum rainfall (~87%) taking place during this period, August being the wettest month. There is average 45 rainy days (days with rainfall of 2.5 mm or more) in a year. Average humidity remains considerably high from July to September (74.5% - 80.5%) and is highest during the month of August.

3. DRAINAGE, SOIL, GEOMORPHOLOGY & GEOLOGY

3.1 Drainage & Soil

Ramganga river, which flows NNW-SSE in the western part of the district, forms the principal drainage. Southwestern periphery is drained by the river Ganga. Other important rivers are Garra, Khannaut, Bahgul, Jokhal and Kathana. River Garra divides the district into almost equal halves.

Soils in the district are deep and well drained, with loamy surface. In the northeastern part, the soils are mainly fine silty to coarse loamy, whereas in southwestern part they are mainly fine to coarse loamy and calcareous (based on Soil Map published by NBSS & LUP).

3.2 Geomorphology

Shahjahanpur district forms part of Central Ganga Plains in the upper Ganga Basin, exhibiting monotonous flat topography, with master slope towards south and southeast. Northern part of the district merges imperceptibly into Terai, marked by thick forests and marshy lands. Ground elevation generally ranges from 148-172 masl. The area can be divided into two broad geomorphic units (Srivastava & Gairola, 1993), an upland – the Varanasi Older Alluvium (VOA) Plain (Bhanger surface) and the low land – the flood plain (Khadar surface). The former is the oldest geomorphic unit covering major part of the area, occupying interfluvial zones above the general flood level of different rivers. The elevation of Varanasi Older Alluvium Plain, which in most part has homogenous flattish topography, varies from 159 to 172mamsl with general southward slope. The surface hosts a number of palaeochannels and tals. Based on lithology, the plain can be subdivided into sandy

and silty-clayey surfaces. The Khadar surface (low land) can be further subdivided into Older Flood Plains of Ganga/ Ramganga/ Garra/ Gomati/ Khannaut/ Katni/ Bahhul/ Dojara rivers and Active Flood Plains of these rivers. In major part, there are two levels of Terrace in Older Flood Plains. The higher level Terrace is an erosional surface over the Varanasi Older Alluvium, whereas the lower level Terraces is made up of Terrace Alluvium.

3.3 Geology

The district is underlain by thick pile of Quaternary alluvial deposits deposited over Siwalik Supergroup, which in turn overlies Vindhyan Supergroup unconformably.

The Newer Alluvium occurs along the courses of major streams forming wedge shaped cover. The formation consists of fine to medium sand, silt with thin clay lenses. Terrace Alluvium of different rivers exhibits different characteristics. In Ramganga basin, it is alternate sequence of fine sand and medium grey micaceous sand, in Garra river, thin khaki silty clay alternating with thick fine medium grained grey micaceous sand, whereas in Ganga, the top layer of Terrace Alluvium is of blackish clay silt.

The Older Alluvium is a thick polycyclic, fining upward sequence of oxidized silt, clay and sand with subordinate kankar concretions. Bore well data of ONGC wells at Tilhar, Shahjahanpur and Puranpur (adjoining Pilibhit district) (compiled and discussed in CGWB, 1997) suggests that this alluvium is 400-590m thick and rests over upper Siwalik.

Sedimentation of Varanasi older alluvium possibly began during Middle Pleistocene in the basin formed over the Siwalik Super group with the rising Himalaya due to post Upper Siwalik upliftment of Himalaya (Singh & Nambiar, 1993). The advent of Holocene heralded the change of climate from cold arid to warm humid, which brought about the next cycle of sedimentation represented by Terrace Alluvium. This is also the period of formation of wide erosional terraces. The deposition of third generation of quaternary sedimentation is still on and represented by point bar and channel bar deposits of recent alluvium.

The basement for Quaternary sediments is not exposed in the district. Basement rocks in the area are concealed under thick pile of Quaternary sediments. As per the bore well data of deep boreholes drilled by ONGC at Tilhar, Shahjahanpur

and Puranpur (adjoining Pilibhit district) in Puranpur depression of Ganga Basin, the Upper Siwaliks (US), consisting of sand/ sandstone and clay/ claystone, form the concealed basement for Quaternary sediments (CGWB, 1997). The lithological distinction between VOA and Siwalik sediments, however, is not very perceptible and the hiatus between the two entities is also not reflected in ONGC lithologs. The Siwalik Supergroup, comprising of Upper Siwalik (US), Middle Siwalik (MS) and Lower Siwalik (LS), in turn, rests unconformably over northern sloping basement of Vindhyan Supergroup, encountered in Shahjahanpur and Puranpur bore wells at 1839m and 3120m respectively. At Puranpur, an additional unit of sedimentaries of about 52m thickness, comprising of ferruginous oolitic rock, laterite and clay, also occurs between Siwalik and Vindhyan Supergroup. In the bore well at Tilhar, drilled up to 2226m and terminating within Mesozoic, Lower Siwalik is absent and Middle Siwalik/ Mesozoic boundary is represented by unconformity at 1698m (CGWB, *op.cit.*). Based on seismological surveys, bottom of Lower Siwaliks at Pawayan, Deokali (Banda block), Miranpur Katra and Banda has been inferred at 1604, 3023, 1642 and 2191m respectively (CGWB, *op.cit.*).

Generalized stratigraphic sequence is given in Table-7.

Table -7: Generalized Stratigraphic Sequence* in and around Shahjahanpur District, UP

Age	Geological Units	Lithology	Geomorphological Units	Landforms
Holocene	Newer Alluvium	Recent Alluvium (thickness: 5-7m) - fluvial sediments; fine to medium loose micaceous sand with minor silt	Active Flood Plains of Ganga/ Ramganga/ Gomti/ Garra/ Khannaut/ Beghul/ Dojara rivers	Point bar channel bar, lateral bar, sandy flats
		Terrace Alluvium (thickness 2-8m) – cyclic sequence of grey to light khaki coloured silt, clay and micaceous sand; thinly laminated; occasionally oxidized	Older Flood Plains of respective rivers, present on both the banks as linear terraces	Abandoned channels, cut off meanders, sandy flats
----- Disconformity -----				
Middle to Upper Pliocene	Varanasi Older Alluvium (VOA)	400 to ~600m thick multiple, polycyclic, fining upward sequence of oxidized silt, clay and sand with subordinate kankar concretions at depth	Varanasi Older Alluvial Plain – the oldest unit covering the highest level	Sandy surface - Sand mounds ridges & flats Silt-clay surface - Palaeochannels, Tals
----- Disconformity -----				
Tertiary	Siwalik Supergroup (US, MS & LS)	>1100 to ~ 2700m thick sequence of sand/ sandstone and clay/ claystone (siltstone is also present at Tilhar)	Not exposed in the area	
~~~~~ Unconformity ~~~~~				
Pre Tertiary Basement rocks belonging to Mesozoic/ Precambrian Vindhyan Supergroup			Not exposed in the area	

* Synthesized after Singh & Nambiar, 1993; Khan & Rawat, 1993; Srivastava & Gairola, 1994; CGWB, 1997

## 4. GROUND WATER SCENARIO

### 4.1 Hydrogeology

Central Ground Water Board has carried out exploratory drilling in the district up to the maximum depth of 456m, i.e mainly within older alluvium. A total of 10 exploratory wells and 1 slim hole have been drilled in the district so far. Lithological units are composed mainly of fine to medium and coarse sand, gravel, clay and kankar, with sand being the dominant component. Kankar is generally associated with clay capping (3-5m or more in thickness) existing all over the area. Clay generally occurs in lenticular form in the upper parts and attains regional character at deeper levels. Perusal of electrical logs of the wells apparently suggests that 4 aquifer groups exist at individual sites, with top and bottom of individual aquifer group varying widely (CGWB, 2012). However, on the basis of fence diagram constructed with the help of lithologs of different wells, exhibiting disposition of different aquifers, three aquifer groups, separated by fairly thick clay beds, can be identified in the district down to the maximum explored depth (Table-8). A conspicuous surface silty clay capping having 3-5m thickness or more also exists almost over entire district. Decreasing resistivity values may point to decreasing granularity with depth.

**Table-8: Summary of Aquifer Groups in Shahjahanpur District, UP**  
(after CGWB, 2006)

<b>Aquifer Group</b>	<b>Average Depth/ Depth Range</b>	<b>Resistivity (Ohm-m)</b>	<b>Remarks</b>
I	Ground level to 140-170m	50-60	Quality of water good
II	140/ 170-325	30-40	Quality of water good
III	Below 325	20-30	Quality of water good except in the deeper aquifer at Imaliya in the southern part, where it is brackish

Ground water in shallow aquifer occurs under unconfined condition and is tapped by dug wells and shallow borewells. Tubewells drilled by State Government generally tap 30-40m thickness in this aquifer in the depth range of 70-130m, with discharge of 2400 to 3600 lpm (CGWB, 2006). In deeper aquifers, ground water occurs under semi-confined to confined conditions. Exploratory wells drilled by CGWB tapping shallow or collectively shallow and deep aquifers have yields ranging from 1483-2074 lpm, whereas the well tapping only second aquifer has yielded 904 lpm (**Table—9; Appendix-I**). Hydrogeological map of the district is presented in **Plate-II**.

**Table-9: Exploratory Drilling by CGWB in Shahjahanpur district, UP (Summarized results in Appendix-)**

Number of EW	Depth Range (mbgl)	Yields (lpm)	Draw-downs (m)	Transmissivity (m ² /day)	Storativity
10	240-456	904 - 2074	2.42 - 22.92	164 - 2010	3x10 ⁻³

## 4.2 Depth to Water Level

As per data of Ground Water Monitoring Stations of CGWB and GWD, UP for 2012, water levels in the district range from 2.60 to 9.17 mbgl during pre-monsoon, with majority of wells falling between 3-7 mbgl. During post-monsoon, water levels range from 0.82 to 8.45 mbgl, with large number of wells having water levels between 2-5 mbgl. Depth to water level contours for pre- and post-monsoon 2012 are presented in **Plate-III & IV** respectively.

## 4.3 Long-term Water Level Trend

Majority of the CGWB monitoring wells analysed show declining water level trends for the period 2003-12, with range of decline 0.06-0.69 m/yr during pre-monsoon and 0.06-0.49 m/yr during post-monsoon (Table-11). Rising trends have also been observed. Maximum decline has been observed at Shahjahanpur, both during pre-monsoon (0.69 m/yr) and post-monsoon (0.49 m/yr), which might be indicative of stress on ground water in urban area.

**Table-11: Summary of Long-term (2003-12) WL Trends in Shahjahanpur District**

WL Trend for	Wells analysed (Nos.)	Range of declining trend (m/yr)	Wells showing declining trend (m/yr) in nos.				Range of rising trend (m/yr)	Wells showing rising trend (m/yr) in nos.
			0.00-0.20	0.20-0.40	0.40-0.60	0.60-0.69		0.00-0.10
Pre-monsoon	6	0.06-0.69	3	1	-	1	0.06	1
Post-monsoon	6	0.06-0.49	3	-	1	-	0.04-0.10	2

## 4.4 Ground Water Quality

### 4.4.1 Quality of Ground Water in Phreatic Aquifer

Central Ground water Board monitors ground water quality of phreatic aquifer through analysis of samples collected once a year (one sample from each block). Ground Water samples collected during 2011 show **Electrical Conductivity (EC)** in the range of 335-750  $\mu$ -Siemens/cm, indicating that ground water is fresh in the district. Variation in EC over the area is illustrated through EC contours on Hydrogeological Map of the district (i.e **Plate-II**). Total hardness (as CaCO₃) ranges

from 100-290 mg/l. **Fluoride** and **Nitrate** are within permissible limits (1.5 mg/L & 45 mg/L respectively) in all the samples.

In a survey carried out by UP Jal Nigam for **arsenic** in ground water in 8 blocks of the district, namely – Dadrol, Jaitipur, Jalalabad, Katra, Khutar, Mirzapur, Sindhauli and Tilhar, arsenic has been detected in GW samples from all these blocks, with some of the samples from 7 blocks having arsenic concentrations above 10 ppb (**Table-12**).

**Table-12: Summary of Survey Carried out by UP Jal Nigam for Arsenic in GW**

Block	No. of HPs (GW samples)	As Concentration 10- 50 ppb (No. of HPs)	As Concentration > 50 ppb (No. of HPs)	% of samples above 10 ppb
Dadrol	170	82		~48%
Jaitipur	128	4		~3%
Jalalabad	137	22		~16%
Katra	174	12	2	~12%
Khutar	84	6	1	~8%
Mirzapur	50	-		-
Sindhauli	224	1		~0.4%
Tilhar	226	32		~14%

*Source: Report on 'Arsenic Toxicity in GW of UP' by State Water Resource Agency, Government of UP compiling results of UP Jal Nigam survey*

#### 4.4.2 Quality of Ground Water in Deeper Aquifers

Exploratory drilling in the district has revealed that the formation water is generally fresh in the deeper aquifers except at Imaliya in the southern part of the district where it has been inferred as brackish in the aquifer occurring below 325m (CGWB, 2012).

#### 4.5 **Status of Ground Water Development**

About 80% area of the district is under agricultural use, with paddy and wheat grown on large scale. Net irrigated area is about 92% of the net sown area, of which 97% contribution comes from ground water. Although there is fairly strong canal network in the district, irrigation is mainly ground water dependent throughout the district (**Table-3 & 13**). This is due to easy access to ground water as water levels are not deep and ground water is directly under control of individual farmer/ user.

**Table 13: Block-wise status of sources of irrigation in Shahjahanpur district**

Block	Canal length (km)	Govt. tube-well (No.)	Perma- nent wells (No.)	Rahat (No.)	Pumpsets				Ground pumpset (No.)
					Electri- city Run (No.)	Diesel Run (No.)	Other (No.)	Total (No.)	
Banda	60	31	0	15	705	6356	46	7107	3
Khutar	58	27	0	20	575	10438	36	11049	3

Contd..

Block	Canal length (km)	Govt. tube-well (No.)	Perma- nent wells (No.)	Rahat (No.)	Pumpsets				Ground pumpset (No.)
Powayan	16	79	0	18	883	7819	26	8728	3
Sindhauri	116	49	0	0	150	6122	41	6313	3
Khudaganj Katra	94	13	0	10	40	6836	8	6884	3
Jaitipur	32	31	0	0	55	4343	33	4431	3
Tilhar	85	7	0	0	134	5120	65	5319	4
Nigohi	105	19	0	10	234	7645	33	7912	3
Kanth	108	15	0	0	36	4740	36	4812	3
Dadrol	65	45	0	12	65	6800	39	6904	4
Bhawal Khera	132	30	0	14	90	5946	79	6115	5
Kalan	0	37	0	22	90	7515	73	7678	3
Mirzapur	0	14	0	20	14	7413	64	7491	3
Jalalabad	21	35	0	0	129	8699	66	8894	2
Madanapur	0	19	0	9	106	5753	48	5907	3
<b>Total Rural</b>	<b>892</b>	<b>451</b>	<b>0</b>	<b>150</b>	<b>3306</b>	<b>101545</b>	<b>693</b>	<b>105544</b>	<b>48</b>
<b>Total Urban</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>-</b>	<b>0</b>	<b>-</b>
<b>Total District</b>	<b>892</b>	<b>451</b>	<b>0</b>	<b>150</b>	<b>3306</b>	<b>105445</b>	<b>693</b>	<b>105544</b>	<b>48</b>

Source: website updes.up.nic.in (Statistical Diary-2012, Table-23; Figures for 2010-11)

Drinking water requirement of the district is met by UP Jal Nigam through tubewells (Piped Water Supply Scheme) and India Mark II hand pumps. As per UP Jal Nigam figures for 2011-12, 2080 villages have India Mark II hand pumps, benefiting a population of 1939404. There are 6 nos. rural Piped Water Supply Schemes, with 8 tubewells catering to 7 villages in Kalan, Banda, Nigohi and Jalalabad blocks (*source: office of Executive Engineer, UPJN*). In urban areas, water supply is through 2666 HPs in 10 towns (Kanth, Allahganj, Khutar, Powayan, Tilhar, Khudaganj, Katra, Jalalabad, Shahjahanpur and Roza) and 45 TWs in 9 towns (all the above towns, except Roza), catering to currently assessed population of 614750 (*Source as above*). Out of the above, 28 TWs and 1375 HPs are located in Shahjahanpur City alone.

#### 4.6 Dynamic Ground Water Resources (as on 31.3.2009)

As per estimation of dynamic (12eplenishable) ground water resource of Shahjahanpur district (as on 31.3.2009), all the blocks have been categorized as 'Safe' (**Plate-V; Appendix-II**). Keeping provision for future domestic and industrial requirements, availability of ground water for future irrigation development comes to 35146.98 ham. Summary of Dynamic GW Resource for the district is presented in **Table-14**.

**Table-14: Dynamic GW Resource, Shahjahanpur district, UP (as on 31.3.2009)**

Net annual GW Availability (ham)	Gross GW Draft for all uses (ham)	Net GW Availability for future development for irrigation (ham)	Over-all Stage of GW Development	Block-wise range of GW Development	Categorisation of blocks
148634.50	111883.26	35146.98	75.27%	59.21% (Banda) to 88.89 % (Kalan)	All 15 blocks 'Safe'

## **5. GROUND WATER RELATED ISSUES AND PROBLEMS**

The foregoing description of ground water scenario does not indicate any major ground water problem in the district. However, following issues may require timely attention in view of their potential adverse impact.

### **5.1 Water Level Decline in Urban Area**

As indicated under Section 4.5 (Table-11), the only monitoring well showing considerable long term decline (69cm/yr and 49cm/yr during pre- and post-monsoon respectively) exists in Shahjahanpur City, suggesting that ground water is under stress mainly in the urban area.

### **5.2 Arsenic in Ground Water**

Survey by UP Jal Nigam in 8 blocks of the district has revealed presence of arsenic in ground water above 10 ppb in 7 blocks, namely - Dadrol, Jaitipur, Jalalabad, Katra, Khutar, Sindhauli and Tilhar (Section 4.4.1; Table-12) . However, arsenic concentrations above 50ppb have been observed only in 3 samples out of total 1193.

## **6. GROUND WATER MANAGEMENT STRATEGY**

### **6.1 Management of Ground Water Development**

The present level of ground water development is 75.27% in the district, leaving net ground water availability for future irrigation development as 35146.98ham. All the 15 blocks have been categorized as 'Safe'. Average pre-monsoon water levels in all the blocks are shallower than 6mbgl. Hence, additional irrigation potential can be judiciously exploited in all the blocks.

### **6.2 Ground Water Management in Urban area**

Declining water level trend in Shahjahanpur City requires timely attention. Emphasis is to be given to Roof Top Rain Water Harvesting (RTRWH) in buildings/ houses/ industrial premises. In this direction, government should take initiatives for installation of RTRWH mechanisms in government buildings. Campaigns to make people aware of the situation and to encourage them to use ground water judiciously, as well as to take up RTRWH should be undertaken. Efforts should be made minimize transmission/ conveyance losses.



### **6.3 Demarcation of Arsenic Affected Area**

Till now only 8 blocks have been taken up by UP Jal Nigam for survey of arsenic in ground water, which has revealed presence of arsenic above 10ppb in 7 blocks and above 50ppb only in 3 samples (out of total 1193). Further studies may be taken up where arsenic above 50ppb has been found. Other parts of the district are also to be covered to demarcate the extent and magnitude of problem.

### **7. AWARENESS AND TRAINING ACTIVITY**

No Mass Awareness Programme or Water Management Training Programme has been organized by CGWB in Shahjahanpur district.

### **8. AREA NOTIFIED BY CGWA**

No area/ block of Shahjahanpur district has been notified by CGWA.

### **9. RECOMMENDATIONS**

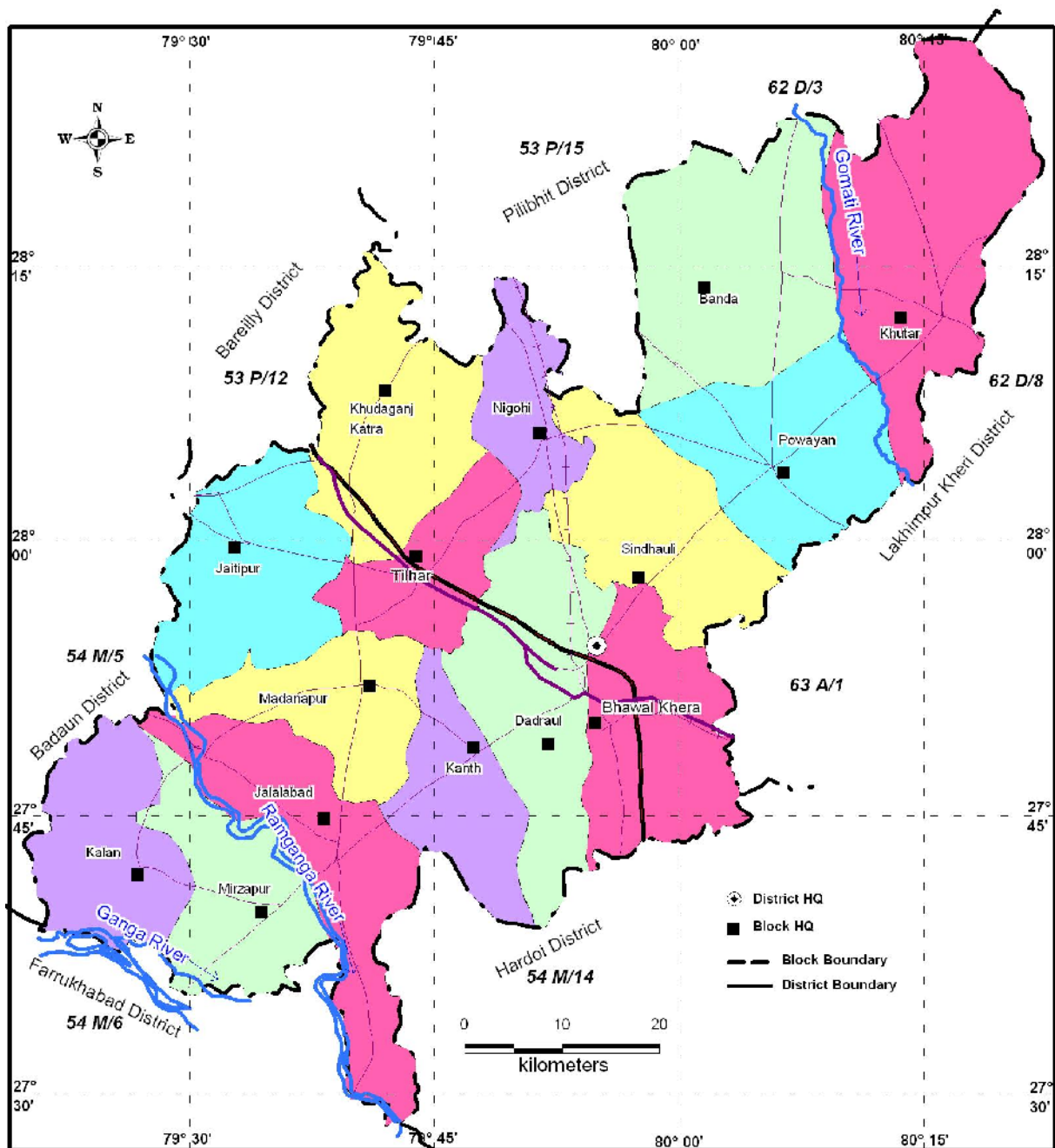
- Management of Ground Water in Urban Area (Shahjahanpur City)
  - Emphasis is to be given to Roof Top Rain Water Harvesting (RTRWH) in buildings/ houses/ industrial premises.
  - Government should take initiatives for installation of RTRWH mechanisms in government buildings.
  - Campaigns to make people aware of the situation and to encourage them to use ground water judiciously, as well as to take up RTRWH should be undertaken.
  - Efforts should be made minimize transmission losses.
- Arsenic in ground water
  - Extent of the problem of arsenic in ground water should be demarcated and its magnitude be ascertained.

### **BIBLIOGRAPHY/ REFERENCE**

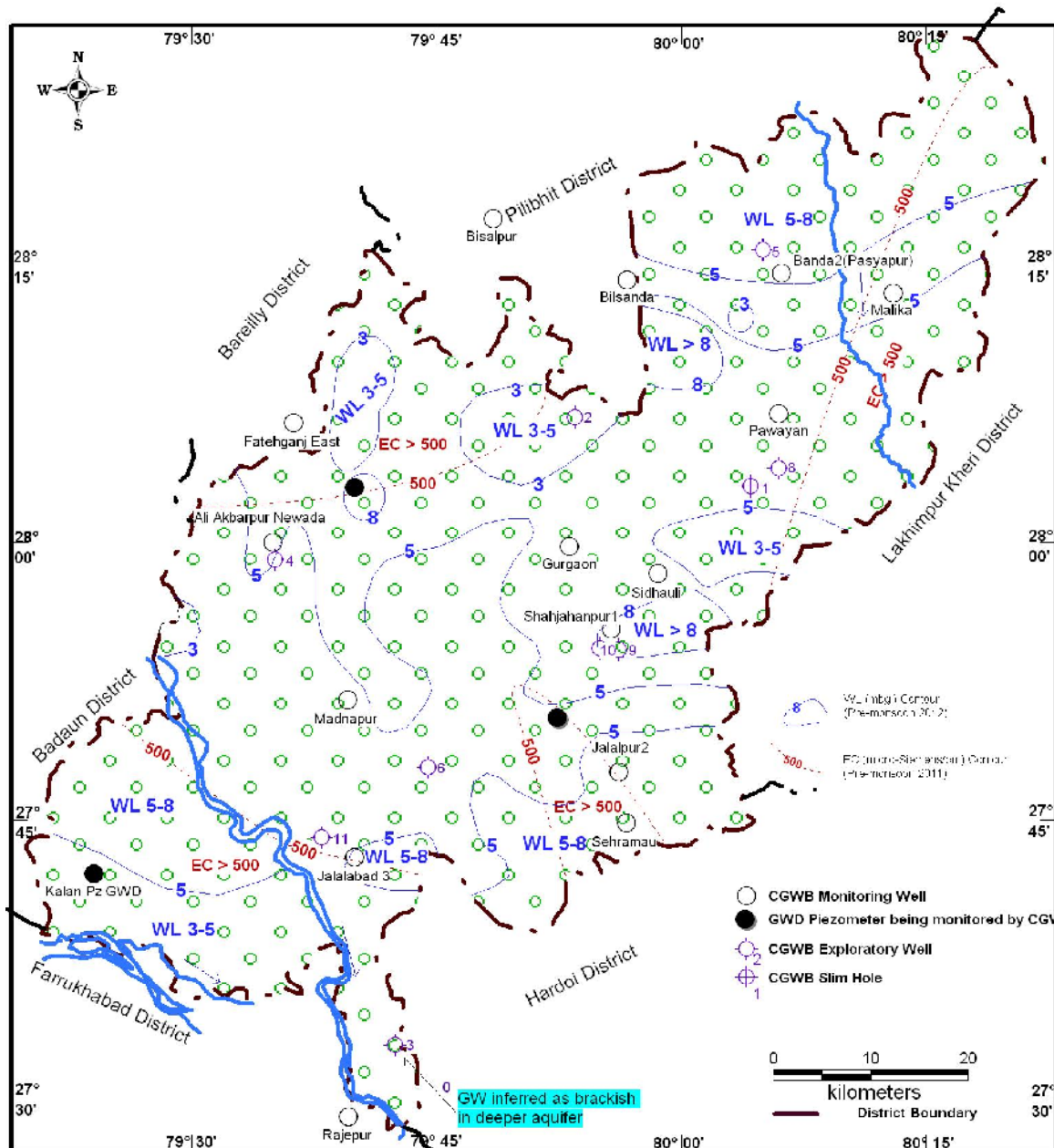
- CGWB, 1997: Delineation of Deep Fresh Water Artesian Aquifers in Ganga Basin by Singh, B.K., Chandra, P.C. and Srivastava, M.M.; *CGWB Unpub. Report Manuscript*.
- CGWB, 2000: Hydrogeology and Ground Water Potential, Shahjahanpur District; *CGWB Unpub. Report*.


- Singh O.P. and Nambiar, K.V., 1993: Quaternary Geology and Geomorphology of a part of Ganga Basin in Districts Badaun and Shahjahanpur, Uttar Pradesh; *GSI Unpub. Report.*
- Khan, A.U. and Rawat, B.P., 1993: Quaternary Geology and Geomorphology of a part of Ganga Basin in parts of Bareilly, Badaun, Shahjahanpur and Pillibhit district, Uttar Pradesh; *GSI Unpub. Report.*
- Srivastava, A.B. and Gairola, B.M., 1994: Quaternary Geology and Geomorphology of parts of Shahjahanpur, Bareilly, Pillibhit & Lakhimpur Kheri districts, Uttar Pradesh; *GSI Unpub. Report.*
- Arsenic Toxicity in Ground Water of Uttar Pradesh - Technical Report of SWaRA, Government of UP
- District Sankhyiki Patrika available on website [updes.up.nic.in](http://updes.up.nic.in) (UP Directorate of Economics & Statistics)
- UP Jal Nigam website [www.upjn.org](http://www.upjn.org)
- Census India web site [www.censusindia.gov.in](http://www.censusindia.gov.in)
- CGWB, 2012: State Geophysical Report of Uttar Pradesh, *CGWB Unpub. Report.*
- Brief Industrial Profile of Shahjahanpur District, UP by MSME Development Institute, Kanpur Ministry of Micro, Small & Medium Enterprise, Government of India (available on <http://dcmsme.gov.in/dips/DIP%20Shahjahanpur%20VK%20Bhatt%20AD%20EI.pdf>)

Administrative Map of Shahjahanpur District, UP

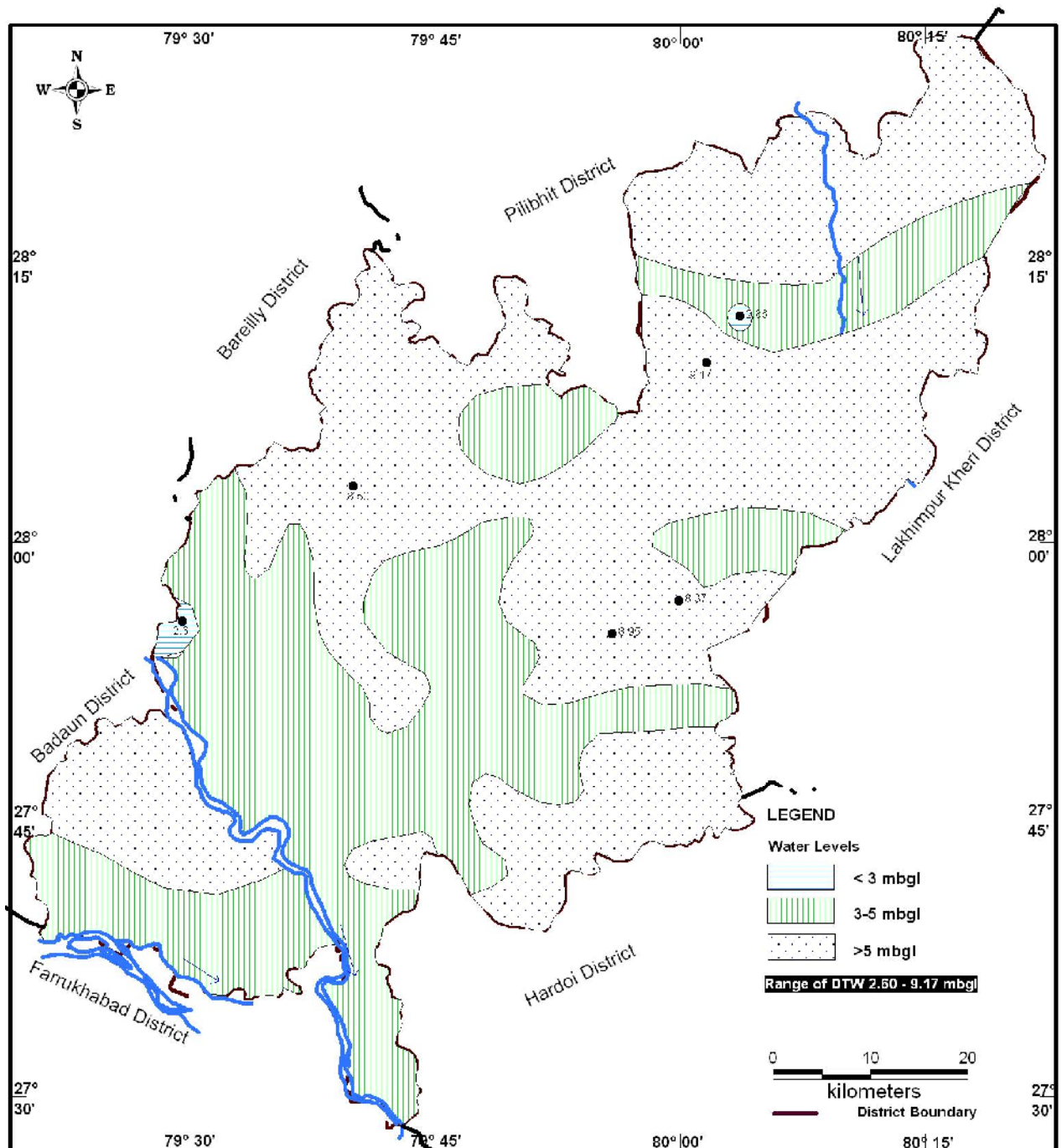


### Hydrogeological Map of Shahjahanpur District, UP



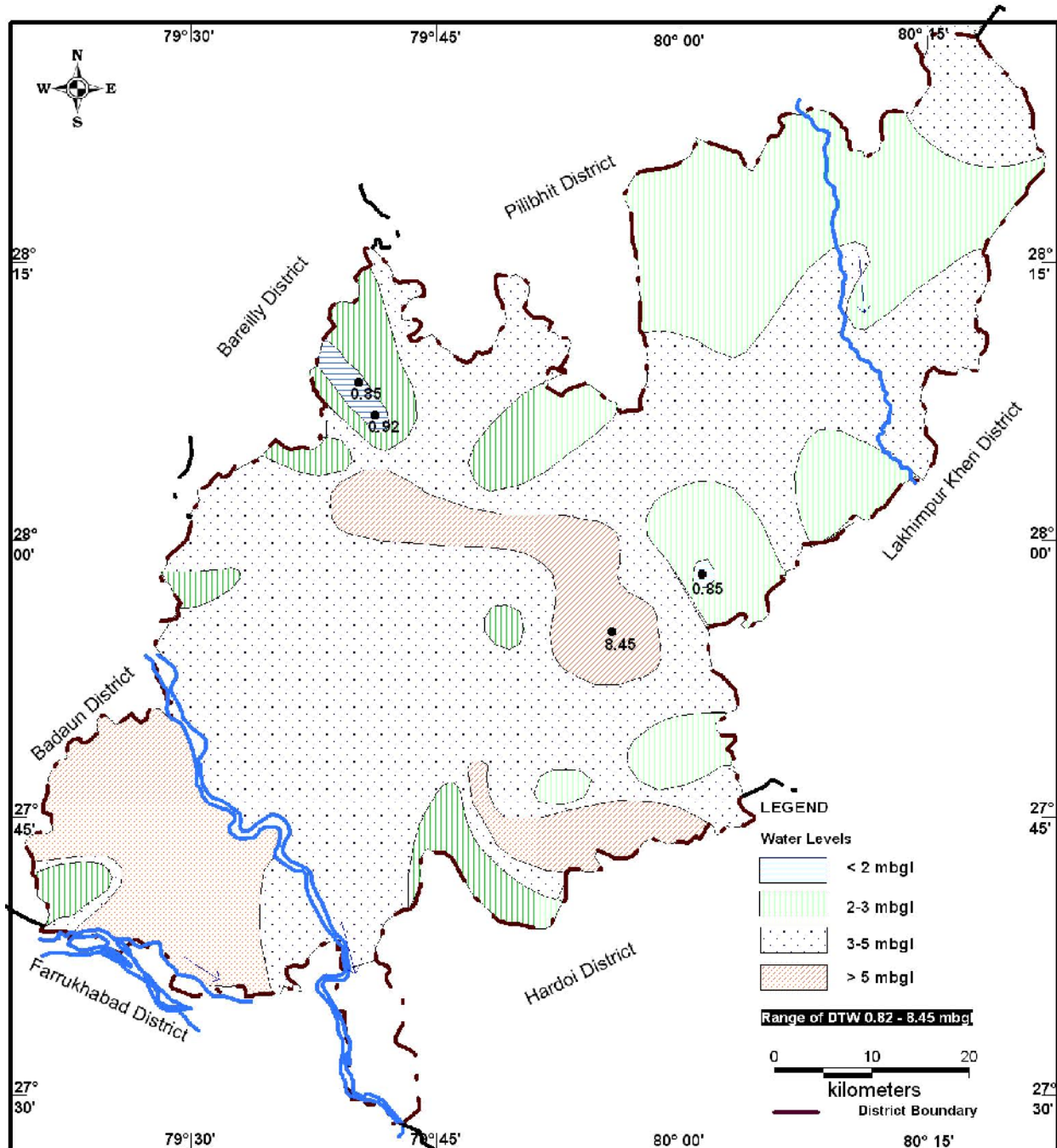

  
 Quaternary Alluvium (Older and Younger)
   
 Thickness: 400-590m
   
 CGWB exploration up to 456m
   
 GW Yield: 904-2074 lpm (up to 250m)
   
 Quality of water fresh;
   
 inferred as brackish in deeper aquifer in southern part;
   
 arsenic above 10ppb in parts of Dadrol, Jaitipur, Jalalabad,
   
 Katra, Khutar, Sindhauli and Tilhar blocks (UP Jal Nigam survey)

### Depth to Water Level in Shahjahanpur District, UP Pre-monsoon 2012

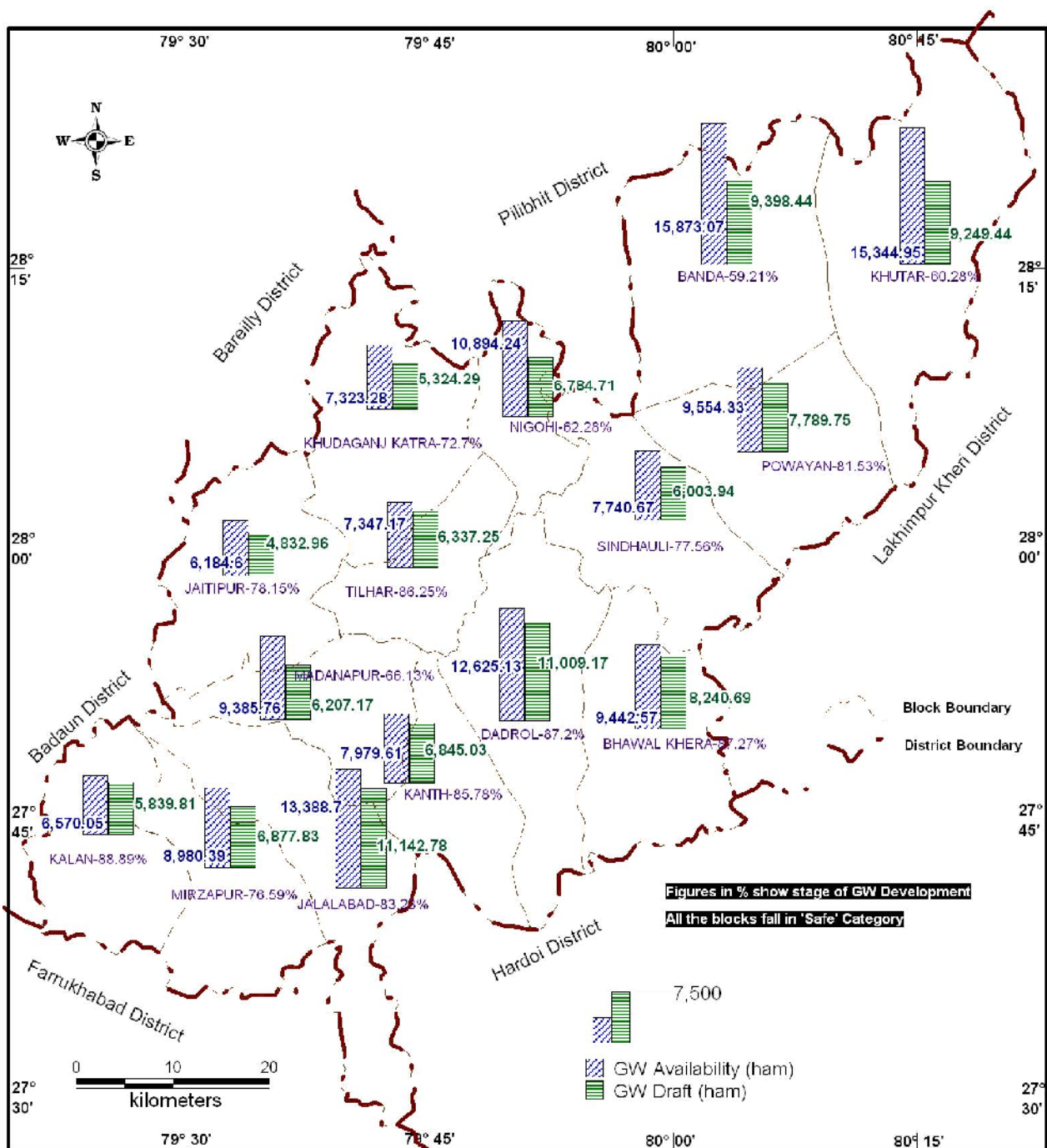




### Depth to Water Level in Shahjahanpur District, UP Post-monsoon 2012



### Block-wise Dynamic GW Resource in Shahjahanpur District, UP (As on 31.3.2009)



## APPENDIX-I

Sl. No.	LOCATION	Block	TYPE OF WELL	DEPTH DRILLED (mbgl)	DEPTH CONSTRUCTED (mbgl)	AQUIFER ZONES TAPPED (mbgl)	STATIC WATER LEVEL (mbgl)	DISCHARGE (lpm)	DRAW DOWN (m)	SPECIFIC CAPACITY (lpm/m) of DD	TRANSMISSIVITY, T (m ² /day)	STORATIVITY, S	REMARKS
1	<b>BARAGAON</b>	Powayan	SH	456.00	220.00	26-32; 33-44; 48-66; 96-79; 90-111; 121-146; 153-166; 180-187; 192-217	---	---	---	---	---	---	
2	<b>BHATAURA PRITHV</b>	Nigohi	EW	450.08	260.00	61-63; 93-111; 126-138; 147-159; 171-183; 192-204; 210-219; 234-246; 250-256							Pumping Test not conducted
3	<b>IMALIA</b>	Jalalabad	EW	450.00	134.00	60-66; 81-84; 102--129	3.13	2028	17.80	114.00	164		
4	<b>LALPUR BARAGAON</b>	Tilhar	EW	453.86	343.00	55-61; 84-90; 111-123; 185-197; 240-264; 320-338							Pumping Test not conducted
5	<b>PATNI (RANMASTPUR BUZURG)</b>	Banda	EW	442.09	315.00	66-84; 102-108; 114-126; 144-162; 186-192; 204-216; 240-246; 258-264; 281-287; 305-311							Pumping Test not conducted
6	<b>RAMAPUR-I (JAMEEMA MUNWARGANJ)</b>	Kanth	EW	160.00	160.00	46-58; 64-82; 110-118; 136-154	4.38	1483	22.92	64.70			
7	<b>RAMAPUR-II</b>	Kanth	EW	451.41	405.00	196-208; 214-220; 268-280; 304-322; 364-382; 394-400	13.93	904	7.81	115.75			Pumping Test not conducted
8	<b>SATWAN BUZURG</b>	Powayan	EW	451.00	435.00	90-102; 114-126; 138-150; 156-168; 186-198; 222-234; 273-279; 291-297; 321-327; 345-351; 363-369; 417-429							Pumping Test not conducted
9	<b>MES SHAHJAHANPUR</b>	Bhawal Khera	EW	363.80	189.00	84-96; 122-132; 144-160; 172-184	6.80	2074	2.42	857.02			
10	<b>ORDNANCE CLOTHING FACTORY SHAHJAHANPUR</b>	Bhawal Khera	EW	261.00	250.00	60-64; 90-94; 107-111; 130-134; 196-200; 213-217; 241-245	8.70	1983	3.80	521.84	2010	3x10 ⁻³	
11	<b>JALALABAD</b>	Jalalabad	EW	240.00	238.00	132-135; 156-162; 174-177; 209-221; 224-233							Pumping Test not conducted



APPENDIX-II

**Dynamic Ground Water Resources, Shahjahanpur District, UP  
(as on 31.03.2009)**

<b>Block</b>	<b>Net Annual GW availability (in ham)</b>	<b>Existing gross GW draft for Irrigation (in ham)</b>	<b>Existing gross GW draft for Domestic &amp; Industrial Water Supply (in ham)</b>	<b>Existing gross GW draft for all uses (in ham)</b>	<b>Provision for domestic &amp; industrial supply for 2025 (ham)</b>	<b>Net GW Availability for future development for irrigation (ham)</b>	<b>Stage of GW development (in %)</b>	<b>Category</b>
Banda	15873.07	8968.40	430.04	9398.44	604.05	6300.62	59.21	Safe
Bhawal Khera	9442.57	7694.28	546.41	8240.69	808.27	940.02	87.27	Safe
Dadraul	12625.13	10689.17	320.00	11009.17	389.36	1546.60	87.20	Safe
Jaitpur	6184.60	4575.00	257.96	4832.96	284.66	1324.94	78.15	Safe
Jalalabad	13388.70	10801.64	341.14	11142.78	355.92	2231.14	83.23	Safe
Kalan	6570.05	5477.90	361.91	5839.81	526.36	565.79	88.89	Safe
Kanth	7979.61	6564.63	280.40	6845.03	373.55	1041.43	85.78	Safe
Katra	7323.28	5022.20	302.09	5324.29	406.21	1894.87	72.70	Safe
Khutar	15344.95	9003.84	245.60	9249.44	245.60	6095.51	60.28	Safe
Madnapur	9385.76	5901.40	305.77	6207.17	407.34	3077.02	66.13	Safe
Mirzapur	8980.39	6569.20	308.63	6877.83	420.11	1991.08	76.59	Safe
Nigohi	10894.24	6422.13	362.58	6784.71	504.40	3967.71	62.28	Safe
Puwayan	9554.33	7442.64	347.11	7789.75	489.49	1622.20	81.53	Safe
Shidhauri	7740.67	5624.58	379.36	6003.94	526.03	1590.06	77.56	Safe
Tilhar	7347.17	6058.37	278.88	6337.25	330.79	958.01	86.25	Safe
<b>Total District</b>	<b>148634.50</b>	<b>106815.38</b>	<b>5067.88</b>	<b>111883.26</b>	<b>6672.14</b>	<b>35146.98</b>	<b>75.27</b>	