NATURE AND CHARACTERISTICS OF AQUIFERS IN MAU DISTRICT: A GEOGRAPHYCAL STUDY

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ABSTRACT

Geology of any region refers to its history of sequential occurrence of rocks. It presents origin, nature and structure of rocks. Occurrence, nature and structure of rocks help to know about their water bearing properties. Generally, alluvium rocks mainly *kankar* and sand or *bazari* and sand denotes better water bearing properties of rocks due to its porosity, permeability and specific yield, which determine the capacity of rocks to hold and transmit water. Alluvium deposits consisting of medium to coarse grained sand are the main source of groundwater for tube wells of the study area. The water table depth and its recharge is controlled not only by climatic factors and relief but also by hydro-geological characteristics of rock formation. The water table stage fluctuates almost continually under the combined influence of a set of forces-causing recharge to or discharge from the groundwater reservoir. But this recharging and discharging properties depends upon nature and structure of rocks mainly on porosity, permeability, thickness and transmissibility of geologic formations. The hydro-geological studies indicate that near groundwater occurs under water table condition while deeper aquifer occurs under semi-confined conditions and water table stage reflects the quantity of groundwater in storage. The water bearing characteristics of a stratum is noted by borings. It is generally determined by on spot examination of the hydraulic pressure prevailing in the stratum by the level to which water rises in the boring tube. It is noted that in non-water bearing stratum, the water level in the tube is appreciably lower than the static level, while in a water bearing stratum, it either approximates to or is higher than the static level.

The main objective of the present paper is to know the hydro-geologic conditions of the study area in reference to water bearing stratum because the study area is predominantly agrarian in nature and farmers are highly dependent on irrigation due to irregularity and unreliability of monsoon.

Key Words: Groundwater, Recharge, Discharge, Hydro-geologic condition, Aquifer, Porosity, Permeability, Water table.

Introduction: The groundwater is more widely and easily available than surface water in study area due to good aquifer zones under the surface. But due to better porosity, permeability, transmisity and specific yield of the alluvial formation, some parts of the study area have much groundwater availability and also have a high irrigation intensity. Although, groundwater fluctuation occurs mainly due to variation in local rainfall and pumping by means of groundwater irrigation but recharge and storage of groundwater depends upon its geologic formation. Therefore, hydro-geologic conditions related with groundwater storage have been identified and discussed in present research paper along with spatial variation of groundwater potential in aquifers, its characteristics and recharge from surface water.

Objective: The main objective of the present research paper is to analyze hydro-geologic conditions of the study area in reference to water bearing stratum with the help of strata chart obtained from tube-well borings. The present study also assesses the state of groundwater resources of Mau district. It includes the occurrence of groundwater in reference to hydro-geologic conditions and water bearing characteristics.

Data Source and Methodology: In the present work secondary data have been collected from different governmental offices. Data related to groundwater aquifer characteristics and hydro-geological conditions have

been obtained from Tube-well Division, Irrigation Department, Mau. On the basis of strata chart geological sections and panel diagram have been drawn and tried to describe and explain the various facts and features of hydro-geologic conditions of the study area.

The Study Area: The study area (District Mau), earlier the part of Azamgarh district was created as a new district on November 19th, 1989. It is situated between the Ghaghara (north) and Bhainsathi rivers (south) and extends between 25° 38´ to 26° 27´ N and 83° 15´ to 83° 47´ E. It covers an area of 1727.96 sq. km. Mau district is divided into four tahsils and nine development blocks namely Paradaha, Kopaganj and Ratanpura development blocks in Mau Sadar, Bardraon, Ghosi and Dohrighat in Ghosi and Muhammadabad Gohana and Ranipur in Muhammadabad Tahsil. There is a single block Fatehpur Mandaon in Madhuvan tahsil. Geological conditions have greatly influenced the hydrological characteristics of the study area. Geologically, the study area is the part of the Great Indo-Gangetic Plain as such is composed of rich alluvial deposits of the rivers Ghaghara, Tons and Bhainsathi. On the basis of the structure, sediment deposition and the highest point of the watersheds of the different channels the district may be divided into three physical units namely (i) The Northern *Kachhar* plain, (ii) The Central Upland *Bangar* plain and (iii) The Southern Lowland *Bangar* Plain. The drainage system consists of important perennial river the Ghaghara and its tributaries and the seasonal rivers namely Tons, Bainsathi, Lerul and Mangai. The district enjoys the tropical monsoon type of climate with seasonal variations in temperature, rainfall and humidity. The mean annual temperature is observed as 25.97°C with annual average rainfall of 83.30 cm. The nature has endowed the Mau district with plentiful supplies of both surface and groundwater.

GEOLOGY The prevailing geological conditions of any region greatly influence the hydrological characteristics; hence the study of geology of Mau district is quite obvious. Geologically, the study area is the part of the Great Indo-Gangetic Plain. It lies in the Ganga-Ghaghra Plain that is why, the area is composed of rich alluvial deposits by the rivers emerging from the Himalaya (**Wadia, 1975**).Alluvium deposits of the study area are related from Pleistocene to Recent Age. The older alluvium, i.e. locally called as "*Bangar*" is of Mid-Pleistocene Age and has formed due to floods and lies well above the present highest flood level of the river. In contrast newer alluvium, Recent to Pleistocene in age, occupies a lower elevation and forms the flood plains of the present day rivers. The geological sequence, lithology and water bearing characteristics of the rock structure of the area is presented in Table 1.

NATURE AND CHARACTERISTICS OF ALLUVIUM

Analysis of strata charts of tube-wells obtained from government and private sources have not only helped to reveal the sub-surface geology and the nature and extent of aquifers and aquitards in the study area but have also helped to determine the amount and extent of the availability of groundwater. The aero-magnetic surveys of the Indo-Gangetic Plain indicate that the basement depth contour for this plain some time even exceeds 7620 m. in thickness. The nature and characteristics of the alluvium have been studied from the geological section prepared from the logs of the State Tube-Wells in the study area (Figs. 1, 2, 3, 4, and 5).

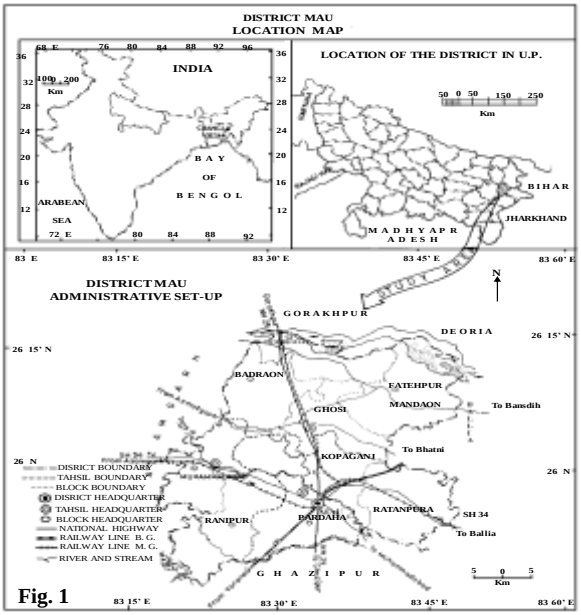
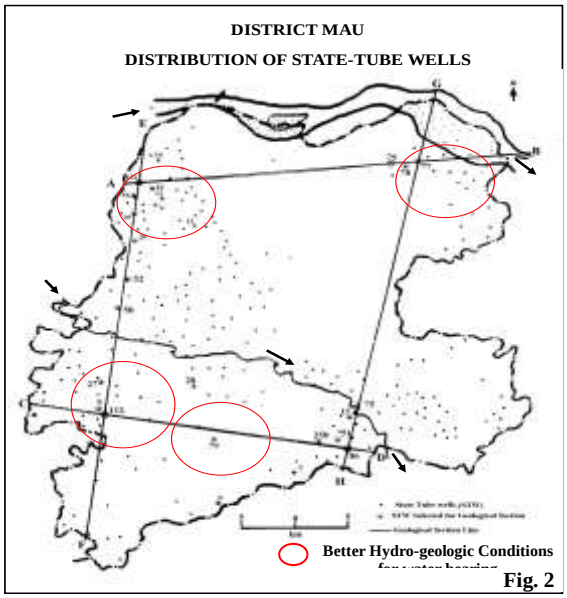


Fig. 1



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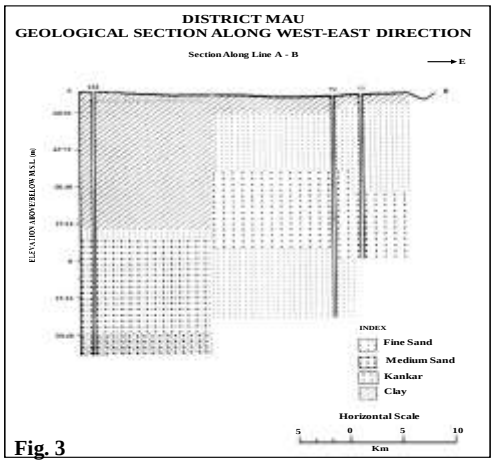
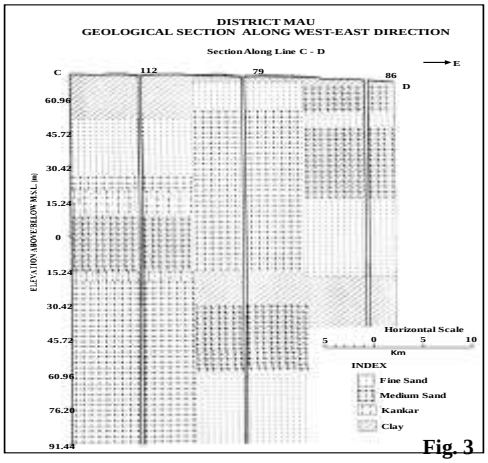


Fig. 3



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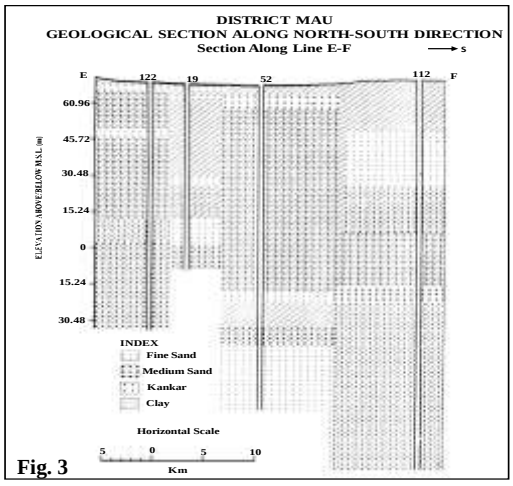

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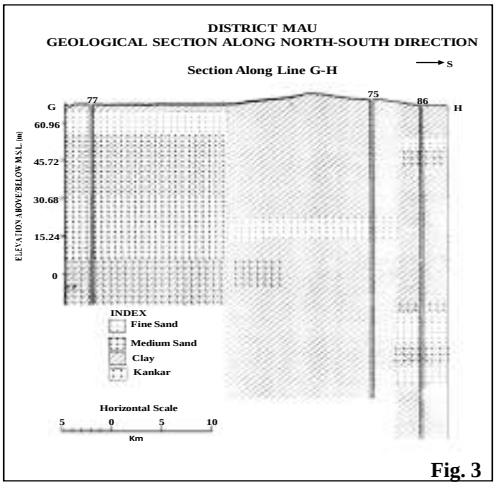


Fig. 3

Table-1 : District Mau: Generalized Stratigraphical Sequence

	System	Series	Lithology	Water Bearing Properties
QUATERNARY	Recent to Upper Pleistocene	Newer Alluvium	Sand of different Grades, gravel and clay	Coarse sediments yields moderate to abundant supply of water to wells
	Upper to Middle Pleistocene	Older Alluvium	Clay, clay with *Kankar*,fine, Medium and Coarse grained sand	
UNCONFORMY				
Rocks of unknown age, possibly the extension of Puranas of Peninsular India				

Source: Based on D.N. Wadia (1975) 'Geology of India' pp.364-375.

Well log gives a vertical section up to the depth reached by the well. The position of the tube-well lines (A-B, C-D, E-F and G-H) along which the sections drawn are shown in Figs. 2, 3, 4, and 5. The details of the various features observed from a study of these sections, for instance, character of sediments, their lateral and vertical extent, succession and correlation etc. are examined below.

The profiles depicting the sub-surface geology of various parts of the study area have been drawn in Figs. 2, 3, 4, and 5. The alluvium of the district up to the depth of 400 m. below ground (300 m. below mean sea level) is of the same lithological types that are being deposited in the region of present. In the study area, the type of sediments varies at some distance along the section. Surface clay is found at all places but where top layer has been removed the thickness of surface clay is very thin. The alluvium soil of the district is comprised of principally clay, sand, *kankar* and sandstone. The *kankar* has been formed as a result of precipitation of calcium carbonate from groundwater. Beds of *kankar* which possess little sand or clay, may have resulted from resorting of the older deposits by streams. The total thickness of aquifers or water bearing strata varies from 30 m. to 70 m.

The section along line A-B passes through *kachhar* region of Badraon, Dohrighat and Fatehpur Mandaon blocks which shows the sub-surface geology of northern part of the region (Fig. 2). The surface slope is towards the east. The north-western and north-eastern parts are higher than the middle part by about 5 m. The upper layer of this part is

also composed of surface clay whose thickness is about 4 m. in the west, 10 m. in the middle part and 5 m. in the east. Below the surface clay lies fine and fine medium sand which has thickness of about 3 m. in the west to west-middle part and 115 m. in the middle and eastern part. Middle and eastern part of the region are fully made up of fine and medium sand which have no any inclusion of other depositions whereas in north-western part, mainly in Badraon, an inclusion of '*kankar'* with clay is found below the fine sand at the depth of 55-60 m. Again 45 m. thick bed of fine sand with inclusion of *kankar* lies below it. The occurrence of *clay-kankar* bed is noted only in the western part. Where as except to clay bed in upper part of the middle and eastern region, along section line, the whole sub-surface area has been made up of fine and medium sand. Therefore, northern *kachhar* area has large aquifers or water bearing stratum.

The section along line C-D passes through southern lowland *Bangar* region in Mohammadabad, Ranipur, Pardaha, and Ratanpura blocks (Fig. 3). It shows the surface geology of the southern region. The surface slope

goes down slowly towards east which is 4 m. higher in the westward than eastward. The top layer in this region is composed of surface clay which is about 20 m. thick in the west, 4 m in the middle with fine sand inclusion and 15 m. thick with *kankar* inclusion in the east. Below the surface clay bed fine sand lies which is 22 m. thick in western part, 15 m. thick in middle part and less than 7 m. thick in eastern part. Below the bed of fine sand, thick bed of fine sand with inclusion of *kankar* and medium sand lies in the western (20 m.) and middle part (60 m.) whereas in the east part clay bed lies with inclusion of *kankar*. After in 21 m. thick bed of clay lies with kankar inclusion, in western part, 45 m. thick in middle part and 40 m. in the eastern part. Below it, 80 m. thick bed of fine sand with *kankar* inclusion in the west part and 30 m. thick of fine sand are observed in the middle part.

In summary, Southern Lowland *Bangar* region has thick water bearing strata with inclusion of clay. This stratum is thicker in the western and middle part than the eastern. The section along line E-F passes through the western part of the district from Ranipur, Muhammadabad and Badraon blocks which shows the geology of the western part (Fig. 4). The southern part is 7 m. higher than the middle part whereas northern part is 3 m. higher than middle part. The top layer in the region is composed of surface clay which is 1-2 m thick in the north, 5-7 m. thick in the middle and 20 m. thick in southern part. Below this bed geology of southern part is firstly made up of fine sand of 20 m. thick bed of clay with *kankar* and 90-100 m. thick bed of fine sand with inclusion of *kankar* whereas the sub-surface of northern and middle part are mainly made up of clay with *kankar* inclusion.

Similarly, the section line G-H presents the geological structure of eastern part (Fig. 5). It shows that middle part of eastern region is 5-7 m. higher than the northern and southern part. It shows that the surface layer is made up of 4-5 m. thick clay bed. In the middle part surface clay is 45-50 m. thick and in northern part it is about 15 m. thick. Below the surface clay, 45-50 m. thick bed of fine sand with inclusion of medium sand lies in the northern part and 7 m. in middle and southern part. After that, clay inclusion with *kankar* lies which is 20 m. thick in the south. Clay of middle part has no any inclusion of other rocks. In summary, northern part has good aquifers because of fine sand, medium sand and clay with inclusion of *kankar* whereas middle and southern part has not good aquifers due to clay and hard clay. In general, the thickness of aquifer increases from west to east and south to north direction. In western and east-southern part, the thickness of aquifer is quite less. Again in the middle and south-west direction the thickness has increased.

There is marked lateral variation in the occurrence of different beds in the alluvium. For example, a particular bed found at a certain elevation above the mean sea level may not be present in adjoining tube-well strata at the same elevation. In fact, the beds are lenticular in shape with rapid lateral and vertical graduation in grain size a characteristics feature of the alluvium deposits (**Geddes, 1960**). In general, the medium to coarse sand either alone or in association with *kankar* or fine sand generally correspond to the meander belt deposits.

SOME CONSIDERATIONS IN THE ASSESSMENT OF GROUNDWATER RESOURCE

Groundwater is one of the earth's most widely distributed important natural resource. The water that occurs beneath the earth surface is variously called as sub-surface water or groundwater or subterranean water. However, it can be divided into two parts, namely, the soil moisture and the groundwater. The former occurs

above the zone of saturation whereas the latter occur below it. The groundwater is found in appreciable amount in permeable geologic formations, known as aquifers. These formations permit appreciable amount of water through them under ordinary field conditions. In close association with aquifers occur aquicludes which are impermeable formations containing water but are incapable of transmitting the same in significant quantities. Clay formation presents an example of an aquiclude. An aquifuge is an impermeable formation neither containing nor transmitting water, compact granite belongs to this group (**Singh, 1983**).

The inter mineral space of a rock or soil may be occupied by the groundwater. Free or unoccupied spaces are known as voids, interstices or pores. These pores are of fundamental importance in the assessment of groundwater potential, because they can act as groundwater conduit. Their size, shape, irregularity and distribution in a rock or soil determine the quantity of groundwater that may be available in an area. Thus, porosity is the measure of the amount of interstices present in a rock or soil formation. It is expressed as the percentage of the volume of the rock mass. Granular sedimentary deposits are of major significance in the availability of groundwater (**Singh, 1983**).

Thomas (**1951**) has described various suitable geological formations that act as aquifers. Probably 90 per cent of all developed aquifers consist of unconsolidated rock, chiefly gravel and sand. Sandstone and conglomerate are cemented forms of sand and gravel. As such, their porosity and yield are reduced by the cementing. The best sandstone aquifers are those which are only partially cemented or those which yield water through their joins. Conglomerates generally have a local distribution and are, therefore, unimportant as aquifers. Crystalline and metamorphic rocks are relatively impermeable and are poor aquifers. But under fracture and decayed conditions, these rocks can yield small amount of water for domestic purposes. Although, clay or coarser material mixed with clay are generally porous, yet their pores are so small that they permit little amount of water. Hence they can be considered as relatively impermeable. Nevertheless, clayey soil does yield small quantities of water from shallow wells which can be used for domestic purposes.

Large aquifers, with great areal extents, may be visualized as underground storage by gravitational force and can be extracted by the wells. Aquifers may be classified as unconfined and confined, depending upon the presence or absence of a water table. An unconfined aquifer is one in which the water table serves as the upper surface of the zone of saturation. It is known as free, phreatic or non artesian aquifers. The water table may be of an undulating nature or it may slope in a particular direction depending upon pumpage from wells, permeability and topographic conditions. Confined aquifers, also known as artesian or pressure aquifers, occur when groundwater is confined under great pressure by the overlying impermeable strata (**Singh, 1983**).

The piezometric surface of a confined aquifer is imaginary surface coinciding with the hydrostatic pressure level of water in the aquifer. The water level in a well penetrating a confined aquifer defines the elevation of the piezometric surface at the point. Contour maps and profiles of the piezometric surface can be prepared from water table data obtained from wells.

HYDRO-GEOLOGIC CONDITIONS

The hydro-geological condition of the study area contains two types of alluvium layer i.e. older alluvium and newer alluvium. Older alluvium is made up with brown clay with sandy beds at depth, which is known as *bangar*. Whereas, newer alluvium is made up of sandy, silty clay on old alluvium layer and known as *khadar*.

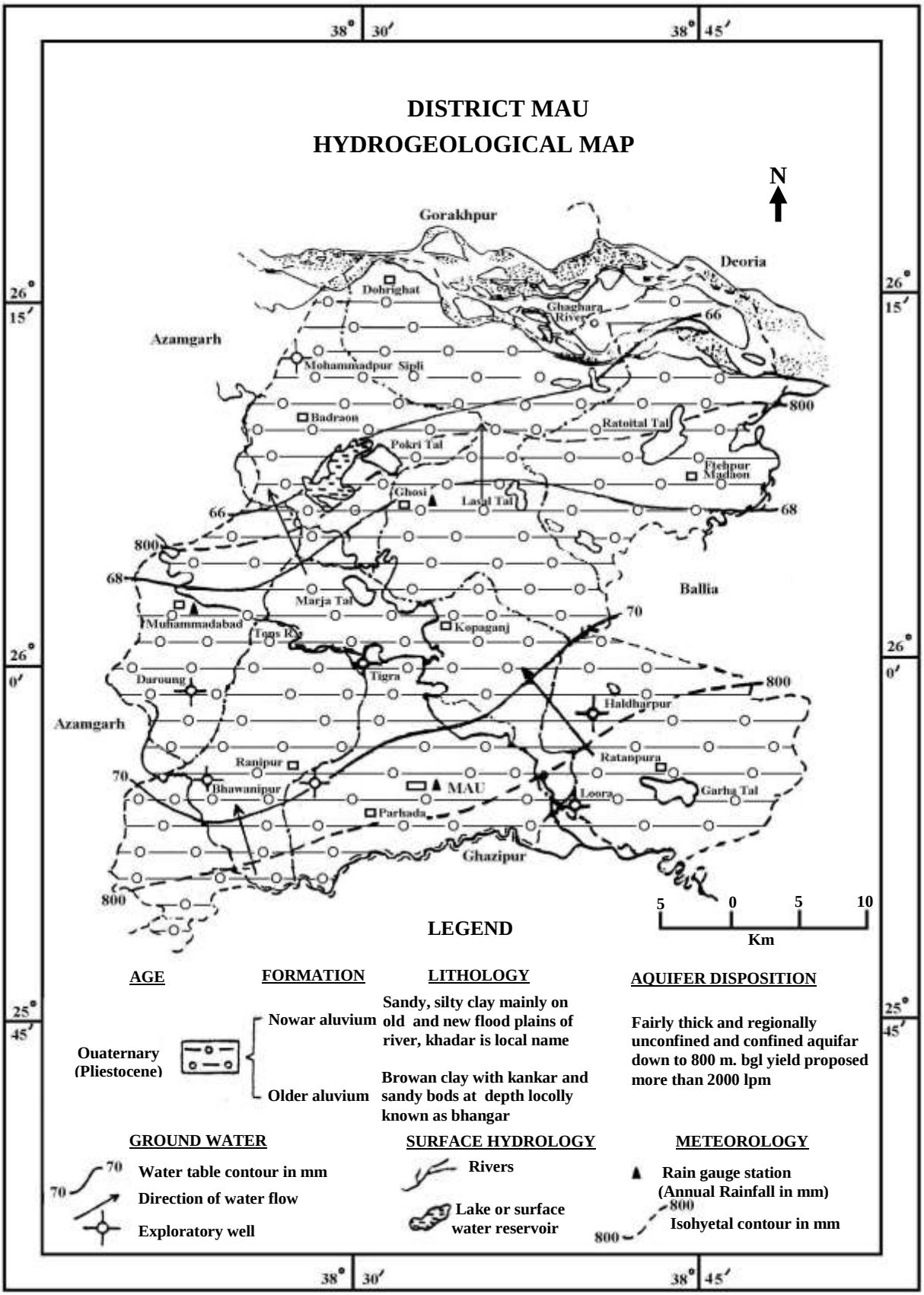
In Mau district, the groundwater occurs in the inter granular pore spaces. Sand and gravel layers act as repository of groundwater. The groundwater exists under water table condition and/or the sediments possess zone of clay. The groundwater is found under the semi-confined to confined conditions in the district (Hydro-geological Map, Fig. 6). Fairly thick and regionally unconfined and confined aquifers are found down to 800 m below ground level and estimated yield has been more than 2000 lpm (litre per minute). Groundwater flows from south to north direction beneath the surface. Water table contour increases from north to south direction which is 66 mm in north *kachhar* region and 70 mm in lowland *Bangar* region (Tab. 2, 3 and 4 and Fig. 6, **Government of Uttar Pradesh, 2010**). Based on the behavior and occurrence of groundwater, the regional groundwater flow system of the district has been described below:

I. SHALLOW AQUIFER ZONE: The shallow aquifer occurring within a depth of 50 m from land surface is considered of a mixture of sand, silt and clay with calcareous nodules (*kankar*) at places. The thickness of the saturated sediments varies from 5 to 24 m. Groundwater in this sediment generally occurs under the water table to semi-confined condition. There are many shallow tube-wells for domestic and irrigational uses in the district by tapping 3 to 12 m zone within 50 m depth.

II. DEEPER AQUIFER ZONE:

A large number of tube-wells have been bored through out the district emphasizing a clear hydrological picture. A perusal of lithological logs shows that there is considerable variation in the granularity and thickness of the aquifers of the study area. The aquifers consist of fine to medium coarse grained sand with intercalation of clay. Here groundwater occurs under confined to semi-confined condition in them. The first aquifers lie between the depth range of 60-140 mbgl (meters below ground level) while the second aquifers lie from 300-400 mbgl in depth range and third aquifers are observed

between the depth range of 450 and550 mbgl in the area. Based on exploratory readings, the block wise position of the water bearing zones are presented below:



Source: CGWB, Drg. No. 1806/05

Fig.- 6

Table 2: District Mau: Blockwise Position of Groundwater Bearing Zone (Badraon,Dohrighat,Fatehpur Mandaon)

a.	Shallow Zone Aquifers 22.40- 44.65 mbgl	Average thickness 22 m (Decreasing towards south)
b.	Deeper Aquifer Zone 67.10 - 73.10 mbgl. .. . .6.0 m 74.50 - 77.50 mbgl. . . .3.0 m 90.50 - 113.500mbgl. . .23.0 m	Cumulative thickness 32.0 m

Table 3: District Mau: Blockwise Position of Groundwater Bearing Zone (Mohammadabad, Kopaganj and Ghosi)

a.	Shallow Zone Aquifers 27.50-39.50 mbgl	Average thickness 12 m (Decreasing towards south)
b.	Deeper Aquifer Zone 375-387 mbgl . . ..12.0 m 393-405 mbgl . . . 10.0 m 426-132 mbgl . . . 6.0 m 459-417 mbgl . . . 12.0 m 477-483 mbgl . . . 6.0 m 513-525 mbgl . . . 12.0 m	Cumulative thickness 60.0 m

Table-4: District Mau: Blockwise Position of Groundwater Bearing Zone (Ranipur, Pardaha and Ratanpura)

a.	Shallow Zone Aquifers 23.50-47.50 mbgl	Average thickness 24.0 m (Decreasing towards south)
b.	Deeper Aquifer Zone 362-374 mbgl . . 12.0 m 399-409 mbgl . . 10.0 m 442-448 mbgl . . 6.0 m 466-472 mbgl . . 6.0 m 475-484 mbgl . . . 9.0 m 499-505 mbgl . . . 6.0 m 508-514 mbgl . . . 6.0 m	Cumulative thickness 55.0 m

Source: Groundwater Department Division Azamgarh, Government of Uttar Pradesh, 2010

HYDRAULIC CHARACTERISTICS OF AQUIFERS

The hydraulic properties of the aquifers of the district have been evaluated by a number of pumping sets results in the study area given in Tab.5 and Fig. 7 which show that the alluvium deposits of the district are good repositories of groundwater. It also shows the presence of semi-confined to confined conditions of groundwater at places as is evidenced by low values of storage co-efficient which obviously are due to the

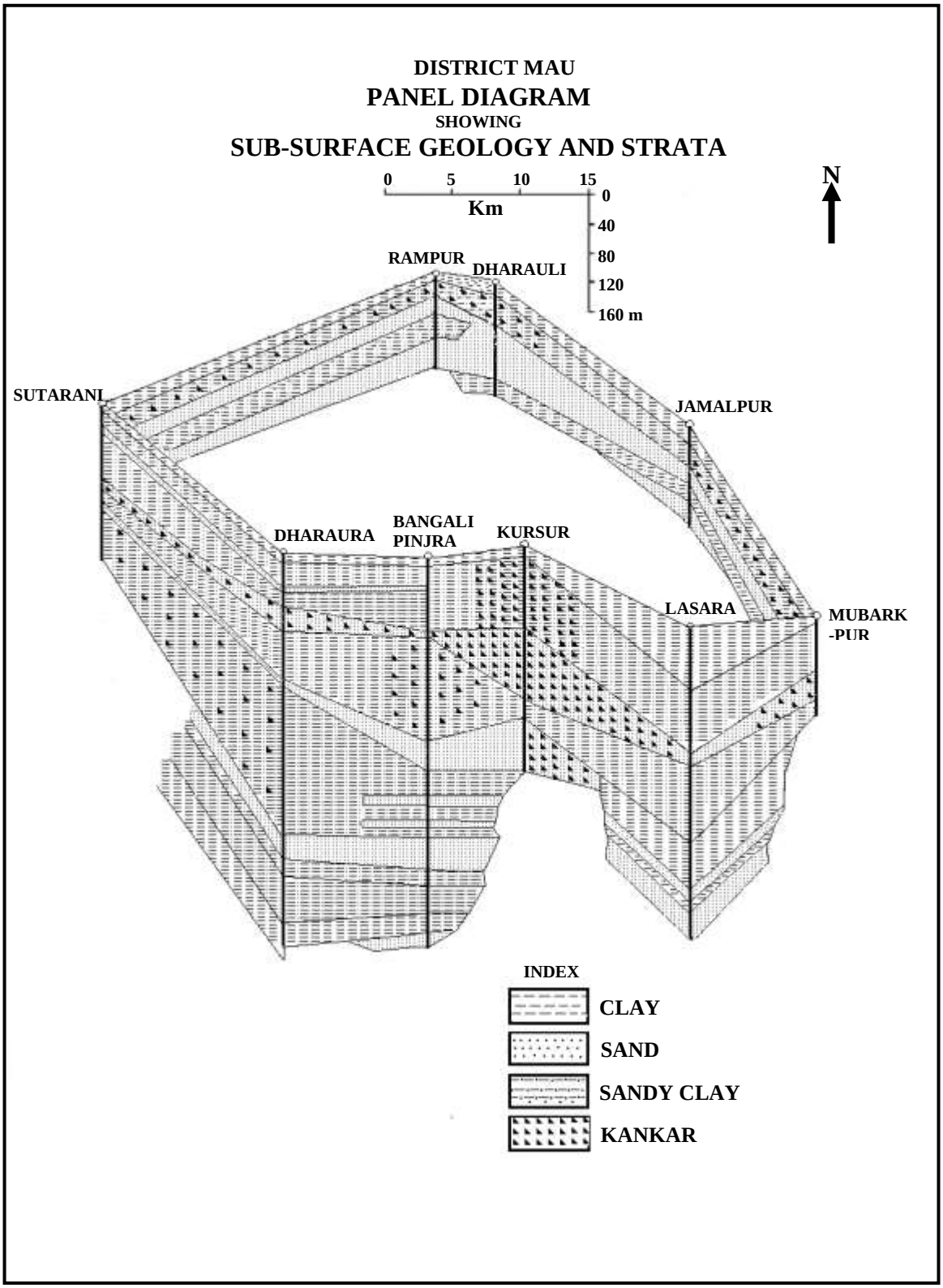
Table-5: District Mau: Hydrogeological Data of Exploratory Wells

Sl. No.	Location Latt./Log. Toposheet	Depth Drilled (mbgl)	Granular Zones Tapped (mbgl)	Thickness of aquifers (m)	Static Water Level (m)	Discharge (lpm)	Draw-Down (m)	Specific Capacity (lpm/m/DD)	Transmissivity(T) (m2/d)	Hydraulic Conducti-vity(m/d)	Storativity	Geology	Remarks
1	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	***11***	***12***	***13***	***14***
1	Bangle Pinjra 25°28’40’’N 83°23’40’’E (63O/5)	750.70	362-374 388-413 438-447 453-459	52	9.26	2330	11.29	206.38	1226	23.57	2.25×10^{4}	Alluvium	Potable Water
2	Bhavanipur-I 25°54’48’’N 83°23’15’’E	558.00	72-74	154	8.52	1514	5.89	257.04	999	6.49	-	Alluvium	Abnd lack of zones
3	Bhavanipur-I 25°54’48’’N 83°23’15’’E	558.00	72-74 124-130 145-158 295-302 318-383 394-455	154	8.52	1514	5.89	257.04	999	6.49	-	Alluvium	Potable Water
4	Darauna 25°51’18’’N 83°21’57’’E	761.20	375-387	60	9.08	2210	4.92	449.19	2913	48.55	-	Alluvium	Potable Water

Source: Groundwater Department Division, Azamgarh, Government of Uttar Pradesh, 2010

Source: Groundwater Department Division, Azamgarh, Government of Uttar Pradesh, 2010

Sl. No.	Location Latt./Log. Toposheet	Depth Drilled (mbgl)	Granular Zones Tapped (mbgl)	Thickness of aquifers (m)	Static Water Level (m)	Discharge (lpm)	Draw-Down (m)	Specific Capacity (lpm/m/DD)	Transmissivity(T) (m2/d)	Hydraulic Conductivity(m/d)	Storativity	Geology	Remarks
1	***2***	***3***	***4***	***5***	***6***	***7***	***8***	***9***	***10***	***11***	***12***	***13***	***14***
5	Haldharpur 26°56'50''N 83°42'50'E (63O/5)	593.12	-	-	-	-	-	-	-	-	-	Alluvium	Potable Water
6	Lasra 25°52'30''N 80°37'45''E	750.32	393-399 403-409 442-448 466-472 475-484 499-505 508-514	45	5.5	2330	11.96	194.82	4104	91.2	$2.95x10^{4}$	Alluvium	Potable Water
7	Mohmadpur 26°12'50''N 83°26'50''E (63N/8)	687.95 N.EN	48-59 68-74 79-96 249-262 283-291 300-325 345-357 417-423 448-482 498-539 558-565	-	-	-	-	-	-	-	-	Alluvium	Slim hole
8	Tigra-I 23°00'N 83°30'E	352.67	-	-	-	-	-	-	-	-	-	Alluvium	Abnd due to caving
9	Tigra-I 23°00'N 83°30'E	610.00	-	-	-	-	-	-	-	-	-	Alluvium	Abnd due to accident



Source: CGWB, Drg. No. 1807/05

Fig.-7

presence of calcareous (nodules) zone acting as aquicludes and giving rise to pressure conditions prevalent in the lower aquifer zone in the area. The wide range of hydraulic conductivity values indicates that the area is heterogeneous laterally. The wells yield copious quantities of water with economic drawdown from water bearing granular zones of alluvial tracts. A tube-well constructed in the alluvial sediment of the district within a depth of 600 m usually yields of the order of 150 to 250 m^3/hr. for drawdown of the order of 4.90 to 11.90 m.

while the tube-well in the shallow zone within a depth of 60 m yields 25.00 to 60 m^3/hr for drawdown of the 3.0 to 12.0 m. The transmissity value varies from 999 to 4104 m^2/day whereas storability varies from 2.25×10^4 to $2.95x10^4$. The hydraulic conductivity ranges from 6.49 to 91.20 m^2/day. However, yield of the wells, depth of water column and nature of wells are lining and the drawdown at which the well are pumped**.** Hydro-geological data of Exploratory Wells Drilled by CGWB in Mau district are given in Tab. 5 and Panel Diagram showing sub-surface geology and strata (Fig. 7).

Conclusion: Geological conditions have greatly influenced the hydrological characteristics of the study area. Geologically, the study area is the part of the Great Indo-Gangetic Plain lying in the Ganga-Ghaghra Plain and as such the area is composed of rich alluvial deposits of the rivers Ghaghara, Tons and Bhainsathi. Alluvium deposits of the study area are related from Pleistocene to Recent Age. Therefore, coarse sediments of newer and older alluvium have better water bearing properties and have capacity to yield moderate to abundant supply of water to wells. According to geological sections along lines A-B, C-D, E-F and G-H, the alluviums of the district is found up to the depth of 400 m. below ground (300 m. below mean sea level) and is of the same lithological types that is being deposited in the other areas. Surface clay is found at all places but where top layer has been removed the thickness of surface clay is very thin. The study area is underlain by a series of fresh water aquifer horizons down to great depth. Quaternary alluvium soil of the district is comprised of principally clay, sand, *kankar* and sandstone. The total thickness of aquifers or water bearing strata varies from 30 m. to 70 m. Therefore, northern *kachhar* area has large aquifers or water bearing stratum. Geohydrological studies carried out in the Mau district indicate that sub-surface groundwater occurs under water table conditions while deeper aquifer occurs under semi confined conditions. In general, the thickness of aquifer increases from west to east and south to north. In western part and in south-eastern part, the thickness of aquifer is quite less. Again in the middle and south-west direction the thickness increases. The beds are lenticular in shape with rapid lateral and vertical graduation in grain size a characteristics feature of the alluvium deposits. In general, the medium to coarse sand either alone or in association with *kankar* or fine sand generally correspond to the meander belt deposits.

REFERENCES

Goddess, Arthur, (1960). The Alluvial Morphology of the Indo-Gangetic plain, its mapping and geographical significance. Trans. Inst. British Geographers, vol. 28.

Government of Uttar Pradesh (2010). Blockwise Ground Water Resource Estimation of District – Mau. Groundwater Department Division, Azamgarh.

Singh, Usha. (1983). Assessment and Prospect of Water Resources in Eastern U.P. The National Geographical Society of India. BHU, Varanasi.

Thomas, H.E. (1951). The Conservation of Ground Water. Subject:Physical SettingMcGraw Hill, New York.
Wadia, D.N. (1997). Geology of India. McGraw Hill Publishing Co., New Delhi, pp. 364-375.