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Demarcation of Feasible Sites for Rainwater Harvesting Using Study of Storativity and Transmisivity in Sus Basin, Solapur District, Maharastra, India

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Abstract

The ground water holding capacity, of an aquifer is determined by knowing storativity and transmisivity. These hydrogeological parameters should be estimated as precisely as possible for quantitative assessment of the aquifer potential and to evolve appropriate strategies for the utilization of ground water. The aquifer parameters transmisivity and storage coefficient are important parameters to decide the groundwater potential in an area and helpful in determining the capacity of aquifer to store water and the ease with which water can flow through permeable zones. Also this helps in delineating areas feasible and non-feasible for artificial recharge. The present study is carried out in the Sus basin, a tributary of Bima River, the main feeder of Krishna River. The basin covers parts of Pandharpur, Mohol and Madha talukas of Solapur district Maharashtra, India. Located on toposheet no. 47 O/5 and 47 O/6 on the scale of 1:50,000 lies between ($17^{0}41^{'}$ to $17^{0}58^{'}$N Latitude $75^{0}20^{'}$ to $75^{0}30^{'}$E Longitude) Covering of an area of 350 sq.km.

Key Words: Aquifer, Storativity, Transmistivity, Permeable, Feasible

Introduction

Modern hydrology depends upon information of groundwater flow system. The flow system may be shallow, intermediate and deep. Precipitation and evapotranspiration depends up on several changes, influences shallow flow system. The deep systems are formed because of deep infiltration of water under favorable geological set up such as sedimentary basins and multiple aquifer systems, formed in the Deccan basalts with alternating permeable and impermeable formations. There are many existing methods for estimation of aquifer parameters. Slichter (1906) gave an equation for determining specific capacity of the wells. Adayalkar and Mani (1973) gave an empirical factor (580), this factor is multiplied with specific capacity value and transmissivity is calculated. Permeability estimation from storage and recovery was suggested by, Hvorster (1951). Jat et. al. (2004) presented a method of straight line for estimation of transmissivity and storage coefficient without the help of type curves.

Raju and Raghav Rao (1967) presented a method, for analysis, which avoids the problem of varying rate of inflow, during pumping of large diameter wells using Cooper Jocobs (1948) straight line method. Method for estimation of aquifer parameters in fractured rock, under linear (non-radial) flow condition, has successfully modified by Jat et al. (2004). Evolution of regional transmissivity pattern by nested squares finite difference model in Deccan trap region was proposed by Narayanpethakar et al. (1993). Pattern of ground water flow in multi aquifer system in the basaltic terrain was also proposed by Narayanpetkar et al. (2006).

Materials and Methods:-

Pumping tests were carried out in Sus basin by pumping water with normal pumps for 18 large diameter wells during August to November 2018. Variation in abstraction rate is monitored through 90 degree "v" notch and drawdown in the water level has been noted at frequent intervals. Pumping has been carried out for 150 to 180 minutes and recovery has been recorded for 170 to 200 minutes. Transmissivity and storativity were estimated by using modified Cooper Jacobs solution method which is in general use for estimation of aquifer parameters by pumping large diameter wells GSDA (2009) manual. The semilog plots of time vs draw down were made and following equation were used for estimation of T and S.

$$T = \frac{2.30 \times Q}{4\pi ds}$$

Where T=Coefficient transmissivity m^2/ day

Q= Average discharge per day

ds= slope of the graph.

$$S = \frac{2.25 \times T \times to}{D^2}$$

Where S = storage coefficient

T = Coefficient transmissivity

t0 =intersection of the graph of time
. since pump started vs drawdown with X axis

D = effective diameter of the well

Transmissivity and storativity so determined from the above equations are used as initial values to achieve refinement by the computer aided method suggested by Singh and Gupta (1988). Time drawdown and recovery curve with field and computed data for two sites are presented in fig. 1.

Result and Discussion:-

Table no. I show the results of aquifer parameter obtained from pump test analysis. Transmissivity (T) varies between 306.32 m^2/ day to 31.05m^2/ day and storativity (S), between 0.0037 and 0.102. The values are higher where weathered, highly jointed / fractured and zeolitic basalts from the earth and along the streams. The transmissivity values so obtained were plotted grid wise to determine regional transmissivity distribution by joining equal transmissivity values and contour map is drawn fig.2. This map reveled that near Khandali transmissivity is 306 m^2/day. Narayanchincholi, Padsali and Babulgoan have a transmissivity of 200 m^2/ day, while Modnimb, Shetphal and southern Padsali represent low transmissivity between, 31to58 m^2/day. The central and southern parts of Sus basin shows, transmissivity between100 to 200 m^2/day.

The distribution of storativity is also plotted grid wise and the distribution of (S) is represented by contour map fig.3. Storativity values are low near Aran, Modnimb, Shetphal and Telanwadi 0.005 to 0.015. While the storativity values are (0.1) higher in the north, that is near Solakarwadi and Padsali. In south near Tungat, Narayanchincholi, and Babulgoan storativity shows medium values 0.02 to 0.05.

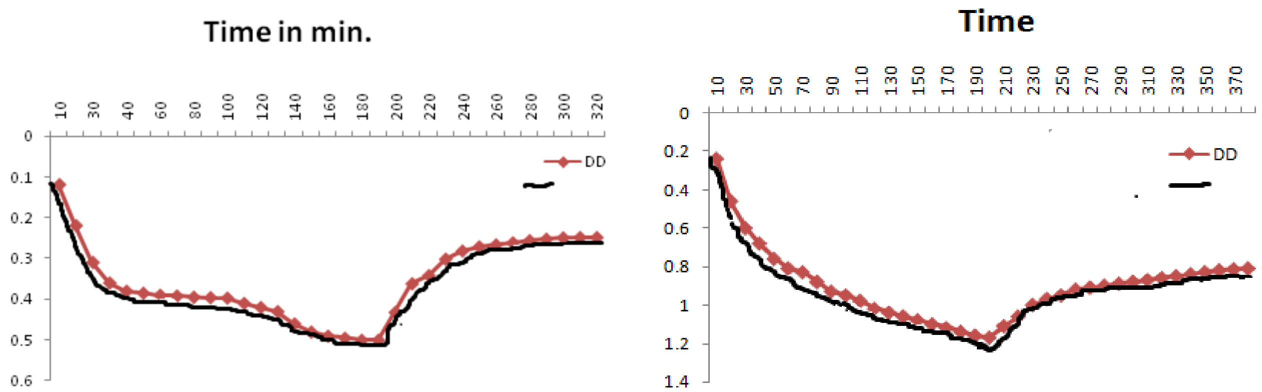

Fig. 1 Time drawdown and recovery curve for two sites

Table No. I

Storativity and Tranmissivity from aquifer test analysis for the different locations in Sus basin

Village	Latitude	Longitude	Storativity	Transmissivity
Padsali	17^0 96` 71”	75^0 39’ 43”	0.0037	38.117
Aran	17^0 94` 21”	75^0 36’ 96”	0.0142	119.86
Setphal	17^0 90`	75^0 43`	0.084	58.35
Modnimb	17^0 92` 47”	75^0 39’ 40”	0.0051	186.67
Solankarwadi	17^0 95` 48”	75^0 40’ 03”	0.0102	62.75
Siddewadi	17^0 92` 47”	75^0 39’ 40”	0.0087	69.70
Telangwadi	17^0 87` 47”	75^0 45’ 19”	0.0048	42.002
Khandali	17^0 84` 42”	75^0 46’ 22”	0.0261	306.32
Papri	17^0 81` 15”	75^0 46’ 68”	0.0121	150.17
Asti	17^0 85` 53”	75^0 40’ 59”	0.0093	145.40
Babulgoan	17^0 75` 57”	75^0 73’ 18”	0.03	194.43
Rople	17^0 79` 04”	75^0 39’ 37”	0.0143	136.38
Tungat	17^0 67` 42”	75^0 42’ 68”	0.0143	108.94
Narayanchincoli	17^0 67` 32”	75^0 39’ 92”	0.0158	203.73
Ishwarvathar	17^0 59` 23”	75^0 38’ 32”	0.0168	204.88
Degoan	17^0 92` 47”	75^0 39’ 40”	0.0099	196.22
Setphal	17^0 88` 52”	75^0 40’ 54”	0.0053	45.88
Modnimb	17^0 91` 94”	75^0 39’61”	0.012	31.05
Yeshwantanager	17^0 92` 47”	75^0 39’ 40”	0.018	127.21
Sidhewadi	17^0 92` 47”	75^0 39’ 40”	0.013	60.68

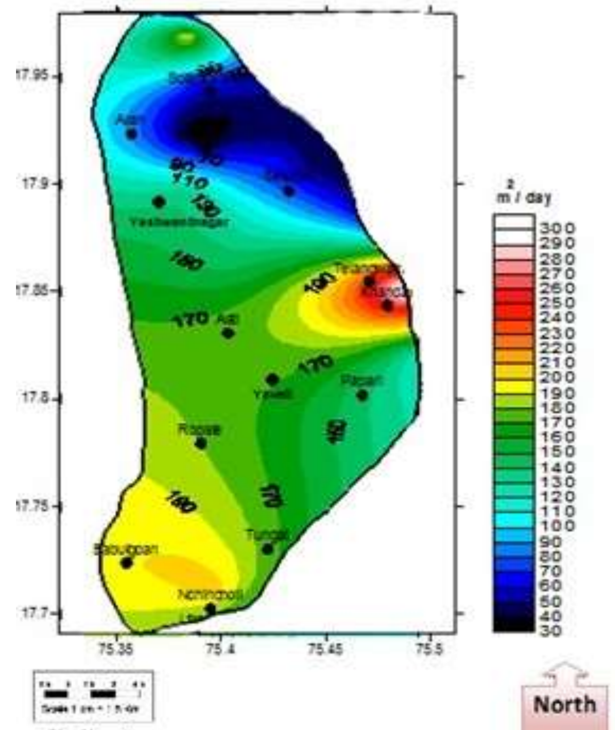

Fig. No. 2

TRNSMISSIVITY CONTOUR MAP OF SUS BASIN, SOLAPUR DISTRICT, MAHARASHTRA

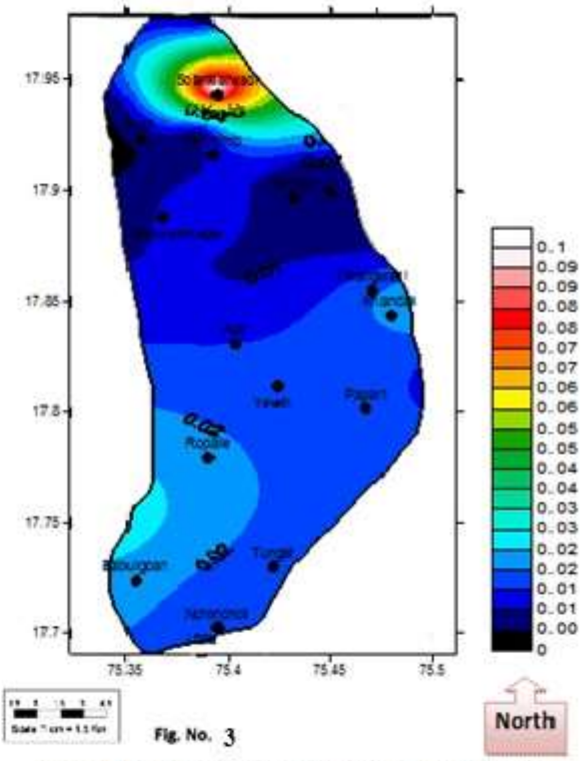

Fig. No. 3

STORATIVITY CONTOUR MAP OF SUS BASIN, SOLAPUR DISTRICT MAHARASHTRA

Conclusion:

It is concluded that the regional distribution of transmissivity and storativity of the weathered, jointed and fractured rocks are higher. When massive rock types make earth section the values are low. It is also noted that the basaltic terrain shows, the heterogeneous distribution of aquifer parameters. From the study, a rock formation of Sus basin has high transmissivity but moderate storativity. Both transmissivity and storativity value suggest that, demarcation of feasible sites for groundwater harvesting in Sus basin has southern and eastern parts of the Sus basin have feasible sites for groundwater harvesting and making the rain water harvesting structures.

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