MORPHOMETRIC ANALYSIS OF DRAINAGE BASIN OF AAM RIVER WATERSHED BY USIN GEOINFORMATICS

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Abstract: This study has been taken up to identify the groundwater recharge potential zones, to be used for better and improved groundwater resources. The thematic layers were first digitized from satellite imagery, supported by ancillary data such as topo -sheets and field investigation data. Groundwater recharge is a basic pre-requisite for efficient groundwater resource development and management, which is particularly vital for India with widely prevalent semi-arid and arid climate. In case the natural recharge is not sufficient, it has to be met through artificial recharge. To provide scientifically, appropriate locations for constructing artificial recharge structures, each hydro-geomorphic unit will be evaluated for its recharge potential and suitably a map showing such groundwater recharge potential zones for appropriate recharge will be prepared. Using remote sensing and geographic information system (GIS) it is possible to take number of different thematic maps of the same area and overlay them on top of one another to form a new integrated layer

IndexTerms: -

1. INTRODUCTION

Morphometric analysis is a mathematical Representation of earth's surface Morphometric analysis of a basin provides information about different aspects and characterizes the drainage system of basin in these aspects National Institute of Hydrology (1993) has studied the morphometric analysis of various basins and it was based on linear, aerial and relief aspects using different mathematical equations. The morphometric analysis can be done through measurement of different aspects like linear, aerial, relief, channel network, aspect and slope of the basin A Morphometric characteristic of hydrologic and geomorphic processes gives the information about the watershed formation in different scale [5]. The runoff of different catchment area and the geomorphologic structure are very sensitive and its dynamic nature was controlled by runoff and this structure gives the morphometric characteristics of the catchment of contributing area There are many morphological parameters such as stream length, stream number, stream order, drainage pattern; drainage density, bifurcation ratio and other linear aspects and relief aspects are studied using remote sensing and GIS technique and also a topographical map . Digital Elevation Model (DEM) data were used for landscaping and also used for generating the elevation model to use the digital elevation data.

2. STUDY AREA

The study area of Aam watershed, admeasuring 335.6 sq.km, in umred taluka in the Nagpur district of Maharashtra, and it extends north 20.761dd to 20.968dd and east 79.102dd to 79.3905dd, which lies in Survey of India toposheet bearing nos. 55P/1, 55P/5. The area is divided into three watershed WGA-2A,3A,4A..shown in figure1.

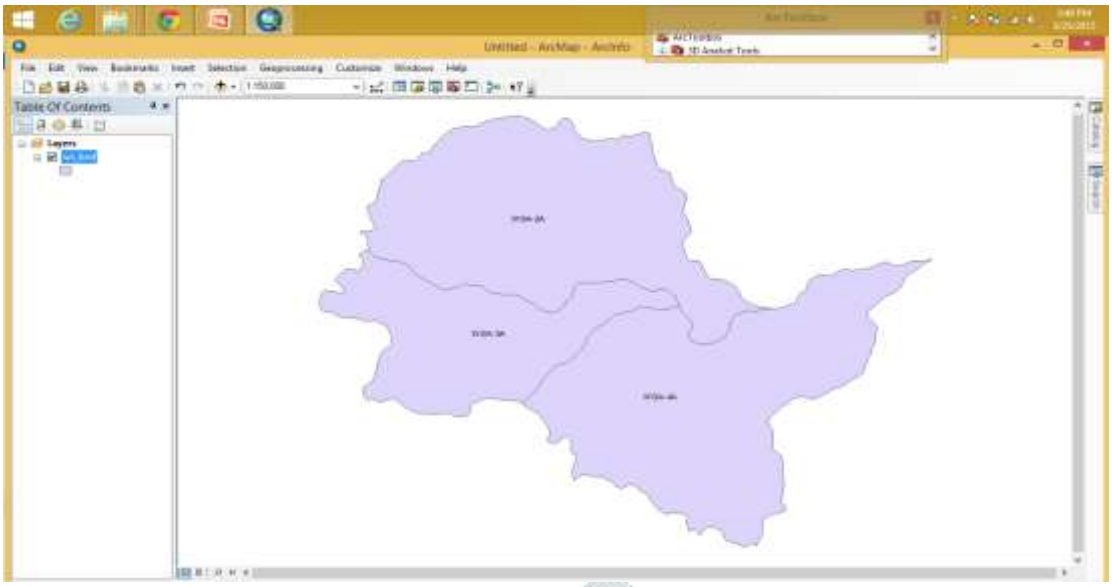

Figure 1showing the study area of Aam watershed WGA-2A,3A,4A

3. METHODOLOGY

First SOI toposheets no. 55P/1, 55P/5 are geocoded with the help of known ground control points (GCPs) on it. These geocoded toposheets are then mosaicked to create the boundary map of study area with relevant details, in the form of shape file using ArcGIS software. Clipping operation is carried out for obtaining required details for study area from the mosaicked toposheets. Using map to image registration technique provided by the Geomatica software image is geometrically rectified and registered with SOI toposheets on 1:50000 scale. The false colour composite (FCC) generated from red, green and blue spectral bands (1, 2 and 3). To enhance the satellite imagery linear, equalization and root enhancement techniques have been used for better interpretation of the geomorphological, soil, structural and other information for preparation of thematic maps from it. For digitization, editing, and topology creation of various features Arc-GIS software has been used.

4. MORPHOMETRIC ANALYSIS

The Morphometric analysis is a significant tool for prioritization of micro-watersheds even without considering the soil map (Biswas et al., 1999).Morphometry in general refers to the quantitative analysis of form, a concept that encompasses size and shape. Attempt to correlate statistical parameters defining drainage basin characteristics and basin hydrology is known as morphometric analysis.In the present study, morphometric analysis has been carried out using Geographical Information System (GIS) techniques to assess the geo-hydrological characteristics of Amb drainage basin through geo-morphometric parameters. For the prioritization of micro-watersheds, Morphometric analysis was done using the linear parameters such as bifurcation ratio (Rb), drainage density (Dd), drainage texture (Rt), length of overland flow (Lg), stream frequency (Fu) and the shape factor such as compactness coefficient (Cc), circularity ratio (Rc), elongation ratio (Re), shape factor (Bs), and form factor (Rf). Linear parameters have a direct relationship with erodability on contrary, the shape parameters have an inverse relation with erodability. Following shows the parameters that are considered for the Morphometric analysis.

Table2: Morphometric Parameters

Sr. No	Morphometric Parameters	Formula	Reference
1.	Stream order (U)	Hierarchical rank	Strahler (1964)
2.	Stream length (Lu)	Length of stream	Horton (1945)
3.	Mean stream length (Lsm)	Lsm = Lu/Nu Where, Lu = Total stream length of order 'u' Nu = Total no. of stream segments of order 'u'	Strahler (1964)
4.	Stream length ratio (Rl)	Rl = Lu/Lu-1 Where, Lu = Total stream length of order 'u' Lu-1 = Total stream length of its next lower order	Horton (1945)
5.	Bifurcation Ratio (Rb)	Rb = Nu/Nu+1 Where, Nu = Total no. of stream segments of order 'u' Nu+1 = Number of segments of the next higher order	Schumn (1956)
6.	Mean bifurcation ratio (Rbm)	Rbm = Average of bifurcation ratios of all orders	Strahler(1957)
7.	Basin length (Lb)	$Lb = 1.312*A^{0.568}$ Where, A= Area of the basin(km^2)	Noorkaratnam(2005)
8.	Drainage Density (Dd)	Dd = Lu/A Where, Lu = Total stream length of all orders A = Area of the basin (km^2)	Horton(1932)
9.	Stream frequency (Fs)	Fs = Nu/A Where, Nu = Total no of streams of all orders A = Area of the basin (Km^2)	Horton(1932)
10.	Drainage texture (Rt)	Rt = Nu/P Where, Nu = Total no of streams of all orders P = Perimeter (km)	Horton(1945)
11.	Form factor (Rf)	$Rf = A/Lb^2$ Where, A = Area of the basin (km^2) Lb^2 = Square of basin length	Horton(1932)
12.	Circularity Ratio (Rc)	$Rc = 4\pi A/P^2$ Where, A = Area of basin (km^2) P = Perimeter of the basin (km)	Miller(1953)
13.	Elongation ratio (Re)	$Re = (2/Lb)*(A/\pi)^{0.5}$ A =Area of the basin (km^2) Lb = Basin Length (km)	Schumn(1956)
14.	Length of flow (Lg)	Lg =2/Dd Where, Dd = Drainage density	Horton(1945)
15.	Compactness constant (Cc)	$Cc = 0.2821*P/A^{0.5}$ Where, P = Perimeter of basin(km) A = Area of the basin (km^2)	Horton(1945)

5. Classified Stream orders

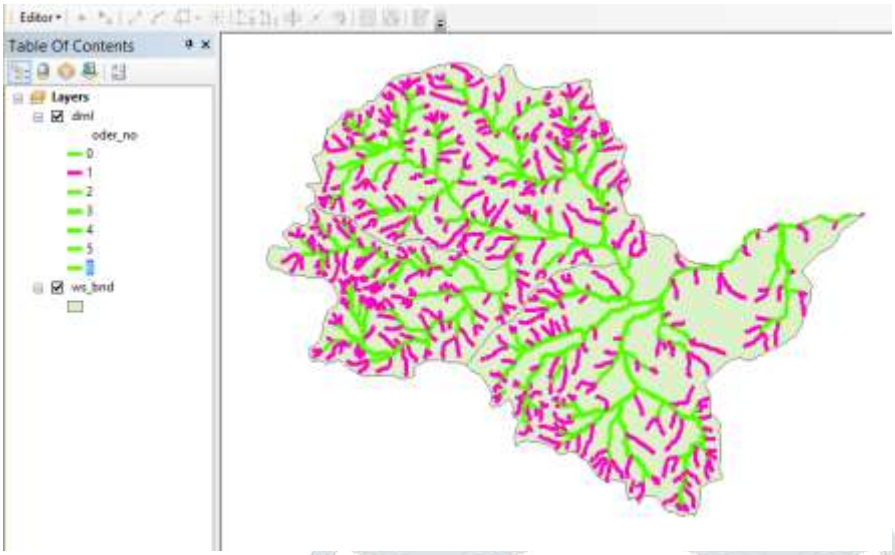

Figure 1:showing stream order no1

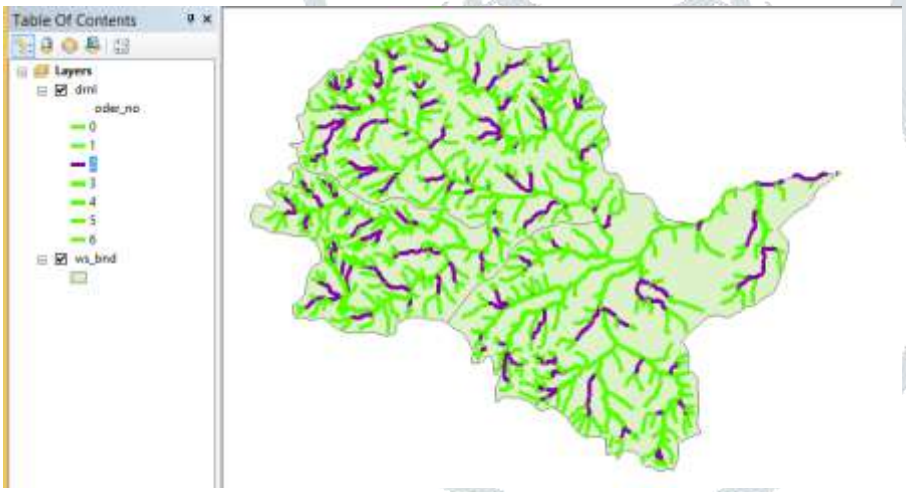

Figure.2 showing stream order no2

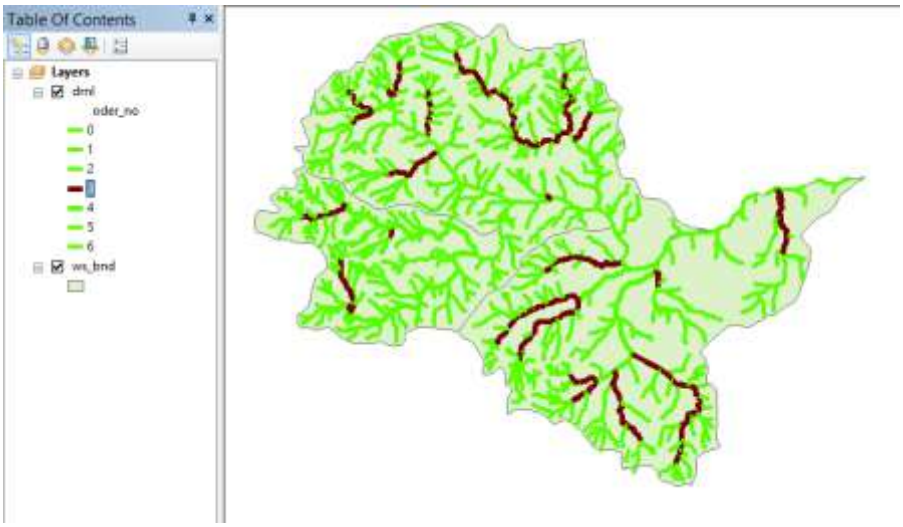

Figure3: showing stream order no 3

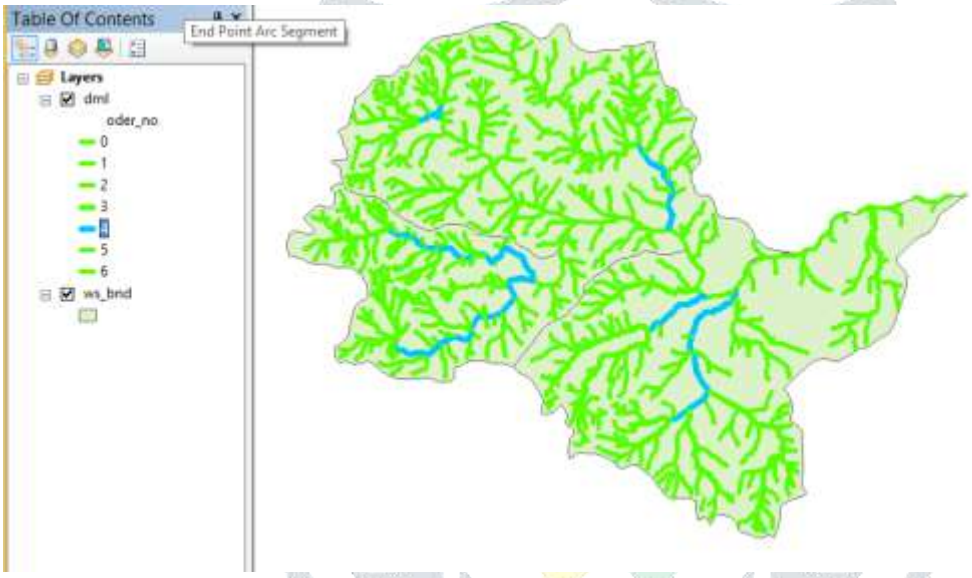

Figure4: showing stream order no 4

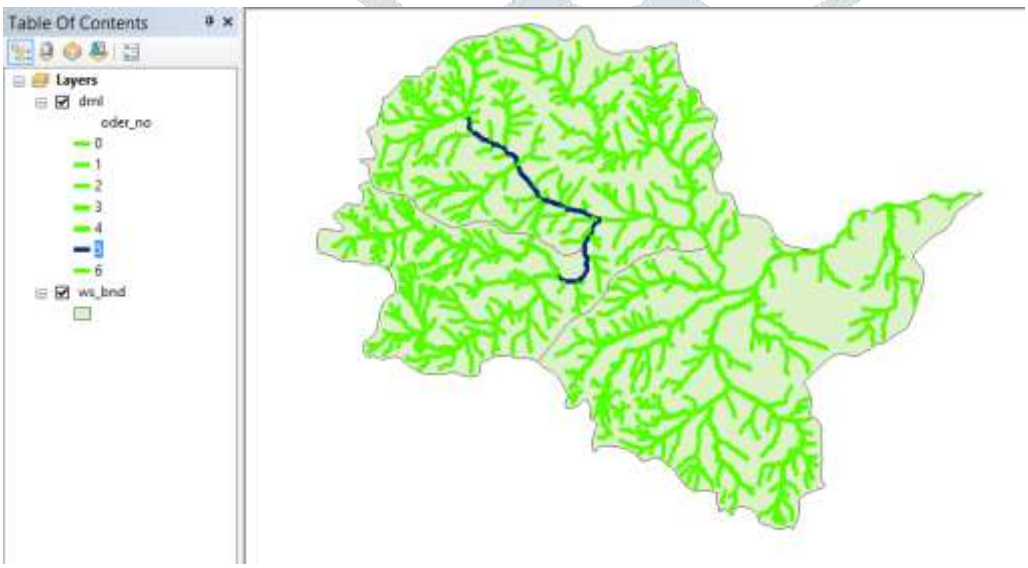

Figure 5: showing stream order no 5

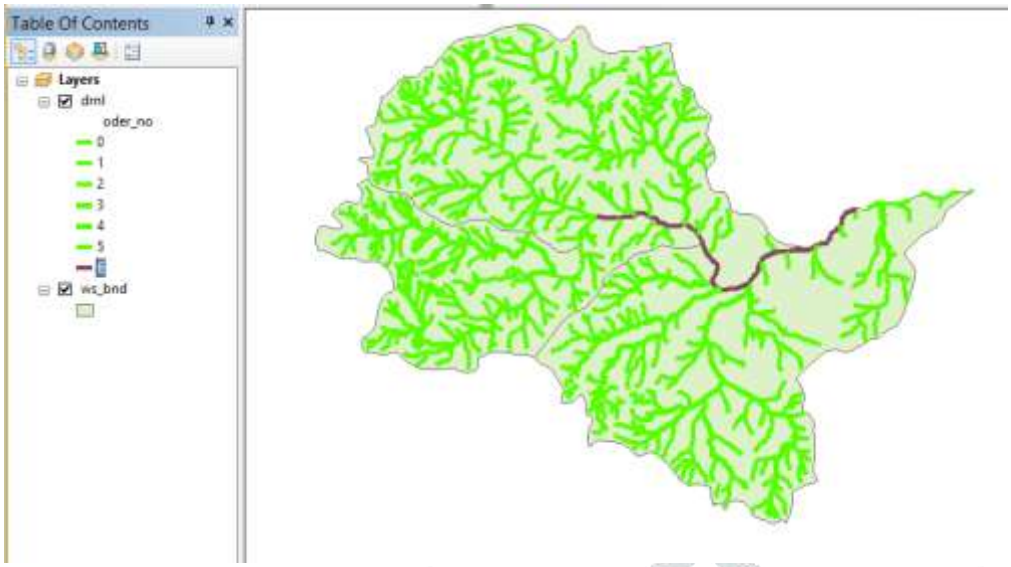

Figure 6: showing stream order no 6

6. ANALYSIS & RESULTS

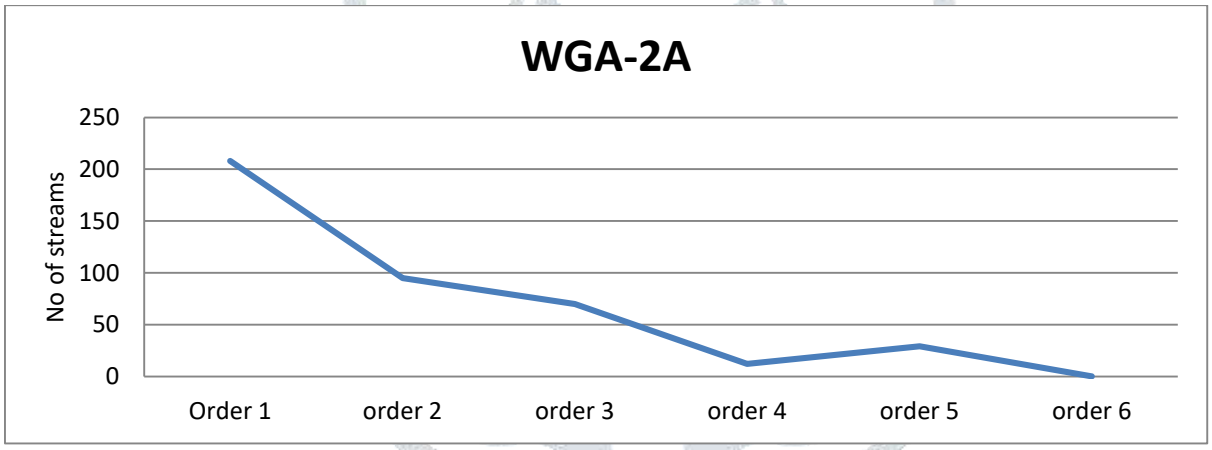

Figure 7: Graph showing no. of streams vs. stream order

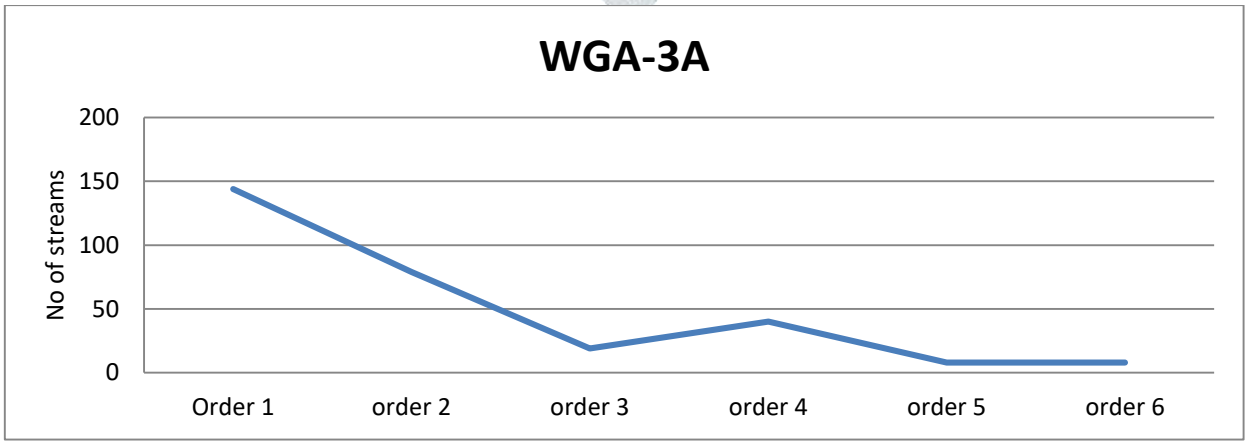

Figure8: Graph showing no. of streams vs. stream order

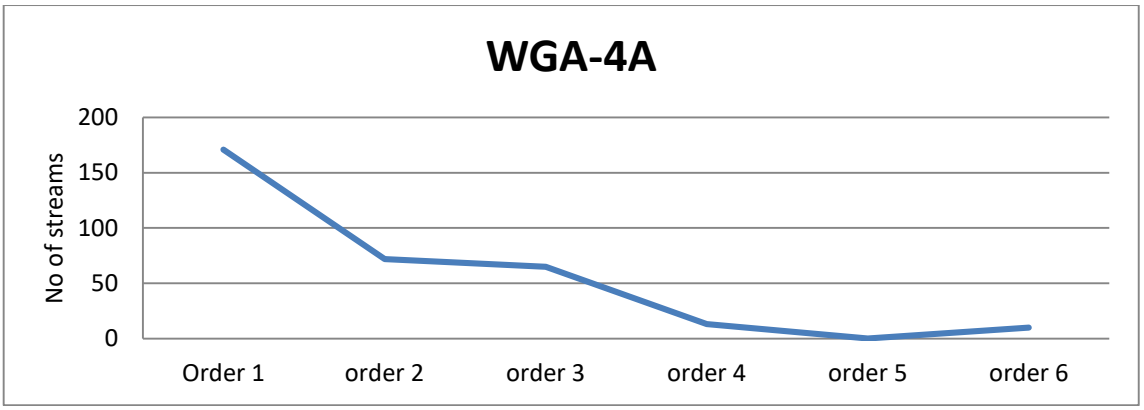

Figure 9: Graph showing no. of streams vs. stream order

7. CONCLUSION

Quantitative analysis of Morphometric parameters, using ARC GIS software is found to be of immense utility in drainage basin, elevation, watershed prioritization for soil and water conservation, flood prediction and natural resources management. Application of Morphometric approach revealed that there are total streams **1045** grooved with each other from order of 1st to 6th sprawled over the area of catchment of Umrer. Detailed study of Umrer watershed gives a useful direction for surface runoff and helps in natural resource development.

- Bifurcation ratio (2.665) indicates that the drainage pattern is dendritic with flat lying sedimentary rock in the region & weakly jointed rocks.
- Drainage density (1.70) indicates the regions of highly resistant of highly permeable subsoil material under dense vegetation cover.
- Circulatory ratio (0.408), elongation ratio (0.623) shows low relief of the terrain and elongated in shape.
- Form factor (0.304) shows that the basic will have a flatter peak of flow for long duration i.e. flood flows are easier to manage (than circular basins).
- According to the morphometric analysis the watershed that should be given the 1st priority is WGA-3A. Then 2nd priority should be given to WGA-2A and the last priority should be given to WGA-4A.

The study area shows that terrain is made up of mainly basaltic rock and exhibits dendritic pattern and is classified as medium runoff zone which give rise to drainage discharge.

The in depth study of Morphometric parameters indicate that the watershed 2 (which includes places like) should be treated for soil erosion first among the entire watershed region of Umrer.

The study shows that the Morphometric analysis using GIS helps to understand complete terrain parameters which lead to finalize watershed development planning and management with respect to water conservation.

8. REFERENCES

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