Application of Remote Sensing & GIS Techniques for Comprehensive Geological & Geohydrological Study of GP-16 Watershed of Aurangabad District, Maharashtra.

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ABSTRACT

The term Remote Sensing is applied to the study of earth's features from images taken from space through satellites, or from nearer to the earth surface using aircrafts. The major asset of Remote Sensing, namely its capability of rapid & accurate level aerial coverage, becomes crucial during the groundwater exploration in water-scare regions. The technique of remote sensing has picked up in the past half a decade, largely due to the availability of digital computers, improved communication systems, digital imaging techniques and space technology. Remotely sensed data can be said to have its origin in photography, where the information about a target area is interpreted from photographs. The study area is covered with uniformly disturbed basaltic rocks which plays vital role in the availability, storage, distribution & transmission of groundwater in the area. The Geohydrological characters of the terrain are affected by Geomorphology, Lithology, Rainfall, Drainage pattern, Lineaments of the area. In the present paper geology, geohydrology of GP-16 watershed of Aurangabad District, Maharashtra which covered the area of 246.22 Sq. Km. has been evaluated by using Remote Sensing & GIS technique. Topographic maps & satellite images have been used to prepare the thematic maps like DEM, Contour, Drainage Map & Litholog of study area. The study has been carried out in the GP-16 watershed to assess geohydrological characters of the Basaltic rock & its influence on the availability of groundwater.

Keywords: - Remote Sensing & GIS, Thematic Maps, Watershed

INTRODUCTION

- **Study area**

a) Location:-The GP-16 watershed is a part of Aurangabad District which is approximately situated in the central part of Maharashtra state & in northern direction of Marathwada region. The study area lies between $75^0$26'to $75^0$47' east longitudes and $19^0$58' to $19^0$46' north latitudes.

b) Climate & Rainfall:- In Aurangabad rainy season starts from the month of June to September, October to February-Winter Season and March to May Summer Season. The Average rain fall of Aurangabad District is 734 mm and the minimum temperature is 5.6 D.C. Maximum Temperature is 45.9 D.C.

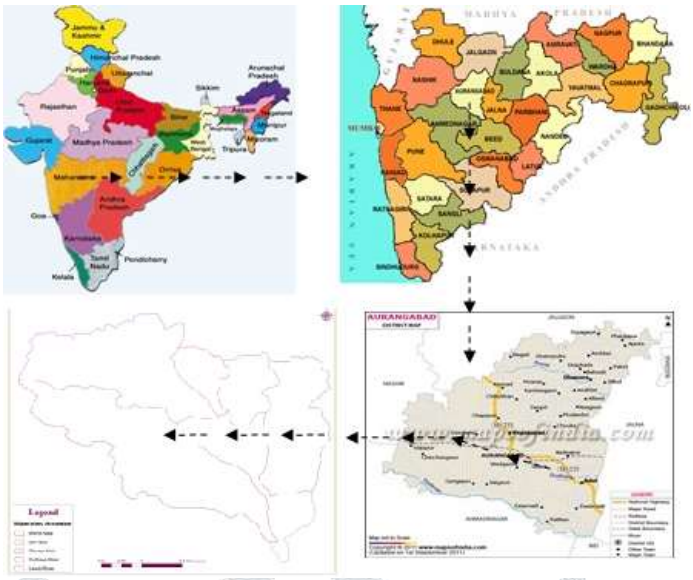


Fig 1: - Location Map of Study Area

FIELD CHARACTERS OF BASALT IN GP-16 WATERSHED

The entire study area is occupied by basaltic lava flows of the Deccan traps of Upper Cretaceous to Lower Eocene age. The lava flows are piled over one another. The individual flow thickness ranges between 2 to 30 metres. The individual flow has its different geohydrological characters.

These different basalt flows are,

1. Aa flows/Compact basalt flows
2. Compound flows/Amygdaloidal basalt flows.
3. Bands of Red Tachylitic basalt.
4. Volcanic Breccia

1. Compact Basalts:

Compact basalt flows are always thick and extensive having tabular forms. The thickness of flow varies from 2 meter to 12 meter. Its top surface is hydro-thermally altered purple to green colour which is vesicular or amygdaloidal and free from jointing. Due to jointing rock has dissected appearance. There may be variation in the pattern of jointing and joint spacing. Joints may be closely spaced or broadly spaced and sometimes may not be interconnected.

Flow No.01, 09, 14, 16, 20 & 29: These flows are of Compact Aphanitic (Fine Grained) Basalt. The joints developed in these flows are closely spaced. Joints are opened up in the upper portion & gradually close towards the lower portion. The flow is having maximum thickness of 58 ft. & minimum of 11 ft. in the study area.

Flow No.02, 6 & 28: These flows are of Compact Basalt which are aphanitic (Fine Grained) in nature. They are unjointed basalt flows having maximum thickness of 25 ft. & minimum of 17 ft. in the study area.

Flow No.4, 7, 11 & 19: These flows area compact porphyritic basalt with small to medium size plagioclase phenocryst, which are white in colors. The joints are broadly spaced joint & are not interconnected with each other. The top portion of flow is hydrothermally altered amygdaloidal basalt. They are having maximum thickness of 21 ft. & minimum of 9 ft. in the study area.

Flow No.26, 31 & 33: These flows are compact porphyritic broadly jointed basalt with small to medium size plagioclase phenocryst, which are white in colors. Maximum thickness of the flow is 35 ft. & minimum is 20 ft.

Flow No.21 & 24: These flows are of compact aphanitic basalt showing three sets of broadly spaced jointing. They are having maximum thickness of 42 ft. & minimum of 31 ft. in the study area.

Photo 1 - Compact Basalt

2. Amygdaloidal Basalt:

On the basis of the thickness and lateral extent amygdaloidal basalt flows are mainly grouped into two categories viz. thin irregular amygdaloidal basalt flows having maximum thickness upto 6 meters and lateral extent upto few kilometres and thicker amygdaloidal basalt flows having thickness upto 15 meters and lateral extent upto few kilometres and average thickness between 5 to 10 meter. Both these flows are characterized by bulbous irregular form, rapidly pinching out, and presence of ropy top surface and pipe amygdales along the bottom of the flow. However, these are un-jointed when fresh and amygdaloidal throughout its thickness. Sometimes middle and bottom portions of these flows are free from vesicles and amygdales in which jointing is developed. Volcanic Breccia it is heterogeneous rock in which angular fragment of different Types of basalt are held together either in red tachylitic matrix or in zeolitic matrix or in grey lava matrix. It has limited field occurrence in the terrain.

Flow No.3,5,8,10,15,18,25,27,30,32: These flows are of Amygdaloidal Basalt. Due to weathering sheet jointing is developed in the flows. The flow is having maximum thickness of 42 ft. & minimum of 9 ft. in the study area.

Photo 2 – Weathered Amygdaloidal Basalt

3. Volcanic Breccia:

In the Deccan Traps vesicular basalts are rare as most of them have been converted into amygdaloidal basalts by the filling of vesicles by secondary mineral. True vesicular basalts with open gas cavities are rare and the amygdaloidal basalt is widespread. As the vesicular basalt is unjointed fresh and compact they are quite impervious.

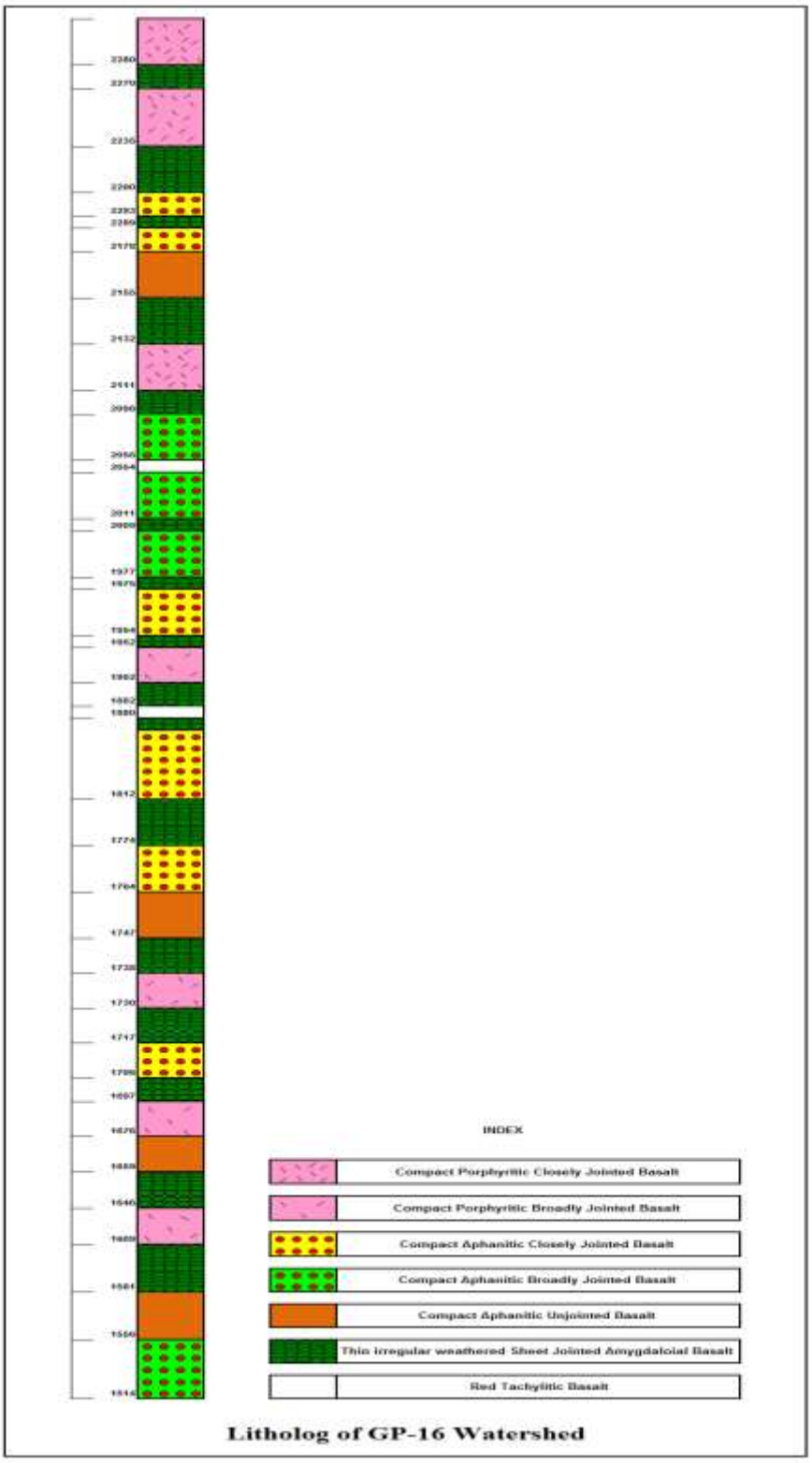
Photo 3 -Volcanic Breccia

4. Red Tachylitic Basalts:

Tachylitic basalts are basaltic glass formed due to rapid cooling and chilling of the lava. It has very much closely spaced mutually perpendicular with three sets of joints. Tachylitic basalts have different shades of colour, such as red, green, brown and black. However, red color is very common. They occur as thin band and pockets and lenses between the lava flows and also as irregular, thin intrusion in the top portion of the flow, when Tachylitic bands occur between the flows their thickness varies from a few centimetres to sometimes upto 3 m. The peculiarity of the Tachylitic basalts is that, in confined condition, below the cover of rock, it occurs as quite hard, red colour rock. But only on exposure to atmospheric conditions, it disintegrates and crumples into powder like material due to opening of joints, hence on surface red colour soil occur.

Flow no.17 & 23: These flows are thin bands of Red tachylytic basalt having thickness of 2 ft.

Photo 4 – Red Tachylitic Basalt



Litholog of GP-16 Watershed

THEMATIC MAP LAYERS

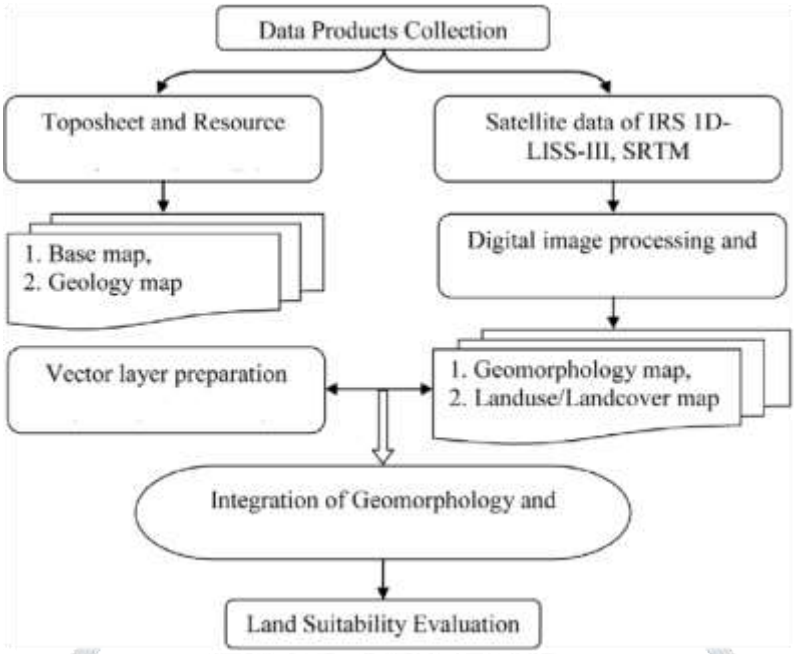
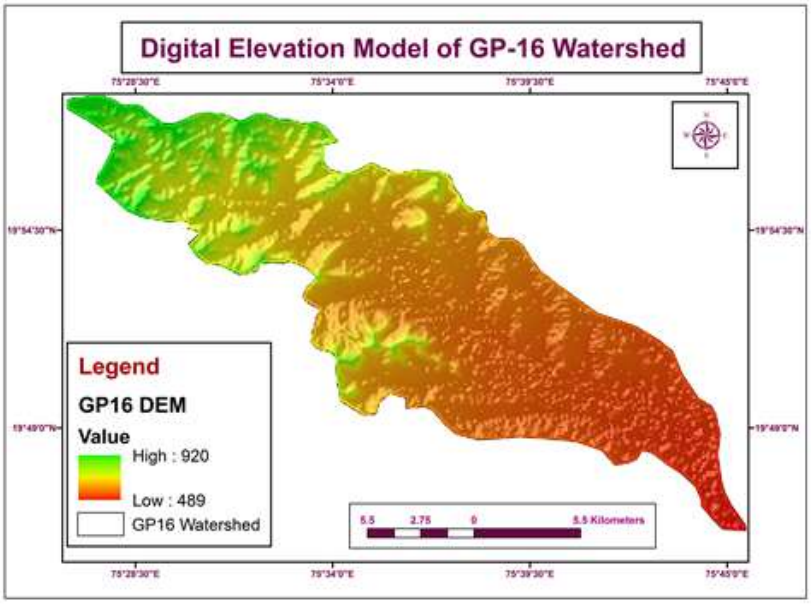


Fig 2 – Methodology of Map Preparation

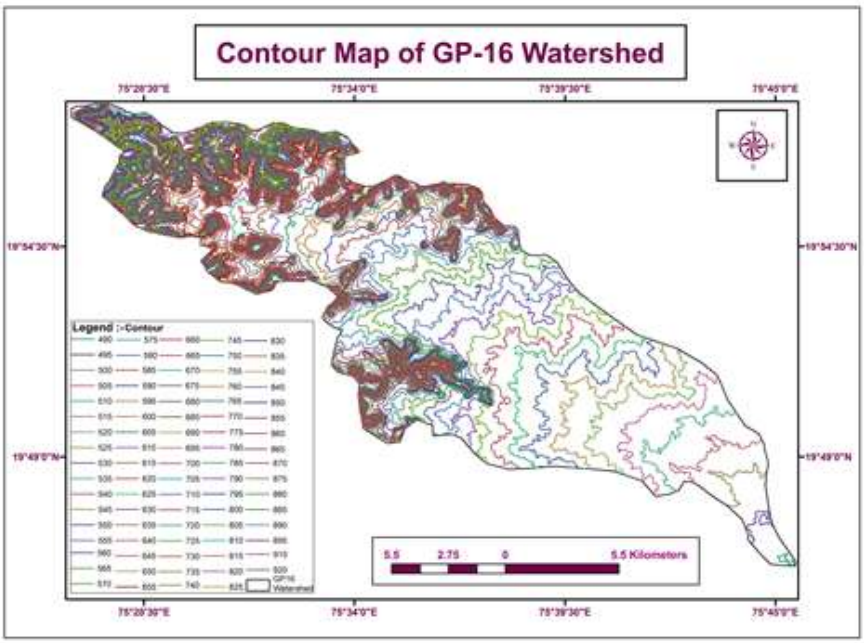
Thematic layers have been prepared separately with the help of IRS LISS III and SOI topo Maps with the help of Map info GIS software. These theme layers are,

1) Research Area Map: GP-16 watershed of Aurangabad District. Research area boundary has delineated and digitized rasterized and georeferenced.

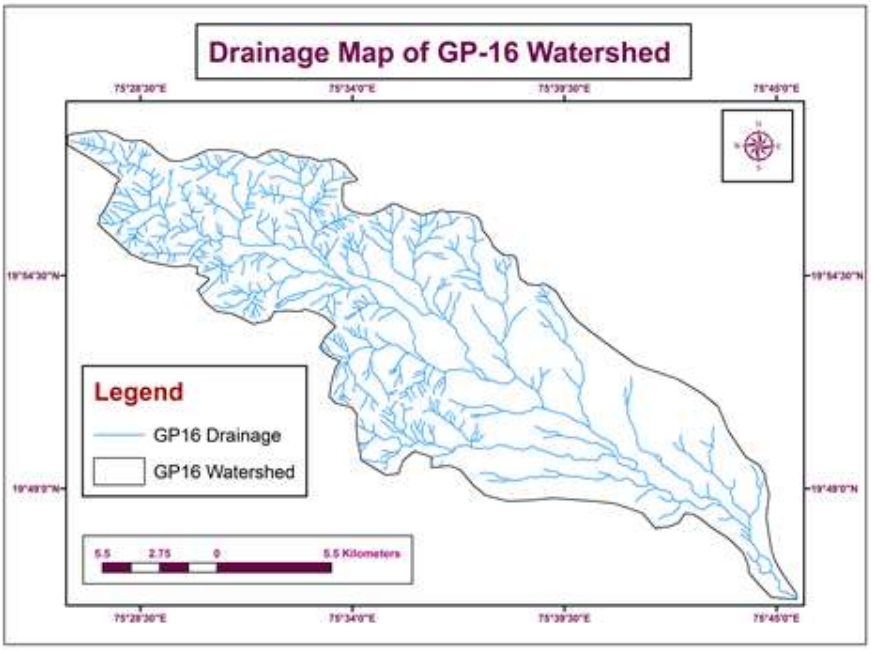
2) DEM Map- A digital elevation model (DEM) 3D CG representation of terrain surface created from a terrain's elevation data.



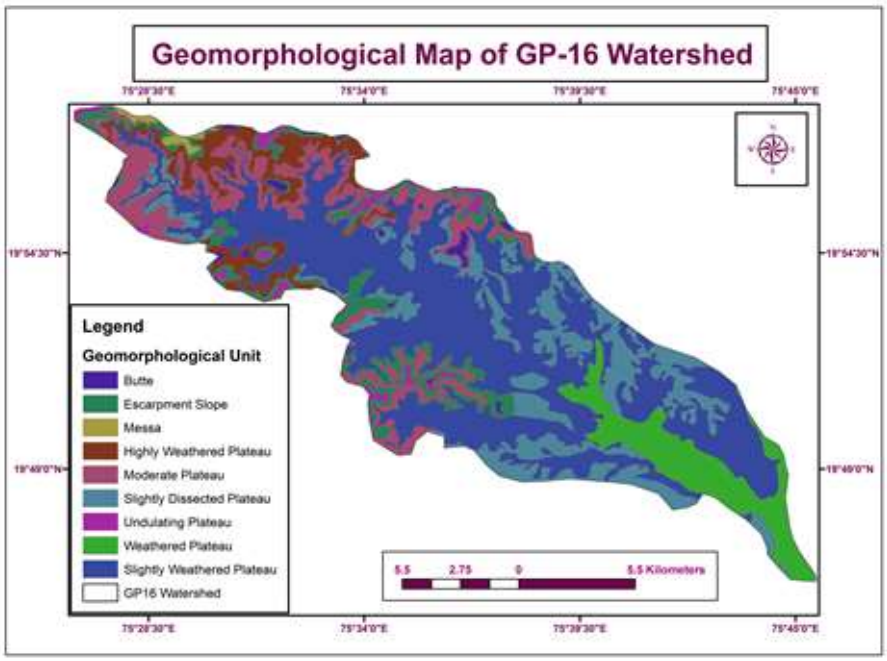
3) Contour Map: Contouring is the most common method for terrain mapping. Contour line connects points of equal elevation, the contour interval represents the vertical distance between contour lines, and the base contour is the contour from which contouring starts. Contour lines are lines drawn on a map connecting points of equal elevation. The contour line represented by the shoreline separates areas that have elevations above sea level from those that have elevations below sea level. Counter map has been prepared with the contour interval of 20 meters. It has been digitized, rasterized and georeferenced.



4) Drainage Map: Drainage map was digitized as a line coverage showing the entire stream network. The tributaries of different extents & patterns were digitized from the geo-referenced mosaic of toposheets & updated from satellite data. It has been digitized; rasterized and georeferenced with the real world coordinates.



5) Geomorphological Map: The physical features developed on the earth's surface are shown in this map.



6) Litholog of the area: From lower elevation to higher elevation of the area different geological flows are demarcated & shown in the litholog. From the top of the hills to the low lying area of GP-16 watershed, well inventory survey is done of 43 dug wells from north to south direction & transverse section taken from vertical road cut of the hills. Fresh rock exposures are available for observation at road cuts.

CONCLUSION

The basaltic terrain in the study area is hard, compact & it does not possess primary porosity & permeability. But the groundwater permits through secondary porosities i.e. joints & fractures formed due to weathering. The suitable zones for groundwater percolation in the GP-16 watershed are identified using Remote Sensing & Geographical Information Techniques. These techniques are used to prepare thematic maps like DEM, Contour, Drainage, Geomorphology maps & Litholog of the study area.

The moderately dissected plateau covers NE & SW part of the study area. The drainage density is also moderate. This area is a runoff zone. A very small part of the study area River is covered by slightly dissected plateau. The area has a gentle slope and good soil cover. The drainage density is lower than the moderately dissected plateau and shows intensive cultivation. This area act is a recharge zone.

There are number of small isolated hills lying over the trap plateau. The concentration is more in the NE part of the study area. These hills have steep slopes, thin soil cover with scanty vegetation. Mostly compact basalt covered this area so there is no possibility of percolation of water. The alluvial plains are covered by alluvial deposits and occur along the narrow stretch along the river course. The area has gentle slope and good soil cover hence the area act as a storage zone of water.

All closely, sheet jointed & highly weathered Basalt flows are suitable for artificial recharge, from these flows percolation of ground water takes place & all these percolated water stored in rocks pore spaces, fractures & joints. These sites are suitable for watershed development structures or artificial recharge structures. Some flows of Compact Basalt & amygdaloidal basalt are hard, compact & unjointed. If joints present are very broadly spaced & not interconnected, all these compact basalt flows are impermeable. If watershed development structures constructed on these flows then there is no percolation & water structures are only use to store water. In such structures water level decrease due to evaporation only. If watershed development structures or artificial recharge structures constructed on permeable basaltic flows we get expected artificial recharge result.

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