# MANAGEMENT SPONSORED

# MINOR RESEARCH PROJECT

**On**

## A Comprehensive geospatial evaluation and management of Buggavanka Watershed in Kadapa, Andhra Pradesh, India


***By***

***Sk. JOHN SAHEB***

**Department of Geology**


**Submitted to**

## The Research Committee

# HINDU COLLEGE, GUNTUR

# August 2021

## DECLARATION

We hereby declare that the **Management, Hindu College, Guntur** sponsored Minor Research Project report titled **A Comprehensive geospatial evaluation and management of Buggavanka Watershed in Kadapa, Andhra Pradesh, India** comprises of our own and original work. It has not been submitted fully or partially to any other institution or organization and is not published.

(SK.JOHNSAHEB)

**SK. JOHNSAHEB**

LECTURER OF GEOLOGY

Hindu College, GUNTUR

**Email id:** johnsaheb44@gmail.com

**CERTIFICATE**

Certified that this is a genuine and bonafide work done by **SK.JOHNSAHEB** lecturer of geology with the Minor Research Project titled **A Comprehensive geospatial evaluation and management of Buggavanka Watershed in Kadapa, Andhra Pradesh, India** sanctioned by **Management, Hindu College, Guntur**.

The Principal

Hindu College,

Guntur

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I am very much greatly thankful to. **Dr.T. Siva Prathap Assistant professor,Head of the Department Earth sciences,** Yogi Vemana University, Kadapa, **Dr. S.V.S.GIRIJA** Professor of Mathematics Hindu College ,GUNTUR

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(SK.JOHNSAHEB

# ABSTRACT


- Ground water investigations conducted by Hydrogeological ,Geophysical and Hydrological methods.
- Hydrological methods:In this type of surveys, the terrain conditions such as weathering and gradients of the rock formations well field in the ,vicinity of the area based on the discharge of the well,structural patterns observed in the well ,favourable physiographic features,and drainage patterns of the area are to be recorded.
- Geophysical methods:The geophysical surveys are essential in arriving at the weathering conditions of the hardrock.Based on the resistivity recorded by Electrical Resistivity meter,the joining,fractured zones may be identified by plotting and drawing the curves which may be compared with master curves.
- The Ground water structures may be constructed based on the resistivity ranges which may be properly interpreted in the area under investigation.

# CONTENTS

# INTRODUCTION

- Water is the most essential element of life on Earth. The demand for water is increasing manifold with population explosion and rapid growth of all sectors of economy. Sustainable development is need of the hour and watershed forms the basic unit in water resource planning particularly in Semi Arid Tropics. Watershed is defined as a Geohydrological unit where all of its water gets collected at one point called as outlet. Classic definition of spring according to Meinzer (1923- 48) is “A spring is a place where, without the agency of man, water flows from a rock or soil upon the land or into a body of surface water”.

- “Buggavanka” is a seasonal tributary to Pennar river basin. “Bugga” stands for “Spring” and “Vanka” for “Stream” in vernacular language Telugu. In Buggavanka watershed all of the water both runoff and spring water joins with “Buggavanka” stream.

- Then recharge occurs as the tertiary action at the recharge area whenever the water is stable or runoff velocity is slow. This groundwater from the aquifer will be discharged as springs, seepages, wells, bore wells etc.

- Springs commonly are available where the water table crosses the land surface. The water wellsprings of such springs, as a rule are unconfined springs where the water streams under gravity and the re-energize zone of such spring is huge all through its elevated area.

# OBJECTIVES

- Morphometry of Buggavanka watershed in kadapa,andhrapradesh,India,using spatial information technology.
- Hydrogeochemistry and assessment of groundwater quality for drinking purpose and integrated interpretation with water quality index studies using GIS.
- water samples were taken from bore wells and dug wells in the research region in feb 2022 to analyze the quality of the groundwater.
- The American Public Health Association recommended analyzing groundwater samples for a variety of chemical characteristics (APHA 1995). pH, EC, TH, TA, TDS, and significant cations such as $Ca^{2+}$, $Mg^{2+}$, $Na^{+}$, $K^{+}$, along with anions like $CO_3^{2-}$, $HCO_3^{-}$, $Cl^{-}$, $NO_3^{-}$ $SO_4^{2-}$.
- Using portable conductivity meter, pH and EC were measured in the field. The concentrations of $Na^{+}$ and $K^{+}$ were measured

using a flame photometer. A spectrophotometer was used to determine the concentrations of $NO_3^-$ and $SO_4^{2-}$. The volumetric approach was used to examine TH and TA as CaCO3, $Ca^{2+}$, $CO_3^{2-}$, $HCO_3^-$, and Cl-. $Mg^{2+}$ was estimated using the contents of TH and $Ca^{2+}$. Some key parameters and indices were derived based on the physico–chemical analyses.

# STUDY AREA DESCRIPTION

- Geographically it lies between the latitudes of 14.23°N & 14.31°N and the longitudes of 78.46°E & 78.54°E falling in the open series maps of Survey of India (SOI) Toposheet numbering D44G15NW.

- The average elevation of the urban parts of Kadapa is 138 metres. The city is traversed by a stream called Buggavanka or RallaVanka which is originated in the Palakondas to the south.

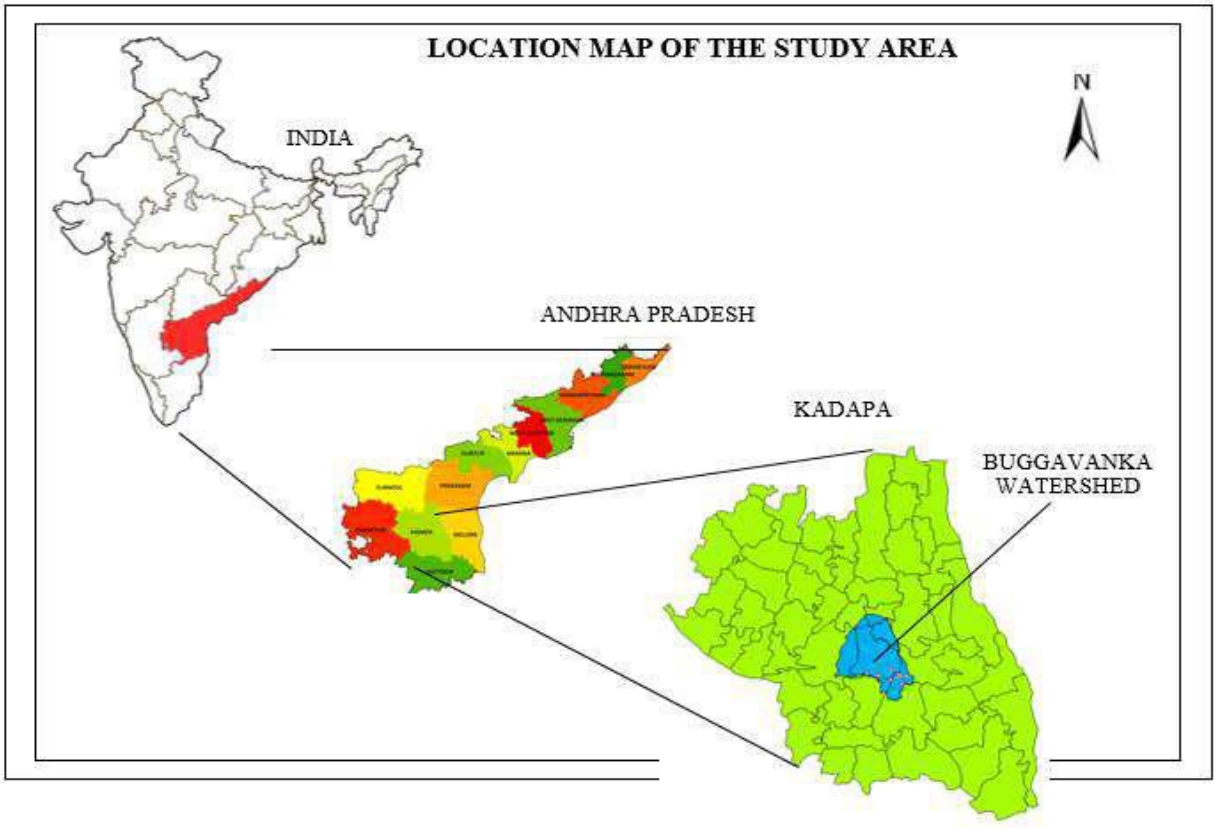
- The present study area constitutes Oppidan Course of Buggavanka / Rallavanka that is traversing across from south to north.

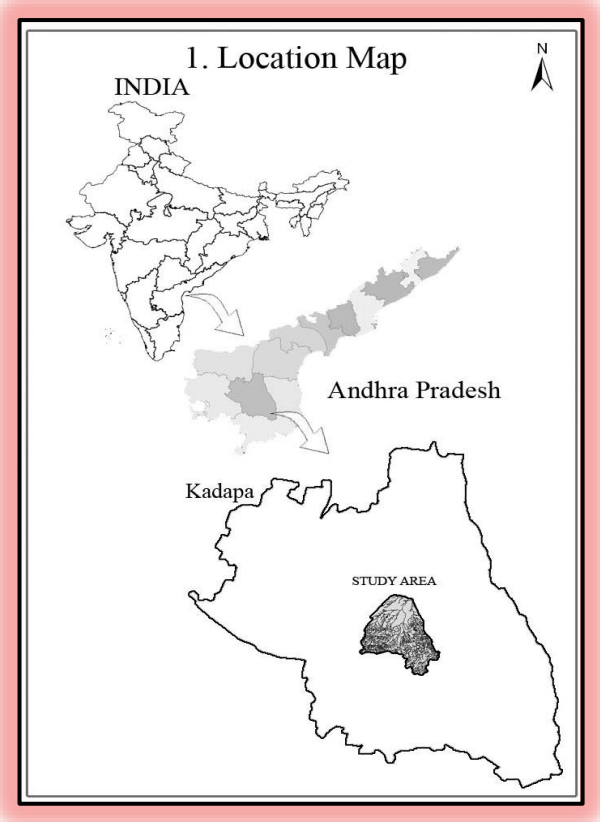
- The climate is medium to dry with mean annual temperature of 32°C.

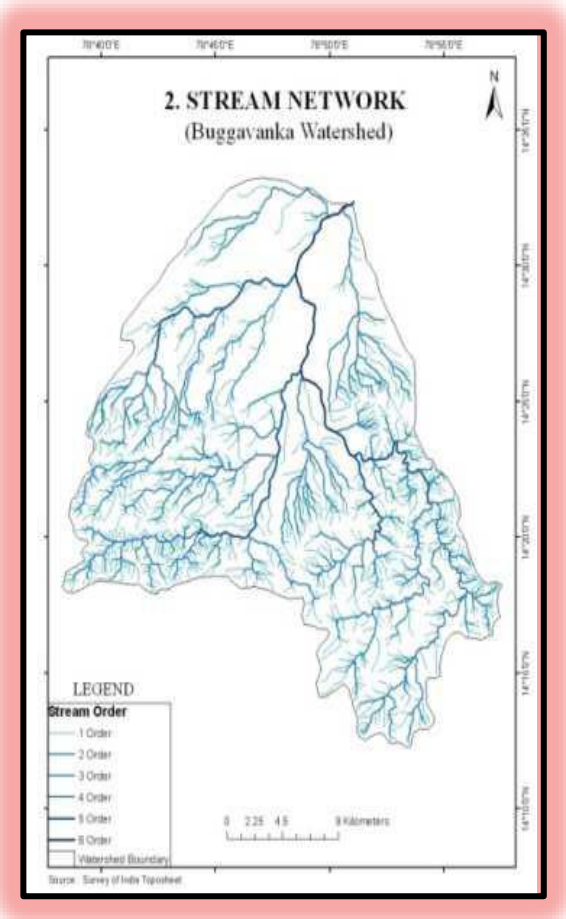
- They are Chintakomma dinne, Pendlimarri, Kadapa, Veeraballi, Vontimitta, Chennur, Ramapuram, Vallur and Sidhout. And a total of 54 villages where the majority of the stake holders are from the Chintakommadinne mandal.

- This area receives rainfall from SW Monsoon and the rainiest months are July and August.

- The Buggavanka stream travels from South to North to join the Penna River for about 57.947 Km encompassing the watershed area 724.73 Km2 with a perimeter of 134.105 Km.

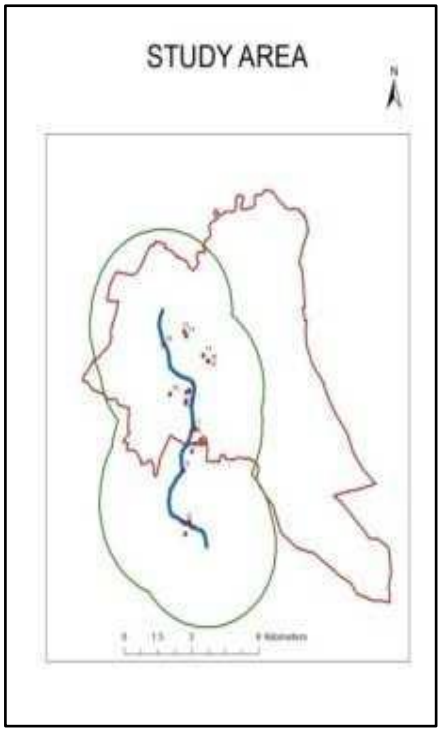



1. Location Map
N
INDIA
Andhra Pradesh
Kadapa
STUDY AREA


2. STREAM NETWORK
(Buggavanka Watershed)
N
LEGEND
Stream Order
1 Order
2 Order
3 Order
4 Order
5 Order
6 Order
Watershed Boundary
0 2.25 4.5 9 Kilometers
Source : Survey of India Toposheet

# Location Map of the Study Area






# FIELD SURVEY

- Field visits need to be conducted at the locations of spring. It is essential that flow from a spring is
- identified as to the geologic formation from which the water discharges. The following are among the basic data
- collection requirements for springs. (Technical Guide to Managing Ground Water Resources, USDA)

1. Latitude-longitude values at spring location
2. Elevation of the spring.
3. Uses of the spring water.
4. Permanence of flow.
5. Discharge pattern of the spring in the year
6. Chemical characteristics of the water.
7. Temperature of spring water

8. Type of spring.

9. Source aquifer.

- As there is no any available previous field data about spring their locations are not known.
- To know their Latitude, Longitude and Elevational values, the springs shape file is converted to kml file in QGIS and then it is

viewed in Google Earth for Navigation.

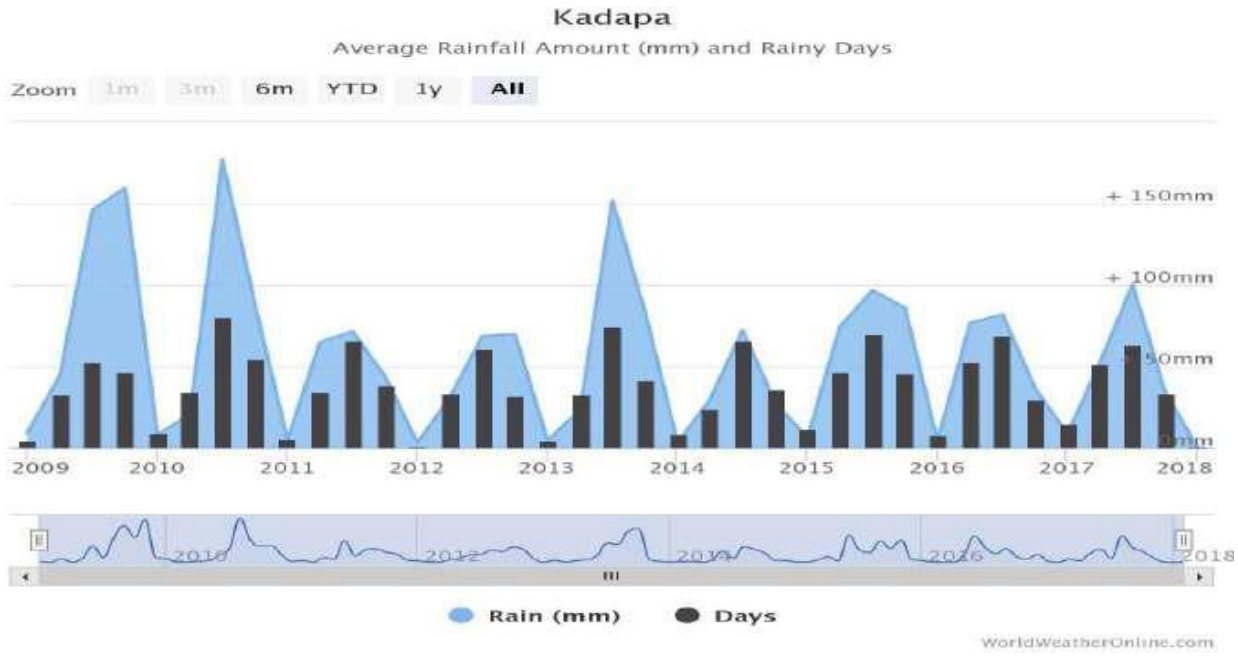
- The springs in the Buggavanka watershed area are physically verified and location is geotagged for future studies. The detailed information is collected from the local villagers as inventory method for ready reference.

- **Field Photographs**

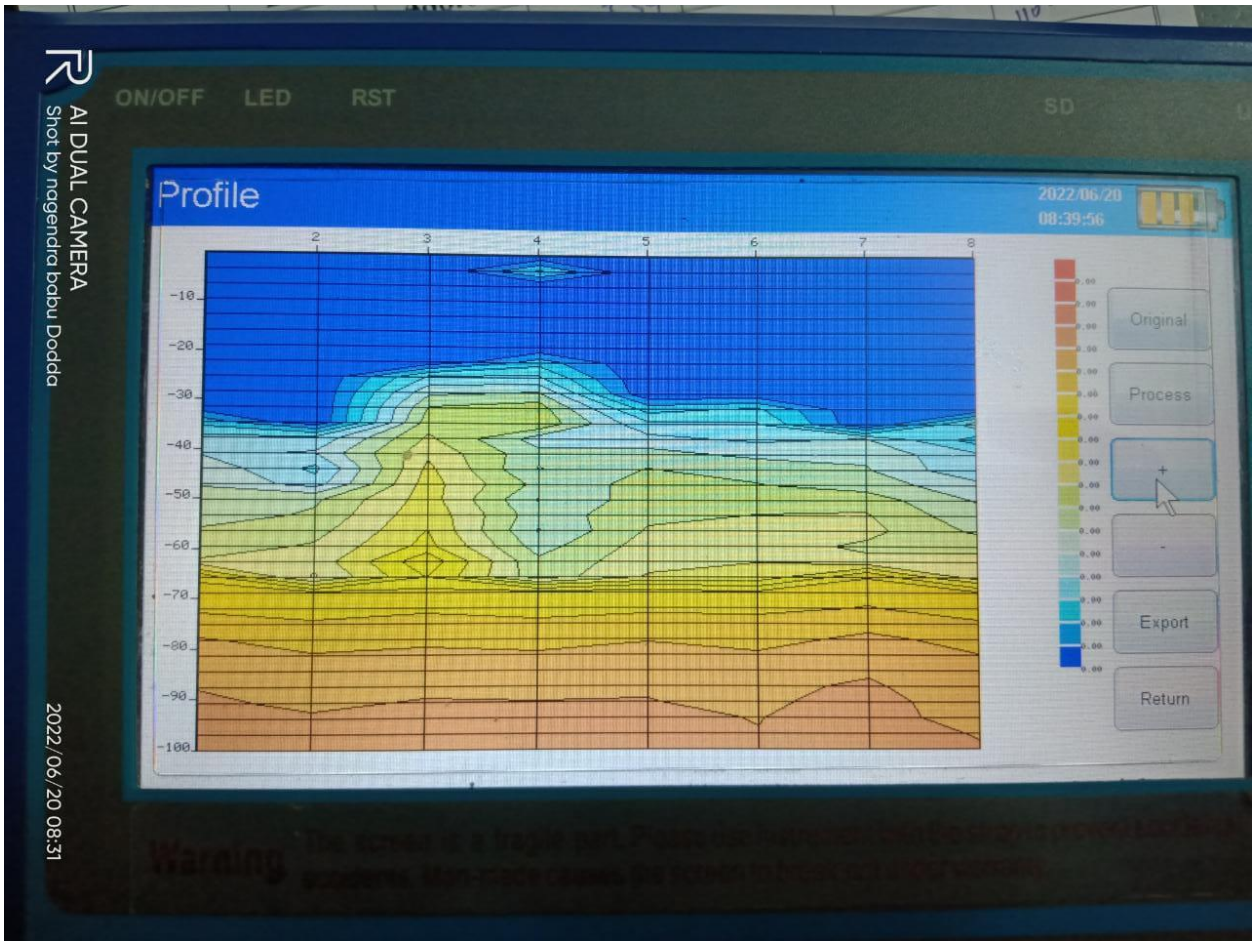
***Spring water*** discharge fluctuations owe primarily due to rainfall pattern in the recharge area or more precisely stated, to variation in the amount of rainwater that is able to infiltrate the ground and recharge the ground water.

- Marked variation in the discharge following rainfall indicates rapid infiltration of rainwater and recharge of the groundwater, it show strongly periodic seasonal rhythm.
- Superimposed on these variations is a periodic (monthly) fluctuation resulting from occasional heavy rain falls, generally in the rainy season.
- The last ten years monthly average rainfall of Kadapa district is presented as below which follows the flow pattern of Buggavanka

stream.




# Kadapa Rainfall Graph




AI DUAL CAMERA
Shot by nagendra babu Dodda
2021/12/08 12:35


AI DUAL CAMERA
Shot by nagendra babu Dodda
2021.12.18 15:17

REPORT ON FEASIBILITY OF GROUNDWATER FOR CONSTRUCTION OF

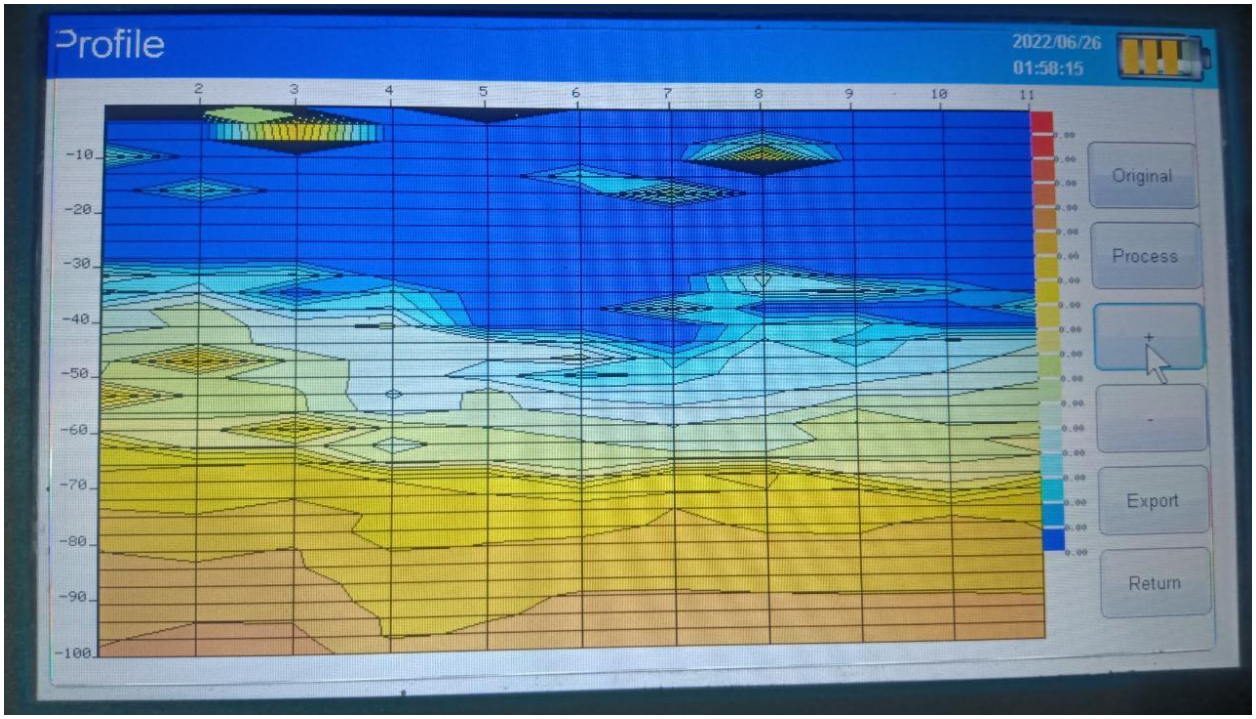
WELL/ BORE WELL/ FILTER POINT/ INFILTRATION WELL/ TUBE WELL

## I. GENERAL:

| | | | |
|---|---|---|---|
| 1 | ID NO: | : | YSR 110502111 |
| 2 | Investigation conducted by | : | Sk. JOHN SAHEB |
| 3 | Date and duration of Investigation | : | 14/3/22 |
| 4 | Name of the beneficiary/ organisation. | : | Thoolakanti Veerna Reddy |
| 5 | Purpose of investigation and requirement of water. | : | Drilling of Free Borewell Under The YSR Jalakala |
| | Location: | : | |
| | Village | : | Gudipadu |
| | Mandal | : | Duvvuru |
| | District | : | YSR Kadapa |
| 6 | Survey No | : | 831/2 |
| | Extent of the area in ha. | : | 2.5 Acres |
| 7 | Coordinates and distance and direction with reference to village central point. | : | Lat: 14.749668 Long: 78.669661 |

## II. PHYSIOGRAPHY AND DRAINAGE:

| | | | |
|---|---|---|---|
| 1 | Topography | : | Flat Land |
| 2 | Soil type and thickness | : | Black |
| 3 | Drainage pattern | : | Dendritic |
| 4 | Elevation (M SL) in m. | : | |
| 5 | Sub-basin name categorisation and stage of development in the basin | : | Penna River basin |
| 6 | Average annual rainfall in mm. | : | 930 mm |
| 7 | Tanks/ Reservoirs/ Canals. | : | Canal JNTP |
| 8 | Proximity to surface water bodies | : | Pond |
| 9 | Stream/ Reservoir (influent/effluent). | : | Stream |
| 10 | Command/ Non-Command . | : | Command - |


Profile
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Original
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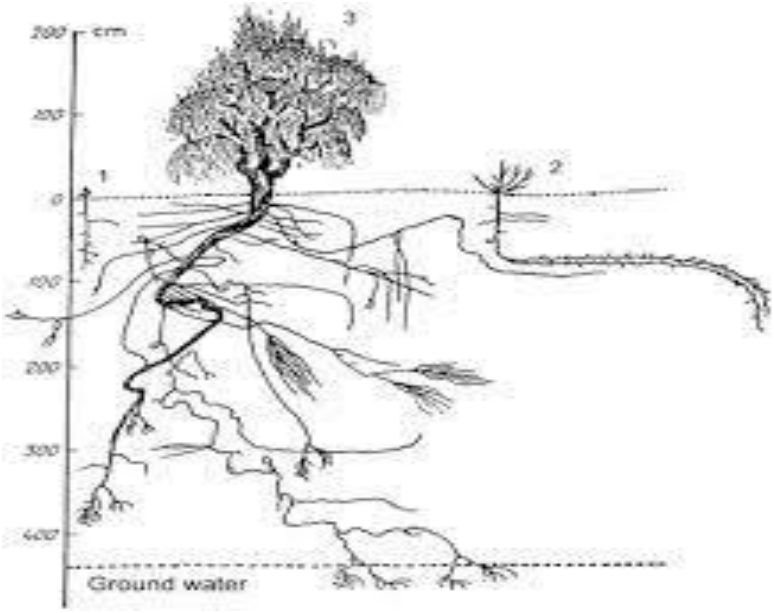
cm
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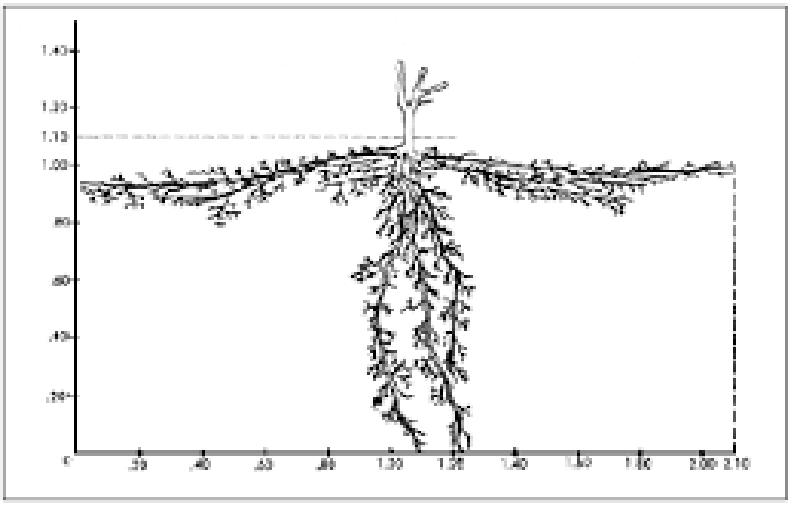
Ground water



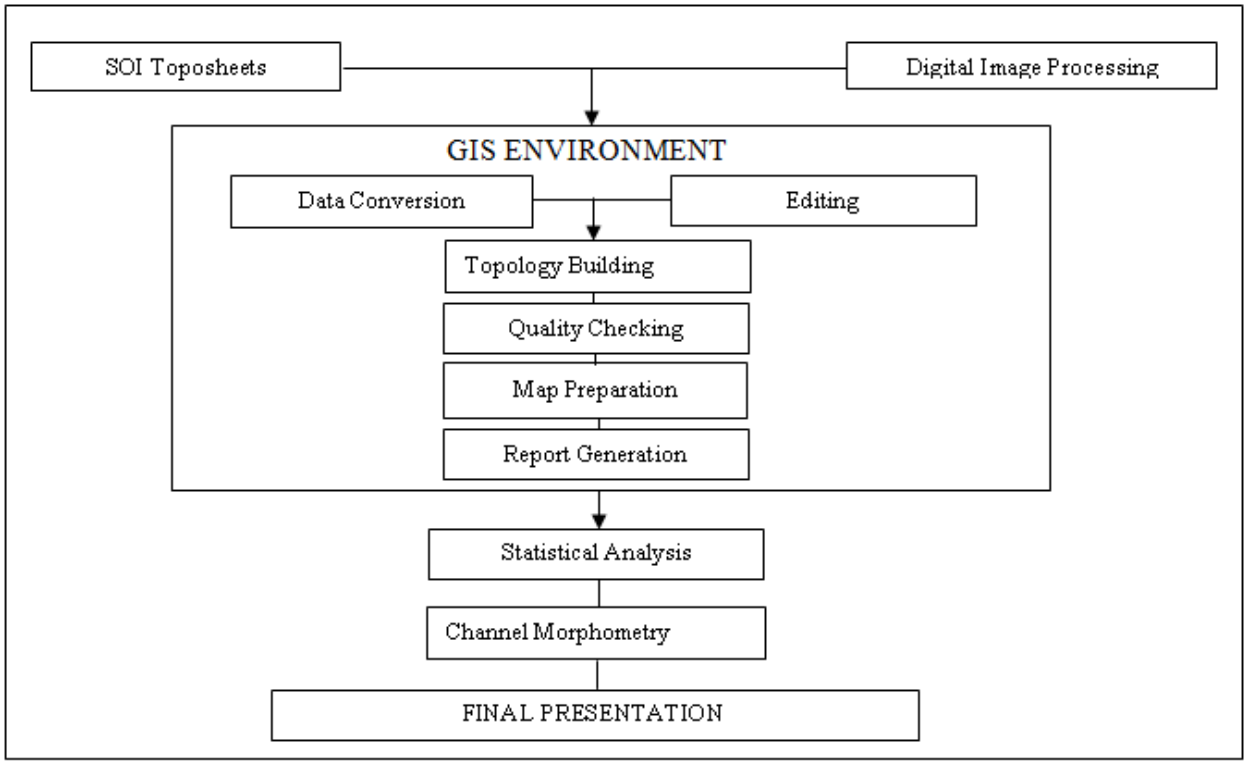
# METHODOLOGY

- Data used for the generating morphometric parameters are Survey of India Toposheets (1:50,000) No. 57J10, 57J11, 57J14, 57J15 and 57J16. ERDAS and ArcGIS are used to process the data and generate the stream attributes of the Buggavanka watershed.
- The broad methodology followed in generating the spatial data is illustrated in the flowchart. The basic channel parameters thus generated in GIS Environment after quality checks are reported using Report tool in ArcGIS.

- This input is taken for statistical analysis for evolving other morphometric parameters.

- The methods adopted for morphometric parameters of Buggavanka watershed and their results are tabulated in Table 1. Linear aspects and Table 3. Areal aspects. The linear aspects of the Morphometry include Stream Order (u), Number of Streams (Nu), Stream Length (Lu) and Bifurcation Ratio (Rb). The areal aspects of the drainage basin are Drainage Density (D), Stream Frequency (Fs), Texture Ratio (T), Basin Length (Lb), Elongation Ratio (Re),Circularity Ratio (Rc) and Form Factor Ratio (Rf).

# Flow Chart Showing the Broad Methodology



# RESULTS AND DISCUSSIONS

- **pH:** The pH of water is very important indication of its quality and provides important piece of information in many types of solubility calculations (Hem, 1985). The pH of the groundwater in the study area is varying between 7.13 to 8.66mg/l. The limit of pH value for drinking water is specified as 6.5 to 8.5 (ISI, 1983).
- **Total Dissolved Solids:** Total dissolved solids of the groundwater is varying from 57 mg/l to 6980 mg/l. the desirable limit of TDS in drinking water is 500 mg/l. Palatability of the water decreases when the concentrations exceeds this limit and may cause gastro-intestinal irritation (ISI, 1983). It is observed that 100% of the groundwater from the area exceeds the desirable limit.
- **Electrical Conductivity:** Electrical conductivity is a measure of water capacity to convey electric

current. The levels of EC under study ranged between 310 to 2580µs/cm. The average level of EC for the study area is 732µs/cm. The conductivity measurement provides an indication of ionic concentrations. It depends upon temperature, concentration and types of ions present (Hem, 1985). The maximum limit of EC in drinking water is prescribed as 1500µs/cm (WHO, 1996). Maximum value of EC 6280µs/cm is observed in the groundwater of Masapeta and minimum value of EC is observed (198µs/cm) is observed in the groundwater of Devunikadapa.

- **Total Hardness:** The concentration of total hardness in Buggavanka surrounding areas is varying from 40 mg/l to 280 mg/l. The limit of total hardness for drinking water is specified as 360 mg/l (ISI, 1983). Water sample of the entire study area exceeds the desirable limits. The hardness of water is due to the presence of alkaline earths such as calcium and magnesium.

**Bicarbonate and Carbonate:** The HCO3 Concentration in the water sample of the study area 60-878.4 mg/l. **In** the study area samples fall in the ‘normal carbonate water’ and samples fall in the ‘under carbonate water’. Hence the water sample of the study area is generally “normal carbonate water”.

**Calcium:** The concentration of in the water samples were between 24 mg/l to 152 mg/l which is derived from calcium rich minerals like feldspars, pyroxenes and amphiboles. The upper limit of calcium concentration for drinking water is specified as 75 mg/l (ISI, 1983). It observed that nearly 94 percent of the groundwater exceeds the permissible limit.

Chloride: The Chloride concentration of the water sample is 49.7 mg/l to 86.6 mg/l. The upper limit of chloride concentration for drinking water is specified as 250 mg/l (ISI, 1983). Nearly 30 percent of the water sample

exceeds the permissible limit. The source of chloride in the water sample is due to the weathering of phosphate minerals and domestic sewage (Karanth, 1987).
Potassium: Potassium concentration is varying from 30 mg/l to 180 mg/l. The limit of chloride concentration for drinking water is specified as 250 mg/l (ISI, 1983). Sodium: Sodium concentration is varying from 280 mg/l to 850 mg/l. The sodium concentration in the water sample is due to weathering of plagioclase feldspar, the use of sodium compounds for corrosion control and watersoftening processes have contributed to sodium concentration in water sample of the

**Planfornextyea:**

- To study and record the morphometric and meteorological parameters like Temperature, Rainfall, etc., of the buggavanka spring area.
- Correlating the Geospatial techniques results with natural conditions using appropriate statistical techniques.
- To recommend the locations of surface water harvesting structures keeping in view the position of existing surface water bodies/land use land capable along with quality aspects. (Canal/tank/lake/ponds etc.).

**Achieved:**

1. A preliminary survey has been carried out at the study are to get stock of the area under investigation.
2. In addition, literature augmentation on the profile of my topic was also done.
3. Conducted field surveys and collected photographs near the Buggavanka spring.
4. Hydrogeochemistry and assessment of groundwater quality for drinking purpose and integrated interpretation with water quality index studies using GIS.

# CONCLUSIONS

- Channel Morphometry of the Buggavanka watershed reveal that the drainage network is less controlled by the tectonic activity and the pattern is sub-dendritic to dendritic.
- Stream frequency of watershed revealed positive correlation with drainage density. Buggavanka watershed is less elongated and lack structural control.
- The variation in the Bifurcation ratio within the watershed is attributed to difference in topographic conditions and lithology. It is evident from the above that the Spatial Information Technology i.e., Remote sensing and Geographical Information system (GIS) are very effective tools in the study of drainage characteristics.

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