

COMMISSION 3

GIS, MAPPING TECHNOLOGY & GEOSPATIAL IMPLEMENTATION

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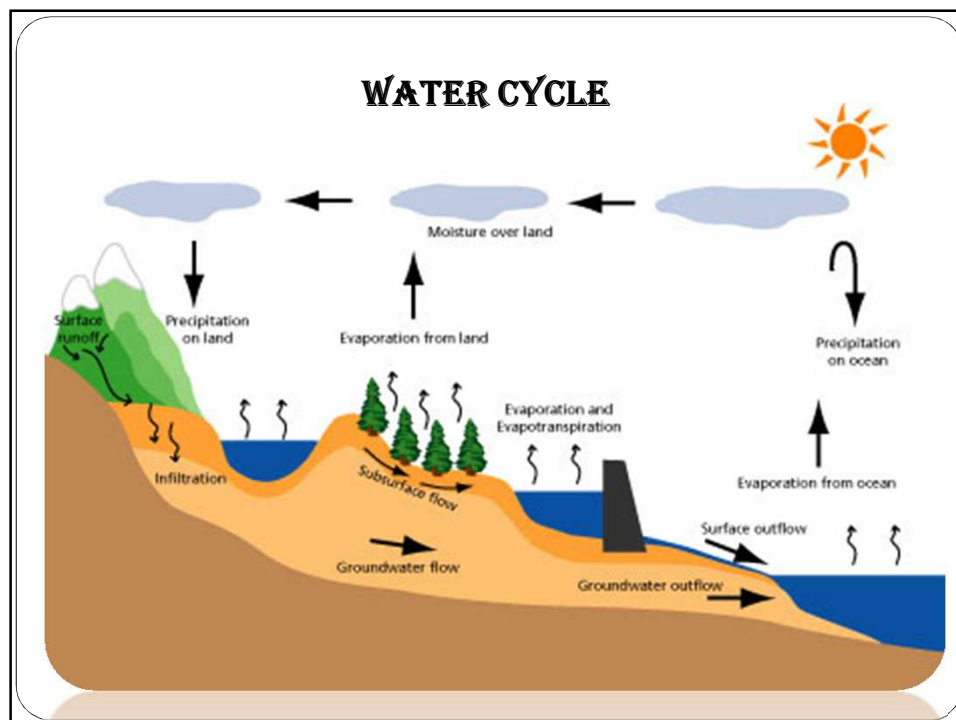
**Investigation of Ground Water Reservoir in part of Asa and
Part of Ilorin West Local Government of Kwara State Using
Geographic Information System.**

BY

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INTRODUCTION

- Water is a chemical compound with the chemical formula H_2O . Its molecule contains one oxygen and two hydrogen atoms connected by covalent bonds, and is vital for all known forms of life.
- surface water is water collecting on the ground or in a stream, river, lake, wetland, or ocean
- Groundwater is water located beneath the ground surface in soil pore spaces and in the fractures of rock formations.
- Surface and ground water are two separate entities. However, there is an ever-increasing need for management of the two as they are part of an interrelated system that is paramount when the demand for water exceeds the available supply.



PROBLEM DEFINITION

Asa river basin is the host of Asa River the major source of recharge for the underground reservoir from which all the wells and boreholes in this river basin tap their water source. The standard water level of wells and boreholes in the area which before now used to be within the range of 16.07607 feet to 21.55505 feet and had recently dropped which has led to little availability of water for the inhabitants within the study area. This leads to the investigation of the underground water reservoir using Geographic Information System techniques to know the volume of water remaining in the water bearing reservoir.

AIM

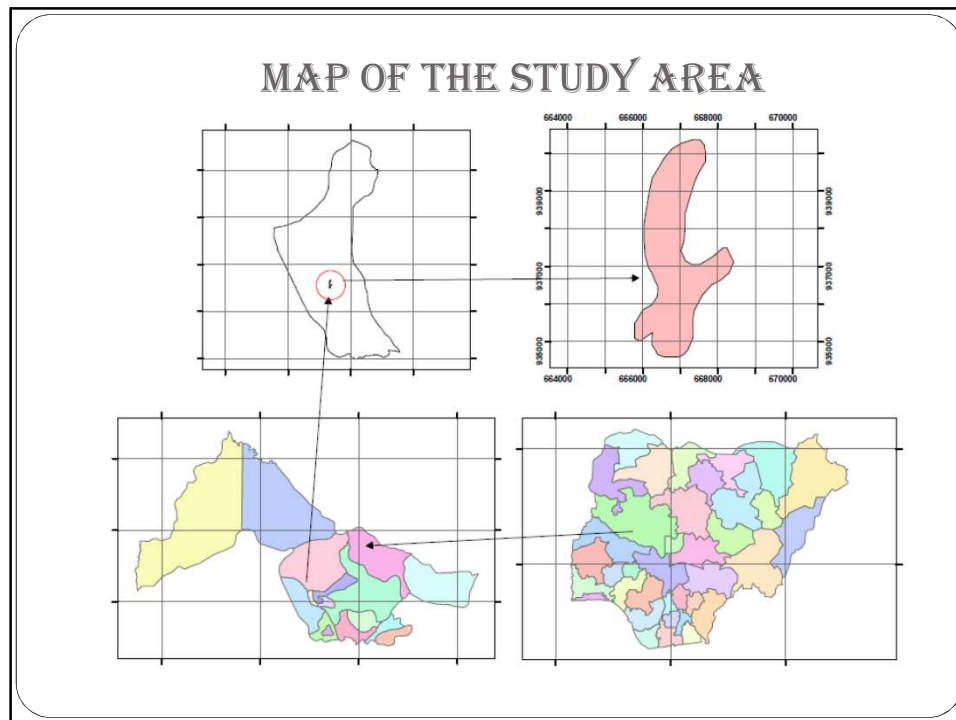
The aim of this research work is to investigate the area and volume of the water bearing reservoir within the study area, using Geographic Information System technology in order to provide information on the hydro-geological characteristics of the area.

OBJECTIVES

- To design and create a geodatabase for the boreholes and well points.
- Carry out watershed analysis of the area.
- Perform inverse distance weighted interpolation from spatial analyst
- Creating a Potentiometric surface for the aquifer
- Create Borelines from Borehole points
- Creating a Geovolume of the Asa river Basin.

THE STUDY AREA

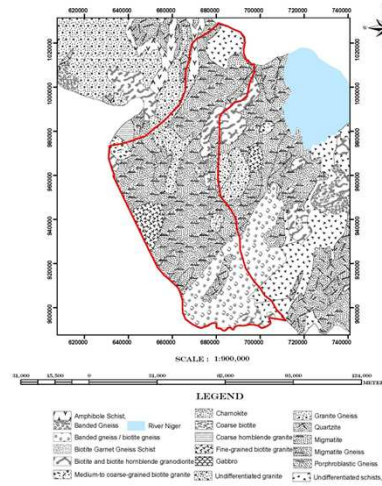
Asa river basin which lies within Asa and Ilorin west local government in Kwara state is located at the boundary of the state at the southwestern part of the state and it is surrounded by Moro local government to the north, Oyun and Offa local government to the South and Ilorin west local government to the East. The study area lies between latitudes $4^{\circ} 12'N$ and $4^{\circ} 29'N$ and longitudes $8^{\circ} 7'E$ and $8^{\circ} 42'E$ with an area of 5036.625km^2



GEOLOGY OF THE AREA.

The Asa river basin consists of basement complex rocks of the older granite type and the undifferentiated types. These rocks in many places have been greatly weathered in-situ and hence there are several pockets of weathered sand and sandy clay lenses within the basin, some of these pockets of weathered materials appear on the surface in several areas. The sand pockets form good aquifers for underground water which recharge the Asa river in the dry season.

MAP SHOWING THE GEOLOGY OF THE AREA.



DATABASE DESIGN

The effective implementation of any GIS research lies on the proper planning and design of the database is known as the heart of GIS. The process of designing a database is known as data modeling, here real world entities and their relationships are analyzed and modeled to conform to the syntax of the software of choice (kufoniyi,1998) The design of database involves the following phases; **Conceptual design, Logical design, Physical design**

DATA REQUIRED.

- SRTM
- Location point of existing wells and boreholes.
- Geological map of Ilorin
- Lineament map of Ilorin

DATABASE CREATION

Following the design phase, the database was created and populated in ARCGIS 9.3 environment. Polygon, Line and Point layers were created respectively for the identified entities. These form individual relations which were then populated with their attribute values.

ANALYSIS.

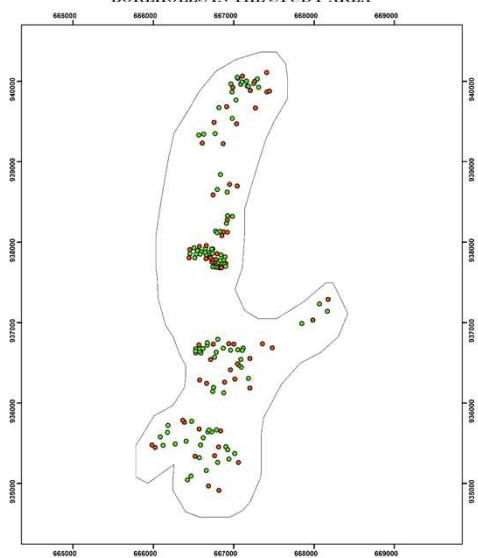
- **SURFACE WATER ANALYSIS**
- WATERSHED ANALYSIS
- POTENTIOMETRIC SURFACE GENERATION
- **GROUND WATER ANALYSIS**
- BORELINE CREATION
- GEOVOLUME CREATION

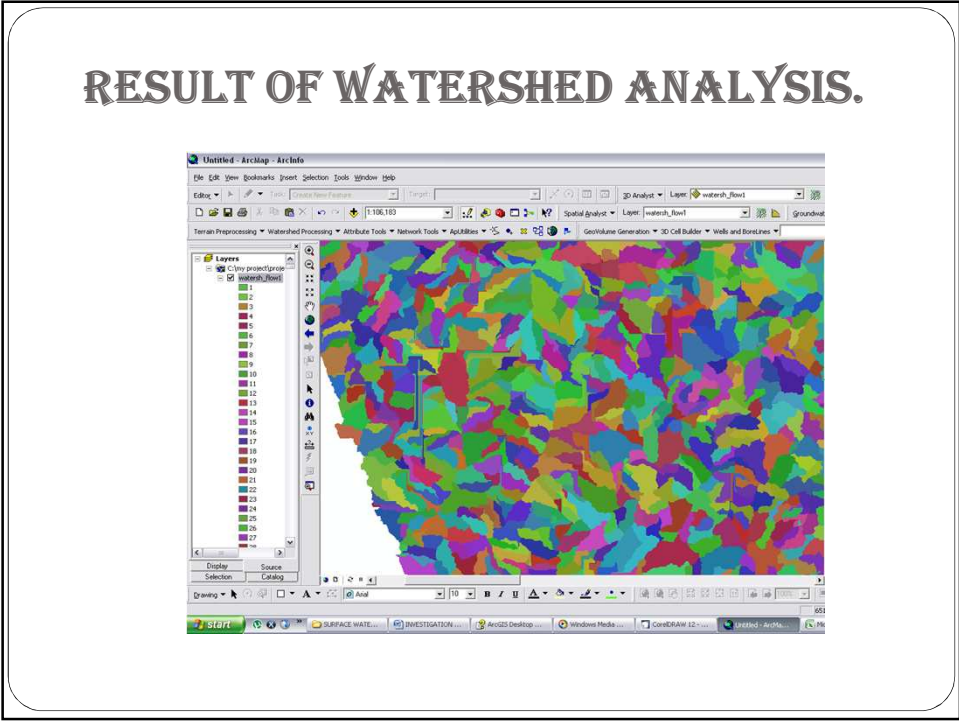
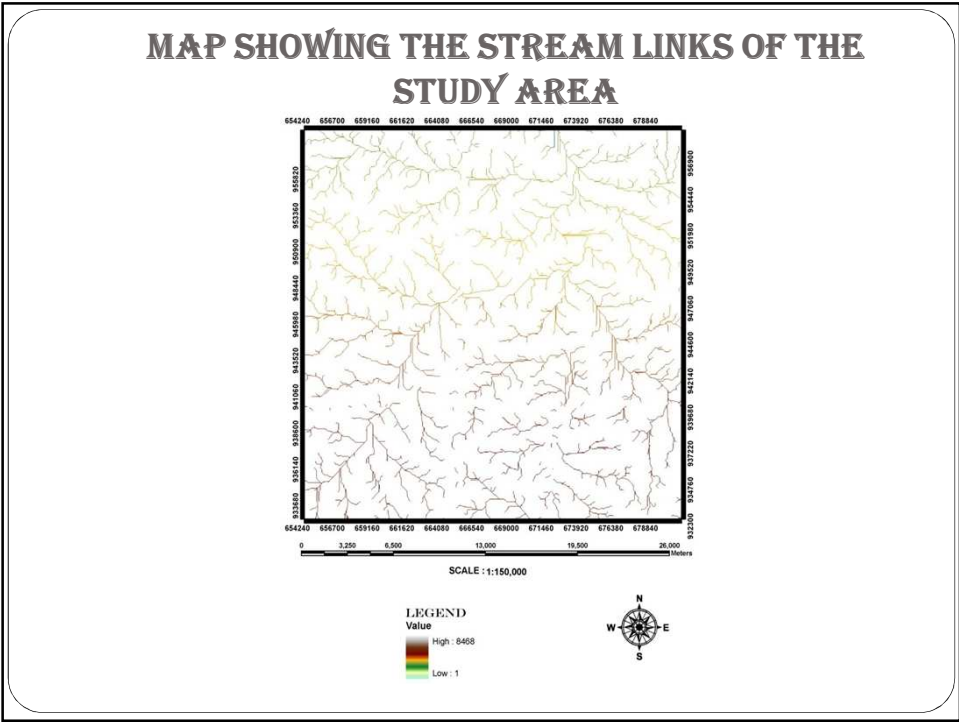
SURFACE WATER ANALYSIS

WATERSHED ANALYSIS.

Watershed analysis is performed to show the direction to which surface water in the area drains and how they recharge the underground reservoirs.

MAP SHOWING THE SPATIAL DISTRIBUTION OF THE WELLS AND BOREHOLES IN THE STUDY AREA

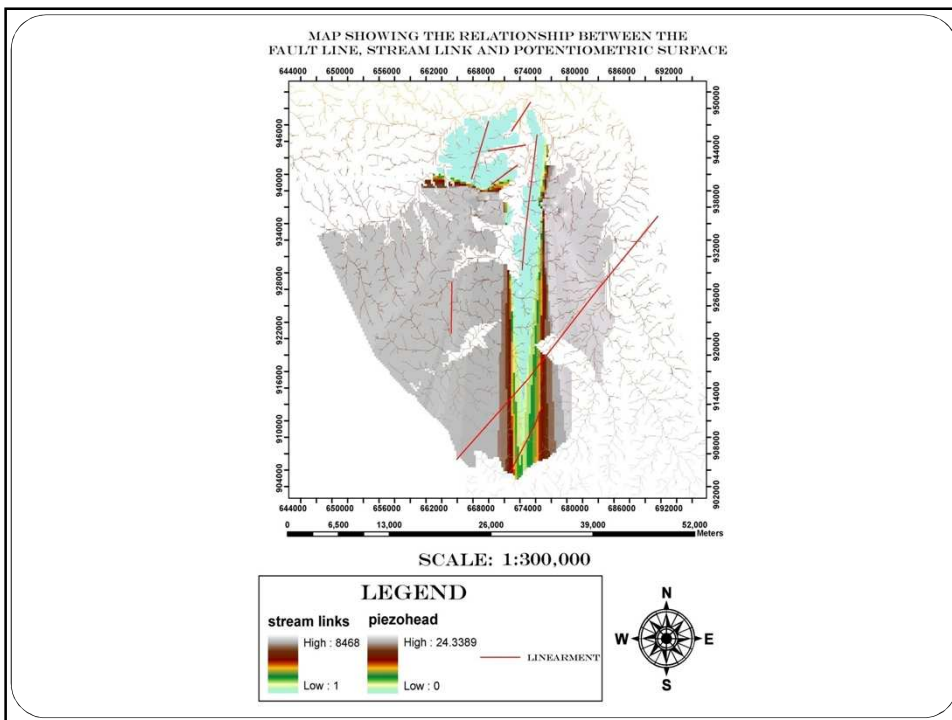
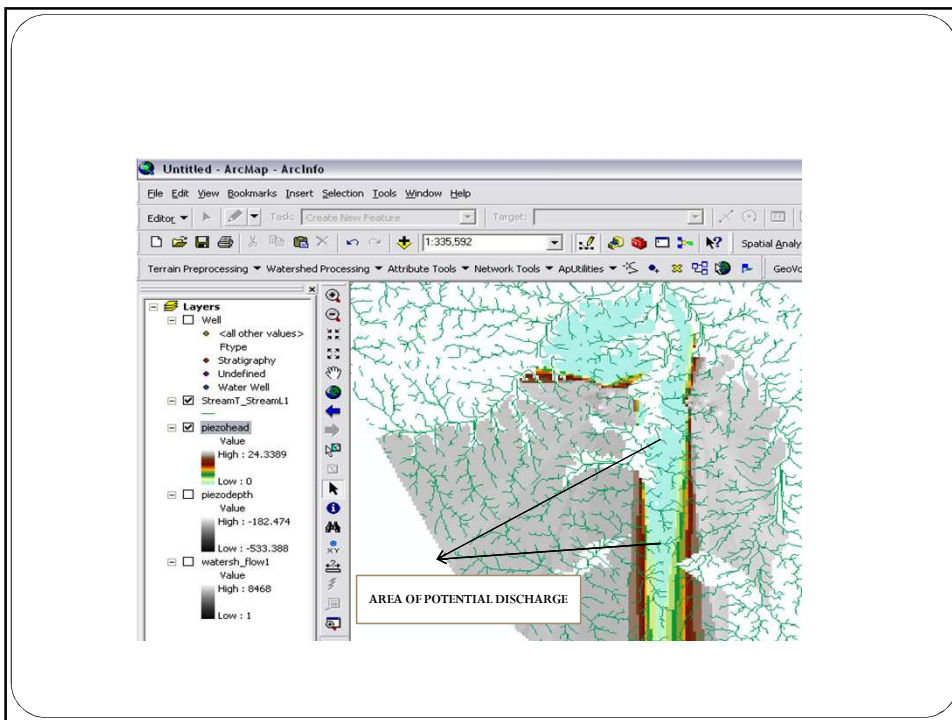


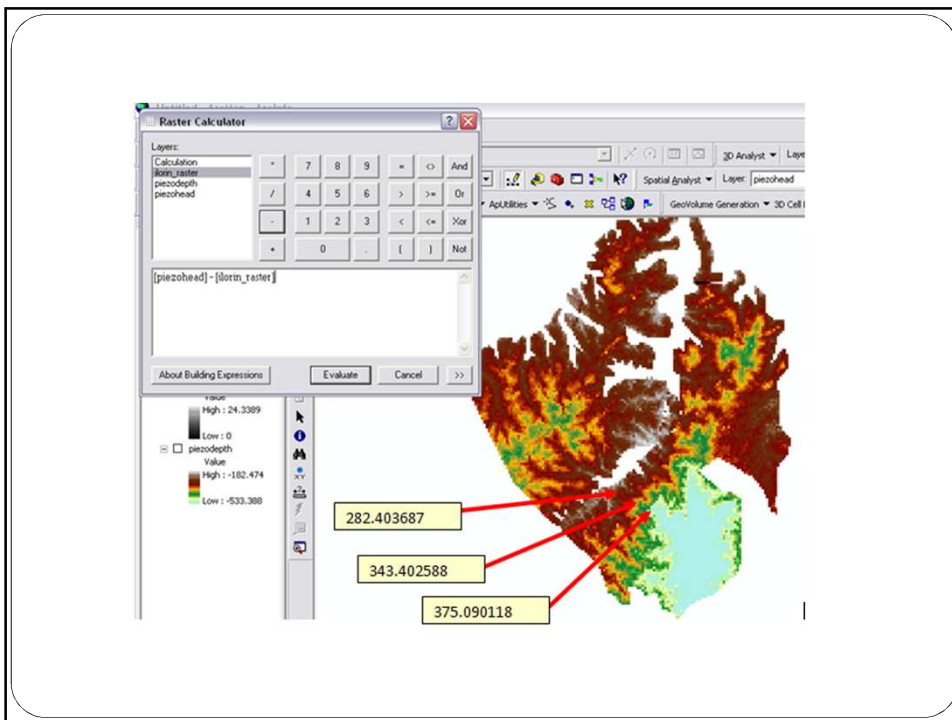


This area is divided into catchments based on the stream links and the drainage pattern each catchment represents a watershed. Each catchment drain into another creating a link between each catchment. And the drainage density of the area is also obtained from the DEM and the flow Accumulation raster of the area. Measured in (length/area) in m/m^2

POTENTIOMETRIC SURFACE

- Potentiometric surface of the river basin was created by interpolating water levels recorded at each wells and boreholes in the study area. This is compared with the digital elevation model (DEM) for finding area that has the potential of discharge.
- To know the point of potential discharge the potentiometric surface raster was generated which was subtracted from the DEM of the study area, using raster calculator. It is noticed that it is getting shallower near the stream and increasing up the gradient.



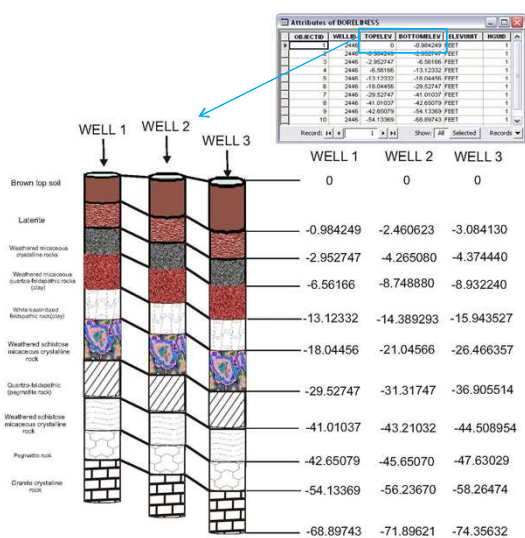


GROUND WATER ANALYSIS

BORELINER CREATION

Borelines are three dimensional objects that represent the hydrostatigraphy along a drilled well. The stratigraphy tables holds the top and bottom elevations observed for each hydrostatigraphy unit, displaying the vertical measurement along the strata of the boreholes in the study area, and show how each of the soil layer is conformably overlain by each other.

LITHOLOGICAL SECTION AND THE BASIN THICKNESS

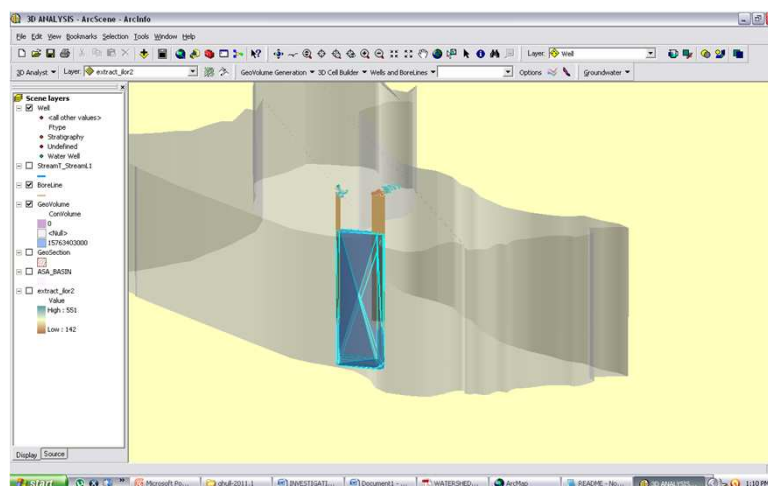


GEOVOLUME CREATION

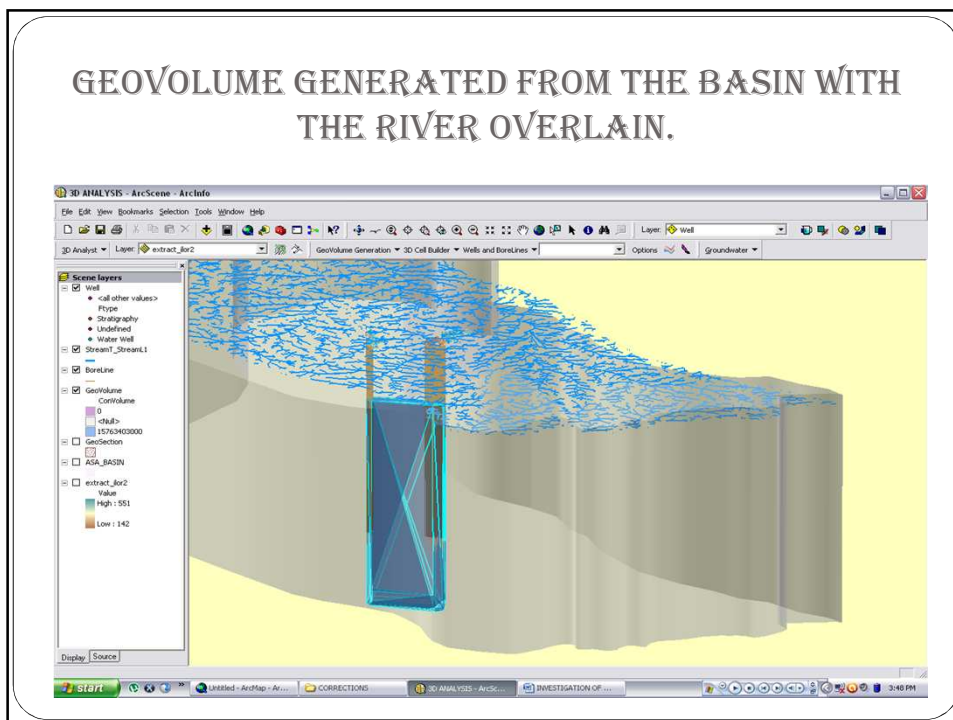
Geovolume which is a multipatch layer used in the calculation of the area and the volume of the water bearing reservoir. A multipatch is a set of three-dimensional triangles that can define the surface of a feature with volume. However, multipatches can be created by linking ArcGIS and external computational geometry programs (QHull algorithm) and attributes computed in the external programs can be written as an attribute of the multipatch.

- (QHull is an algorithm that reads a set of points to generate a multipatch through triangulations)

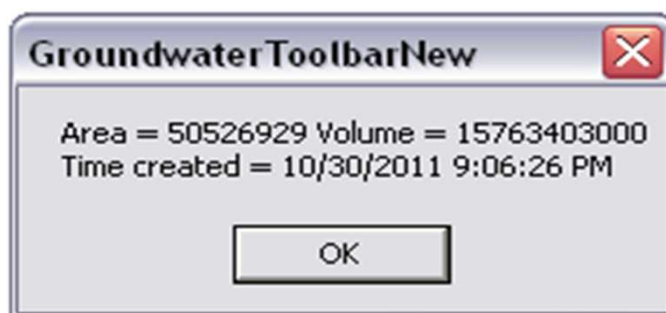
GEOVOLUME GENERATED FROM THE BASIN



GEOVOLUME GENERATED FROM THE BASIN WITH THE RIVER OVERLAIN.



THE AREA AND THE VOLUME OF THE UNDERGROUND RESERVOIR



The result showing the area and the volume of the water bearing reservoir calculated is in m^2 / m^3 . The date and the time the analysis was done is equally generated automatically

SUMMARY

The aim of this research work is to investigate the area and the volume of the water bearing reservoir available within the study area, using Geographic Information System technology in order to provide information on the hydro-geological characteristics of the area.

RECOMMENDATIONS

As a result of the outcome of this research work and the experience gained, it is hereby recommended that.

- Decision makers should apply GIS as a tool in solving problems and making decisions as any decision made is influenced by spatial facts on ground.
- GIS technology should be used in underground reservoir investigation. It helps to serve the people better.
- Study of GIS by decision makers should be encouraged as it helps to eliminate doubt and make them serve the people better.

CONCLUSION

GIS has been comprehensively applied to the process of underground reservoir investigation effectively. The results of this research work have revealed the capabilities of GIS at solving spatial problems and providing information which aid decision making. This also corroborates the fact that GIS is a veritable tool that can be applied to any discipline/endeavor for solving locational, unstructured problems and in taking highly sensitive decisions.

THANK YOU FOR YOUR ATTENTION.