

# Determining the Archaeological Areas in Iraq Geographically by means of the GIS and Its Impact on the Development of Civilization

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## Abstract

Iraq possesses ancient historical riches from the great architectural and cultural heritage that are of special importance represented by the archaeological cities. Which are among the most important monuments in Iraq. Therefore, they have been highlighted in this study for their employment in tourism through the development of an executable mechanism and the use of (GIS) technology for what It has an important role in the analysis and production of tourist maps in all its forms, and these effects can be used to attract tourists at the local and international levels, which contribute to the development of the economy and the prosperity of civilization by preserving archaeological areas through the maps provided, because the current Iraqi archaeological atlas has not been updated since 1971.

## Introduction

Iraq possesses a set of factors that make it at the forefront of countries attracting tourism with its many tourist components, foremost of which are archaeological sites with their historical and civilizational importance being the first civilization known to man, and representing different time and historical periods, and they are the result of a long series of social interactions and clear evidence of ancient traditions and customs in addition to due to the geographical diversity in the climate and terrain of Iraq from north to south all these factors constitute an element of tourist attraction if they are properly invested. Therefore, development of archaeological places through deepening interest in them and preserving them through maps that clearly identify them and make them attractive places for tourists in the world . The Iraqi antiquities in all their classifications are considered among the most important historical sources in the world because of their important archaeological repertoire, representing great civilizations such as Ur, Babylon and many other important civilizations that must be preserved and surveyed geographically by electronic systems and, Geographic information system GIS which is a computer based system that collects maintains, stores, analyzes, outputs and distributes spatial data and information. In this regard several geographical surveys are being conducted that cover the entirety of Iraq from east to West and from north to south. Iraq is located in the heart of the ancient and modern world. Iraq is located within three zones (37, 38 and 39). Its center is Baghdad, which is located at 45° longitude E and 33° latitude N. Iraq is bordered by Turkey (Anatolia) in the north, Iran (Persia) in the east, Kuwait and Saudi Arabia (the Arabian Peninsula) in the south and Jordan and Syria (Levant) in the west.

## Chapter one :

### The concept of a geographic information system.

There are several definitions of a geographical information system that differ according to the uses of this system in different sciences. Also, these definitions are developing rapidly with the successive development of technology, and the development of the applications of this system. However, it is possible to mention some of these definitions, including:

#### 1- Dueker 1979 definition:

A geographic information system is a special case of information systems that contain information bases that depend on the study of the spatial distribution of phenomena, activities, and objectives that can be defined spatially, such as points, lines, or spaces to make the data ready for retrieval and analysis, or inquiring about data through it.

#### 2- Definition ((Burrough, 1986):

A geographic information system is a set of software packages that have the ability to enter, store, retrieve, process and display field data for a part of the Earth's surface.

#### 3- Definition (1987Smith et al):

A geographic information system is a database system that contains organized spatial information, in addition to containing a set of operations that answer inquiries about a spatial phenomenon from the database.

#### 4- Definition (NCGIA, 1990):

A geographic information system is a set of information equipment, software and automated functions that allow scanning, storing, managing, analyzing, modeling and displaying data related to their geographical locations in order to solve complex problems related to planning and management.

#### GIS components:

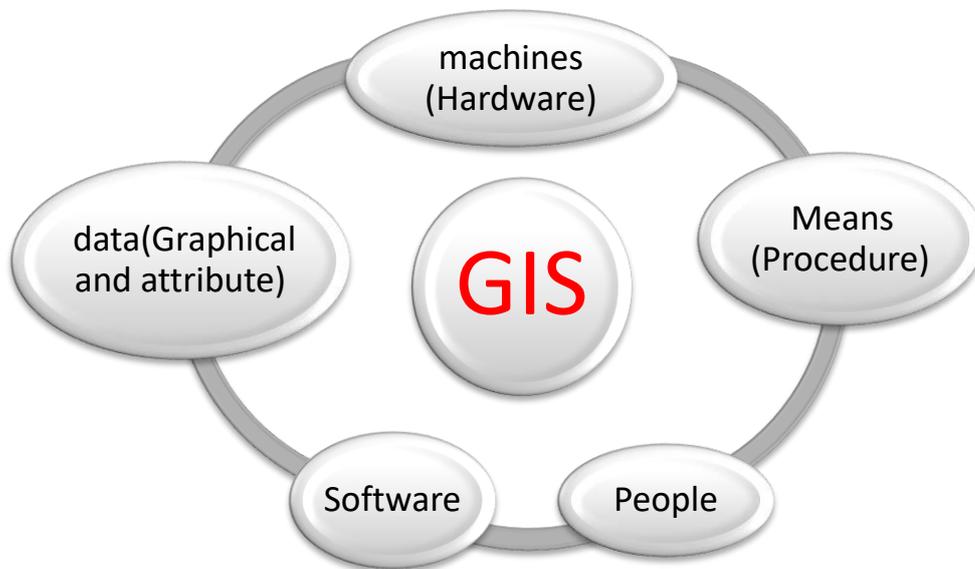


Fig. 1. Diagram showing the components of a system GIS

#### Machines (hardware)

The concept of a machine in any information system is the computer on which that system operates. Now GIS programs work on many types of computers from mainframe services to serving giant projects to personal computers that can be used in business alone or in a network consisting of a group of personal computers, in addition to as well as the spread of GPS devices on the surface of the earth which are used to determine the coordinates of certain points on the Earth's surface.

#### programs (Software)

GIS programs provide tools and methods for storing, analyzing and displaying geographic information. Among the basic components of GIS programs are tools for entering and adapting geographic information with the presence of application interfaces (GUI) as a tool for easy communication between the device and the user. The programs consist of a set of basic components, which include:

- 1- Tools for storing different forms of descriptive or geographical data.
- 2- Integration with database programs (Relational Database).
- 3- tools for research, analysis and presentation.
- 4- User easy application interface (GUI) for easy handling of the program.
- 5- Tools for making Topological Relationships between the elements of the (GIS).
- 6- Tools and means that allow a large number of users to enter data and work simultaneously and with high efficiency (Multi-User Management).

#### Data (Graphical & attribute Data).

Data is the most important component of GIS. Data within GIS is divided into:

- Tabular Data: It includes data from tables and various statistics about natural elements that can be represented by nature.
- Spatial data: It includes geographical data that represents nature and can be collected from aerial photographs, satellite images, and digital maps (Aerial Photos, Satellite Images, Digital Maps). Geographical data and related table data may It can be self-assembled or purchased from a data selling source.

#### People.

GIS technology has limited value without the people who manage the system and create plans to apply it to real world problems. GIS users range from technical professionals who design and develop the system, to those who use it in their daily work.

#### Means (Procedure).

A successful GIS is one that operates on the basis of a well designed plan and business rules that provide models and specialized practical practices for each institution. Examples of analytical methods include the application of functions related to sciences such

as climate, hydrology, or urban planning through GIS, or the application of quality control methods. Quality Control to ensure the accuracy of data entry, or network analysis, or other analytical means that serve different applications.

## Chapter Two:

### The concept of cultural heritage:

Cultural heritage as defined by UNESCO can be defined as “the monuments architectural works, sculptural and photographic works on buildings, elements or formations of a rich character, inscriptions, caves, and groups of monuments, all of which are of exceptional universal value from the point of view of history or art and science”

### Iraqi cultural heritage:

Iraq is rich in many cultural heritage sites whose roots lie in the depths of human history since the first human civilizations on the surface of the earth. However, despite that, only four sites have been included in the World Cultural Heritage List prepared by UNESCO. As for thousands of other sites they are still suffering from neglect until the present time. The cultural heritage sites included in the world cultural heritage list can be sequenced since their inclusion and as published on the official website of the organization as follows:

#### First (urban kingdom):

Located in Nineveh Governorate, it was under threat according to UNESCO data until 2015. It is a large fortified city with a wall fortified with towers, subject to the influence of the Parthian Empire and the capital of the first Arab kingdom. Hatra resisted the Roman invasion twice, in the years 116 and 198 AD. As for the ruins of the city especially the temples where Greek and Roman architecture are mixed with decorative elements with oriental features and roots they testify to the greatness of its civilization.



Fig. 2. urban kingdom

#### Second Ashur (Eastern Citadel):

It is located in Salah al Din Governorate, threatened since 2003, and according to the 2015 data of UNESCO. It is located on the banks of the Tigris River in northern Mesopotamia, in a distinct geographic-environmental area with an agricultural irrigation system and distinctive irrigation systems. The city arose in the third millennium BC. And between the fourteenth and ninth centuries BC, the city became the first capital of the Assyrian Empire, a "city-state" and an international trade crossroads. Then the city was destroyed by the Babylonians, but it was able to rise from the ashes in the Parthian era between the first and second centuries.



Fig. 3. Ashur (Eastern Citadel)

#### Third / Erbil Citadel:

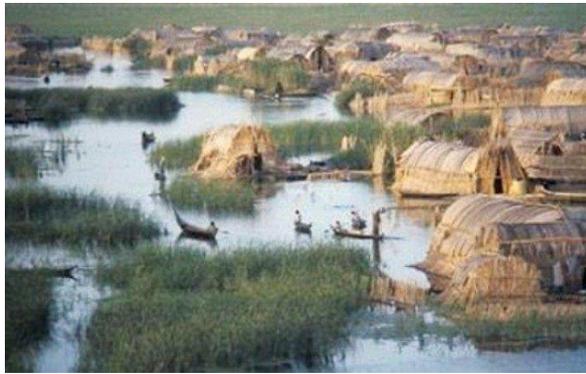
It is located in Erbil governorate in Iraqi Kurdistan. Its history dates back to the Assyrian era. It was built for defensive purposes as it was considered an impenetrable fortress for the city of Erbil at that time. The Erbil Citadel when it was established included the entire city.



**Fig. 4. Erbil Citadel**

#### **Fourth / the (Ahwar) Marshes of Iraq:**

It is located in (Dhi Qar, Nasiriyah, Maysan, and Muthanna) are group of water bode that cover the low lands located in the south of the Iraqi alluvial plain, and are in the form of a triangle. The cities of Al-Amarah, Nasiriyah, Basra and Dhi Qar are located on its heads. The area covered by water expands at the time of the flood in late winter and during the spring, and the summer days are reduced. The first Arabs called these areas "Al-Bataeh" the plural of "Buta'ha" because the waters stagnate in them, and they flowed and expanded in the ground, and reeds grew in them. On (July. 17. 2016) UNESCO agreed to place the marshes on the world heritage list as an international nature reserve. In addition to the ancient archaeological cities located near them. Such as Ur, Eridu and Warka.



**Fig. 4. Marshes of Iraq**

### **Chapter Three:**

#### **Documenting Heritage Using GIS**

The documentation of Iraqi heritage sites is divided into two main parts:

- a. Documenting heritage sites that were discovered during archaeological excavations and the possibility of using them as an electronic tourist guide.
- b. Documenting heritage sites that have not yet been revealed.

From this division the importance of the GIS system emerges from where it is a documentation tool that performs the process of archiving heritage sites that were previously revealed during excavations through the development of maps, aerial photographs, archaeological surveys and detailed information for easy access on the one hand, and considering this the system is one of the means that contribute to the inclusion of heritage sites that have not yet been included in the list of world cultural heritage. Which was prepared by UNESCO and which was referred to previously. Its importance also lies in the fact that it represents a tourist guide for Iraqi heritage sites. Which it can be prepared in an easier way than the system prepared for specialists in the field of antiquities. It shows the most important heritage features and the most important tourist and recreational facilities that the tourist needs. It can also be linked to the internet by designing it in the form of an application that can be downloaded from the internet for free, and it can also work on a mobile phone as well as on a laptop computer. It should be noted that an information system was established through which it included the administrative units of the governorates of Iraq with a brief description of the most prominent landmarks and cultural centers for each of the governorates of Iraq. Available information about Iraqi cultural heritage centers.

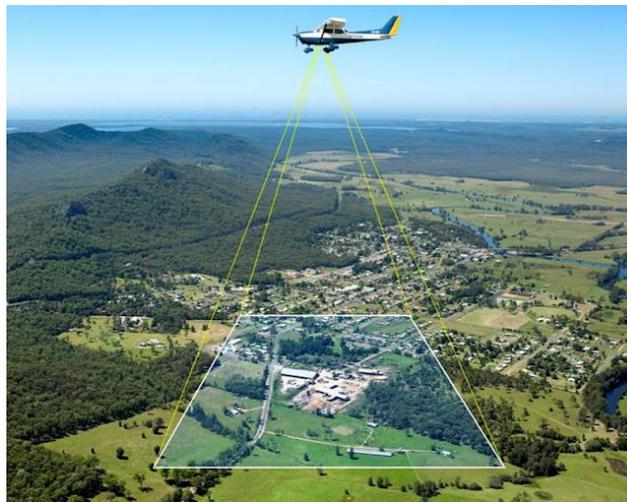


**Fig.5. Information system for the provinces of Iraq**

The process of archaeological documentation is not limited to documenting cultural heritage sites that were discovered during archaeological excavations. Its importance also lies in the archaeological sites on which no excavations have taken place yet. In addition to the possibility of conducting archaeological excavations with the help of this system as one of its functions is to be a substitute for paper records. In any case, the archaeological documentation process goes through a number of steps:

**1- Aerial Survey Process**

The aerial survey is carried out through a camera installed in the fuselage of an aircraft, with the aim of making a set of measurements on images or drawing maps of areas that do not have maps. As well as the possibility of updating all existing maps through the captured aerial photos and all the data necessary to document them in the system GIS.



**Fig.6. Aerial Survey Process**

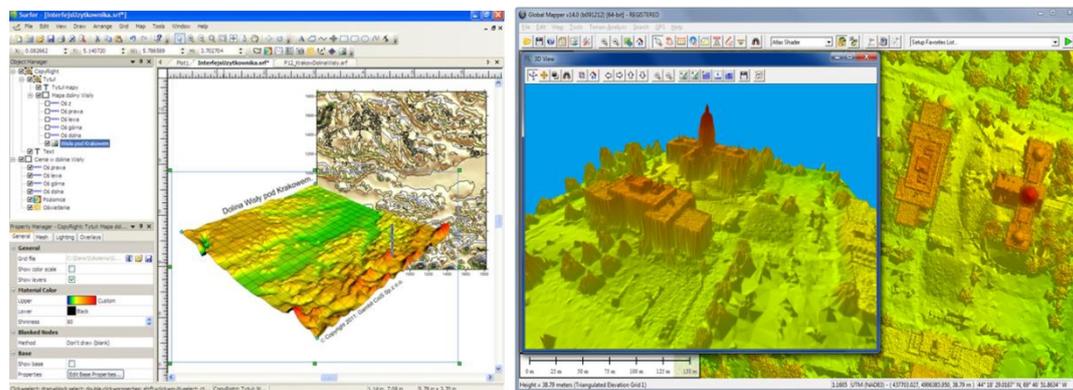
**2- Ground or field survey**

The process of the ground survey of the archaeological site goes through many important scientific steps in order to give a detailed description of the site before commencing the excavation process. However, one of the most important steps to be taken at the outset is (determining and dividing the study area). Where the archaeological site is divided into a group of squares whose dimensions vary according to the study area that will be subject to the excavation in the archaeological site, and this process is carried out using a number of surveying devices such as the level device, total station and theodolite, and a number of tools used for linear measurement such as range poles, rods, pegs, tape, and field notebook.



**Fig.7. The tools used in the land survey**

Through this the study area is divided into a number of squares and an appropriate indication of the networking points. In the end we obtain a contour map by entering these data into special programs to make this type of maps including the surfer program and the Global Mapper program if we adopt aerial measurements in take the heights of the study area.



**Fig.8. a) Surfer program**

**b) Global Mapper program**

After conducting aerial and ground surveys, and taking measurements, maps and descriptive information for the study area. All this information is placed in one of the programs dedicated to geographic information systems, including MapInfo, ArcMap and MapInfo Corporation, where the program allows detailing the information in database tables 'Access' directly. The ArcMap program also depends on the presence of a topographical or satellite visual map or an aerial image of the study area which is entered into the program by knowing three known points the ground coordinates (X,Y), and defining and projecting them to convert the map or image from 2D to 3D after which the required field information is entered. To the program represented by the position of the layers. They are dropped at their specified location on the map recorded in the program then the different layers are drawn including:

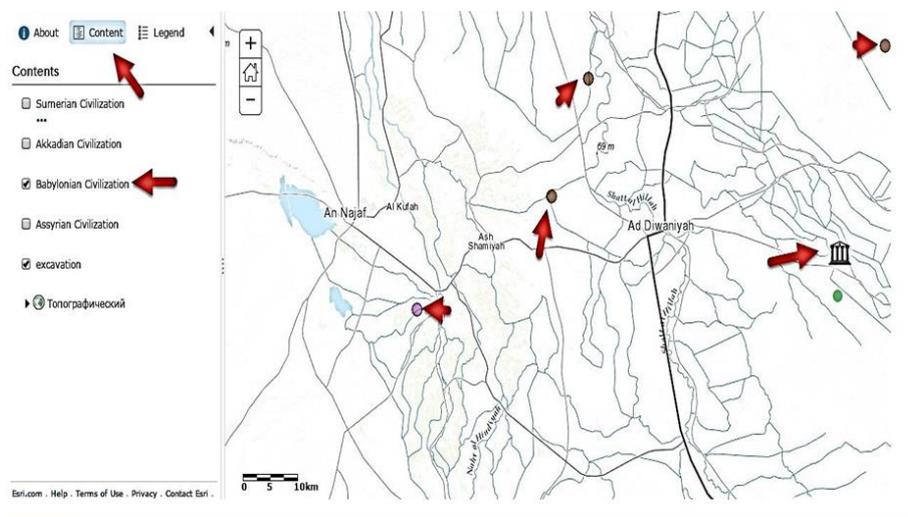
- A geological map of the area showing the geological formations and the boundaries separating them.
- A special layer for the drawn contours, which represent the structural map of the contour separating the two formations in the region.
- layers of archaeological finds.

Arc Map as well as MapInfo is one of the programs dedicated to geographic information systems, and it is used to prepare and exploit spatial reference data. It is provided like other GIS programs with a graphical interface and a set of tools and commands that allow the user to view maps, tables , graphs, and perform a set of analyzes and database queries. The program allows the possibility of linking various websites and data to databases .It allows the achievement of a number of functions the most important of which are:

- 1- Setting and numbering the maps.
- 2- Completing and structuring databases.
- 3- Create thematic maps.

- 4- Create and edit graphs.
- 5- Spatial analysis.
- 6- Inquiries about the database based on a set of simple or compound criteria.
- 7- Integrating maps with information taken from multiple sources.
- 8- Dealing with a large group of external databases by importing and exporting tabular files.

This program has been applied in documenting 79 cultural sites in Iraq, and it was used as an experimental model for this system, through which a detailed description of all the archaeological sites included in it was given. It can be developed by converting it as a free online application, as published on the Internet via the official “Arcgis” website, and through this system we can find any archaeological site by using the find tool where the user appears a dialog asking him to enter the name of the archaeological site he wants to search for. It is also possible to show the content where it has been divided into a group of layers (Sumerian civilization, The Akkadian civilization, the Babylonian and the Assyrian civilizations..etc) Figure [9] and by selecting one of the options the selected cultural heritage sites that belong to that civilization appear on the map, and the system provides the user with a set of options represented in flash feature Select Feature, Zoom to Feature, or identify feature or unselect feature. Which shows finding one of the cultural heritage sites on the digital map with the work of selecting it as well as zoom to feature.



**Fig.9 Program options for the archaeological site**

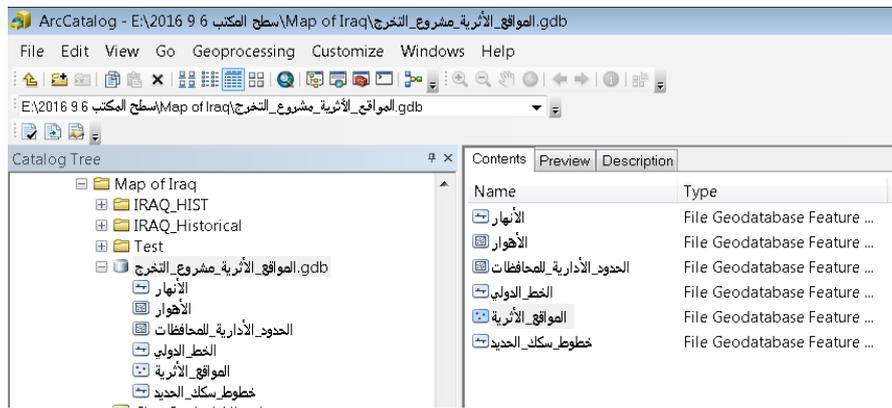
#### Chapter Four:

##### Practical application to use GIS

A spatial database was created using ArcGIS to build and analyze existing archaeological sites. The governorates of Dhi Qar and Qadisiyah were selected as a study area for the research outputs from the spatial data and within the archaeological site surveys for the year (2010-2015). The following steps have been taken:

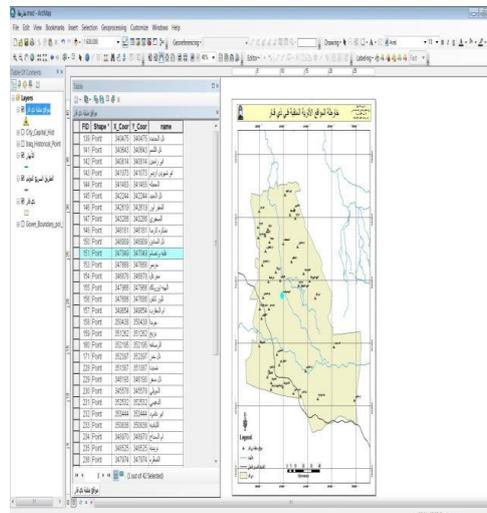
**Spatial Geo Database:** One important term in GIS system is the installation of geographical locations of the archaeological sites precisely by using Global Positioning System (GPS).

The spatial database was created using the Arc Catalog, which is part of the ArcGIS10.3 software package, the project database is set up according to the geographic coordinate system and the WGS84 and WGS84 support platform. The database was designed according to the standard specifications shown in Figure [10].



**Fig.10. Steps to build a spatial geodatabase**

Points are distributed according to the distribution of archaeological sites, with the name of the archaeological site placed above each point Figure [11].



**Fig.11. Descriptive table of the archaeological site**

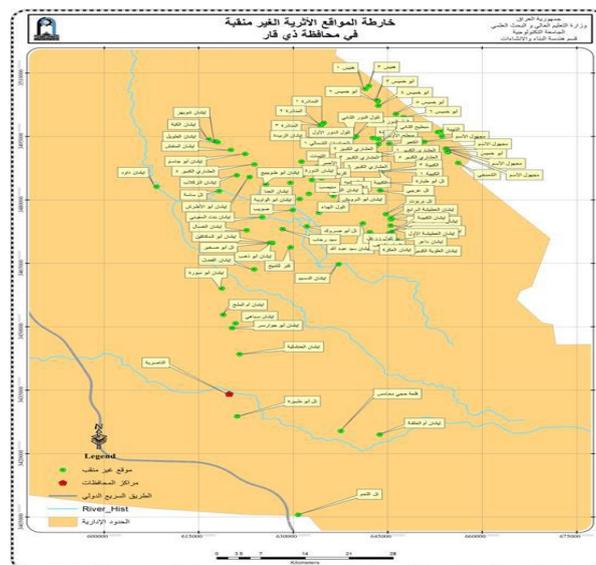
After completing the process of drawing points and identifying all archaeological sites above each point, a map is obtained showing the distribution of the provinces in Iraq Figure [12].



**Fig.12. The resulting map of the selected archaeological sites**

The process of checking and detecting errors is done through topological correction, which is one of the important stages in the process of drawing and preparing the geographical database. After the process of entering the parameters of the topology process is completed. We use another program Arc MAP for the purpose of checking and detecting errors if any in the graphics, and they are processed and corrected changes to the original layer are stored in maps or in digital copies.

After completing the data entry process and conducting the necessary surveys, we obtain a map of the undeclared monuments of Dhi Qar Governorate Figure [13] . A thematic map of archaeological sites in Al-Qadisiyah Governorate is produced Figure [14].



**Fig.13. Map of the undiscovered archaeological sites of Dhi Qar governorate according to the 2010 survey**

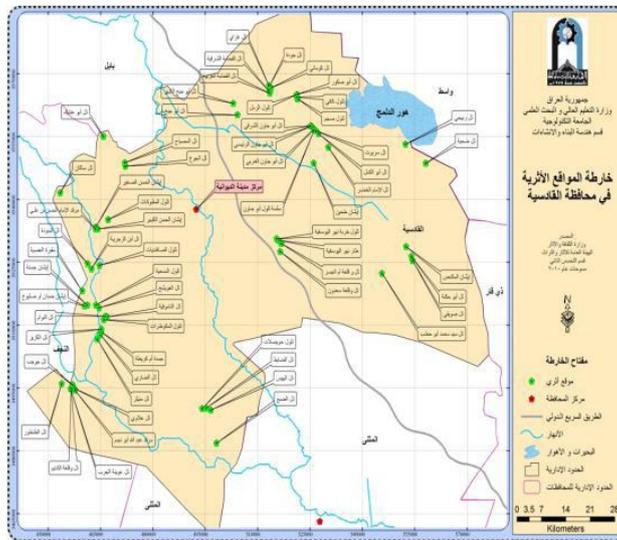


Fig.14. Production of a thematic map concerning archaeological sites in Qadisiyah governorate

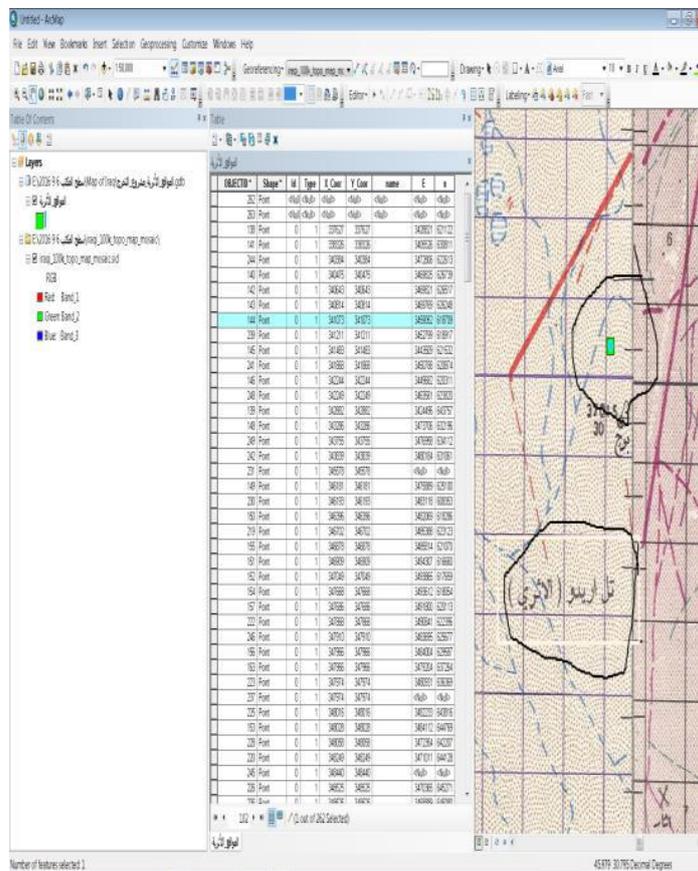


Fig.15. Production of full geodatabase system

### Uses of information systems (GIS) in the field of archaeological tourism.

(GIS) can be used as an integrated information system, as it is an effective technology that contributes to the preparation of spatial databases and linking them to descriptive databases, which make a description of the geographical place to be inquired about. Therefore, the capabilities of this system are distinguished in the field of entering, processing, preserving and updating data related to the archaeological site drafting and preparing detailed maps with a spatial reference thus updating the existing historical, urban, economic and infrastructure studies that contribute to decision making because of its ease in retrieval, identification and analysis of data using different methods and based on the idea of the multiplicity of fields in which GIS is used it was necessary to include archaeological studies within these areas and to expand this idea because of the limitations of the traditional methods used in documenting archaeological sites and their limitations in the process of processing and analysis. For this reason GIS technology has become one of the main tools that are used in the process of planning and managing archaeological sites and documenting them for

tourism. Therefore, GIS programs are among the important programs that contribute to the work of electronic geographical databases. Which take different forms for example, maps, tables and charts. Through which decisions will be taken that will contribute to the development of archaeological tourism.

Accordingly, the importance of using information systems (GIS) to locate archaeological sites and preserve them from disappearance as a result of several reasons, including wars and political conflicts, including the inability to access them and other reasons. In all fields, especially raising economic income as a result of tourism revenues

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