The Importance of Remote Sensing Technology and its use in the Study of Environmental Systems (Detection of Groundwater, Model).

Assistant Prof. Dr. / Abd AL- Salam Muhammad Mail Aljughaifi.

University of Baghdad, College of Education / IbnRushdfor Humanities Sciences, Department of Geography.
a.mail@student.uw.edu.pl

Abstract:
The main objective of this research know is to evaluate the ability remote sensing techniques to detect ground water in the study area.To achieve this goal, American satellite imagery (Landsat-7) was used to cover the study area.
And use of the digital image processor program **(ERDAS IMAGINE)(Earth Resources Data Analysis System)**in order to improve aerial image and the signature of the real coordinates of the area and classified according to the nature of the region, then analyze this image by comparing them with geophysical methods used to identify groundwater wells.
This analysis of the ability of remote sensing techniques and digital image processing has proven to identify groundwater sites depending on the study and classification of the surface crust covering the area, which provides an effective tool for exploring groundwater.
Keywords: ***Electromagnetic spectrum, electromagnetic waves, remote sensing, groundwater, satellites, sensing.***

-Research problem:
Many groundwater wells drilled in villages, cities, institutions and agricultural projects without consulting geologists and not using modern technologies in them such as wells records (wells logging)its losses are huge due to the selection of the location that is not appropriate for the well and not to put filters that bring water inside the well in the required way so the use of remote sensing techniques was a must to know the crust layers of surface that bear the presence of water then it is confirmed by geophysical methods that have the ability to study the lithological nature and classification of ground layers containing water reservoirs, thus, the problems of the wells that are drilled without being overturned shall be solved by an electric probe.

-Research Objectives:
1 - Definition of remote sensing technology and the extent of its importance and use in the study of environmental and geological phenomena.
2 - Geophysical methods (electrical resistance, logging of Kleber, and gamma rays) and their role in determining the environmental and lithological nature of rocks and their properties and stocks of water, Oil and Gas.

-Remote Sensing:

1: Introduction:

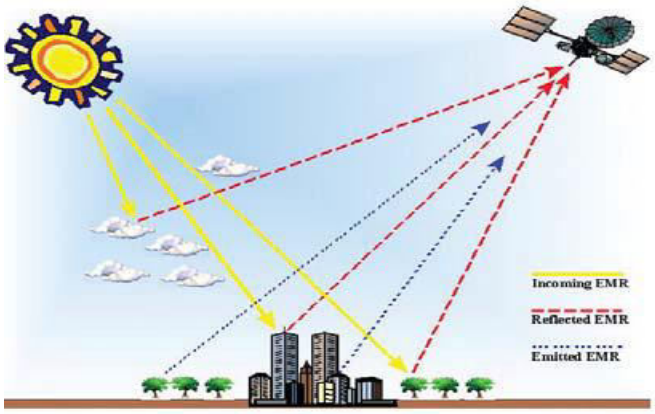
Remote sensing is the science that uses the properties of electromagnetic waves emitted or reflected (Electromagnetic Waves) from the bodies ground or aerial or water seas and oceans, ***(Report Geophysicist Environmental Services and Development, October, 2009, the University of Baghdad, the Environment Department).***

Remote sensing means the sum of operations that allow information about something on the surface of the Earth to be obtained without there being a direct connection between him and the information capture device known as remote sensing it is the science and art of studying and analyzing things and inferring information from a distance, it is the technology that enables us to study the physical and chemical characteristics of the various bodies and details of things without the need to touch or access them and make measurements on it directly,from this definition we conclude that the task of interpreting aerial and space imagery is one of the vital tasks of remote sensing, the hearing, sight and smell are all regarded as a form of remote sensing.

2 - Scientific work of remote sensing:

The sun is the basic natural source of electromagnetic energy and various forms of artificial energy radiated electromagnetic energy waves of varying lengths,here we mention that the light which can the human eye can feel it and thus distinguish objects and identification of which within the limits of its capacity and scope as mentioned above is a special type of electromagnetic radiation energy visible and non-visible, they are emitted as waves of varying lengths, but at a constant speed, the speed of light according to tracks in the form of sinusoidal curves.It is the interaction of electromagnetic energy with bodies that determines the ability to see or bodies sense,the energy does not interact with themselves, but in fact fall from its sources on nearby bodies and far and wherever it can enter and reach, interact with it,we through our eyes and through satellite and aerial images, devices and electronic systems and special visual effects we feel these interactions and disclose the identity of these things (plantings - buildings - water - roads - carts - projects ... etc.)***(Commission of remote sensing, University of Baghdad, satellite image (Landsat-7).).***

Figure. (1) Shows the scientific work of remote sensing.



3: Forms of electromagnetic energy reaction:

3 –1-Reflection: It is a partial or total reversal of the falling energy on an object, Reflected off this body to back to its source without changing its nature.

3 – 2- Transmission: Is, the energy that falls on the body pass unchanged in nature them to spread again in another medium.

3 – 3 –Absorption: Here, electromagnetic radiation is converted to another form of energy, as heat.

3 – 4 – Emission: Here is being re-issuing part of the electromagnetic energy absorbed within the body either with the same original wavelengths as the energy falling on the body and the Interacting, or at different wavelengths.

3 – 5 -Scatter or dissipate: Being deflection of the path of energy falling on an object, dissipates or absorbs within the body itself.Depending on these forms of energy and the type of falling objects it so it identifies the vision of things, falling parts of the electromagnetic energy falling from the sun are either dissipated or absorbed (converted into heat or other forms of energy) in the atmosphere due complicated interactions between parts of this energy and particles or particles distributed in the atmosphere, ranging from (gases, particles, and Aerosols, Vapor, and water droplets), some of the important results of these reactions are preventing the penetration of harmful UV rays and other types of energy from the short wave to the atmosphere, the extent of transmission of different types of electromagnetic energy through the atmosphere depends on the wavelengths of these types and on the nature and properties of materials suspended in the atmosphere, which are being interacted with before reaching the ground, in addition to the depth of the atmosphere layers that this energy will cross**.**

The amount of dispersion of a type of electromagnetic radiation is proportional to the inverse of the fourth force of the wavelength.

All materials at temperatures above absolute zero (^{5}273) emit electromagnetic radiation whose density and spectral behavior are proportional to the temperature of their surfaces**.**

The black body is characterized by its absorption and release of all the energy falling on it and is therefore considered an ideal radiator as it does not increase in temperature or decrease**.**

4: Identity or spectral footprint:

Different bodies and things interact with electromagnetic radiation differently, this difference in reaction output is due to two main factors, one of which is the difference in wavelengths of electromagnetic radiation falling on objects the second is the difference in characteristics or composition atomic, partial and crystalline bodies themselves**.**

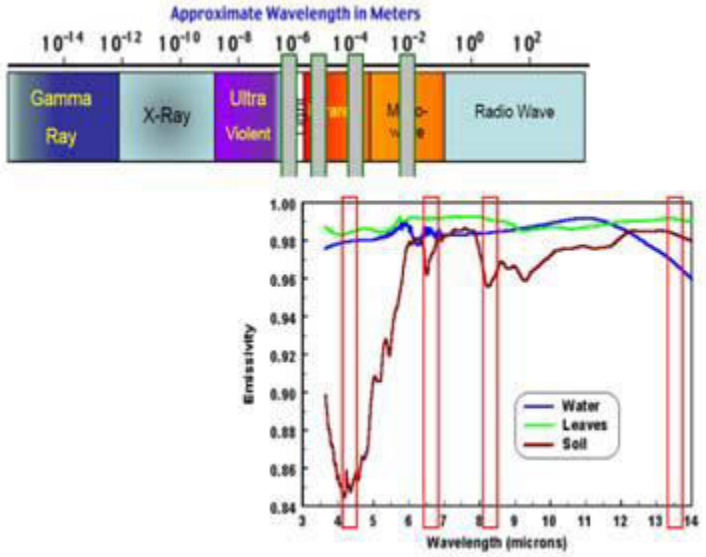
The amount of electromagnetic radiation of different lengths of wave which is reflected from an object (As a result of its interaction with energy) it is picked up by a

remote sensing device that identifies the identity or the spectral footprint of this object**.**

5: The field of the electromagnetic spectrum:

The part of the electromagnetic energy whose wavelengths ranging from (0.4 um) (0.7 um) it is who can Senses the human eye and thus things are distinguished by their colors, and the following figure shows the field of the electromagnetic spectrum.

Figure (2) field of the electromagnetic spectrum.



Considered the seven basic colors of white light located within range (0, 4)–(0, 7) of electromagnetic energy.

Most types of aerial imagery used in remote sensing affairs are the product of acidification films that are sensitive to the part of the electromagnetic energy located within or around the visible field that is, approximately from (1,2 u_m) to (1,3u_m)**.**There are, of course, modern and advanced remote sensing systems that can sense a wider range of electromagnetic radiation and thus was able to devise more precise information and best and more comprehensive about a lot of features and details of the various natural phenomena**.**

6: The importance of remote sensing:

The years of World War I (1914-1918) saw extensive use of remote sensing technology by taking aerial photos and with the end of this war, remote sensing uses for civilian ends began (transportation - agriculture - geology - hydrology ... etc.); and developed significantly during the Second World War (1939-1945), where many devices were invented and developed that help to analyze and interpret aerial imagery for the purposes of mostly military. After World War II in the fifties and sixties, civilian applications returned to take on a larger size dozens of devices and hundreds of tools appeared on the markets help in the affairs of taking pictures and recording information, processing, classification, analysis, and taking them out and stored. Since the beginning of the seventies, satellite imagery has become the primary source of

information in the fields of military and agricultural affairs, economic development, management, exploration, identification and investment of natural resources, and in studies related to atmospheric pollution and the monitoring and study of planets and other bodies,***(Yasser ShabanBakhit, et al,*****2016**). perhaps the most important characteristic of satellite imagery or information is the tremendous speed in obtaining it and the vast coverage, whether that is horizontal (vast areas of the globe appear on one image) or vertically (the different ground layers appear on one image and can be studied and analyzed simultaneously) and the continuity of obtaining pictures of the same area at renewable time periods**.**The researchers, planners and engineers, do not hide the importance of speed and inclusiveness in obtaining and benefiting from information in a range, it can be said that making maps of an average scale of an average Earth in the intensity of detail using modern satellite imagery requires approximately 1% of the time which takes the same work using direct floor space methods and the equivalent of 10% of the time required to use the air space methods in the scope of inclusivity, satellite imagery has enabled it easy to communicate between parts of the globe thus achieving information integration and more accuracy in the analysis, especially those related to the environmental, geological, hydrological and military aspects, ***(Dr. Abd Al-Nabi Muhammad Abdul-Hadi, 1992).***

7: Remote Sensing Sections:

The optimal exploitation of natural resources (water - lands - minerals - petroleum and others)**, *(Prof .Dr. Richard Sealy, 2010),*** requires knowledge of modern science, which is the science of remote sensing which enables us to obtain continuous information about the studied things without direct available contact between the sensors and these things, and based on this definition, remote **sensing includes:**

(A) Aerial images style which is known as aerial photography**.**

(B) Satellite method, which is called Space sensors**.**

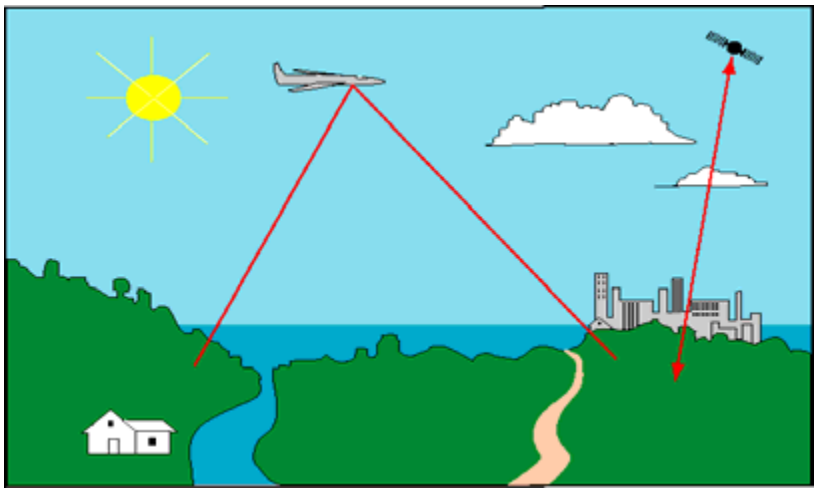
It can extend to the include electromagnetic waves that geophysicists use in their study of groundwater it is possible that this definition gives us the right to consider what doctors rays and waves used in detecting diseases is one of the methods of remote sensing, with the development of the computer and satellites, none of us can any longer know where the remote sensing will extend in the near or far future***,(Dr. AbdRabb al-Nabi Muhammad Abd al-Hadi, 1992).***

7 -1- atmospheric sensor:

Prevailing the command in remote sensing technology is to base on the effects of the interaction of aerial images it is originally a reaction resulting from the interaction of a portion of electromagnetic energy with the objects depicted and the reflection of this part of the electromagnetic energy on the things you want to determine the identity or the development of information around, ***(Dr. Abd Al-Nabi Muhammad Abdul-Hadi, 1992).***

Figure 3 shows the aerial photo capture by aircraft equipped with cameras the military forces often use it in explorations, surveys, security and intelligence forces, as well as agricultural companies, to spray pesticides and follow up on agricultural fields.

Figure- (3) aerial Sensing.



7-2 - Space Sensing:

Space sensor is that science, which shows satellite data that exist in space they apply in the paths elliptical around the Earth and it works to reveal the material contained by the earth through the trips of these moons around their tracks,***(Dr. Yousef Siyam, 1994).***

Figure (4) space sensor.

Satellite data is a spectral emission that reflects the identity of the reflected objects. They are types the including:

A - French satellite data:

Each vertical scenery of the image covers a floor area of 60 x 60 km, as for oblique scenes the maximum degree of inclination is [5]27, each covering an area of 60 x 80 km, but this kind uncommon.

B - American satellite data (Landsat):

It started with two generations of Landsat, the first generation covering data (Multispectral Scanning) (MMS) and the second generation covers data (Thematic

Mapper) (TM) each of these types has its own construction, which is different from the other at the same time, it differs from building the French satellite data which MMS Scenery represents 185 km x 178 km and it consists of 3,240 columns and 2,256 rows as for TM images, each one represents an area of 180 x 180 km and consists of 6454 rows and 6454 columns**.**

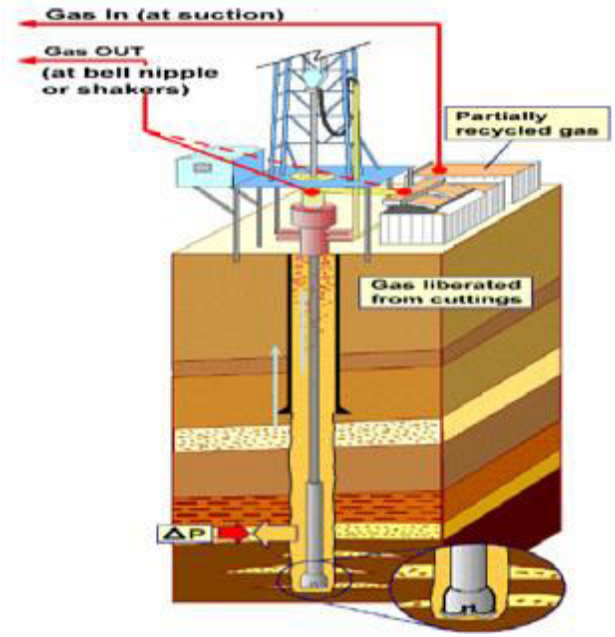
The base point for each of them represents a floor area of $ 30 × 30 meters before the geometric correction and symbolized by the symbol AT after this correction reduces the area to 28.5 × 28.5 meters.

In order to obtain data for a region, it is necessary to know the Universal system of image reference the private locates images within the catalog and this system consists of two numbers, the first indicates the path, and the second number indicates the position of the image, and notes that the number of tracks varies from Landsat to the another for example, the number of tracks in the case of Landsat first generation is 250 tracks numbered from west to east, the number of rows is 119 row, It may be kept in this system when archiving the second generation of Landsat**.**

7-3- Ground Sensing (Geophysical Methods):

Ground Sensing, means studying above the earth's surface such as images that picks up by radar underground study such as geophysical methods, which concerned with the study of rocks, layers, and geological structures by electromagnetic radiation that come out in the form of curves show the properties of these rocks and the water, minerals and petroleum they contain**.**

Figure (5)Geophysical sensing.



8- Research methodology:

It includes the study of the surface and is by space remote sensing (satellite data) and study under the surface, by means of ground remote sensing (wells logging)**.**

Figure (6): Zaghdan Valley, southeast of Haditha.

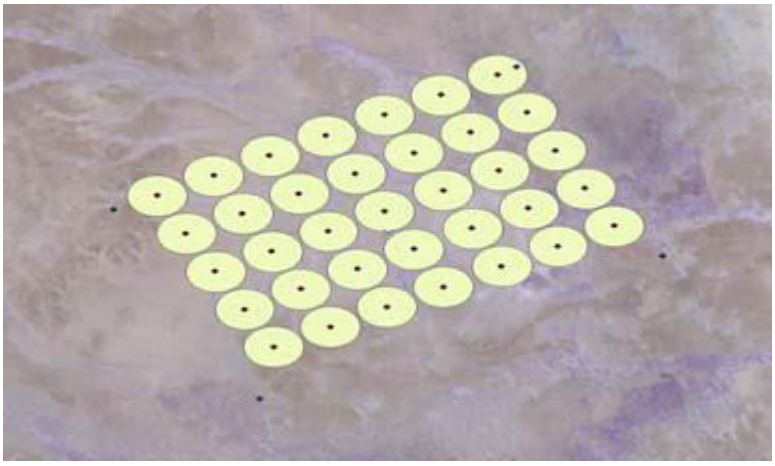


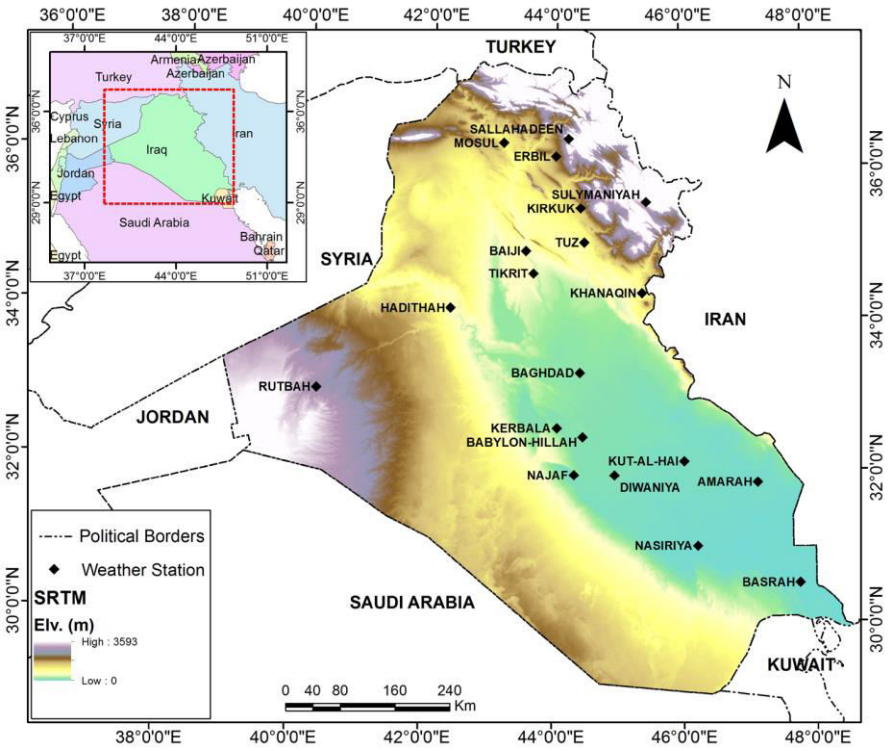
Figure (6) is a Landsat-7 image of a part of the study area we find that the data is clear, as the violet color represents the low places, valleys and creeks these circles were represented by it they are pivot sprinklers (agricultural) and the centers of these circles represent the underground wells on which the geophysical study was conducted (Gamma rays, Qualitative resistance, Self-effort)**.**

8-1 - Data:

-Geological data (surface study):

Geological phenomena of the region are shown to us by analyzing the geological map and satellite data (Landsat)**:**

Figure (7): the geological map of Iraq.

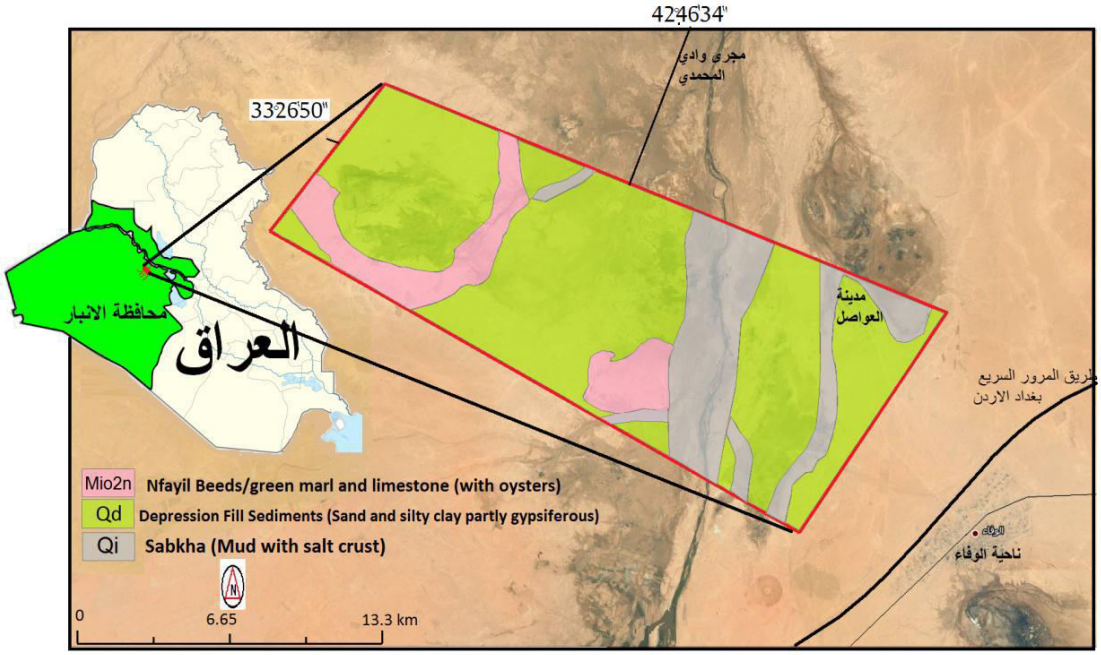


Source: USGS (2004).

Figure 7 shows the components of each region of the rocks, the rocks are either igneous volcanic out of the ends of the earth subsoil sedimentary or metamorphic due

to weather and climate factors and through this geological map show us that the area belongs to the basin, which is mostly sandstone and its sedimentary rocks forming layers on top of each other**.**

Figure (8) image of Landsat-8 of the study area.



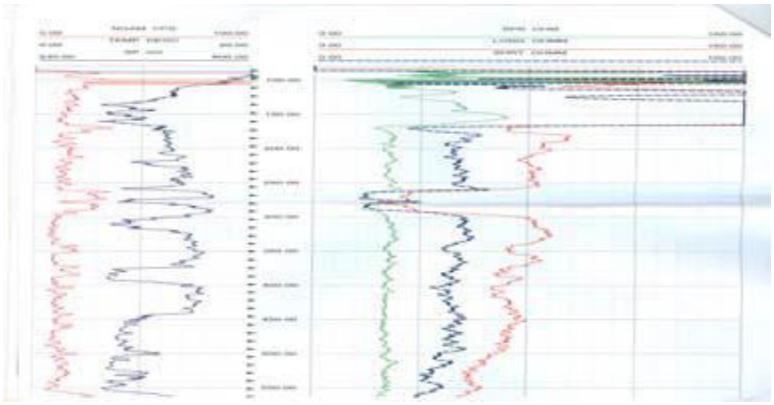
Source: The researcher's work is based on the satellite image of the Landsat-2019 satelliteGeological Map (1: 250000), 1994, issued by the General Authority for Geological Survey and Mineral Investigation, Gray Board, SHEET-NI-38-9).

The surface crust of the study area was classified by (ERDASE PROGRAM) the shape consists of six layers the blue color represents the main stream of Zaghadan valley that flows into it, and the milky color represents the flood sediments as well as in the rest of the layers each color represents a layer, we find that the area is dominated by flood sediments and sand, in addition to valleys and creeks that indicate the presence of water in the region**.**

-Analysis and results of geophysical field work:

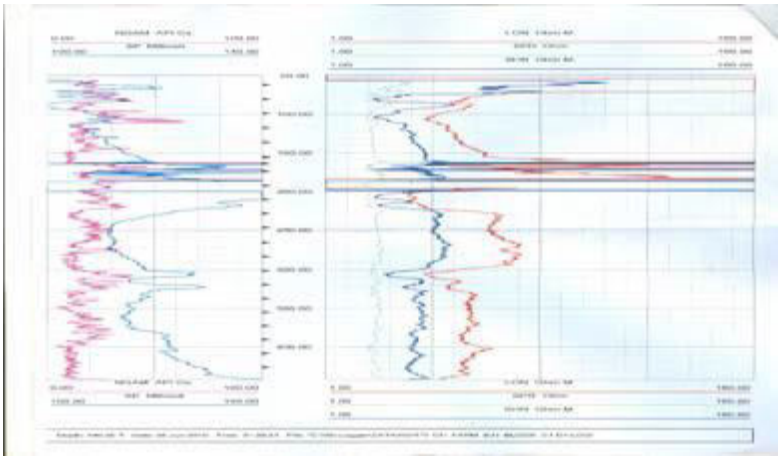
Geophysical well logging were completed process (Gamma-rays - self-effort-qualitative resistance) to confirm the ability of remote sensing techniques in the search for groundwater**.**

Figure (9) Analysis and Results of Well No. (1).



Well logging No. (1).

Figure (10) Analysis and Results of Well No. (2).



Well logging No. (2).

Figure 9 and 10) reflects wells recordings (Gamma-rays- self-effort- qualitative resistance) which clarifies the characteristics of the ground layers and we find in these wells that the resistance ranges between (30 - 95) ohms / meters in the depths between (100-659 feet)**.**

Conclusion:

The researcher concluded that remote sensing is a modern science and a renewed and advanced technology with the development of modern technologies such as imaging techniques, computer science, its hardware, software and other sciences, it is aforked science that enters in many fields, such as military and security sciences, geology, agriculture, disaster prevention, astronomy, meteorology and geographic information systems, building maps, as well as it enters resolving the problems facing institutions, governments, and organizations such as staving off disaster, knowing hurricanes before they appear, and repelling the enemy before arriving through radar and othersetc. and thus can, with high efficiency and speed, help in making the right fast decision and taking the necessary precautions well in advance, each according to his field**.**

In this research, the researcher was able to connect remote sensing techniques and satellite data with geophysical methods, these techniques have proven to play a major

role in determining the environmental, geological, and natural lithological phenomena that have given strong evidence of the existence of groundwater in the study area**.**

Results:

1. The area is mostly flat and dominated by some simple highlands.
2. The area is covered with shallow sediments consisting of limestone, gravel, sand and clay under a depth of less than 31 meters,it is located above a higher line for shallow components and their layers.
3. The previous layer follows the limestone components from 30-500 meters deep, its resistance ranges from 70-120 ohms / meter. It consists of layers synonymous over each other (Gravel - coarse sand - fine sand) and it is one of the best high-permeability layers, which in turn allow the production of large quantities of water.
4. Best reservoirs produced water in the valley Zaghdan are reservoirs that are in the depths of between 125 meters to 250 meters.

Recommendations:

1. We must join efforts and exchange common experiences between countries, institutions, companies and people with high experience in such sciences and technologies, especially remote sensing, geographical information systems and other sciences as well as, activating conferences and practical scientific workshops, and setting up training courses that publish that and learning it for everyone who benefits until the benefit becomes common and the common interests are fulfilled.
2. You must make use of remote sensing and geophysical sensors in well drilling operations.
3. Every well it is drilled it must have operations well Logging which determines water reservoirs and depths, then filters are placed parallel to them to bring water with high efficiency.

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