The Use of Modern Technologies and its Impact on The Estimation of Surface Water Flow to Choose The Optimal Sites for Water Collecting in The WadiKaifah in The Desert of Iraqi's Jazeera

Dr. Mohammed Musa Hammadi Al-Shabani
Assist. Prof.
College of Arts / Anbar University,
Anbar - Iraq

Dr. Salah Othman Abdel-Ani
Ministry of Education /
Anbar Education Directorate
Anbar - Iraq

Abstract:

The Paper deals with the study of mechanisms for selecting suitable sites for water collecting , due to their importance for the area in which the WadiKaifahah basin is located within the borders of the Jazirah desert, which is characterized by drought and the fluctuation of its rainfall from one season to another. The selection of watershed sites was based on the US Soil Conservation hypothesis (SCS-CN) to estimate the volume of surface runoff through a set of indicators represented by finding the relationship between the types of land cover and the types of hydrological soils to measure the nature of the valley surface for permeability and infiltration depending on remote sensing techniques and systems. Geographical information (GIS), as the (CN) values ranged between (77-91) showed that it has adequate surface runoff, and then estimating the depth of runoff (Q) for the valley basin to estimate the annual volume of runoff (QV), which reached its lowest value. It has (181400 m3) and its highest (21150800 m3), and finally it reached to determine the four most suitable sites for the construction of dams for the watersheds based on the topography of the area and the results of the (SCS-CN) method.

Key words: *modern technologies, runoff, water collecting , and WadiKaifah.*

INTRODUCTION:

Rainwater collecting is one of the important hydrological studies, especially in dry and semi-dry regions, because it is an important means of exploiting rainwater in season of rain, and making use of it in many areas that help to achieve development for desert areas that suffer from water scarcity due to its fluctuation Season to season, as well as its importance for providing water for drinking and irrigation of pastures and other agricultural purposes.

- **Research problem:**
  - Can we rely on natural factors and morphometric and hydrological indicators in determining the most suitable sites for establishing water catchments for collecting water by using modern technologies?
  - Ability of using modern technologies in establishing water catchments for collecting water.

Research Hypothesis:

The valley is characterized by natural, morphometric and hydrological qualifications that help in selecting suitable sites for the watersheds for the purposes of water collecting and using them in the desert development process.Modern technologies have an important role in determining suitable sites for water collecting.

Objective of Research:

The research aims to highlight the role of the natural, morphometric and hydrological qualifications in determining suitable sites for water collecting by using modern technologies that save time and effort in such studies, as well as building a database that includes detailed information about the nature of the area that contributes to the desert development process, the fact that the area is located In a dry climate.

- **Methodology:**

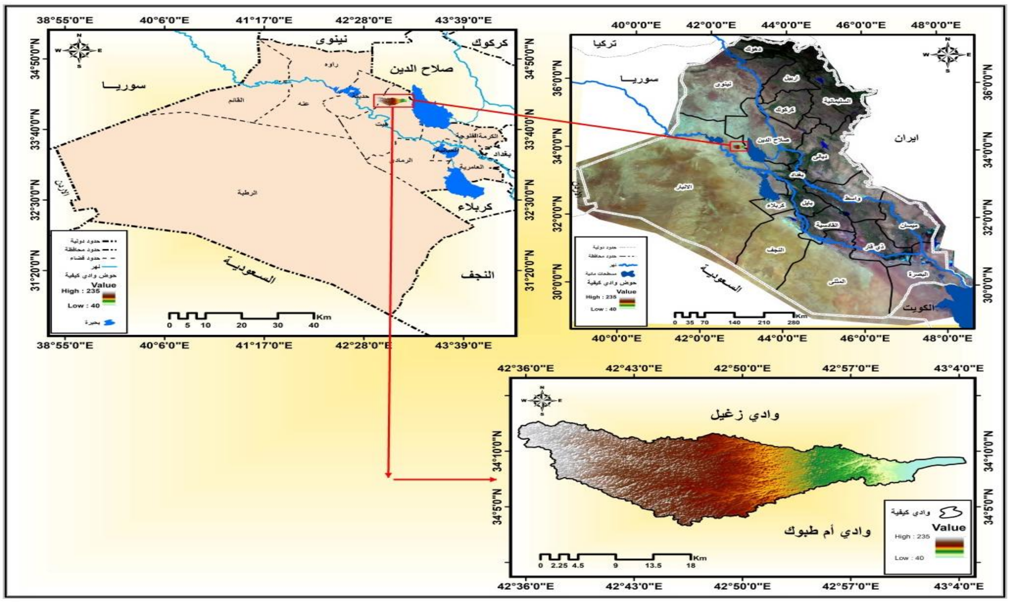
The research relied on the quantitative analytical approach through applying mathematical equations and analyzing their results based on modern technologies to select the best sites for watersheds.

- **Limits of research :**

The WadiKaifahah basin is located within the borders of the Jazeera Badia in the northeastern part of Anbar Governorate, between two latitudes (34 ° 3'15 "N - 34 ° 12'41" N) north and between longitudes (42 ° 35'30 "E - 43 ° 4'26 "E) East.

It is bordered on the north by WadiGhazil and on the west by Wadi Abu Dalaya, while on the south it is bordered by Wadi Umm Tabuk, while its eastern border ends at Lake Tharthar so that its final course flows into it, as shown in the map (1).

The site of the WadiQifah basin from Anbar and Iraq



Reference : based on:

- Republic of Iraq, Ministry of Water ReReferences, Public Survey Directorate, Map of Iraq and Anbar Administrative Governorate, for the year 2019, scale (1/1000000).
- Iraq topographic map at scale of 1: 100,000 for the year 1990 issued by the General Commission for Survey.
- Digital elevation model (DEM) with distinguished resolution (30 × 30), and Arc Map 10.4.1 outputs.

References of data and technologies used:

1. Remote sensing data for the satellite (landsat-8) captured on 7/2/2020 and the OLI sensor.
2. Digital Height Model (DEM) with distinctive accuracy (30 × 30) meters, for the year 2000.
3. Iraq topographic map, scale 1: 100,000 for the year 1990, issued by the General Commission for Survey.
4. Climatic data for the period 1981-2017 for Haditha station issued by the Iraqi Directorate of Meteorology and Seismic Monitoring.
5. Arc Map v 10.4.1, 9.2 v Erdas Imagine program, v 12 Global mapper program.
6. Mathematical equations adopted to measure the flow curve according to (USDA) as follows:

A- The value of (s) can be calculated through the following equation:

$$S = \frac{25400}{CN} - 254$$

B- Calculating the value of La, which is equal five values of s and it is calculated as follows: Ia = 0.2s,

C- To calculate the depth of surface runoff, the following equation is used: : $Q = \frac{(P-Ia)2}{(p-Ia)+s}$

As:

P = rain fall. (inch)

S = Maximum runoff after the start of runoff (inch).

La = primary extracts before the start of run-off, such as soil, surface depressions, evaporation and transpiration (inch).

Q = Depth of runoff (inches). P = rain (inch).

D- Calculate the volume of surface runoff through the following equation:

As:

Qv = volume of runoff m^3.

Q = Depth of runoff / mm.

A = Basin area / km2.

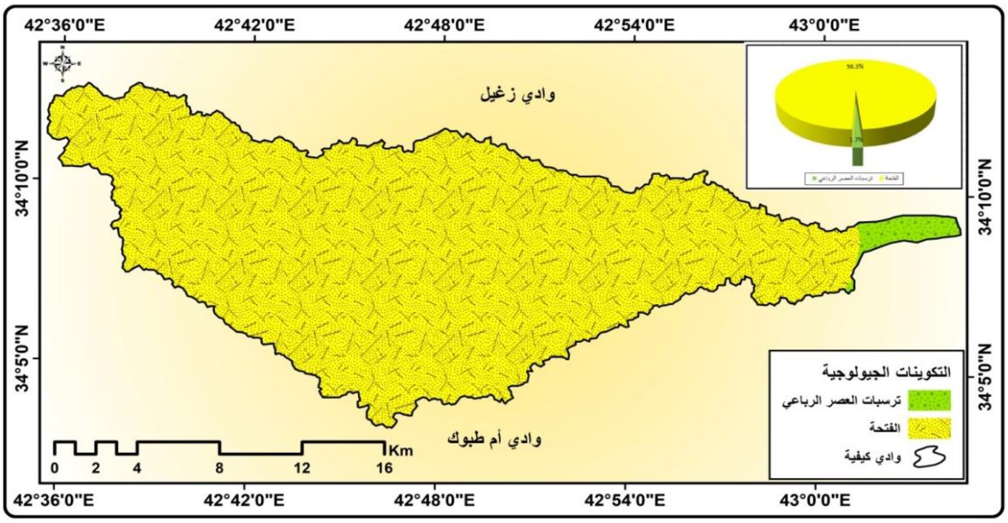
1000 = conversion factor, to be the unit of measurement for the final results in cubic meters.

First: The Geological Formations Of The WadiKaifahah Basin.

The search area is located within the formations of two eras, the first era is the Miocene age represented by the formation of the hatch, this formation exists in the form of hills with regular and separate surfaces, as it consists of a cyclic sedimentary sequence of coherent green baby stone, limestone and gypsum, as the thickness of this member reaches (8 - 20 meters (1), and it occupies (98.3%) of the basin area, as in Map (2) and Table (1).

Map (2)

Geologic formations of the Kaifah Valley Basin



Reference : Depending on the Republic of Iraq, Ministry of Industry and Minerals, General Establishment for Geological Survey and Mineral Investigation, Geological Map, Plate No. 1, 3rd Edition, for the year 2000, scale 1: 250,000. Arc Map 10.4.1.

Table (1)

The Areas And Proportions Of The Geological Formations Of WadiKefa Basin

Formation	Area Km^2	Percentage
Sedimentations of Quadrant Age	6	1.7%
Hole	343	98.3%
Sum	349	100%

Reference : Based on Map (2), and application10.4.1. Arc Map

As for the second formation, it is represented by sediments of the Quaternary age, which is formed by deposits represented by a mixture of sand, silt, and coarse-grained gravel, and its thickness ranges between (0.5 - 2.5) meters (2), and constitutes (1.7%) of the total basin area .

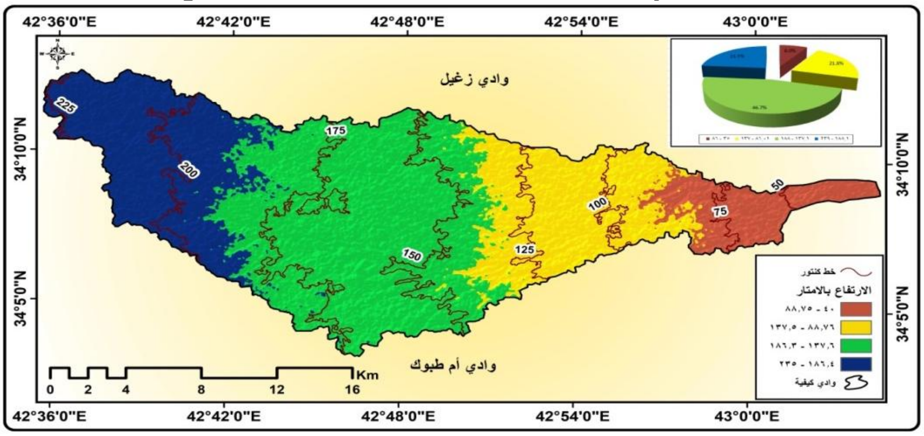
Second: The Terrain Characteristics Of The WadiKaifahah Basin They Are Represented By:

1. **Heights.**

Through map (3) and table (2) we find the variation in the height of the valley surface, as the highest elevation categories are shown at the Reference area ranging between (186.4 m - 235 m) above sea level, an area of (82 km2) formed a rate of (23.5%). From the total area of the basin, until it reaches the lowest level of the elevation classes, as it ranged between (40 m - 88.75 m) above sea level and an area of (28 km2), which is equivalent to (8%) of the total area of the basin.

Map (3)

Ranges of elevation for the Kaifahfa Valley Basin



Reference : Based on digital elevation model (DEM) with distinguished resolution (30 × 30), and output of Application 10.4.1 Arc Map.

Table (2)

Areas And Elevation Ratios For The WadiKaifahBasin

Class height in meters	Area Km2	Percentage
40 -88.75	28	8.0%
88.76 – 137.5	76	21.8%
137.6 – 186.3	163	46.7%
186.4- 235	82	23.5%
Total	349	100%

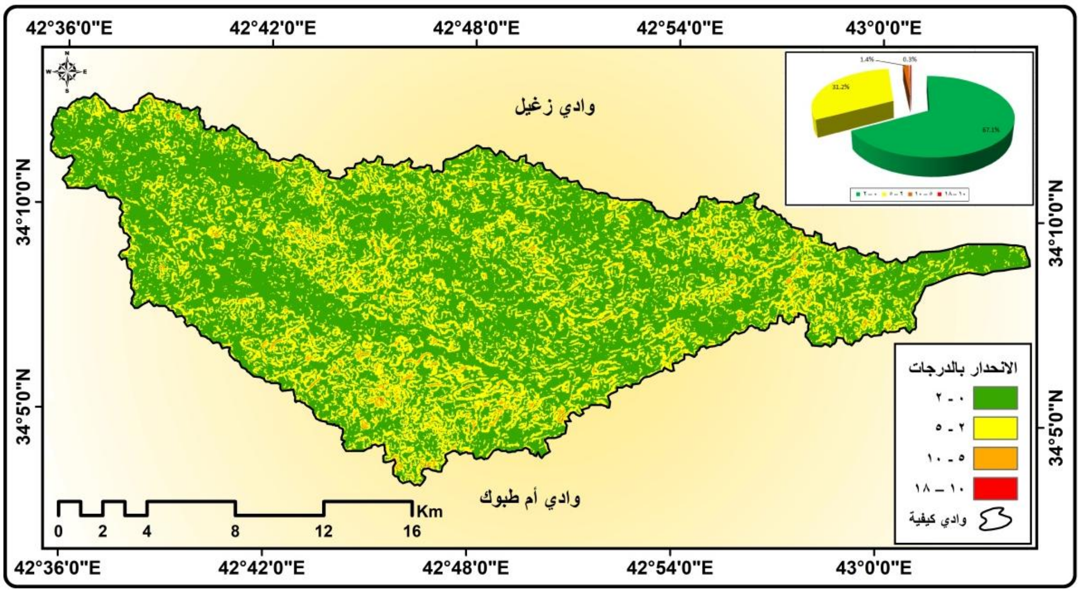
Reference : Based on Map (3), and application 10.4.1. Arc Map

2. **Slopes.**

The slope categories ranged from semi-flat to moderate lands, where the first slope category (0 - 2 degrees) recorded (67.1%) of the area of the valley basin, which is the most widespread, while the category (2-5 degrees) amounted to (31, 2%), while the third group, confined between (5-10 degrees), reached (1.4%), while the fourth group, confined between (10-18 degrees), was the least widespread, and it recorded a percentage of (0.3%) of the area The total basin, as shown in Map (4) and Table (3).

Map (4)

The gradations of the slope of the Kaifahfa Basin



Reference : Based on digital elevation model (DEM) with distinguished resolution (30 × 30), and application 10.4.1. Arc Map.

Table (3)

Shapes and angles of the land slopes of the WadiKaif basin, according to the Yonk classification

Sprocket shape	Class of elevation	Area Km2	Percentage
Semi-flat lands	0 – 2	234	67.1%
Slope land	2-5	109	31.2%
Slightly sloping grounds	5-10	5	1.4%
Land of moderate slope	10-18	1	0.3%
Total		349	100%

Reference : based on:

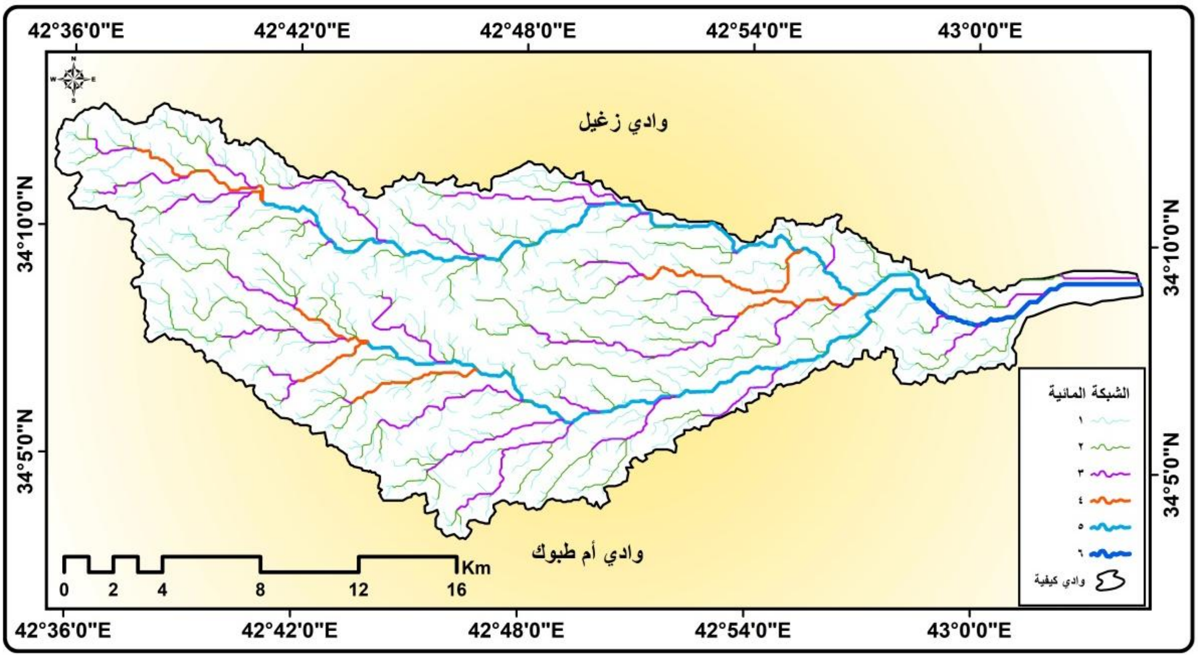
- GirzisDawood, The Formation of the Earth's Surface, Applied Geomorphology, College of Education, Al-Mustansiriya University, University House for Printing, Basra, 2000 AD, pp. 123-124.
- Map (4).
- Arc map Application 10.4.1.

Third: The Morphometric Analysis Of The Kaifah Valley Basin.

The study of water basins regards one of the recent trends that have received great attention from many geomorphological and hydrological studies alike, due to its importance in determining the amount of water drainage of waterways and then knowing the amount of sediment formation, as well as its contribution to the emergence of some sedimentary and sedimentary ground forms due to their impact on The river flow system is largely in the basin in terms of shape, area, and topographic characteristics, as basins differ among themselves in geometric shapes, as some of them have a round, rectangular or triangular shape, and this is due to the nature of the drainage pattern of the valley network, which is related to the geology of the area, soil type, natural vegetation and time (3). In order to know the spatial, formal and topographic characteristics, as well as the characteristics of the water drainage network, it is shown in Map (5) and Table (4).

Map (5)

Water network for the Kef Valley Basin



Reference : Based on digital elevation model (DEM) with distinguished resolution (30 × 30), and application 10.4.1 Arc Map.

Table (4) Morphometric characteristics of the WadiKaifah basin

Characteristics of Area and shape								
Area in Km2	Perimeter / km	Length of Basin/ km	Average width / km	Area cohesion ratio	Perimeter cohesion ratio	Factor Elongation	Pelvis shape coefficient	Ratio of length / width
349	133.6	44.6	7.8	0.247	2.08	0.47	0.175	5.71
Characteristics of Terrains								
	Length of pelvic km	The lowest height m	The heights Height m	The difference m	Degree terrain m / km	Relative terrain m / km	Roughness value	
	44.6	51	235	184	4.12	0.13	0.39	
Characteristics of the water drainage network								
Total of valleys	The sum of the lengths of the valleys is km	Area km2	Valley longitudinal density / km / km2	The numerical density of the valley / km2	Rate of stream stability Km2 /km	Real length / km	Ideal length / km coefficient of curvature	Inflection coefficient
978	756.6	349	2.676	2.802	0.46	51.7	41.3	1.25

Reference : Based on Map (5), & application Arc Map 10.4.1.

Third: Mechanisms For Water Collecting By Adopting The SCS-CN Method For The WadiKaifah Basin.

This mechanism is considered one of the most important basic pillars on which hydrological studies depend by relying on the classification of the land cover of the valley basin, and then determining the hydrological properties of the soil, which are the most important elements for calculating surface runoff.

1. **Classification of the land cover of the WadiKaifah Basin.**

It is evident from map (6) and table (5) that the search area is classified into three categories:

A- Vegetable cover in poor condition:

This variety occupies the least area of the valley basin, as it occupies an area of (20 km2) downstream areas with a ratio of (5.7%) of the total area.

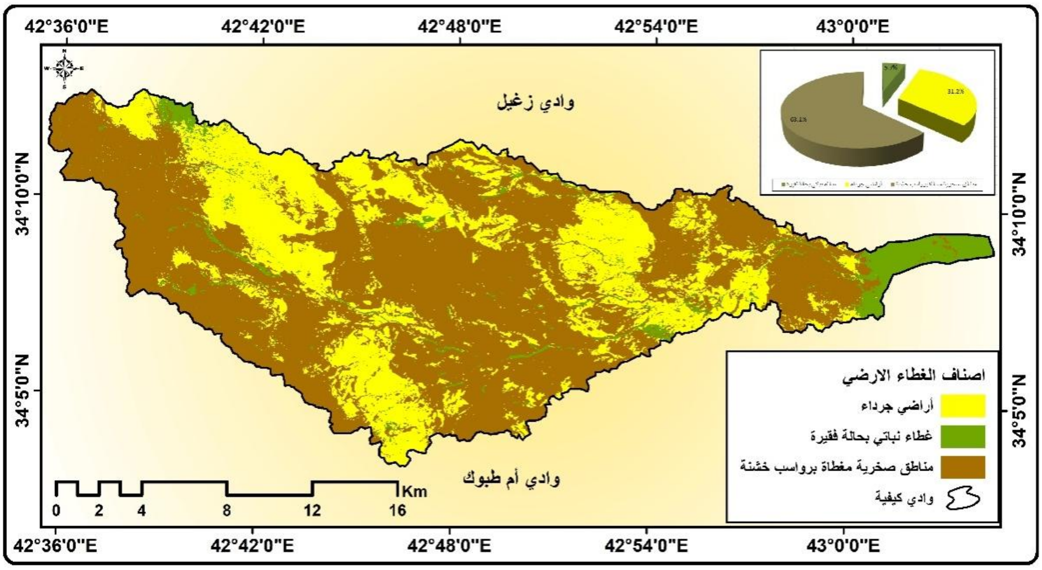
B- Barren lands:

This type represents the open and unused lands in the basin, and they spread in all parts of the basin with an area of (31.2%), the area of (109 km2) of the total area.

C- Rocky areas covered with coarse sediments:

This variety occupies the largest area of the basin by about (220 km2), equivalent to (63.1%) of the basin area, it spreads in most parts of the basin and consists of sediments that were broken up as a result of carving and sedimentation operations during the rainy season.

Map (6)
Varieties of ground cover for the WadiKaifah basin



Reference : Based on the LAND SATLC 8 satellite image captured on 7/2/2020, & application 9.2 Erdas Imagine and application Arc Map 10.4.1.

Table (5) Areas and ratios of the land cover classes for WadiKefa Basin

Land cover varieties	Area Km	Percentage
Vegetable cover in poor condition	20	5.7%
Barren lands	109	31.2%
Rocky areas covered with coarse sediments	220	63.1%
Total	349	100%

Reference : Based on Map (6) and application Arc Map 10.4.1.

2- The types of hydrological soils for the WadiKaifahah basin.

Based on the American classification of the Soil Conservation Service (SCS), the valley basin was classified into two hydrological groups according to the soil texture through which the relationship of soil tissue to the emergence of surface runoff can be determined. As we notice from the map (7) and table (6) the presence of the following two classes:

A. Hydrological soils / Class (B)

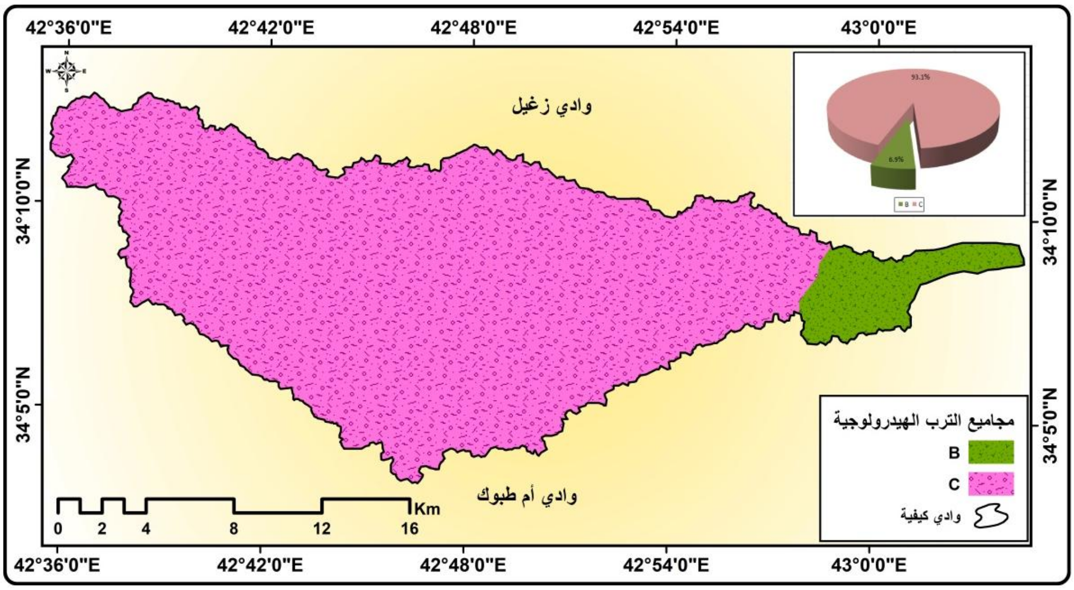
These soils are characterized by being composed of coarse to medium coarse tissue, with medium depths and a flow rate less than type C, and they are spread over the downstream areas and have an area of (24 km2) with a percentage (6.9%) of the total valley area.

B. Hydrological soils Class (C):

This soil occupies a large area of the basin, about (325 km2), equivalent to (93.1%) of the total area, and is characterized by a sub-medium infiltration rate that allows for increased flow rates over it.

Map (7)

Types of hydrological soils for WadiKaifah



Reference : based on the World Food Organization, the FAO classification, and outputs of application Arc Map 10.4.1.

Table (6)

Areas and percentages of the types of hydrological soils in the WadiKaifahah basin.

Type of soil	Area km	Percentage
B	24	6.9%
C	325	93.1%
Total	349	100%

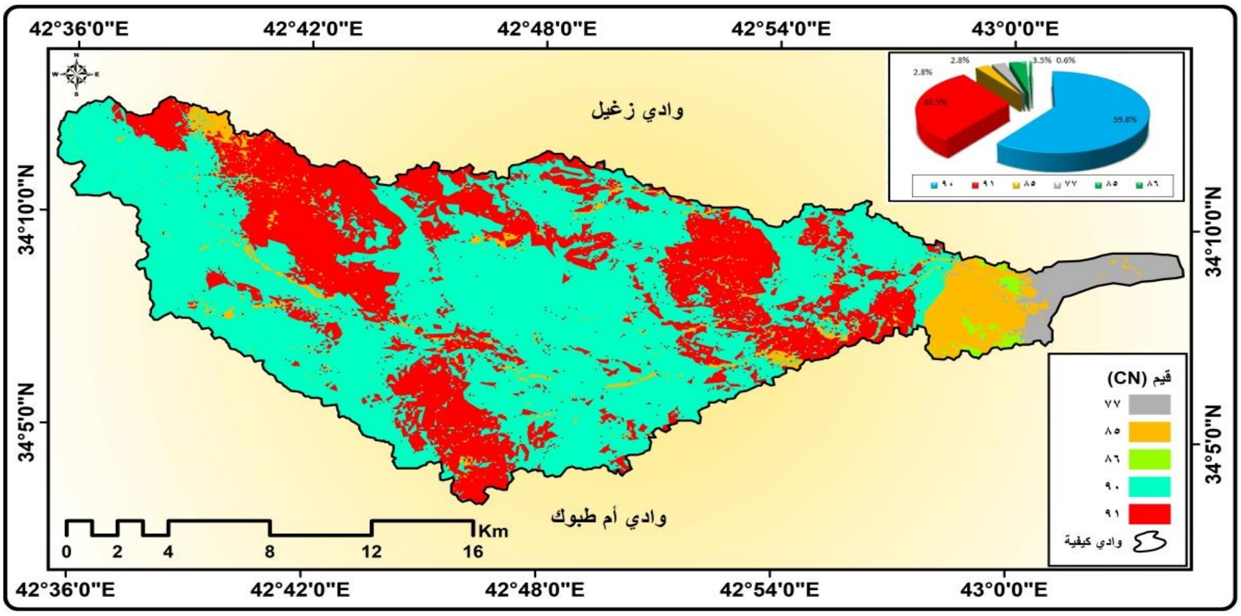
Reference : Based on Map (7), and application Arc Map 10.4.1.

3- Extraction of the curved number values (CN - SCS) for WadiKaifahah basin.

The values(CN) express the extent of the surface's ability to permeability to water depending on the types of land cover and soil quality, and it is a value ranging between (0 - 100), so the higher the value from (100) the surfaces are less permeable to water and thus are more runoff, on the contrary. If the values approach zero, then the surfaces are more permeable and therefore less runoff (4).

Through the Arc Map 10.4.1 program, the two layers of land cover were matched with the hydrological soil layer by using the Combine tool to finally get to the extraction of (CN) values. CN) for WadiKefa basin whose values ranged between (77-91) with a weighted average of (85.7) values, indicating that the basin surface tends to have sufficient flow velocity to establish suitable sites for watersheds for collecting water.

Map (8)
Distribution of the extracted curves (CN) values for the Kaifahfa Basin



Reference : Based on Map (6, 7), and application Arc Map 10.4.1 output.

Table (7)

The areas and percentages of the extracted CN values for WadiKaifahah basin

Seq.	Values of CN	Area Km^2	Percentage
1.	91	106	3.4%
2.	90	209	59.9%
3.	86	2	0.6%
4.	85	10	2.8%
5.	85	12	3.5%
6.	77	10	2.8%
Weighted average/85.7		349	100%

Reference : Based on Map (8), and application Arc Map 10.4.1.

4- Calculation of the maximum possibility coefficient (S) for water retention after the start of runoff for the WadiKaifahah basin.

The coefficient (S) reflects the water-saturated state of the soil completely after the demarcation process stops and the surface runoff begins, i.e. the maximum potential of the soil to retain water after the start of the runoff.

The closer the value to (zero) indicates the weak ability of the soil to retain water, which negatively affects the amount of running water (5).

The data of Table (8) and Map (9) indicate that when equation (a) is applied, the highest values of this parameter are (75.9) and an area (10 km2), while the lowest values are (25.1) and an area (106 km2).

Table (8)

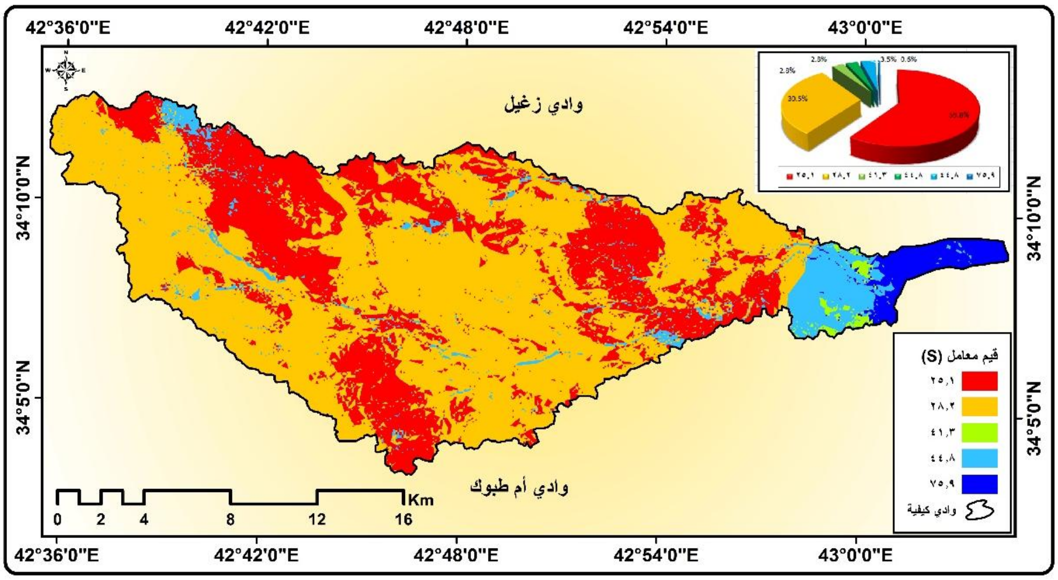
areas and percentages of the extracted coefficient (S) values for WadiKefa basin.

Seq.	Values of S	Area Km^2	Percentage
1.	**25.1**	**106**	**30.5%**
2.	**28.2**	**209**	**59.8%**
3.	**41.3**	**2**	**0.6%**
4.	**44.8**	**10**	**2.8%**
5.	**44.8**	**12**	**3.5%**
6.	**75.9**	**10**	**2.8%**
Total /		**349**	**100%**

Reference : Based on Map (8), and application Arc Map 10.4.1.

Map (9)

Distribution of extracted coefficient (S) values for WadiKaifahah basin



Reference : Based on data of Table (8), and application Arc Map 10.4.1.

5- Calculation of the initial extraction factor (La) for the WadiKaifahah basin.

This parameter indicates the amount of precipitation lost before the start of the runoff process by evaporation and leakage, or what is intercepted by plants or water accumulated in surface depressions. The lower the loss of rainwater before the start of the runoff, i.e. the values approaching (zero), indicating an increase in the surface runoff process, while the values of the initial extraction rate become equal to the rate of running water on the surface if the median value of the parameter is (50.8). On the mediator, it indicated an increase in the amount of rainwater losses, which has a negative impact on the amount of running water on the surface (6).

Through the application of equation (b), the results of Table (9) and Map (10) showed that all values ranged between (5 - 15,2) that is, they are less than the median, which means the possibility of generating surface runoff in sufficient quantities to allow the process of exploiting them.

Table (9)

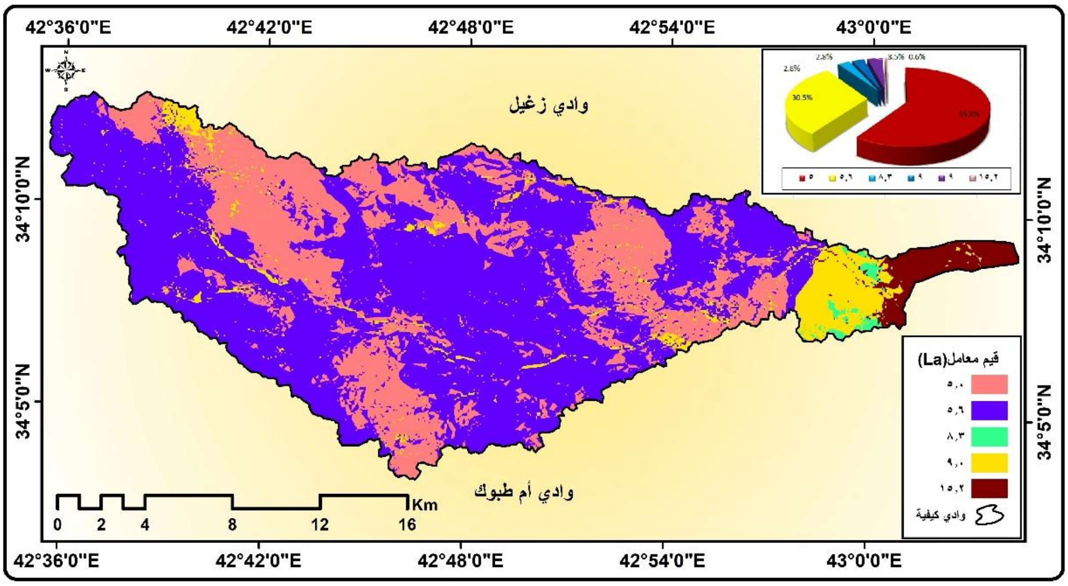
Areas and percentages of extracted Initial Extraction Factor (La) values for WadiKefa basin.

Seq.	Values of Fa	Area Km^2	Percentage
1.	5	106	30.5%
2.	5.6	209	59.8%
3.	8.3	2	0.6%
4.	9	10	2.8%
5.	9	12	3.5%
6.	15.2	10	2.8%
TOTAL		349	100%

Reference : Based on (La) coefficient equation, and application Arc Map 10.4.1.

Map (9)

Distribution of the extracted Initial Recovery Factor (La) values for WadiKefa basin



Reference : Based on data of Table (9), and application Arc Map 10.4.1.

6- Estimating the depth of surface runoff (Q) for the WadiKaifahah basin.

Refers to the summary of the interaction between a certain rain wave with the components and characteristics of the drainage basin, as the depth of runoff at the surface varies according to the type of land cover and the amount of soil permeability. In order to derive this parameter, the flow depth equation was relied on with reference to the amount of rain for the period (1981-2017) [(7)]

The results of Table (10) and Map (11) after applying equation (c) showed the variation in the depth of runoff between the parts of the valley basin, where the highest values of runoff depth were (120.8) mm and the lowest were (68.9) mm.

Table (10)

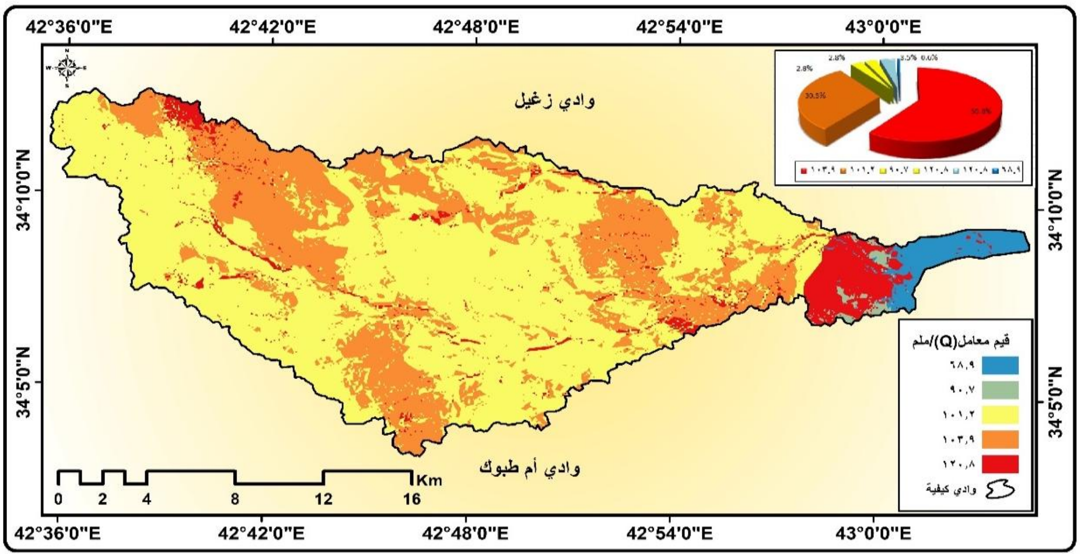
Extracted areas and percentages of the values of (Q) / mm coefficient for WadiKaifahah basin.

Seq.	Values of Q	Area Km^2	Percentage
1.	13.9	106	30.5%
2.	101.2	209	59.8%
3.	90.7	2	0.6%
4.	120.8	10	2.8%
5.	120.8	12	3.5%
6.	68.9	10	2.8%
TOTAL		349	100%

Reference : based on (Q) coefficient equation, and Application Arc Map 10.4.1.

Map (11)

Distribution of the extracted surface runoff depth (Q) coefficient values for WadiKaifahah basin.



Reference : Based on of data table (10), and application Arc Map 10.4.1.

7- Estimating the volume of surface runoff (QV) for WadiKaifahah basin.

The volume of surface runoff refers to the total runoff to the area of the basin, as it is one of the important hydrological studies in determining the sites of establishing water catchments by estimating the size of the floods that the area is exposed to and its exploitation for water collect (8).

When applying the formula (D) to the Wadi Basin, it is noticed how the values of the surface runoff volume varied, as the highest values reached (21150800 m3) and an area (209 km2), and the lowest amounted to (181400 m3) that occupied an area (2 km2) of the total area. As shown in the data in Table (11) and Map (12).

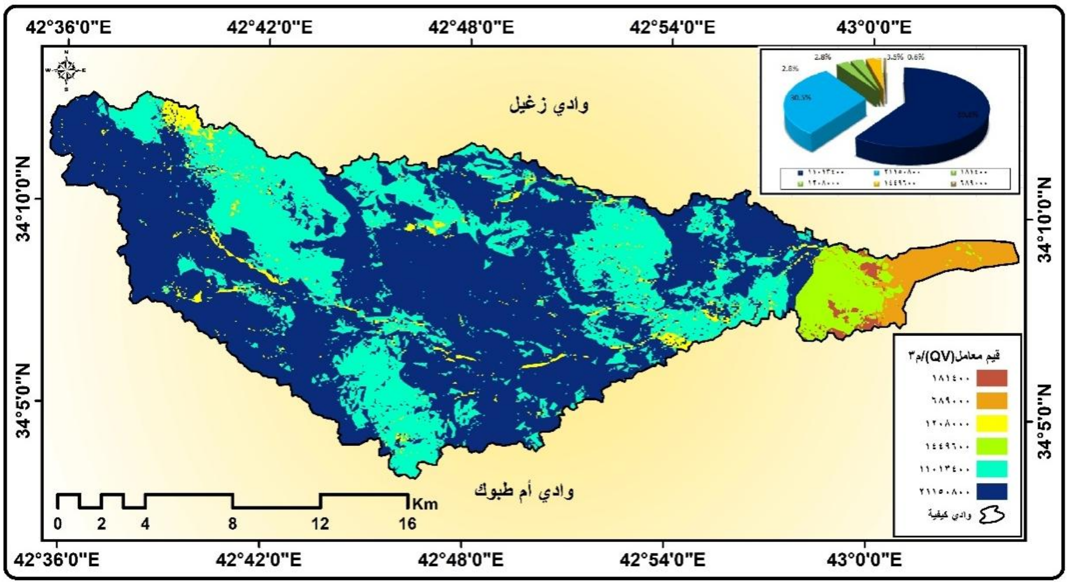
Table (11) areas and percentages of the values of the coefficient (QV) / m3 extracted for the WadiKaifahah basin

Seq.	Values of QV	Area Km^2	Percentage
1.	11013400	160	3.5%
2.	21150800	209	59.8%
3.	181400	400	0.6%
4.	1208000	10	2.8%
5.	1449600	12	3.5%
6.	689000	10	2.8%
Total		349	100%

Reference : Based on the (QV) coefficient equation, and application Arc Map 10.4.1.

Map (12)

Distribution of the extracted surface runoff depth (QV) coefficient values for WadiKefa basin.



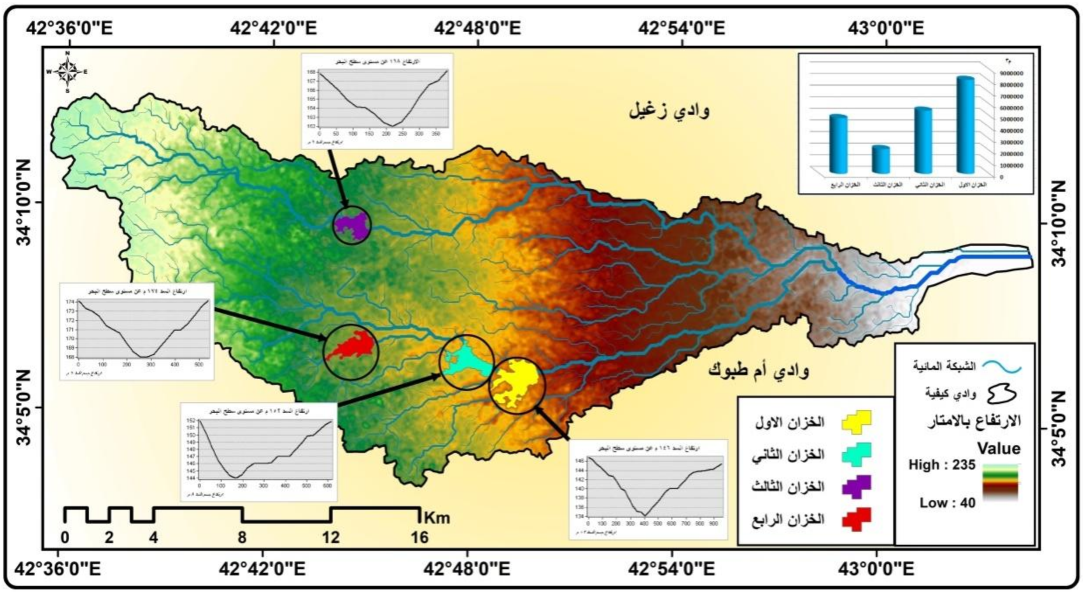
Reference : Based on data of Table (11), and application Arc Map 10.4.1.

8- Determining the sites of watersheds for water collecting in the WadiKaifahah basin.

Depending on the natural characteristics of the results of applying water collecting mechanisms through the (SCS-CN) method for WadiKaifahah basin, and then matching these results with the digital elevation model (DEM) to choose the best sites that are characterized by the convergence of the contour lines from the beginning of the dam with their spacing in the storage site in line with With the ranks of river courses, as it is possible to determine four sites most suitable for a watershed; The first dam is located at a height of (145 m) above sea level with a storage capacity of (8095448 m3), while the second dam is located at a height of (152 m) above sea level and has a storage capacity of (5447037 m3), while the third dam is located at a height of (174 m) above sea level and a storage capacity (2138018 m3), while the storage capacity of the fourth dam was (4806059 m3) and is located at a height of (168 m) above sea level, as shown in map (13) and table (12).

Map (13)

Proposed sites for the construction of dams for the WadiQif Basin



Reference : Based on digital elevation model (DEM) with distinguished resolution (30 × 30), and output of application Arc Map 10.4.1.

Table (12)

Elevation levels and storage on the dam sites of WadiKaifahah basin.

Seq.	Elevation at sea level	Height of Dam body	Storage amount
1.	145	12	8095448
2.	152	8	5447037
3.	174	6	2138018
4.	168	6	4806059

Reference : Based on Map (13), and application Arc Map 10.4.1.

- **Results:**

1. Ability of using satellite images in hydrological studies and reaching the required results through analysis and interpretation processes depending on remote sensing techniques and geographic information systems.
2. Most of the basin area falls within the category of hydrological soils (C), as it constituted (93.1%) of the basin area and is characterized by the low infiltration rate of water, which helps to create a surface runoff suitable for the water collecting process.
3. The land cover varieties are suitable for the surface runoff process, as barren lands and rocky areas covered with coarse sediments accounted for (31.2%, 63.1%) for each type, while the poor vegetation type accounted for (5.7%) of Total basin area.
4. Results of using the (SCS-CN) method showed that most of the values have a surface runoff suitable for the water collecting process, as the annual surface runoff volume of the basin ranged between (181400 m3, 21150800 m3).
5. Results of the study showed by proposing four sites suitable for the construction of dams for the water collecting process, based on a set of indicators included in the research. The storage capacity was about (8095448 m3, 5447037 m3, 2138018 m3, 4806059 m3) for each tank.

Recommendations:

1. Using future plans to utilize the valley's water by constructing dams and utilizing them in agricultural and pastoral projects.
2. The necessity of establishing hydrological monitoring stations that work to monitor the drainage of the surface runoff of the WadiKaifahah basin, in order to provide the necessary data for the process of optimal investment of this water.
3. Using the remote-sensing data and programs and geographic information systems in hydrological studies, as they have an important role in giving accurate results in a short time and with less effort, by providing planners with a detailed database that helps them make the best decision.

Footnotes:

(1) VarujanKhajikSisakyan, Sundus Mahdi Salih, Report on the Geology of the Ramadi Plate, Ministry of Industry and Minerals, General Establishment for Geological Survey and Mining, Geological Survey Department, 1995, p.7.

(2) TiporBuday, The regional geology of Iraq, 1980, op. cit. p49.

(3) Ahmed Ali Hassan Al-Bawwati, Wadi Al-Ajeej Basin in Iraq and the Uses of Its Terrestrial Forms, PhD Thesis (unpublished), College of Arts, University of Baghdad, 1995, p.16.

(4) Conservation Service, Urban Hydrology For small watershed, Technical releases 55, and Ed, U. S. Dept. of Agriculture, Washington D.C (1986).

(5) DialyKhalaf Hamid, Spatial Analysis for Estimating Surface Runoff Volume Using (CN) SCS for Basin (Southern Murr Valley) - Northern Iraq, Tikrit Journal of Pure Sciences, Issue 21, 2016, p. 116.

(6) Elena V. Brevnova, Green-Ampt Infiltration Model Parameter Determination Using SCS Curve Number (CN) and Soil Texture Class, and Application to the SCS Runoff Model, requirements for the degree of Master, College of Engineering and Mineral ReReferences, at West Virginia University, p6.

(7) The rain data for a modern station was relied on for the period (1981-2017).

(8) USDA, National, Nonpoint Reference Monitoring Program (NNPSMP), Surface Water Flow measurement for Water Quality Monitoring Projects, 2008.p1-3

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1. *Al-Bawwati, Ahmed Ali Hassan, Wadi Al-Ajeej Basin in Iraq and the Uses of Its Terrestrial Forms, PhD Thesis (unpublished), College of Arts, University of Baghdad, 1995.*
2. *Hamid, DialyKhalaf, Spatial Analysis for Estimating Surface Runoff Volume Using (CN) SCS for Basin (Southern Murr Valley) - Northern Iraq, Tikrit Journal of Pure Science, Issue 21, 2016.*
3. *Sisakyan, VarujanKhajik, Salih, Sundus Mahdi, Report on the Geology of the Ramadi Plate, Ministry of Industry and Minerals, General Establishment for Geological Survey and Mining, Geological Survey Department, 1995.*
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5. *Soil Conservation Service, Urban Hydrology For small watershed, Technical releases 55, and Ed, U. S. Dept. of Agriculture, Washington D.C (1986).*
6. *TiporBuday, The regional geology of Iraq, 1980, op. cit. p49.*
7. *USDA, National, Nonpoint Reference Monitoring Program (NNPSMP), Surface Water Flow measurement for Water Quality Monitoring Projects, 2008.p1-3.*