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Distributing and Evaluating the Locations of Petrol Stations in Diwaniyah, using Geographical Information Systems

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Abstract: The research is considered one of the researches in which the complete analyzes and results are produced by relying on GIS techniques, and it aims to analyze the distribution pattern of the stations within the boundaries of the city of Diwaniyah and compare the locations of these stations with the conditions and planning criteria for site selection, and building an information base A modernized geography of fuel filling stations that serves the concerned authorities in taking appropriate decisions related to these stations with the possibility of adding other data fields to this base for future development. We were also relying on the data obtained by the relevant authorities, such as the determinants and conditions necessary for the construction and construction of fuel stations in cities, in addition to field visits to those stations. The study assumed that the fuel stations were established without planning, and there are areas where there are no fuel filling stations, which forces the beneficiary of the service to travel a greater distance that leads to an increase in costs and an increase in the time taken to obtain the service in addition to non-compliance with safety procedures, which leads to occurrence Fire accidents and heavy loss of life and property. we found that the pattern of geographical distribution of fuel stations in the city of Diwaniyah is a sporadic pattern of distribution dispersed in the south and southeast direction and combined in the northwest direction and tilted at an angle of 34 degrees from the north to the west, and the small number of gas stations in the south and southeast sides of the city despite the density of population The high level in this region and its concentration in the northern and northwestern region, in addition to that 30% of the stations obtained a percentage of 100% appropriate to the parameters and conditions that must be met in the construction and construction of gas stations in cities and 20% of these stations got a lower percentage in the evaluation that we did in this research It was 75% a good percentage and 50% of the stations got 87.5% a good rate.

***Keyword**: petrol stations, GIS, ArcGIS*

1 Introduction:

The importance of gas station services to any society reflects the extent of the country's economic development, as it is one of the basic necessities of the population, and this aspect has gained great prestige in many countries, because the development and increase of gas stations is evidence of the country's ability to achieve economic development as well as in line with the increase in population density and the increase in numbers. Vehicles in cities and for society to perform its functions efficiently. This requires an equitable spatial distribution of these stations in a manner consistent with the density of the population in the city sectors. The importance of studying the locations and number of fuel stations in the city is due to their connection to the lives of the residents due to the services they provide that are directly related to the needs of the population [1].

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Geographical knowledge, especially applied ones, has witnessed a remarkable development in various fields, and with the emergence of geographic information systems (GIS) technology on the scene, and its high potential in spatial analysis, many researchers called to enter more deeply into this technology and dive into its joints, and from here The importance of employing this technology came by analyzing the efficiency of the spatial distribution of gas stations in the city of Diwaniyah, within the field of spatial distributions (Measuring Geographic Distributions) through the program (Arcgis10.3) used in the study[2] [3]. Hence our conviction of the importance of geographic information systems (GIS) in planning. Urban and its ability to study spatial distributions.

The city of Diwaniyah is one of the important urban centers whose population is witnessing a continuous increase in its population. In view of the importance of gas station services being part of the important services in any city and due to the huge and unexamined increase in the number of vehicles in Iraq in general, and their direct connection with the population, and the city's need for a thorough scientific study on the reality of the spatial distribution of these stations, this study came to shed light on This vital sector, discussing its problems, and measuring the efficiency of spatial distribution in light of the standards adopted in the country, using the technology of geographic information systems (GIS) as an effective tool in the method of applied surveying [4].

1-1: Research problem:

The research problem was identified with the low efficiency of the spatial distribution of fuel stations in the city of Diwaniyah, in line with the density of the population, in addition to knowing whether environmental determinants and safety conditions have been applied in this distribution or is there an override of these determinants?

1-2: Research objective:

The study in this aspect aims to achieve the following objectives:

1. Knowing the efficiency of implementing the distribution and construction of fuel stations in the city of Diwaniyah in accordance with environmental specifications and occupational safety conditions.
2. Preparing digital maps of the actual locations of these stations in the city and the locations of the proposed stations.
3. Identify the spatial distribution pattern of the fuel stations in the city of Diwaniyah, using geographical information systems (GIS).

1-3: Research justification:

Given the importance of gas station services in the city stemming from its connection to the lives of the population, and the role of geographic information systems in urban planning, this study came for several considerations, the most important of which are:

1. The lack of academic scientific studies on the subject of research that dealt with the study area.
2. Absence of using geographic information systems in studying spatial distributions, addressing spatial relationships and preparing detailed maps, especially in the field of oil installations for the study area.

2 Study area location:

1. The study area is Al-Diwaniyah, the capital of Al-Diwaniyah Governorate. It is located in southern Iraq, as shown in Figure (1), about 180 km south of Baghdad and 320 km north of Basra. It lies between these coordinates (30.5 ° -32.5 ° N) and (44.5 ° -46 ° E), and its total area is about 7886 square kilometers. Its population is about (403,726) persons. The average temperature of it ranged from 35°C in summer to 10°C in winter but the standard is 23°C roughly [5],[6].

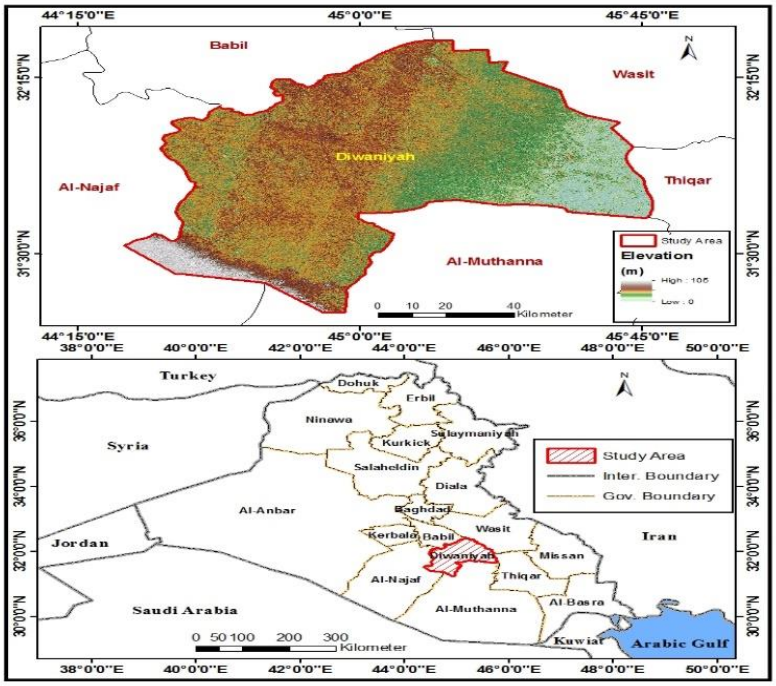

Fig:1the study area

2-1: Research Methodology:

Any study must follow a clear scientific approach, so the approach that we followed is the descriptive one that depends on the study of the phenomenon as it exists in reality through interest as an accurate description as well as the systems approach (the inductive analytical approach) through the technique of geographic information systems (GIS), Starting from data collection, processing and analysis using (ArcGIS V.10.3) software through the (Spatial Analysis) package.

The fuel stations located in the city of Diwaniyah, the center of the province of Diwaniyah, were chosen as a sample for research due to the availability of the aerial photo and the information needed to search for this city through the assistance of the Directorate of Municipalities of Diwaniyah.

2-2: Field study:

There is no doubt that the field study is the best complementary method in geographical studies, as it ensures the transfer of the real spatial reality with extreme accuracy, as it may not be possible for the researcher to obtain information from its sources, such as the official departments and the concerned authorities, so it is approved to go to the field.

We have made a field visit to the gas stations spread in the city of Diwaniyah and know the locations of these stations as in Figure (2), and through the (Google Earth) program, the locations of these stations were determined on the maps. As follows:

Fig: 2 represents some gas stations in Diwaniyah

1: The Oil Products Distribution Company and the relevant oil departments were approached to take information and data about the fuel stations in Diwaniyah, the methods of their establishment, the environmental determinants and the environmental safety conditions that must be observed in the construction and construction and the selection of the locations of these stations. They were asked to provide us with maps of these stations and we did not obtain from them all the required information. The reason is for security reasons, as they say, but we have obtained the conditions and limitations that must be taken into account in construction and site selection, which will be indicated later.

2: After addressing and visiting the Directorate of Municipalities of Diwaniyah, a recent aerial photo for the year 2021 of the city of Diwaniyah was obtained. Aerial photos are considered one of the technical means in explaining the manifestations of the surface of the earth to identify the development in the uses of the land and it is the main material used in this research, through which and by means of geographic information systems We were able to distribute fuel stations in the city of Al-Diwaniyah and conducted the required research material on them. we also obtained detailed maps for this city and useful information about the environmental precautions and restrictions that must be followed in choosing the locations of gas stations in cities, as well as the need to establish petrol stations in places with a population density than in less densely populated places.

2-3: Controls, terms and conditions for establishing gas stations:The controls and conditions for establishing fuel filling stations were obtained from the Oil Products Distribution Company, Diwaniyah Branch, as shown in Figure (4)[7].

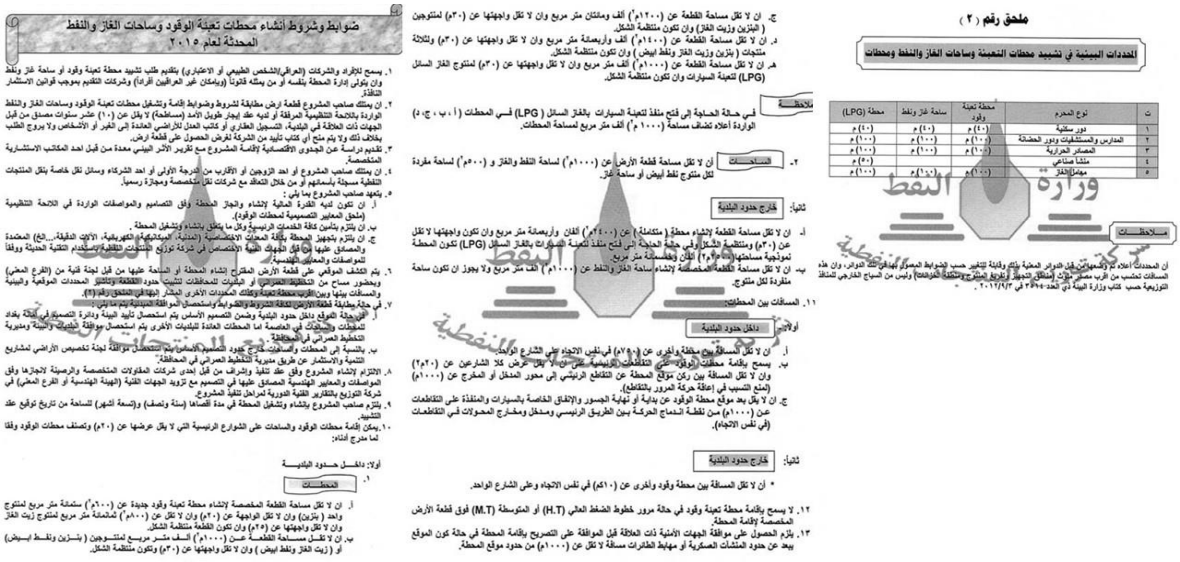

Fig 3 Controls and conditions for determinants of the petroleum products distribution company for the establishment of fuel filling stations

Here, we have relied in this research on these determinants and conditions and a statement if they are followed properly in the distribution and choosing the appropriate place for the construction of the station.

2-4: Gas stations in Diwaniyah:

Through field visits to governmental and private fuel stations in Diwaniyah, and through the information we obtained from the General Company for the Distribution of Petroleum Products, Diwaniyah branch, the names and locations of these stations were obtained, and through the (Google Earth) program, the exact locations of these stations' centers were obtained (Figure 4) Which we will take advantage of in downloading it accurately on the aerial image of the city of Diwaniyah, using the Arc GIS Desktop Program (version 10.3), and as shown below:

1- Al-Shumoos station built: located in the area of Umm Tabashi / Al-Diwaniyah-Al-Sunnia road

2-Al-wafidin station: located in the university neighborhood / University Street (there is a service street in front of the station)

3- New Diwaniyah governmental station: the one located opposite to Silo Diwaniyah (there is a service street in front of the station)

4- Al-Qaswaa station built: the one located opposite the role of Sayed Muhammad / Diwaniyah-Najaf Road

5- Al-Beshara station: located in the area of Soub al-Shamiya / adjacent to the Hateen Mosque

6- Luluat Al-Diwaniyah constructed station: located on Sayed Muhail Road (it is often frequented by heavy tankers)

7- The rented Al-Qadisiyah station: located on Al-Iskan Street

8- Al-Ta'akhi Station built: located in the Jalabiyya neighborhood, near the Police Academy (there is a service street in front of the station)

9- Al-Hadara Built Station: located in Al-Hadara neighborhood / Al-Diwaniyah Road - Dagarah

10-Umm Al Khail Station: located on Umm Al Khail Main Street.

Fig: 4 Gas stations in Diwaniyah on google map

3: Methodology and data analysis:

After studying the previous researches in this field and showing the possibility of doing a similar research on the city of Diwaniyah and using geographic information systems, and explaining the nature of the distribution of these stations in accordance with the environmental determinants and the necessary conditions set by the Ministry of Oil in the construction and construction of fuel stations in cities, and we saw it is easy for GIS to engage In this regard, and to show the appropriateness of distributing these stations according to the conditions and determinants, but the program must be fed with the correct information necessary to obtain accurate results, after that the stage of collecting information from the relevant departments and from the stations themselves, which we encountered difficulty in obtaining some of them, especially the oil departments and stations, for reasons they see as security .

After that, we stored this information and research resources in a way that would facilitate our analysis and study, followed by the data analysis phase, which was preceded by the stage of cutting the study area from Landsat images, where a formal file must be created that represents the boundaries of the study area first. This figure can be viewed at it is a revision of the figure that represents the municipal borders of Diwaniyah Governorate based on the map of urban areas from the municipality of Diwaniyah.

And then drawing in layers on the aerial image of the city of Diwaniyah, available for the year 2021, using (ArcGIS desktop ver. 10.3), where the main and secondary streets were drawn, residential and commercial complexes were drawn, and the Diwaniyah River, the train tracks, hospitals, health centers, schools and other institutions.

Finally, the locations of the stations were determined with high accuracy and named according to what exists in the reality of the situation and the data of these stations were entered. This was followed by a graphical analysis of this information by entering all the determinants and conditions as shown in Figure (5).

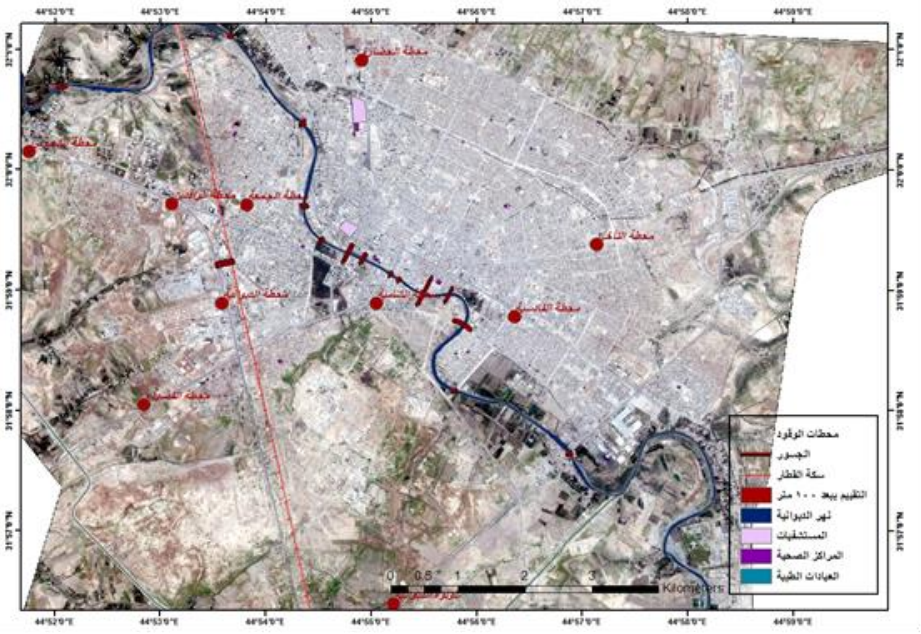

Fig 5 Drawing residential complexes and government centers and determining gas stations

3-1: Analyzing data and producing results:

3-1-1: Using Buffer

Through the Proximity list and included in the Analysis Tools toolkit, this matter is resorted to (Buffer) to identify the scope of influence based on the planning rates of gas stations, as the distance specified in the site selection conditions requires a station to move away from the nearest station by a distance of 750 meters within the municipal boundaries Thus, the value of the influence range will be determined by the distance of 375 meters from each station. By referring to Figure (6), we find that the closest distance between two stations is 1400 meters between the Umm Al Khail fuel station, which is under construction, and the Al-Wafdien gas station, which is located on the university road in the other direction. Therefore, this condition has been met between all stations in the city of Diwaniyah.

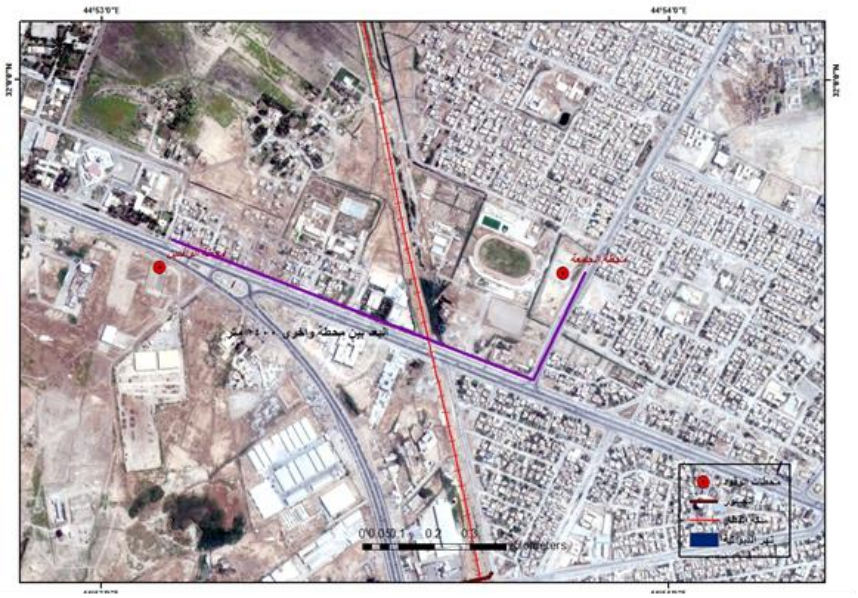

Fig 6 the distance between two stations

The Buffer command was also used in determining the other conditions, which are the environmental determinants that must be provided in the construction of fuel stations,

which were inferred by the General Company for the distribution of fuel stations in Diwaniyah as in Table (1)

Table 1 Environmental determinants in the construction of fuel stations

No.	Forbidden type	A fuel filling station
1	Residential role	40 m
2	Schools, hospitals and nurseries	100 m
3	Thermal sources	100 m
4	Gas plants	100 m

These settings were entered using the (Buffer) command in (Arc GIS desktop ver. 10.3)

So it became clear to us that almost all the stations meet the conditions and conform to the specifications according to the required specifications and are mentioned in Table (1), except for the two leased Qadisiyah station, which is located on Al-Iskan Street and Al-Beshara government station, which is located in the Sob Al-Shamiya area Figure (7) and (8), where we found the proximity of the residential floors to The leased Qadisiyah fuel station is less than 40 meters from the back side of the station, and this is outside the environmental limits, as well as near the governmental Al-Beshara fuel station for industrial stores in the Sob Al-Shamiya area with a distance of less than 100 meters, and these stores have been found to contain thermal sources after our visit to the site and this is considered Exceeding environmental and safety restrictions

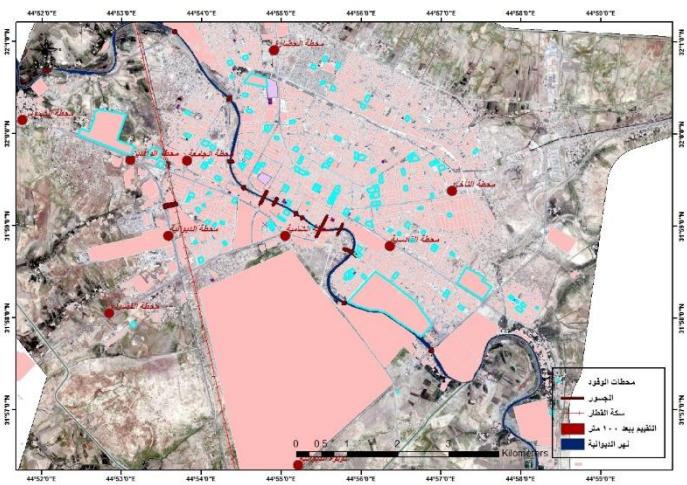

Fig 7 Qadisiyah fuel filling station

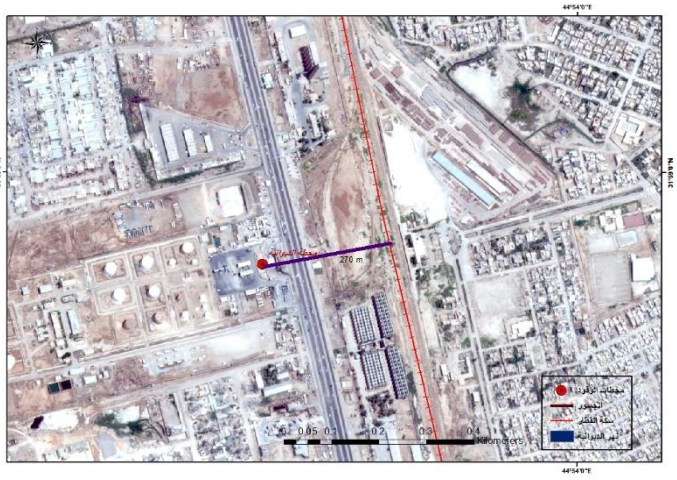

Fig 8 Al-Beshara Fuel Filling Station

Fig 9 Distance from hospitals and schools

Fig 10 the distance from the train tracks

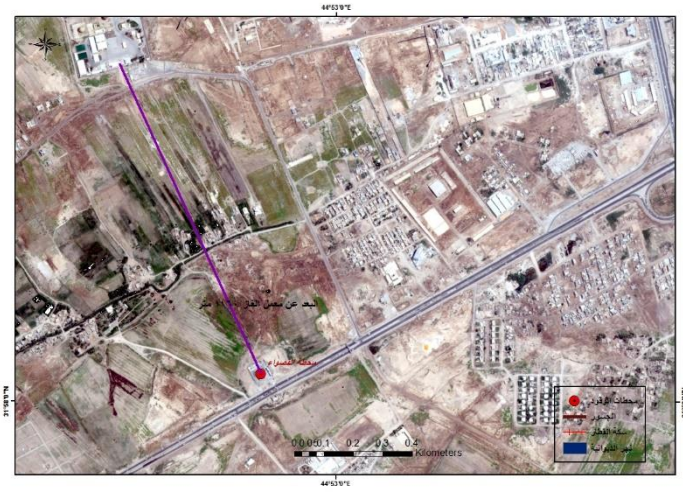

Fig 11 Distance from the Gas Plant

Fig 12 Distance from Residential Complexes

As for the remaining stations, there is no violation of the environmental conditions and determinants, as shown in Figures (9), (10), (11) and (12):

Where we have noted the commitment of the construction and site selection for these stations to environmental determinants, construction and safety conditions. We also noted that all stations in the city of Diwaniyah are located on main streets and this is a good thing, but some of the stations do not contain the main streets on which they are located on a service street that reduces traffic congestion in the event of entry and exit Vehicles to and from the station to refuel, especially in case of fuel crises.

This may not be among the determinants of constructing filling stations with fuel, but it is considered a good thing to reduce traffic congestion in the city of Diwaniyah. It has been observed that there are only three petrol stations out of ten petrol stations in Diwaniyah which have a service street in front of which are:

1- The newly constructed station of arrivals: - Al-Jamaa District / University Street.

2- New Diwaniyah governmental station: - opposite to Diwaniyah silo.

3-- Al-Ta'akhi station built: - Al-Jalabiyah neighborhood, near the Police Academy.

3-1-2: Using the Directional Distribution command:

The Directional Distribution command in the Measuring Geographic Distribution group belonging to the Spatial Statistics Tools group is used to show the spatial directional measures of the set of point features, and it shows the direction of the station's geographic distribution. North towards west and its concentration in this direction despite the low population density of the city in this direction than in the southeast direction of the city with the largest population density.

We also notice that the distribution is concentrated in this site with six stations, and the distribution is dispersed in the rest of the city and with the boundaries of two stations towards the southeast and one station to the south, Figure (13).

Here, the distribution is dispersed in these locations, and we also note that there is one station serving the city center with a high presence of vehicles, and thus the geographical distribution of fuel stations is not good in terms of concentration and direction of distribution.

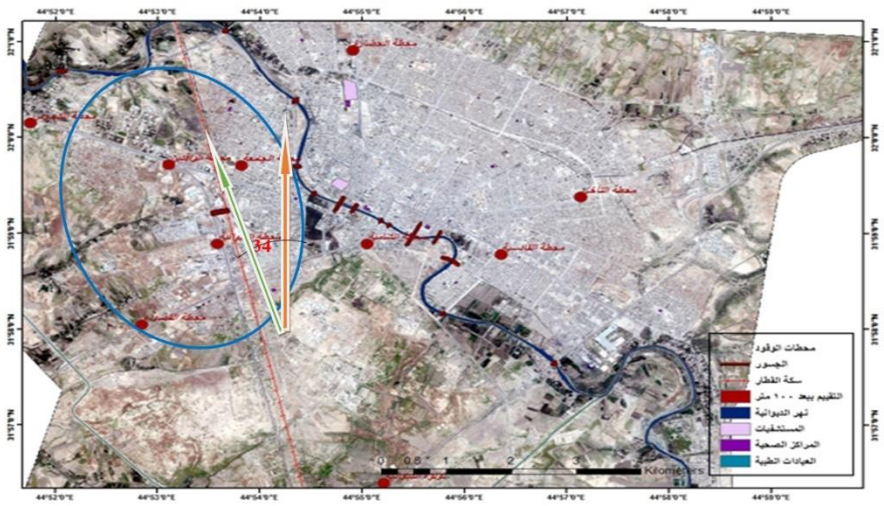

Fig 13 Geographical distribution of fuel stations in Diwaniyah

3-2: Suggested locations for new fuel stations:

After the poor distribution, which we noticed in high density areas, we found a lack of distribution for stations in the southern and southeastern regions of the city, so the work was done using (Arc GIS desktop ver.10.3) and by using the geographic distribution command, we have identified areas with a large population area, and several sites have been proposed for these stations, taking into account the conditions and determinants necessary for establishing and selecting the sites for these stations.

Figure (14) shows the location of the first proposed station, which is located in the southeastern part of the city

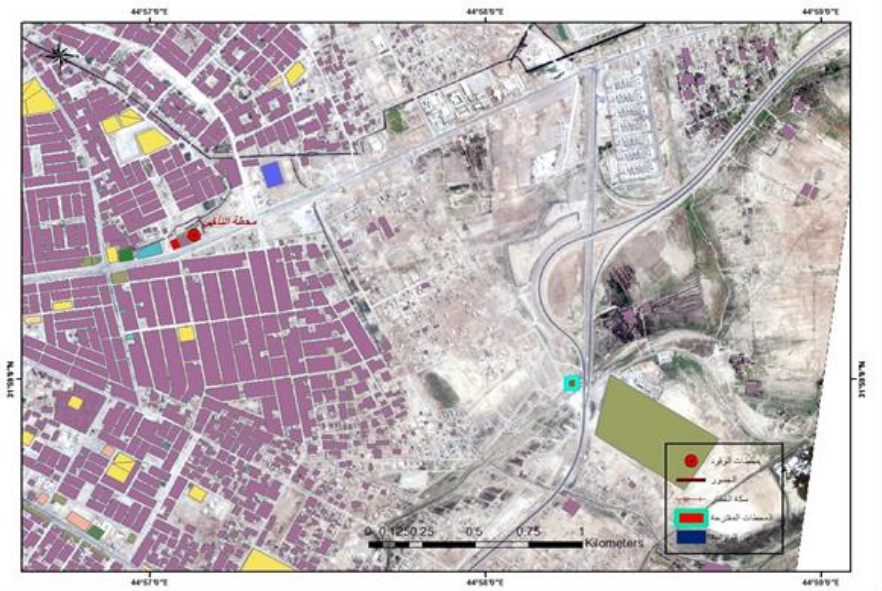

Fig 14 The location of the first proposed station

Specifically, in the street leading to Afak district, on the opposite side of the residential complex.

The location of the second proposed fuel station has also been identified, which is located in the southeastern part of the city, specifically in the Al-Wehda neighborhood, as shown in Figure (15).

Fig 15 The location of the second proposed station

3-3: Final evaluation of the stations' locations:

Table (2) shows the final evaluation of the locations of the petrol stations in Diwaniyah according to the environmental conditions and determinants that must be available to select the sites for these stations before construction and construction, as as shown in the above table, eight determinants have been identified for selecting sites and they were boycotted with the stations in Diwaniyah and a note and evaluation of the commitment of these stations With the restrictions and limitations, the number 1 indicates the commitment of these stations to these determinants, and the number zero is their lack of commitment, and the final total of the evaluation and the proportionality ratio were obtained by dividing the total by the number of determinants.

Table 2 The extent of suitability of Diwaniyah fuel stations for site selection

No.	Criterion	Evaluation									
		Al-Shumoos	**Al-wafidin**	**New Diwaniyah**	**Al-Beshara**	**Al-Qaswaa**	**Luluat Al-**	**Al-Qadisiyah**	**Al-Ta'akhi**	**Al-Hadara**	**Umm Al Khail**
1	The distance from the nearest school or hospital is not less than 100 meters	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
2	The distance from the nearest residential presence shall not be less than 40 m	**1**	**1**	**1**	**1**	**1**	**1**	**ZERO**	**1**	**1**	**1**
3	The minimum distance between one station and another is 750 m	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
4	The station should be located on a main street	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**

5	Availability of a service street in front of the station	**ZERO**	**1**	**1**	**ZERO**	**ZERO**	**ZERO**	**ZERO**	**1**	**ZERO**	**ZERO**
6	Its distance from the train tracks is more than 100 meters	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
7	Its distance from the gas plant is more than 100 m	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**
8	Its distance from thermal sources is more than 100 m	**1**	**1**	**1**	**ZERO**	**1**	**1**	**1**	**1**	**1**	**1**
	Total	**7**	**8**	**8**	**6**	**7**	**7**	**6**	**8**	**7**	**7**
	Fit ratio	**% 87.5**	**% 100**	**% 100**	**% 75**	**% 87.5**	**% 87.5**	**% 75**	**% 100**	**% 87.5**	**% 87.5**

Through the suitability ratios in the above table, we find that the stations that obtained an adequate percentage (100%) for the parameters and conditions are only three out of ten stations, which are (Al-Wafidin station located in Al-Jamaa neighborhood, New Diwaniyah station, located opposite to grain storage Al-Diwaniyah and Al-Ta'akhi station, located near police Academy).

The number of stations that got an adequate percentage (87.5%) for the parameters and conditions are five stations out of ten stations, which are (Al-Shomoos station, located on Al-Diwaniyah - Al-Seniya road, Al-Qaswa station, located on Diwaniyah - Najaf road and Luluat Al-Diwaniyah station located south of the city and Al-Hadara station, which is located on the road Diwaniyah - Daghara and finally "Umm Al Khail Station on Umm Al Khail Main Street).

As for the stations that received the least appropriate percentage (75%) for the conditions and conditions, only two out of ten stations were (Al-Qadisiyah station, located on Al-Iskan Street, and the governmental Al-Beshara station, located next to the Hittin Mosque).

Consequently, it becomes clear to us that 30% of the stations obtained a rate of 100% appropriate to the parameters and conditions that must be met in the construction and construction of gas stations in cities and 20% of these stations got a lower percentage in the evaluation that we learned in this research, which was 75% an appropriate rate and 50% of The stations got an appropriate rate of 87.5%, and these rates are considered good. It is possible to address the errors that occurred and to avoid the risks resulting from them. It is up to the relevant authorities.

3-4: Away from geographic information systems:

Away from the application of geographic information systems, we have noticed that there are fuel stations that do not serve the city 100% by virtue of their location according to the direction of traffic to the main street on which these stations are located, which are fuel stations (civilization, suns and expatriates) as they are located in the direction of traffic inside the city and the difficulty of entering this station and supply it By vehicles that are inside the city, they serve the vehicles coming from outside the city, for example the vehicle that is from the city of Diwaniyah and wanted to go to the governorate of Baghdad or Wasit finds it difficult to refuel from the civilization fuel station, and thus it increases from the stations located in the direction of Daghara, which is located on the direction of The movement of that vehicle, as well as the case for the stations of Al-Shomoos and Al-Wafidin.

4: Conclusions:

1: The geographical distribution of fuel stations in the city of Diwaniyah is a sporadic pattern of distribution, dispersed in the south-southeast

direction, combined in the northwest direction, and tilting at an angle of 34 degrees from the north to the west.
2: The lack of fuel stations in the southern and southeastern sides of the city, despite the high population density in this region and its concentration in the north and northwest regions.
3: That 30% of the stations obtained a percentage that is 100% appropriate to the parameters and conditions that must be met in the construction and construction of gas stations in cities and 20% of these stations got a lower percentage in the evaluation that we learned in this research, and it was 75% an appropriate percentage and 50% of the stations It got a good 87.5% rate.
4: Failure to use modern programs, theories and methods of work in selecting sites for fuel stations, such as geographic information systems and other modern methods used in city planning, an indication of the wrong geographical distribution of these stations.
5: The lack of sufficient information for researchers in this field from the relevant authorities, such as digital maps, aerial photos, and paper maps, and if any, they cannot be obtained under the pretext of confidentiality of information.
6: Most of the stations do not have a service street in front of them to absorb the irrigated momentum in the event of entering and leaving vehicles for refueling, especially in cases of fuel crises or at peak time.

5: Recommendations:

Through the results we obtained through previous research and conclusions, we reached a summary of the recommendations listed below, and we hope that the relevant authorities and those interested in this field take these recommendations into consideration in the case of the current stations or in the case of choosing a site and constructing future stations:
1: Creating green spaces with dense trees separating the stations and schools or residential presence in the event they are near it to reduce the damage of volatile gases from the stations and their impact on the neighborhood or in preventing the danger in cases of fires.
2: Creating a service side road parallel to the main road and to the side near the station, or making a setback in the outer fence of stations that do not have a service street in front of them to accommodate the density of vehicles wishing to refuel.
3: Concerned parties should think seriously about the necessity of introducing modern technologies in the case of selecting sites and constructing fuel stations in cities and building advanced digital information bases that can be updated and updated on an up-to-date basis that includes the necessary data required for fuel stations because they are the basis for planning and decision-making processes based on Correct scientific foundations and an example of these techniques is geographic information systems.
4: Not to underestimate the environmental determinants and conditions necessary for the selection and construction of gas station sites by the relevant authorities and by the investors, because these determinants and conditions are set for the safety of the citizen and the safety and cleanliness of the environment in which he lives.
5: Paying attention to the entrances and exits of the stations and the locations of the stations with respect to the direction of vehicles traveling to take full advantage of the station's location.
6: Proposing new fuel stations in places with densely populated cities in the city that lack sufficient fuel stations.

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