

*Full Length Research Paper*

# Spatial analysis of the petrol stations in Khan-Younis city using geographic information system (GIS) techniques

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This study was conducted in Palestine, the Gaza strip in Khan Younis City. The study aimed at analyzing petrol stations locations in Khan Younis City. It used geographic information system (GIS) based multi standard analysis. 25 petrol stations are available in Khan Younis City, distributed in 11 neighborhoods. A preview was created about the different petrol stations in Khan Younis City. This outline includes the actual status map, default geographical status map, the standard distance for the distribution map, the directional distribution map, and Areas of specialization areal map, the Petrol stations in Khan Younis City. Spatial analysis of the distribution of Petrol stations was performed through basic 4 standards. The first standard is "The minimum distance between the location of the station and facilities of services (schools, hospitals, wedding halls, nursing homes, factories) for 80 m" show that there are 16 petrol station committed to the first standard, while 11 petrol station in violation of the first standard of 25 petrol station. The second standard is "The minimum distance between the location of the station and craft shops that use flame in its work for 10 m", show that there are 19 petrol station committed to the second standard, while the 6 petrol station in violation of the second standard of 25 petrol station. The third standard " The minimum distance between the location of the station and the limits of military facilities for 300 m, counted from the outer limits of the station" show that there are 21 petrol station committed to the third standard, while the 4 petrol station in violation of the third standard of 25 petrol station. The fourth standard is "The horizontal distance between the station boundaries and the electricity high pressure lines not less than 10 m" show that there are 24 petrol station committed to the fourth standard, while the 1 petrol station in violation of the fourth standard of 25 petrol station standard. And finally the researcher found a direct correlation relationship between population density and the number of stations in every neighborhood.

**Key words:** Spatial analysis, geographic information system (GIS), petrol, station, Khan-Younis.

## INTRODUCTION

A petrol station, petrol station, fueling station, or service station is a facility which sells fuel and lubricants for

vehicles; the most common fuel sold is petrol and kerosene. Petrol station is a retail establishment where

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motor vehicles are refueled, lubricated, serviced, and sometimes repaired. Petrol stations should be located not only where they are in fact accessible but where they can be easily located by strangers and that, in details, they should be placed where they will be little danger and congestion as possible. Most petrol stations sell petrol or diesel, some carry specialty fuels such as liquefied petroleum gas (LPG), natural gas, hydrogen, biodiesel, kerosene, or butane while the rest add shops to their primary business, and convenience stores (Ayodele, 2011; Abdul Hamid et al., 2009).

### Problem statement

The increase in urban population and the growth of the number of cars and other vehicles generate various kinds of demands, one of which is fuel. A considerable amount of cars fuel is wasted due to the long urban paths and unnecessary trips. Increase in vehicles triggered increasing demands for fuel and by extension fuel station, since engines are made to use petroleum products and Petrol station are the places where fuel is sold. Petrol station, petrol station, gas station or petroleum outlet is defined as any land, building or equipment used for the sale or dispensing of petrol or oil for motor vehicles or incidental thereto and includes the whole of the land, building or equipment whether or not the use as a petrol station is the predominant use or is only a part thereof. Most petrol stations sell petrol or diesel, some carry specialty fuels such as liquefied petroleum gas (LPG), natural gas, hydrogen, biodiesel, kerosene, or butane while the rest add shops to their primary business (Ayodele, 2011; Abdul Hamid et al., 2009).

Geographic information systems (GIS) approaches and related products have been widely used in the people's daily life. GIS provide the appropriate tools for analyzing the effective factors on spatial data and non-spatial data (Keeble, 1968). It is powerful computer-based tools for the capture, storage, management, retrieval, query, analysis and presentation of spatial data. GIS ability as spatial data processing and analyses tools available can be used to manage a wide range of Information (Keeble, 1968; Mc-Lafferty, 2003; Richards et al., 1999; Mohammed et al., 2005; Palestinian Central Bureau of Statistics, 2007).

### Aim of the study

The main aim of this study is to analyze the spatial distribution of petrol stations in Khan Younis City using GIS-based Multi-Criteria Analysis (MCA). The aim of this research can be summarized as analysis of petrol stations locations in Khan Younis City.

### Study area

This study was conducted in Palestine, Gaza strip, Khan

Younis City. Khan Younis is a Palestinian city, the center of Khan Younis, located in the southern part of the Gaza Strip, and Jerusalem away from the distance of 100 km to the south-west. It is bordered to the south of Rafah and north of Deir El-Balah, a coastal province overlooking the Mediterranean Sea to the west and on the east by Israel. considered Khan Younis, the second largest city in the Gaza Strip in terms of population and area after the Gaza City, where the number of today its population nearly 200,000 people, which represents 17% of the population of the Gaza Strip. As an area of 54 km<sup>2</sup>, making it one of the most densely populated Palestinian cities (Palestinian Central Bureau of Statistics, 2007).

Khan Younis City is one of the five Governorates in the Gaza Strip which is administered by Palestine, aside from its border with Israel, airspace and maritime territory. According to the Palestinian Central Bureau of Statistics, the City had a population of 280,000 in 2007; its land area is 69.61% urban, 12.8% rural and 17.57% comprising the Khan Younis refugee camp (Palestinian Central Bureau of Statistics, 2007) (Figure 1 and 2).

### METHODOLOGY

There are several steps in this study as follows:

1. A preliminary survey was carried out to identify and document Petrol station in Khan Younis City. This acquainted the researcher with the knowledge of the area and provide guide on how to source the data, types of data needed and preparation for the field work.
2. Transform all the above mentioned data in an appropriate way with ArcGIS software.
3. Preparing the basic maps for the study area including Khan Younis City GIS maps to create preview of Khan Younis City in 2016 of:
  - a. The actual status of the Petrol stations in Khan Younis City.
  - b. The default geographical status (the default status) of the Petrol stations in Khan Younis city.
  - c. The standard distance for the distribution of the Petrol stations in Khan Younis city.
  - d. The directional distribution of the Petrol stations in Khan Younis City.
  - e. Areas of specialization areal of the Petrol stations in Khan Younis City.
4. Spatial analysis of the distribution of Petrol stations through the four basic standards:
  - a. The minimum distance between the location of the station and facilities of services (schools, hospitals, wedding halls, nursing homes, factories) for 80 m.
  - b. The minimum distance between the location of the station and craft shops that use flame in its work for 10 m.
  - c. The minimum distance between the location of the station and the limits of military facilities for 300 m, counted from the outer limits of the station.
  - d. The horizontal distance between the station boundaries and the electricity high pressure lines not less than 10 m.
5. Perform statistical techniques on the data to investigate the relations between (density of Neighborhoods population with petrol stations numbers, neighborhoods distances with number of Petrol

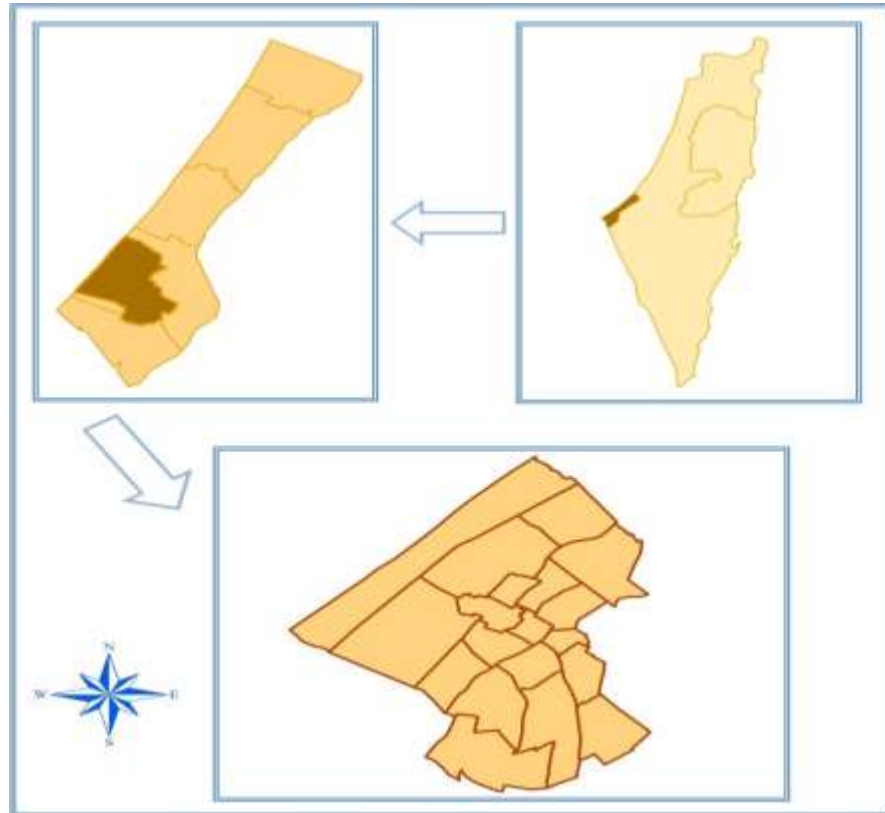


Figure 1. Khan Younis City displaying through geographical information systems. Source: By Researcher.

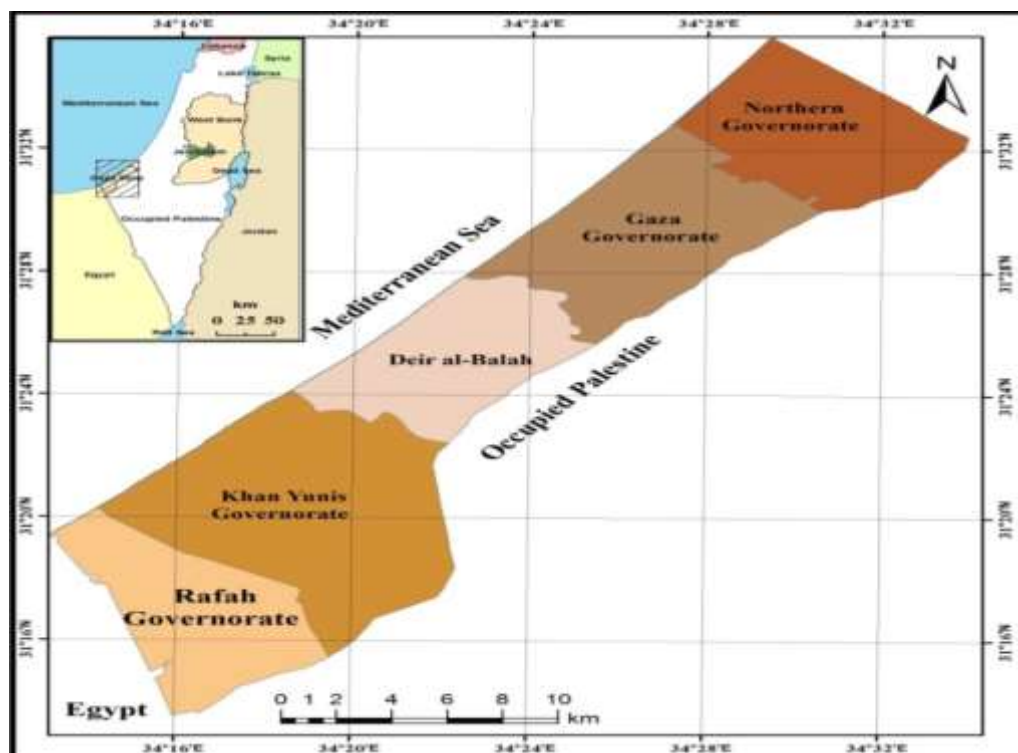


Figure 2. Gaza strip displaying through geographical information systems. Source: By Researcher.

**Table 1.** Distribution of Petrol stations on Khan Younis neighborhoods

Neighborhood	Number of stations	POP_Coun
City Center neighborhood	1	9900
Al Sheikh Nasser neighborhood	1	6576
Khan Younis Camp neighborhood	1	52615
AL Amal neighborhood	1	13153
Maaain neighborhood	1	14250
Jort Allout neighborhood	2	10431
Gizan Alnajar neighborhood	2	3288
AL Manara neighborhood	3	10139
AL Mahata neighborhood	5	21923
AL Katiba neighborhood	2	7673
AL Satar neighborhood	4	9900
AL Mauasi neighborhood	2	7000

stations numbers in it).

## RESULTS AND DISCUSSION

### A preliminary survey of petrol stations in Khan Younis City

A preliminary survey of Khan Younis City petrol stations was carried out to identify, document and create GIS preview of Khan Younis City in 2016 Khan Younis City contain 25 Petrol stations distributed on all Khan Younis neighborhoods (Table 1).

### GIS maps

The basic maps for the study area including Khan Younis City GIS maps prepared to create actual and default geographical status (the default status), the standard distance for the distribution, directional distribution, and areas of specialization areal of the petrol stations in Khan Younis City.

The entire field survey has been done for the city of Khan Younis, according to the division of neighborhoods by the Khan Younis Municipality maps, to determine the number and distribution of petrol station and its locations on the GIS map are shown in Figure 3, petrol stations distributed on all Khan Younis neighborhoods.

Khan Younis City has 25 Petrol stations distributed on 12 neighbors. The center of spatial gravity of the petrol stations which is located in Al Sheikh Nasser neighborhood (Figure 4 and 5).

Through a measuring mechanism of the geographical center by using GIS programs possibilities and through which the monitoring the various elements of the current situation for the distribution of petrol stations at the city of Khan Younis and the geographic center of the petrol stations was located in the neighborhood of Sheikh

Nasser (Figures 6, 7, 8 and 9).

### Spatial analysis of the distribution of petrol stations through the four basic standards

The minimum distance between the location of the station and facilities of services (schools, hospitals, wedding halls, nursing homes, factories) was 80 m.

As shown in Figure 10, the petrol stations are classified in terms of the first standard, which stipulates that the minimum distance between the location of the station and facilities of services (schools, hospitals, wedding halls, nursing homes, factories) for 80 m calculated from the outer limits of the station.

As shown that there are 16 petrol station is committed to the first standard, while the 11 petrol station in violation of the first standard of 25 petrol station.

The minimum distance between the location of the station and craft shops that use flame in its work for 10 m.

As shown in Figure 11, the petrol stations are classified in terms of the second standard, which stipulates that the minimum distance between the location of the station and craft shops that use flame in its work for 10 m.

As shown that there are 19 petrol station is committed to the second standard, while the 6 petrol station in violation of the second standard of 25 petrol station.

The minimum distance between the location of the station and the limits of military facilities for 300 m, counted from the outer limits of the station.

As shown in Figure 12, the petrol stations are classified in terms of the third standard, which stipulates that the minimum distance between the location of the station and the limits of military facilities for 300 m, counted from the outer limits of the station.

As shown that there are 21 petrol station is committed to the third standard, while the 4 petrol station in violation of the third standard of 25 petrol station.



Figure 3. Khan Younis City neighborhoods borders.

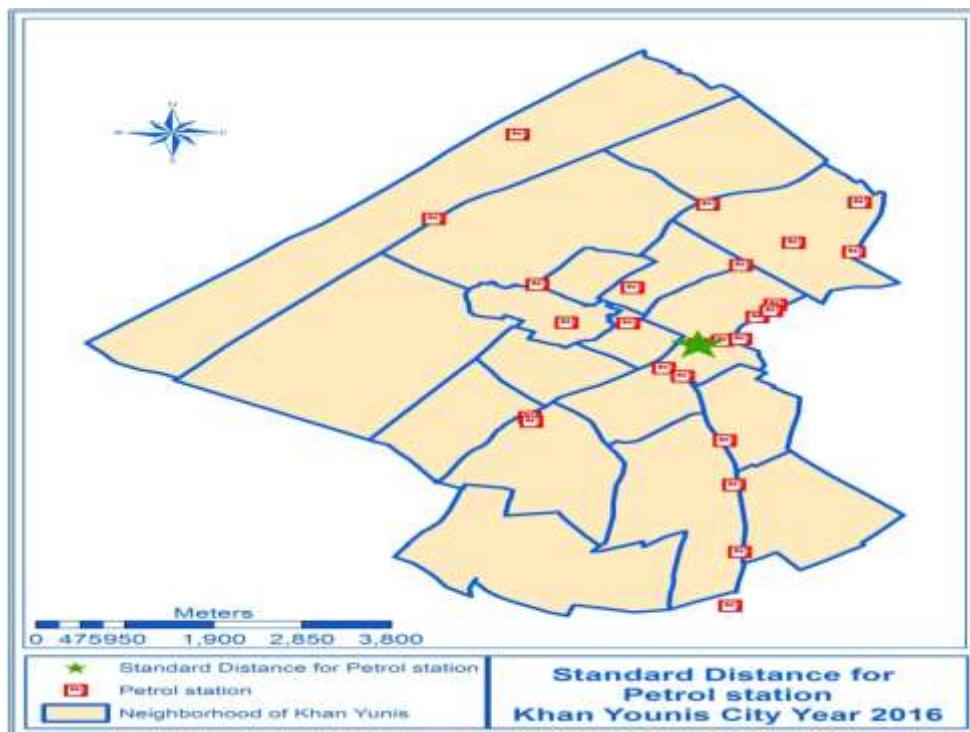
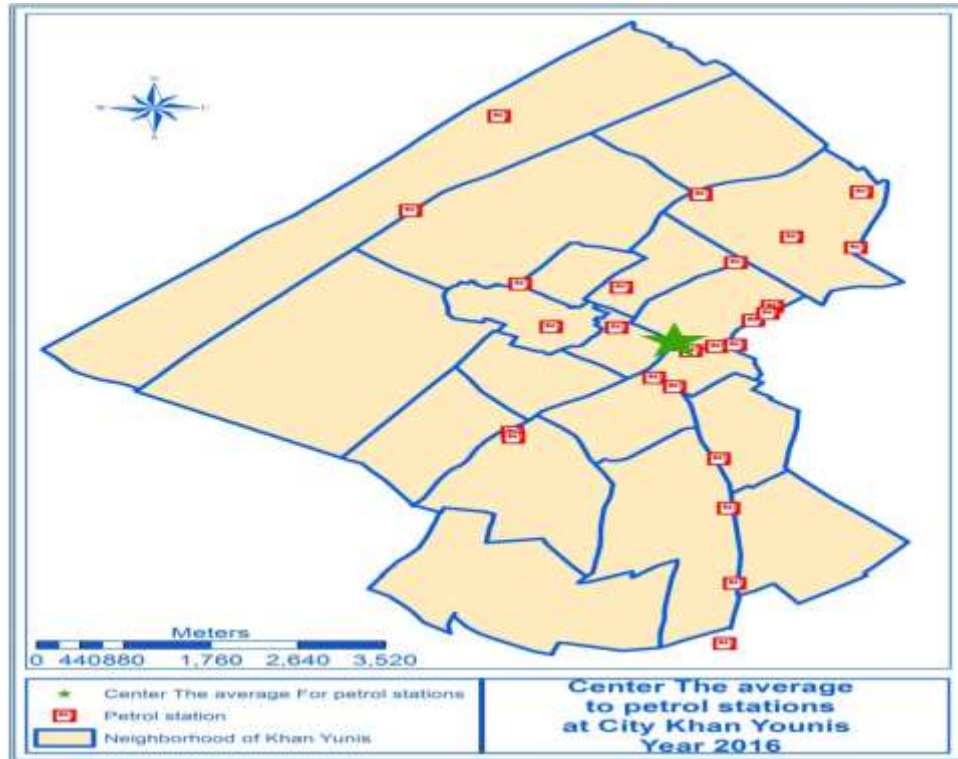
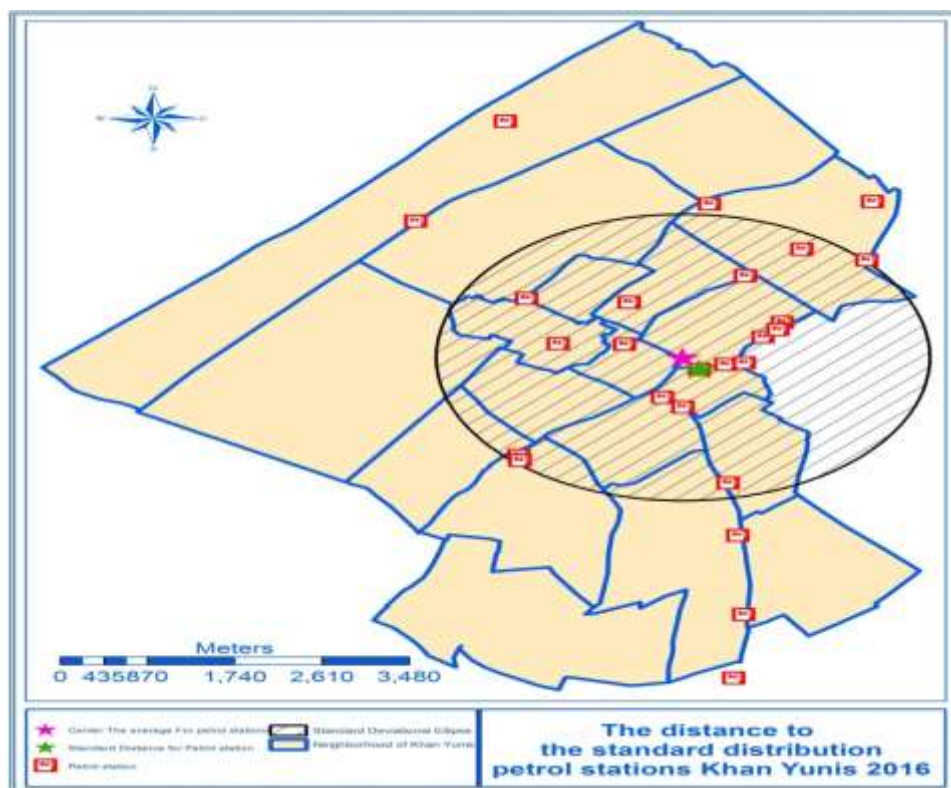


Figure 4. The center of spatial gravity of the Petrol stations in Khan Younis 2016. Source: By Researcher.

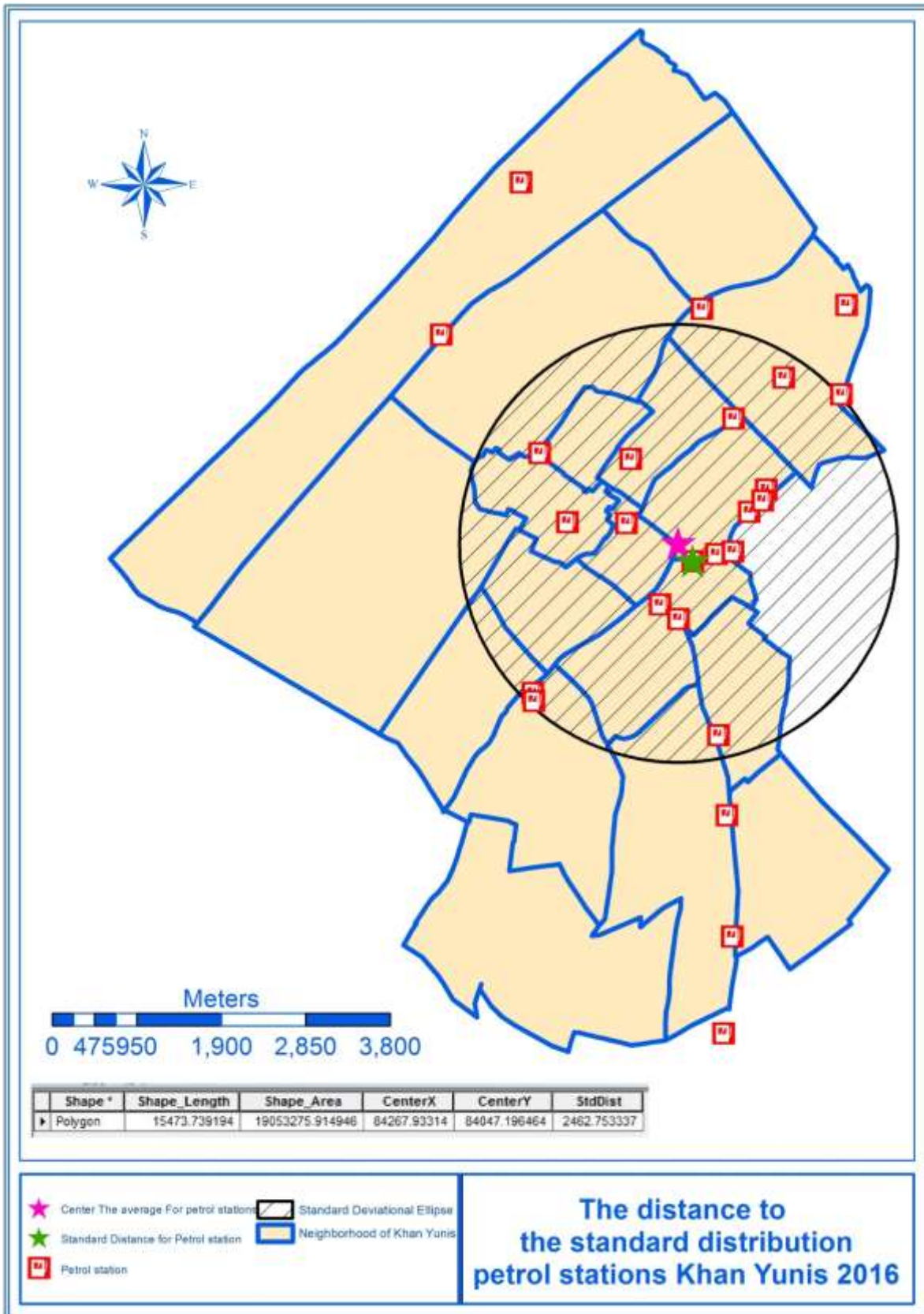




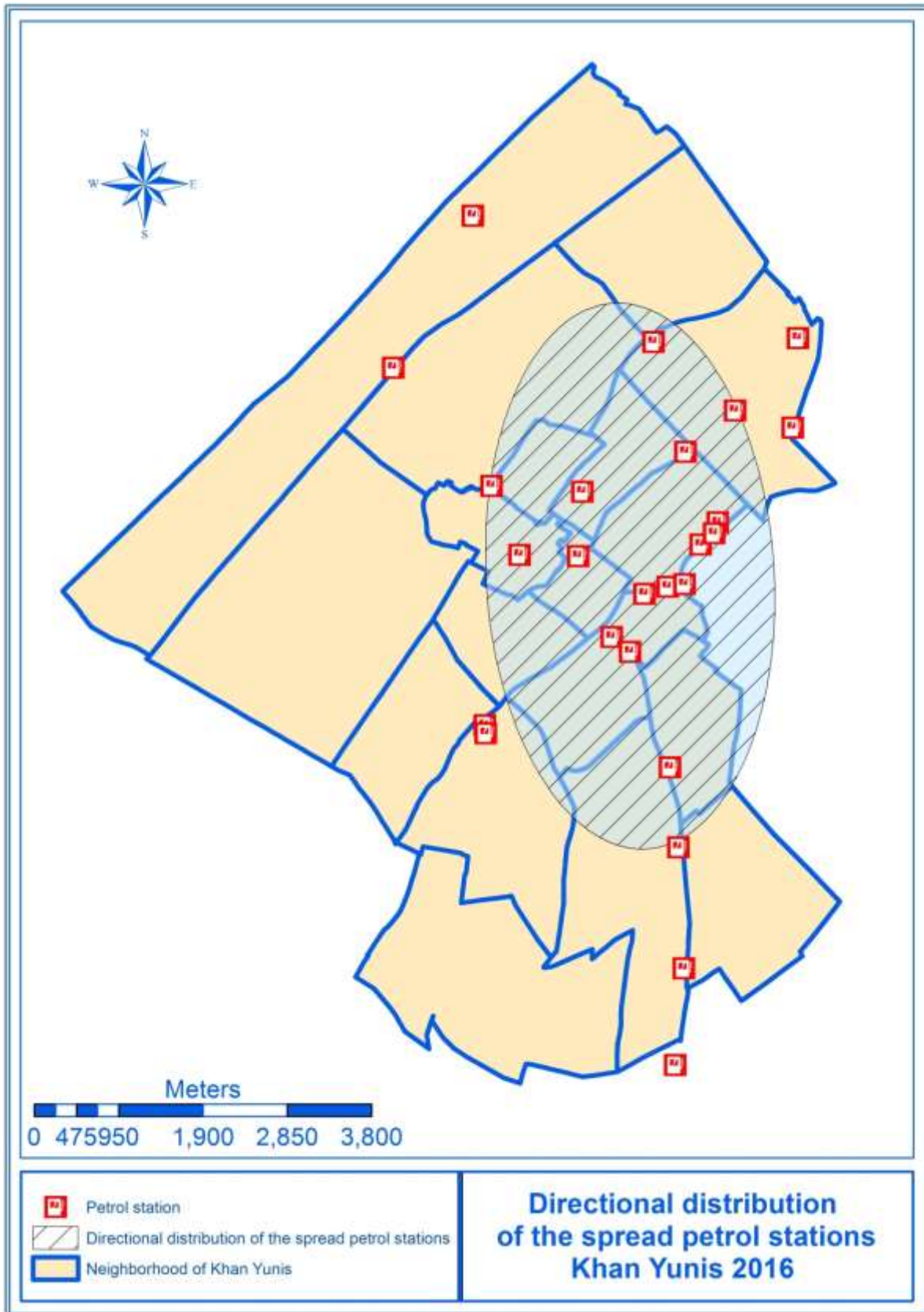
**Figure 5.** Default geographical status (the default status) of petrol stations in the neighborhoods of the city of Khan Younis 2016. **Source:** By Researcher.



**Figure 6.** The standard distance for the distribution of petrol stations in the neighborhoods of the city of Khan Younis 2016. **Source:** By Researcher.

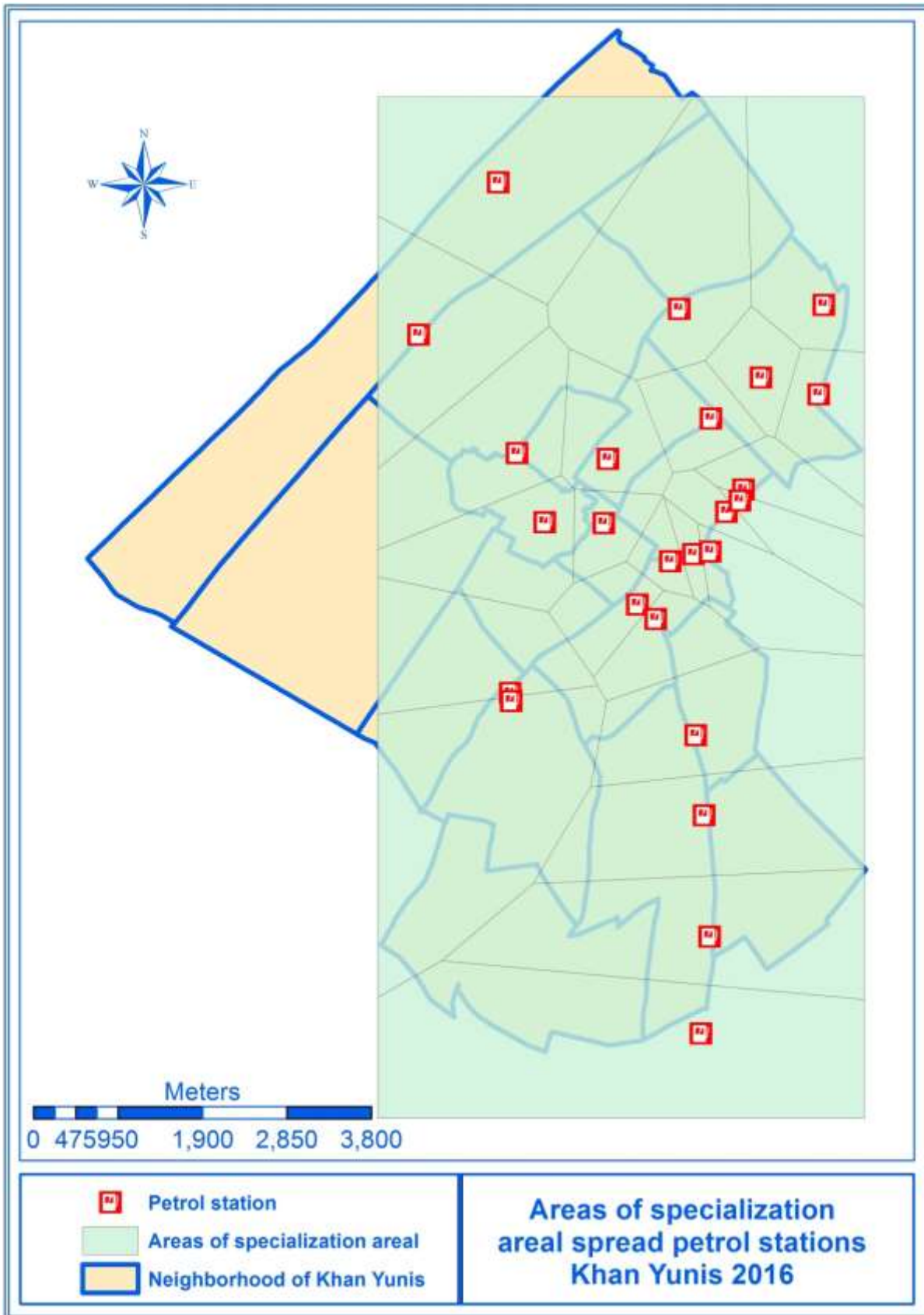


**Figure 7.** The standard distance for the distribution of petrol stations in the neighborhoods of the city of Khan Yunis 2016. Source: By Researcher.

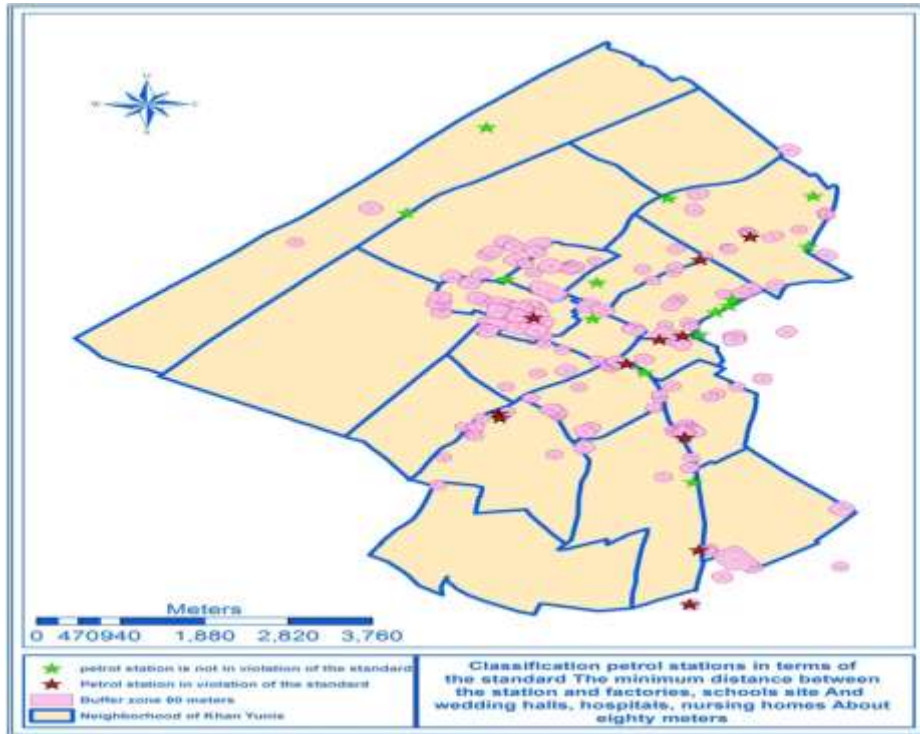


**Figure 8.** Directional distribution areas of specialization area of petrol stations in the neighborhoods of the city of Khan Yunis 2016. Source: By Researcher.

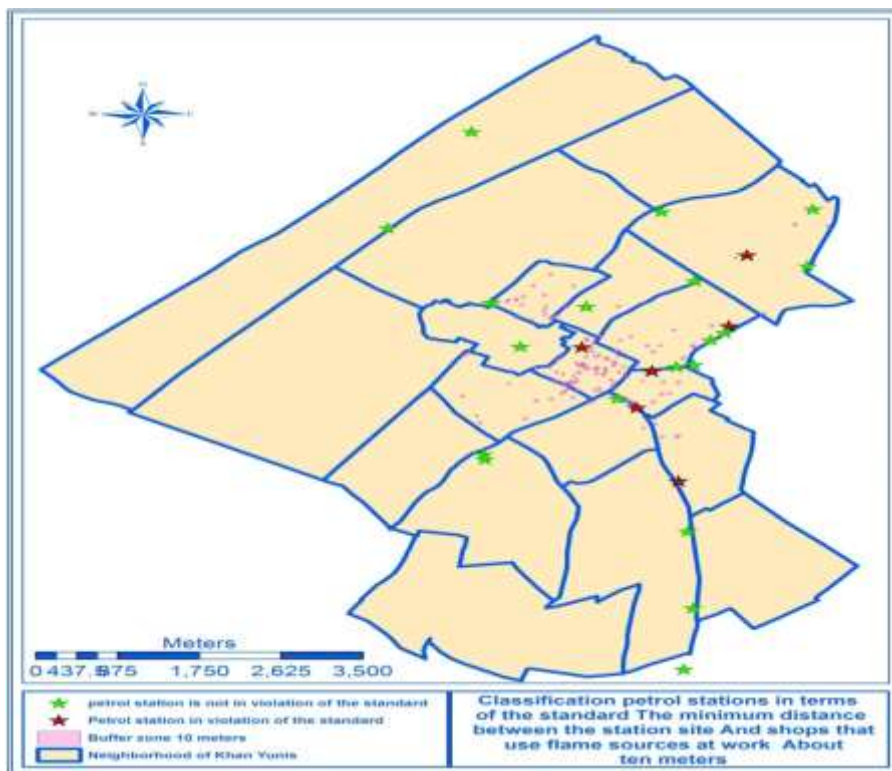




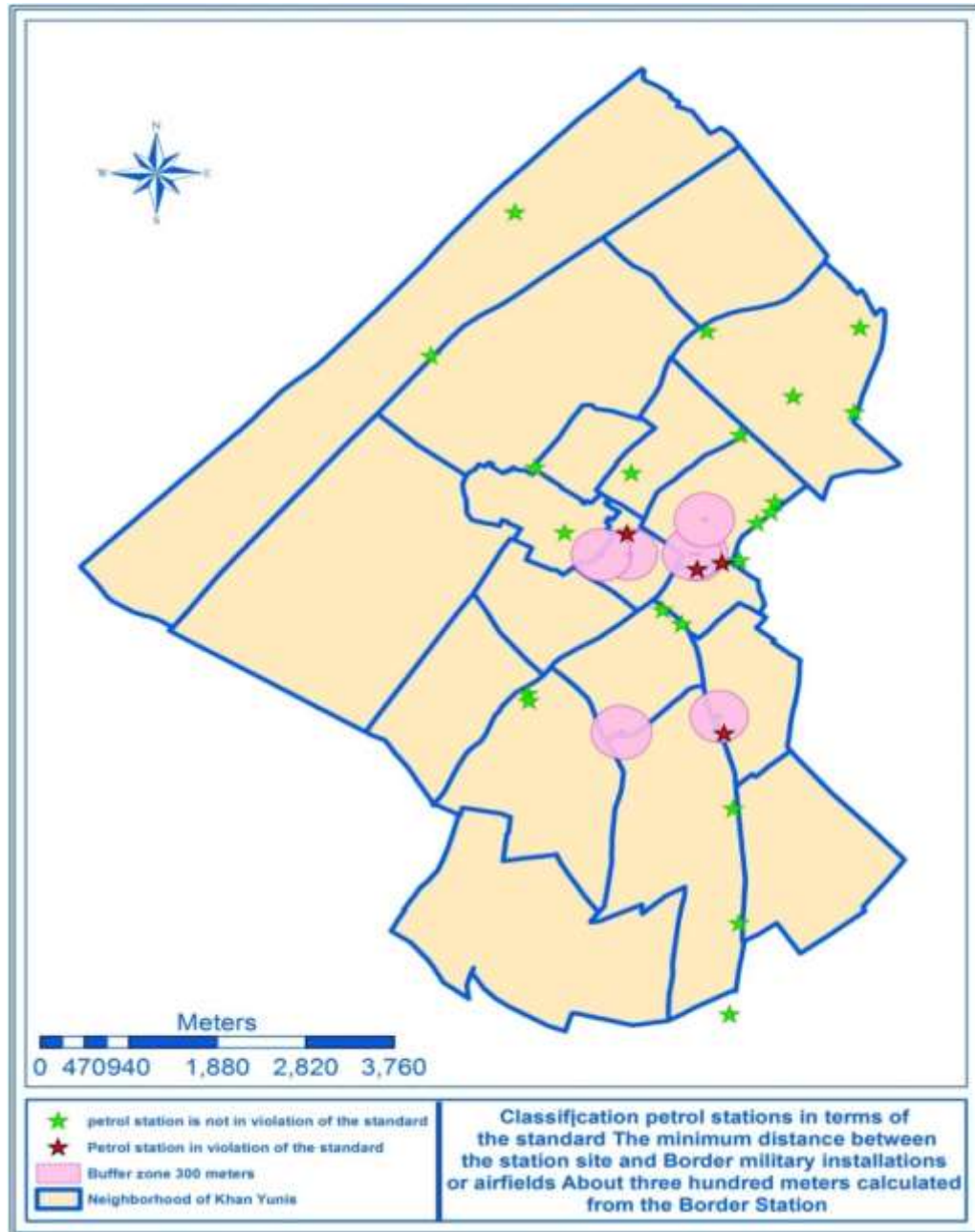
**Figure 9.** Areas of specialization area of petrol stations in the neighborhoods of the city of Khan Yunis 2016. Source: By Researcher.



**Figure 10.** Classification petrol stations in terms of the standard the minimum distance between the station, factories, schools site and wedding halls, hospitals, nursing homes about eighty meters.



**Figure 11.** Classification petrol stations in terms of the standard the minimum distance between the station site and shops that use flame sources at work about ten meters.



**Figure 12.** Classification petrol stations in terms of the standard the minimum distance between the station site and border military installations or airfields about three hundred meters calculated from the border station.

The horizontal distance between the station boundaries and the electricity high pressure lines was less than 10 m.

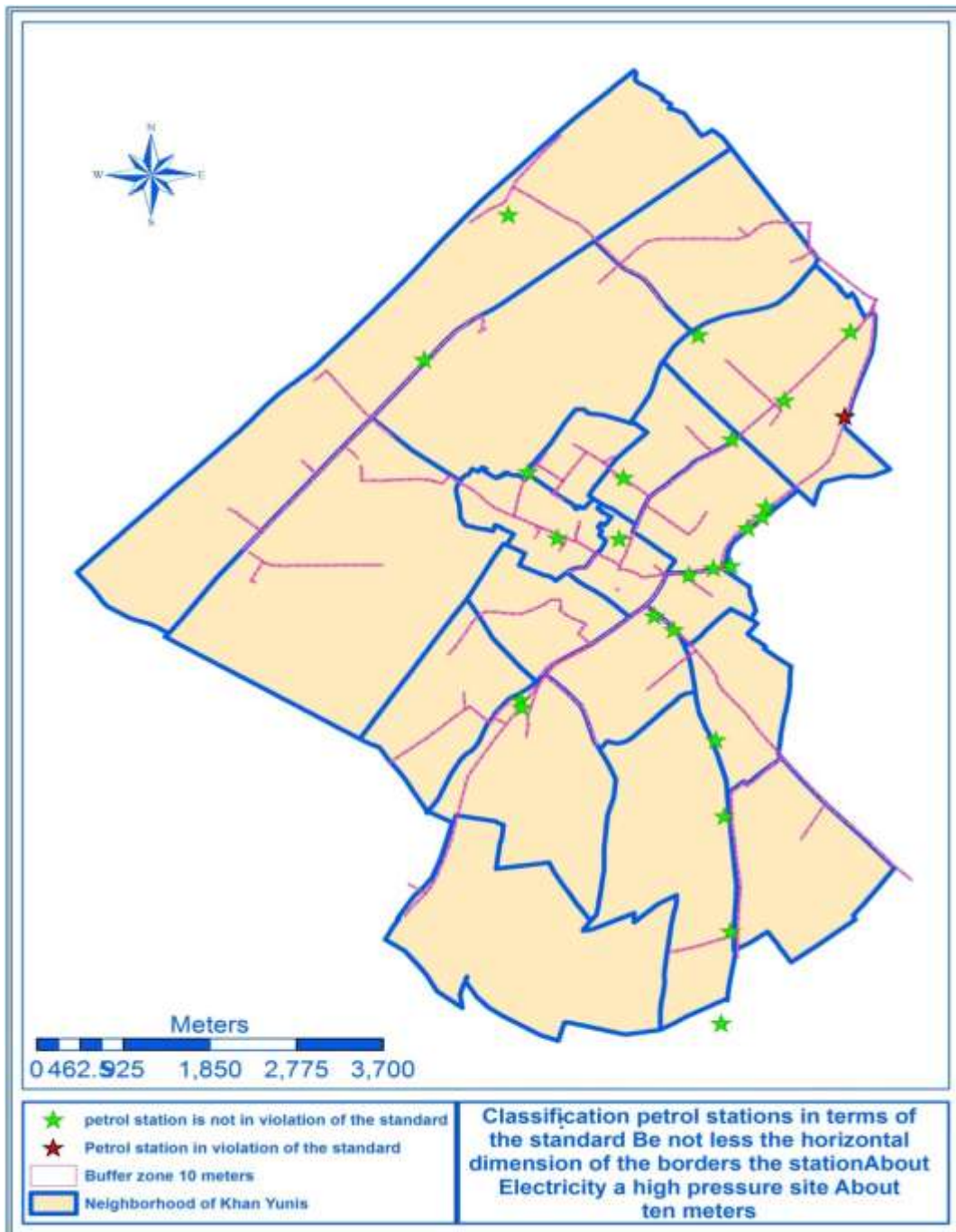
As shown in Figure 13, The petrol stations are classified in terms of the fourth standard, which stipulates that the horizontal distance between the station boundaries and the electricity high pressure lines not less than 10 m.

As shown that there are 24 petrol station committed to

the fourth standard, while 1 petrol station in violation of the fourth standard of 25 petrol stations.

**Perform statistical techniques on the data to investigate the relations between densities of neighborhoods population with petrol stations numbers**

A preliminary survey of the city of Khan Younis that it



**Figure 13.** Classification petrol stations in terms of the standard be not less the horizontal dimension of the borders the station about electricity of the pressure site about ten meters.

contains 25 petrol stations spread over 12 neighborhoods, here, the researcher will investigate and identify the relationship between density of neighborhoods population with petrol stations numbers, based upon the researcher will clarify whether the distribution of stations geographically proportional to the population density of each neighborhood or not.

As shown in the Table 2, the number of stations geographically proportional with the population density of each neighborhood of city of Khan Younis, where higher the population density in a given neighborhood has increased the number of stations it and lower the population density decreases the number of stations.

Based on that, the relationship between population



**Table 2.** The numbers of station and population density in each Neighborhood

S/N	Neighborhood	No. of stations	POP_Coun
1	City Center neighborhood	1	9900
2	Al Sheikh Nasser neighborhood	1	6576
3	Khan Younis Camp neighborhood	1	52615
4	AL Amal neighborhood	1	13153
5	Maain neighborhood	1	14250
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7	Gizan Alnajar neighborhood	2	3288
8	AL Manara neighborhood	3	10139
9	AL Mahata neighborhood	5	21923
10	AL Katiba neighborhood	2	7673
11	AL Satar neighborhood	4	9900
12	AL Mauasi neighborhood	2	7000
	Total	25	166848

density and the number of stations in every neighborhood is a direct correlation, due to the planning and organization in Khan Younis municipality and the licensing authority.

### Proposed locations for new petrol stations

The proposed location for new petrol stations is given in Figure 14.

### Conclusion

This study was conducted in Palestine, Gaza strip, Khan Younis City. The aim of this study was to analyze the petrol station locations in Khan Younis City using the GIS based multi standard analysis. 25 petrol stations founded in Khan Younis City distributed on 11 neighborhoods, preliminary preview created of petrol stations in Khan Younis City, which include the actual status map, default geographical status map, the standard distance for the distribution map, the directional distribution map, and areas of specialization area map the petrol stations in Khan Younis City. Spatial analysis of the distribution of petrol stations performed through basic 4 standards.

The first standard is "The minimum distance between the location of the station and facilities of services (schools, hospitals, wedding halls, nursing homes, factories) for 80 meters" shown that there are 16 petrol station is committed to the first standard, while the 11 petrol station in violation of the first standard of 25 petrol station.

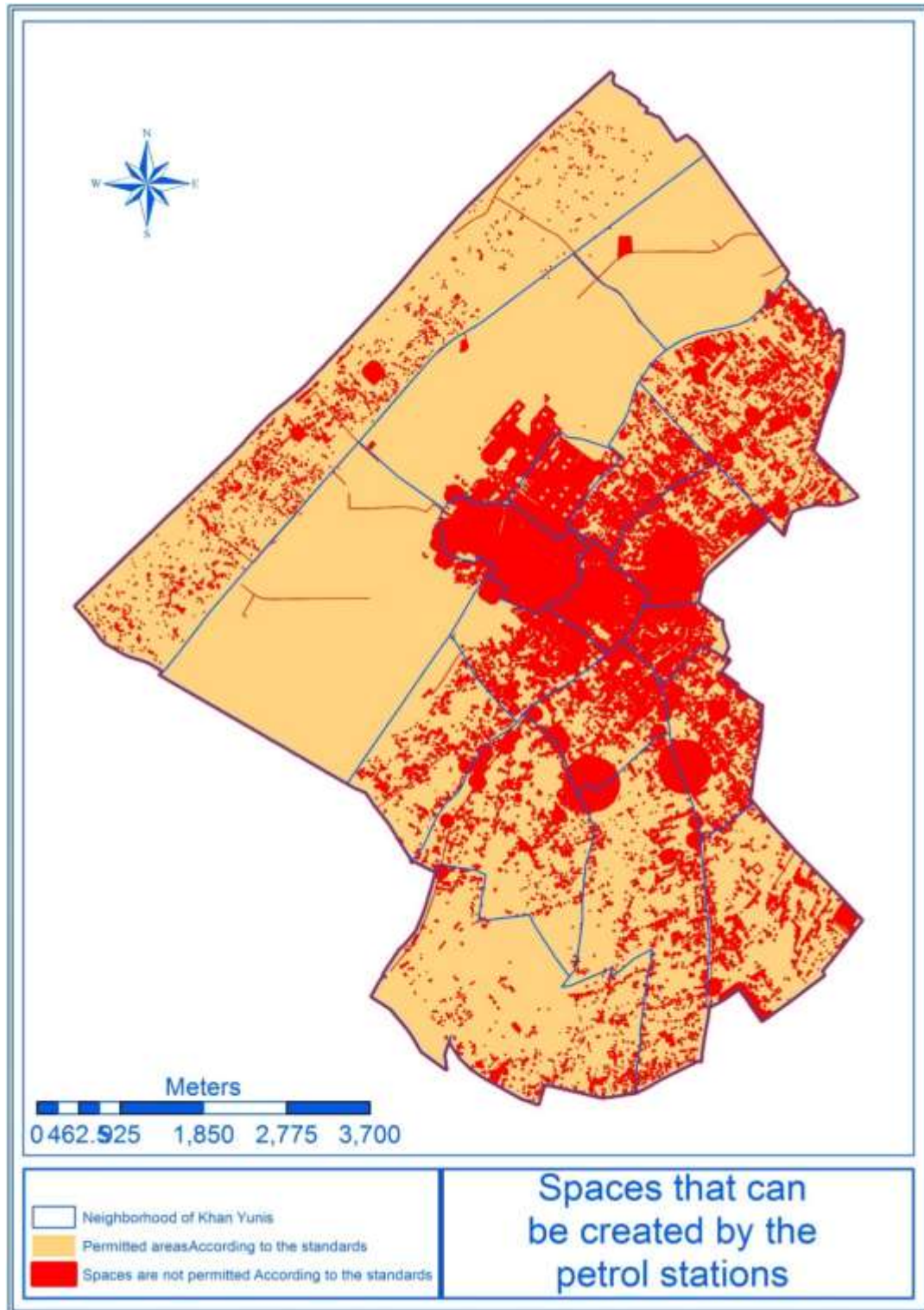
The second standard "The minimum distance between the location of the station and craft shops that use flame in its work for 10 m", shown that there are 19 petrol station is committed to the second standard, while the 6 petrol station in violation of the second standard of 25 petrol station.

The third standard " The minimum distance between the location of the station and the limits of military facilities for 300 m, counted from the outer limits of the station" shown that there are 21 petrol station is committed to the third standard, while the 4 petrol station in violation of the third standard of 25 petrol station.

The fourth standard " The horizontal distance between the station boundaries and the electricity high pressure lines not less than 10 meters" shown that there are 24 petrol station is committed to the fourth standard, while the 1 petrol station in violation of the fourth standard of 25 petrol station standard. And finally the researcher found a direct correlation the relationship between population density and the number of stations in every neighborhood.

### RECOMMENDATIONS

1. Commitment when establishing new fuel stations to be proposed in areas that have been clarified in the search results.
2. Applying geographic analyzes of all petrol stations in the governorates of the Gaza Strip as one unit, in order for researchers, scholars and professionals to benefit from the analyzes.
3. Documenting GIS maps, plans and results of this research in the information base of the Ministry of National Economy and the Municipality of Khan Younis, so that they can return them in case of giving a license to set up a new petrol station.
4. Tightening of the legal proceedings and intimidating the owners of petrol stations to be in conformity with the standards laid down.
5. Continuing monitoring by the licensing department and the Ministry of National Economy up, and inform the violation stations need to correct their wrongdoing.
6. Creation of green areas surrounding the petrol stations.
7. Harmonization of work between the electricity company



**Figure 14.** Spaces that can be created by the petrol stations.

and the Ministry of the Interior and the Ministry of National Economy and the Municipality of Khan Younis, to promote and raise the commitment level of the petrol

stations owners.

8. Conducting seminars and workshops for the owners of petrol stations, to strengthen the spirit of cooperation with

researchers and scholars.

## CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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