Spatial analysis of communication towers in the solution Department and the use of electromagnetic geographic information systems in calculating the safety zone of waves emanating from communication towers in Babylon for the year 2024

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Conclusion

In this study ,the power density issued from the receiving and transmitting towers of the mobile phone was measured using the field power device (MRS60)manufactured by the German company Grmine,and in this research, field and statistical measurements were made using the gis10.4 program from the Interpolation toolbox and the Kring tool was selected to represent the results of measuring the electromagnetic power density issued by a number of communication towers belonging to companies (security ,Asia cell ,Etisalat ,ether, Cork) for the regions (Hilla Center, sponsorship, Vanguard) and working with the GSM system in different places and times in order to identify the transmission capacity of electromagnetic waves emanating from communication towers and its relationship to conditions The amount of variation of the broadcasting capacity of different towers under the same conditions and the extent to which the broadcasting capacity complies with internationally approved standards . It has emerged from the standard results from different towers that there is a noticeable difference in the broadcasting capacity issued from different towers under the same conditions, and that this difference increases in the distancenear the tower (30 meters to 100 meters) as well as in open areas and decreases in the distance away from the tower, especially at Measurements indicate that proximity to towers within a distance of less than 300 meters may result in exposure to radiation levels exceeding some international standards, requiring regulatory caution.and the best results are at a distance of 400 meters from the tower, which is the area of the Health Campus. The GIS program was used to determine the patterns of distribution of the 53 towers belonging to the mentioned companies, and the study found that the pattern of distribution of towers took the clustered pattern with a value of 0.63, and the most important findings of the study were that there is an inefficiency in the distribution of towers in the Hillah district, as the towers are very clustered, and the study recommended reconsidering the structure of spatial distribution of communication towers in Hillah district according to planning standards so that there is parity between the distribution of towers within the district, the area of the district and the population.

Key words:
Antenna, Harmless Radiation, Electrometric wave, Mobil phone Tower, GIS, standard deviational, standard decision

Introuction

After the occupation of 2003, Iraq was invaded by a wave of electronic conflicts represented by the use of mobile phone technology, despite its great importance in use, but it left a major imprint on the lives of citizens of all segments, and due to the high demand for it in use, especially after the absence of security in the country, which made the mobile phone a necessity of the life of the residents, especially those living near these towers [5] The technological revolution witnessed by the telecommunications sector and the aspiration of countries towards the development of this sector in various ways, considering that it is the basic environment that they must provide and overcome as many difficulties as possible to benefit from it, many problems related to the damage caused by towers and antennas have appeared and the matter has reached the courts to claim compensation for and take note of the legal basis for communication companies about possible damages for towers Antennas [2] Legal norms in the field of Environmental Protection are aimed at preserving and maintaining the environment by regulating the behavior of people, controlling their activities and their relationship with the environmental environment in which they live, and combating any encroachment on the environment or on the Environmental order and balance, as these rules prohibit actions that lead to imbalance or cause pollution of one of the parts of the biosphere or threaten the fungal life of living organisms with danger [2] The research deals with studying the efficiency of the spatial distribution of communication towers in the Hillah district using geographic information systems through the use of spatial distributions in the Arc GIS 10.4 program to analyze spatial data and applying the method of average geographical center, standard distance and Neighborhood Link Analysis . Modern means of communication have led to the development of the study of geography, liberation from the geographical space of the built-up space to the outside, increased rates of movement and migration from rural to urban, all of which helped to change the components of urban society and the occurrence of imbalance in the components of rural society, and communications also helped young people to leave work in cities and leave work in agricultural lands [15] Since years ago, the law confirms that a mobile device is safe and no more dangerous to human health, and they say that the standards and measurements of the waves used in mobile networks overlook radio and television transmission waves in terms of their power, and then the research confirms the danger of radio and television transmission tower waves to human health is out of the question in this field, and some still believe that the effect of mobile network waves is only thermal, i.e. raises the temperature of the tissue exposed to these waves, and they ignore, intentionally or unintentionally, that there are biological effects due to exposure to these waves, but the picture is now little by little, there is a large amount of scientific research published and funded by governments Industrial companies have consistently shown that mobile tower waves and the device itself have negative health effects [14] The amount of energy that reaches the human body is measured by what is known as the energy density and its units are mill watts / cm2 or volts / meters and the maximum allowed in both the United States of America and Britain is 0.1 mill watts / cm2, as for the amount of energy absorbed by the human body for radio waves was expressed by the rate

of specific absorption the World Health Organization has approved the maximum specific absorption rate of 0.08 W / kg [13]

The first search

The practical side

Field work:

1-dividing the study area into three areas of Babil governorate, namely the center of Hilla governorate, in terms of sponsorship and Vanguard, and conducting electromagnetic power density tests for several telecommunications companies in Iraq, including Ether, etisalat company, security company, Cork company and Asiacell company in order to identify the results of each of these companies separately and compare the results and the intensity of electromagnetic power with international and Iraqi units as shown in Table No. (2)

2-the telecommunication towers were detected in the field and a database was designed for some towers located in Babylon governorate within the study area
The 69 towers that have received environmental approval are distributed over the study area, where the number of towers in Hilla district reached (53) towers and the number of towers
In the sponsorship Area (4), the number of communication towers in the Vanguard area (12) towers and 12 towers were selected to measure the intensity of electromagnetic power
And the database of these towers based on the population density and includes several information, including the coordinates of each of these towers for the specified areas
By searching and projecting these coordinates on the map of Babylon governorate as in Figure No. (1) as well as projecting these points on the aerial image as in Figure No. (2)

3-dependence of electromagnetic power density measurements on the SMRZ 60 device and the unit of measurement Watt / square meter 4-in order to determine and evaluate the results of measurements of the intensity of the electromagnetic power of the waves emanating from the communication towers, the distances were relied on (30 m, 100 m, 200 m, 300 m, 400 M) to find out the values of the intensity of electromagnetic power at each of these distances and record these values for each of the towers within the tables (2,3,4) and discuss these results and determine the safety zone or the area of the health campus to be a scientific reference in the independent for the decision-maker when granting environmental approvals issued by the Ministry of environment in order to preserve the health of citizens from the effects of electromagnetic waves emanating from these towers and the Prevention of possible dangers from them.

Working within the GIS program:

1-Using the Interpolation tools (IDW, Kriging, and Trend Surface) in the ArcToolbox of ArcGIS 10.4"power density determined by distances (30m, 100m, 200m, 300m , 400m) for each of these towers for the companies mentioned in the research and analysis of their results as follows :

Tool Books →Interpolation→IW, Kiering, Trend

2-the Hillah District sector was selected to conduct spatial analysis of communication towers located in the district and used the Geographic Information Systems Program for the purpose of spatial and statistical analysis through the toolbox and according to the following steps

1-Nearest neighbor link analysis

Arc Toolbox →Spatial Statistic Tools→Analyzing Patterns→Average Nearest Neighbor

2 - Analysis of the average position:

Spatial Statistic Tools→Measuring Geographic Distributions →Central feature

3. Standard distance analysis:

Spatial Statistic Tools→ Measuring Geographic Distributions→Standard Decision

4-analysis of the trend pattern of spatial distribution:

Spatial Statistic Tools→ Measuring Geographic Distributions→Standard Deviational Ellipse

Table No. (1) Shows the database of types of communication towers in the study area

Environmental approval	**Y**	**X**	**distance(m)**	**the site**	**Tower type**
There is concet	32.441806	44.422528	30,100,200,300,400	Hilla center	Ather
There is concet	32.464139	44.416389	30,100,200,300,400	Hilla center	ourcounection
There is concet	32.446417	44.395611	30,100,200,300,400	Alsadrin square	zan and Asia cell
There is concet	32.453917	44.423778	30,100,200,300,400	Alamer area	Ather
There is concet	32.458639	44.401194	30,100,200,300,400	Alamer area	Awish
There is concet	32.392694	44.654528	30,100,200,300,400	Altaliea	cork
There is concet	32.395222	44.677167	30,100,200,300,400	Altaliea	Asia cell
There is concet	32.397472	44.673917	30,100,200,300,400	Altaliea	cork
There is concet	32.392694	44.654528	30,100,200,300,400	Altaliea	Asia cell
There is concet	32.231833	44.380722	30,100,200,300,400	kafl albbas area	cork
There is concet	32.222194	44.365111	30,100,200,300,400	kafl albbas area	Asia cell
There is concet	32.232944	44.381139	30,100,200,300,400	kafl albbas area	Ather

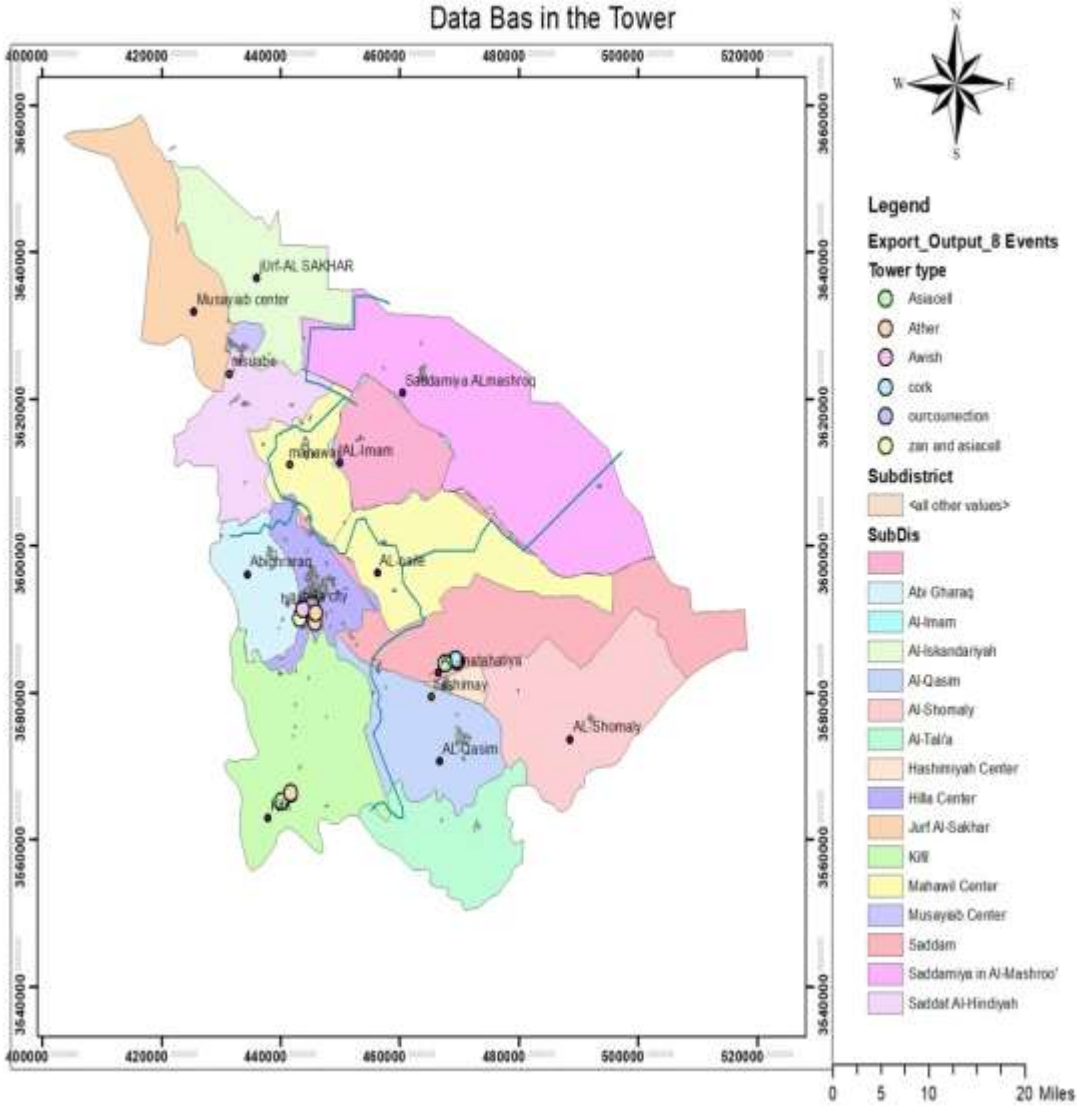

Figure (1) map of the province of Babylon Muscat with the study area communication towers (source researcher)

Figure (2) an aerial photograph of the projected telecommunication towers of the study area (source researcher)

The second topic

Previous studies

1- Issa et al. (2016) in his study dealt with the prediction of the coverage of telecommunication network towers using geographic information systems, where this study aimed to find out the quality of network coverage in the study area and to know the areas with poor coverage to be addressed by redistributing towers or increasing the number of antennas or the construction of new towers in the area to address the weakness and and divide the signal strength levels into several Scopes for all towers in the study area to distinguish the areas where coverage is placed in order to be processed to provide excellent services to citizens

2-while ANI and Assai (2018) discussed the efficiency of the distribution of telecommunication network services (Zain Iraq) in the wetland district using geographic information systems, where the study aimed to study the spatial distribution of telecommunication network towers and the extent of their efficiency for the population based on Geographic Information Systems Technology, the study also relied in its methodology on the analytical approach to find out the nature of the spatial distribution of irregular spacing of human settlements.

3-Mohammed Adel Mahmoud (2024) dealt with the damage of mobile phone communication towers and ways to address them under the provisions of the Civil Law, where research shows that mobile phone towers may cause damage to people living near them due to the radiation emanating from them, as it is scientifically proven that an increase in radiation emanating from these towers can cause health diseases affecting people living in the most recent was the Law No. 1 of 2010 on the Prevention of non-ionizing radiation.

4-the student Ayat Ali Khudair Abbis (2023) explained in her study the impact of cell towers on general human health and the damage they may cause to the functions of the brain and nervous system, especially when mobile phone towers began to spread among residential neighborhoods and above buildings in such a way that residents became concerned about the health risks that may be involved in those towers near residential complexes in general and human health in particular through the electromagnetic radiation emitted by those towers .

5-the researcher touched a.Dr. tanzeeh Majid Hamid (2024) and M.The need of the community to organize land uses within the urban space and this need is driven by the increase in the number of residents and their ambition to obtain a high level of quality of life, which requires proper and sustainable urban space planning through the signing of service projects to be available with high quality to all residents.

6-Hassan Shoukry Ibrahim (2015) dealt with a spatial analysis of the levels of non-ionizing radiation pollution emitted by mobile phone towers in Basra, the Journal of the Faculty of arts of Basra, the levels of non-ionizing radiation emitted by mobile phone stations and towers in Basra, pointing out that the study used a set of techniques such as EMF-180 electromagnetic wave detector and GIS Geographic Information Systems, as well as adopting a spatial analysis approach in interpreting the data.

7 - Sanaa Saeed Al Labaid (2024) explained the evaluation of the efficiency of the geographical distribution of telecommunication network towers in the municipality of the north in Riyadh (the case study of the Jasmine neighborhood), where the study aimed to find out the efficiency of the distribution of telecommunications towers in the Jasmine neighborhood located in the north of Riyadh using GIS to determine the distribution patterns of the 63 towers of the Saudi

telecommunications company, Mobily and Zain in the neighborhood

The third topic

Results and discussion

1-discussion of the results of measuring the electromagnetic power density of the communication towers of the study area

It is possible to evaluate the effects resulting from exposure to electromagnetic waves as thermal effects and non-thermal effects [1,5] as the exposure of the human body or part of it to these waves may cause the emission of heat inside the body due to the absorption of electromagnetic energy by the body . The thermal effect is an effect that can be monitored and its causes understood, and methods have been developed to prevent its occurrence. But the non-thermal effect is still being researched and studied , There are many researches and articles that do not see sufficient evidence to confirm the validity of the claim that weak electromagnetic fields cause harm to humans [1,3,6] and a report was recently issued by the group of independent experts in mobile phones [3] this report indicated that the available information indicates that exposure to electromagnetic waves below the upper limit set in the approved standards does not cause harm to the general public he pointed out that there is evidence of the existence of biological effects of exposure to these weak waves, he also pointed out that this does not necessarily mean that These effects lead to damage or diseases, and it requires further research and investigation

Figure (3) shows a comparison between the results of measuring the electromagnetic power density of two ether and security communication towers in the center of Babylon governorate, where the highest value (0.06) w / M^2 for the ether tower was recorded at a distance of 30 M and the highest value for the security communication tower (0.36) w / M^2 at a distance of 30 M and the average value (0.000047) w / M^2 at a distance of 100 meters for the ether Tower, as well as the average value of the electromagnetic power density (0.00028) W\M^2 at a distance of 100 meters the minimum power density for the ether tower was (0.000011) W\M^2 at a distance of 400 meters, which is the area of the health campus, and for the security Tower the minimum was (0.000075) W\M^2 at a distance of 400 meters and when comparing these results with the determinants The international power density of non-ionizing radiation we find that it is within the internationally permissible limits as well as the Iraqi standard (0.4) w\m^2

In Figure No. (6), which shows the comparison between the results of measuring the power density of the Asia cell and Cork telecom towers in Al-Kafl Al-Abbas neighborhood, the highest value of (0.21) w / m^2 for Asia cell tower and a distance of 30 meters, the highest value of (0.38) for Cork tower at a distance of 30 meters and the average value of (0.00016) w / M^2 for Asiacell tower at a distance of 100 meters and also the average value of (0.0031) for Cork tower at a distance of 100 meters and the limit the minimum electromagnetic power density

(0.000041) for Asiacell tower at a distance of 400 meters, which is the health campus or safety zone, as well as the minimum power density (0.00007) W / M^2 at a distance of 400 meters for Cork tower and when comparing the results with the density determinants of International capacity as in Figure No. (1) We find that the results fall within these parameters as well as within the Iraqi standard (0.4) w\m^2

Figure (8) shows the relationship between the measurement results of the Cork tower and the Asia cell Tower, where the highest limit of the results was the measurement of the electromagnetic power density of these two towers in terms of nature (0.39) for the Cork tower at a distance of 30 meters and 0.34 for the Asiacell tower at a distance of 30 meters and the average power density (0.0031) for the Cork tower at a distance of 100 meters as well as the average power density (0.00027) for the Asiacell tower at a distance of 100 meters and the minimum for the value of the electromagnetic density (0.0007) watts per square meter for the Cork tower at a distance of 400 meters, as well as the minimum power density (0.00006) at a distance of 400 meters and when comparing these results with global and international determinants as in the table No. 1 we find that all the results fall within the international parameters as well as within the Iraqi standard for electromagnetic radiation, which is given a value of 0.4 W / m2.

As for figure no. (4,5), which shows the relationship between the results of measuring the power density of our communication company and the ether in the center of Babylon governorate, the highest limit of the density of figure No. 4 (0.015)W / m2 was reached at a distance of 30 meters and in Figure No. 5 the highest limit was reached at a distance of 30 meters (0.21)Watts on a square meter of the tower and the minimum as in Figure No. 4 (0.000003) Watts on a square meter at a distance of 400 meters as well as the minimum as in Figure 5 reached (0.000001) at a distance of 400 meters and when comparing these results with the International and global determinants, we find that all the results fall within the International and international specifications as well as the Iraqi standard, which gives the value of capacity density (0.4) watts per square meter .

When observing figures (7) sponsorship and Figure (9) Vanguard, we find that the upper limit of the power density, as in Figure (7) in the sponsorship area, reached (0.54) at a distance of 30 meters for the ether Tower, the upper limit for the Asia cell tower reached (0.21) watts per square meter at a distance of 30 meters, the minimum (0.00011) for the ether tower at a distance of 400 meters, as well as the minimum for the Asia cell tower at a distance of 400 meters (0.000041 figure No. (9)on the vanguard side, the maximum power density value reached (0.036), which is affiliated to Cork company at a distance of 30 meters, and the maximum limit for Asia cell tower reached (0.0014), while the minimum limit for Cork tower reached (0.000007) at a distance of 400 meters, and the minimum limit for Cork tower reached (0.000007) at a distance of 400 meters, and the minimum When comparing these results with the global and international determinants in Table No. 2, we find that all the results fall within the International and international specifications, except for the ether Tower, which reached the maximum value of the capacity density value (0.54) , which is considered outside the International and international standard, as well as the Iraqi standard

Table (2) some international power density limits for non-ionizing radiation

Power density W\M2	International exposure limits approved by some countries
0.5	New Zealand
0.24	Exposure limit in CSSR Belgium, Luxembourg
0.1	Exposure limit Poland, China, Italy, Paris
0.095	Exposure limit in Italy
0.095	Exposure limit in Switzerland
0.09	Ecology 1998 Germany Ecology 1998
0.02	The limit of exposure in Russia since 1970, Bulgaria, Hungary

Table No. (3) Measuring the intensity of the electromagnetic power of some communication towers of the Hillah Center

Y	X	Distance(m)	measurement result(w/m2)	the site	Tower type
32.441806	44.422528	30	0.21	Hilla center	Ather
		100	0.00016		
		200	0.000083		
		300	0.000055		
		400	0.0000012		
32.464139	44.416389	30	0.015	Hilla center	ourcounection
		100	0.000011		
		200	0.0000059		
		300	0.0000039		
		400	0.0000029		
32.446417	44.395611	30	0.074	Alsadrin square	zan and Asia cell
		100	0.000058		
		200	0.000029		
		300	0.000019		
		400	0.000014		
32.453917	44.423778	30	0.06	Alamer area	Ather
		100	0.000047		
		200	0.000023		
		300	0.000015		
		400	0.000011		
32.458639	44.401194	30	0.36	Alamer area	Awash
		100	0.00028		
		200	0.00014		
		300	0.000095		
		400	0.000075		

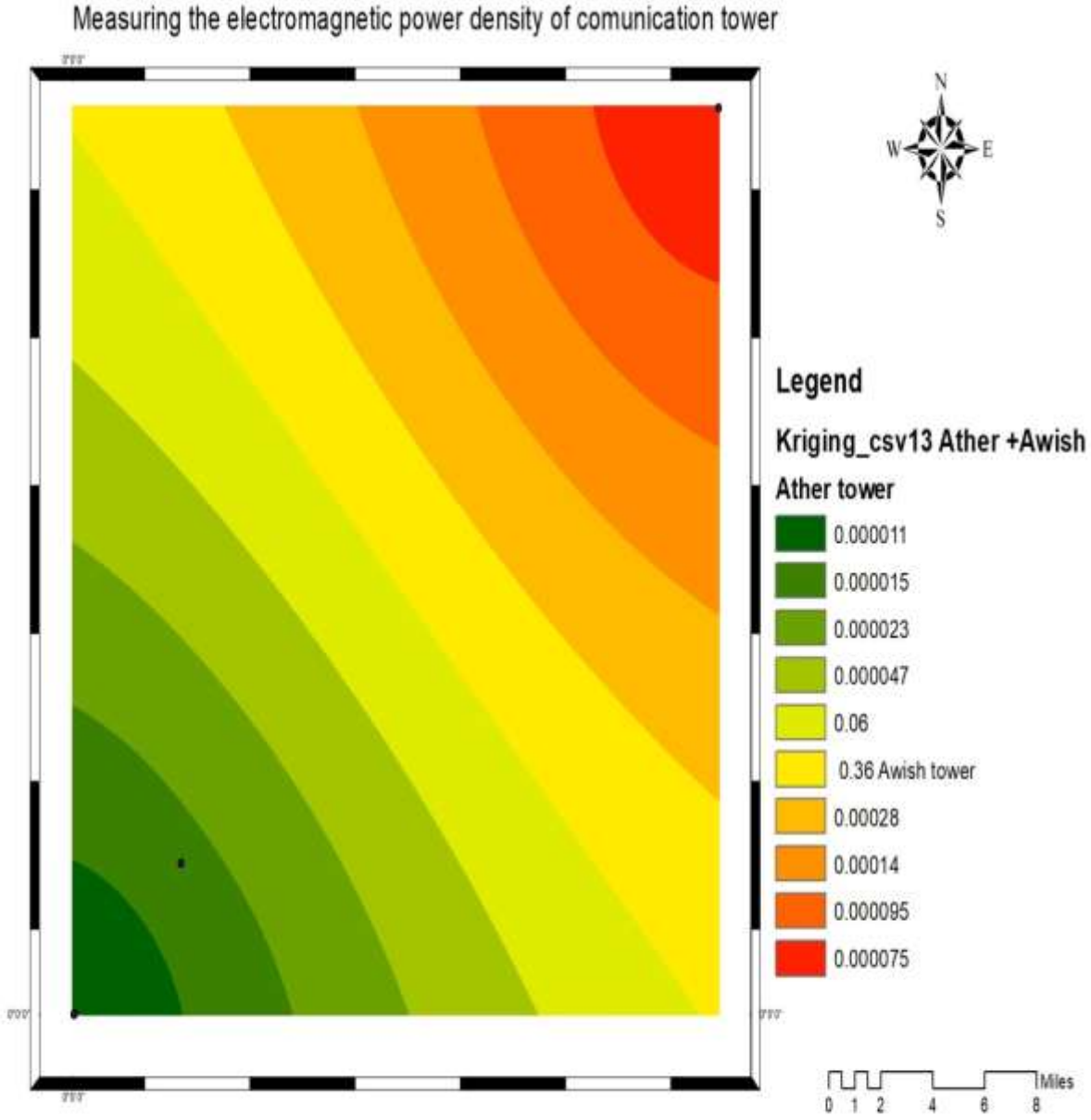
Measuring the electromagnetic power density of comunication tower
N
W
E
S
Legend
Kriging_csv13 Ather +Awish
Ather tower
0.000011
0.000015
0.000023
0.000047
0.06
0.36 Awish tower
0.00028
0.00014
0.000095
0.000075
Miles
0 1 2 4 6 8

Figure (3) shows the results of measuring the power density of the ether and security communication towers (source: researcher)

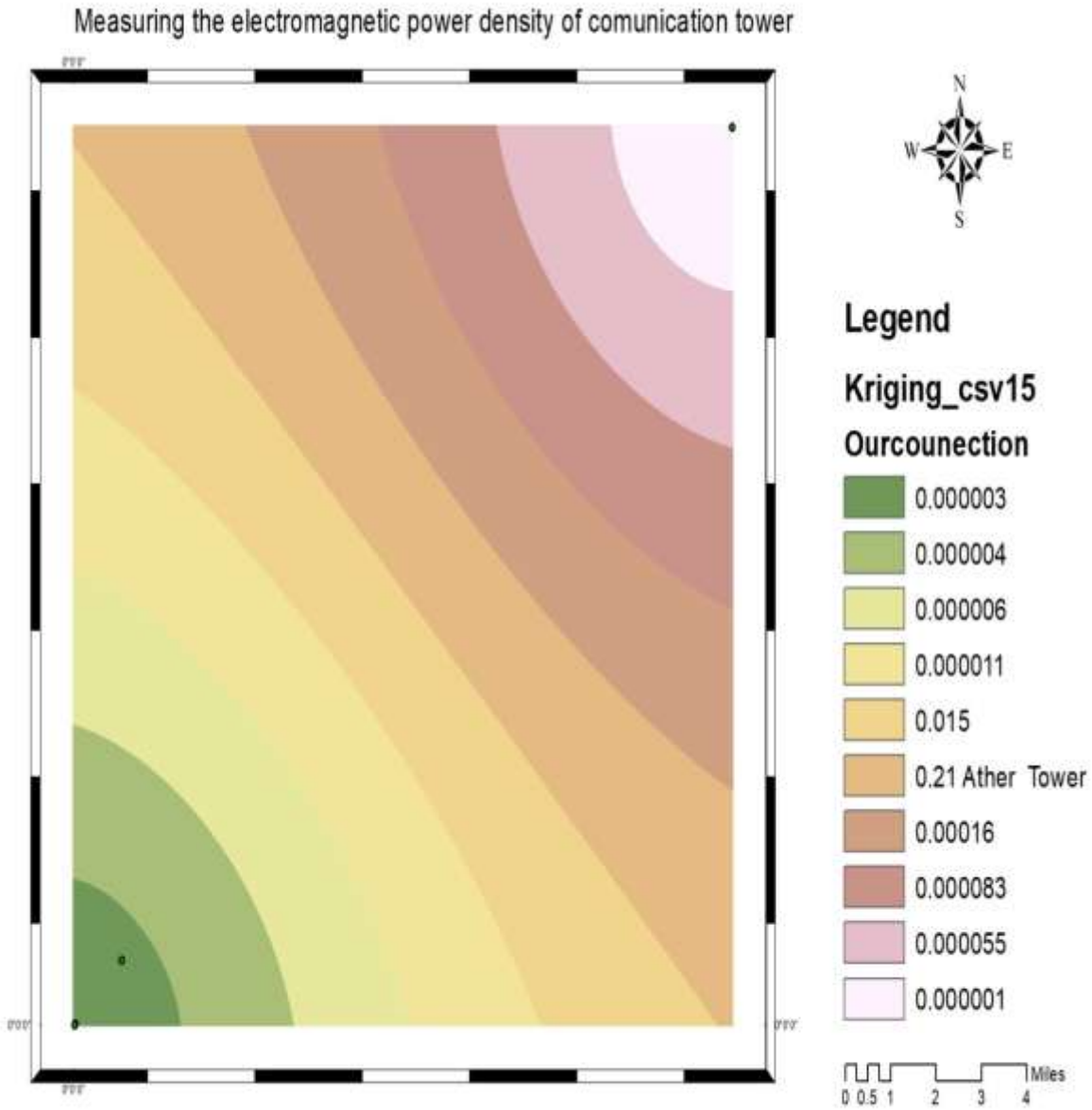

Figure (4) shows the measurement of the power density of the two communication towers of our connection and the ether center of the Hillah (source researcher)

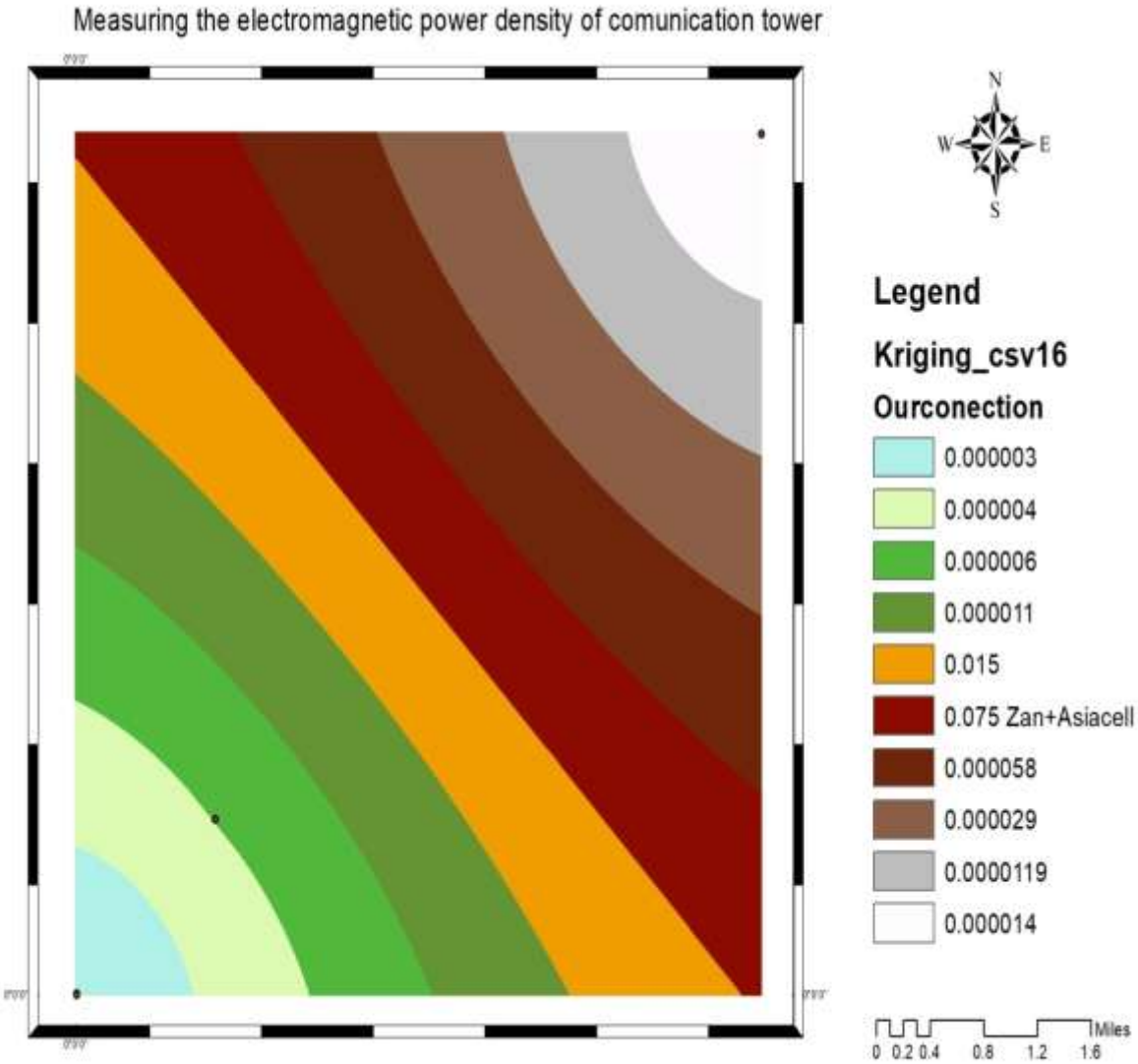

Figure (5) shows the measurement of the density of the electromagnetic potential of our contact and the acyclic center of the drum (source researcher)

Table No. (4) Measuring the intensity of the electromagnetic capacity of some communication towers in the sponsorship area

Y	X	Distance(m)	measurement result(w/m2)	the site	Tower type
32.231833	44.380722	30	0.38	kafl Al lbas area	cork
		100	0.00031		
		200	0.00015		
		300	0.00011		
		400	0.00007		
32.222194	44.365111	30	0.21	kafl Al lbas area	Asia cell
		100	0.00016		
		200	0.000083		
		300	0.000055		
		400	0.000041		
32.232944	44.381139	30	0.54	kafl Al lbas area	Ather
		100	0.00042		
		200	0.00021		
		300	0.00013		
		400	0.00011		

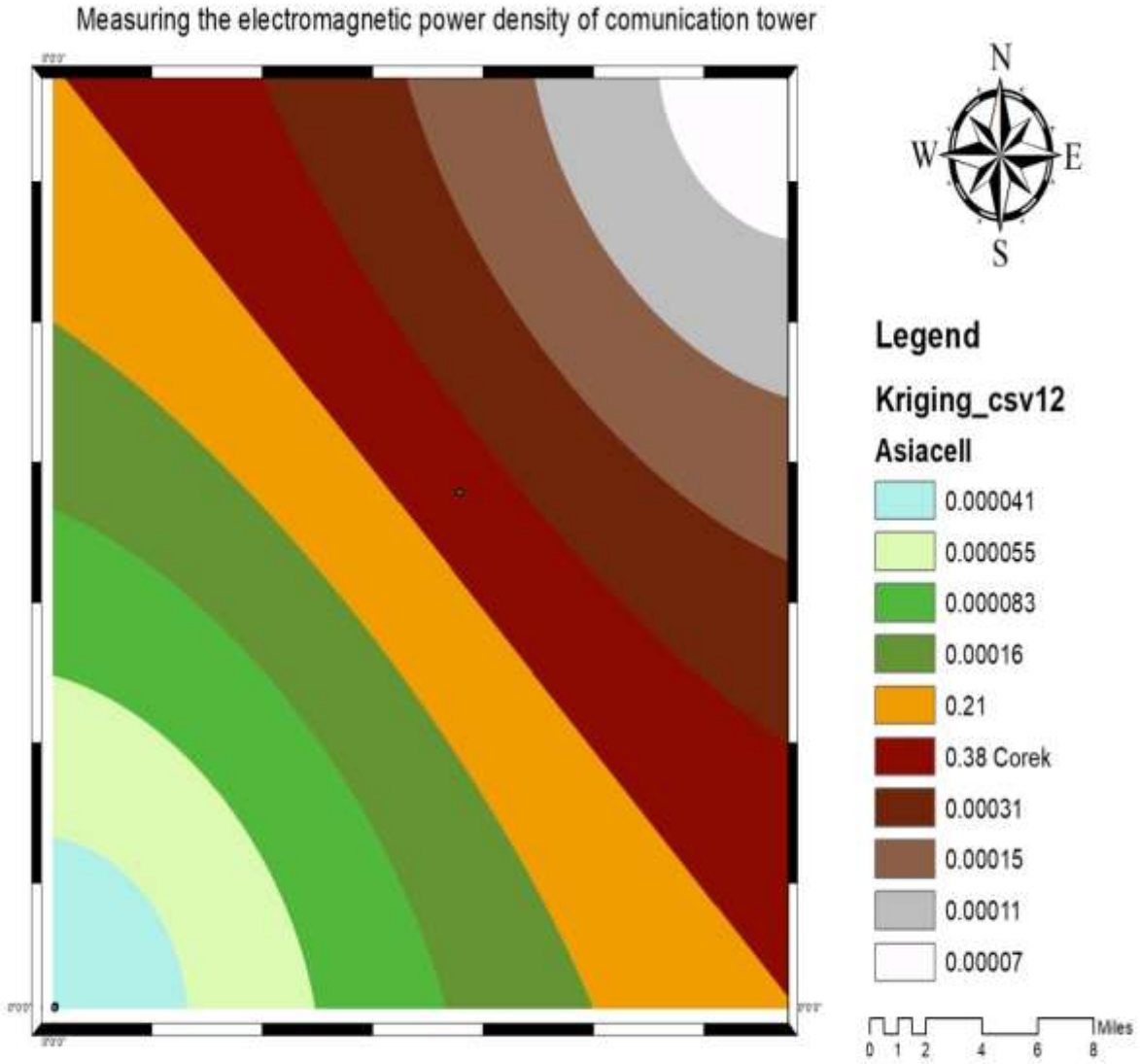

Figure (6) shows the measurement of the power density of the Asia cell and Cork telecom towers in the sponsorship area (source researcher)

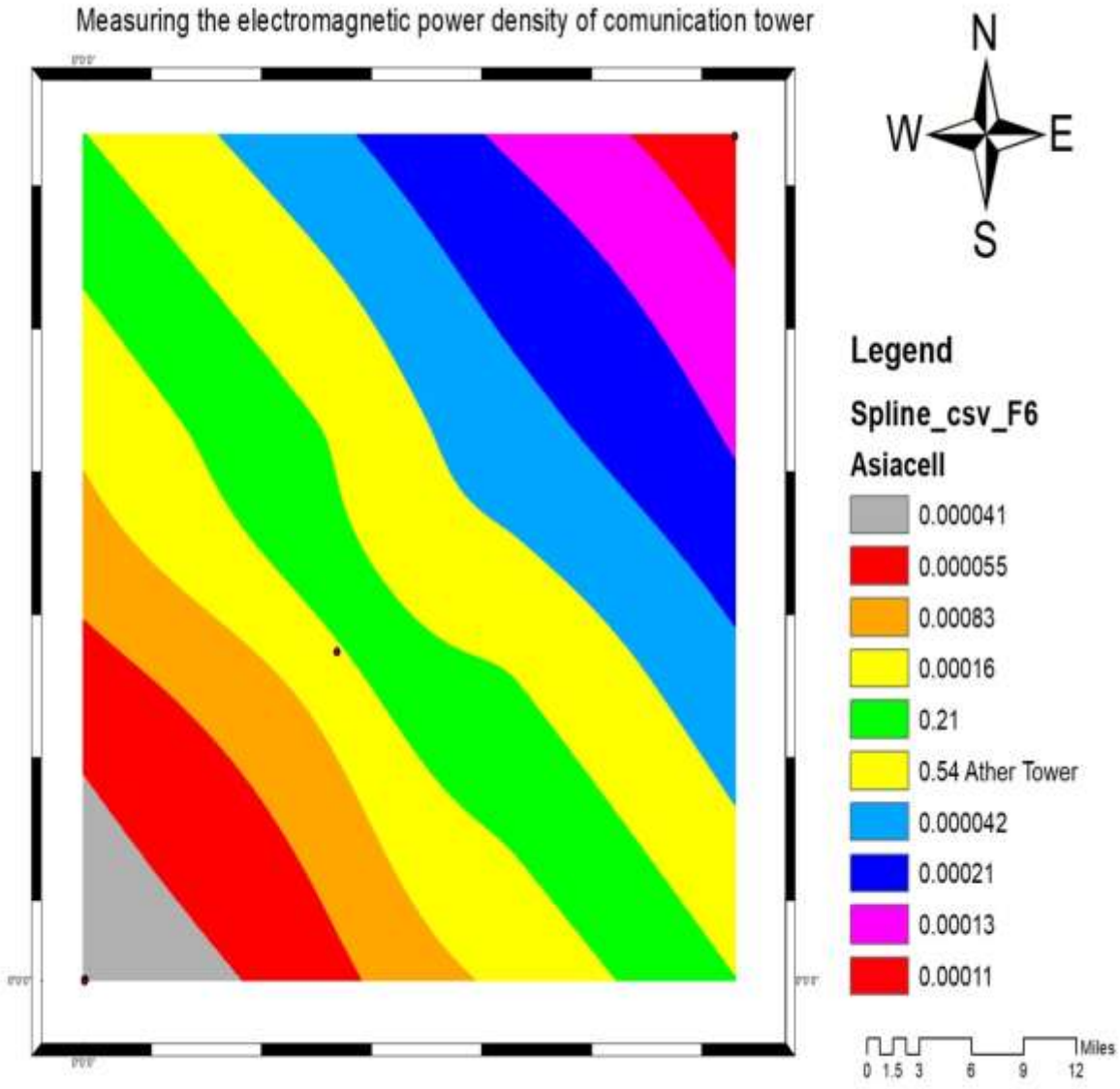

Figure (7) shows the measurement of the power density of the ether and Asia cell communication towers in the sponsorship area (source researcher)

Table No. (5) Measuring the intensity of the electromagnetic power of some communication towers in the Vanguard area

Y	X	Distance(m)	measurement result(w/m2)	the site	Tower type
32.39269	44.65453	30	0.39	Altaliea	cork
		100	0.00031		
		200	0.00015		
		300	0.00011		
		400	0.00007		
32.39522	44.67717	30	0.34	Altaliea	Asiacell
		100	0.00027		
		200	0.00013		
		300	0.00009		
		400	0.00006		
		30	0.036	Altaliea	cork
32.39747	44.67392	100	0.000011		
		200	0.000005		
		300	0.000009		
		400	0.000007		
32.39269	44.65453	30	0.0014	Altaliea	Asiacell
		100	0.000011		
		200	0.0000055		
		300	0.0000037		
		400	0.0000027		

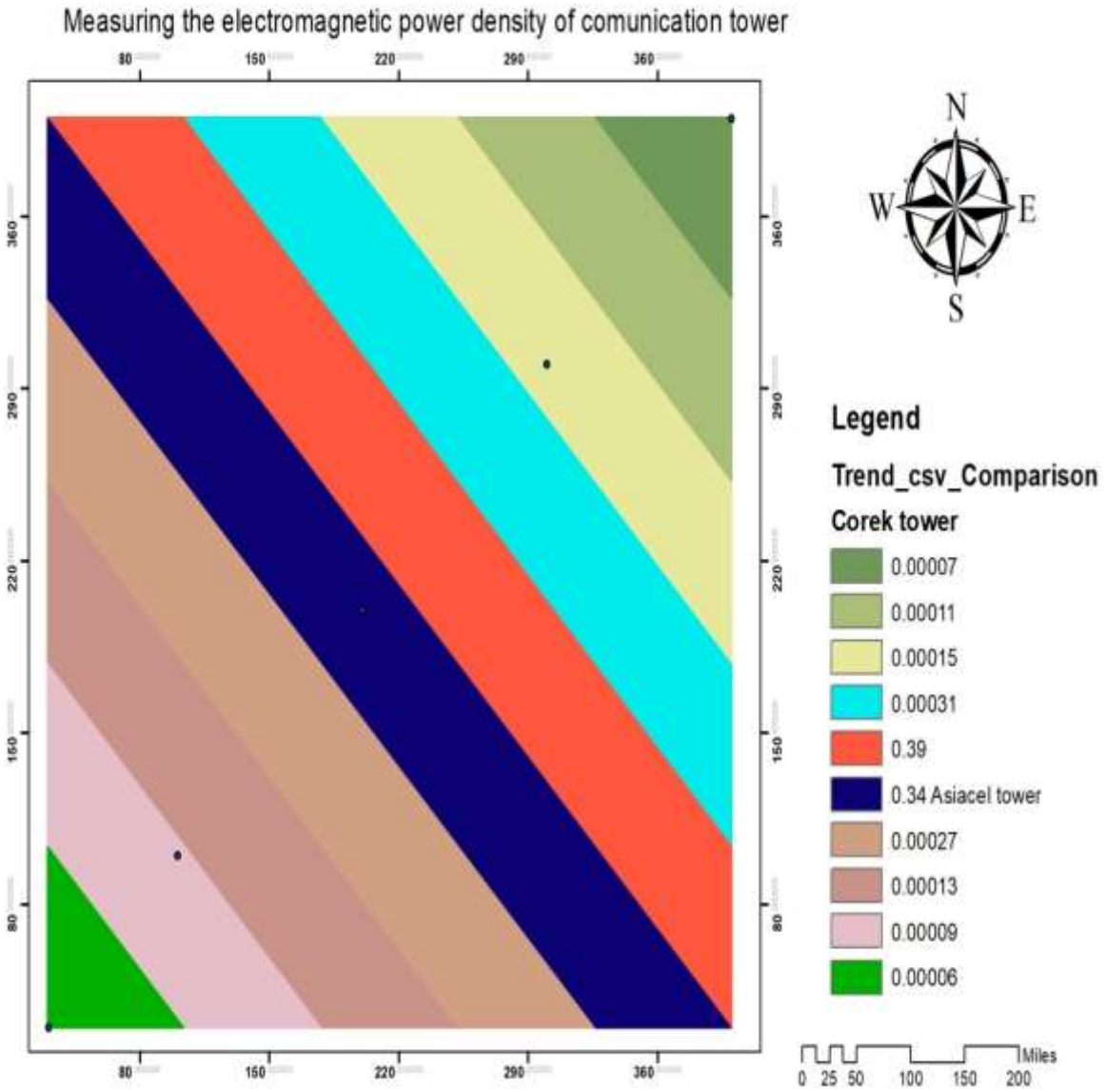

Figure (8) shows the measurement of the intensity of the electromagnetic potential of the Asia cell and Cork telecom towers towards the forefront (source researcher)

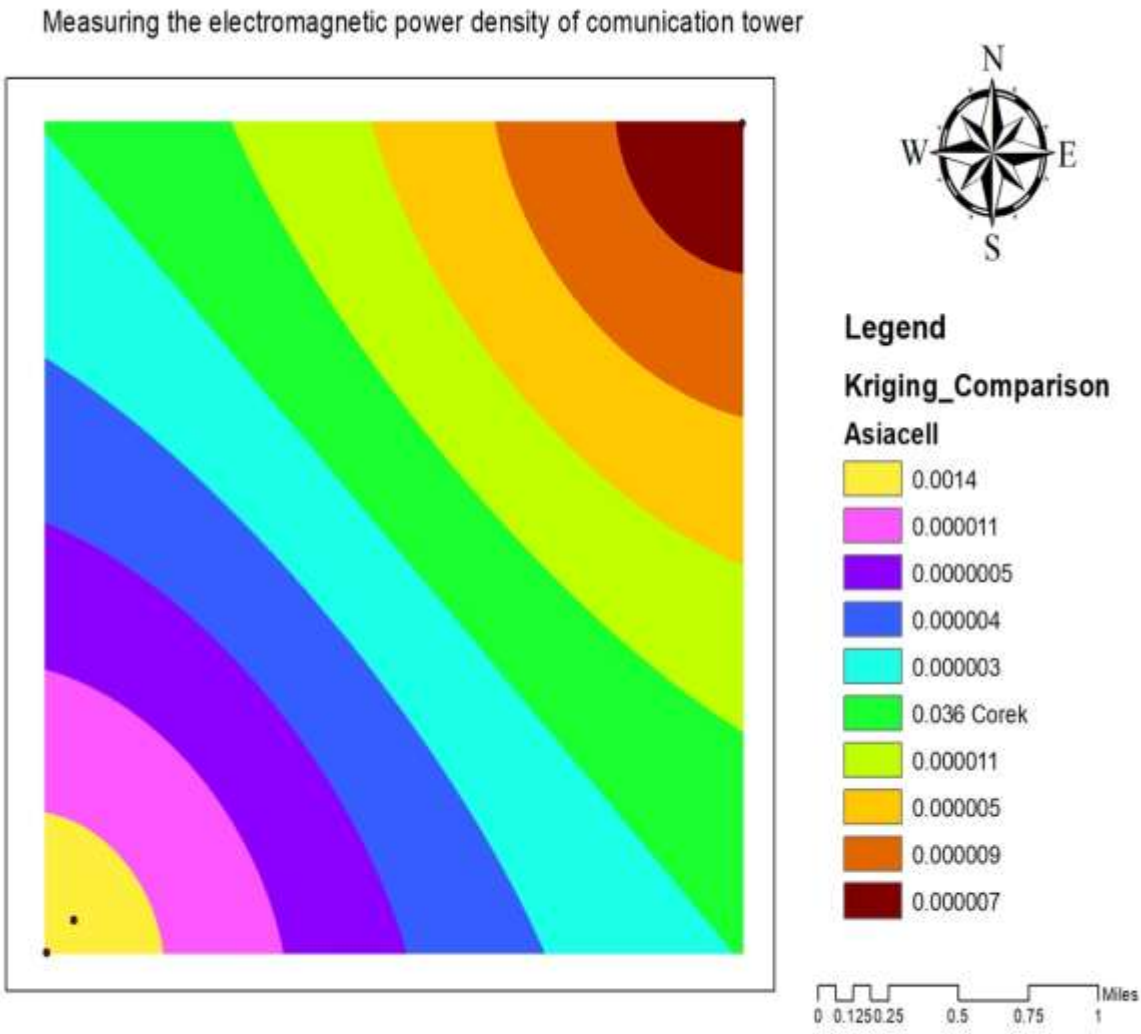

Figure (9) shows the measurement of the intensity of the electromagnetic potential of the Cork and Asia cell communication towers towards the Vanguard (source researcher)

2-discussing the product of the spatial analysis of the communication towers of the Hillah district

Modern geographical studies focus on spatial and statistical analysis using GIS tools for services and the problem of variation in their distribution and ease of access, as it has become the focus of attention of geographers in order to achieve a fair and equal distribution of a service location, and geographic information systems technology is used in that field, the most important of which is the analysis of distribution patterns methods The following

1-Analysis of the Central future medium Center

This tool works to determine the average locations of geographical phenomena and the average center, we mean in spatial distributions that it is he who determines the landmark or geographical phenomenon that mediates all the points of the study area, and in this study, the center that mediates all the Centers of communication towers for Babylon governorate, Hillah district, was analyzed and Figure (10) shows the point of actual or realistic raster distributions.

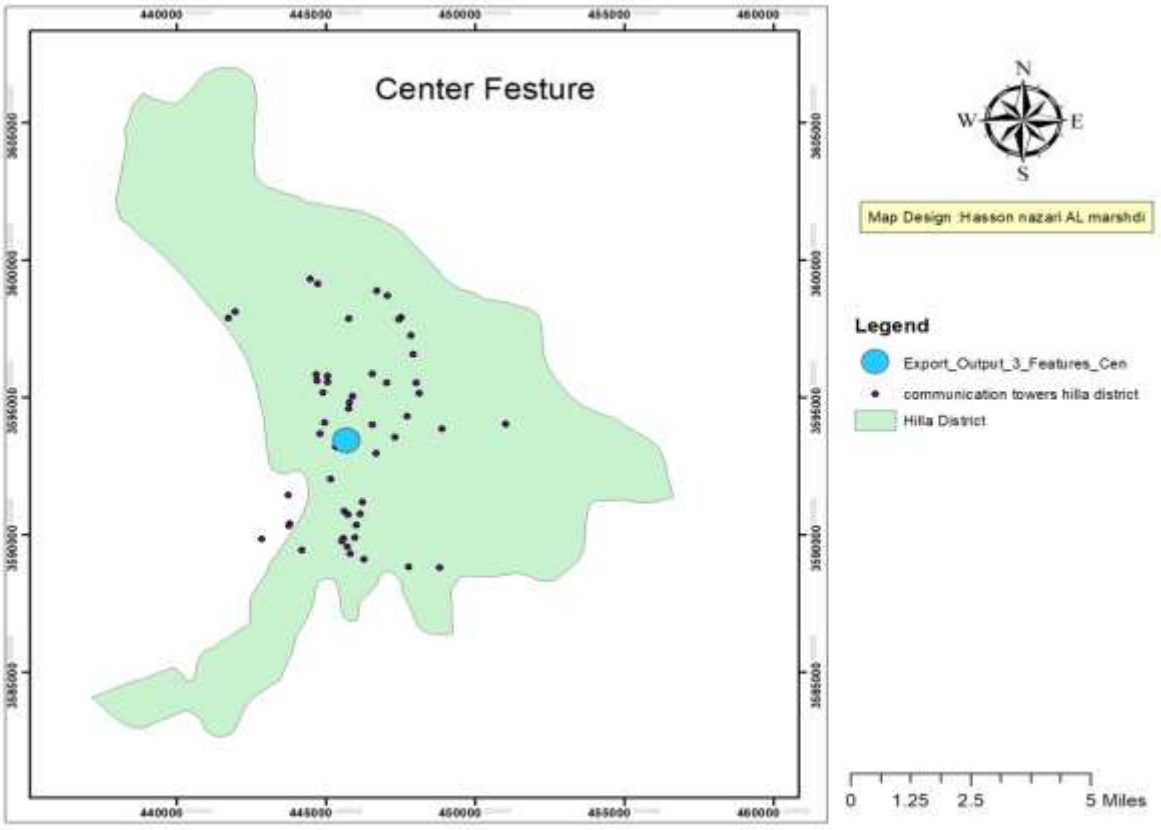

Figure (10) the figure shows the analysis of the average center of the Hillah district communication towers (source researcher)

2- Standard Distance

It is represented by a circle whose center is the location of the average center of distribution, two thirds of the location is located within the circle and one third outside its perimeter and the standard distance of any spatial distribution is equal to the square root of the square of the deviations of the coordinates of points or locations from the spatial average of this distribution and the smaller the circle drawn indicates the concentration of the spatial distribution of the phenomenon, but if it is large, the spatial distribution is dispersed, i.e. in other words, the distance of the circle is directly proportional to the degree of spread of the spatial distribution and that 56% of the points are located inside the circle and The location of any point close to the center with a probability of 97% is noted from the results of the program analysis, as in the figure represented by drawing a circle representing the standard distance, within which 56% of the points are communication towers around the average geographical center with 30 centers. It is evident from the reading of the standard distance that the communication towers in the Hillah district are more spread around the center of their rate , and it is clear through spatial analysis that the optimal distance Communication towers are those that are located inside the circle and those that are located outside it are considered to be a dispersed distribution away from the centralization of spatial distribution

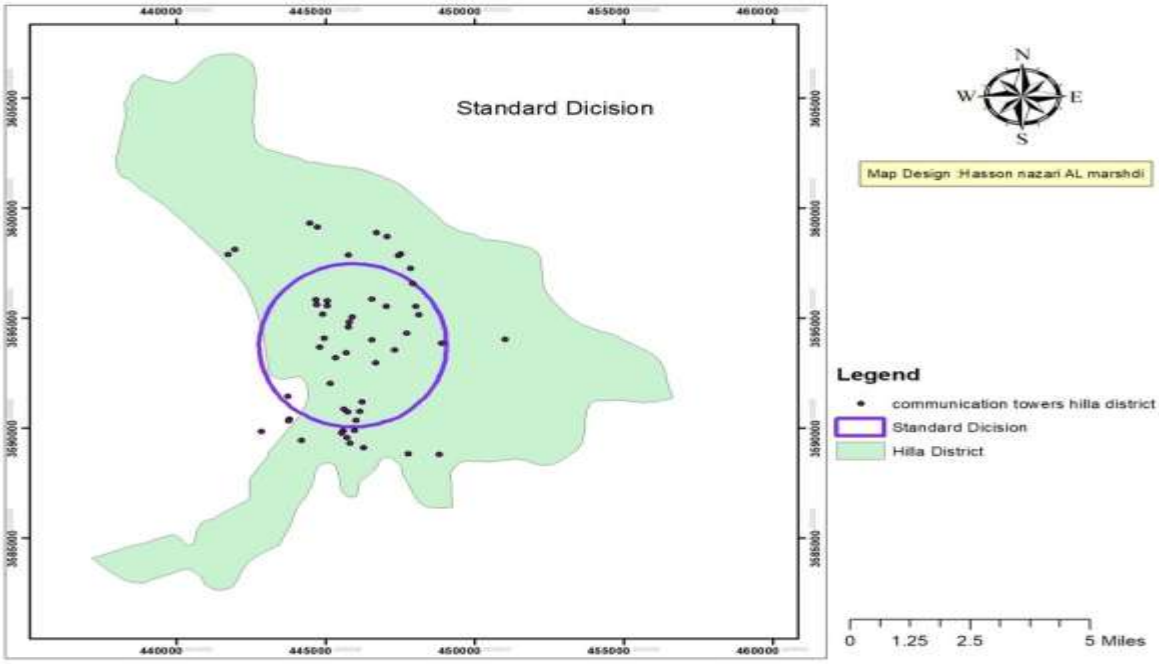

Figure (11) the standard distance of the spatial distribution of communication towers in Hillah (source researcher)

3-Standard Deviational Ellipse

From this spatial analysis, it is inferred that the choice of the distribution of raster geographical phenomena has a certain pattern in the distribution, which is one of the measures of the directional centrality of a group of geographical features; the Ellipse arises as a new landmark and is calculated from the average center (Sharif Al-Shafi'i 2009, p. 385)

Figure (12) shows that the area is the most attractive in its spatial relations due to the proximity of the locations of communication towers with medium distances, while the rest of the towers that are located outside the oval shape are far from the central distribution, and their function is not achieved ideally, which requires redistribution in a way that ensures a balanced spatial distribution that takes into account the population density and the area of the area, and that 62% of the points are noted from the results of the program analysis, as in Figure (12), represented by drawing an oval shape represents the direction of spatial distribution, and 0.62% of the points of communication towers about the direction of spatial distribution the average geographical center has 33 centers, and the optimal distance is the one located inside the oval shape

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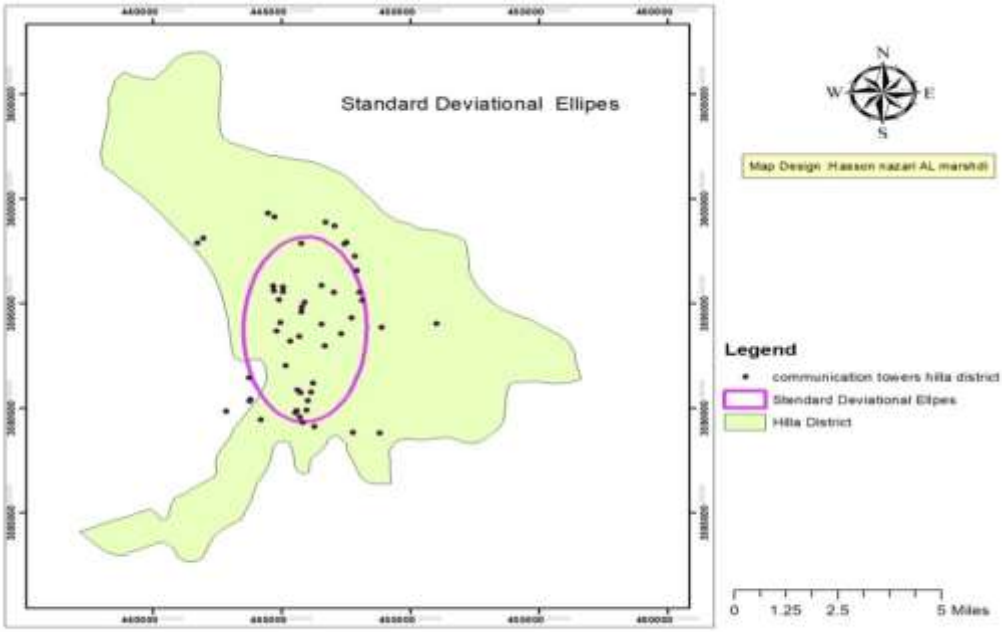

Figure of the Hillah District (source researcher) (12) analysis of the spatial distribution of the spatial distribution of the communication towers

4-Nearest Neighbor Analysis

The Neighborhood Link technology helps to recognize the spatial pattern taken by the studied geographical phenomenon and contributes to the disclosure of the spatial image The study used the Arc GIS 10.4 program to arrive at the spatial pattern taken by the communication towers using the nearest neighbor analysis, the result of which was as shown in Figure (6), and from it it is concluded that the spatial pattern of communication towers across the geographical space of the suit is a very close pattern " (clustered), where the result of the nearest neighbor reached 0.75% , and this analysis indicates that there is a lower probability of the 1% that this pattern is due to the coincidence factor. Therefore, we conclude from the R value of the neighborhood relevance coefficient for communication towers in Hilla district that the distribution pattern is very clustered, that is, the number of towers is insufficient in the study area and there are areas that are not served, and it is important to point out that what determines whether the distribution is clustered or irregular is the confidence level of the Z value below an indicative level of not less than 95%, the distribution of points for communication towers takes a non-random pattern, and the pattern is clustered with a confidence level(0.01%), the probability that it is random with a confidence level(0.5%), and the pattern the value of Z is related to the amount of a standard deviation from the average, and through Figure (6) the results of the program analysis are shown, which shows an output of the distribution patterns The results also contain the Z value that accompanies the confidence levels, and the results showed that the pattern of spatial distribution of the locations of communication towers in the Hillah district is clustered and falls within the confidence level (0.01) and the Z value is greater than(2.58 -) and the value of the calculation of the pattern of distribution of towers conducted by the program by dividing the average distance calculated by the level of the expected distance is 0.63 and show the value of Z (-3.37)

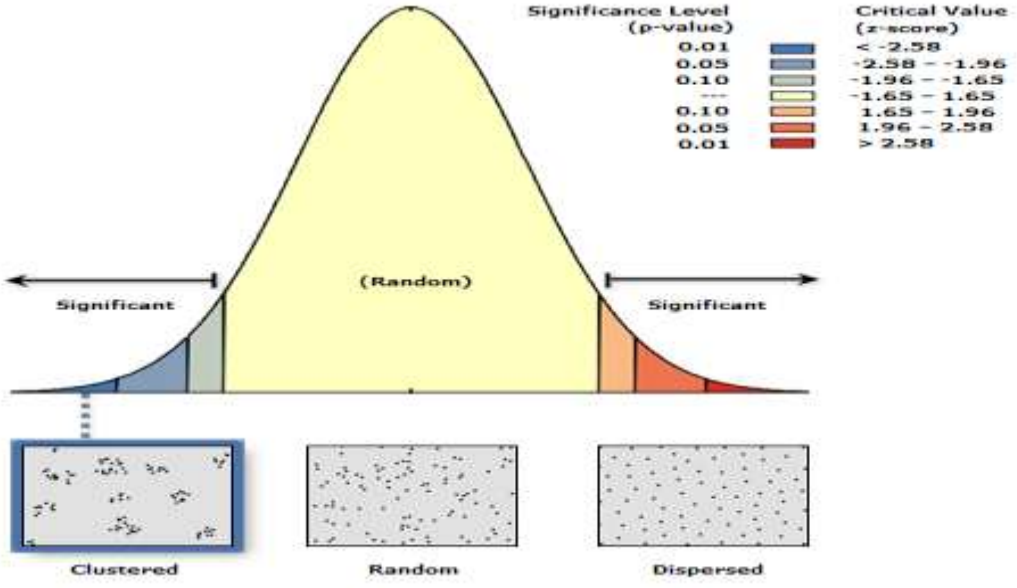

Figure (13) analysis of the nearest neighbor of the spatial distribution of communication towers in Hillah District (source researcher)

The fourth topic

Conclusions

1-the results indicate that the density of the measured capacity decreases with moving away from the tower and is very low at a distance of 300 m and absent at a distance of 400 M, which is the area of the health campus, so the study confirms and shows all the authorities responsible for granting environmental approvals in the Ministry of environment to take into account the findings of the study and the distance between the tower and residential areas (300-400 m)

Among the conditions of environmental approvals granted to company owners in order to protect citizens and prevent possible dangers from non-ionizing radiation emanating from telecommunications towers in Babylon governorate and all governorates of Iraq

2-all measured values did not exceed the internationally permissible limits recommended by some international organizations and the International Committee for the Prevention of non-ionizing radiation, except for the ether Tower, Al-Kafl area, where the maximum power density reached (0.54) W/m2, which is higher than the limit allowed in Iraq and within the limits allowed in New Zealand, as in grandfather No. 1, where the highest value of power density is 0.5 W /M 2

3-the study shows through the analysis of the Neighborhood Link, which is one of the spatial analysis tools in the Geographic Information Systems Program for telecommunications towers in the Hillah district, that the distribution of telecommunications towers in the judiciary is very clustered, as shown in Figure (13), and this requires reconsideration by the responsible authorities, especially the planning department at the Ministry of Environment and the environmental impact Department, which grants environmental approvals to companies in order to distribute the towers fairly distribution taking into account all areas in the judiciary

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Recommendations

1- the need to take advantage of the application of geographic information systems as an integrated system that contributes to the development of evaluation studies of services and move away from spontaneity in choosing the location of towers and follow the planning principles and standards to reduce the cost and completion time and ensure the quality of coverage

2- the environmental survey system provided for in Ministerial Decree No. 25 of 2015 must be activated to monitor the work of the towers after their installation by measuring the strength of the electromagnetic rays emitted by them 3 the need to measure the level of emission of non-ionizing radiation emanating from communication towers inside residential and service buildings in Babylon governorate

4- The establishment of an organization or an independent local authority concerned with non-ionizing radiation emanating from telecommunications towers contributes to the development of laws, regulations and legislation that preserve the safety of citizens and preserve the rights of competent authorities and companies operating in this field

5- Oblige companies working in the field of telecommunications to issue periodic certificates indicating the level of emission of non-ionizing radiation and provide guidance on how to assess and monitor human exposure to radio frequencies and electromagnetic waves.

6- It is necessary to prevent children from using a mobile phone because of the dangers to the child's brain and eyes, because it is one of the most responsive areas to the radiation issued either from the tower or from the mobile phone due to the lack of blood

7- The need to install towers away from residential areas so that the distance between the tower and the house is not less than 300 to 400 meters 8. With the permission to establish new mobile networks within the population communities or near public service places such as schools and universities, even if it is better to transport them outside the cities.

The fifth topic

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