

Detect irregularities of master plan by comparison with land use, using GIS and remote sensing techniques for Falujah city

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Abstract

Most of Iraqi Cities suffering from delaying of the update of Master plan, especially in the period between 1980 and 2003 the main reasons this delay are the Gulf War and the Economic Blockade. Increasing of population is the major factor causes changing in urban land use due to the human demand. These changes cause differences between master plan and real situation. To mention the spatial irregularities in Falujah City, the comparison between the master plan layers and updating land use map layers has achieved in this paper to determine the spatial change and irregularities in the city, that represent the reality of situation in case study . The changes were remarked; the areas of changes were calculated in table and thematic map were produced in our paper to illustrate the goal. This data processed using combination of GIS technique, and global positioning system GPS and geo media software.

Key Words: GIS, Master Plan, Land Use, Fallujah City

كشف المخالفات للمخطط الاساس بمقارنته مع استعمالات الارض باستخدام تقنيات التحسس النائي و نظم المعلومات الجغرافية
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الخلاصة

عانت المدن العراقية تأخيرا في تحديث مخططاتها والتصاميم الاساسية خصوصا للفترة بين ١٩٨٠ و ٢٠٠٣ بسبب حرب الخليج والحصار الاقتصادي. ويمكن اعتبار النمو السكاني هو العامل الرئيسي المسبب للتغيرات في استخدامات الارض بسبب زيادة متطلبات السكان. هذه التغيرات سببت اختلافات بين التصميم الاساس و واقع الحال. لاجل تعيين التغيرات المكانية في مدينة الفلوجة، تم اجراء مقارنة بين التصميم الاساس و خارطة استخدامات الارض لمدينة الفلوجة والتي تمثل واقع حال لاستخدامات الارض لمنطقة الدراسة. الاختلافات بينها حددت و مساحات تلك الاختلافات حسبت في جداول وحصلنا على خارطة موضوعية توضح الهدف من البحث. تمت معالجة البيانات باستخدام تقنيات نظم المعلومات الجغرافية ، ونظام التموضع العالمي و استخدم برنامج جيو ميديا لنظم المعلومات الجغرافية

1. Introduction

As a result of population growth and socio- economic necessities, some quick changes are usually occurred. On the other hand, these changes create differences between master plan and reality situation of the urban area. Determining of land use changes has an important role in urban development.

Master plan provides a long range vision for built environment of a community [3]. It guides an appropriate use of land within a municipality in order to protect the public health and safety [3]. The aim of the master plan update is to guide future development to meet future demand, consider potential environment, and socio economic impact [7]. But most of master plans have been created without any georeferencing in terms of latitude and longitude, this makes it extremely difficult to locate or reference master plan in a spatial environment [2].

Fallujah city is one of the most important cities of AL-Anbar, which has been affected from increasing population density due to the local population growth causing the change in urban land

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use. Feature plans become essential to find a way to solve this problem by using appropriate techniques. The process of determine the spatial changes and irregularities can be undertaken using what have become known as Geographic Information System (GIS).

A geographic information system (GIS) is a computer based tool for mapping and data analyzing that exist and events that happened on earth [4]. GIS is a special case of information systems where the database consists of observations on spatially features, activities or events which are definable as points, lines, or areas[8].

In this paper, GIS has been applied to detect the changes in the land use of the study area. This technique is easier and faster than other traditional methods to detect the Land use changes in Fallujah city. These changes were remarked, and the area of these changes were calculated and represented in the table (3). In addition, new thematic map has been created for all residential neighborhoods changing, and all changes numbers of land use in Fallujah city has calculated. The final results are the most irregularities between the master plan and reality situation as shown in figure (13).

2. Aim of Study

The main aims of this paper are to detect the differences and irregularities between the master plan which updated in 1980 and real land use which represents the situation in 2012 of Fallujah city. Furthermore, create maps and estimate statistical data for these differences. These results can be used by the department of municipalities and getting advantage by updating the master plan or remove override.

3. Study Area

Fallujah is a city 50 kilometres east of Ramadi. The city has an important position because it extends along Euphrates River, bounded by the international highway, and includes the University of AL-Fallujah. These features increase the importance of the city and show the dense houses and commercial area demand in future ;as well as, it is closed to Baghdad about 50 Km to the north west of Baghdad.

The case study shown in the figure (1) is located between $43^{\circ}41'42''$ and $43^{\circ}52'30''$ longitudes and $33^{\circ}19'35''$ and $33^{\circ}23'05''$ latitude with total area of approximately 70 sq. km. It includes 21 sectors as shown in figure (2) and table (1).

Fallujah city includes 21 sectors as shown in table (1) which represent the name and area in Sq.M of each sector and figure (2) shows the boundaries of these sectors after installing them over the satellite image, we studied only 14 Sectors, because of the data availability.



Figure1. Area of Interest (Google Earth)

Table 1, sectors of Fallujah city with Areas

NO.	Name of residential neighborhood	Area sq. m2
1	AL- QADSEAH	1548507.4
2	AL- SHURTAH	1261337
3	AL- THUBAT	1344383.2
4	AL- MUALLMEEN	1331775.5
5	AL-WAHDAH	635073.5
6	AL- JOLAN	1545961.7
7	AL- MUATASM	375099.8
8	AL-RASAFI	402936
9	AL-JAMHURIAH	467093.5
10	AL- ANDALUS	690932.6
11	AL- RESALAH	1265624.3
12	NAZAAL	1281935.6
13	AL- SANAI	2824566.2
14	AL- TAMEEM	1108515.3
15	AL- KHDRAA	1070024.5
16	AL- YARMUK	1866953.9
17	AL- AMEEN	1489374.6
18	AL- SALAM	522163.7
19	AL- MAMON	1347421.4
20	AL- MANSOR	971518.4
21	AL- JAMEEH	1673482.1

**Figure2. sectors boundaries of Fallujah city**

4. The Reason behind Choosing Fallujah as a Case Study

The main reason of choosing Fallujah is to update the current Master plan of this city, the old and valid Master plan of Fallujah which published in 1980 to work for 20 years till 2000. However, it is still used because the updating is not produced yet. The Land use map has been produced by Alcatel Lucent Telecom Company field survey since 2012. This map produced for fiber optic project so it did not cover the entire city. We get this data, and we start apply our approach.

5. Data sources and a question

1. Master plan Map (soft as a Pdf file) of 1980 - Ministry of Municipalities and Public Work / General Directorate of Physical plan, as shown in figure (3).
2. Land Use (Fallujah Map) - Alcatel Lucent Company 2012. The maps received with complete GIS, each parcel in the map has ID (serial number), as shown in figure (4).
3. Satellite image for Falujah City from World View 2 satellite with a spatial resolution of 50 cm in 2012, as shown in figure (5).
4. Geo media Pro V.15, GIS software product by Intergraph Company, used to collect, manage and analyze the data to achieve the aims.
5. GPS Garmin Navigator, 3m accuracy. Used to achieve the location of with the satellite image



Figure3. Fallujah Master Plan of 1980



Figure4. Map of Fallujah sectors with ID and table of data (Alcatel Co.)

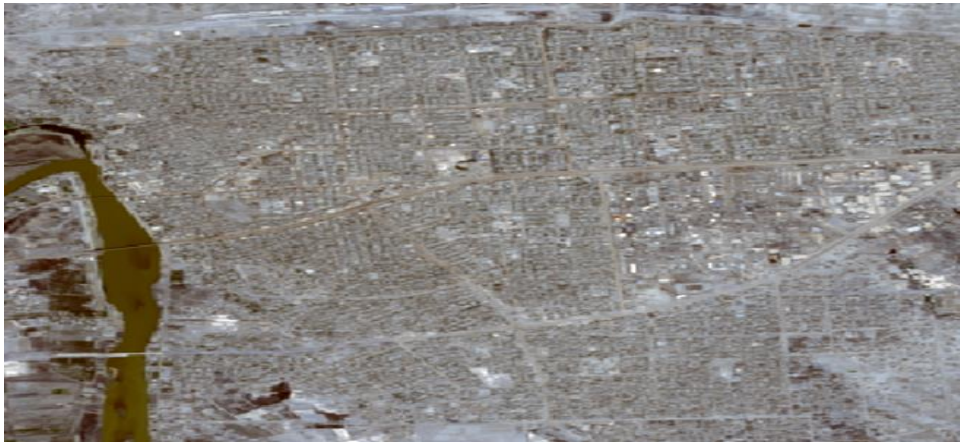


Figure5. Satellite Image

6. Methodology

In order to compare between the master plan layers and land use map layers which represent the reality of situation for Fallujah city and detect the irregularities between them by Geomedia Pro V.15 software.

We starting the work by using Gemedia GIS software, inserting the satellite image dated 2012(it is the same image used by the surveyors) to be the reference to all other layers like the master plan map and the land use map (both of them pdf files not image files), we set them by registering to the satellite image. Then digitize the parcels and insert the usage to the data base regarding to the IDs already available in the lad use map. After that the thematic map created by classifying all parcels regarding to the usage, made the comparison between the land uses, the master plan and got the results. The flow chart in figure (6) explains the steps:

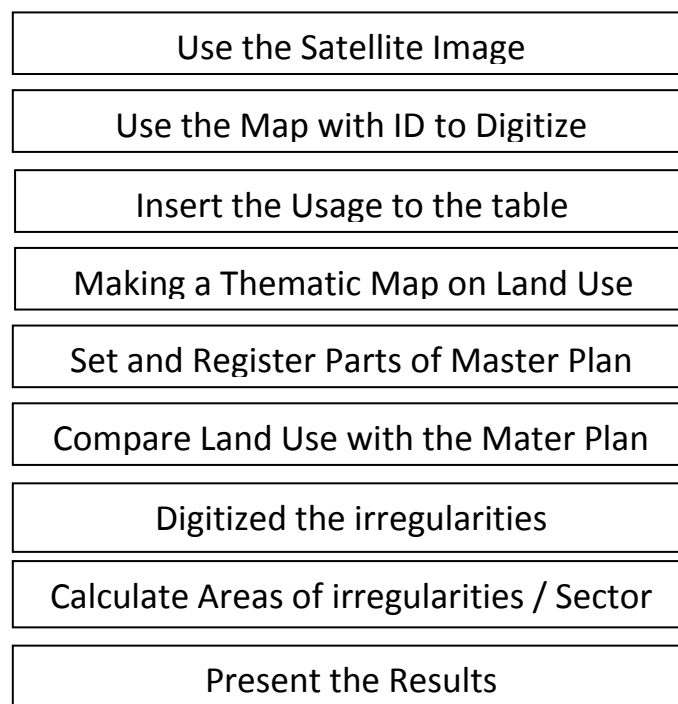


Figure6. Flow chart

Using the satellite image for the city, start running GeoMedia software, create a warehouse to begin draw the parcels as a polygon feature in new feature class by aiding of the map with ID as shown in figure (7).Each drown parcel take the ID and type of usage by inserting the usage to the table as shown in figure (8) from the map with ID received from Alcatel Lucent Company.

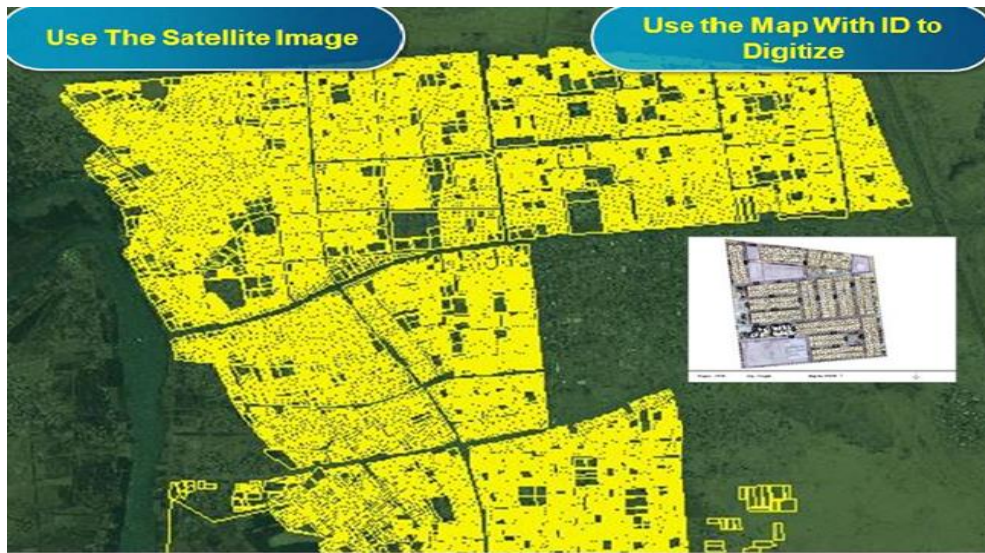


Figure7. Digitizing the parcels

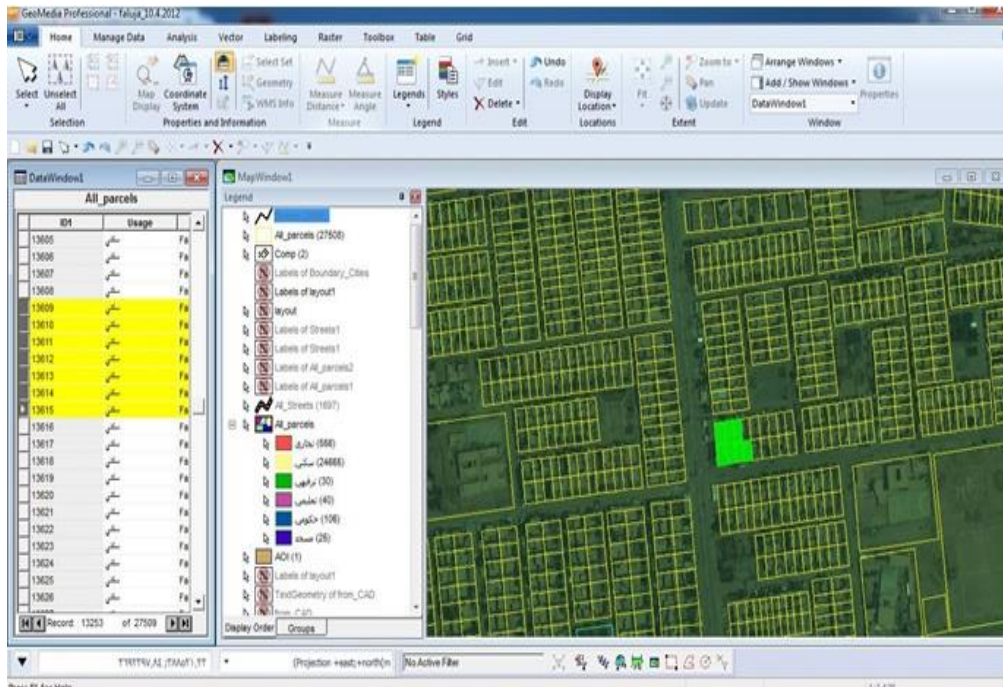


Figure8. Insert usages

Using Maps with IDs, all the data received of the land use from Alcatel Lucent Company is in one layer called parcels. But this layer has data base includes many fields. We used these data to make the analysis and get the thematic map use. In Geo media Pro V.15 classify and symbolize spatial data of land use into six classes shaded with different color depend on attribute field type usage, as shown in figure (9a,b).The classes obtained to land use are commercial , educational, recreation, governmental, religious, and residential.

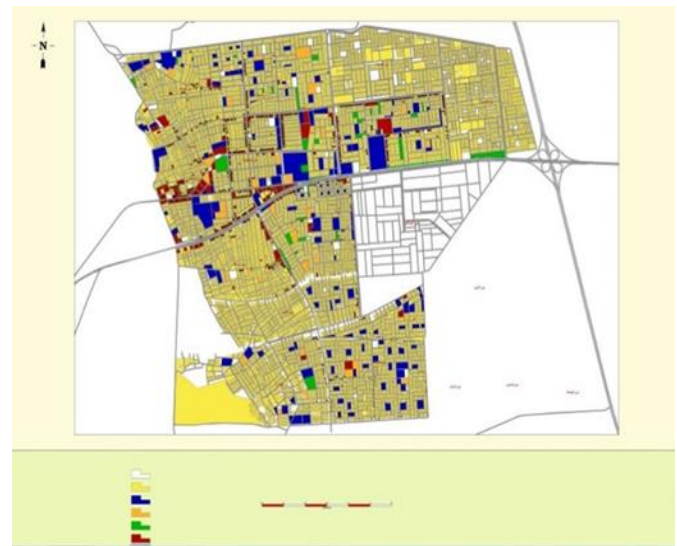
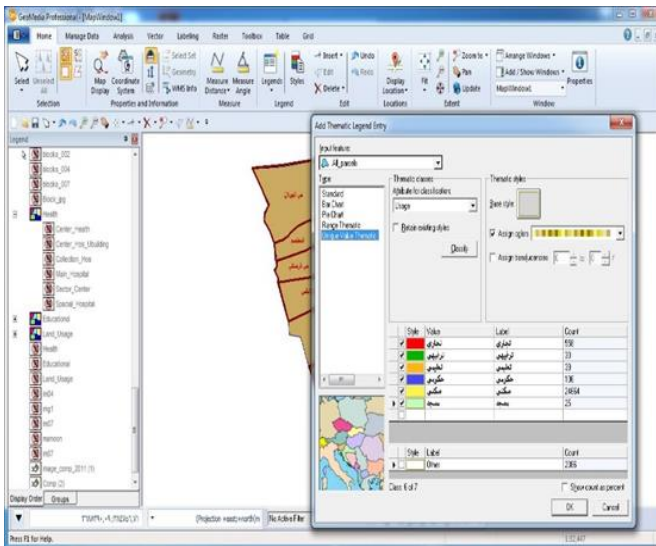


Figure9a. Add thematic entry

Figure9b. Thematic map

Make Thematic map by setting the Master Plan as a Base Map, to make the comparison regarding to this base map. The master plan consists of eight layers, these layers are: Residential, Commercial, Public Use, Facilities, Health Centers, Educational, Green Area, and Religious. We found that the layer (Governmental) in land use group opposite to (Public Use) in master plan, but we have 2 more layers (Police Facilities and Health Centers) in the master plan and these two layers already exist in the same layer of Governorate in the Land use. So we merged the police facilities (1 feature) and the health centers (2 features) with the layer Public Use to be exactly equal to the layer of Land Use. Now, we have land use data consists of six classes and master plan data consists of six classes too, as shown in fig (10 a, b).

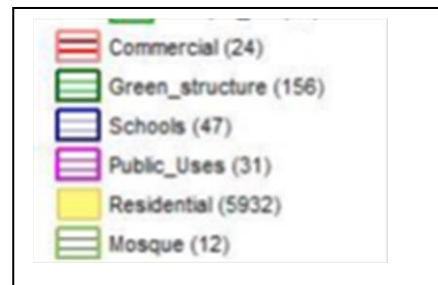
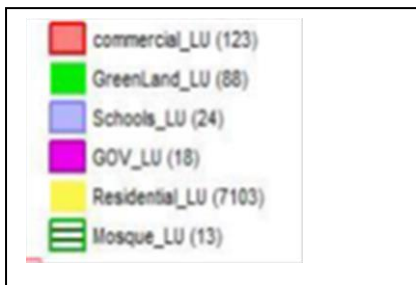


Figure10a. Layers of thematic use legend

Figure10b layers of master plan legend

Make Comparison by using two sets of data one of them is the land use layers (classes) of thematic map which present the reality situation and the other is the land use layers (classes) of master plan. To start the analysis and comparison between them, in this step georeferencing and rectify to the master plan depend on the same features and streets network in thematic map use as shown in figure(11).

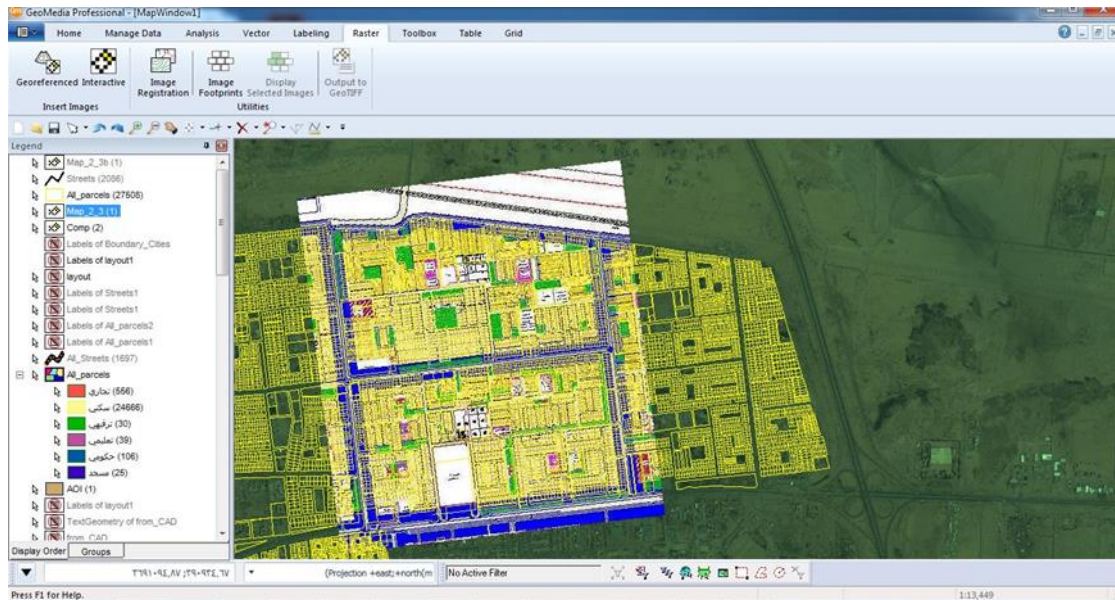


Figure11. Set and register a part of master plan

Starting the comparison land use layers in master plan and land use layers of thematic (reality situation) sector by sector, and layer by layer, as shown in figure(12).

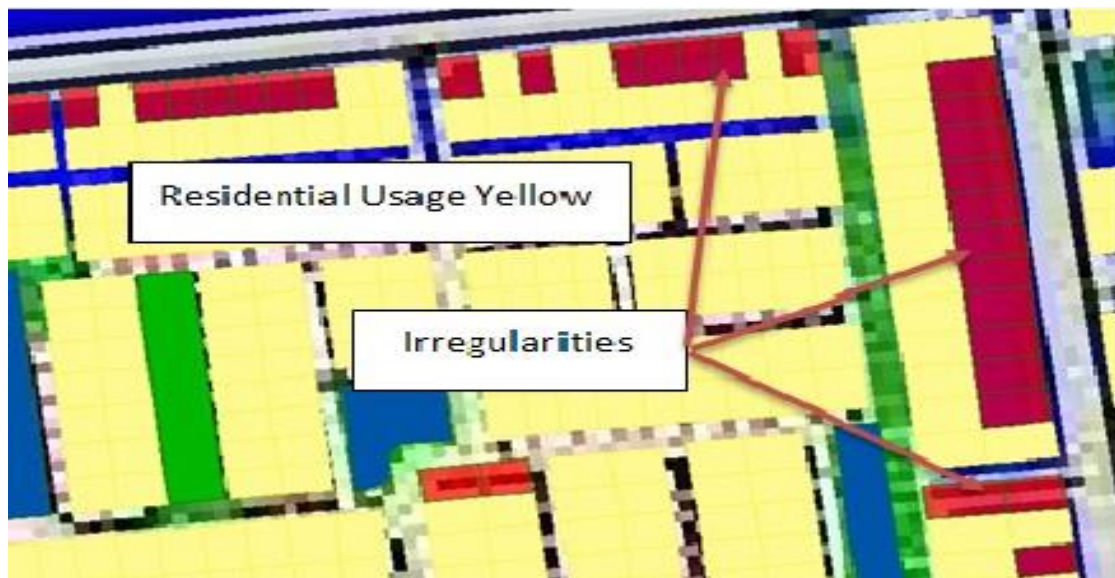


Figure12. Comparison Master Plan layers with thematic map

The Irregularities were observed by creating irregularities layer for all layers (classes) of case study, select the irregularities, and draw them as a polygon feature in new feature class and edited attribute for all polygon, add new field with name (Type) to edit class type to all polygon, and add another new field with name (Area) to write the area of each polygon, as shown in figure (13).

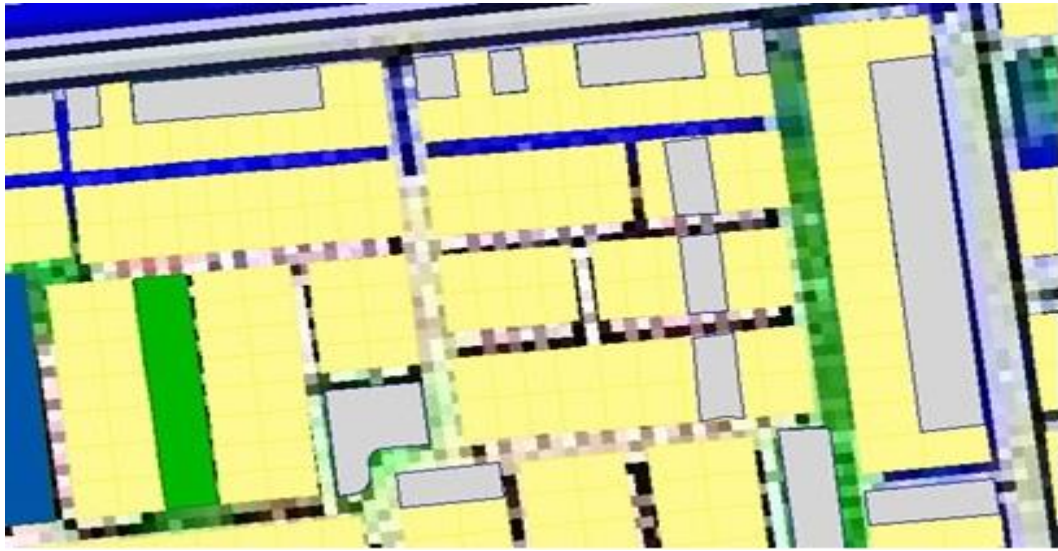


Figure13. Digitizing the irregularities in grey colour

7. The results

Comparing land use classes to Hay AL-QADSEAH in master plan layers and land use layers in thematic map (reality situation), calculate the number and area of differences between them as shown in table (2), there are 20 differences in Recreation use.

Table 2, Difference to AL-QADSEAH

NO.	Design use	Difference	Difference No.	Area m2	Actual use
1	Residential	NA			
2	Educational	NA			
3	Governmental	NA			
4	Recreation	A	20	25055	Residential
5	Commercial	NA			
6	Religious	NA			

From comparison and analysis, the total irregularities and differences in all Residential Neighborhood of the case study in all classes between master plan and land use were identified as shown in table3and figure (14).

Table 3, All Difference in Number and Area

Sector name	Use change		Difference no.	Area m2
	From	To		
Al-Qadseah			20	25055
Al- Shurtah	Recreation	Residential	2	12800
Al-Thhubat	Recreation	Residential	40	90575
Al- Muallmeen	Residential	Commercial	1	340
Al- Wahdah	Residential	Religion	5	6429
Al- jamhuriyah	Recreation	Government	2	2509
Al- Jolan	Recreation	Residential	12	18926
Al- Muatasm	Residential	Commercial	8	17754
Al- Rasafi	Recreation	Government	1	614
Nazaal	Recreation	Religion	18	9858
Al-Andalus	Residential	Commercial	1	728
Al-Tameem	Residential	Religion	4	5654
Al- Yamuk	Recreation	Government	8	4032
Al- Khdraa	Residential	Commercial	10	12588

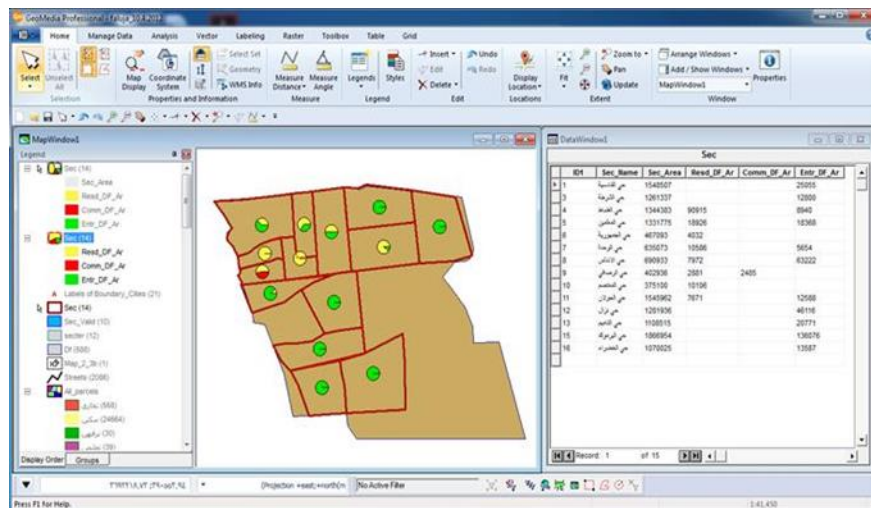


Figure14. Present results

8. Conclusion

By reviewing and analysing Tale .3 which includes the irregularities we found that:

- 1-Most irregularities and differences are in commercial, residential, and recreation land use in all the sectors of the case study area.
- 2-Most of the irregularities are from residential usage, 131 residential parcels changed to commercial use and 5 to religion.
- 3- The second usage has irregularities is recreation, where about 86 parcels changed to residential and 30 parcels changed to governmental use.
- 4- The results present that the municipality did not protect the recreation use.
- 5-There is shortage in commercial use in the design, therefore, we found big change to commercial use.
- 6- Shortage in religion use.
- 7-Many parcels changed to governmental use.

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