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*Full Length Research Paper*

# The study of urban growth impact in tourism area using remote sensing and GIS technique for north part of the UAE

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**Due to the complex nature of tourism resources of the Northern part of the United Arab Emirates (UAE), the potential of Geographical Information Systems (GIS) and Remote Sensing (RS) in resolving these issues was used. The study was an attempt to use existing GIS data layers to identify sensitive natural environment and archaeological heritage resources that may be threatened by increased urban growth and give some specific recommendations to protect the area. By identifying sensitive natural environment and archaeological heritage resources, public agencies and citizens are in a better position to successfully protect important natural lands and direct growth away from environmentally sensitive areas. The paper concludes that applications of GIS and RS in study of urban growth impact in tourism resources are a strong and effective tool that can aid in tourism planning and decision making.**

**Key words:** Tourism, urban growth, GIS, remote sensing, Ras al Khaimah, UAE.

## INTRODUCTION

The success of tourism in any country depends on the ability of that country to sufficiently develop, manage and market the tourism facilities and activities in that country (Briassoulis and Straaten, 1999). In the United Arab Emirates (UAE), tourism is one of the industries with the strongest effect on the economy because it helps in developing other sectors. According to statistics supplied by Department of Economic Development in the Emirate of Ras al Khaimah (RAK) (2007), tourism in the Northern part of the UAE contributes about two percent to the Gross Domestic Product (GDP) (Department of Economic Development, 2007). The tourism sector is estimated to have generated 19 billion US dollars in 2007 for the UAE (Alittihad, 2008). The UAE Government in her quest to diversify her mono-cultural economy, which is heavily dependent on petroleum export, has decided to take some measures to promote travel and tourism (Ministry of Economy, 2007). The aims of these measures to make the UAE the ultimate tourism destination in the Middle East and to make tourism one of the greatest foreign exchange earners in an oil dependent economy.

The Northern part of the UAE has a diverse coastal environment with a variety of ecosystems and an extremely rich natural environment and archaeological heritage (Potts, 2000). It exhibits a number of important characterristics related to its future as a resort communities. It is contains creeks and marshlands, with extensive intertidal mudflats and mangroves (United Arab Emirates University, 1993). Also, a number of freshwater springs and seepages add greatly to local biodiversity. The complex of habitats represented is unique in the UAE and indeed along the Gulf coast. The region forms a protective barrier on the seaward side of the creek. The area is unique in the UAE and Arabian Gulf for the following reasons:

i) The study area is an important spawning and nursery ground for fish, many of which are of commercial importance (Guneem, 2001).
ii) Rich biodiversity - preliminary studies have identified 393 species of birds, fish and corals, other marine life, insects and plants (Government of Ras al Khaimah, 2007).
iii) Nationally and internationally important as a feeding site for resident and migratory birds - 197 species of birds have been recorded in the Hulaylah area which is nearly half the total number of birds species recorded for the UAE (Government of Ras al Khaimah, 2007).
iv) Regionally unique coastal vegetation due to freshwater springs and seepages.


**Figure 1.** Location of the study area.

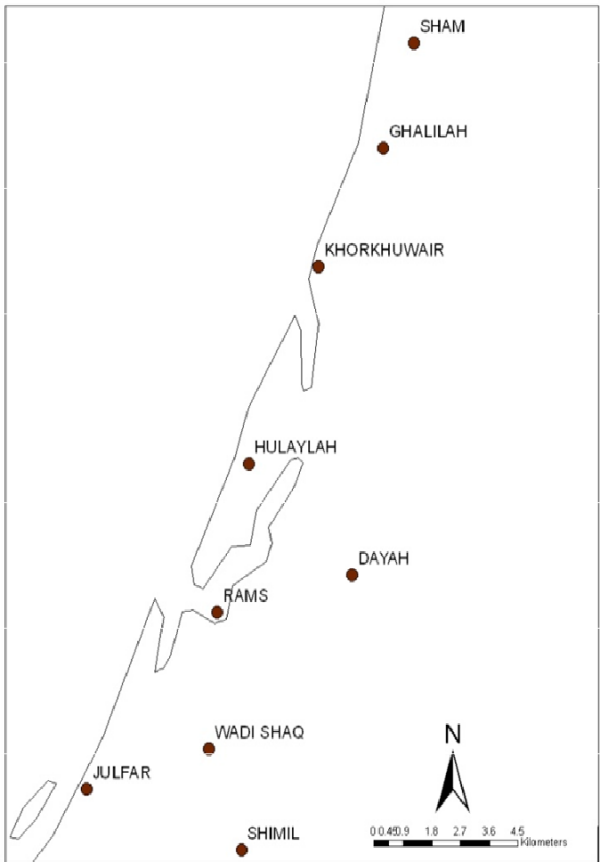


**Figure 2.** Location of the main towns in the study area.

v) Scenic importance with an impressive mountain backdrop.

vi) Rich archaeological heritage with 1,400 years of settlement history.

The study area located in the northern part of Ras al Khaimah (RAK) emirate, the most northerly emirate on the UAE's between 25º 50' to 26º 05' North latitude and 56º 00' to 56º 10' East longitude with the area of 120 square kilometers (Figure 1). It has borders with the Sultanate of Oman from the east and north and Arabian Gulf from the west and city of RAK from the south. The region has a coastline of about 30 km on the Arabian Gulf, backed by a fertile hinterland, with a separate en-clave in the heart of the Hajar Mountains to the southeast (United Arab Emirates University, 1993). It is of great natural, heritage and tourism importance with a long history of settlement and unique archaeological sites. One of the main reasons, why this area has always been important for settlement is its combination of all the four types of landscapes that can be found in the UAE: the fertile plain, the mountain region, the coastal region and the desert environment. The interaction of these different regions, together with their individual lifestyle, formed the very special heritage of the Northern Part of the UAE (Altabour, 1998).

The study area is one of the fastest growing regions in the country. The increase in population along the region, as well as rapid growth of towns, has increased the threat to natural resources and archeological sites. The population of the study area has increased 256% from approximately 12,300 in 1975 to 43,800 in 2005 (Ministry of Economy, 2006). Temporally, urban expansion shows fast growth stages, with the high-speed growth districts shifting to the north and east side of the region. The study area (Figure 2) contains the smaller communities of Sham, Ghalilah, Khorkhuwair, Hulaylah, Dayah, Rams, Wadi Shaq, Julfar and Shimil which are developing rapidly. In some towns, the proximity between protected areas and the settlement areas were greatly increase. For example, in Shimil the average distance from a city to a protected area was 500 m in 2008, as compared to 2,300 m in 2001. Such proximity increased the pressures on archaeological sites and natural resources and increases the likelihood of resource extraction and other threats to these protected places.

Satellite remote sensing data have been proven useful in assessing the natural resources and in monitoring the changes (Bahaire and Elliott, 1999). The study used Geographical Information Systems (GIS) and Remote Sensing (RS) to identify sensitive natural environment and archaeological heritage resources that may be threatened by increased urban growth. GIS is now recognized widely as a valuable tool for managing, analyzing, and displaying large volumes of diverse data pertinent to many local and regional planning activities (Chen, 2002) . Its use in environmental planning is rapidly increasing. Tourism is an activity highly dependent on environmental resources. It is also a phenomenon, which in the event of a lack of planning and management is likely to erode its environ-

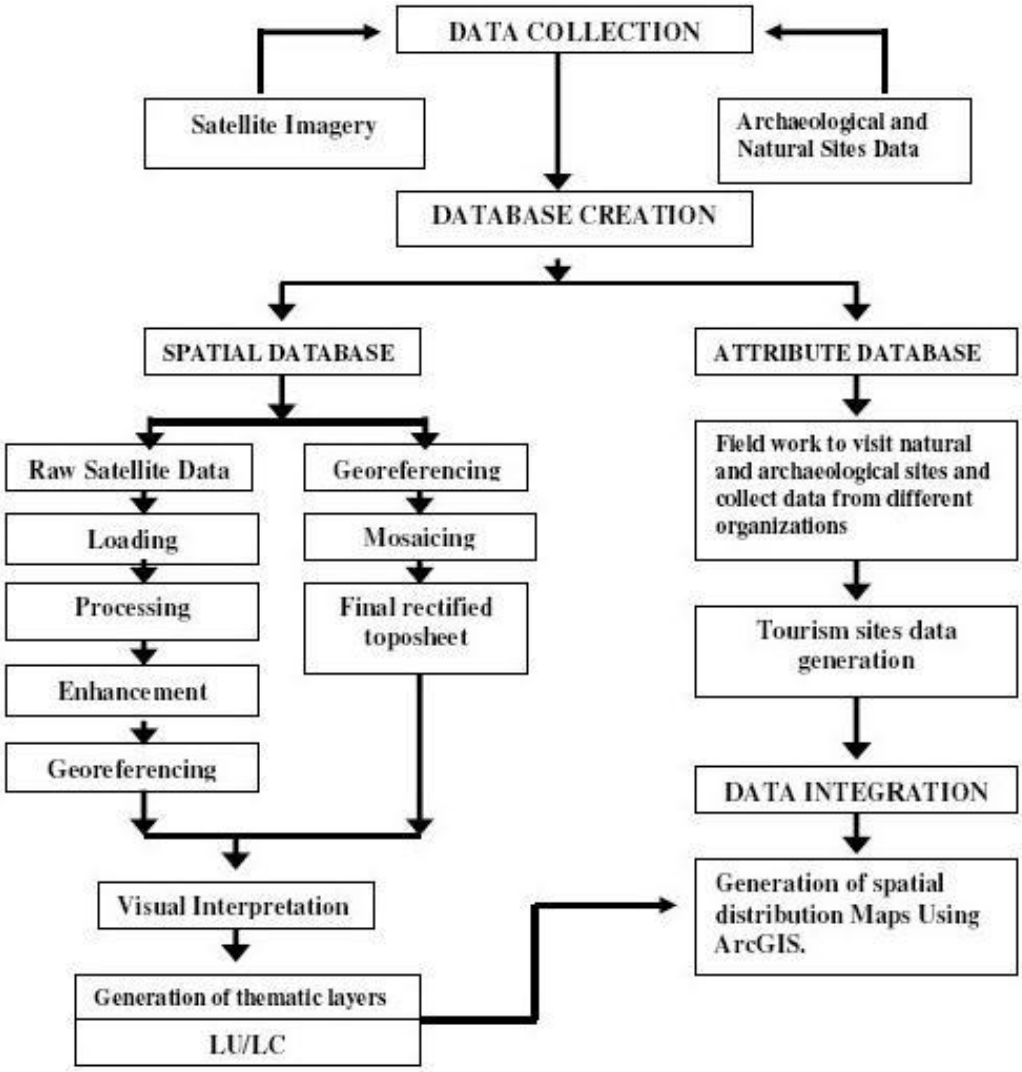


**Figure 3.** Methodology flowchart adopted for the study.

mental base (Whelan, 1991). Hence, the strength of tourism planning can be enhanced by GIS applications. GIS can be regarded as providing a toolbox of techniques and technologies of wide applicability to the achievement of sustainable tourism development (Bahaire and Elliott, 1999).

This paper gives a background on tourism sites in the Northern part of the UAE and how government should manage them. The study was an attempt to use existing satellite RS and GIS data layers to identify sensitive natural environment and archaeological heritage resources and types of threats by increased urban growth. The study prepares maps of high priority natural environment and archaeological heritage resources for protection. By identifying sensitive natural environment and archaeological heritage resources are in a better position to successfully protect important tourism sites, and direct growth away from environmentally sensitive areas.

## MATERIALS AND METHODS

The methodology adopted for this study is shown in flowchart (Figure 3) . For this study, all GIS analyses were performed using ArcGIS 9.2 and ERDAS image processing software. Available GIS databases used in this study are described below:

### Land use / land cover

A raster database of land use and land cover for the study area was used as the source of land use/ land cover information. This database, created from 2008 IKONOS satellite imagery which were acquired from Space Reconnaissance Center in the UAE Air Force and Air Defense, contains 7 land cover classes. Pixel size is 1 m.

### Archaeological heritage

RAK Museum has been collecting information on the locations, age, and characteristics of the Build Heritage and Tombs (Velde, 2007). This database has been digitized from 1:5,000 scale quadrangle

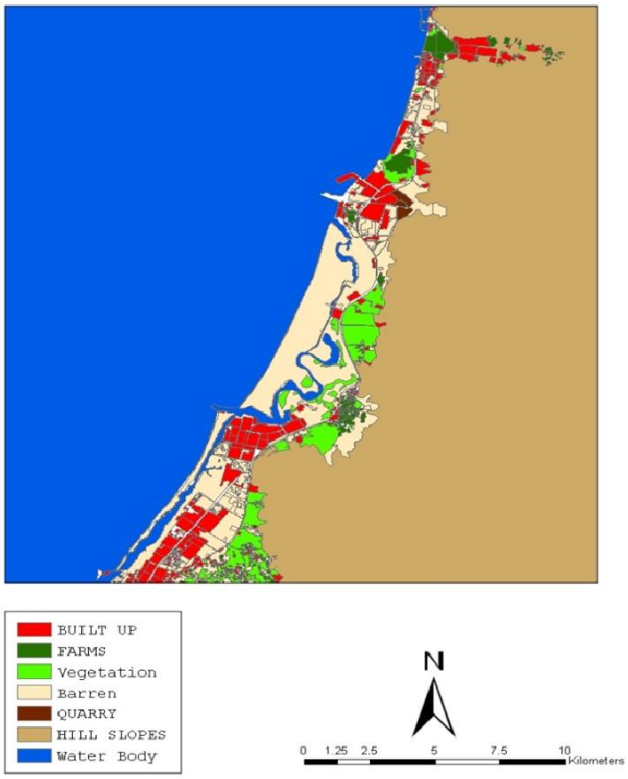


**Figure 4**. Classified 2008 date image

maps for the study area. The data was then loaded into the mapping program, ArcGIS9.2, where final maps were created.

#### Structure Plan for study area from 2005 to 2025

Vector coverages of structure plan which determine the big picture or vision of the future urban form of the study area were obtained from the Planning and Survey Administration at the RAK Municipality (Government of Ras al Khaimah, 2005).

#### Private landowner boundaries

Vector coverage for the boundaries of privately owned lands was obtained from the RAK Land Department.

The methodology below describes the GIS and RS processes used to identify, protect and manage various natural environment and archaeological heritage resources likely to be at risk from the impacts of urban growth in the Northern part of the UAE:

i) Classify IKONOS satellite imagery for the year of 2008 to generate thematic layers of land use and land cover. Geocoding and georeferencing of IKONOS data is done by extracting ground control points (GCPs) from RAK network survey using ERDAS image processing software. All IKONOS images are rectified to a common UTM (Universal Transverse Mercator) coordinate system based on the 1,550,000 topographic maps of RAK Emirate produced by the Planning and Survey Administration in RAK Municipality.
ii) Develop general natural environment and archaeological heritage resources map for the study area, emphasizing measurable and mappable structural attributes.
iii) Prepare component overlay maps to investigate how private landowner boundaries and present land use affect archaeological heritage resources and how Structure Plan for the future land use suitable with natural environment and archaeological heritage resources distribution.
iv) Implement GIS-based procedures to generate buffer maps with a minimum 300 meter wide to protect a natural environment and archaeological heritage resources.
v) Review protection areas map, verify on-ground as needed and evaluate resulting maps.
v) Develop recommendations to protect the study area.

## RESULT AND DISCUSSION

Satellite remote sensing, in conjunction with GIS, has been widely applied and been recognized as a powerful and effective tool in analyzing land use and land cover categories (Skidmore et al., 1997; Chen, 2002; Lu et al., 2004). Seven land use and land cover types are identified and used in this study, including: (1) built up land, (2) Farms, (3) Vegetation, (4) Barren, (5) Quarry, (6) Hill slopes, and (7)water body. The final classification product provides an overview of the major land use and land cover features of the Northern part of the UAE for 2008 (Figure 4). Tabulations and area calculations provide a comprehensive data set in terms of the overall landscape, description and land use suitability for tourism development, which have occurred (Tables 1 and 2).

The result of GIS analyses shows that the Northern part of the UAE has variety for tourism resources which can use for future tourism development. Figure 4 shows the areal extent and spatial occurrence of the urban expansion. Rapid urban development in the form of small towns and different economic activities are showing in different places in the study area. The urban development extended out of old towns and have negative affected of sensitive tourism resources in some areas. In contrast, those old towns, such as in Sham, Ghalilah, Dayah, and Rams, do not show a rapid increase in urban or built up land because they have no land to expand further (as they have already expanded fully in the past). The commercial and residential growths have to be associated with tourism development and sustainable development has to become a goal for study area communities (Briassoulis and Straaten, 1999).

Farms have a share of approximately two percent of the total study area. Basically, palm trees are the main crop and located in Sham, Ghalilah and Dayah. During the year 2000 palm fields covered 78 percent of the total agriculture area, but now these area threatened by the housing development projects because of population growth and the need of residential accommodations (Guneem, 2001). The agricultural areas important for tourism development and consider as ecotourism attraction (Briassoulis and Straaten, 1999).

The study area is more along the fringes of the mangrove area in many places especially in Ghalilah, Dayah, and Rams. The mangroves provide important environmental benefits to society such as fish nursery, filter air and water and eco-tourism value (Jongbloed et al., 2003). Also, it transforms the environment into a green

**Table 1**. Land use/land cover classification class and description of the study area.

| Class | Description |
|---|---|
| Built up | Includes all residential, commercial, and industrial development. |
| Farms | Includes palms farms and some vegetable farms. |
| Vegetation | Includes all vegetation features that are not typical of forest, including mangrove and pasture grasslands, recreational grasses, sammer trees, scrub or shrub like vegetation features. |
| Barren | Barren or sparsely vegetated areas most often representative of bare earth or soil. |
| Quarry | Open pit mine from which rock or minerals are extracted |
| Hill slopes | Steep area with average height of 900 m. |
| Water body | All water bodies including streams and marine water environments (coastline of Arabian Gulf, lagoons, creeks, and harbors). |

**Table 2.** Land use / land cover statistics of the study area

| Land use class | Area (sq 1km) | Land use suitability for tourism development |
|---|---|---|
| Built up | 21 | The commercial and residential growths have to be associated and sustainable with tourism development. |
| Farms | 3 | Area under agriculture should not be converted to other schemes. Any infrastructure development should be restricted. |
| Vegetation | 8.5 | Highly important for ecotourism, can serve as main ecotourism attraction, area need to be managed and conserved. |
| Barren | 22 | Plantation areas should be properly monitored and protected from any encroachment. |
| Quarry | 1 | Not suitable. |
| Hilly slop | 59 | Suitable in some area. |
| Water Body | 5.5 | Suitable for ecotourism Infrastructure development. |
| Total | 120 | |

and productive area. Moreover, Acacia tortilis, known as Al Samr in Arabic, is one of the desert vegetation in the study area which consists largely of shrubs, bushes and trees located far away from each other (Westren, 1989). These trees have umbrella- shaped and big shrub 2- 6 m high, branching from base, dusty-green and leaves are too many on branches (Jongbloed et al., 2003) . These trees distributed in two mean areas Shimil and Dayah. These resources are important for tourism development and consider as ecotourism attraction.

In the South of the study area, where the mountains do not approach the coast, there are sandy beaches (United Arab Emirates University, 1993) . Also, the Oman Mountains, rising in places to 1,800 m, separate the region from Gulf of Oman. The steep mountain slopes run directly to the shore in some places (Guneem, 2001). The hill slopes in the Northern part of the UAE have good effect in some area on the tourism activities and suitable for future tourism development.

Also, the study area is endowed with an extensive coastline that varied landscape, where a wide variety of activities can be indulged (Guneem, 2001). It is gifted with many natural lagoons and creeks, most of them girdled with mangrove swamps providing potential grounds for fisheries resources. Khor Hulaylah and KhorKhuwair are an important fish spawning and nursery areas (Government of Ras al Khaimah, 2007). Nevertheless, there are small harbors at in Sham, Ghalilah, Dayah, and Rams on the Arabian Gulf. The water body in the Nor-thern part of the UAE has great effect on the tourism acti-vities and suitable for future tourism development.

The tourism resources in the study area are under threat, suffering from decline and degradation due to a combination of direct and indirect impacts by urban growth. Many archeological sites in the study area are located on private property (Figure 5) . Eight tombs in Shimil and five tombs in Dayah located in private landowner. Two major tombs can be combined in the study area: (1) the beginning of the second millennium BC and this period, called the Wadi Shaq Period (2000 - 1600 BC) (Velde, 2007). Most of these tombs are large above ground with an average length of 8 -10 m (Altabour, 1998). (2) The Umm an-Nar Tomb was built around 2100 BC and is the largest known tomb from this period in the UAE and

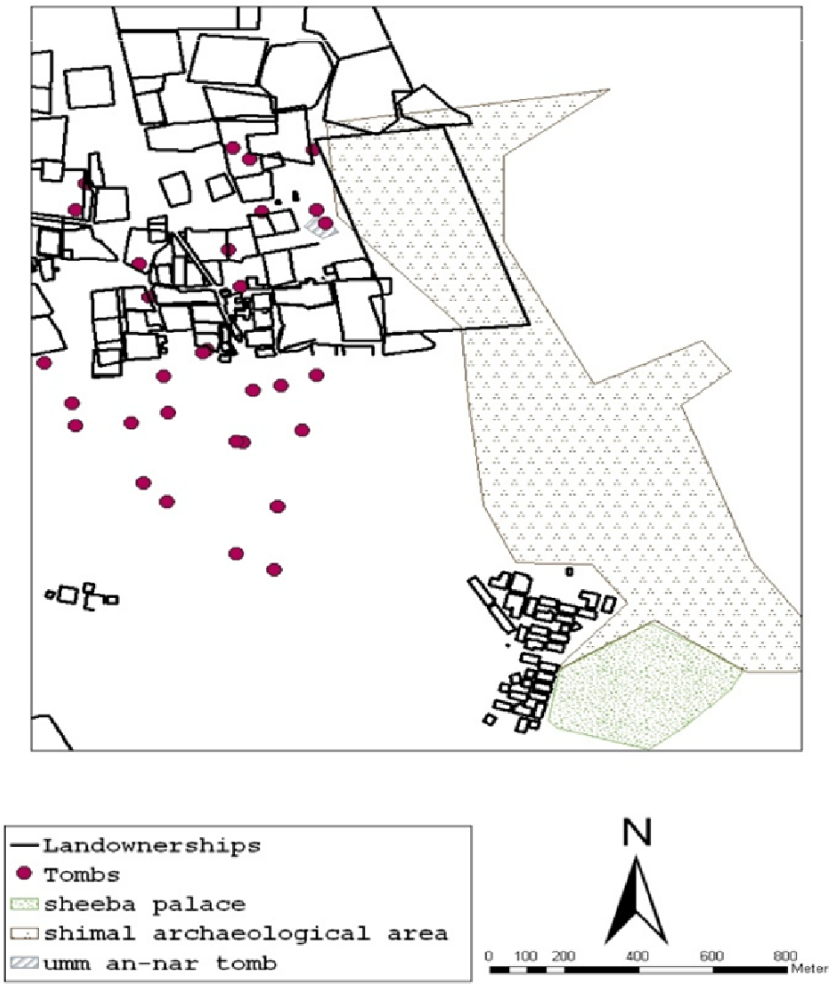


**Figure 5.** Archaeological sites that affected by land ownerships.

Oman (Velde, 2007). Also, there are two stone houses are outstanding and unique examples of summer houses in the palm gardens of Ras al-Khaimah (Velde, 2007). Both deserve to be protected and restored and need to be set back into their original environment of a palm garden. This will transform theminto beautiful examples of the palm garden culture once so typical for the Northern part of the UAE. At first the land has to be acquired as both houses are still privately owned. Both houses should be protected from destruction and the area be decreed as a historical area. One way to ensure that these sites are preserved and protected is for the lands on which they are located to be brought into public ownership or to be acquired "in fee" by preservation groups. That is, all rights to such property are acquired. In pursuing natural environment and archaeological heritage conservation needs on privately owned lands, it is often easier to deal with a few large private landowners than many owners of small parcels. In addition, the residents of study area must be educated about their sites' significance, provided management assistance, and informed about stronger presservation options available to protect archaeological sites in their area (Whelan, 1991).

The Master Development Plan of the study area (2005 - 2025) is one of the baseline document for environmen-tal and tourism assessment (Government of Ras al Khaimah, 2005). The spatial map of development orientation has been overlaid on the tourism sites to initiate preliminary assessment. Figure 6 shows the spatial map of master development plan for the period 2005 - 2025 and tourism significant resources of the study area. One square kilometer of Julfar town located in residential land use. This town is the most important archaeological site for the medieval ages in the lower Arabian Gulf. It was a large town developed in the thirteenth century at the coastline north of modern Ras al Khaimah. During the next 300 years this town was the largest trading town at the Arabian side of the Gulf (Potts, 2000). The location of Julfar town in the master plan should convert to conservation zone to protect the area from residential sprawl.

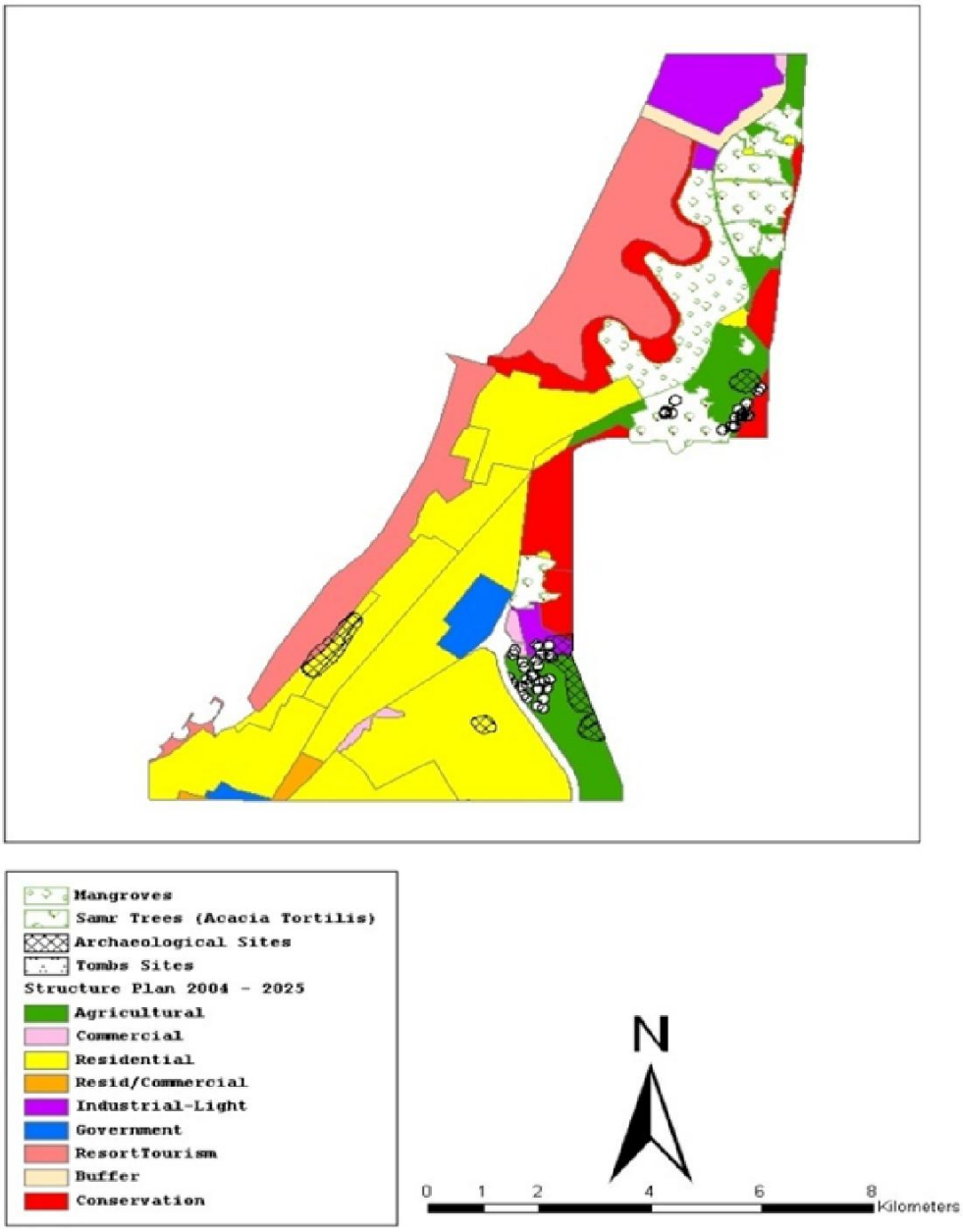


**Figure 6.** Spatial map of master development plan for the period 2005 – 2025 and tourism significant resources of the study area.

Also, one of the important archaeological sites of the study area is the monumental wall of Wadi Sur which was the most important defense of the trading town Julfar in the medieval ages. It runs absolutely straight from Sheba's Palace to the creek of Ras al-Khaimah with a length of more than 7 km (Velde, 2007) . Large parts have been already destroyed by modern development and it urgently need to preserve the proposed area for a reconstruction to its original size (Altabour, 1998). The finished reconstruction would be a massive and very impressive monument for tourism and local visitors as well. Also, the Queen of Sheba's Palace is part of the densest concentration of archaeological and historical sites at the foot of the mountains above Shimil. It is the only ancient Islamic palace know in the UAE and dates back to the days of Julfar. Also, Dayah Fort is one of the important archeological sites in the study area. Dayah Fort is located in north of the Rams Town. Dayah has always been a very fertile area and has been settled at least since the third millennium BC (Altabour, 1998). Records show that the Fort appears to have been built during the 19$^{th}$ Century on the foundations of much older structures (Velde, 2007). It is the only hilltop fort still in existence in the UAE (Altabour, 1998). The

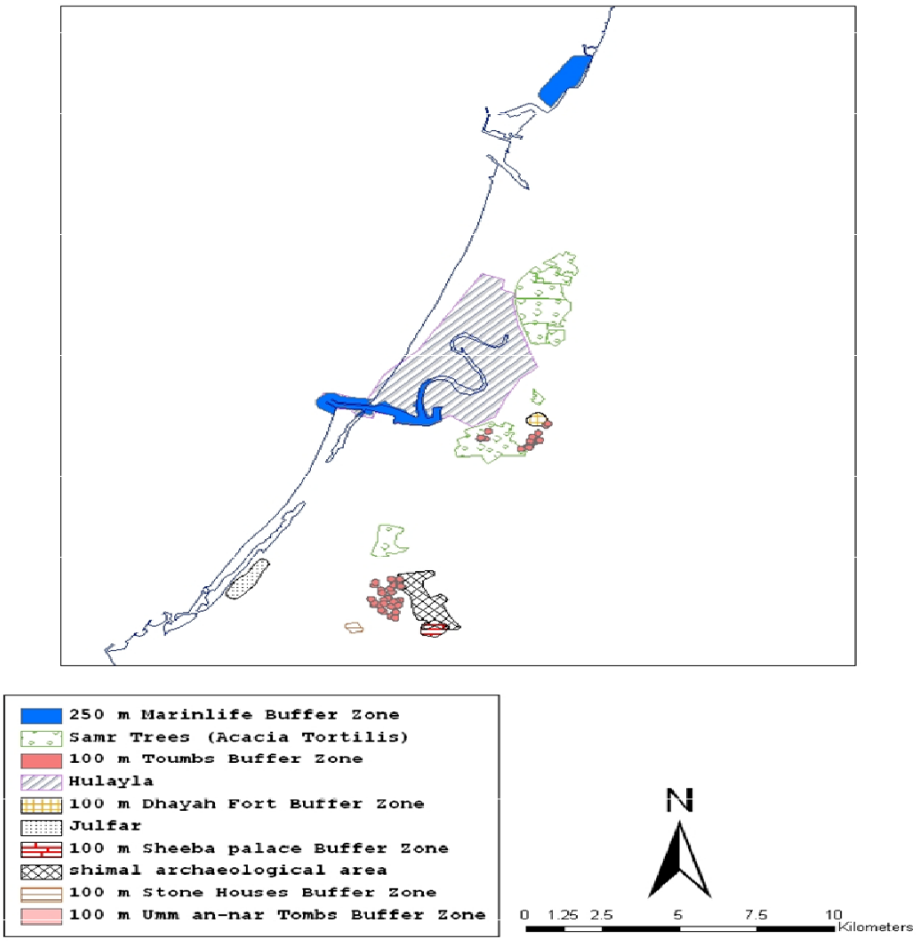


**Figure 7.** Strategic conservation areas.

location of a Queen of Sheba's Palace and Dayah Fort in the master plan located in the agriculture zone and the monumental wall of Wadi Sur located in the residential zone. All these sites should convert to conservation zone to protect the area from residential sprawl and agricultural activities.

By combining information extracted from the literature and field experience with a unique combination of satellite image data, we have generated a ten-class map of strategic conservation areas (Figure 7). Recognizing sustainable limits and adhering to some simple environmental guidelines and standards could have avoided the worst of the damage (Whelan, 1991). If urban growth is to be controlled, plans have to be formulated, guidelines and standards derived, natural parks and reserves have to be created, and rules have to be written, implemented, and enforced by governments (Shekhar, 2004). Priorities for protection include: (1) Hulaylah nature reserve which is located about 11 km north of RAK city near the town of Rams. The size of protection area is approximately 10 km². The area contains a creek (Known locally as Khor Hulaylah) and marshland, with extensive intertidal mudflats and mangroves, (2) a 2.4 km coastal buffer in Hulaylah and Khorkhuwair to protect marine life and fisheries, (3) Julfar; (4) a 100 m buffer around all archaeological sites in Shimil and Dayah which contains around – tombs (Wadi Shaq tombs and Umm an-Nar Tomb), Queen of Sheba's Palace, Dayah Fort, Wadi Sur Monument, and Shimil historical houses. Habitats of lower priority for protection include the Samr trees (Acacia tortilis) of the region that are primarily in timber use. All these areas are important to the tourism development.

The result of this study indicates that the natural resources and archeological sites in Northern part of the UAE are under threat. The study area most affected by urban growth contains some of the highest concentrations of natural resources and archeological sites in the region - these places tend to be small, but significant. With the base information that the study developed, the regular monitoring and proper management decisions should be pursued for the sustainability of the tourism resources in the study area. If the Government do not improve urban planning now, the study area may lose some natural resources and archeological sites for good. Governments, city planners and conservationists can work together to predict and plan in advance for urban growth threats to

natural and heritage resources. Having information on urban growth impacts to these protected areas enables planners to shape the growth of cities before it is too late, and to implement more sustainable urban planning.

## Conclusion

Tourism resources for the Northern part of the UAE is a highly complex resources, and thus requires tools that aid in effective decision making to come to terms with the competing economic, social, and environmental demands of sustainable development. The UAE government should prepare a tourism databases and a GIS system, so that planners can be accessed for archaeological heri-tage information as part of development planning pro-cesses. Applications of GIS in urban planning, tourism and recreation planning illustrate that GIS is a strong and effective tool that can aid in tourism planning and decision-making (Bahaire and Elliott, 1999). The power of GIS lies not only in the ability to visualize spatial relationships, but also beyond the space to a holistic view of the world with its many interconnected components and complex relationships (Nath et al., 2000). The worst of the damage could have been avoided by recognizing suitable limits and adhering to some simple environmental guidelines and standards will successfully develop tourism in sustainable manner (Briassoulis and Straaten, 1999). By identifying sensitive natural environment and archaeological heritage resources of the Northern part of the UAE, public agencies and private citizens are in a better position to successfully protect important natural lands and direct growth away from environmentally sensitive areas.

## Protection Recommendations

This study has identified a number of areas that have the potential to add value to the tourism development in the UAE. In order for maximum value to be gained from any subsequent replication of this research the following recommendations are made:

i) Archaeological heritage sites in Dayah and Shimil should be acquired by the government. These areas are the highest priorities for outright purchase as they support the rarest historical resources in the region, and they are not likely to be adequately protected through any other means.

ii) Study area comprehensive land use plans should be revised to prescribe conservation-oriented land uses for the highest priority ecological resources identified in this project. Land use plans should specifically include 100 m buffer zones along all archaeological heritages and 250 m buffer zone along mangroves and Marine life to the Arabian Gulf.

iii) A wider tourism and heritage master plan for Rams, Hulaylah and Dayah should be prepared as the whole area contains a combination of unique heritage features along a five kilometer transect from coast to mountain.

iv) Establish GIS inventories of all tourism resources of historic preservation and cultural resources at UAE. A first priority is to assess what inventories exist currently, what GIS needs to be established or modified, and how various inventories can be encouraged to utilize uniform methods for access. A second priority is to asses existing spatial data for accuracy and insure a process for quality control or ground-truthing of location information is a part of the GIS inventory process at all levels (Bahaire and Elliott, 1999). By having a comprehensive inventory of historic preservation, archaeological and cultural resources, which includes GIS information, all emirates will have a tool for better making others aware about how these resources can contribute to a region history, culture, sense of place and economy (Van der Knaap, 1999).

v) In order to combine all of these data sources between different emirates data sources, all of the cultural resource management agencies should be using the same standards for the representation, distribution and use of this critical information, to create a comprehensive inventory of our significant resources (Bahaire and Elliott, 1999).

vi) Provide training and education to historic preservation and cultural resource professionals regarding the geo-informatics technological tools available to them through GIS and global positioning systems (GPS) (Arnold and Norris, 1998).This would include how to complete individual property entries with accurate GIS information; work with digitally accessible inventory systems to update and locate historic preservation and cultural resources (Bahaire and Elliott, 1999). Training at the local level is especially important. Historic preservation professionals on the ground must be able to participate meaningfully in the cultural resource data standard creation and implementtation process.

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