King Fahd University of Petroleum & Minerals
College of Engineering Sciences
Civil Engineering Department

Geographical Information Systems(GIS)

Term Project Titled
Delineating Potential Area for Locating new Facility Using GIS

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5
1
4

Table of Contents

Abstract

Decision makers are nowadays confronted with huge tasks and challenges for more accountability and transparency in steering and executing their responsibilities than ever. For the last couple of decades to date, with emergence of Geographical information systems (GIS) at various scale, GIS has been re-shaping the manner in which decision makers are approaching complex problems for much better solutions in much easier ways. The technology demonstrated a great deal of providing reliable means for apt decisions and as well as good management in different organization at various levels of human endeavors.

As appropriate site location for any given purpose in present modern world is of paramount significant due to rapid urbanization and industrialization particularly in the developed countries, there is need to identify appropriate sites for locating new facilities. Relatively, this paper is a project that illustrates the capability of GIS. It is a case study that demonstrated how GIS could be employed to delineate a single area for locating new business infrastructure for optimum benefit. According to certain criteria set, the area was curved-out accurately and perfectly from so many abundant areas available within Washington state in U.S.A.

1. Introduction

Initiating private or public enterprise involves adequate planning, optimum utilization of available resources and appropriate location of infrastructures and facilities in order to ensure optimum benefit. These basic factors imminently need spatial data for effectiveness and efficiency for robust analysis towards making rational and fruitful decisions. However, owing to the complexity and wide potential variability of spatial data, the need for a tool with higher efficacy in correlating data location and their corresponding attributes that can adequately address and tackle spatial analysis for optimum benefit cannot be overemphasized. Interestingly, GIS technology deals excellently with spatial data regardless of its volume coupled with the gravity and complexity of analysis required; these unique characteristics render the technology most suitable for any sort of spatial analysis. . The advantages of GIS in data documentation and processing that distinguish it from other related technology include:

- quick updating of information,
- automated cartography,
- integration of information by linking spatial and attribute data,
- spatial analysis,
- automation and production of maps at different scales and
- Visualization.

3. Problem Statement

The owner of a business organization in Washington State of USA that specialized in dealing with daily need commodities wears e.t.c services realized that the population of U.S resident immigrants is fairly increasing and in addition the number of tourists and visitors trooping into Washington escalates rapidly. As manager of the organization, in attempt to boost the status and business opportunities of his organization he wanted to conduct feasibility studies that would pave way for appropriateness of indulging into securing a single pilot facility capable of providing services to meet special demands of these categories of individuals. The studies, would be executed in the following chronological order

- To identify the counties mostly patronized by tourists and visitors, and moreso, having larger population of immigrants.

- To delineate the most potential area for appropriate locating new pilot facility for optimum benefit.

- Identify the most suitable location within the delineated area and appropriateness of location of new facility therein.

- Check the level of availability and make assessment of adequacy of existing facilities within the delineated area.

- To identify the type of commodity the aforementioned groups of people highly demand.

4. Aim and Objectives

The main aim of the study is to demonstrate the effectiveness of GIS tool in delineating suitable area for erecting new infrastructures to meet certain set of criteria.

The specific objectives of this study include:

- Identifying criteria for delineating suitable site location to satisfy certain criteria of interest.

- Applying the set of criteria in ArcGIS analysis to delineate the suitable area.

- Identifying the potential area for further consideration and evaluation.

5. Study constraint

The two main constraints encountered during the study undertaken were lack of adequate time and data limitation. The study could have identified better key relevant criteria in order to make robust and more detailed analysis in delineating most appropriate areas if there were enough time and adequate most relevant data of the study area. Indispensable efforts dissipated within the limited time towards securing additional relevant data other than those from ESRI CD-Rom all ended in futility.

6. Study area

The study was confined to Washington, a state in the U.S.A. The reason for selecting was due to the following geographical facts:

- It is located at the extreme northwest of U.S.A bordering South American and Asian continents rendering it a gate-way to the country.

- Moreover, large population immigrants particularly of Asian and Hispanic- Spain, Portugal e.t.c- origin reside therein.

- Population (1994): 4,867,000 (19th in size)

- Size is 68,139 square miles (20th in size)

7. Tool of study

The tool of study is ArcGIS 8.1, software developed by ESRI (Environmental Systems Research Institute). This powerful tool, as other GIS softwares can capture, and accept analyzing and manipulating spatial data to get output and create quality presentation within one single framework in an easy, interesting and exiting matter.
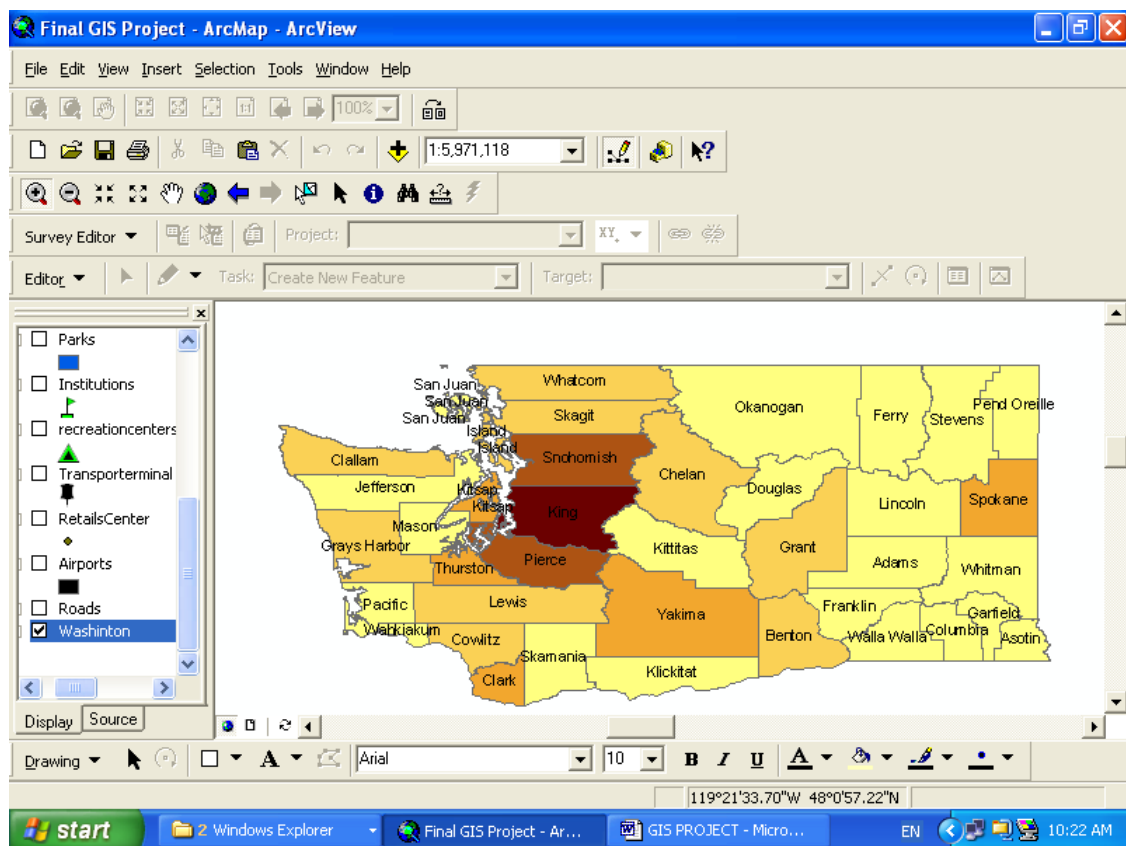

Figure1: Population distribution of Washington State of U.S.A according to county.

8. Data source and available layers

Data to be used for the analysis are solely secured from ESRI data CD-ROM. As shown in figure1 above, the following eleven digital data layers of the study area were available during the study:

1. Washington layer.

2. Transport terminals layer.

3. Recreational centers layer.

4. Retail centres layer.

5. Airports layer.

6. Parks layer.

7. Roads layer.

8. Institutions layer.

9. Data analysis Methodology

The project would employ the Multicriteria Analysis (MCA) method, within the GIS environment through using selection by location and by attributes commands followed by buffering and intersection command within geoprocessing wizard. Other operations such as clipping layers, over layers and dissolves tool were as well employed. The analysis was towards on curving-out potential areas based on factors such as distance or proximity from certain features, features within certain layer with unique properties e.t.c. The final result that satisfied all the given criteria was arrived after subsequent and

continuous intersecting layers upon layers. Factors considered for the study and their

corresponding attached hypothetical criteria and justifications are given in table below.

	Factors	Criteria	Justification
1	Counties with larger No. of residents	Asians>20,000 Hispanic>10,000, Others> 5000	To identify potential areas housing immigrant residents to ensure high level of patronage for profit making.
2	Availability of airports	Counties with atleast one airport.	Based on fact that airport reflects potentials for tourists and visitors reaching a county.
3	Proximity to transport terminals	Within 5km from transport terminal	Due to popularity rail and road transport in USA mostly people patronize them. The facilities resorts need to be accessible to demanding people. If it is not fairly accessible, there will be low patronage
6	Proximity to recreation sites	Within 1km from a recreation	Closeness to recreation and historic sites enhances the patronage of the facility resort. 1km (walking distance) is recommended so that other activities at the recreation sites may attract appropriate people.
7	Distance from parks	Not beyond 4km from parks and tourist resort.	Tourist, visitors and residents frequent parks. This will attract people patronizing the parks.
8	Distance from institutions	Within 5km from institutions	Academic institutions in USA are centers where huge numbers of immigrants are found and also they attract tourist and visitors.
9	Proximity to retail centers	Not beyond 2 km from major retail centres	Retail centres are well-known by residents. Tourists and visitors are also guided to meet their demands there.
10	Proximity to major roads	Within 2km from major roads	To locate it within patrons walking distance particularly during congestion period.

10. Project Findings

The analysis within the given set of criteria succeeded in identifying a single area located in King County, which is one of most populated, most developed and busiest county within the Washington state. The delineated area is the optimum potential location.
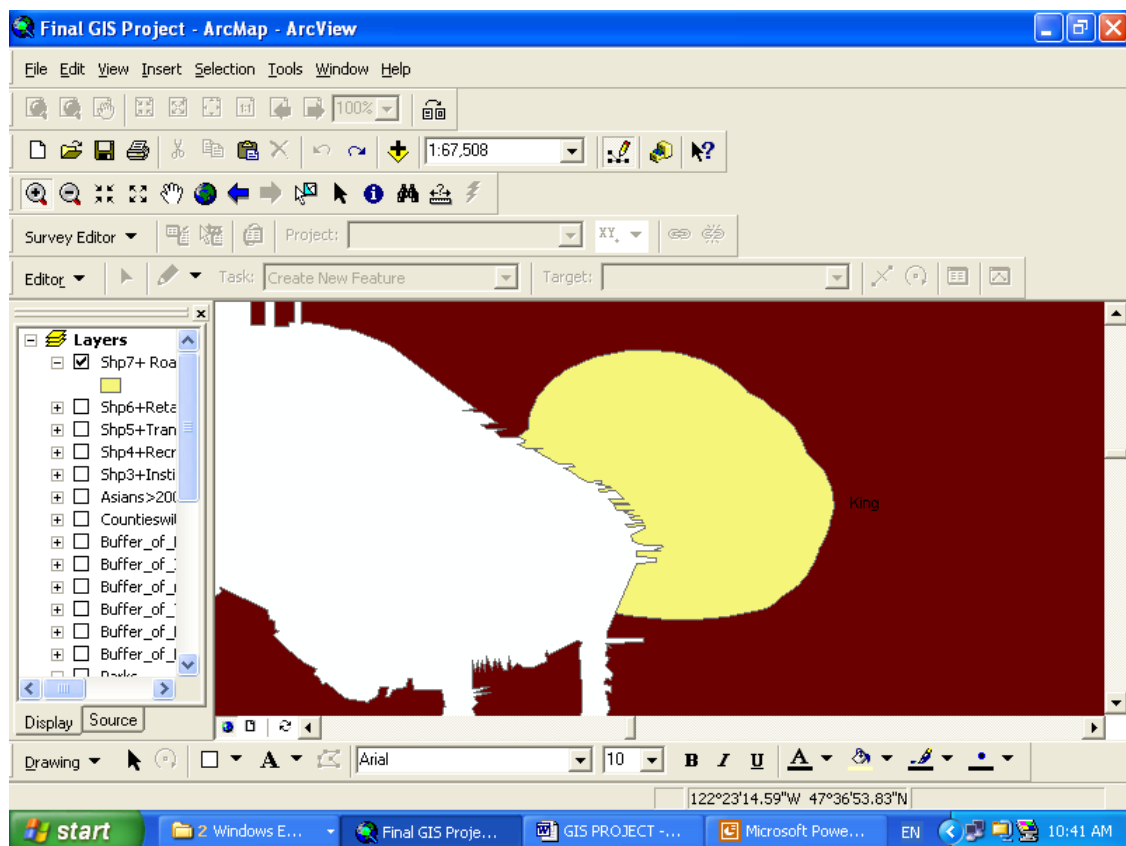

Figure2: Showing the single selected area located in King county.

11. Conclusion and Recommendations

The study has shown that a GIS is a good tool to help aid in finding of suitable and optimum single for any given purpose. It also reflects its capability for locating multiple site depending on given criteria. The single area delineated was in only one county among the 39 counties in the 68,139 square miles state selected by applying criteria such as proximity to urbanized area, proximity to airport, proximity to road network and proximity to and distance from water body. GIS made the process of making preliminary decision in siting more efficient as it was very easy to find suitable sites quickly and then recommend them for further study. In nutshell, the project could concluded as

- demonstrated the capability and efficacy of GIS in delineating a single area-within vast land- that satisfied pre-given criteria
- Portrayed the usefulness of GIS as a forerunner tool that could enhance career opportunity.

The study makes the following recommendations:

- the user should ensure that valid criteria .
- the user should ensure the availability of relevant data which are in compatible and acceptable format.
- For any GIS project, sound knowledge, relevant data and valid criteria are important and governing parameters for success.

Reference

- Census Bureau (2002) US demographic data by counties.

  http://tier2.census.gov/cgi-win/usac/select.exe

- ESRI data CD-ROM

- Al-Ramadan, B. M. (1998). GIS application in Environmental Protection: A case study of GIS as tool for site selection. Paper presented at the 1st Middle East International GIS Conference, Bahrain.

- Tim, O., Eileen, N., Robert, B., Carolyn, G., and Laura, F. (2001). Getting to know ArcGIS desktop. ESRI Press Redlands California.
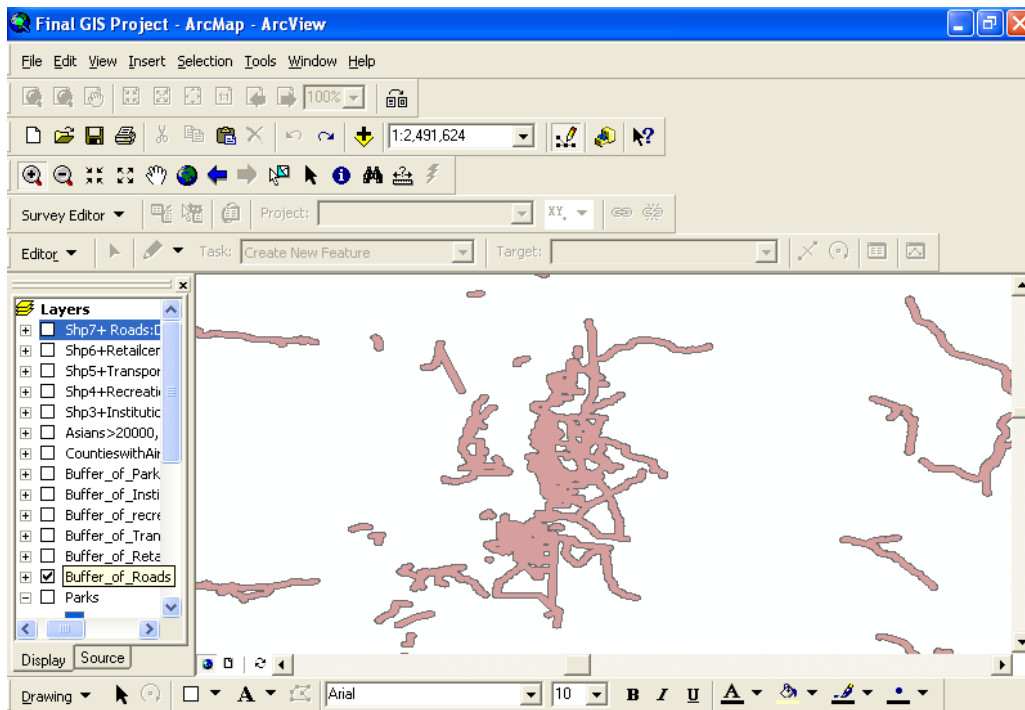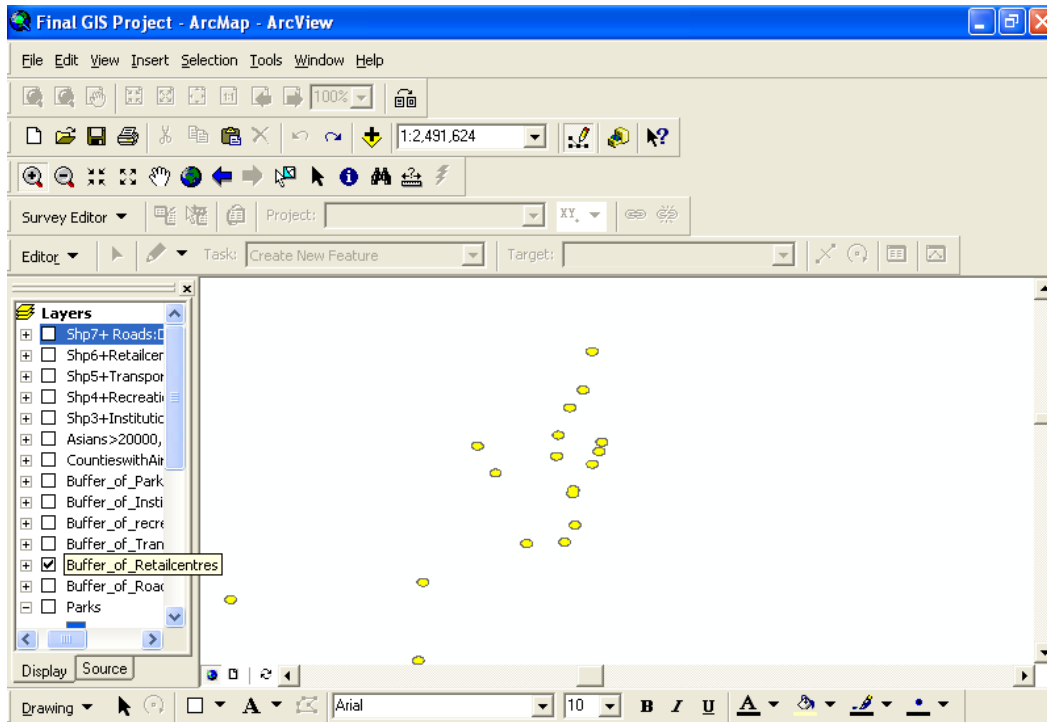
Appendix
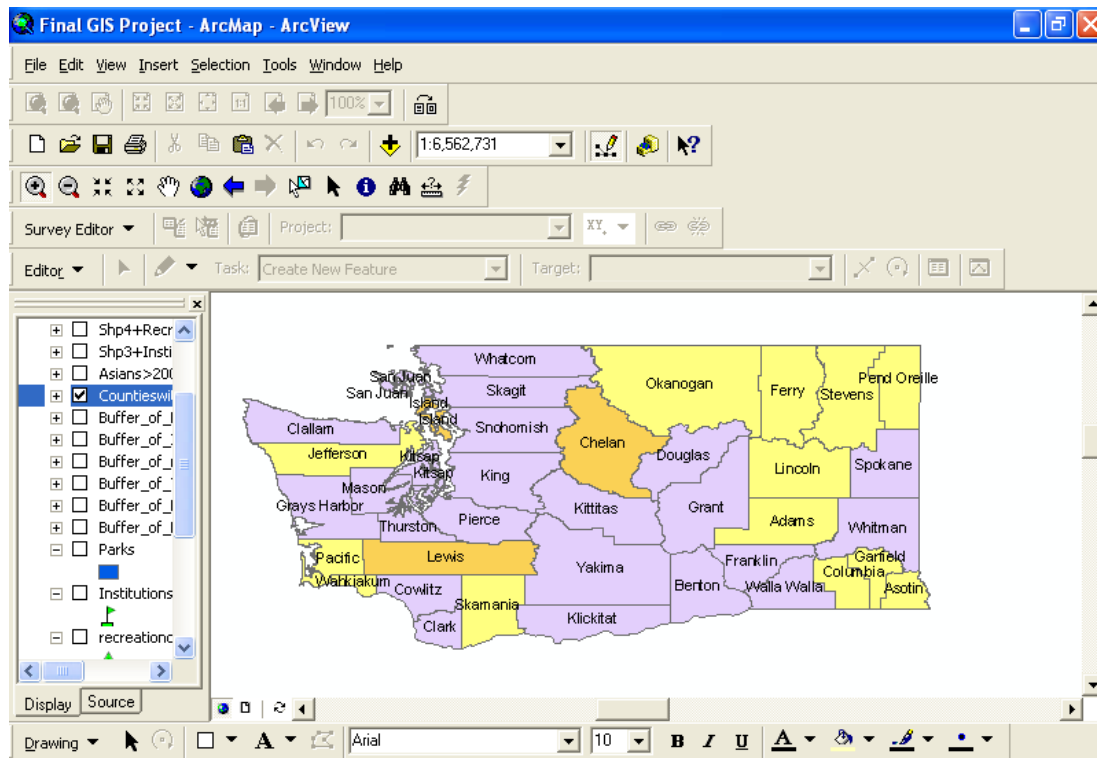
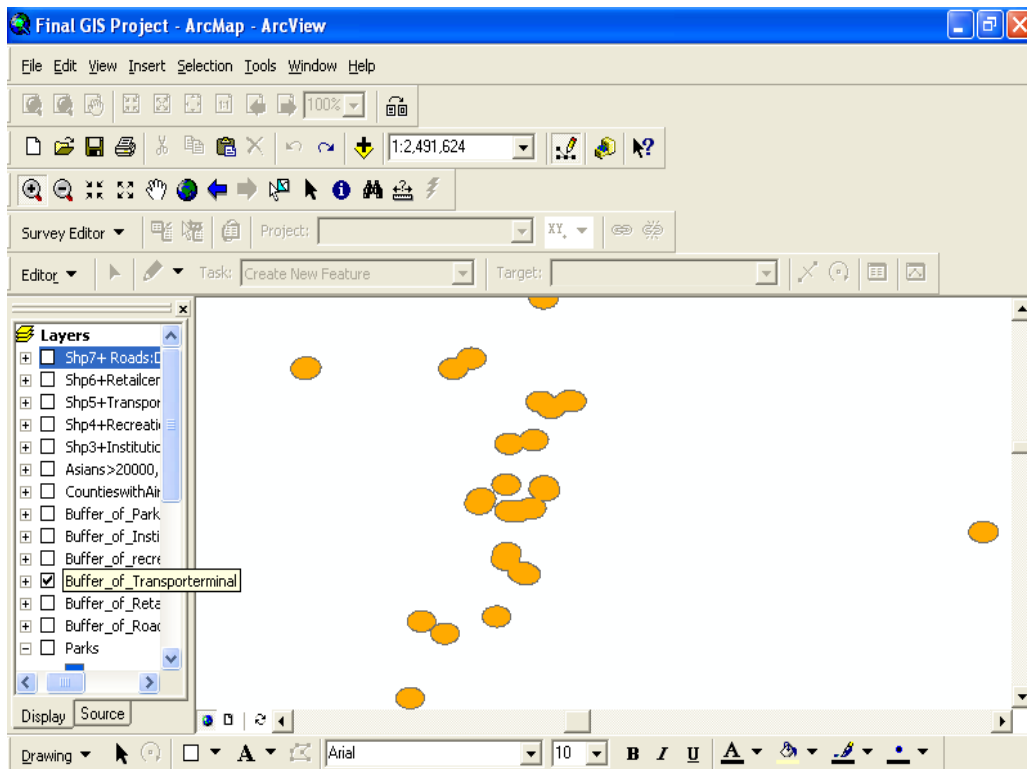**B1:** showing counties with at least one airport
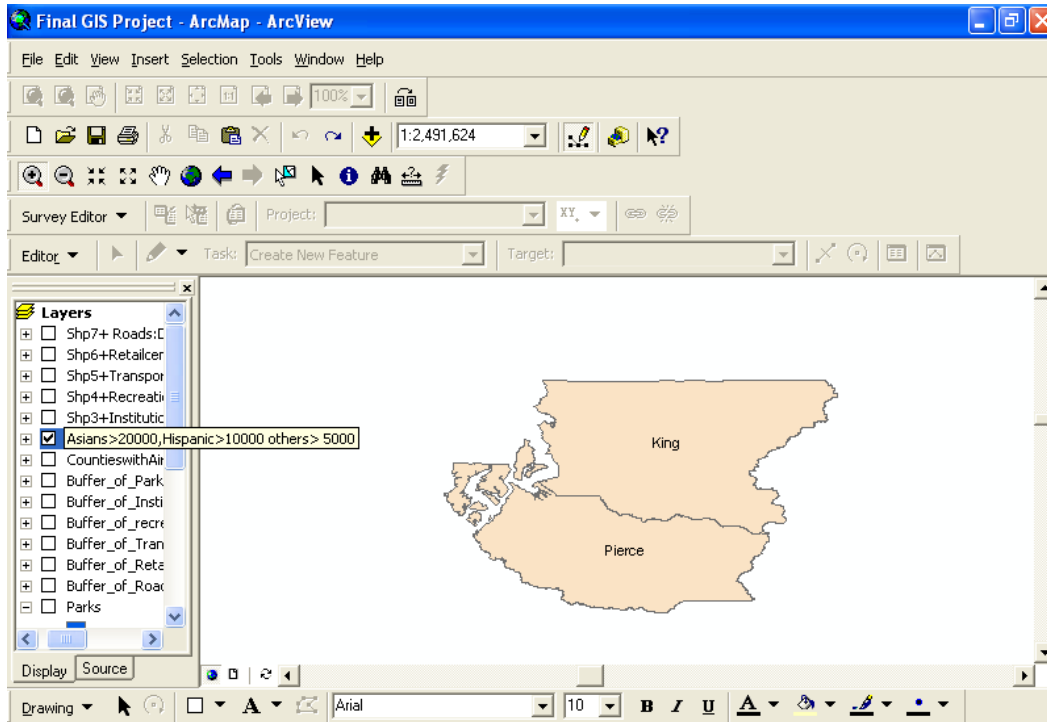
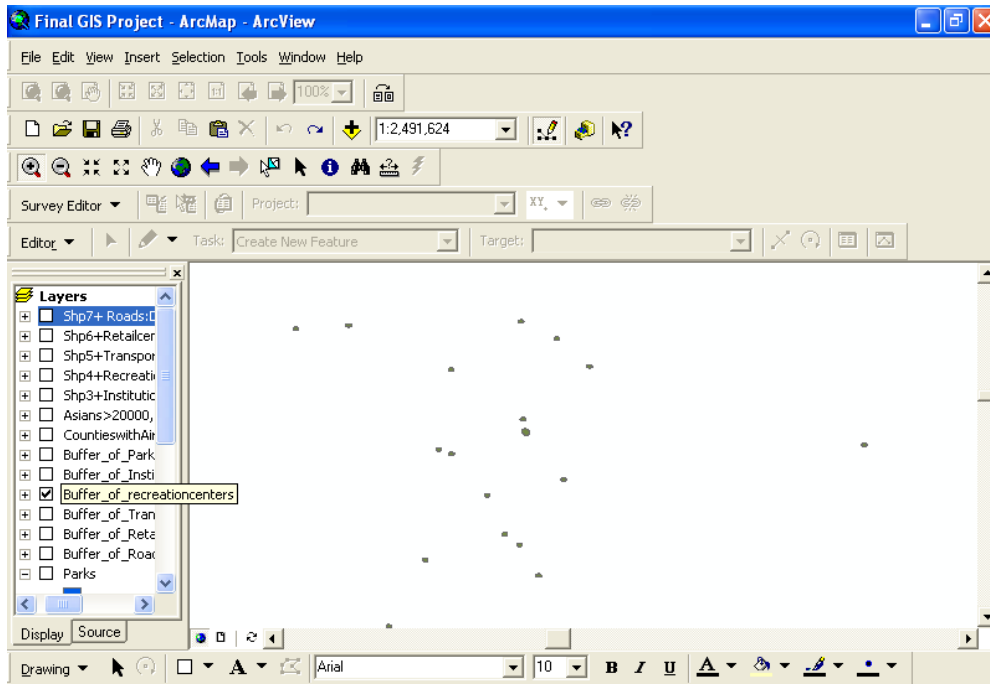**B2**: Showing the selected counties with airport that meet the population criteria.

B3: Showing buffers of road at 2km.
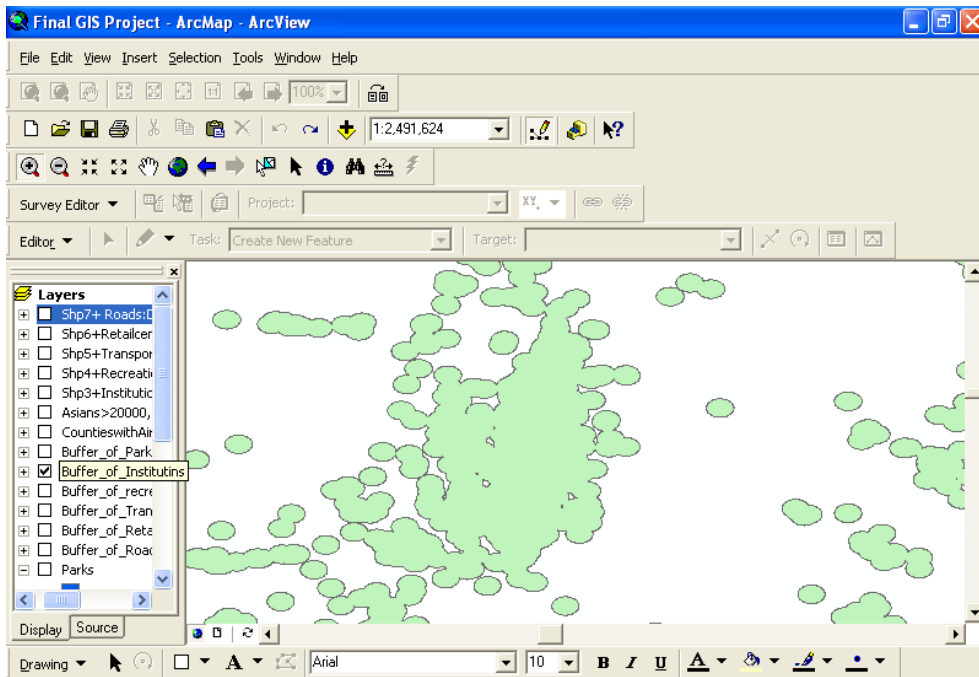
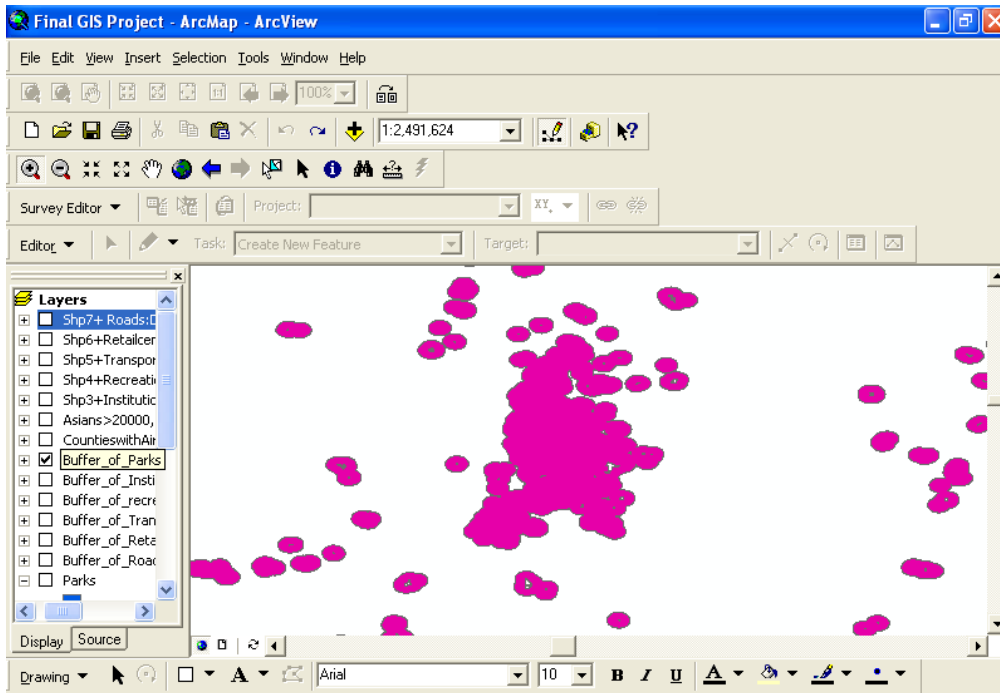**B4**: Showing buffers of retail centers at 3km

B:5 Showing buffers of transport terminals at 5km

B6: : Showing buffers of recreation centers at 1 km

B7: Showing buffers of institutions at 5 km

B 8: Showing buffers of parks centers at 4 km