

Urban Sprawl in Carver County, MN

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Abstract

Land cover can change greatly over time. Especially in suburban areas near major cities. Carver County, MN is just west of the Twin Cities and has experienced population growth over the years. This project used images from USGS of July 2003 and July 2011 to assess urban sprawl of the area and where this urban sprawl is taking place. Images were downloaded from Earth Explorer and clipped to an outline of Carver County. Each image had an unsupervised classification and a cluster bust done to further analyze the area. Then a matrix union was performed to assess the changes in urban growth. There was an increase in urban growth, primarily from the grass/agriculture class in the 2003 image. The area where urban sprawl took place was primarily on the east side or where small cities were already established, and around the lakes. Cloud coverage produced some error in comparing these images not allowing a full analysis. Further analysis can be done using accuracy assessment to better indicate areas on growth and development in Carver County. This type of analysis can be used in future planning for the city and do determine where future urban development may occur.

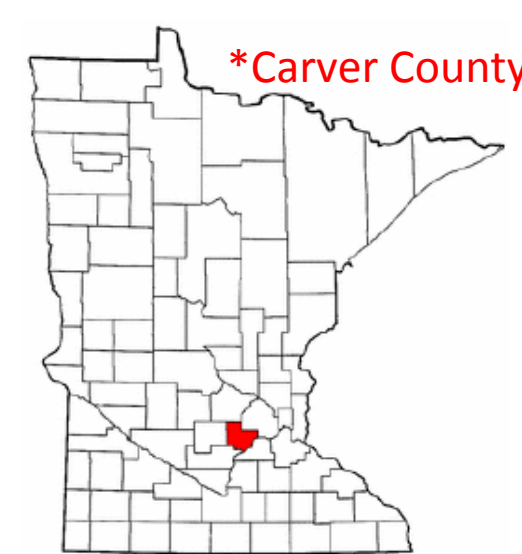
Introduction

Land cover in any given area can change greatly over time. This is especially true in growing suburban areas, known as urban sprawl. Carver County is a metro of the greater Minneapolis area in Minnesota. This area started experiencing sprawl in the 1950 and 60's with most of the growth in wooded and lakeshore areas (Carver County 2030 Comprehensive plan, 2010). Over the years of 2000 to 2010, the population of this county has grown from 70,000 to 91,000 (Carver County 2010 Census). Previous studies of the metro areas have found increased urban growth to be useful for future planning as well as studies in fish assemblages in streams (Carver County 2030 Comprehensive plan, 2010; Yuan et al, 2005; Wang et al, 2003). They have projected a growth from 2008 to 2030 of 9,836 acres in additional growth within Carver County (Carver County 2030 Comprehensive plan, 2010). Mapping the area for land cover change can over time can give us clues into where the trend of growth occurs and where to expect even further growth in the future. The focus of this project was to show the land cover change from 2003 to 2011 in Carver County and analyze where the majority of urban is developing. This project took Landsat 5 images from 2003 and 2011 acquired from USGS. There are several ways to classify land cover change, in this approach an unsupervised classification, a cluster bust of two classifications, and a matrix comparison was used to assess the changes in land cover.

Data and Methods

DATA

- Study Area: Carver County, MN
- Satellite image 1&2: from USGS (georectified)
 - Landsat 5, WGS84, Zone 15, bands 1-5, 7
 - 1: 7-03-2003
 - 2: 7-25-2003
- Aerial Photo: acquired from U.S. Department of Agriculture.
 - NAD83, UTM Zone 15
 - Year 2003
- Carver County outline polygon: acquired from Minnesota Geospatial information Offices
 - NAD83 UTM Zone 15



METHODS

- ArcMap 10.1 was used to clip the images to the carver county outline polygon
- An unsupervised classification (ISODATA) of 25 classes was performed on both images
 - Classed into Water, Forest, Grass/Agriculture, Urban, Cloud, and two mixed classes. (The aerial photograph was used to compare ground cover in 2003)
- A cluster bust for the two mixed classes for both images was performed using an unsupervised classification of 10 classes.
- A union matrix and report was completed to compare 2011 to 2003.

Results

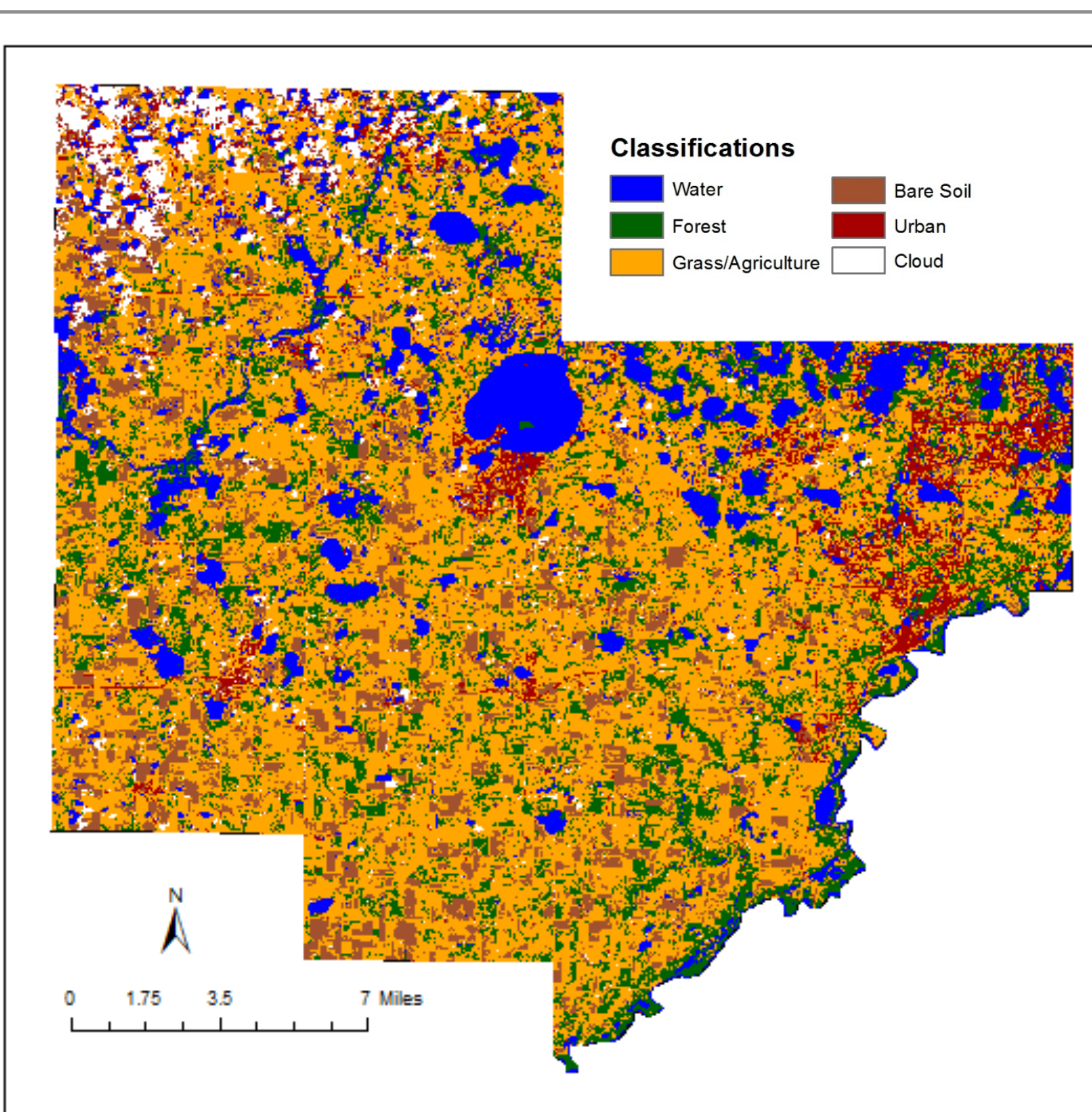


Figure 1. Land Cover in Carver County: July 03, 2003. Covers were assigned via an unsupervised classification in ERDAS Imagine followed by two cluster busts of two mixed classes. Several of the water classified pixels in the northwest corner are shadows due to cloud cover.

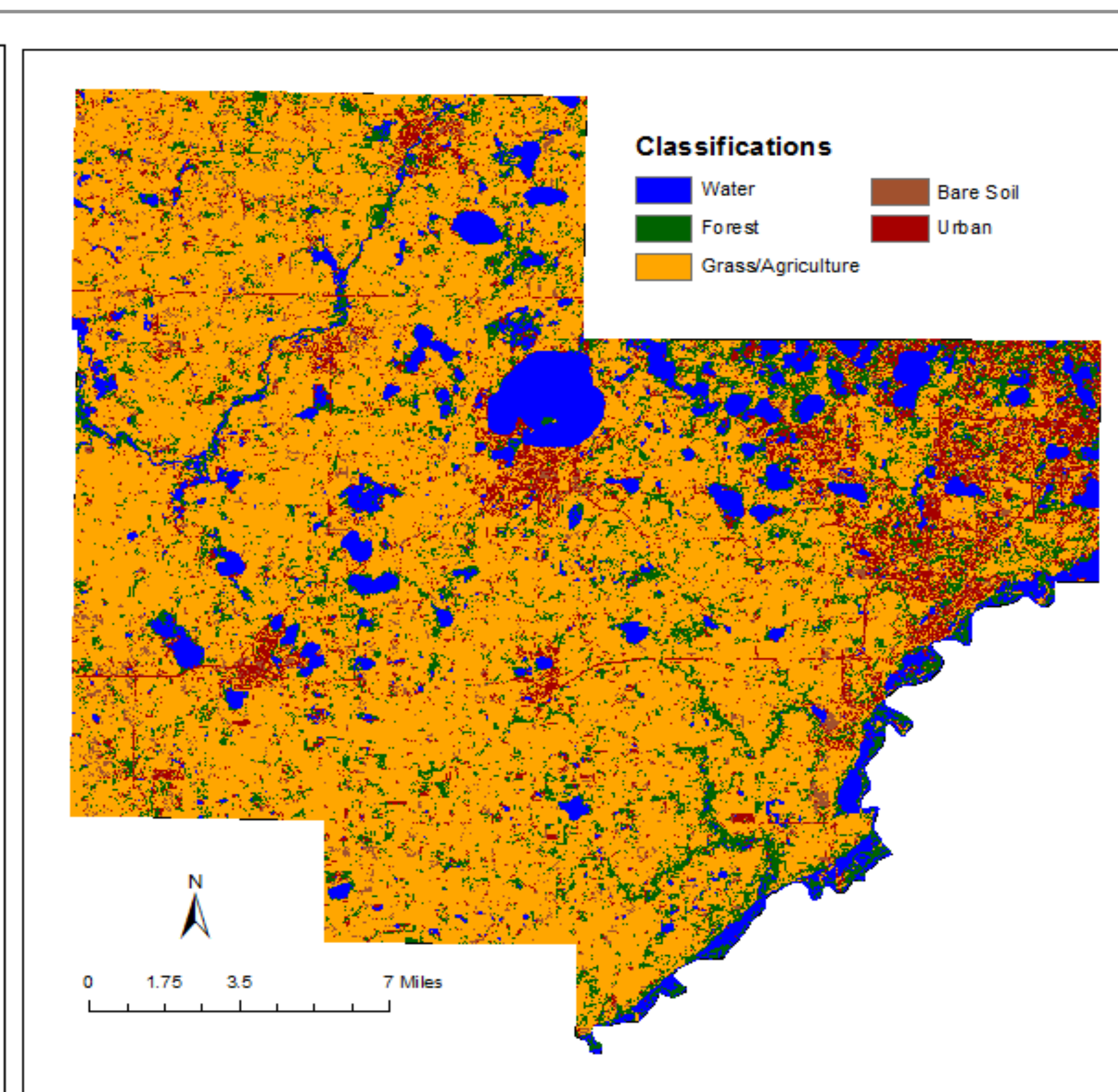


Figure 2. Land Cover in Carver County: July 25, 2011. Covers were assigned via an unsupervised classification in ERDAS Imagine followed by two cluster busts of two mixed classes.

Urban increased from 5,300 to 8,600 hectares of land from 2003 to 2011. The majority of that change was from the grass/agriculture class (36%) (Table 1). Overall, grass/agriculture increased from 52,500 to 65,500 hectares. In contrast, forest decreased from 15,000 to 12,000 hectares and bare soil decreased from 10,500 to 3,000. The changes for each class can visually be seen in figures 1 and 2. The majority of urban changes are seen on the east side (Fig 3).

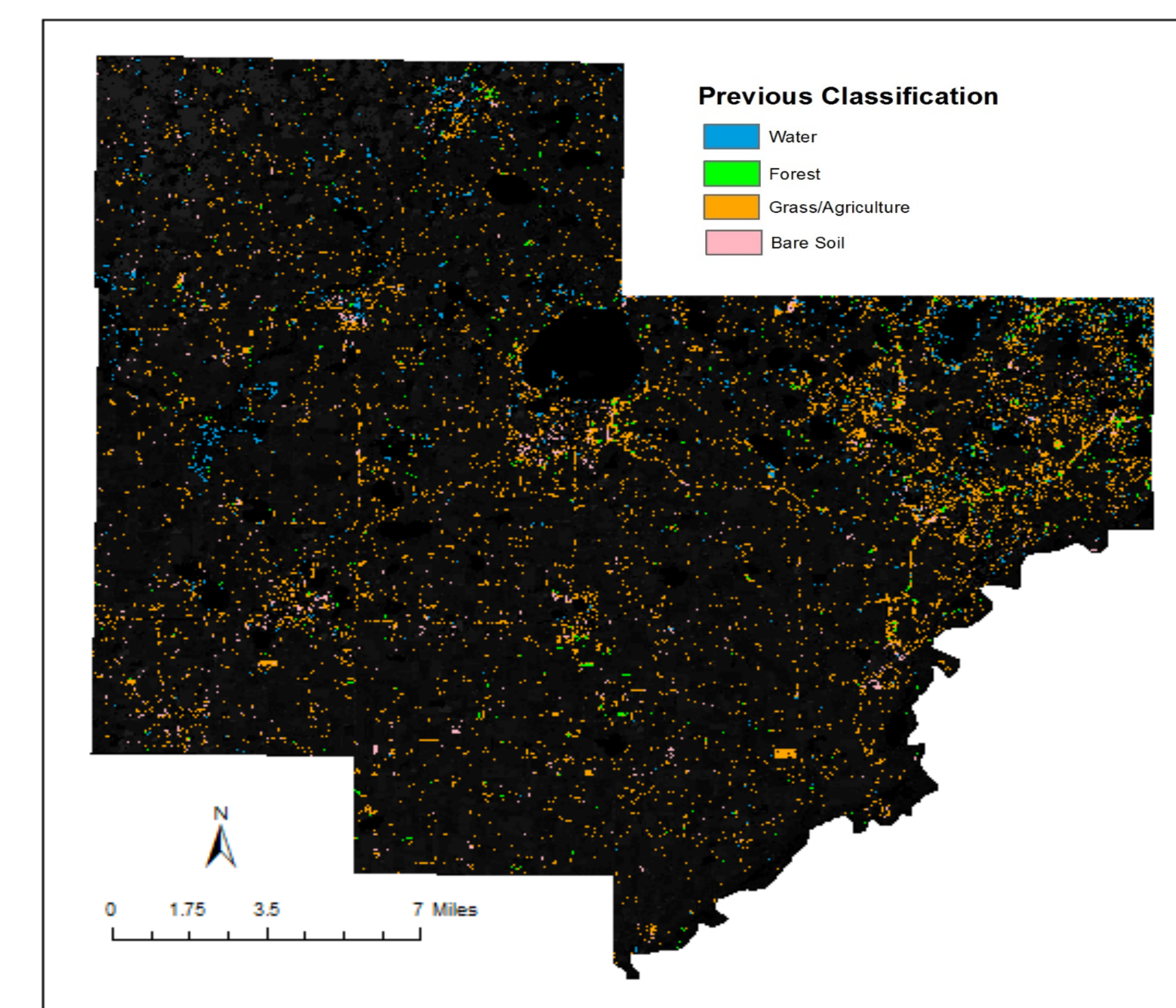


Figure 3. Matrix Union of 2003 & 2011 Land Cover images. This represents the land covers from the 2003 image of Carver County that are now classified as urban. Grass/Agriculture from the 2003 image has the largest overlap (36%) for the urban classification in the 2011 image.

Class	Percent	Hectares
1. Water	3.75	198.27
2. Forest	6.99	369.81
3. Grass/Agriculture	35.91	1900.8
4. Bare Soil	6.62	350.46
5. Urban	46.74	2473.83

Table 3. Matrix Report of Urban comparing 2011 image to 2003 image. Urban is the highest consistent class as expected, and grass/agriculture is second.

Discussion

Overall, you can see the increase in urban sprawl from the increase of the urban class. This coincides with the increase in population over the years mentioned before. This is largely seen around the lakes, previous small towns, and the east side. This is likely due to the Minneapolis area being east of this county and the desirability of lakeshore property. Although there was an increase in grass/agriculture, about 2,500 hectares of that was in the cloud coverage before, therefore it may have previously been grass/agriculture. Additionally, there are more water pixels in the northwest area in the 2003 image, which are likely due to shadows and not water bodies. In future comparison, an area without cloud coverage would be ideal.

The decrease in forest, looks to have been replaced with agriculture (Fig's 1 and 2). There was a large difference in bare soil from 2003 to 2011 and that could be due to the difference in dates between the images. A certain crop abundant in the area may have been harvested in late July, or the bare soil was due to development that was underway. This could account for the 6% of bare soil from 2003 that was changed to urban in 2011. Further evaluation to development projects in the county could be assessed to find out.

Previous studies of other counties around the Minneapolis area have used classification methods such as weighted regression (Ghosh & Manson, 2008), which could be used in future studies of this area. Furthermore a study of counties around the Twin Cities, including Carver County, did an accuracy assessment (Yuan et al, 2005) which could be used to validate results found here as well as see what areas may have been missed due to cloud coverage.

Conclusion

Urban sprawl can be seen over the time of 2003 to 2011 in Carver County, MN. Through this analysis urban sprawl and the areas where this happened can be further understood. The east side had majority of change and the land that changed was primarily grass/agriculture. Future studies should include a map without cloud coverage as well as a ground cover truth image for accuracy assessment to improve the results. Also, more land coverage's could be helpful to further analyze where urban development is happening in Carver County.

References

1. Carver County Minnesota. 2010 Census Data. Retrieved from <http://www.co.carver.mn.us/departments/LWS/census.asp>
2. Ghosh, D., & Manson, S.M. (2008). Robust principal component analysis and geographically weighted regression: urbanization in the Twin Cities metropolitan area of Minnesota. *Journal of the Urban Regional Information Systems Association*, 20(1), 15-25.
3. The Carver County 2030 Comprehensive Plan. (2010). Public Health & Environmental Division Planning and Water Management Department. Retrieved from http://www.co.carver.mn.us/departments/LWS/docs/03_Land_Use_100427.pdf
4. Wang, L., Lyons, J., & Kanehl, P. (2003). Impact of urban land cover on trout streams in Wisconsin and Minnesota. *American Fisheries Society*, 132, 825-839
5. Yuan, F., Sawaya, K. E., Loeffelholz, B. C., & Bauer, M. E. (2005). Land cover classification and change analysis of the Twin Cities (Minnesota) Metropolitan Area by multitemporal Landsat remote sensing. *Remote Sensing of Environment*, 98, 317-328.