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Population Growth and Municipal Water Insecurity in Mesa County, Colorado



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Abstract

The purpose of this project was to utilize GIS software to develop a population and daily domestic water resource requirement analysis for Mesa County, Colorado by answering the question of what municipalities within the county have the highest potential of developing water insecurities between the years 2000 and 2019. The methods for developing the spatiotemporal population change of Mesa County, Colorado utilize attribute manipulation and statistical tools within ArcGIS Pro. The four municipalities, Clifton, Loma, Fruita, Grand Junction, and Orchard Mesa experienced the greatest population increase and daily water resource requirement increase marking these areas as the most likely to develop water insecurities in the future. While substantial population growth has taken place over the past twenty years through the county, most of the of growth occurred between 2000 and 2010, allowing for municipalities to adapt to the increase in population over the past decade. This project took a broad view of the county's daily water use and found that the county has access to enough fresh water to support a growing population, and that other factors such as surface water quality and management are a more pressing line of study.

Introduction

Global population continues to rise, the need for community development sustainability analysis will continue to grow as well. Change in any capacity brings about different resource requirements for our communities. Under the condition of limited resources, regional population growth can induce severe community vulnerabilities (Neumann et al., 2015). This project was designed to determine the change in daily water requirement by census tract throughout Mesa County, Colorado from 2000 to 2019, strictly as a function of population change. Figure 1 below is a map showing the designated study area.

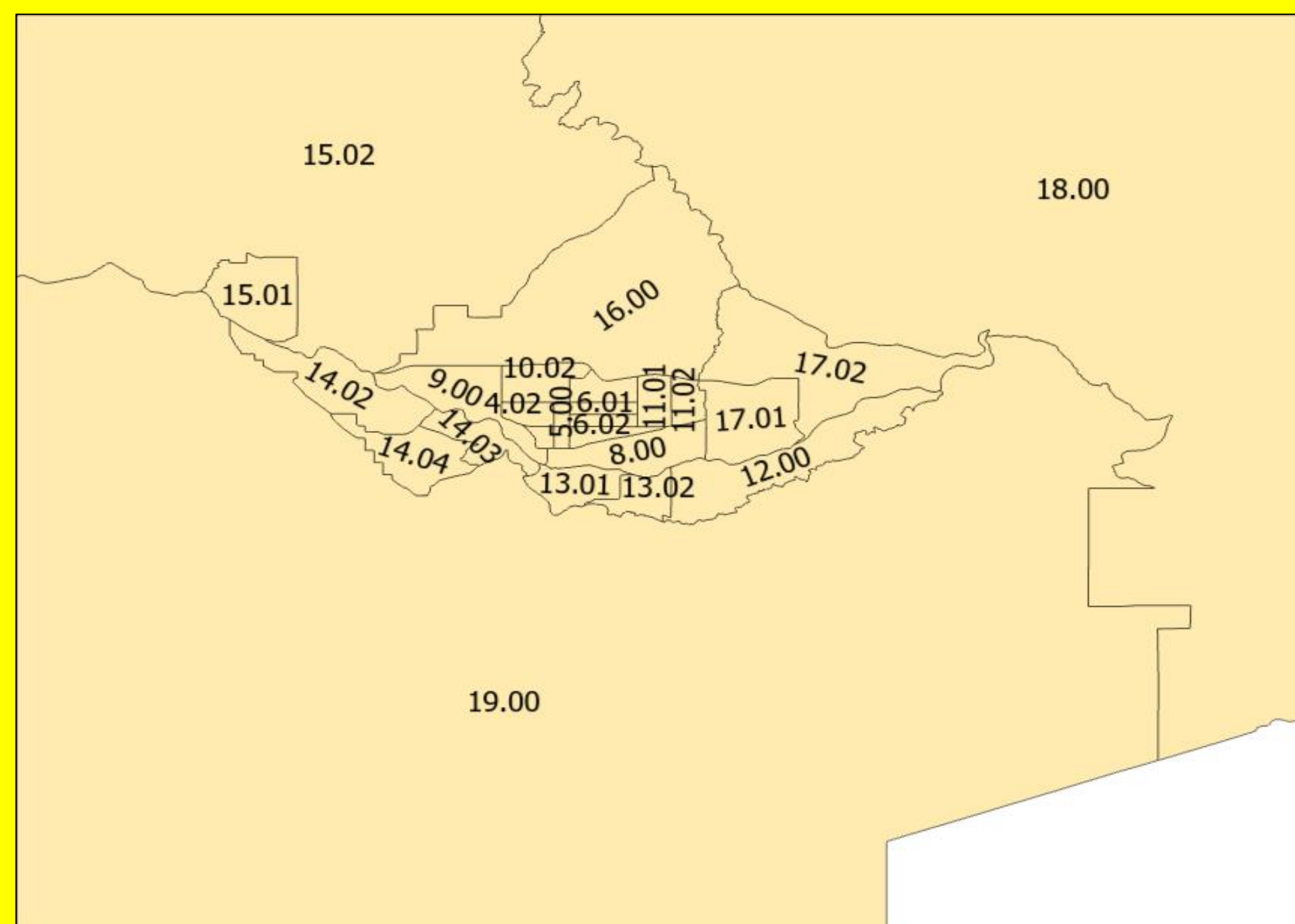


Figure 1: Study Area

Methods

For this study, American Community Survey (ACS) data for 2019 and Decennial Census (DC) data for 2000 and 2010 was used to determine population change in Mesa County. Estimations on daily per capita water use were taken from both the USGS and Colorado Water Commission. A baseline of 136 gallons per person per day was estimated within the region for a 2019 water requirement, based on 2015 projections for Mesa County, Colorado (Colorado Water Conservation Board, 2015). Using historical data for daily per capita use in 2000 and 2010, the USGS estimates a use of 122 and 139 gal per person per day for 2000 and 2010, respectively. Using population change data, along with this water use data, the attribute table functions for analysis within ArcGIS Pro were used to quantify the change in daily water use per tract.

Results

Over the past twenty years, there have been significant changes to the water requirements within Mesa County, Colorado with more change occurring from 2000 and 2010 as opposed to 2010-2019. Mesa County experienced a population increase of 34,936 people and an increase in 6,382,538 gallons of daily water use between 2000 and 2019. Figure 2 is a choropleth of water use change in Mesa County between 2000 and 2019. Table 1 displays the estimates of population change and daily water requirement change over the past twenty years broken up by time frame. The municipalities that experienced the greatest population growth and greatest change in daily water use per person are the municipalities of Clifton, Loma, Fruit Grand Junction, and Orchard Mesa.

Table 1: Estimates of Population and Daily Water Use Change

Time Span	Average Change in Census Tract Population	Total County Change in Population	Average Change in Census Tract Water Use (gal)	Total County Change in Daily Water Use (gal)
2000-2010	1,171.8	30,468	238,899.5	6,211,387
2010-2019	172.9	4,495	6,582.7	171,151
2000-2019	1,344.7	34,963	245,482.2	6,382,538

Table 2: Daily Water Use Change for the top 6 Tracts and Municipalities

Tract Number	Census Tract Associated Municipality	Water Use Change by Time Frame		
		2000 – 2010	2010 – 2019	2000 - 2019
15.01	Fruita	959286	42898	1002184
17.01	Clifton	883041	34599	917640
8.00	Grand Junction	430880	102334	533214
15.02	Fruita/Loma	359562	33030	392592
13.01	Orchard Mesa	397441	-33683	363758
13.02	Orchard Mesa	323427	17913	341340

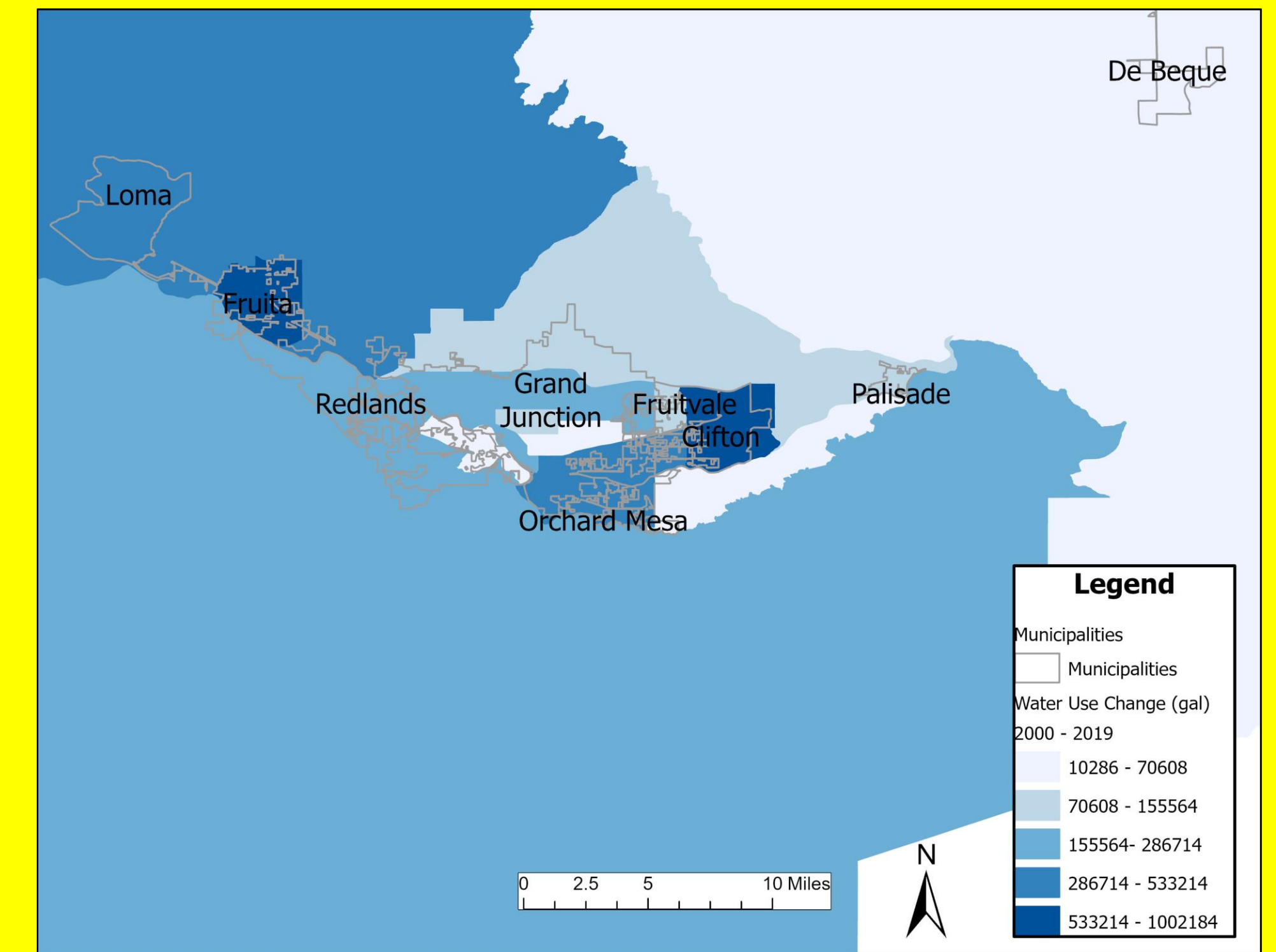


Figure 2: Water Use Change

Discussion

The results produced using this method of analysis did answer the question this project set out to understand. Based on the population change within Mesa County, Colorado, how has the daily water use also changed. What this analysis overlooks are the various other aspects of community that affect water resource allocation other than population change. This project acts as a baseline analysis for understanding the raw quantities of change occurring within the county, but further analysis is needed to understand the true projection of the county's water resources.

Conclusion

Water resource sustainability analysis requires many more inputs than what was used in this short semester project. While this data can be useful in understanding the average increase of daily water use in Mesa County, Colorado, this project has a limitation in that it does not address the issue of whether certain areas face water insecurity. The next step in analysis is to further extend the bounds of analysis, and understand what the water is being used for, and what resources are available.

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