Threatening Dams in Georgia

"Georgia Population Most at Risk from Hazardous Dams and the Potential Impact on People and Property"

Mina Lee

ENVS 250: Fundamentals of Cartography & GIS

12/ 7/ 2019

I. ABSTRACT

Dam is a useful infrastructure that provides environmental, commercial, and industrial benefits to human. People understand the benefits and impacts of constructing dams but do not understand the importance of its maintenance. As more dams are getting neglected in the United States, Georgia also has a high number of hazardous neglected dams. With more information about Georgia dams' locations, elevation and flood plains, and population density, this study focuses on the hazardous dams in Georgia and potential impact on people and property. Through this study, a thematic map representing the range of hazardous dam's potential impact is provided for people to be aware of the future danger. Topographic maps showing the possible dangerous zones in the area of specific dams, Atlanta Reservoir No.1& NO.2 and Carriage Lake Dam, are generated to provide informative data and safety guidelines to the communities within the danger zones.

II. BODY

1. INTRODUCTION

Dam is one of the useful constructions for water resources, working as a barrier to restrict the flow of water from streams, lakes, ponds, or underground streams. Through Dams, people have obtained many positive and negative environmental, commercial, and industrial benefits. Dams have been constructed to prevent floods, to supply water resource, and to generate energy -hydropower. Dams also cause numerous environmental impacts: blocking fish migrations, raising temperature, creating chemical composition, and many more ("Environmental Impacts of Dams"). Dams were constructed before the Industrialization and, with its long history, many dams in the United States were also constructed before people had sufficient knowledge about hydrology. However, due to the large number of existing dams in the United States, the sustainable management of dams gained an increasing importance. As populations have exponentially grown, cities have expanded, and technology has been improved, more dams were neglected by more people. Neglected dams could make damages on not only plants and animals but also on people's daily life as they affect air, water, and soil pollution from wastes as well as the changes in ecosystems (Sait, Nermin, Fatih, Nurcan).

An article, "The Threat of aging Dams in Georgia", explains a recent investigation in which among 1,688 high-hazard dams Georgia has nearly two hundred unsatisfactory or poor condition dams. With drastic changes in climate, this infrastructure problem could give life-threatening dangers to homes, business, highways, or entire communities in Georgia. This danger can lead to ~$70 billion dollars to be fixed (Darnell).

Through this project, we wanted to produce a geospatial database including an inventory of Georgia Dams highlighting those most at risk and the potential impact on people and property. We also focused on the ethnicities of population who would be in danger due to high-hazard dams so to know the socio-economic relationship between the area around high-hazard dams and the people who live within those areas.

This study will provide a safety guideline to make people be aware of the potential dangers they could encounter from their living areas. Also, this study can inform the necessity of funds to the low-income family or communities with high potential risks.

2. OBJECTIVES

The main goal of this study is for the safety reasons. The study will locate most hazardous dams in Georgia and inform people who are at risk from hazardous dams. It will also to find the relationship between the racial group and risk from dams.

3. METHODS

3.1 Neglected Dams

Lists of neglected dams across the US is collected from an *AP* analysis ("Dams in the US: A Legacy of Neglect" 2019). Among 1,688 high hazard dams on *AP* analysis, 168 Georgia dams that are rated in poor or unsatisfactory condition were selected and collected alphabetically to be used for the study (Table 1).

Table 1. List of Georgia hazard Dams (screenshot)

	A	B	C	D	E	F	G	H	I
1	4-J Farms Lower Lake Dam	Cartecay River Ws Str #5	Erin's Place Lake Dam	Jackson Creek Lake Dam	Little River W/s Str. #34	N. Ga. Rendering Plant Ox	Rainbow Lake Dam	Sharp Mountain Creek Ws	Vogel State Park Lake Dam
2	Athens Waterworks Reservoir Dan	Cartecay River Ws Str #6	Euharlee Creek Ws Str #4	Jason Creek Lake Dam	Little River W/s Str. #35	Nelson Hill Subdivision Lal	Ridge Brooke Lake Dam	Sharp Mountain Creek Ws	Walden Woods Lake Dam
3	Atlanta Reservoir Dam No. 1	Cartecay River Ws Str #7	Fowler Lake Dam	Keeter Lake Dam	Little River W/s Str. #36	Nicholson Lake Dam	Rocky Comfort W/s Str. #!	Sharp Mountain Creek Ws	Walter Richards Lake Dam
4	Baughs Crossroad Lake Dam	Chastain Lake Dam (Lowe	Frank C. Amerson Jr. Lake	Kiker Lake Dam	Little River W/s Str. #37	Noonday Creek Ws Str #17	Roskin Lake Dam	Shaw Lake Dam	Watson Road Lake Dam
5	Bedgood's Lake Dam	Chastain Lake Dam (Upper	Glenn Lake Dam	Kings Cliff Lake Dam	Little River W/s Str. #38	Noonday Creek Ws Str #4	Sallacoa Creek Watershed	Skyland Lake Dam	Wigley Lake Dam
6	Belair Lake Dam	Clark Apple Orchard #3	Glenover Drive Lake Dam	Lake Ashely Dam	Little River W/s Str. #39	North Fork Broad River Ws	Sandy Creek Ws Structure	Soque Creek W/s Str. #44	Willow Lake Dam
7	Berry Reservoir Dam	Clear Lake Dam	Goshen Plantation Lake Da	Lake At Ansley Dam	Little River W/s Str. #40	North Fork Broad River Ws	Sandy Creek Ws Structure	South Fork Broad River W,	Woodbridge Lake Dam
8	Big Cedar Creek Ws Str #32	Cochran Lake Dam	Grandview Lake Dam	Lake Dow Dam	Little River W/s Str. #41	North Fork Broad River Ws	Sandy Creek Ws Structure	South Fork Broad River W,	York Lake Dam
9	Big Cedar Creek Ws Str #41	Conasauga Lake Dam	Graves Lake Dam	Lake Dow North Dam	Little River W/s Str. #42	Odom Lake Dam	Sautee Creek W/s Str. #1!	South Fork River Ws Str #;	Young Lake Dam
10	Big Cedar Creek Ws Str #48	Cowan Lake Dam	Harrison Lake Dam	Lake Forrest Dam	Little River W/s Str. #43	Palmetto Creek Structure I	Sautee Creek W/s Str. #1!	South River W/s Str. #51	
11	Black Rock Mountain Lake Dam	Dalton Utilities Impoundm	Hazel Creek W/s Str. #19	Lake Franklin Dam	Little River W/s Str. #44	Parker Lake Dam	Seagraces Mill Pond Dam	Stonegate Lake Dam	
12	Blackmon Lake Dam	East Point Reservoir Dam	Hazel Creek Ws Str #7	Lake George Dam	Little River W/s Str. #45	Pfau Lake Dam	Sequoyah Lake Dam	Stonerbidge Lake Dam	
13	Boleman Hill Road Pond Dam	Edmondson Lake Dam	Hightower Creek Ws Str #:	Lake Kathy Dam	Little River W/s Str. #46	Piedmont Lake Dam	Settingdown Creek Sub W	Stringers Lake Dam	
14	Bull Creek Ws Str #12	Ellijay River W/s Str. #3 D	Hogans Lake Dam	Lake Rockdale Dam	Little River W/s Str. #47	Ping Log Creek Dam No. 8	Settingdown Creek Ws Str	Summit Chase No. 1 Dam	(Upstream)
15	Bull Creek Ws Str #14	Ellijay River W/s Str. #4 D	Hulsey Pond Dam	Lake Swan Dam	Little River W/s Str. #48	Ping Log Creek Watershed	Settingdown Creek Ws Str	Talking Rock Creek Ws Str	#13
16	Burdine's Pond Dam	Ellijay River Ws Str. #10	Hunnicutt Lake Dam	Lake Wildwood Dam	Little River W/s Str. #49	Plantation Subdivision Lak	Settingdown Creek Ws Str	Tara Lake Dam	
17	Burgess Lake Dam	Ellijay River Ws Str. #11	Imerys SC Clay Impoundm	Lakefield Commons Lake I	Little River W/s Str. #50	Posey Lake Dam	Settingdown Creek Ws Str	Tera Lee Lake Dam	
18	Carriage Lake Dam	Ellijay River Ws Str. #12	Indian Lake Dam	Lakeview Plantation Dam	Little River W/s Str. #51	Pumpkinvine creek W/s St	Settingdown Creek Ws Str	The Farm Lake Dam	
19	Cartecay River Ws Str #3	Ellijay River Ws Str. #9	Irene Lake Dam	Laura Lake Dam	Little River W/s Str. #52	Pumpkinvine creek W/s St	Seventh Day Adventist Lak	Timber Lake Dam	
20	Cartecay River Ws Str #5	Erin Lake Dam	J. Stephens Lake Dam	Lawson Lake Dam	Little River W/s Str. #53	Pumpkinvine creek W/s St	Sharp Mountain Creek Ws	Trout Farm Lake Dam	

After a list of high-risk dams in Georgia was collected, the data was compared with ESRI data, "Georgia Dam Inventory". Each dam in the data was organized and categorized to either no risk or risk so that the dataset of dams would show the distinction on the map. The distinction of risk and no risk dams was done by changing symbology of Georgia Dams to unique values and marked risk dams to black circle points and no risk dams to no color circle points.

3.2 Population around Neglected Dams

In order to see the population around neglected dams, dataset of Census_2010_Blocks_Georgia was used. Data was zipped together and was uploaded on the BOXShare so exported as a shapefile and to be used for the ArcGIS. Buffering fifteen-miles around high-risk dams was conducted and labeled as "high risk area" to find the potential impact range of neglected dams.

The relationship between the region around neglected dams and population within the areas was shown through by running a "spatial join" of two datasets and changing the newly spatial joined layer's symbology to graduated colors based on "TotalPop2010".

3.3 Ethnicity

The relationship between the potential impact range and total percentage of ethnicities (White, Black, Asian, Hispanic/Latino) was found by calculating mean total White, Black, Asian, Hispanic/Latino and other populations in each census for high risk areas (spatial joined dataset from previous step). Also, to compare whether if the differences between types of ethnicities in high risk areas and those of Georgia in general exist or not, pie chart for Racial Categories at high risk areas and other pie chart of Racial Categories in Georgia were created.

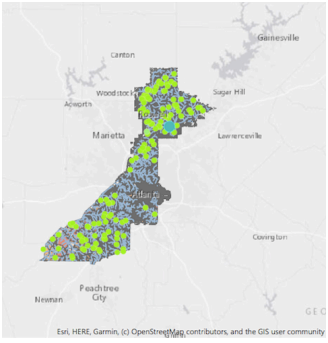
3.4 Case Study I

Case Study I show how many people living around Atlanta Reservoir No1. And No.2 are at risk if the water overflows and its possible path when water overflows.
Topographic features were imported from online website *Fulton County Topographic Contours Download Tool*, and all shapefiles were merged into one layer, "ContourLines". Running a tool, "Topo to Raster", created a raster file of "ContourLines" and the raster file's symbology was changed to white to black to show the elevation (named a layer TopogrphicRaster). "Hillshade" tool was used to create a hill shade layer of topographic raster and "Slope" tool was used to create slope layer of the topographic raster. In order to see the elevation more clearly, symbology was changed to green to red color so that red color would show higher elevated areas.
2010 US Census Bureau blocks, Rivers & Streams, Lakes & Ponds, Floodplains were imported from Emory BOX share Building footprints were imported from online Regional Commission. All the collected datasets were then added to map. Building layer's symbology was changed to color, gray and the Census block's symbology was changed to graduated color by "totpop10" and renamed the layer as Population by Census Block.

3.5 Case Study II

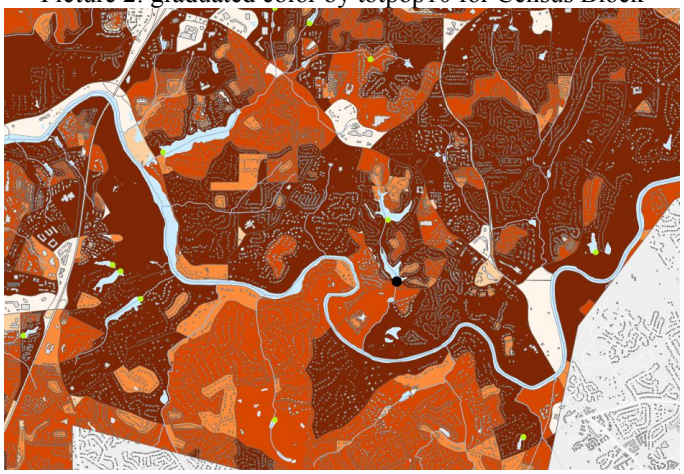
The purpose of Case Study II is to find high-risk dams in Fulton county in which the highest density of population lives in. Among all the high-risk dams, Carriage Lake Dam was selected to see how many people would be in danger if the water overflows and its potential impact around the areas (picture 1).

Picture 1: Hazardous dams in Fulton County

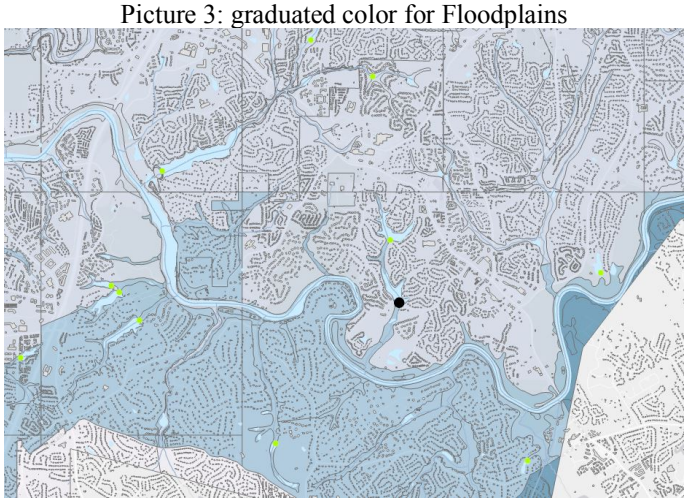


Same as Case Study I, Topographic features (Tile Name: C05-T2464, C05-T2454, C05-T2455, C05_T2465) were imported from online website *Fulton County Topographic Contours Download Tool*, and all shapefiles were merged into one layer, "TopoCarriage". Running a tool, "Topo to Raster", created a raster file of "TopoCarriage" and the raster file's symbology was changed to white to black to show the elevation (named a layer Topo). "Hillshade" tool was used to create a hill shade layer of topographic raster and "Slope" tool was used to create slope layer of the topographic raster. In order to see the elevation more clearly, symbology was changed to green to red color so that red color would show higher elevated areas.
2010 US Census Bureau blocks, Rivers & Streams, Lakes & Ponds, Floodplains datasets were imported from Emory BOX share and Building footprints dataset was imported from online gisdata, fultoncountyga. All the collected datasets were then added to map. Building layer's symbology was changed to color-white, the Census block's symbology was changed to graduated color, continuous orange, by "totpop10" (picture 2), both Rivers & Streams and Lakes & Ponds' symbology was changed to color, 2nd water (line), and floodplains' symbology was changed to graduated color, continuous blue (picture 3).

Picture 2: graduated color by totpop10 for Census Block

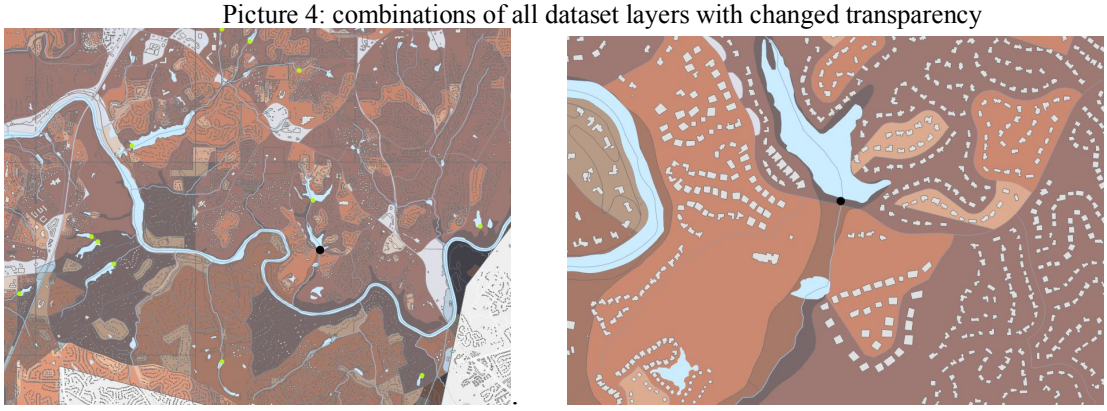


Picture 3: graduated color for Floodplains

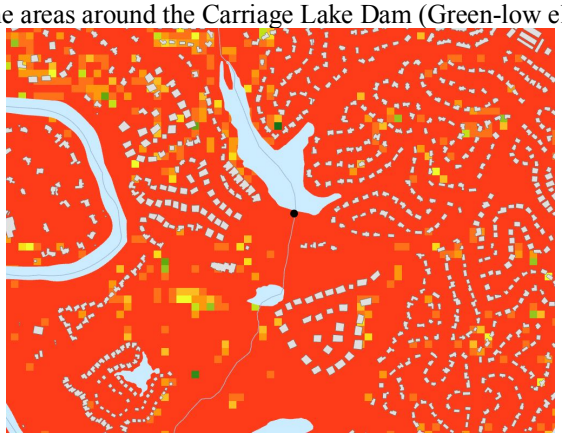


Different from the Case Study I, each of layers was intersected with Fulton County polygon layer from "counties" layer from GIS class folder to specify the map to Fulton County's range. The transparency of each layers was used to overlap with other layers of the map on top of the population layer (picture 4).
However, the slope and hill shade layer were not used for this case study since both layers do not show obvious distinctions in elevation (picture 5). Instead, since the area is highly residential and have many buildings, it used floodplain layer and population density layer to see the impact of the dam.

Picture 4: combinations of all dataset layers with changed transparency



Picture 5: Slope Layer for the areas around the Carriage Lake Dam (Green-low elevation Red-high elevation)

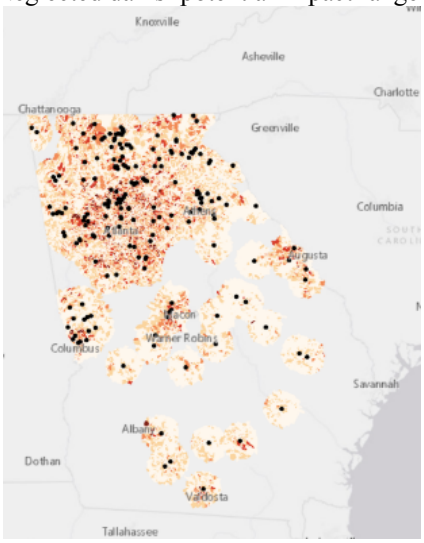


4. RESULT

4.1 High Risk Dams and Population

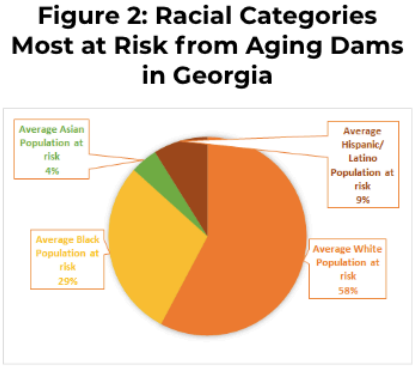
Geological map depicts the range of neglected dams' potential impact (Figure 1). High Risk Areas are centered around the northern part of Georgia. Atlanta is one of the cities with many high-risk dams.
Among all, 174,810 census areas are at risk. Since each area contains forty-four people, approximately 7,691,640 people are under the risk.

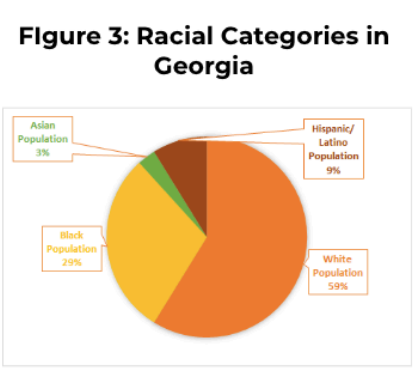
Figure 1: Neglected dams' potential impact range (15 miles)



Pie charts for Racial Categories from Aging Dams in Georgia and Racial Categories in Georgia do not have a great distinction. Average Asian population at risk is 4%; average Hispanic/ Latino population at risk is 9%; average Black population at risk is 29%; average White population at risk is 58%. Average Asian population in Georgia is 3%; average Hispanic/Latino population in Georgia is 9%; average black population in Georgia is 29%; average White population is 59%, meaning there is no greatest relationship between the ethnicities in Georgia and ethnicities rates in high risk areas.

Figure 2: Racial Categories at High Risk Areas & Racial Categories in Georgia

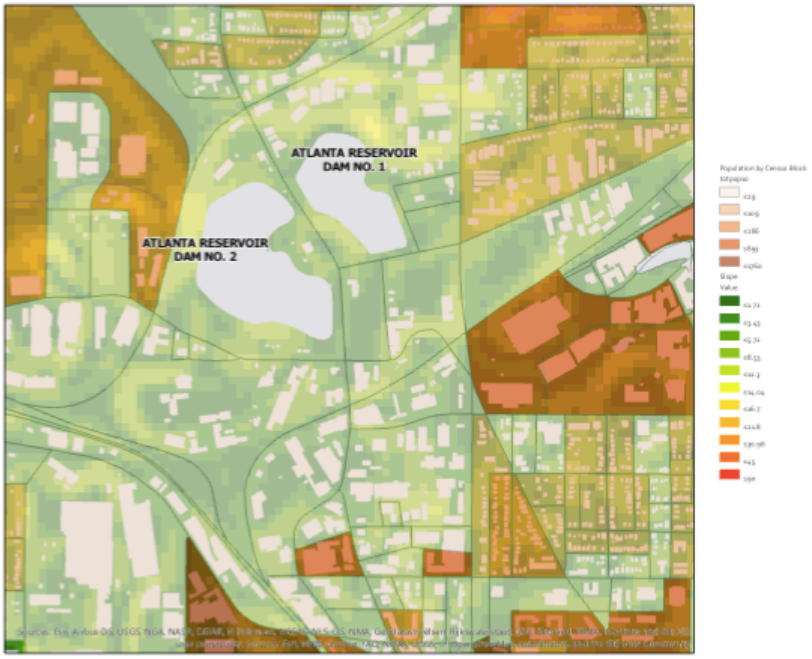




4.2 Case Study I & II

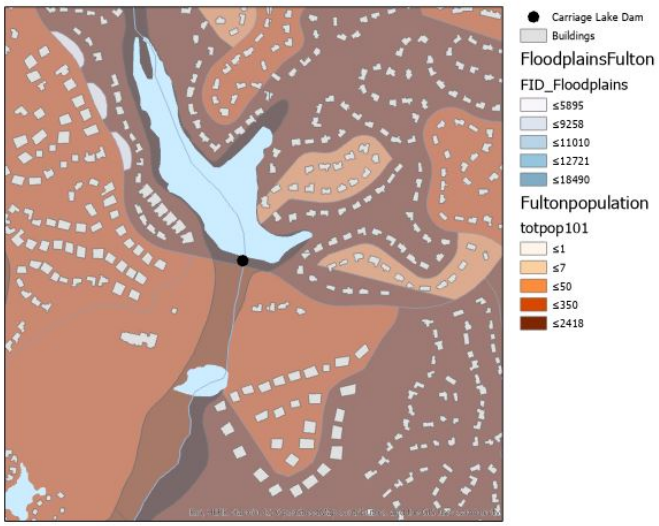
The river will overflow into areas of low elevation which colored dark green. Since these areas do not have high density but some buildings will be damaged if the water overflows. However, the overflow from dams will likely avoid highly populated residential neighborhood (Figure 3).

Figure 3: Case Study I (Atlanta's Reservoir No.1 and No.2)



Fulton Carriage Lake is location in North of Atlanta. It was built in 1974 but the last inspection was done on February 3, 2016. The area with dark orange represents both a high-density population and higher risk of getting flooded from high-risk dams. The Carriage Lake Dam will not have significant impact compared to the areas near Chattahoochee River, but possible dangers could happen if the dam overflows since the area around the dam has high population and many residential areas/ buildings (Figure 4).

Figure 4: Case Study II (Carriage Lake Dam)



5. DISCUSSION

The sustainable management of dams is critical in preventing any potential risk that could happen from the failure of infrastructures' maintenance. The first step to take is to notice the locations on a map which can be used a s a digitized map for people to locate high-risk dams or as a fundamental data to analyze its future impact. The range of high-risk dams is essential for this map to inform people who unaware of possible dangers. However, due to the limitations of each dams' information on sizes and structure, it was hard to provide accurate ranges of possible danger, so the approximate of fifteen miles around the dams was used as a foundation.

Focusing on hazardous dams' possible impact range, to whom it may cause damages was another focal point to analyze in the study. Using 2010 census data, it was proven that approximately an average Asian population at risk is 4%, an average Hispanic/ Latino population at risk is 9%, an average Black population at risk is 29%, and an average White population at risk is 58%. Considering that average population in Georgia is consecutively 3%, 9%, 29%, 29%, the relationship between the ethnicities and the hazardous dams' possible impact area have no critical relationship and no one group is disproportionately at risk. People do not choose their living areas based on the amounts of dams in the neighborhood neither choose it by knowing about the possible environmental dangers in the community. However, specific analysis on cities showing diverse ethnicity rates (ex. Duluth, Doraville, Decatur) could have shown different results as what this study has gotten.

Locating in the Fulton County, dams' possible impact range was analyzed with three properties: population, floodplains, and elevation. Both Case Studies on Atlanta Reservoir No.1 & No.2 and Carriage Lake Dam are concluded that both dams will not cause highly dangerous situations to people and buildings around. Even though it could affect a few closer ones in distance, it is likely to avoid the highly populated residential areas because they are located in high elevation areas that would minimize the impact.

III. CONCLUSION

Neglected dams are critical danger to the people who live around. Digital map was created to increase awareness of potential danger and, possibly, the necessity of maintenance. Despite the fact that two focused studies do not show the obvious and most dangerous impact to the highly populated residential areas, the collapse of dams or flooded dams will definitely affect people, properties, and communities around. Therefore, it is important for people to expand their awareness and importance of maintenance of hazardous dams and achieve ultimate goal of living in a safe region. Furthermore, Georgia government needs to understand necessity of not only the maintenance, but also the installation of safety measures, public education, public safety reporting, and constant monitoring of these dams.

IV. REFERENCE

CAnorld03, 2019. Georgia Dam Inventory, https://www.arcgis.com/sharing/rest/content/items/148c4e7aa3ca450fbe682dd01d24c95.

Dams in the US: A legacy of Neglect. (2019, November 8). Retrieved from https://interactives.ap.org/dams-legacy-of-neglect/.

Darnell, Tim. "It's going to wash away us and a lot of beer, Atlanta brewery owners says of one leaky dam". *AJC, the Atlanta Journal Constitution*. November 14, 2019. https://www.ajc.com/news/georgia-has-more-dangerous-dams-than-any state/q2Bsh3NyKD8kltXsO7GstK/

"Environmental Impact of Dams*"*. *International Rivers people water life*. https://www.internationalrivers.org/environmental-impacts-of-dams.

Flood Plains. 1998. Federal Emergency Management Agency. http://www.fgdc.gov/metadata/fgdc-std-001-1998.dtd.

Fulton County Topographic Contours Download Tool. (n.d.). Retrieved from https://gis.fultoncountyga.gov/apps/topodownloadmapviewer/.

Fulton_County_GIS. Structure Footprints. Compiled by the Fulton County Department of Information Technology, GIS Division. Retrieved from https://gisdata.fultoncountyga.gov/datasets/027967b8d0fa4ed7bd844d98371dd560_0.

Lake & Ponds. 1999. GA Department of Transportation. http://www.fgdc.gov/metadata/fgdc-std 001-1998.dtd.

Lieb, A. David. Casey, Michael, Minkoff, Michelle. "AP: At least 1,680 dams across the US pose potential risk". *AP*. November 11, 2019. https://apnews.com/f5f09a300d394900a1a88362238dbf77

"Public Safety Around Dams". *ASDSO*. https://damsafety.org/public-safety

Rivers & Streams. 1997. GA Department of Transportation. http://www.fgdc.gov/metadata/fgdc std-001-1998.dtd.

Sait,T., Nermin, Anul., Fatih, E., Nurcan, Durmus. Positive and Negative Impacts of Dams on the Environment. *International Congress on River Basin Management*. https://cvc.ca/wp-content/uploads/2011/02/60.pdf