Water Utilities Vulnerability Due to Climate Change

WRPI Report

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Executive Summary

Water utilities throughout the United States focus on the quantity and quality of the water resources that are available to that certain utility. Future climate change has a large impact on freshwater resources, whether it may be a great abundance of water, or a drought in the resource. Risk and resilience assessments can be made to weigh the specific parameters of any certain water utility. The assessments are based upon 10 different parameters, these being: increased temperature, extreme precipitation, storage capacity, water utility interconnection availability, inland flooding, drought, wildfires, rise in sea level / coastal storm intensity, erosion / landslides, and water quality. Depending on where the utility is located, an assessment can be made given their previous weather conditions, and gradually increasing these conditions caused by climate change for future planning. Once the assessment is made for the utility there are strategies established to help the utility lower their vulnerability score, which ultimately makes the utility more resilient, meaning the water supply is more sustainable.

Project Objectives

Climate change has gradually increased with time, and will only continue to do so. Water utilities around the United States are trying to figure out how they can prepare for these gradual changes that affect their urban and rural sector water supply. Therefore in order to help utilities be more resilient, every parameter that may affect their water supply has to be accounted for, and a plan must be developed to prepare for future climate change, so they can keep the negative affect that climate change has on water to a minimal.

I am majoring in Biosystems and Agricultural Science Engineering, after graduating in December 2020 I will strive to land an engineering career position in the water industry. USDA has given me the opportunity to research different areas of the water industry, which has not only increased my interest but also my knowledge. I am very thankful for the opportunity to work with the USDA; this program has opened my eyes to many different areas of water that have helped me learn in order to be a better engineer in the future.

The objectives of this project were to research how climate change affects water supply in terms of water utilities around the United States. As climate changes over time it will affect the quantity and quality of water supply. This project establishes a vulnerability scale that showcases how vulnerable a certain water utility is, given their average climate characteristics. Overtime climate changes will increase primarily due to human generated anthropogenic greenhouse gases. The average increase in climate change is taken in consideration when calculating a utilities vulnerability scale. The

scaling system allows the water utility to prepare for each section of the scale in order to make that utility more resilient, which ultimately achieves a lower vulnerability scale.

Project Approach

When I first started this project I was unaware how much climate change affects water supply overtime. The first step in executing this project was to make an Annotated Bibliography by researching all different areas of water vulnerability and the risk factor involved in all different parts of the world. Once I figured out problems in water supply due to climate change that were happening all over the world, I was able to narrow down the research to specific problems that water utilities are experiencing in the United States. One side of the United States receives a high amount of precipitation yearly and the other receives hardly any precipitation yearly. For instance California has a low percentage of precipitation, therefore this state is more susceptible for drought; where as Louisiana or another state on the East Coast receives a high amount of precipitation yearly is more susceptible to flooding. Whether a utility is expecting drought or flooding, both of these disasters cause many more problems that need to be considered and evaluated. Once the utility is able to pin point their vulnerabilities, the vulnerability scale (show in the appendices) can be used to show the utility what areas they need to focus on the most, in order to make the water supply more sustainable and less vulnerable.

Project Outcomes

After researching many different areas on climate change vulnerability, a vulnerability score was developed. The higher the vulnerability score, the more vulnerable the utility; the lower the score, the less vulnerable and more resilient the utility. This score is used to help any water utility nationwide, to analysis their rural and urban regions that are contributing to a high vulnerability score due to climate changes. After the water utility has been given a vulnerability score, there are many different parameters that can be followed to help make the water utility more resilient, ultimately lowering their vulnerability score. The score is given on 10 different sections, each section is on a 0 to 10 scale, and therefore the whole score in given on a scale of 0 to 100. The closer the score is to zero correlates to a well diversified and very resilient water utility; the closer the score is to ten shows that the water utility needs to assess all parameters contributing to changing climate and how it correlates to their water utility, in order to lower the vulnerability of the utility. This climate change risk evaluation is based upon ten different climate changing parameters, these being: increased temperatures / extreme heat, extreme precipitation, storage capacity, water utility interconnection availability, inland flooding, drought, wildfires, rise in sea level / coastal storm intensity, erosion / landslides, and water quality. Each section will be given a score between 0 - 10, if the score is close to 10 in each section, this will result in a high vulnerability score, with the total score being between 0 - 100. There are specified solutions to help reduce each section of the score. Therefore, water utilities have the availability to be more resilient by following the certain parameters.

Conclusions

In conclusion, this project was very beneficial to my engineering career as I hope to land a career position with a local water utility. Researching water vulnerability due to climate change is extremely helpful for me to understand especially living in the Valley in California where there is a drought problem. This project establishes a scale that is showcased in the appendices below. Utilities are able to use this scale to understand what areas they need to work on depending on the average climate characteristics that their community typically receives. Once the utility receives a score based on the scale below, it is able to pin point the sections that received a high score and use certain parameters to help lower these scores, in order to make the water utility more resilient and less vulnerable. By making a utility more resilient, this allows the utility to supply their community with clean water without having to worry that the water supply with run low.

Since Covid-19 happened, these internships were moved to online work only, and luckily I was fortunate enough to be assigned to this project. Given the circumstances this project was solely done by online research, meaning there were no hands on experiments involved.

Appendices

Category	Temperature Increases / Extreme Heat	Extreme Precipitation	Storage Capacity	Water Utility Interconnection Availability	Inland Flooding	Drought	Wildfires	Sea Level Rise / Coastal Storms	Erosion and Landslides	Water Quality	Total Score
Scale	0 – 10	0 – 10	0 – 10	0 – 10	0 – 10	0 – 10	0 – 10	0 – 10	0 – 10	0 – 10	0 – 100
	10 = Frequent High Temperatures	10 = High Yearly Precipitation Total	10 = Low Storage Capacity	10 = Low Amounts of Interconnection Availability	10 = High Inland Flooding	10 = High Drought Potential	10 = High Wildfire Potential	10 = Increase in Sea Level (Coastal Areas)	10 = High Erosion and Landslide Potential	1.0 = Low Water Quality	0 = Lowest Vulnerability Score 100 = Highest Vulnerability Score
Utility Example	6	8	5	4	7	2	2	7	3	7	51

References

1.) Story Map Series. (n.d.). Retrieved June 18, 2020, from https://epa.maps.arcgis.com/apps/MapSeries/index.html?appid=03d35ca84b5944f8b3ab59bf3a981462

2.) United States Environmental Protection Agency. (May 2016). Version 3.0 Methodology Guide. https://www.epa.gov/sites/production/files/2016-05/documents/creat_3_0_methodology_guide_may_2016.pdf

3.) EPA. (September 2014). Flood Resilience. United States Environmental Protection Agency. Retrieved July 07, 2020, from www.epa.gov/sites/production/files/2015-08/documents/flood_resilience_guide.pdf.

4.) Increases in Wildfire-Caused Erosion Could Impact Water Supply and Quality in the West. (2017, September 7). Retrieved July 02, 2020, from https://www.usgs.gov/news/increases-wildfire-caused-erosion-could-impact-water-supply-and-quality-west-2