Record Flooding in Dane County

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Key words: Flooding, Historic, Groundwater, Land Management, Young Surveyor

SUMMARY

The Western portion of Dane County, Wisconsin, USA experienced historic rainfall in August 2018. In some areas, over a foot of rain fell in 24 hours, which far exceeds a "100-year" rain event for that region. Rural and urban areas were greatly affected by the overflowing rivers and lakes.

Not only has unpredicted rain damaged property and life from the flash floods, but groundwater has increased more than ten feet in some areas of Dane County, and is at record levels. Farmland is turning into lakes, and lakes are flooding houses. The rain is still coming; as of August 2019, Dane County has experienced eight inches of rain above normal annual averages.

The County is taking action to improve flooding resiliency and has put multi-year stormwater plans in place. Dane County is adapting to the changing climate and preparing for the future. The weather is not what it used to be.

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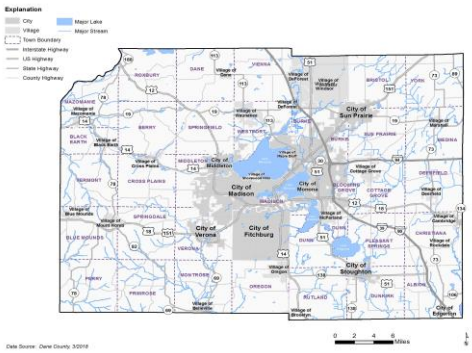
1. INTRODUCTION

Dane County, Wisconsin, USA is 1,238 square miles (3,210 square kilometers) with a population of 542,364, the second most populated county in Wisconsin (United States Census Bureau, 2019). There are 69 named lakes and ponds, 475 miles (764 kilometers) of streams and rivers, and more than 52,000 acres (21,044 hectares) of wetlands in Dane County (Land & Water Resources Department, 2019).

Date Source: google.com

Date Source: NOAA.gov



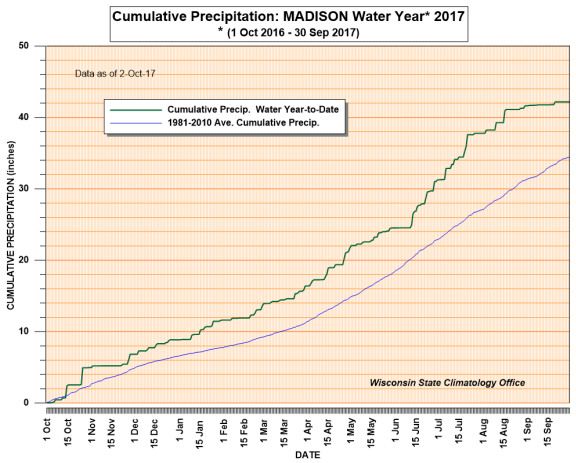
Date Source: Dane County

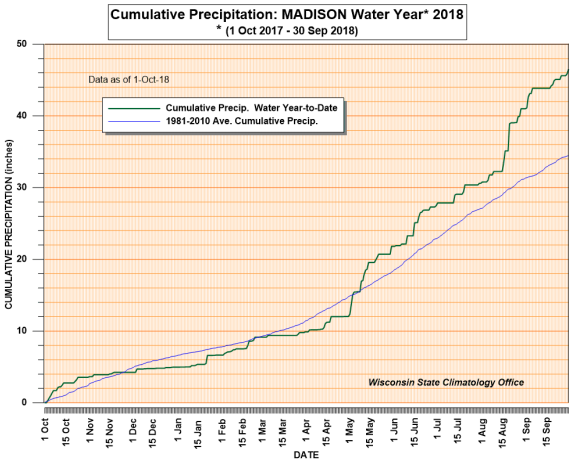
In August of 2018, up to 15 inches of rain fell in less than 24 hours after an already very wet spring and summer. Bridges washed out, entire cities were under water and fields turned into lakes in a blink of an eye.

2018 was the second wettest year on record since record keeping began in 1864; 50.64 inches of rain fell in Madison, WI which is 47 percent higher than normal annual amounts (Wroge, 2019.)

2. WHAT PRECEDED THE HISTORIC FLOODING

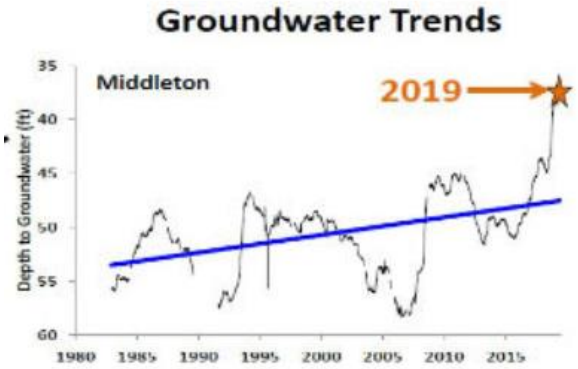
Many things led up to historic flooding in Dane County. Record rainfall was observed at more than 120 weather stations across the Midwest in 2018 (Tetzlaff, 2019). Not only was 2018 extremely wet, but 2017 was also a very wet year. In April, May, June and twice in July rainfall events were up to five times normal amounts according to Midwest Climate Watch data. A result of increased rainfall is increased groundwater. According to the Wisconsin Department of Natural Resources (DNR), groundwater is at historic highs throughout the state.





Data Sources: Wisconsin State Climatology Office

With groundwater being at historic highs, lakes, rivers, streams and wetlands are also elevated. There are four major lakes in Dane County, all being part of the Yahara River Watershed, which is about one-quarter of Dane County. Fields that were once plowed and produced vast amounts of corn, beans, and vegetables are now underwater and remain underwater in 2020.



According to the Land & Water Resources Department of Dane County (LWRD), the loss of over 30% of wetlands in Dane County reduced flood water storage, and urbanization has increased two times since 1970, this is a huge factor in flash flooding and prolonged high lake levels.

3. THE DEVASTATION

There was over $154 million in damage from flooding between August 17 to September 3 of 2018 in Dane County. $78.3 million of damage to residential, $37 million of damage to businesses and $39 million in damage to local government. The most devastating outcome of the flood was the loss of a 70-year-old

Data Source: WBAY News, August 20, 2018

man, who was swept away when trying to exit his SUV which was submerged in flood water.

2019 has also been affected by the 2018 flooding. According to Joe Parisi, County Executive, "Nearly one of every 10 acres of cropland in this county went unplanted this year because areas that were forever farm fields had small lakes in them well into the early part of this summer." During the spring melting of snow in 2019, basements had water damage where water had never been seen before.

Data Source: WSAW News

Floods caused 1.6 billion dollars in crop damage across the United States in 2018, according to Statista.com. There were millions of dollars of agricultural production losses in Dane County in 2018 and again in 2019 due to high groundwater according to Joe Parisi, County Executive.

Data Source: Wisconsin the Beautiful a YouTube Channel

4. WHAT DANE COUNTY IS DOING

Some factors of increased damage which contributed to flooding are slope, constriction points, aquatic plants, clogged storm drains, urbanization, rainfall patterns, wetland loss, and saturated soils according to the LWRD. Dane County Executive, Joe Parisi included over $18 million in the 2019 budget to improve Dane County's flood readiness (Becker, 2019). Some projects the county overtook are:

4.1. Land Purchase

Dane County purchased over 600 feet of shoreline to better manage water flow through the Lower Yahara River. They also purchased 160 acres of land otherwise slated for development near the Pheasant Branch Conservancy to convert to prairie. This will prevent 5 million gallons of stormwater run-off

Data Source: Dane County

that would have entered the watershed had the property been developed according to the Land & Water Resources Department Task Force. In May of 2019 Dane County also purchased 84 acres of wetlands to restore the area for additional flood storage and mitigation. This purchase also protects a stretch of Six Mile Creek, a fishery and spawning ground for native fish according to the County of Dane Wisconsin Press released on May 2, 2019.

Another land program that Dane County is implementing is to convert traditional row crops to permanent vegetation. They are giving tax incentives to existing landowners without having to purchase the land and getting the same outcome as if they had purchased the land. (Becker, 2019)

4.2. Sediment and Aquatic Plant Removal

Dane County is executing a several-year, five-phase plan to remove sediment from the Yahara River Watershed. The plan is to remove sediment to improve water flow, flood storage capacity, and fish and wildlife habitat for approximately $2 million. There is an estimated 8.5 million pounds of sediment that enters the Yahara River and Lakes each year from urban runoff. (Vruwink, 2019)

In addition to sediment removal, Dane County purchased two new aquatic plant harvesters and a hydraulic crane to remove aquatic plants, trees and other large items of debris that restrict the flow of water. This brings the county's total to thirteen harvesters and two crane barges. There are over 64 miles (103 kilometers) of shoreline and 485 acres (196 hectares) of water that aquatic plants are currently being removed from. In 2018, almost 9,000 tons of material was removed, which is believed to have doubled the flow of water through the Yahara River (Vruwink, 2019).

Data Source: Dane County

4.3. Dam Management and Lake Levels

Dane County, the DNR, and the City of Stoughton have been coordinating to lower water levels in the Yahara River and Lakes. The Babcock and Lafollette Dams have been opened in full flow 51 weeks a year since August of 2016. Part of the Yahara River Task Force Plan is to improve dams to make them

capable of holding water in a 100-year rain event. They are also looking into removing dams to return the water flow to its natural state.

The last time the DNR reviewed the minimum lake level elevations of the Yahara Lakes was in 1979 according to the LWRD. The county works hard to keep lakes above minimum and below maximum elevations. With climate change and increased rain events the county is asking the DNR to review the lake minimums with the new data from mitigation actions per the Yahara River Task Force Plan.

Some lakes in Dane County do not have outlets. To keep the lake a usable natural resource and to protect the houses, businesses, and farms built around them from flooding, Dane County started pumping lakes to keep the levels low. When the pumping systems were designed it was before record rain events. Pumps are no longer keeping up and structures and roads are now under water. Some lakes are five feet above water levels from 2010. The high groundwater and excess rain have allowed lakes to overcome the banks and flow over land to other lakes. Pristine lakes surrounded by contaminated lakes are now contaminated. Additional pumping is not feasible due to the contamination. Dane County is in the process of buying out the properties left along the lakes.

Data Source: West Point Town Hall Facebook Page

4.4. Stormwater and Infiltration

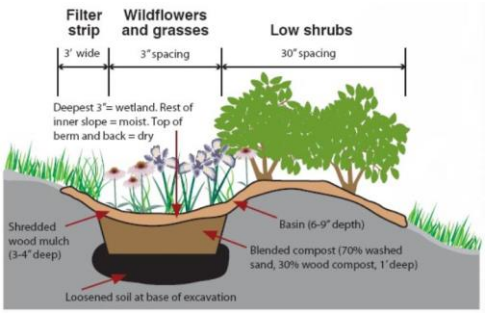
Dane County requires Stormwater Management Permits for many different scenarios, including but not limited to recording a subdivision plat, creating a commercial or industrial lot, redeveloping more than 4,000 square feet of existing property and other activities that increase runoff, flooding, soil erosion, water pollution or property damage. The permits allow Dane County and municipalities to require minimum flood mitigation measures as required by state and local ordinances.

The county requires that new development has no increased stormwater runoff volumes above pre-development levels, meaning 100% volume control of the annual average runoff. The county also requires rate control for new developments. Post-development peak flows cannot exceed pre-development peak flows for rain events ranging from the 1- to 100-year storm events. This provides some protection to downstream landowners from the flooding risk

that can accompany development. There are also policies and procedures to facilitate in the standardization of design and installation of infiltration practices per the Yahara Flooding Technical Report.

Due to recent flooding, many public agencies have been updating and increasing the size of storm pipes and inlets. They have also been more vigilant at cleaning out storm drains and ditches more often throughout the year.

Dane County and local municipalities also provide money to homeowners who want to install rain gardens on their property to decrease the amount of surface runoff. Madison, Wisconsin has a goal of 1,000 new rain gardens on private property by the end of 2020. They also have a program to install terrace rain gardens in front of residences when the road is reconstructed.



Data Source: City of Madison

4.5. Education

Dane County has been and continues to educate their first responders. With the large events of 2018, they were able to see what was working and what wasn't and improve how they respond to large scale flooding events. The Flood Toolkit, a planning guide for public health and emergency response professional guild, was revised in March of 2019. First responders also received a new airboat to allow them to get to areas to save people in areas that were not possible in 2018.

Dane County has many resources for their residents to learn more about flooding and how they can reduce their risk. There are several websites and guilds for people to read to reduce property loss and understand warnings. They also educate people about flood insurance, even if they are not in a high-risk area, they may still want to obtain flood insurance from the Federal Emergency Management Agency.

Dane County also created a task force which allowed for input from residents. The task force consisted of engineers, government employees and the general public. The task force is currently working on proposals for sediment removal locations, lake levels, and resident education.

One way to prevent flooding in your home is to create a sandbag barrier. Dane County purchased two additional sandbag machines and created many sand fill sites throughout the county to help its residents protect their homes from high lake and river levels.

Data Source: The Stoughton Courier Hub

5. HOW A SURVEYOR HELPS WITH FLOODING

Land Surveyors play a big role in helping to mitigate flooding. A land surveyor can also be detrimental to flooding if they are not doing their due diligence. Land surveyors determine elevation for many different types of projects, including engineered designs, flood maps, and topographical surveyors just to name a few. They can also play a big role after a natural disaster.

5.1. Federal Emergency Management Agency (FEMA)

In 1979, the U.S. Federal Government created FEMA to prevent, respond to and recover from disasters related to flooding among other natural disasters. As a result, FEMA created flood insurance and did flood studies throughout the United States. The flood studies showed all the areas surrounding water that would be affected by flooding in a 100-year and 500-year flood event. The maps were last updated in 2006 and are now digital maps that anyone can use to determine high risk flood areas. Land surveyors help to take elevations established by FEMA and relate them to the ground. Land surveyors are the only people that can accurately and precisely determine the elevations of the ground and properly read the FEMA Maps, called “panels.” Land surveyors help to make the flood studies more accurate so that people are assessed properly for their flood insurance. They can also educate home buyers, realtors, and lending companies about the importance of flood studies and flood insurance.

When a potential home or land buyer hires a land surveyor, there are a few things every land surveyor should do. The first thing should be to identify if the property is in a floodplain. They can advise buyers of the risk and help to remove the property from a floodplain by determining the exact elevation of the property or buildings in relation to the FEMA panels. If a land surveyor does not do their due diligence, there could be great cost to the owner if a flood

event does occur, or they may not be able to build on the property they just purchased.

5.2. Construction

Land surveyors determine the elevation of the existing ground by creating topographical (topo) maps. Topo maps are used by engineers for the design of projects. Accurate topo maps are key to the success of a project when it comes to water runoff and water storage.

After the engineer designs the project, a land surveyor stakes out the design so that construction companies can build the project per the engineer's design. Without the land surveyors, grades can be missed, structures and roads can be placed in wrong locations, and projects can fail. The land surveyor is also the last check on the design to make sure there are no errors in the design. Sometimes errors are not found in the design until a land surveyor is staking in the field. The land surveyor can identify the errors and assist the engineers in finding a solution.

After the design is complete, usually a land surveyor does an as-built of the project to verify the project was built per the design. Without the as-built, engineers would not be able to identify causes of issues if they are to arise. This also helps with improving designs for future projects because it allows the engineer to see if the project was built per plans but still has issues.

Data Source: Soil Movers LLC

Land surveyors also map the bottom of bodies of water. They use high tech equipment like echo sounders or just measure the depth of the water using a level rod. Having accurate depths of pounds and waterways allows engineers to calculate the storage capacity and flow volume. If waterways are constricted or filling up action can be taken before flooding events occur.

5.3. After a natural disaster

Natural disasters can sometimes leave land unrecognizable. Land surveyors would reestablish boundaries and determine flood elevations. Land surveyors help in restoring a sense of normalcy. According to the International Federation of Surveyors (FIG), assuring sound human settlements for internally displaced persons and refugees is the number one goal. The land surveyor may help in dispute resolution, conflict management, land tenure

issues and protection of property rights. Land surveyors can help communities rebuild the physical world after a natural disaster strikes.

REFERENCES

Arbuckle, BA, 2019, Dane County launches weed cutters to mitigate lake flooding, Channel 3000, Madison, January 12, 2020, https://www.channel3000.com/dane-county-launches-weed-cutters-to-mitigate-lake-flooding/

Becker, AB, 2019, Dane County Seeing record groundwater levels one year after historic flooding, The Cap Times, February 1, 2019, https://madison.com/ct/news/local/govt-and-politics/dane-county-seeing-record-groundwater-levels-one-year-after-historic/article_965e1dd1-9a77-5f84-8613-ec6b9883eaea.html

Land & Water Resources Department, LWRD, 2019, About Dane County Lands and Waters, Land & Water Resources Department, January 12, 2020, https://lwrd.countyofdane.com/About-Dane-County-Lands-and-Waters

Novak, BN, 2018, Flood damage exceeds $154 million in Dane County, officials say, Wisconsin State Journal, February 1, 2020, https://madison.com/wsj/weather/flood-damage-exceeds-million-in-dane-county-officials-say/article_0635e674-c057-57a0-a888-fe2983367b76.html

Tetzlaff, TT, 2020, Record rainfall hit cities across Wisconsin in 2018, Green Bay Press Gazette, January 20, 2020, https://www.greenbaypressgazette.com/story/news/2019/01/16/wisconsin-weather-record-rainfall-hit-cities-across-state-2018/2536243002/

United States Census Bureau, USCB, 2019, Quick Facts: Dane County, Wisconsin, Census Bureau, January 12, 2020, https://www.census.gov/quickfacts/fact/table/danecountywisconsin,WI/PST045219

Vruwink, AV, 2019, Dane County Announces Five Phase Project to Improve Flow out of Yahara Lakes, Mitigate Flood Risk, County of Dane Wisconsin, January 25, 2020, https://www.countyofdane.com/PressDetail/9787

Vruwink, AV, 2019, Dane County to Award Grant to Groundswell Conservancy for Land Purchase in Westport, Will Help Preserve and Restore Six Mile Creek and

Surrounding Wetlands, County of Dane Wisconsin, January 25, 2020, https://www.countyofdane.com/PressDetail/10403

WisDNR, 2019, Groundwater levels and aquifer response, Wisconsin Department of Natural Resources, January 20, 2020, https://dnr.wi.gov/topic/WaterUse/gwLevels.html

Wroge, LW, 2019, 2018 ends as second-wettest year recorded in Madison, Wisconsin State Journal, February 1, 2020, https://madison.com/wsj/weather/ends-as-second-wettest-year-recorded-in-madison/article_e840263b-56d8-58c8-901c-6494b8e870c9.html

BIOGRAPHICAL NOTES

Alysen Tierney started surveying in high school in 2002. She obtained her professional license in 2010 in Wisconsin. Alysen has worked in the public and private sector of land surveying. She has surveyed, designed and inspected entire projects relating to all aspects of construction. Alysen is a member of many surveyor organizations: the National Society of Professional Surveyors including the Young Surveyors Network, the Wisconsin Society of Land Surveyors including president of the Young Surveyors Network and a member of the State Board, and the FIG Young Surveyors Network North America. She is a member of the Outreach, Education and TrigStar committees. Alysen is also on the Madison College Civil Engineering Advisory Committee and was an advisor to the University of Madison Engineers Without Boards students during their 2010 Haiti mission. Alysen is very active in promoting the surveying profession and is always trying to learn more or teach others.

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