

# More than you ever wanted to know about Flood Control in Fairfield

---

**Gerald Quindry, Ph.D.**

Professional Engineer, Retired

## Introduction

The problem of flooding within the City of Fairfield after storm events has resulted in a lot of discussion, confusion, and speculation about the causes and possible solutions. I will offer below my observations and some background information to support them.



Johnson Creek just below the breached dam at Lakeside Park September 8, 2018

## Summary

For those who do not wish to wade through a very long discussion, here are the basic points:

- There is no one cause of the problem.
- There is no single solution to the problem.
- Laws and regulations will block some proposed solutions desired by the public.

- Some parts of solving the problem will be unpopular with local residents.
- Essential parts of solving the problem will be expensive.
- Possible sources of funds – Federal, state, or local – are elusive, at best.

## Terminology Used in Flood Management

In any discussion of precipitation and flooding, terms like “100-year flood” are used. These terms are often misinterpreted. Prior to diving into the discussion, terms like these need to be understood. They actually represent the probability of an event within a given time frame. For example, the 100-year flood would be one that would have a 1-in-100 chance of happening in any given year. A 10-year flood would be a smaller one that would have a 1-in-10 chance of happening in a year. But flooding is considered to occur randomly; it does not keep a regular schedule. If a 100-year flood happens in the year 2022, there is still a 1-in-100 chance that a similar flood will occur in 2023. Rather, *on average*, they will occur once in 100 years.

The terminology for precipitation events is even more confusing. The “24-hour, 100 year precipitation” indicates both a rainfall duration (24-hours), and a recurrence interval (100 years). The 24-hour, 100 year precipitation would be the amount of rain that would accumulate in a 24 hour period, and would have a 1-in-100 chance of occurring in any given year. For very local flooding issues, like the parking lot at a shopping mall, an engineer might apply the “10-minute, 5-year precipitation event” for proper design of the drainage system. As the size of the drainage area increases, longer duration events are more applicable. For areas the size of Fairfield, it is typical that storm durations of one or two days are best indicators of flash flooding events.

## Causes

There are many factors that contribute to the extensive flooding that is being experienced by residents of Fairfield. Some of the causes of flooding are long-term trends. Some are man-made on a much shorter time frame.

### Long Term Trends

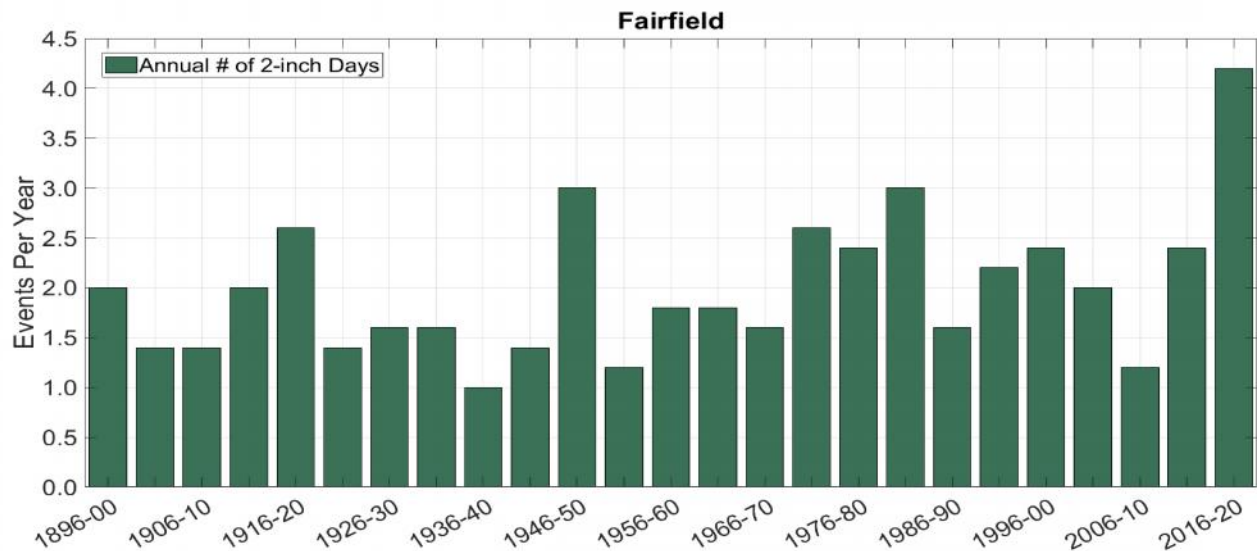
Two climate related factors that may be important to the flash flooding experienced in Fairfield are the amount of rain that falls, and the frequency of intense storms. A very high intensity storm might, for example, drop an inch of rain in ten minutes. A low intensity storm could drop the same amount of rain, but take two days of steady drizzle to do it. It would not take a giant leap of common sense to think that if we have more frequent high intensity storms and more rainfall in total, we likely will experience more flooding. Eventually a creek will expand its channel if the high flow rates are common, endangering buildings that are too close to the banks. Also, the structures that allow water to pass below streets, highways, and railroad

tracks were sized many decades ago. With increasing and more intense rainfall, they may now be too small to meet the demands now placed upon them.

### Rainfall Intensity

The table and chart below were provided by Dr. Trent Ford, the Illinois State Climatologist. They show the long term trend of increasing rainfall intensity at Fairfield. To summarize, increasing rainfall intensity is shown by historical data accumulated at the WFIW radio station.

<b>Estimated Return Interval and Probability of Annual Exceedance</b>			
<b><i>Storm Event</i></b>	<b><i>Technical Paper-40 (1961)</i></b>	<b><i>Bulletin 70 (1989)</i></b>	<b><i>Bulletin 75 (2019)</i></b>
September 7-8, 2018 3.84” in 8-hours	10-year event 10% annual chance	8-year event 12% annual chance	4-year event 25% annual chance
July 15-16, 2020 4.25” in 4-hours	100-year event 1% annual chance	50-year event 2% annual chance	30-year event 3% annual chance



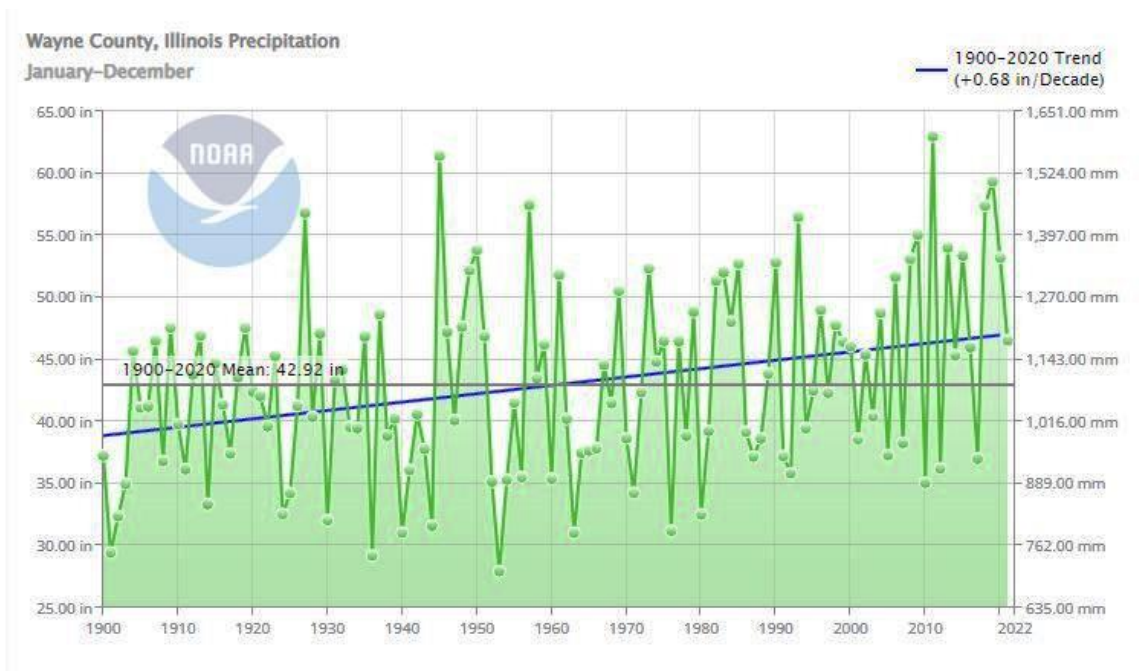
Engineers use guidance published in various technical papers and bulletins published by state agencies to guide the design of culverts, bridges, and dams. Keeping in mind the terminology discussed previously, the upper table shows how the flood events in September, 2018, and in July, 2020 would be categorized using historical and current design standards. For example, if

the flood event of July 2020 is evaluated based on the 1961 rainfall table, it would be categorized as having a 1-in-100 chance of occurring, a “100-year storm.” But the rainfall tables were updated in 1989, and again in 2019. That same amount of rainfall was categorized as a 50-year storm in the 1989 update of rainfall tables, and as a 30-year event in the latest available update. There are more frequent events of this intensity.

The chart shown can indicate the same sort of rise in storm intensity. All rain events from 1895 to 2020 have been divided into 5-year increments. The number of rainfall events with more than 2 inches of rain in a 24-hour period was then counted. Each bar of the chart shows the average number of days with 2 inches of rainfall that occurred in each year in the 5-year increment. Although I do not know the exact year that the Lakeside dam was constructed, the chart indicates that in the time around 1910, there was an average of less than 2 rainfall events a year that resulted in two inches of rainfall. In the most recent time period shown, 2016 to 2020, there was an average of 4.2 events each year that had two inches of rainfall.

### Total Rainfall Amount

With regard to precipitation amount, and at Dr. Ford’s suggestion, I have retrieved a chart from the National Ocean and Atmospheric Administration (NOAA) web site that shows historical annual precipitation in Wayne County. The horizontal grey line is the long-term average precipitation. The sloping blue line is the trend in precipitation, showing an increase of more than 7 inches per year of rainfall over the period 1900 to 2020.



NOAA National Centers for Environmental Information, Climate at a Glance: County Time Series, published March 2022, retrieved on March 8, 2022 from <https://www.ncdc.noaa.gov/cag/>

Considering both the increased rainfall intensity and increased rainfall amounts, it is very likely that flash flooding is becoming more of a concern over time based, at least in part, on these long-term trends.

### **Short Term Causes**

There are a host of causes of increased flash flooding that relate to development of Fairfield since the Lakeside Park Reservoir was constructed more than 110 years ago. As legendary investor Warren Buffet said, “Only when the tide goes out do you find who’s been swimming naked.” The intentional breaching of the reservoir’s dam in 2007 caused the flood protection provided by the reservoir to be reduced significantly. That revealed the shortcomings in, or lack of, other flood management policies that were hidden by the protections afforded by the dam.

### **Increased Urban Development**

Every paved road or parking lot, every new building rooftop, every drainage tile placed to drain a basement or a ‘wet spot’ in the back yard, contributes to the rapid runoff of rainfall into street curbs, sewers and stream channels. When runoff arrives more quickly from many sources, the drainage systems are confronted with higher peak flows. Those peak flows are the crest of the flash floods and mark the high water mark of the flooding. Construction of a single building on previously undeveloped land may seem to be an insignificant contributor to flooding issues, but the combined impact of many such improvements over decades is important. The old established creek beds and storm drains are not capable of handling the higher peak flow in the same way they did decades ago.

### **Ageing Infrastructure**

Older sections of town are served by a very old system of sewers. The old sewers can become obstructed by shifting or settlement, and by tree roots growing into the lines. The older sewers are constructed of clay pipes that deteriorate over time, and rougher pipes slow the flow of water through them. Also, older catch basins and sewer manholes were constructed by hand-laid bricks rather than the precast concrete structures that are commonly used today. The mortar in the old brick structures deteriorates with time. Bricks then can become dislodged, partially blocking the flow of water in the sewer below.



Interior of clay tile sewer line showing misaligned pipe on the left, rough, deteriorated pipe walls and a partial obstruction in the distance (Water Street between NW 4<sup>th</sup> and NW 5<sup>th</sup> Streets)2016

### **Inadequate Maintenance**

With limited budgets, city crews responsible for maintaining the built infrastructure, as well as those responsible for landscape maintenance, face challenges that may be beyond their capacity in spite of their best efforts. Litter and leaves accumulate in the street gutters. The covers of catch basins get blocked by that debris. The catch basins themselves become filled with the debris. Sewers become obstructed by foreign objects or tree roots. Silt fills in creek channels under bridges and box culverts. Brush and trees grow in the creek channels and form more of a blockage to flow as they grow larger and larger.

### **Breaching the Dam at Lakeside Park**

The reservoir at Lakeside Park is the major point of discussion in any talk about flooding in Fairfield. More than 100 years ago, the reservoir was created by building a dam on Johnson Creek, which flows through town from northwest to southeast. Breaching the dam in about 2007 was required by the Illinois Department of Natural Resources, Dam Safety Program. That action has been the focus of many complaints about increased flooding. The loss of temporary flood storage capacity in the reservoir is an important cause of the increase in peak flood levels within the city. The presence of the dam for a century gave an assurance that it was acceptable to build in the natural floodplain of the creek. Over time, those houses and other structures have become an established part of the landscape. But the dam was breached because it did not meet the safety requirements required of all dams in Illinois.

## Possible Solutions

There is no single action that will resolve flooding issues in Fairfield. It will take a combination of measures to make a pronounced difference. Also, I do not want to imply that there are no efforts in place, or that city employees are not making their best efforts with their available resources to prevent flooding.

### Encourage On-site Water Capture

“I am only one, but still I am one. I cannot do everything but still I can do something; and because I cannot do everything, I will not refuse to do something that I can do.”

Edward Everett Hale

As noted above, the development of the town has resulted in many paved areas and rooftops that prevent infiltration of water into the ground. There can be no realistic expectation that everyone will tear out their driveways and sidewalks to increase the infiltration of rainwater. But there are measures that can be taken with any new construction or major repair of existing surfaces to reduce runoff. Where appropriate, concrete and asphalt surfaces can be built or repaired using materials that allow water to infiltrate through the surface and enter the groundwater table rather than rapidly flooding the streets with surface runoff. Adoption of effective building codes for flood management may be necessary to encourage such practices.

Water captured in a rain barrel beneath roof gutter downspouts can assist in lowering peak flow during intense rain events. The water can be used for watering plants during dry periods. Even if the barrel is just allowed to drain after the storm has passed, it will have served to reduce the peak flow of the flash flood. Dry wells placed in the yard to receive rooftop runoff can do the same. A public information campaign to encourage these practices may be effective, or they can be forced by adopting building codes requiring them in new construction.

### Keeping Debris and Leaves out of Storm Drains

The city currently performs services regarding the drainage infrastructure in town. Sewer obstructions are cleared. Catch basins are emptied of debris. It may be possible to increase efforts when a large storm is predicted. Rather than maintaining a regular schedule of street sweeping particular areas of town on a specific day of the week, it might be possible to schedule added effort the day before a predicted storm event. As the storm approaches, streets in flood-prone areas could be swept to remove debris that will block storm drains when the storm arrives.

### Remove Obstructions from Stream Channels

Trees and brush grow naturally along and in the creek channels in town. These eventually grow to the point that they obstruct the flow of water in the channel, and the creek rises and spreads

out of its banks to flood nearby areas and structures. To the extent legally possible, these obstructions need to be controlled to increase the flow of water in the channel. It should be noted, however, that clearance of stream channels may be in conflict with wetlands regulatory requirements. The banks of streams sometimes are classified as protected wetlands.

At some locations, particularly at the west entrance to Maple Hill Cemetery, it has been noted by past investigations that silt accumulates in the culverts of street crossings. The silt needs to be removed on a regular basis at that and any other locations where it is present.



Leo French Park, with the west cemetery entrance in the background, 2018

### **Evaluate Road Culvert Size**

Johnson Creek and its tributaries pass through a number of culverts and beneath bridges in town. Some of these may be undersized for the anticipated flow, and cause water to back up behind the restriction. In particular, the crossing of Route 15 on the east side of town at Maple Hill Cemetery may be the cause of flooding in the area immediately north of the highway. A request of the State Highway Department for them to review the crossing may find that is the case. However, there may be an unintended consequence of improving the flow of water beneath the highway. Houses south of the highway may experience higher flood peaks.





South Entrance to Maple Hill Cemetery north of Illinois Route 15, 2018

### **Replace the Reservoir at Lakeside Park**

Replacing the lost flood storage capacity of the reservoir will likely be the most important step that can be taken to control flooding in Johnson Creek below the dam. It is likely that it would be the most important part of solving the city-wide problems, but not a complete solution. Replacing the flood capacity of the dam is a very complex issue, with a variety of local, state, and Federal government agencies and their bureaucracies involved. Sometimes the goals and requirements of one agency conflict with the goals or regulations of another. Also, as much as we might like to have a level playing field, (or one tilted in our favor) the agencies are subject to political pressures beyond our control. Finally, no entity has a surplus of funds to pass out for local projects.

The reservoir as it formerly existed could not be legally replaced by simply rebuilding the spillway that was breached. It was breached intentionally and for a reason. It did not meet standards of safety under Illinois law. Under current state requirements for dam safety, replacement requires the excavation of the dam footprint down to bedrock and that a drain tile installed along the length of the dam near the center of the sloped sides. This drain would prevent the dam from being undermined by water seeping beneath the structure which could cause the dam to fail. In addition, a well-designed secondary spillway is required. It would need to be designed to meet the expected flow from an extremely large storm event.

A replacement dam and reservoir constructed for flood control would be very different in appearance than that of the old reservoir. As a flood control facility, the water level would be kept low to allow maximum storage of flood water. This conflicts with the desire of nearby residents for a scenic recreational lake and makes it less desirable as a recreational facility. Recreational lakes need to have a stable water level to maintain the attractiveness and prevent a mud flat from showing during times of low rainfall. To prevent erosion and conceal the unsightly mud flat in shallow parts of the reservoir, the reservoir would best be lined with rock rubble from the high water elevation to below the lowest anticipated water level. The slopes of the dam above the water would be gentle to allow it to be mowed to prevent trees from establishing in the earthen dam material. The slope of the sides of the reservoir under the water would be steepened to limit the area where algae and cattails would take hold.

To make the reservoir as deep as possible, the silt and organic matter that has accumulated over the 100-year of the life of the reservoir would need to be removed. This dredged material could have limited options for disposal. It could not be used in construction of the new dam because of the high organic content.

The wetlands designation of the reservoir bottom area is an issue that is both confusing and frustrating. The wetlands designation for the Lakeside reservoir is a problem, but it has a solution that is described in more detail below in the regulatory section of this write-up.

### **Atkinson Forest Nature Preserve**

“I know you think you understand what you thought I said but I'm not sure you realize that what you heard is not what I meant.”

Alan Greenspan

The potential for development of the Atkinson Forest area north of Fairfield into a nature preserve has been discussed as a possible remedy for flooding in Fairfield. At a city council meeting early in 2020, I was asked about the potential and made a comment that has been amplified beyond my intended meaning. I did not in any way “hail” the potential nature preserve as a major contributor to solving the problem, as was inferred in a local newspaper column afterwards. Mr. Greenspan’s quote above applies. Please allow me to explain in more detail.

As discussed above, there is no single solution to the problem of flooding in town. The replacement of the reservoir at Lakeside Park with a similar reservoir, or a flood retention basin, is likely to be a key part of the solution. But replacing the reservoir will not, in itself, be the silver bullet that solves all the flooding issues. When asked by a council member if the Atkinson Forest area could help control flooding, I agreed. It is true that anything that delays the flow of water into town from the north would help. I noted that I had done a very rough

estimate, and the Atkinson Forest area perhaps could add twenty percent of the benefit of replacing the Lakeside reservoir with a similar one. That rough estimate was based on assumptions that I did not describe at the time. An important assumption is that the area would be dedicated more to flood control and less to recreational use and a nature preserve. I presume the supporters of the nature preserve concept would not be in favor of that change in focus. I also did not take into account any flood mitigation that is already provided by Atkinson Forest as it now exists as an undeveloped, wooded area.

The Atkinson Forest area, and the drainage area that flows through Atkinson, represents only a small portion of the overall watershed into Johnson Creek in Fairfield. As such, the control of that flow will not solve problems that arise in other areas of drainage, or are caused by obstructions in the stream channels in the city limits.

## Laws and Regulations

“I've always felt the nine most terrifying words in the English language are: I'm from the Government, and I'm here to help.”

Ronald Reagan, August 12, 1986 at Springfield, Illinois

There are many Federal and state laws and regulations overseeing the development and use of land and waters in the United States. To promote the general welfare of the public, programs under these laws and regulations sometimes restrict what landowners can do with their property. The affected landowners may feel that their right to do as they please on their own ground is being inappropriately restricted. Many measures to reduce flooding in an area, especially the older measures, move the floodwaters downstream more rapidly. The downstream landowners then are subject to higher flood levels. On the other hand, measures to delay water flow, creating a lake or wetlands, can cause increased flooding in and around areas upstream of the water feature that has been created. In that event, upstream neighbors can be subject to higher floods. The regulatory programs are overseen by a long list of government agencies. Each of the programs can conflict with the requirements of other government efforts. The other programs were established to support a different law or regulation.

## Dam Safety Regulations

In the particular case at hand, the breaching of the Lakeside Park dam was required by dam safety regulations that are administered by the Illinois Department of Natural Resources, Dam Safety Division. The regulations were developed to serve an important purpose; to prevent a very large storm event, or a poorly designed or maintained dam, to cause great damage or loss of life if a dam failed. The failure would cause a large surge of water from the reservoir. All dams in Illinois are covered by the safety regulations, and the construction of the Lakeside dam

more than 110 years ago did not meet the safety requirements that now are required of all dams in the state. These requirements are retroactive, meaning that older dams are required to meet current safety requirements.

The owner of the dam, the Fairfield Park District, was ordered to either remove the hazard by breaching the dam, or make modifications that would allow it to meet current design standards. The necessary modifications would be very expensive, so the dam was breached with the intent of making necessary improvements at a later date, if funds were available. The risk of a large flood event was greatly reduced by breaching the dam. However, an unintended consequence of that action was to increase the amount of small flooding events that impact property directly below the dam. The risk of a very large, catastrophic flood was reduced, but the risk of smaller flashflood events increased.

Other regulatory programs, both within the Illinois Department of Natural Resources and those administered by the Army Corps of Engineers, Illinois Environmental Protection Agency, U.S. Department of Agriculture, the Illinois Department of Financial and Professional Regulation, and others have their areas of focus which are not considered by the dam safety requirements.

### **Wetlands Designation**

A particularly frustrating issue in the Lakeside saga is the contention that the reservoir bottom became a wetlands when the reservoir was drained and the newly created wetlands is protected by Federal EPA regulations that are administered by the Illinois EPA and the Army Corps of Engineers. To obtain a permit for the project replacing the reservoir, the owner could potentially be required to replace the wetlands that would be destroyed by the project. Replacing the ten acres of wetlands behind the dam with new wetlands at a different location would add significantly to the cost of the project.

This is similar to the situation the city was in several decades ago, when an attempt was made to expand the drinking water side-channel reservoir near the water treatment plant. The long and unsuccessful attempt to gain regulatory approval for that reservoir expansion ultimately led to the city being responsible, at considerable expense, for developing 32 acres of wooded wetlands just north of Mill Shoals and halting construction of the needed side-channel reservoir. The destruction of wetlands near the Little Wabash River was caused either through a miscommunication of the permit approval process, or simply a frustration with regulators and regulations in general.

In about 2015, at the direction of Mayor Chuck Griswold, I addressed the question of wetlands at Lakeside Park with the Illinois EPA officials that are responsible for wetlands preservation. Their original position was as described above. Protracted communications with Illinois EPA personnel and with the Fairfield Park District have revealed a possible way around that

regulatory requirement, but the issue remains one of many obstructions in the long road to successfully rebuilding a reservoir. A resolution of the issue may be available because the reservoir was already in place when the wetlands protection program was established. The regulations were not made retroactive. The argument can be made that replacing the reservoir is allowed if the replacement project restores what was there decades ago.

### **Work Without Permits**

As an additional regulatory consideration, it has been suggested that replacement of the reservoir could be accomplished simply by contracting with a local company with earthmoving equipment to replace the breached spillway or building a new dam. Doing so would place the dam owner in a very shaky position, with the Corps of Engineers, IEPA, and IDNR in opposition. The contractor (or whoever designed the structure) would be vulnerable to action of the Illinois Department of Financial and Professional Regulation for practicing engineering without a license. Replacing the spillway would only place the reservoir back in the condition it was in when breaching was required by the dam safety requirements. In the second case, construction of the dam would place the owner and contractor in violation of the requirement that dams of this nature be permitted under the dam safety regulations and designed by a professional engineer. Also, without approval of the dam safety regulators, and a professional engineer in responsible charge of the design, it would be impossible to obtain any governmental funding for the project.

### **Federal Flood Management**

Prior to the 1960s, it was common for rural property owners to remove the trees from flat lowland areas to create additional productive farmland. Drainage districts were formed to straighten the winding streams that drained the properties. The straightened channels more quickly remove the excess rainfall that would prevent the farmland from being productive. At the same time, urban areas were becoming larger, with broad areas of paved surfaces draining into sewers and manmade drainage channels that quickly removed rainfall from these areas.

It took a while for policy makers to recognize that many acres of land had been cleared or paved; many winding streams had been turned into straightened drainage channels; and the storm sewers and the drainage tiles installed, when taken in aggregate, caused increased flooding in the major rivers that drain large areas of North America. It also did not help that these rivers were being confined by more and always higher levees that eliminated the storage of flood waters in their floodplains. The land behind the levees became valuable farmland or residential subdivisions.

In the late 1960s, the government began to change its approach, focusing more on wetlands protection and other measures to hold water near its source, rather than building more and more facilities to allow water to quickly flow downstream within restricted channels. This

change in policy has caused some landowners to be caught in a trap, where past practices that encourage rapid discharge of rainfall runoff are now discouraged. The landowner's investment in improving their land is at risk, and maintenance of the drainage improvements may no longer be permitted.

Also, by 1968, private insurance companies were reluctant to write flood insurance policies because of the risk of huge losses in large, multi-state flood events with overtopped levee systems. The federal government stepped in with the National Flood Insurance Program. It offers flood insurance to the public that private insurance companies no longer offered. As an unintended consequence, it became possible for individuals to build in flood-prone areas with little financial risk. They could purchase low cost flood insurance to protect them. Politics being politics, the rates charged for the insurance were too low to cover the cost of the losses due to flooding. The program has the authority to borrow money from the U.S. Treasury, and according to the Congressional Research Service, by 2017, the accrued debt exceeded 30 billion dollars. In response to the growing debt, the Flood Insurance Program underwent a legislative revision that dramatically raised the insurance rates. Homeowners who had participated in the program for years were shocked by their new rates.

The National Flood Insurance Program has established flood risk zones that identify areas where there is an elevated risk of flooding. The most significant of these is the 100-year floodplain. The floodplain map for Fairfield is many decades old, and reflects the risk that included having the Lakeside reservoir providing flood protection.

The original floodplain mapping was completed decades ago, using the survey data available at that time. With the development of new, extremely accurate laser-based tools for measuring distances, it became possible to produce much more accurate ground elevation data. The new data are being used to produce better flood projections and create better floodplain maps. The technology was first used in critical, high population areas, and now is being used to improve mapping throughout the country. Work for the Wayne County area is now underway. Also noteworthy is the fact that the new data will reflect the fact that the former reservoir at Lakeside no longer provides flood control. The anticipated outcome is that new maps, when finally completed, will include more residential properties in the 100-year floodplain than were included in the original maps. Adopting any flood management plan for the city will add constraints to existing homes in the newly designated flood zones. This adds pressure to replace the flood protection that was formerly provided by the reservoir so that the area at risk is as small as possible.

One requirement to obtain federal flood insurance is that the property to be insured must be in a community that has adopted minimum standards for land use within the floodplain. It is my understanding that Fairfield has never adopted such standards in building codes. The standards would prevent construction within the 100-year floodplain unless the building is flood-proofed by, for example, raising it on stilts. No construction would be allowed in areas of the 20-year floodplain. The first step in obtaining any flood management grant or loan for the city would likely involve joining the National Flood Insurance Program, and implementing a set of building codes that would restrict the use of some properties in town. Once in the program, it would be difficult for a property purchaser to obtain a mortgage on property if it was in the floodplain and did not meet the code requirements.