STUDY SESSION
Storm Water Commission Presentation – Historic Flood
CITY HALL, Fifth Floor
6801 Delmar Blvd., University City, Missouri 63130
Monday, January 9, 2023
5:30 p.m.

AGENDA

1. **MEETING CALLED TO ORDER**

At the Study Session of the City Council of University City held on Monday, January 9, 2023, in the absence of Mayor Terry Crow, Mayor Pro Tem Bwayne Smotherson called the meeting to order at 5:30 p.m.

In addition to the Mayor Pro Tem, the following members of Council were present:

Councilmember Stacy Clay
Councilmember Aleta Klein
Councilmember Steven McMahon
Councilmember Jeffrey Hales; *(excused)*
Councilmember Tim Cusick

Also in attendance were City Manager, Gregory Rose; City Attorney, John F. Mulligan, Jr.; Professor Emeritus Robert Criss, and Mark Holly, of the Stormwater Commission.

2. **CHANGES TO THE REGULAR AGENDA**

None

3. **STORM WATER COMMISSION PRESENTATION RE: HISTORIC FLOOD**

Mr. Rose asked Council to receive the Stormwater Commission's review and recommendations associated with the flooding that occurred on July 26, 2022, and July 28, 2022.

Commissioner Criss stated the Stormwater Commission is an outgrowth of the Task Force established by former Councilmember Paulette Carr. It is constituted entirely of scientists and engineers and assisted by Liaison, Councilmember Cusick, and City Attorney, John Mulligan. Commissioner Criss stated over a thirty-year period he has published 40+ scientific papers on Missouri hydrogeology and flooding.

The Characteristics of Flash Floods

- **The record flood of 1993**
  - Water covered the Mississippi River from bluff to bluff
  - Flooding lasted for months and was above flood stage for over 100 days
  - In the most severe parts of the rise the water rose 19 feet in 27 days
  - The flow of the river went up a factor of almost 2 1/2 cubic feet
  - There were 19 fatalities

- **The flood of December 2015 and January 2016**
  - The Meramec River was above flood stage for 8 days
  - The water level rose 26 feet in 4 days
  - The flow of the river went up a factor of 5 cubic feet

- **The Flood of September 14, 2008**
  - The creek bottom of Deer Creek is 17 feet below the bridge deck
  - The creek would rise every time it rained and then go back down
  - The water level increased 20 feet in 7 hours
  - The flow of the creek went from 5 cubic feet per second to over 10,000 cubic feet; three times the flow of the Meramec River, and by the end of the day it was gone.
  - Two U City residents were killed

- ***Fatalities for flash floods are vastly more severe than they are for regional floods, and have a particular significance for U City.***

- ***Flash floods develop suddenly with little warning. They occur frequently in the heart of neighborhoods.***

Are Floods Getting Worse?

- With only 25 years of inundation records on small creeks, there is not enough statistical data to reach any noteworthy conclusions
- U City has experienced significant flooding in three of the last four years
- Records for the Mississippi River date back to the Civil War
- Since World War II people have noted a significant trend in water levels that were unheard of 100 years ago; the frequency of these water levels has occurred within the last 10 years

- **Floods are getting worse**
  - While many want to attribute this to climate change; which is a factor with smaller creeks, the main factor is river constriction
  - The Mississippi River is half as wide as it was historically, and all of its islands and sandbars are gone
  - The reduction in width by a factor of 2 is true up the Missouri River and all across the State to Sioux City, Iowa
  - Narrowing of rivers makes flood rates higher

- ***USGS studies calculated that the cover of the River des Peres' basin is 43 1/2 percent Impervious; higher than almost any place in Missouri.***

- Flow Impedance equals higher floods
- Flow = width x depth x velocity

In U City

- Flow restrictions and channelized River Des Peres
- Half the length is cement lined and floor or concrete walls
- Undersized tunnels and bridges
- Debris clogging, which causes water to go over the top
- Restricted River Des Peres
- Impervious surfaces

The 1909 plat map shows what the River des Peres looked like before any fixes were attempted.

- We built where we should not have
- We built on the geomorphic floodplain
- We straightened the river
- We channelized the river
- We ran it into a tunnel

Commissioner Criss stated as a natural scientist he believes that some of these actions do not represent the most cost-effective measures.

July 2022 Flood Synopsis: Rainfall & Hydrologic Response

After the last flood, the Stormwater Commission, Eric Stein, and several of their academic associates rented equipment and made an inundation map of the event.

Commissioner Criss stated the real eye-opener was that the River des Peres' tunnel was overtopped for the first time since its construction in 1940. That resulted in the disruption of the MetroLink System; one fatality near Skinker Blvd; damage to Fire House Number 1 on Vernon Ave., and the flooding of homes located to the east of the tunnel.

The River des Peres is the most flash flood-prone stream in Missouri

- **Natural Factors:**
  - Small Watershed
  - West to East Flow, along the predominant storm track
  - The Pennsylvanian bedrock has low permeability

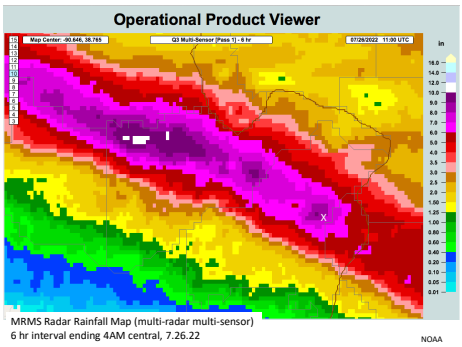
- **Human Factors: Floodwater Acceleration**
  - Over half of its length has extremely high impervious areas; cement-lined with concrete/stone walls that run into a tunnel that is horrifically undersized
  - Channelization, Straightening, Loss of Natural Storage Capability
  - Storm Sewers Convey Water into Channels Rapidly
  - Destruction of Riparian Borders
  - Undersized and clogged bridges
  - Floodplain construction: Higher Floods *and* More Damage
  - Climate Change: More Intense Storms

The human factors that are within the public's control are far more important than climate change.

With funding from U City, Commissioner Criss stated he and Commissioner Stein, established stream rain gauges that are now a part of the Early Warning System.

- The Early Warning System was installed in March and was fully operational by October 2021
- The Commission also installed a network of 9 in-stream sensors along the channel of the River des Peres
- An inundation map was created by studying the 2008 flood protocols

These elements, along with the combination of several factors, resulted in the Commission's ability to capture this last event, which is the best-documented flash flood in history.



This map illustrates the six-hour rainfall that occurred in July 2022.

- The (X) at the end of the purple/pink area denotes U City
- Multiple thunderstorms that continued to follow the same storm tract resulted in U City receiving almost 10 inches of rain

Commissioner Criss stated although the media described this as a 1 in a 1000-year flood event, exaggerated return intervals are used to deemphasize the frequency of an occurrence. But in his opinion, no one will have to wait for the second coming to see this happen again.

The Noah graphs in the Commission's presentation show what happened in U City by illustrating rainfall intensities for different recurrence intervals. For example; during a 10-year flood, you would receive .98 inches of rain every 10 minutes.

Commissioner Criss stated that based on the graph, 6 and 12-hour rainfall events could indeed be categorized as a 1 in a 1000-year storm. But the July flood was more like a 50-year storm because 1 or 2 hours of rainfall is what really drives flash floods, not 12 hours. The hard rain started falling in U City around 1 a.m., and by 2 a.m. there were only 2 inches of rain. However, the majority of the river's increase happened before 2 a.m. and the continued rainfall simply added insult to injury. That's what caused the vast amount of this City's flooding problems.

FEMA provided a diagram in 2015 with a cross-section of height vs. distance upstream for the River des Peres that illustrated the theoretical water elevations for a 10, 50, 100, and 500-year flood. According to FEMA, this was more like a 10 or 20-year flood near the Groby Bridge. But as you move downstream it becomes a 50-year flood; then a 100-year flood, and a 500-year flood as you reached the mouth of the tunnel.

Reality is far more informative than graphs and diagrams

Commissioner Criss stated while this was certainly a horrific event pattern, the reason there was so much bad inundation near the tunnel mouth and along Vernon and Dartmouth is because of inadequate structures, clogging, or the system being overcharged. All of which require further study.

This flood resulted in tens of millions of dollars in damages; one fatality; more than 50 rescues, and hundreds of condemned homes and vehicles. The most significant damage occurred because buildings and homes were constructed where they should not have been, along the floodplain.

Most of the flooding U City experiences occurs in the summer

Recommendations

Many of these recommendations were made years ago and can be accomplished with no cost to the City.

1. The Commission needs a website, lecture series, and high-water signs to provide helpful information to the public.
2. Connection of the Early Warning System to Code Red is urgently needed.
3. Better coordination with MSD is needed for channel maintenance, downspout disconnections, drainage improvements, record keeping, etc.
4. City staff needs to work with the commission to integrate and routinely update data on condemned & damaged properties, FEMA information; etc.
5. Inspectors need a standardized protocol for collecting property information following a flood that should include 1st floor and basement water levels.
6. The City should strengthen codes for impervious surfaces.
7. The City should require disclosure of flood history for rentals and home purchases as suggested by SEMA; possibly as part of the occupancy permit.

- **2023 Budget Items**
  - $20k for additional stream monitoring and EWS Enhancement.
  - Estimated $35k - Top Priority. Contract with surveying company for 1st-floor elevations of all properties subject to flooding, to prioritize buyouts and floodproofing recommendations.

Data-Driven Flood Management Decisions

- A database documenting the effects of flooding on U City properties is essential for identifying the types of mitigation applicable to each property, including buyout priorities and preparing damage reports required by FEMA after a flood. *(Following the July flood, the Commission made significant strides in developing such a tool)*
- A study performed by Commissioners Criss & Stein based on precise measurements of flood levels up and down the channel led to the development of an inundation map that may be the most precise ever developed for a flash flood in an urban stream.

Commissioner Criss stated Commissioner Holly integrated the Commission's inundation map with Google Maps, an Excel database, and parcel information from St. Louis County, to help everyone better understand the flood risks on individual properties and make cost-effective mitigation decisions. So, if the City decides to conduct a survey, that information will also be added to this map.

Commissioner Holly informed Council that the Google Map was inadvertently left out of tonight's presentation. So, while he will provide a few details about it this evening, he would like the opportunity to demonstrate how this tool works sometime in the future.

The integrated map contains all of the parcels listed in the County's database that are believed to have been involved with potential flooding, as well as those properties that have already been condemned. So, when you look at the inundation boundaries on the map it acts much like a lasso that reaches out and drags in all of the properties where flooding might occur over a range of water levels.

When looking at the condemnation locations vs. the map, the map indicates that there are potentially 670 parcels that could potentially be impacted by flooding. And while working with Tim Scott from the City's Property Maintenance Division, Commissioner Holly stated he learned that approximately 230 of these homes had been affected by the flood. Although it was somewhat bewildering to see that there were no condemnations on Dartmouth, and there was a stream of houses that had already been condemned on Vernon. This is another reason why the Commission has recommended that the 1st-floor elevations of those 670 parcels be surveyed because it will save the City valuable time when trying to determine the direction it should take to implement preventive measures.

Commissioner Holly stated he believes the Commission has a pretty good handle on the flooding situation and what it means to the City. And they have also started developing a way to fill out FEMA forms electronically so that inspectors can fill them out in real-time.

Councilmember Clay thanked the Commission for their presentation and posed the following questions to Commissioner Criss:

Q. When looking at the Commission's recommendations to the City, which one do you think should take top priority?

A. *Number one would be **a** connection of the Early Warning System to Code Red, and number two would be to establish a website for the Commission that would provide helpful information to the public about flooding and its impacts on a community.*

Q. Although Council receives sporadic updates from the Army Corps of Engineers and MSD regarding their role in this remediation, does the Commission have a better understanding of where they are in this process?

A. *The Corps studied the installation of a detention basin; which in his minority opinion might have been beneficial in smaller events like the ones in 2019 and 2020, but he does not think it would have had any impact during this latest flood.*
There would have been many more homes underwater along Wilson Avenue during this last event, and perhaps, more fatalities, if they had not been bought out after the 2008 flood. So, I believe that the most cost-effective thing that can be done is floodproofing and additional buyouts. The Commission can help the City identify the most impacted homes and prioritize which ones should be flood-proofed or bought out, but it's got to be data-driven. However, if the City wants models and a lot of expense, then it can wait for the government to help.

U City needs to do what U City can do first and the Commission believes that all of its recommendations should be implemented before the upcoming flood season this summer.

Mr. Rose stated what is happening with the Army Corps of Engineers as it relates to the detention basin, is that Council advanced the construction of a basin to help mitigate flooding that occurs in U City, as well as other communities downstream, and they expect to have final approval for construction by May. At that point, it will be up to the City to work with Congresswoman Bush in an attempt to garner funding for the basin through an appropriations bill at the federal level. The total cost of this project is estimated to be 13 million dollars, with the City being responsible for 35 percent of the cost.

He stated he thinks everyone can agree that stormwater management is a regional issue. But at this point, he is not convinced that the regional agency believed to have responsibility for stormwater management and the communities being impacted are aligned with what that agency should be doing.

Mr. Rose stated he certainly applauds the efforts of the Stormwater Commission on their study of the events that occurred on July 26th and 28th of 2022. But, while some of their recommendations highlight the need for more stringent maintenance of the river and a greater focus on the infrastructure needed to better manage stormwater runoff, what he has indicated to Council is the belief that buyouts only represent a part of the solution. Buyouts would not have had any impact on the stormwater runoff that occurred on Olive Blvd. So, this needs to be looked at and elevated from a regional perspective rather than piecemeal, to ensure that infrastructure is in place to address stormwater runoff throughout the entire region. Mr. Rose stated he would certainly agree that the City has a responsibility to try and mitigate the runoff that occurs in its own community, but even that won't solve these overarching regional problems.

Councilmember Cusick posed the following questions to Commissioner Criss:

Q. Could you elaborate on the difference between what the Commission is doing with its data-driven flood management information vs. the models provided by the Army Corps of Engineers?

A. *The only way to understand a natural phenomenon like this one is to study the phenomenon itself. Yet, the only thing the Corps has done is present models. They have never walked the River des Peres or made any measurements.*

FEMA's 2015 profile is identical to the HUD profiles of 1977. And these models have no semblance to the red lines depicted on the Commission's graph illustrating what happened during this latest event. The Corps recently assured the City by its modeling that the flows measured by the USGS would have easily gone through the tunnel and would not have been overtopped. So, I believe the way to solve a problem is with real data, not modeling. And that's exactly what the Commission can offer.

Q. Isn't modeling what the Corps has based most of their conclusions on?

A. *Sure, because they've made no measurements. Years ago, I pointed out by survey, that the Pennsylvania Avenue Bridge was undersized, had a big sandbar in front of it, and that what exacerbated the problem was that the Groby Bridge was also undersized.*

More recently, I've walked the river, made hundreds of isotopic measurements, and utilized in-stream sensors to collect water samples to conduct chemical analyses of the river. So, you've got to get down there to see what the problems are.

Q. What can be done to better manage and improve the channelization of the river?

A. *Debris clogging the undersized bridges and restricted parts of the river is one problem. But the biggest problem is the delivery of accelerated runoff on impervious surfaces and storm sewers, plus an undersized channel that impedes the flow and causes water to pile up. There also might be a problem with the tunnel mouth. So even though the Corps' models indicate that there is no problem, he would advocate for installing additional sensors to start collecting data.*

Q. There is a lingering question as to why the tunnel was not able to handle the runoff. So, do you know if there is something wrong with the tunnel?

A. *I don't know why the tunnel overtopped, so it needs to be looked at and studied. It could have been simply overcharged, but the heaviest rainfall terminated southeast of U City. And Commissioner Stein made a report that a big tree had fallen in the channel a couple of weeks before the storm.*

Q. Should the tunnel have been able to handle the flow of runoff that occurred?

A. *According to the modeling it should have. But the only way to figure it out is with measurements.*

Councilmember Cusick stated he is so impressed with this Commission and believes the City owes them a great deal of gratitude for all the blood, sweat, and tears they have put into developing and providing this data.

4. ADJOURNMENT

Mayor Pro Tem Smotherson thanked the entire Commission for all of their work and adjourned the Study Session at 6:27 p.m.

LaRette Reese
City Clerk, MRCC