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Date: June 25, 2021

TO: Council, Mayor, & City Manager

FROM: James Walton PE, CRS Coordinator, Stormwater Utility

SUBJECT: Annual Floodplain Management Plan Progress Report

The City's latest Flood Management Plan was adopted by resolution 200561 as part of the MARC Multi-Hazard Plan for Kansas City, MO. Additionally, the City is part of the Federal Emergency Management Agency's (FEMA's) Community Rating System (CRS), which requires an annual progress report for the City's floodplain management plan within the Regional Multi-Hazard Mitigation Plan. This report is for the prior Annual Report relating to resolution 150882. Next year will begin resolution 200561's first annual review.

For credit under the CRS, the floodplain management plan's annual progress report must be distributed to the media and be made available to the public. These Progress Reports will be placed on the City's website at: https://www.kcwater.us/crs/

This Plan officially accounts for our 1-20-2017 Adopted FEMA floodplains, that leveraged all Local, State, & Federal mitigation projects for Brush Creek and Blue River completed to date, some of which go back to the 1970's. The following Projects are under construction, or going through re-mapping/accreditation for physical mitigation and Flood insurance based mitigation benefits to reduce both community flood risk and flood insurance premiums: Dodson Levee, Swope Park Industrial Levee, Turkey Creek Levee, KS & MO CID Levee, and 31st & Roanoke Interceptor, Turkey Creek. First and Second Creek remapping and development support continues through CTP and City Funding. Partnership with 3 of 4 Cities, with further negotiations with 1 of 4 continue for Little Blue River re-mapping efforts through FEMA.

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Annual Floodplain Management Plan Progress Report

1. Background

There are 27 primary objectives in the Prior Regional Multi-Hazard Plan for Flooding, with 87 action items related to flooding hazards. The following are the twenty-seven plan objectives:

2010 Multi-Hazard Plan (Ongoing Objectives within the 2015 Plan):

1. Examine repetitive flood loss properties within Kansas City, MO and determine feasible and practical mitigation options
2. Integrate flood mitigation strategies with projects and activities designed to (1) protect, restore or enhance ecosystems and the environment and/or (2) create recreational opportunities for the community.
3. Reduce flood-related damage to public, residential and commercial property in flood-prone areas through structural and nonstructural retrofits or removal of property.
4. Discourage new development in floodplains and flood-prone areas.
5. Improve flood hazard assessments and flood mapping.
6. Enhance public awareness and education efforts related to flooding.
7. Participate in, and ensure compliance with, flood mitigation and floodplain management programs.
8. Implement or improve flood warning systems.

2015 Multi-Hazard Plan (Update)(Objectives 9 through 27)(All objectives still apply):

9. Increase public awareness of health and disease related issues associated with flood waters
10. Enhance the capabilities of city departments with flood response duties to mitigate damage from floods
11. Increase public awareness on procedures to mitigate damage from flooding
12. Enhance the EOC capability to monitor and mitigate flood conditions
13. Improve the capabilities of water rescue teams to mitigate loss of life
14. Improve the capability of the Aviation Department to mitigate the damage from flooding
15. Examine repetitive flood loss properties within Kansas City, MO and determine feasible and practical mitigation options
16. Reduce flood related damage to public, residential, and commercial property in flood prone areas through structural and non-structural retrofits or removal of property
17. Mitigate flooding damage to public facilities
18. Improve and enhance the capability to respond to and mitigate damage from flooding incidents
19. Integrate flood mitigation strategies with projects and activities designed to protect, enhance, or restore ecosystems and the environment
20. Examine repetitive flood loss properties and determine feasible and practical mitigation options
21. Integrate flood mitigation strategies with projects and activities designed to protect, restore, or enhance ecosystems and the environment and/or create recreational opportunities for the community.
22. Reduce flood related damage to public and private property in flood prone areas through structural and nonstructural retrofits or removal of property
23. Discourage new development in floodplain and flood prone areas
24. Improve flood hazard assessments and flood mapping
25. Enhance public awareness and education efforts related to flooding
26. Participate in and ensure compliance with flood mitigation and floodplain management programs
27. Implement or improve flood warning systems

What follows is an assessment of all 87 activities within the 27 Plan Objectives.

2. A review of the plan's Action Items

1. Examine repetitive flood loss properties in each county and determine feasible and practical mitigation options.

1a. Work with owners of repetitive flood loss properties to identify feasible mitigation strategies and potential opportunities; determine property owners' interest in specific mitigation options.

Ongoing: The City has identified or geo-located 203 existing or prior historic Repetitive Loss Properties which have been used to create 86 Repetitive Loss Areas that contain 652 individual parcels, of which 162 are City owned, within KCMO. 198 of these repetitive loss numbers are geospatially located to 165 locations City-wide parcel locations.

Of the 165 geo-located parcels with 203 repetitive loss numbers assigned to them:

53 Repetitive Loss numbers have been removed through demolition with a total of 85 repetitive loss structures removed.
&
65 more Repetitive Losses have been mitigated,

Of these 65 mitigated Repetitive Losses approximately half are fully removed from the effective 1-20-2017 regulatory floodplain, the rest have flood risks that are 6 to 7 feet lower.

The 1-20-2017 regulatory floodplain accounts for all channel mitigation work for:

1.) Blue River from 63rd St. to the Missouri River
2.) And Brush Creek from Roanoke to the Blue River
3.) In Blue River these mitigations have reduced regulatory flood elevations by 6 to 7 feet. In Brush Creek the reductions are even greater.
4.) The new regulatory modeling removed 1,999 structures from the regulatory floodplain. They also added 722 structures in though, due to much greater accuracy in terrain, modeling, cross sections and increased regulatory flows from upstream communities.
5.) The net reduction in flooded structures was 1,277 fewer flooded structures within KCMO.

Within just the Blue River and Brush Creek channel mitigation efforts:

1.) 2.29 square miles of historic regulatory floodplain (1,466 Acres) was removed from the new 1-20-2017 regulatory floodplains due to just the Brush Cr. and Blue River Channel mitigation projects.
2.) Up to 1,033 structures were removed from the 1-20-2017 regulatory floodplain within Brush Creek and Blue River.
3.) Using a 7% to 12% market value improvement from removal of this regulation burden, and a $116 dollar per sq. ft. valuation for improved structures, gives: 47.9 to 82.1 million in increased market value to these 1,033 structures.
4.) This can bring in 2 to 5 million within Jackson County alone.
5.) Annually.

The City of Kansas City, MO has:

1.) Removed (acquired and demolished) 3 commercial pad site structures leasing dozens of spaces within the floodway and removed 2 residential lots post 2017 floods. 2 more residential lots were privately bought and removed.
2.) Removed 3 structures using an FMA grant we won through SEMA/FEMA.
3.) Removed 3 structures
4.) Removed or reduced the number of flooded structures in Repetitive Loss Areas (RLA's):

RLA's:

1,2,3,4,5,6,7,10,11,12,13,14,15,16,17,18,19,22,24,34,43*,44*,45,47,48,53,54,55,56,59, 62,64,70,72*,73,79,

That's 36 of 86 RLA's with notable removals and/or mitigations. 41.9% of RLA's have mitigation or removals that have been completed. Please note that 3 of 36 are in an area mitigated, but not yet remapped.

5.) The Stormwater utility spends significant time on these efforts and on communication with parties seeking information and assistance relative to their risk. We provide such information and funnel all parties into our Drainage Complaint and PIAC processes for funding and plan this route through Grant efforts for FMA and or BRIC related Grant Efforts.

6.) The City has a completed City wide Watershed Capital Improvements Plan which has identified potential projects. These improvements are to be revised and given their 1991 to 2007 age, can be less cost benefit oriented, but they are still guidelines for areas with known issues, allowing coordination for mitigation efforts.

7.) The City did pass a 150 billion bond to assist on State and Federal stormwater mitigation projects of larger scale. This was done due to a lack of funds within the PIAC 1% sales tax, which has been using more and more funding for debt services. This money has specific projects listed, or "others as necessary". With more than 2 billion in identified flood mitigation needs still (despite all we have done already), this fudning has had much pressure for use, and is critically needed as City matching funds for many larger projects.

This year's mass mailings to high risk properties for the RLA's included
Work in these areas has been incorporated in the City's GIS and is available for continuous update and tracking each year.

Annual mass mailings to the owners of the 652 parcels, of which 162 parcels are City Owned occurred. Parcel owners that have responded to these outreach efforts since January of 2014 have expressed various levels of interest for information. The City has provided the level of threat known from flood risk information available and discussed mitigation methods such as PIAC and grants and the need for flood insurance and ability to receive it anywhere. Many owners have provided helpful information as to what flooding they had seen that can help to confirm what we believe to be the case from FEMA modeling and flood risk data and or from City modeling and flood data. All parties have been asked to consider submitting for PIAC funding related to their flooding issues. The City has advised that while funding is minimal, the City is using all data provided to begin grant requests that can further leverage dollars towards mitigation or buyout needs with time. Landowners have been advised that submitting a request to PIAC also provides documentation of the flooding problem, initiates an investigation of the problem and assists in justification for possible future grant applications as well as PIAC dollars for buy-out or mitigation options. Landowners have also been informed of the mitigation information available on the FEMA and City websites. The above has helped in several Buyout efforts. See section 1c. for more.

<u>1b. Identify potential funding opportunities to implement mitigation options for repetitive flood loss properties.</u>

Ongoing: The City has completed the identification of all repetitive loss properties and developed repetitive loss areas for these zones of higher flood threat. We continue to update this data with annual information provided by FEMA. These methods are much more difficult than expected, but manageable. The City has noted that our AW-501 information when sent is often not incorporated into the FEMA records, resulting in more time spent verifying that all repetitive locations are captured. The City records are notably weak in alias and master address records as is the County records and this also has need for improvement to more easily track changes. Recent efforts by the CRS Coordinator for Water Supply has resulted in potential improvements in alias addressing for master address records thanks to additional new experts within our GIS group, for which the CRS Coordinator is deeply indebted to. The City has noted many repetitive loss claims that will route to tenants of pad site locations and alias addresses for these locations. More work is needed to make sure we always can lock down to a 1 to 1 identification. The City has identified methods to leverage potential funding through the following sources:

1. Public Improvement Advisory Committee (PIAC)
2. Voter Approved GO Bonds for 150 million for stormwater improvement needs (meant for leverage for larger US Army Corps. projects also) and has a 20 year payback period.
3. Future voter approved Utility Fee/Tax increases
4. Public Safety Committee
5. US Army Corps. of Engineers (COE)
6. FEMA
7. SEMA

PIAC: The City's Public Improvement Advisory Committee (PIAC) (Sales Tax Funds) Is now one of two ways in which stormwater mitigation can be achieved. The City's Stormwater Utility still cannot use any of its revenues to improve systems, only repair, maintain and study/design. PIAC dollars have steadily decreased as this 1% sales tax has been used to fund more and more City Debt. The PIAC group for stormwater was once 13 staff strong in Public Works. In the Stormwater Utility, it is now 2.5 staff with some CAD support.

Bonds: City Voters approved Bond funds (150 million) for Storm Utility needs and improvements. This source has a list of non-exclusive needs associated for the Bond funds. US Army Corps projects have been funded for their local match in this manner, due to the limited PIAC dollars available. It must be noted that this bond funding will have a 20 year debt service period. Funds will be used within 10 years or less time and competition for these bond dollars is mounting. Currently there is much effort to obtain use of these funds. The City still has over 1.97 billion in identified stormwater needs so competition to be a funded project is intense. Recent efforts within Brookside have resulted in use of the stormwater Bonds to assist in at least partial sanitary sewer separation efforts through a new separated storm interceptor. The cost from stormwater's Bonds is unknown at this time but will be in the tens of millions of dollars. Use of funds with respect to cost benefit is even more critical in stormwater, as everything impacts and is impacted by stormwater to varying degrees that can be ignored or over weighted easily for desired outcomes. It is harder in Stormwater to hold parties to the most critical benefit to cost needs than any other utility due to the

interrelated complexities of storm issues on all aspect of the community and its past and future development. Conversely it is also easier for parties to pull stormwater in as a source to aid them monetarily in solving their rain, runoff or combined sewer need, but without necessarily the full stormwater Utility benefit to cost approach needed to maximize all community benefits from capital spending on multiple needs.

Future Voter Approved Utility Fee/Tax increases: have been an internal effort for the last **21 years**, but have not occurred regardless, largely due to the City's consent Decree on combined and separate sanitary sewers. While the recent 2017 floods did obtain voter approval for 150 million in Bond funds that can be used for capital improvements, it did not obtain a vote to deal with the ongoing deficit spending of 6 million per year from depleting stormwater utility reserves within a utility that is collecting approximately 11 million annually for 900 miles or more of underground storm systems. Severe cuts in funding have occurred to right-size limited funding. Staffing reductions have occurred and vacancies are being permanently removed, ever eroding the Utilities capacity in addition to limited funding. Storm was first to develop a true citywide model based Capital Improvements Plan in 2007 but has repeatedly been unsuccessful in making its case for small increases having large Community benefits for stormwater needs compared with competing wastewater and water utility needs. Ironically many of the solutions that can benefit combined sewer needs can also benefit storm sewer needs, but efforts to show this path have not been successful, though studies (TFCI and NEID) have shown these pathways.

Public Safety Committee: Historically this Committee's focus relates to flood threat, but has been focused on many needs such as Fire, Ambulance, Health, Police and Emergency Response. The Storm Utility, given its funding position, has been able to obtain $410,000 in funding from the Public Safety Committee to support our flood warning systems. This winter or spring the Storm Utility intends to have its flood warning system completely surveyed in for datums and real time flood elevations and then linked to FEMA flood elevaitons and flood depths and estimation methods for time of travel from upstream gages to downstream in order to develop correlated warnings for known flood risks. This will identify about 5,800 polygons with flood depths and flood elevations for 10yr to 500yr FEMA flood severity storms and build this into the flood warning system. This is expected to increase our warnings by 400% or more from our current payload of only ~ 500 warnings. This path to substantially improved warnings capabilities community wide is due to FEMA completing flood depth grids for a little more than 90% of the City's regulatory stream flood areas for 10-yr to 500-yr severities. The Stormwater Utility is also working on efforts to improve warnings directly in the field for road flooding. We've continued to meet with automated barricade companies to push them to simplify and reduce the instrumentation within system sinorder to bring down the cost of sties. We are using Signage based methods in the field combined with multiple stage based signs in each direction to warn on depth of water in select road locations. We hope to use Public Safety for these efforts going forward. The City has identified more than 1,000 locations requiring barricades.

US Army Corps. The US Army Corps of Engineers (COE) and City have worked projects underway throughout the City for more than 50 years. These projects have removed or mitigated repetitive flood loss properties. COE projects reduce repetitive loss through mitigation projects such as channel and levee improvements. The City has

conducted projects that eliminate or mitigate structure flooding, including repetitive losses for over 50 years. City has historically funded its part of this effort's local match through PIAC dollars, however debt service has degraded this ability and thus the GO Bond again is used for the Local match to Us Army Corps. Projects which ranges from 25% to 50% depending on the project type. It should be noted that recently the US Army Corps. Was granted funding for 3 major levee's to be improved in Kansas, one of which protects KCMO's Westside area in Missouri. This funding was 100% by the Federal government with no local match due to the high cost of the work. This effort alone could have used up the 150 million in GO Bonds. Educating the public on such victories is difficult, but critical to showing how much the Stormwater Utility has achieved with so little compared with our neighboring Water and Wastewater Utilities.

FEMA and SEMA: FEMA and SEMA dollars require annual Competitive Grant efforts, in which the City is working to be more competitive. The City was successful in using FEMA's Cost Benefit Software to make a convincing case to win a FEMA FMA grant. This work removing 3 structures is now complete. The city put together Cost Benefit Analysis for BRIC Based Grants this last year, but ultimately did not submit these to SEMA due to confusion on what was and was not covered under BRIC. We are working with SEMA and FEMA to keep BRIC OPEN, allow system wide solutions in an area that meet cost benefit analysis. We cannot use BRIC effectively without some level of buyout within the effort. Most areas that need mitigation, improvements, cannot get there affordably through mitigation of the structures that remain. They are often too frequently and severely flooded for this to be cost effective. BRIC allows a community wide approach with Life Lines that can leverage in benefits in many forms. Unfortunately we are now one year behind others familiarizing and competing for these BRIC grant dollars. **The CRS Coordinator would like to note that our initial grant win and the post 2017 flood approach would not have been possible without the required 501/502 repetitive loss efforts built into CRS and the work this requires annually. Several pathways have aligned and CRS has been the most critical piece, though it is still not realized.**

1c. As funding allows, repetitive flood loss properties and structures will be targeted for buyout.

Ongoing: The Stormwater Utility has been able to change the way the City looks at flood mitigation. Before the idea of a buyout process was resisted vs. efforts to use some form of engineering mitigation. The repetitive loss and loss area process has allowed the City to use the new FEMA flood models and flood elevation data with FEMA's Benefit Cost Analysis software to show convincing pathways for lower cost mitigation projects. The FMA and BRIC grant processes are excellent examples vs. a costly and risky series of regional detention basins of 240 acre-ft. storage along with 1 million in channel widening, riparian destroying, channel work, to mitigate approximately 92 pre FIRM properties. We've been able to make the case for less expensive, less risky, more beneficial incremental change, which is easier to work towards over time with limited funding.

As noted above, with the official adoption of our 1-20-2017 effective FEMA floodplains. We can show removal and/or mitigation within:

Repetitive Loss Areas (RLA's): 1,2,3,4,5,6,7,9,10,11,12,13,14,15,16,17,18,19,22,24,34,43*,44*,45,47,48,53,54,55,56,59,62,64,70,72*,73,79,

This is 36 of 86 RLA's with removals and/or mitigations. 41.9% of RLA's have mitigation or removals that have been completed. Please note that 3 of 36 are in an area mitigated, but not yet remapped.

- New RLA #79: This RLA was created this year from updated FEMA data. It aligns with an area just North of RLA #34. 2 parcels where purchased by the City here, 1 was a new loss following our 2017 floods. The land will be incorporated into the Park system. The remainder of this new RLA #78 may not be bought out, but may use a shallow berm, depending on the watershed wide and physical model of Indian Creek that are currently underway to find the best benefit to cost solutions for Indian Creek as a whole. The CRS Coordinator has kept this new RLA separate for tracking purposes given our new 1-20-2017 FEMA mapping updates and our documented 2017 flooding and damages. This area has completed acquisitions for 4 parcels and related structures all of which are slated for demolition in 2019.
- RLA #34: Repetitive Loss Area 34 has four major pad site structures with multiple tenants. Two residential properties, not in RLA #34 were acquired and demoed by private parties. Two [more] floods occurred in the summer of 2017 which substantially damaged all 4 commercial pad sites. 3 of 4 have been acquired and demolished by the City, the 4th, is very small and abandoned at this time. Once this last structure is removed all of RLA #34's structures will be eliminated. At least 2 of the 3 purchased by City were determined to be destroyed, (substantially damaged), the third was close enough to justify acquisition to prevent repeat flooding. At this time the area being cleared of structures may become a trailhead, however the Indian Creek physical modeling and related work for benefit cost ratio solutions will find this area constricting for flows. IT is unknown how upstream protection vs. the constriction of flow at Wornall will work out for benefit to cost ration needs post the 2017 floods.
- RLA #64: An FMA grant was won by the City for flood insured properties to acquire up to 4 of 13 parcels in RLA 64. 3 losses are scheduling for demolition. Upon completion of the work the FEMA to SEMA to City Grant dollars will be returned to purchase and demolish an additional 3 structures in RLA #64.
- RLA #20: One repetitive loss properties and one repetitive loss area property was acquired and demoed in RLA Area 20.
- RLA #56: On Repetitive Loss Property and area was purchased and the location converted into storage and energy control for stream network.
- RLA #62: This loss was acquired as part of road widening and stream mitigation efforts for Waukomis Cr. This repetitive loss area and all structure risks within it have been removed from flood zone through buyout, demolition and road and stream side improvements.
- RLA #73: One repetitive loss property and 36 additional repetitive loss area parcels have been mitigated or acquired for Parkway Improvements. Only 6

repetitive loss area structures remain, all of which are mitigated. This project involved major parkway and road and stream improvements and significant acquisitions for the widened Parkway. Improvements at Chouteau and Parvin Rd. for arterial road safety.

- RLA#79: Redevelopment of fuel station resulted in the acquisition and removal of two residential structures from this RLA. Later, flooding resulted in the City acquisition of two more followed by demolition.
- Adoption of the 1-20-2017 Effectives has removed a net of 1,277 structures (-1,999 + 722 mapped in by 1-20-2017 floodplains) from the Communities FEMA regulatory floodplain.
- All Channel mitigation work for Brush and Blue River is adopted, with 1,033 structures removed form regulatory floodplain, with increased market value for these structures estimated to be 7% to 12%, or 47.9 to 82.1 million in increased market value, resulting in 2 to 5 million in additional Jackson County tax revenue.
- Mitigation and/or removal of structures from the regulatory floodplain has been accomplished in the following RLA's, following the adoption of our 1-20-2017 FEMA Floodplains:

  RLA's 1, 2, 3, 4, 5, 6, 7, 19, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 22, 24, 53, 54, 55

The City's 1,132 storm water capital improvement recommendations identified by City modeling also contains up to 135 buyout recommendations. More buyouts will be justifiable by benefit to cost comparisons vs. engineering mitigation based methods. The Storm CIP is aging and was incomplete in benefit to cost aspects, especially with respect to buyouts and elevation of structures.

It must be noted that the City has densely populated development and that in many areas buyout may not be the appropriate path. These areas of mitigation are reported on elsewhere.

1d. With stakeholders, explore incentive options to encourage property owners to take action to prevent or reduce future flood losses.

Ongoing: The Stormwater Utility has found a negative positive reinforcement loop here. Notices to Repetitive loss area properties tend to return 10 to 20 requests for assistance annually. These can easily evolve into a half dozen or more potential mitigation projects or acquisition projects. There is much more need, even with the low response level, than there is capital. Some have work that is on-going, others need a path developed. FEMA flood depth data again has helped by allowing the City to analyze impervious for structures, roads, driveways, parking lots and sidewalks to inform owners of the level and frequency of flood risk and to discuss what potential private options they may have and what public processes may exist for potential assistance, generally by grant, PIAC, or less likely, GO Bond dollars. This aspect needs more development within the Stormwater Utility. In fact our strongest asset in this area has been our Emergency Management Office and their efforts to do trainings and assistance to the public on all disaster risks, including flooding. This effort strongly

pushes parties to prepare for and plan for flood risks, but the amount of material to cover cannot be done only on flood risk. The Stormwater Utility has developed a HOA level presentation and training for flood risks and the 4 kinds of flooding that properties and structures can experience. This is being used and improved on an ongoing basis. Our Water Services Funded, KC to the Sea program continues to have significant success in schools, though COVID-19 made much outreach this last year forced most education into a virtual form which defeats much of the Kc to the Sea Program. It has been an incredibly difficult year for our educators. A path like this is going to be needed and an ability to do this exists within certain not-for profit groups that can help be informed advocates that assist the City in getting education to those that need it most.

2. Integrate flood mitigation strategies with projects and activities designed to (1) protect, restore or enhance ecosystems and the environment and/or (2) create recreational opportunities for the community.

2a. Consider the construction of detention basins, small lakes and greenways or riparian corridors in areas of new development to channel and catch storm water, thereby reducing the likelihood of flooding.

Ongoing: The Stormwater Utility continues to focus on IDENTIFICATION. Stormwater and Combined Sewer issues are ALWAYS open systems issues. The Analysis is much more complex and time-consuming to assess what is occurring, and conventional methods are often improperly structured around the methods of the 1950's and 1970's in which information had to be weighted and reduced down and focused on the area, you could afford, to analyze. Those days are gone, but the more effective pathways to fully identify conditions and related systems within in a community that impact combined sewers and storm sewers requires much more information to be collected and much leveraging of this higher accuracy data into more modern software and hardware able to effectively identify risks of many forms down to 10 sq. ft. terrain raster or TIN. The Storm Utility has completed:

1.) An overly complex two part model called Town Fork Creek Integrated was completed in April 2014 which will be taken in the next year to the level required for all forms of accurate data collection and analysis with higher resolution modeling methods in a new round of work that will also, merge combined sewer and storm sewer and system concerns, while identify risks for both utilities to a scale of about 10 to 25 sq. ft. resolution as Triangulated Irregular Network terrain (TIN). Done without CIP and engineering assumptions, this method can best show all forms of cost from installation to life-cycle in order to determine the best path forward, for the lowest cost for both Utilities. This method can also potentially help on the difficult funding conditions within the metro relating to these two Utilities.

2.) IDENTIFICATION, Hydrology and the earth's surface and soils are crucial aspects that require detailed and accurate analysis. This type of work is not really possible to the level required by consulting engineers for small developments, where the average plat size is 11 acres. Their profit/loss creates a real burden here of negatively reinforcing costs, especially when the more accurate data generally results in more accurate and lower flows. This path is clearly safest for the public but hardest on development seeking to complete micro and/or macro drainage studies and then determine their development. The City has completed 1D

with 2D developed GIS products for Twin Creeks and we have completed full 2D modeling and GIS for this area as well. The City is now in phase 3 of this effort to build out all of the necessary ArcGIS-Online products to provide this detailed hydrology, flow path, time of concentration, CN, Impervious, soil and vegetative cover type product to determine where flows enter and leave any boundary provided and their existing conditions. These tools are paramountly critical to public safety as done poorly existing conditions flows can be double, triple to even ten times actual flow conditions. Many errors, mistakes and misses can result in these scenarios. Poor CN's are not the main cause, though they certainly can contribute. The most serious issues come in the time of concentration or time of travel components in analysis, flow path slopes, and soil/vegetation mixes and impervious that can increase or decrease infiltration and runoff with more or less rapid Travel Times. Missing part of a streams flow length and path **drastically increase existing flows**. Having these products completed and updated geospatially in say a 2 year cycle, **would be extremely beneficial to the public, and affordable.** Requiring their use for development is a critical path. KCMO has approximately 80 square miles of territory that is as yet undeveloped (some is agricultural, which is developed). These areas are our future flood risks and identifying inaccurate existing conditions flows will rapidly sign and seal a false reality professionally that results in negative impacts in the future that threaten life and property and put the public, police, fire, emergency services, ambulance and barricade staff at risk in the future. Not doing this, is not good for the children, parents, grand-parents and is also absolutely not sustainable. Many of these products do not necessarily need the modeling completed, so much as the geospatial analysis for the supporting hydrology data that can be used by the modeling to obtain accurate existing conditions flows. It should also be noted, that agricultural use is common in much of the above 80 square miles of rural land I referred to as undeveloped. Agricultural use is a development and can have serious impacts on water quality and quantity. In fact many of our most degraded streams are due to agricultural uses. Often streams stabilize and seek a decades long restorative and re-establishment after lands develop into residential and commercial office, light industrial uses in the typical suburban patterns. This points to another issue in identification. How have we changed from the prior oringal native conditions before human-kind. This condition is what shaped the terrain, landscape, streams and flow paths we see. Going back even a few hundred years, still with the influence of umankind through burning, a notably different native condition and behavior can be shown. Scientifically, how can we ever seek to prevent harm, without knowing the original conditions? How can we ask what tools, methods and techniques are best to prevent harm but also encourage re-stabilization and perhaps even some degree of improved conditions better than the existing conditions? The City's APWA 5600 standards, though old, have been held onto because they can require more be done when risks are identified downstream such as flooded roads, structures, erosion. An original native conditions would be very valuable to provide the entire history for that land, vs. what is currently proposed for change and the future prosperity, in a manner that proved the most benefit and least harmful impact. Quickly, easily, at lowest cost and delay in time to projects. Such information would also allow much process improvement and reduction in steps and regulations and ultimately make both design and review much easier to complete on all things stormwater.

3.) Our Stream Buffers, excluding Blue River from 63rd to the Missouri and Brush Creek, regulate to the FEMA 100-yr SFHA flood plain boundary as Middle Zone. The original intent

of this Ordinance and chapter was absolute for preventing structures within any kind of A Zone and within any area the city completed 100-yr floodplain and adopted this for regulatory purposes at the local level in a manner that was not well defined. Revisions, process and many groups and interest have revised this and the latest overhaul within Chapter 88-415 does have some aspects which the Water Services Stormwater Utility is in discussions with City Planning and Development (CPD) regarding the potential impacts of some of these changes to the original strength, language and intent of words, such as "hardship" defined in the manner used within FEMA's Variance Procedures documentation for Floodplain Administrators relating to regulating in accordance with Federal 44 CFR. The Stormwater Utility is also in discussions with CPD with regard to efforts on remapping the original stream buffer boundaries, which were converted to line work in the last steps fo negotiations with many interties and interests. The original methods are complex on how and how much area is inspected and considered to be within the outer zone. Improvements are being discussed that can make the process easier for all parties involved and potentially more flexible and more able/likely to use our conservation development standards.

4.) Detention, small lakes, greenways, and repairing corridors. Some of these items need the above steps more than others, but all of them need the above items. Stream buffer corridors will be eroded and streams cut deeper and wider if systems are designed for flows 200% of true existing by methods submitted as existing, but inaccurate, and reviewed but approved, due to the lack of data to help reviewers find the flaws in already **professionally sealed macro and micro studies**, without hours and hours of review time, even days. DO NOT think this is just a KCMO issue, this is NATIONWIDE. And there are effective solutions right here to resolve it. You must accurately identify risk for existing conditions if you are to assure you prevented harm. Otherwise it is just a claim. These items are crucially valuable and can control harm and prevent higher risk development while creating habitat pathways that preserve and protect riparian corridors. KCMO is heavily involved in these pathways and there is much more to do to improve further. Currently our stream buffers

The city has noted many key and critical lengths to successful stormwater risk identification. We have come to understand that the focus on mitigation is not the focus needed. The focus needs to be on IDENTIFICATION. Technologies and tools have drastically improved in just the last few years, let alone the last decade. Many needed solutions are possible now and more cost effective with very high accuracy and quality. The aim is to improve quality data and analysis to support designers and professional engineers to meet their fiduciary obligations to the Public. An example 270 acre TIF submittal claim to have 1,565 cfs of runoff in existing conditions with a 2,600 foot flow path. The true flow path was more than **7,400 feet long** and **the flows from Twin Creeks were less than 600 cfs**. The designer acknowledge they had missed crucial information with impacts to the existing flows. This Consulting firm moved into the micro development of plans side and a new Consultant took over this macro and micro drainage study effort. The TIF enlarged adding more development footprint. In additional tributaries. For the main macro drainage path they provided a flow that was within reason for this area of about 700 cfs. However the added area and subsheds where then converted into Project Areas that were then treated as micro drainage

areas. These project area analysis and drainage area analysis all resulted in notably higher flows at the micro level. Again hourse were spent, even with the supporting data to itemize all of the deficiencies and quality concerns that should have prevented an engineer from sealing the study, but did not. It is common for existing flows to be higher than they should be in macro and micro stormwater proposals, showing less increase from developments added impervious allows for less need of storage and less identified harm downstream. There are dozens of methods to submit stromwater analysis, it is no longer tenable for Cities to constantly wade into these professional methods and look for places where the methods fail to accurately identify existing and proposed impacts, flows and needs. Twin Creeks, if adopted by resolution by Council will become the Macro and micro stromwater studies for existing and original native conditions here, leaving the developer and designer to account for it in their proposed solutions to storm issues caused by development and best avoid harm and flood risks. The Stormwater utilities Leadership, has joined the FEMA Certified Technical Partner's Program of FEMA and this has resolved the funding restrictions ran into for Twin Creeks Phase 3, a Phase 2 was done for direct 2D modeling with unused funds, due to the lack of ability to complete the review support products. With funding resolved come 7-1-2021, this effort can finally move through process to be completed. The Twin Creeks watershed plans have not yet been adopted. These methods lend themselves to much larger benefits in more rural and undeveloped areas, like Second and First Creek. This information is beneficial and easily achieved in the urban core as well, as these methods capture much more flood than the conventional modeling methods and consider every inlet and pipe and surface interface in the modeling to identify where water will really go based on accurate 2018 LiDAR terrain when pipe networks and inlets can no longer collect flow, pressurize or the surface floods to counteract some pressure from systems. The urban areas also tend to have combined storm and sanitary sewage issues. The City has 58 square miles of combined storm and sanitary system. Solutions that solve stormwater flood risks and partially separate from the combined sewer can result in solutions to both the combine sewer consent decree obligations and the non-mandated flood risks of the City. A focus only on frequent events and only on the benefits for sanitary but not the benefits from flood risk reduction that also solves combined sewer needs creates an inaccurate assessment of the best project benefit to cost solutions. It also ignores Atlas 14 and other trends on increased severity and frequency of rains that can potentially drive more overflows within the consent decree than expected. More severeextremes of drought are also possible.

In the end the need to step away from riparian areas and the low flow paths that water will always seek to find is critical, but without accurate information on where and how these systems behave, it is difficult to propose a solution that tries to step back from areas of high risk in the most cost effective manner for the largest number of combined City, public and private needs.

The City's Storm water Utility has completed watershed studies analyzing over 97% of the City's 318.9 square miles. The Storm Water Utility's KC-One efforts standardized and prioritized 1,132 capital improvement recommendations with an estimated cost of $1,974,371,000 in 2007 dollars. The City provided 12 million in watershed study modeling to FEMA and the US Army Corps. provided their modeling for hydraulic modeling for the main stems of Brush Creek and Blue River allowing our 1-20-2017 overhaul of all modeling, floodplain, floodway, flood elevations and flood depth data

through FEMA. This partnership has allowed us to show in detail the risks within the FEMA regulatory areas and aids the case to give flooding its space.

Our KC-One improvements include:

223 green solutions projects with a probable cost of $264,473,000, which includes detention, channel improvements that support improved wildlife habitat, stream function and stabilization and additional attenuation/storage of flow and use of protective embankments, as well as land acquisition efforts aimed at reducing peak flows and volumes while mitigating damages and risks to properties near streams.

Over 76 detention basins have been identified with a total storage recommendation of at least **3,923 Acre-ft.** and an estimated probable construction cost of $45.6 million. The 3,923 Acre-ft. of storage mitigation will benefit stream habitats, property owners and structures and transportation systems, while reducing conveyance costs. But it can have risks and dam safety is a critical component. The lack of funding has also led to some locations developing. One location attempted to submit a regional detention proposal but failed to meet the many requirements of design within APWA 5600 and it's Supplements on regional detention. Ultimately the effort stopped.

The locations and sizing components have been completed for all of these detention basins, but only at an early study level of detail. The solutions have been modeled to confirm they mitigate flood needs, but additional study and design work is needed to confirm the storage needs can be achieved without significant public safety concerns and with a benefit to cost ratio that is notably better than other mitigation methods, including buyout methods. The Stormwater Utility has noted evidence that methods which mitigate flood risk through acquisitions can be notably lower cost. Such methods can also be critically safer to the public vs. large scale storage methods that can have dam failure risks which require inundation mapping for dam failure that shows greater risk for harm to more territory than existing flood risk, in the event of a dam breach. Put another way, the study based efforts within the modeling work could easily evaluate if storage could solve flood risk issues and could assign some level of cost for these capital improvement costs, but at a study level these do not fully vet all costs, such as relocation of sanitary sewers and did not consider flood risks relating to these dams nor full consideration of operations and maintenance costs long term. The KC-One projects also did not consider probable maximum precipitation (PMP) requirements due to downstream residents and their risk from dam failure or breach scenarios. This aspect, along with issues relating to climate change and their impacts on cost to achieve levels of Stormwater service for these storage facilities, rapidly develop into notable expenses that can easily show a naturalization and acquisition based path is usually much less costly, much more publically safe and much better future proofed for additional development or additional climate change, both of which will result in increased storm severities and larger potential future 1% annual storms. This path can also be managed more easily and with each project further reduces community flood risk while improving a streams ability to flood, spread out and attenuate its own peak flows, where once there were high risk structures. A City must consider the long term from a multi-generational perspective. No utility is more impacted, affected or difficult to do this for than stormwater, where literally everything a community may do and become may impact future flood risk. **We have still only fully identified ~ 30% of known flood**

risks, primarily from FEMA flood depth and floodplain data, which City modeling did update.

2b. In concert with existing comprehensive and land use plans, develop a strategy for acquiring flood-prone property for use as open space or park land.

Ongoing: The new FEMA regulatory floodplains for City provide 32.49 square miles of existing FEMA NFIP 100yr (1% annual) floodplain, 29.23 square miles is not within federal lakes/rivers of 10 acre size or greater. This is the denominator for KCMO's ratio of open space to floodplain. The majority of City floodplain is contained within a Stream buffer where no structures are allowed by ordinance. However, there is a part of town where open space is defined by ownership and not ordinance due to US Army Corps. projects. This is the area from 63rd St. to the Missouri on Blue River and from State Line to Blue River on Brush Creek. In this non-buffered area the Storm Utility has identified over 1.5 sq. miles of existing lands owned by City or qualifying entities and 0.8 square miles of lands in ROW as protected floodplain. Of this total ROW and Parcel area, 0.1 square miles of parcel lands and 0.2 square miles of ROW are impervious surfaces and cannot be counted. This is a total of 2.0 square miles of open space within the non-stream buffered Brush Creek and Blue River systems. It should be noted that the City has actually lost significant credit from the updated FEMA floodplains due to the large amount of City and US Army Corps. flood mitigation work properly documented and mapped within Brush Creek and Blue River in our FEMA 1-20-2017 floodplains. The community now owns 13% less of the floodplain, because much that we owned was along Blue River and Brush Creek **which have both been significantly mitigated for flood risks**. Further, the City is no longer tallying the City, County, State owned lands that are within Floodplain throughout the City. We are tracking this only where Stream buffer DOES NOT exist in Blue River and Brush Creek. This has dramatically reduced the amount of area noted as City owned. The Stream buffer Ordinance is far more effective and complete as a floodplain management tool for development and structures.

Stream Buffer based Open space and Ordinance 081033 Chapter 88-415 & 88-410. The community defines a Streamside Buffer, where only road or utility crossings are allowed perpendicular to stream. Middles Zone, where FEMA regulatory A, AO, AH, AE Zones (or City identified 1% annual chance (100-yr) floodplain) exists, in which no structures are allowed by ordinance. The third region of the Stream Buffer is the Outer Zone buffer which is a minimum of 25 ft. to 75 ft. wide outside of the Middle Zone and includes all lands of 15% slope or higher that contact this 25ft to 75ft area. In Outer Zone, structures are also not allowed due to flood risk and environmental risks and needs of the community and the public we serve. The City stream buffer does not include Blue River North of 63rd Street to the mouth of the Missouri River nor does it include Brush Creek. The stream buffer protects the riparian function and flood storage and prevents unwanted high risk development within these flood risk and environmental areas that can change through many forms over time. The stream buffer ordinance does not alter any aspect of ownership. This method is much more effective and efficient to regulate and monitor. Few communities with an area of 318.9 square miles have achieved so much protection of floodplain. The City's ongoing efforts have resulted in significant land holdings within floodplains, much, but not all of which is often setup as park lands or permanent open space. More will be needed with time but less

will be required for acquisition vs. preservation by the Stream Buffer Ordinance. The City can work to preserve trail and stream corridor connectivity and not necessarily own all of the lands needed vs. use of deed restrictions, easements or covenants due to the stream buffer ordinance. This is critical as streams move and meander and ownership changes, yet still bear's responsibility for such issues. In total the Stream Buffer ordinance 081033 provides 23.0 square miles of parcel protection and 1.9 square miles of protected ROW. 2.7 miles of this total 24.9 square miles is impervious area (roads, sidewalks) that cannot be credited. Using streamside and middle zones only, the Stream Buffer Ordinance protects 22.2 square miles of our regulatory FEMA floodplain as adopted on 1-20-2017. An additional 2.0 square miles of lands are owned within Blue River and Brush Creek regulatory floodplain, where the stream buffer does not exist. Kansas City therefore has obtained prevention of flood risk for structures in 24.2 square miles of 28.1 square miles of regulatory floodplain that is not federally owned and larger than 10 acres in size. This is 86% of the total floodplain. This DOES NOT include the Outer Zone which CRS can allow credit for as well. The Outer Zone, using only the 75 ft. buffer for the stream segments within the stream buffer, contains 7.81 square miles of lands protected from structure development and the higher risk that such development would bring with it. If one includes this area then KCMO would have 32.01 square miles of 28.1 square miles protected from high risk structure development. This would be 113.9% of the 420 amount within CRS, and credit can be provided for this. It should be noted that there is a 430 Higher Regulatory need that can further aid needs here.

Annually, the Storm Water Utility assists the City Manager's office in determining properties owned by the City which can be sold without storm threats and with the correct limitations. The Storm Water Utility also works closely with Parks in efforts to identify park lands which may be able to assist in mitigating flood threats. One such effort, is Repetitive Loss Area #73 which is a major parkway transportation corridor improvement with stream improvements for Buckeye Creek. This process involved much land acquisition which was known to have significant flood risk and much of this was converted into park lands parallel to the parkway on its east side. Out of 37 repetitive loss area parcels, only 6 remain with structures that have received mitigation from flood risk. 31 of 37 parcels are now owned by the City of Kansas City, MO and managed as natural riparian corridor with a stream trail by Parks and Recreation with a more formal lawn based park area east of Chouteau Parkway where residential lots were acquired.

The above process continues post our 2017 flood events, which have acquired more lands within floodway that will have structures demolished and land use converted to park use without structures and, longer term to flood control mitigation efforts to reduce base flood elevations with proper benefit to cost ration analysis completed.

2c. Identify funding sources for the acquisition of flood-prone land for environmental, recreational and flood mitigation uses.

Ongoing: The City has identified many methods of funding and leverage that can assist the City in acquisition efforts as follows:

- **The U.S. Army Corps:** Provides significant funding leverage for larger scale

projects that the City could not otherwise fund. With Federal and sometimes State leverage, the City is able to put more of its money towards needed acquisitions on which projects can be completed. Most projects require the City handle acquisitions and allow this as matching leverage in the larger project total cost which City usually must match 25% to 50% of the total cost in.

- **FEMA and SEMA Funds:** This area is not fully developed due to more effort and implementation of additional tools such as HAZUS to pursue competitive grants for assistance in land acquisitions, relocations or removal of dangerous existing structures within flood-prone areas.
- **Public Improvement Advisory Committee (PIAC) (Sales Tax Funds):** These funds, from the City's 1% sales tax for infrastructure, can be used for storm water facility improvements, park improvements and acquisition of repetitive loss properties. These limited funds are requested by all City departments, as well as the public and private parties for various needs.
- **Storm Water Utility User Fee/Tax (with voter revisions):** This fee/Tax is small when compared to other Utilities and is limited to the operation, maintenance and repair of the existing storm sewer systems and planning by the vote of the people. The Utility has not yet been given a day before the voters to change the funds available or to allow improvements or mitigating solutions, up to and including acquisition. Mitigation efforts prior to the 2017 floods resulted in a prevention of an estimated, are estimated to have preve Our current Fee/Tax cannot be used for improvements or acquisitions, but only maintenance, operations and repairs to existing stormwater assets. Stormwater mitigation/improvement projects can be extremely expensive, particularly in older areas where stormwater design was simply part of the combined sanitary system with inlets added and some limited added pipe size for extremely frequent storms aimed more to drain the road eventually, than to protect the public. Modern stormwater standards in these areas require massive upgrades, or a complete change in how we see the use of our landscape. Many refuse to consider this level of expense to meet modern standards. That also serves to separate storm needs from consent decree needs, resulting in two separate views of capital improvements. This is not cost effective. Each can solve expenses for the other, but each is being looked at without consideration of the other. In 20 of 58 square miles of combined storm and sanitary system, mitigating for both needs together can literally save half the cost of both CIP's, solving two problems for the price of one. Technology, software, hardware, GIS, asset management and condition assessment all play there part here. The new methods are new and there use is less understood so the up line engineer's with greatest experience go back to what they know best. Some of the younger may be beginning to see the path, but they lack the authority and standing to make the case or win. So I make it here. Mitigating both consent decree combined sewerage and storm flood risk issues requires use of all our new tools and a different approach to acquisitions and mitigation. The Storm Utility has re-evaluated many projects with an aim towards avoiding additional infrastructure costs and eliminating flood risks by acquisition when mitigation is simply too costly, but much more is needed in this path of study to improve results and community benefits to cost for both consent decree and stormwater needs.
- **GO Bonds:** The Voters did pass a 150 million dollar approval for bonds to assist in stormwater capital improvement needs. This was done due to the high debt

service on the City's 1% earnings tax, which has resulted less ability to fund PIAC based storm project improvements. The GO Bonds continue matching funding needs for US Army Corps. And related PIAC stormwater improvements projects or buyouts. Go Bonds are tied to a list of potential projects which is larger than the GO Bond funding's ability to fund, so the ability to use this funding source is more limited and more dependent on Council's willingness to support given competing needs on the GO Bond list. Remember the Stormwater utilities total Capital Improvements needs are more than 1.9 billion dollars. The Bond may be spent in 10 years with debt service for 20 years.

2d. Consider alternative uses for floodplains and flood-prone areas, such as sports fields, parks, wildlife habitats, etc.

Ongoing: The City has made gains in wildlife habitat efforts through its stream buffer ordinance and continues efforts throughout the City and within the Blue River and Brush Creek watersheds for park lands and wildlife habitat through Joint City and COE efforts. The City has provided 12 million in watershed modeling as leverage and more than $550,000 in funding to FEMA to obtain our new 1-20-2017 flood modeling through FEMA standards and guidelines and our FIRM, and FIS products, now adopted into our Chapter 28 Floodplain Management ordinance on 1-20-2017. This last year the Stormwater Utility became a Certified Technical Partner in order to leverage our 1-20-2017 effective floodplain mapping, modeling, FIRMs and FIS data as our NFIP and 44 CFR regulatory law. The New floodplains account for significant mitigation efforts over decades of time by the City, State and Federal parties such as FEMA, SEMA and the US Army Corps. The City's Stream Buffer ordinance directly references all FEMA regulatory A Zone types as our Middle Zone Buffer restricting development of structures in all forms. The stream buffers also maintain a minimum Outer Zone width of 25 ft. to 75 ft. to up to 250 ft. within which the riparian corridor is to be preserved. This helps to allow better use of sports fields and wildlife in the right places with respect to flood risk and flood storage needs. The City has identified all of its Park Lands and assets within GIS and continues through PIAC (Sales Tax) and other tax revenue dollars to better size these for use in areas with known flood risks. All of this serves the alternative uses goal, by better preserving lands in floodplain. As an example, the City has at least 5.41 square miles of Park lands within the 1% FEMA SFHA floodplain; however, the Stream Buffer protects 22.2 square miles of 1% FEMA SFHA floodplain **without requiring ownership**, creating a linked network of riparian reaches for wildlife along streams which includes their entire FEMA floodplain. Trail systems continue to tie these networks of streams and rivers together with neighborhoods and businesses bringing people back to these natural systems, while also showing how the urban environment can better acts within and around them. The Stream Buffer also protects 6.26 square miles of Outer Zone Stream Buffer and 14.02 square miles of regulated streams. The above data has been updated to include the new 1-20-2017 FEMA regulatory A Zones that are within the City stream Buffer Ordinance. 28.1 square miles of 32.48 square miles is not federally owned lakes and rivers in KCMO regulatory FEMA floodplain. 22.2 square miles of this regulatory floodplain is protected by stream buffer which allows no structures to be built due to the risk of flood damages. Of the remaining 6.1 square miles that is FEMA regulatory floodplain, but not within City declared Stream Buffers, 2.0 is owned by City, County or other qualifying owners or in ROW. This remaining 2.0 square miles has already removed impervious coverage in parcels and in ROW. 24.2

square miles of 28.1 square miles of SFHA is protected from high risk structure development within these areas that retain so much natural function, flood storage and attenuation function. Adding to this the Outer Zone Buffer of 7.81 square miles results in a ratio credit of (24.2+7.81) / 28.1 = 1.13 for the City of Kansas City, Missouri's efforts to preserve and protect stream functions and prevent high flood risk development. These buffers do far more for far less cost. However, this area has already been determined to only resolve approximately 30% of the total land area flood risk within the City's 319 square miles of territory. FEMA regulations stop at approximately 1 square mile sized tributaries. The area not within FEMA regulation due to this stream size aspect contains the remaining 70% of flood risk within the community. Notable flood risk exists here and a notably percentage of community repetitive losses are outside the FEMA regulatory floodplains in areas that can easily be shown to have flood risk.

2e. Work with area environmental groups, property owners and other stakeholders to develop and implement flood mitigation strategies that also promote the restoration and/or sustainability of fish and wildlife habitats

Ongoing: See 2f. These efforts are ongoing through the City's MS4 Program, our PIAC and Storm Utility based funding as applicable and other State and Federal Matching dollars and programs. This last year the Stormwater Utility was able to gain back its MS4 Program, which had been consolidated into our Wastewater Utilities more point source based permitting. This was in part done due to the Stormwater utilities funding situation, however funding was not altered, while organizational differences resulted in internal decisions that non-point source, and point source issues like MS4 were best retained within the Stormwater Utility's Engineering Services Group. MS4 funding, is being discussed now as a source for SDI-12 based water quality monitoring instrumentation within the existing flood warning system. This has been in discussion for some time, but the path is now getting significant support.

2f. Develop partnerships between regional emergency management, floodplain management and environmental groups to educate one another and the public of the benefits of collaboration and identify specific programs and activities that can be developed and implemented jointly.

Ongoing: The City's Storm Water Utility has had a long and rewarding relationship with the Office of Emergency Management (EM) based on our 21 years (of 27 years) of joint efforts and operations in emergency response for flooding needs using the City's expanding flood warning system. The Stormwater Utility is now coordinating with Emergency Management on aspects of these 32 action items and other ongoing flood and barricade efforts and planning needs.

The Office of Emergency Management provides a variety of all hazard educational activities as requested. This includes general information on preparedness for a variety of hazards including potential flooding. A portion of the Community Emergency Response Team training addresses public health issues including water purification.

In addition, the City has also developed partnerships with the Mid America Regional Council, Bridging the Gap, Heartland Conservation Alliance, the Home Builders

Association of Greater Kansas City, the Missouri River Watershed Event and Missouri River Clean-Up, the Little Blue River Watershed Association the Blue River Watershed Association and the Friends of Lakeside Nature Center. Water Services has also developed the KC to the Sea Program for critical education to students on watershed and water resource issues. Water Services has also begun providing grant dollars for 501c3 not for profit groups compete for on an annual bases. The City has also participated in numerous educational activities directed toward the public, specific business groups and City employees to provide education regarding flooding issues and water quality concerns such as the Missouri River and Blue River Cleanups. All of these programs and educational aspects continue, but were prevented from operating for much of 2020 due to COVID-19. Some efforts to virtualize, or to go to field based efforts, masked and with distance were done, but these efforts were much more difficult with COVID.

3. Reduce flood-related damage to public, residential and commercial property in flood-prone areas through structural and nonstructural retrofits or removal of property.

3a. Encourage homeowners and businesses in flood-prone areas to elevate mechanical systems (i.e. furnaces, hot water heaters, electrical panels, etc.).

Ongoing: For new construction, Chapter 28 of the City's Code of Ordinances prohibits enclosure of usable space under the first story below base flood elevation plus 1 foot without proper wet-floodproofing for residential or dry-floodproofing for commercial & industrial zoning. In all cases the top of lowest floor and the lowest part of any mechanical, electrical or HVAC, including ductwork to be at least 1 foot above the regulatory base flood elevations within the community. The City also spent $550,000 to improve our 1-20-2017 FEMA mapping in Jackson County, which included the elimination of all A Zone. There were some small exceptions where justifiable, but A Zone in KCMO Jackson County is less than 0.1% of the SFHA here. Unfortunately this IS NOT the case in Clay and Platte Counties. Had we known we would have funded efforts to eliminate A Zone there also. Much more Base Flood Elevation data exists within KCMO within the official FEMA regulatory models, within the FIS floodway Tables and within the FIS Flood Profiles where interpolation for the regulatory base flood elevation can be determined within 0.1 ft. for any portion of regulatory floodplain adopted by our Chapter 28. Any mechanical or electrical equipment must also be elevated per the 1 foot free board requirement. For existing construction (Pre-FIRM or Re-mapped structures within the effective regulatory floodplains), the City can require elevation of the mechanical and electrical equipment only if they are part of a "cumulative improvement" (City uses cumulative improvement accumulating the cost of all permitted improvements for the last 5 years of time in order to determine if proposed improvements will exceed the 50% market value of the structure). The City also must follow Chapter 28 and 44 CFR regulatory requirements for substantial damage to structures relating to any kind of disaster (fires, floods, tornadoes etc…). Again, if the structure meets or exceeds 50% damage vs. its correctly determined market value of the structure, then the structure must be brought fully into compliance with our current effective regulatory floodplain products adopted by community and SEMA and FEMA. In such cases the structure must be "brought up to code" and this can be notably expensive. The City does encourage the public to elevate such mechanical systems

given the relatively low cost of doing so vs. an entire structure, but the City cannot require this unless the amount of improvement triggers a “cumulative improvement for all improvements permitted over the last 5 years from the latest permit request”, or unless the structure sustains 50% or more damage and becomes designated as substantially damaged. Our recent 1-20-2017 updates to regulatory floodplain products have had positive or negative impacts in various areas for many reasons, but all parties seeking to LOMA out must follow the required Elevation Certificate process which also requires that all mechanical and electrical equipment be elevated above the regulatory base flood elevation. This federal FEMA LOMA process DOES NOT require the 1 ft. of freeboard that the City would require.

Our 1-20-2017 regulatory floodplain product updates have resolved a large amount of inaccuracies within the older regulatory products including a lack of corrections for City, State and Federal mitigation projects that, in some cases have gone on and now completed over as long as 50 years. While the City has obtained evidence of some accuracy issues within Indian Creek, which we are working on for post flood mitigation issues through physical modeling methods, the new products are still notably more accurate in base flood elevations than those that existed prior. They are also much more accurate than what FEMA would have adopted if the City had not leveraged in $550,000 of its own funding (in addition to its already donated 12 million in modeling work) to the FEMA remapping efforts within the Jackson County portion of the City. Data is much easier to obtain and provide and consequently it is much easier to tell people the elevation needed or the depth of flooding occurring relative to mechanical systems now. FEMA’s regulatory floodplains stop at one square mile, allowing considerable development in unregulated areas, which have vulnerabilities. Within the City up to 66% of our lands are in this upper square mile of area and therefore lack FEMA regulatory floodplains. That is up to 210 square miles of City area with no defined FEMA floodplain or water surface elevations to assist in design efforts related to basements, electrical, HVAC or mechanical systems, grading, development or other improvements. A general elevation requirement may also be considered for all basement construction with respect to electrical and mechanical systems. This would allow a minimum safety factor, aiding flood insurance claims, and better protection for unknowns and other long term future occurrences that could occur and damage a home’s mechanical or electrical systems. The City still has a significant need to build out the modeling upstream of FEMA with critical flood elevation, flow and erosion threat analysis similar to the Twin Creeks Pilot area or the East Bottoms modeling methods for combined sewer areas. Such a more detailed set of data and information can prevent many forms of poor design and construction by simply pointing out that an 8 acre drainage area is flowing through the yards and is too close to the homes as proposed by plat. Such a plat would never be proposed without correction, if the data was already known, and if it was, would be much easier to show by supporting data that the risk was unacceptable. Much more work is needed. The City’s newly adopted Chapter 28 still uses a 1 foot freeboard, less freeboard than our 25 ft. width stream buffer from the FEMA regulatory 1% floodplain edge provides which is usually closer to 3 or more feet depending on slope. While the City does educate to elevate and build above flood risks and to identify all risks and develop emergency plans, we can only encourage where we do not already require.

3b. Encourage water and wastewater districts to elevate vulnerable equipment,

electrical controls and other equipment at wastewater treatment plants, potable water treatment plants and pumping stations.

Ongoing: The Kansas City, Missouri Water Services Department's operating Divisions operate a Water, Sanitary and Storm Water Utility. The Water and Wastewater Utilities work closely with the Storm Water Utility and the City Floodplain Manager to assure that all mechanical equipment is installed with the necessary base flood elevations and flood protections as critical infrastructure. The City did support and fund the creation of the 500-yr 0.2% Annual Exceedance Probability base flood elevations and profiles within our FEMA FIS studies. This aids any efforts to add, or improve existing facilities. Further, the City's Chapter 28, 50% cumulative improvement regulatory compliance also applies here. Again, within Jackson county KCMO, the $550,000 in funds provided to FEMA to complete this portion of the 1-20-2017 mapping updates resulting in some special request products for the City form FEMA's Consultant. Most notably all cross sections within Jackson county floodplain were output with 1yr, 10yr, 25yr, 50yr, 100yr and 500yr flows and base flood elevations attributed from the modeling.

The new FEMA floodplains, floodways and related flood elevations have created significantly easier and more accurate information to access on flood risk concerns for water, wastewater and stormwater utility assets. Many older facilities are still grandfathered in as Pre-FIRM systems, but are at notable risk for flood damages. Discussions on several facilities continue to occur, and long term planning and facility needs, relating to our consent decree for combined and separate overflows relating to wastewater have begun to account for these needs better, in order to achieve the right regulatory and consent needs where regulation requires. The new regulatory data and modeling has proven critical and valuable, multiple times, in acknowledging the risks and problems that do exist and acknowledging that long term plans need to change. In one area this has led to discussions on a potential ring levee. Much more is needed.

3c. Encourage utility providers to assess their facilities, distribution systems, etc. for vulnerability to flooding and, if necessary, retrofit or modify them to decrease vulnerability.

Ongoing: The Kansas City, Missouri Water Services Department's operating Divisions, operate a Water, Sanitary and Storm Water Utility. The Water and Wastewater Utilities work closely with the Storm Water Utility and the City Floodplain Manager to assure that such facilities account for necessary flood protection. Significant efforts and funding to protect sanitary, storm and water assets from floods and stormwater is ongoing with notable amounts of improvements following chapter 28 regulatory requirements including up to 15 sanitary improvements not yet underway. In addition the City's Stormwater Utility has developed a geospatial database which provides minimum, average and maximum flood depths for 10-yr, 25-yr, 50-yr, 100-yr and 500-yr FEMA regulatory modeling flood depths by terrain. With these tools and the original raster flood depth grid data it is easy to provide an initial non-surveyed analysis of flood risks within facilities for any portion of the land and for structures, roads, parking lots as well. A 2nd round of improvement to these tools is underway using 2018 LiDAR data that once fully vetted, may be made publically available on the City's Parcel Viewer tool. Equalizing's what parties know. A Disclaimer will always be required for this toolset. Only survey can validate risk relative to regulatory base flood elevations.

3d. As funding allows, repetitive flood loss properties and structures will be targeted for buyout.

Ongoing: This is ongoing through WSD and leveraged dollars through PIAC, GO Bonds, the Storm Water Utility (when allowed), Waterways, the COE and potentially other State and Federal funding sources going forward. WSD is tracking all acquisition efforts annually from Waterways and Storm Water Utility efforts and is adding critical knowledge into WSD's parcel fabric related to these acquisitions going forward. This process will assist in taking up the effort of better documentation, analysis and assessment of the historical purpose for their acquisition and the needs for the future which these lands serve including flood attenuation. As shown in 1c. above, the City has created a process for determination of benefits for buyout vs. other mitigation efforts and leveraging dollars for such efforts in real world projects. Please see activity 1C in this Progress Report for latest accomplishments. With the official adoption of our 1-20-2017 floodplain models and products and this CAV Cycle Audit, KCMO is now able to document 26 more fully removed repetitive flood loss properties (structures) and the Partial mitigation of another 31 repetitive loss properties due to mitigation efforts.

Some 1C highlights on repetitive flood loss efforts completed or ongoing in the last two years are shown below:

As noted above, with the official adoption of our 1-20-2017 effective FEMA floodplains. We can show removal and/or mitigation within:

Repetitive Loss Areas (RLA's): 1,2,3,4,5,6,7,9,10,11,12,13,14,15,16,17,18,19,22,24,34,43*,44*,45,47,48,53,54,55,56,59,62,64,70,72*,73,79,

This is 36 of 86 RLA's with removals and/or mitigations. 41.9% of RLA's have mitigation or removals that have been completed. Please note that 3 of 36 are in an area mitigated, but not yet remapped.

- New RLA #79: This RLA was created this year from updated FEMA data. It aligns with an area just North of RLA #34. 2 parcels where purchased by the City here, 1 was a new loss following our 2017 floods. The land will be incorporated into the Park system. The remainder of this new RLA #78 may not be bought out, but may use a shallow berm, depending on the watershed wide and physical model of Indian Creek that are currently underway to find the best benefit to cost solutions for Indian Creek as a whole. The CRS Coordinator has kept this new RLA separate for tracking purposes given our new 1-20-2017 FEMA mapping updates and our documented 2017 flooding and damages. This area has completed acquisitions for 4 parcels and related structures all of which are slated for demolition in 2019.
- RLA #34: Repetitive Loss Area 34 has four major pad site structures with multiple tenants. Two residential properties, not in RLA #34 were acquired and demoed by private parties. Two [more] floods occurred in the summer of 2017 which substantially damaged all 4 commercial pad sites. 3 of 4 have been

acquired and demolished by the City, the 4th, is very small and abandoned at this time. Once this last structure is removed all of RLA #34's structures will be eliminated. At least 2 of the 3 purchased by City were determined to be destroyed, (substantially damaged), the third was close enough to justify acquisition to prevent repeat flooding. At this time the area being cleared of structures may become a trailhead, however the Indian Creek physical modeling and related work for benefit cost ratio solutions will find this area constricting for flows. IT is unknown how upstream protection vs. the constriction of flow at Wornall will work out for benefit to cost ration needs post the 2017 floods.

- RLA #64: An FMA grant was won by the City for flood insured properties to acquire up to 4 of 13 parcels in RLA 64. 3 losses are scheduling for demolition. Upon completion of the work the FEMA to SEMA to City Grant dollars will be returned to purchase and demolish an additional 3 structures in RLA #64.
- RLA #20: One repetitive loss properties and one repetitive loss area property was acquired and demoed in RLA Area 20.
- RLA #56: On Repetitive Loss Property and area was purchased and the location converted into storage and energy control for stream network.
- RLA #62: This loss was acquired as part of road widening and stream mitigation efforts for Waukomis Cr. This repetitive loss area and all structure risks within it have been removed from flood zone through buyout, demolition and road and stream side improvements.
- RLA #73: One repetitive loss property and 36 additional repetitive loss area parcels have been mitigated or acquired for Parkway Improvements. Only 6 repetitive loss area structures remain, all of which are mitigated. This project involved major parkway and road and stream improvements and significant acquisitions for the widened Parkway. Improvements at Chouteau and Parvin Rd. for arterial road safety.
- RLA#79: Redevelopment of fuel station resulted in the acquisition and removal of two residential structures from this RLA. Later, flooding resulted in the City acquisition of two more followed by demolition.
- Adoption of the 1-20-2017 Effectives has removed a net of 1,277 structures (-1,999 + 722 mapped in by 1-20-2017 floodplains) from the Communities FEMA regulatory floodplain.
- All Channel mitigation work for Brush and Blue River is adopted, with 1,033 structures removed form regulatory floodplain, with increased market value for these structures estimated to be 7% to 12%, or 47.9 to 82.1 million in increased market value, resulting in 2 to 5 million in additional Jackson County tax revenue.
- Mitigation and/or removal of structures from the regulatory floodplain has been accomplished in the following RLA's, following the adoption of our 1-20-2017 FEMA Floodplains:

  RLA's 1, 2, 3, 4, 5, 6, 7, 19, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 22, 24, 53, 54, 55

<u>3e. Elevate public facilities in flood-prone areas. Encourage home owners and businesses to elevate their structures.</u>

Ongoing: WSD and City Planning and Development both continue to assist in such efforts for departments undergoing retrofit, alteration or expansion of existing facilities where allowed. Regulations and accurate, usable and obtainable technical data are the keys to this. Facilities in higher risk locations have been determined from flood depth grid data, as mentioned in 3c., and the City has used this to analyze where its own flood risks may be greatest or most critical. The next step is to inform on these higher risk facilities in order to assure that if and when they look into improvements they are prepared for the realities of their situation. A path is being worked on to ultimately make these products publically available through the City's Parcel Viewer.

The Stormwater Utility has obtained hardcopy and digital copies of many FEMA resources which we now use in public information and public meeting efforts. Two of particular use are P-936 / July 2013 Floodproofing Non-Residential Buildings and P-312 3rd Edition / June 2014 Homeowners Guide to Retrofitting, Six ways to protect your home from flooding. Keep in mind that resources like these have not historically been used within Kansas City as educational tools to the public or private sector or to public facility needs, or in internal review and support of mitigation and flood protection standards and practices. This is another shift in how we are diversifying the tools and working to build more pathways and resources to use in finding the right solutions for a given flood risk situation. Some of this is due to the recently adopted 1-20-2017 floodplains which also triggered an update to the City Chapter 28 floodplain regulations. Some of it is an evolution in staff efforts to identify more flood risks and be better able to assist those flood risks with better information and analysis support for their needs and mitigation options. This year we have sent a GIS Analyst to two HAZUS Trainings for for flood risk analysis. These items have provided more information, resulting in further research and investment in tools. One major facility has been working to modify consent decree solutions in a manner that would better protect from long term flood risks which may include: Elevating?, Ring Levee? Or relocation of facilities behind the existing levee? Such efforts have also allowed significant education of up line staff and politicians, particularly with use of our two 2017 flood events. These recent events have helped to identify flood risk as a long term cost and risk to public safety with noted costs and solutions.

This year a uniquely challenging Pre-FIRM location with a finished basement below the BFE was seeking to do additions that would attached to said basement, through an existing Garage door opening that would be enclosed. There were at least 4 reviews with verification of the Market value at the time of permit application and the cost of the work proposed which was determined to be significantly below 50% of the market value of the existing improved structure. The Owner and consulting team were advised of the Communities 5 year cumulative improvement tracking and assorted risks that could trigger Chapter 28, such as severe flooding, fire, tornadoes etc… They were advised on the benefits of flood insurance and value of ICC coverage, but warned that ICC ONLY covers flood damages for increased cost of compliance. The non-complaint, but Pre-FIRM basement was estimated to be 1.7 ft. below the BFE. Owner and consulting team opted to do some surveying and review of this supported they should improve the survey and noted an error. A non-EC based survey showed the basement to be 1.68 ft. below the BFE, after some errors were corrected. The BFE has increased from upstream increases in runoff/discharge from other communities that have been mapped into their floodplains. The additions and access to a basement below the BFE for the

below 50% Pre-FIRM structure resulted in a number of careful items to monitor. Regarding freeboard, structural strength and ability to withstand water table below the addition with top of lowest floor above the BFE. A concrete stairway was proposed that would enter into the former Pre-FIRM garage door, thereby remaining above the 1 ft. freeboard for BFE in the addition, but transissioning into the Pre-FIRM basement that was not obligated to be elevated, given the market value vs. construction/improvement costs. Significant time, discussion, education and reviews had to occur. The City also had to request assistance from the State and FEMA Region 7 to be absolutely sure all requirements will be met for Chapter 28, 44 CFR and all related FEMA defined procedures. All of this was for a $116 dollar permit. There was an understandable amount of strain on the owner and consulting team given the additional requirements to assure minimum public safety needs. City did share options on flood insurance and potential options the owner may wish to consider regarding methods they may be able to consider to obtain Zone X classification by LOMA and EC, should the owner so choose. Given the owner's initial goals, the time taken and the added costs this option is unlikely to occur, but the effort continues. There is an incredible amount to inform and explain on. There is much need for expertise both in the field and professions and in house in terms of our own staff training needs. Insurance costs can be notably high here depending on what is or is not done. Risk, probability and the concerns for a future 300-yr or 864-yr (8-21-2017) rain event in just the wrong area to cause severe harm. For humanity it is hard to consider so many what if's, while dealing with a project that is being delayed due to greater regulatory compliance needs for public safety. These minimums must be met, and the community is only more committed to doing so.

3f. Identify incentives to offer home owners and businesses to remove or retrofit their structures in flood-prone areas.

Ongoing: WSD's Storm Utility has discussed aspects and options of altering its stormwater utility user fee that can serve to reward various good behaviors and discourage harmful uses which can aggregate into extremely expensive mitigation challenges. A list of potential incentives has been created for various uses that could be given credit, but it is a difficult balance to minimize the cost of documentation before creating the incentive. The existing Storm Utility Fee is on average less than $3.00 per residential lot and thus a 5% or even 20% discount for various good behaviors is not enough to encourage **any** real change most of the time. To date we have not been given a chance with the voters for any Storm Utility Fee or Fee use improvements. Task 3f is not progressing at this time and is subject to our efforts to get on the ballot for a vote on the Stormwater Fee. A push was made for this following the 2017 floods, but the window of opportunity could not be made. Our Stormwater Go Bonds, were voted on and were approved by the Public for up to $150 million in improvements using a list of non-inclusive example locations and needs. These bonds will be paid off over 20 years but will likely be spent in ten years. Currently the bonds will be paid back through General fund sources and not the Stormwater Utility Fee, which has no financial ability or by ordinance authority to pay for these improvements. Part of the need was also to assure the ability to pay for FUTRE federal mitigation projects known to be coming which the City would be required to provide significant matching funds to. The only real pathway to incentivize to date is through the Stormwater utilities efforts to develop programs and processes for flood mitigation programs that compete for grant dollars to mitigate known flood issues. This program have evolved from the CRS and PIAC

processes and efforts to move away from mitigation methods that were limited to pipe and inlet collection and conveyance based mitigation solutions and find more cost effective mitigation pathways with better benefits to cost. At this time there is only a very limited programmatic incentive process and not a monetary or other form of incentive.

The Stormwater Utility has been in some discussions with a number of companies specialized in retrofitting and wet-flood-proofing, and dry-flood-proofing (for commercial/industrial) solutions to mitigating flood risks. There is a massive footprint of basements within the City of Kansas City, MO. Soils and tornadoes tend to support and lend themselves to basements here and the majority of Pre-FIRM strucutres in floodplains are single family residential with basements or crawlspaces. This type of retrofitting needs a program and a path that is like clockwork to support, inform and perhaps someday fund or grant assist such efforts. Incentives could be to work with in a larger scaled grant effort such as BRIC, or even to provide some limited flood insurance assistance, if the structure is mitigated and LOMA'd with EC to be Zone X after mitigation vs. AE, AH, AO etc… While KCMO has eliminated 1,999 structures from our floodplains using modeling and mitigation, we have also added, 722 in added floodplain lengths or in areas where floodplains and BFE's increased, with negative consequences to owners. Years back, following the adoption of the 1-20-2017 floodplains FEMA began an effort to inform home owners that were negatively impacted by the changes in floodplains and BFE's. FEMA had a limited, I believe 1 year time period in which structures newly impacted by the floodplain could obtain a lower cost preferred risk policy. Once the FEMA time table was over, if these owner's had not applied for flood insurance, their rates would have become like any other post firm structure, requiring an EC that would then be used to determine notably higher cost flood insurance than the preferred risk policy. There is a need to inform while reducing the cost of flood insurance. Indeed the cost of flood insurance is a serious deterrent, especially if added to a risk, owners have not yet seen and have difficulty visualizing, much less believing sometimes. Simple retrofits are always key and this is always critical with C2.e) Mechanical, electrical, HVAC and ductwork, but such does not solve more costly risks. I have been in homes with frustratingly terrible contracted work done, that would not work, and already was not working to mitigating flooding. Sometimes these issues are nowhere near regulatory floodplains and a matter of poor grading and a need to regrade to take more runoff away from a structure. Equally as critical to the above, is the need to assure by code and by inspection and enforcement that structures are graded to be several feet higher than the terrain around them, assuring runoff will move away from a foundation. Sadly there are 4 types of flooding that can damage/destroy a home and only one of these if floodplain based.

The City uses flood depth data for structures, parking lots, roads and other pervious and impervious features to assist on identifying the severity of flooding and the potential options that may exist.

There has been little real success on finding an effective method to incentive here, but there are systemic and procedural standards and requirements that can do much good to prevent.

4. Discourage new development in floodplains and flood-prone areas.

4a. Adopt ordinances prohibiting residential and commercial development in the flood plains or flood-prone areas.

Ongoing: The City's stream buffer ordinance # 080736 works in combinations with our Open Space and Conservation Development Ordinance # 080770 and with the effective FEMA Zona A floodplains of FEMA for the community per the NFIP. These regulations achieve substantial flooding and environmental protections by establishing policies that protect flood prone areas without the cost of acquiring the properties. Further, the Stream Buffer trumps other uses with priority on environmental buffer for stream function, flood attenuation and wildlife. The City has successfully restricted the use of Floodplain areas to trails, transportation and utility corridors. The City has also successfully eliminated the use of structures within the first 25 to 250 feet of Outer Zone, where the Outer Zone begins where the FEMA 100-year floodplain boundary ends. Thus no structures are allowed: within the stream channel, the 100-year, 1% annual chance floodplain or the first 25 to 250 feet of the effective regulatory FEMA A Zone floodplains of any type where stream buffers are defined. Any elimination of riparian assets also requires mitigation with multiplier.

The Stream Buffer Ordinance will eliminate the expense and need for acquisitions in undeveloped parts of the City where regulatory FEMA floodplains exist, by already protecting these areas from high risk forms of development that can lead to frequent damages and risks to life and safety. The Stream Buffer DOES NOT protect all Regulatory FEMA floodplains within the City limits. The stream Buffer Ordinance does not include interior levee AO and AH flood zones primarily because these areas have no defined stream buffered streams and are generally highly and heavily developed. The City's Regulatory Stream buffer also does not include Blue River effective FEMA floodplains from 63rd Street to the Missouri River nor does it protect the main Brush Creek tributary to Blue or the Gilham Tributary to Brush Creek. The Stream Buffer does prevent the construction of structures within 22.2 square miles of effective FEMA 1% annual Floodplains in Zones A and AE within Kansas City, MO, out of 28.1 square miles of non-federally owned lake or river larger than 10 acres or wider than 300 ft. Thus the Stream Buffer secures 79.0% of the City's regulatory FEMA effective floodplain. The remaining 6.1 square miles of effective FEMA floodplain is not regulated by stream buffer, but requires all Chapter 28 regulatory requirements plus 1 ft. of freeboard and of this 6.1 square miles 2.0 square miles is owned by the City or qualifying County or State entities. This 2.0 square miles already removes any impervious area from the portion of these parcels and ROW in regulatory floodplain. Removing all impervious and accounting for all buffer and owned lands provides the City with OSP lands that do not allow structures for 24.2 of 28.1 square miles of the newly adopted 1-20-2017 FEMA regulatory floodplain. This is 86.12% of the City's Regulatory Floodplain that counts within the CRS program.

The buffer also uses an approximate buffer upstream of FEMA's floodplains using the City's modeled floodplains and an Outer Zone that also prevents development of these higher risk structures. The approximate buffer is as restrictive but allows in field riparian corridor identification, which can erode the identified City floodplains. The City's Outer Zone Buffer, buffers from the FEMA regulatory A or AE zone boundary or the City floodplain boundaries and adds an additional 25 to 75 ft. and up to 250 ft. of buffer.

The 250 ft. buffer can be used for conservation development per Chapter 88 allowing denser structure development outside the outer zone, while allowing a larger outer zone footprint to be conserved. Including just the outer zone component the City gains an additional 7.81 square miles of pervious open space protection within our City limits which can be counted within Activity 420. This is an additional (6.1 / 28.1)*100 = 27.8% of riparian corridor protections. The total protected is 24.2 + 7.81 = 32.01 of 28.1 square miles of regulatory floodplain that counts. This give a total of 113% protection for Activity 420 Open space within the City of Kansas City, MO. Again, while these protections do go further upstream than FEMA, they still fall far short of the total distance needed. It is still possible that as much as 60% of the communities flood risks are upstream of these regulatory protective measures. Risk travels every low flow path upstream and complete analysis will need methods like those within our Twin Creeks effort.

4b. Develop or amend comprehensive and/or land use plans to specifically address development in flood-prone areas and recommend strategies for decreasing the jurisdiction's vulnerability to flooding.

The city has an adopted Land Use, Zoning and expected Future development plan. The City has also adopted and updated its Zoning and Development Code and its Code of Ordinances at:

https://library.municode.com/mo/kansas_city/codes/zoning_and_development_code?nodeId=ZODECOKAMI_400_SERIESDEST

Stream Buffers are also linked within 88-415 of the new Zoning and Development Code. 88-405-16 Suitability of Land states that, "Land subject to flooding, improper drainage or erosion, or extreme topography, or which, for other reasons, is unsuitable for development, may not be platted for any use that will constitute a danger to health or safety or property destruction." This phrase is new and very open and thus allows more justification for Twin Creek's methods that fully identify flood and erosion risks from all streams and flow paths of surface water and runoff. The City has been able to leverage significant planning dollars into the creation of these modernized ordinances and codes, which now provide clear ecosystem and wildlife habitat benefits, restrict development of structures from high cost flood-prone areas, and use an ongoing process to update and improve what is known to be flood-prone. These ordinances also reward and encourage more protection of stream buffer, by allowing levels of densification in development to offset the protection of more buffer area through Conservation Areas per ordinance # 080770. Unfortunately flood issues are still broken into many areas and thus it is very difficult to put the pieces together for what can and cannot be allowed.

The City has adopted through Ordinance #200418:

- 2018 International Building Code
- 2018 International Existing Building Code
- 2018 International Residential Code
- 2018 International Fuel Gas Code

- 2018 International Mechanical Code
- 2018 International Private Sewage Disposal Code
- 2018 International Energy Conservation Code
- 2018 Uniform Plumbing Code
- 2017 National Electrical Code
- Safety Code for Elevators and Escalators, ASME A17.1-2016
- Safety Code for Existing Elevators and Escalators, ASME A17.3-2015
- Safety Requirements for Personnel Hoists and Employee Elevators for Construction and Demolition Operations, ANSI A10.4-2016
- Safety Standard for Platform Lifts and Stairway Chair Lifts, ASME A18.1- 2014
- Standard for Elevator Suspension Compensation and Governor Systems, ASME A17.6-2010 [*Note this is the currently adopted edition*].
- Also recommended is the adoption of the ASME Safety Code for Wind Turbine Tower Elevators, ASME A17.8-2016

In general The City has very modern regulatory processes but we lack the right supporting technical information and geospatial knowledge to identify all the risks within the community relating to flooding, erosion and water quality, <u>especially upstream of where FEMA regulatory products stop</u>. Staffing, funding, turnover and training are always strains on the expertise needed. These responsibilities are the Stormwater Utility's and we have not moved rapidly enough to aid downtown in many of their efforts to modernize regulations and streamline them based on better in field knowledge. We know what to do, have done it ourselves in house and found a select few consultants that can do the work needed, but all watershed studies need to be updated with a path like that of Twin Creeks (2D) or in complex urban areas like East Bottoms, Infoworks ICM 2D methods to fully identify with high geospatial accuracy all flood risks (and other risks, such as overflows) for all parties and also save costs by <u>focusing parties on the realities first</u>, <u>so they can better design to account for them and still maximize benefits and profits safely.</u>

<u>4c. Levy fees on new residential, commercial and infrastructure development in floodplains or flood-prone areas to finance flood mitigation, preparedness, response and recovery actions.</u>

<u>Ongoing:</u> Like the Storm Utility Fee need, the idea of a fee increase for development within higher risk areas has not gained momentum, though it does have support within WSD and City Development. This is further complicated by the reality that all flood risks are not known and identified throughout the community to the extent needed. Some areas, know more, others know nothing. The current City fee for a development that requires regulatory FEMA reviews through our Bulletin 120 is **<u>$58.00 dollars</u>**. In order to break even a department would need to <u>FULLY</u> complete one permit in <u>30 minutes</u> including the overhead of my position. That would require 30 minutes to be divided amongst: 1.) All permit and review submittals. Most every FEMA regulatory permit requires multiple submittals due to the complexity and the quality of the initial and on-going permit submittals. 2.) Final approval of the permit, 3.) Final inspection and 4.) Final verification that all required products have been provided, allowing a Certificate of Occupancy. Doing all of these steps involves at least 4 Groups/Divisions/Departments at this time. Who believes that all that can be done for $58 dollars? FEMA regulatory processes per the City's Chapter 28 and per Federal 44 CFR requirements and

processes can be very extensive and complex. As an example, FEMA has a process called a "Conditional Letter of Map Revision" or CLOMR. **CLOMR's ARE NOT just a letter**. They operate within various parts of 668 pages of Federal Regulations, which the City is obligated to be party to per our Chapter 28 and National Flood Insurance Program (NFIP) responsibilities in order to obtain Federal Disaster Assistance of ANY kind within our Community. In one case The City has reviewed a CLOMR three times internally with non-concurrence, then sent it out to professional for review two more times at cost to the community. Following this FEMA had to be brought in to assist in finding resolutions to the complex needs and potential impacts and minimum legal requirements per Chapter 28 and NFIP. The issue continues. It has continued for three years without materials sufficient for concurrence. For $58 dollars. The requirements are complex, the consulting firms may or may not fully understand them and may or may not fully achieve them. The Community is the last stop, before FEMA and should we fail, we risk FEMA coming back to require us to correct misinterpretation of the 44 CFR minimum legal requirements. It is also possible that FEMA may themselves miss or grant a condition that City may dispute. The City is in the middle of these issues and both sides can come back to us with requirements based on our review and findings, which we receive… $58 dollars for doing. The level of regulatory complexities that can occur within floodplain management is incredibly complex and it is rare that a FEMA based permit review process within the City could be FULLY completed by all responsible parties and reach the point of Certificate of Occupancy for just 30 minutes of staff time for $58 dollars' worth of permit work. Discussions with City Development on the schedule and timing of improvements and fees is along the lines of the types of needs required in order to be in compliance and the cost to complete all/each of those components in review. This also moves into a need to better develop our Information Bulletin 120, and designate within it; all the various pathways of FEMA regulatory Review that may occur and revised costs associated with each type of permitting pathway with estimates on the time it may take. This can set a more accurate minimum Fee, better understanding of the steps, obligations and schedule time those efforts will require along with additional fees. Again FEMA regulatory process exists within no more than 34% of the City's territory, with 66% of the City's territory in the upper square miles of tributary streams were FEMA regulation does not exist. The above efforts do not resolve this aspect of stormwater management and flood risk management needs. We literally have both worlds. In World One there is no "Official data" available (like FEMA has), the City watershed models are not adopted by Council and also do not go far enough upstream to identify all flood risks in every case (Plats average 11 acres in size, watersheds may go this low or may stop at 40 or in some rural areas, 300 acres. The average is 50 acres for all watersheds). This last subshed, has no hydraulics and no known flood conditions within it by these old Hydrologic (and 1D) methods of modeling. Professionals use any of the methods allowed in APWA 5600 upstream of FEMA to make their case for existing and proposed post development flows. The City must review and check all these methods, with little time to use internal products to assist or catch errors, issues or seek correction/discussion. Ultimately the professional consultant sealing is responsible. But the time and ability to fully vet the work is limited. Having a standard watershed starting point, as we do with FEMA regulatory areas can dramatically improve the work. This is what Twin Creeks is seeking to do. It is what East Bottoms could do, if taken further. It is also repeatable throughout the 319 square miles of KCMO. To fill in all the gaps and details throughout the watershed down to a ~ 25 square foot equivalency with known flood depths, flows, volumes, velocities etc... for

each of those 25 square foot segments of terrain, forest, pavement, structure or lawn, all the way down and through FEMA regulatory areas until the stream leaves City Limits.

It should also be noted that IB120 has been updated to more fully inform and define what is required to be in compliance with Chapter 28.

Method Two, uses FEMA's regulatory world but all parties are subject to their methods, processes, systems and steps and the time tables they take to complete which are extensive. If a consultant needs the FEMA regulatory modeling, that request takes a minimum of 3 to 4 weeks and if not found can take longer. FEMA methods and minimums are very different from the City's APWA 5600 methods and **neither method** streamlines the use of modern technology and tools to minimize the regulations needed on the books. Both our current APWA 5600 and the FEMA regulatory process as it exists now are using regulations to address needs and then leaving it to professionals to choose technologies to meet those minimums. This is not a path for innovation. It is the opposite. It creates a status quo. Consider this, do you want to develop hundreds of pages of regulations. Then try to build many varieties of technologies and tools to meet them? Or do you want to develop technologies that accurately and precisely identify all the risks. Then use that technological geospatial data to decide what you will regulate about the mitigation of risks that you will accept, USING THOSE TOOLS?

The City has done an initial update of its IB120 FEMA floodplain regulatory process. There will be more updates to make but critical definitions, steps and requiremtns were clearly entered to assure parties understood the needs. Again, more IB120 will be needed. Breakout of all the different types of review that can occur per Chapter 28 and 44 CFR, with assign prices to each type with definitions and details for what each type will require and the expected amount of time they may take between City and FEMA processes, with advisement these are estimates only. We have put hundreds of hours to one complex FEMA regulatory CLOMR. We have spent thousands on additional professional expertise to separately analyze and find CLOMR needs. For $58 dollars. We did so because it had to be done for public safety and was required per Chapter 28 and 44 CFR regulations. While this occurred. Other duties could not be done while this occurred. We do not have the staff to do this. Funding must be correctly provided based on the true cost of the regulatory process and the time and staffing it requires. Twin Creek's 2D methods are critical to protecting our public with fully defined accurate and precise high resolution flood risk data to minimize our review costs and improve all professionals starting data available, thereby improving their solutions and avoiding, mitigating or eliminating more community risks. This can be win-win.

5. Improve flood hazard assessments and flood mapping.

5a. Obtain parcel data (assessed valuation and other information) for flood boundary areas and enhance vulnerability assessments for these areas.

Ongoing: The City collects information from four (4) counties which it uses to maintain a complete City parcel base with ownership and other attribute information. This is updated annually at varying frequencies depending on the originating County's capabilities. Additional coordination will continue to work towards the linkage of critical

identifying attributes between Counties and the City for use in GIS and other database products to build better analytical tools to assist City needs, including assessment related data and flood vulnerability assessment. The most critical in house need would be land and building market valuations. This data can be collected now, but takes a number of websites, connections and GIS products to easily manage and collect. City IT and GIS staff has declined substantially since the recession and the City does not have nor maintain a Parcel Fabric, just a GIS parcel layer set, nor do we have a tie to market value information driven by geospatial data and sharing of it between City and Counties. Recently the City began to not version Parcels in ESRI do to complex issues with ESRI's versioning software for change tracking and due to staffing limitations. WSD has developed a separate set of parcel data and works to update from all downtown data in a new manner without versioning, but neither WSD nor City IT in General Services have been able to develop a Parcel set that includes assessed land and improvement value for any period of time for four counties, given our limited staff and resources. Ongoing efforts exist here, but have not made progress this year due to other needs in the parcel data between our four counties that General Services IT and WSD have had to deal with this year.

5b. Partner with FEMA in the Cooperating Technical Partners (CTP) Program to increase local involvement in, and ownership of, the flood mapping process.

Completed and Ongoing: !!!! ☺ !!!! ☺ !!!! The City of Kansas City, Missouri is now a Cooperating Technical Partner through FEMA and is using this path for further discussion and development of key needs, tools, studies and work with funding provided for this from FEMA Region 7 through SEMA. This path initially has provided about $650,000 for critical needs that had been unfunded for the needs for some time. It will take time to learn the program, its quarterly updates and tracking and eventually begin to leverage further funding for further work needs within the community. Since 2007 only 3 watersheds have been studied by the Stormwater Utility. Technologies, capabilities in identification of risk have all dramatically changed and improved, resulting in the most innovative period of time every seen for stormwater and combined sewer or real time modeling and flood risk needs. As a CTP and a CRS Community we can better compete for Grant dollars through FMA, BRIC, and in turn better compete for further funding. CTP will do much to open doors on technologies, tools, research and real world solutions and practices that correct and innovate stormwater flood risk issues. Thomas Kimes has been responsible for all of this effort, with much assistance from Region 7 FEMA as well. Without the CTP program, the Stormwater utility would have had no funds for any existing studies such as: Town Fork Creek, Second and First Creek (Twin Creeks) NEID, Brookside etc… Nothing would have happened due to a lack of funds available in the Stormwater Utility. Thanks to Thomas Kime's efforts, experience and skills and the same qualities and skills in critical FEMA Region 7 staff, we rise again as Lazarus.

5c. Purchase HAZUS-Flood software from FEMA, possibly in conjunction with other local or regional stakeholders.

Ongoing: HAZUS is free software and the challenge is more in the setup and learning and development of the data geospatially that HAZUS needs to complete analysis for estimation of damages at various levels of accuracy. SEMA has completed a HAZUS

analysis for all of the State of Missouri including the lands of the City of Kansas City, MO and using Missouri GIS points for structure locations with flood depth data for our community. WSD has used the Risk Mapping's raster depth data provided by FEMA from our recent 1-20-2017 flood plain and flood model updates to develop average, minimum and maximum flood depths for 10%, 4%, 2%, 1% and 0.2% annual chance storms. We've done this for all roads, driveways, structures, sidewalks, parking lots athletic fields etc.… Other improvements and issues have been resolved and learned. This Summer Water Services Stormwater utility was able to get approval and training for EMI HAZUS courses on flooding for one of our GIs Analysts. This persons skills are notable and this gives real potential for further improvements that can leverage HAZUS geospatial dataset for Operations, Maintenance, Planning, Study and Analysis of flood risk within the Community. EMI Courses have been completed for E0313 and E0172 during 2018 and 2019. Our GIS Analyst has been approved for another course this summer as well. Our GIS Analyst for a time became part of the GIS Division, but has returned to Stormwater, due in large part to the amount of amazing technologies and tools he can so crucially develop and support for our needs. This will allow us to get back onto the training efforts above for HAZUS which had been delayed due to staff reporting changes and COVID.

5d. Coordinate the collection of demographic, economic, watershed, land use and other data required by the HAZUS-Flood software program and/or GIS systems.

Ongoing: Many of the geospatial data sources needed for HAZUS already exist within the City's GIS including: watershed, land use, impervious, topographic and floodplain related information. HAZUS software will require changes to these geospatial data sources to attribute and store them in the manner HAZUS requires, while other geospatial datasets will need to be built for HAZUS entirely. Many have been created. HAZUS can serve as a standard repository for what is needed and how it should be compiled. Completion of these efforts with staff and resources will create a flagship approach identifying effective mitigation methods within specific environments of the City. The most challenging known piece needed is coordinating with the four counties to obtained assessed value of land and property improvements. This activity is now considered ongoing, but progress has been too slow given other duties and demands for limited staff numbers EMI Courses have been completed for E0313 and E0172 during 2018 and 2019. Our GIS Analyst has been approved for another course this summer as well.

5e. Conduct an in-depth flood risk analysis utilizing HAZUS data and create detailed maps based on GIS technology to identify areas at risk from flooding.

Deferred: Unfortunately Task 5e became deferred due to other needs and demands for limited Storm Utility staffing and a period of time in which we had lost our GIS analyst. SEMA has actually completed a Level 1 HAZUS process for the City and the entire State through AMEC Foster Wheeler, now Wood. The City needs to obtain all of this information and compare it with what we have partially created in house that is polygon based, vs. point based like the State on structures. We are incredibly grateful that SEMA was able to champion this need and that KCMO was in an area where depth grids had first been tried, allowing us to benefit from SEMA's HAZUS efforts. This has

allowed the City's investment in watershed studies and modeling to continue to provide aid in ways we would not have thought possible when they were first started in 1991. Task effort 5e is minimally ongoing at this time, only because the City was able to get QL2 LiDAR flown in March of 2018 with funding by the Water Services Department. The Storm utility made the case for the benefits to the City and to the 3 Water Utilities and was able to get approval. We almost got QL1. Resources are still limited. But the next steps will be to leverage SEMA's work and then improve it using this new QL2 LiDAR. The introductory HAZUS EMI Course was approved for 2019 and attended by our GIS analyst before a brief re-org to the GIS Division. Hazus Trainig was not completed in 2020, due to the changes in staffing and priorities. This is being worked on for 2021 now. EMI Courses have been completed for E0313 and E0172 during 2018 and 2019. KCMO, is leaving this in a deferred status as SEMA did the work in question for HAZUS and KCMO had a year in which staffing changes prevented growth here. HAZUS is crucial to our needs and will help drive crucial data storage and collection and survey.

6. Enhance public awareness and education efforts related to flooding.

6a. Encourage home owners and businesses to purchase flood insurance.

Ongoing: The City is currently sending notifications to the owners of 490 properties and encouraging these owners to obtain flood insurance. The City owns the remaining 162 properties of the total 652 and was allowed to not mail these to ourselves. The City has been building its knowledge base of the Flood Insurance program and how it operates within the banking and real estate communities and has identified a need for providing more accurate information to the public and professional parties on what the rules and requirements are for flood insurance. There is a clear need for public education to the citizens and to insurance agents and companies. The Stormwater Utility has developed a "Road Show" for community education on stormwater, flooding, FEMA and flood insurance issues which we are working to provide to the Community. Emergency Management provided public education for the emergency response and safety side of flood risk concerns which is shown below in 6b. We have again supported the University of Missouri in Kansas City (UMKC) for two NSF grants that will work to improve flood response and flood identification and use this information to inform and educate the public and community in order to inform on flood risks, flood response and emergency situations and inform on what situations may be in the specific areas they live and work within to be aware of. To educate the story must relate to your audience:

1 foot of water, at 1 foot per second (0.68 mph) **takes your child from you**.
1 foot of water, at 3 feet per second (2 mph) **takes you from your loved ones**.
1 foot of water, at 12 feet per second (8.2 mph) **takes your vehicle and all in it**.

6b. Obtain brochures and related publications on flood mitigation, preparedness, response and recovery from FEMA, SEMA the American Red Cross and other organizations and provide them to home owners and businesses in flood-prone areas.

Ongoing: The Stormwater Utility has obtained a large amount of FEMA online

documentation which we use in house and with the public though not in mass education. The Stormwater Utility has obtained 50 copies of FEMA P-312 3rd Edition June 2014 Homeowner's Guide to Retrofitting and FEMA P-936 July 2013 Floodproofing Non-Residential Buildings. In house we store most of the FEMA products needed in floodplain and floodway regulations as well as aspects of MT-1, MT-2, LOMA, LOMR, LOMR-F and NO Rise Certification, EC's, FPC's. The Stormwater Utility is the reviewing party for City Development on all FEMA floodplain review and has found the online resources to be extremely large. There is much to cover and build upon and account for. We do assist and provide links and PDF's of FEMA products to parties in need of a baseline understanding of methods and practices. This is very commonly needed for permit efforts as well as flood risks for the public. Most submittals are, "less than correct" and "less than complete".

The City's Office of Emergency Management (OEM) continues to conduct public outreach activities for individuals, neighborhoods, and businesses, and when appropriate advises participants to review their important documents including insurance coverage and obtaining flood insurance as needed. These basic personal and business preparedness presentations are accommodated as requested without waiting lists at this time. OEM stocks a wide variety of all hazard outreach materials that are provided free of charge upon request. OEM staff frequently participates in community events to provide preparedness information to the public.

Citizens, organizations, companies, public and private; can make requests for hazard preparedness materials, information and education from OEM. In addition OEM has developed a disaster preparedness workbook that can be downloaded at:

https://www.kcmo.gov/city-hall/departments/city-manager-s-office/office-of-emergency-management/emergency-preparedness-presentations

The City provides critical web links for FEMA related materials at:

https://www.kcwater.us/crs/

The City has dropped the use of FEMA hard copy materials within the Kansas City Public Library due to the difficulty in keeping materials in house and preventing their theft.

6c. Partner with emergency services, public health, human services organizations, appropriate state and federal agencies and the business community to conduct special public education events, such as Flood Mitigation and Preparedness Workshop.

Ongoing: See 2f. Public education needs for hazard planning are provided by request through limited staff resources within the Office of Emergency Management (OEM). Currently organizations, companies, public and private can make requests for hazard preparedness materials, information and education from OEM. More partnership, coordination and funding should be placed on developing such methods to provide more effective information and data to the public in partnership with the Office of Emergency Management with additional resources.

https://www.kcmo.gov/city-hall/departments/city-manager-s-office/office-of-emergency-management/emergency-preparedness-presentations

7. Participate in, and ensure compliance with, flood mitigation and floodplain management programs.

7a. Participate in the National Flood Insurance Program (NFIP) and Community Rating System (CRS).

Complete and Ongoing: The City has been part of the CRS Program for more than 9 years now as of this annual report and has been a participant in the NFIP Program since 1978. We continue to work and improve with limited funds and resources.

7b. Obtain the latest copies of flood insurance rate maps (FIRMS), floodplain maps and similar documents.

Complete and Ongoing: The WSD's Storm Utility and the City Planning and Development Department both maintain the latest copies of flood insurance rate maps (FIRMS), floodplain maps, Flood Insurance Studies and similar documents. The Storm Utility has shared the Historic digital copies of these materials, in TIF and/or PDF formats from FEMA and internal sources, with requesters and other Departments. Our new Effectives are also digitally stored in TIF, PNG, and PDF forms. The new DFIRM panels are very challenging to use and often the City uses the NFHL GIS data with the FIS and Panel to aid in determinations, with verification form the FIRM, FIS, Floodway Data Table or modeling as required. The City uses the existing Shape file products for the NFHL online within our parcel viewer mapping at:

http://maps.kcmo.org/apps/parcelviewer/

Under Layers checkbox the Floodplain's to see them. We are working on providing other GIS Products through Parcel Viewer. This may include flood depth grid data, but a funding cost issue is slowing progress.

8. Implement or improve flood warning systems.

8a. Determine the need for stream gauges in waterways without flood warning systems or additional stream gauges in waterways with flood warning systems already in-place.

Ongoing: In Feb. 2000 the City's Water Services Storm Utility had 18 flood warning gages within its 318.9 square mile community with over 36 watersheds. Since then 2 major build outs and many more incremental installations and relocations have increased the number of City Flood Warning stream gauges to 72, with 2 more owned by Birmingham Levee but Operated and Maintained through the WSD Storm Utility by contract. There are 321 sensors O&M'd by the WSD Storm Utility. An additional 360 sensors are being added as SDI-12 soil moisture, temperature and salinity instrumentation. Further SDI-12 sensoring for Snow/Ice, road temp and water state will be added as will water quality. The City shares its data with three other local flood warning systems now leveraging a total of 187 total sites in the metro area with 907

total sensors. KCMO estimates its final system build out size approaching 85 to 95 sites. Development of Warnings that specifically define what threat can occur by when and where and what actions to take is key. These warnings have proven to be very effective and stable, allowing us to track and prove changes in conveyance improvements and further refine warnings. Warnings build-out is tiered and takes much time, but is best leveraged with modeling runs for event thresholds of severity usually in a 2-year (50% chance) to 500-yr (0.2% chance) framework. This method uses the modeling water surface elevations for known rainfall severity and a streams response to this rainfall intensity. The modeling provides severity and elevations which we use in our topographic data or survey to assist in identifying when severe threats to life and safety begin and increase in threat. The flood warning gauges then assist over time to further calibrate this information to real world events and real world response time. This can also benefit modeling, though this is not yet cost effective with current resources.

The current Kansas City, MO flood warning system converted warnings from our former system to our new Contrails system this February 2019. The process resulted in 444 warnings transferring of 558 flood warnings for stage and rain. The old system actually had been developed to convert ALERT1 sites and sensors to ALERT2 and this process required rebuild of warnings also. In reality the old system had approximately 278 warnings assigned to ALERT 1 and 280 warnings assigned to ALERT2 Site and Sensor ID's that were duplicates of the old sites and sensors. The new system has expanded the number of warnings in part due to adding in warnings developed for the 2017 floods. The City can still add 1,000 to 2,000 additional warnings using existing data, but we are first completing system wide survey through the USGS of all stage sensors in order to develop flood elevations. The city has identified approximately 950 potential barricade sites for roads this last year and developed a real time web and cell based way to track and designate these for closure and reopening. This tool also needs a phase of work that leverages in the known flood risks identified by FEMA flood depth products and by our North East Industrial 2D TIN based modeling which has identified up to 50 locations where only 3 have currently been located. The City's old "Common Barricade" sites, known to frequently flood total 109. These also need vetted to confirm all have been located into the new ~ 950 sites. Barricades are often NOT stream driven in flood response and therefore the ability to warn for them and buy time to close before the flooding occurs is not known on most of these sites, when they are not flooded by known streams with real time data tracking stage or flood elevation. We are close and may be able to accomplish much on the next level of stream based warnings and known potential barricade sites in this coming year. However, the flood warning system and these new barricade duties are separate duties. Flood monitoring cannot continue to monitor and advise on closures, evacuations or known warnings or rain threats while also managing the barricade response process. There is a larger and new barricade activity now needed. The flood warning system is also limited on where and how much time it can conceivably buy to close or evacuate known flood risks before they occur. Times may be very minimal due to stream size in smaller, heavily urbanized reaches, there may be only 10 to 20 minutes response time to a warning. In such areas, logistics make responding before the threat occurs very difficult and the solutions bend towards more expensive on site warnings like flashing lights or automated barricades, which can be much more expensive to operate and maintain. The human element is of course crucial. Barricades can be broken, or driven around and flashing lights can be ignored. See more on the recent 2017 Floods in 8b.) below.

8b. Work with local governments and other stakeholders to share data from flood warning systems in multiple jurisdictions.

Ongoing: KCMO also is in partnership with the City of Overland Park, KS and Johnson County, KS and now the Unified Government of Kansas City, KS. Three parties now share all ALERT1 and ALERT2 protocol data through a timed repeater network and shared receiving stations with backup. The unified Government has added approximately 18 sites using ALERT 1 protocol and these are received and transferred to all other parties as well. UG is our 6th remaining flood warning operator in the Greater Kansas City metropolitan area. Kansas City, Missouri continues to partner with the Birmingham Drainage District, maintaining two gage sites for them which we also installed to assist them with interior drainage and levee stop log closure needs. These gages are operated and maintained by KCMO and get warnings development and assistance from KCMO while leveraging data/information from 11 additional sites in Shoal Creek owned and operated by KCMO. This can greatly aid the Birmingham Drainage District in severe flood threats and save lives in a disaster. Kansas City, Missouri has at last converted to the same enterprise Contrail Server setup by OneRain which Overland Park, KS uses. This has brought back ALERT2 data collection and allows Kansas City, MO to begin planning steps for conversion to an ALERT2 network over time. Contrail is a web enabled method of data collection, tracking and warnings and can send mass wireless warnings for flood risks and the remaining time to act and actions needed. On 7-26/27-2017, 8-5-2017 and 8-21/22-2017 KCMO suffered significant flooding events within the Urban Core, parts of the northland and much of Blue River, Indian Creek, and Dykes Branch Creek. The flood warning system rapidly identified record threat levels that would put 5.5 foot of water into structures and advised we had 80 minutes to act before crest. It took approximately 20 minutes to coordinate and organize in order to begin the effort to get into the field to begin road closures. In two events parties became trapped, 2 in a facility and one in a tree, when their car was washed up against it, and thus prevented from going into the stream long enough for them to climb into the tree. Even with this lead time Fire and Police were not able to prevent business owners, which knew they had risk, but did not understand the danger to themselves in being there, nor the exceptional severity of the rains and flood waters heading downstream for them. Regardless the system showed its ability to rapidly inform and drive actions and this resulted in rapid mobilization of police fire and eventually barricades. It was clearly shown that the scale of the event was of a type not seen since October 4, 1998. The number of barricades and the sheer size of the area in which they were required essentially resulted in Police, Fire and Infrastructure vehicles from Water Services, Public Works and Parks and Rec being used to block roads that were or would flood. FEMA's Flood Depth Grid data was used by the flood monitor to identify the locations within Blue River, Indian Creek and Dykes Branch that were likely to flood and FEMA flood depth data and its impacts on roads, parking lots and structures was also used and ultimately switched to due to speed. USGS stage and discharge data was not correct during the 8-22-17 event at 95th St. downstream of the confluence of Indian and Blue River on 8-21/22-2017 due to an error during the event that reports a stage high of 39.12 ft. vs. 42.21 feet at the USGS gage at the Bannister Federal Complex. USGS rapidly corrected this issue, caused by a record height creating issues with instrumentation and with flood response. The events showed many needs and deficiencies but also showed our core focuses were working

and did exactly what we needed them to. The issue is a need for more of them to support our knowledge base and known actions to take with more lead time to complete tasks before it is too late. The flood risk data identified the locations of threat and aided the Barricade Police and Fire staff in road closure needs. The time gained allowed us to reduce water rescue threats, but the coincident storm behavior and timing of crests and instrumentation issues resulted in incorrect calls for the 8-21/22-2017 event that resulted in more severe flooding on Blue River from Gregory Road to Bannister Rd. Flows at Bannister were 49,600 cfs a new record flow and these flows flooded out and attenuated down to 33,400 cfs by the time the crest reached 40 Highway just north of I-70. This was not a rapid flash flood event and this was also critically helpful as it gave us more time for flood crests to travel and attenuate. The event clearly showed me what I had always feared, that there are not enough warnings and even if we knew all that would happen and had 1 hour to respond to each, we would not have the staff and resources to get to all needs. There is much more room for improvement. The FEMA flood depth data when used with impervious data provides more than 5,800 flooded roads, parking lots and structures within the City's 318.9 square miles. And that only covers ~ 34% of the total land area. Approximately 66% of the land area of Kansas City, Missouri is in the upper square mile of tributary streams, where FEMA regulatory floodplains and flood depths do not exist and where I therefore have no known flood risks to develop flood warnings for. The City has now had 5 notable to severe floods on Indian Creek since 2008.

This year. Warnings were expanded in the conversion from the old FWS to the new Contrails system. Complicating issues on Facilities and systems have recently occurred that will require: New instrumentation due to equipment issues relating to GPS rollover on 4-7-19 at midnight when GPS "rolled over" from week 1024 to week 0. Our Concentrator failed to successfully update and account for time corrections with its 5 year old board resulting in an inaccurate time shift in data which could not be corrected with the existing equipment. GPS was disabled and the time statically set, otherwise equipment would fail again on the 1st of every month. The new equipment will also drive a need to add back our primary reception site and to prepare for and complete FCC approvals for ALERT frequencies in order to convert to ALERT2 form our older ALERT1 protocol telemetry system. Soil moisture sensors are to be added and a second server is to be brought up that hopefully can eventually be spun up for a live to the public flood warning system. The City intends to supply known warnings data and to develop thresholds into the Contrails system from warnings to more easily aid parties in visually seeing and identifying risk and how risk can propagate from upstream to downstream.
The Flood Warning System is correlational. Its warnings are primarily built of severe rains, which means shorter duration and faster moving thunderstorm cells. Recently the Flood warning system had 8 to 9 inches of rain… over two weeks of time in late April and early May 2019. This low rain resulted in triggers for our 3rd worst floods on Indian Creek upstream… but the low rain intensity meant the creek was rising slowly overall, without large waves of water cresting and adding together as they traveled downstream. The result was that the upstream warning recommending up to 2 foot of water in structures and 1 foot or more of water on 2 heavily used streets, did not occur. The warning DID NOT Correlate to the lower intensity and longer duration rains we received. The flood elevation difference was 4.6 feet! These systems do work, but they are not perfect, nor fool proof. They do not identify cause directly and one can be mistaken to believe an event will not or will occur due to the warnings built and the type of rains

occurring or complexity of the stream or river system and development. In the end there is a need for supporting real time modeling, but such will not occur without funding and years of effort.

8c. Develop and implement procedures to quickly analyze and disseminate information from flood warning systems to the public.

Ongoing: The City continues to leverage quick analysis of flood threats and impacts using its existing warnings for 74 sites and 113 additional sites from Johnson County, KS, Overland Park, KS, the USGS and the Unified Government of Kansas City, KS. All of this rain and stream gage data is currently available through the www.stormwatch.com web site which is accessible to the public. Together these sites have been used to develop over 444 warnings within the Kansas City, MO flood warning system.

But the number of warnings is nowhere near enough, nor do they cover the full range of flood severities that could threaten the community. Additionally the warnings are correlations and not directly causational. They are correlated to shorter duration more intense rains. The warnings within the system also still mostly trend to be for 10-year or less severe storms and only cover portions of the network where such heavier rains had been recorded. The 7-26-17 and 8-21-17 flood levels and timings have been built in as new warnings where warnings were obtainable. These can approach the 25-yr, 50-yr and 100-yr levels in Indian and parts of Blue River and in a few other streams in the northland and southland (Line Cr., Round Grove Creek etc…). FEMA's flood depth data has created the ability to add 5,800 other known threats or the number necessary for efficient emergency response for at least 30% of the City's known flood risks by area. Depths have been collected from the field for flooding for the 2017 event. These warnings have been built into Contrail.

The City has obtained its 2018 LiDAR data. FEMA has also recent flown 2020 LiDAR for Jackson county. This data will be used in house to re-analyze flood depth risks and to correct for issues in the older 2006 LiDAR on flood depth and flood risk identified for Roads. Structure and parking lot data will also be updated, but should be less subject to change vs. roads and bridges over streams. The updated data should confirm flood elevations and flood depths and accurately account for flood depths for bridge decks and road embankments over streams, unlike the old products which had too much hydro-reinforcement. Once completed the next step will be a methodology to develop stream flow lines and flow velocities for ranges of depth and development in order to estimate travel time of flood crests from upstream to downstream. With this piece warnings will be added into the flood warning system for the 10-yr, 25-yr, 50-yr, 100-yr and 500-yr floods for all known FEMA flood risks for those severities by FEMA effective modeling. From there the products will need to be monitored and significant improvements made for how well they may correlate and how well the time to peaks agrees from upstream to downstream. Where there is not gaging to "buy" enough time to act, this will identify potential locations where new gaging should be added for the flood warning system to complete warnings developed form the above efforts. Weighted basin averaging has not yet been built into the new Contrails flood warning system for rain catchment to tributaries in order to identify tributaries and creeks with severe rain rates and amounts. This basin averaging is needed to also help see, rain

duration to assign a rain severity for the watershed and potentially identify rains that are in the 10-yr, 25-yr, 50-yr, 100-yr and 500-yr ranges in order to gain lead time for crests likely to build and cause downstream flood risks. This can buy more time, before crests pass stage sites to confirm a likely risk traveling downstream.

Efforts to complete these tasks in 2021 are underway. Once completed we should be able to add an extensive Activity 610 into our CRS program.

Flood warning systems only get better… but they only get better if you keep harvesting, updating and analyzing the data and information they have and what is known to happen where and by when (on average from prior events or models). If you don't know, you can't warn, protect, or mitigate. If the severity of rain that is occurring is not in the system, you're on your own with what you do know, and the resources you can put in the field… in a response mode. Prevention is always better than response based reaction. When in response mode, more damage, and most critically more lives can be lost. One person died in flood waters within KCMO in site of a closed road and flood warning gage site during the 8-21-2017 floods within Round Grove Creek. There were dozens in flood waters. There were multiples of doubles rescued by water rescues. There were situations where water rescue staff of the City took notable risk to themselves to save lives. Better warnings within the flood warning system, with more lead time for specific actions can inform on the real resource demands. Those resources can be worked on as can response and logistics and hopefully, along with barricading and road closure needs more property can be mitigated from damages and more lives saved. Those persons saved… MAY NEVER KNOW THEY WERE SAVED, if these systems do what they can to protect life and property and prevent them from reaching the point where they might enter harm.

9. Increase public awareness of health and disease related issues associated with flood waters

Collect and disseminate public education materials that address health and disease issues associated with flood waters

Deferred: This is a deferred action.

Utilize various methods of social media to inform and educate the public regarding health and disease issues associated with flood waters

Deferred: This is a deferred action.

Identify funding resources for mechanisms to disseminate information to the public regarding protection against health and disease issues associated with flood waters

Deferred: This is a deferred action.

10. Enhance the capabilities of city departments with flood response duties to mitigate damage from floods

Coordinate the city-wide flood barricade task force and update the SOP annually

Ongoing: This task is completed annually. Our Emergency Management Planner is making significant changes to the SOP at the request of WSD Stormwater utility that should complete in 2021. This SOP update is also being used by WSD to alter and update warnings. Based on the logistical challenges in barricading that occurred and the need to stretch Fire, Police, Public Works, Parks and Recreation, and Water Services staff and vehicles to block roads using vehicles when Barricading was not yet in place, the City has confirmed that severe events can easily overwhelm our common barricade site scenarios. In 2018 the Stormwater Utility used its GIS analyst and Specialist to develop a more complete list of potential barricade locations and then build these into a Real Time ESRI Collector based software package using ArcGIS online that can be used on cell phones in the field, tables or computers. So far it has identified more than 950 potential barricade sites. It will be reviewed for the known 109 common barricade sites to confirm they are built in and it will add more as identified and needed, such several dozen flood locations in the North East industrial Levee that are known from 2D modeling but not yet built in. The system has been shown to the Barricade teams and obtained interest and support to try out in the field. So far learning the system has been ongoing with good success. Water Services Dispatch uses a System called Hansen to fill work orders, this system is too time consuming and cumbersome during events to assign, even with the spatial data entered geospatially and assigned some manner of addressing. The PeopleSoft 311 system has similar issues and required double data entry. Typically WSD Dispatch ends up on paper, then must push the data into Hansen and then into 311 after the event when there is time. We do not know at this time how the Collector Barricade app will be integrated into this, but we hope there will be a way to auto generate the Hansen Work Order and 311 note for need and when met note this as well along with when the road is opened back up. The need is real time tracking that avoids all need for use of radios or cell systems. The 5 departments working all use different frequencies. Some use only cell, resulting in a difficult ability to track what has been requested and how it is being handled. Storms and flooding in a metro can be spread out and focused. Kansas City received both of these on both the 7-26/27-2017 event and on the 8-21/22-2017 event. The City is broken into 4 Barricade Regions for the 319 square miles. Public Works handles 2 Regions, Parks and Recreation handles areas south of 63rd St. and Water Services handles all areas along the Levees to 31st street in Jackson County portions of KCMO. This works in lower severity common flood conditions for frequent flood locations. It does not work for needs throughout the City coupled with extreme barricade and closure demands within an area spanning 100 square miles. Barricades had been placed throughout the City and the numbers needed had not been seen, even in the 10-4-1998 event. Blue River and Indian Creek are major systems with nearly 300 square miles of drainage coming to them, 140 square miles of this from the State of Kansas. Currently Public Works has 200 Barricades, Water Services has 200 Barricades and Parks and Recreation has 50 Barricades. This is not enough barricades by any means and at least 1 department said they would not buy more with their funds.

The EOC's new SOP is reversing the numeric severity of flood risks due to changes at the federal level. This will require the re-writing of all warnings. In the future a Level 4 may be a level 1 or 2, where the lower the number the more severe, serious, dangerous the event is. There will still be a "monitoring" level" when only a few EM/WSD staff may be monitoring the weather behavior and timing. Level 4 activates the EOC but with minimal staff. Level 3 brings in any or all of the following: Police, Fire, and one or all of the Barricade Departments as needed. Level 2 brings in all Departments and the City Manager and generally ramps into a larger scale efforts with many supporting Non-Profits and Mutual Aid aspects potentially under way up to and including State and/or Federal Support if severity warrants it. A Level 1 is

guaranteed to be a Disaster Declaration with

A reality of what Mother Nature can do has been shown. The City was able to do much, but also did not know all of the issues that would occur, which resulted in many large scale areas for water rescues, notably in the Dodson Industrial and Swope Park Industrial areas. The City can always do better. The lead time gained by the flood warning system was not enough and was not as fully and efficiently used as needed for large, severe, wide spread rain and flood threats in a community of 319 square miles. Frankly, it was also useless if it did not know when to warn that flooding was forecast to occur in X hours/minutes and closure or evacuations were needed. We've been saying the problems are there. We've been given a chance to see the problems and improve them. Parties continue to align to do so. This will be a critical example of how to leverage the right technology and continual improvement into our response needs. I am still not there. All of this is my 24/7 responsibility.

11. Increase public awareness on procedures to mitigate damage from flooding

****Include flood and NFIP information in preparedness outreach and campaigns**

Ongoing: The Storm Water Utility is using its Stormwater Roadshow presentation for meetings to HOA's and neighborhoods to inform on all matters relating to stormwater issues including the four general ways in which structures can be flooded, with a start on information for what can be done about them. This has a large amount of information on FEMA and flood insurance and it makes it absolutely clear that ANY HOMEOWNER CAN OBTAIN FLOOD INSURANCE WITHIN CITY LIMITS, BECAUSE ANY HOIME CAN FLOOD BY ANY OR EVEN ALL OF THE FOUR METHODS SHOWN. Time and again the City is told by parties that their insurance agent said they did not need insurance, or could not get it or were not eligible. Significant training and education is clearly needed of the public and professionals. The methods of submittal to the City for PIAC are provided and all questions and lines of discussion are followed through on.

The City's: https://www.kcwaterservices.org/crs/ website also provides significant resources to the public to find their risk and look into flood insurance options.

Recently the City put up the new NFHL regulatory floodplains online which can be reached at:

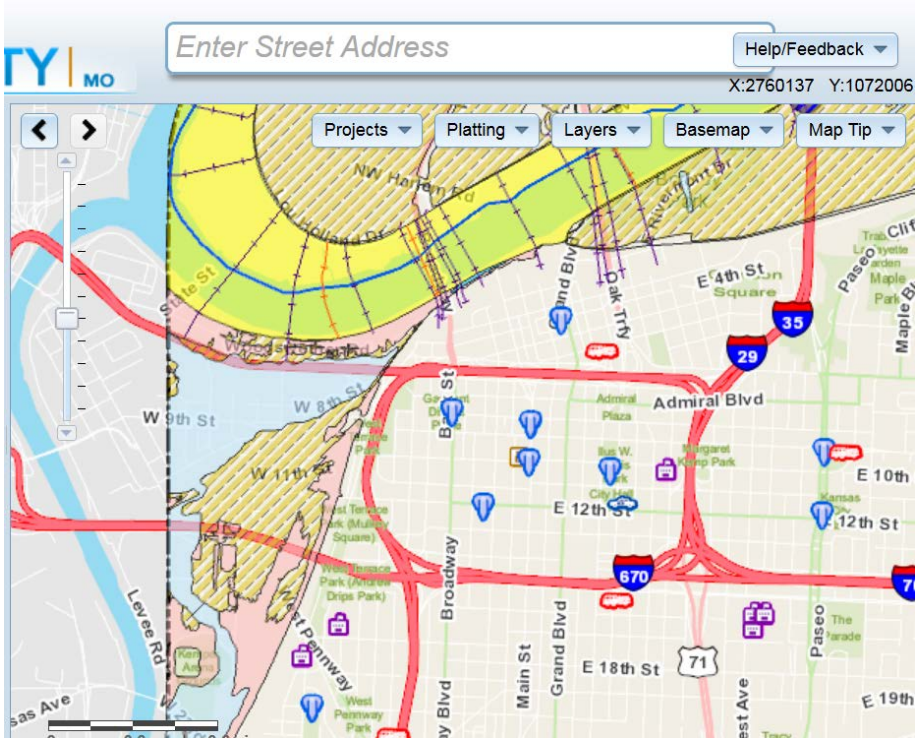
http://maps.kcmo.org/apps/parcelviewer/

Select the [Layers] Drop Down and then on the lower Left "Check the box" for [Floodplain].

This will then allow you to search by your address or many other fields in order to find any location in the City of Kansas City Missouri and see the NFHL shape file for the regulatory floodplains. As well as:

1. The FEMA FIRM Panel they are in
2. The 100-year Regulatory BFE
3. The FEMA 100-year Regulatory Flood Elevations (the modeled Cross Section flood elevations)
4. FEMA Stream Lines
5. FEMA Floodplain (All Zones and types)
6. The Historic FEMA Floodplain (Prior to 1-20-2017)

More is needed, but the above is the beginning steps. The desire is to provide more turn-key information here and refer persons to the right City Development and Water Services Department Stormwater Utility staff for additional information, education, services such as those provided in our 320 and 440 Activities as well as FEMA resources. Below is an Example of the Tool which you can reach online. Much thanks to our IT Division in General Services in supporting and getting this data up as part of our educational outreach to the Public on the new FEMA floodplains adopted on 1-20-2017.



Research and utilize social media to share weather forecasts and flood safety information

The Emergency Manager's Office uses a Facebook account which posts weather related risks and concerns including rainfall, storms, winds, tornadoes, ice and snow which is located at:

https://www.facebook.com/kcmooem/

The City also pays for more detailed weather forecasting information for all forms of hazard through a private company known as Weather or Not, Inc. This company's data is for internal City use though and copyrighted and cannot be provided by the City to the public. Negotiations may occur allowing its use in emergency conditions by the City with reference to Weather or Not as an allowance for fee in the next 5 year contract with WON. The City recently reduced the amount of funds that can be used for such professional technical services contracts before they require approval through Council. This will require a reduction in the available length of the contracts down to 3 years or less and require more bid processes and costs to continue these critical internal services that may be usable for public information in future contracts.

12. Enhance the EOC capability to monitor and mitigate flood conditions

Upgrade and enhance the surveillance capability of the EOC to monitor flood conditions

Complete and Ongoing: During 2015 and early 2016 the Emergency Operations Center (EOC) of the Emergency Manager's Office went through a major upgrade which included increasing display screen to 31, HD screens, multiple redundant feeds for weather data, television/radio feeds, internet and complete access and display of the City's 3500+ cameras. The state of the art audio/video distribution system allows the sharing of all information throughout the facility. Prior to this the City had a dozen locations with video cameras placed where we could not use flood warning gages and where visual need was high for flood risks which the Emergency Management Office funded, installed and has maintained with some contract support. OEM staff is in the process of inventorying all cameras city-wide. OEM will be working with the Stormwater Utility which will identify what video and camera sites can see what parts of potential flood risks within the community. We've not yet been able to do this, but this is due more to Stormwater Utility Staffing. Storm needs to get with OEM on cameras and work out if they have them located in GIS or only have locations, description and/or approximate addresses. If the Later much more work will be needed by Stormwater utility to determine the locations where cameras are. In time it would also help to know the elevation of the camera and the Zoom capabilities as this could be turned easily into a level of visible use and may be able to identify what can and cannot be seen from a given position and elevation. The flood warning system cannot fully cover all known risks, so having this mix of methods of investigation will aid us in confirming what has occurred while improving and adding better flood warnings for more flood risks thanks to these camera and video assets. These video and camera systems also have many other uses for many public safety concerns for the community as well. OEM has been effectively pushing standardizing and organizing these needs in one form for all City needs. OEM's chief Technology, Past EM and usually Duty Officer is slated for retirement. It is believed that all aspects of the EOC's O&M and IT support will be provided by General Services IT. This is a concern at this time as the position may not be filled and may be eliminated. Such would be a serious challenge to the already limited staff within the Office of the Emergency Manager. These persons are on call 24/7 for EVERY type of need or issue that may demand rapid critical organized response to protect and serve.

13. Improve the capabilities of water rescue teams to mitigate loss of life

Identify funding sources to enhance the operational capabilities of water rescue teams in conducting rescues in flood waters

Ongoing: The City's Fire Department funds and uses an advanced Water Rescue group with equipment including rafts, and boats and conventional safety equipment for Fire Engines. Funding is provided through the Public Safety Committee and through base tax revenues for General Fund used to fund the Fire Department and Staff.

42 water rescues for 7-26/27-2017 and at least 160 water rescues for 8-21/22-2017 were completed. 1 loss of life.

There was one loss of life, in which the loss occurred before police or fire reached the location on 8-21/22-2017. The vehicle was swept off of a private low water crossing and then deposited a short distance downstream on the bank. Two persons within the vehicle attempted to leave the vehicle but one was swept up by the velocity of water and taken

downstream. This resulted in a search and rescue and then search and recovery effort.

Fire, Police and the Health Department use the Public Safety Sales Tax for their needs. This funding resource is key to their ongoing training and support and improvements for Water Rescue.

Identify and conduct training courses and exercises for water rescues in flood waters

Ongoing: Training is continually done for the water rescue, Technical Rescue groups of the Fire Department's 1,200 staff. That training has now been tested in real world events for more than 202 water rescues during the summer of 2017 floods. More training continues and is ongoing every year.

Ongoing: Improve the capabilities of water rescue teams through providing equipment and other means to conduct flood water rescues

Larger scale water rescue efforts by boat and raft found problems with equipment. Boat props were destroyed by collision with below water materials, including in one case a fire hydrant! It is clear that a low draft, no proper means of water rescue is needed. Low draft boats that are wind based or water pump based in propulsion should be researched and obtained for the potential use in multiple locations. Two major theatres for water rescues on 8-21/22-2017 showed high depths and high velocities of water in water rescue needs. Drone video footage clearly showed that Swope Park Industrial had the greatest velocity threats while Dodson Industrial showed the deepest waters. Dodson mitigation is under construction with an estimate of 3 years to completion. Swope Park Industrial is now funded through Washington D.C. with work beginning to ramp in phases. Locally there is a Flyover Bridge over rails and earthen Levee that timing of is being worked out between local funding and Public Works and Us Army Corps. Public Works. Drone video of the water rescue efforts and the velocity of waters to deal with was used in D.C. to push for authorization of funding for these last major Blue River mitigation projects within the I-435 Loop. These flood risks are not yet mitigated. Even when mitigated, levee failure or overtopping is still possible, and therefore, while the risk is mitigated, water rescue is still a critical need. The most valuable need learned from our 2017 floods, is the need for **low draft, non-prop** propulsion to support and protect both our Water Rescue crews and those rescued.

14. Improve the capability of the Aviation Department to mitigate the damage from flooding

Enhance and upgrade equipment and protocols to respond to and mitigate the damage from flooding

Ongoing: The airport has worked with the Stormwater Utility to update the watershed modeling within Todd Creek, Brush Creek (North), Rush Creek and Prairie Creek as it relates to KCI. The Storm utility has provided all FEMA and City modeling and advised that the official FEMA floodplain data is needed form FEMA for any aspects relating to the regulatory flood plain and flood elevations. FEMA LiDAR and terrain along with City and MARC GIS products have been provided for vegetation, impervious, soils etc.… to assist in the Airports efforts to redesign the Airport. The runways have been discusses with respect to storm conveyance systems and federal requirements vs. City requirements for these KCI Airport owned storm Utility Assets. Flood Depths data has also been provided and the Airport has funded additional

consulting services work for watershed efforts for the Airport area. Zoning in this area is expected to be predominantly light industrial with some commercial. KCI has significant open space and in a sense is so native, that it has both migratory bird and deer concerns which it must manage with respect to flights. KCI airport is on the bluffs between Todd, Rush, Brush and Prairie Creeks making it a much less flood prone Airport than many. Only intense rains localized on the airport itself could create issues with runways and such rains would already have the Airport closed for wind, visibility, heavy rains and maybe hail. There are some RCB's under some northern runways which drain to the Northeast towards Todd Creek. These are designed to Federal minimum standards for an airport. Additional discussions with the Downtown Airport with respect to combined and separate sewers within the Airport are under discussion for needs and authority.

KCI continues its construction efforts for the new KCI airport in the Northlands NW portion of the I-435 Loop and I-29 and is in good shape on schedule. The location of KCI is in the upstream headlands of: Todd, Prairie, Second and Brush Creeks on the divide between watersheds draining north into the Platte River and watersheds draining West or SW ultimately more directly to the Missouri River than via the Platte River.

The Downtown Airport is levee protected from the Missouri and Kansas Rivers and links to the North Kansas City District Levee in a manner that can be closed as well as the Harlem area of Kansas City, Missouri. In this area the Stormwater Utility's Levee Committee assists the airport in U.S. Army Corps. related needs and issues relating to the levee system that protects this airport from flood risks. This levee includes pumps, drainage and toe drain systems. This airport is much more at risk from severe flood risks from the Missouri River Basin and the Kansas River Basin (1993 was caused by the Kansas River predominantly(alone)).

Identify alternate staging and evacuation areas for personnel and equipment in the event of flooding

Ongoing: Flooding at the KCI Airport is actually extremely minimal and isolated in nature due to the bluff which splits into four watershed systems beneath the airport itself. For KCI the only issues are the Northern Runways which could in theory flood from heavy enough rains exceeding the RCB level of service of the storm system under this portion of the runway. This could be improved in various ways, but again the drainage is more for the airports impervious than it is for significantly large watershed drainage areas. Time of concentration within the KCI airport is likely in the 10 minute range.

Flooding at the Downtown Airport (Charles B Wheeler Airport) is another matter. This Airport is landlocked by HWY 169 on the East, the Downtown Airport levee to west and south and Missouri River North, West and South. The Downtown Airport is of smaller footprint and runway lengths and was never going to be able to handle the metropolitan demand for flights. The 1951 floods halted airport traffic into the Downtown Airport from flood damages and along with severe levee failure and flooding throughout the metro area levee systems. This resulted in the direction to create the KCI Airport in the northland for the metro area. It is essentially accurate to say that the City of Kansas City, Missouri learned from the 1951 floods and determined the long term public/commercial Airport needs of the metropolitan area had to be relocated due to land/runway and flood risk needs at the Downtown Airport. As mentioned it was relocated where it could not easily flood at the top of four watersheds resulting in only extremely brief and isolated severe weather on small runway segments. The Downtown Airport still functions with significant levee elevation, pump station and toe drainage

improvements post 1951 floods. Flood events can exceed the levee's mitigation capacity though this would have to exceed the 0.2 percent annual chance flood to overtop. The risk of forms of levee based failure and flooding is still present given levees, pump stations, interior drainage issues and the potential for heavy but isolated rain events over the airport with coincident high water on the Missouri and/or Kansas Rivers. Put another way this is an Airport that may need to be completely shut down and completely evacuated in some scenarios of flood threat. Levee monitoring, NOAA and US Army Corps. River forecasts and radar and forecasts for heavy rains within the metropolitan area would be the key components that drive the need to consider mobilization and evacuation of materials and equipment at the Downtown Airport. HWY 169 serves as the primary access and egress for the Downtown Airport and in the event of levee flooding or failure would be closed. Significant materials can be rapidly moved out and located to KCI in emergency Levee based flood concerns. This would include notable historic materials from TWA. It should be noted that many historic Aircraft reside at the Downtown Airport, some of which are no longer flight worthy. Other more common and smaller flightworthy private airplanes may not be able to relocate without long term schedules for flood threats. In general NOAA's river forecasts can provide 7 days lead time, while the U.S. Army Corps. can sometimes add more prediction time. In the end the Storm Water Utility has developed a simplified spreadsheet with river miles and average speeds for river velocity which we use to gain additional time on estimating Crest travel times upstream of Omaha or Sioux Falls into the Kansas City metro area Levee Systems. The 1993 Missouri river flood was driven by flooding of the Kansas River We lack this for the Kansas River and additional travel time information could assist on this flood source. The 1993 flood event, from the Kansas River was the flood flow of record and came within 6 inches of overtopping in some levee areas. Clearly there are Coincident storm scenarios in which heavy rains, flooding and peaks could travel through the Metro area in a form that could overcome levee mitigation capabilities and levels of service. You need only consider the size of the Kansas River Watershed and the Missouri River watershed and consider rain events that could load up each in a manner that travels through the metro at similar times. Isolated, heavy rains during high river flows are a more frequent concern for the Downtown Airport. When pumps are the only way to dewater the Downtown Airports interior, the risk for flooding within the levee is more significant, from localized heavy rains that could occur during high flood times of the Missouri and or Kansas River. Pump capacity is always more limited than gravity flow and use of such facilities always has additional strain on a levee system. Levy Failure would tend to be from 1.) overtopping, 2.) Levee weakening and slumping and 3.) Pump station driven failures or failures along the levee or toe drain systems. Of these 3 all can be seen with time to prepare, but the 3.) for pump station related harm to the levee is potentially the most sudden form of failure.

15. Examine repetitive flood loss properties within Kansas City, MO and determine feasible and practical mitigation options

****With stakeholders, explore incentive options to encourage property owners to take action to prevent or reduce future flood losses**

Ongoing: Updated information on this item is addressed under Goal/Objective 1. d. in the ongoing 2010 Plan which actively continues here in the 2015 plan. See 1. d. for progress here.

****Ensure adherence to practices and requirements outlined in the Regulated Stream Management ordinance adopted in 2011**

MARC/KCMO Error: This activity is not for KCMO, it is believed it was meant for another community within the MARC Multi-Hazard Plan and its Floodplain Management Plan component. There is no such Regulated Stream Management Ordinance within the City of Kansas City, Missouri. This plan item is not from Kansas City, Missouri and has likely been incorrectly placed within the wrong Community as a Floodplain Management Plan Objective/Activity. The City uses our newly adopted 1-20-2017 Chapter 28 Floodplain Management for NFIP regulatory compliance along with our Stream Buffer Ordinance 080736 (See Floodplain management Plan items 4 a.) and our Zoning Land Use, Building Codes and Conservation practices (See Floodplain Management Plan 4 b.).

16. Reduce flood related damage to public, residential, and commercial property in flood prone areas through structural and non-structural retrofits or removal of property

Encourage homeowners and businesses in flood prone areas to elevate mechanical systems

Ongoing: Currently these items are only caught via the permitting process for new development, cumulative improvements exceeding 50% of market value over 5 years or substantial damages exceeding 50% of market value of building or via PIAC Based Drainage Complaints. Again the City has eliminated the flooding of 1,033 structures from flooding through Brush Creek and Blue River Mitigation. While these items are educated on and discussed there is no significant encouragement at this time to convince persons to modify their structure(s) in ways that reduce their flood risk by using structural and non-structural retrofits. They can be advised to do this, but not obligated unless they exceed the cumulative improvements or are substantially damaged. The Water Services Departments Stormwater Utility is preparing a major effort in public education on flood risks and options for mitigation. Presentations and materials have been put together to be tested in multiple neighborhoods and then community centers. Discussions with private professional companies who specialize in regulatory flood mitigation techniques to bring structures up to Chapter 28 NFIP standards and thereby reduce flood insurance premiums are being spoken with to be a part of the meetings. Wet and Dry flood-proofing (commercial only), elevating and other techniques and tools will be used. This is a critically missing piece that the Stormwater utility can improve flood risk, potentially increase flood insurance coverage while also reducing the cost of that flood insurance. But these methods do not resolve affordability, income, demographics or the real-world conditions of a given structure, which may ultimately find no solutions short of some form of buyout program.

Encourage water and wastewater districts to elevate vulnerable equipment at wastewater treatment plans, potable water treatment plants, and pumping stations

Ongoing: Currently these items are also only caught via the permitting process for new development, cumulative improvements exceeding 50% of market value over 5 years or substantial damages exceeding 50% of market value of building. While these items are educated on and discussed there is no significant encouragement at this time to convince persons to modify their structure(s) in ways that reduce their flood risk by using structural and non-structural retrofits. They can be advised to do this, but not obligated unless they exceed the cumulative improvements or are substantially damaged. The market value of various

buildings, structures or mechanical/electrical or HVAC equipment is of importance also. Breaking work down to the specific structure and sometimes system can be appropriate.

Encourage utility providers to assess their facilities and infrastructure for vulnerability to flooding and, if necessary, retrofit or modify them to decrease vulnerability

Ongoing: The Stormwater Utility has done this by use of the FEMA Flood Depth data for impervious structures. The next step is to assess those structures back to the Utility or public entity that operates, owns and maintains them. There are many wastewater pump stations in the field in less developed and in heavily developed parts of town. It is now possible to communicate on all these structure locations and provide the potential frequency and severity of flood risk. This information has been provided on some Wastewater and Stormwater Facilities. So far there has not been a Water Utility need. The information still needs more work and analysis. This will be done through the GIS Analyst mentioned that will be working to develop a GIS based method of tracking flood risk needs and dealing with them, be they barricade needs or flooded structures or equipment. Long term planning for several wastewater treatment plants have been investigating methods of mitigation as well.

17. Mitigate flooding damage to public facilities

Research the feasibility of installing water pumping equipment in public facilities to reduce the damage from minor flooding

Deferred: This is a deferred action.

Implement flood damage mitigation mechanisms such as water pumping equipment

Deferred: This is a deferred action.

Identify funding sources to implement flood damage mitigation mechanisms such as water pumping equipment

Deferred: This is a deferred action.

18. Improve and enhance the capability to respond to and mitigate damage from flooding incidents

Identify funding sources and replace damaged barriers to prevent traffic through high water areas thus mitigating the loss of life.

Ongoing: The Stormwater Utility has identified 648 Barricade locations from GIS products, including analysis of roads based on the FEMA flood depth data and local pipe and culvert capacity issues that can lead to flooding of roads. This list is FAR FROM complete, and in fact, creating it resulted in many of our 109 remaining common Barricade locations from being within the 648 developed form GIS Analysis localized frequent flooding does not have to correlate in any way to FEMA or even pipe network systems in a manner that simple GIS could identify flood risks for. Assuming 750 locations with Barricade needs the next step is to identify the total lanes of traffic that would need barricaded followed by the Departments responsible for them in order to identify a total Barricade Level Demand for these known locations. This GIs collector + ArcGIS Online tool is being used by our barricade teams via Tablets and cell

phones to communicate barricade requests, en-route, closed and re-opened status. The tool does need a method of storing long term a database of activity in a time sequenced manner using GIS. At this time we have only an "Event A" and "Event B" method we can use in storms. After an event the information must be pulled and stored as a directory and then the "Event Map" must be cleared of all recorded activity or attached images related to flooding. The tool is very valuable, but this history, database tracking component is needed, and much harder to do in ArcGIS Online. We expect to work on this in the winter of 2021 hopefully. Otherwise 2022. This work will be used to track in field needs and their status by multiple parties and will serve as the basis for what warnings to build into the flood warning system and what lead time those warnings can get for identified flood risks. Field survey work and wire weight installations will be needed for many of the 74 flood warning sites in order to link flood depth to flood stage and flood datum for sites upstream. A method of analysis for travel time of flood water crests will be needed from upstream to downstream for various FEMA flood severities. At this point the development of the warnings, the stage datum triggers and the actions and flood risks identified with the time available before they occur will be possible to enter into the flood warning system. This will address and improve our capability to respond for frequent to sever flood threats in the 33% of the City that has FEMA 29.3 square miles of regulatory floodplains.

With respect to mitigation the City of Kansas City, Missouri has been able to document at least 100 million in prevented flood damages to 1.7 million square feet of structures within Blue River from Stadium Drive to the Missouri River. This is the oldest portion of mitigated flood improvements achieving the 30-year level of service and lowering flood depths and elevations by 3 to 11 feet in areas. Additional mitigation has occurred from Stadium Drive to 67th St., also to the 30-year level of service or better and from Brush Creek at Belleview/Roanoke to the Blue River which has 500-year level of service in the plaza and 100-year for all of the rest of Brush Creek. The recent 7/26/2017 and 8/21/22/2017 flood events resulted in flood levels on Blue River that are estimated to have prevented approximately:

19. Integrate flood mitigation strategies with projects and activities designed to protect, enhance, or restore ecosystems and the environment

Work with area environmental groups and other stakeholders to develop and implement flood mitigation strategies that promote the sustainability and/or restoration of wildlife and fish habitats

Ongoing: The Stormwater Utility and Water Services Department contracts with the Little Blue and Blue River Watershed Associations for environmental trainings, stream teams and an award winning school educational programs for teachers called KC to the Sea. All of these teach and stress the interconnectedness of stormwater and other water related issues and show the impacts on streams and systems and their condition and quality. All of these efforts spend time on flood threats and conditions and the effects and changes we can create from the way we develop and the way we convey runoff. Water Services also funds and supports the Missouri and Blue River cleanup efforts to help offset many of the trash related issues that find themselves into stream networks or occur simply from illegal dumping which harm riparian ecosystems.

20. Examine repetitive flood loss properties and determine feasible and practical mitigation options

****Work with owners of repetitive flood loss properties to identify feasible mitigation strategies and potential opportunities; determine property owners' interest in specific mitigation options**

Ongoing: Updated information on this item is addressed under Goal/Objective 1. a. in the ongoing 2010 Plan which actively continues here in the 2015 plan. See 1. a. for progress here.

****Identify potential funding opportunities to implement mitigation options for repetitive flood loss properties**

Ongoing: Updated information on this item is addressed under Goal/Objective 1. b. in the ongoing 2010 Plan which actively continues here in the 2015 plan. See 1. b. for progress here.

****As funding allows, repetitive flood loss properties and structures will be targeted for buyout**

Ongoing: Updated information on this item is addressed under Goal/Objective 1. c. and 3. d. in the ongoing 2010 Plan which actively continues here in the 2015 plan. See 1. c. and 3. d. for progress here.

With stakeholders, explore incentive options to encourage property owners to take action to prevent or reduce future flood losses

Ongoing: Updated information on this item is addressed under Goal/Objective 1. d. in the ongoing 2010 Plan which actively continues here in the 2015 plan. See 1. d. for progress here.

21. Integrate flood mitigation strategies with projects and activities designed to protect, restore, or enhance ecosystems and the environment and/or create recreational opportunities for the community.

Consider the construction of detention basins, small lakes, and greenways or riparian corridors in areas of new development to channel and catch storm water, thereby reducing the likelihood of flooding

Ongoing: Updated information on this item is addressed under Goal/Objective 2. a. in the ongoing 2010 Plan which actively continues here in the 2015 plan. See 2. a. for progress here.

In concert with existing comprehensive and land use plans, develop a strategy for acquiring flood prone property for use as open space or park land

Ongoing: This is an effective but older method of preservation or multi-use. The modern equivalent is the use of Stream buffers which is what the City has done as the better more modern method to protect the public while not increasing the cost of governance through higher O&M costs by the City born by the public. That said the need for comprehensive land use plans with a strategy for acquiring flood prone property for use as open space or multi-use park land is still a critical component. In the older Jackson County portion of the City, these methods have been very successfully used and they will have their place in the northland's

park based and trail based open space and park efforts, adding further protective and educational value to riparian corridors, trails and other stream buffered and or park lands that serve as ecosystem based habitat. Such pathways also allow the negotiation of easements for items like riparian bike & pedestrian trails, which maintains some tax base from otherwise stream buffered area. The smaller the public footprint for O&M or higher cost non-native maintenance the better for the community and wildlife, by using the City's Stream Buffer regulations and related ordinances.

It must be noted that the reason this is not the typical pathway for the City of Kansas City, Missouri is as follows:

1. See Floodplain Management Objective 4 Activity a.
2. The City has used its Stream Buffer Ordinance to essentially protect the open space of FEMA regulatory floodplains within much of the City. 22,707 + Longview Lake = 662 = of 29.3 square miles of FEMA regulatory Floodplain within the City is regulated by the Stream Buffer Ordinance.
3. Of the remaining 10.74 square miles of FEMA regulatory Floodplain, generally from 63rd St to the Missouri River on Blue River and the primary Brush Creek floodplain, the City of Kansas City, Missouri or the County of Jackson County, already own 6.33 of 10.74 square miles of this territory without stream buffer by ordinance. Of 29.3 square miles of FEMA regulatory floodplain only 4.41 square miles lacks buffer protection or ownership by City or County. These areas do still have stream buffer requirements per our APWA 5600 and BMP Manual Standards, though these are not as protective as the City's Stream buffer Ordinance.
4. Parks Twin Creeks efforts have not resulted in any additional preservation beyond stream buffer. Development is moving rapidly into the Second and First Creek area and the pattern is dense suburban and commercial mix The Stormwater Utility is the technical support for City Planning and Development on these FEMA permit efforts and have been assisting all trail designers with key ways to simplify their work and avoid regulatory issues in design work within floodplains and floodways for trail systems. The most challenging piece is always stream crossings which obligate obtainment of official FEMA regulatory modeling for use in No Rise Analysis, unless they can avoid fill, obstruction and elevate above the flood elevation with at least 1 foot of freeboard. The City does use a FEMA No impact in Floodway Document from FEMA which Region VII FEMA recommended to also assist on such efforts. It should be noted that efforts to assist by advising on how to avoid higher regulatory challenges have still resulted in much delay in trail development. This has voiced some opposition within government to the higher degree of regulation and the reviews for FEMA and APWA Stream conditions which can slow efforts on trail development.

It must also be noted though, that such trail systems can be isolated and can switch back across creeks using trail bridges and low water crossings. These pathways can create traps during rain events and can create greater challenges for Police and especially for Fire in the event of water rescue, technical rescue or ambulance service needs. Accessibility may be much more difficult. The 911 system is a critical link to rapidly and accurately locate a caller and rapidly identify the fastest route to reaching them.

Identify funding sources for the acquisition of flood prone land of environmental, recreational, and flood mitigation uses

Ongoing: Updated information on this item is addressed under Goal/Objective 2. c. in the ongoing 2010 Plan which actively continues here in the 2015 plan. See 2. c. for progress here.

Consider alternative uses for floodplains and flood prone areas that have less impact from flooding

Ongoing: Open Space, Stream Buffer, park lands, various types of sports services that do not use improved athletic fields (flooding of these has high costs to clean and repair). These bases are well covered within the City of Kansas City, Missouri. The challenge now is in developing and planning for the needed interconnected systems along riparian corridors within the community that add activity, connectivity, engagement with natural and recreational resources and other services to the community with appropriate trailheads.

Work with area environmental groups and other stakeholders to develop and implement flood mitigation strategies that also promote the restoration and/or sustainability of fish and wildlife habitats

Ongoing: Updated information on this item is addressed under Goal/Objective 2. e. in the ongoing 2010 Plan which actively continues here in the 2015 plan. See 2. e. for progress here.

Develop partnerships between emergency management, floodplain management, and environmental groups to provide education regarding the benefits of collaboration

Ongoing: This goal is similar to Goal/Objective 2. f. in the ongoing 2010 Plan which actively continues here in the 2015 plan. The difference is that the above DOES NOT say: "and identify specific programs and activities that can be developed and implemented jointly."

Identify specific programs and activities that can be developed and implement with stakeholders

Ongoing: The Stormwater Utility's Engineering Services division is working with the office of Emergency Management on SOP improvements for the flood warning system. USGS has been consulted with to survey in and benchmark all pressure transducer's and radar sites with wire weights and check bars surveyed and benchmarked. This data is being used to then correct datum and stage to fit to actual water surface elevations. And that is then being tied to the FEMA depth grid products developed for KCMO for the 1-20-2017 floodplains. Unfortunately FEMA did not scope to have water surface elevations provided, only depth. Efforts to obtain water surface elevations (since they had to be made in order to get depth grid raster's were made with Baker, but Baker did not preserve and could not locate this data. KCMO will use the raster depth grids from FEMA for 10-yr, 25-yr, 50-yr, 100-yr and 500-yr to add to the raster grid land elevations of that time in order to get a water surface elevation, this will then be reviewed and analyzed for potential errors or discrepancies and then the latest 2018 Raster will be used to subtract from that water surface elevation data to obtain a more current 2018 (or 2020 if Jackson LiDAR/Raster is provided) depth grid set. This data will then be tied into the flood warning systems warnings which will then be expandable to include all of the FEMA depth and water surface derived products in order to identify upstream to downstream correlational flood risks within the community. We will also work to develop a travel time estimation method in order to assist on identify what can occur and the time available in which to act.

A case is being made in the Stormwater utility to coordinate with Mid America Regional Council and potentially the NRCS/USDA for Hydrologic analysis support and vegetative cover analysis. Some of these products have been developed in the past, but it is past due to have much higher resolution and accurate assessment of surface conditions with further analysis that will identify needed hydrologic information to support review of macro and micro drainage studies for valid existing conditions runoff analysis. The focus will be on what is needed to gain various resolution, accuracy improvements and how these items might be repeated over time, including terrain, slope, accumulated basin area slope, flow path analysis, accumulated flow path based slope, vegetative cover analysis, agricultural cover and land use analysis and roughness, infiltration and soil type parameter's. With all of these it will be possible to develop travel time and time of concentration accumulating paths. All of this together will allow a very effective geospatially vetted and updateable existing conditions runoff analysis. These are City wide needs, which can gain immediate City wide usage for improved development analysis of stormwater conditions.

As a CTP the Stormwater Utility has begun to discuss further CTP work with partner CTP, relating to watersheds shared in common. Blue River, Indian Creek, tomahawk Creek, Turkey Creek and Brush Creek almost all drain in by-state, multi-community ways and a watershed wide approach and standard would be of great benefit to all.

The Stormwater Utility is working with FEMA, the City of Independence, Lee's Summit, MO, Jackson County and any other interested community's to obtain a completed watershed wide Little Blue River FEMA hydrology and hydraulics update leveraging modern technologies and tools. The aim is also to develop and identify more flood risk throughout the community without a 1 sq. mile restriction for local needs, but also without expansion of existing FEMA SFHA. The improved tools will be used to regulate at the local level and aspects like those above relating to MARC may prove very beneficial here as well.

Programs for education, watershed and water quality already exist with the Little Blue River and Blue River Watershed Associations and the Lakeside Nature Center, Bridging the Gap and Heartland

All of these stakeholder groups function to inform on watershed issues and needs and to educate for the future.

More can be more easily developed with success on the many needs identified within this floodplain management plan.

22. Reduce flood related damage to public and private property in flood prone areas through structural and nonstructural retrofits or removal of property

Encourage residents in flood prone areas to elevate mechanical systems

Ongoing: Updated information on this item is addressed under Goal/Objective 3. a. in the ongoing 2010 Plan which actively continues here in the 2015 plan. See 3. a. for progress here.

Encourage water and wastewater districts to elevate vulnerable equipment at water and wastewater facilities

Ongoing: Updated information on this item is addressed under Goal/Objective 3. b. in the ongoing 2010 Plan which actively continues here in the 2015 plan. See 3. b. for progress here.

Encourage Utility providers to assess their facilities, distributions systems, etc. for vulnerability to flooding and, if necessary, retrofit or modify them to decrease vulnerability

Ongoing: Updated information on this item is addressed under Goal/Objective 3. c. in the ongoing 2010 Plan which actively continues here in the 2015 plan. See 3. c. for progress here.

As funding allows, repetitive flood loss properties and structures will be targeted for buyout

Ongoing: Updated information on this item is addressed under Goal/Objective 1. c. and 3. d. in the ongoing 2010 Plan which actively continues here in the 2015 plan. See 1. c. and 3. d. for progress here.

Elevate public facilities in flood prone areas and encourage private sector facilities to do likewise

Ongoing: Updated information on this item is addressed under Goal/Objective 3. e. in the ongoing 2010 Plan which actively continues here in the 2015 plan. See 3. e. for progress here.

Identify incentives to offer home owners and businesses to remove or retrofit their structures in flood prone areas

Updated information on this item is addressed under Goal/Objective 3. f. in the ongoing 2010 Plan which actively continues here in the 2015 plan. See 3. f. for progress here.

23. Discourage new development in floodplain and flood prone areas

****Levy fees on new residential, commercial, and infrastructure development in floodplains or flood prone areas to finance flood mitigation, preparedness, response, and recovery actions**

Ongoing: Updated information on this item is addressed under Goal/Objective 4. c. in the ongoing 2010 Plan which actively continues here in the 2015 plan. See 4. c. for progress here.

24. Improve flood hazard assessments and flood mapping

****Obtain parcel data for flood boundary areas and enhance vulnerability assessments for these areas**

Ongoing: Updated information on this item is addressed under Goal/Objective 5. a. in the ongoing 2010 Plan which actively continues here in the 2015 plan. See 5. a. for progress here.

****Coordinate the collection of demographics, economic, watershed, land use, and other data required by the HAZUS- Flood software program and/or GIS systems**

Ongoing: Updated information on this item is addressed under Goal/Objective 5. d. in the ongoing 2010 Plan which actively continues here in the 2015 plan. See 5. d. for progress here.

****Conduct an in-depth flood risk analysis utilizing HAZUS data and create detailed maps based on GIS technology to identify areas at risk from flooding**

Ongoing: Updated information on this item is addressed under Goal/Objective 5. e. in the ongoing 2010 Plan which actively continues here in the 2015 plan. See 5. e. for progress here.

****Using city, state, and federal products develop, analyze, and prioritize flood risk, severity, and frequency for structures, land/parcels, and roads/RoWs. Continuously improve with 3 key phases of development by: 1) Regulatory Floodplain Areas, 2) Non-Regulatory Floodplain Areas with hydraulic monitoring, and 3) Upstream Hydrology Areas with stream accumulation paths for flow accumulation and risk.**

Ongoing: Item 1.) has been completed using the FEMA flood depth data for 10%, 4%, 2%, 1% and 0.2% annual chance storm event severities. All, impervious: roads, driveways, structures, parking lots, sidewalks, gravel surfaces, patios, decks, roofs, have minimum, average and maximum flood depths based on the LiDAR to raster terrain of the area and the depth grid raster from FEMA. The same has been completed for pervious areas, parcels and rights of way. If it can be a polygon we've done the statistical analysis of flood risk for minimum, average and maximum flood depths. Polygons are crucial here, we broke up impervious polygons further using the FEMA Flood Zones and Sub Types, such as Floodways in order to be able to better break down the data in the future with updated raster or TIN data, in the case of our 10 square mile East Bottoms Levee District (NEID). 1 of 3 is complete. Use now is aimed at integration into the flood warning system and development of field needs for signage, closures, barricade support and logistical needs verses the frequency and severity of flood depths, and use of Floodway to prioritize over non-floodway, lacking velocity grids.

Item 2.) has only been completed in approximately 34 of 318.9 square miles of Kansas City, Missouri, which includes the Twin Creeks region of First and Second Creeks (24 square miles) and the North East Industrial District (10 square miles). Work like this is needed throughout KCMO in order to identify all flood and erosion risks within the community in the upper square mile tributaries which FEMA lacks regulatory floodplains for that contains approximately 66% of the Communities land area. The data being created here is also aimed at assessing original native conditions, existing and the City's future land use to compare the impacts and changes over time in stream velocity, flow and geomorphic change. All of this is necessary in order to see the change that has been rendered upon the community, compare it to the past and make informed and accurate decision on impacts, risks and ongoing changes such as stream meander, widening, deepening and degrading water quality from changes in the runoff rate, duration and pattern. All of this provides the degree of stability or instability in the system which drastically impacts the true risk over time. A Community lasts hundreds of years, hopefully, that means development has a very long lifespan if done properly and very long

flood risk costs if build where impacts and costs will occur with future change. The above work has been amended as the original task used 1d modeling methods to develop 2D geospatial impacts needed to support storm issues, impacts and review. Phase two of Twin Creeks has been completed, converting the 1D work to Hec-RAS 2D in full, or nearly in full. While Hec-Ras 2D has good capabilities, it has serious limitations within any area that also has any form of underground conveyance system or collection. This continuing Hec-Ras limitation within the base software NEEDS RESOLVED. Pressure based flows, dynamic, pressure, collection and iterative analysis for flow into and out of piped network systems back to the terrain is needed. This limitation resulted I scenarios where neighborhoods and tributaries had to be SEPARATED from the HEC-RAS rain on mesh/terrain and instead routed in XP-SWMM or PC-SWMM or EPA-SWMM, often as subshed based underground + collection systems. This reversion back to subsheds compromised the entire purpose of complete Identification of potential flood risks within the community. It also create a technological barrier that compromises the quality of information for residents near conveyance systems. This has serious social justice concerns. A Utility needs to seek to identify risk fully and equally, not be selective on who gets answers, and who does not, “because we used Hec-Ras 2D”. Use of Hec-Ras 2D was a disappointment in outcome due to this continuing conveyance system limitation for pressurized flow within the modeling product. There is also no GPU based acceleration capabilities for the model. These issues force the City into a multi-model platform or modeling methods based on the degree of development. Infoworks ICM continues to be the preferred urban core 2D modeling for KCMO.

Item 3.) is critical to support stormwater plan review support with City Planning and Development processes with proposed developments. The Stormwater Utility has completed 34 square miles of such flow path analysis work in First and Second Creeks, and in the Northeast Industrial District interior drainage area behind the East Bottoms Levee. These surface flow paths built from accurate Terrain surfaces are 1 of 2 absolutely critical geospatial products for modeling. Modeling methods can be 1D and 2D in nature but both benefit from defining flow paths first. This data is critical to stormwater plan and drainage study review efforts. The City’s APWA 5600 stormwater drainage standards state that any drainage area larger than 2 acres must have a defined surface flow floodplain and water surface elevation if underground conveyance cannot convey the 1% annual chance storm. The City does not know where all these flow accumulation paths of 2 acres or larger are. The City therefore relies on the Designers to provide this data and this is not done at the professional level required. Many are missed in review and in submittals. The City needs such drainage areas down to 0.25 acres in all 318.9 square miles of our community. Our future path is likely to use Hec-Ras 5 2D and Infoworks ICM 2D methods using Raster and TIN Meshes for flow, depth and velocity, sheer stress etc. All 1D/2D modeling methods typically combine the methods and require boundaries where 1D methods are used for definable channels and cross sections of depth verses shallow flow 2D reaches and pathways over land. A decision tree is required for how and when to convert from 2D to 1D and for how to identify and confirm the existence of an accumulating flow path overland. Historically these have always been missed by methodologies of lumped weighted averaged subshed or sewershed methodologies which ignored hydraulics within these upper subshed areas. This enforces an area of unknowns on the community. KCMO will now apply rainfall in event storms, cumulative storms and real gage based rainfall for actual historical events to models to track behavior and better confirm and calibrate modeling to fit reality accurately. The only subshed that should ever exist in KCMO modeling in the future is the raster grid or Triangulated Network of the TIN. Rain should fall directly to the grid, vegetative cover, surface roughness, infiltration, depression

storage and absorption all can be applied based on existing GIS of known vegetation and impervious land cover. In this way all of the public benefits and every pipe and inlet will be added to the terrain models and accurately connected to them to receive runoff or reject it and add to it if pressurizing. Everything in stormwater and combined sewer modeling comes back to rainfall accumulation and travel paths on the surface and who they connect to underground pipe networks and inlets with respect to accurate terrain. This method of modeling, though new, can save up to 1.5 billion or more between the City's combined sewer and stormwater capital improvement needs simply by accounting for the benefits of both needs to justify difference types of design and construction that advantage both needs together. In combined sewer analysis, separation is extremely expensive and tends to be the option of last resort, however those same areas typically have extremely poor stormwater levels of service and flood frequently, often multiple times per year shallowly. If one was to separate major trunk systems for storm they could end the issue of overflows and solve storm flood risks on roads at least to the 10% annual chance storm and potentially to eh 1% annual chance storm for many structures in non-FEMA flood plain areas. This method would reduce the amount of high rate treatment and reduce the operating costs for combined sewers which currently is estimated to be 14 million more per year, just to operate, more than the entire Storm Utility's Annual Revenue. The key point is always that terrain and flow path is key.

The QL2 LiDAR has and derived Raster data has been used to develop many other products including flow path analysis by raster accumulation. The method still needs more refinement and especially better connectivity to storm system sforflow paths in a correct "To" and "From" manner. The Storm Utility made a case for this need, pushing for QL0 and providing the benefits of high accuracy, precision and classification of LiDAR Las points for terrain, vegetation and buildings. Initially we had approval for QL1, but budgets resulted in a need to reduce to QL2. This level is still fully classified and notably better than historic LiDAR. No LiDAR has been flown in Jackson in 14 years and none in Clay or Platte in 11 years. Debate ranges on a need for this data every 2 to 5 years in heavily urbanized areas. The City has completed flow path analysis for 34 square miles of community territory at high accuracy with full accounting of sumps, collection d pipe/culvert systems for how flowpath routes and to where. .

The City has also begun to use this data and begun to scope and require such flow path identification in work. Most recently efforts within the Brookside tributary of Brush Creek, Town Fork Creek, the "40th and Monroe" tributary to Blue River, which is part of our Brush Creek watershed modeling, and Twin Creeks have developed such products from 0.5 acres to 3 acres drainage area resolutions. Geospatially this is critical for any serious stormwater review process if one is to see what may potentially be impacted by proposed changes where.

Develop and regularly update a mitigation list for structures, land/parcels, and roads/ROWs with a ranking for these based on depth, severity, and frequency of flooding. Provide to SEMA/FEMA through their mitigation tracker if they update the tracker to accept large datasets vs. individual manual data entry.

Ongoing: A GIS Analyst was assigned the task of completing this effort in 2018 and developing a method to track the need, location and status of these risks. The initial work was completed using 2006 and 2009 LiDAR data with FEMA regulatory flood depth raster data. It identified:

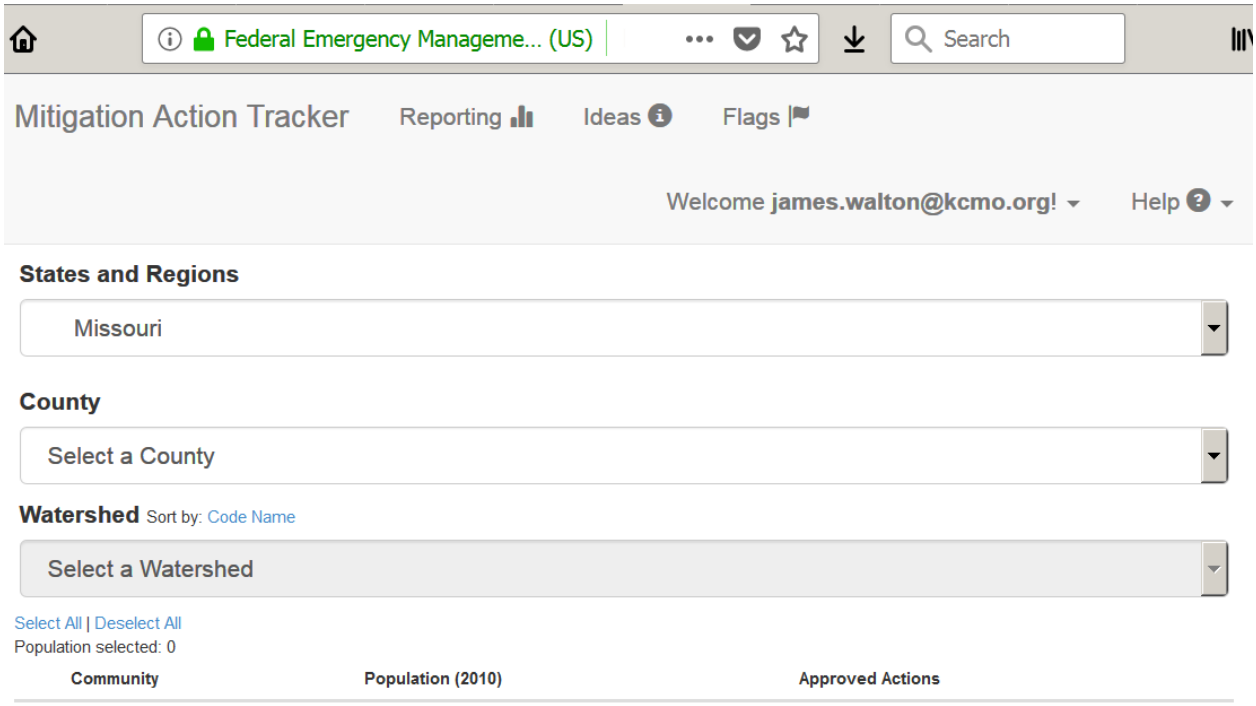
Flooding of:

10% Annual Exceedance Probability Storm:	865 Structures	1.85 to 2.7 ft. depth average
4% Annual Exceedance Probability Storm:	1,350 Structures	1.46 to 2.13 ft. depth average
2% Annual Exceedance Probability Storm:	1,875 Structures	2.12 to 2.99 ft. depth average
1% Annual Exceedance Probability Storm:	2,777 Structures	2.16 to 2.94 ft. depth average
0.2% Annual Exceedance Probability Storm:	4,715 Structures	3.27 to 4.04 ft. depth average

The above does not filter out sheds, detached garages or other forms of non-primary Structures. The above uses 2006 and 2009 LiDAR based raster data. Stormwater intends to update these products to use the much higher accuracy, resolution and precision of our new 2018 LiDAR with better raster products that can allow us to more accurately avoid flood depth errors in our analysis due to hydro-reinforcement practices that may remove road embankments. This does not impact structure flood depths, but does affect road based flood risk analysis.

The above data has been used to build out a far better, but still notably incomplete picture of the amount of road barricade risks within the community. The City has a Common Barricade Program which has 109 of 120 remaining locations that commonly need barricading. However products like the above have identified an additional 648 “road crossings” identified with flood risks that require barricading. These road crossings are themselves only one type of road flooding that can occur.

So part of the effort is based on barricades, part on structures, parking lots and driveways and all will leverage surveyed, benchmarked with stage, known datum and water surface elevations in order to leverage in thousands of new warnings identify risks and the time until they will travel to a location creating flood risks. City cannot manually enter 5,715 flood risks for structures and more than 1,000 for roads. KCMO has more than 2 billion in stormwater needs down to the resolution of 50 acre drainage areas. The FEMA Region 7 Mitigation Action Tracker has only 23 actions, only 2 of which are in Missouri. None are from KCMO. KCMO Knows of, but must manually enter 5,715 known Mitigation Actions. Getting these in is crucial as, without Notice for these to SEMA through the Mitigation Action Tracker or through individual NOI’s (even more time consuming) there is no way to seek Grant dollars for any of these needs <u>when appropriate</u>. The Two Missouri requests are to relocate residences from floodways. Despite more than 450 million in mitigation efforts by Local, State and Federal efforts in KCMO, we still have thousands of these types of structures from Pre-FRIM days of development and now… from re-mapping efforts, especially in Little Blue River Watershed. This step is critical and analysis of the needs and prioritization before entry is equally critical. KCMO cannot fully compete for dollars in disaster Area Declarations, without this effort completed, particularly in post disaster situations. This effort is ongoing, but the Mitigation Action Tracker <u>still does not allow a means to mass populate a community</u>. We cannot log 5,715 + thousand Mitigation Action Needs manually.



****Work to develop these map, data, and list products for GIS tools for direct use by public and private needs to fulfill multiple needs for information to aid flood mitigation**

Ongoing: A focus on the Needs is critical, The State HAZUS analysis and the City's flood depth polygon analysis data can be used to determine the level of needs and prioritized to be loaded into the Mitigation Action Tracker. KCMO has learned that a recommendation is not as important as complete identification of the flood damages and situation throughout the tributary. Without this complete modeling and analysis of all flood impacts, there is no way to correctly identify the best mitigation solutions and confirm they are done in a manner that has no impacts, upstream/up-pipe or downstream/down-pipe; only benefits. The solution or recommendation component can "lock down options" or filter how parties view a "project", it is necessary to analyze all types of need, options, benefits and costs and doing so will result in a complete hybrid set of solutions for all area needs. In some locations an undersized culvert or storage may be part of the mitigation solution. In others buyout or elevation, relocation or flood-proofing may be the best path. Generally no one method of solution solves all parts of a particular flood risk area's needs. What helps in one area may hurt in another. A methodology is needed for this to cover options. Rapid benefit to cost analysis methods from the State Level 1 and City HAZUS data may or may not be possible, in order to help prioritize mitigation actions by watershed, council district etc.… This task is ongoing with significant GIS Analysis and field support needs still required. Again the Mitigation Action Tracker must grant a means of loading mass point data for community needs. This data cannot be manually entered for 5,715 known flood risks, which only account for 90% of the regulatory flood zone in KCMO that itself accounts for at best, only 30% of the Communities total land area's flood risks. How many flood risks truly exist? 9,900? 13,714? **We do not know. That is unacceptable.**

****Using city, state, and federal products complete the modernization of city regulatory and non-regulatory floodplains and adopt by the three phases outlined in Action #4 over time**

Ongoing: The City has provided 12 million in watershed modeling and more than $500,000 in funding to complete the FEMA map modernization efforts for KCMO community floodplains. This work has been completed and the new regulatory models and products have been adopted as of 1-20-2017. This was the Level 1 FEMA regulatory watershed Zone/Area.

City has completed 3 of 36 watersheds for Non-FEMA regulatory drainage areas, the upper square mile tributaries that comprise approximately 66% of the communities total land area. This area has no known or regulated flood conditions in a form that is easily used, provided, or analyzed. A notable portion of this area's flood risks are not identified at all. There is watershed modeling down to on average 50 acres, but this data is not in a form that is easily used or built into any regulatory processes. 31.9 square miles of regulatory FEMA floodplain for 318.9 square miles of City territory have been completed. The effort to use the deliverables to change how these areas review flood risk, using the better, more geospatial data, and how the City uses this data to simplify regulatory process while gaining real world stormwater runoff goals that prevent harm from development to a much higher level is needed and begun in some areas. In general the goal here is to provide upfront information and goals that allow developers and designers to focus on solutions and the realities of real world problems with known goals needed on runoff, flood risk and erosion risk issues. It is not about the procedures so much as validated end results using the developed data. This method will not regulate in the same manner as FEMA. It will work to preserve areas of high flood and erosional risks subject to meander and failure. This is level 2.). Level 3.) Uses 2.)'s modern revolutionary terrain and modeling capabilities with accurate underground systems and surface inlets to correctly identify and provide all risks to a range of 10 to 25 square foot resolution by various terrain methods. Level 3.) is the effort to change how we regulate and review stormwater concerns and will integrate the new data and known risks into our regulatory review process and provide this information on day one and on any day for any part of the City in which someone may be interested in development or re-development or mitigation. A Pilot effort for Level 3.) has been completed and is being amended. But the process needed to create the regulatory methods has not been funded due to the lack of Storm Utility Revenues and dwindling reserves combined with millions in annual general fund obligations transferred from other Departments to the Stormwater Utility. The Stormwater Utility has always been revenue starved and this has always forced us to find better, more cost effective and correct solutions on the technical, planning and modeling side. This need was not recognized in the first round of watershed studies and modeling. The software at that time also lacked the modern methods and capabilities that we can now so effectively use to identify all flood risks and model them directly. Stormwater Modeling, and sanitary and combined sewer modeling have all undergone a software and hardware paradigm shift. Some engineering FIRM's have noted this. The majority HAVE NOT. Industry experience is extremely slow to change, but the benefits from change are an order of magnitude greater and savings exist that can half capital improvement needs between some Utilities in some parts of town. Round 2 of City watershed modeling, which will leverage 2D methods forcing rain on terrain and to every inlet and every pipe and surface path possible from the terrain resolution is critical. But funding is critically void at this time. At this Tiem Twin Creeks will amend to complete 2D modeling vs. 1D modeling and to use the City's 2018 LiDAR data. Brookside has used GO Bond dollars but may not be using the above methods to fully identify all risks for storm and combined sewer concerns to a 10 to 25 square foot terrain TIN. GO Bond may be the only way to force the right pathway's forward at this time in 2019. The estimate is 6 million in modeling and terrain work with up to 3 million in GIS work on assets and condition assessment and Geospatial products for the entire City. This work will take years to complete.

Update City Stream Buffers based on new regulatory and non-regulatory products' 1% severity or better

Ongoing: Discussions continue between the Stormwater utility and the City Planning and Development Department on this need. Other aspects of the need and beenfitshave begun between the Stormwater Utility and City Development on this effort. The Twin Creeks Level 2.) and Level 3.) watershed and pilot stormwater management review processes also address this need and have provided both a potential stream buffer and an erosion risk and meander risk component aimed at creating a "Total Hazards Buffer" The prior ordinance specifically calls out the official FEMA regulatory flood products. It does not call the documents out. Therefore it transitioned with no need for update to the new FEMA effective products. In some areas this means the stream buffers grew or decreased or extended depending on the differences between the now historic FEMA floodplains, which we digitized into GIS and have online and the new NFHL effective FEMA floodplains. Our Approximate Buffer areas, may have become FEMA regulatory Buffers with defined 1% flood zones. But the existing Stream Buffer ordinance # 080736 used streamlines to designate where stream buffers existed and left it to the engineering professionals to obtain the FEMA data to draw in the Effective floodplain middle zone, where no structures were allowed within the regulatory floodplain. At this time, while structures are prevented, fill is still allowed by regulatory steps as defined in Chapter 28 and 44 CFR. It then sets defined minimums of 25 feet and maximums of 150 to 250 feet of Outer Zone to further "back away" from the riparian, flood and erosion zones with respect to structures. The Buffer is a minimum of 25 ft. to 250 ft. from the outside edge of the regulatory AE or A Zones designated as stream buffers. On average this creates a 3 ft. Freeboard just from the 25 ft. buffer. Few recognize this.

The challenge here is the need to have a GIS layer of the Total Stream Buffer Risk Zones and their types. Doing so results in a need to update the Buffer is FEMA data changes or other modeling data changes, versus the method of using stream centerlines to call out the locations. Simplicity is critical and in this case the Stormwater Utility desires to map these products into GIS so that they are easier to check, review and track for proper use in plats, developments, parcels, permits, designs, studies and development proposals. The cost of a need to update is worth the benefit to accurately identify and bound the stream buffer areas for flood erosion and meander risks geospatially. This effort is ongoing, but proceeding conditionally to the pilot Twin Creeks areas efforts to change our stormwater management methods in that 24 square mile portion of KCMO. Discussions continue with City Planning and Development and the Stormwater Utility, but funding is absent in Stormwater at this time, short of an in house effort, which is not likely.

Use products that classify, identify, and weigh community flood risks and the technological tools developed for them to improve regulation and information sharing to get enhanced mitigation, improvements, and future developments.

Ongoing: This effort is also ongoing through the work within Twin Creeks for First and Second Creek is in 24 square miles of the City's northland. The North East Industrial District Levee unit has been fully modelled using Infoworks ICM 1D/2D modeling for all inlets, outfalls, storm and combined systems and surface runoff, infiltration and rain to mesh (TIN) to a resolution of 200 to 400 sq. ft. This work was 10 sq. mile sin size and included 8 or more pump stations for activation when MO River reached certain heights, thresholds relative It has

also partially completed in the 10 square miles of the North East Industrial District but with fewer end products, more focused on flood depth, velocity, storage and sheer stress for interior levee drainage concerns in this flat terrain of the Missouri River floodplain with 200 foot cliff sides sending runoff in to 13 outfalls and pump stations. This area is going through accreditation by FEMA with new floodplain mapping as a final change. In Twin Creeks the effort will focus on 2 crucial dual paths that are required. 1.) is integration of stormwater review for a Twin Creeks Pilot Area within the new EnerGov permit management system. An ArcGIS Online method is also being developed in order to setup methods to provide the GIS data needed for given areas which the community can set boundaries for manually through a web-viewer or provide a GIS or CAD boundary for in order to get all the information they need for their area of interest. Both paths must be effectively executed in order for this to work. The correct goals and data must be shared between the private side and the in house public review side to assure the information has been used and the outcomes achieved that runoff goals and risk avoidance or mitigation may require. Twin Creeks will be amended for 2D modeling conversion and 2D input/output updates using our new 2018 LiDAR. The regulatory process and adoption of it for Twin Creeks will not be funded at this time due to funding limitations for the Stormwater Utility's Budget for 5-1-2018 to 4-30-2019.

25. Enhance public awareness and education efforts related to flooding

Encourage home owners and businesses to purchase flood insurance

Ongoing: Updated information on this item is addressed under Goal/Objective 6. a. in the ongoing 2010 Plan which actively continues here in the 2015 plan. See 6. a. for progress here.

Obtain brochures and related publications on flood mitigation, preparedness, response, and recovery from federal, state, and other organizations and provide them to those residing in flood prone areas

Ongoing: Updated information on this item is addressed under Goal/Objective 6. b. in the ongoing 2010 Plan which actively continues here in the 2015 plan. See 6. b. for progress here.

26. Participate in and ensure compliance with flood mitigation and floodplain management programs

****Participate in the National Flood Insurance Program (NFIP) and Community Rating System (CRS)**

Ongoing: Updated information on this item is addressed under Goal/Objective 7. a. in the ongoing 2010 Plan which actively continues here in the 2015 plan. See 7. a. for progress here.

****Obtain the latest copies of the flood insurance rate maps (FIRMs), floodplain maps, and similar documents**

Ongoing: Updated information on this item is addressed under Goal/Objective 7. b. in the ongoing 2010 Plan which actively continues here in the 2015 plan. See 7. b. for progress here.

27. Implement or improve flood warning systems

Determine the need for stream gauges in waterways currently lacking flood warning systems or additional stream gauges in waterways with flood warning systems already in place

Ongoing: The prior analysis on this needs reconsideration based on the 5,800 flood risks identified by FEMA flood depth data and City impervious polygons for structures, roads, parking lots, driveways. Our GIS Analyst's efforts will assist and support these needs by identity where gaging is light or lacking for lead time for flood threats to the community. Currently a dozen additional locations were expected along with some USGS discharge locations in the northland.

Work with local governments and other stakeholders to share data from flood warning systems in multiple jurisdictions

Ongoing: Updated information on this item is addressed under Goal/Objective 8. b. in the ongoing 2010 Plan which actively continues here in the 2015 plan. See 8. b. for progress here.

Develop and implement procedures to quickly analyze and disseminate information from flood warning systems to the public

Ongoing: Updated information on this item is addressed under Goal/Objective 8. c. in the ongoing 2010 Plan which actively continues here in the 2015 plan. See 8. c. for progress here.

3. Why items have not been completed

Of the **87 Action Items eight are now considered deferred or minimally progressing** with two more that, if funding is not provided, may also become deferred for the Twin Creeks Pilot Stormwater Management Pilot area. 91% of the Floodplain Management Plan is ongoing or complete while 9% is deferred with the potential for 2.3% more to become deferred. Some actions are notably more critical and dependent in series for other actions than others. The need to identify all flood, erosion and meander risks is critical to many other goals and needs and the ability to achieve many critical steps depends on having this data to make the case for next steps such as the Twin Creeks Stormwater Management Pilot Area efforts. Much future progress is also critically dependent upon the ability of the Stormwater utility to achieve rate increases which have been frozen for more than 13 years at levels far below the actual need. Staffing is minimal and stretched through many tasks but has been able to define staffing needs and expertise and hire for more specialized help on critical planning, modeling and watershed management needs. This small group of three where once there was only one has now been partially broken up due to resources and staffing needs with less time and ability to focus on the originally hired goals and purposes. This former group is now stretched into all other stormwater needs and duties which is pulling the group more into a reactive form of stormwater management that cannot focus on getting the solutions critically needed to take us forward in a way that best saves lives and mitigates property. How do we use the existing limited staff and where to build the foundational needs that vertically aid more flood services required within the community? At this time the Stormwater Utility continues to lack any form of ballot measure that might resovle it's 15 years without any increase in Utility Fee's from an already severely underfunded rate position already, relative to the benefits we have leverage

for the community. No ballot has been approved or added to date, moving us into 2021. It is very unlikely we will be placed on that ballot. Reserves are critical and cuts continue to occur, even as duties continue to be increased as we stretch ourselves thin to support, serve and review storm issues for CPD. are close without significant changes in funding.

4. Recommendations

1. Funding. The Stormwater Utility is underfunded with depleting reserves. Many efforts needed are marginalized due to current limited budgets, staff and resources. The Stormwater Utility must focus on what funding avenues can best:

   1.) Identify flood risk, (fully throughout the community rural or urban),
   2.) In order to develop flood risk prevention, (prevent build out into existing or future flood risk, (Our Twin Creeks methodology)).
   3.) And accurately identify where <u>all flood risks exist</u>, in order to most cost effectively mitigate any, without harming any other.

   The Stormwater Utility's limited Funding places all 3 areas of major effort at risk of deferment. The ongoing objectives of this floodplain management plan and the City's Community Rating System Program are also at risk of being halted due to the current funding situation within the Stormwater Utility. Without funding increases there is no notable improvement in 1.) or 2.). Area 3.) flood risk mitigation is limited to U.S. Army Corps. and Go Bond funding or limited PIAC funds while lacking the necessary completed work of 1.) to assure the quality of those flood risk mitigation needs. Too many the old way of completing watershed studies, which relies on use of much more limited data for software methods that have not fundamentally improved in 40 years for the same node, link hydrologic subshed methods. These methods fail to identify all flood risks, even along the path of focus of the study, issues can be missed. We must focus on use of the correct modern technologies, software and hardware tools with the correct geospatial products, and proper survey, identification of assets and identification of their condition if we are to correctly locate all risks within every watershed fully and truly be able to consider all of this issues in any development, re-development or mitigation effort to reduce flood risk and protect the public from flood risk. Without complete knowledge, negative impacts will continue to accumulate within the watersheds but with all the proper licensed professional support for the limited, but allowed regulatory methods used. There is much more regulatory language, because there is not correct use of the right technologies FIRST. Without a change in the Stormwater Utility Fee/Tax funding baseline these programs and plans will be halted, with only basic minimal operation, maintenance and limited emergency services continued.

2. A City Planner is needed for this Floodplain Management plan the Dam Safety Plan and for the CRS Coordinator Role as part of the Engineering Services Division of the Stormwater Utility. The role of Floodplain Administrator, if properly funded/supported may be most efficiently managed within the Stormwater Utility. But these duties require significant funding/resources and staff time, requiring review, inspection, enforcement and other needs, which we lack authority for. The Stormwater Utility is already committing much of this time for technical support of the floodplain Administrator in CPD, but these and other duties have been added since 2014, without funding or staffing. If funding reaches the end of Stormwater Utility Reserves, the process will no

longer be one of dissolving vacant positions, but actually letting positions go. Reserves were expected to be at risk of exhaustion in 2020, but joining the CTP and obtaining Public Safety funding support for the Storm Utilities flood warning system provided nearly $700,000 dollars to very depleted funding.

3. The Engineering Services Division needs to consider and plan for potential study of all repetitive loss areas for an RLAA Analysis pathway which can then allow for Notices of Intent to Missouri SEMA by the City that would then allow the City to compete for dollars more effectively during Disaster Declarations and annually from annual Federal Grant dollars. This method has worked in East Fork Line Creek. Without NOI's to Missouri SEMA you cannot easily compete for post Disaster Declaration dollars, nor can you work to compete for FMA or PDM grant dollars when there is no Disaster Declaration to leverage federal assistance from. Seeking completion of an RLAA pathway is contingent on Funding, the City Planner position, GIS Analysis, Hazus, benefit to cost analysis, and further staff and staff development.

4. The Engineering Services Division and many other Departments and Offices within the City would benefit from existing training within multiple disciplines of engineering, planning, geosciences, emergency management and floodplain management through the Emergency Management Institute for at minimum, the following courses as follows:

Course:		**Hours**
E0165	Hazard Mitigation Insurance in Disaster Operations	8
E0172	Hazus for Flood	32
E0179	Application of Hazus for Disaster Operations	32
E0180	Core Principles for Hazard Mitigation Insurance Specialists	21
E0190	ArcGIS for Emergency Managers	32
E0194	Advanced Floodplain Management Concepts	26
E0210	Recovery from Disaster: The Local Community Role	28
E0241	Cooperative Technical Partners	28
E0272	Core Principles for Floodplain Management Specialists	20
E0273	Managing Floodplain Development through the NFIP	24
E0276	Benefit-Cost Analysis: Entry Level	16
E0279	Retrofitting Flood-Prone Residential Buildings	28
E0282	Advanced Floodplain Management Concepts II	24
E0284	Advanced Floodplain Management Concepts III	26
E0285	Providing Post-Disaster Substantial Damage Technical Assistance	7
E0313	Basic Hazus	32
E0317	Comprehensive Data Management for Hazus	32
E0278	National Flood Insurance Program Community Rating System	30
E0291	Community Dam Safety, Preparedness and Mitigation	32
E0312	Fundamentals of Building Science	28
E0321	Management of Individual Assistance	32
E0705	Fundamentals of Grant Management	24
Total		**562.**

Those highlighted in yellow/light gray have been taken by our GIS analyst. Unfortunately it will not be until 2020 before that GIS Analyst gets training in E0317, which is critical in how to push our GIS derived data into HAZUS. Still, progress is

occurring. A specific Server is being built using ArcGIS 10.6.1 and the Latest HAZUS software and needed applications. Our GIS Analyst will likely pull in the Missouri State HAZUS work recently completed by Wood PLC for Missouri SEMA, to build from. These tools used points identified for structures and assigned estimated flood depths/elevations to those points. The City has polygons for all these structures and can do further analysis to improve flood risk identification and the flood depths and elevations potentially seen. This is critical for funding assistance.

The list of EMI courses above is not inclusive and exceeds 14 weeks of specialized training. It creates a complete knowledge base of where the best methods, technologies, tools and practices exist and encourages discussion and partnership between these many Departments and Offices which operate under limited resources with a significant need to share expertise and co-develop solutions to complex stormwater issues impact and are impacted by every aspect of public and private life.

The Engineering Services Division of the Stormwater Utility is focusing on Hazus based training and emergency response and will move into floodplain management, cost benefit and grant based efforts to improve our preparedness to: know flood risks, know the actions needed, act in time, support recovery and obtain state and federal dollars for recovery and mitigation with the correct information on flood risk, frequency, damages and cost vs. benefit of mitigation. The Engineering Services Division of the Stormwater Utility is also focused on prevention needs in order to break the cycle of repeating the patterns of the past in rural to urban with correspondingly increasing flood impacts and harm.

5. City staff should continue their implementation and improvement of this floodplain management plan on an annual basis per CRS requirements. The next 5 year MARC Multi-Hazard floodplain management plan for 2020 will need significant organizational improvements in order to remain within the CRS Program. The new 2020 Multi Hazard plan was adopted on 8-5-2020 and will be used as the basis for annual reports in the coming year. However it should be noted that the new plan had many additional parties involved, who added a notable amount of tasks that will require tracking and verification of progress, completion etc… and revised floodplain management plan will be required to go through a 10 step process with the CRS Coordinator as part of the Multi Hazard Plan's development committee. If the CRS Coordinator and the ten step process in Table 510-1 below are not followed, the City could lose its CRS standing. The new8-5-2020 Multi Hazard and Floodplain Management Plan must follow the following per CRS:

Table 510-1. Planning steps for mitigation and for the CRS.		
Multi-hazard Mitigation Planning	CRS	Maximum
Phase I – Planning process		
§201.6(c)(1)	1. Organize	15
§201.6(b)(1)	2. Involve the public	120
§201.6(b)(2) & (3)	3. Coordinate	35
Phase II – Risk assessment		
§201.6(c)(2)(i)	4. Assess the hazard	35
§201.6(c)(2)(ii) & (iii)	5. Assess the problem	52
Phase III – Mitigation strategy		
§201.6(c)(3)(i)	6. Set goals	2
§201.6(c)(3)(ii)	7. Review possible activities	35
§201.6(c)(3)(iii)	8. Draft an action plan	60
Phase IV – Plan maintenance		
§201.6(c)(5)	9. Adopt the plan	2
§201.6(c)(4)	10. Implement, evaluate, revise	26
Total		382

It has done so and fully documented all the needed supporting documentation and resources and notated by page and book where more information can be found.

6. City staff should work to identify the needs and limitations for each action item and prioritize their import and in series or in parallel need in order to best focus limited staff, funding and resources. Where are the most critical needs and wins? How do we assure their success in order to support more success elsewhere with less uphill effort to improve and develop floodplain management planning needs into City, public and private functions in the most beneficial ways with the least cost?

7. City staff should leverage technological solutions that add to our abilities to inform and supply the necessary flood risk information that best supports flood risk prevention and flood risk mitigation needs. These methods are known and the technologies and tools obtained; however, significant terrain, asset, geospatial and modeling work is required that funding is not available for. Completing these technological steps has been done and the methods are vetted in the North East Industrial District, Town Fork Creek and the Twin Creeks areas. The Technologies can be developed that more effectively update, reprocess, run and produce the precise, high accuracy, high resolution flood risk information needed. Once completed, further analysis can be completed that aids in gaining more local, state and federal funding support, but not without an increase of the existing Stormwater Utility Fee/Tax first.

8. City staff should focus on the greatest benefit to cost items that can best support the largest number of activities and goals. These are most commonly the flood risk Identification and flood risk prevention pathways. Flood risk mitigation is much more expensive as it is dealing with already created flood risks which are much more expensive to mitigate than they would have been to prevent. A Mitigation Project seeks to “Do something” about the problem at x,y. In order to correctly do that “something” at

x,y, one must have the correct information about all that contributes to the problem and be able to use that information to solve without passing harm on to others. Once designed, then construction must be completed. Much of our flood risk is not identified or known and therefore our review of what we know in terms of flood risk is compromised and our ability to prevent flood risks is degraded or even non-existent. Designs can be less than they should and harm can be missed by professionals due to the methods used. Professionally obligating this work in a patch work plat by plat and micro/macro storm drainage study method, or PIAC flood problem by PIAC flood problem is not efficient, effective or well standardized. This piecemeal process actually compromises the Professionals efforts and makes the task harder while forcing more conflict between budgets schedules, deadlines and clients. Each professional will use different methods and defend them. We need to already know and have this flood risk information. The professional needs to be able to use that vetted flood risk information to focus on design of their needs while best planning for and dealing with the flood risks as their profession requires. Professionals can better focus on their client's goals, while still avoiding or accounting for stormwater issues and flood risk prevention or mitigation needs in their plans, designs and construction. Many technical needs come back to what we do or do not know on flood risk information in our community. A focus to correctly and fully develop this information is needed in order to take many next steps in a manner that will:

- Best and fully inform on flood risks to 10 sq. ft. with flow path and flows to 0.25 acres
- Best and fully avoid flood risk now and in the future by using these known risks to avoid harm and better plan, design and construct our community(s).
- Best and fully inform the public
- Best and fully inform Governing Bodies and Committees on needs, knowns and options
- Best inform on the steps needed and push for status on those steps that may be accomplished in series and in parallel first.
- Best evaluate and compare the Benefits vs. the Costs for needs and best itemizes those needs into Notices of Intent on file with the state to compete for dollars for those needs based on benefits vs. cost.
- Best compete for Local, State and Federal funding sources and Grants. The best benefits for the least costs can compete for grant dollars. One example is SEMA. SEMA uses Notices of Intent by communities to compete for federal dollars. NOI's are documented and put on file by communities through SEMA at the state level. One cannot effectively have NOI's on file without having already best identified the flood risks in order to make a case for how to avoid or mitigate them by NOI. Further, many Grants are limited to those with flood insurance and do not allow assistance for those uninsured. Submitting and organizing NOI's allows for outreach to make the case for private insurance that expands the ability to leverage grants to do more good. This also best prepares us for post disaster dollars. Disaster declarations are difficult to get, requiring millions in local damage to City and County Assets and damages of more than 8 million in multiple counties at the State level in order to request Federal Disaster Assistance through the President. Post Disaster Declaration SEMA/FEMA would focus on the NOI's submitted to SEMA as first choice for funds. This is the planning equivalent of being shovel ready post disaster declaration. Use of this data to evaluate and make the case for solutions is key to proactively advancing our needs in floodplain and flood risk management, flood risk

prevention and flood risk mitigation. It best competes for dollars within the state and at the national and local levels.

- Best inform on storm water needs to obtain local support for funding that can be leverage with additional state and federal dollars. Many needs can greatly benefit from local and committee dollars to help develop the case and document the needs that allow us to compete for more dollars at the state and federal levels annually or post disaster declarations within our Community. It does not take a disaster to succeed. We were unable to declare a Disaster Declaration for either the July 26/27 2017 or the August 21/22, 2017 floods in part because of more than 450 million in mitigation which the City had already completed over more than 50 years of effort. We prevented more than 100 million in private and public damages from these historic mitigation efforts just from 40-hwy to the Missouri River on Blue River. With more fact finding potentially up to 200 million in damages for each 2017 flood event may be possible to show. Our 450 million mitigation investment (a significant majority of which came from State and Federal dollars) paid for itself in 25 days from two storm events. Flood Risk Mitigation was critical to us for the Summer of 2017, but Flood Risk Identification has much less cost for much more benefit and deliverables to the City. Flood risk identification directly aids us in Flood Risk Prevention and in Flood Risk Mitigation now and into the future. It is the key to developing the case to gaining more local, state and federal funding support. Identify (flood risk) and you can Prevent (flood risk), Identify (flood risk) and you can Mitigate (flood risk) where it is too late for prevention. The Sooner the Stormwater Utility is funded at the level needed to complete Flood Risk Identification, the sooner we can leverage that into more effective and more citywide flood risk prevention and flood risk mitigation that best leverages local, state and federal support and community benefits. Without this piece the case for funding cannot be best made and harm cannot be prevented, in a no cost way that improves value, rather than further degrades and compromises it.