Date: May 15, 2018

TO: Council, Mayor, & City Manager

FROM: James Walton PE, CRS Coordinator, Stormwater Utility

SUBJECT: Annual Floodplain Management Plan Progress Report

The City’s Flood Management Plan was adopted by resolution 150882 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.

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.kcwaterservices.org/about-us/stormwater/
Annual Floodplain Management Plan Progress Report
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Annual Floodplain Management Plan Progress Report

1. Background

There are 27 primary objectives in the 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 (Objectives 9 through 27):

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
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 geo-located 164 properties and identified 198 Repetitive Loss Numbers. We have analyzed the remaining 164 properties for their flood causes, scale and issues to 2018. Of these, FEMA or the City has successfully documented that 36 are mitigated, or do not apply to the Kansas City, MO community. An additional 83 have been identified as having received mitigation from completed or ongoing capital improvement projects aimed at mitigating flood threats. Many of these mitigation efforts are now shown in the newly adopted floodplains from FEMA dated 1-20-2017, which used 12 million in City funded watershed models as leverage. Of the total 198 Repetitive Loss Numbers historically listed within KCMO, the City has identified only 45 of these that have no known mitigation ongoing or completed. There are now a total of 590 parcels within repetitive loss areas. Of the 590 parcels, 176 are City or Land Bank owned parcels, the vast majority of which have had structures demolished, resulting in a mailing need for 414 parcels within repetitive loss areas. From prior discussions with our ISO Specialist we do not need to send mailer’s to the City for its parcels. Much of the associated benefits and mitigation is due to federal leverage coupled with City Public Improvements Advisory Committee (PIAC) funds and other funding sources. The City’s has gained approval by its voters for 150 million in bond funds in 2017 for stormwater mitigation needs. The City’s Stormwater Utility continues to leverage PIAC dollars with Federal dollars for design, acquisition and construction efforts within City watersheds. Kansas City, MO has done extensive acquisitions and demolitions work over the decades since the initial FIRM maps for our community. It will take time and effort to gain credit within CRS for these efforts. It is important to note that the City has been successful in acquisitions and mitigation efforts for flood risks and we can gain significant credit in these areas with sufficient staff time and documentation. For mitigation, FEMA gives credit for any mitigation of 25-yr or better level of protection. Recently the City’s Stormwater Utility was able to successfully compete for the acquisition and demolition of 4 properties through FMA grant efforts. In Turkey Creek the mitigation of an additional 16 repetitive losses including 51 parcels in repetitive loss areas shall benefit from completion of a Bi-State Joint funded levee and storm interceptor improvement. This effort is being done in partnership with The US Army Corps of Engineers, The Unified Government of Kansas City, KS and the government of Kansas City, MO. Upon completion updated modeling, floodplains, floodways and flood elevations will be produced which eliminate approximately 7,000 cfs from crossing the state line and flooding along Southwest Blvd. and then into the West Bottoms KS and MO Levee Units. One last Interceptor is
also beginning construction for a 1 square mile tributary of drainage to be intercepted near 31st and Roanoke. This work will be critical for mitigation. More work will be needed in future phases to further mitigate Southwest Blvd. and the West Bottoms Levee Units of KS and MO.

Work in these areas has been incorporated in the City’s GIS and is available for continuous update and tracking each year.

The above has also allowed for annual mass mailing to the owners of the 414 parcels now within repetitive loss areas. 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.

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

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. 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) 20 year payback.
3. Public Safety Committee
4. US Army Corps. of Engineers (COE)
5. FEMA
6. SEMA
The City’s Public Improvement Advisory Committee (PIAC) (Sales Tax Funds) is now one of two ways in which stormwater mitigation can be achieved currently. The City’s Stormwater Utility still cannot use revenues to improve systems, only repair, maintain and study/design.

City Voter Approved GO Bond funds (150 million). 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. 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.

Public Safety Committee, historically this Committee’s focus relates to flood threat, but has been focused on many needs. The Stormwater Utility has begun to develop a plan to request funding assistance through this Committee to improve flood response and water rescue, evacuation, closers and barricades through flood warning and camera based systems now available within an upgraded Emergency Operations Center (EOC) facility. In general where the cost is moderate and the benefits assist multiple departments (as they always do on flood risk and response) we believe we can make a powerful case for comparatively small dollars resulting in dramatic improvements. This path is completely due to FEMA’s election to develop flood depth risk raster data for 10-yr, 25-yr, 50-yr, 100-yr and 500-yr flood severities. The City has used this data with local impervious to determine flood risks and identify what floods first and how severely. This data will now be used to drive cases for improvement to flood response and methods.

There are active COE and City projects underway in the City which are mitigating or eliminating repetitive flood loss properties. COE projects reduce repetitive loss through mitigative projects, channel and levee improvements. The City has conducted projects that eliminate or mitigate repetitive losses for over 40 years. 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 seek FEMA FMA grant dollars. SEMA was incredibly helpful in teaching the steps and needs to file a grant which with further consulting aid was properly submitted and able to compete and win. This has resulted in a pivotal change in KCMO in refocusing on acquisition as a tool, verses mitigation systems only. This grant would not have been won without our Repetitive Loss and Loss Area analysis work, building the base to use FEMA’s Benefit to Cost Analysis software with updated FEMA modeling data to show the value of the grant dollars.

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 successfully one FMA grant is an excellent example as the alternative was a combination of in series 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. 3 of 4 repetitive loss properties will be acquired in this effort. 1 of 4 dropped their insurance and is no longer eligible. The City uses a portion of a 1% PIAC sales tax for public storm water improvements which can include storm water mitigation needs. This has been successful on a number of projects resulting in the following structure and property buyouts and demolition efforts:

- **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 are repetitive loss properties and one is a repetitive loss area property.
- **RLA #20**: One repetitive loss properties and one repetitive loss area property was acquired and demoed in RLA Area 20.
- **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 #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 and 2 more not in RLA #34 are now going through potential acquisition and demolition removal negotiations by the City. Two floods occurred in the summer of 2017 which substantially damaged some structures creating Chapter 28 requirements for flood mitigation in order to restore. Additional efforts may occur in this area going forward.

The City’s 1,132 stormwater capital improvement recommendations identified by City modeling also contains up to 135 buyout recommendations. More buyouts may be found to be cost effective as these recommendations are study based and use various watershed studies, one of which is 22 years old.

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. 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

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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 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 needs to learn from Emergency Management and begin to grow a similar program for flood risk to invite and inform the public through. Discussion have begun on how to do this with our Public Information group which has been incredibly successful in their KC to the Sea program in schools using not-for profits. 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. The City has submitted with UMKC for two NSF grants relating to flood risk needs which includes the critical needs of socially educating on what private parties can do on flood risk to help themselves, to be prepared and to support City efforts to use limited dollars and methods to help. This social education will focus on efforts like flood depth and flood-proofing, flood preparedness and methods to mitigate and reduce damages and better protect life and property. It will heavily push the public on flood insurance and stress that any property can get flood insurance.

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 City has begun to transition to a more holistic approach for runoff. 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, where no structures are allowed. Our methods now focus more on the total best long term solution and this generally does not favor expensive mitigation driven projects in the same manner as in the past. We are moving into a buyout, buffer and multi-use riparian corridor path.

Our Twin Creeks Watershed effort seeks a pilot stormwater and floodplain management plan area that is based on technology that identifies all flood and erosional risks down to 5 to 10 acre drainage areas using HEC-RAS and uses flow accumulation methods to route all surface flow paths and identify all flow paths. The streams in question are First and Second Creeks in the northland, east of KCI Airport. These streams barely have 40 miles of regulatory stream, but have over 600 miles of surface flow paths that can threat various types of buildings and development if not considered in the design. The goal is to have all of this information geospatially on day one in order to be able to set reasonable practical goals for runoff, flood and erosional risk. The desire will be to support the methods that mimic unaltered
conditions to the best extent practical. The belief is that this will show a lower cost method of plat development that avoids the cost of pipe networks in trade for offsets or allows changes in path so long as downstream impacts are vetted to be no worse or better as a result of the proposed development. These methods lend themselves too much larger benefits in more rural and undeveloped areas, like Second and First Creek. This information is beneficial in the urban core as well, as these methods capture much flood threat missed on the surface and can consider every inlet and pipe and surface interface in the modeling to identify where water will really go based on accurate LiDAR terrain when pipe networks and inlets can no longer collect flow. 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 separate or soft 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 paths.

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 Stormwater Utility has completed watershed studies analyzing over 95% of the City’s 318.9 square miles. The Stormwater 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 Brush Creek and Blue River allowing our 1-20-2017 overhaul of all modeling, floodplain, floodway, flood elevations and flood depth data by 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.

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.

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 32.48 square miles of existing FEMA NFIP 100yr (1% annual) floodplain, 29.30 square miles is not within federal lakes/riders of 10 acre size or greater. This is the denominator for KCMO's ratio of open space to floodplain. The Storm Utility has identified over 10.55 sq. miles of existing lands owned by City or qualifying entities and 1.60 square miles of lands in ROW as protected floodplain. Of this total ROW and Parcel area, 0.54 square miles of parcel lands and 0.56 square miles of ROW are impervious surfaces and cannot be counted. These lands serve as open space. This works out to: 

\[(10.55+1.60) - (0.54 + 0.56) / 29.30 = 11.05 / 29.30 = 0.377 = 37.7\% \text{ of KCMO floodplain already owned by the City, counties or other qualifying parties.}

It should be noted that the City has actually lost significant credit from the updated FEMA floodplains due to the large amount of US Army Corps. and City flood mitigation work completed and now revealed within our regulatory FEMA floodplains adopted on 1-20-2017. 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.

It should also be noted that the community also has a stream buffer ordinance which calls out all FEMA regulatory A Zones as the Middle Zone Buffer of the stream buffer ordinance. No structures are allowed in the middle zone. 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 is much more valuable than actual ownership for the City as it protects the riparian function and flood storage but does not transfer the obligation of ownership to the City. This method is much more effective. In the end the City has multiple methods to preserve riparian flood reaches and flood storage. 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 the lands needed vs. use of deed restrictions, easements or covenants due to the stream buffer ordinance. 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 Stormwater 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.
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 COE 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 leverage in the larger project.
- 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.
- Stormwater Utility User Fee - This fee 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 mitigative solutions, up to and including acquisition.
- In the last year the City has focused on existing PIAC projects, internal studies and design. Many of these efforts have focused on when and where such buyouts are beneficial. The Stormwater 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.

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 and more than $500,000 in funding to FEMA in the efforts to update our FEMA floodplain mapping and modeling as a community. This work has resulted in our new FEMA floodplains adopted on 1-20-2017 by the City for our Chapter 28 and NFIP regulatory laws. The New floodplains account for significant mitigation efforts over decades of time by the City and Federal parties such as FEMA, SEMA and the US Army Corps. The City’s Stream Buffer ordinance directly references the Regulatory FEMA A Zones as our Middle Zone Buffer in which no structures may be built, but roads may be. The stream buffers also maintain a minimum Outer Zone width of 25 ft. 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 18.56 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. The Stream Buffer also protects 7.81 square miles of floodplain outside FEMA regulation via City modeling as Approximate Stream Buffer. 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. 29.3 square miles of 32.48 square miles is not federally owned lakes and rivers in KCMO regulatory FEMA floodplain. 18.56 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 10.74 square miles that is FEMA regulatory floodplain, **but not within City declared Stream Buffers**, 5.45 +0.88 is owned by City, County or other qualifying owner or in ROW. The total impervious within Stream Buffer and Non-Stream Buffer Regulatory floodplains is 1.12+0.16+0.32. 18.56+5.45=23.93 square miles of SFHA already protected from development of structures and able to be preserved for natural functions and flood storage and attenuation functions. And, again the City Stream Buffer also declares Additional Approximate Stream Buffer zones upstream of FEMA regulatory floodplains in 7.81 square miles. This could allow a ratio credit of 31.1 of 29.3 or 31.1/29.3 = 1.06 for the City of Kansas City, Missouri’s efforts to preserve and protect stream functions and prevent high flood risk development.

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 Stormwater Utility based funding as applicable and other State and Federal Matching dollars and programs.

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 Stormwater Utility has had a long and rewarding relationship with the Office of Emergency Management (EM) based on our 18 years (of 26 years) of joint efforts and operations in emergency response for flooding needs using the City’s expanding flood warning system. Stormwater 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. 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.

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 flood level and requires the elevation of the finish floor to be at least 1 foot above the 100 year flood level (one foot freeboard required). Any mechanical or electrical equipment must also be elevated per the 1 foot free board requirement. For existing construction the City can require elevation of the mechanical and electrical equipment only if they are part of a “substantial improvement” or substantial damage condition. While the City does encourage the public to elevate such mechanical systems, it cannot require this unless the amount of improvement triggers a “substantial improvement”.

The above code was limited by very old floodplain products with poor flood elevation data until the recent 1-20-2017 adoption of new FEMA floodplains, models and flood elevations and flood depths occurred. 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, 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. 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. 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.

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 flood protection.

The new FEMA floodplains, floodways and related flood elevations have created significant easier to access information 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 have occurred in which the new regulatory data and modeling has proven critical and valuable 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 levees. Levee Accreditation efforts by FEMA in the East Bottoms Levee Unit using the new interior levee drainage area flood analysis will show how complex these systems are and will have notable impacts on Utility facilities, pump stations and the private sector.

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 (15 locations) of FEMA permitting currently processing for sanitary protection efforts.

Power Utilities will be provided the City’s flood depth data for structures in order to aid them in potentially elevating meters or determining shutdown needs by risk in future flood events.

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, GEO 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.

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

- 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.
- RLA #20: 1 repetitive loss property and one repetitive loss area property was acquired and demoed in RLA Area 20.
- RLA #73: One repetitive loss and 36 additional repetitive loss area parcels have been mitigated or acquired. Only 6 structures remain, all of which are mitigated to some extent. 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 #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 and 2 more not in RLA #34 are now going through potential acquisition and demolition removal negotiations by the City. Two floods occurred in the summer of 2017 which substantially damaged some structures creating Chapter 28 requirements for flood mitigation in order to restore in some cases. Additional efforts may occur in this area going forward.

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

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 are the key to this. Facilities in higher risk locations have been determined from flood depth grid data and the City has used this to assess 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. 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. 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. Most of this is due to the newly adopted 1-20-2017 floodplains which also triggered an update to the City Chapter 28 floodplain regulations. These items have provided more information, resulting in further research and investment in tools. One major facility has been working for some time to determine their options. Do they elevate? Ring Levee? Relocate in phases to existing levee protected lands? The long term is being brought in thanks to the regulatory realities of need, public safety and risk.

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 Stormwater 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 change. To date we have not been given a chance before the voters for any Stormwater 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. Our next chance is fall of 2018.

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 and wildlife. The City has successfully restricted the use of Floodplain areas to trails, transportation and utility corridors only. 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 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 Zona A Floodplains. 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 protects all
Regulatory FEMA floodplains within the City limits. The stream Buffer Ordinance does not include interior levee AO and AH flood zones, it 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 18.56 square miles of effective FEMA 1% annual Zone A Floodplains within Kansas City, MO, out of 29.3 square miles of non-federally owned lake or river larger than 10 acres or wider than 300 ft. Thus the Stream Buffer secures 63.3% of the City's regulatory FEMA effective floodplain. The remaining 10.74 square miles of effective FEMA floodplain is not regulated by stream buffer, but requires all Chapter 28 regulatory requirements plus 1 ft. of freeboard. In addition, the City, County or other qualifying entities have purchased 6.33 square miles of the remaining 10.74 square miles not regulated by the stream buffer ordinance. Removing all impervious and accounting for all buffer and owned lands provides the City with OSP level protection without structures for 23.29 of 29.3 square miles of the newly adopted 1-20-2017 FEMA regulatory floodplain.

The buffer also uses an approximate buffer upstream of FEMA's floodplains using the City's modeled floodplains. This approximate buffer is as restrictive but allows in field riparian corridor identification, which can erode the identified City floodplains. By creating stream buffers from both the FEMA and the KCMO floodplains, the City has gained the ability to protect an additional 7.81 square miles of riparian corridor and flood risks that are not regulated by FEMA for an additional 26.7% of OSP credit. This is a highly protective endeavor, given the lack of FEMA floodplains in these areas where the City has already invested on leveraged modeling in these upstream tributaries.

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 the Twin Creeks 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.

In general, The City has very modern regulatory processes but we currently lack the right technical information and geospatial knowledge to identify all the risks within the community relating to flooding, erosion and water quality. These responsibilities are the Stormwater Utilities 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 for us to be able to properly protect all parties and also save costs by focusing parties on the realities first, so they can better design to account for them or even benefit from them.

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.

Ongoing: Like the Stormwater 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. The current City fee for a development that requires regulatory FEMA reviews through our Bulletin 120 is $58.00 dollars. In order to break even one permit would need to be complete in 30 minutes including overhead. 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 would be completed with just 30 minutes of staff time. 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 can set a more accurate minimum Fee from which to make the case for something that accounts for the impact of development in these regions and cover true local community cost of permitting relating to at least the FEMA regulatory flood risk component. 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.

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 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. This will help 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.

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

**Ongoing:** While the City is not a Cooperating Technical Partner at this time with FEMA, its Stormwater Utility has provided and obtained the full use of all City modeling as leverage data for Clay, Platte and Jackson County DFIRM maps. The City has further investigated the requirements and benefits of becoming a Cooperating Technical Partner and found that our current condition limits our ability to consider this path at this time. The Stormwater Utility needs significant increases in funding, staffing and expertise and in ability to build improvements. This effort continues to be deferred. Currently the lack of funding is the Stormwater Utility’s most critical issue, ongoing aging and insufficient storm infrastructure issues vs. public safety and water quality needs.

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. But the fundamental need is for the City to train limited staff in HAZUS through EMI course work and then begin funding the effort to develop these tools to assist the City in flood response and post flood recovery. This effort is now considered ongoing. EMI Courses are being requested and scheduled for Stormwater Utility GIS Analyst/Specialist Staff for 2018 and 2019 for E0313 and E0172.

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. EMI Courses are being requested and scheduled for Stormwater Utility GIS Analyst/Specialist Staff for 2018 and 2019 for E0313 and E0172.

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 Stormwater Utility staffing. 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 Stormwater utility made the case for the benefits to the City and to the 3 Water Utilities and was able to get approval. The next steps will be to leverage SEMA’s work and then improve it using this new QL2 LiDAR. EMI Courses are being requested and scheduled for Stormwater Utility GIS Analyst/Specialist Staff for 2018 and 2019 for E0313 and E0172.

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 414 of 590 properties and encouraging these owners to obtain flood insurance. The City owns the remaining 176 properties for the total of 590. 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. Emergency Management is doing much on public education for the emergency response and safety side of flood risk concerns which is shown below in 6b. We’ve applied through the University of Missouri-Kansas City (UMKC) for two NSF grants. These grants will work to improve:

- Flood response and flood identification
- Inform and educate the public and community on flood risks flood response and emergency situations
Inform on what situations may be in the area 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 also purchased 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 assisting City Development with 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.

The City’s Office of EM conducts a variety of 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. EM stocks a wide variety of all hazard outreach materials that are provided free of charge upon request. EM 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 EM. In addition EM has developed a disaster preparedness workbook that can be downloaded at:


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

https://www.kcwaterservices.org/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:** 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. Water Services has provided two Post Flood workshops for flooded areas relating to Blue River and the 2017 flood events. A 3rd is needed and I am behind schedule in putting that effort together and getting with the dozens of property owners within the Dodson Levee unit area.

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 8 years now as of this annual report and has been a participant in the NFIP Program for decades. Recent efforts with FEMA to use City 12 million in City modeling and $500,000 in City funds allowed the current Effective FEMA floodplains to complete and be adopted on 1-20-2017 with many thanks to SEMA and FEMA in their efforts.

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

**Complete and Ongoing:** The WSD’s Stormwater 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 Stormwater Utility has shared the Historic digital copies of these materials, in TIF and/or PDF formats from FEMA, 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.

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 gauges 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 O&M’d by WSD Stormwater Utility. The City shares its data with three other local flood warning systems now leveraging a total of 187 total sites in the metro area. 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 stream’s 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 has over 558 flood warnings for stage and rain. Development and improvement has limitations in flash flood prone streams where response 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 makes 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 (UG) 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 or more foot of water into structures and advised we had 80 minutes to act before crest. It took approximately 20 minutes to coordinate and organize and get into the field to begin road closures. Even with this time in two events parties became trapped, 2 in a facility and one in a tree, when their car was washed up against it, and prevented from going into the stream. 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 before the rains warned of severe flooding. 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. This information was not correct 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 United States Geological Survey (USGS) gage at the Bannister Federal Complex. USGS rapidly corrected this issue, caused by a record height creating issues with instrumentation. The events showed many needs and deficiencies but also showed our core focuses were working and did exactly what we needed them to. 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 what was 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 we therefore have no known flood risks to develop flood warnings for.

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

Ongoing: The City continues to leverage the 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 558 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. The warnings within the system tended, up to the Summer of 2017 to be for 10-year or less severe storms and only cover portions of the network where such heavier rains had been recorded. FEMA’s flood depth data has created the ability to add 5,800 other known threats or the number necessary for efficient emergency response. Depths have been collected from the field for flooding for the 2017 event. More work is still needed on this in the Dodson Levee Unit area. These warnings will be built into Contrail and then the effort to develop the FEMA flood depth data into the system will be begun. Weight basin averaging will be built into the flood warning system for rain catchment to tributaries in order to identify tributaries and creeks with severe rain rates and amounts.

Flood warning systems only get better… but they only get better if you keep harvesting and updating 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.

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 and was completed on 4-19-2018 from 1 to 4:30 PM at Emergency Managements EOC. 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. The group has discussed the merits and uses of 3 different systems to better coordinate and communicate barricade needs. Communication of the status of needs for spatial locations and a way to rapidly show them as, 1.) Requested/Assigned, 2.) In Route, 3.) Barricaded, 4.) Recovered. and the need to. The Storm Utility stated that our GIS Analyst has been assigned a task to use the Flood Depth Risk data he has developed for: Roads, Structures, Parking Lots and other Impervious to develop a Collector Based GIS system that can do what is required using cell systems in the field to push the data up when in range for what has been completed. 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. Emergency Management uses a system called Web EOC and it is absolutely the best short term path and may be the best long term path as well. Web EOC has a geospatial Mapping capability that can be purchased and upgraded in which could allow a more easily controlled and tuned system. The reality is those that need this system need complete technical control of it. If it works through systems like Hansen or 311, the ability to improve it will be dramatically slowed and degraded. 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. 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.

It has been a slow effort to develop better information on what floods and what is needed where. FEMA’s flood depth grids are the only reason we can make the dramatic improvements we now need. It will take much coordination between parties to find what works and begin to implement, test and improve it. Significant progress can be made this year. 2 forms will likely evolve: The GIS Analyst Collector effort to develop the in field system for all locations, flood frequencies and severities and track them through cell systems back to other supporting GIS. A Web EOC method is needed in the short term which may be able to incorporate the Collector method in time. Currently The EOC has 4 levels of activation. Level 0 is monitoring from home. Level 1 activates the EOC but with minimal staff. Level 2 brings in any or all of the following: Police, Fire, and one or all of the Barricade Departments. Level 3 brings in all Departments and the City Manager and has generally ramped into a large scale effort 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 reality of what Mother Nature can do has been shown. The City was able to do much, but can 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. We’ve been given a chance to see the problems and improve them. Parties are aligning to do so. This will be a critical example of how to leverage the right technology and continual improvement into our response needs.

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

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

**Ongoing:** The Stormwater Utility setup and assisted FEMA on a Public Meeting this year where we supported their efforts in speaking with the public about the newly adopted floodplains and specific public concerns and needs related to their private lands and the new FEMA floodplains and flood elevations. The condition of their lot, the options they might seek and the methods and time limits they had to work with, given the adoption of the new floodplains were all part of this effort. The meeting was scheduled and held at the Brush Creek Community Center which the Stormwater Utility was able to get at no charge through Parks and Recreation due to the Public Outreach component of the Federal, State and Local information to share on flood risks and public safety and options in mitigating risk.

The City’s: [https://www.kcwaterservices.org/crs/](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:


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. 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.

It should also be noted that many mailers by both FEMA and the City were sent out to the Public advising on the coming floodplain changes within the City of Kansas City, Missouri. FEMA used the City as a test location to better inform on the changes in order to test what methods were most effective and if flood insurance and other early submittals in order to use lower cost flood insurance premiums were possible for those with negative impacts.

**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/kcmoem/

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 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. EM staff is in the process of inventorying all cameras city-wide. EM 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. 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.

**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 or 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.

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. A person within the vehicle attempted to leave the vehicle but was swept up by the velocity of water and taken downstream. This resulted in a search and rescue and then search and recovery effort.

Significant flooding was clearly occurring and significant success in water rescues achieved. In the one loss of life reported, the person reacted rapidly to seek escape without 911 requests 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 training for more than 202 water rescues during the summer of 2017 floods. More training is needed and post event evaluation is occurring.

**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 did find 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 shovel ready as we speak but approval for funding in Washington D.C. is still needed and will be pushed for heavily in 2018. Drone video of the water rescue efforts and the velocity of waters to deal with will be used in D.C. to push for authorization of funding for this last major Bleu River mitigation project. Water Rescue will always be a critical need as there is no level of mitigation effort that will eliminate the risk of flooding from severe rain events. We have learned of critical low draft non-prop propulsion needs to support our Water Rescue crews and will work to obtain these materials through Public Safety or General Fund sources for the Fire Department.

**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.
KCI is designing for the next airport as we speak and working to phase the new construction in and close down the old ring airport system which KCMO has used for many years. Schedules are being worked on and the design work by consultants for the watershed studies and modeling have all used existing City and FEMA knowledge.

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 assist the airport in Us 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 US 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. 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 is using a GIS Analyst to complete and develop a GIS Collector based system that tracks flood risk needs for barricading of streets and flooding of homes, driveways and parking lots. 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 Bellevue/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.

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 program 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 and the Stormwater Utility has coordinated with the University of Missouri-Kansas City (UMKC) and the Heartland Conservation Alliance on two different NSF grant methods for improvements in emergency response, flooding and flood warning for the community using the 5,800 none flood risks identified from FEMA flood depth data that the City has further analyzed for impervious and pervious areas. These efforts if won include a public outreach of flood risks to the community and the development and development social technologies and messaging to rapidly inform on flood risk issues. 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. 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, but with a smaller public footprint by using the City’s Stream Buffer regulations and ordinance.

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. 18.56 of 29.3 square miles of FEMA regulatory Floodplain within the City is regulated by the Stream Buffer Ordinance.
3. In Jackson County 6.33 of the remaining 10.74 square miles of City FEMA regulatory Floodplain is owned by the City or County and already committed as Park Lands or open space.
4. Parks and Recreation has begun an aggressive effort in Second Creek, part of the Twin Creeks watershed development area, to develop linear trails systems along the stream networks and systems in order to gain benefit and connectivity within the community through the native open space preserved for flood services, wildlife, water quality and riparian forests. The methods will allow use of easements for trails and less actual acquisition by the City.
through Parks and Recreation while also tying together the neighborhoods and community in a manner that provides greater health as well.

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 weak 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 and 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 City has identified two NSF Grants and developed committees to submit which can develop into stakeholders if awarded for community needs.

Programs for education, watershed and water quality already exist with the Little Blue River and Blue River Watershed Associations and the Lakeside Nature Center.
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). This work 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.

Item 3 is critical to support stormwater plan review and City 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%
anual 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.

And to that end KCMO has funded through the Water Services Department, new QL2 Lidar
and this has been flown in Late March of 2018. This level is still fully classified and notably
better than historic LiDAR. No LiDAR has been flown in Jackson in 12 years and none in
Clay or Platte in 9 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.

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 has been assigned the task of completing this effort in 2018 and
developing a method to track the need, location and status of these risks. Part of the effort
will be based on barricades, part on structures, parking lots and driveways. All will use
methods of prioritization. This data will then be used to attempt to mass populate the FEMA
Mitigation Action Tracker where we prioritize project needs. 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. Essentially without Mitigation Actions and without Notice for these to SEMA there is
no way to seek Grant dollars for any of these needs when appropriate. 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 hundreds of
these types of structures from Pre-FRIM days of development. This step is critical and
analysis of the needs and prioritization before entry is equally critical. Having said that a
manner of automatically loading this data is also needed and there is no means of doing this

Comment [LJ3]: Is this a dollar amount?
in mass for all known mitigation needs. KCMO cannot fully compete for dollars without this effort completed, particularly in post disaster situations. This effort is ongoing, but the Mitigation Action Tracker still does not allow a means to mass populate a community.

**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 data can be used to determine the level of need and prioritize a smaller subset of projects 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. The solution or recommendation component can be locking on options and thus it is necessary to assess types of need and cover more options to allow use of hybrid solutions for area needs. In some locations an undersized culvert or storage may be part of the mitigation solution. In others buyout or elevation or relocation may be the best path. Generally no one method of solution solves all parts of a particular flood risk area’s needs. 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. Again the Mitigation Action Tracker must grant a means of loading mass point data for community needs. This data cannot be manually entered for the scale of needs in KCMO.

**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 or provided. 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. 34 square miles of 318.9 have been completed and the effort to use the deliverables to change how these areas review risk with, 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. In general the goal here is to provide upfront information and goals that allow developers and designers to focus on solution the realities of real world problems and 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.) and level 3.) in which the 2.) uses modern revolutionary terrain and modeling capabilities with accurate underground systems and surface inlets to correctly identify and provide all risks down to 5 acres by HEC-RAS methods and down to the TIN mesh by Infoworks ICM methods (3 ft to 10 ft. most likely in TIN form). 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 redevelopment. A Pilot effort for Level 3.) has been requested for budgeting by the Stormwater Utility in Water Services, however it may not be funded due to the lack of Stormwater Utility Revenues and the high consumption of reserve funding from more than a decade of frozen fees (taxes by a recent Missouri Law change) and millions in 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 completely recognized in the first round of watershed studies and modeling then could not do what it can do now with the revolution in software capabilities with 2D modeling. Round 2 of City watershed modeling is critical to both Stormwater utility needs and Wastewater combined sewer needs. But funding is critically void at this time. Level three efforts to pilot new ways to manage stormwater risks and review within the community may be ongoing or it may be deferred, depending on our coming 5-1-2018 budget.

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

**Ongoing:** Discussions have 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 create 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. The existing Stream Buffer ordinance # 080736 used streamline 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. 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 challenge here is the need to have a GIS layer of the Total Stream Buffer Risk Zones and their types, however 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, 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.

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 Creeks in 24 square miles of the City’s northland. 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. This system has had several fall backs in its scheduled “Go Live” data including one in April 2018. An ArcGIS Online method is also needed 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. This Objective is either ongoing or deferred, depending on 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.

**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.

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

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 10 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 help on critical planning, modeling and watershed management needs with a small group of three where once there was only one. This small group is also stretched into other needs and duties and such duties can take over or reprioritize, pulling them into other needs, such as stormwater asset management vs. stormwater flood risk tools. In truth the two are part of the same whole, but each has critical needs. At this time the Stormwater utility needs to be on the City ballot for Fall of 2018 with significant allowance for improvements and funding and deliverables back to the community needing to be called out in that Utility Rate increase vote. Reserves are critical and cuts 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 more expensive flood risk mitigation will be required.

   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 US 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. 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 plan the Dam Safety Plan and for the CRS Coordinator Role as part of the Engineering Services Division of the Stormwater Utility.

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 (NOI) 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 as follows:

<table>
<thead>
<tr>
<th>Course</th>
<th>Hours</th>
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<tbody>
<tr>
<td>E0165 Hazard Mitigation Insurance in Disaster Operations</td>
<td>8</td>
</tr>
<tr>
<td>E0172 Hazus for Flood</td>
<td>32</td>
</tr>
<tr>
<td>E0179 Application of Hazus for Disaster Operations</td>
<td>32</td>
</tr>
<tr>
<td>E0180 Core Principles for Hazard Mitigation Insurance Specialists</td>
<td>21</td>
</tr>
<tr>
<td>E0190 ArcGIS for Emergency Managers</td>
<td>32</td>
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<tr>
<td>E0194 Advanced Floodplain Management Concepts</td>
<td>26</td>
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<tr>
<td>E0210 Recovery from Disaster: The Local Community Role</td>
<td>28</td>
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<tr>
<td>E0241 Cooperative Technical Partners</td>
<td>28</td>
</tr>
<tr>
<td>E0272 Core Principles for Floodplain Management Specialists</td>
<td>20</td>
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<tr>
<td>E0273 Managing Floodplain Development through the NFIP</td>
<td>24</td>
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<tr>
<td>E0276 Benefit-Cost Analysis: Entry Level</td>
<td>16</td>
</tr>
<tr>
<td>E0279 Retrofitting Flood-Prone Residential Buildings</td>
<td>28</td>
</tr>
<tr>
<td>E0282 Advanced Floodplain Management Concepts II</td>
<td>24</td>
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<tr>
<td>E0284 Advanced Floodplain Management Concepts III</td>
<td>26</td>
</tr>
<tr>
<td>E0285 Providing Post-Disaster Substantial Damage Technical Assistance</td>
<td>7</td>
</tr>
<tr>
<td>E0313 Basic Hazus</td>
<td>32</td>
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<tr>
<td>E0317 Comprehensive Data Management for Hazus</td>
<td>32</td>
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<tr>
<td>E0278 National Flood Insurance Program Community Rating System</td>
<td>30</td>
</tr>
<tr>
<td>E0291 Community Dam Safety, Preparedness and Mitigation</td>
<td>32</td>
</tr>
<tr>
<td>E0312 Fundamentals of Building Science</td>
<td>28</td>
</tr>
<tr>
<td>E0321 Management of Individual Assistance</td>
<td>32</td>
</tr>
<tr>
<td>E0705 Fundamentals of Grant Management</td>
<td>24</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>562</strong></td>
</tr>
</tbody>
</table>
This list 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 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 Future 2020 Multi Hazard and Floodplain Management Plan must follow the following per CRS:
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 and y. In order to correctly do that “something” at x and 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 stormwater 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 40 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.